

PESTICIDE DEALER TRAINING MANUAL

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

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Pesticide Dealer Training Manual

Table of Contents

Part 1 - Chapter	I.....Pesticide Dealer Licensing
	II.....State Laws and Regulations
	III.....Federal Pesticide Laws
	IV.....Toxicity of Pesticides
	V.....Residue, Tolerance, and Registration
	VI.....Ecology and Environmental Considerations
	VII.....Safety Precautions
	VIII.....Personal Protection for the Applicator and Worker
	IX.....Symptoms of Pesticide Poisoning
	X.....First Aid for Pesticide Poisoning
 Part 2 - Chapter	 XI.....Integrated Pest Management
	XII.....Pests
	XIII.....Types of Pesticides
	XIV.....The Label
	XV.....Formulations
	XVI.....Filling and Mixing
	XVII.....Calculations for Mixing Pesticides
	XVIII.....Equipment
	XIX.....Calibration
	XX.....Weather-Wise Application
	XXI.....Disposal
	XXII.....Storage
	XXIII.....Record Keeping
	XXIV.....Liability
	Answers to Questions.....
	Glossary.....
	References.....

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Table of Contents

Part 1 - Chapter	I.....Pesticide Dealer Licensing
	II.....State Laws and Regulations
	III.....Federal Pesticide Laws
	IV.....Toxicity of Pesticides
	V.....Residue, Tolerance, and Registration
	VI.....Ecology and Environmental Considerations
	VII.....Safety Precautions
	VIII.....Personal Protection for the Applicator and Worker
	IX.....Symptoms of Pesticide Poisoning
	X.....First Aid for Pesticide Poisoning

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.

NOTE: You will not be tested on Chapter XVI - Mixing and Filling; Chapter XVII - Calculations for Mixing Pesticides; Chapter XVIII - Equipment; and, Chapter XIX - Calibration. These chapters contain information that is specific to the activities of the pesticide applicator. You may, however, want to read these chapter for your own edification.

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 Regulations 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 Regulations 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.

As a licensed pesticide dealer, you are legally responsible for being thoroughly familiar with the Regulations, in their 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 Department of Agriculture as a pesticide dealer.

Licensing Requirements

Prior to the issuance of a license, Class “A” and Class “B” pesticide dealers must: apply to the Commissioner 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.

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, State and by permit only.

- 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 *Appendix “A(2)” of the Vermont Regulations for Control of Pesticides*, available from the Department’s Plant Industry Division, to identify these products **OR** call the Vermont Department of Agriculture at (802) 828-3475.
- Restricted Use - “By Permit Only”: Those pesticides which may be purchased and used only after securing a special permit from the Commissioner of Agriculture, Food and Markets, or the Agency of Natural Resources . Pesticides are classified as “Restricted Use - by permit only” after determination that routine use of the chemical could result in harm to human health or the environment. You must refer to *Appendix “A(2)” of the Vermont Regulations for the Control of Pesticides*, available from the Department’s Plant Industry Division, to identify these products.

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” pesticides are generally for use outside of the home, and contain more than 3% total active ingredient. In addition, all turf care products, excluding aerosols or products containing either Bacillus thuringiensis or potassium fatty acids, regardless of percent active ingredient, and that do not meet the Class “A” definition, are identified as Class “B” pesticides.

Class “C” - Homeowner/Specialty

• Those pesticides which are generally used in and around the home and which contain not more than 3% total active ingredient. A number of additional products have been classified as Class “C” including: pet supplies such as shampoos, dips, tick and flea collars and dusts (except lindane products) which shall not exceed 7% total active ingredient; antimicrobial agents such as disinfectants, sanitizers, slimicides, etc.; animal repellants; swimming pool supplies; and insecticides including Bacillus thuringiensis, Bacillus popilliae, Bacillus lentimorbus, or potassium fatty acids. Please refer to the *Vermont Regulations for Control of Pesticides* for a more complete list of Class “C” products.

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

- **Class “A” license** - entitles a pesticide dealer to sell any pesticide registered in the State of Vermont: restricted use pesticides, “by permit only” pesticides, and Class “B” and “C” pesticides.
- **Class “B” license** - entitles a pesticide dealer to sell Class “B” and Class “C” pesticides that are registered in Vermont. Class “B” dealers shall not sell Class “B” pesticides to Class “C” dealers.
- **Class “C” 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 Department of Agriculture upon request.

- Annual sales reports of “by permit only” and restricted use pesticides sold on a calendar year basis shall be submitted to the Department with the application for license renewal.
- Annual sales reports shall include: the product name; EPA registration number; size and number of containers and the county of intended use (you may use the applicator’s county of residence).

- Annual sales reports must be submitted regardless of whether any restricted use pesticides were sold.
- In the event that a licensed pesticide dealer should choose not to renew his/her license, the annual sales report is still required to be submitted for the last year in which a valid license was held.

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 Department of Agriculture, Food and Markets, Plant Industry 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 Department of Agriculture at (802) 828-2431.

- **Material Data Safety Sheets (MSDS):** All Class A Dealers shall submit a MSDS to their local fire department for each Class A Restricted Use Pesticide that is stored at their establishment.
- **Tier Two Pesticide Inventory Report:** All Class A Dealers shall submit a Tier Two Pesticide Inventory Form to the Department of Agriculture for each Class A pesticide that is stored at their establishment.

☛ 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 material safety data sheet (MSDS) 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

- Pesticides may not be stored in food areas.
- Legible labels shall be maintained on all pesticide containers and bulk storage containers at all times.
- Except during loading and unloading, stored dry pesticide shall be covered by a roof or tarpaulin which will keep precipitation off the pesticides.
- 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.

(NOTE: You should refer to the *Vermont Regulations for Control of Pesticides* for the complete regulatory requirements regarding the bulk 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

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.

**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 Department 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.

Check the Department's Plant Industry Division's home page at www.state.vt.us/agric/pid.htm for a schedule of the waste pesticide drop-off times. Call your Solid Waste District for upcoming events if you don't see yours on the list. Please call the contact person in advance before dropping off pesticides. Other questions regarding waste or obsolete pesticides should be directed to the Vermont Department of Agriculture at (802) 828-2431.

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

You may ask why a pesticide dealer needs to know about the certification of pesticide applicators. The answer is easy - pesticide dealers can sell restricted use pesticides *only* to certified pesticide applicators, or individuals operating under their direct supervision. Uncertified applicators must have written authorization from a certified applicator to purchase specific restricted use pesticides.

Before you sell a Class "A" pesticide:

- ☞ Make sure you 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 Department 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

Chapter II

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.



Summary of the Vermont Regulations for Control of Pesticides

This is a brief summary of the Vermont Regulations for Control of Pesticides, in accordance with Title 6 Vermont Statutes Annotated, Chapter 87. As a pesticide applicator, you are required to comply with Federal laws and State regulations. While this summary is intended to assist you in reading and understanding the Regulations — it is not a substitute for reading the Regulations. Applicators are responsible for fully reading the Regulations. Information contained in the Regulations supercede any conflicting information in the CORE and Subcategory study manuals.

I. PESTICIDE CLASSIFICATION - Refer to Section X, pages 31-34 of the Regulations for detailed descriptions of pesticide classifications.

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

In Vermont, pesticides are classified into four groups:

A. Class “A” Pesticides - are considered “restricted use” pesticides. This type of pesticide can only be purchased and used by a certified applicator, or by an individual under the direct supervision of a certified applicator. A pesticide can be classified as “restricted use” by either the Environmental Protection Agency (EPA) or the state. A state can classify a product as “restricted use” even if it has not been classified as “restricted use” by the EPA. However, the state cannot classify a product for “general use” that has been classified as “restricted use” by the EPA. The acute and chronic effects, environmental and aquatic effects, the potential for fire and explosion, water contamination, necessary training, and application methods are some things taken into consideration when classifying a product as “restricted use”.

B. “By Permit Only” Pesticides - are “restricted use” pesticides that may only be purchased and used by persons who have been issued a special permit from the Commissioner of Agriculture. Examples of products requiring a permit include chlordane, heptachlor and mercury compounds.

C. Class “B” Pesticides - are general use products that can be purchased by anyone. Class “B” products are outdoor use products with greater than three percent (3%) active ingredient. Turf products are also classified as class “B”, except those containing Bacillus thuringiensis and potassium fatty acids, which are classified as Class “C” products.

D. Class “C” Pesticides - are used in and around the home. The percentage of active ingredient

is usually less than three percent. There are a few exceptions, as in the case of pet supplies, where the active ingredient may be up to seven percent, or pool treatments and insect repellents, which may have an unlimited percentage of active ingredients.

II. REGULATION - In order to regulate the sale, purchase and use of pesticides, the Vermont Department of Agriculture issues certificates, licenses and permits. These documents allow the Department to control and closely monitor pesticide sale, use and disposal.

A. Applicator Certification - Refer to Section VII, pages 24 - 25, and Section IX, page 31 of the Regulations for details on the requirements for certified private and commercial pesticide applicators. Many people use pesticides every day, from the homeowner spraying for lawn weed control on his or her own property, to the commercial applicator hired to control a pest infestation. Regulating pesticide use includes grouping applicators into different categories, depending upon the intended use of a pesticide. An applicator becomes certified when he or she has proven competence and knowledge by passing written examinations.

i) **Private Applicators** - are persons who use, or supervise the use of, pesticides other than “restricted use” pesticides on land that they own or rent. The land is either residential in use, or in the production of an agricultural commodity. In order to apply a “restricted use” pesticide (Class “A”) to an agricultural commodity, the private applicator must become certified, or work under the direct supervision of a certified applicator.

ii) **Commercial Applicators** - are persons that apply ANY pesticide (Class “A”, “B”, or “C”) to the lands or homes of another for remuneration or gratis. All commercial applicators must be certified, or must be working under the direct supervision of a certified commercial applicator.

iii) **Non-commercial Applicators** - are persons who occasionally use pesticides in the course of their employment. If they use any pesticide products other than a Class “C” product, they must become certified or work under the direct supervision of a certified applicator. For example, a person cleaning a hotel room and using a disinfectant does not need to become certified. A golf course employee applying herbicides to a golf green would need to become a certified, non-commercial applicator, or work under the direct supervision of a certified, non-commercial applicator.

Direct supervision is defined as “on-site supervision of a pesticide application by a certified applicator who is capable of calibration of equipment, prescribing pesticides, calculating volumes of pesticides to be applied, and dealing with emergency situations which might occur.” In practical terms, this means that when making applications on agricultural land, the uncertified applicator must be on the same farm with the certified applicator while applying pesticides. In commercial situations, the uncertified applicator must be in viewing distance of the certified applicator. In either circumstance, it is the certified applicator’s responsibility to thoroughly train the uncertified applicator about proper application

techniques, safety, protective equipment, avoiding pesticide drift, etc. The certified applicator is ultimately responsible for supervising the activities of the uncertified applicator.

B. Dealer and Company Licenses - Refer to Section XI, pages 34-35 of the Regulations for dealer license requirements and Section VI, page 24 for company license requirements.

i) **Dealer Licenses** - are issued to people that sell pesticides. The type of license needed depends on the class(es) of pesticides that will be sold by the dealer. A dealer's license is issued to individuals who must be a full-time employee of the store or retail sales outlet. There are three categories of dealer licenses that correspond to the pesticide classification system. To obtain a Class "A" or Class "B" dealer's license, you must take and pass an examination and submit the required fee. A Class "C" license does not require an examination, but still requires a fee.

a) **Class "A" Dealer's License** - allows a person to sell restricted use pesticides as well as Class "B" and Class "C" pesticides.

b) **Class "B" Dealer's License** - allows a person to sell Class "B" and Class "C" pesticides.

c) **Class "C" Dealer's License** - allows a person to sell Class "C" pesticides only.

ii) **Company Licenses** - are issued to any business entity which applies pesticides to the lands or homes of others for remuneration or gratis. **All companies in the business of applying pesticides must be licensed.** All certified commercial applicators must work for licensed companies. Company licenses do not require an examination. You must fill out a form and submit the required fee.

C. Permits - Refer to Section IV, pages 12-22 of the Regulations for permit requirements. The Department of Agriculture issues permits for certain uses of pesticides. If the activity you are about to perform requires a permit, do not apply a pesticide without the proper permit. The following activities require a permit:

i) **Rights-of-Way Clearing and Maintenance** - A permit must be obtained from the Commissioner for each application of herbicide for the purpose of clearing or maintaining rights-of-way.

ii) **Aerial Applications** - A seasonal permit must be obtained for the aerial application of pesticides to agricultural commodities. Applicators must obtain a permit for each contract to aurally apply pesticides to non-agricultural commodities.

iii) **Experimental Use** - Any person who wants to use an unregistered pesticide, or who

wants to use a registered pesticide for an unregistered use, must first obtain an experimental use permit.

iv) **Bird or Animal Control** (other than voles, moles, mice and rats) - Area-wide and limited-area application of pesticides for the control of pest birds and animals requires a permit. Bird and animal pests are those that may be declared a pest by the Commissioner. Permits are not required for the use of bird or animal repellants.

v) **Golf Course** - A golf course must have a permit for pesticide application before any person can apply pesticides on any land on that golf course. Each golf course must have a pesticide management plan detailing how pests such as insects, weeds, diseases and rodents are managed on the golf course.

vi) **Water Quality** - Prior to using pesticides in waters of the State, a person must obtain a water quality permit from the Vermont Department of Environmental Conservation.

III. STANDARDS OF OPERATION - Refer to Section IV, page 12 of the Regulations, for details.

All pesticide applicators and licensed companies are required to adhere to certain standards of operation when applying pesticides in Vermont. These standards of operation are designed to ensure proper application of pesticides and to reduce unnecessary risk. By following these standards of operation, pesticide applicators can protect themselves, others, and the environment.

A) All pesticides must be applied consistent with their labeling. In Vermont, you may apply a pesticide at less than the labeled rate.

B) Pesticide applicators must minimize the drift of pesticides off target.

C) Methods and materials which insure safe and efficient application must be used.

D) When drawing or pumping water, an anti-siphoning device must be used to prevent the back flow of materials into water sources.

E) Pesticides shall only be applied when climatic, pest and other conditions are proper for the control of the pest.

F) No false or fraudulent claims may be made concerning safety or control efficacy of a pesticide product.

G) Weekly spray reports must be filled out accurately and completely.

H) If applying pesticides that provide control within the soil profile, a fifty (50) foot buffer must be left around all private wells, unless written permission is given by the owner.

I) Commercial applicators must supply their customers with a written bill or invoice which contains:

- i) the product's common name or trade name
- ii) the product's EPA registration number
- iii) the amount of product used
- iv) the pests treated for
- v) the name and signature of the applicator

J) Commercial applicators making applications to turfgrass or landscape plants must also inform the customer of:

- i) the pesticide application rate used
- ii) the availability of the product label and Material Data Safety Sheets (MSDS)

Points of access to treated areas must be posted with signs, as prescribed by the regulations.

IV. RECORDS - Refer to Section V, pages 23-24 of the Regulations for details.

As a certified applicator, you must keep records of your pesticide applications. Records enable you to compare the efficacy of different pesticides and rates. They also allow you to make wise buying decisions, by showing how much material you actually used the previous year.

A. Private Applicators

- i) Private applicators must record: (Records must be kept for two years)
 - a) Product name
 - b) EPA registration number
 - c) Amount of product used
 - d) Date applied
 - e) Location (farm name or town)
 - f) Pests treated for

B. Commercial and Non-commercial Applicators - Commercial and non-commercial applicators are responsible for two types of records - routine operational records and annual use reports.

- i) Routine Operation Records must include the following information: (Records must be kept for two years)
 - a) Product name
 - b) EPA registration number
 - c) Amount used
 - d) Date applied
 - e) Location
 - f) Pests treated for

ii) Annual Use Reports - To be submitted to the Commissioner annually. Each year, an annual use report form will be mailed to commercial and non-commercial applicators with a certification renewal form. Applicator certificates will not be renewed without the submission of an annual use report. Annual use reports shall be submitted regardless of whether pesticides were applied during a given year or not. On this report, applicators must include:

- a) Product name
- b) EPA registration number
- c) Product manufacturer
- d) Amount use
- e) Purpose for use
- f) The county where it was used

C. Licensed Companies - shall be responsible for maintaining the routine operational records and submitting the annual use pesticide reports compiled by their certified commercial applicators. Certified non-commercial applicators who do not work for licensed companies are responsible for the maintenance and submission of these records.

D. Licensed Class "A" Dealers

i) Annual Sales Reports - Each year, an annual sales report of "restricted use" and "by permit only" pesticides shall be submitted to the Commissioner. Annual sales reports shall be submitted regardless of whether or not "restricted use" or "by permit only" pesticides were sold. These reports shall include:

- a) Product name
- b) EPA registration number
- c) Size and number of containers
- d) County of intended use (may use applicator's county of residence)

V. PENALTIES - Refer to Section III, page 11 of the Regulations, for penalty information, and Section XII, pages 35-36 for details on emergency notification and reporting of spills.

A. Accident Reporting - If you have a pesticide accident (such as a spill), you must report it immediately to either the Vermont Department of Agriculture, Plant Industry (802-828-2431), or the Vermont Department of Public Safety (800-641-5005). Failure to do so may result in a fine. All pesticide accidents must be reported. If you have any question as to what constitutes an accident, call the Department at (802) 828-2431.

B. Violations - The Department has many ways to deal with violations of the Regulations.

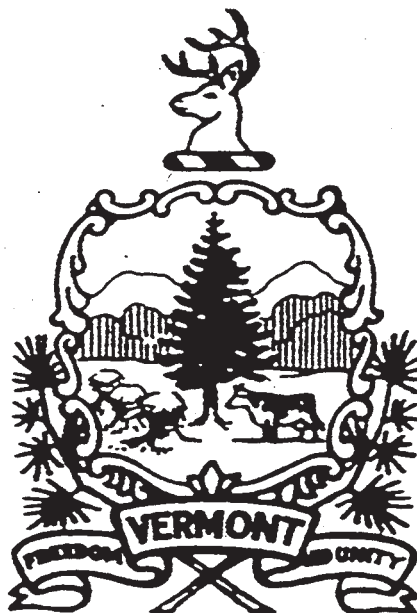
- i) Cease and desist order - requires that you immediately stop the violating action.
- ii) Suspension, revocation, or amendment - of licenses, certificates or permits.
- iii) Fines - The Department may fine private applicators up to \$1,000 per violation, and commercial applicators up to \$5,000 per violation.

VI. SUMMARY

This is only a brief summary of the Vermont Regulations for Control of Pesticides. Applicators are responsible for complying with all of the Regulations in their entirety. You should fully read and understand the Regulations before becoming certified to apply pesticides in Vermont.

VERMONT REGULATIONS FOR CONTROL OF PESTICIDES
IN ACCORDANCE WITH 6 V.S.A. CHAPTER 87

EFFECTIVE: August 2, 1991



STATE OF VERMONT
DEPARTMENT OF AGRICULTURE, FOOD AND MARKETS
116 STATE STREET
DRAWER 20
MONTPELIER, VT 05620-2901

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

Philip R. Benedict, Director
Plant Industry Section
Department of Agriculture, Food and Markets
116 State Street
Drawer 20
Montpelier, VT 05620-2901
(802) 828-2431

PREAMBLE

The goal of these pesticide regulations is to encourage the use of the most environmentally responsible approach to effective pest management. The Department of Agriculture, Food and Markets believes that with the knowledge and use of integrated pest management (IPM) skills and soil/water conservation techniques currently available this goal will be achieved.

Vermont Regulations for Control of Pesticides

TABLE OF CONTENTS

SECTION I -	DEFINITION	5
SECTION III -	POWERS OF THE COMMISSIONER	11
SECTION IV -	RESTRICTIONS ON THE USE AND APPLICATION OF PESTICIDES	12
SECTION V -	MAINTENANCE OF RECORDS BY CERTIFIED LICENSED COMPANIES, LICENSED PESTICIDE DEALERS AND PESTICIDE PRODUCING ESTABLISHMENT	23
SECTION VI -	COMPANY LICENSE	24
SECTION VII -	REQUIREMENTS FOR CERTIFIED COMMERCIAL AND CERTIFIED NONCOMMERCIAL APPLICATOR	24
SECTION VIII -	CERTIFICATION STANDARDS FOR COMMERCIAL APPLICATORS AND NONCOMMERCIAL APPLICATORS USING OTHER THAN CLASS "C" PESTICIDE	25
SECTION IX -	CERTIFICATION OF PRIVATE APPLICATORS	31
SECTION X -	CLASSIFICATION OF PESTICIDES AND LIMITATIONS ON SALE	31
SECTION XI -	PESTICIDE DEALER LICENSES.	34
SECTION XIII -	TRANSPORTATION, STORAGE AND DISPOSAL OF PESTICIDES.	36
APPENDIX B	42

**STATE OF VERMONT
VERMONT REGULATIONS FOR CONTROL OF PESTICIDES
IN ACCORDANCE WITH 6 V.S.A. CHAPTER 87**

Effective Date:

SECTION I - DEFINITION

1. Accident: any release of a pesticide or pesticide mix from its container or application equipment which is contrary to label instructions for use of that pesticide, or which violates these regulations.
2. Agricultural commodity: any plant, or part thereof, including but not limited to sod and ornamental tree production, or animal or animal product produced by persons (including farmers, ranchers, vineyardists, nurserymen, Christmas tree growers, aquaculturists, floriculturists, orchardists, foresters, or other comparable persons) primarily for sale, consumption, propagation, or other use by man or animals.
3. Aircraft: a motorized device used for flight.
4. Anti-siphon device: any equipment designed and constructed to prevent the accidental backflow or siphoning of pesticide into any water supply or to prevent contamination by a pesticide of other materials being injected at the same time such as fertilizers or other pesticides.
5. Application sites or treatments for rights-of-way means:
 - a. Foliar: The placing of a pesticide upon the leaves of growing plants.
 - b. Basal: The placing of a pesticide upon the stem at the base of a growing tree or shrub.
 - c. Stump: The placing of a pesticide upon the cut surface of a stump.
 - d. Soil: The placing of a pesticide upon the ground for uptake by plants in the immediate vicinity.
6. Application of a pesticide: the placement for effect of any pesticide at or on the site where pest control or other response is desired.
7. Applicators regulated in Vermont are defined as follows:
 - a. Certified commercial applicator: any person certified under the categories and standards of Section VIII, Vermont Regulations for Control of Pesticides.
 - b. Commercial applicator: a person who applies pesticides to the lands or homes of another whether for remuneration or gratis under the direct supervision of a certified commercial applicator.
 - c. Private Applicator: any person who uses or supervises the use of any pesticide other than those classified restricted use 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 pesticides to the property of neighboring producers of agricultural commodities without a commercial applicator's certificate, providing that the applicator receives no compensation other than the trading of personal services between the applicator and his neighbor.
 - d. Certified private applicator: a private applicator who has been certified under the requirements of Section IX, Vermont Regulations for Control of Pesticides. Certified private applicators may purchase, use or supervise the use of restricted use pesticides.

- e. **Noncommercial Applicator:** a person who uses or applies pesticides in the course of employment. It is anticipated by these regulations that in most instances the use of pesticides will comprise only a portion of the applicator's duties and that other employment responsibilities will be unrelated to pesticide application. Noncommercial applicators are exempt from the company licensing requirements. Noncommercial applicators without certification may apply only Class "C" pesticides in the course of their employment. Persons without certification who are hired as independent contractors for the exclusive purpose of applying Class "C" pesticides shall have the burden of proof in any departmental hearing to rebut the presumption that they are commercial applicators.
 - f. **Certified Noncommercial Applicator:** a noncommercial applicator who has been certified under the standards and categories of Section VIII, Vermont Regulations for Control of Pesticides. A certified noncommercial applicator may purchase, use or supervise the application and use of restricted and Class "B" pesticides in the course of their employment. Certified noncommercial applicators are exempt from the company licensing requirements. Certified noncommercial applicators shall comply with all other requirements of these regulations.
8. **Appurtenance:** all valves, pumps, fittings, pipes, hoses, metering devices, mixing containers, and dispensing devices which are connected to a storage container, or which are used to transfer liquid pesticide or pesticide rinsate into or out of a storage container.
 9. **Brownout:** foliar discoloration resulting from the application of pesticides or other vegetation control methods.
 10. **Bulk pesticide:** liquid pesticide in a container larger than 210 gallons (795 liters) or dry pesticide in undivided quantities greater than 100 pounds (45 kilograms). It includes mini-bulk pesticide containers, except as otherwise specified.
 11. **Chemigation:** any process whereby a pesticide(s) is (are) mixed with water and applied through irrigation systems to land and/or crops including, but not limited to, agricultural, nursery, turf, golf course, ornamental or greenhouse sites through an irrigation system.
 12. **Commissioner:** the Commissioner of Agriculture, Food and Markets of the State of Vermont or a duly authorized agent.
 13. **Company license:** a license issued by the Department of Agriculture to business entities which apply any pesticides to the lands or homes of another person for remuneration. No person or business entity may contract to use any pesticide on the lands of another without first obtaining a company license. A company license does not exempt a commercial applicator from applicable certification requirements. The regulations pertaining to the company license became effective January 1, 1981, and can be found in Section VI of these regulations.
 14. **Conspicuous point of access:** the usual and customary entrance(s) where people are likely to enter a treated area and observe warning signs pursuant to Section IV 8.
 15. **Demonstration:** to conduct or supervise field research or exhibitions with old, new or experimental use pesticides or pesticide application methods or equipment or to exhibit, sell or recommend pesticides to the general public, pesticide applicators or pesticide dealers.
 16. **Department:** the Vermont Department of Agriculture, Food and Markets.
 17. **Direct supervision:** on-site supervision of pesticide application by a certified applicator who is capable of calibration of equipment, prescribing pesticides, calculating volumes of pesticides to be applied, and dealing with emergency situations which might occur.
 18. **Discharge:** a spill, leak, accidental or intentional release, or other emission of pesticide from a storage container, container or appurtenance, and includes a discharge into secondary containment. It does not include a fully contained transfer of bulk pesticide which is made pursuant to sale, storage or distribution or releases that are in accordance with label directions.
 19. **Distribute:** to import, consign, sell, offer for sale, solicit orders for sale, or otherwise supply pesticide for sale or use in this State.

20. Drift: the airborne movement of a pesticide during or immediately after its use or application to a site unintended for its use or application.
21. Dry pesticide: pesticide which is in solid form prior to any application or mixing for application and includes, but is not limited to, formulations such as dusts, wettable powders, dry flowable powders and granules.
22. Economic poison: 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, which the Commissioner shall declare to be a pest or any substance produced, distributed or used as a plant regulator, defoliant or desiccant.
23. Enterprise: any form of doing business, including, but not limited to, sole proprietorships, partnerships, joint ventures and corporations.
24. EPA: the United States Environmental Protection Agency.
25. Equipment: any mechanical device used to apply pesticides.
26. Environmentally Sensitive Areas: include those areas which are significant wetlands as defined by the Vermont Wetlands Act, necessary wildlife habitat (10 V.S.A. Section 6001(12) and which contain endangered or threatened species (10 V.S.A. Section 5401(6) and (7).
27. FIFRA: the Federal Insecticide, Fungicide, and Rodenticide Act, 7 USC 136 et seq.
28. Forest trees: plants which are primarily used for wood, watershed protection, land stabilization purposes, or wildlife habitat.
29. Fruit and crop plants: plants which are primarily used to produce food, forage, or seed.
30. Full-time employee: an employee who works 35 hours minimum per week. A full-time employee does not include seasonal personnel.
31. Golf Course: any contiguous area upon which the game of golf is played including such supporting operations as practice greens, tees and driving areas, whether existing or proposed.
32. Golf Course - existing: a golf course, after construction, when it has been opened for play.
33. Golf Course - proposed: a golf course, including expansions of existing courses, which is in the design, permit or construction stage and has not been open for play.
34. Ground water: water below the land surface which occurs in a saturated zone of the soil.
35. Half-Life: the time required for disappearance of one-half of the pesticide residue present.
36. KOC: a measure of the tendency of a pesticide to be strongly attached, by chemical or physical bonds, to soil particle surfaces. The higher KOC values have a stronger attachment to soil and a lesser tendency for the pesticide to move off-site except with sediment movement.
37. Loading: any act of transferring pesticide to or from any storage container or to any mobile application equipment.
38. Liquid pesticide: pesticide in liquid form and includes, but is not limited to, solutions, emulsions, suspensions, and slurries.
39. MSDS: Material Safety Data Sheet is a document required for each hazardous chemical including pesticides by the Occupational Health and Safety Act. It contains health and safety data as well as physical properties pertinent to the chemical which will aid in an emergency situation. MSDS can be obtained through the distributor or the manufacturer of the pesticide.
40. Manufacture: to process, manufacture, formulate, prepare, compound, package, repackage or label any pesticide.

41. Mixing: the act of combining pesticides and/or solvents or diluents for the purpose of application.
42. Ornamental and flowering shrubs and plants: plants used for ornamental purposes not otherwise classified as shade trees.
43. Person: any individual, partnership, association, corporation, or organization of persons whether incorporated or not, including any municipality, state, or federal agency or subdivision of any state.
44. Pesticide: economic poison as defined in 6 V.S.A. Section 911 and Section I 21. of the Regulations For Control of Pesticides.
45. Pesticide applicator: any person who uses any pesticide.
46. Pesticide dealer: any person who distributes, takes orders for sale, offers for sale or sells pesticides.
47. Prescreened Pesticide List: a list of pesticides which due to their relative immobility and limited persistence (as measured by parameters such as, but not restricted to solubility, KOC and half-life) are unlikely, under normal conditions and acceptable use, to leave established turf grass and enter surface and/or ground water.
48. Private Non-Residential Property: property open to the public and which is not a residence, such as an athletic field.
49. Public Non-Residential Property: property open to the public and which is not a residence, such as a commercial business.
50. Public Water System: any system or combination of systems owned or controlled by a person which provides piped drinking water to the public which has: a) has at least ten service connections, or b) serves at least an average of at least twenty-five individuals for at least 60 days a year. Public water system shall also mean any part of a piped system which does not provide drinking water, if such use of such a part could affect the quality or quantity of the drinking water supplied by the system.
51. Public (or private) Water Source Protection Area: a surface or subsurface area from or through which contaminants are reasonably likely to reach a public (or private) water source.
52. Public (or private) Water Source: any surface or ground water supply used as a source of drinking water for a public (or private) water system.
53. Restricted use pesticides: those pesticides classified under Section 3(d) of FIFRA as amended, U.S. Environmental Protection Agency or those pesticides classified by the Commissioner as Class "A".
54. Right-of-way: an interest in real property, above, on or below the ground, which 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 these regulations, it is immaterial whether the right-of-way is owned, leased, or an easement. The term "right-of-way" includes properties owned or leased by utilities where that property is used as a right-of-way.
55. Shade trees: plants which are primarily used for shade, aesthetic value, ornamentation or windbreak.
56. Simple Dilution Analysis: 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.
57. Storage: storage of pesticide by a person who uses, manufactures or distributes pesticide.
58. Storage container: a container used for the fixed storage of bulk pesticide; a rail car, nurse tank, a portable container of mini-bulk pesticide or other mobile container which is used for the fixed storage of bulk pesticide for more than 15 consecutive days. It does not include a container which is used solely for emergency storage of leaking pesticide containers which are 55 gallons or smaller.
59. Storage facility: a location at which bulk pesticide is held in storage.

60. Surface Water: any river, stream, creek, brook, reservoir, pond, lake, spring and any other body of surface water, whether natural or artificial.
61. Turf: a covering of mowed vegetation growing together with an upper soil stratum of intermingled roots and stems.
62. Turf-grass: a species or cultivar of the plant family Graminae usually of spreading or upright habitat, which is maintained as a mowed turf.
63. Use of a pesticide: any handling, release or exposure of a pesticide to a human or the environment including, but not limited to:
 - a. application of a pesticide, which includes mixing or loading of equipment and any required supervisory action in or near the areas of application;
 - b. storage of pesticides and pesticide containers;
 - c. disposal of pesticides and pesticide containers; and
 - d. recommendation of pesticide applications.
64. Utility: railroad companies, pipelines operators, communication companies and electric companies whether public or privately owned.
65. Vegetation means:
 - a. herbaceous plants: species that do not develop woody stems;
 - b. brush: woody species of shrubs, trees, vines, and brambles generally not exceeding ten feet in height; and
 - c. trees: woody species generally reaching a height of ten feet at maturity.
66. Vermont Act 31: the State law enacted by the General Assembly of Vermont on May 3, 1985, relating to Community and Worker Right-to-Know; Sec. 1. 18 V.S.A. Chapter 36.
67. Water Supplies: any developed source of water whether public or privately owned, that is intended for human consumption.

SECTION II - LICENSES, CERTIFICATES, AND PERMITS ISSUED BY THE DEPARTMENT OF AGRICULTURE, FOOD AND MARKETS

1. Licenses - The following licenses are issued by the Department:
 - a. Company license: shall be obtained by business entities which apply pesticides to the lands and homes of others for remuneration. See Section VI.
 - b. Dealer licenses are issued in the following categories:
 - (1) Class "A": shall be obtained by persons who sell restricted use pesticides. Also entitles licensee to sell Class "B" and Class "C" pesticides. See Section X.
 - (2) Class "B": shall be obtained by persons who sell Class "B" pesticides. Also entitles licensee to sell Class "C" pesticides. See Section X.
 - (3) Class "C": shall be obtained by stores or other sales outlets which sell Class "C" pesticides. See Section X.

2. Certificates - The following certificates are issued by the Department:

- a. Commercial and noncommercial applicator certificates: shall be obtained by persons who apply or supervise the application of pesticides to the lands and homes of others whether for remuneration or gratis. Applicators who apply pesticides under the direct supervision of a certified commercial applicator are exempt from the certification requirement. Noncommercial applicators (as defined in Section I. 8.) shall be certified if they use or supervise the use of Class "B" or restricted use pesticides in the course of their employment, except when they work under the direct supervision of a certified applicator. See Section VII.
- b. Private applicator certificate: shall be obtained by private applicators (as defined in Section I.) who wish to purchase and use restricted use pesticides. See Section IX.

3. Permits - The following permits are issued by the Department:

- a. Aerial application permits: shall be obtained before applying pesticides from an aircraft. Two types of aerial permits are issued: an aerial agricultural permit which is good for an entire season and special aerial permits for specific jobs. See Section IV.
- b. Right-of-way permits: shall be obtained before applying pesticides to rights-of-way, as defined in Section I. See Section IV.
- c. Experimental use permits: shall be obtained to use an unregistered pesticide or to use a registered pesticide for an unregistered use. See Section IV.
- d. Bird or animal permits: shall be obtained to control bird or animal pests that may be lethally controlled by use of a pesticide under statute or declared a pest by the Commissioner. See Section IV.
- e. Special permits for the sale or use of specially restricted pesticides: shall be obtained before using specially restricted compounds as established by statute or these regulations. See Section IV.
- f. Golf course permit: shall be obtained in accordance with the provisions herein before applying pesticides to a golf course. See Section IV.

4. Procedures for obtaining licenses, certificates, or permits.

- a. Businesses or persons who wish to obtain a license, certificate or permit shall:
 - (1) Request the appropriate application form from the Plant Industry Division of the Department of Agriculture, Food and Markets;
 - (2) Complete the appropriate form and return it to the Plant Industry Division;
 - (3) Remit any fees required by law or these regulations when the completed form is submitted;
 - (4) Satisfy all prerequisites established by these regulations to demonstrate competence or financial responsibility for the particular license, certificate, or permit requested:
 - (a) Examinations required as part of the prerequisite for a license or certificate will be maintained for a period of one year unless an active file is established; and
 - (b) Inactive files will be destroyed one calendar year after a holder of a license or certificate fails to renew that certificate or license.
 - (5) Businesses and persons proposing to store, use or distribute pesticides are advised that the statutes and regulations administered by the Vermont Occupational Safety and Health Program may be applicable to them. For further information, write or call the Vermont Department of Labor and Industry, 7 Court Street, Montpelier, Vermont; telephone number: 802/828-2765.

SECTION III - POWERS OF THE COMMISSIONER

1. Suspension or revocation of licenses, certificates, or permits.
 - a. The Commissioner may amend, suspend or revoke any license, certificate or permit for failure to comply with 6 V.S.A. Chapter 87 or any rule or regulations adopted under its authority or for being subject to a final order imposing a civil penalty under 7 USC Section 136(j) or for being convicted under 7 USC Section 136(j) 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 Commissioner within five (5) days of receipt of a notice of violation.
 - b. If the Commissioner finds that public health, safety or welfare imperatively requires emergency action and the Commissioner incorporates a finding to that effect in his order, summary suspension of a license, permit or certificate may be ordered, pending proceedings for revocation or other action.
2. The Commissioner may restrict or regulate any pesticide product or device which is deemed to be ineffective or which constitutes an undue hazard to the public or the environment. Any person aggrieved by a decision of the Commissioner under this section may request a hearing within fifteen (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 use of this product.
3. Pesticide cease and desist order.
 - a. The Commissioner may issue a cease and desist order for failure to comply with 6 V.S.A. Chapter 87 or any rule or regulation adopted under its authority with an opportunity for hearing if a written request is filed with the Commissioner within five (5) days of receipt of the cease and desist order.
 - b. It shall be unlawful to violate a cease and desist order.
4. The Commissioner may, in furtherance of the purpose of 6 V.S.A. Chapter 87 and the regulations adopted pursuant to this chapter, enter the business premises of any licensed company, certified applicator, or persons using pesticides to inspect records, equipment or obtain pesticide samples.

The Commissioner may enter any job site at which a certified applicator is employed or where pesticides are used to request information regarding pesticide use at that site, to test equipment or to obtain samples of pesticides or other samples including, but not limited to: soil, water, air, food, plant material and animal tissue, from both treated and untreated areas.
5. The Commissioner may enter into reciprocal agreement with officials of other states and federal agencies and grant certificates on a reciprocal basis provided that:
 - a. Certification requirements are substantially the same as those required by Vermont;
 - b. The certified applicator knows and abides by Vermont's pesticide control law and regulations;
 - c. The certified applicator pays all appropriate fees;
 - d. The certified applicator is a resident of and has a valid pesticide applicator license or certificate issued by a state which has established a reciprocal agreement with Vermont; and
 - e. The certified applicator's reciprocal certificate is valid for the entire calendar year. Applicators with certificates which 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 forty-five (45) days from the date of expiration. Failure to provide confirmation will result in the revocation of reciprocal certificates.
6. In addition to authority conferred by these regulations, the powers of the Commissioner include all statutory authority vested in the Commissioner, now or in the future, to enforce state pesticide laws and regulations. The Commissioner shall develop and implement policies and strategies for the management of pesticide use and the protection of ground and surface water resources.

SECTION IV - RESTRICTIONS ON THE USE AND APPLICATION OF PESTICIDES

1. Registered and recommended uses of pesticides.
 - a. All pesticide uses or recommendations for use shall comply with that pesticide's label, which shall be registered with the U.S. Environmental Protection Agency and the Department (except as provided under authority for pesticide use in Section 18 and 24(c) of FIFRA as amended).
 - b. Pesticide Drift - Pesticide applicators shall use pesticides and conduct operations under conditions known to minimize contamination of non-target land and water areas.
2. Standards of operations - All pesticide applicators and licensed companies:
 - a. Shall use only methods and equipment which insure safe and efficient application of materials.
 - b. Shall use equipment with an effective anti-siphoning device to prevent backflow when drawing or pumping water to fill pesticide application devices.
 - c. Shall use equipment with an effective anti-siphoning device to prevent backflow when drawing or pumping water to be used in chemigation operations.
 - d. Shall operate in a careful manner and only when climatic, pest or other conditions are proper for controlling pests in the locality.
 - e. Shall make no false or fraudulent claims. The term "fraud" includes, but is not limited to, intentional misrepresentation through verbal or written statements, the media, falsified records, invoices or reports or false statement on applications for licenses or certificates.
 - f. Shall fill out weekly spray reports accurately.
 - g. Shall conform to the application restrictions established in 6 V.S.A. Chapter 87, the Regulations for Control of Pesticides and permits issued thereunder.
 - h. Shall cooperate with Department requests to observe spraying operations, to inspect equipment, to inspect pesticide related records, to inspect business premises and to conduct pesticide-related sampling.
 - i. Shall apply all pesticides consistent with their labeling. Use of a pesticide in the following manner shall be considered application consistent with the labeling:
 - (1) applying a pesticide at any dosage, concentration or frequency less than specified on the labeling;
 - (2) applying a pesticide against any target pest not specified on the labeling if the application is to the crop, animal or site specified on the labeling except when the labeling specifically states that the pesticide may be used only on pests specified on the labeling;
 - (3) employing any method of application not prohibited by labeling;
 - (4) mixing a pesticide with fertilizer when such mixture is not prohibited by labeling or state regulations;
 - (5) using a pesticide for agricultural or silvicultural purposes at a dilution factor less than label dosages as authorized by the EPA in regulations or in advisory opinions.
 - j. Shall provide the following information (on a bill, invoice or other written documentation) to all customers or persons for which pesticide applications are exchanged for remuneration, at the time of application except for applications under Section IV 8:
 - (1) the common or trade name for each pesticide used;
 - (2) the EPA registration number for each pesticide used;

- (3) the amount of each pesticide used;
 - (4) the pest(s) treated for; and
 - (5) the name and signature of the applicator.
- k. Are advised that Vermont Occupational Safety and Health Program requirements may be applicable to their activities.
 - l. Shall use pesticides so as not to exceed the primary groundwater quality enforcement standards identified in Chapter 12.702 of the "Ground Water Protection Rule and Strategy" in accordance with 10 V.S.A. Chapter 48.
 - m. Shall manage the use of pesticides to reduce the concentrations of pesticides in groundwater to the preventive action limits established by Chapter 12.702 of the "Ground Water Protection Rule and Strategy" when monitoring indicates the presence of pesticide concentrations in groundwater that exceed the preventive action limits.
 - n. Shall obtain a Water Quality Permit (from the Vermont Department of Environmental Conservation, Water Quality Division), prior to using pesticides in waters of the State.
 - o. Shall maintain a fifty (50) foot buffer when applying pesticides which provide control within the soil profile around any existing private well unless written permission allowing a lesser distance has been granted by the well owner.
- 3. Protection of Bees - To prevent destruction of pollinating insects and contamination of honey crop, all persons are prohibited from spraying pesticides to flowering crops, including but not limited to alfalfa, apples, blueberries, clover, pumpkins, raspberries, squash or trefoil without prior notification of apiculturists who have established apiaries on the premises. Any individual hiring commercial applicators shall be responsible for notification of the apiculturist prior to the application. Apiculturists who are notified of spraying operations shall remove their bees from the area or cover the hives to prevent exposure.

The following pesticides are exempt from the requirement of Section IV, subsection 3:

- a. Blossom thinning sprays consisting of sodium salt or 4,6-Dinitro-o-cresol (DNC) or Dinitro orthocyclohexylphenol.
 - b. Fungicides.
- 4. Rights-of-way clearing and maintenance
 - a. No person, including utilities as defined in Section I., shall use herbicides for the purpose of clearing or maintaining a right-of-way without first obtaining a permit from the Commissioner for each application as provided in this section.
 - (1) A request for permission to use a herbicide on a right-of-way shall be made before April 1 of the year of the proposed spray application.
 - (2) Application shall be made on a form provided by the Commissioner. In the case of utilities, as defined in Section I., the application shall be signed by an officer of the utility and who shall agree to conditions to be set forth by the Commissioner in the permit. Final action by the Commissioner will be taken only after the submitted application form has been forwarded to the Vermont Pesticide Advisory Council (VPAC) members for review and recommendation in accordance with 6 V.S.A. Section 1102(d)(1).
 - (3) The application form shall be accompanied by two sets of geodetic maps marked with the right-of-way. With the assistance of the Department of Health, the Department of Agriculture, Food and Markets, shall mark the public water supplies along the right-of-way and return one set of maps to the permit applicant. The other set shall be retained by the Department on permanent file. Subsequent requests for permits to treat the same right-of-way shall require re-submission of the permit applicant's set of maps for update.

- b. After applying for a permit to use herbicides on a right-of-way, the permit applicant shall publish a notice of the intent to use herbicides which satisfies the following criteria. A copy of the notice shall be supplied to the Department prior to publication. The notice shall:
- (1) be published not less than 25 days nor more than 60 days before the commencement of spraying;
 - (2) be published for one (1) day a week for two (2) consecutive weeks in each of two (2) newspapers prescribed in Appendix B, for every county to be affected by the right-of-way spraying. If the notices are printed in a daily newspaper, the notice shall be published on Thursdays. If notices are printed in a weekly newspaper, the notices shall be published on whatever day the paper is published;
 - (3) be at least two (2) columns wide by three (3) inches high;
 - (4) set forth the name and address of the permit applicant; a reasonable identification of the affected right-of-way; the names of the towns where the spraying is to be done; the approximate date of the herbicide application; that a permit has been requested from the Commissioner; the method by which the herbicide is to be applied; the chemicals to be used; the name, position, address and telephone number of a person from the permit applicant to contact for further information; the address and phone number of the Department of Agriculture, Food and Markets, identifying it as the appropriate place to contact with comments and/or complaints; a warning to residents along the right-of-way that water supplies and other environmentally sensitive areas near the right-of-way should be protected from spray and that it is the resident's responsibility to notify the contact person of the existence of a private water supply near the right-of-way.
- c. Applicants conducting vegetative management along rights-of-way shall submit a long-term vegetative management plan which should include:
- (1) A general statement of policy and goals;
 - (2) Identification of a biologically sound schedule to achieve long-term objectives including a specified time interval between original control and subsequent scheduled control;
 - (3) Description and identification of the species to be eliminated or controlled versus the species to be left in various types of vegetative settings;
 - (4) List and description of techniques and conditions under which given mechanical, chemical and other methods would normally be considered appropriate;
 - (5) Procedure for identifying, evaluating, reporting and responding to right-of-way maintenance problems;
 - (6) Establishment of clearance standards sought, based on kilowatt of transmission line and the part of the right-of-way to be controlled; i.e., central strip, side strip, high visibility, other;
 - (7) Establishment of standards and practices for:
 - (a) Wetlands;
 - (b) Wildlife;
 - (c) Erosion control;
 - (d) Aesthetic considerations.
 - (8) Establishment of right-of-way inspection and monitoring standards including frequency of inspection, manner of inspections and what is to be taken note of; suggested list -- heights of road crossing screens or ideal clearance level, danger trees, evidence of tree-conductor contact, species identification, conditions of sensitive areas, notation of condition of specially or experimentally treated areas;

- (9) Retention of records to coincide with maintenance cycle of company including right-of-way inspection dates, maintenance schedules, maintenance activities;
 - (10) Provisions for periodically reviewing, evaluating and revising long-range plans and the time interval for such revisions;
 - (11) A plan to assure contractor accountability in implementing the plan such as drawing-up a comprehensive contract for contractors or developing a contractor training program, to familiarize and provide detailed instructions to field personnel in the concepts of the vegetative management plan so that field personnel can demonstrate an understanding of the practices and standards contained in the document. This may include: identification of plant species and their role in the overall management scheme, what is expected practice in sensitive areas, correct techniques to use in a given situation, knowledge of standards sought in a given situation.
- d. In addition to newspaper advertisements, further notification by one of the following methods containing the information set forth in 4.b.(4) shall be provided by:
- (1) three (3) spot messages per day on each of two (2) radio stations in the area of spraying on two (2) consecutive days during the two-week period prior to the commencement of spraying.
 - (2) U.S. mail to residents adjacent to the right-of-way during the calendar year of spray application, at least two weeks prior to such application.
 - (3) a personally delivered printed statement to residents of property adjacent to the right-of-way during the calendar year of spray application, at least ten (10) days prior to such application.
- e. The permit applicant shall notify the Department of the option used and the dates implemented. The text of this notice shall be supplied to the Department prior to implementation.
- (1) Upon notification by the landowner or water supply user, the permit applicant shall mark private water supplies on their maps.
 - (2) Prior to spraying, the permit applicant shall flag all public and private water supplies marked on their maps as well as other sensitive areas as designated by the Commissioner in the permit.
 - (3) The permit applicant shall furnish the certified applicator with a copy of the right-of-way maps showing flagged areas and a copy of the approved permit.
 - (4) The applicator shall not spray near the flagged areas.
- f. All right-of-way clearing or maintenance by the use of herbicides shall be conducted by certified applicators or persons working under the direct supervision of certified applicators.
- g. All uses of herbicides on rights-of-way shall be conducted by the certified applicator in a manner that minimizes the extent and duration of foliar brownout.
- h. Right-of-way spraying operations shall be conducted in a manner and under weather conditions which prevent deposits of pesticides to areas outside the rights-of-way.
- i. The clearing of brush, trees and other vegetation from rights-of-way shall be conducted in accordance with other applicable provisions of state and federal laws and regulations.
- j. All operations conducted prior, during or subsequent to the aerial application of pesticides to rights-of-way, including, but not limited to, gaining access, landing of aircraft, refilling operations and the like, shall not be conducted on private lands near the right-of-way without the owner's prior written permission. Written permission shall be maintained by the permit applicant for one (1) year following completion of the operations and shall be available to the Commissioner upon request.
- k. All permits issued by the Commissioner shall establish buffer strip distances to protect the waters of the state. Buffer strip distances shall be determined according to the type of spray operation, properties of chemicals to be used and the characteristics of the areas to be treated.

5. Aerial applications of pesticides

- a. An applicant applying for a company license or certificate to engage in aerial application of pesticides shall meet all the requirements of the Federal Aviation Administration and the Vermont Agency of Transportation, Aeronautics Section, to operate the aircraft and equipment described in the application.
- b. Aerial applications shall be conducted by certified applicators only.
- c. All aerial pesticide applications require an approved permit prior to application.
 - (1) Aerial applicators shall obtain a permit for each contract to apply pesticides for purposes other than the treatment of agricultural commodities. Permits may not be issued for more than one spray season.
 - (2) Aerial applicators shall obtain a permit annually for the treatment of agricultural commodities.
- d. Materials listed on Attachment A, subsection 2, "Control Details for Permit Application", as recommended by the Vermont Extension Service or other state agencies will be used for permit review.

6. Experimental use permit

- a. Any person who desires to use an unregistered pesticide or who desires to use a registered pesticide for an unregistered use shall first obtain an experimental use permit from the Commissioner. Permits may be issued for three (3) kinds of experimental uses:
 - (1) A state-issued permit as authorized under Section 5(f) of the FIFRA (as amended) to accumulate information or data necessary to register a pesticide use for special local needs.
 - (2) A state-issued permit to conduct laboratory or greenhouse tests or limited replicated field trials to confirm such tests or other tests in which the purpose is to determine the value of the substance for pesticide purposes or to determine its toxicity or other properties to the extent permitted under EPA regulations.
 - (3) A state-issued authorization to conduct an experimental use in Vermont for all or some of the uses provided in the label under the experimental use permit issued by EPA pursuant to Section 5(a-e) of FIFRA as amended.
- b. A state experimental use permit may, subject to the terms and conditions of the state's certification from the Administrator of EPA, be issued when the Commissioner determines that the conditions under which the use of the experimental pesticide will be conducted are satisfactory. The permit shall be for a specified period commensurate with the experimental program submitted, but in any case not to exceed one year. Permits may be renewed or extended upon request if circumstances warrant. The permittee shall supervise the test program and evaluate the results of testing at each site of application. The permittee shall report immediately to the Commissioner any adverse effects from the use of or exposure to the pesticide.
- c. A report shall be submitted to the Commissioner at the conclusion of the experimental pesticide treatment or at the expiration date of the experimental use permit. The report shall include the data gathered during the testing program, the dates of application, any adverse effects to the environment and recommended directions for use which might be submitted for future registration.
- d. The application of a pesticide under a state experimental use permit shall be under the supervision of a certified applicator as required by labeling and any additional restrictions imposed by the Commissioner in the permit.
- e. When a pesticide is applied to a food or feed crop under an experimental use permit where a tolerance has not been established for that particular crop and use pattern, then:
 - (1) the crop must be destroyed after harvest; or

- (2) the crop may be used for further testing, provided that the crop may not be consumed by humans. If the crop is consumed by test animals, the animals or animal products may not be used for human or animal consumption.

7. Bird and other animal control exclusive of the phylum chordata (families Cricetidae and Muridae).

Cricetidae: (moles and voles)

Muridae: (rats and mice)

- a. Bird and animal pests are those that may be declared a pest by the Commissioner. The Commissioner may declare a bird or animal to be a pest in a specific situation where there is a likelihood of damage to health, the economy or where harm to other wildlife may occur or in the event of injury or severe annoyance.
 - (1) Types of use that may be authorized by permit:
 - (a) Area-wide application of pesticides on agricultural commodities, wildlife and for human protection.
 - (b) Limited-area applications of pesticides where the use of those pesticides could have a detrimental effect on non-target animal life adjacent to the structure, lot or yard which is specifically treated or may affect food or food products.
- b. Any licensed company or certified applicator applying pesticides for the lethal control of pest birds or other pest animals shall apply to the Commissioner, on an approved form, for a permit to perform such control operation.
 - (1) The application for a permit shall state the problem and the pest to be controlled, the pesticide to be used, rate to be applied, the area to be treated, disposal of the controlled pest and unused pesticide and the treatment time period.
 - (2) For municipal or community-wide operations, a written request or statement granting permission for such operation signed by an official of the municipality shall be submitted with the request.
- c. All requests for application of pesticides for bird or animal control on open land shall be reviewed by the Vermont Fish and Wildlife Department and Vermont Department of Health and notification of all limited-area requests for application of pesticides shall be submitted to the aforesaid departments if approved by the Commissioner.
- d. Control operations may also be subject to guidelines or directives which are established by the Vermont Commissioner of the Fish and Wildlife Department, Vermont Commissioner of Health, the U.S. Fish and Wildlife Service and the Vermont Commissioner of Labor and Industry.
- e. Permits are not required for the use of animal or bird repellents.

8. Notification and Posting of turf-grass and landscape pesticide application:

- a. No outdoor application by certified commercial or non-commercial applicators of pesticides to turf-grass or landscape plants shall be made on residential, single or multi-family or public non-residential properties, such as athletic fields without the following provisions having been met.
 - (1) At the time the service is being requested, the customer shall be provided with written information regarding the identification of the pesticides (common or trade name, EPA Registration number) and the rates being proposed for use. In addition, the customer shall be informed, in writing, of the availability of labels and Material Safety Data Sheets for these pesticides and any existing EPA Fact Sheets for the active ingredients contained within.
 - (2) At the beginning of each application, the applicator shall post a sign(s) prescribed below, at conspicuous points of access to the treated area(s). The applicator shall leave such sign(s) posted with instructions to remove 24 hours after application. This shall mean that if a property has more than one entrance or point of access then the corresponding number of signs shall be posted. The

specifications of the sign shall be as follows:

- (a) Shall be at least 4 x 5 inches, of sturdy, weather resistant material
- (b) Shall be with contrasting colors using the indicated point type size
- (c) Shall contain no additional words or symbols on the front panel; however, the back panel may include any additional information such as emergency number or company name
- (d) Shall be posted at least 12" above the ground
- (e) Shall contain the date and time of application on the back of the sign

C A U T I O N

Pesticide Application



KEEP OFF UNTIL DRY

CUSTOMER: Please remove after 24 Hours.

- (3) Immediately upon completion of each application, the applicator or their employer shall leave at the residence or with the property manager a written statement containing the following information:
 - (a) Name, address and telephone number of the company or non-commercial facility providing service
 - (b) Pesticide applicator's name and certification number
 - (c) Common or trade name, EPA Reg. #, amount used and pest(s) treated for each pesticide applied
 - (d) Post-application label safety precautions, if applicable
 - (e) Application date, time and location
 - (f) Instructions that signs should remain posted for at least 24 hours
- (4) Upon request, by either customer or adjoining landowner, a copy of the pesticide label, Material Safety Data Sheet or available EPA Fact Sheet shall be provided by the applicator or their employer.
- (5) Upon request, the applicator or their employer shall provide the customer with prior notification of the timing of each pesticide application.

NOTE: Golf courses shall be regulated by Section IV 8b. of this regulation. Outdoor commercial or noncommercial pesticide application to turf-grass or landscape plants made on private non-residential properties shall comply with either Section IV 8a. or Section IV 8c. of the regulations.

- b. Pesticide applications made by certified commercial or noncommercial applicators on golf course turf-grass or landscape plants shall require the posting of a written notice on the clubhouse bulletin board or the first tee by the course superintendent or their designee.

- (1) The written notice shall contain information as specified under Section IV 8a.(3)(a-f) and include the specific location and number of each fairway, green, tee and driving area, etc., where pesticide is applied. The Commissioner reserves the right to approve the use of alternate wording to fulfill the written notice requirement on a case by case basis. Alternate wording must be submitted to the Commissioner, in writing and approved prior to its use.
 - (2) The notice shall be posted prior to application and remain on the bulletin board or the first tee for at least 24 hours after application.
 - (3) Upon request, a label, Material Safety Data Sheet or EPA Pesticide Fact Sheet for the specific pesticide(s) used shall be made available to any golfer using the facility or course employee for their review.
- c. Outdoor commercial or noncommercial pesticide application to turf-grass or landscape plants made on fenced, private non-residential properties shall require the posting of a written notice(s) in visitor reception area(s) and main employee entrance(s) by the grounds superintendent or their equivalent. All other private non-residential properties without fencing shall comply with Section IV 8.a.
- (1) The written notice shall contain information as specified under Section IV 8a.(3)(a-f) and the specific location where each pesticide is applied.
 - (2) The notice shall be posted prior to application and remain in place for at least 24 hours after application.
 - (3) Upon request, a label, Material Safety Data Sheet or EPA Pesticide Fact Sheet for the specific pesticide(s) used shall be made available to any visitor or facility employee for review.
- (d) This regulation does not cover the injection of pesticides directly into plant material and does not apply to rights-of-way or utility applications.
- (e) This regulation does not apply to private pesticide applicators or certified private pesticide applicators.
9. Golf Course Permits:
- a. No person shall use a pesticide(s) on a golf course without first obtaining a permit from the Commissioner as provided in Section IV 9. except as described in Section IV 9.b. The permit process shall begin as follows:
 - (1) Existing golf courses shall submit to the Commissioner their name, address, location and information identifying surface water, private water sources of abutting landowners, public water sources, private or public source protection areas and environmentally sensitive areas present on the golf course. The amount and type of pesticide used on the golf course over the last three (3) years is also required. A form will be provided by the Commissioner for the submission of this information.
 - 2) The Commissioner shall determine a schedule staggered over the next five (5) years when each golf course existing on the effective date hereof shall file an application for a permit and shall notify each course in writing, certified mail, return receipt requested. The scheduling of golf courses will be prioritized on the basis of risk and will require those golf courses with the highest risk potential to submit first.
 - b. An existing golf course may continue to use pesticides until either it fails to file an application for a permit on the date scheduled by the Commissioner or a permit is denied.
 - c. An application for a permit shall be on a form provided by the Commissioner and conform to the provisions of Section IV 9 h. and be signed by an officer of the golf course and the golf course superintendent completing the form, who shall agree to the conditions to be set forth by the Commissioner in the permit. Applications for a renewal permit shall be filed with the Commissioner three (3) months prior to the expiration of the existing permit. An application for renewal shall detail any proposed changes to the existing pesticide management plan of the golf course.

