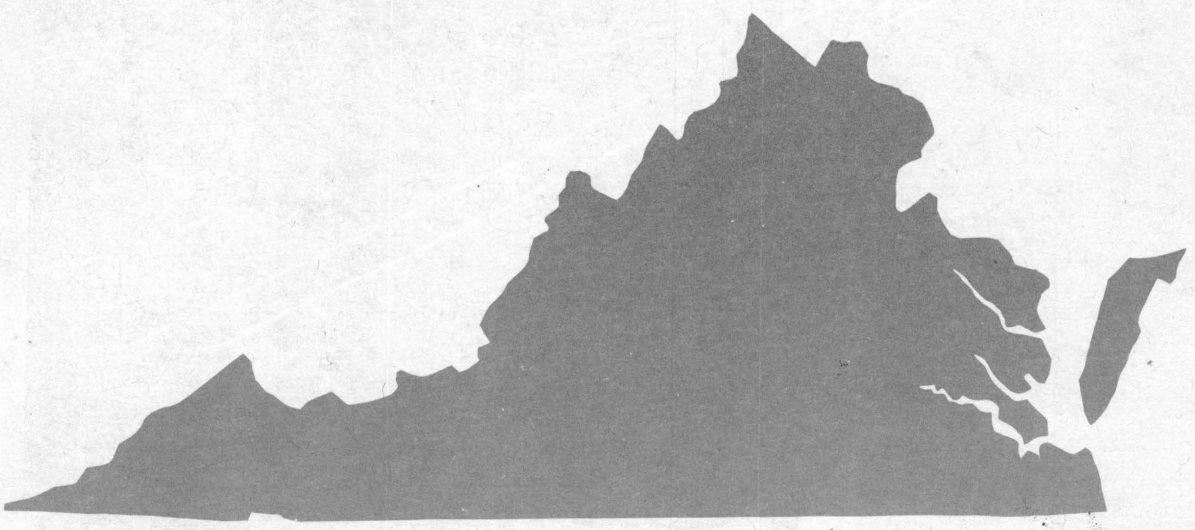
PESTICIDE APPLICATOR CERTIFICATION TRAINING MANUAL



EXTENSION DIVISION • VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

READ THIS FIRST!

This manual will help prepare pesticide applicators for certification. The material is presented in an easy-to-read style and includes some practical examples. Tests will be administered by the Virginia Department of Agriculture and Commerce. *It is important to study this manual.*

There are *two* ways in which this manual can be used:

1. SELF STUDY — Studying the manual and reviewing the questions at the back will help in preparation for the certification tests.

2. PREPARATION FOR TRAINING SESSION — The Virginia Cooperative Extension Service will conduct training sessions to help applicators prepare for the tests. This manual will contain the basic material used in all sessions.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. W. E. Skelton, Dean, Extension Division, Cooperative Extension Service, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.

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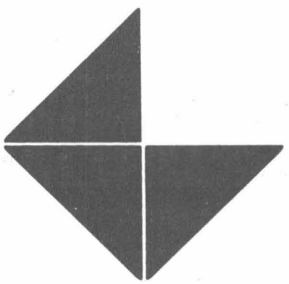
PESTICIDE APPLICATOR TRAINING MANUAL

Core Manual



NORTHEASTERN REGIONAL PESTICIDE COORDINATORS

PRIVATE & COMMERCIAL APPLICATOR OBLIGATIONS UNDER VIRGINIA LAW

RESPONSIBILITIES ASSOCIATED WITH THE SUPERVISION OF NON-CERTIFIED APPLICATORS

The Virginia Law and Regulations permit the application of restricted use pesticides by non-certified applicators provided the non-certified applicator is competent and is working under the direct supervision of a certified applicator whose certification permits the type of application.

You, as a certified applicator, will be responsible for the actions of the non-certified person and must be available when and if needed, even though you may not be physically present (unless pesticide label requires your presence) at the time of application. You, the certified applicator, must keep the non-certified person fully aware of all directions for use and safety precautions and must provide the non-certified applicator either at the application site or at the loading and mixing site:

(1) detailed written or printed directions for applying the restricted use pesticide. (Pesticide product label may suffice);

(2) detailed written or printed instructions describing procedures to be followed inorder to prevent injury to the applicator, other persons or the environment. (Pesticide product label may suffice) and;

(3) detailed instructions for contacting you, the supervising certified applicator (i.e. name, location, phone number radio contact, etc.) that when followed will result in direct communication with you.

In addition, the non-certified applicator must receive verifiable, specific and individual job or work assignments and instructions from you, the certified applicator, prior to the use and application of any restricted use pesticide.