- d. The Commissioner will forward the application to the Vermont Pesticide Advisory Council (VPAC) for review and recommendation under 6 V.S.A. Section 1102(d)(1). VPAC's review shall be based on the established requirements of statutes, regulations and guidelines.
- e. The Commissioner shall issue or deny the permit after consideration of VPAC's recommendation, risk to human health and the environment, the pesticide management plan as it relates to the use of pesticides and the past history of the golf course. The Commissioner may restrict or deny the use of a pesticide in accordance with 6 V.S.A. Section 1104(3) and other applicable provisions of the law. All parties aggrieved by a decision of the Commissioner under this section may request a hearing within fifteen (15) days of the receipt of notice of the decision.
- f. Permits issued by the Commissioner:
 - (1) Shall be conditioned on the operation of the golf course according to an approved pesticide management plan.
 - (2) Shall, when necessary and appropriate, establish additional buffer strips to protect surface waters and environmentally sensitive areas. The need for buffer strips shall be determined according to the type of application, properties of chemicals to be used and characteristics of the areas to be treated.
 - (3) May require sampling and analysis of ground and surface water as a condition to the use of a pesticide. Those pesticides on the Prescreened Pesticide List would not require sampling or analysis unless the Commissioner determines that this type of information is critical to the evaluation of the risk to human health or the environment. Due to its cost, sampling and analysis will be required only when the Commissioner determines it is reasonably necessary to assess compliance with statutory or regulatory standards for protection of the environment or human health and will limit the variables. All parties aggrieved by a decision of the Commissioner under this section may request a hearing within fifteen (15) days of the receipt of notice of the decision.
 - (4) To a proposed golf course shall be conditioned on the course being built as is represented in the application and requires the applicant to submit proof within sixty (60) days after completion.
 - (5) Shall be issued for a period of five (5) years and therefore expire at the end of the five (5) year period. The permit shall identify the pesticides permitted either by specific reference to each pesticide or reference to the Prescreened Pesticide List. The use of other pesticides may be added by modification of the five (5) year permit. Modifications shall be requested on forms provided by the Commissioner and shall be processed, issued or denied in the same manner as provided for permits, except that the term shall coincide with the term of the permit being modified.
- g. The Commissioner shall approve and maintain the Prescreened Pesticide List along with specifications for its use on golf courses upon review and recommendation from VPAC. Pesticide(s) may be added or deleted at any time. Any person may submit to the Commissioner a request to add or delete a pesticide under this section. The request shall include a current EPA Pesticide Fact Sheet or equivalent and any other data desired to be considered. The Commissioner shall either approve or deny the request and notify the applicant in a timely manner.
- h. Applications for a permit to use pesticides on a golf course shall contain the following information:
 - (1) General Information
 - (a) Name of the golf course
 - (b) Location
 - (c) Mailing address
 - (d) Golf Course Superintendent who is responsible for completing the application
 - (e) Name and position of an officer of the golf course

- (f) Date of application
- (2) Permit Status
 - (a) Initial, renewal or modification
 - (b) Course classification; existing, existing with proposed expansion or proposed
- (3) Pesticide Information. Identification of the pesticide(s) to be used as follows:
 - (a) Pesticides found on current Prescreened Pesticide List. Indicate specific pesticides by common and trade name and EPA Registration Number.
 - (b) Pesticide(s) other than those found on the Prescreened Pesticide List shall be identified by both common and trade name, EPA Registration Number and by attaching a current EPA Pesticide Fact Sheet or equivalent. The KOC, solubility, half-life (soil) and any additional information as specified in Section IV 9h.(6) shall be provided for each pesticide.
- (4) Golf Course Description. A description of the golf course as it exists or is designed as follows:
 - (a) A site plan (which may be an orthophoto map, scale 1:5000'), marked with the following:
 - i. tees, greens and fairways, by hole number and supporting operations;
 - ii. areas irrigated and source of water for irrigation;
 - iii. all surface waters identified by name, if known;
 - iv. all known ground waters;
 - v. private water sources of abutting properties;
 - vi. public water sources and source protection areas;
 - vii. identification and location of any environmentally sensitive areas;
 - viii. property boundaries;
 - ix. each building and its use; and
 - x. legend, scale, north designation;
 - (b) A topographical map, which may be a U.S.G.S. topographical map with the boundaries of the golf course identified thereon and a general written topographical description including minimum and maximum slopes and any distinct topographical features.
 - (c) The square feet of each green and tee, and identification of any green or tee which is within 100 feet of any surface waters.
 - (d) Approximate acreage of each fairway specifying closely mowed areas and rough areas individually.
 - (e) The square miles of the drainage area for flowing waters at the point of exit from the golf course property.
 - (f) The surface acreage and average depth of any ponded surface waters and the location of its primary source of supply.
 - (g) A soils map and key as mapped by the United States Soil Conservation Service or other reliable source, including identification of soils of high erodibility.
- (5) Pesticide Management Plan. A detailed account of how pests such as insects, weeds, diseases and rodents are managed on the golf course as follows:
 - (a) A general statement of the policy and listing of the goals of the pesticide management plan, including the golf course's strategy for minimizing pesticide use;
 - (b) A description of pest problems associated with turfgrass and ornamentals during the past five (5) years, including locations and the extent of infestation. For proposed golf courses a description of anticipated pest problems and the rationale for each;

- (c) A description and rationale of the pest management strategies that are or will be employed, including biological, chemical and cultural controls;
 - (d) A description of pest monitoring practices that are or will be utilized;
 - (e) A description and location of pesticide storage, handling and mixing areas; a Spill Response Plan and proposed measures to prevent accidental releases;
 - (f) A description of irrigation practices, including the type of system used, rates and intervals of irrigation;
 - (g) For proposed golf courses, a description of any unique feature of its design which will minimize pest problems;
 - (h) A description of any buffer zone established or to be established to protect surface waters, private and public water supplies, and environmentally sensitive areas.
- (6) Other Pesticides, Additional Information. When the use of a pesticide(s) is (are) requested which is (are) not found on the current Prescreened Pesticide List or when otherwise required by the Commissioner to evaluate risk, the applicant will provide additional information which will justify the use of the pesticide within an acceptable level of risk. The following information or any other pertinent information may be submitted in support of this justification:
- (a) Expected pesticide concentrations:
 - i. nearest private and all public water sources of concern using a Simple Dilution Analysis, calculated using a proportion of either well yield and/or precipitation and irrigation;
 - ii. in flowing surface water at the point of exit from the golf course boundary.
 - iii. in standing surface water only when deemed necessary after consultation with the Department of Environmental Conservation, Water Quality Division.
 - (b) In graphic or matrix form, a comparison between the expected pesticide concentrations and Vermont Water Quality Guidelines, Chapter 12 Groundwater Protection Rule Standards and Department of Health Drinking Water Standards.
 - (c) The hydrogeologic setting, including hydrogeologic flow patterns, receiving waters, recharge and discharge areas, range of depth to groundwater, aquifer type, if present and hydraulic conductivity.
 - (d) Identification of any environmentally sensitive areas and a general discussion of whether the use of pesticides will destroy or significantly imperil the same.
- i. Golf courses shall keep and maintain operating records and report pesticides on forms provided by the Commissioner for that purpose as follows:
- (1) Operational records of pest problems encountered, control methods employed and their effectiveness, the type and amount of pesticide(s) used, its purpose, date and area of the golf course where applied; a record of rainfall; and a summary of irrigation utilization. These records must be maintained for a period of five (5) years and shall be made available to the Commissioner upon request.
 - (2) A pesticide use record for each calendar year shall be submitted to the Commissioner prior to January 1 of the following year. A form will be provided by the Commissioner for this purpose.
 - (3) Maintenance of the records and report of pesticide use as provided above shall exempt the golf course or certified applicators employed by it from the record and reporting requirements of Section V. 2, 4 and 6.

SECTION V - MAINTENANCE OF RECORDS BY CERTIFIED LICENSED COMPANIES, LICENSED PESTICIDE DEALERS AND PESTICIDE PRODUCING ESTABLISHMENTS

1. Certified private applicators shall record, for all restricted use pesticides, the pesticide product name, Environmental Protection Agency (EPA) Registration Number, amount used, date of application, location of application (farm name and town) and the pest(s) treated for during each year. This information is to be held for a period of two years and shall be furnished to the Commissioner upon request.
2. Certified commercial and certified noncommercial applicators shall keep and maintain pesticide operational records in a manner prescribed by the Commissioner on forms provided for that purpose.
 - a. Routine operational records shall be kept which state the pesticide product name, EPA Registration Number, amount used, date of application, location of application (farm name and town) and the pest(s) treated for during each year. These records must be maintained for a period of two years and shall be made available to the Commissioner upon request.
 - b. A pesticide use report shall be submitted to the Commissioner annually. The report shall state the EPA Registration Number, the product name, the manufacturer, the amount used, the general purpose for which it was used and the county in which it was used.
 - c. Annual pesticide use reports shall be submitted together with an application for the renewal of certification to the Commissioner prior to January 1 of each year. Commercial and noncommercial pesticide applicator certificates shall not be renewed without the submission of an annual use report. Annual use reports shall be submitted regardless of whether pesticides were applied during a given year or not.
3. Persons applying pesticides under the authority of a permit issued by the Department shall comply with all record keeping and reporting requirements imposed by the Commissioner as conditions of the permit.
4. Licensed companies shall be responsible for maintaining routine operational records and submitting the annual pesticide report. Certified noncommercial applicators, who do not work for licensed companies, will continue to be responsible for the maintenance and submission of these records.
 - a. The licensed company shall collect operational records required by this section from its certified applicators and hold them for a period of two years. These records shall be made available to the Commissioner upon request.
 - b. The annual pesticide use report shall be submitted together with the company license renewal application to the Commissioner prior to January 1 of each year.
5. Licensed Class A dealers shall keep and maintain records of the sales of pesticides and shall make them available for inspection to the Commissioner. Records shall be maintained on forms provided by the Commissioner.
 - a. A report of special permit and restricted use pesticides sold on a calendar year basis shall be submitted together with the application for license renewal to the Commissioner by all Class "A" pesticide dealers prior to January 31 of the following year. Reports may be required by the Commissioner at any other time, provided the request is made in writing.
 - b. Pesticide dealer reports shall include the product name, the EPA registration number, the size and number of containers and the county of intended use. For the purpose of reporting the county of intended use, pesticide dealers may use the applicator's county of residence.
 - c. Annual sales reports must be submitted regardless of whether or not restricted use pesticides were sold.
6. Annual records may be required for treatments of pests as deemed necessary by the Commissioner.
7. In the event that a certified applicator, licensed company or licensed pesticide dealer should choose not to renew a certificate or license, the annual use and/or sales reports are still required for the last year in which a valid certificate and/or license was held.

8. Refer to Section XII, Community Right-to-Know, for a complete description of additional requirements that may be applicable to pesticide companies, applicators, dealers and producers.

SECTION VI - COMPANY LICENSE

1. Any enterprise applying pesticides to the land or home of another for remuneration must be licensed by the Department. Exceptions to the company license requirement shall be:
 - a. Doctors of Medicine and Doctors of Veterinary Medicine applying pesticides as drugs or medication during the course of practice.
 - b. Applicators certified under Category 10, making recommendations and applying pesticides in demonstration or research programs.
 - c. Private applicators who apply pesticides to a neighbor's property in exchange for services.
 - d. Certified and noncertified noncommercial applicators.
2. The company license shall be renewed yearly. The license shall extend from January 1 through December 31.
3. A fee of forty dollars (\$40.00) shall be charged for a company license.
4. The Commissioner may deny an application for a company license when the applying company is owned, controlled, or operated by persons or their employees who have been determined to have violated Vermont's pesticide laws, or any rule or regulation adopted under its authority, or any order of the Commissioner under 6 V.S.A. Chapter 87 within two years preceding the date of application.
5. Applicants who are denied a company license may request a hearing to review the decision within fifteen days of receipt of the denial.
6. Licensed companies and those requiring licensing shall be responsible for ensuring they only employ pesticide applicators that are properly certified under these regulations, prescribed by the Commissioner in Section VIII and that applicators employed by them remain certified for the duration of their employment with the company, except that those employees working under the direct supervision of a certified applicator need not be certified.

Licensed companies shall supply the Department with a list of all certified commercial applicators they employ. They shall send written notice to the Department within thirty (30) days whenever a certified commercial applicator is hired or leaves their employment.

SECTION VII - REQUIREMENTS FOR CERTIFIED COMMERCIAL AND CERTIFIED NONCOMMERCIAL APPLICATORS.

1. All noncommercial applicators who use other than Class "C" pesticides and all commercial applicators who use pesticides shall be certified in accordance with the applicator standards established in these regulations, or work under the direct supervision of a certified commercial or certified noncommercial applicator. (See definition of "direct supervision", Section I.)

Exceptions: Persons conducting research in laboratories, or Doctors of Medicine or Doctors of Veterinary Medicine applying pesticides as drugs or medication during the course of their normal practice are exempt from the certification requirement.
2. The candidate for certification shall satisfactorily meet standards prescribed by the Commissioner in Section VIII.
3. Candidates for certification shall take a written examination covering general standards and specific standards required for each category an individual expects to operate under. A candidate must be certified in each specific category that he or she intends to work in.

- a. A candidate shall have a maximum of three opportunities to achieve a passing score on the certification examination during a twelve (12) month period. This twelve (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 (7) days to retake the examination. If a candidate fails twice, there shall be at least a twenty-eight (28) day waiting period before retaking the exam for the third time.
4. Certificates issued in any category may be further restricted by the Commissioner as a condition of issuance, when the Commissioner determines that the restrictions are necessary to protect human life or the environment. For example, a certain category certificate may be restricted to allow only the use of specific pesticides in that type of work.
5. Fees: A fee of twenty dollars (\$20.00) shall be assessed for each category or sub-category certification issued. The maximum total fee charged for categories per candidate shall be seventy-five dollars (\$75.00). Payment of fees for persons who are employees of federal, state or municipal government and who apply pesticides as part of that employment shall be waived.
6. The certification year will extend from January 1 through December 31.
 - a. Certification of noncommercial and commercial applicators may be renewed annually for up to five years after which recertification shall be required. The Commissioner may furthermore require recertification whenever necessary and determine the procedure to be utilized involving either additional training or reexamination.
 - b. Certified noncommercial or commercial applicators shall send written notice to the Department within thirty (30) days of changing employers. The name of the new employer shall be supplied in the notice.
7. Denial of certificate: The Commissioner may deny issuance of a certificate to any person failing to adequately demonstrate competency on any examination or who otherwise fails to participate in training required in lieu of written examination or who is currently under a suspension or revocation of certificate by the Commissioner.

SECTION VIII - CERTIFICATION STANDARDS FOR COMMERCIAL APPLICATORS AND NONCOMMERCIAL APPLICATORS USING OTHER THAN CLASS "C" PESTICIDES

1. Noncommercial applicators who use pesticides other than Class "C" and all commercial applicators, except those who work under the direct supervision of a certified applicator, shall be certified according to categories which reflect the types of pesticide use for which they have been examined and found competent.

Applicants for certification in the categories and sub-categories described in this section shall demonstrate their competence to meet standards described under general standards, category specific standards and standards for supervision of noncertified applicators in this section. Applicants shall take a written examination covering general standards and specific standards required for each category an individual expects to operate under.

2. Description of categories and sub-categories.
 - a. Category 1: Agricultural Pest Control.
 - (A) Plant - For use in production of food, forage and fiber agricultural crops.
 - (B) Animal - For use on animals and to places on or in which animals are confined. Doctors of Veterinary Medicine engaged in the business of applying pesticides for hire, publicly holding themselves out as pesticide applicators are included in this category. Doctors of Veterinary Medicine who apply pesticides as drugs or medications during the course of their normal practice are exempt from certification requirement. See Section VII.
 - b. Category 2: Forest Pest Control - For use in forests, forest nurseries and forest seed producing areas.
 - c. Category 3: Ornamental and Turf Pest Control.
 - (A) Ornamentals and Shade Trees - For use to control pests in the maintenance and production of Christmas trees, ornamental trees, shade trees, shrubs and flowers.

- (B) Turf - For use to control pests in the maintenance and production of turf.
 - d. Category 4: Seed Treatment - For use on seeds.
 - e. Category 5: Aquatic Pest Control - For use as applied to, or adjacent to, standing or running waters and includes but is not limited to, waters of the state, drinking water reservoirs, industrial lagoons and sewage or wastewater treatment plant lagoons.
 - f. Category 6: Rights-of-way Pest Control - For use in the maintenance of public roads, electric power lines, pipelines, railway rights-of-way or similar areas.
 - g. Category 7: Industrial, Institutional, Structural, and Health Related Pest Control
 - (A) Industrial, Institutional and Structural Pest Control - General - For pesticide use in, on or around food handling establishments, human dwellings, institutions, such as schools or hospitals, industrial establishments, including warehouses and grain elevators and any other structure and adjacent area, public or private, for the protection of stored, processed or manufactured products.
 - (B) Health Related Pest Control - For out-of-door pesticide use in control of mosquitoes and other biting arthropods.
 - (C) Food Processing Pest Control - For use of the pesticides to control pests in, on or around food processing plants which may include, but are not limited to, bakeries, dairy product processing, canning and frozen food packing, confection manufacturing and meat product processing plants.
 - (D) Wood and Fiber Product Pest Control - For control of pests which degrade or prematurely destroy the service, life and usefulness of wood and fiber products.
 - (E) Antimicrobial Pest Control - For the use of pesticides to control pests in non-potable cooling waters and in water or slurries used in industrial processing, in, on or around human dwellings, commercial establishments, institutions, including but not limited to, schools and hospitals, industrial establishments and any other structures and adjacent areas whether public or private.
 - h. Category 8: Public Health Pest Control - For use by governmental employees in public health programs for the management and control of pests for medical and public health importance.
 - i. Category 9: Regulatory Pest Control - For use by state, federal, and other governmental subdivisions for control of regulated pests.
 - j. Category 10: Demonstration and Research Pest Control - For individuals who demonstrate pest control to the public, supervise demonstrations or conduct field research with old, new or experimental use pesticides. Included in this category are those individuals who demonstrate, sell or recommend pesticides to applicators, dealers or the public.
 - k. Category 11: Aircraft Pest Control - For the application of pesticides from any aircraft for the control of pests in any of the preceding categories.
3. General standards for all categories and sub-categories of commercial applicators.
- a. All commercial applicators shall demonstrate practical knowledge of the principles and practices of pest control and safe use of pesticides. Testing shall be based on examples of problems and situations appropriate to the particular category or sub-category of the applicator's certification and the following areas of competence:
 - (1) Label and labeling comprehension.
 - (a) The general format and terminology of pesticide labels and labeling;
 - (b) The understanding of instructions, warnings, terms, symbols and other information commonly appearing on pesticide labels;

- (c) Classification of the product, general or restricted; and
 - (d) Necessity for use consistent with the label.
- (2) Safety. Factors including:
- (a) Pesticide toxicity and hazard to man and common exposure routes;
 - (b) Common types and causes of pesticide accidents;
 - (c) Precautions necessary to guard against injury to applicators and other individuals in or near treated areas;
 - (d) Need for and use of protective clothing and equipment;
 - (e) Symptoms of pesticide poisoning;
 - (f) First aid and other procedures to be followed in case of a pesticide accident; and
 - (g) Proper identification, storage, transport, handling, mixing procedures and disposal methods for pesticides and used pesticide containers, including precautions to be taken to prevent children from having access to pesticides and pesticide containers.
- (3) Environment. The potential environmental consequences of the use and misuse of pesticides as may be influenced by such factors as:
- (a) Weather and other climatic conditions;
 - (b) Types of terrain, soil or other substrate;
 - (c) Presence of fish, wildlife and other non-target organisms; and
 - (d) Ground and surface water drainage patterns.
- (4) Pests. Factors such as:
- (a) Common features of pest organisms and characteristics of damage needed for pest recognition;
 - (b) Recognition of relevant pests; and
 - (c) Pest development and biology as it may be relevant to problem identification and control.
- (5) Pesticides. Factors such as:
- (a) Types of pesticides;
 - (b) Types of formulations;
 - (c) Compatibility, synergism, persistence and animal and plant toxicity of the formulations;
 - (d) Hazards associated with use;
 - (e) Factors which influence effectiveness or lead to such problems as resistance to pesticides;
 - (f) Dilution procedures; and
 - (g) Residues associated with use.
- (6) Equipment. Factors including:

- (a) Types of equipment and advantages and limitations of each type; and
- (b) Uses, maintenance and calibration.
- (7) Application techniques. Factors including:
 - (a) Methods of procedure used to apply various formulations of pesticides, solutions and gases, together with a knowledge of which technique of application to use in a given situation;
 - (b) Relationship of discharge and placement of pesticides to proper use, unnecessary use and misuse;
 - (c) Prevention of drift and pesticide loss into the environment; and
 - (d) Principles of chemigation including appropriate equipment.
- (8) Laws and regulations. Applicable state and federal laws and regulations.
- 4. Specific standards of competency for each category and sub-category of commercial applicators.

Because of the frequent proximity of human habitations to application activities, applicators in all categories must demonstrate practical knowledge of application methods which will minimize or prevent hazards to humans, pets and other domestic animals.

Certified applicators in each category will be particularly qualified with respect to the practical knowledge standards elaborated below:

- a. Category 1: Agricultural Pest Control.
 - (A) Plant. Applicators must demonstrate practical knowledge of crops grown and the specific pests of those crops on which they may be using pesticides. The importance of such competency is amplified by the extensive areas involved, the quantities of pesticides needed and the ultimate use of many commodities as food and feed. Practical knowledge is required concerning soil and water problems; preharvest intervals, reentry intervals, phytotoxicity and potential for environmental contamination, nontarget injury and community problems resulting from the use of restricted use pesticides in agricultural areas.
 - (B) Animal. Applicators applying pesticides directly to animals must demonstrate practical knowledge of such animals and their associated pests. A practical knowledge is also required concerning specific pesticide toxicity and residue potential, since host animals will frequently be used for food. Further, the applicators must know the relative hazards associated with such factors as formulation, application techniques, age of animals, stress and extent of treatment.
- b. Category 2: Forest Pest Control. Applicators shall demonstrate practical knowledge of types of forests, forest nurseries and seed production and the pests involved. They should possess practical knowledge of the cyclic occurrence of certain pests and specific population dynamics as a basis for programming pesticide applications. A practical knowledge is required of the relative biotic agents and their vulnerability to the pesticides to be applied. Because forest stands may be large and frequently include natural aquatic habitats and harbor wildlife, the consequences of pesticide use may be difficult to assess. The applicator must therefore demonstrate practical knowledge of control methods which will minimize the possibility of secondary problems such as unintended effects on wildlife. Proper use of specialized equipment must be demonstrated, especially as it may relate to meteorological factors and adjacent land use.
- c. Category 3: Ornamental and Turf Pest Control.
 - (A) Ornamental and Shade Tree. Applicators shall demonstrate practical knowledge of pesticide problems associated with the production and maintenance of ornamental trees, shrubs and plantings including cognizance of potential phytotoxicity due to a wide variety of plant material, drift and persistence beyond the intended period of pest control.

- (B) Turf. Applicators shall demonstrate practical knowledge of pesticide problems associated with the production, establishment and maintenance of turf including cognizance of potential phytotoxicity due to a wide variety of turf grasses and other plant types found in and around turf plantings, drift and persistence beyond the intended period of pest control.
- d. Category 4: Seed Treatment. Applicators shall demonstrate a practical knowledge of types of seeds that require chemical protection against pests and factors such as seed coloration, carriers and surface active agents which influence pesticide binding and may affect germination. They must demonstrate practical knowledge of hazards associated with handling, sorting and mixing and misuse of treated seed such as introduction of treated seed into food and feed channels, as well as proper disposal of unused treated seed.
- e. Category 5: Aquatic Pest Control. Applicators shall demonstrate a practical knowledge of the secondary effects which can be caused by improper application rates, incorrect formulations and faulty application of pesticides used in this category. They shall demonstrate practical knowledge of various water use situations and the potential of downstream effects. Further, they must have practical knowledge concerning potential pesticide effects on plants, fish, birds, beneficial insects and other organisms which may be present in aquatic environments. These applicators shall demonstrate practical knowledge of the principles of limited-area application.
- f. Category 6: Right-of-way Pest Control. Applicators shall demonstrate practical knowledge of a wide variety of environments, since rights-of-way exist over many different terrains, including waterways. They shall demonstrate practical knowledge of problems on runoff, drift, excessive foliage destruction and ability to recognize target organisms. They shall also demonstrate practical knowledge of the nature of herbicides and the need for containment of these pesticides within the right-of-way area and the impact of their application activities in the adjacent areas and communities.
- g. Category 7: Industrial, Institutional, Structural and Health Related Pest Control
- (A) General Pest Control. Applicators shall demonstrate a practical knowledge of a wide variety of pests, including their life cycles, types of formulations appropriate for their control and methods of application that avoid contamination of habitat and exposure of people and pets. Since human exposure, including that of babies, children, pregnant women and elderly people is frequently a potential problem, applicators must demonstrate practical knowledge of the specific factors which may lead to a hazardous condition, including continuous exposure in the various situations encountered in this sub-category. Because general pest control may involve outdoor applications, applicators must also demonstrate practical knowledge of environmental conditions, particularly related to this activity.
- (B) Health Related Pest Control. Applicators shall demonstrate practical knowledge of vector-disease transmission and nuisance pests as these relate to and influence application programs. A wide variety of pests from the phylum arthropoda are involved and it is essential that they be known and recognized and appropriate life cycles and habitats be understood as a basis for control strategy. The applicators shall have a practical knowledge of the importance of such nonchemical control methods as sanitation, waste disposal and drainage. Because health related pest control may involve outdoor applications, applicators must also demonstrate practical knowledge of environmental conditions, particularly related to this activity.
- (C) Food Processing Pest Control. Applicators shall demonstrate practical knowledge of a wide variety of pests, including their life cycles, types of formulations appropriate for their control and method of application that avoids contamination of food, food processing equipment and packaging materials, damage and contamination of the processing area and exposure of people. Since human exposure, including pregnant women and elderly people, may be a potential problem, applicators must demonstrate practical knowledge of the specific factors which may lead to a hazardous condition, including any continuous exposure in the various situations encountered in this sub-category.

Because food processing related pest control may involve outdoor and indoor applications, applicators must also demonstrate a practical knowledge of environmental conditions, particularly related to this activity. They shall demonstrate a practical knowledge of fumigation techniques and need for containment and post treatment ventilation.

- (D) Wood and Fiber Product Pest Control. Applicators shall demonstrate a practical knowledge of a wide variety of pests, including their life cycle, types of formulations for control and method of application that avoids contamination of food or feed, damage and contamination of habitat and exposure to people, pets and domestic animals. Since exposure to humans, including children, may be a potential problem, applicators must demonstrate practical knowledge of the specific factors which may lead to a hazardous condition including any continuous exposure conditions included in this sub-category.
- (E) Antimicrobial Pest Control. Applicators shall demonstrate a practical knowledge of the wide array of pests (algae, bacteria, fungi and shellfish) that infest a cooling water system or water used in industrial processing and the methods and reasons for their control. Applicators must also have a practical knowledge of the pesticide formulations and hazards associated with the use of pesticides in non-potable cooling waters or water used in industrial processing, in, on or around human dwellings, commercial establishments, institutions, industrial establishments, pulp mills and any other structures and adjacent areas, public or private. Applicators shall demonstrate a practical knowledge of the different types of cooling water systems or water used in industrial processing and the various methods of testing for and identifying pest infestations.
- h. Category 8: Public Health Pest Control. Applicators shall demonstrate practical knowledge of vector-disease transmission as it relates to and influences application programs. A wide variety of pests is involved, and it is essential that they be known and recognized and appropriate life cycles and habitats be understood as a basis for control strategy. These applicators shall have practical knowledge of the importance and employment of such nonchemical control methods as sanitation, waste disposal and drainage.
- i. Category 9: Regulatory Pest Control. Applicators shall demonstrate practical knowledge of regulated pests, applicable laws relating to quarantine and other regulation of pests and the potential impact on the environment of restricted use pesticides used in suppression and eradication programs. They shall demonstrate knowledge factors influencing introduction, spread and population dynamics or relevant pests. Their knowledge shall extend beyond that required in other areas of the country where emergency measures are invoked to control regulated pests and where individual judgments must be made in new situations.
- j. Category 10: Demonstration and Research Pest Control. Persons demonstrating and recommending the safe and effective use of pesticides to other applicators and the public will be expected to meet comprehensive standards reflecting a broad spectrum of pesticide uses. Many different pest problem situations will be encountered in the course of activities associated with demonstration, and practical knowledge of problems, pests and population levels occurring in each demonstration situation is required. Further, they should demonstrate an understanding of pesticide-organism interactions and the importance of integrating pesticide use with other control methods. In general, it would be expected that applicators doing demonstration pest control work possess a practical knowledge of all the general standards requirements. In addition, they shall meet the specific standards required for categories 1 through 9 as may be applicable to their particular activity. Persons conducting field research or method improvement work with pesticides should be expected to know the general standards. In addition, they shall be expected to know the specific standards required for categories 1 through 9 applicable to their activity, or alternatively, to meet the more inclusive requirements listed under "Demonstration".
- k. Category 11: Aircraft Pest Control. Applicators shall demonstrate a practical knowledge of problems which are of special significance in aerial application of pesticides. Among the subjects involved will be weather and drift, chemical dispersal equipment, tank, pump and plumbing arrangements, nozzle selection and location and ultra-low volume systems. In addition, aerial applicators will need a practical knowledge of aircraft calibration, field flight patterns, droplet size considerations, flagging methods and loading procedures. Applicators will also be required to demonstrate comprehension of labeling information for each category or sub-category of intended operation from appropriately selected labels provided. The Commissioner will rely upon the Federal Aviation Administration and the Vermont Agency of Transportation, Aeronautics Section, to determine the aeronautical competence of spray pilots and the airworthiness of their aircraft.

Applicators will be required to demonstrate recognition of target area characteristics as well as characteristics of nontarget areas to avoid accidental damage or contamination.

SECTION IX - CERTIFICATION OF PRIVATE APPLICATORS

1. Persons applying restricted use pesticides on property owned by them or on land rented by them for the production of agricultural commodities shall be certified or work under the direct supervision of a certified applicator. Certification shall be limited to allow the use of only those pesticides for which competency is determined.
2. Before receiving a certificate, the private applicator shall meet requirements set forth by the Commissioner as standards for private applicator certification. Competency shall be established either by passing a written examination or by active participation in a training program approved by the Commissioner. Persons unable to read will be examined individually by an oral examination procedure covering standards for private applicators and knowledge of labeling and use patterns for each pesticide the applicator intends to use.
3. Standards of competency for private applicators.

As a minimum requirement for certification, a private applicator must show that he possesses practical knowledge of the pest problems and pest control practices associated with his agricultural operations; proper storage, use, handling and disposal of the pesticides and containers and his related legal responsibility. This practical knowledge includes ability to:

- a. Recognize common pests to be controlled and damage caused by them.
 - b. Understand the label and labeling information -- including the common name of pesticides he applies, pest(s) to be controlled, timing and methods of application, safety precautions, any preharvest or reentry restrictions and any specific disposal procedures.
 - c. Apply pesticides in accordance with label instructions and warnings, including the ability to prepare the proper concentration of pesticide to be used under particular circumstances taking into account such factors as area to be covered, speed at which application equipment will be driven, the quantity dispersed in a given period of operation and the principles of chemigation including appropriate equipment.
 - d. Recognize local environmental conditions that must be considered during application to avoid contamination.
 - e. Recognize poisoning symptoms and procedures to follow in case of a pesticide accident.
4. Certification and renewal.
 - a. Private applicators will be certified according to the pesticide needs associated with the agricultural commodities they produce.
 - b. Any person who is qualified and has adequately met standards for determination of competency shall be certified.
 - c. Private applicator certificates shall be issued for a five-year period after which recertification will be required. Recertification requirements may be met by participation in additional training approved by the Commissioner or by reexamination.

SECTION X - CLASSIFICATION OF PESTICIDES AND LIMITATIONS ON SALE

1. General: The U.S. Environmental Protection Agency classifies all registered pesticides available to consumers as either general use or restricted use for the purposes of federal regulation. Vermont recognizes federal, state and by permit only restricted use pesticides as Class "A". Vermont classifies all registered pesticides used, sold, distributed or manufactured within the state into three categories known as:

Class "A" -	Restricted Use - federal, state and by permit only
Class "B" -	Controlled Sale
Class "C" -	Homeowner/Specialty

All pesticides sold in Vermont must be registered with the State under 6 V.S.A. Chapter 81, the Pesticide Registration Act.

2. Identification of Class "A" - Restricted Use, Class "B" - Controlled Sale and Class "C" - Homeowner/Specialty pesticides.
 - a. Class "A" - Restricted Use - federal: shall be those federally restricted use pesticides identified by the EPA designation "Restricted Use Pesticide" on the product label.
 - b. Class "A" - Restricted Use - state: shall be those pesticides classified general use by EPA and re-classified as restricted use by the Vermont Department of Agriculture, Food and Markets 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) Container construction and size
 - (7) Those requiring training due to special concerns
 - (8) Method of application
 - c. Class "A" - Restricted Use - by permit only: shall be those pesticides which may be purchased and used only after securing a special permit from the Commissioner. Pesticides are classified Class "A" - Restricted Use - by permit only by the Commissioner with the advice of the Vermont Pesticide Advisory Council after a determination that routine use of the chemical could result in harm to human health or the environment. Any sale or use whether or not currently registered under the FIFRA as amended for the following products is forbidden unless a permit is obtained from the Commissioner:
 - Aldrin
 - Daminozide (Alar - food uses)
 - Endrin
 - Mercury
 - Sodium Arsenite
 - Sodium Fluoroacetate (Compound 1080)
 - Dieldrin
 - Heptachlor
 - Dibromo-chloro-propane (DBCP)
 - Chlordane
 - d. Class "B" - Controlled sale: shall be those pesticides determined to be less hazardous than Class "A" under the criteria expressed in subsection 2.b but require some control over where products are sold. Class "B" pesticides are generally for use outside of the home and contain more than 3% total active ingredient, however, the Commissioner reserves the right to classify additional pesticides as Class "B".

The Commissioner has classified the following additional pesticides as Class "B":

- (1) All turfcare, excluding aerosols or products containing either Bacillus thuringiensis or potassium fatty acids regardless of percent of total active ingredient and does not meet Class "A" definition.

- e. Class "C" - Homeowner/Specialty - shall be those pesticides which are generally used in and around the home and which contain not more than 3% total active ingredient; however, the Commissioner reserves the right to classify additional pesticides including non-homeowner specialty products as Class "C".

The Commissioner has classified the following additional pesticides as Class "C":

- (1) Limited percentages of active ingredients:
 - (a) Anti-fouling paint containing mercury - of not more than 0.5% total active ingredient and which conform to the U.S. Department of Agriculture or Environmental Protection Agency, Pesticides Regulation Division, Interpretation No. 3 under FIFRA as amended.
 - (b) Pet supplies - shampoos, dips, tick and flea collars and dusts except lindane products which shall not exceed 7% total active ingredient.
 - (c) DDVP impregnated strips (Vapona strips) - concentrations not over 20% in resin strips and pet collars.
- (2) Unlimited percentage of active ingredients:
 - (a) Wood preservatives and sapstain control agents other than creosote, inorganic arsenicals and pentachlorophenol
 - (b) Antimicrobial agents such as disinfectants, bacteriostats, bactericides, mildewcides, mildewstats, viricides, sanitizers, slimicides, sterilants and industrial preservatives
 - (c) Animal repellents, indoors and outdoors
 - (d) Insect repellents for human use
 - (e) Moth flakes, crystals, cakes and nuggets
 - (f) Indoor aquarium supplies
 - (g) Swimming pool supplies
 - (h) Pediculocides and mange cure on humans
 - (i) Pheromone baits and floral lures
 - (j) Premixed paints containing preservatives and which make pesticidal claims
 - (k) Aerosols, excluding Class A; including fumigator bombs
 - (l) Insecticides containing bacillus thuringiensis, bacillus popilliae, bacillus lentimorbus or potassium fatty acid
 - (m) Colorants used to control algae growth by providing shade
 - (n) Animal ear tags
- (3) The petroleum solvent fraction of the product's formula shall not be considered an active ingredient for the purpose of Class "C" classification procedures.

3. The following pesticides are prohibited from use in Vermont:

- a. All uses of pesticides cancelled or suspended under FIFRA amended at the time these regulations are adopted are hereby prohibited in Vermont. All uses of pesticides prohibited in the future by the U.S. Environmental Protection Agency will be prohibited in Vermont by adoption of regulations pursuant to 3 V.S.A. Chapter 25.

- b. All DDT - Dichloro-diphenyl-trichloroethane use is prohibited by 6 V.S.A. Section 1105, as of December 31, 1971.
 - c. All pesticide products formulated from technical grade 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T) which contain more than 0.10 ppm 2,3,7,8-tetra chlorodibenzo-para-dioxin (TCDD) shall not be sold or used in the State of Vermont.
4. Limitations on sales of pesticides.
- a. Limitations on sales of Class "A" - Restricted Use - federal, state or by permit only:
 - (1) Dealers shall obtain a Class "A" dealer's license before they may sell Class "A" - Restricted Use pesticides.
 - (2) Class "A" pesticides shall be sold only to certified applicators and persons who produce written authorization from a certified applicator to purchase specific restricted use pesticides. Written authorization shall include the certificate number of the certified applicator authorizing the purchase, as well as the name and quantity of the pesticide desired.
 - (3) Class "A" pesticides shall not be displayed for self-service or stored in food areas.
 - (4) Class "A" - Restricted Use - by special permit only pesticides shall be sold only to certified applicators who produce a special permit issued by the Commissioner authorizing the purchase.
 - b. Limitations on sales of Class "B" pesticides.
 - (1) Dealers shall obtain a Class "A" or Class "B" dealer's license before they may sell Class "B" pesticides to the general public.
 - (2) Class "B" pesticides may not be stored or displayed in food areas.
 - c. Limitations on sale of Class "C" pesticides:
 - (1) Dealer's shall obtain either a Class "A", Class "B" or Class "C" dealer's license before they may sell Class "C" pesticides to the general public.
 - (2) Class "C" pesticides may not be stored or displayed in food areas.

SECTION XI - PESTICIDE DEALER LICENSES.

- 1. Class "A" and Class "B" licenses.
 - a. No store or other retail sales outlet shall sell restricted use or Class "B" pesticides unless a licensed dealer is a full time employee of the store or retail sales outlet. Persons who pass the tests required for Class "A" or Class "B" dealer licenses shall be entitled to sell the following classes of products:
 - (1) Class "A" license: Licensees may sell any pesticide registered in the State of Vermont, subject to the limitations imposed by these regulations. Generally, Class "A" licensees may sell restricted use, Class "B" and Class "C" pesticides.
 - (2) Class "B" license: Licensees may sell any Class "B" or Class "C" pesticides registered in the State of Vermont.
 - b. Prior to the issuance of a license, a pesticide dealer must apply for a license to the Commissioner and then pass a written and/or oral examination conducted by the Commissioner to show that the applicant possesses adequate knowledge of: regulations, classification of pesticides, safe handling, hazards and disposal of pesticides which will be sold or recommended for use.

- c. Holders of Class "A" and Class "B" dealer licenses are required to notify, in writing, the Department within thirty (30) days of a change of employment, including a change from one branch store location to another.
- 2. Class "C" licenses are issued to retail outlets, entitling the licensee to sell Class "C" pesticides from that location. No examination is required. Class "C" licenses are issued upon payment of the required fee.
- 3. All sales and technical field representatives of commercial companies recommending or demonstrating pesticides to "agricultural type" company stores and individuals shall be certified under Section VIII, Demonstration and Research Pest Control, and shall make annual reports of sales of pesticides classified for restricted use plus materials used for demonstrations.
- 4. Salesmen for wholesale companies operating in Vermont and selling to institutions, governmental subdivisions and retail sales outlets other than "agricultural type" company stores shall be licensed according to the classification of the pesticide sold. Salesmen selling only Class "C" pesticides are exempted from this provision.
- 5. License classification, renewals and fees
 - a. A pesticide dealer's license shall state the classification of pesticides the dealer is qualified to sell and will be considered as one category for fee assessment purposes.
 - (1) Pesticide dealers shall be classed as follows:
 - (a) Class "A" dealer refers to a dealer licensed to sell restricted use pesticides, Class "B" pesticides, special permit pesticides and Class "C" pesticides. Class "A" dealers shall not sell restricted use pesticides or special permit pesticides to Class "B" or Class "C" dealers.
 - (b) Class "B" dealer refers to a dealer licensed to sell Class "B" and Class "C" pesticides. Class "B" dealers shall not sell Class "B" pesticides to Class "C" dealers.
 - (c) Class "C" dealer refers to a dealer licensed to sell Class "C" pesticides only.
 - (2) A license fee of twenty dollars (\$20.00) will be assessed for the issuance of a Class "A" or Class "B" license; a fee of ten dollars (\$10.00) will be assessed for the issuance of a Class "C" license as provided under Section 1109 by 6 V.S.A. as amended in 1989.
 - b. The license year will extend from January 1 through December 31 and the license must be renewed annually by January 1 of each year.

Licenses may be renewed without examination provided the conditions under which the original license was issued have not changed. However, the Commissioner may determine that additional instruction or examination is necessary to meet new criteria relative to any pesticide use, handling or disposal.

SECTION XII - COMMUNITY RIGHT-TO-KNOW REQUIREMENTS, EMERGENCY ACTIONS AND ACCIDENT REPORTING

This Section incorporates Vermont Act 31, An Act Relating to Community and Worker Right-to-Know of 1985, and accident reporting requirements as they affect the production, use or storage of pesticides. These requirements affect certified commercial and noncommercial applicators, certified private applicators, licensed applicator companies, Class A Dealers, those persons working under a certified applicator and pesticide producing establishments. These requirements are also applicable to those individuals that are required to be licensed or certified under Section II.

1. Emergency Actions

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.

2. Emergency Notification

- a. All Class A, B and C Dealers, certified commercial and noncommercial 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 the:

Vermont Department of Agriculture, Food and Markets
 Plant Industry Section
 116 State Street
 Drawer 20
 Montpelier, VT 05620-2901
 (802) 828-2431

OR

Vermont Department of Public Safety
 Waterbury State Complex
 103 South Main Street
 Waterbury, VT 05676
 1-800-641-5005 - operating 24 hours; 7 days/week

3. Material Safety Data Sheets (MSDS)

- a. All Class A Dealers, certified commercial and noncommercial applicators, licensed pesticide applicator companies, pesticide producing establishments shall submit a MSDS, to the local fire department for each Class A Restricted Use Pesticide that is produced, stored or used at their facility. All certified private applicators with greater than ten (10) full-time employees shall also submit MSDS as appropriate.

4. Tier Two Pesticide Inventory Report

- a. All Class A Dealers, certified commercial and noncommercial applicators, licensed pesticide applicator companies and pesticide producing establishments shall submit a Tier Two pesticide Inventory Form, to the Department, for each Class A Restricted Use Pesticide that is produced, stored or used at their facility. All certified private applicators with greater than ten (10) full-time employees shall also submit a Tier Two Pesticide Inventory Form as appropriate.

SECTION XIII - TRANSPORTATION, STORAGE AND DISPOSAL OF PESTICIDES.

1. Transportation.

- (a) Pesticide applicators shall secure pesticides during transportation to prevent spillage.
- (b) Pesticide applicators and dealers shall ensure that vehicles owned, leased, rented or borrowed by them for the purpose of transporting pesticides are placarded in accordance with state and federal transportation regulations.

2. Storage: Standards Applicable To Pesticide Storage, Mixing and Loading Facilities.

- (1) During the use or storage of pesticides, commercial and private applicators shall not leave pesticides or pesticide containers in any area which is readily accessible to unauthorized persons, livestock or wildlife.
- (2) Labeling of storage containers.
 - (a) In addition to federal regulatory requirements concerning the labeling of pesticide storage containers, legible labels shall be maintained on all bulk storage containers at all times.

- (3) Storage of dry pesticide in bulk quantity.
 - (a) Except during loading and unloading, stored dry bulk pesticide shall be covered by a roof or tarpaulin which will keep precipitation off the pesticides. Dry bulk pesticide stored outdoors shall be kept in storage containers. Storage containers shall be placed on pallets or on a raised concrete platform. Storage facilities shall be secured against entry by unauthorized persons, livestock or wildlife.
- (4) Storage containers and appurtenances.
 - (a) General requirements. Storage containers and appurtenances shall be constructed, installed and maintained so as to prevent the discharge of liquid bulk pesticide. Storage containers and appurtenances shall be constructed of materials which are resistant to corrosion, puncture or cracking. Materials used in the construction or repair of storage containers and appurtenances shall meet or exceed the manufacturer's recommendations and may not be of a type which react chemically or electrolytically with stored bulk pesticide in a way which may weaken the storage container or appurtenance, create a risk of discharge or adulterate the pesticide. Materials used for valves, fittings and repairs on metal containers shall be compatible with the metals used in the construction of the storage container, so that the combination of metals does not cause or increase corrosion which may weaken the storage container or its appurtenances, or create a risk of discharge. Storage containers and appurtenances shall be designed and constructed to handle all operating stresses, taking into account static head, pressure buildup from pumps and compressors and any other mechanical stresses to which the storage containers and appurtenances may be subject in the foreseeable course of operation.
 - (b) Appurtenances. Every storage container connection, except a safety relief connection, shall be equipped with a shut-off valve located on the storage container or at a distance from the storage container dictated by standard engineering practices. Valves shall be secured to protect against vandalism or accidental valve openings which may result in a discharge. Pipes and fittings shall be adequately supported to prevent sagging and possible breakage due to gravity and other forces which may be encountered in the ordinary course of operations.
 - (c) Vents. Any air tight storage container used for liquid bulk pesticide shall be equipped with a pressure relief vent which opens and closes within the designed pressure limits of the container, so as to relieve excess pressure, prevent evaporative losses and prevent the entry of precipitation into the container. All other storage containers used for liquid bulk pesticide shall be equipped with a cover or closure which will relieve excess pressure, prevent evaporative losses and prevent the entry of precipitation.
 - (d) Liquid level gauging devices. Every storage container shall be equipped with a liquid level gauging device by which the level of liquid in the storage container can be readily and safely determined. A liquid level gauging device is not required if the level of liquid in a storage container can be readily and reliably measured by other means. **EXTERNAL SIGHT GLASS GAUGES ARE PROHIBITED.**
 - (e) Security. Outdoor storage containers and containment facilities shall be located within a permanent fenced area or equivalent security system approved by the Commissioner that is designed reasonably to prevent access by unauthorized persons and to provide reasonable protection against access by livestock or wildlife. Appurtenances shall be fenced or otherwise secured to provide reasonable protection against vandalism or unauthorized access which may result in a discharge. Valves on storage containers shall be locked or otherwise secured except when persons responsible for facility security are present at the facility. Valves on rail cars, nurse tanks and other mobile pesticide containers parked overnight at a storage facility shall be locked or secured except when persons responsible for facility security are present at the facility.
 - (f) Filling. Storage containers may not be filled to more than 95 percent of rated capacity unless the storage container construction or location provides for constant temperature control.

(5) Mixing, loading and rinsate collection areas.

- (a) Paved surfaces and catch basins. Any mixing, loading and unloading, including mini-bulk filling, of pesticide or washing or rinsing of pesticide application equipment that takes place at commercial pesticide application and storage facilities must take place on a pad which is paved with asphalt or concrete. The paved surface shall be curbed or constructed with sufficient slope to drain into a liquid-tight catch basin. The curbed surface and catch basin shall be of adequate size and design to contain 125 percent of the capacity of the largest mobile container used.
- (b) Protection against damage by moving vehicles. Storage containers and appurtenances, including pipes and transfer hoses, shall be protected against reasonably foreseeable risks of damage by trucks and other moving vehicles engaged in the loading or unloading of pesticide.
- (c) Recovery of discharges. Discharges incident to loading or unloading of pesticide shall be promptly recovered from the paved surface and catch basin. If recovery of any of the spill for use as originally intended is not feasible, then procedures shall be employed to dispose of the discharged pesticide and any resulting clean up material as a hazardous waste in accordance with the statutes and regulations of Vermont's Hazardous Waste Management Law, 10 V.S.A. Chapter 159.

(6) Secondary containment for liquid bulk pesticides.

- (a) General requirements. Storage containers shall be enclosed in a secondary containment facility which is adequate, in the event of a discharge, to prevent the movement of liquid pesticide to waters of the state including groundwater. A secondary containment facility shall consist of a wall and liner as provided under paragraphs (d) and (e) or a prefabricated facility as provided under paragraph (f) of this subsection. Precipitation shall not be permitted to accumulate within a secondary containment facility. Empty pesticide containers shall not be stored or accumulated within secondary containment facilities.
- (b) Capacity. The capacity of a secondary containment facility shall be at least equal to the sum of the following: (1) 110 percent of the greatest volume of liquid which could be discharged from the largest storage container within the secondary containment facility; and (2) the total volume of discharged liquid which would be displaced by the submerged portions of all other storage containers, fixtures and materials located within the secondary containment facility.
- (c) Storage with other commodities. No other commodity, except liquid pesticide, pesticide rinsate or recovered pesticide discharges may be stored within a liquid pesticide secondary containment facility.
- (d) Walls. The walls of a secondary containment facility shall be constructed of earth, steel, concrete or solid masonry and be designed to withstand a full hydrostatic head of any discharged liquid. Cracks and seams shall be sealed to prevent leakage. Walls constructed of earth or other permeable materials shall be lined as provided under paragraph (e) of this subsection. Earthen walls shall have a horizontal-to-vertical slope of at least three to one, unless a steeper slope is consistent with good engineering practice and shall be protected from erosion. Walls may not exceed 6 feet (1.8 meters) in height above interior grade.
- (e) Linings. The base of a secondary containment facility, and any earthen walls of the containment facility, shall be lined with asphalt, concrete, an approved synthetic liner. Liners shall meet the following requirements:
 - (1) Asphalt or Concrete Liners. Asphalt or concrete liners shall be designed according to good engineering practices to withstand any foreseeable loading conditions, including a full hydrostatic head of discharged liquid. Cracks and seams shall be sealed to prevent leakage.
 - (2) Synthetic Liners. Synthetic liners shall have a minimum thickness of 30 mils (0.8 millimeters), and be chemically compatible with the materials being stored within the facility. The synthetic liner shall be protected by a 6 inch (15 centimeter) soil layer below the liner, and a 12 inch (30 centimeter) soil layer above the liner. Both soil layers shall be free of large rocks, angular stones, sticks or other materials which may puncture the liner. The use of synthetic liners for the construction of secondary containment facilities shall be approved

by the Commissioner provided the manufacturer of the liner provides the Department with a written confirmation of chemical compatibility and a written estimate of the life of the liner. Synthetic liners shall be installed under the supervision of a qualified representative of the manufacturer, and all field constructed seams shall be tested, and repaired if necessary, in accordance with the manufacturer's recommendations.

- (f) Prefabricated facilities. A prefabricated facility shall be composed of a rigid prefabricated basin having both a base and walls constructed of steel or synthetic materials which are resistant to corrosion, puncture or cracking. Materials used in the facility shall be chemically compatible with the products being stored within the secondary containment facility. The prefabricated facility shall be designed and installed to withstand all foreseeable loading conditions, including the tank load and a full hydrostatic head of any discharged liquid.
- (g) Recovery of discharges. Discharges incident to the storage, loading or unloading of pesticide shall be promptly recovered from within the secondary containment facility. If recovery of any of the spill for use as originally intended is not feasible, then procedures shall be employed to dispose of the discharged pesticide and any resulting clean up material as a hazardous waste in accordance with the statutes and regulations of Vermont's Hazardous Waste Management Law, 10 V.S.A. Chapter 159.

(7) Inspection and maintenance

The operator of a storage facility shall routinely inspect and maintain storage facilities, storage containers, and appurtenances in accordance with the following schedule in order to minimize the risk of a discharge.

- (a) Valves and other appurtenances shall be inspected for leakage and proper operation at least weekly.
- (b) The contents of each bulk storage container shall be measured and recorded at least weekly to facilitate the monthly inventory reconciliation as required by paragraph 8(d).
- (c) Secondary containment facilities shall be inspected annually to assure compliance with subsection (6).
- (d) All equipment and supplies mandated by the Discharge and Response Plan shall be maintained in sound working order.
- (e) A written record of all inspections and maintenance shall be made on the day of the inspection or maintenance, and kept at the storage facility, or at the nearest local office from which the storage facility is administered.

(8) Recordkeeping

- (a) The following records shall be prepared and maintained on file at every storage facility, or at the nearest local office from which the storage facility is administered. Furthermore, records shall be maintained for at least five years, and shall be made available for inspection and copying by the Commissioner upon request.
- (b) A record of all discharges at the storage facility, including the date and time of discharge, the type of liquid bulk pesticide discharged, the volume of the discharge, the cause of the discharge, any action taken to control or recover the discharge, and the method of use or disposal of any recovered discharge. The discharge record shall be completed on the day the discharge is discovered, and shall be promptly updated to show measures taken to control, recover, use or dispose of the discharge.
- (c) A regular record of the liquid pesticide levels in each storage container. The level in each storage container shall be measured and recorded at least weekly, as provided in paragraph 7(b).
- (d) A monthly inventory reconciliation, showing the amount of liquid bulk pesticide from each storage container which is lost or unaccounted for at the end of each monthly period.

- (e) Inspection and maintenance records pertaining to storage containers, appurtenances, and secondary containment facilities, as provided under paragraphs 7(a) and 7(c).
 - (f) A record of manufacturers' compatibility statements as provided under paragraphs 6(e)(2) and 6(f).
- (9) Preparations for control and recovery of pesticide discharges

- (a) Discharge response plan. The operator of a storage facility shall prepare a written discharge response plan for the storage facility. The operator shall keep the plan current at all times. A copy of the plan shall be kept readily available at the storage facility or at the nearest local office from which the storage facility is administered, and shall be available for inspection and copying by the Department. The operator of the storage facility shall inform the local fire and police departments of the existence of the plan, and shall provide a current copy of the plan to the local fire department.

The plan shall include:

1. The identity and telephone number of the persons or agencies who are to be contacted in the event of a discharge, including persons responsible for the stored pesticide.
 2. For each bulk pesticide stored at the facility, a copy of the label affixed to the storage container, the Material Safety Data Sheet (MSDS) and a complete copy of the labeling that would ordinarily accompany sale of the pesticide.
 3. A map identifying the location of bulk pesticide storage containers located at the storage facility.
 4. For each type of bulk pesticide stored at the facility, the procedures to be used in controlling and recovering, or otherwise responding to a discharge.
 5. Procedures to be followed in using or disposing of a recovered discharge.
 6. Storage facilities shall also comply with applicable requirements of Section XII - Community Right-to-Know and Accident Reporting.
- (b) Equipment and supplies. Applicators, manufacturers and distributors who store bulk pesticides shall have access to pumps and recovery containers which can be used to control and recover discharges, and to personal protective equipment and clothing for use by persons involved in discharge control and recovery. Pumps, recovery containers, personal protective equipment and clothing and persons capable of deploying and operating them, shall be readily available in an emergency. Pumps, recovery containers, personal protective equipment and clothing required under this subsection may include those provided by a local fire department or other persons, if the use and availability of such equipment is arranged in advance as part of a discharge response plan. Pumps, recovery containers, personal protective equipment, and other materials used in control and recovery of discharges shall be decontaminated promptly after the discharge has been recovered, and may not be used for other purposes until they have been decontaminated. Absorbent materials suitable for the control and cleanup of small liquid discharges shall be kept readily available at every storage facility.
 - (c) Training. Persons employed at the storage facility shall be made aware of and trained in discharge response procedures, pursuant to the discharge response plan.

(10) Underground liquid storage prohibited

- (a) No liquid bulk pesticide or pesticide rinsate shall be stored underground. This prohibition does not apply to a watertight catch basin used for temporary collection of discharges or runoff.

(11) Alternative technology

- (a) The Commissioner may exempt any person or company from a requirement under this regulation if compliance is not technically feasible, but only if the Commissioner finds that alternative measures

provide substantially similar protection for the waters of the state. A person desiring to implement technology inconsistent with the provisions of this regulation shall make such a request in writing and shall provide the Commissioner with adequate information to show that the alternative measures requested provide substantially similar protection for the waters of the state.

3. Disposal of pesticides and pesticide containers.

a. Pesticide containers.

- (1) Disposal of pesticide containers shall comply with instructions on the labeling and with other state and federal regulations.
- (2) If practical, pesticide drums shall be shipped to recycling centers capable of handling pesticide containers.
- (3) Empty pesticide containers shall not be stored or accumulated within a secondary containment facility.

b. Obsolete, excess, and mixtures of pesticides shall be disposed of according to the statutes and regulations established by Vermont's Hazardous Waste Management Law, 10 V.S.A. Chapter 159.

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

APPENDIX B**GRAND ISLE**

- The Islander
- Burlington Free Press

FRANKLIN

- The Messenger
- Burlington Free Press

ORLEANS

- Newport Daily Express
- Burlington Free Press

ESSEX

- Caledonian Record
- Burlington Free Press

LAMOILLE

- Burlington Free Press
- The Times Argus

CHITTENDEN

- Burlington Free Press
- The Times Argus

CALEDONIA

- Caledonian Record
- Hardwick Gazette

WASHINGTON

- The Times Argus
- Burlington Free Press

ADDISON

- Addison County Independent
- Rutland Herald

ORANGE

- The Times Argus
- The Valley News (West Lebanon)

RUTLAND

- Rutland Herald
- Burlington Free Press

WINDSOR

- The Valley News (West Lebanon)
- Claremont Eagle

WINDHAM

- Brattleboro Reformer
- The Town Crier (Bellows Falls)

BENNINGTON

- Bennington Banner
- Rutland Herald



STATE OF VERMONT

DEPARTMENT OF AGRICULTURE, FOOD & MARKETS

APPENDIX "A(2)"

"RESTRICTED-USE" PESTICIDES

Attached and Annexed to

VERMONT REGULATIONS FOR CONTROL OF PESTICIDES

Vermont Department of Agriculture, Food & Markets
Plant Industry Division
116 State Street, Drawer 20
Montpelier, VT 05620-2901
Tel.: (802) 828-2431

Effective Date: March 30, 2000



116 STATE STREET
DRAWER 20
MONTPELIER, VT 05620-2901

SOME HELPFUL INFORMATION:

1. Appendix "A" is based on the Caswell Editions of Acceptable Common Names and Chemical Names for the Ingredient Statement of Pesticide Labels, _____ United States Environmental Protection Agency (EPA). The chemical and common names included in this Appendix appear as they are required to appear on the pesticide-product label.
2. This Appendix contains an alphabetical and numerical listing of common names, chemical names, and the most frequently used trade names for products classified as "restricted-use" products in Vermont.
3. Products included in this listing may be classified "restricted-use" at the national level by the EPA, or at the state level by the Vermont Pesticide Advisory Council (VPAC). Federally-restricted products must include a restricted-use statement on the product label; however, this statement is not required on the label for products restricted only at the state level.
4. All products with Federal "Restricted Use" labels are automatically Class "A" (restricted-use) products in Vermont, even if those products are not included in this Appendix.
5. All products with the restriction "By Permit Only" may be purchased and used only by persons who have been issued a permit by the Commissioner of Agriculture, Food & Markets, or the Department of Water Resources.
6. For further information, please contact your dealer, county UVM-Extension Agent, or the Vermont Department of Agriculture, Food & Markets.

HOW TO USE THE LIST OF RESTRICTED-USE PESTICIDES:

EXAMPLE QUESTION #1: *Is Simazine a restricted-use product?*

Simazine appears in the Appendix as follows:

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
1816	Simazine		All above 10%

Simazine appears in alphabetical order as product number 1816. Look in the "Restriction(s)" column (the far right column) to find that all products containing more than 10% Simazine are restricted.

EXAMPLE QUESTION #2: *Is Dursban a restricted-use product?*

Dursban appears in the Appendix as follows:

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Dursban	509	

Dursban is a trade name and appears in alphabetical order with the reference number 509. Find 509 in the "Prod. No." column (far-left column). Product 509 identifies Chlorpyrifos, which is the common name for Dursban. The "Restriction(s)" column states, "All above 13%." Therefore, all Dursban products containing more than 13% Chlorpyrifos (the product's active ingredient) are restricted-use products.

EXAMPLE QUESTION #3: *Is 4-Amino-3,5,6-Trichloropicolinic Acid a restricted-use product?*

This product appears in the Appendix as follows:

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	4-Amino-3,5,6-trichloropicolinic acid [Access, Grazon, Picloram, Tordon]	1645	

This chemical name appears in alphabetical order. (*Note: Disregard all numbers that precede the first word of the chemical name*). The product names listed in brackets after the chemical name include common names and other frequently used trade names. Both the common names and trade names will also appear in the Appendix and should have the same reference or product number.

In Example 3 above, the chemical name has the corresponding reference number 1645. Find 1645 in the "Prod. No." column, (*Access, Grazon, Picloram, and Tordon will also refer you to Ref. No. 1645*). Picloram, is the common name for 4-Amino-3,5,6-Trichloropicolinic Acid. Now refer to the "Restriction(s)" column and you will see "All above 2%," which indicates that all products containing 2% or greater amount of Access, Grazon, Picloram, or Tordon are restricted-use products.

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	AASTAR		All
	Aatrex	156	
	Accent	1477	All
	Access	1645	
	Acclaim		All
	Acetochlor [<i>Harness</i>]		All
	3-(alpha-Acetylbenzyl)-4-hydroxycoumarin [<i>Coumaphene, Warfarin</i>]	2117	
9	3-(alpha-Acetylfurfuryl)-4-hydroxycoumarin [<i>Coumafuryl, Fumarin</i>]		All
	Acquinite	490	
	Acritet	15	
14	Acrolein		All
	Acrylaldehyde	14	
	Acrylofume	15	
15	Acrylonitrile [<i>Acritet, Acrylofume, Carbacryl, Ventox</i>]		All, discontinued by the manufacturer
	Actidione or Acti-dione	601	
	Actispray	601	
	Agrimek	157	
16	Alachlor [<i>Broncho, Bullet, Cannon, Freedom, Lariat, Lasso, Partner</i>]		All
	Alar	619	
18	Aldicarb [<i>Temik</i>]		All
19	Aldrin		Canceled in 1987
85	Allyl alcohol		All

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Alpha-tox	824	
	Alpha-Napthylthiourea	1472	
92	Aluminum or magnesium phosphide [<i>Delicia, Phostoxin</i>]		All
	Amaze	1391.3	
	Ambush	1575.5	
94	Ametryn [<i>Evik, Trinatox D</i>]		All
	Amiben	374	
	3-Amino-2, 5-Dichlorobenzoic Acid [<i>Amiben, Chloramben</i>]	374	
100	Amino-6-(1,1-Dimethylethyl)-3-(Methyl-thio)- 1,2,4-Triazin-5 (4H)-one [<i>Lexone, Metribuzin, Sencor</i>]		All above 3%
104	4-Aminopyrdine [<i>Avitrol 200</i>]		All, Permit required
105	N'-(2,4-dimethylphenyl)-N-[(2,4-dimethyl-phenyl)- imino]methyl]-N-methylmethanimidamide [<i>Amitraz</i>]		All, except Apicultural use
106	Amitrole [<i>Amizine, Amizol, AT-90, Weedazol</i>]		All above 2%
	4-Amino-3,5,6-trichlorpicolinic acid [<i>Access, Grazon, Picloram, Tordon</i>]	1645	
	Amitraz	105	
	Ammo	604	All
	ANTU	1472	
	Aprocarb	1238	
	Aqua-Kleen	708	
	Aquacide	958	
	Aqualin	14	
	Aquathol	1002	Aquatic use, Water Quality permit required

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Aquazine	1816	Aquatic use. Water Quality permit required
	Arsenal	1190	
145	Arsenic acid (CA) or Orthoarsenic acid		All above 2%, except Calcium arsenite as snail & slug bait
	Arsenical Wood Preservatives (CCA or ACA)		All
	Asana	590	
	AT-90	106	
	Atratul	156	
156	Atrazine [<i>Aatrex, Atratul, Bullet, Conquest, Lariat, Marksman, Prozine</i>]		All above 2%
	Avadex	683	
157	Avermectin [<i>Agrimek</i>]		All
	Avitrol 100	1499	
	Avitrol 200	104	
	Azinphos-ethyl	828	
	Azinphos-methyl	899	
	Azodrin	901	
161	Azoxystrobin [<i>Heritage, Quadris</i>]		All above 5%
	Bandane	1669	
	Banvel	671	
165	Barium Carbonate		All, discontinued by the manufacturer
166	Barium fluosilicate		All
167	Barium metaborate		All
	Battle	1268	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Baygon	1238	
	Bayluscide	707	
	Baytex	1098	
	Baythroid		All
	Beacon	1700	
172.5	Bendiocarb [<i>Turcam</i>]		All above 3%
	Benlate	173	
173	Benomyl		All tree-injection uses
179	Benzene hexachloride (all isomers) [<i>BHC</i>]		All above 3%
	Benzene hexachloride, gamma isomer [<i>Lindane</i>]	1282	
	Beta-butoxy beta'-thiocyano diethyl ether and 2-(2-Butoxyethoxy)ethyl thiocyanate [<i>Lethane 384</i>]	277	
	BHC	179	
	Bicep	156 & 1440	
	Bidrin	900	
185	Bifenthrin [<i>Brigade, Talstar</i>]		All above 5%
	Birlane	412	
209	O,O-Bis(p-chlorophenyl) Acetimidoylphosphoramidothioate [<i>Phosacetim</i>]		All baits equal to or above 0.1%
	2,4-Bis(Isopropylamino)-6-methoxy-S-triazine [<i>Pramitol, Primatol, Prome-ton</i>]	1735	
	2,4-Bis(Isopropylamino)-6-(methylthio) -S-triazine [<i>Caparol, Promatol Q, Prometryn</i>]	1736	
229	Bis(Tributyltin) oxide [<i>TBT, TBTO</i>]		Aquatic uses canceled. Other non-aquatic, wood- preservative uses : Class "C"

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Bladafume	1927	
	Bladex	422	
	B-Nine	619	
	Bolstar	1078	
	Bomyl	886	
	Brigade	185	
	Broadstrike	1102	
242.5	Brodifacoum		All above 0.05%
250.1	Bromodiolone		All above 0.005%
	Bromofume	1056	
	Bromonal	261	
	Bromoxynil	261	
	Bronate	261	
	Bronco	16	
	Buctril	261	
263	Bufencarb [<i>Bux</i>]		All, discontinued by the manufacturer
	Bullet	16 & 156	
265	Butachlor		All above 3%
	Butanedioic acid mono (2,2-dimethyl hydrazide) [<i>Alar, B-Nine, Daminozide</i>]	619	
267	Butanoic anhydride or Butyric anhydride		All
	Butoxone	765	
277	beta-Butoxy beta'-thiocyano diethyl ether [<i>Lethane</i>]		All, discontinued by the manufacturer

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Butylate	1039	
	Butyrac	765	
	BUX	263	
	Caddy	312	
312	Cadmium compounds [<i>Caddy</i>]		All
330	Calcium cyanide [<i>Cyanogas</i>]		All
	Cannon	16	
	Carbacryl	15	
	Caparol	1736	
355	Carbofuran [<i>Furadan</i>]		All
356	2-Carbomethoxy-1-methyvinyl dimethyl phosphate, alpha isomer & related compounds or Methyl 3-hydroxy-alpha crotonate, dimethyl phoshate [<i>Phosdrin, mevinphos</i>]		All
359	Carbon disulfide		All
360	Carbon tetrachloride [<i>Dowfume, Vulcan</i>]		All
361	Carbophenothion		All
	Carzol SP	1117	
	Chemisterilents		All
374	Chloramben		All above 5%
386	Chlordane		By permit only
	Chlorfenvinphos	412	
	Chlorinated camphene, technical (67-69% chlorine) [<i>Toxaphene</i>]	1986	
	Chlorinated C3 Hydrocarbons (1,2-dichloro-propane & 1, 3-dichloropene and other related compounds)	790	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
391	Chlorine		All pressurized containers of chlorine gas
	2-Chloro-4,6-Bis(Ethylamino)-S-Triazine [Aquazine, Princep, Simazine]	1816	
	2-Chloro-4,6Bis(Isopropylamino)-S-Triazine [Mildcep, Milogard, Primatol P, Propazine]	1740	
412	2-Chloro-2-diethylcarbamoyl-1-methylvinyl dimethyl phosphate or 2-Chloro-N, Diethyl-1,3-Hydroxyc-rotonamide, Ester of dimethyl phosphate [Dimecron, Phosphamidon]	1641	
	2-Chloro-2'-6'-Diethyl-N-(Butoxy methyl) Aletanilide [Butachlor]	265	
	2-Chloro-2'6'-Diethyl-N-(Methoxy methyl)-Acetanilide [Alachlor, Lasso]	16	
	2-Chloro--N(Ethyl-6-methylpheny)-N--(2-methoxy-1-methylethyl)acetamide [Bicep, Dual, Metolachlor]	1440	
	2-Chloro-4-ethylamino-6-isopropyl amino-S-triazine [Aatrex, Atrazine, Bicep]	156	
422	2-[[4-Chloro-6(ethylamino)-S--triazin-2-yl]amino]-2-methylpropionitrile [Bladex, Cyanazine, Extrazine]		All
432	2-Chloro-N-isopropylacetanilide [Propachlor, Ramrod]		All above 3%
	2-Chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl]benzenesulfonamide		All above 2%
	Chlorophacinone [Rozol]	481	
481	2-[(p-Chlorophenyl)phenylacetyl]-1,3-indandione [Chlorophacinone, Liphadione Partox, Rozol]		All tracking powders, dust, and ready-to-use 0.2% or greater
	S[{(p-Chlorophenyl) thio}methyl} O,O-diethyl phosphorodithioate [Carbophenothion, Trithion]	361	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
490	Chloropicrin [Acquinite, Nemax, Picfume, Timberfume]		All
491	3-chloro-1,2-propanedid [Epibloc]		All granular
499	3-Chloro-p-toluidine hydrochloride [Starlicide]		All
509	Chlorpyrifos		All above 13%
510	Chlorsulfuron [Glean]		All
512	Clethodim [Select]		All
	Clipper		All
512.5	Clomazone [Command]		All
	Clonitralid	707	
512.7	Cloransulam Methyl		All
	Cobra	1265	
	Colonel	1556	
	Command	512.5 & 512.7	
	Compound PA-14		All
	Compound 1080	1851	
	Compound 4072	412	
	Conquest	156 & 422	
	Contour	1191	
	Co-Ral	513	
	Coumafuryl	9	
	Coumaphene	2117	
513	Coumaphos [Co-Ral]		All above 3%
	Counter	1924	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
514	Chromic acid [<i>Osmosek</i>]		All wood-preservative uses except brush-on
570	Creosote & related compounds		All
	Crossbow	2030	
	Curbit	1057	
	Cyanazine	422	
	Cyanide Compounds (All cyanide compounds)	330	
590	Cyano(3-phenoxyphenyl)methyl 4-chloro-alpha-(1-methylethyl)benzeneacetate [<i>Asama, Pydrin</i>]		All above 2%
	Cyano-3-phenoxybenzyl 3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropane carboxylate [<i>Karate</i>]		All
	Cyanogas	330	
	Cybush	604	All
596	4-cyclododecyl-2,6-dimethylmorpholine benzoate [<i>Dodemorph, Miban</i>]		All
601	Cycloheximide [<i>Actidone, Actispray</i>]		All
	2-Cyclohexyl-4,6-dinitrophenol	923	
	Cyclone	1556	
602	Cyfluthrin [<i>Baythroid, Decathalon, Tempo</i>]		All above 2%
	Cynoff	604	
604	Cypermethrin [<i>Ammo, Cybush, Cynoff</i>]		All above 2%
	2,4-D	708	
	2,4-DB	765	
	2,4-DP	774	
605	Dacthal		All

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
619	Daminozide		All non-food uses; all food uses canceled in 1989
	Dasanit	825	
	Dazomet	1952	
	DBCP	656	
	DDD	693	
	D-D Mixture	790	
	DDVP	797	
	Decathalon	602	
	Dechlorane	976	
	Delicia	92	
	Delnav	941	
632	Demeton		All
682	Diallate		All
	Diazinon	824	
656	1,,2-Dibromo-3-chloropropane [DBCP, Fumazone, Nemagon]		All Canceled in 1985
261	3,5-dibromo-4-hydroxybenzonitrile [Brominal, Bromoxynil, Bronate, Buctril]		All
671	Dicamba [Banvel, Marksman]		All above 8%
679	Dichlofenthion		All
690	3,5-dichloro-N-(1,1-dimethyl-2-propynyl)benzamide		All WP above or equal to 50%
693	Dichloro diphenyl dichloroethane [DDD, TDE]		All Canceled in 1971
707	2',5-dichloro-4'-nitro-salicylanilide, 2-aminoethanol salt [Bayluscide, Clonitralid]		All Require Water-Quality perm.

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
708	(2,4-Dichlorophenoxy) Acetic acid [<i>Aqua-Kleen, 2,4-D, Weed-B-Gon</i>]		All above 20% or containers larger than 1 gallon. Aquatic use requires Water Quality Permit
765	4-(2,4-Dichlorophenoxy) Butyric acid [<i>Butoxone, Butyrac, 2,4-DB</i>]		All above 20% or containers larger than 1 gallon
774	2-(2,4-Dichlorophenoxy) Propionic acid [<i>Dichlorprop, 2,4-DP, Weedone</i>]		All above 20% or containers larger than 1 gallon
	3-(3,4-Dichlorophenyl)-1-methoxy-1-methylurea or N-(3,4-Dichlorophenyl)-N'-methoxy-N'-methylurea [<i>Diuron, Linuron, Lorox</i>]	1284	
	O(2,4-Dichlorophenyl)O,O-diethyl phosphorothioate [<i>Dichlofenthion, Nemacide, VC-13</i>]	679	
786	2,4-Dichlorophenyl p-nitrophenyl ether [<i>Nitrofen, Tok</i>]		All, Canceled in 1984
	Dichlorprop	774	
790	1,2-Dichloropropane		All, discontinued by the manufacturer
790.5	1,3-dichloropropene [<i>Telone</i>]		All
797	2,2-Dichlorovinyl dimethyl phosphate & related compounds [<i>DDVP, Dichlorvos, Vapona</i>]		All above 1% (20% resin strips & pet collars excepted)
	Dichlorvos	797	
	Diclofop-methyl: 2-[4-(2',4'-dichlorophenoxy)- henoxy]methyl propanoate [<i>Hoelen, One Shot</i>]		All
	Dicofol		All above 1 quart container
	Dicrotophos	900	
806	Dieldrin		All, Canceled in 1987
823	O,O-Diethyl S-{2-(ethylthio)ethyl} phosphoro-dithioate [<i>Disulfoton, Di-Syston</i>]		All except granules or tablets 2% or less
	O,O-Diethyl O-{2-(ethylthio)ethyl} phosphoro-thioate and O,O Diethyl S{2-(ethylthio)ethyl}phosphorothioate [<i>Demeton, Systox</i>]		All

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	O,O-Diethyl S-{(ethylthio)methyl} phosphoro-dithioate [<i>Phorate, Thimet</i>]	1639	
824	O,O-Diethyl O-(2-isopropyl-6-methyl-4- pyrimidinyl) phosphorothioate [<i>Alfa-tox, Diazinon, Spectracide</i>]		All above 15%, except for seed-treatment products
825	O,O-Diethyl O-{p-(methylsulfinyl) phenyl} phosphorothioate [<i>Dasanit, fensulfothion</i>]		All
	O,O-Diethyl)-(p-nitrophenyl) phos-phorothionate or O,O-Dimethyl O-P-Nitrophenyl phosphorothioate [<i>Parathion</i>]	1558	
828	O,O-Diethyl S-{(4-oxo-1,2,3-benzotriazin-3-(4H)-yl)methyl} phosphorodithioate [<i>Azinphos ethyl, Ethyl Guthion</i>]		All
834	O,O-Diethyl O-pyrazinyl phosphorothioate [<i>Thionazin, Zinophos</i>]		All, discontinued by the manufacturer
	O,O-Diethyl O-(3,5,6-Trichloro-2-Pyridyl) phosphorothioate [<i>Chlorpyrifos, Dursban, Lorsban, Trichlor-pyrphos</i>]	509	
[839]	N-[[(4-chlorophenyl)amino]carbonyl]-2-,6-difluorobenzamide) [<i>Diflubenzuron, Dimilin</i>]		All
	Diflubenzuron	839	
	2,3-dihydro-2,2-dimethyl-7 -benzofuranyl methylcarbamate [<i>Carbofuran, Furadan</i>]	355	
	6,7-Dihydrodipyridol { 1,2-a:2',1'-c } pyrazinediinium dibromide or 1,1'-Ethylene-2,2'-Bipyridylum [<i>Diquat Bromide, Reglone</i>]	958	
	Dimecron	1641	
	2-((((4,6-dimethoxyprimidin-2-yl) amino-carbonyl))aminosulfonyl))-N,N-dimethyl-3-pyridinecarboxamide [<i>Accent</i>]		All above 2%
840	Dimethenamid (<i>Frontier</i>)		All
841	Dimethoate		All above 20%

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	M-{{(Dimethylamino)methylene}amino}-phenyl methylcarbamate hydrochloride [Carzol, Formetanate]	1117	
	4-(Dimethylamino)-3,5-xylyl methylcarbamate [Mexacarbate, Zectran]	1441	
	2,2-Dimethyl-1,3 benzodioxol-4-yl methyl-carbamate [Bendiocarb, Ficam]	172.5	
	1,1'-Dimethyl-4,4'-bipyridinium bis (methylsulfate) or 1,1'-Dimethyl-4,4'-bipyridinium dichloride [Gramoxone, Paraquat]	1555 or 1556	
	O,O-Dimethyl O-{p(dimethylsulfamoyl) phenyl} phosphorothioate [Bash, Famfos, Famphur]	1093	
	O,O-Dimethyl S-{2-(ethylsulfynl)ethyl} phos-phorothioate [Metasystox, Oxydemeton Methyl]	1084	
	S-{{1.1-Dimethylethyl}thio}thio}methyl} O,O-Diethyl phosphorodithioate [Counter, Terbufos]	1924	
886	Dimethyl 3-hydroxyglutaconate dimethyl phosphate [Bomyl]		All
	O,O-Dimethyl O-{4-(methylthio)-m-tolyl} phosphorothioate [Baytex, Fen-thion]	1098	
896	O,O-Dimethyl O-p-nitrophenyl phos-phorothioate (or thiophosphate) [Methyl parathion, Penncap-M]		All
897	O,O-Dimethyl O-(4-nitro-m-tolyl) phosphorothioate [Sumithion, Fenitrothion]		All forestry uses
899	O,O-Dimethyl S-{{4-oxo-1,2,3-benzotriazin-3(4H)-yl)methyl} phos-phorodithioate [Azinphos Methyl, Guthion]		All above 1%
	3{2-(3,5-Dimethyl-2-oxocyclohexyl)-2- hydroxyethyl} glutarimide [Actidone, Cycloheximide]	601	
)	Dimethyl phosphate ester with 3-hydroxy-N, N-dimethyl-cis- crotonamide [Azodrin, Monocrotophos]		All, Canceled in 1988

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	O,S-Dimethyl phosphoramidothioate [<i>Methamidiphos, Monitor</i>]	1325	
	O,O-Dimethyl phosphorodithioate, S-ester with 4-(mercaptomethyl)-2-methoxy-delta 2-1,3,4-thiadiazolin- 5-one [<i>Melthidathion, Supracide, Ultracide</i>]	1327	
	Dimilin	839	
	Dinex	923	
921	4,6-Dinitro-o-cresol [<i>DNOC</i>]		All, Banned in the U.S.
923	4,6-Dinitro-o-cyclohexylphenol 2-cyclohexyl-4, 6-dinitrophenol [<i>Dinex, DN-11</i>]		All, discontinued by the manufacturer
933	Dinoseb		All, Canceled
	Dinitrocyclohexyphenol	923	
	2,3-P-dioxanedithiol S,S-Bis (O,O-diethyl phosphor- odithioate) & related compounds [<i>Delnav, Dioxathion</i>]	941	
941	Dioxathion		All above 2%
	Diphacin	942	
942	Diphacinone		All above 1%
	Diphenadione	942	
	2-(diphenylacetyl)-1,3-indandione [<i>Diphacin, Diphenadione, Diphacione</i>]	942	
	Dipterex	2020	
958	Diquat dibromide (<i>Aquacide</i>)		All above 1%; for aquatic use a Water Quality Permit is required
	Disulfoton	823	
	Di-Syston	823	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Diuron	975	
	DMTT	1952	
	DNBP	932	
	DNOC	921	All, Banned
976	Dodecachlorooctahydro-1,3,4-metheno 1H-cyclobuta {cd} pentalene [<i>Dechlorane, Mirex</i>]		All, discontinued by the manufacturer
	Dodemorph	596	
	Dowfume	360	
	Dual	1440	
	Dursban	509	
	Dyfonate	1081	
	EDB	1056	
1001	Endosulfan		All above 3%
1002	Endothall [<i>Aquathol, Hydrothol</i>]		All; for aquatic use a Water Quality Permit is required
1009	Endrin		All, Canceled in 1985
	EPN	1080	
	Epibloc	491	
	Eptam	1042	
	EPTC	1042	
	Eradicane	1042	
	Esfenvalerate		All above 2%
20	Ethion		All
1021	Ethoprop		All

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	2-(Ethylamino)-4-isopropylamino-6-methyl-thio-2-triazine [<i>Ametryn, Evik</i>]	94	
1039	S-Ethyl Diisobutylthiocarbamate [<i>Eptam, EPTC, Eradicane</i>]		All above 6%
	O-Ethyl S,S-Dipropyl phosphorodithioate [<i>Ethoprop, Mocap, Prophos</i>]	1021	
1056	Ethylene dibromide [<i>Bromofume, EDB</i>]		All
1057	Ethylfluralin [<i>Curbit, Sonalan</i>]		All
	Ethyl Guthion	828	
1061	Ethylene oxide [<i>ETO</i>]		All
1078	O-ethyl-O-[4-(methylthio)phenyl]-S-propyl phosphorodithioate [<i>Bolstar, Sulprofos</i>]		All
1079	{Ethyl 4-(methylthio)-m-tolyl isopropyl phosphoramidate (CA) or Ethyl 3-methyl-4- (methylthio)phenyl (1-(methylethyl) phosphora-midate } (CA*) [<i>Fenamiphos, Namacur</i>]		All
1080	O-Ethyl O-(p-nitrophenyl) phenylphos-phonothiate or ethyl P- nitrophenyl thionobenzenephosphonate [<i>EPN</i>]		All, Canceled in 1987
1081	O-Ethyl S-phenyl ethylphosphonodithioate [<i>Dyfonate, Fonofos</i>]		All
	N-(1-Ethylpropyl)-3,4-Dimethyl-2,6Dinitrobenzene-phosphonate [<i>Pendimethalin, Prowl</i>]	1559.5	
	3-(1-Ethylpropyl)phenyl methylcarbamate and M-(1methylbutyl) phenyl methylcarbamate [<i>Bufencarb, Bux</i>]	263	
1084	S{2-(Ethylsulfinyl)ethyl} O,O-dimethyl phosphorothioate [<i>Metasystox, Oxydemetonmethyl</i>]		All
	ETO	1061	
	Evik	94	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Exceed	1700 & 1745	
	Extrazine	422	
1093	Famfos		All above 1%
	Famphur	1093	
	Fenamiphos	1079	
	Fenitrothion [<i>Sumithion</i>]	897	
	Fenoxaprop-ethyl: (+)-ethyl 2-[4-[6-chloro-2-benzoxasolyl oxy]phenoxy]propanate [<i>Acclaim, Horizon, Option, Whip</i>]		All above 2%
	Fensulfothion	825	
1098	Fenthion		All above 1%
09	Fenvalerate		All above 20%
	Ficam	172.5	
1100	Fipronil [<i>Regent</i>]		All
	Fish Toxicants (See Piscicides)		
	Flexstar	1114	
	Flit MLO		All above 5 gallon container
1101	Fluazifop [<i>Fusion</i>]		All
	Flucythrinate [<i>AASTAR, Payoff</i>]		All
1102	Flumetsulam [<i>Broadstrike</i>]		All
1103	Flumiclorac Pentyl Ester [<i>Resource</i>]		All
1109	Fluoroacetamide		All
1113.5	1-methyl-3-phenyl-5(3-(trifluormethyl)phenyl)-4(H)-pyridione [<i>Fluridone, Sonar</i>]		All, for aquatic uses a Water-Quality Permit is required
	Fluridone	1113.5	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
1114	Fomesafen [<i>Flexstar</i>]		All
	Fonofos	1081	
1115	Formaldehyde		All above 2.5%
1117	Formetanate hydrochloride Freedom	16	All
	Frontier	840	
	Fumarin	9	
	Fumazone	656	
	Furadan	355	
	Fusion	1101	
	Garlon	2030	
	Glean	510	
1120	Glusofinate Ammonium [<i>Liberty</i>]		All
	Goal	1551	
	Gramoxone	1555 or 1556	
	Grazon	1645	
	Guthion	899	
1122	Halofenozide [<i>Mach II</i>]		All above 1.5%
1124	Halosulfuron Methyl [<i>Manage, Permit</i>]		All
	Harness	8	
	Heptachlor	1139	
1139	Heptachloro-tetrahydro-methanoindene & related compounds [<i>Heptachlor</i>]		All, By permit only

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	1,2,3,4,5,6-Hexachlorocyclohexane [<i>BHC</i>]	179	
	Hexachloroepoxyoctahydro-endo,exo-dimethanonaphthalene & related compounds [<i>Dieldrin</i>]	806	
	Hexachlorohexahydro-endo, exo-dimethanonaphthalene 95% & related compounds [<i>Aldrin</i>]	19	
	Hexachlorohexahydromethano-2,4,3- Benzo dioxathiepin 3-oxide [<i>Endosulfan, Thiodan</i>]	1001	
	Hexachloro octahydro epoxydimetha-nonaphthalene [<i>Endrin</i>]	1009	
	Hoelon		All
	Horizon		All
1118	Hydrocyanic acid		All
	Hydrothol	1002	
1190	Imazapyr [<i>Arsenal, Lightning</i>]		All
1191	Imazethapyr [<i>Contour, Lightning</i>]		All
	Isafos [<i>Triumph</i>]		All
	Isobenzan	1508	
	Isofenphos	1391.3	
1238	O-Isopropoxyphenyl methylcarbamate [<i>Aprocarb, Baygon, Propoxur, Tendex</i>]		All above 3%
1241	Isopropyl carbanilate		All
1257	2-Isovaleryl-1,3-indandione [<i>PMP, Valone</i>]		All above 6%
	Karate		All
	Kerb	690	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Krovar	975	
1265	Lactofen [<i>Cobra</i>]		All
1268	Lamda Cyhalothrin [<i>Battle</i>]		All
	Lannate	1328	
	Lariat	16 & 156	
	Larvin	1975	
	Lasso	16	
	Lethane 384	277	
	Lexone	100	
	Liberty	1120	
	Lightning	1190 & 1191	
1282	Lindane (99% gamma isomer of benzene hexachloride) or Gamma isomer of benzene hexachloride from lindane		All above 3%, except for EC ornamental-use products packaged 1 pint or less, which allows up to 20%, or seed treatment
1284	Linuron		All above 6%
	Liphadione	481	
	Lorox	1284	
	Lorsban	509	
	Mach II	1122	
	Magnesium Phosphide	92	
	Manage	1124	
	Marksman	156 & 671	
	MCPP/MCAA		All above 18%

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
1316	Mercury compounds		All, By permit only, except exterior paints & drugs under PRD #3 FIFRA; Interior-paint use canceled in 1990
	Merit	1200	
	Mesuroi	1436	
	Metam-sodium	1865	
	Metasystox-R	1084	
1325	Methamidophos [<i>Monitor</i>]		All
1327	Methidathion [<i>Supracide, Ultracide</i>]		All
1328	Methomyl [<i>Lanabait, Lannate, Nudrin</i>]		All
	2-Methoxy-3,6-Dichlorobenzoic Acid or 3,6-Dichloro-0-Ansic Acid [<i>Banvel, Dicamba</i>]	671	
1341	Methyl bromide		All
	Methyl-1-(Butylcarbamoyl)-2-Benzimidazole-carbamate [<i>Benlate, Benomyl</i>]	173	
	3-(1-Methylbutyl)phenyl methyl-carbamate [<i>Bufencarb, Bux</i>]	263	
	Methyl N',N'-Dimethyl-N- {methyl carbamoyl}oxy}-1-thioxamimidate [<i>DPX, 1410 Oxamyl, Vydate</i>]	1543	
	2-(1-Methylethoxy)phenol methylcarbamate [<i>Aprocarb, Baygon</i>]	1238	
1391.3	1-Methylethyl 2-[[ethoxyl[(1-methylethyl)amino]-phosphinothioyl]oxy]benzoate [<i>Amaze, Isofenphos, Pryfon</i>]		All liquids 65% or greater
1398	Methyl isothiocyanate [<i>Vorlex</i>]		All
	S-Methyl N-{(methylcarbamoyl)oxy} thioacetimidate [<i>Lannate, Methomyl, Nudrin</i>]	1328	
	2-Methyl-2-(methylthio) propionaldehyde O-(methylcarbamoyl)-oxime [<i>Aldicarb, Temik</i>]	18	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Methyl parathion	896	
	1-methyl-3-phenyl-5-[3-(tri-fluoromethyl)phenyl]-4(1H)-pyridione [<i>Fluridone, Sonar</i>]	1113.5	
	3-(1-Methyl-2-Pyrrolidyl)Pyridine [Nicotine as free alkaloid]	1479	
1436	4-(methylthio)-3,5-xylylmethylcarbamate [<i>Mesuro, Methiocarb</i>]		All agriculture & outdoor uses, except slug and snail baits
	Methiocarb	1436	
1440	Metolachlor		All
	Metribuzin	100	
	Mevinphos	356	
1441	Mexacarbate		All above 2%, except slug & snail baits as Class B; discontinued by the manufacturer
	Miban	596	
	Milo-fume	1952	
	Milogard	1740	
	Mirex	976	
	Mocap	1021	
	Monitor	1325	
	Monocrotophos	901	
	Mylone	1952	
1472	alpha-Naphthylthiourea [<i>ANTU</i>]		All, discontinued by the manufacturer
	Nemacide	679	
	Nemacur	1079	
	Nemagon	656	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Nemax	490	
	Nemex	790	
	Nialate	1020	
1477	Nicosulfuron [<i>Accent</i>]		All
1479	Nicotine		All
1480	Nicotine salts (e.g., Nicotine sulfate)		All above 40%
	Nitrofen	786	
	Nitrogen, liquid		All
1499	4-Nitropyridine [<i>Avitrol 100</i>]		All, permit required
1505	Norflurazon [<i>Predict</i>]		All
	Nudrin	1328	
	Octachlor-2,3,3a,4,7,7a-Hexahydro-4,7 Methanoindane or Octachloro-4,7-Methano-tetrahydroindane & related compounds [<i>Chlordane</i>]	386	
1508	Octachlorohexahydro-4,7-methanoisoben-zofuran [<i>Isobenzan, Telodrin</i>]		All, discontinued by the manufacturer
1509.5	Octamethylpyrophosphoramidate [<i>Schradan</i>]		All
	One Shot		All
	Option		All
	Osmose K	514	All
	Oust	1910	
	7-Oxabicyclo(2.2.1)Heptane-2,3- Dicar-boxylic acid [<i>Aquathol, Endothall, 3,6-endoxohexa- hydroph-thalic acid</i>]	1002	
3	Oxamyl [<i>Vydate</i>]		All above 5%
	Oxydematon-methyl	1084	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
1551	Oxifluorofen [<i>Goal</i>]		All
	Paclobutrazol-(t)-(R*,R*)- - [(4-chlorophenyl)methyl]-a-(1,1-dimethylethyl)-1H-1,2,4-triazole-1-ethanol [<i>Clipper</i>]		All
1555	Paraquat dichloride		All above 0.5% cation
1556	Paraquat [<i>Colonel, Cyclone, Gramoxone, Prelude, Surefire, Topgun</i>]		All above 0.2% cation
1558	Parathion		All
	Partner	16	
	Partox	481	
	Payoff		All
	PCP	1564	
	Peak	1745	
1559.5	Pendimethalin [<i>Prowl, Prozone, Squadron</i>]		All above 5%
	Penncap-M	896	
1564	Pentachlorophenol & related compounds		All
	Permethrin	1575.5	
	Permit	1124	
1575.5	(3-phenoxyphenyl)methyl 3-(2,2-dichlorethenyl)-2,2-dimethylcyclo propanecarboxylate [<i>Ambush, Permethrin, Pounce</i>]		All above 2%
1639	Phorate		All above 1%
	Phosacetim	209	
1640	Phosalone		All above 2%
	Phosdrin	356	
1641	Phosphamidon		All above 1%

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
1644	Phosphorus (White or Yellow)		All, By permit only
	Phostoxin	92	
	Picfume	490	
1645	Picloram		All above 2%
	Pindone	1661	
	Pinnacle	1970	
	Piscicides (Fish Toxicants)		All
	Pival	1661	
1661	2-Pivalyl-1,3-indandione [<i>Pindone, Pival, Tri-ban</i>]		All above 3%
	PMP	1257	
	Poast	1790	
1669	Polychlorobicyclopentadiene isomers (Chlorine content 60-62%) [<i>Bandane</i>]		All, discontinued by the manufacturer
	Pounce	1575.5	
	Pramitol	1735	
	Predict	1505	
	Prelude	1556	
	Premerge	933	
	Premier	1200	
	Primatol A	156	
	Primatol P	1740	
	Primatol Q	1736	
	Primatol S	1816	
1700	Primisulfuron [<i>Beacon, Exceed</i>]		All

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Princep	1816	
1730	Profenofos [<i>Select</i>]		All
1735	Prometon		All above 8%
1736	Prometryn		All above 6%
	Pronamide [<i>Kerb</i>]	690	
	Propachlor	432	
1740	Propazine		All above 8%
1741.5	Propetamphos		All EC 50% or greater
	Prophos	1021	
	2-Propenal [<i>Acrolein, Acrylaldehyde</i>]	14	
	Propoxur	1238	
1745	Prosulfuron [<i>Exceed, Peak</i>]		All
	Prowl	1559.5	
	Proxol	2020	
	Prozine	156 & 1559.5	
	Pryfon	1393.3	
	Pydrin	590	
	Pyramite	1750	
1750	Pyridaben [<i>Pyramite</i>]		All
1751	Pyridate [<i>Tough</i>]		All
	Quadris	161	
	Ramrod	432	
	Regent	1100	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Reglone	958	
	Resource	1103	
	Rozol	481	
	Sarolex	824	
	Schradan	1509.5	
	Scout		All
	2-Sec Butyl-4,6-Dinitrophenol [Dinoseb, DNBP, Premerge]	933	
	Select	512 & 1730	
1784	Selenium Compounds		All
	Sencor	100	
790	Sethoxydim [Poast]		All
1816	Simazine		All above 10%
	SMDC	1865	
1823	Sodium Arsenite		All, By permit only
1833	Sodium Chlorate		All Single-ingredient, fire hazard
1845	Sodium dichromate		All except brush-on
1851	Sodium fluoroacetate [Compound 1080]		All, By permit only
1865	Sodium methyldithiocarbamate [Metam-Sodium, SMDC, Vapam]		All containers larger than 1 quart
	Sonalan	1057	
	Sonar	1113.5	
	Spectracide	824	
	Squadron	1559.5	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Starlicide	499	
	Strobane	1927	
1900	Strchnine & its salts		All uses, except below-ground hand application
1910	Sulfometuron methyl [<i>Oust</i>]		All
	Sulfotepp	1948	
1914	Sulfuric acid		All dessicants
1916	Sulfuryl fluoride [<i>Vikane</i>]		All
	Sulprofos	1078	
	Sumithion	897	
	Supona	412	
	Supracide	1327	
	Surefire	1556	
	Sutan	1039	
	Systox	632	
	Talstar	185	
	TBT or TBTO	229	
	TDE	693	
	Tefluthrin		All granular
	Telodrin	1508	
	Telone	790.5	
	Temik	18	
	Tempo	602	
	Tendex	1238	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	TEPP	1949	
1924	Terbufos [<i>Counter</i>]		All
	Tergitrol [<i>Compound PA-14</i>]		All — Sales and use restricted to U.S. Fish & Wildlife Service
1927	Terpene polychlorinates (65 or 66% chlorine) consists of chlorinated camphene, pinene, and related polychlorinates [<i>Bladafume, Strobane</i>]		All above 5%
1948	O,O,O,O-Tetraethyl dithiopyrophosphate [<i>Sulfotepp</i>]		All
	O,O,O',O'-Tetraethyl S,S'-methylene bisphosphorodithioate [<i>Ethion, Nialate</i>]	1020	
1949	Tetraethyl pyrophosphate [<i>TEPP</i>]		All
1952	Tetrahydro-3,5-dimethyl-2H-1,3,5 -thiadiazine-2-thione [<i>Dazomet, DMTT, Mico-Fume, Mylone</i>]		All, except industrial microbiocides
	TFM	2081	
1964	Thallium sulfate		All, Canceled in 1972
1970	Thifensulfuron methyl [<i>Pinnacle</i>]		All
	Thimet	1639	
	Thiodan	1001	
1975	Thiodiocarb [<i>Larvin</i>]		All
	Timberfume	490	
	Thionazin	834	
	TOK [<i>Nitrofen</i>]	786	
	Topgun	1556	
	Tordon	1645	
	Tough	1751	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
1986	Toxaphene, Technical chlorinated camphene 67-69% chlorine, etc.		All
	Tralometrin [<i>Scout</i>]		All above 2%
	Tribute	1099	
1997	Tributyltin fluoride		All anti-fouling paint
	Tributyltin methacrylate		All anti-fouling paint
2024	2,4,5-Trichlorophenoxyacetic acid [2,4,5- <i>T</i>]		All, Canceled
	Trichlorpyrphos	509	
2030	Triclopyr [<i>Crossbow</i> , <i>Garlon</i>]		All above 2%
2081	a,a,a-trifluoro-4-nitro-meta-cresol [<i>TFM</i>]		All — Sales and use restricted to U.S. Fish & Wildlife Service
	Trinatox D	94	
2101	Triphenyltin hydroxide		All
	Trithion	361	
	Triumph		All
	Turcam	172.5	
	Ultracide	1327	
	Valone	1257	
	Vapam	1865	
	Vapona	797	
	VC-13	679	
	Ventox	15	
	Vikane	1916	
	Vorlex	1398	
	Vulcan	360	

Prod. No.	Chemical, Common, or Trade Name	Ref. No.	Restriction(s)
	Vydate	1543	
2117	Warfarin		All above 3%
	Weed-B-Gon	708	
	Weedazol	106	
	Weedone	774	
	Whip		All
	Zectran	1441	
2141	Zinc phosphide		All above 2%
	Zinophos	834	

Questions for Self-Study - Chapter II

Using the *Vermont Regulations for the Control of Pesticides* **and** the Appendix “A(2)” to the regulations, determine whether the following pesticides are Class “A”/Restricted Use (A), Class “B” (B), Class “C” (C), or if a special permit is required for their use (P):

1. 3% Guthion
2. 2% Baygon Bait Insecticide
3. 0.1% Mercury
4. 6% Pendimethalin
5. Chlordane
6. 5% Agrimek
7. 8% Battle
8. 25% Aqua-Kleen, for aquatic use
9. Sodium Arsenite
10. 30% WP Kerb

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.

FIFRA:

FIFRA

- 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 “*Restricted 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.

The Worker Protection Standard

In August 1992, EPA issued revised regulations (Title 40 CFR Part 170) governing the protection of employees on farms, forests, nurseries, and greenhouses from occupational exposures to agricultural pesticides. The new Worker Protection Standard (WPS) covers both workers in areas treated with pesticides and employees who handle pesticides for use in these areas.

- **Agricultural workers** - those who perform tasks related to the cultivation and harvesting of plants on farms or in greenhouses, nurseries, or forests.
- **Pesticide handlers** - those who handle agricultural pesticides (mix, load, apply, clean or repair equipment, act as flaggers, etc.)

The revised regulations are intended to reduce the risk of pesticide poisonings and injuries among agricultural workers and pesticide handlers through appropriate exposure reduction measures. Reducing overall exposure to pesticides will be accomplished by:

- prohibiting handlers from exposing workers during application.
- excluding workers from areas being treated and areas under a Restricted Entry Interval (REI).

The standard also mandates notifying workers about treated areas. Mitigating exposures will be accomplished by requiring decontamination supplies and emergency assistance. Workers will be informed about pesticide hazards through required safety training (workers and handlers), safety posters, access to labeling information, and access to specific information about the treated areas.

All of the requirements are described in the "WPS How To Comply" manual. Copies of this manual are available from your local Cooperative Extension office.

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.

Pesticide Registration

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 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."

Old Pesticides

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.

EPA Options for Regulation

- 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.

Food, Drug and Cosmetic Act of 1938

The Food Drug and Cosmetic Act (FFDCA) of 1938 has been amended several times in its history. It is administered by the Food and Drug Administration of the Department of Health and Human Welfare.

FFDCA governs, among other things, pesticide residue levels in food or feed crops marketed in the U.S. Under the FFDCA, EPA has the responsibility for setting tolerances, or maximum legal limits for pesticide residues on food commodities marketed in the U.S. The purpose of the

tolerance program is to ensure that U.S. consumers are not exposed to unsafe food-pesticide residue levels. The Food and Drug Administration has the responsibility for enforcing tolerance levels set by EPA. This law:

- provides for monitoring of food crops for pesticide residues and enforces tolerances.
- provides for monitoring and enforcement of food additive tolerances and prosecutes violators.
- works jointly with EPA to register pesticides used on animals.
- provides for monitoring of pesticide residues in animals by the Meat Inspection Division of the U.S. Department of Agriculture.

The Occupational Safety and Health Act (OSHA) of 1970 is administered by the Occupational Safety and Health Administration of the Department of Labor. This law:

- requires any employer with eleven or more employees to keep records of all work-related deaths, injuries and illness and to make periodic reports. Minor injuries needing only first aid treatment need not be recorded. Records must be made if the injury involved medical treatment, loss of consciousness, restriction of work or motion, or transfer to another job.
- requires investigation of employee complaints that may be related to pesticide use, reentry or accidents.

Occupational Safety and Health Act (OSHA) of 1970

This rule written and administered by OSHA, provides protection for employees exposed to hazardous chemicals. Pesticides are considered hazardous chemicals. An employee is defined as a worker who may be exposed to hazardous chemicals under normal operating conditions or in foreseeable emergencies. Exposure or exposed means that an employee is subjected to a hazardous chemical in the course of employment through any route of entry (inhalation, ingestion, skin contact or absorption), and includes potential (i.e. accidental or possible) exposure.

This law:

- requires employers to read the Standard and understand the provisions and responsibilities of an employer.
- requires a list of the hazardous chemicals in the work place be made.
- requires employers to obtain material safety data sheets (MSDS) for all hazardous substances on their list.
- requires all containers to be labeled.

Hazard Communication Standard (HCS)

- requires a written communication program be developed and implemented.
- requires that employee training be conducted based upon the chemical list, MSDS and labeling information.
- employers must create a hazard communication file, and make it available to any employee upon request in a reasonable period of time.

Resource Conservation and Recovery Act of 1976

The Federal Resource Conservation and Recovery Act (RCRA) is administered by the Environmental Protection Agency to manage all hazardous wastes.

Under this law:

- private applicators (farmers) who properly dispose of pesticide wastes, excess pesticides, and triple rinsed empty containers on their own property are in general exempt from the requirements of this law (state requirements are often more strict).
- others who accumulate 2.2 pounds per month or more waste containing acute hazardous chemical or 2200 pounds of waste (220 pounds in NYS) containing a hazardous chemical are regulated; must register as a generator of hazardous waste and obtain an ID number from EPA and follow certain disposal requirements.
- triple-rinsed used containers can be disposed of in EPA approved sanitary landfills without an ID number or further regulation. Regulated waste includes unrinsed containers, excess pesticide and pesticide dilutions, rinse water, etc. which contain a listed chemical and cannot be properly used.

To find out if a pesticide is listed in RCRA call:

EPA RCRA Hotline 1-800-424-9346

8:30 am - 7:30 p.m. EST Monday through Friday

- probably any pesticide not listed as hazardous in RCRA should be treated as hazardous because any flammable, corrosive, reactive, or toxic waste is considered hazardous even if not on the list. State hazardous waste regulations should also be followed.

Transportation Safety Act of 1974

The Transportation Safety Act of 1974 authorized the U.S. Department of Transportation (DOT) to declare, issue and enforce hazardous materials regulations for all modes of transportation. These regulations, contained in Title 49 of the Code of Federal Regulations (49 CFR), cover any safety aspect of transporting hazardous materials, including the packing, repacking, handling, describing, labeling, marking, placarding and

routing of such materials. Many states have adopted these federal regulations and are enforcing them.

The materials included under this regulation are explosives, compressed gases, flammable liquids and solids, poisons and several other classifications of chemicals. Many pesticides are not defined by the DOT as hazardous although most of the hazard classes defined include pesticides.

The shipper who offers a hazardous material for transportation in commerce shall describe the hazardous material on the shipping paper as required by the regulations. The applicator or carrier may not transport a hazardous material unless it is accompanied by a shipping paper. However, in most cases pesticides do not need shipping papers unless the quantity of the material in one package equals or exceeds the "Reportable Quantity" (RQ) listed in the regulations. A pesticide would be considered a "hazardous substance" if its active ingredient is equal to or greater than the reportable quantity (RQ) per package. When transporting hazardous materials, the shipping paper must be within reach of the driver while in the seat belt. When the driver is away from the vehicle the shipping paper must be on the driver's seat or in the pouch of the vehicle door.

SARA Title III is a Federal Right-to-Know law that affects those that produce or store hazardous chemicals. Pesticide producers, distributors, retailers and some pesticide applicators are among those that must comply with this law. It is designed to inform communities regarding hazardous chemicals located in the vicinity and addresses the need for community emergency response plans in the event of an accident.

Title III has many sections, however, the areas that affect the pesticide applicator, applicator business, or dealer are confined to four sections:

- section 302 - Emergency planning and notification describes when notification of the state and local officials is required. EPA has assigned a Threshold Planning Quantity (TPQ) for each active ingredient (not total weight of formulated product). When the product in storage is at or above the TPQ the State Emergency Response Commission (SERC) must be notified in writing. Each facility is also required to designate a coordinator to work with the Local Emergency Planning Committee (LEPC). The state will notify the LEPC that your operation is covered under SARA. This is a one time notification.
- section 304 - Emergency release reporting describes the safety measures when an accidental release (such as a spill) of any extremely hazardous substance occurs. If all the following occur:
 - the pesticide was spilled.
 - is covered under SARA Title III.

Superfund Amendments and Reauthorization Act of 1986 (SARA Title III)

- the spill quantity was greater than the Reportable Quantity (RQ).
- and the spill created off-site exposure.

You must:

1. notify the SERC.
2. notify the LEPC.
3. report the release to the National Response Center (1-800-424-8802).

If a pesticide is applied according to the label, the use is exempt from emergency release reporting.

- section 311 - Material safety data sheet reporting is required under SARA Title III. Employers are required to obtain and keep material safety data sheets and submit copies of each MSDS (or a listing of the MSDS that must be maintained) to their local fire department, the LEPC, and the SERC. There is one exclusion for the section 311 requirement. If a chemical is used solely for household, consumer, or agricultural purposes, then notification is not required.
- section 312 - This section states that facilities must submit an annual chemical inventory to their local fire department, LEPC, and SERC. This inventory must include all hazardous chemicals stored at the facility at or above 10,000 pounds and any extremely hazardous chemical stored at or above 500 pounds (or 55 gallons) or above the TPQ, whichever is less. Agricultural producers are exempt from this section.

The Endangered Species Act (ESA) of 1973

The purpose of the Endangered Species Act (ESA) is to protect endangered species. The ESA is administered by the Fish and Wildlife Service (FWS), of the Department of the Interior. The ESA makes it illegal to kill, harm or collect endangered wildlife or fish or remove endangered plants from areas under federal jurisdiction. It also mandates that other federal agencies ensure that any action they carry out or authorize is not likely to jeopardize the continued existence of any endangered species, or to destroy or adversely modify its critical habitat.

The FWS determines whether a species is endangered. An endangered species is a plant or animal which is in danger of extinction throughout all or a significant portion of its range. A threatened species is one likely to become endangered in the foreseeable future. The reasons a species becomes endangered or threatened are complex and difficult to correct. Destruction of habitat is one of the major reasons for the decline of some species. Habitat destruction is usually the result of industrial, agricultural, residential or recreational development. Within the United States about 275 animals and 190 plants have been listed as endangered or threatened. Once a species is listed as endangered, the FWS may

designate that its critical habitat be protected from destruction or modification in any way.

EPA is required to ensure that registered pesticide use is unlikely to jeopardize endangered species. Jeopardize means that the action "appreciably reduces the likelihood of survival of the species." To accomplish this, EPA estimates the maximum environmental concentration of each pesticide. If this estimated concentration may affect an endangered species the pesticide is referred to the FWS. The FWS determines if the pesticide uses are likely to jeopardize the endangered species. When FWS finds that the uses may cause jeopardy to the endangered species, the agency will recommend alternatives and/or restrict the use of the pesticide within the habitat of the affected species. If the pesticide will adversely affect the species, but not to the point of jeopardy, FWS provides discretionary conservation recommendations.

EPA responds to the FWS jeopardy opinions by making changes to the pesticide label. The new label language may contain specific restrictions or it may direct pesticide applicators to read an Endangered Species Bulletin with directions for the use of the pesticide where endangered species may be affected.

Ultimately, protection of endangered species from pesticides will fall to the pesticide applicator. Preserving the biological diversity of our planet by protecting endangered species will contribute to the overall quality of life. Each plant or animal is part of a complex food chain; break one of the links and others are adversely affected. One disappearing plant can take with it up to thirty other species that depend on it, including insects, higher animals and even other plants.

Regulations governing agricultural aircraft operations are administered by the Federal Aviation Administration in the U.S. Department of Transportation. It issues commercial and private aircraft operator certificates for such operations under Title 14, Code of Federal Regulations, Part 137.

Other Regulations

Pesticide regulation is very complex, merging science, public policy, and law. Since scientific knowledge constantly changes, as do the needs of society, the pesticide regulatory process is never at a standstill. EPA continuously updates pesticide decisions as knowledge increases and improves.

Questions for Self Study — Chapter III

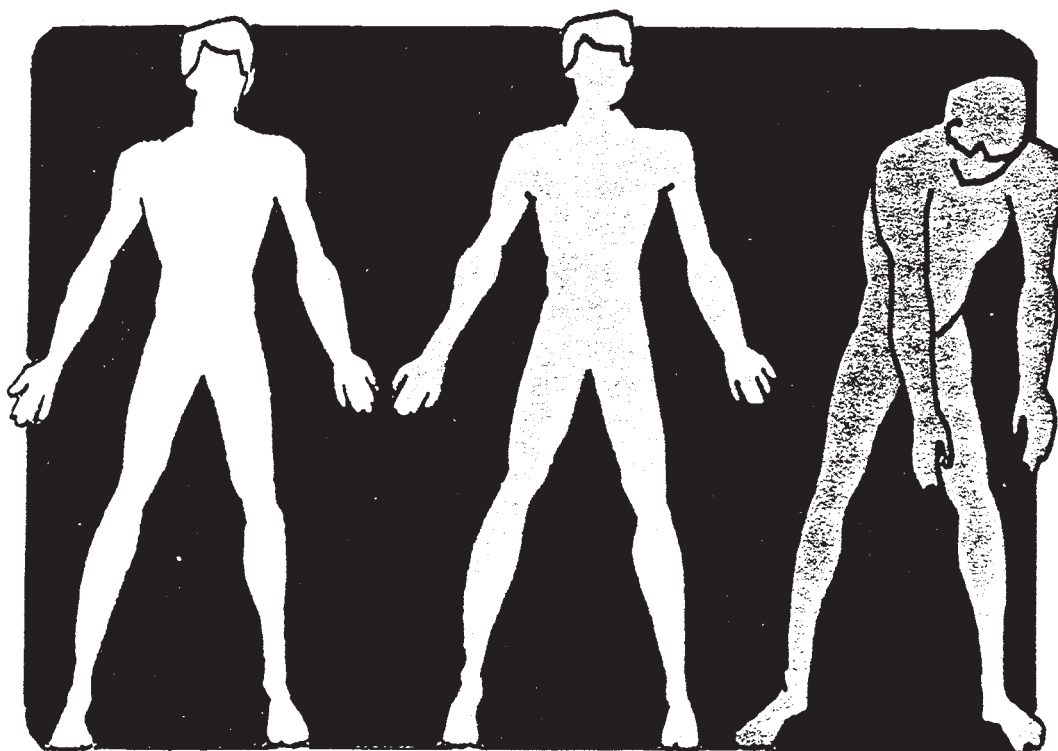
1. What is the full name and acronym of the federal agency mandated to regulate pesticides?
2. What is the full name and acronym for the law EPA uses to manage pesticides?
3. FIFRA governs the licensing or registration of pesticide products. Before a pesticide may be marketed in the U.S. what must EPA do?
4. Discuss two types of penalties defined by FIFRA for applicators that violate the law.
5. Does FIFRA provide for prison terms for violators of the law?
6. What are regulations?
7. Define Restricted Entry Interval.
8. EPA regulations require warnings be given to workers. Discuss the warning requirements.
9. What is EPA's pesticide registration decision based on?
10. If EPA determines that a pesticide poses a risk to workers, what options for regulation does EPA have?
11. If EPA determines that a pesticide poses a risk to consumers what options for regulation does EPA have?
12. Which federal agency sets food tolerances for pesticides? Which federal agency enforces food tolerances for pesticides?
13. What is the purpose of the tolerance program?
14. Which Act is administered by EPA to manage all hazardous waste?
15. How can triple-rinsed used pesticide containers be disposed of?
16. FIFRA allows states to establish standards. What kind of standards?
17. Which agency administers the Hazard Communication Standard?

18. Applicators generate waste during normal work operations. List those that are "regulated waste" under RCRA.
19. The regulations interpreting the Transportation Safety Act are contained in 49 CFR. What do these regulations cover?
20. What is the act SARA III designed to do?
21. What is an endangered species?
22. Which federal agency determines what species are endangered?
23. If a pesticide is found to jeopardize an endangered species, what changes may happen to the pesticide label?
24. Who ultimately bears the responsibility of protecting endangered species from pesticides?

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:

$$\text{RISK} = \text{TOXICITY} \times \text{EXPOSURE}$$

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.

Types of Pesticide Exposures

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 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.

The Qualities of the Exposed Individual

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.

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.

Measuring Toxicity

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.

Acute Toxicity Measures

Lethal Dose Fifty (LD₅₀)

"Lethal Dose Fifty" (LD₅₀) is one way the toxicity of chemicals are measured. LD₅₀ is the amount of a pesticide that has killed half of the animals in a laboratory test. The LD₅₀ is found for both dermal and oral routes of exposure. For example, an acute oral LD₅₀ indicates the amount of pesticide swallowed that has killed half of the animals tested.

The smaller the LD₅₀ value, the less chemical required to kill half of the test animals, and the more poisonous the pesticide. So, a pesticide with a dermal LD₅₀ of 25 (rabbit) is more poisonous than a pesticide with a dermal LD₅₀ of 2000 (rabbit).

LD₅₀'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. LD₅₀'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 LD₅₀ 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 LD₅₀ 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 LD₅₀ 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 interchangeably 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

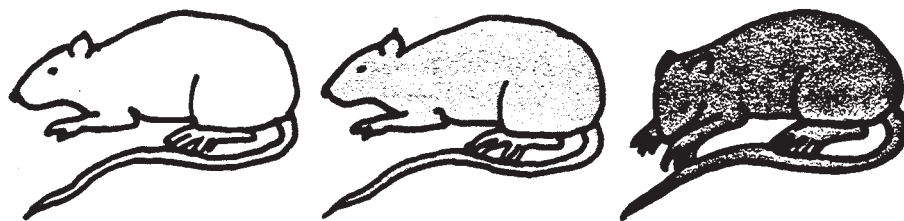
Lethal Concentration Fifty (LC_{50})

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/m³).

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).

Chronic Toxicity Measures



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.

Acute Toxicity Label Warning Statements

The following table indicates the four categories of pesticide toxicity:

Categories of Acute Toxicity—

Category	Signal Word Required on Label	LD_{50}		LC_{50}	Approximate Oral Dose That Can Kill an Average Person
		Oral mg/kg	Dermal mg/kg	Inhalation mg/l	
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 tea- spoonful 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.

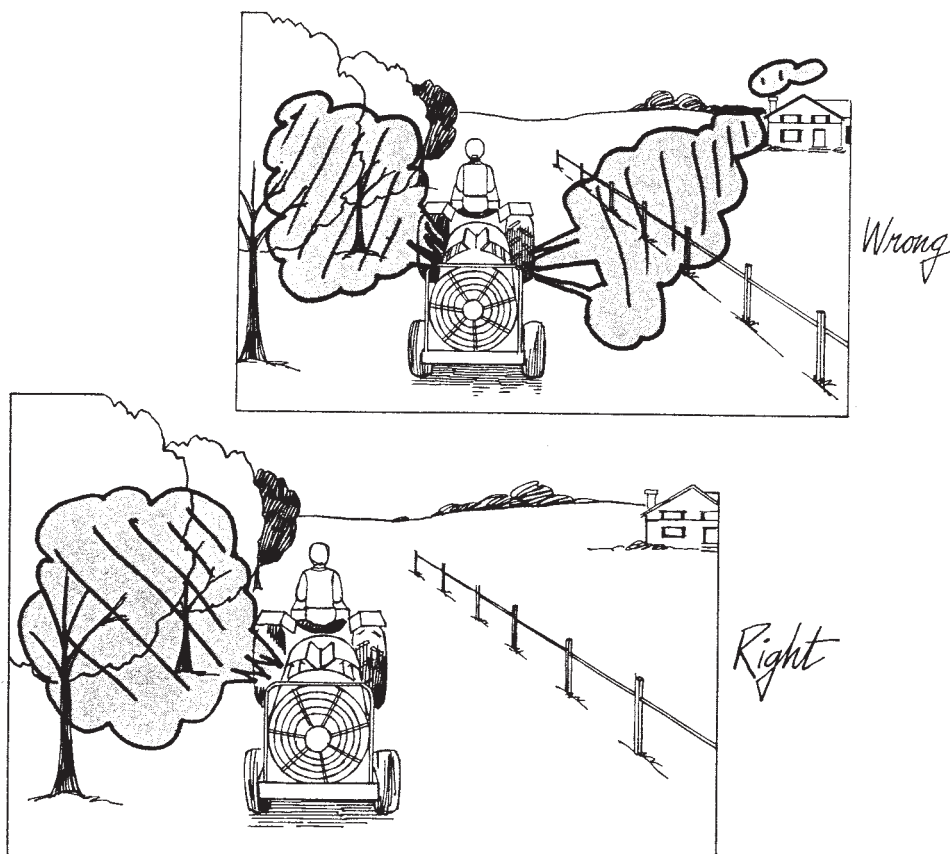
Concentration and Dosage. Usually, the more concentrated a formulation is the more hazard it poses. Dilute the concentrated pesticide and you reduce the hazard. For example, one ounce of pesticide A contains a lethal oral dose. If the same one ounce of pesticide A is diluted in ten gallons of water, 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

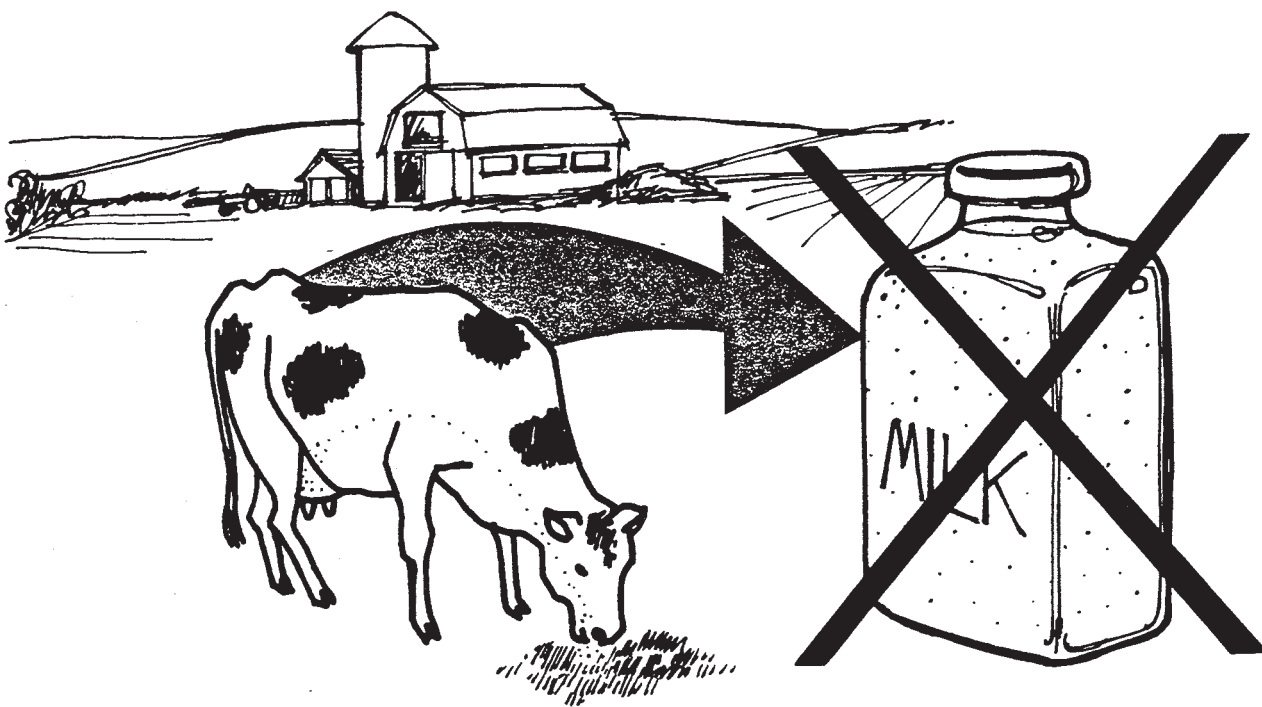
1. What is the definition of toxicity?
2. Pesticides may enter the body in three different ways. Name them.
3. Can some pesticides be as dangerous when they are absorbed through the skin as they are when they are taken orally?
4. _____ (oil, paste, or water-based) pesticide solutions are most likely 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?

Residue, Tolerance, and Registration

Chapter V

The use of pesticides is strictly controlled in the United States. Every chemical which has possible use as a pesticide is closely tested and reviewed before it is marketed. The laws controlling the use of pesticides on food or feed crops are more strict. The amount of pesticide remaining on the crop at harvest is carefully regulated.



Goals of This Chapter

- Distinguish between deposits and residues.
- Understand both the positive and negative features of long-lasting residues.
- Explain a tolerance and the criterion involved in setting a tolerance.
- Determine the importance of "Days to Slaughter" and "Days to Harvest."
- Learn what information is important in registering a pesticide.

Residues

The pesticide which is on the leaves, skin, or other surface right after application is the **deposit**. Sometimes the deposit can be easily seen, as with many dusts or wettable powders. At other times it cannot be seen with the naked eye. If the pesticide deposit remains on the surface for a period of time, it is called a residue. Some pesticides leave little or no residue. Heat, light, moisture, soil organisms, and other chemical reactions in the environment quickly break them down. Other pesticides are not quickly broken down. They leave a residue on the crop or in the environment for weeks, months, or years. Depending on how and where it is used, each pesticide will vary in how long a residue remains on the crop or surface. Therefore, information on residues is required on each crop the pesticide is applied to. Unfortunately, a pesticide may drift over from a nearby field and leave a residue on a crop or surface.

A long-lasting residue may be desirable because the pesticide is effective for a longer period of time. It need not be applied as often and thus may be cheaper to use. However, long-lasting residues are not always desirable. The chemicals may remain on food or feed and be hazardous to those eating them. The residues may remain in the soil to interfere with crops that are planted at a later date. Or they may remain on the surface and injure workers or others who reenter the treated area. Clearly it is important to know what residue, if any, remains after a period of time. Food, in fact, may have no residue because it may never have been treated, or it was treated at less than the maximum dose and the residues may have degraded.

Tolerances

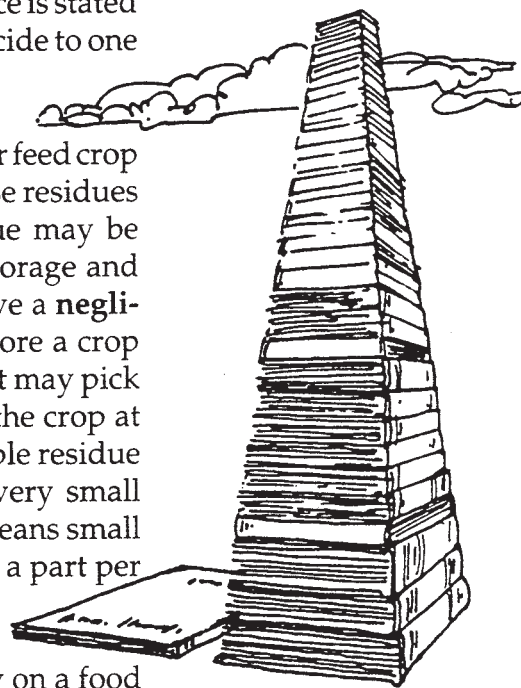
Many times residues remain on food or feed crops at harvest time. Since these crops are to be eaten, safe amounts of residues must be established. The maximum amount of residue which may remain on a harvested crop is called a tolerance. Federal law requires that a tolerance be set for every

food or feed use of each pesticide before it is registered. The tolerances vary from crop to crop depending on the many safety factors involved. If the residue exceeds the set tolerance, the crop may not be marketed or sold. It is subject to condemnation and seizure by federal or state regulatory agencies.

How Tolerances Are Set. Much information is gathered and studied before a tolerance is set. Studies on test animals are done to determine the acute and chronic toxicity of the chemical. Toxicity to fish, birds, and mammals is also determined. The length of time the pesticide remains in the environment is measured. Possible long-term effects such as buildup in animals or in the environment are studied. All these factors (and others) are taken into account before setting a tolerance. The tolerance is usually set at least 100 times smaller than the highest dose which has no effect in test animals. For example, 200 parts per million of pesticide A have no effect on test animals. Then the tolerance for pesticide A on any food or feed crop could be no higher than 2 parts per million (ppm). The "safety factor" is 100 times. The tolerances for pesticide A may not be as high as 2 ppm. Field tests may show that acceptable pest control is achieved using doses and methods that result in a residue much less than 2 ppm. Then the tolerance would be set at 1 ppm. [The tolerance is stated in parts per million (ppm) by weight. That is, one part of pesticide to one million parts of crop or meat.]

Negligible Residue Tolerances. A residue may be on a food or feed crop even though no pesticide was ever directly applied to it. These residues result from **indirect** contact with the chemical. The residue may be found, for example, in livestock which have eaten sprayed forage and grass. Edible meat of livestock containing residues must have a **negligible residue tolerance**. Or when a herbicide is applied before a crop emerges, a residue may be left in the soil. As the crop grows it may pick up a small amount of the herbicide. If the residue is still in the crop at harvest, a negligible residue tolerance must be set. A negligible residue tolerance (usually just "negligible residue") is set when a very small residue is likely to be on food or feed at harvest. Negligible means small or minor. The negligible residue is usually one tenth (0.1) of a part per million or less. It is far below any toxic level.

Finite Tolerances. When a pesticide will be applied directly on a food or feed crop and animal, a finite tolerance is set. A finite tolerance (often just "tolerance") is usually larger than a negligible residue. However, it is still well below possible toxic levels. To be eaten, a tolerance must have been set, unless it is exempt from tolerance.



*A book 1/16 inch thick is
1 ppm of a stack
1 mile high!*

Days to Harvest

Most pesticides break down in the environment. As they break down, the residue on the crop or animal becomes smaller. Therefore, the residues remaining at harvest depend on how long before harvest the pesticide is applied. "Days to Harvest" is the least number of days between the last pesticide application and the harvest day. ("Days to Slaughter" is used with livestock.) Both are listed on the label. For example, when pesticide A is applied on the day of harvest, it leaves a residue of 10 ppm. However, when it is applied 7 days before harvest, it leaves a residue of only 2 ppm. If acceptable pest control is possible by applying 7 days before harvest, EPA will often set the tolerance at **2 ppm** and the "Days of Harvest" at **7 days**. If days to harvest, recommended dosages and other label instructions are followed, the residue on the crop should be under the set tolerance.