RECORD KEEPING REQUIREMENTS FOR COMMERCIAL APPLICATORS

All certified commercial applicators or their employer must keep and maintain for a period of two (2) years records of all applications of restricted use pesticides. These records must be maintained separately or distinguishable from the customary sales invoices that you provide your customers and shall include (see suggested format):

(1) Name and address of customer and address of site of application if different.

(2) Name and certification number (or certification number of the supervising certified applicator) of the person (s) making the application.

(3) Date of application. (Month, Day, Year)

(4) Type of plants, crop, animals or site (s) treated and principal pest (s) to be controlled.

(5) Acreage, area, or number of plants or animals treated or other appropriate description.

(6) Pesticide applied including label name (brand name), type formulation and company name appearing on the label.

(7) Total amount (pounds, gallons, etc.) of pesticide mixture applied.

(8) Type of equipment used. (Including required personal protective equipment when applicable)

(9) Disposal method of unused pesticide (s) or empty containers.

These records will, upon written request, be made available for inspection and/or copying by the Commissioner or his authorized agent.

While not required, all private applicators are encouraged to keep and maintain records of all applications of restricted use pesticides.

RECORD OF APPLICATION OF RESTRICTED USE PESTICIDES
(Suggested Format)

To Be Maintained for Two Years from Date of Application
To Be Maintained Separately or Distinguishable from the Customary Sales Invoices Provided Customers

Name and Certification Number of Applicator or Name of Non-Certified Applicator and Certification Number of Supervising Certified Applicator	Date of Application (Mo/Day/Year	Type of Plants, Crops, Animals, Site(s) Treated Principal Pests To Be Controlled	Acreage Area or Number Plants or Animals etc. Treated	Pesticide Applied Including Label Name (Brand Name) Type Formulation and Company Name Appearing on Label	Total Amount of Mixture Applied (lbs.,gals., etc.)	Type Equipment Used (Including Required Personal Protective Equipment)	Disposal Method of Unused Pesticide(s) or Empty Containers

EVIDENCE OF FINANCIAL RESPONSIBILITY

The Virginia Law and Regulations require that all certified commercial applicators furnish, prior to issuance of a license, certain evidence of financial responsibility consisting of either liability insurance or surety bond conditioned to liability resulting from the handling, storage, application or use and/or misuse or disposal of any restricted use pesticide.

The minimum coverage and conditions for liability insurance or surety bond include:

(1) Fifty thousand dollars ($50,000) coverage for bodily injury or death to each person and one hundred thousand dollars ($100,000) for each occurence and;

(2) Twenty-five thousand dollars ($25,000) property damage coverage for each occurence.

You must maintain this minimum coverage at all times during your license period. Your insurance carrier or surety must furnish the evidence of responsibility on appropriate forms, certifying the amounts and conditions. If you reduce your coverage, you must notify the Virginia Department of Agriculture and Commerce ten (10) days prior.

COMMERCIAL APPLICATOR FEES

The Virginia Law requires that all certified commercial applicators (except employees of local, state or federal governmental agencies) pay a fee of twenty-five dollars ($25) for the initial certification and fifteen dollars ($15) for the annual license renewal. The Law also prohibits any commercial applicator from having to pay an additional fee if he desires to be certified in one or all of the ten commercial categories. Thus, you will only have to pay one fee and you can become certified in any or all ten of the commercial categories without paying an additional fee.

PREPARED BY: Virginia Department of Agriculture & Commerce

November, 1975

PESTS

RECOGNIZING PESTS

Identifying the agent (insect, weed, disease, etc.) causing a problem to a crop is an important part of using pesticides properly. The first step in applying pesticides is to determine the specific pest you want to control. Once the pest is identified, the applicator can select the appropriate pesticide to do the job. Unless the pest causing the problem is accurately determined, the applicator may waste time and money applying the wrong pesticide.

Identify the pest causing damage to crops or livestock may involve: 1) Learning the specific insects, weeds, and diseases associated with a particular crop or animal; and 2) Recognizing the damage caused by certain pests.

You probably already know most of the pests you see on the job and can select the appropriate pesticide for their control. But sometimes unfamiliar pests or damage appears. These must be properly identified before you can select a pesticide. Don't guess. Contact your Extension Agent for help in identifying pests.

There are four main groups of pests:

1. Insects, mites, ticks, and spiders
2. Birds and rodents
3. Weeds
4. Fungi, bacteria, viruses and nematodes

It is important that you are familiar with some of the basic characteristics of these groups.