Registration

Even though a tolerance is set for a pesticide on a specific crop, it still cannot be legally used until registered. Every pesticide and every use must be registered federally by the Environmental Protection Agency (EPA). EPA reviews all the required information on the pesticide. This includes toxicity studies, wildlife and environmental studies, breakdown and residue studies, chemical studies, etc. Registration will be granted only if the Administrator finds that the benefits of its use outweigh the risks. EPA also reviews and registers all statements which appear on the pesticide label. (See Chapter XIV, The Label.) No pesticide may be bought, sold, or used in the United States until it has federal registration for the product, the use, and the label.

It is up to you, the applicator, to help make sure that all food complies with established tolerances. Only you can be sure that no illegal residues remain on food crops. Follow label directions carefully. Do not be responsible for seizure of your customer's or his neighbor's crop!

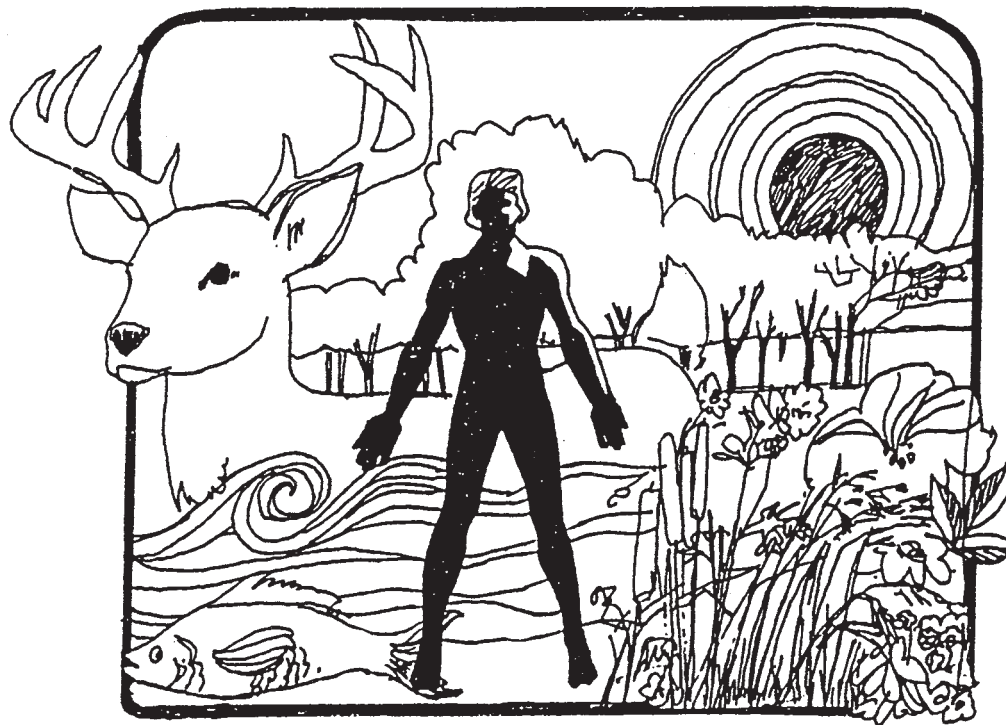
Questions for Self Study—Chapter V

1. What is the difference between a *deposit* and a *residue* ?
2. How can long-lasting residues be *desirable* ? *Undesirable* ?
3. What is a *tolerance* ? When must a tolerance be set?
4. Can a food or feed crop have *more* than the set tolerance of a pesticide on it and still be *legally marketed* ?
5. What information determines the setting of a tolerance?
6. At least what margin of safety ("safety factor") is used in setting tolerances?
7. Does the marketed food sometimes have less pesticide residue than the set tolerance? When?
8. Can food crops and animals contain pesticide residues even when they are not directly sprayed by the pesticide?
9. When are Negligible Residue Tolerances set?
10. When are Days to Slaughter or Days to Harvest important? What are they for?
11. Is it necessary for every pesticide to be registered before it is sold or used?
12. What are some of the types of information that the Environmental Protection Agency reviews before registering a pesticide?

Ecology and Environmental Considerations

Chapter VI

The words "environment" and "ecology" have been increasingly in the news. Man is beginning to fear that his daily activities may be limiting the future use of resources. Pesticide use and drift can affect air quality; pesticides in the food chain can threaten wildlife populations; and soil may no longer be suitable for optimal crop production. Pesticides are now recognized to be non-point sources of water pollution. As a result, pesticide practices are being watched closely. As pesticide applicators, it is important to do your job carefully by both controlling pest populations and at the same time protecting the environment from the potential adverse effects of pesticide use.



Goals of This Chapter

- Understand the dangers of pesticides in the environment and what causes them.
- Be familiar with how pesticides pollute groundwater and what steps can be taken to prevent it.
- Understand how pesticides persist in the environment.

Pesticides in the Environment



The human race needs a place to live with clean air and water, food which is not harmful, and an environment which will not threaten our health and safety. Since we share this planet with many other living creatures, we also have an obligation to protect the earth's resources from degradation. Few people will argue with the statement that pollution will grow as our planet's population grows. It is important that sensitivity and awareness of these problems also grow. Population increases will require more food, fiber, and building materials and will create an increasing demand on the earth's finite resources. An additional effect of the population crunch will be an increase in environmental sensitivity and government regulations to protect the environment from pesticide pollution.

Pesticides can/may enhance public health and the environment when they are used properly and wisely. For example, they have been used to control pests which could be harmful to man. Rats carrying plague or mosquitoes carrying malaria are two good examples. These control programs are necessary, especially in crowded cities and countries with large numbers of people. However, pesticides can also harm public health and the environment. Any pesticide which is off-target is a pollutant and can be dangerous. Even when delivered "on-target," uncontrollable exposure of non-target species can result in adverse effects. The benefits of pesticide use are meaningless if pollution occurs through misuse and/or carelessness.

Air and Pesticides

Air must be available for plants and animals to live. It is a source of oxygen for breathing as well as receiving carbon dioxide waste. Air has the ability to move particles for long distances. Most of the time this ability aids mankind. It causes rain, for example. Unfortunately, for the pesticide applicator this same ability is the cause of drift. Drift is the movement of spray particles or droplets away from the spray site, before they reach the target crop or ground surface. Pesticides in the air are not controllable and may settle into waterways, homes, lawns, wooded areas, etc. Drift must be avoided.

Controlling drift is important for the commercial applicator as well as the private applicator. To be effective, the pesticide must be applied

precisely on target at the correct rate, volume, and pressure. Drift from the target area may injure people, pets, wildlife, and sensitive plants. Drift of herbicides can damage nearby crops, forests, or landscape plantings. Poorly timed applications can kill bees and other pollinators which are working in the area. Beneficial parasites and predators that help control pests may also be killed. Drift can also be a problem indoors. Pest control operators must be aware that forced air heating systems and air conditioning units can move sloppily applied pesticides.

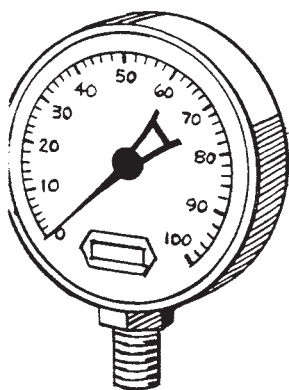
Particle Drift. Particle drift is influenced by many factors. Particle size, nozzle design and orientation, pressure, temperature, humidity, evaporation, height of release, air velocity and movement are among several important considerations.

Particle and droplet size. The smaller the particle size, the greater the potential for drift. Dust formulations are made of small particles and have a greater potential for drift than granular formulations. Small liquid droplets, especially those under 150 microns, also tend to drift more than large droplets. Whenever practical the applicator should use the largest droplet size in obtaining effective pest control.

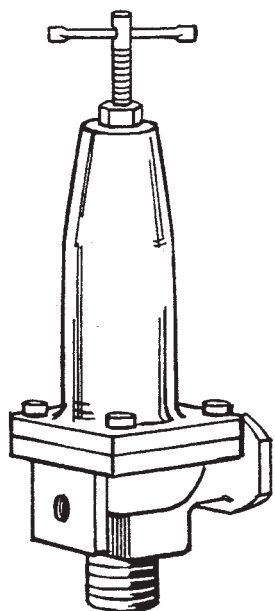
Nozzle type, orientation and size. In terms of liquid drift control, the nozzle is probably more important than pressure. All nozzles produce a range of droplet sizes. Nozzles which produce small (fine) droplets should be avoided. Placement of the nozzle in the air stream, especially where airblast and aerial application equipment are concerned, also affect droplet size. Nozzles pointed across the air flow produce smaller droplets. This is caused by wind shear.

Pressure. Droplet size is influenced by pressure. Some equipment operators will correct drift by varying pressure. The higher the pressure, the smaller the droplet. With smaller droplets better coverage may be gained resulting in higher chemical performance but at the expense of drift control. Because larger droplets are heavier and more difficult to move off target, reducing the pressure will help control drift.

Height of nozzle. Nozzles positioned too high will disperse spray over a wider area. This will also increase the likelihood of drift because spray particles must fall over a greater distance. The applicator must decide the desired swath width by striking a balance among nozzle spray angle, pressure, and height above the target. For example, if an operator increases the application pressure and the rate, but maintains the swath width, he should lower the nozzle to compensate for the increased pressure. Lowering the nozzle may require switching to nozzles with a wider spray angle.



Pressure Gauge



Pressure Regulator

Air movement. Both horizontal and vertical air movement can affect drift. Unless it is calm, most pesticide applications are subjected to constant air movement. Indoors, heating and air conditioning systems move air and can move pesticides. Outside, unpredictable changes in this air movement can happen at any time to cause spray drift. Thus, wind direction and speed directly affect the direction, amount, and distance of drift.

Temperature and Humidity. The rate of droplet evaporation is determined to a great degree by temperature and humidity. A droplet that evaporates before reaching the target does not control pests.

Vapor Drift. A pesticide that has vaporized (evaporated) can be carried from the treated area by air currents. The movement of pesticide vapors in the atmosphere is called vapor drift. Vapor drift, unlike spray or dust drift, is related to the chemical properties of the pesticide. Unlike the drift of sprays and dusts that can sometimes be seen during an application, vapor drift is not visible. Vapor drift can be caused by vapor leakage. Fumigants and other volatile materials exert pressure on the environment around them. Like air in a balloon, they are actively trying to escape. Stopping vapor leakage from their containers is done by keeping them closed or sealed. Fumigation sites must also be sealed properly to keep the pesticide from leaking. Applying these materials with vapor tight equipment is important. Some herbicides in particular can volatilize and move from a treated area, reducing control of the target weeds and increasing the likelihood that non-target plants will be injured. Pesticide vapors inside a dwelling can also cause injury, particularly if the occupants are sensitive.

Application of a volatile pesticide should be avoided when conditions favor volatilization, such as high temperature. The vapor pressure rating of a pesticide may help the applicator know the volatility of a pesticide. However, pesticide labels usually do not have the vapor pressure rating. Labels will give warning statements that the applicator must be sensitive to. The following are examples:

- At high air or ground surface temperatures, vapors from this product may injure susceptible plants.
- Under very high temperatures, vapors from this product may injure susceptible plants in the immediate vicinity.
- Off-site movement of spray drift or vapors of this product can cause foliar whitening or yellowing of some plants.

What can be done to avoid drift?

- Apply the largest effective droplet size.
- Use the lowest practical pressure.
- Choose nozzles that produce large numbers of large particles.
- Place nozzles with the air stream and not across it.
- Apply as close as practical to the target.
- Use a drift control additive.
- Do not apply when wind, temperature, or humidity are unfavorable.
- Choose non-volatile (those that do not vaporize easily) pesticide formulations.

The careful use of pesticides is of prime concern to everyone today. Many factors interact to influence the distance material will drift from the target area. Even when common sense and good application technology are followed, drift can still be a problem for the applicator. Label instructions must be followed and strict attention must be given to the control of pesticide drift.

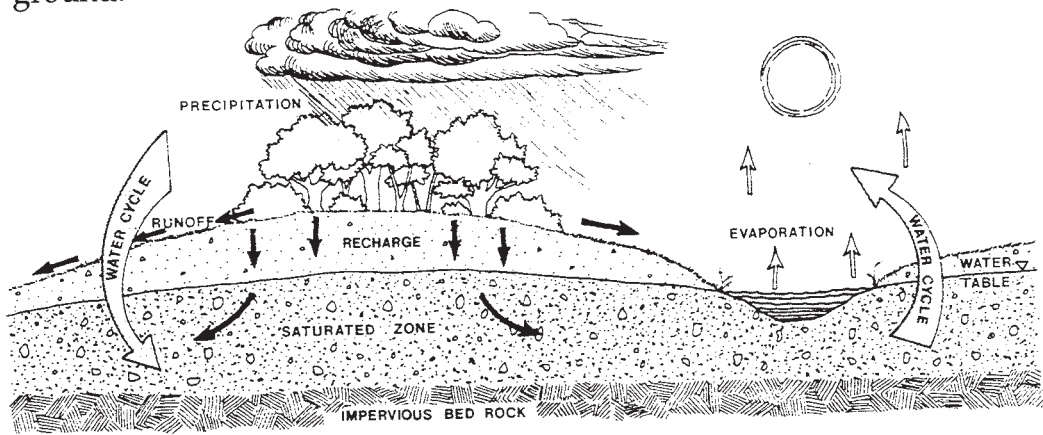
Water as a Natural Resource. Water is one of our greatest resources and is essential for all life. Man needs clean water for drinking, cooking, and bathing. Clean water is also essential to farmers who must feed livestock and irrigate crops. Half of the U.S. population and 90% of the rural population rely on groundwater for their drinking water. Groundwater makes up 96% of the world's total fresh water resource. Once considered to be safe from pollution, groundwater is now a threatened natural resource.

Groundwater and the Water Cycle. Groundwater is part of the water cycle. Groundwater is primarily stored in aquifers; geologic formations of permeable rock, sand, and gravel that contain enough water to yield usable amounts to wells and springs. Groundwater may come to the surface naturally at a spring or it may be drawn to the surface from a well. The cycle begins with precipitation such as rain or snow. Runoff from this enters surface waters, lakes, streams, and rivers. Some of this water seeps through the ground where moisture is drawn up by plant root systems. Water also moves downward through the soil (leaches) to become part of the groundwater. Water is then returned to the atmosphere through plant transpiration and evaporation from surface water, thus completing the water cycle.

Surface water results from precipitation, runoff, and the exchange of water from underground aquifers. Small streams flow and become rivers, gaining in water volume as the flow finds lower points along the

Pesticides and Water Resources

waterway. The water gained along the way is often from a groundwater source. Where groundwater reaches lakes, streams, rivers or oceans it is released and becomes surface water. Streams can also lose water into the ground.



How Pesticides Pollute Groundwater. Under certain conditions, contaminants — including soil nutrients, wastes, and chemicals — can migrate to groundwater sources. Pesticides applied correctly to a site may be moved downward with rain or irrigation water, reaching the water table below. This method of contamination is called non-point source pollution. Pesticides may enter a well directly from spillage or back-siphonage, thus entering the groundwater directly. This is called point source pollution. Because groundwater moves slowly, contaminants do not spread quickly. After pesticides reach groundwater they may continue to break down, but at a much slower rate because of less available light, heat, and oxygen. Thus, they can remain underground in slow-moving plumes for an indefinite period. When groundwater becomes contaminated, the polluted water may eventually appear in the surface water streams, rivers, and lakes. Because of the complex nature of groundwater, when the contamination is detected it is often widespread. Even if the contamination is stopped, it may take years before an aquifer can purify itself through natural processes. Once contaminated, groundwater is difficult and expensive to clean. Water from this source may be unusable for years. The best protection against groundwater pollution is prevention.

Factors that Affect the Fate of Pesticides in Water. Various processes affect the fate of pesticides following an application, disposal, or spill. The two basic processes are those that transfer chemicals or influence their movement, and those that degrade or break down chemicals. The primary transfer processes are adsorption, volatilization, runoff, leaching, and removal of treated crops or animals from an area. The degradation processes are microbial, chemical, and photodegradation.

Adsorption. Adsorption is the binding of chemicals to other particles. Pesticide adsorption in soil depends on the pesticide properties, soil moisture content, soil pH (acidity), and soil texture. Soils high in organic matter or clay are the most adsorptive, while coarse, sandy soils that lack organic matter or clay are much less adsorptive.

A soil-adsorbed pesticide is less likely to volatilize, leach, or degrade. When pesticides are tightly bound to soil particles in highly adsorptive soil, they are less available for absorption by plants and microorganisms. However, soil adsorbed pesticides can be lost by erosion. Understanding adsorption factors can reduce damage to sensitive plants, leaching to groundwater, and the presence of illegal residues in a food or feed crops.

Volatilization. Volatilization is like evaporation. A solid or liquid can change its state and turn into a gas or vapor. For example, water left in an open pan volatilizes (evaporates) into water vapor and disappears. Some pesticides are very volatile. The volatility of a pesticide depends on its vapor pressure and temperature. The volatilization of pesticides increases with higher air temperature and air movement, low relative humidity and when spray droplets are small.

Runoff. Runoff occurs when water carries pesticides, either mixed in the water or bound to eroding soil, to off target points. Rain carries pesticides off plant leaves to foliage near the ground and into the soil. The amount of pesticide runoff depends on the grade or slope of an area, the erodibility and texture of the soil, the soil moisture content, the amount and timing of irrigation or rainfall, and the properties of the pesticide.

Leaching. Some pesticides move through the soil and leach into groundwater. Several factors influence pesticide leaching. A pesticide that is easily dissolved in water moves with the water as it seeps through the soil. Soil structure and texture influence the rate and depth of pesticide leaching. Sandy and gravel soils have poor adsorption characteristics and allow water and pesticides to leach through quickly. A heavy clay soil does not allow for rapid leaching. Adsorption influences pesticide leaching because pesticides that are strongly adsorbed to soil particles leach less. The Soil Conservation Service is a good source of information on soil types, characteristics, and geological formations of your area. Leaching of pesticides from treated areas, mixing and rinsing sites, waste disposal areas, and manufacturing facilities is a major ground-water concern.

Groundwater Protection. Most of man's activities change the quality of the underground water sources. Polluted water typically enters an aquifer in recharge water originating at the land's surface. Pollution can also be injected directly into an aquifer, for example, by back-siphoning directly into a well.

To minimize pesticide leaching to groundwater sources, consider the following steps:

- Read the label for any warnings.
- Evaluate the need, method, and frequency of pesticide use.
- Use alternative pest control methods whenever possible.
- Identify and know the vulnerability of the soil and leaching potential of the pesticide you are using.
- Consider the location of the pesticide application in relation to groundwater and surface water. Know the water table depth and the permeability of the geological layers between the surface and the groundwater. Be cautious around sinkholes or old wells because surface water easily reaches groundwater from these conduits.
- Reduce pesticide use and handling close to water wells. Groundwater contamination by pesticides or other pollutants can enter a well directly from the surface, through openings in or beneath a pump base, or through soil adjacent to the well. Well construction should be far from pollution sources. Avoid pesticide spills at all times and be especially careful in the vicinity of wells.
- Choose pesticides with the least potential for leaching into the groundwater. Look for characteristics which identify the pesticide as being insoluble, relatively instable, and readily adsorbed to soil.
- Follow directions on the label.
- Apply pesticides at the appropriate time.
- Measure the pesticide properly and carefully. Calibrate accurately and often. During calibration, check the equipment for leaks and malfunctions.
- Avoid spills and back-siphoning. The end of the fill hose should be held above the water level in the spray tank to prevent chemicals from back-siphoning into the water supply. Use an anti-backflow device (an air gap or check valve) when siphoning or pumping water directly from a well, pond, or stream. Some states require a mechanical anti-backflow device fitted on all filling equipment. Check the state regulatory section for details in your state.
- Accurately direct the application to the target site.
- Dispose of pesticides properly. Pesticides must be disposed of in accordance with local, state, and federal laws. Triple-rinse containers. Pour the rinsewater back into the spray tank to treat labeled sites or crops.
- Store pesticides properly in accordance with label directions. Pesticide storage facilities should be away from wells, cisterns, springs, and other water sources.
- Maintain records of pesticide use. Check with local and state regulations for record requirements.

- Comply with pesticide certification requirements.

Wildlife. Fish, birds, and mammals are assets to man and an essential part of the ecosystem. Parks, farmland, lawns, golf courses, etc., generally provide habitat for wildlife, as well as surrounding wooded areas and waterways. Therefore, care should be taken to protect these areas when applying any pesticide.

Wildlife and Endangered Species

Endangered Species. Certain plants and animals have been identified as endangered or threatened species. An endangered species is one on the brink of extinction throughout all or a significant portion of its range. A threatened species is one likely to become endangered. A major problem for most wildlife is the destruction of habitat, usually the result of industrial, agricultural, residential, or recreational development. If wildlife habitat is threatened or destroyed by incidental exposure to pesticides, the wildlife is in danger as well. Reproduction of fish and wildlife can be affected by sublethal doses of pesticides in diets. Since all living things are part of a complex, delicately balanced network, the removal of a single species can set off a harmful chain reaction affecting many others, thus recovery is difficult or perhaps even impossible. It has been estimated that a disappearing plant can affect up to thirty other species, including insects, higher animals, and even other plants that depend ultimately on that plant.

EPA has estimated that approximately 900 U.S. counties are known to contain endangered species. Pesticides can be harmless to wildlife when used carefully and on target. Every effort must be made to avoid causing harm to these important populations.

Honeybees. Honeybees help pollinate commercial crops and home gardens. The particular pesticide and the application method can reduce the chances of bee kills. Pesticides should not be applied to, or allowed to drift to crops in bloom. Shade trees and weeds should not be sprayed during bloom. Mow cover crops and weeds to remove the blooms prior to spraying. At the time of application, weeds in bloom also may attract bees to the area, increasing the chances of bee kills. Ideally, pesticides should be applied when there is no wind and bees are not "working" plants in the area. Damage can be minimized if the application is made late in the afternoon with a spray that breaks down within hours. In general, evening applications are the least harmful to bees.

Do not treat near hives. Bees may need to be moved or covered before applying pesticides near colonies. Do not let spray drip and form puddles or accumulate in wheel tracks. General area-wide application of pesticides may be harmful because bees cannot avoid contact with the spray on flowers or in water. Thus, the total wild bee loss may be sizable.

Check the product labels for specific bee hazards. Select the pesticide that is least harmful to foraging bees. Avoid using formulations that are harmful to bees. Dusts present more of a hazard to bees than sprays. Wettable powders are usually more hazardous to bees than either emulsifiable concentrates or water soluble formulations. However, microencapsulated insecticides are minute capsules that bees can carry back to the hive just like pollen. These capsules of poison are distributed throughout the hive affecting much of the colony. Ultra-low volume applications of some materials are sometimes more toxic than regular sprays. Granular formulations are generally the safest for bees. Some states have bee protection regulations in effect. Check with the state regulations section for details.

Food. With the help of pesticides more food per acre can be produced. Diseases, insects, and other plant pests can be greatly reduced. There can be higher yields and better crop quality. However, good farm land may become unfit for crops. Overdoses of pesticides, which remain for a long time in the soil, can ruin the land. The crop may absorb the pesticides from the soil and can be over tolerance level at harvest. The pesticide may kill all or most plant life and make the land useless for farm or recreational use. Applying too much pesticide increases the chance of illegal pesticide residue in crops and food, and could result in an unacceptable health risk to the consuming public. Finally, applying pesticides at higher than labelled rates is a violation of state and federal law.

Food and Pesticides

Food Chain. Wildlife has an important place in the food chain. The food chain characterizes how animals and plants are interdependent. Each animal has a place in the chain based on the type of food consumed. Animals that consume plants are near the bottom of the chain. Animals which eat these plant-eaters are on the next level. Carnivorous animals are at the top of the chain. Application of pesticides over broad areas may eliminate certain needed food sources. Elimination of food sources can cause wildlife to relocate to other areas, substitute other food sources, or die. Wildlife moving to another area can create additional competition for food and space with resident species. A predatory animal lacking prey may shift to a valued game species or even domestic livestock. Fish and wildlife can be exposed to pesticides by eating animals poisoned by pesticides or plants containing pesticides. Also, this pesticide transfer could occur with birds feeding on insects, earthworms, etc. In this complex food chain each animal has an important place.

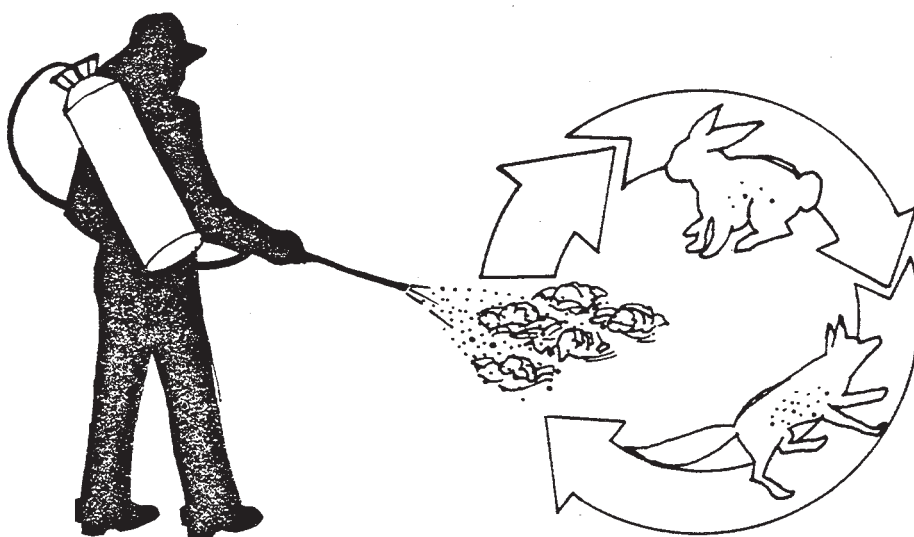
Accumulative Pesticides. Some pesticides can build up in the body of animals (including man). These pesticide accumulations can reach a level where health is affected. With a steady diet of plants or animals that are carrying pesticides, predators can accumulate these pesticides as well.

This is how pesticides slowly accumulate in the food chain. Since mankind is at the top of the food chain and meat consumption is fairly high, people could be carrying higher levels of pesticides than other animals.

Non-accumulative Pesticides. The pesticides that do not build up in the body of animals or in the food chain are non-accumulative. These pesticides break down rapidly into other relatively harmless materials. For example, organophosphate pesticides initially have high toxicity and pose hazards. Because they do not accumulate in most biological systems, they are generally not as dangerous to the environment as other chemicals. Usually pesticides that degrade quickly are less harmful to the environment.

Persistent Pesticides. Persistent pesticides remain in the environment without breaking down. Although they can be useful for long-term insect, disease, or weed control, sometimes they last in the environment indefinitely. Persistent pesticides do not necessarily accumulate in animal bodies or in the food chain, but they could injure or kill plants in the vicinity afterwards. Some pesticides persist in the soil but do not seem to build up in animals. For example, atrazine, a popularly used agricultural herbicide does not bioaccumulate, yet it is a persistent pesticide. The persistent nature of some pesticides is used to our advantage. Termiticides are used to protect wood in buildings from termite attack. They are both expensive and difficult to apply. It is therefore desirable for the termiticide to be persistent, protecting the building for a long time after only one application.

Pesticide Persistence



Microbial degradation. Some pesticides are destroyed in soils by microbial degradation. This occurs when microorganisms such as fungi and bacteria use a pesticide as food. Microbial degradation can be rapid and thorough under the proper soil conditions. Conditions that favor microbial growth include warm temperature, favorable pH levels, adequate soil moisture, aeration, and fertility. Adsorption also influences microbial degradation because adsorbed pesticides are less available to microorganisms, and they therefore degrade slowly. Certain pesticides require higher application rates to compensate for the pesticide lost through microbial degradation. In an extreme case of accelerated microbial degradation, pesticides that are normally effective for weeks suddenly become ineffective within days. In such a case, previous pesticide applications may have stimulated the buildup of certain microorganisms that were effective in rapidly degrading the pesticide.

Chemical degradation. Chemical degradation is the breakdown of a pesticide by processes not involving a living organism. The adsorption of pesticides to the soil, soil pH levels, soil temperature, and soil moisture contribute to the rate and type of chemical reactions that occur. Many pesticides, especially the organophosphate insecticides, are susceptible to degradation by hydrolysis in high pH soils or spray mixes. Because the products of chemical degradation are usually nontoxic or nonpesticidal, the amount of pesticide is reduced, as is the potency.

Photodegradation. Photodegradation is the breakdown of pesticides by sunlight. Pesticides applied to foliage, soil, or structures vary considerably in their stability when exposed to sunlight. Like other degradation processes, photodegradation reduces the amount of chemical present and lowers the level of pest control. Mechanical incorporation into the soil during or after application, or by irrigation water or rainfall following application, can reduce pesticide exposure to sunlight.

Do your part to aid the environment. Protect your surroundings by practicing proper pesticide use.

Questions for Self Study — Chapter VI

1. Can fish and other wildlife survive great changes in their natural environment?
2. When a pesticide evaporates and moves off target, what is this called?
3. Name four of the eight factors that influence drift.
4. What unique ability does air have which is the cause of pesticide drift?
5. Why should honey bees be protected?
6. How does the use of pesticides affect wildlife and recreational activities?
7. How do mammals, fish and birds accumulate high pesticide residue levels making their meat unfit for human consumption?
8. How do pesticides reach groundwater?
9. When does a pesticide become a pollutant and potentially dangerous?
10. How do pesticides reach streams and ponds to cause fish kills or make the water unfit?
11. How should pressure be changed to reduce liquid droplet drift?
12. What are two possible consequences of pesticide drift onto forage and pastureland or into drinking water?
13. Can pesticide pollution actually aid the pests you are trying to destroy? How?
14. What is an aquifer and why is it important?
15. What is the name given to the complex prey-predator relationship in which all animals (including man) take part?
16. The best protection against groundwater pollution is _____.
17. At what level is man in the food chain?

18. What is a nonaccumulative pesticide?
19. Explain the difference between accumulative and persistent pesticides?
20. Do persistent pesticides accumulate? Why?
21. Can persistent pesticides be relatively harmless to the environment? Why?
22. Briefly describe the water cycle.
23. What is an endangered species?
24. Name the three ways pesticides break down after application.
25. Why are organophosphates often low environmental dangers?
26. Pesticides that _____ (slowly or quickly) degrade in the environment are the least hazardous?

Safety Precautions

Chapter VII

You, an applicator working with toxic materials, are interested in safeguarding your health. You also want to protect other people and the environment from pesticide injury. Many pesticide accidents result from careless practices or ignorance. Learn safe procedures; it's for your own good!



Goals of This Chapter

- Learn proper safety precautions for before, during and after pesticide application.
- Understand the importance of cleanup measures.
- Understand the need for personal protective equipment.

Before Application

Before you decide to apply pesticides, always be sure that all factors are favorable for protecting you, others, and the environment. Do not consider applying pesticides if all the factors described in this chapter are not as they should be.

Many safety precautions should be taken *before* you actually begin applying pesticides. Too many pesticide applicators are dangerously and unnecessarily exposed to pesticides while they are preparing to spray. Most pesticide accidents can be prevented with informed and careful practices.

All pesticide users are strongly advised to keep thorough records for personal, crop, and economic protection. Regulations require specific records (see Chapter II), but beyond requirements they can be very helpful. Information on previous applications can prevent damage to sensitive crops, as well as prevent the presence of illegal residues. Consistent, yearly records will assist you in your pest control practices and guide you in future pest control programs.

Plan Ahead. Always read the label on the pesticide container before you begin to use it. Make sure that you understand everything you need to know about the pesticide ahead of time so that you are a responsible user. Carefully follow all the directions and precautionary advice on the label.

Be sure that you are prepared to deal with an emergency exposure or spill before you begin using pesticides. Be prepared for emergency exposures and know the first aid procedures for the pesticides you use. Always post emergency phone numbers. If you or any of your fellow workers feel sick, do not try to finish the job. Leave the treated area and seek help immediately. To prepare for accidental spills, have some kind of absorptive material available such as kitty litter, clay, activated charcoal, or sawdust to soak up spills or leaks. Hydrated lime should be available for decontamination of spill surfaces. Keep plenty of soap, detergent, and water — or anything else suggested on the label for emergencies or cleanup. In case a change of clothing is necessary, have extra clothes or a protective suit available.

Finally, you should have a good understanding of your legal responsibilities when you or your workers handle and apply pesticides. Do not guess about this or anything else about your work. If you have questions about pesticide safety, techniques involving pesticide use and

disposal, emergency situations, or your responsibilities under the law, call your state pesticide regulatory agency or your local Cooperative Extension agent before you use pesticides.

Move Pesticides Safely. Carelessness in transporting pesticides can result in broken containers, spills and contamination. Once pesticides are in your possession, you are responsible for safely transporting them. Accidents can occur even when transporting materials a short distance. If a pesticide accident occurs, you are responsible. Do all you can to prevent a transport problem, but be prepared in case an emergency should arise.

The safest way to carry 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 should occur. Never carry pesticides inside your car, van, or truck cab. Pesticides may cause injury or death if they spill on you or your passengers; hazardous fumes may be released. Spills on seat covers are very hard to remove, and may be a source of future contamination if they are not cleaned up properly. Never leave your vehicle unattended when transporting pesticides in an unlocked trunk compartment or open-bed truck. You, and not your company are legally responsible if curious children or careless adults are accidentally poisoned by unattended pesticides.

Children must never be allowed to ride on or near pesticides. Never transport groceries or livestock feed near pesticides. 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. Any spills in or from the vehicle must be immediately cleaned up, using correct procedures. If a spill is large, regulatory authorities must be notified.

Some pesticides are designated "hazardous substances" by the Department of Transportation (DOT). Certain guidelines apply to the transportation of pesticides that are on DOT's list of hazardous substances. For example, shipping papers must be carried in the truck cab if designated pesticides are moved on the highway. The truck may also be required to display a sign ("placard") which indicates that hazardous substances are being transported. The state DOT office should be contacted for detailed information on which pesticides are on the hazardous substance list, and what rules apply to them during transportation.

Personal Protective Equipment. The need for personal protective equipment depends mainly on the pesticide being handled. You may wear ordinary work clothes (long sleeve shirt and pants) while using pesticides of low toxicity (category III or lower toxicity levels), but it is a good idea to reserve one set of work clothes specifically for this purpose. More toxic chemicals (categories I and II) require coveralls worn over another layer of clothes, or chemical-resistant protective suits. In the Worker Protection Standards (WPS) for agricultural pesticides, the

EPA defines a material as “chemical resistant” if it shows no measurable movement of pesticide through the material during use.

Personal protective equipment requirements are printed on pesticide labels. These requirements are based on the toxicity, route of exposure, and formulation of that pesticide. When working with moderately (category II) or highly toxic (category I) pesticides, wear coveralls over another layer of clothes or a chemical-resistant protective suit, chemical-resistant gloves, and chemical-resistant footwear to prevent exposure of the skin to the pesticide. If the pesticide is an eye irritant, wear goggles, shielded safety glasses, or a face shield. If ordinary coveralls will wet through, use a chemical-resistant suit or apron. Synthetic rubber boots protect against liquid and dry formulations. Natural rubber boots are effective only for dry formulations.

The activity, the environment, and the handler also influence the choice of protective equipment. The activity-related factors are type of activity, duration, equipment, and deposition pattern of the pesticide onto the handler. Mixing/loading procedures often require extra precautions when the pesticide is in concentrated form, but a closed mixing/loading system can reduce this risk. Airblast application more often results in greater applicator exposure than in other application methods, so additional precautions are advisable. Activities that deposit pesticides on the head or scrotum require protective head- or body-gear because these body parts absorb pesticides at a much faster rate than other body parts.

Wind increases the risk of outdoor pesticide application. When exposed to downward drift, wear a wide brimmed, chemical-resistant hat that protects the face and back of the neck. Consider wearing a face mask, shielded safety glasses, or goggles. Be aware that extreme heat and humidity can cause heat stroke and exhaustion. Other environmental considerations are terrain, proximity to public places, and open versus closed spaces.

You, the pesticide applicator, make the final decisions in the selection, use, and care of personal protective equipment. No one protective garment offers universal protection. Each pesticide use demands individual choices of protective equipment. Carefully read the pesticide label for protective equipment requirements and take additional precautions as indicated by the activity, environment, and your own personal needs.

Mixing and Filling. Protective gear is especially important when you mix and load pesticides in their undiluted, concentrated forms. Studies show that you are at a greater risk of accidental poisoning when handling pesticide concentrates. Pouring pesticide concentrates from one container to another is the most hazardous activity. That is why it is important that you wear protective clothing and equipment before you handle pesticides.

Read and carefully follow the label directions each time you mix pesticides. Even if you have used a pesticide before, read the label again. Pesticide labels frequently change. Each new container may have important new label information that must be followed. Carefully choose the pesticide mixing and loading area. It should be outside or in a well ventilated area away from other people, livestock, pets, and food or feed. It is best to mix and load pesticides on a concrete pad where spills are easily cleaned up. Pesticides should not be mixed in areas where a spill or overflow could get into a water supply. Handling areas are frequently located near a pond or stream bank. In such a situation, grade the area to slope away from the water. If you or your workers must work indoors, or at night, work in a well-ventilated area with good lighting. If possible, do not work alone, especially when using highly toxic pesticides. It is a good idea for anyone handling extremely poisonous materials to talk to, or make eye contact with another person every two hours.

Measure pesticides carefully, making sure to mix them in the appropriate proportions. Different pesticides should not be mixed together unless a combination is called for on a label, and/or if an authority has been consulted. Remember, pesticides should be kept in their original containers so that the label directions and precautions are always with the toxic material. It is always a good idea to label all items that are used for handling pesticides (measuring utensils, protective equipment, etc.) to prevent their use for other purposes.

Plan your application so that you **mix and use only what is needed**. Do not use any more than the amount listed on the label. Using more product than the label recommends will not do a better job of controlling pests and is illegal. The overuse of pesticides may:

- raise the cost of pest control.
- increase the chance of illegal pesticide residues in treated foods.
- increase the possibility that pesticides may reach and contaminate groundwater.
- lead to pesticide resistance.

Open pesticide containers carefully to decrease the possibility of accidental splashes, spills, or drift. Do not tear paper containers open, use scissors for safe, spill free opening. Be sure to clean tools that are used for opening containers. To prevent contamination, always make sure opening tools are used only for pesticide-related work.

When pouring pesticides, always stand with your head well above the container and the filling hole of the spray tank, so that you and your clothing do not get splashed. Never use your mouth to siphon a pesticide from a container. While you should not be using pesticides when there is a strong wind, if there is any breeze, make sure that it is blowing away from you or from your right or left when you pour or mix these toxic materials.

Never leave a spray tank unattended while it is being filled, as it may overflow. Install anti-siphon devices on filler pipes and/or always maintain an air gap between the filler pipe and the tank. Close containers after each use to prevent spills. If a pesticide spills on the floor or ground, it should be cleaned up immediately. A pesticide spill can potentially cause great harm to others, as well as cause environmental contamination. Toxic quantities of some concentrated chemicals may remain in soil for many months or years.

Equipment. Carefully choose the most suitable equipment for applying your pesticides. Always use equipment correctly and take good care of it. Before you begin using your equipment, check it thoroughly to be absolutely sure that everything is working properly. Calibrate your equipment so that you apply the exact amount of pesticide necessary. Be sure there are no leaks in hoses, pumps, or tanks. Check for loose connections and worn spots in hoses that could leak or burst. One way to check for leaks is to operate the equipment at normal pressures with clean water before filling with pesticide mixture. If belts, pulleys, or drive chains are exposed, put guards around them so that you, children, or other people cannot be injured. The spray tank should have a tight lid so that neither you nor others will be splashed and spray materials will not leak onto the ground.

Prenotification. Before application, make sure that the treatment area is clear of all unprotected people. Many states require that all persons in the intended treatment areas, or even in adjacent areas, be informed about pesticide applications before the pesticides are applied. This warning is referred to as "prenotification". Prenotification of a pesticide application is intended to protect others from exposure to pesticides. Check with your state pesticide regulatory agency or your local Cooperative Extension agent for the prenotification procedures required by your state.

During Application



While you are applying pesticides there are many safety precautions to follow. You are responsible for the protection of not only yourself but other people, domestic animals, and the environment as well. You cannot afford to be careless!

Avoid Exposure. Even moderately toxic chemicals can be poisonous to you when they are used day after day. Pesticides can contaminate clothing and may soak through to your skin. Do not work in drift, spray, or runoff unless you are properly protected. If pesticides spill on your gloves, be careful not to wipe your hands on your clothing. Work in pairs when you are dealing with hazardous pesticides. Handlers of highly toxic pesticides should try to make visual or voice contact with another person every two hours. Carefully supervise your employees to make sure that all safety precautions are followed.

Never blow out clogged hoses or nozzles with your mouth. Use a nylon bristle brush for clearing out these equipment parts. Be sure that any tool that is used for this kind of job does not get used for anything else!

Wash your hands and face thoroughly after you use pesticides and before you do any other activity. Never eat, drink, or smoke when handling pesticides. Chemicals can get transferred from your hands to your mouth during smoking. Don't smoke in recently treated areas. Smoking with pesticide-soiled hands can also be extremely dangerous if flammable chemicals are being used.

Not all labels will state it, but you as a pesticide applicator are required by law to prevent direct or indirect exposure of workers and other persons. Keep children, unauthorized persons, and pets out of the area to be sprayed and at a safe distance from sprayers, dusters, filler tanks, storage areas, and/or old pesticide containers.

Avoid Sensitive Areas. Avoid spraying near houses, schools, playgrounds, hospitals, bee hives (apiaries), lakes, streams, pastures, or sensitive crops. If you must spray near sensitive areas, never spray or dust outside on windy days. Even with low winds, always apply downwind from any sensitive area. Plan your applications for times when people, animals, pets, and nontarget pests (such as honey bees) will not be exposed. Notify residents and beekeepers when you plan to spray in their areas and urge them to take appropriate precautions. Never spray directly into or across streams, ponds, or lakes without first checking with authorities regarding appropriate procedures or necessary permits. Completely cover or remove toys and pet dishes, as well as close all of the windows. Be sure that children and pets are not present in the area of the pesticide application. Avoid sensitive indoor areas such as infants' rooms, food preparation and storage areas, heating and air conditioning systems, and also be familiar with pet and fish tank locations.

Avoid Drift, Runoff, and Spills. Pesticides that fall anywhere but on the target area can injure people, crops, and the environment. Choose weather conditions, pesticides, application equipment, pressure, droplet size, formulations, and adjuvants that minimize drift and runoff hazard. Spills can be avoided by taking simple precautions.

Avoid Equipment Accidents. Properly maintained and carefully used equipment contribute to safe pesticide application. Poor maintenance and careless use of equipment add to the hazard posed by pesticides.

- Be sure to turn off your machinery before making any adjustments or repairs on it. If someone else is doing repair work on equipment that has not been cleaned, warn them of possible hazards.
- Do not allow children, pets, or unauthorized people near the pesticide equipment. If you are working some distance from your equipment or at the end of a long spray hose, have someone keep watch near the sprayer so that no one gets injured by the machinery.

- Between jobs, pressurized tanks or systems (i.e. hand held sprayers) should be depressurized. Turn off main pressure valve on bulk containers and release the pressure remaining in your application wand.
- Once the tank is empty, release the pressure from your application equipment. Be sure to close the outlet valves. Always return equipment to appropriate areas for cleaning and storage when pesticide applications are completed.

Safety and caution does not end with the application of the chemical. Proper cleanup and safety measures are still necessary. Complete one job entirely before going on to the next.

Storage and Disposal. Try to use all the pesticide in your tank. If you have some left at the end of the job, use the remainder on other target locations at the recommended dosage. Clean the equipment and put it away immediately after use to prevent accidents.

Do not leave pesticides or pesticide containers out in the field or at the application site. Be sure to account for every container used. Safely dispose of empty containers. Do not reuse pesticide containers for any purpose. NEVER give them to children for any use. Partially used pesticides should be stored in their tight original containers in a locked building. Keep children and uninformed people away from the storage area. (See Chapters XXI Disposal and XXII Storage.)

Clean Up. Mixing, loading, and application equipment must be cleaned as soon as you are finished using them. A question that is often asked by applicators: Is wash water from cleaning application equipment hazardous? EPA's response to this question is as follows:

John H. Skinner, Director, Office of Solid Waste, United States Environmental Protection Agency, in a letter dated July 22, 1985 states:

"Airplane washing rinsewater is not hazardous via mixture rule....The Agency does not believe that the pesticide residue left on the aircraft is a discarded commercial chemical product. The residue does not qualify as a material discarded or intended to be discarded."

"Consequently, we are withdrawing our previous interpretation that airplane washing rinsewater is a hazardous waste via the mixture rule."

Marcia E. Williams, Director, Office of Solid Waste, US EPA, in a letter dated May 30, 1986 states:

"Since the Agency sees no difference between washwaters from aerial versus ground application equipment, it is logical that the interpretation issued in July 1985 should also extend to the washwaters from ground equipment."

"Consequently, the rinsewater would not be considered a hazardous waste under the mixture rule and would only be considered hazardous if the rinsewater exhibited one of the characteristics of a hazardous waste identified in Subpart C of Part 261."



The preceding citation is from (Bert L. Bohmont, The Standard Pesticide User's Guide [Englewood Cliffs, NJ: Prentice Hall, Inc., 1990], 349).

Marcia William's letter refers to Subpart C of Part 261. This jargon refers to specific sections of the Code of Federal Regulations that describe hazardous wastes. These sections describe characteristics of ignitable, corrosive, reactive, or extraction procedure toxic wastes (Parts 261.21 - 261.24 of the Code of Federal Regulations). Check with your state pesticide regulatory agency for specifics on how pesticide wash or rinsewater must be handled in your state.

Cleaning should be done in a special area that has a wash rack or concrete apron with a sump for catching contaminated wash water. The best way to dispose of wash water containing a registered pesticide is to use it as directed on the label. Collect the contaminated water and use it to dilute the pesticide or a compatible pesticide if possible. **Waste from equipment cleanup must be kept out of water supplies and streams.**

It is extremely important for pesticide equipment to be properly cleaned between applications. Accidental injury or death of sensitive plants or animals may occur from applications that are made with slight residues of previously-used pesticides in equipment.

Be sure to clean the inside and outside of the equipment, including the nozzles. This job should only be done by trained persons who are wearing proper personal protective equipment. The outside of your equipment should be washed so that people touching it will not be exposed to pesticides. The inside must also be cleaned so that dangerous chemical mixing does not occur.

At the end of each day take a shower. Wash your body and scalp thoroughly with soap and water. Remember to scrub your nails. Place pesticide-soiled protective equipment in a designated place away from people, pets, and the family laundry. Launder washable clothing separately every day — this applies to regular work clothes worn under protective coveralls, as well as to garments directly exposed to pesticides. Disposable or limited-use garments should not be reused. Discard according to applicable federal, state, and local regulations. Ask your state regulatory agency for disposal recommendations.

Wash Pesticide-Soiled Clothing. Spray clothing should be changed and washed daily. The pesticides on your clothes could harm other people who touch them. Keep pesticide-soiled clothing away from the family laundry and warn the person who will be washing your spray clothes of possible dangers. The person doing the laundry should wear chemical-resistant gloves. Do not allow children to play in or near the contaminated clothing. Do not dry-clean pesticide-contaminated clothing. The recommended procedures for cleaning pesticide-soiled clothing for reuse are given on the following page:

- Air. Hang garments outdoors to air. Sunshine and ventilation aid in the breakdown of certain pesticides. Do not hang contaminated garments with uncontaminated garments. Do not hang contaminated garments close to residences or in areas frequented by people or pets.
- Prerinse. Use one of three methods: 1) hose off garments outdoors in an area away from people and pets, 2) rinse in separate tub or pail kept for that purpose, or 3) agitate in an automatic washer.
- Pretreat. Rub a heavy-duty liquid into the heavily soiled areas of the pesticide-contaminated garment.
- Washer load. Always wash garments separately from family wash. Pesticides can move from contaminated clothing to other clothing, to equipment, or to the unprotected hands of the person doing the laundry. Wash garments contaminated with the same pesticide together.
- Load size. Wash only a few garments at a time.
- Water level. Use full water level.
- Water temperature. Use hot water, 140°F or higher.
- Wash cycle. Use a normal 12-minute wash cycle.
- Laundry detergent. Use a built heavy-duty laundry detergent. Built detergents contain additional cleaning agents that control water hardness, increase and maintain alkalinity of wash water, react with oily soils, and suspend particulate soil. Built detergents are needed for pesticide-contaminated clothing because the pesticide is often mixed with other soils. Polyphosphates are the preferred builder because they clean well without forming a precipitate that adheres to the clothing. Where phosphates in detergents are prohibited, as in New York State, sodium carbonate, sodium aluminosilicate, and sodium nitrilotriacetate may be used as builders. Use the amount recommended on the package; use more for heavily soiled garments or hard water. Remember to dissolve powdered detergent before adding the clothing to the washing machine.
- Rinse. Use two full warm rinses.
- Rewash. Wash contaminated garments two or three times before reuse for more complete pesticide removal.
- Dry. Hang outdoors to avoid contaminating dryer and to encourage further dissipation of the chemical.
- Clean washer. Run a complete, but empty cycle. Use hot water and detergent.

Entering a Treated Area. Unprotected people should wait until the proper time to enter an area that has had a pesticide application. The entry restriction is the period of time that should pass between treatment and returning to a treatment area. Entry restrictions may be found on some pesticide labels. Restricted entry intervals (REI) are one type of entry restriction. Do not allow workers, children, or other persons to reenter the sprayed area until this time has passed. When no restricted entry times are stated on the label, use good judgement in allowing people to return to treated areas or structures. Always wait at least until sprays dry, dusts settle, and vapors disperse. If you must reenter an area early after spraying:

- Be sure to wear all the necessary personal protective equipment required on the label.
- Do not touch treated surfaces.
- Be sure to have decontamination water nearby and know how to use it.

Some highly toxic pesticides (organophosphates and carbamates) have legally specified entry restrictions of 24 or 48 hours. These time periods are listed on the pesticide labels. Some states have set even longer reentry times for some pesticides because of particular climatic conditions and other special hazards that exist in their areas.

Carelessness causes injury and death. Protect yourself, others, and the environment by using care and common sense. Learn safe procedures, it's for your own good!

Questions for Self Study — Chapter VII

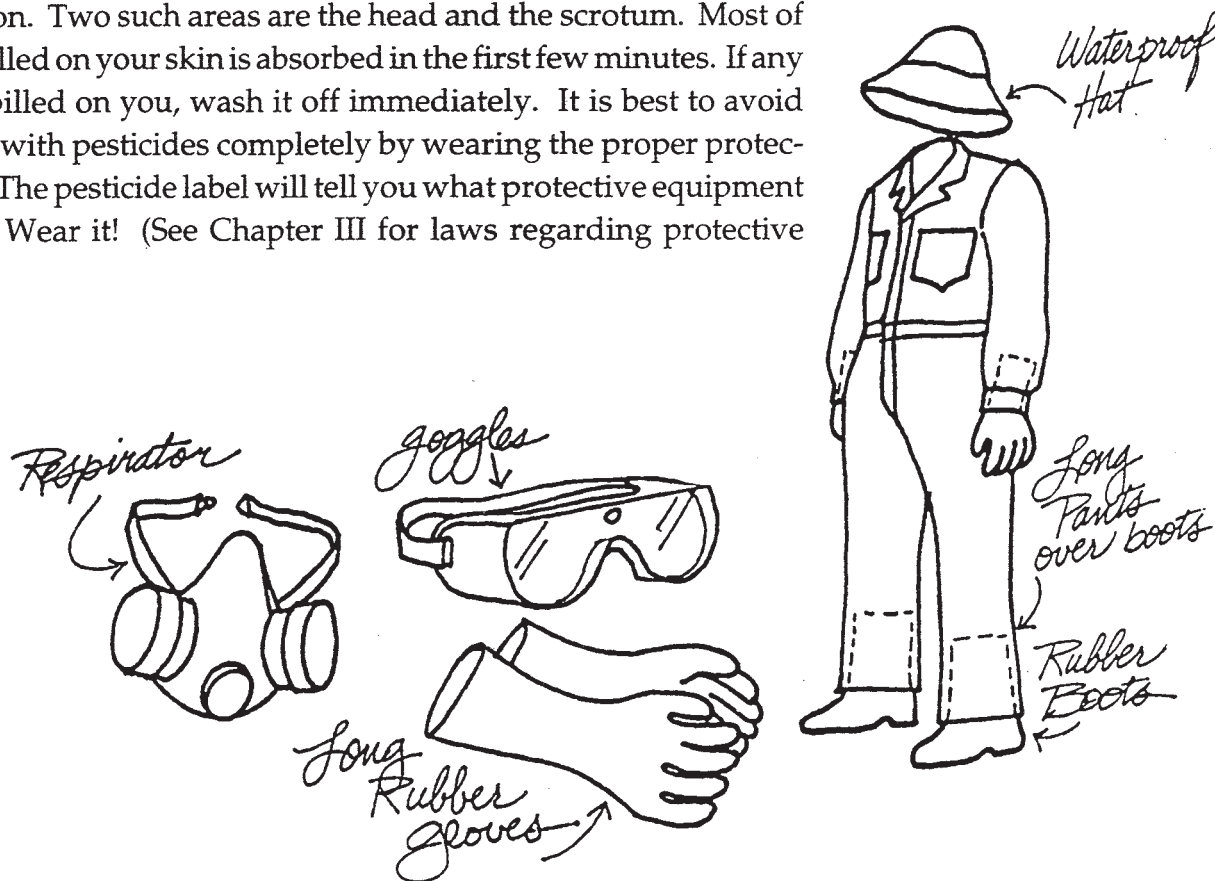
1. Give two reasons why pesticide accidents occur.
2. What should you consider before using pesticides?
3. How should you clean your washing machine after laundering pesticide-soiled clothing?
4. What are some of the problems which could be encountered by transporting pesticides: (a) inside a truck, (b) inside a truck with groceries, livestock feed, and children, or (c) in the back of a truck with groceries, livestock feed, and children?
5. In what kind of containers should pesticides be stored?
6. Why do you need to wear a wide brimmed, chemical-resistant waterproof hat and not a cap when you will be exposed to downward pesticide drift?
7. Why should all clean protective equipment and clothing not be kept with pesticides in a locked pesticide storage area?
8. When you are planning to work with pesticides, where should you look for information on the protective clothing that is necessary?
9. What material should gloves and boots worn during pesticide handling be made out of?
10. Do you need to wear protective clothing while mixing and filling, or just when you will be exposed to downward drift?
11. How should you stand when you are filling a spray tank?
12. Why is it dangerous if a spilled pesticide concentrate is not cleaned up immediately?
13. What should you do if a nozzle gets clogged up while you are spraying pesticides?
14. Name five ways of avoiding exposure while applying pesticides.
15. If you or your partner feel sick on the job should you leave the work half done or try to "finish-up"?

16. If the pesticide is not too toxic, is it OK to let children and pets play in the area while you are spraying there?
17. When you are spraying near houses, playgrounds, and bee colonies is it up to the owners to keep out of your way or remove the bees, or should you warn them and then take every precaution?
18. Name three ways to cut down accidents commonly caused by equipment.
19. What procedures should be followed after a job is finished?
20. Explain what "reentry" means. How do you find out a reentry interval for the pesticide(s) that you are using?
21. What can you do for an accidental spill of a pesticide?

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.

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-

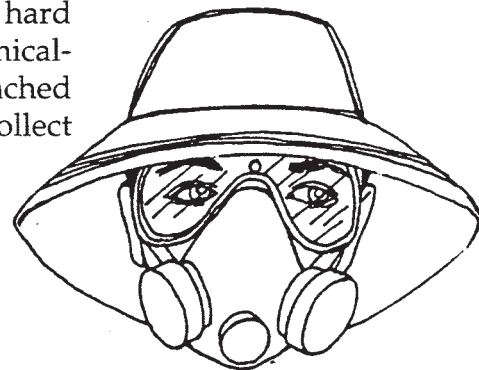
ers or layered socks.) Remember to put your pant legs outside the boots, otherwise the pesticide can drain into the boot. Wash boots after each use and dry thoroughly inside and out to remove all pesticide residue. Use them only for pesticide applications. It is wise to keep two pair of boots on hand 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.

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.

Goggles or Face Shield

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.

Head and Neck Coverings



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.

Respirators

Air-Purifying Respirators

Air-purifying respirators remove contaminants from air by filtering the air. In the majority of situations where a pesticide applicator will need a respirator, an air-purifying respirator will provide adequate protection. These respirators will not protect the applicator from all airborne pesticides, such as fumigants, and are not to be used when the oxygen supply is low. The pesticide label will specify which type of respirator must be worn. Air-purifying respirators can be categorized into four styles; cup-shaped filters, full or half-face facepiece style with cartridges, full or half-face facepiece style with a canister and the powered air-purifying respirator.

The dust/mist-filtering respirator must be worn when the pesticide label requires one and when the risk of inhaling pesticide dusts, powders, mists, aerosols, or sprays is present. The cup-style dust/mist-filtering respirators are usually made of stiff fabric that is shaped like a cup. It is worn on the face and covers the nose and mouth and filters out dusts, mists, powders, and particles. Pesticide handlers must wear cup-style or cartridge-style dust/mist-filtering respirators with a NIOSH/MSHA approval number prefix TC-21C.

A respirator that also removes vapors must be worn if the pesticide label requires it and when there is a risk of inhaling gases or vapors. Respirators with full or half-face facepiece and have one or more cartridges that contain air-purifying materials can meet this requirement. This facepiece style also comes with a large canister that contains more air-purifying materials than a cartridge does. This style must seal tightly against the face. A fit test is necessary before using a cartridge or canister respirator for the first time. Wear cartridge respirators approved for organic vapor removal plus a prefilter approved for pesticides with NIOSH/MSHA approval number TC-23C or a canister respirator approved for pesticides with NIOSH/MSHA approval number prefix 14G.

Powered air-purifying respirators (PAPRs) force air through air-purifying material (cartridge or canister) to assist the wearer in obtaining clean filtered air. These are positive pressure respirators and are good for users with respiratory problems or with facial hair that may prevent a tight seal with full or half-face respirators. Powered air-purifying respirators purify contaminated air and do not provide oxygen or supply air from an outside source.

The filters may need to be replaced two or more times each day. The filters and prefilters should be replaced when:

- The filter element is damaged or torn.
- When the respirator manufacture or the pesticide label requires it. If their recommendations are different, use the most frequent interval recommended.
- The end of each day's work period, if no other instructions are available.

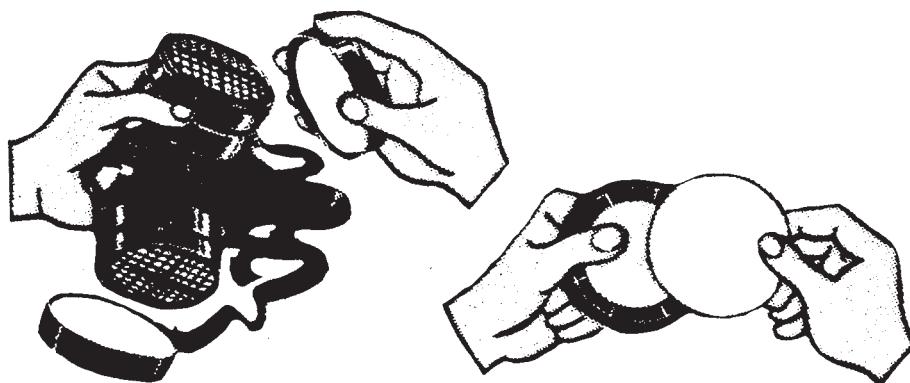
Air-Supplying Respirators

Air-supplying respirators are used in situations where the other types of respirators will not provide enough protection. They are also used when the oxygen supply is low and when the pesticide label requires one. Supplied-air respirators supply clean air through a hose directly to the face mask. The working distance is thus limited to the length of the hose. Wear supplied-air respirators with a NIOSH/MSHA approval number prefix TC-19C. A self-contained breathing apparatus (SCBA) supplies clean air from cylinders that are carried. They allow more freedom of movement and require specialized training for their proper use. The air supply is limited to between 30 and 60 minutes. Wear SCBA with a NIOSH/MSHA approval number prefix TC-13F.

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 facepieces 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.

Use the Respirators Correctly



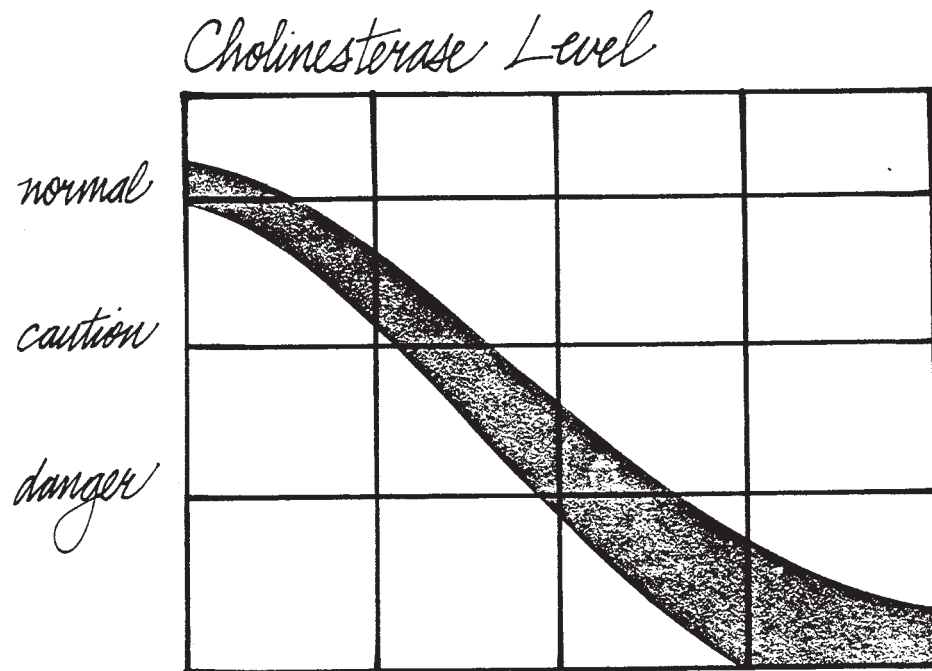
- After each use, wash the face piece with detergent and warm water. Rinse thoroughly and wipe dry with a **clean** cloth. Store the respirator, filters, and cartridges in a clean, dry place away from pesticides. A tightly closed plastic bag works well for storage.

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.

Cholinesterase Tests

Consider getting your blood tested to find your normal or base level of a natural chemical called cholinesterase. This chemical is necessary for your nervous system and without it you will die. Both carbamate and organophosphate pesticides attack this chemical in your blood and make it useless. Once your base level of cholinesterase has been determined, a simple blood test will show if you still have the normal amount. If you



INCREASING EXPOSURE WITHOUT PROPER PROTECTION

do not, you have been overexposed to either an organophosphate or carbamate pesticide. You should avoid further contact with these pesticides until your cholinesterase level has returned to normal. In severe cases antidotes must be given. Follow your doctor's directions. Any applicator working with highly toxic chemicals should have his cholinesterase level tested at regular intervals throughout the spray season. (Cholinesterase tests are not useful for n-methyl carbamate pesticides.)