INSECTS, MITES, TICKS AND SPIDERS

Insects and their relatives -- the mites, ticks and spiders -- are the most abundant animals on earth. Some are serious pests of man's crops, livestock and structures. But not all insects, mites and spiders are pests. Many of them feed on other insects and spiders, and are considered beneficial. Most spiders are beneficial because they feed on insects and other small animals.

Insects are probably the most important pests in this group. They can be distinguished from mites, ticks and spiders by:

1. The presence of 6 legs (mites, ticks and spiders have 8 legs)
2. The presence of wings (most adult insects have wings; mites, ticks and spiders do not)

To identify common insect pests and damage you should know something about the mouthparts and life cycle of insects.

INSECT MOUTHPARTS

Most common insect pests have either chewing or sucking mouthparts.

Chewing - Insects with chewing mouthparts include grasshoppers, beetles, caterpillars and grubs. They have large jaws with several sharp teeth that can be used to bite off and chew plant parts. The damage caused by insects with chewing mouthparts may be: 1) Holes in plant leaves; 2) Tunneling in plant stems and branches; and 3) Eating plant roots and seeds.

Sucking - Insects with sucking mouthparts include aphids, plant bugs, stink bugs and leafhoppers. They have long, slender mouthparts that can be inserted into plant stems, leaves and roots. Through these tube-like mouthparts the insects can suck out plant juices and transmit plant diseases. The damage caused by insects with sucking mouthparts may be: 1) Yellowing of leaves and stems; 2) Wilting of leaves; and 3) Scars on fruit.

Mites and ticks also have sucking mouthparts. Mites are usually pests of plants and shrubs. Ticks suck the blood of man and other animals.

INSECT LIFE CYCLE

Insects pass through different stages as they develop from the egg to adult. Insect pests attack plants and animals during at least one stage in their life cycle. Understanding the life cycles of the common insect pests will help you to apply pesticides at the proper time to control the pest.

The life cycle of some insects involves a larval or caterpillar stage, followed by a pupal stage, and then the adult.

Egg———Larva or Caterpillar———Pupa———Adult

Some examples of insect pests with this kind of life cycle include: potato beetle, alfalfa weevil, armyworm & cutworm, tobacco hornworm, and house fly.

Some insects do not pass through a larval or pupal stage in their development. The immature stages look similiar to the adult, except they lack wings.

Egg———Nymph———Nymph———Adult

Examples of insect pests with this kind of life cycle include: grasshoppers, stink bugs, plant bugs, cockroaches, aphids and leafhoppers.

BIRDS AND RODENTS

Large animals like birds and rodents are sometimes pests to man. They feed on stored grain, fruit and may cause health problems. Consult your Extension Agent for information on the identification and control of large animal pests.

WEEDS

Weed control is an important part of every agricultural operation. You should know something about the identification and life cycle of the common weeds in your area. Your Extension Agent can help you identify weeds.

Plants can be divided into three basic life cycle groups: annuals, biennials and perennials.

Annuals - Plants that have a one year life cycle are called annuals. They grow from seed, mature and produce seed for the next generation in one year or less. Examples are: crabgrass, cocklebur and pigweed.

Biennials - Plants with a two year life cycle are biennials. They develop a root system and leaves the first year. The second year they develop seeds. Examples are: bull thistle, burdock, musk thistle.

Perennials - Plants that live for two years and longer are called perennials. They are dormant during the winter. Some grow from seed; others produce tubers or bulbs below ground. Examples are: Johnsongrass, bindweed, dandelion, Bermudagrass, Canada thistle and most woody plants.

FUNGI, BACTERIA, VIRUSES, NEMATODES

Plant diseases are caused by fungi, bacteria, viruses and nematodes.

Fungi - The cause of a number of plant diseases, including apple scab, stalk rot in corn and powdery mildew.

Bacteria and Viruses - Microscopic, one-celled plants that can attack other plants. Many viruses are carried by insects, usually aphids and leafhoppers.

Nematodes - Very small round worms. Many nematodes are harmless, but some attack the roots, stems, and leaves of crop plants.

CONTENTS

Introduction

All pesticide applicators are required to know basic safety and handling rules for pesticide use. The purpose of this manual is to help you learn those facts and skills. By reading each chapter and then testing yourself with the questions at the end, you can teach yourself what you need to know.

This is the basic or core manual for all pesticide applicators. Later on manuals will be developed for specialty areas such as agricultural use, aerial applicators, pest control operators, etc. You should place the manual for your specialty area into the binder with this core manual. Then you will have a complete and up-to-date reference and review manual.

This core manual has been divided into two sections. The first section dealing with laws, regulations, toxicity and safety, covers background information that every pesticide applicator should know. The second section describes the steps and decisions which every applicator has to make in his daily routine on the job.

The questions are designed to help you get the important points from each chapter. If you can answer the questions correctly you should be able to pass any tests for certification.

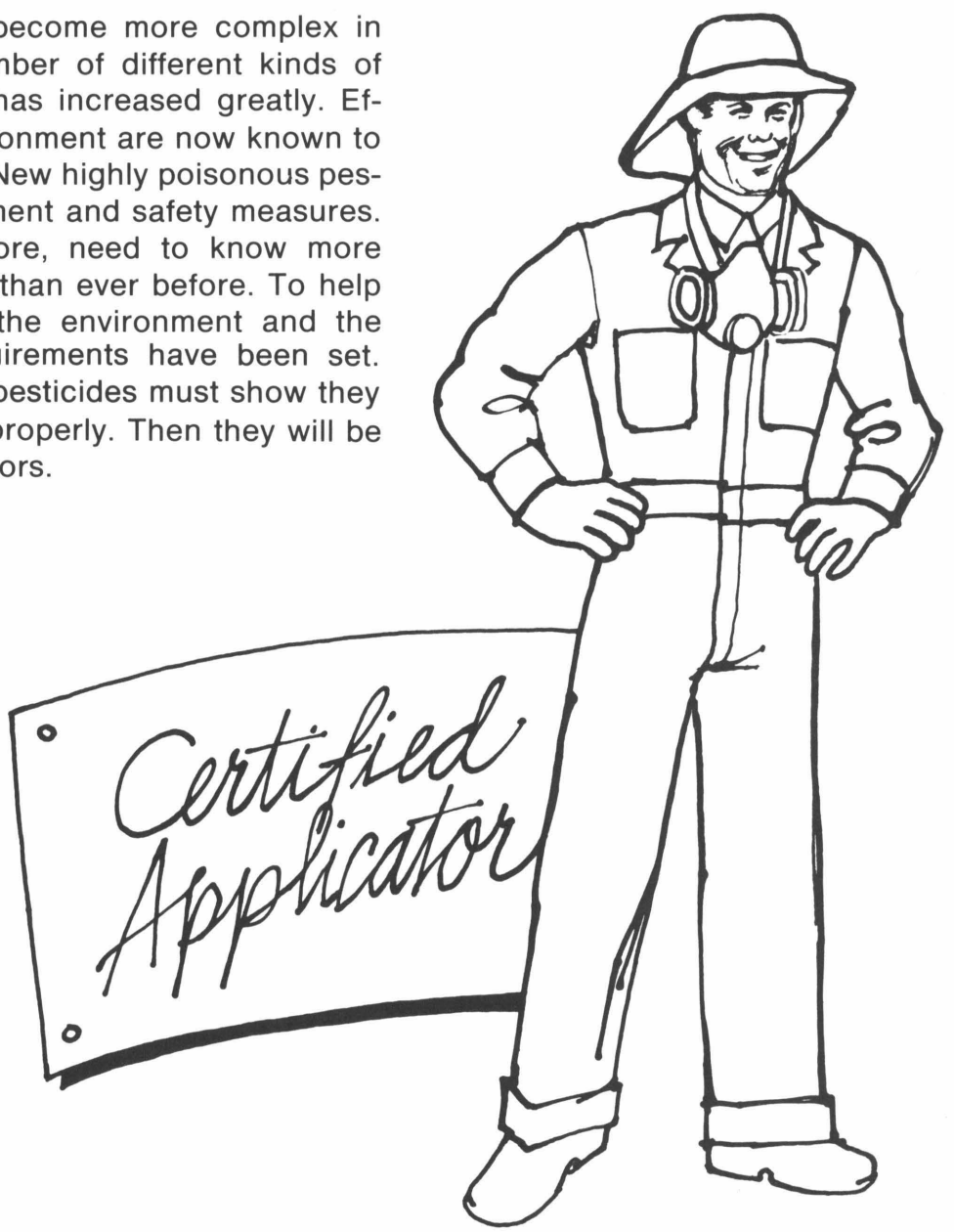
New information will be sent to you as it becomes available. It should be added into the binder so you will remain up-to-date at all times.

PESTICIDES ARE NOT FOR AMATEURS. TO PROTECT PEOPLE AND THE ENVIRONMENT, PESTICIDE APPLICATORS MUST BE PROFESSIONALS!