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.

Entry Restrictions

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 CFR 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

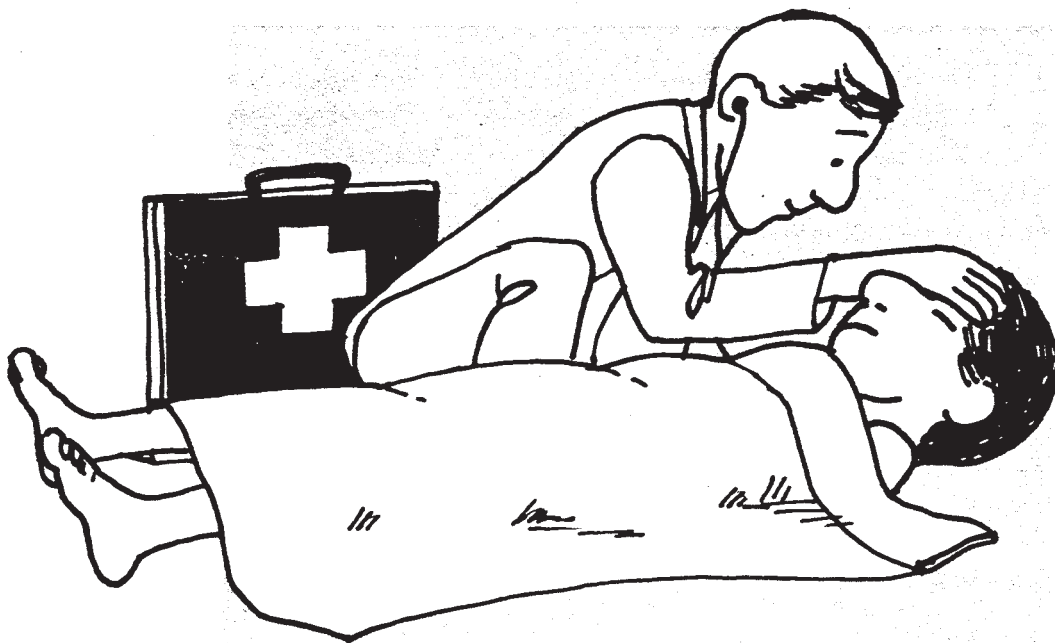
1. What is the most common cause of pesticide poisoning for applicators?
2. When should you wear elbow length chemical-resistant gloves?
3. Why not use cotton or leather gloves when handling highly toxic pesticides?
4. Must you always wear a chemical-resistant suit when handling highly toxic chemicals?
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?
14. When are cartridge respirators often used?
15. What is the main drawback of cartridge respirators?
16. Should you try to fit the respirator so that some air can leak in around your face?
17. When should you replace the filter on your respirator?
18. How often should the cartridges on your respirator be changed?
19. How should you safely clean and store a respirator?

20. Is it safe to work alone when you are handling highly toxic pesticides?
21. If you are careful, is it all right to snack or chew tobacco while you are on the job?
22. Should you wear your pesticide soaked clothing again as soon as it dries and only launder it once or twice a week?
23. Cholinesterase tests show whether you have been overexposed to _____ or _____ pesticides.
24. Why should you wash your hands **before** removing your gloves?
25. Does natural rubber protect against liquid pesticides?

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.

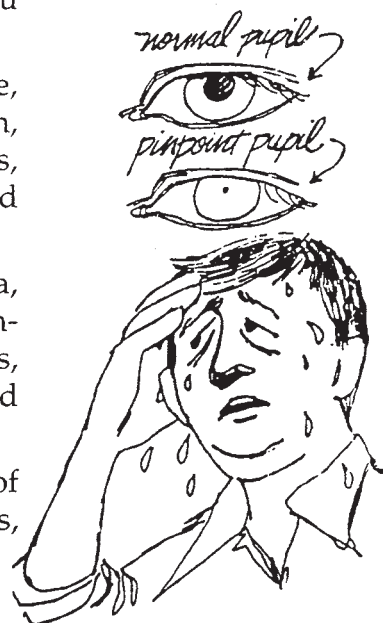
Unfortunately, all pesticide poisoning symptoms are not the same. Each chemical family (i.e., organophosphates, carbamates, chlorinated hydrocarbons) can attack the human body in a different way. However, you should be aware of the general symptoms of pesticide poisoning.

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.

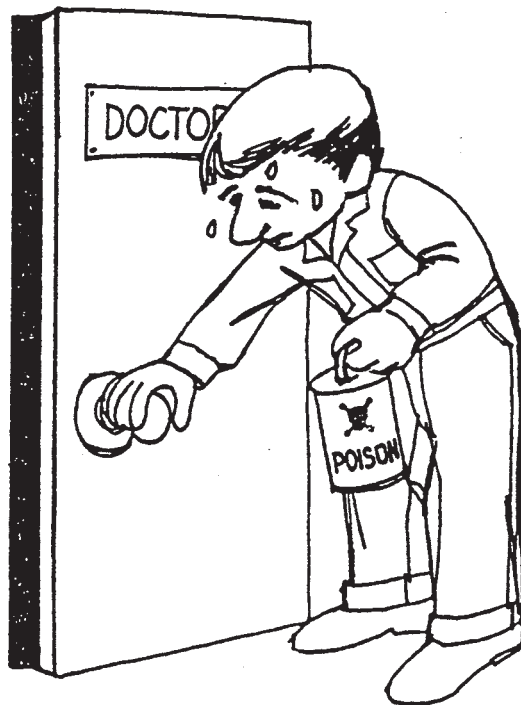
General Symptoms



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.

Chemical Families

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



Effects of Pesticide Chemicals on the Human Body

Chemical Family	Type of Pesticide	Action on Human System	Symptoms Internal Exposure	Symptoms External Exposure	Symptoms Chronic Exposure
1. Organo-phosphates <i>diazinon</i> ^C <i>Spectracide</i> ^T	Insecticides, acaricides	Inhibits acetylcholinesterase (an enzyme) in the tissues	Headache, dizziness, weakness, shaking, nausea, stomach cramps, diarrhea, sweating	Minimal rashes but readily absorbed through the skin	Loss of appetite, weakness, weight loss, and general feeling of sickness
2. Carbamates <i>carbaryl</i> ^C <i>Sevin</i> ^T	Insecticides acaricides	Reversible changes in acetylcholinesterase enzyme of tissues	Headache, dizziness, weakness, shaking, nausea, stomach cramps, diarrhea, sweating	Minimal rashes but readily absorbed through the skin	Loss of appetite, weakness, weight loss, and general feeling of sickness
3. Organo-chlorines (Chlorinated Hydrocarbons) <i>methoxychlor</i> ^C <i>Marlate</i> ^T	Insecticides, acaricides (HCB is a fungicide)	Disrupt function of nervous system, mainly the brain	Headache, dizziness, weakness, shaking, nausea, excitability, disorientation	Minimal rashes but readily absorbed through the skin	Some buildup in the fat tissues. May cause nervousness, weakness, and shaking
4. Pentachlorophenol <i>penta</i> ^C <i>Pentacron</i> ^T	Herbicides, defoliants, molluscicides, germicides, fungicides, and wood preservatives	Toxic to liver, kidneys, and nervous system	Headache, weakness, nausea, excessive sweating	Highly irritating to skin, eyes, nose, and throat	Weight loss, weakness, anemia
5. Chlorophenoxy Pesticides <i>2,4-D</i> ^C <i>Weed-B-Gon</i> ^T	Herbicides	Irritant to lung, stomach and intestinal linings. Injure liver, kidney, and nervous system	Prompt vomiting, burning sensation in stomach, diarrhea, muscle twitching	Moderately irritating to eyes, skin, and lungs	Do not remain in body; passed out within hours or days
6. Paraquat and Diquat	Herbicides	Injure skin, nails, cornea, liver, kidney, linings of stomach and intestine, and respiratory system	Burning pain, nausea, vomiting, and diarrhea	Irritates and injures skin and nails	
7. Thiocarbamates and Dithiocarbamates <i>Zineb</i> ^T	Fungicides	Low human toxicity	Nausea, vomiting, diarrhea, weakness, and nasal stuffiness	Irritating to skin, eyes, nose, and throat	
8. Pyrethrins and Pyrethroids <i>Prentox</i> ^T , <i>Ectiban</i> ^T		Very low human toxicity	Slight toxic reaction		

Chemical Family	Type of Pesticide	Action on Human System	Symptoms Internal Exposure	Symptoms External Exposure	Symptoms Chronic Exposure
9. Arsenical Pesticides	Rodenticides, insecticides, acaricides, marine anti-fouling compounds, desiccants, herbicides, fungicides	Toxic to liver, kidney, brain, bone marrow, and nervous system	Headache, burning stomach pain, vomiting, diarrhea, dizziness. Garlic odor on breath and feces	Swelling of mouth and throat, irritating to nose, throat, and eyes	Accumulates in body. Chronic headaches, dizziness, stomach-aches, salivation, low fever, garlic breath
10. Coumarins, Indandiones, and other Anti-coagulants <i>warfarin</i> ^c		Prevents blood from clotting	Usually no reaction if low accidental dose ingested	Minimal	
11. Sodium Fluoroacetate <i>Compound 1080</i> ^T	Rodenticides	Extremely toxic. Affects heart tissue and brain	Stomach pain, vomiting, hallucination, nervousness	Minimal	
12. Zinc Phosphide <i>Phosdrin</i> ^T	Rodenticides	Highly toxic; severe intestinal irritation; severe injury to liver, kidneys, nervous system and heart	Intense nausea stomach pain, excitement, chills, cough	Minimal	
13. Yellow phosphorus	Rodenticides	Highly toxic; blood system injury; injury to liver, nervous system, heart, and kidneys	Breath has garlic odor; feces may glow and smoke from phosphorus fumes; vomiting and diarrhea; burning pain in throat, stomach, and intestines	Dermal exposure usually low; irritates nose and throat	
14. Strychnine and Crimidine	Rodenticides	Acts directly on cells in the brain and spinal cord to cause convulsions	Blue skin color; violent convulsions	Minimal	
15. Red Squill <i>Dethdiet</i> ^T	Rodenticides	Low toxicity	Prompt vomiting and nausea	Minimal	Excreted rapidly; not retained in body
16. ANTU and Norbormide	Rodenticides	Selectively toxic to rats; toxic to humans only in huge suicidal doses	Blue skin, labored breathing	Minimal	

Chemical Family	Type of Pesticide	Action on Human System	Symptoms Internal Exposure	Symptoms External Exposure	Symptoms Chronic Exposure
17. Sulfur Dioxide, Formaldehyde, Chloropicrin, and Acrolein	Fumigants	Strong irritant of lungs and throat	Headache, dizziness, nausea, wheezing, cough	Severe irritation of eyes, nose, and throat. Blisters on skin	
18. Methyl Bromide, Ethylene Oxide and Propylene Oxide	Fumigants	Serious injury to lungs; injures nervous system	Coughing of frothy fluid; severe shortness of breath, drowsiness, shaking, weakness	Irritates eyes, nose, and throat	Lack of coordination
19. Halo-carbons <i>ethylene dibromide</i> ^C	Fumigants	Injures heart muscles; also injures lungs, brain, liver and kidneys	Shock, drowsiness, shaking weakness	Irritates eyes, nose, throat. Blisters and redness on the skin	Liver damage, weight loss, and jaundice
20. Carbon disulfide	Fumigants	Injury to nervous system	Headache, dizziness, nausea, and disorientation	Irritates eyes, nose, and throat. Blisters and redness on skin	Pain, tingling and weakness of arms and legs; loss of mental functions
21. Phosphine	Fumigants	Injures lungs, liver, kidneys, and nervous system	Weakness, shaking, vomiting, cough, difficulty in breathing, intense thirst	Irritates eyes, nose, and throat	Pain in eyes and nose; nosebleeds; abdominal pain
22. Metal Phosphides <i>aluminum phosphide</i> ^C <i>Phostoxin</i> ^T	Fumigants	Injures lungs, liver, kidneys, heart and nervous system	Nausea and vomiting followed by weakness, shaking, and dizziness	Irritants	
23. Sulfuryl Flouride <i>Vikane</i> ^T	Fumigants	Injures lungs and kidneys	Muscle twitching, convulsions	Irritant	Injury to kidneys and lungs
24. Hydrogen Cyanide, Acrylonitrile, and Sodium Cyanide	Fumigants, rodenticides	Injury to brain and heart tissues	Headache, nausea, dizziness, constriction of throat, drowsiness, nervousness. Sudden unconsciousness	Irritant	
25. 4-Amino pyridine <i>Avitrol</i> ^T	Avicides	Disrupts nervous system functions	Thirst, nausea, dizziness, weakness, excessive sweating		

Chemical Family	Type of Pesticide	Action on Human System	Symptoms Internal Exposure	Symptoms External Exposure	Symptoms Chronic Exposure
26. Chlordi-meform <i>acaron</i> ^C	Insecticides, miticides	Bladder injury	Abdominal and back pain; painful urination; blood in urine	Skin rash; sweet taste in mouth	
27. Copper salts and Organic Complexes <i>copper sulfate</i> ^C	Fungicides	Injures intestinal lining, brain, liver, kidneys, and blood	Prompt vomiting; burning pain in chest; diarrhea, headache, sweating	Irritates skin and eyes; damages mucous membranes	
28. Cycloheximide <i>Acti-dione</i> ^T	Fungicides	Irritates stomach and intestine; injury to kidneys, brain lining, and nervous system	Excitement, tremors, salivation, diarrhea	Minimal	
29. Endothall	Herbicides, algicides	Damages heart, blood vessels, nervous system, and intestinal lining.	Convulsions, shock, lack of coordination	Irritating to eyes, skin, and mucous membranes	
30. Nicotine Sulfate <i>Black Leaf 40</i> ^T	Insecticides	Injures nervous system	Nausea, headache, diarrhea, dizziness, shaking, abdominal pain, lack of coordination, sweating, salivation.	Minimal but readily absorbed through the skin	
31. Phenylmercuric Salts <i>phenylmercury acetate</i> ^C <i>Agrosan</i> ^T	Fungicides	Injures nervous system and kidneys	Delirium, muscle weakness, lack of coordination	Minimal	Weakness and lack of coordination in arms and legs; difficulty in talking and swallowing
32. Sodium Chlorate <i>Atritol</i> ^T	Herbicides, defoliants	Injury to intestinal lining, nervous system, and kidneys	Swelling of mouth and throat; pain in esophagus, stomach, and intestines; restlessness	Irritant	
33. Acetamides <i>butachlor</i> ^C <i>Machete</i> ^T	Herbicides	Irritants		Moderately irritating to skin and eyes	
34. Acetanilides <i>alachlor</i> ^C <i>Lasso</i> ^T	Herbicides	Irritant		Mild irritants; propachlor is a skin irritant and sensitizer	

Chemical Family	Type of Pesticide	Action on Human System	Symptoms Internal Exposure	Symptoms External Exposure	Symptoms Chronic Exposure
35. Alumino Flouride Salt <i>cryolite</i> ^C <i>Kryocide</i> ^T	Insecticide	Irritant		Slight irritant of eyes, nose, and skin	
36. Bensoic and Benzilic Derivatives <i>chloramben</i> ^C <i>Amiben</i> ^T	Insecticides, herbicides	Irritant		Irritating to skin and respiratory tract	
37. Benzonitriles <i>bromoxynil</i> ^C <i>Buctril</i> ^T	Fungicides, Herbicides	Irritant	Moderately irritating to lungs	Moderately irritating to skin	
38. Dithiocarbamates <i>mancozeb</i> ^C <i>Dithane M-45</i> ^T	Herbicides, fungicides	Do not inhibit cholinesterase; mild irritants.		Mild irritant to skin, eyes, nose, and throat	
39. Carbanilate <i>propham</i> ^C <i>Chem-Hoe</i> ^T	Herbicides	Irritant		Irritant and skin sensitizer	
40. Dicarboximides <i>captan</i> ^C	Fungicides	Irritant		Skin irritant	
41. Dinitroaniline Compounds <i>trifluralin</i> ^C <i>Treflan</i> ^T	Herbicides	Irritant		Slightly to moderately irritating to skin, eyes, nose, and throat	
42. Oxadiazola <i>oxadiazon</i> ^C <i>Ronstar</i> ^T	Herbicides	Irritant		Irritating to skin and eyes	
43. Picolinic Acid <i>triclopyr</i> ^C <i>Garlon</i> ^T	Herbicides	Irritant	Irritates lungs	Irritating to skin, eyes, nose, and throat	

Chemical Family	Type of Pesticide	Action on Human System	Symptoms Internal Exposure	Symptoms External Exposure	Symptoms Chronic Exposure
44. Pyridazinone <i>maleic hydrazide</i> ^C <i>Retard</i> ^T	Growth retardant	Irritant		Slightly irritating.	
45. Phosphonomethyl Glycine <i>glyphosate</i> ^C <i>Roundup</i> ^T	Herbicides	Irritant	Irritates lungs	Irritates eyes	
46. Thiadiazin(ol) <i>betazon</i> ^C <i>Basagran</i> ^T	Herbicides, fungicides	Irritant	Vomiting, diarrhea, shaking, and weakness caused by bentazon herbicides	Moderately irritating to skin, eyes, nose, and throat	
47. Triazines <i>atrazine</i> ^C <i>AAtrex</i> ^T	Herbicides	Irritant		Mildly irritating to skin, eyes, nose, and throat	
48. Uracils <i>bromacil</i> ^C <i>Hyvar</i> ^T	Herbicides	Irritant	Irritating to lungs	Irritating to skin, eyes, nose, and throat	
49. Urea Derivatives <i>diuron</i> ^C <i>Karmex</i> ^T	Herbicides, insecticides	Irritant		Moderately irritating to skin, eyes, nose, and throat	

C = Common name

T = Trade name

Table modified based on similar table in "Applying Pesticides Correctly", USDA, USEPA, written by Sally McDonald.

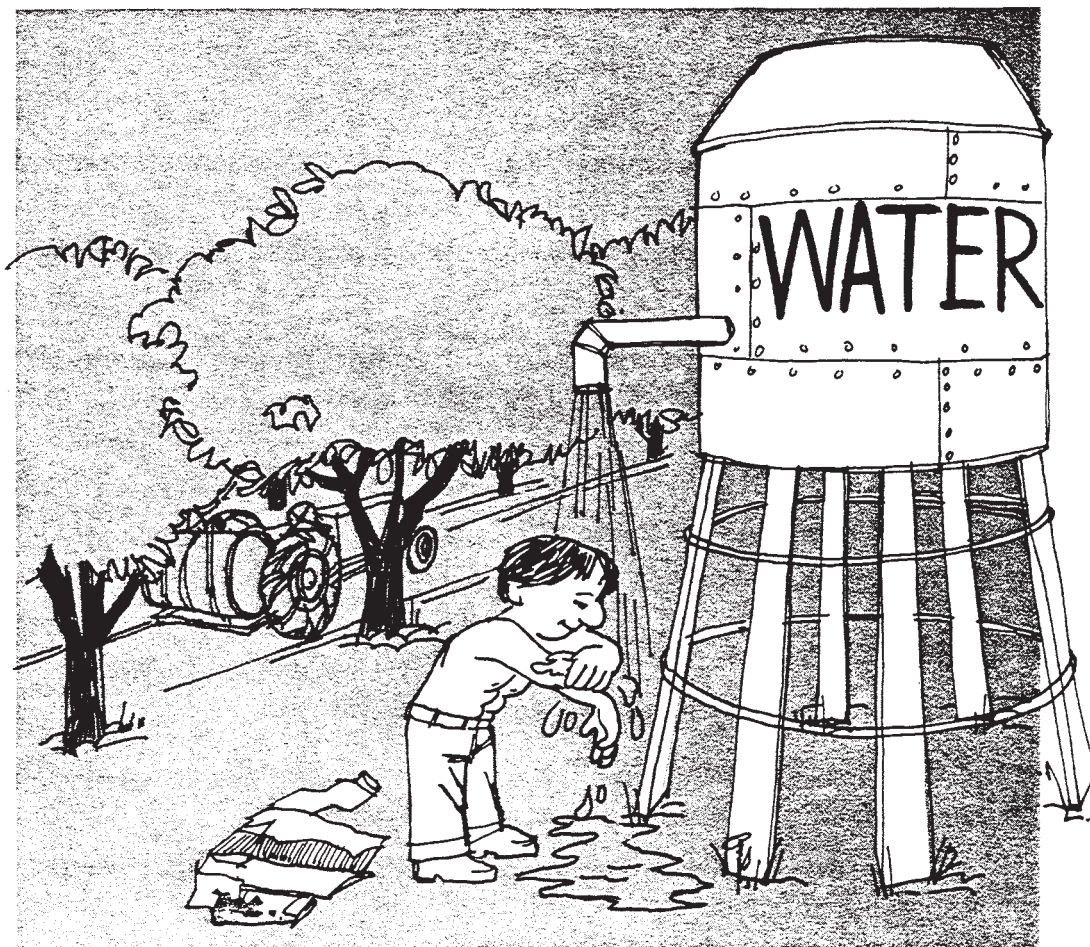
Questions for Self Study — Chapter IX

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?
8. What are the three major chemical families? Give examples of pesticides found in each family.

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.

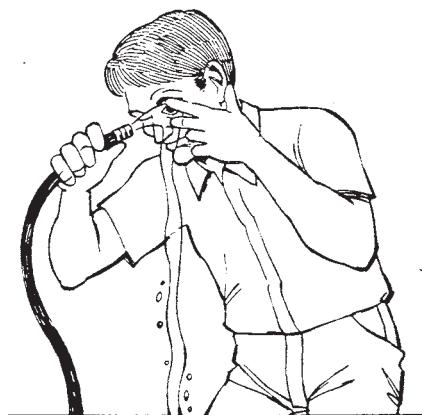
WARNING: Do not allow any pesticide to get on you while you are helping the victim.

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.



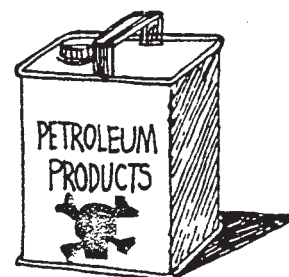
Inhaled Poisons (dusts, vapors, gases)

- 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.

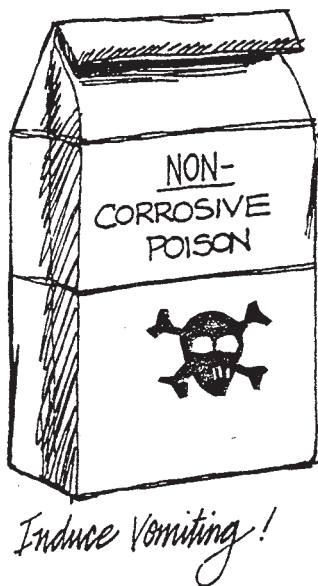
Swallowed Poisons—When should you make the victim vomit?

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



Do NOT induce vomiting!



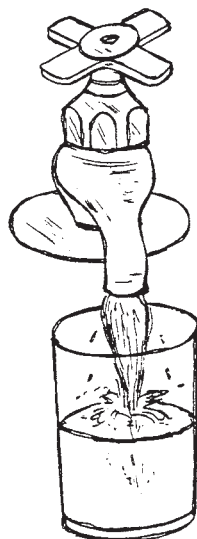
poison will burn the throat and mouth as severely coming up as it did going down. Dilute the poison as quickly as possible. For acids or alkalis, use milk or water. For patients one to five years old, use one to two cups; for patients five years and older, use up to one quart. For acids, milk of magnesia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

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.

Shock

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.

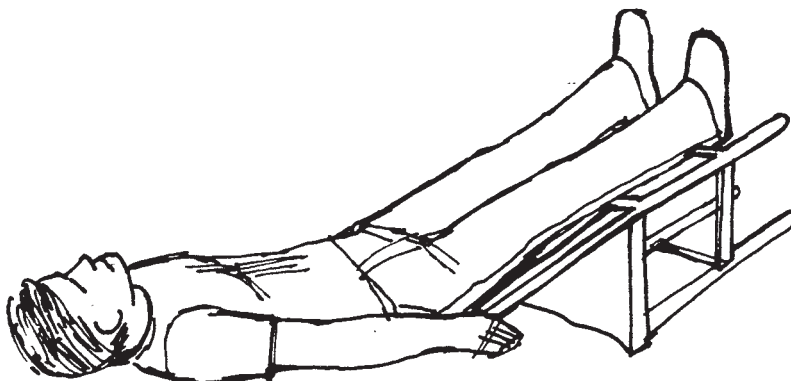
- Unless he is vomiting, keep the victim flat on his back with his legs up 1-1 1/2 feet above his head.
- Keep the victim warm enough to prevent shivering. Do not overheat.
- Keep the victim quiet and reassure him often.

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.

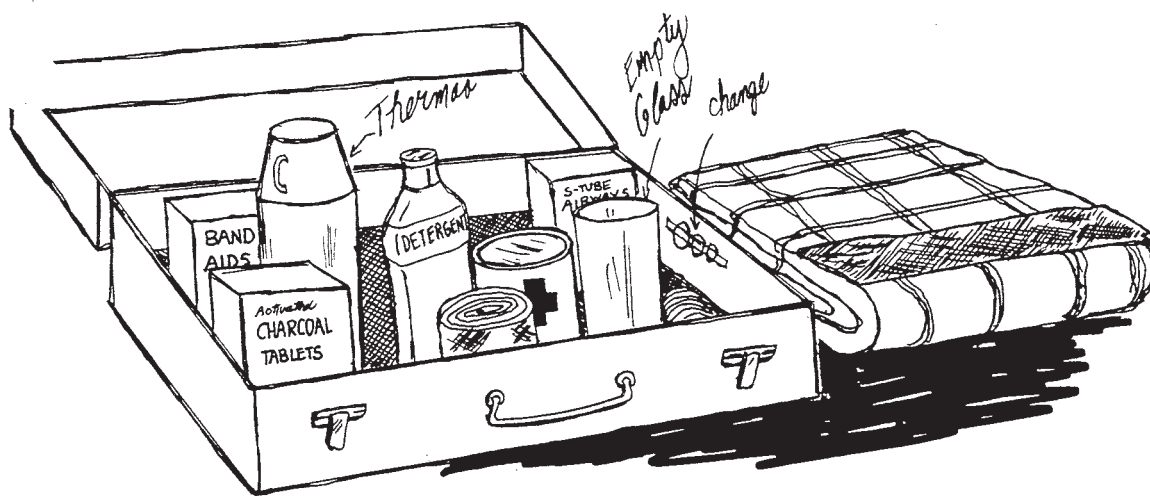


First Aid Kit for Field and On-the-Job Use

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.

For Your Physician's Use if Needed

Antidotes such as those described below should be prescribed or given only by a qualified physician. They can be very dangerous if misused.

Group I—Organophosphates

Azodrin, Bidrin, Bomyl, Carbophenothion (Trithion), Co-Ral, Dasanit, DDVP (Vapona), demeton (Systox), Diazinon, dimethoate (Cygon), dioxathion (Delnav), Di-Syston, Dursban, Dyfonate, EPN, ethion, famphur (Warbex), fenthion (Baytex), Guthion, Metasystox-R, Methyl parathion, Monitor, parathion, phorate (Thimet), Phosdrin, phosphamidon, Schradan (OMPA), Supracide, TEPP.

Antidotes:

1. **Atropine Sulfate** is used to counteract the effects of cholinesterase inhibitors. Injections should be repeated as symptoms recur.
2. **Protopam Chloride (2-PAM)** should also be injected to counteract organophosphate poisonings. It is given intravenously.

Do Not Use morphine, theophyllin, aminophyllin or barbituates.

Group II—Carbamates

Carzol SP, mexacarbate (Zectran), aldicarb (Temik), carbofuran (Furadan), methomyl (Lannate), carbaryl (Sevin).

Antidotes:

1. **Atropine Sulfate** is used to counteract the effects of cholinesterase inhibitors. Injections should be repeated as symptoms recur.
2. **Do Not Use Protopam Chloride (2-PAM).**

Medical Antidotes for Pesticide Poisoning

Medical Antidotes for Pesticide Poisoning

(continued)

Group III—Chlorinated Hydrocarbons
endrin, dieldrin, aldrin, lindane, endosulfan (Thiodan).

Antidotes:

1. **Barbiturates** for convulsions or restlessness.
2. **Calcium Gluconate** given intravenously.
3. **Do Not Use epinephrine (adrenalin).**

Group IV—Inorganic Arsenicals
sodium arsenite, Paris green.

Antidotes:

1. **BAL (dimercaprol)** is specific for arsenic poison. Inject intramuscularly.

Group V—Cyanides
For Poisons Such As: hydrogen cyanide, Cyanogas.

Antidotes:

1. **Amyl Nitrite** through inhalation.
2. **Sodium Nitrite** given intravenously.
3. **Sodium Thiosulfate** given intravenously.

Group VI—Anticoagulants
For Poisons Such As: warfarin, Fumarin, Pival, PMP (Valone), diphacinone (Diphacin).

Antidotes:

1. **Vitamin K** orally, intramuscularly, or intravenously.
2. **Vitamin C** useful adjunct.

Group VII—Fluoroacetates
For Poisons Such As: sodium fluoroacetate (1080).

Antidotes:

1. **Monacetin (glycol monoacetate)** intramuscularly.

Group VIII—Dinitrophenols

For poisons such as: DNOC, DNOCHP.

1. **Do Not Use atropine sulfate.**
2. Maintain life supports.
3. **Sodium Methyl Thiouracil** may be used to reduce basal metabolic rate.

Group IX—Bromides and Carboxides

For poisons such as: methyl bromide, Carboxide, ethylene dibromide.

Antidotes:

1. **BAL (dimercaprol)** may be given before symptoms appear.
2. **Barbiturates** for convulsions.

Group X—Chlorophenoxy Herbicides, Ureas, Miscellaneous

For Poisons Such As: 2,4-D, 2,4,5-T, monuron (Telvar), diuron (Karmex), Hyvar-X, endothall, Diquat, Paraquat.

Antidotes:

1. None.
2. Maintain life supports.

Medical Antidotes for Pesticide Poisoning (continued)

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!

A Checklist for Preventing Pesticide Accidents

Yes	No	Store Your Pesticides Safely
<input type="checkbox"/>	<input type="checkbox"/>	Do you have a separate space to store pesticides?
<input type="checkbox"/>	<input type="checkbox"/>	Do you keep it locked and are the windows tight, barred or boarded over?
<input type="checkbox"/>	<input type="checkbox"/>	Do you keep all your pesticides in this storage rather than in the garage, feed room, basement, porch, kitchen or refrigerator?
<input type="checkbox"/>	<input type="checkbox"/>	Do you store herbicides separately from other pesticides?
<input type="checkbox"/>	<input type="checkbox"/>	Are there signs on your storage so firemen and others are warned?
<input type="checkbox"/>	<input type="checkbox"/>	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!

- | | | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Do you always keep pesticides in the original container instead of old "coke" bottles, milk cartons or other food containers? |
| <input type="checkbox"/> | <input type="checkbox"/> | When people ask you for a little spray mix out of your tank do you refuse? |
| <input type="checkbox"/> | <input type="checkbox"/> | Do you always remember what is in an unlabeled container? |
| <input type="checkbox"/> | <input type="checkbox"/> | Do you always remember the safety precautions, antidotes and directions for use, even though the container is not labeled? |
| <input type="checkbox"/> | <input type="checkbox"/> | Do you safely dispose of unlabeled pesticides, rather than take a chance with your memory? |

Use the Recommended Clothing and Protective Equipment

- | | | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Do you read the label to see what protective clothing you should wear? |
| <input type="checkbox"/> | <input type="checkbox"/> | Do you start each spraying day with clean spray clothing? |
| <input type="checkbox"/> | <input type="checkbox"/> | Do you check the signal words and precautions for use on the label to see what protective equipment is necessary? |
| <input type="checkbox"/> | <input type="checkbox"/> | Do you wear the protective equipment recommended on the label? |
| <input type="checkbox"/> | <input type="checkbox"/> | Do you clean and maintain your protective equipment regularly and often? |
| <input type="checkbox"/> | <input type="checkbox"/> | Do you throw away rubber gloves that have only tiny holes in them? |

Spills and Splashes of Concentrates can be Very Hazardous!

- | | | |
|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | Do you know what to do if you should spill a pesticide on yourself while mixing? |
| <input type="checkbox"/> | <input type="checkbox"/> | Do you wear adequate footgear with your pant cuffs on the outside, so pesticides won't run into your footgear? |
| <input type="checkbox"/> | <input type="checkbox"/> | Do you have sawdust, vermiculite, kitty litter or some other absorbent on hand to soak up spills? |
| <input type="checkbox"/> | <input type="checkbox"/> | Do you always watch your sprayer tank when filling so it won't run over and spill on the ground? |

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?

A Checklist for Preventing Pesticide Accidents

(continued)

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?

Pesticide Dealer Training Manual

Table of Contents

Part 2 - Chapter	XI.....Integrated Pest Management
	XII.....Pests
	XIII.....Types of Pesticides
	XIV.....The Label
	XV.....Formulations
	XVI.....Filling and Mixing
	XVII.....Calculations for Mixing Pesticides
	XVIII.....Equipment
	XIX.....Calibration
	XX.....Weather-Wise Application
	XXI.....Disposal
	XXII.....Storage
	XXIII.....Record Keeping
	XXIV.....Liability
	Answers to Questions.....
	Glossary.....
	References.....

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.

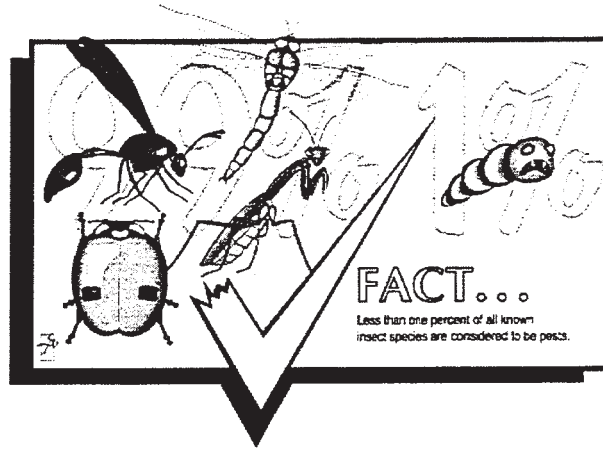


PEST IDENTIFICATION



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.

What to look for:



Insects and mites

All insects have six legs, but other than that they are extremely variable. They include such organisms as beetles, flies, bees, ants, moths, and butterflies. Mites and spiders have eight legs--they are not insects. However, for the purposes of this chapter, they will be considered insects.

Insects damage plants in several ways. The most visible damage is chewed plant leaves and flowers. Many pests are visible and can be readily identified, including the Japanese beetle, Colorado potato beetle, and numerous species of caterpillars such as tent caterpillars and tomato hornworms. Other chewing insects, however, such as cutworms (which are caterpillars) come out at night to eat, and burrow into the soil during the day. These are much harder to identify but should be considered if young plants seem to disappear overnight or are found cut off at ground level.

IPM TIP

• The single best IPM tool to carry is a magnifier! • A magnifier is an important part of visual inspection, and lets you see the small details that are helpful in the identification of weeds and insect pests. • A 10X magnifier is a good starting point for most pest scouting.

Sucking insects are extremely common and can be very damaging. These insects insert their mouth parts into the plant tissues and suck out the plant juices. They also may carry diseases that they spread from plant to plant as they move about the yard. You may suspect that these insects are present if you notice misshapen plant leaves or flower petals. Often the younger leaves will appear curled or puckered. Flowers developing from the buds may only partially develop. Look on the underside of the leaves as that is where many species tend to gather. Common sucking insects include leafhoppers, aphids, mealy bugs, thrips, and mites.

Other insects cause damage by boring into stems, fruits, and leaves. They may disrupt the plant's ability to transport water. They also create opportunities for disease organisms to attack the plants. You may suspect the presence of boring insects if you see small accumulations of sawdust-like material on plant stems or fruits. Common examples of boring insects include squash vine borers and corn borers

Diseases

Plant disease identification is extremely difficult. In some cases, only laboratory analysis can conclusively identify some diseases. Disease organisms injure plants in several ways. Some attack leaf surfaces and limit the plant's ability to carry on photosynthesis. Other organisms produce substances that clog plant tissues that transport water and nutrients. Other disease organisms produce toxins that kill the plant or replace plant tissue with their own.

Symptoms associated with plant diseases may include: the presence of mushroom-like growths on trunks of trees; leaves with a grayish mildewy appearance; spots on leaves, flowers, and fruits; sudden wilting or death of a plant or branch; sap exuding from branches or trunks of trees; and, stunted growth.

Misapplication of pesticides and nutrients, air pollutants, and other environmental conditions such as flooding and freezing can also mimic some disease problems. Yellowing or reddening of leaves and stunted growth may indicate a nutritional problem. At first glance, blossom end rot of tomato, in which the bottom of the tomato turns black, might appear to be a disease caused by some pathogen. It is actually caused by the plant's inability to take up calcium quickly enough during periods of rapid growth. Prevent this problem with adequate moisture--adding more calcium is of no benefit! Leaf curling or misshapen growth may be a result of herbicide misapplication.

PLANT DISEASE BASICS

• Plant diseases need three elements to become established: 1) the disease organism; 2) a susceptible species; and, 3) the proper environmental conditions. • Some disease organisms can live in the soil for years; other organisms are carried in infected plant material that falls to the ground. • Some disease organisms are carried by insects. • Good sanitation will help limit some problems. • Planting resistant varieties of plants prevents many diseases. • Rotating annual crops in a garden also helps to break the disease cycle.

• **You will likely have the most opportunity to alter the environment in favor of the plant and not the disease!** • Healthy, vigorous lawn and garden plants have a higher resistance to pests. • Plants that have adequate, but not excessive, nutrients are better able to resist attacks from both diseases and insects. • Excessive rates of nitrogen often result in extremely succulent vegetative growth and can make plants more susceptible to insect and disease problems, as well as decrease their winter hardiness. • Proper watering and spacing of plants limits the spread of some diseases. • Some disease species require free standing water in which to spread, while other species just need high humidity. • Proper spacing provides good air circulation around plants. • The use of trickle irrigation, where water is applied to the soil and not the plant leaves, may be helpful.

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.

Scouting in the Yard or Garden:

Scouting a garden is done by examining a representative sample of each crop to determine the average infestation level. The number of plants to examine can vary according to the type of crop and size of the planting. You may look at all the plants of a crop if there are only 5 or 6 in the planting, or you may look at a sample of 10 plants if there are as many as 50 or more plants per crop. Probably the best rule to go by for the average home garden is to examine enough plants to feel comfortable that you know what pests are present and how much damage is being done.

When examining plants, it is important to look at them closely. Get down on their level! By doing so, you will be able to see the egg masses or small larvae that are present before damage is evident. All parts of the plants should be examined. Pests may be found on the underside of leaves, of the tops of leaves, on stems, in stems, in buds, or in developing fruit. For example, even though the pods of a bean plant may not show feeding damage from a bean leaf beetle, the damage the beetle does to the foliage can cause a reduction in the yield of the plant and the quality of the bean. In sweet corn, corn earworm eggs tend to be found on the silks and spider mites tend to be found on the undersides of the lower leaves.

IPM TIP

• While looking for signs of damage from insects and diseases, make sure to check for indications of adequate fertility and moisture. • Sub-optimal levels of nutrients and water can weaken plants and make them susceptible to attack by insects and diseases.

It is only by thorough scouting that you will truly know what is going on in your garden. In some situations, drop cloths or sweep nets can be used as collection devices to aid in pest monitoring.

INSECT MONITORING TOOLS

Use insect traps and sweep nets to monitor the occurrence of insects. Captured insects can then be identified and counted to determine if the action threshold for pest control has been reached.

- A sweep net is a funnel-shaped net attached to a long handled frame that is swept back and forth through the foliage.
- Insect traps and lures consist of a visual and/or scent attractant, plus a device to capture the insect once it arrives. A visual attractant often resembles a food source or an egg-laying or resting site. Scent lures may smell like food or a female insect.

Good record keeping is essential to make maximum use of information gathered during garden and yard inspections. Record your information in a quantitative fashion. For example, record the number of insects founds per plant or leaf, rather than recording “few” or “many”. After the growing season, review this information. You may notice certain patterns, such as more damage or pests on certain varieties of plants or around certain dates. Use this information next year to anticipate and be ready for your pest problems. Also, information from regular inspections will allow you to evaluate which control practices are effective and which need to be modified.



Good record-keeping allows you to know when to expect certain pest problems and plan to deal with them effectively .

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 prey 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

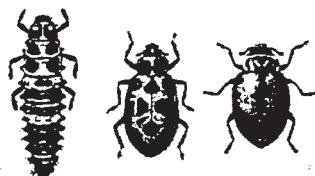
builds up. Therefore, the presence or absence of a healthy population of beneficial insects, or pests showing the effects of parasites, should be taken into consideration when determining the need for a “rescue treatment”.

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.

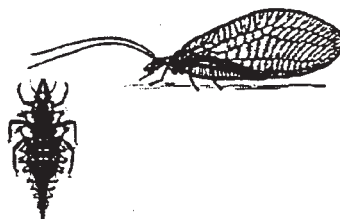
Figure 1. Beneficial Insects that Feed on Pests

**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.

Scouting in the Home:

Scouting for pests in the home is not that different from scouting for pests in the garden. You need to know where the pests are likely to be found, and you need to look closely for any evidence they may have left behind. The two basic approaches to take include *visual inspection* and the use of *monitoring traps*.

Visual Inspection: Use a flashlight and a magnifying glass (hand lens) during the inspection. Look for the pests themselves as well as other evidence of pests such as

droppings (especially from cockroaches and rodents), frass (from wood borers), gnawing, tracks and grease marks (from rodents), damage (such as powderpost beetle exit holes), and shed insect skins. The presence of feeding debris and frass is an indication of an active infestation.

Examine window sills regularly since many insects fly or crawl towards light. Insects may also be found inside lighting fixtures, behind baseboards and moldings, under furniture, in floor cracks, behind radiators, or in air ducts.

Remember to look for conditions that may lead to pest infestations. Check for moisture problems, both indoors and out, which may encourage moisture-related pests such as carpenter ants, termites or mold. Look for damaged screens, doors and walls which would allow pest entry. Note any sanitation problems. Fresh flowers and potted plants may also be infested with insects.

Inspecting outdoors will also provide you with clues to indoor pest problems. Heavy landscaping near the building foundation and plants such as ivy growing on walls increases the risk of outdoor pests moving inside. Moisture problems around the foundation, gutters or air conditioning units can favor moisture-related pests. Bright exterior lights will attract insects to the exterior of the house. Poor management of outdoor trash receptacles may also attract rodents that will then try to enter through any opening available.

Monitoring Traps: Even the most thorough visual inspections may not provide information on pest problems when the pests are well hidden from view or are active only at night. In these cases, the use of monitoring traps can provide information on the presence of a pest, as well as their numbers. Three major types of monitoring traps are available: sticky traps (which use an adhesive to capture insects), pheromone traps (which use chemical attractants to lure certain species into the trap), and insect light traps (which use UV light to lure and capture certain flying insects). Those traps most appropriate for homeowner use include sticky traps and pheromone traps.

Sticky Traps: Are simply paper, cardboard or other materials with one or more surfaces covered with glue. The placement of sticky traps is critical. If your traps remain empty, that does not necessarily mean you do not have a pest problem. It may mean that you placed the trap in the wrong area. This is why you must be familiar with the pest and its habits. You should place traps in the most likely areas of infestation and in travel-ways. When monitoring for cockroaches, for example, place the traps in areas such as inside cabinets, under sinks and stoves, under kitchen equipment, and next to trash cans. While sticky traps are typically not used as control devices, they may be employed as such in

sensitive situations where pesticides cannot be used.

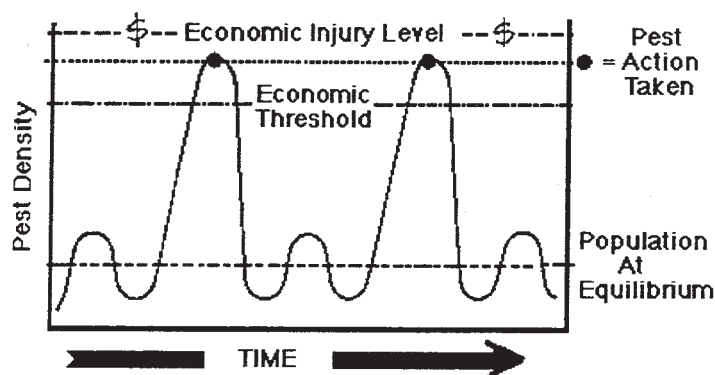
Pheromone Traps: Pheromones are natural scents that insects use to communicate with one another. Some are sex attractant pheromones that attract only the male insect. Others use aggregation pheromones that attract both males and females of the same species. These types of traps are particularly useful in monitoring “stored product” pests such as cigarette beetles and Indianmeal moths, and outdoor pests such as gypsy moths, Japanese beetles, fungus gnats and many pests of field crops and fruit trees.

Pheromone traps are most useful as an early warning system, and can help gauge how severe the problem is. Use of pheromone traps after treatment can evaluate the effectiveness of the control strategy.

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.

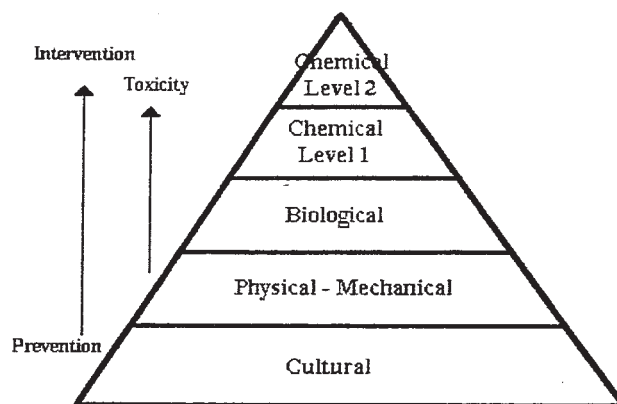


Figure 3. (Source: The Pennsylvania IPM Program, <http://paipm.cas.psu.edu>)

1) **Cultural** - 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) Chemical - 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 and 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.

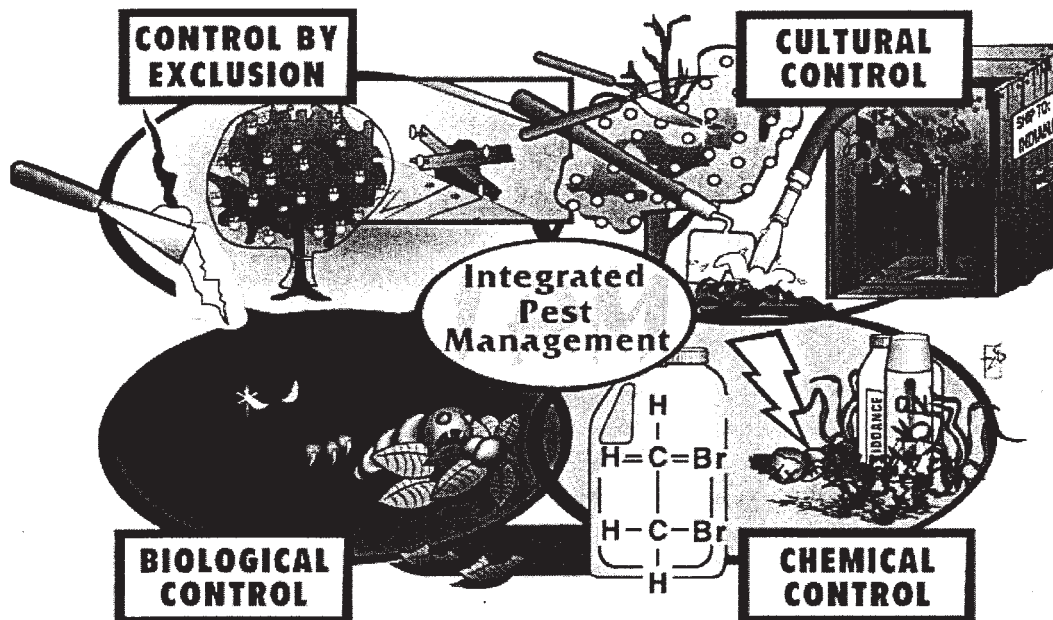
❸ (RE)DESIGN the Use of Pesticides Out of the System. IPM reduces pesticide use by:

- ⇒ 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 plants 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. Choose 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

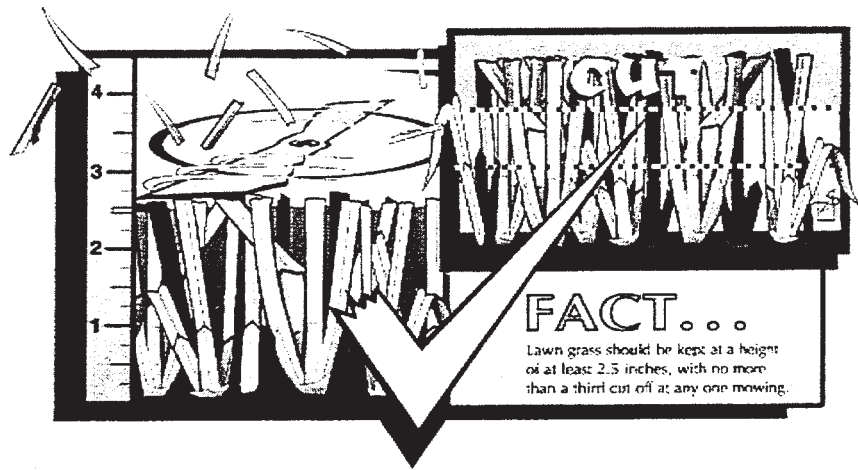
It is important to understand how nutrients are packaged in fertilizer products. The three numbers on the label are required by law to inform the consumer of the percentage (by weight) of nitrogen, phosphorous, and potassium in the package. The numbers 24-6-12 on a fertilizer label indicate that the 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.

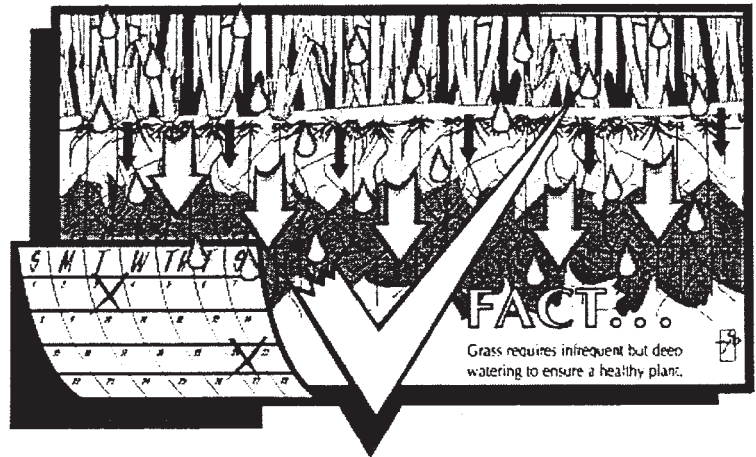
Mow often so that no more than 1/3 of each leaf blade is removed each time the grass is cut. This may mean more frequent mowing in the spring and fall, with less frequent mowing during the summer. Lawns should be mowed about 1/2 inch higher in summer to help grass plants tolerate heat and drought stress. 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

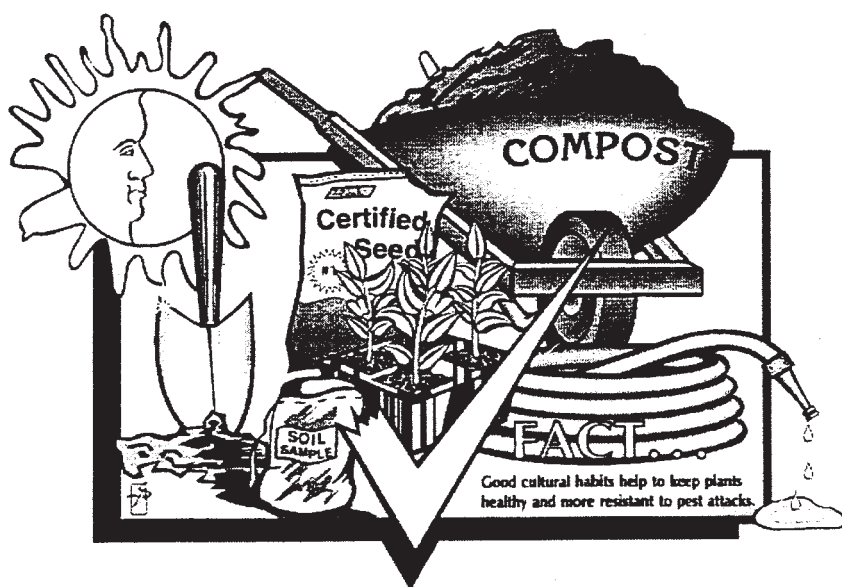
Organic matter such as compost should be mixed into the soil at the beginning of each gardening season unless the soil is heavy clay that holds too much water for long periods of time. Garden soil should be tested at least every three years and amended by fertilizing as required. A loose, fertile soil 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

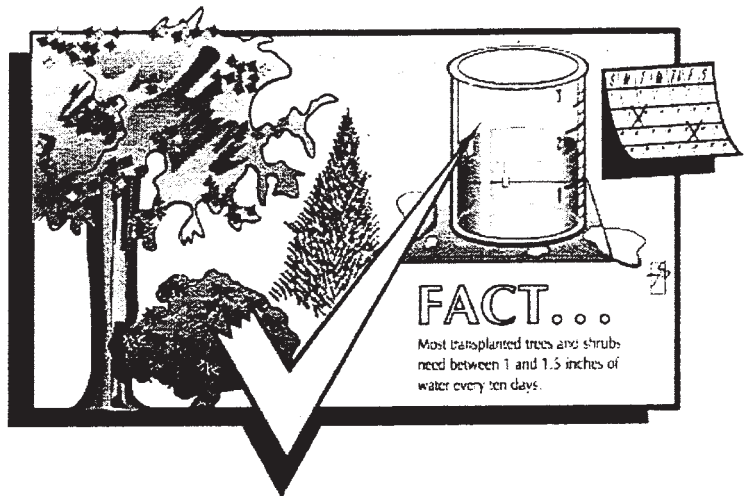
should not be added unless a reliable soil test has indicated the need. (Contact the University of Vermont Agricultural and Environmental Testing Lab: (802) 656-3030)

✓ **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

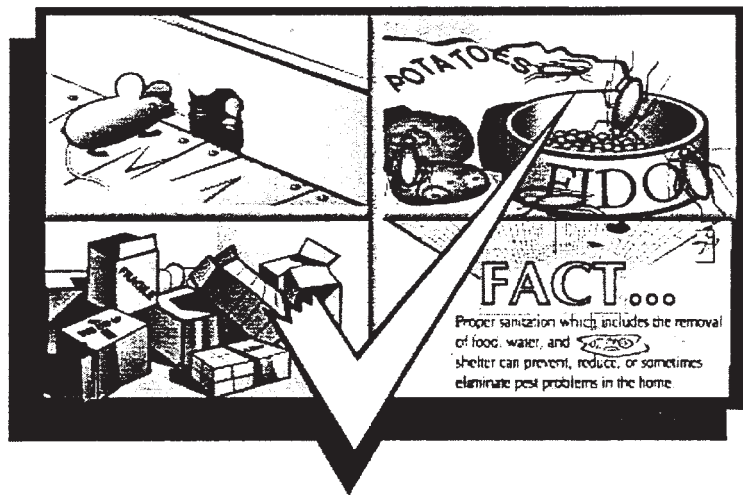
Proper and complete identification of the pest is critical. For example, identifying an insect pest as a cockroach is not sufficient. German, American, Oriental, and brown-banded cockroaches have very separate and distinct biologies and behavior patterns; and a thorough understanding of those characteristics 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.



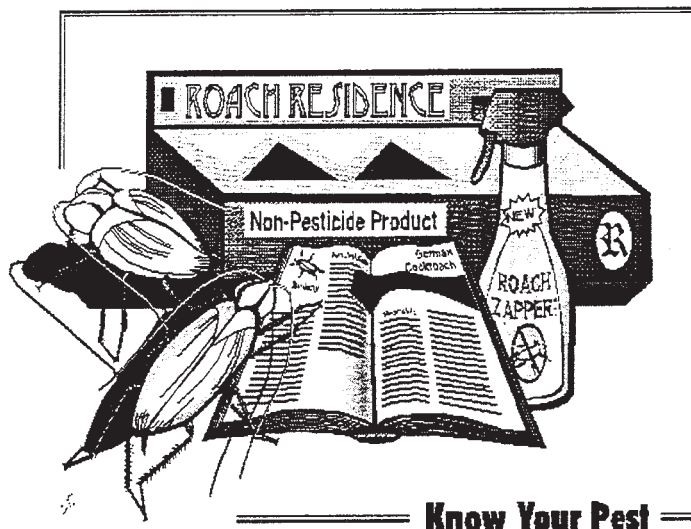
✓ Pest-Proof the Home (Exclusion)

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.

RESOURCES

Get information at these web sites and find references to many other resources.

Integrated Pest Management Sites:

- <http://ctr.uvm.edu/ctr/elecpubs.htm> - University of Vermont Extension Pest Control Publications
- <http://pss.uvm.edu/mg/mg> - UVM Extension Master Gardeners
- <http://www.hort.cornell.edu/gardening/index.html> - Cornell University Gardening Fact Sheets
- <http://www.nysaes.cornell.edu:80/ipmnet/> - Integrated Pest Management in the Northeast

Pesticide Related Sites:

- <http://www.state.vt.us/agric/pid.htm> - Vermont Department of Agriculture Plant Industry Division
- <http://www.state.vt.us/agric/wastepest.htm> - Waste Pesticide Collection Schedule for Farmers and Homeowners in Vermont
- <http://www.epa.gov/pesticides/> - EPA Office of Pesticide Programs
- <http://ace.orst.edu/info/nptn> - National Pesticides Telecommunication Network
- <http://ace.orst.edu/info/nptn/rmpp.htm> - Recognition and Management of Pesticide Poisonings
- <http://ace.orst.edu/info/extoxnet/faqs/index.htm> - EXtension TOXicology NETwork: Frequently asked questions about pesticides

PEST IDENTIFICATION SITES

- <http://www.ifas.ufl.edu/~insect/index.htm> - In-depth Profiles of Insects, Mites, Nematodes, and Other Organisms
- <http://plantfacts.ohio-state.edu/> - A Nationwide Search Engine for Fact Sheets
- <http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html> - University of California - How to Manage Pests - Diseases.
- <http://www.cas.psu.edu/docs/CASDEPT/PLANT/ext/fact.html> - Pennsylvania State University - Plant Disease Fact Sheets

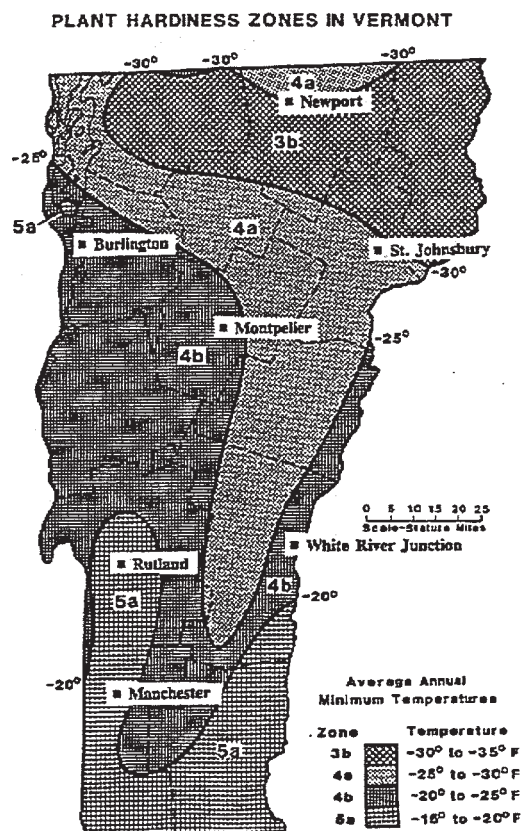
University of Vermont Extension
OH 53



New Vermont Hardiness Map

By Leonard P. Perry, Extension Professor

The hardiness map below is an enlarged portion of the USDA hardiness map, generated by Meteorological Evaluation Services of Amityville, NY. It was generated from the 1974-1986 data of the stations listed below having at least 10 years of data, as well as stations outside Vermont. This time period was the most recent prior to publication for which reliable data were available, giving 10 years for most sites. As can be seen, many sites have become colder over this period compared to the period of the previous USDA map, believed to be about 1930-1960. This recent period of cold extremes is verified by reports of freeze damage to plants which had not occurred during the earlier period. As with any hardiness zones, they are only a starting point in plant selection and hardiness considerations. (See [OH 54](#) for a further discussion of hardiness).