Part 1

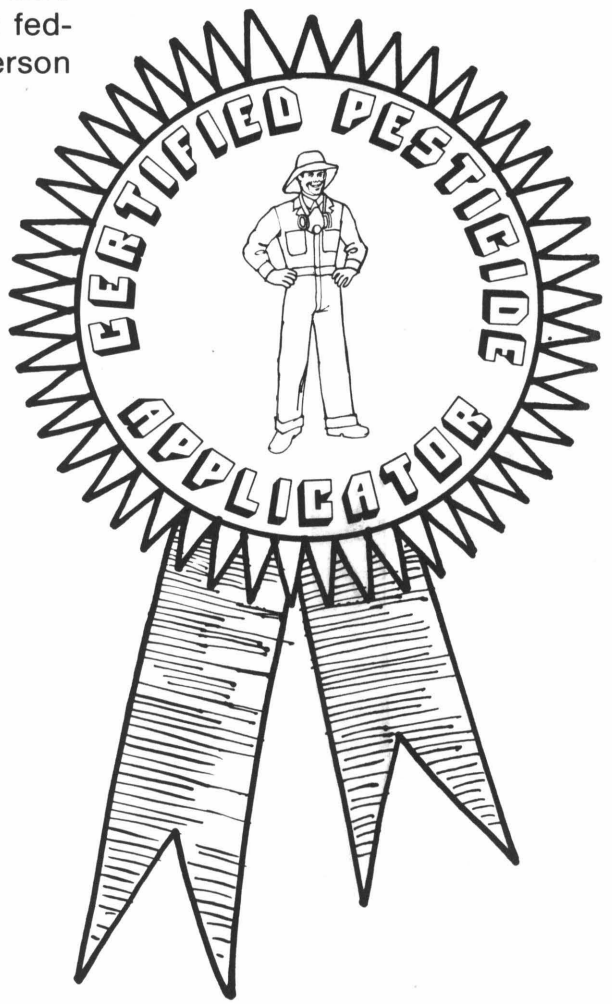
chapter I
Pesticide Applicator Certification

Pesticide application has become more complex in the past few years. The number of different kinds of pesticides available for use has increased greatly. Effects on wildlife and the environment are now known to be important considerations. New highly poisonous pesticides require special equipment and safety measures. Pesticide applicators, therefore, need to know more about safety and proper use than ever before. To help protect the general public, the environment and the applicator himself, new requirements have been set. Now most people who apply pesticides must show they know how to use pesticides properly. Then they will be certified as pesticide applicators.



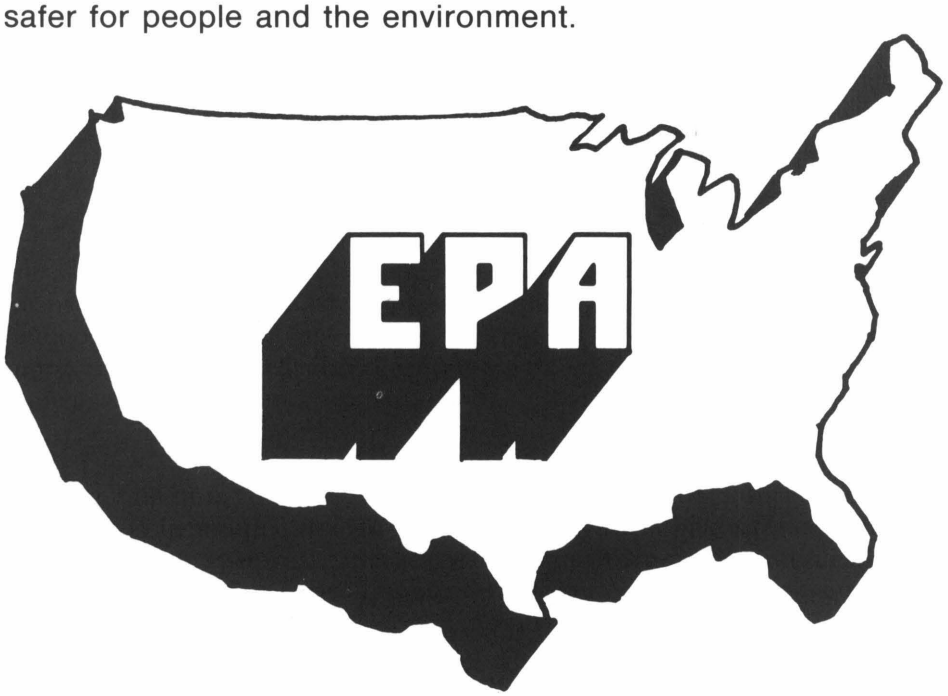
chapter II
State Laws and Regulations

Each state has laws governing pesticide use, too. 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 the 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.