Annual Minimum Extreme Temperatures in Degrees Fahrenheit

Station Name	lat		long		elev ft	Extreme Minimums													avg 74-86
	deg	min	deg	min		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	
Ball Mountain Lake	43	07	072	48	1130	-21	-20	-26	---	-21	-25	-19	-23	-20	-23	-25	-8	-14	-20.4
Bellows Falls	43	08	072	27	270	-10	-11	-19	-15	-11	-17	-21	-20	-20	-11	-22	-10	-12	-15.3
Bristol 5 NNW	44	12	073	07	500	-23	-19	-25	-29	-18	-28	-30	---	---	---	---	---	---	msg
Burlington WSO AP	44	28	073	09	330	-24	-16	-24	-20	-19	-30	-26	-27	-17	-20	-17	-15	-14	-20.6
Cavendish	43	23	072	36	800	-25	-23	-31	-24	-25	-32	-25	-26	-28	-23	-30	-16	-20	-25.2
Chelsea	43	59	072	27	800	-26	-25	-31	-28	-24	-34	-32	-31	-29	-26	-30	-24	-20	-27.6
Cornwall	43	57	073	13	490	-26	-14	-25	-29	-18	-29	-23	-28	-19	-16	-13	-11	-15	-20.4
Dorset 1 S	43	15	073	06	980	-23	-17	-23	-15	-18	-30	-27	-22	---	---	---	---	---	msg
Enosburg Falls	44	55	072	49	420	-35	-31	-34	-30	-32	-38	-37	-41	-33	-31	-26	-30	-24	-32.4
Essex Junction 1 N	44	31	073	07	340	---	---	---	---	---	---	---	---	---	---	---	---	-22	msg
Montpelier FAA AP	44	12	072	34	1130	-22	-14	-19	-20	-21	-25	-27	-34	-18	-22	-23	-19	-13	-21.3
Morrisville 2	44	32	072	36	730	-32	---	---	-23	-27	-30	-33	---	---	---	---	---	---	msg
Mount Mansfield	44	32	072	49	3950	-23	---	---	-35	-24	-30	-38	-37	-28	-36	-25	-24	-27	-29.7
Newport	44	56	072	12	770	-33	-24	-31	-24	-28	-30	-28	-31	-27	-26	-24	-27	-23	-27.3
North Danville	44	28	072	07	1140	-28	-23	-24	-19	-22	---	---	---	---	---	---	---	---	msg
Northfield	44	10	072	39	670	---	---	---	---	---	---	---	---	---	---	---	---	---	msg
Northfield 3 SSE	44	06	072	37	1410	---	-25	-24	-22	-23	-27	-31	-35	-25	-20	-20	-22	-15	-24.0
Readsboro 1 SE	42	45	072	56	1120	-14	-15	-21	-14	-16	-25	-20	-21	-18	-12	-25	-7	-10	-16.7
Rochester	43	51	072	48	830	-25	-26	-30	-18	-23	-28	-30	-25	-25	-20	-28	-15	-14	-23.6
Rutland	43	36	072	58	620	-21	-14	-19	-16	-14	-26	-23	-23	-17	-16	-18	-8	-16	-17.7
St. Albans Bay	44	48	073	10	110	-29	-15	---	---	---	---	---	---	---	---	---	---	---	msg
Saint Albans Radio	44	50	073	05	390	---	---	---	---	-14	-26	-25	-31	-20	-22	-16	-19	-15	msg
Saint Johnsbury	44	25	072	01	700	-28	-21	-29	-25	-24	-32	-31	-31	-27	-21	-28	-23	-25	-26.5
South Hero	44	38	073	18	1100	---	-10	-18	---	-12	-20	-22	-26	-15	-14	-12	-12	-15	-16.0
South Lincoln	44	04	072	58	2020	---	---	---	---	---	---	---	---	-22	-21	-23	-19	-20	msg
Vernon	42	46	072	31	230	-12	-15	-18	-15	-12	-18	-20	-17	-18	-10	-22	-9	-11	-15.1
Waterbury 2 SSE	44	19	072	45	760	-25	-22	-26	-19	-23	-26	-26	-27	-22	-21	-23	-17	-13	-22.3
West Burke	44	39	071	59	900	-32	-27	-33	-30	-29	-37	-35	-38	-31	-25	-32	-29	-25	-31.0
Woodstock 2 WSW	43	37	072	33	750	-24	-27	-35	-24	-22	-37	-30	-24	-27	-26	-28	-16	-20	-26.1

Notes: lat=latitude, long=longitude, elev=elevation in feet above sea level, ---no data,
msg=not enough data for 10 year average.

Edited in March 1998.

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Plant Hardiness

By Leonard P. Perry, Extension Professor

Plant hardiness is an often misunderstood topic deserving special discussion. It is not as simple as it may appear. Often oversimplified, not taking into account all the possible factors involved, the question of whether or not a plant is hardy may lead to a wrong answer and disappointment if the plant dies or does not bloom.

Hardiness is genetic. That is why some plants are hardier than others, even why some cultivars are hardier than others of the same plant. They may have been bred or selected as being hardier clones. To confuse this further, plants adapt or change genetically over time to their climate. This is why a species growing in a southern location may not be as hardy as the same species growing in a northern location. This may be a consideration when buying plants, or ordering them through the mail.

Roots, stems, leaf buds, and flower buds usually all are hardy to different temperatures. This is why many perennials die to the ground in winter, only to have their roots survive and produce new shoots the following spring. It is also why forsythia often have leaves but no flowers. The flower buds, being less hardy than the leaf buds, are killed by cold. If flowers appear to a particular height, but not above, this represents the depth of snow cover that protected the flower buds during the killing cold.

Hardiness is a function of location in a different sense as well. A particular, plant such as impatiens, may be perennial in a southern or warmer climate, only to be annual if moved to a colder climate. It is hardy, but only to a certain temperature. Keep this in mind when books or articles, especially those from other countries, call a plant annual or perennial.

The most discussion, though, revolves around hardiness zones. These are geographic zones shown on maps that share the same range of average annual minimum winter temperatures. Few references list hardiness zones for heat--in other words, how high a temperature can a particular plant endure. Maples, lilacs, and many of our herbaceous perennials cannot take the heat of hot climates, or need more cold than they get there to bloom properly.

To begin, check to see what hardiness map you are using. There are at least three in gardening publications: one from the Arnold Arboretum in Boston; one from the USDA based on data from about 1930 through 1960 and seen prior to 1990; and a revised USDA map seen from 1990, based on more recent data reflecting a period of cold extremes since the mid-1970s. The same numbered zone represents different temperature ranges on the older USDA and the Arnold maps, but they are the same on the older and the new USDA maps. Only the location of zones on the map has changed on the new USDA version. (Most areas have become colder! See [OH 53](#) for the new version for Vermont.)

As already mentioned, these zones as mentioned are averages, which means some years may be colder. Even though a plant may be listed as hardy in a particular zone, an unusually cold year may come along and kill it. If a plant is listed as hardy in a zone or two colder, it is likely hardy. On the other hand, a plant

listed for one or two zones warmer may also grow in a site under certain conditions.

These conditions, which determine whether a plant will survive in a particular site, together are known as the microclimate. They include soil type, exposure to sun and wind, and other factors, such as slope and proximity to buildings. After the zone in which a site is located, or macroclimate, is determined, these microclimate factors should be considered.

If a soil is heavy, wet, of low pH or low fertility, or in general not suited to the plant, it can cause stress that may result in winter injury. On the other hand, if the soil is too fertile, the plant may grow late into the season--not hardening off properly. This, too, may result in winter injury or lack of hardiness. Amendments such as compost or peat moss can be used to improve poor soils.

Mulches can be used to moderate soil temperatures, keeping them from getting as cold as they might otherwise and possibly injuring roots. They are especially useful on exposed sites where protective snow cover may blow off. Sites exposed to winter winds, usually from the north and west, can cause evergreens to dry out, resulting in winter injury, such as leaf burn. A protected site, or shielding plants with a burlap screen in an exposed one, helps prevent this. Sites exposed to early morning sun in winter may result in "frost cracking" of bark of some trees, especially young ones. This results from the rapid heating of frozen bark by the sun. Tree wrap or guards help prevent this.

If a plant is near a building, it may be in a warmer hardiness zone in that spot. This may be from heat loss by the building, or the sun's heat absorbed by it.

A slope is often typical of a site farther, perhaps by several hundred miles for steep slopes, in the direction in which it faces. In other words, a steep southern facing slope may be a whole hardiness zone or two warmer than adjacent level areas. This is important if a site is on a hill or in a valley. A hillside may also have airflow down it, resulting in less chance of frost.

By this point, buying a hardy plant may seem totally confusing, but it need not be. Just keep the hardiness zones and their limitations in mind when choosing a plant. Then keep the microclimate factors in mind when placing it for planting. Although this will not guarantee hardiness, as mother nature can't be predicted, it should result in minimal loss to plants from winter injury.

(Also, see [OH 53. "Vermont Hardiness Map"](#) and [OH 3. "Preparing the Garden for Winter."](#))

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Last reviewed April 24, 1998.

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.

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.

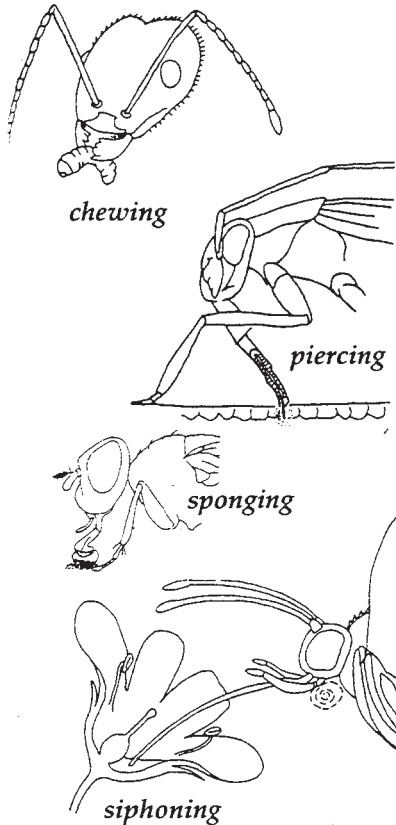
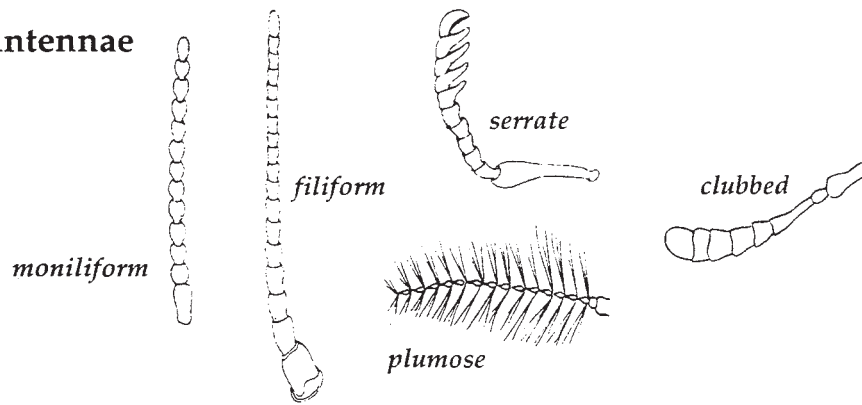
Insect Body Characteristics

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

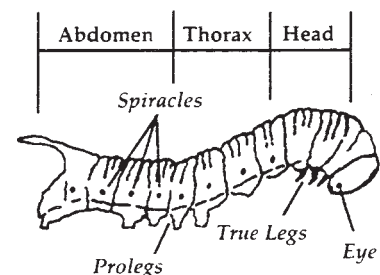
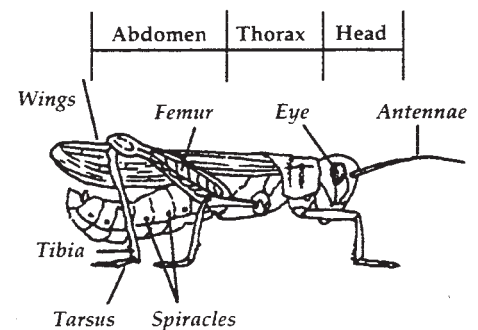


Mouthparts are different in various insect groups and are often used in classification and identification. The type of mouthpart determines how the insect feeds and what sort of damage it does. It is important that the applicator have some knowledge of these types of insect mouth parts:

- **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).

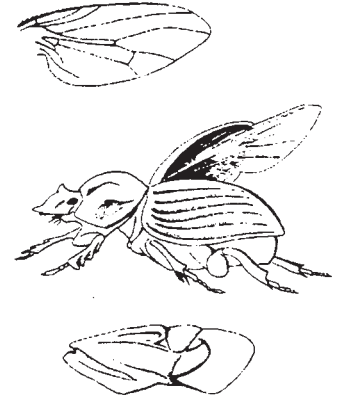
Thorax. The thorax, or middle body segment, has three pair of legs and sometimes one or two pair of wings (forewings, hindwings).

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. 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 Reproduction and Development

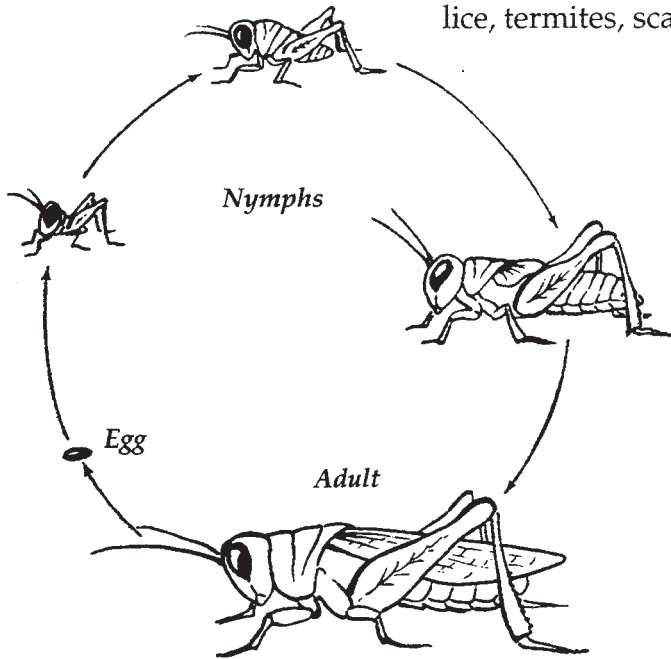
Insect Metamorphosis (development). Insects go through a series of changes as they develop from the egg to adulthood. This process of growth is called metamorphosis.

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

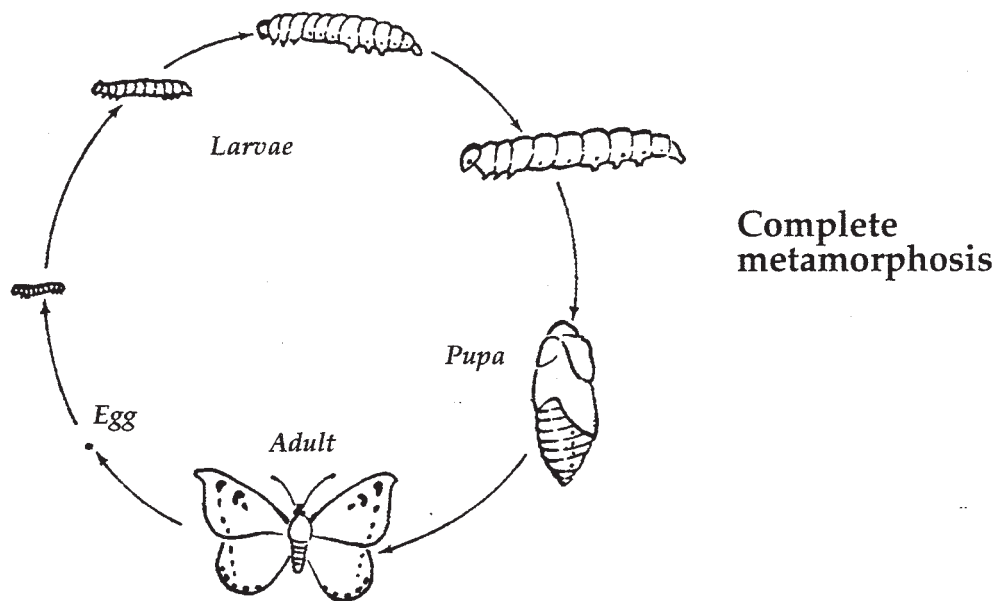
are both wingless. Some examples are: springtails, firebrats, and silverfish.

- **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.



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.

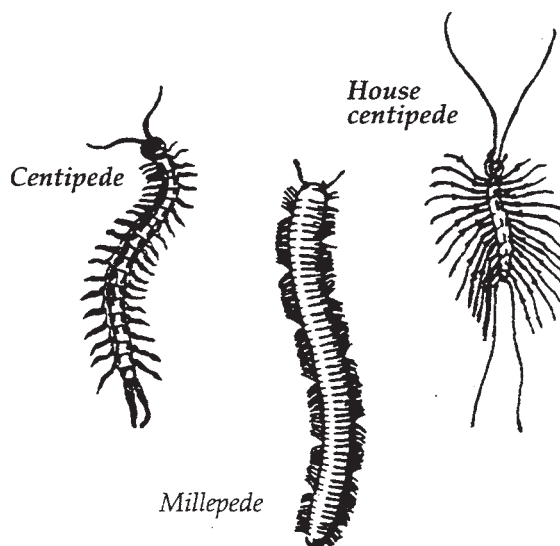
Spiders, ticks, mites, sowbugs, pillbugs, millipedes, and centipedes resemble insects in habit, appearance, life cycle, and size. Although they are not insects, they are often mistaken for them. The pesticide applicator needs to be familiar with these pests when evaluating a problem.

Insect-Like Pests

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

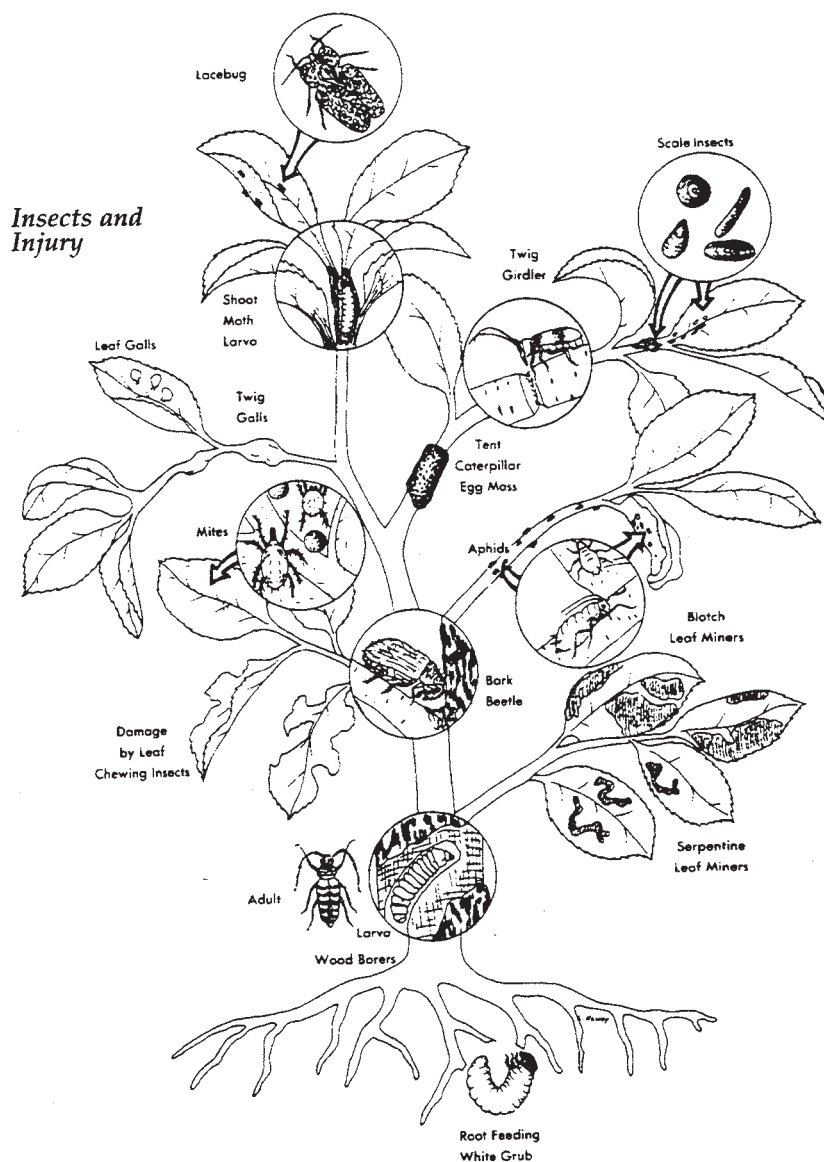
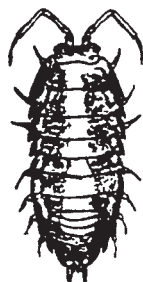


adapted to feeding on decaying organic material. Thus, they are found in decaying leaf litter, rotting logs, and near damp debris near foundations.

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

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.

Sowbug



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.

A plant disease is any harmful condition that alters a plant's 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.

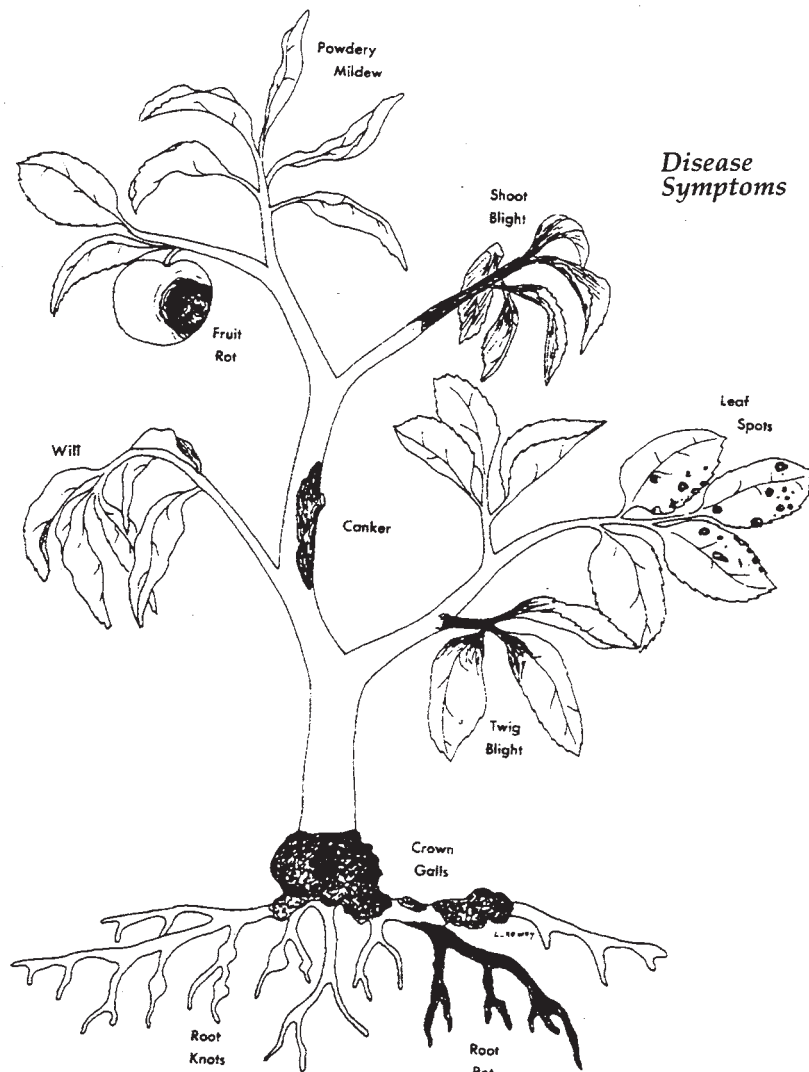
Fungi. Fungi are plants that lack chlorophyll and cannot make their own food. Fungi are the most frequent pathogens on plants. They feed off other living organisms or live on dead or decaying organic matter. Most of the time fungi are beneficial because they help release nutrients from dead plants and 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, leafhoppers)

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.

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.

Plant Development Stages

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.

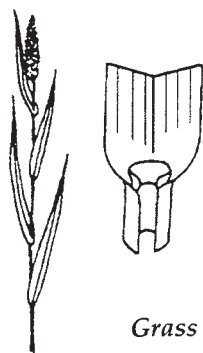
Sepals - the greenish hull surrounding the flower when it is budding.

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.

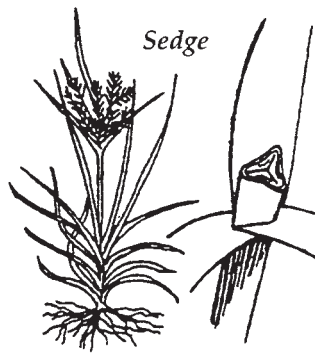
Sedges. These are similar to grasses, but they have triangular stems and three rows of leaves. They are sometimes listed under grasses on the pesticide label. These plants often are found in wet places, but are principal pests in fertile, well-drained soils. Yellow and purple nutsedge are perennial weed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

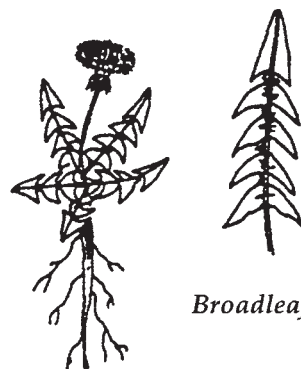
Major Classes of Weeds



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.

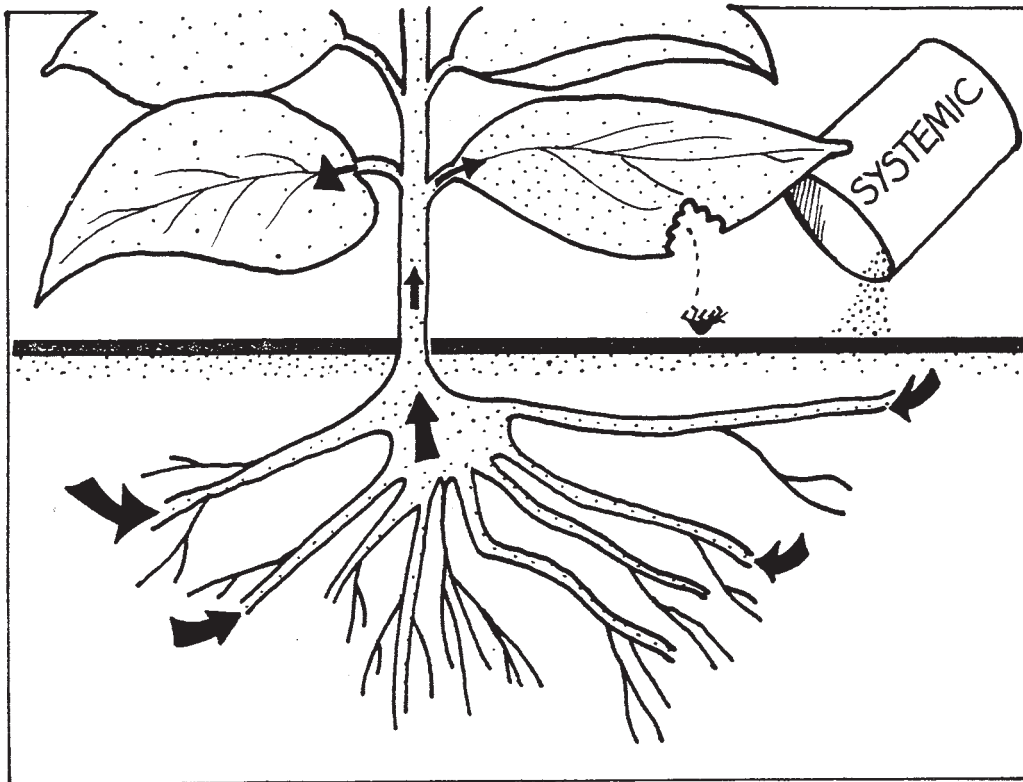
Questions for Self Study - Chapter XII

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

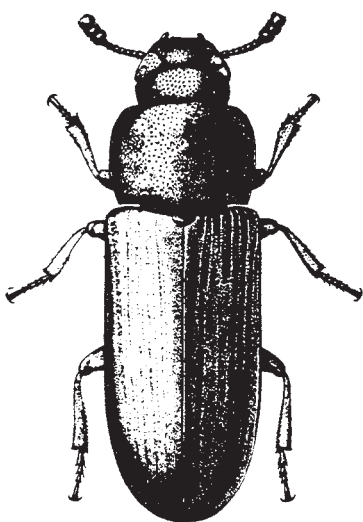
A pesticide is any chemical which is used by man to control pests. The pests may be insects, plant diseases, fungi, weeds, nematodes, snails, slugs, etc. Therefore, insecticides, fungicides, herbicides, etc., are all types of pesticides. Some pesticides must only contact (touch) the pest to be deadly. 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 (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.

Miticides and Acaricides



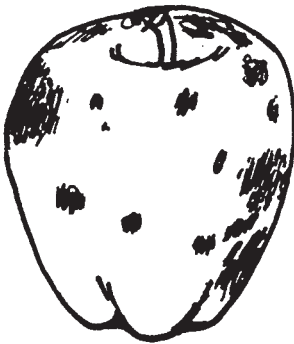
Fungicides are chemicals used to control the fungi which cause molds, rots, and plant diseases. All fungicides work by coming in contact with the fungus, because fungi do not “swallow” in the normal sense. Therefore, most fungicides are applied over a large surface area to try to directly hit every fungus. 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.

Fungicides

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.

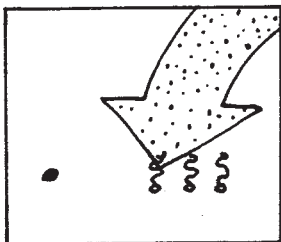
Most protectant fungicides are fungistatic. This means they prevent or inhibit fungal growth. Once the fungistatic action ceases, the controlled fungus may grow again or produce spores. Thus, a protectant fungicide may have to be applied at regular intervals to continue the protection from infection.

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

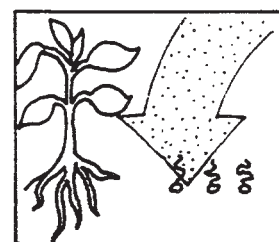
Nonselective herbicides are toxic to all plants. These are often used when no plants are wanted in an area. For example, nonselective herbicides could be used for clearing under guardrails or for total control of weeds in industrial areas.

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.

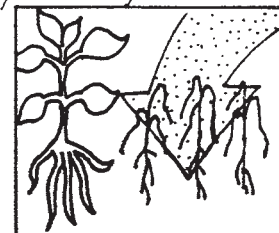
Preplanting vs. Preemergence vs. Postemergence. The timing of an herbicide application is important. Care must be used to get the job done effectively without injuring desirable plants. The directions on the label tell you when to apply the herbicide for best results. **Preplanting** treatments are made 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.



*post-emerged plant
pre-emerged weeds*



post-emergence

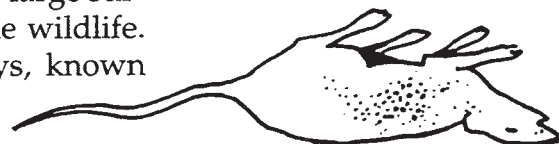
A **plant growth regulator** (or plant regulator) increases, decreases or changes normal growth or reproduction in a plant. Fertilizers and other nutrients are not included. Some growth regulators are used to move up or move back the normal harvest date for the crop. Others are used to obtain better 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.

Defoliant 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.

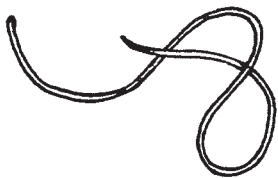
Growth Regulators and Harvest Aids

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.

Rodenticides



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.

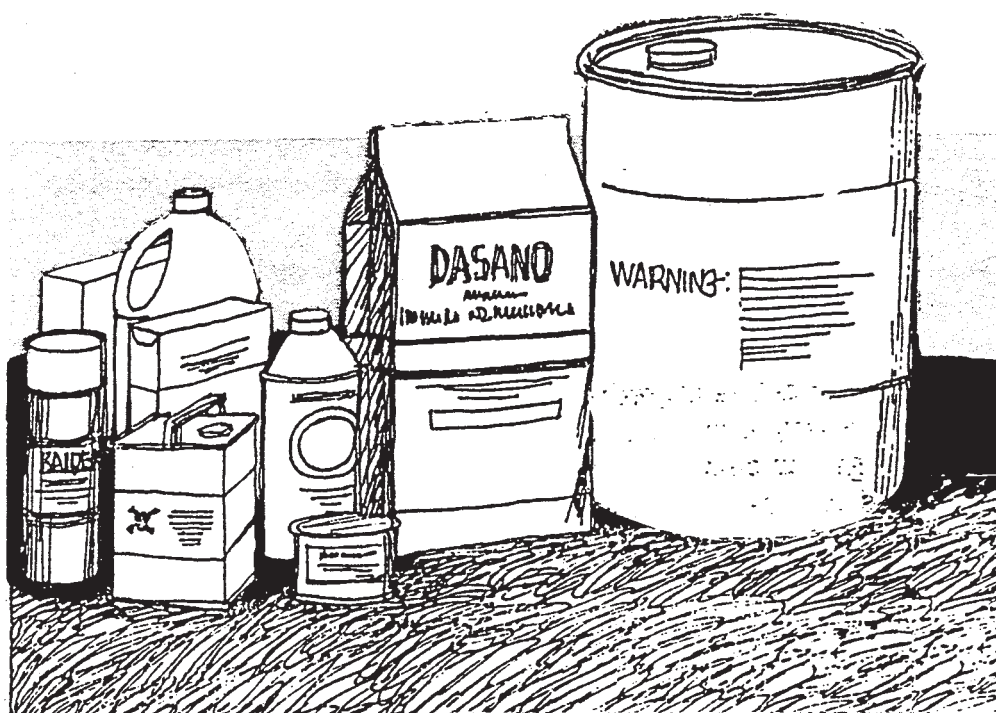
Questions for Self Study — Chapter XIII

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?

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.

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.

Dusts (D)

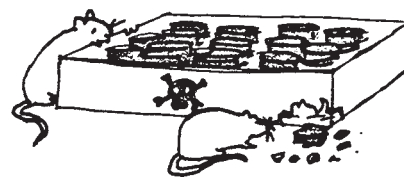
A poisonous bait is a food or other substance mixed with a pesticide that will attract and be eaten by pests and eventually cause their death.

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.

Poisonous Baits



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.

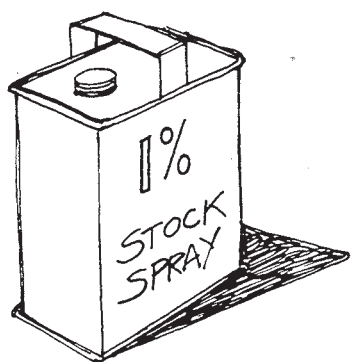
Ready-To-Use (RTU)

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.



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.

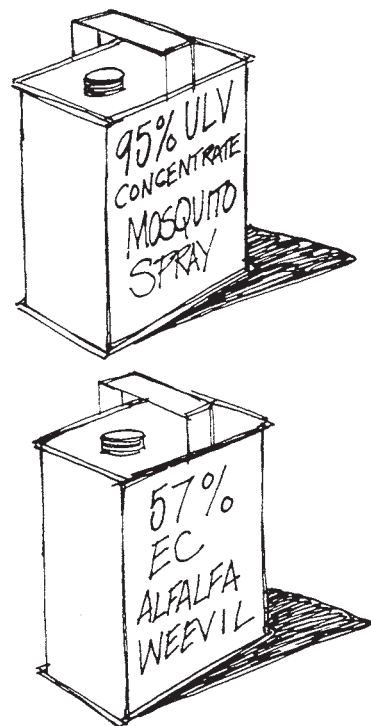
Disadvantages. It is easy to underdose or overdose because of the high concentration of pesticide, if directions for mixing are not carefully followed. Mixtures of emulsifiable concentrates may be phytotoxic. Also, because of the high concentration and liquid form, which is usually easily absorbed through 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).

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.

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%.

Emulsifiable Concentrates (EC)



Flowables (F)

Wetable or Soluble Powders (WP or SP)



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.

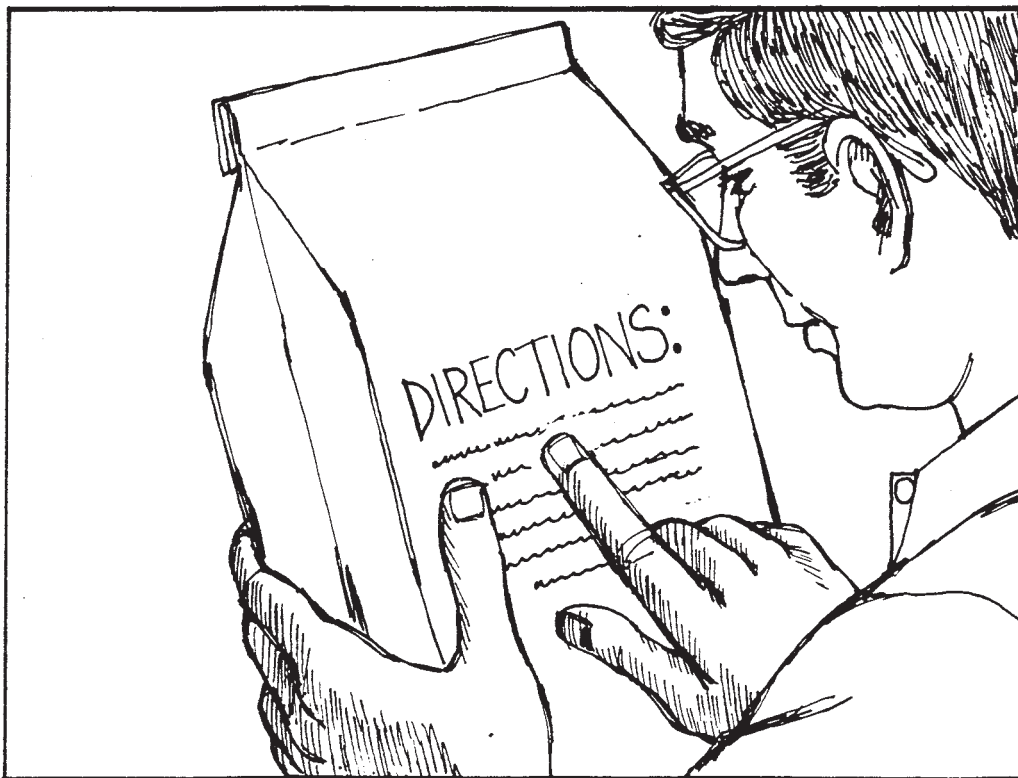
Questions for Self Study — Chapter XV

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 *dust* 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 *emulsifiable 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.

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.

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.

Compatibility

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.

Phytotoxicity

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!

The Label and the Law

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."

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.

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.

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.

RESTRICTED-USE PESTICIDE

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

General Classification

ACTIVE INGREDIENT

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

INERT INGREDIENTS ... 50%

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

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.

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.

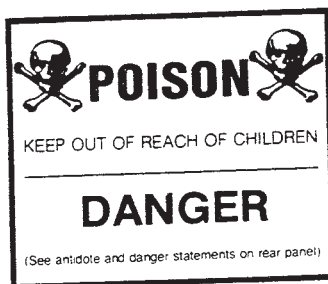
Establishment Numbers. The establishment number (for example, EPA Est. No. 5840-AZ-1) appears on either the pesticide label or the container. In case something goes wrong, it identifies the facility that produced the product.

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.

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



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.

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.

**PRECAUTIONARY
STATEMENTS**

**HAZARDS to HUMANS
and DOMESTIC ANIMALS.**

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

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).

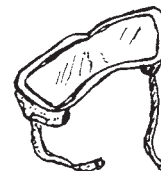
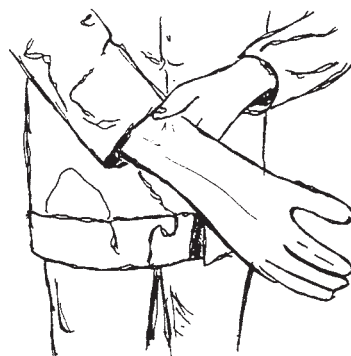
A WARNING label, for example, might carry the statements: "Causes skin and eye irritation. Do not get in eyes, on skin, or on clothing. Wear goggles while handling." Even though the label does not specifically require them, you should wear coveralls over regular work clothing, chemical-resistant gloves, 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.

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.

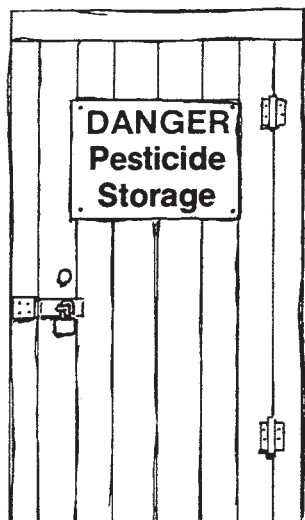
The entry restriction may be printed in any one of several places, such as under "General Information," or "Directions for Use," etc. If no

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.

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.

In the future there may be some directions for use (which pesticide applicators must obey) that are referred 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:

Directions for Use by Reference

“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.

DIRECTIONS FOR USE 2		WARNING OR CAUTION STATEMENTS 1	NAME OF PRODUCT 9	TYPE OF FORMULATION 5	INGREDIENT STATEMENT 8
<p>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.</p> <p>HOUSEHOLD PESTS (Roaches, Ants, Flies): 2 Tablespoons 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.</p> <p>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.</p>		<p>PRECAUTIONARY STATEMENTS</p> <p>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. Tranziaapon is a cholinesterase inhibitor and can cause symptoms similar to those caused by other organic phosphate compounds.</p> <p>If poisoning should occur, CALL A PHYSICIAN IMMEDIATELY. Note to Physicians: Emergency Information call (123) 456-7890.</p> <p>ATROPINE IS ANTIDOTAL.</p> <p>KEEP AWAY FROM DOMESTIC ANIMALS AND FOODSTUFFS.</p> <p>NOT FOR STORAGE IN OR AROUND THE HOME.</p> <p>DO NOT USE, POUR, SPILL OR STORE NEAR AN OPEN FLAME.</p> <p>DO NOT STORE BELOW 25 DEGREES F.</p> <p>PROTECT FROM HEAT.</p> <p>COMBUSTIBLE! KEEP AWAY FROM HEAT AND OPEN FLAME.</p> <p>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.</p>	<p>MAKES UP TO 24 GALLONS DILUTED SPRAY</p> <p>ZAPPO</p> <p>TRANZIAPON INSECT SPRAY</p>		<p>ACTIVE INGREDIENTS BY WT.</p> <p>Tranziaapon* 49%</p> <p>Aromatic Petroleum Derivative Solvent 34%</p> <p>Inert Ingredients 17%</p> <p>*3,3 Ditransudate of cismercapto pontificate</p>
<p>RE-ENTRY STATEMENT</p> <p>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.</p> <p>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.</p> <p>Written or oral warnings must include the following information:</p>		<p>STORAGE AND DISPOSAL</p> <p>Do not contaminate water, food or feed by storage or disposal.</p> <p>STORAGE: Store in a cool, dry area.</p> <p>PESTICIDE DISPOSAL: Pesticide wastes are toxic. Improper disposal of excess pesticide spray mixture or residue 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.</p> <p>CONTAINER DISPOSAL: Triple rinse. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.</p>	<p>KILLS INSECTS:</p> <ul style="list-style-type: none"> APHIDS RED SPIDER MITES FLIES MEALYBUGS SCALES AND HOUSEHOLD PESTS 		<p>CAUTION: KEEP OUT OF REACH OF CHILDREN</p> <p>See back panel for additional cautions.</p>
<p>DANGER</p> <p>(insert area or field description) treated with tranziaapon 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 tranziaapon and describe his condition. For further information see the STATEMENT OF PRACTICAL TREATMENT portion of the pesticide label.</p>		<p>DIRECTIONS FOR USE</p> <p>It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.</p> <p>Product #2222 EPA Reg. No. 0000 EPA Est. 111-22-3</p>	<p>NET CONTENTS 8 FL. OZ.</p> <p>CONTAINS 4.8 LBS. OF TRANZIAPON PER GALLON</p>		
<p>CHEMICO CHEMICAL COMPANY 10000 MAIN STREET BEAVERTON, MD 54321</p>		<p>RE-ENTRY STATEMENT</p>		<p>REGISTRATION AND ESTABLISHMENT NUMBERS</p>	<p>NET CONTENTS</p>
<p>NAME AND ADDRESS OF MANUFACTURER</p>		<p>MISUSE STATEMENT</p>		<p>CHILD HAZARD WARNING</p>	

Questions for Self Study — Chapter XIV

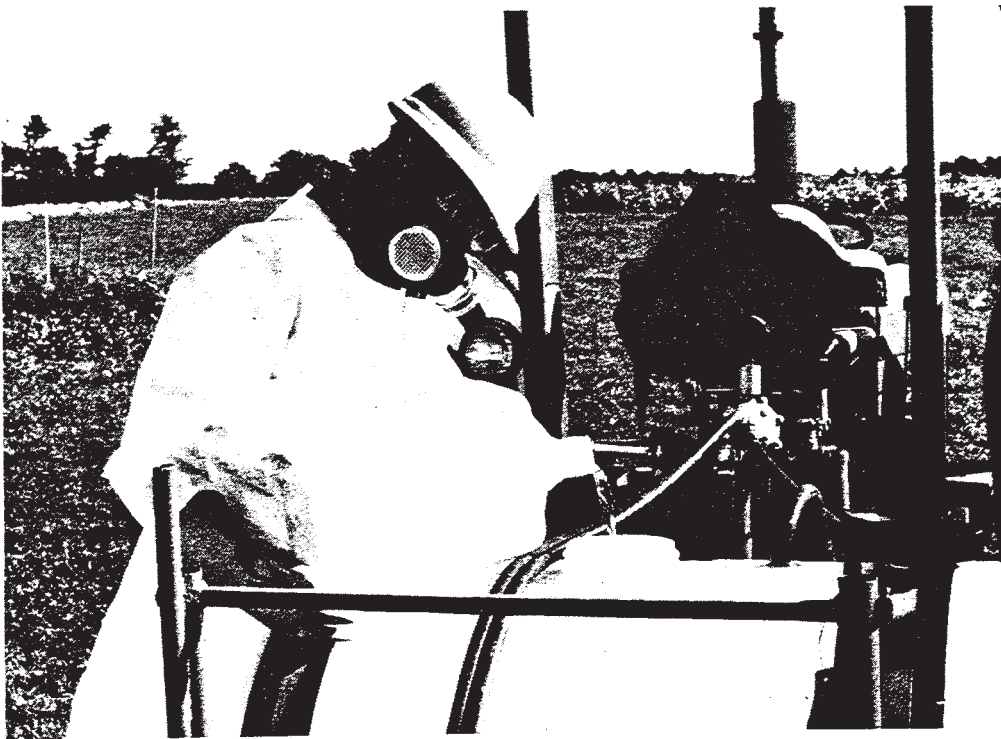
1. Are the words "Keep Out of Reach of Children" on all pesticide labels?
2. Does the label specify the protective equipment necessary for cautious use of each pesticide?
3. If the intended use is not listed on the label, but you are pretty sure it works, should you go ahead and use it anyway?
4. If 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?

Filling and Mixing

Chapter XVI

Some pesticides are used as purchased. These include baits, garden dusts, dry granular materials, aerosols, and some liquid household and livestock sprays. However, most custom applicators will stock concentrated pesticides, such as wettable powders or emulsifiable concentrates that must be diluted with other liquids before using. Water is the most common liquid used for diluting pesticides.



Goals of This Chapter

- Learn to determine how, when, and where to mix concentrations of pesticides.
- Understand the importance of protecting the environment from spills and the safety measures that should be taken.
- Learn how to determine the compatibility of pesticides.

When to Mix

It is best not to add the pesticide to the tank or the granules to the hopper until just before you are ready to apply. This is particularly true when you are going on a job that you have not checked previously. If the pest is different than you had expected, you may be faced with the disposal of a tankful of the wrong pesticide. On the other hand, a pest control operator treating an apartment should never carry any concentrate into the apartment. Therefore, you will have to mix the pesticide beforehand.

Safe Practices for the Applicator



The applicator is most likely to be dangerously exposed to pesticides when mixing since handling the concentrated form is hazardous. You may splash liquid concentrates on your skin or in your eyes unless they are protected. You may spill them on your clothing where they can soak through to the skin or expose whoever handles the clothing later on. You may breathe particles from highly concentrated wettable powders or from granules or dusts. You may contaminate your hands and then unintentionally carry the pesticide to your mouth when smoking, eating, or just rubbing your lips or eyes. Always wear adequate protective clothing and equipment. Always put them on before handling or opening a pesticide container. Remember that a respirator or an appropriate form of eye protection should be worn if there is any chance of pesticide inhalation or eye exposure. Use chemical-resistant gloves, goggles, and a respirator when handling moderately toxic materials, even if the label does not call for them. Never use bare hands when mixing a highly toxic material or when cleaning a tank. It is also important that soap, water and good washing facilities be maintained at the mixing area. Never eat, drink, or smoke while handling pesticides.

Equipment should be operational and calibrated prior to filling and using. The spray tank must also be clean; oil, grease, and chemical residues can cause incompatibility problems. The agitation system should be running and the spray tank should be approximately half filled with water before any pesticide is added. Always keep your head higher than the level of the fill hole and do not allow the pesticide to spill or splash when putting it into the tank.

Review the label before opening the container so that you are familiar with current mixing and usage directions. This is essential — directions, including amounts and methods, often change.

Carefully choose the pesticide mixing and loading area. It should be outside, away from other people, livestock, and pets. Pesticides should not be mixed in areas where a spill or overflow could get into a water supply. If possible, mix and load pesticides on a concrete pad so that spilled pesticides can be removed and not absorbed into the ground. Handling areas frequently must be near a pond or stream bank. If this is the case, the area should be graded to slope away from the water. If you must work indoors, or at night, be sure there is adequate ventilation and light. Have a supply of clean water and soap available and, if possible, do not work alone.

Do not tear paper containers to open them; use a sharp knife or scissors. Clean the tool afterwards and do not use it for other purposes. When pouring from a container, keep the container at or below eye level and avoid splashing or spilling on your face or protective clothing. Never use your mouth to siphon a pesticide from a container. Always stand upwind, or so that the wind does not blow the pesticide toward your body. To prevent spills, close containers after each use. If an accident occurs, attend to it immediately. Remove any contaminated clothing and wash yourself thoroughly with soap and water. Spills on the floor or ground should also be attended to immediately. Some chemicals in the concentrated form will remain in toxic quantities in the soil for months.

Measure accurately; follow label instructions and mix only the amount you plan to immediately use. Newer measuring devices, such as “tip and pours”, are a great help in handling small amounts of concentrate. All measuring devices (spoons, cups, scales) should be labeled and kept in the pesticide storage area and should never be used for other purposes.

The environment can be easily harmed by careless mixing and filling procedures. Areas where pesticides are mixed and equipment is filled have great potential as sites where groundwater can be contaminated with pesticides. Groundwater has been contaminated because pesticides spilled during filling and mixing, run off the area during rinsing and washing, or were back-siphoned directly into the water source. When adding the additional water to a spray mixture, the water pipe or hose should remain above the level of the mixture, never contacting it. This prevents contamination of the hose and avoids the possibility of back-siphoning the pesticide into the water source. Suction hoses should be equipped with antisiphoning devices. If suction hoses are not equipped with devices such as check valves, the spray mixture from the tank may escape down the hose into a water source. Contact your state regulatory

Protect the Environment

agency for information on antisiphoning device requirements. If the applicator allows the tank to run over when filling, the overflow carrying pesticides will usually end up in the water source or as toxic puddles on the ground. Never leave a piece of equipment unattended when it is being filled.

Spills and Safety Measures

The most hazardous activities involving pesticides are mixing and loading of concentrates. Use no more than the amount called for to prevent injury to exposed plants and/or animals and to prevent illegal residues. Do not combine pesticides unless the combination is called for on the label or you have consulted an authority.

The following procedures are recommended for cleaning up small spills or spills that will not contaminate water. Remember to wear all protective clothing indicated on the pesticide label during the entire cleaning process.

1. Contain the spill. Do everything possible to immediately stop the leak or spill. If the material is a liquid, construct a dam to prevent it from spreading.
2. Isolate the contaminated area. Rope off the area or use chalk to draw a line around it. Keep people at least 30 feet away from the spill.
3. Soak up the spill. Spread an absorbent material such as vermiculite, fine sand, or sawdust over the entire spill.
4. Collect the material for disposal. Sweep or shovel the contaminated absorbent material into a heavy-duty plastic bag.
5. Decontaminate the area. For floors, work a decontamination agent (usually hydrated lime or a high pH detergent) into the spill area with a coarse broom. Add fresh absorbent material to soak up the now contaminated cleaning solution. Sweep or shovel the contaminated material into a heavy-duty plastic bag. Repeat this procedure several times to ensure thorough decontamination. For soils, shovel the top 2 to 3 inches of soil into a heavy-duty plastic bag. Next, cover the area with at least 2 inches of lime. Finally, cover the lime with clean topsoil. Minor spills can sometimes be cleaned up by immediately applying activated charcoal to the contaminated surface.
6. Clean up contaminated vehicles and equipment. Use a mixture of liquid bleach and alkaline detergent to clean metal surfaces. Porous materials and equipment such as brooms, leather gloves, and sponges cannot be decontaminated effectively and, therefore, must be disposed of.
7. Dispose of contaminated materials. Remember that this includes contaminated absorbent materials, soil, and porous equipment. Check with your state regulatory agency to find out where you may dispose

of these materials. Most can be disposed of in a licensed sanitary landfill, but some contaminated materials are considered hazardous waste and require special handling.

For major spills, or spills that may contaminate water, follow the first three steps under the directions for cleaning up minor spills. Then call the CHEMTREC telephone number (800) 424-9300. A qualified person will answer and direct you regarding what procedures to follow and whom to notify. If necessary, the area coordinator will dispatch a pesticide safety team to the site.

Spills may also require notification steps to other authorities. If a state highway is the site of a spill, notify the highway patrol and the state highway department. If food is contaminated, notify state or federal food and drug authorities and city, county, or state health officials. If water is contaminated, notify public health authorities; regional, state, or federal water quality or water pollution authorities; and the state fish and game agency.

"Empty" pesticide containers are not truly empty. As soon as they are emptied, containers with liquid pesticides should be triple-rinsed as described in Chapter XXI (Disposal). Measuring cups should be rinsed and the rinsewater put into the spray tank. Rinse them at least three times with the same liquid that the tank is being filled with. Pour the rinsewater into the spray tank to avoid disposal problems and wasting product. Replace container caps and close bags. Return them to the pesticide storage area. All containers must be accounted for and properly disposed of. Otherwise, they too may end up in a water source or may poison other people or animals. Rinsing can save you money too!

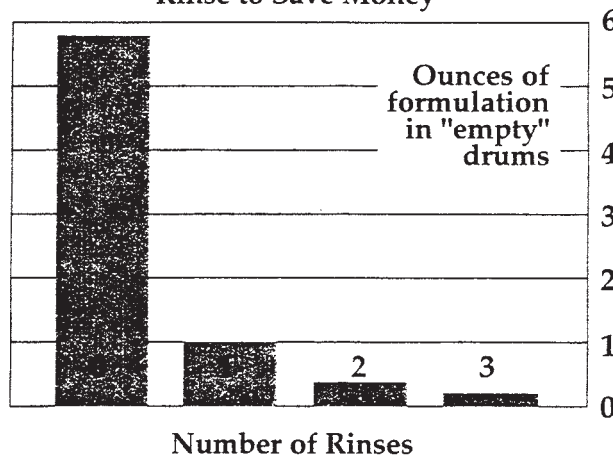
Empty and Rinse

Empty to Save Money

Amount of Residue	\$ Loss at:	
	\$20/gal.	\$30/gal.
6-1/2 oz. (5 gal.)	\$1.00	\$1.50
34 oz. (55 gal.)	\$5.00	\$7.50

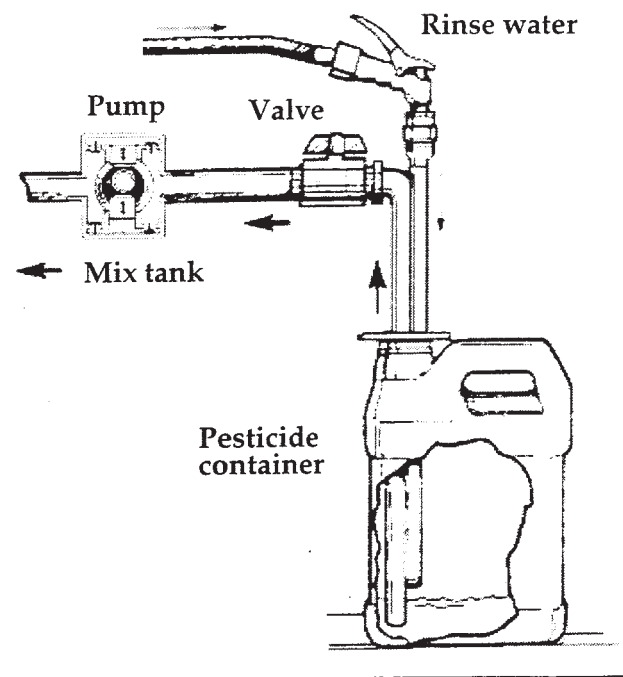
An easy way to cut costs!

Rinse to Save Money



Closed Pesticide Handling Systems

A closed handling system allows you to remove a pesticide from its original container, rinse the empty container, and transfer the pesticide and rinse solution to the spray tank without contacting the pesticide. These handling systems can dramatically reduce your exposure to concentrated pesticides. There are two basic types of closed systems; gravity systems and suction systems.



Gravity systems, sometimes called “punch and drain” systems can open, drain, then deliver the pesticide to the equipment tank. Unopened pesticide containers are inserted into a box, which is then sealed. A punch opens the container allowing all of the pesticide to drain into the mixing tank. The punch is attached to a clean water line which sprays the inside of the container to rinse it and then returns the rinse to the mixing tank. The applicator then removes the rinsed pesticide container for disposal. The limitation of gravity systems is accomplished because full containers are used and it is not possible to use part of a pesticide container.

Suction systems pump the pesticide out of the container through a probe inserted into the container. Some containers are being equipped with built-in probes. A pipe moves the pesticide to the mixing tank. A clean water pipe rinses the container when it is empty and the rinse water is added to the mix tank.

Compatibility

Often two or more pesticides are mixed together in the sprayer tank in order to control more than one pest with the same application. However, the pesticides must be compatible; that is, they must be able to be mixed together without reducing their effectiveness in any way. Some pesticides may be **chemically** incompatible. A chemical reaction between them may result in loss of pesticide activity, increased toxicity to the applicator, or injury to the treated surface. It is possible for the pesticide to be **physically** incompatible as well. Mixing the pesticides may cause wettable powders to form lumps. Liquids may settle into layers or form solids that settle out. The label often lists compatibilities of the pesticide involved and compatibility charts are available in pest management recommendations, pesticide trade publications, etc.

A way to remember the sequence for mixing solids and liquids is W-A-L-E. When formulations of different types, including wettable powders, water dispersible granules, liquid flowables and emulsifiable concentrates are mixed together in the spray tank, they should be added in

the right order to assure proper dispersion and uniformity.

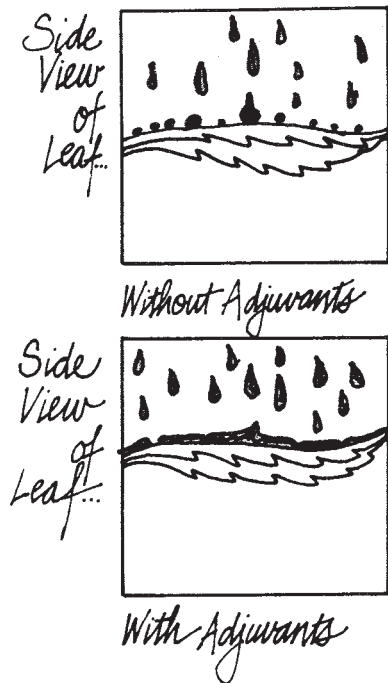
- Fill the spray tank 1/4 full of water and get the agitation going until the water in the tank is rolling.
- Now begin the W-A-L-E sequence:
 1. Add wettable powders and water dispersible granules first. (W)
 2. Agitate until the W's are uniformly dispersed, meanwhile adding water until the tank is 90% full. (A)
 3. Add flowable liquids. (L)
 4. Emulsifiable concentrates go in last. (E)
- Now top off the tank, continue agitation and the pesticides are properly mixed.

It is better to mix liquids with liquids or wettable powders with wettable powders, rather than a liquid with a wettable powder. Small quantities of wettable powders often mix easier if a slurry is made first.

Keep in mind that water characteristics influence the effectiveness of some pesticides. Alkaline spray water, for example, can lead to chemical breakdown of many organophosphates and carbamates. If your water supply is alkaline, especially if the pH is 8.0 or greater, and you are using a pesticide that is sensitive to high pH, you can and should lower the pH of the water in the spray tank. A pH in the range of 4-6 is recommended for most pesticide sprays. You can adjust your spray solution to the 4-6 pH range by using adjuvants that are marketed as buffering agents.

Water pH

Adjuvants



An adjuvant is a chemical added to a pesticide mixture that helps the active ingredient to do a better job. Most pesticide formulations include a small percentage of adjuvants (additives). Wetting agents and emulsifiers are needed so that the pesticide chemical will mix with water. Spreaders and stickers help make the active ingredient spread evenly over the treated surface and stay there in spite of rain, wind, or bad weather. Some pesticides, especially herbicides, must be absorbed by the target to be effective. Penetrants aid the pesticide to get through the outer surface (leaf, root, skin) and into the plant. The formulation, as manufactured, contains enough of these materials for many jobs, but sometimes extra additives are called for. For example, when treating waxy surfaces such as cabbage or onion leaves, a spreader-sticker may be needed. These extra additives are added directly into the spray tank. Care must be taken to use only the amount recommended or the result may be less deposit rather than more, resulting in poor control. Other types of additives include thickeners, emulsifiers, buffering agents, and foaming agents.

Special caution during mixing and filling are well worth your time and effort. Your reward will be safety for you, others, the environment and perhaps saving a little money too.

Questions for Self Study — Chapter XVI

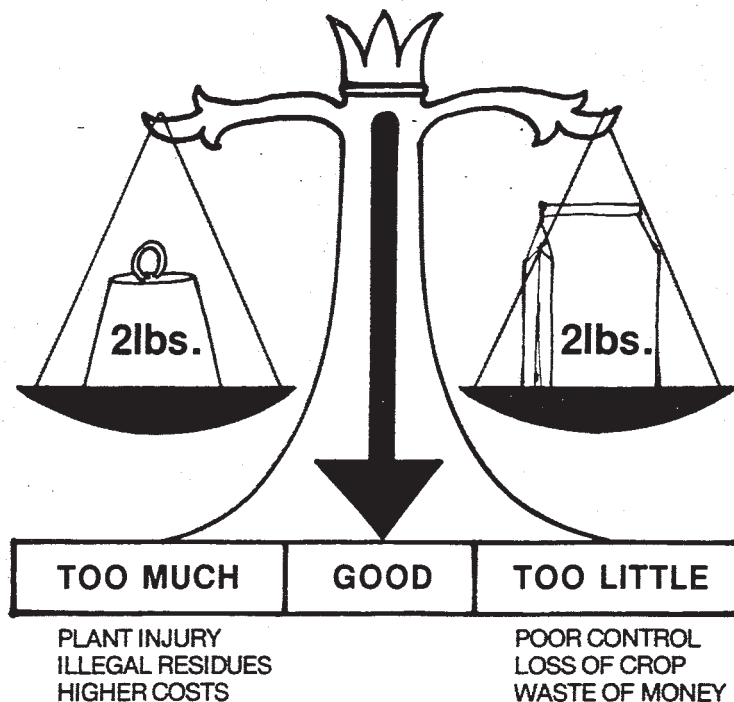
1. Which pesticide formulations must be diluted before they are applied?
2. When is the best time to add the pesticide to the spray tank? Why?
3. Why is mixing the time when the applicator is most likely to be dangerously exposed to pesticide poisoning?
4. Through which route(s) of entry is the applicator likely to be exposed during mixing?
5. Why are anti-siphoning devices important to protect the environment?
6. When you empty a pesticide container, why is it necessary to rinse it out?
7. How many times should you rinse an empty pesticide container and measuring cups, etc.?
8. Can you mix all types of pesticides together without any problem? Why?
9. What does compatibility mean?
10. Where can a pesticide applicator find out if two pesticides are compatible?
11. What is an adjuvant?
12. For what kind of a job would you use a spreader-sticker?
13. Why is it important to measure out the correct dosage of an adjuvant to add to the spray tank?
14. Should a pesticide applicator wear protective clothing while mixing or filling pesticides? Why?
15. For most pesticide sprays, what is the recommended pH level?
16. When a pesticide is accidentally spilled, what is the first thing an applicator should do?