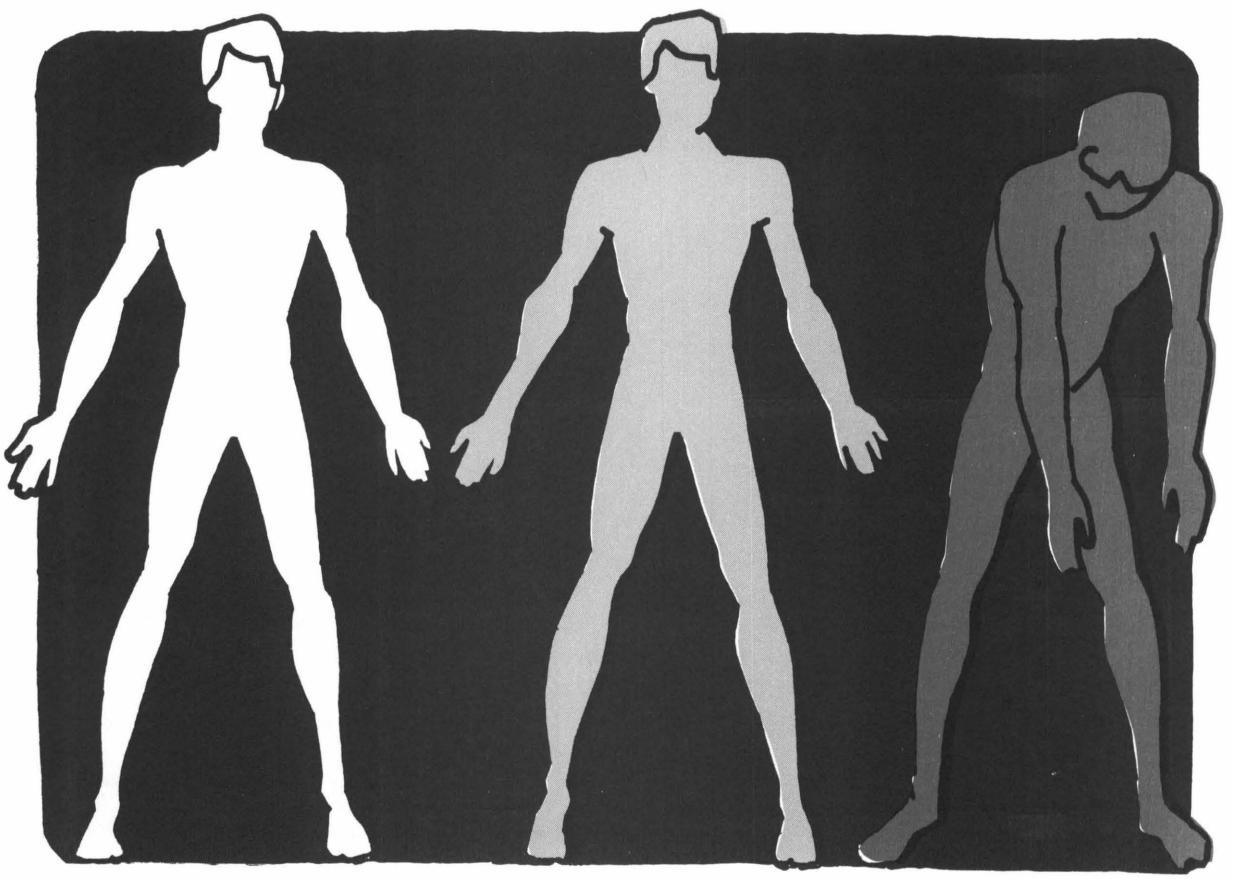
chapter III
Federal Pesticide Laws

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 safe use in the past are now required by law. These include such areas as record keeping, 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 adjustments will have to be made to meet the new requirements. All the new standards are designed to help make pesticide use safer for people and the environment.

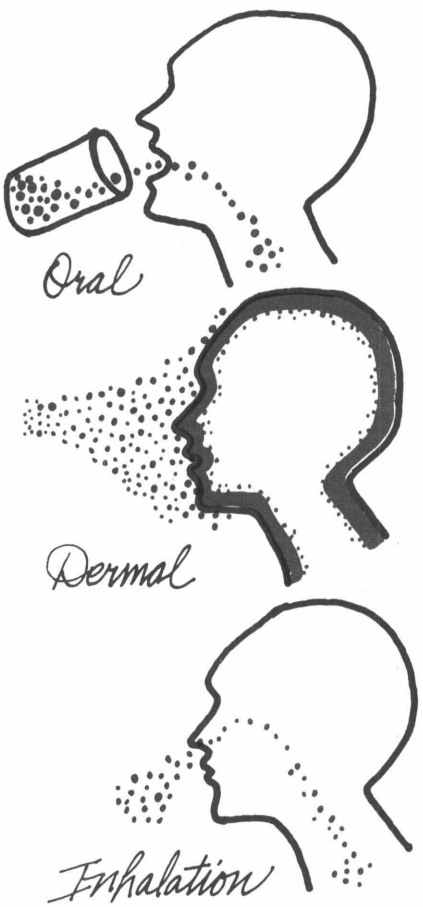


chapter IV
Toxicity of Pesticides

Pesticides are designed to control pests. Most control the pest by poisoning it. Unfortunately many pesticides are poisonous to humans too. Some are very poisonous (toxic) and may kill or seriously injure humans. Others are fairly safe (non-toxic). Even the fairly safe pesticides can irritate the skin, eyes, nose or mouth. You should use caution whenever you handle any pesticide!



Routes of Entry (How pesticides enter the body)



Pesticides can enter the body in three ways. You may be poisoned no matter which way they get in. You can even be poisoned without knowing it, especially if the pesticides enter through your skin or lungs.

Oral. Pesticides may enter the body through the mouth. They may be taken in by mistake while eating or smoking on the job, or when improperly stored in food containers. Sometimes pesticides are swallowed on purpose as in suicide.

Dermal. Pesticides can also be taken in through the skin. Wearing clothing which is wet through with pesticides, or allowing pesticides to fall directly on the skin while mixing or spraying can be dangerous. Dry materials—dusts, wettable powders or granules—can also be absorbed. Some pesticides do not pass through the skin very quickly. Others, however, can be as dangerous entering through skin as when taken by mouth.

Pesticides pass through the skin on some areas of the body more quickly than on other areas. You must be especially careful with your eyes. The back of the hands and the wrists absorb more than the palms do. The armpits, back of the neck, groin and feet take in pesticides easily too. Cuts or scrapes allow pesticides to enter even more easily than usual.

Inhalation. You can breathe in pesticides too. Pesticides in the form of dusts, spray mist, or fumes can be sucked into your lungs as you inhale. This route of entry is important during mixing of wettable powders, dusts or granules. You can also be poisoned when fumigating or spraying without the proper respirator in a closed area, such as greenhouses, apartments or grain bins. Even inhalation of dilute pesticides can result in poisoning.

Which Route Is More Important? The dermal and inhalation routes of entry are likely to be more important to the pesticide applicator than the oral route. You do not 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. You can be poisoned no matter which way the pesticide enters your body. It may even enter in all three ways and poison you.

Kinds of Toxicity

Toxicity Means "How Poisonous." In other words, if you know the toxicity of a pesticide, you know "how poisonous" it is. The toxicity of a pesticide must be measured in more than one way. Many pesticides are dangerous after one large dose. Some pesticides, however, are dangerous after small, repeated doses.

Acute Toxicity is "how poisonous" a pesticide is to an animal (or man) after a single exposure. A pesticide with a high acute toxicity is deadly if even a very small amount is absorbed. Usually "how poisonous" one pesticide is compared to another is judged on acute toxicity. It is also 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 "how poisonous" a pesticide is to an animal (or man) after small, repeated doses over a period of time. Chronic toxicity is very important because some pesticides can remain in the body for a long time. If you are exposed often to these pesticides they may remain and build up in your body. You can be poisoned without ever getting a large dose of pesticide! Chronic toxicity is measured as chronic **oral** toxicity, chronic **dermal** toxicity, and chronic **inhalation** toxicity.

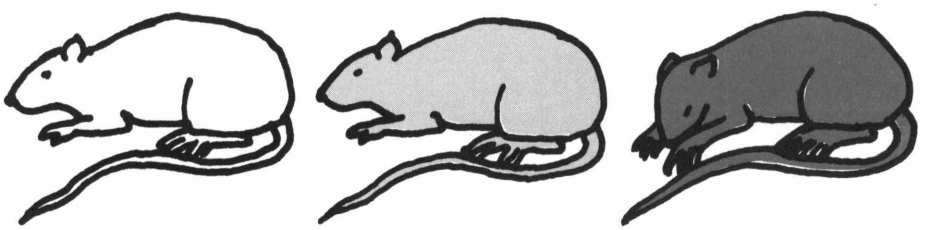
Measuring Toxicity

Finding out the toxicity of a pesticide is not easy. Obviously humans cannot be test animals. Other animals (usually rats) are used. However, just because a pesticide is very poisonous to rats doesn't mean it is also very poisonous to dogs, cows, man or wildlife. Likewise, a pesticide which is relatively non-toxic to rats is not always fairly safe to other animals. Toxicity studies are just guidelines. They are used to estimate "how poisonous" a pesticide is compared to another pesticide.