Calculations for Mixing Pesticides

Chapter XVII

In mixing a finished spray, it is most important to add the correct amount of pesticide to the mix. Too little may result in a poor job, while too much may result in injury to the treated surface, illegal residues, or unnecessary expense. Directions for mixing are given on the label and only very simple calculations are necessary.

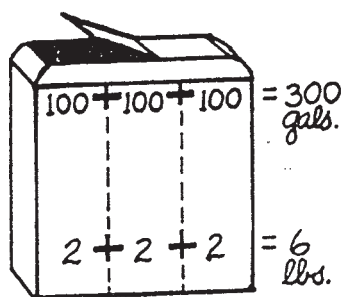
RECOMMENDED: 2 POUNDS PER ACRE



Goals of This Chapter

- Understand the importance of adding the correct amount of pesticide to a mix.
- Learn to do correct calculations for mixtures of pesticides.

Wettable Powder Mixing



You may be given directions to add 2 pounds of pesticide to 100 gallons of water and you wish to fill a 300 gallon tank. Since you know that 300 gallons is 3 times 100 gallons, you simply add 3 times 2 pounds, or 6 pounds in 300 gallons. If you wish to mix only 20 gallons of finished spray, you must use some simple arithmetic. Follow these steps:

1. Find what part 20 is of 100.

$$\frac{20}{100} = \frac{2}{10} = \frac{1}{5} \text{ OR 20 goes into 100 five times.}$$

So 20 gallons is $\frac{1}{5}$ of 100 gallons.

2. Therefore, you must add $\frac{1}{5}$ of 2 pounds of pesticide to your finished spray.

1 pound contains 16 ounces; 2 pounds contains 32 ounces.

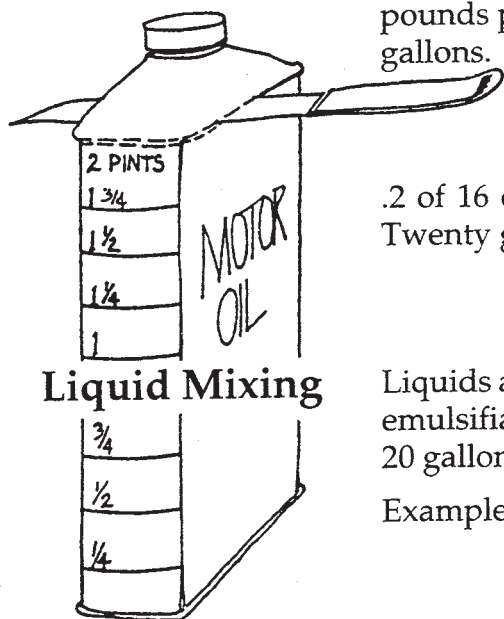
$$\frac{1}{5} \text{ of 32 oz.} = 32 \text{ divided by 5}$$

$$\begin{array}{r} 6.4 \\ 5 \overline{) 32.0} \\ \underline{30} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

Another way to handle the above situation would be to figure that at 2 pounds per 100 gallons, .2 (two tenths) pounds is required for every 10 gallons.

$$\frac{2 \text{ lb.}}{100 \text{ gal.}} = \frac{.2 \text{ lb.}}{10 \text{ gal.}}$$

.2 of 16 ounces = 3.2 ounces, so every 10 gallons requires 3.2 ounces. Twenty gallons would require 6.4 ounces.



Liquid Mixing

Liquids are mixed in the same manner. If your directions call for 2 pints emulsifiable concentrate per 100 gallons, 300 gallons will take 6 pints and 20 gallons will take .2 (two tenths) of 2 pints.

Example:

$$\begin{array}{l} 2 \text{ pints (1 quart)} = 32 \text{ fluid ounces.} \\ .2 \text{ of 32} = 32 \times .2 = 6.4 \text{ fluid ounces} \end{array}$$

Sometimes you will find directions telling you to make a finished spray of a specific percentage, for instance, 1% spray for ants. The pesticide may be formulated as a 57% emulsifiable concentrate. To make a 1% finished spray, you would add 1 part of pesticide to 56 parts of water. For example, 1 fluid ounce in 56 fluid ounces (1 3/4 quarts) of water.

When mixing percentages you should remember that 1 gallon of water weighs about 8.3 pounds and 100 gallons weigh about 830 pounds.* Thus, to make a 1% mix of pesticide in 100 gallons of water you must add 8.3 pounds of active ingredient of pesticide to 100 gallons of water. The following formulas may be used for reference.

Formula for Wettable Powder Percentage Mixing. To figure the amount of wettable powder to add to get a given percentage of active ingredient (actual pesticide) in the tank:

$$\frac{(\text{gals. of spray wanted}) \times (\% \text{ active ingredient wanted}) \times 8.3 (\text{lbs./gal.})}{(\% \text{ active ingredient in pesticide used})}$$

Example

How many pounds of an 80% wettable powder are needed to make 50 gallons of 3.5% spray for application by mist blower?

$$\frac{50 (\text{gals. wanted}) \times 3.5 (\% \text{ wanted}) \times 8.3 (\text{lbs./gal.})}{80 (\% \text{ active ingredient})} = \frac{1452.5}{80}$$

$$= 18.1 \text{ lbs. } 80\% \text{ WP}$$

Formula for Emulsifiable Concentrate Percentage Mixing. To figure amount of emulsifiable concentrate to add to get a given percentage of active ingredient (actual pesticide) in the tank.

$$\frac{(\text{gals. of spray wanted}) \times (\% \text{ active ingredient wanted}) \times 8.3 (\text{lbs./gal.})}{(\text{pounds of active ingredient per gallon of concentrate}) \times 100}$$

Example

How many gallons of a 25% emulsifiable concentrate (2 pounds pesticide per gallon) are needed to make 100 gallons of 1% spray?

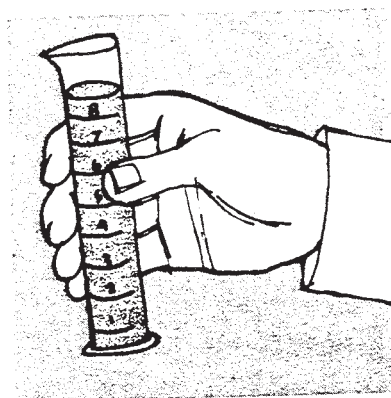
$$\frac{100 (\text{gals. wanted}) \times 1 (\% \text{ wanted}) \times 8.3 \text{ lbs./gal.}}{2 (\text{lbs. active}) \times 100} = \frac{830}{200} = 200 / \frac{830.00}{1000}$$

$$4.15$$

$$4.15 \text{ gallons } 25\% \text{ EC}$$

*One gallon of kerosene weighs 6.6 pounds. One hundred gallons weighs 660 pounds.

Percentage Mixing

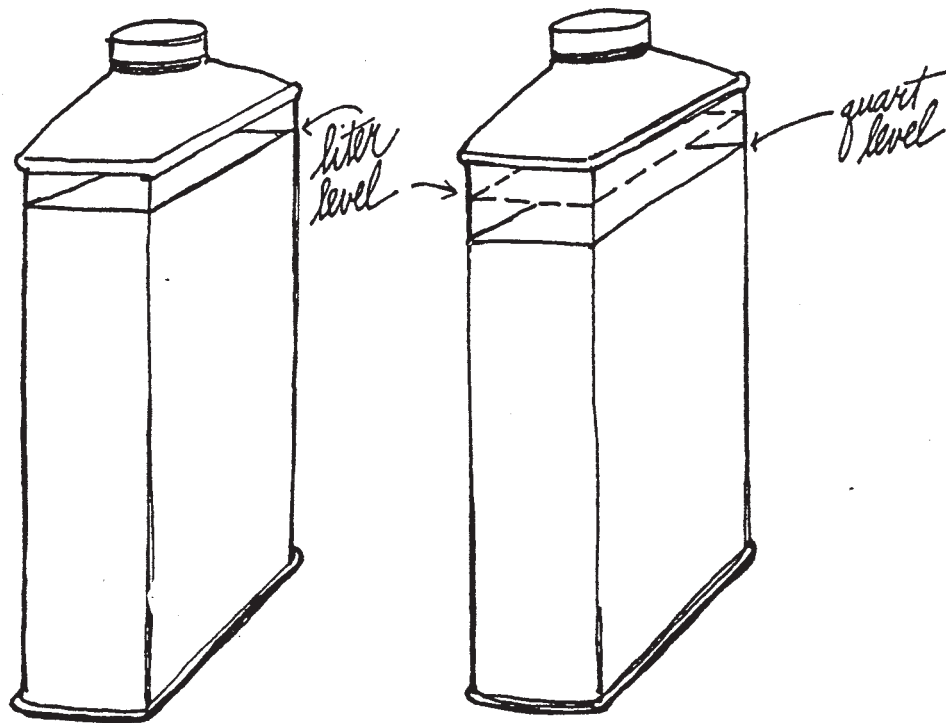


Square Feet Mixing

Often the label will give mixing instructions in terms of quantities of pesticide to be used per 1000 square feet as in turf treatments, or per acre as in commercial vegetables. In this case you will have to determine and adjust the amount of liquid your sprayer applies over a given area. This is called calibrating the equipment. When the equipment is calibrated you can add the proper amount of pesticide to give the recommended dosage per area. Calibration is described in Chapter XIX.

Useful Facts to Remember

- 1 gallon of water weighs about 8.3 pounds.
- 100 gallons of water weigh about 830 pounds.
- 1 pound = 16 ounces = 453.6 grams.
- 1 pint = 16 fluid ounces = 473 milliliters.
- 1 quart = 32 fluid ounces = 946 milliliters = .946 liters.
- 1 pound wettable powder per 100 gallons = 1 tablespoon per gallon (approximately).
- 1 pint emulsifiable concentrate per 100 gallons = 1 teaspoon per gallon.



$$1 \text{ Liter} = 1.06 \text{ Quarts}$$

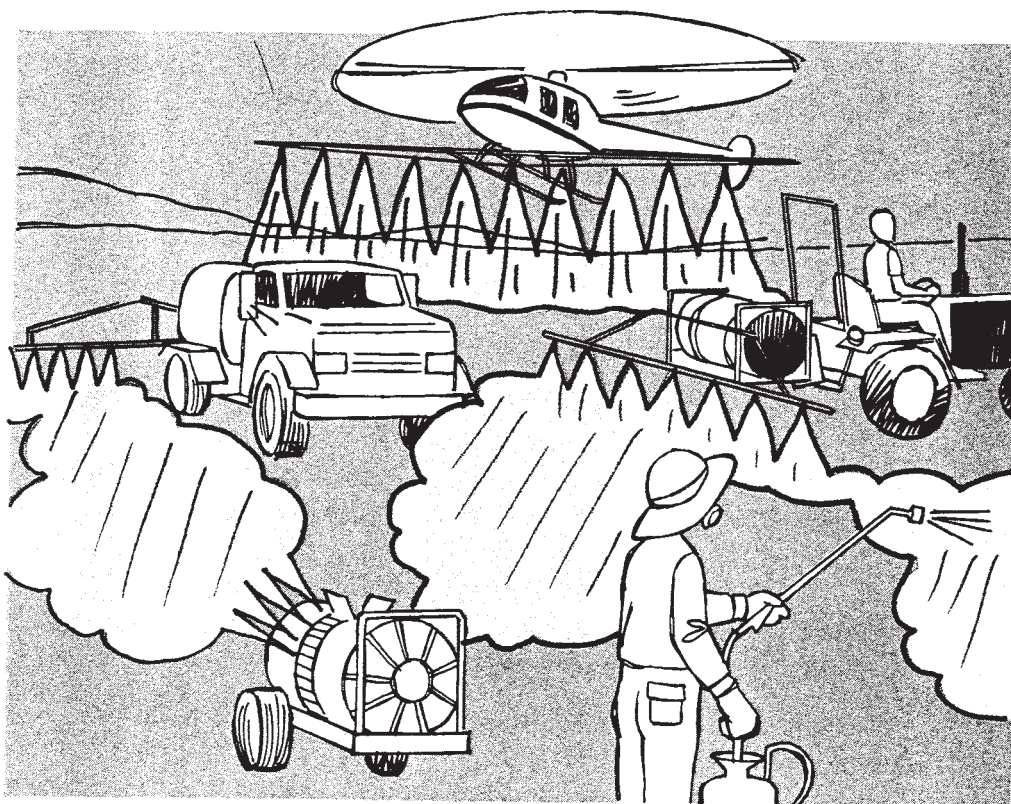
Questions for Self Study — Chapter XVII

1. Why is it so important to add the correct amount of pesticide to the mix?
2. If your recommendations call for 3 pounds of wettable powder per 100 gallons of finished spray, how much do you put in a 450 gallon tank? Show your calculations.
3. How much do you put in an 80 gallon tank at 3 pounds per 100 gallons?
4. If the label says to mix 3 pints per 100 gallons of an emulsifiable concentrate, how much do you put in a 300 gallon tank? How much do you put in a 50 gallon tank?
5. If one pound of WP is recommended per 100 gallons of water, how many tablespoons of WP would you add to one gallon?
6. If two pints of EC are recommended per 100 gallons of water, how many teaspoons of EC would you add to one gallon?
7. How much does 100 gallons of *water* weigh? 100 gallons of *kerosene*?
8. How many gallons of 25% emulsifiable concentrate would you add to a 50 gallon tank to get a 1% mixture?
9. How many pounds of 25% wettable powder must you add to 100 gallons of water to get a 1% active ingredient mixture?

Equipment

Chapter XVIII

Pesticide application equipment varies widely from the simple paintbrush, plunger duster, pressurized can or aerosol bomb to the modern agricultural airplane that is fully equipped with liquid spray systems and/or granular spreaders. There are also several types of support equipment — filler pumps, tank trucks, nurse or mixing tanks, front-end loaders, etc. — that are not used in actual application but that make the spray operation more efficient.



Goals of This Chapter

- Learn the names and uses of the various types of application equipment.
- Learn how to select the best application equipment for the job.
- Understand the basic principles of operation for each type of equipment.
- Know the advantages and disadvantages of each type of application equipment.

Choose Your Equipment Wisely

Most application equipment can be used for several different kinds of problems. By choosing the type of equipment best suited for his type of work, the applicator can save himself and his customers time and money. The aerial applicator's equipment differs greatly from that of the structural pest control operator. The arborist uses machinery suited for arborist needs. Even when he specializes in a specific type of pest control the pesticide applicator will need to make a choice of equipment. The choice will depend on his working conditions, pesticide formulation, type of area treated, possible problems, etc. While large power equipment may be desirable for some problems, other jobs may be best done by using small portable or hand equipment. Most application equipment can be placed into two groups; one group that applies dry pesticide formulations and another for liquid pesticides.

Dry Formulation Equipment

Dusters

Dusters blow fine particles of pesticide dusts onto the target surface. They may be very simply constructed. Often the package containing the pesticide dust acts as the duster, such as a plastic squeeze bottle or a telescoping tube with a spout. Even the larger powered models are of simple construction. Dusters are used mostly by home gardeners, pest control operators, and truck gardeners for individual spot treatment of plants or a small area. In some areas dusts are still applied with aerial application equipment.

Advantages. Dusters are lightweight, relatively cheap, and fast acting. They do not require water.

Disadvantages. Dusts are highly visible, drift easily and are difficult to control. Because of this, dusters are less desirable for most crops or large outdoor jobs.

Granular equipment is designed to apply coarse, dry particles that are uniform in size to soil, water, and in some cases foliage. Spreaders may work in several different ways including pneumatic whirling discs (seeders, fertilizer spreaders), multiple gravity feed outlets (lawn spreaders, grain drills), soil injectors (furrow treatments), and ram-air (agricultural aircraft).

Granule Spreaders

Advantages. Granular equipment, like dusting equipment, is light, relatively simple, easy to calibrate, and no water is needed. Because granules are uniform in size, they flow easily and are relatively heavy. Seeders and fertilizer spreaders can be used to apply pesticide granules, often without modification.

Disadvantages. Granular formulations have a limited number of uses and are known to poison non-target wildlife if left uncovered. Therefore, the applicator will need other machinery for controlling most leaf feeding insects and plant diseases.

Sprayers

More pesticides are applied with sprayers than with any other equipment. Consequently, there are many different types and sizes of sprayers varying from hand operated units to machines weighing several tons. Some apply dilute pesticide mixtures while others apply concentrates. Some use low pressure and low gallonage (low volume) and usually have simple roller pumps. Others are high pressure and/or high volume, usually supplied by high pressure piston pumps. Some apply spray through single outlets or nozzles while others use multiple nozzles linked by sections of pipe or tubing to form a boom. The principal types are described below but there may be several variations or combinations of these types.

Liquid Formulation Equipment

Hand operated sprayers are most commonly used by individuals for their own relatively small pest problems. However, the commercial applicator will often find it convenient and efficient to have hand sprayers for small jobs that do not require larger powered equipment or that require only a small amount of spray. They are also used for small jobs in hard-to-get-at areas where the spray equipment must be carried in. Hand sprayers use carbon dioxide or compressed air to force the spray liquid through a nozzle. These sprayers may be available for use with single or multiple nozzle systems. The capacity of hand sprayers generally ranges from one-half to five gallons.

Hand Operated Sprayers

Advantages. Hand sprayers are economical, uncomplicated, lightweight, yet will do a surprising amount of work and adapt to many

different problems. The spray is easily controlled when it comes to direction, drift, etc., because relatively little spray is used at low pressure.

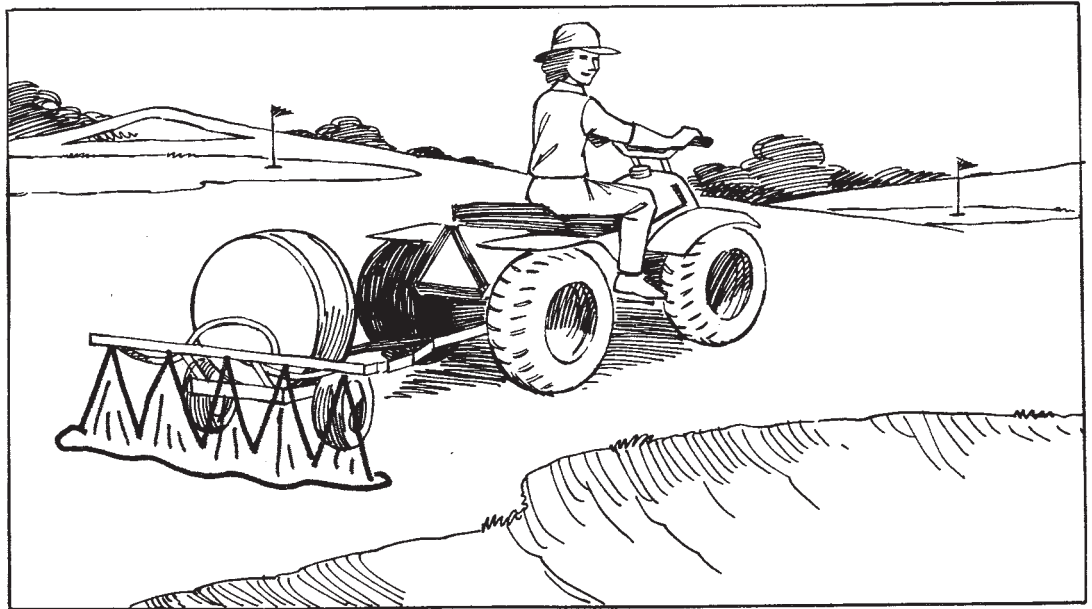
Disadvantages. Hand sprayers are efficient and practical for small jobs only. Wettable powders tend to clog regular nozzles and agitation is frequently poor.

Low Pressure Boom Sprayers

These sprayers are usually mounted on tractors, trucks, or trailers. They are designed to be driven over field crops or large areas of turf, applying the pesticide in swaths. Low pressure sprayers generally use a relatively low volume of dilute spray ranging from 10-40 gallons per acre and applied at 30-60 psi. Typical low pressure sprayer components consist of a pump, tank, agitation system, flow control valves and the boom. Low pressure sprayers use roller or centrifugal pumps.

Advantages. Low pressure sprayers are relatively inexpensive, lightweight, adapted to many uses and can cover large areas rapidly. They are usually low volume, so one tankful will cover a large area.

Disadvantages. They will not adequately penetrate and cover dense foliage because of their low capacity (pressure and gallonage). Because most use hydraulic agitators, wettable powder formulations often settle out. However, if mechanical agitators are used the problem is solved.



High pressure sprayers are often called “hydraulic sprayers.” They operate with dilute mixtures and different pressures from two hundred and fifty up to several hundred psi. The design of high pressure sprayers is similar to that of low pressure sprayers, the only difference being that the components have to withstand high pressures. When fitted with booms they can do any work done by a low pressure boom sprayer. They may also be fitted with handguns. The handguns are used for spraying shade trees and ornamentals, livestock, orchards, buildings, unwanted brush, rights-of-way, commercial crops, etc.

High Pressure Sprayers

Advantages. High pressure sprayers are useful for many different pest control jobs. They have enough pressure to drive spray through heavy brush, thick cow hair, or to the tops of tall shade trees. Because they are strongly built, they are long lasting and dependable. Piston pumps are standard and resist wear from gritty or abrasive materials. Mechanical agitators are also standard and keep wettable powders well mixed in the tank. With a long hose, targets in hard-to-get-at places such as trees, shrubs, etc., can be treated. If label directions for mixing are followed the applicator is not likely to overdose.

Disadvantages. High pressure hydraulic sprayers have to be strongly built and can be heavy and costly. They usually use large amounts of water and thus require frequent filling. The pesticide can easily be misdirected, causing drift and off-target contamination.

Air blast sprayers use air and water to deliver the pesticide to the target surface. The pesticide mixture is pumped through a nozzle or a series of nozzles. A high performance fan (blower) creates an air blast that blows the pesticide away from the spraying nozzle. The rushing air shatters the liquid into tiny droplets that are carried to the target by the air blast. The high speed air aids in breaking up larger droplets and transporting the smaller droplets for thorough coverage. The droplets may be carried 10 to 40 feet effectively depending on the need and the fan speed. Air blast sprayers are typically used in operations involving tree spraying, but are also used in field crop situations where the air blast provides a more effective means of penetrating foliage and providing coverage on all parts of plants.

Air Blast Sprayers

Advantages. A small amount of pesticide mixture covers a large area and little operating time is lost in refilling. They are usually less tiring to operate than hydraulic sprayers and are particularly adapted to applying sprays over a large area in a relatively short time. They provide an effective means of delivering pesticide to hard-to-reach areas and through dense foliage.

Disadvantages. Air blast sprayers are relatively expensive machines. Since the pesticide is carried by an air blast, they must operate under calm

conditions. Windy conditions interfere with the normal pattern of application of the blower. Wind can also cause the small, fine particles of concentrate to drift into surrounding areas where they may do damage. The visible mist that is blown into the air gives the perception that pesticides are missing the target. Larger models may not be able to treat hard-to-get-at areas.

Low, Ultra-low Volume Sprayers, and Volume Air Sprayers

ULVs and mist blowers

Mist blowers use a fan or whirling disk to break up and blow spray droplets toward a target. Both units apply low volumes of pesticide on target in the form of a mist. The mist consists of small droplets and is often hard to see. These sprayers depend on a metering device, which may or may not be a conventional nozzle. Low volume mist blowers use a diluted pesticide mixture, but ULV mist blowers use undiluted concentrate.

Advantages. Saving time and labor is the main advantage of low and ultra-low volume sprayers. This is accomplished by limiting the amount of liquid carried. These devices are light weight and easy to use. Effective pest control is achieved with a minimum of liquid applied, thus eliminating the problems with wet, dripping walls, animals or plants.

Disadvantages. Calibration is critical and overdosing is a potential problem because the applicator is applying a concentrate or nearly concentrated pesticide. Applying pesticides in favorable weather becomes more critical with this equipment than with air blast sprayers. A more concentrated mixture is being applied and drift could have devastating effects. Coverage with very low volumes on some crops may be less effective and thus less control is achieved. The use of concentrated pesticides increases the risk to the applicator. There are only a limited number of pesticides labeled for ULV application at the present time.

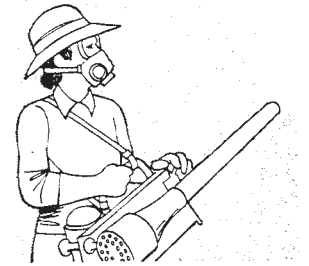
Aerosol Generators

Foggers

Aerosol generators break certain pesticide formulations into very small, fine droplets (aerosols). An individual droplet cannot be seen with the naked eye. When large numbers of droplets are formed, they can be seen as a fog or smoke. This is why the machines are commonly called "foggers." In some foggers, heat is used to break up the pesticide. These are called thermal aerosol generators. Other foggers break the pesticide into very fine particles with rapidly whirling discs, air blast breakup, or extremely fine nozzles. Aerosol generators are usually used to completely fill an area with a pesticidal fog, whether it be a greenhouse, warehouse, or open recreational grounds. Insects and other pests in the treated area can be controlled when they come in contact with the aerosol fog.

Advantages. The droplets produced by foggers are so fine they do not stick to surfaces within an area. Therefore, foggers can be used in the home for flying insects, in commercial buildings for a variety of pests, or outside in populated areas for blackflies and mosquitoes without leaving unsightly residues. The droplets float in the area and penetrate tiny cracks and crevices in furniture or through heavy vegetation to reach pests in hard-to-get-at places. Because they blanket an area, it is difficult for pests to escape exposure.

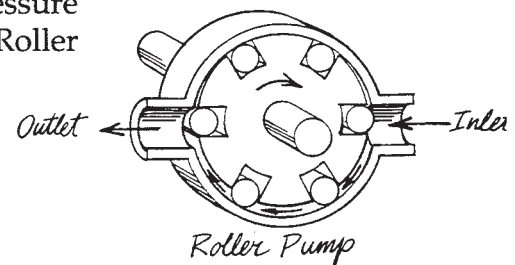
Disadvantages. Since most of the droplets produced by aerosol generators do not stick, little residual control of a pest is possible. As soon as the aerosol moves out of an area other pests can move back in. Also, the droplets produced are so fine that they drift for long distances and may cause unwanted contamination or injury. Most aerosol generators require special pesticide formulations. A general purpose formulation usually is not suitable. When foggers are used outside, the weather conditions must be just right. For example, if an area is being treated for mosquitoes, rising air currents could carry the aerosol harmlessly over the pests and out of the area. There must be little or no wind, otherwise the pesticide may be flushed from an area before it can be effective. When a building or an area is treated, it should be ventilated before it can be reoccupied to avoid harmful exposure to the pesticide.

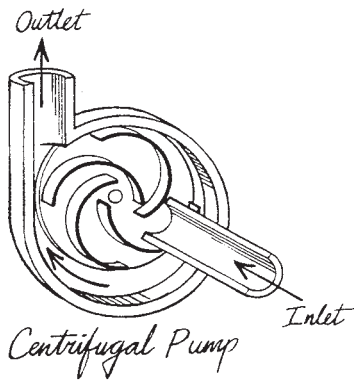


Flexible-Impeller pumps. Flexible-impeller pumps have a series of rubber "paddles" attached to a rotating hub. The pump housing is eccentric in shape and squeezes the paddles as the rotor turns. This pump has an automatic pressure relief characteristic. The paddles will not return to the radial position if the pressure is too high. The pump is limited to low pressures (less than 50 psi) and can handle all except highly abrasive materials.

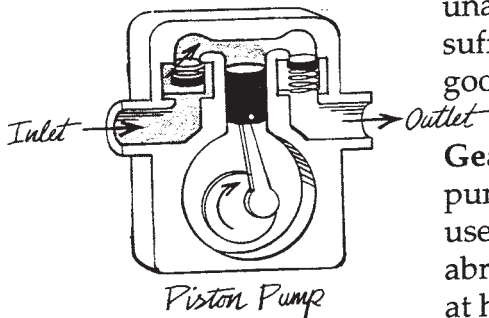
Roller pump. Roller pumps are probably the most widely used pump because they are effective, flexible and inexpensive. The "rollers" of a roller pump fit into slots of a rotating hub. The slots allow the rollers to follow the eccentric shape of the housing. As the rollers pass the inlet port, they push the liquid around the housing and toward the outlet port. As the rollers near the outlet port, the spaces become smaller and fluid is pushed out. The output from a roller pump decreases as the pressure increases because the rollers leak back fluid between rollers. Roller pumps are easily and economically rebuilt when worn.

Pumps





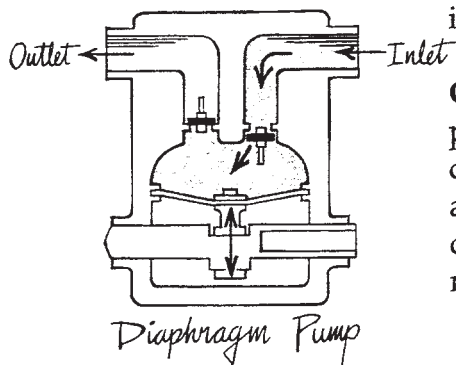
Centrifugal pumps. Centrifugal pumps have become increasingly popular in recent years. They handle abrasive materials well and their high capacity provides plenty of hydraulic agitation. This pump has an automatic pressure relief characteristic. One of the limitations is that they must be driven at high speed to develop pressure. Belt, gear, or hydraulic drives are used to gear up the pump to high speed. This pump requires priming unless it is located below the level of the supply tank. Pump output falls off rapidly at 30 to 40 psi. The steep performance curve is an advantage as it permits controlling pump output with a relief valve. However, it also produces uneven pump output under some conditions.



Piston pumps. Pistons are "positive displacement" pumps, which means that every time the piston moves the liquid must move. There is no leakage inside the pump chamber or automatic pressure relief characteristic like the roller pumps have. The piston pump output is virtually unaffected by pressure. Pump output is usually low and may not be sufficient for hydraulic agitation. It is the most expensive pump, but good for wettable powders and other abrasive mixtures.

Gear pumps. The gear pump is a semi-positive displacement type of pump and was used on many early sprayers. Gear pumps are rarely used today because of the high wear rate that occurs when pumping abrasive fluids. It is well suited to pumping oil suspensions or emulsions at high volumes and pressures. The internal parts (housing and gears) are generally made of bronze and the shaft is made of stainless steel. The pump cannot be rebuilt and must be thrown away when it is worn.

Diaphragm pumps. The pumping action in a diaphragm pump is produced by moving a flexible diaphragm. Liquid is drawn into one chamber on the downstroke and forced out of another on the upstroke. These pumps may be constructed with either one or two diaphragms. The diaphragm is resistant to wear from abrasives, but may be worn by certain chemicals. Diaphragm pumps are moderately priced and servicing is easy and economical.

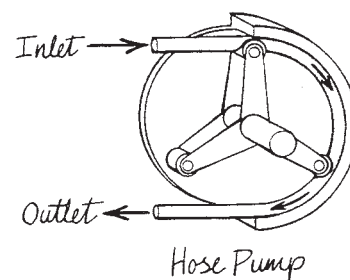


Ground driven pumps. Ground driven pumps, or metering pumps, are powered by a ground wheel. When speed changes, the rate of pumping changes accordingly. The major advantage of these pumps is that the application rate is held constant as the speed changes, compensating for changes in terrain and surface conditions. There are two types of pumps normally used on sprayers with ground drives.

The **variable-stroke piston pump** is designed to change the length of the piston stroke to adjust the application rate. Increasing piston stroke increases flow; reducing stroke cuts flow. When driven by a ground wheel, the applicator selects a flow rate by setting the piston

stroke. Once the flow rate is selected it will stay the same whether the sprayer is traveling one mph or five mph.

The **hose pump** consists of a series of rollers on a reel with a flexible hose stretched over the reel. As the ground wheel drives the reel, the rollers push a fixed amount of fluid around the hose, thus pumping the fluid. Flow from this pump cannot be changed.



Nozzles for sprayers are very important to proper pesticide application. Even experienced applicators often overlook the proper selection and maintenance of nozzles, perhaps the most important component of liquid pesticide application equipment. You as a new candidate for applicator certification must realize from this point on that with improper or worn nozzles, accurate application can never be utilized.

Sprayer Nozzles

Nozzles (often called “spray tips”) serve three functions:

- Meter or regulate the flow of the liquid
- Atomize the liquid stream into droplets
- Spread droplets in a specific pattern

Regulate flow. A nozzle regulates the flow of liquid with the size of its orifice. The pressure of the liquid is also a factor. With most nozzles, flow rate increases as pressure increases. However, doubling the pressure does not double the flow rate. Pressure must be increased four times to double the flow rate.

Atomize stream. Atomization of a liquid into droplets is caused by the tearing action of air. The nozzle spreads the liquid into a thin unstable sheet which breaks up into droplets as it hits the air. Each nozzle produces a range of droplet sizes from very small to large. Droplet size is measured in microns—one micron is equal to one millionth of a meter. An increase in the pressure causes an increase in tearing action, thus the droplets become smaller. If the droplets are too small drift will become a problem. If droplets are too large they will not stick to the surface and will roll off. Droplet size is an important consideration when selecting nozzles. Most nozzle manufacturers give droplet size information in their catalogues.

Spray nozzle tip wear. Worn nozzles have poor spray patterns and higher flow rates than new nozzles. Determine spray tip wear by comparing the flow rate of the used tip to the flow rate of a new one. Check the flow of each used tip by using an accurate graduated container and collecting liquid for a measured time. If the flow rate of the used tip is five percent greater than a new one, it should be replaced.

Actual droplet sizes

- 500 Microns
- 1,200 Microns
- 5,500 Microns

One inch = 25,400 Microns

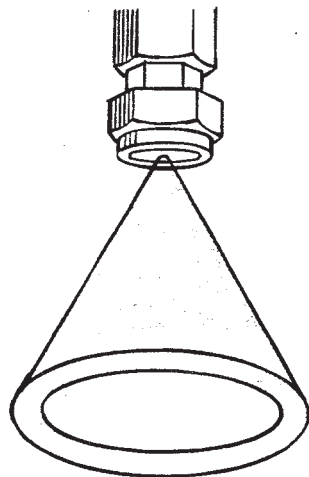
Maintain the nozzle. Nozzles must be protected from grit and dirt by adequate screens. Finely machined edges that control spray pattern can be damaged by the sanding action of dirt and abrasive spray mixtures. Clogged tips should be cleaned with a soft bristled brush only, never use a metal object. Use extreme care with soft tip materials such as plastic and brass. **Remember!! Never put a dirty, clogged nozzle to your mouth to clean it.**

Nozzle materials. Materials used to construct spray nozzles are chosen for their cost and durability. Although other materials are in use today, the following list gives the most common types.

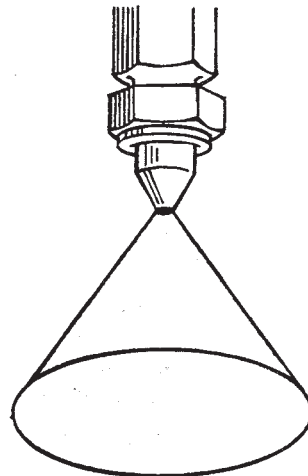
- Brass - probably the most commonly used, least resistant to wear and relatively inexpensive.
- Plastic and nylon - used for non-abrasive formulations, resists corrosion, and inexpensive. Not recommended for high pressure.
- Stainless steel - non-corrosive, excellent wear resistance and relatively expensive.
- Hardened stainless steel - useful for highly abrasive formulations, most expensive.
- Ceramic - most durable tip for highly abrasive and/or corrosive chemicals.

Nozzle Spray Patterns

Hollow cone and solid cone nozzles produce a circular pattern. Hollow cone nozzles generally make finer, smaller particles than the solid cone. These nozzles are used on handgun sprayers and row crop sprayers. They generally penetrate foliage well and are used to apply fungicides, insecticides and sometimes herbicides.

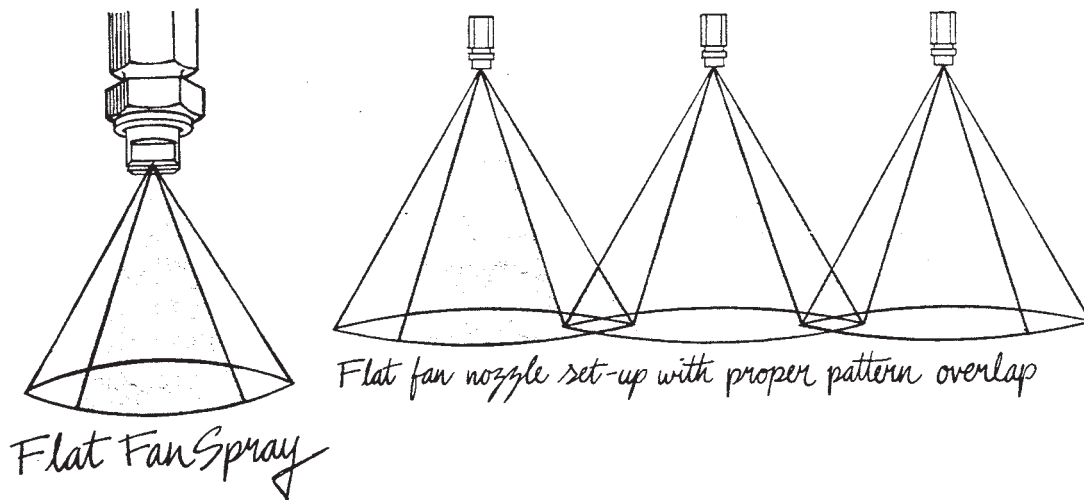


Hollow Cone Spray

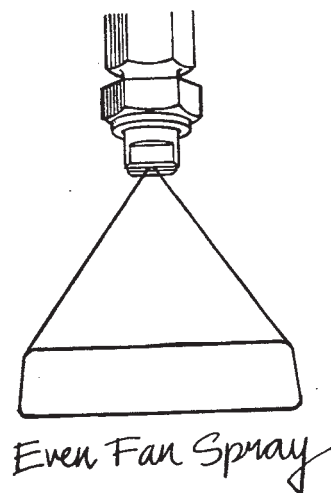


Solid Cone Spray

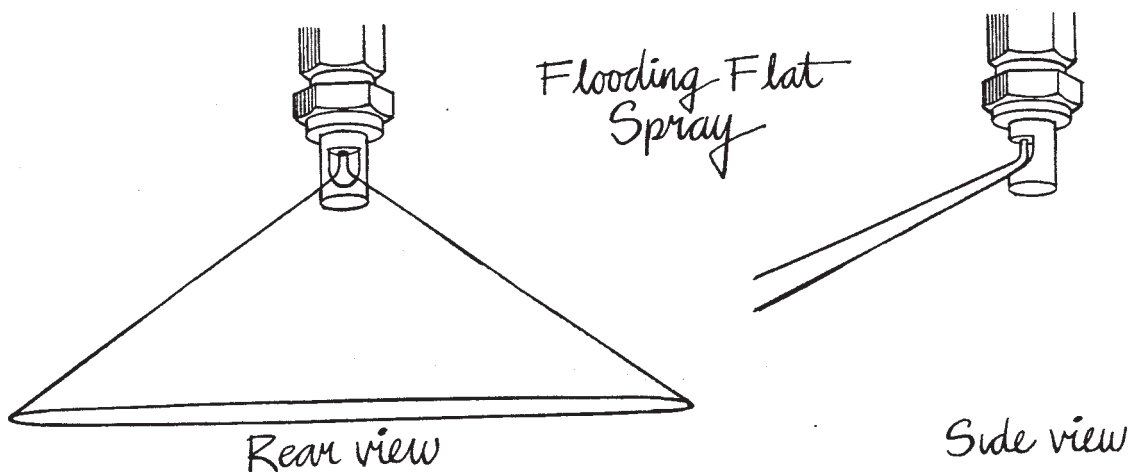
Flat spray nozzles are used to broadcast most types of pesticides. The pattern is fan shaped with gradually tapered edges. Uniform coverage across the sprayer width is achieved by overlapping the tapered portion of the pattern. This is also a common spray pattern used for applying structural pesticides to floor or wall surfaces.

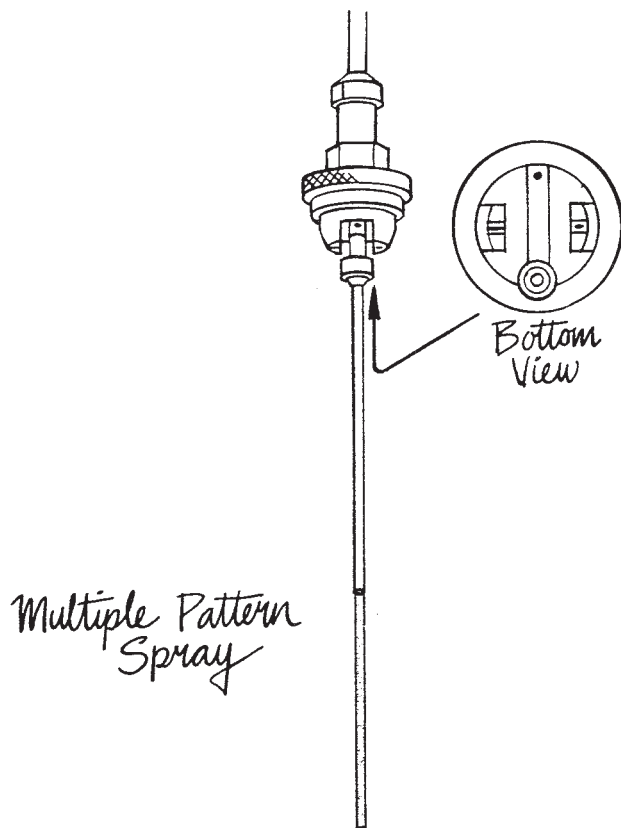


Even spray nozzles produce a narrow rectangular pattern with a sharp cut of edges. They are used for band applications of chemicals and are frequently used with planting equipment.



Flooding nozzles are often used for broadcast application of fertilizers, herbicides and defoliants. They deliver a wide flat spray pattern consisting of large droplets. They can be mounted on a boom in a variety of positions and are sometimes used alone for boomless broadcast spraying.





Multi-pattern spray nozzles are used on professional hand held sprayers and usually provide the applicator with a choice of different patterns built into one nozzle. Usually two flat fan patterns are available; one that produces fine particles and low volume patterns and a large volume fan with large particles. Another pattern will be the pin stream, used to apply the pesticide into a hole or crevice. There may also be a "crack and crevice" accessory tool attached as well. The applicator selects these patterns by loosening the nozzle collar and turning the nozzle body so that the desired pattern is used.

Care of Equipment

Whether equipment is very simple or very complex, it must be properly cared for so it will be both dependable and safe. Cleaning equipment including hoses, nozzles, pumps, tanks and hoppers is very important. Pumps and other equipment that will be stored in below freezing weather should be thoroughly drained, or better yet alcohol or antifreeze should be circulated through the equipment. Nozzles should be removed, cleaned, and stored.

Cleaning Sprayers

Clean the sprayer after each days use. Wear appropriate protective clothing when cleaning any piece of application equipment. Flush with clean water inside and out to prevent corrosion and accumulation of chemicals. When finished for the season or when changing chemicals, clean the sprayer thoroughly with a cleaning agent. Be careful to avoid contaminating water supplies and avoid injury to plants or animals when washing.

These steps are suggested:

1. Wash off the inside of the tank and partially fill it with water. Flush this water through the nozzles. When the tank is empty repeat these steps so that two complete rinses are done.
2. Take off the nozzle tips and screens. Clean them in a strong detergent solution or kerosene using a soft brush.

3. Fill the tank a third time, this time adding a cleaning agent. Refer to the following table for information on the type and amount of cleaning agent.

Cleaning Agents and Rates for Cleaning Sprayers		
<i>Pesticide used</i>	<i>2.5 gallons Cleaning solution</i>	<i>Instructions</i>
Insecticides ¹ and/or fungicides.	1 Tbsp. powder detergent ²	Agitate, flush, and rinse.
Hormone herbicides, salt or amine formulations (2,4-D, dicamba, MCPA, etc.) ³	1/2 cup household ammonia	Thoroughly agitate, flush small amount through system, and let remainder stand in sprayer overnight. Flush and rinse.
	OR	
	3 Tbsp. washing soda (sal soda)	Same as above except let stand for at least 2 hours.
	OR	
	1/4 lb. trisodium phosphate	Same as above except let stand for at least 2 hours.
	OR	
	2 Tbsp. fine activated charcoal and 1-2 oz. powder detergent ²	Agitate, operate sprayer for 2 minutes, let remainder stand for 10 minutes, then flush through sprayer. Rinse.
Hormone herbicides, ester formulations (2,4-D, brush killers, MCPA, etc.) ¹	4 oz. washing soda (sal soda) + 1-1/2 cup kerosene + 1 Tbsp. powder detergent ²	Rinse inside of tank and flush small amount through system. Let stand at least 2 hours. Flush and rinse.
Other herbicides (atrazine, simazine, alachlor, etc.	1 Tbsp. powder detergent ²	Rinse with clean water before and after using sudsy solution.

¹ Organophosphate and carbamate insecticides may be detoxified by adding household ammonia to the cleaning solution (1/2 cup per 2.5 gallons).

² Liquid detergent may be substituted for powder detergent; mix at a rate to make a sudsy solution.

³ Caution: Since only a trace of 2,4-D herbicide can damage sensitive plants, it may be risky to use an insecticide or fungicide in a sprayer that has been used to apply 2,4-D.

Cleaning Granular and Dust Application Equipment

These devices must also be cleaned following use. Here are some recommended steps:

1. Remove all pesticide from the device. This may require taking it apart to be thorough.
2. Clean the inside of the hopper.
3. Use sand paper or a wire brush to clean rusted parts. Paint the cleaned parts.
4. Coat the inside with oil. Oil or grease the bearings.
5. Thoroughly clean and oil the flow control slides or valves.
6. Excess oil should be wiped off if it will contact the chemical upon the next use.

If a pesticide applicator uses common sense, chooses the right formulation, the right pesticide, and the right machine to apply it, he can expect a good pest control job.

Questions for Self Study — Chapter XVIII

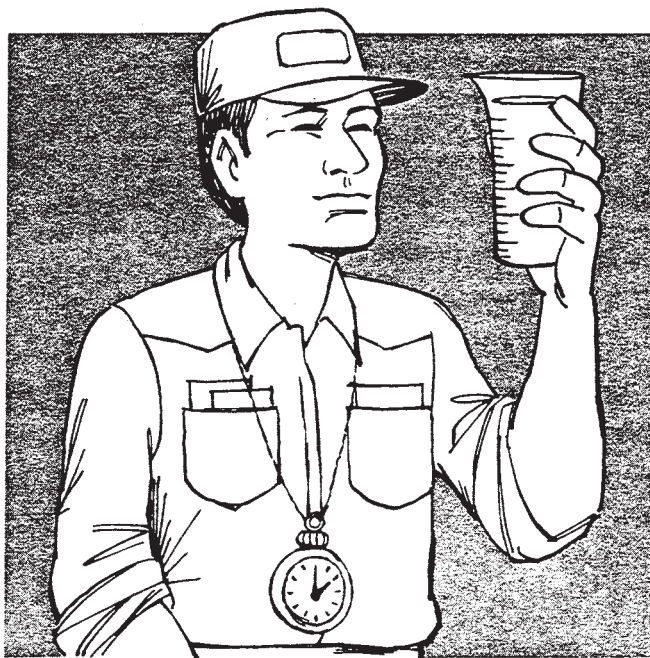
1. What are some of the common types of support equipment? Why use it?
2. When you choose the pesticide application equipment for a job, what do you have to consider?
3. Who usually uses dusters?
4. Can seeders and fertilizer spreaders often be used to apply granules? Are changes necessary?
5. Can an applicator usually “get by” with owning just a granule spreader? Why or why not?
6. What type of pesticide equipment might you choose if you wanted to reach pests in hard-to-get-at places and then reoccupy the area soon afterwards?
7. Would a fogger be a good choice if there is a sensitive area nearby and the wind is blowing softly?
8. Which type of *sprayer* would you probably choose for treating a small garden in a residential area? Why?
9. Do only homeowners have good use for hand operated sprayers? Explain your answer.
10. If your job was to treat a few acres of forage crop and water was not easily available, what type of *sprayer* would you probably choose? Why?
11. Would you use the same sprayer if the pesticide was only formulated as a wettable powder and the crop had dense foliage? Why?
12. Is a hydraulic sprayer a low pressure or a high pressure sprayer?
13. What type of sprayer would you probably choose to treat an oak tree in a backyard with a wettable powder formulation? Why?
14. If water was not readily available and there was no wind, would you choose another sprayer to treat the oak tree? Which one? Why?

15. If you were an inexperienced applicator, which type of sprayer might easily lead you to injure crops or wildlife by overdosing with concentrated pesticides?
16. How much must the pressure increase to double the flow rate?
17. Identify four nozzle materials and describe their wear resistance characteristics.
18. Name a pump that has automatic pressure relief characteristics.
19. What is a major advantage of ground driven pumps?
20. List the three functions of a spray nozzle.
21. How do you determine if a spray tip is worn?
22. When is a spray tip worn too much to use?
23. Which nozzle delivers a wide flat spray pattern consisting of large droplets?
24. When should a sprayer be cleaned?
25. When cleaning a sprayer, how many times is water put into the tank and flushed out?

Calibration

Chapter XIX

Calibration precisely determines the output of the application equipment under controlled conditions. The pesticide manufacturer spends millions of dollars to determine the rate at which the pesticide should be applied. Proper pesticide application is applying just enough pesticide to give effective control. Unlike the weather, for example, the application rate of the equipment is one factor that is under absolute control of the applicator. Calibrating your equipment is the first step in controlling the application. Calibration will also identify faulty equipment components and provide the applicator with the confidence that comes with a job well done.



Goals of This Chapter

- Understand the importance of and how to calibrate different types of sprayers.
- Learn the important facts involved in sprayer preparation.
- Know how to check for mistakes.

Why Calibrate?

The effectiveness of any pesticide depends upon the proper application and placement of the chemical. The purpose of calibration is to insure that your chemical application machinery is uniformly applying the correct amount of material over a given area. Although you may have the right chemical mixture, it is still possible to apply the wrong amount. Insufficient application results in an uncontrolled pest problem. Too much applied pesticide results in pollution, environmental and human health problems, and lost profit. Pesticide delivery can change with equipment wear, gauge error, nozzle error, wheel slippage, speedometer error, and friction loss. Always pay close attention to make sure your machinery is properly calibrated.

Some reasons to consider calibration:

It is estimated that 60% of sprayers have a calibration error greater than + or - 10 %.

43% of sprayers have greater than + or - 10% variation in discharge from individual nozzles.

32% have inaccurate travel speed.

27% have improper boom height for the nozzle spacing and nozzle discharge angle.

13% have inaccurate pressure gauges. Many of the gauges indicate too low pressure.

8% have inadequate hose size to supply nozzles, causing pressure to drop in the system.

Finding Gallons per Acre — Known Area Method

One method of determining overall sprayer performance does not require any arithmetic. You just mark out an acre. (An acre is a square 209 feet on a side or a rectangle 100 feet by 436 feet, or a similar area totalling 43,560 square feet). Fill the spray tank with water and spray the acre as if you were applying the pesticide. Measure the amount needed to refill your tank. This is your rate per acre. If it takes 9.9 gallons to refill the tank, then you are spraying at the rate of 9.9 gallons per acre. Calibration checks using this method are good to use throughout the growing season to monitor sprayer performance. However, this method cannot tell you anything about the condition of individual nozzles on the sprayer. Examination of individual nozzles will not only give you information on the output from each nozzle, but this information can also be used to adjust the rate of delivery.

Liquid Application

Boom sprayers meter the pesticide solution out of several nozzles along a long pipe or other structure called a boom. Each nozzle or group of nozzles deliver the same amount of pesticide to the site as the other nozzles along the boom. When using a boom sprayer, the following cleaning and calibration steps are recommended.

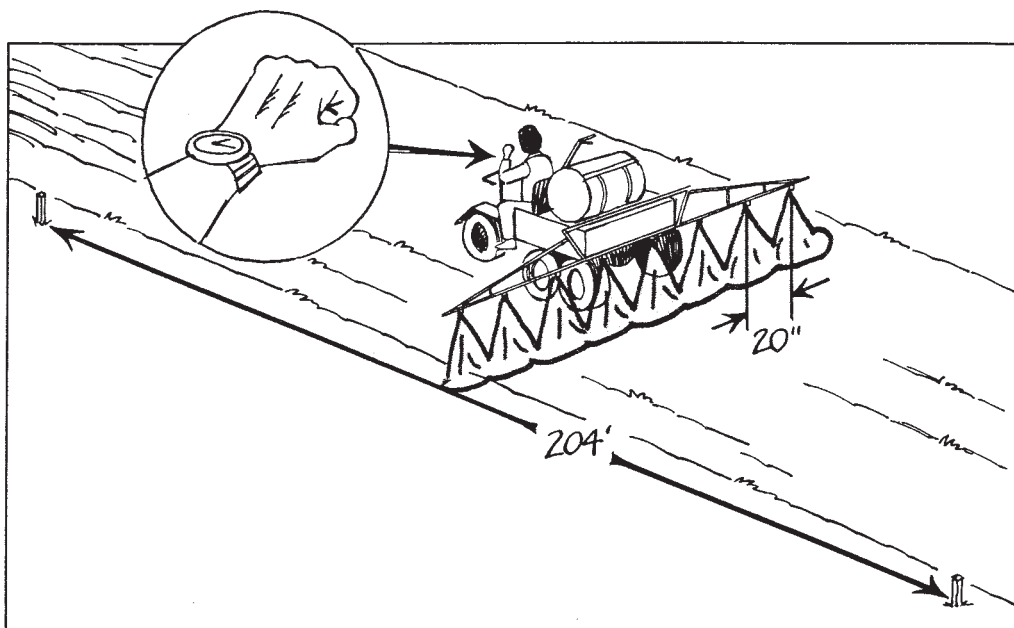
Boom Sprayer Calibration Method

Sprayer preparation

- Thoroughly clean all nozzles and screens to ensure proper operation.
- Check all nozzles to see that they are the desired make and model.
- Make sure that all spray patterns are uniform from each nozzle. Replace nozzles that do not have uniform spray patterns.
- Be sure that all nozzles have the same volume of delivery. This can be checked by placing similar containers under each nozzle. Use a graduated measuring cup marked in fluid ounces. All containers should fill at the same rate. Replace any nozzle whose flow rate is 5% greater or less than the average flow rate of all of the nozzles. Make accurate speed and pressure readings as well as cup measurements.
- Select an operating speed (usually three to five mph). When spraying, be sure to use the same speed used for calibrating.
- Select an operating pressure. Adjust pressure to desired psi while the pump is operating at normal speed. Make sure water is flowing through the nozzles.

Sprayer calibration

- Measure a course according to nozzle spacing. In the table below, for example, if your nozzle spacing is 20 inches, measure a course 204 feet long.



Nozzle spacing (inches)	12	16	20	24	28	32	36	40
Course length (feet)	340	255	204	170	146	127	113	102

- At the chosen spraying speed, measure the time in seconds it takes the sprayer to cover the measured distance. Do several runs. For best accuracy make sure you can read the time to at least the nearest second. A one second error in speed measurement could result in an application error of 5%.
- With the sprayer motionless, operate at the selected pressure and pump speed. Catch the water from several nozzles for the same number of seconds it took you to cover the measured distance.
- Determine the average output per nozzle in fluid ounces. The ounces collected per nozzle equals the gallons per acre applied for one nozzle per spacing. It is important that your collection device allows you to make measurements to the nearest ounce for best accuracy. NOTE: For directed spraying applications where two or more nozzles per spacing are used, multiply the average nozzle output by the number of nozzles per spacing to get the number of gallons applied per acre.

Band spraying is the application of a pesticide to a strip along a crop row.

Sprayer calibration

- Follow the method above for calibration of boom sprayers. However, the rates of application are for broadcast spraying and must be adjusted for the particular band width and row spacing used.
- Calculate the number of gallons applied per sprayed acre in the band by using the following formula:

$$\text{Gallons per sprayed acre} = \frac{\text{Gallons}}{\text{Field acre}} \times \frac{\text{Band width (in inches)}}{\text{Row spacing (in inches)}}$$

Sprayed acre—the sum of the area of the treated bands.

Field acre—the total area to be treated.

Example

Application is 10 gallons per field acre in 12 inch bands on 24 inch rows. What is the rate per treated acre?

$$\frac{10 \text{ gallons}}{1 \text{ acre}} \times \frac{12 \text{ inches}}{24 \text{ inches}}$$

The rate per sprayed acre is 5 gallons.

Band Sprayer Calibration Method

Step 1: Nozzle Flow Rate

Nozzle orientation, high volume, and pressure of the air blast sprayer make it difficult to catch the nozzle output. Place tubes or hoses over the nozzles and allow them to drain into buckets. Collect the liquid for 60 seconds. Measure the water in the buckets after the 60 seconds. This step results in the applicator knowing how much liquid will be applied in one minute, as well as finding faulty nozzles.

Step 2: Ground Speed

The spray application rate varies with ground speed. It is best to determine your forward speed when traveling over actual field conditions and pulling the sprayer with approximately a half full spray tank. In orchard applications, you will probably be working with tree row volume (TRV) calculations, where the volume of the tree foliage dictates how much liquid you will be applying. In row crop applications, the application rate will be on an area basis. In this situation it will be necessary to estimate the sprayed width. In either situation, it is important to know exactly how much liquid is coming out of each nozzle. Never rely on your speedometer for the actual mph measurement. Wheel slippage and variation in tire size, due to wear, can cause as much as a 30 percent difference between the actual speed and the speed indicated on your speedometer. Speed under field conditions can be

Air Blast Sprayer Calibration Method

Wheel slippage and variation in tire size, due to wear, can cause as much as a 30 percent difference between the actual speed and the speed indicated on your speedometer. Speed under field conditions can be found by using a test course. Map out a course 88 feet long, which is 1/60 of a mile (88 ft./5280 ft.) Drive the course at your normal spraying speed. From a running start, record the number of seconds it takes to drive the 88 feet. Divide the number of seconds recorded into 60 and the result will be miles per hour.

Example

If you record 15 seconds while driving 88 feet, the field speed is $60/15 = 4$ mph.

Hand Sprayer Calibration Method

It is just as important to calibrate manual sprayers as it is powered sprayers. Generally, these sprayers are calibrated by determining the amount of liquid required to adequately cover the intended target.

Step 1: Area Measurement

Measure and mark off an area 20 feet by 50 feet (1000 sq. ft.). Practice spraying the area with water. The most uniform method of application over a horizontal area is to spray the area twice, walking and swinging the nozzle back and forth, with the second application at right angles to the first application.

Step 2: Liquid Measurement

Once you are able to maintain a uniform spray pattern, fill the sprayer with water to a known mark and spray area. Refill the sprayer, measuring the amount of water required to fill to the original level. The amount of water needed to refill the tank is the amount used per 1000 sq. ft.

Example

One gallon of water was added to a one gallon hand-operated sprayer. After spraying a 100 square foot test area, it was determined that 8 ounces of water was needed to refill the tank to the one gallon mark. At this application rate, how many square feet of carpet could be treated with one gallon.

spray used = 8 ounces on 100 sq. ft.

one gallon of water = 128 ounces

$$\frac{128 \text{ ounces}}{8 \text{ ounces}} = 16$$

16 X 100 sq. ft. = 1600 sq. ft. could be treated with one gallon of liquid.

If your sprayer is delivering less than or more than enough spray to each acre, you can change the rate by using one of three methods:

Changing Delivery Rate

- **You can change the pump pressure.** Lower pressure means less spray delivered; higher pressure means more spray delivered. This is usually not a good method because a pressure change will change the nozzle pattern.
- **You can change the speed of your sprayer.** Slower speed means more spray delivered; faster speed means less spray delivered. Doubling the ground speed of the sprayer reduces the application rate by one-half. Speed change may be practical for small changes in number of gallons, but not for large delivery changes.
- **You can change the discs or jets in the nozzles to change the amount each nozzle delivers.** The larger the hole in the disc, the more spray delivered. This is usually the preferred method.

Granular application equipment comes in many different forms, but each must be calibrated carefully. The use of this type of equipment varies from small units for home lawns to units built for covering wide swaths for field work. Calibration of granular application equipment requires you to measure the amount of granules spread over a known area. You must calibrate using the pesticide granule to be applied, because each granule flows differently. You also must recalibrate each time you switch types of granular pesticides. Run the calibration test over an area where the granules can be collected (i.e. tarp covered area, concrete driveway). Speed is not a critical factor when the granular application equipment is ground driven. However, the equipment should be operated at a speed that will allow an even flow of material.

Granular Application

Step 1: Area Measurement

The area used for calibration of your granular application equipment will depend on the type of equipment used. At least 1000 sq. ft. is recommended for a drop spreader and 5000 sq. ft. for a rotary spreader. Avoid contamination of the area that will later be treated.

If it is not possible to spread over a measured area, then place a bag or catch pan under your spreader to catch the chemical. The catch container must not interfere with the delivery of the chemical.

Step 2: Chemical Measurement

Collect and weigh the amount of chemical spread over the known area. The application rate will be in weight of material collected for the area covered (usually per 1000 sq. ft. or per acre).

Example 1

You are applying insecticide from a chemical box on a corn planter, using a 12 inch band. A bag is placed under the drop tube to collect the granules. The planter is driven a total of 1000 ft. One ounce of insecticide was collected in the bag. What was the application rate in ounces per treated acre?

$$\begin{aligned}\text{Application area} &= \frac{\text{band width} \times \text{foot} \times \text{area traveled}}{12 \text{ inches}} \\ &= \frac{12 \text{ inches} \times 1 \text{ foot} \times 1000 \text{ feet}}{12 \text{ inches}} \\ &= 1000 \text{ square feet} \\ \text{Application rate} &= \frac{1 \text{ ounce (dry)}}{1000 \text{ sq.ft.}} \times \frac{43,560 \text{ sq. ft.}}{1 \text{ acre}} \\ &= 43.56 \text{ ounces per treated acre}\end{aligned}$$

Example 2

You wish to apply turf chemicals using a push-type drop spreader. A 1000 sq. ft. area (20 ft. by 50 ft.) is measured on smooth concrete. The chemical is added to the spreader and is spread over the measured area. After spreading is finished, the material is swept up and it is determined that 6 ounces of chemical was delivered. What was the application rate?

$$\begin{aligned}\text{Application rate} &= \frac{6 \text{ ounces (dry)}}{16 \text{ ounces}} \times \frac{1 \text{ pound}}{1000 \text{ sq.ft.}} \\ &= 6 \text{ ounces per 1000 sq. ft.}\end{aligned}$$

Check for Mistakes

After your chemical application equipment is calibrated, you should check it often. Be sure that you are treating the same amount of area (acres, square feet, etc.) for each tankful, as you had figured on. If you find that you are treating more for each area or less area than you figured on, you should stop the application immediately and recalibrate. If you have figured wrong or your application equipment changes its delivery rate, you should be able to catch it before you make a major mistake.

Remember the facts behind calibration and it will become simple and easy. A well calibrated sprayer makes for an effective job, as well as saves on materials and money.

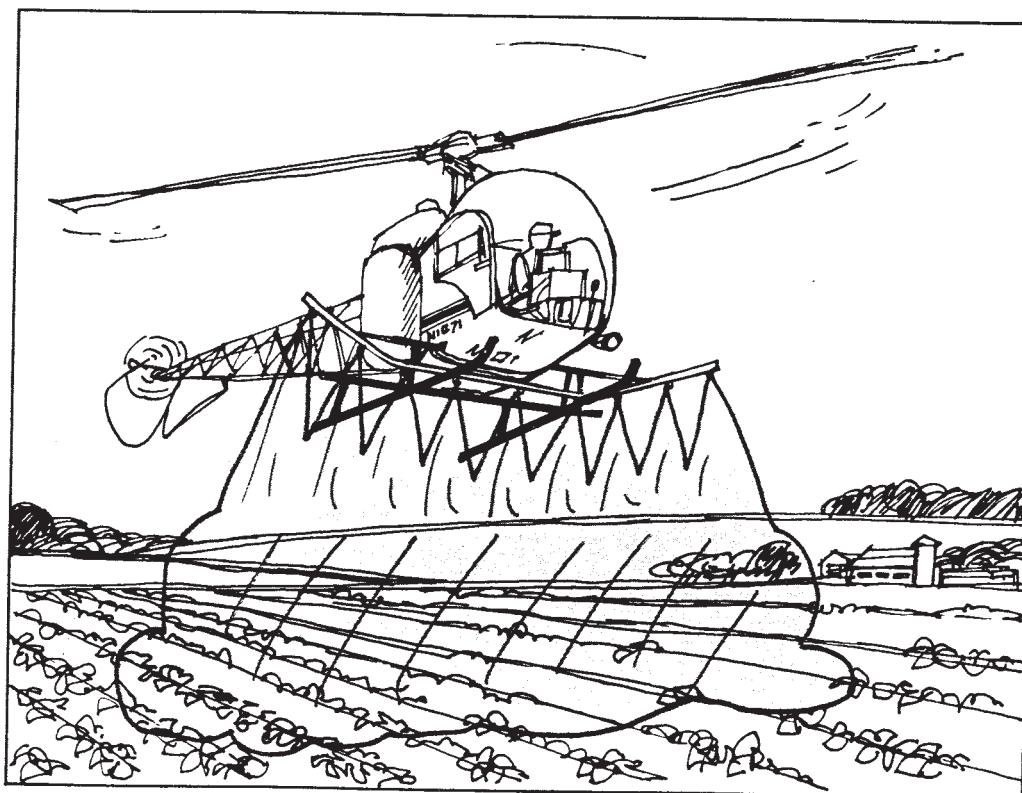
Questions for Self Study — Chapter XIX

1. When you have the right mixture in your spray tank, can you still apply the wrong amount of pesticide?
2. What is the delivery rate?
3. Why is an air blast sprayer difficult to calibrate?
4. Once your sprayer is calibrated, does it always remain the same or should you recheck it often?
5. If your sprayer is delivering less spray to each acre than you want it to, how would you usually change the rate?
6. What must you measure to calibrate granular application equipment?
7. Must you calibrate granular application equipment each time you change granules? Why?
8. What facts must you know for the "Finding Gallons per Acre — Known Area Method" method of sprayer calibration?
9. A 10 ft. sprayer with six nozzles on 20 inch centers is used to apply herbicides on a golf course fairway. At the desired speed setting, the sprayer travelled across a 204 ft. course in 40 seconds. How is the application rate calculated using this information?
10. Thirty-two ounces of water was collected from one spray nozzle in 30 seconds. What is the nozzle delivery rate in gallons per minute (GPM)?
11. Are speedometers accurate enough to be used in calibrating pesticide equipment?
12. Explain how speed can be measured using an 88 foot course.

Weather-Wise Application

Chapter XX

Weather-wise application can reduce pesticide hazard to the environment. A good applicator carefully checks the weather conditions before beginning spray procedures. Not only do a few simple precautions protect the environment, but in terms of dollars and cents they aid the applicator. Pesticides which do not reach or remain on the target areas are wasted. More pesticide, time, and money must be used to control the pests in the target area.



Goals of This Chapter

- Learn the role that weather conditions can play in both helping and hindering the applicator.
- Understand the hazards of windy day application and who is legally responsible for mistakes.
- Learn the advantages of early morning or evening application.
- Understand the roles of humidity and temperature inversion in regard to pesticide application.

Avoid High Temperature and Low Humidity Conditions

Temperature and humidity affect pesticide drift. High temperature and low humidity increase the rate of evaporation of the pesticide. Small droplets that completely evaporate leave pesticide particles in the air that may be carried several miles away from the treatment area (vapor drift).

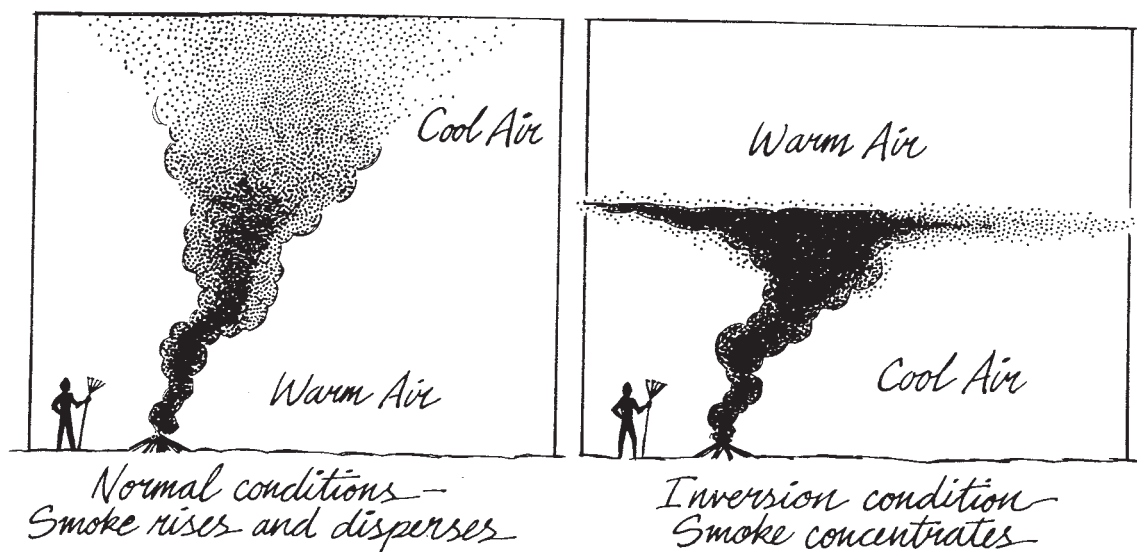
Avoid Windy Days

High winds increase drift and result in the loss of pesticide from treated areas. Drifting pesticides increase the possibility of injury to wildlife, pollinators, and domestic animals. They may settle on forage, pasture or wildlife areas or contaminate water. Pesticide application on quiet days reduces the inhalation and contact hazard to the applicator and the bystander. Drift onto sensitive crop areas can also be avoided in this way. The applicator is legally responsible for any injury or money loss due to pesticide drift onto non-target areas. Don't take a chance by spraying in the wind.

Other Wind and Temperature Considerations

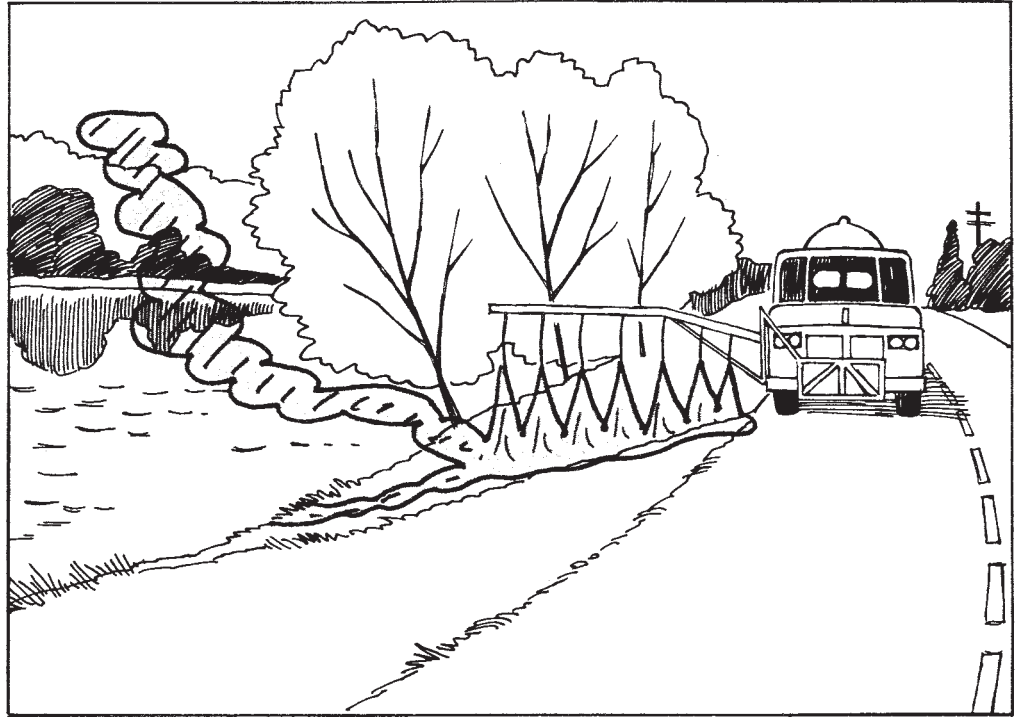
The drift of pesticides is also affected by the air turbulence. The air turbulence is determined by the difference between the temperature at ground level and the temperature of the air above it. Normal weather conditions cause heating of the soil. If the air just above the soil is warmer than the air aloft, upward air currents begin. The larger the temperature difference between air above the soil surface and the air aloft, the stronger the air currents. These air currents could carry spray droplets and pesticide particles a considerable distance away from the treatment area. Do not apply pesticides when such turbulent conditions exist.

An **inversion** occurs when the air near the soil surface is cooler than the air above it. The warm air forms a cap that blocks upward air movement that would otherwise help disperse the chemicals. Wind can aid in air mixing and reduce inversion conditions. However, low wind conditions during inversion conditions may cause small spray drops to remain suspended in the air. The droplets will eventually move out of the treatment area as a concentrated cloud. Smoke can be used as a good indicator of an inversion condition. Do not apply pesticides when inversion conditions exist.



Spray applications should not be made just before a rain, because the pesticide washes off and the pests are not controlled. Rains cause runoff and tend to wash the pesticide away from the target areas. The runoff can carry the pesticide into sensitive areas where crops or wildlife could be injured. Runoff can also reach surface waters such as farm ponds, streams and waterways. Ultimately, this can cause contamination, fish kills, and injury to domestic animals.

Avoid Application Just Before Rains



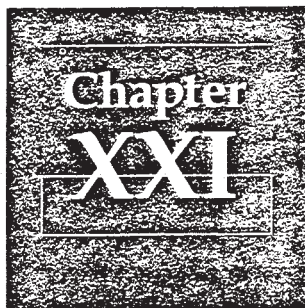
Consider Early Morning or Evening Application

Wind speed is usually lowest and humidity higher at these times of the day, thus drift hazard is greatly reduced. Children and domestic animals are less likely to be in sprayed areas during these hours. Avoiding full daylight hours lowers the contact danger to wildlife such as birds, mammals, and pollinators, who often visit crop lands during the day.

Questions for Self Study — Chapter XX

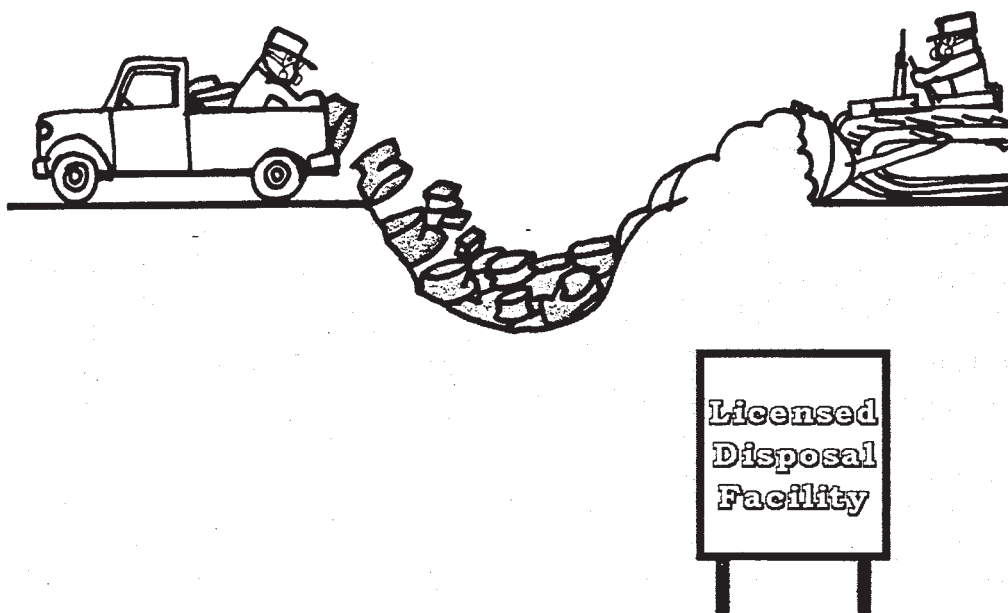
1. Can weather conditions actually aid in reducing pesticide pollution?
2. Can weather-wise application aid the applicator economically?
3. Why should a careful applicator avoid applying pesticides on windy days?
4. Why are drifting pesticides more hazardous?
5. Does windy day application pose increased hazard for the applicator and the bystander?
6. If a pesticide drifts onto non-target areas resulting in injury or economic loss, who is legally responsible?
7. Why must spray applications dry onto a surface before a rain?
8. What harm can pesticide runoff do?
9. What are two advantages of early morning or evening application?
10. What weather factors affect drift?
11. When does an inversion occur?

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 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.

Empty Pesticide Containers

When using containers holding liquid formulations:

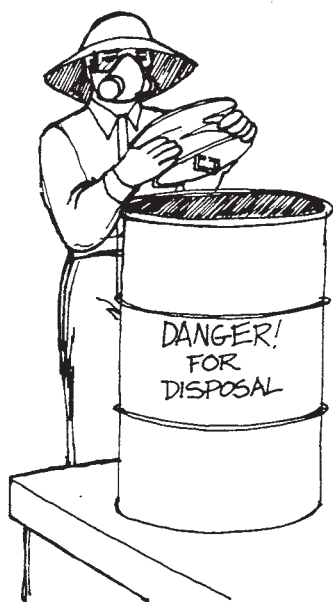
- Triple-rinse the container **immediately** after emptying.
 - Fill the container one-quarter full with the proper diluent (water, oil or liquid fertilizer).
 - Replace the closure or plug the opening of the container.
 - Rotate the container, making sure to rinse all surfaces.
 - Turn the container 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.

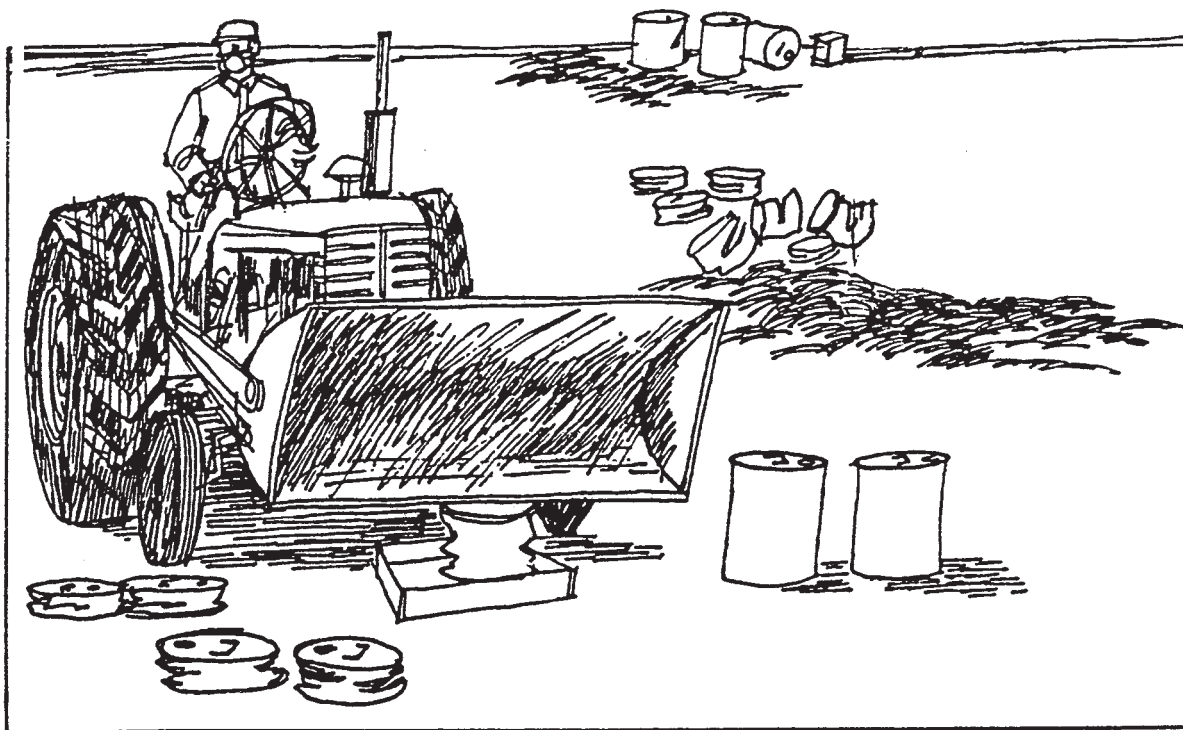
Disposal of pesticides and their containers can be a problem. They should be returned to the manufacturer whenever possible. Otherwise, you must choose the method which is best for you and still protects others and the environment. Federal and state laws may require that you use certain methods when 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.

Methods for the Disposal of Pesticides and Pesticide Containers

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?

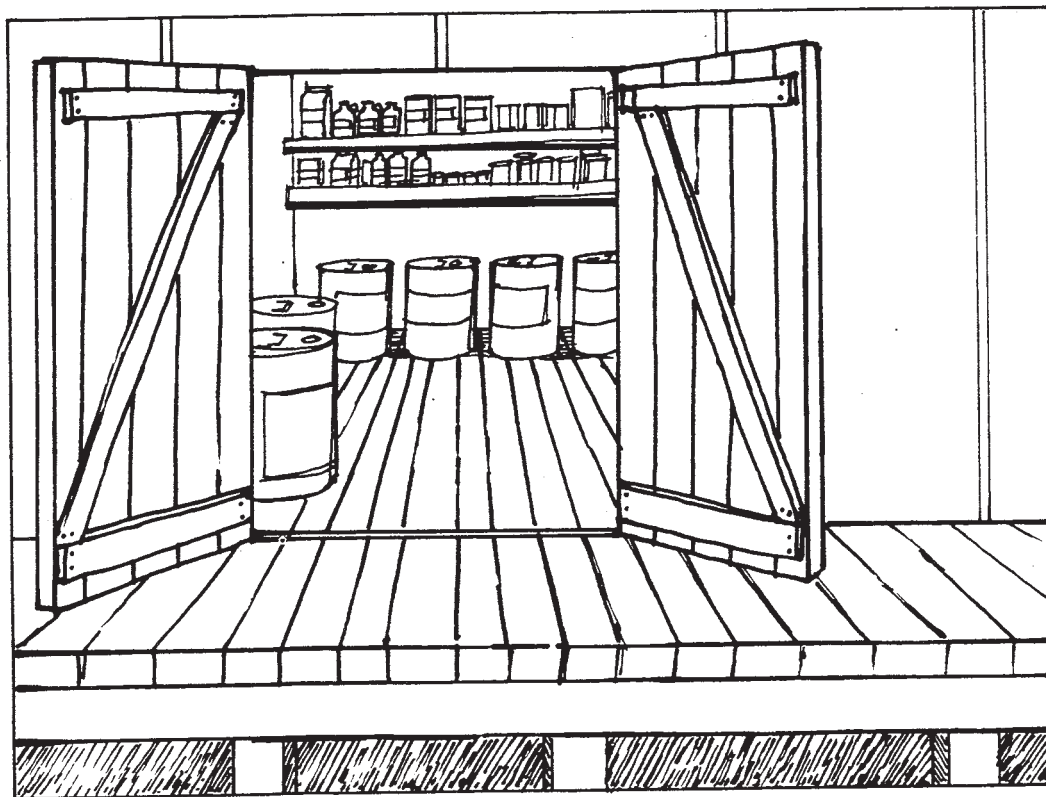
15. What are the ways to dispose of pesticide rinsate remaining after an application job has been completed?
16. Describe the triple-rinse steps for cleaning pesticide containers and explain why it is important to follow them prior to final disposal.
17. Cite reasons why burial is not a good disposal 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

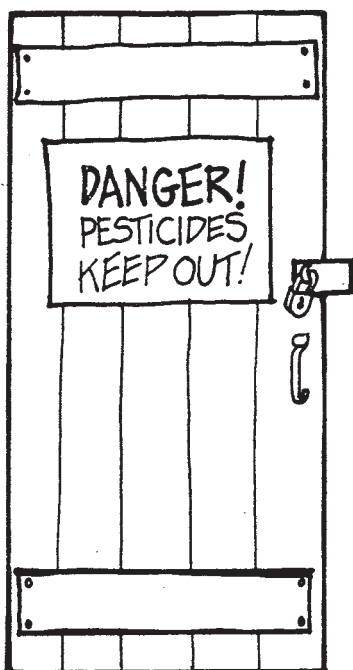
No job is really finished **until** the pesticides, containers, and your equipment have been put away properly. Get into the habit of storing all of your materials safely before you clean up and go home, or on to the next job. While you are cleaning up and putting away the pesticides, containers, and 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.

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.

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.

Arranging Your Storage Area

Handling Pesticide Containers



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

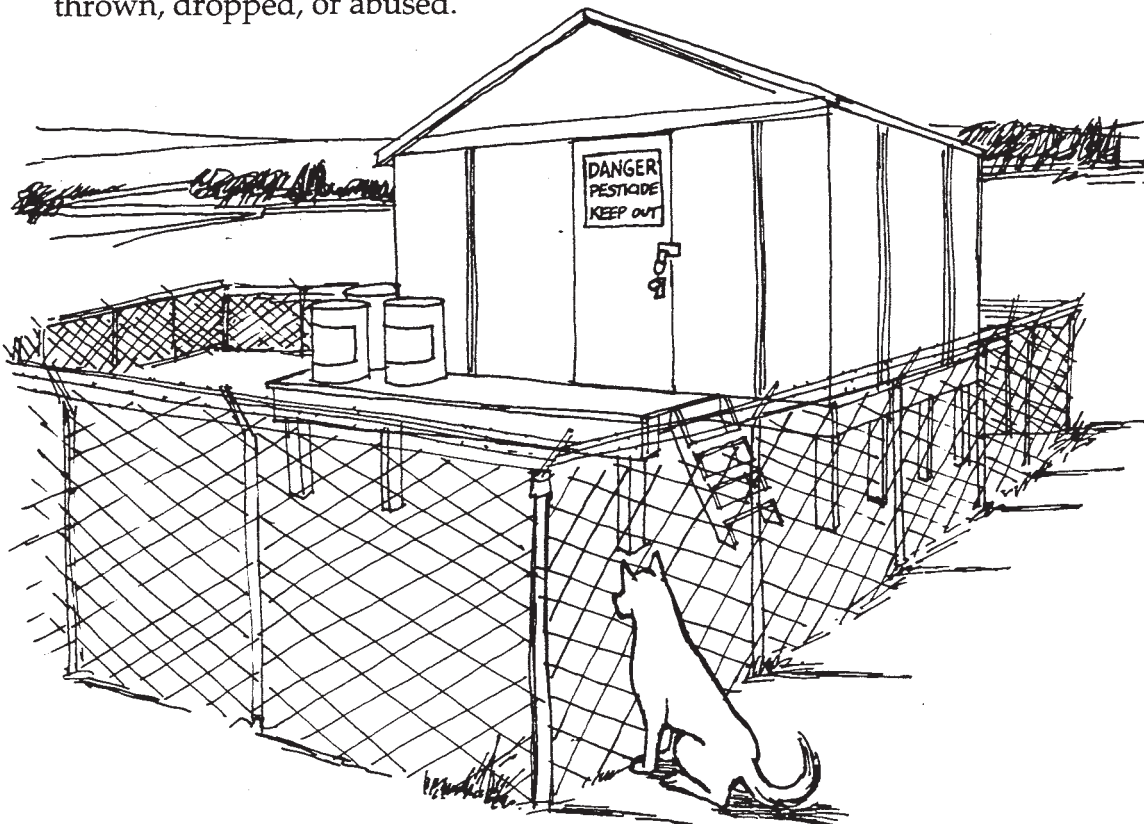
All pesticide application equipment should be stored in a special area. The equipment could be contaminated with pesticides. All items used for handling pesticides at the storage site, which might be used for other purposes, should be labeled "contaminated with pesticides" and should not be removed from 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.

Yes No

- | | | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Separated from offices, workshops, livestock areas |
| <input type="checkbox"/> | <input type="checkbox"/> | Separated from wells, streams, lakes, ponds, wildlife |
| <input type="checkbox"/> | <input type="checkbox"/> | Separated from food and feed |
| <input type="checkbox"/> | <input type="checkbox"/> | Fire resistant building materials |
| <input type="checkbox"/> | <input type="checkbox"/> | Impermeable flooring |
| <input type="checkbox"/> | <input type="checkbox"/> | Liquid spill containment (berms, 25% of liquid storage) |
| <input type="checkbox"/> | <input type="checkbox"/> | Anti-spark electrical components |
| <input type="checkbox"/> | <input type="checkbox"/> | Heating system (maintain above 32 degrees F) |
| <input type="checkbox"/> | <input type="checkbox"/> | Ventilation system with an outside switch (to vent vapors and maintain at less than 95 degrees F) |
| <input type="checkbox"/> | <input type="checkbox"/> | Locked doors |
| <input type="checkbox"/> | <input type="checkbox"/> | Fenced |
| <input type="checkbox"/> | <input type="checkbox"/> | Warning signs posted |
| <input type="checkbox"/> | <input type="checkbox"/> | Racks for off floor storage |
| <input type="checkbox"/> | <input type="checkbox"/> | Emergency eyewash and shower immediately available |
| <input type="checkbox"/> | <input type="checkbox"/> | Routine wash-up facilities near by |
| <input type="checkbox"/> | <input type="checkbox"/> | Spill kit and fire extinguishers readily available |
| <input type="checkbox"/> | <input type="checkbox"/> | Personal protective equipment available |
| <input type="checkbox"/> | <input type="checkbox"/> | First aid kit |
| <input type="checkbox"/> | <input type="checkbox"/> | Prepared emergency response plan on file |
| <input type="checkbox"/> | <input type="checkbox"/> | Pesticide inventory on file |

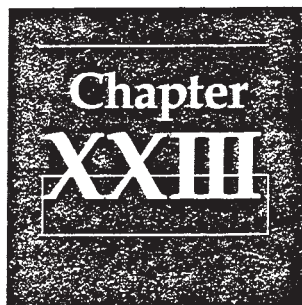
Storage Facility Check List

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?

Record Keeping



Besides just meeting the requirements, keeping records of pesticide usage is a wise precaution. Records can establish proof of proper use or they are helpful in finding the cause of error, if an error is made. They can also provide information to trace residue and/or damage problems. Records can also save you money. They allow you to compare the results obtained from different pesticides. You can improve your pest control practices and efficiency too. They also help to reduce pesticide misuse. Careful records from year to year guide you in buying only the amount of pesticides you will need. Therefore, you can reduce winter carryover.

DATE AND TIME	AREA OR TARGET TREATED AND PEST	EQUIPMENT	FORMULATION, LOT NUMBER AND RATE (per acre, per 100 gallons, etc.)	TOTAL FORMULATION ADDED TO TANK OR HOPPER	AMOUNT OF MIXTURE USED	AMOUNT TREATED AND LOCATION	ADDITIONAL COMMENTS (Weather, applicator, severity of infestation, etc.)
5/12/73 3-5 PM	Smith's Alfalfa weevil	Lawrence blower	malathion methoxychlor Double M 3 qts./acre #P340	15 gal.	50 gal.	20 acres Fields across the road from Jones	NE Wind at 4 MPH, sunny 70°, driver KAP, Alfalfa weevil
5/14/73 7-9 PM	Johnson's Veal Lice	Root-Lowell	Ciorap 1oz./animal #24-3	4 gal.	4 gal.	500 calves	Lice on veal calves, calves 5 weeks old, condition good, #47 sick, Helper KAP
5/15/73 6-7 AM	University Lawns weeds	Keep weed sprayer	2, 4-D 4 lbs./gal. Chapman #H57-4	3 gal.	160 gal.	12 acres Arto Quad	Broadleaved weeds, No wind, sunny, dandelions 3" across Driver-RFP

Goals of This Chapter

- Learn how pesticide application records can be helpful to you.
- Know when and how to fill out record sheets.
- Understand the importance of standard forms.

What Are the Requirements?

The more information you keep on record, the more useful the records will be to you. Carry a notebook with you in the field. All the information is right there in front of you. Do not try to memorize all the necessary items. Fill in a standard form to be sure that you get all the necessary data every time.

Information Needed

- Time of day and date of application
- Crop or target
- Pest
- Equipment used
- Pesticide used
 - Common name
 - Trade name
 - Formulation and % active ingredient
 - Lot number (in case of cross-contamination or failure to control)
- Total formulation added to tank or hopper
- Amount of mixture used
- Amount or numbers treated (acres, trees, sheep, etc.)
- Additional comments
 - Location
 - Weather
 - Applicator
 - Severity of infestation

On every record form there should be a space left for **additional comments**. This space should be used to jot down information for your own personal use. This information can be used to improve your business, either through better customer relations or by saving you money. Such records can also be helpful in liability cases.

Remember, the job is never finished until the paper work is done.

Questions for Self Study—Chapter XXIII

1. Besides meeting the requirements, how can pesticide application records be helpful to you?
2. How can pesticide records help you to improve your pest control practices and efficiency?
3. When is the best time to fill out record sheets? Why?
4. Why bother filling out standard forms? Why not just jot down the things you need to know?

Liability

Chapter XXIV

Almost all pesticides are considered hazardous. Even the most careful applicators sometimes have damage claims brought against them. The usual claims are for nonperformance, misapplication, crop injury, property damage, and/or contamination of non-target areas. It is important for all certified applicators to be informed of the most common claims which could be brought against them.



Goals of This Chapter

- Recognize and understand the liability issues of incorrect application procedures.
- Learn the steps you should take to protect yourself against pesticide misuse suits.
- Understand the importance of insurance.

Drift

Drifting pesticides are a major cause of environmental contamination and damage to non-target areas. In general, the courts have held the pesticide applicator and the customer who hired him jointly liable in drift cases. The customer is responsible when he hires or contracts for a “particularly dangerous operation” such as the application of pesticides. However, don’t depend on the customer to share costs. He may file another suit against you claiming that you agreed not to cause drift damage. In certain instances, the manufacturer of the pesticide may also be held liable. If the label does not clearly warn about the possibility of drift, the manufacturer may share liability.

Target Site

Claims of injury to the target site (crop, turf, shrub, etc.) that was treated or claims that the pesticide had not performed as expected involve the dealer, the manufacturer, and the applicator. The courts must decide which of the three recommended or guaranteed the product for that specific use on that target. The party in error must accept the blame and pay damages. Applicators must make sure that all pesticides they use are recommended on the label for that purpose. Detailed records of all pesticide applications can be used in this circumstance to support the applicators’ claim of proper pesticide use. Then, and only then, may the blame possibly be placed on the manufacturer.

If the target site injury was not great or total, the customer or applicator must show how much damage was from the pesticide and how much was from other conditions such as weather, disease, etc. This breakdown is not necessary in cases with great or total injury. Both the applicator and customer may be held liable for injury resulting from negligent application.

Personal Injury

The application of pesticides is considered an especially dangerous or, in legal terms, an “ultra-hazardous” activity. As a result, the pesticide applicator is liable for any injury to a person from the pesticide. Usually the injured person can recover damages without proving negligence of

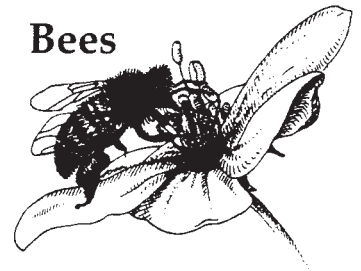
the applicator. The injured party must only prove that he is free of any negligence and did not assume the risk of pesticide exposure. The liability in most cases involving personal injury or death depends on proving the applicator negligent.

If the pesticide is applied on a field, crop, or area other than the one it was intended for, serious problems can result. In the event that damage or over-tolerance occurs or that the owner just didn't want the area treated, the applicator may be charged with negligent application. Defense is very difficult. Double check on addresses, site locations, and all landmarks before you treat an area. Applying pesticides to the wrong site can be very costly.

Wrong Site

Honeybees are very important to the farmer and often he has his own colonies or hives. However, bees are insects and are very susceptible to many pesticides. If the bees in hives are killed as the result of drift from nearby application sites, the applicator can be held legally responsible and must pay for damages. In some states an applicator is liable only if he fails to notify adjacent landowners prior to the pesticide application. Some states require notification of registered beekeepers prior to applications in the vicinity of beehives. Check your state regulations for this requirement.

Bees



However, if bees are exposed to the pesticides while in the sprayed site, the applicator is not usually liable. Unless the applicator has ignored a label direction that specifically would have protected the bees, the courts have ruled that the bee is trespassing and that the land doesn't need to be safe to uninvited animals. Play it safe! Know where the beehives are located in your area. Warn the beekeeper beforehand when and where you will be spraying.

The rulings on "attractive nuisance" usually involve cases where children are attracted to ground equipment or aircraft and injure themselves. The owner and/or applicator are held liable for injuries caused to children, even if they are trespassing, when the landowner fails to take reasonable precautions to prevent injuries from dangerous equipment which can be attractive to children. In order for a precaution to be reasonable, children must frequent an area so that the landowner expects their presence.

Attractive Nuisance

Therefore, beware! Do not leave ground equipment with exposed drive belts, drive wheels, gears, or any moving parts unattended in areas where children can get to them. Aircraft should never be parked where

curious children can find them. Pesticides in unlocked or open vehicles should never be left unattended. Empty containers and aerosol cans are also **attractive** and **dangerous** to children. Store and dispose of them properly!

Noise

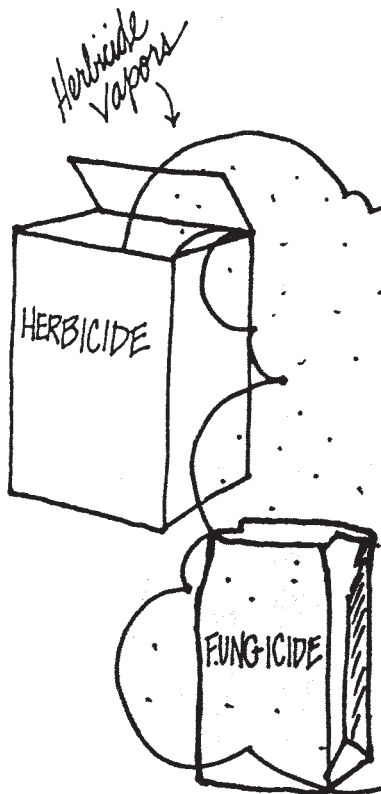
Recently claims have been brought against applicators for noise damage. Home owners, as well as others, have claimed damage or loss of property value caused by noise of aircraft and ground equipment operating above or near their property. They must prove direct loss of property due to noise from machinery operated carelessly or negligently. In some cases, an owner will claim that an applicator made an unlawful flight over his property without his permission. This is especially important in aerial applications when pull-ups over nearby property are necessary. Applicators and owners are legally liable only if the noise created is excessive or unreasonable. Reasonable noise is not legally a nuisance, even though it may be irritating. Successful defense is possible when the applicator can show that the noise wasn't the cause of injury or that no damage occurred.

Cross Contamination

Every year there are cases of pesticide cross contamination reported which may damage the sites being treated. There are three ways that this may occur:

1. The applicator may make an error in mixing or filling in the spray tank. He may not have removed all the pesticide left over from the last application. In this case, both the applicator and owner may be liable.
2. Open containers of herbicides such as 2,4-D can vaporize (become a gas) and penetrate other pesticides which are stored nearby. When other pesticides are applied, a 2,4-D contamination can seriously injure the site.
3. The manufacturer may make a mistake in labeling, formulating, or refilling a container.

The applicator must know which container of pesticide was used on the site so that laboratory tests can be made. The lab tests can show whether the contamination occurred during mixing and filling or earlier. In cases involving herbicide contamination, it is difficult to prove whether it is the result of vaporization during storage or manufacturer error. The courts must decide who is to blame.



NOTE: All applicators should write the location and the date that the pesticide was applied on the label of each pesticide container. They should also record the lot number in case cross contamination does occur. Detailed records of every application should be kept.

If you become involved in any legal problem, act carefully and promptly. Always be friendly and helpful. **Never** admit liability. Be careful whom you give information to about your spray operation. Offer to look into the matter immediately.

What To Do When You Are Involved

- Examine your records to make sure that you were actually operating in the area at the time of the alleged injury.
- Make sure that all of your records are up-to-date, particularly as to the identity of the equipment used, temperatures, wind direction and velocity, and all other pertinent data.
- Proceed to the scene immediately and make notes of all essential information when you get there.
- Record the presence of any adverse condition that you observed at the time of your investigation, particularly insect infestations, disease, water stress, late planting, and carry-over effect from any other materials that may have been used.
- Photograph, using color film and a sufficiently close focal length, any adverse condition found so that the symptoms can be examined by an expert.
- Save the container that was used in the job. If it is not practical to save the whole container, save the label or use close-up color photography to record the label.
- Notify your insurance company immediately.
- If you do not have insurance for the loss involved, request permission to have an expert examine the site or the property, so that you may have the benefit of his opinions.
- If a chemical company is involved, notify them immediately. They will probably also want to send their experts to the site.
- Obtain the names and addresses of all witnesses who might testify to the nature of the operation and conditions of the site before and after. In the event that the site of application is perennial, examine the USDA aerial photographs to ascertain the condition of the orchard or other perennial plantings in years prior to the year of alleged injury.

Insurance

To protect yourself and your business you, as a pesticide applicator, should have insurance for possible pesticide mishaps. Some states have insurance requirements. It is now required in some states to list your insurance company on the pesticide certification application, before it is valid. There are many different types of insurance plans, they include bodily injury, property damage, restricted chemical liability and comprehensive chemical. The plan you choose should fit your needs and your business. Be sure to explore the costs, benefits, and drawbacks of each insurance plan before you buy. You need to know exactly what your coverage includes. An insurance agent who specializes in pesticide insurance is the best person to advise you on your individual insurance needs.

Public Relations

It is always important to maintain a good public image as a pesticide applicator. Here are some things to consider:

- **Always be courteous.** First impressions can often be long lasting. Calm words help to open future discussion.
- **Listen to the question.** Let the person know that you understand the basis for his or her concern.
- **Be prepared.** Applicators should know what materials are being applied, why they are being applied, and what its basic characteristics are. Keep accurate records.
- **Have an answer.** Be as informed as possible and do not give information you are not sure of.
- **Take information.** Include name, location, date, time and details of the situation and request for information.
- **Be prompt.** Problems may come up during the busiest times, but dealing with them as quickly as possible may make the difference between an easy solution or a complicated expensive one.
- **Keep good records.** A simple file that includes inquiries and course of action taken may prove to be important documentation.

No matter how careful you are, accidents will happen. You must be prepared for any emergency. Above all, keep calm.

Questions for Self Study — Chapter XXIV

1. If you apply a pesticide and the wind carries it off target, are you liable even though you tried to be careful?
2. If the site you applied a pesticide to is injured, even though you followed the directions and dosages on the label, who could be liable?
3. Is the application of pesticides legally considered to be an ultra-hazardous activity?
4. Can you be sued for applying pesticides to the wrong target area, even though no damage is done?
5. What is the legal standing of bees who are killed while they are “visiting” in a sprayed field?
6. From a legal standpoint, why should you never leave pesticide equipment or empty pesticide containers around where children could be attracted to them?
7. If someone accuses you of pesticide misuse, what steps should you take to protect yourself?
8. List at least three practices that are important for good public relations.
9. Who can best advise you on your insurance needs?

Answers

to Self Study Questions

☐ Pesticide Dealer Licensing -Chapter I

1. Refer to Appendix "(A2)" of the *Vermont Regulations to Control Pesticides*.

2. Class "A" -Restricted Use pesticides, as determined by federal and state government, and "by-permit-only" pesticides.

Class "B" -"Controlled Sale" "" General use products typically for use outside of the home, and containing more than 3% active ingredient. Class "B" pesticides also include all turf products except those containing *Bacillus thuringiensis* or potassium fatty acids.

Class "C" -Homeowner/Specialty -General use products for use in a dn around the house, and which do not contain more than 3% active ingredient. Some products may exceed 3% active ingredient and still be considered Class "C" such as antimicrobial agents, pet supplies, animal repellants and insecticides including *Bacillus thuringiensis* or potassium fatty acids.

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 labels should be maintained on all

pesticide containers and bulk storage containers at all times; except during loading and unloading, stored dry pesticide shall be covered by a roof or tarpaulin which will keep precipitation off the pesticides; 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 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.

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.

☐ State Laws and Regulations - Chapter II

1. 3% Guthion- A
2. 2% Baygon Bait Insecticide -C
3. 0.1% Mercury -A, by Permit Only
4. 6% Pendimethalin -A
5. Chlordane -P
6. 5% Agrimek -R
7. 8% Battle -R
8. 25% Aqua-Kleen, for aquatic use -Restricted Use, Water Quality Permit Required
9. Sodium Arsenite -A, By Permit Only
10. 30% WP Kerb -Class B

❑ Federal Pesticide Laws - Chapter III

1. Environmental Protection Agency (Full); EP A (acronym).
2. Federal Insecticide, Fungicide, and Rodenticide Act (Full), FIFRA (acronym).
3. EPA must review the application for registration, approve each use pattern and assign a product registration number.
4. FIFRA provides civil penalties when the violation of a regulation was unintentional and criminal penalties when the law was knowingly violated.
5. Yes. Up to 30 days for private applicators and up to one year for commercial applicators.
6. Regulations are interpretations of the law and have the force of a law.
7. Restricted Entry Interval (REI) is the time immediately following application of a pesticide to a treated area when unprotected workers may not enter.
8. Warnings must be timely to the situation, may be given orally, by posting, or both and should be given in the language that can be understood by the workers involved.
9. Registration decisions are based on the Agency's evaluation of test data provided by the manufacturer.
10. EPA can change reentry intervals, change the application rates, formulation types, and require posting of signs warning workers that treatment has occurred.
11. EPA can require longer pre-harvest intervals, changes in manufacturing processes, and reduction in application rates or frequencies. EPA can also cancel or suspend the use of a pesticide.
12. EPA sets food tolerances; FDA enforces food tolerances.
13. The purpose of the tolerance program is to ensure that U.S. consumers are not exposed to unsafe food-pesticide residue levels.
14. Resource Conservation and Recovery Act of 1976.
15. In an EPA-approved sanitary landfill.

16. More strict.
17. The Occupational Safety and Health Administration (OSHA) which is part of the Department of Labor.
18. Regulated waste includes: unrinsed containers; excess pesticides and pesticide dilutions; rinse water which contains a listed chemical and cannot be properly used.
19. The regulations in 49 CFR cover any safety aspect of transporting hazardous materials, including the packaging, repackaging, handling, describing, labeling, marking, placarding, and routing of such materials.
20. SARA Title III is designed to inform communities regarding hazardous chemicals located in the vicinity and addresses the need for community emergency response plans in the event of an accident.
21. An endangered species is a plant or animal which is in danger of extinction throughout all or a significant portion of its range.
22. Fish and Wildlife Service (FWS) of the Department of the Interior.
23. New label language may contain specific restrictions or it may direct pesticide applicators to read an Endangered Species bulletin with directions for the use of pesticides where endangered species may be affected.
24. You, the applicator.

❑ 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.
15. LD50 means "Lethal Dose Fifty ." It refers to the amount of a chemical that causes death in half, or 50%, of the experimental animals exposed to it by a particular route of exposure. The "Lethal Concentration Fifty ," or LC50 of a pesticide is the amount of chemical in the air that causes half, or 50% of test animals to die when they inhale it.
16. No, they simply tell us how much of the chemical it takes to kill half of the test animals.
17. The higher the LD50, the less toxic the pesticide.

18. Six milligrams per kilogram (mg/kg) is the same as 6 parts per million (ppm), since a milligram is one millionth of a kilogram.

19. Pesticides can: cause deformities in unborn offspring (teratogenic effects), cause cancer (carcinogenic effects), cause mutations (mutagenic effects), poison the nervous system (neurotoxicity), or block the natural defenses of the immune system (immunotoxicity). Pesticides can also have: local or systemic effects; immediate or delayed effects; reversible or irreversible effects; singular, additive, or synergistic effects.

20. Signal words and warning statements are based on a pesticide's LD50 and other measures of its toxicity, including its oral, inhalation, or dermal toxicity, as well as other local effects.

21. Pesticides that are categorized as relatively non-toxic must bear the signal word "CAUTION" on their labels. Those that are highly toxic must bear the signal words "DANGER" on their labels. Those that are considered slightly toxic must also state "CAUTION" on their labels. And those that are moderately toxic bear the label signal word "WARNING".

22. While they can be similar, there is a difference between toxicity and hazard. The toxicity of a substance is its characteristic ability to cause injury to a living system. On the other hand, hazard is the chance, or "risk" that danger or harm will come from the use of a pesticide.

23. No. A highly toxic pesticide may be considered hazardous because of the risk that it poses to the public, wildlife, or the environment. However, with proper handling, a highly toxic pesticide could actually pose a low risk or low hazard.

24. Many factors besides a pesticide's actual toxicity can make it hazardous. These include: the skill of the applicator; the "target" involved; the type of pesticide; the qualities of the exposed individual; the formulation chosen; the other chemicals involved in the formulation; and the concentration and dosage used.

□ Residue, Tolerance, and Registration-Chapter V

1. The pesticide which remains on the treated surface is called a deposit. A residue is a deposit which remains on the surface for an extended period of time.
2. Long-lasting residues are desirable because of long-lasting protection, less frequent application, and are economical. Undesirable effects of residues are hazards to consumers, workers, or they may interfere with future crop production.
3. Tolerance is the established maximum amount of residue which may remain on a food or feed crop. A tolerance must be set before the pesticide is registered for use on food or feed.
4. No. It is subject to condemnation and seizure by federal and state regulatory agencies.
5. The results of toxicity studies on animals and the environment.
6. 100 times.
7. Yes. Food may have no residues, may never have been treated, was at less than the maximum dose, and the residues may have degraded.
8. Yes. Due to indirect contact with a chemical.
9. When a very small residue is likely to be on food or feed at harvest.
10. It is the least number of days between the last pesticide application and the harvest or slaughter day. To assure that the residue on the commodities are under the set tolerances.
11. Yes. Every pesticide is registered federally by EPA.
12. EPA reviews toxicity studies, wildlife and environmental studies, breakdown and residue studies, chemical studies, etc.

❑ Ecology and Environmental Considerations-Chapter VI

1. No. Sometimes even small changes in their environment can greatly reduce their chances for survival.
2. Vapor drift.
3. Particle size, nozzle design and orientation, pressure, temperature, humidity, evaporation, height of release and air movement.
4. Air can carry pesticide particles over long distances to drift and settle off target.
5. Their work as pollinators is necessary for crop production.
6. Yes. Pesticide-kills of mammals, birds and fish have occurred. Pesticide applications can also alter habitat or reduce food supply, thus injuring wildlife.
7. Yes. Some pesticides can build up in the body of animals (including man).
8. Pesticides applied correctly to a site may be moved downward with rain or irrigation water reaching the water table below. Pesticides may enter a well directly by spillage or back- siphonage, thus entering the groundwater directly.
9. When pesticides drift off target or are applied over the dose recommended on the label, they are dangerous. Carelessness is a relevant factor in contributing to pollution of the environment.
10. Runoff, soil erosion and rainfall carry pesticides to water sources.
11. Reduce pressure and increase the droplet size. Larger droplets drift less.
12. People, pets and livestock can be injured by pesticide exposure. Pasture grasses could be destroyed. Milk or meat could have illegal pesticide residues if cattle eat contaminated forage. Water may become too contaminated to drink; aquatic organisms may be destroyed and the cost of cleaning will be very high.
13. Yes. Pesticides can destroy the predators and parasites that naturally control pests.

14. An aquifer is a geologic formation of permeable rock, sand or gravel that stores large amounts of water. Many people use water from aquifers for drinking.
15. Food chain.
16. Prevention.
17. Near the top of the food chain.
18. Non-accumulative pesticides are ones that do not build up in the bodies of animals or in the tissues of plants.
19. Accumulative pesticides slowly build up in the bodies of animals. Persistent pesticides remain in the environment without breaking down.
20. No. Persistent pesticides remain in the environment without breaking down. This does not mean they also have the necessary characteristics to accumulate in animals or plants.
21. Yes. Persistence is not always bad for the environment, although there have been cases when it was. Long lasting or persistent pesticides are important for long-term protection of structures from termites, for example. There are persistent pesticides that stay on target, control specific pests and cause no adverse environmental impact.
22. Water falls to the earth as precipitation. The precipitation runs off the surface to become surface water. Water also seeps through the soil to become groundwater. Water goes back into the atmosphere by evaporation and transpiration.
23. It is a species on the brink of extinction throughout all or a large portion of its range.
24. Microbial, chemical and photodegradation.
25. Their chemical strength does not have a long lasting effect. Those organophosphates that degrade quickly in the environment are the least hazardous.
26. Pesticides that degrade quickly in the environment are the least hazardous.

☐ Safety Precautions-Chapter VII

1. Most pesticide accidents result from lack of up-to-date knowledge or unsafe handling.
2. Before pesticides are applied you should know the pest, extent of damage, weather, conditions of the treatment area, plus take time to read the label and take all precautions.
3. Run a complete, but empty cycle. Use hot water and detergent.
4. Excessive dermal, inhalation, or oral exposure to pesticides may cause injury or death in humans. Contamination of food and feed may occur from hazardous fumes and spills of pesticides. Since they may spill or give off hazardous fumes, these toxic materials must never be carried (a) inside a truck, (b) inside a truck, with groceries, livestock feed, and children, or (c) in the back of a truck, with groceries, livestock feed, and children. In addition, pesticides must not be left unsupervised. Children may be exposed to toxic doses through innocent play in or near pesticide containers.
5. Pesticides should be stored only in original tightly-sealed containers.
6. Activities that deposit pesticides on the head require protective head gear because the scalp can absorb pesticides at a fast rate. A wide brimmed, chemical-resistant hat protects the face, eyes, mouth, and back of the neck.
7. To avoid contaminating the clean clothes.
8. The pesticide label.
9. Both gloves and boots should be made of chemically-resistant material.
10. Yes. It is important that you put on protective clothing and equipment before you handle concentrated pesticides.
11. When pouring pesticides, always stand with your head well above the container and the filling hole of the spray tank so that you and your clothing do not get splashed.
12. A pesticide spill can potentially cause great harm to others, as well as cause environmental contamination. Toxic quantities of some concentrated chemicals may remain in soil for many months.

13. Stop spraying, move to an untreated area, and use a soft brush to clean the plugged nozzle.

14. — Wear protective gear during pesticide application.
— Always use only the labeled amount of pesticide during your applications.
— Do not work in drift, spray, or runoff unless you are properly protected.
— If chemicals spill on your gloves, be careful not to wipe your hands on your clothing.
— Wash pesticide-soiled clothing with detergent and water.

15. If you or any of your fellow workers feel sick, do *not* try to finish up the job. Get out of the area immediately and get help.

16. Never let children and pets play in an area during spraying.

17. Yes. Notify residents and beekeepers when you plan to spray in their areas and urge them to take appropriate precautions.

18. — Choose the safest equipment for your pesticide's application needs.
— Do not allow children or unauthorized people near the pesticide equipment.
— Use your equipment correctly.
— Take good care of your equipment.

19. Try to finish using all the pesticides that you have mixed up in your tank or hopper. Never leave partly-filled equipment in the field. If you have some left at the end of the job, use it up on target crops that are permitted on the label. Once the tank is empty, release the pressure from your application equipment. Return equipment to appropriate areas for cleaning and storage when pesticide applications are finished.

Wash your hands and face thoroughly after you use pesticides and before you do any other activity. At the end of each day, wash your body and hair thoroughly with soap and water. Wash clothes with detergent and water as soon as possible after the exposure. Rinse boots and shoes to prevent accidentally tracking chemicals into dwelling areas. Keep all clothes that have been exposed to pesticides away from other clothes, including family laundry.

20. The reentry interval is the period of time that should pass between treatment and returning to a treatment area. Safe reentry intervals may be on the pesticide label. When no reentry times are available, always wait until sprays dry, dusts settle, and vapors disperse. If you must reenter an area soon after spraying, be sure to wear all the necessary protective clothing as required on the label.

21. Have some kind of absorptive material available. Have bleach or hydrated lime for decontamination. Keep soap detergent and water close at hand. Have a change of clothes available.

❑ 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.
14. These respirators are used either for relatively short exposure periods to concentrated chemicals or for a long exposure period to low concentrations of toxic chemicals.

15. Leakage around the face shield.
16. No. The respirator should seal all around your face.
17. Replace it when it looks dirty or if breathing becomes difficult.
18. Cartridges should be changed after every eight (8) hours of use.
19. Wash the face piece with detergent and warm water. Rinse. Wipe dry with clean cloth. Store in a tightly closed plastic bag.
20. No. Always work in pairs when handling highly toxic chemicals.
21. If you wash your face and hands before eating, drinking or smoking, it is probably ok.
22. No. It is not ok to wear it again after it dries. It must be laundered first.
23. Carbamate. Organophosphate.
24. Washing before removal will not contaminate your hands or the inside of the gloves.
25. No. Natural rubber is only effective for dry formulations.

❑ 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.
8. Organophosphates - For example, parathion, TEPP, Phosdrin, Thimet. Carbamates -For

example, Temik, Furadan, Zectran, Carzol. Chlorinated Hydrocarbons - For example, Endrin, Dieldrin, Thiodan, Aldrin.

❑ 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.

❑ Filling and Mixing-Chapter XVI

1. Wettable powders or emulsifiable concentrates.

2. Add pesticides to the spray tank immediately before you are ready to apply them. At this point, the amount of pesticide needed is easier to estimate and the correct pesticide can be chosen.

3. The pesticide applicator is handling the concentrated form of the pesticide. When mixing them, you are more likely to be exposed to liquid splashing on clothing and skin.

4. Dermal and inhalation.

5. Anti-siphoning devices keep spray mixture in the tank from escaping down the hose into the water source, stream, pond, or well.

6. Small but important quantities remain in a container after it is emptied. Triple-rinsing removes these residues.

7. Three.

8. No. Pesticides can be chemically or physically incompatible. Mixing incompatible pesticides may lead to a mixture that doesn't work or lumps and sludge forming in the bottom of the tank.

9. Compatible means mixing pesticides together without reducing their effectiveness chemically or physically.

10. The pesticide label.

11. An adjuvant is a chemical added to the pesticide mixture that helps an active ingredient do a better job.

12. A spreader-sticker is used when treating waxy surfaces such as cabbage or onion leaves.

13. Use the amount recommended or the result may be less deposit rather than more, and the pest control will be reduced.

14. Yes. The most hazardous activities involving pesticides are mixing and loading concentrates. Wearing protective clothing will reduce the risk to the handler.

15. Between 4 - 6.

16. Contain the spill.

☐ Calculations for Mixing Pesticides-Chapter XVII

1. Too little may result in poor results, too much in crop injury, illegal residues or unnecessary expense.

2. Answer = 13.5 pounds. There are 4.5 times as much water in the 450 gallon tank, so 4.5×3 , pounds = 13.5 pounds

3. Answer = 2.4 pounds in 80 gallons. 3 pounds = 3×16 ounces = 48 ounces. 80 gallons is $80/100$ of 100 gallons = $4/5$.

$$4/5 \times 48/1 = 192/5 = 38.4 \text{ ounces}$$

$$38.4 \text{ ounces} / 16 \text{ ounces in a pound} = 2.4 \text{ pounds in 80 gallons.}$$

4. Answer = 9 pints or 1 gallon and 1 pint in 100 gallons.

$$\text{Answer} = 1 \frac{1}{2} \text{ pints in 50 gallons.}$$

5. 1 tablespoon.

6. 2 teaspoons.

7. 100 gallons water weighs 830 pounds.

100 gallons of kerosene weighs 660 pounds.

8. Answer = 2 gallons of pesticide.

1% = 24 parts of water to 1 part of pesticide.

1% = 24 gallons of water to 1 gallon of pesticide —25 gallons.

50 gallons 1% mixture = 2 X 24 gallons water = 48 gallons water.

2 X 1 gallon pesticide = 2 gallons of pesticide.

9. Answer = 33.2 pounds.

100 gal = 830 pounds = 1% of 830 = 8.3 pounds active ingredient needed.

1 pound active ingredient = 4 pounds 25% wettable powder.

4 X 8.3 = 33.2 pounds 25% wettable powder .

❑ Equipment - Chapter XVIII

1. Filler pumps, tank trucks, nurse or mixing tanks, front-end loaders, etc. They make spray operation more efficient.

2. Working conditions, pesticide formulation, type of area treated, possible problems, etc.

3. Home gardeners, pest control operators, and truck gardeners for individual spot treatment of plants or small areas.

4. Yes. No changes are necessary.

5. No, because granular materials do not stick well to foliage and additional machinery is needed.

6. Aerosol generators or "foggers".

7. No.

8. Hand operated.

9. No. The custom applicator will often find it convenient for small jobs that do not require larger powered equipment.

10. A low pressure boom sprayer. Use a low volume of dilute spray so that one tankful will cover a larger area.

11. No. They will not adequately penetrate and cover dense foliage because of their low capacity (pressure and gallonage). Wettable powder formulations often settle out.
12. A high pressure sprayer.
13. High pressure sprayer. Mechanical agitators are standard and keep wettable powders well mixed in the tank.
14. Yes. An airblast sprayer. It works well if there are no windy conditions and a little water will cover a large area. Only the concentrate spray tank must be filled.
15. Air blast sprayer.
16. Pressure must be increased four times to double the flow rate.
17. Brass - least resistant to wear.
Plastic and nylon - not recommended for high pressure, resists corrosion.
Stainless steel- excellent wear resistance.
Hardened stainless steel- useful for highly abrasive formulations.
18. Centrifugal pumps, flexible-impeller pumps.
19. The application rate is held constant as the speed changes.
20. To meter or regulate the flow of the liquid. Atomize the liquid stream into droplets. Spread droplets in a specific pattern.
21. Worn nozzles spray bad patterns and higher flow rates than new nozzles. Determine spray tip wear by comparing the flow rate of the used tip to the flow rate of a new one.
22. If the flow rate of the used tip is five percent greater than a new one, it should be replaced.
23. Flooding nozzles.
24. Clean your sprayer after each day's use.
25. Water is flushed out three times when cleaning a sprayer properly.

❑ Calibration-Chapter XIX

1. Yes. Non-calibrated application equipment will apply the pesticide at an unknown rate. Unless calibrated, it could be under or over applying the pesticide.
2. Delivery rate is the total amount of pesticide delivered on the target over a period of time.
3. Nozzle orientation, high volume, and pressure of the air blast sprayer makes it difficult to catch the nozzle output.
4. It must be rechecked often. Nozzles can wear or become plugged, thus changing the delivery rate.
5. Change pump pressure, speed, or nozzles.
6. You must measure the amount of granules spread over a known area.
7. Yes, because each granule flows differently.
8. The number of square feet in an acre, the speed of your sprayer, the width of your spray boom, and the delivery rate of your sprayer.
9. Catch the spray from one nozzle in a container for 40 seconds (time it takes to travel speed course). The ounces of water collected represents the application rate in gallons per acre.
10. Delivery rate = $\frac{32 \text{ ounces (wet)}}{30 \text{ seconds}} \times \frac{1 \text{ gallon}}{128 \text{ ounces}} \times \frac{60 \text{ seconds}}{1 \text{ minute}} = 0.5 \text{ GPM}$
11. No. Wheel slippage and variations in tire size often make speedometers inaccurate.
12. From a running start, record the time it takes to drive 88 feet. Divide the number of seconds recorded into 60 and you have calculated the miles per hour .

❑ 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 EPA 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.

❑ Record Keeping-Chapter XXIII

1. Records can establish proof of proper use in damage suits.

2. Records help to reduce pesticide misuse, as well as guide you in buying only the amount of pesticide you will need.
3. In the field. All the information is right in front of you.
4. By filling in a standard form you are sure to get all the necessary data.

❑ Liability-Chapter XXIV

1. Yes. The applicator and/or customer are responsible for his/her actions.
2. The dealer, manufacturer, applicator, or owner may be liable.
3. Yes. Application of pesticides is legally considered as ultra-hazardous.
4. Yes. It is the applicator's responsibility to apply the pesticide to the proper target area.
5. They are considered to be "trespassing" and therefore, the applicator is not usually liable. In some states, the applicator can be liable if procedures for prior notice to adjacent landowners are not followed.
6. They are an "attractive nuisance" and the owner and/or applicator are held liable.
7. Some steps to protect yourself are:
 - check your records
 - make notes of the scene
 - record conditions at the scene
 - take photos
 - save the pesticide containers
 - notify insurance company and chemical company
 - make a list of all witnesses
8. Always be courteous, listen patiently, be prepared, be able to answer any questions, take notes, be prompt, and always keep good records.
9. An insurance agent who specializes in pesticide insurance.

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 driven 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.

LC₅₀—The concentration of a pesticide in air which would kill half of the test animals exposed to it. The lower the LC₅₀ value, the more poisonous the pesticide is. It is often used as the measure of acute inhalation toxicity.

LD₅₀—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 LD₅₀ value, the more poisonous the pesticide. LD₅₀ 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.

NEMATOCIDE—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 accidentally 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 of plants, 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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D. A. Rutz, Director
R. D. Gardner
E. P. Harrington
W. G. Smith

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