Acute Toxicity Measures. The commonly used measure of acute oral and dermal toxicity is LD_{50}. LD means Lethal Dose (deadly amount). LD_{50} values are measured from 0 up. The **lower** the LD_{50}, the **more poisonous** the pesticide. A pesticide with an acute oral LD_{50} of 500 would be much **less** toxic than a pesticide with an LD_{50} of 5. Usually LD_{50} values are measured in milligrams per kilogram. Often you will note the abbreviation "mg/kg" following the number value. "Milligram" and "kilogram" are metric units of weight similar to "ounce" and "ton." Milligrams per kilogram is the same as parts per million. For example, the oral LD_{50} of Pesticide A is 5 mg/kg. Therefore it would take only 5 parts of Pesticide A for every 1 million parts of body weight to kill a test animal.

Acute inhalation toxicity is measured by LC_{50}. LC means Lethal Concentration. "Concentration" is used instead of "dose" because the amount of pesticide inhaled from air is being measured. LC_{50} values are measured in milligrams per liter. Liters are metric units of volume similar to a quart. The **lower** the LC_{50} value the **more poisonous** the pesticide.

Chronic Toxicity Measures. There is no standard measure like LD_{50} for chronic toxicity studies. Often the length of the experiment 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. The chronic toxicity of organophosphate and carbamate pesticides is measured by cholinesterase levels in the blood. These families of pesticides can poison slowly by attacking a chemical called "cholinesterase" in the blood. (See Chapter VIII, Cholinesterase Tests.) A low level of cholinesterase means danger. Stay away from organophosphates and carbamates until the level is normal again.



Label Warning Statements

To alert pesticide users to the toxicity of a pesticide, a signal word must appear on most labels. Four different categories are used. Signal words are used to tell the user whether the chemical is highly toxic, moderately (medium) toxic, slightly toxic, or relatively non-toxic. Label warning statements are based on acute toxicity. Acute oral toxicity, acute dermal toxicity, and acute inhalation toxicity are all used to determine the correct category for each pesticide. For example, the acute oral toxicity and acute dermal toxicity of a pesticide are in the slightly toxic category. But the acute inhalation toxicity is in the highly toxic category. The pesticide label will have the signal words for a **highly toxic** pesticide.

Categories	Signal Word Required on The Label	Categories of Acute Toxicity			Probable Oral Lethal Dose for 150 lb. man
		LD_{50}		LC_{50}	
		Oral mg/kg	Dermal mg/kg	Inhalation mg/l	
I Highly Toxic	DANGER — skull and crossbones POISON	0 thru 50	0 thru 200	0 thru 0.2	A few drops to a teaspoonful.
II Moderately Toxic	WARNING	from 50 thru 500	from 200 thru 2000	from 0.2 thru 2	Over one teaspoonful to one ounce.
III Slightly Toxic	CAUTION	from 500 thru 5000	from 2000 thru 20,000	from 2.0 thru 20	Over one ounce to one pint or one pound.
IV Relatively Non-toxic	CAUTION	greater than 5000	greater than 20,000	greater than 20	Over one pint or one pound

Hazard

Hazard Is the Risk of Danger. It is the chance that danger or harm will come to the applicator or bystanders or consumers or livestock or wildlife or crops, etc. from the use of a pesticide. Hazard is often confused with toxicity. They are not the same. A highly toxic pesticide is usually considered "hazardous" because of the high risk that the applicator, bystanders, etc. can be injured. However, safe and careful handling of a highly toxic pesticide can make it a low risk or low hazard. Many factors besides toxicity can make a pesticide hazardous. These include: the target involved, the formulation chosen, the concentration and dosage used, the type of pesticide, and the skill of the applicator.

Target. A pesticide is hazardous if it is used on a plant or animal which can be easily injured by it. If a pesticide does not injure plants, there is a low hazard when using the chemical on or around them. However, that same chemical could be highly toxic to animals. If used on or around animals, there is a bigger risk than when used on or around plants. The pesticide is hazardous to animals, but not hazardous to plants. Try to choose the pesticide which is **least** hazardous to the target you are treating.

Formulation. Formulations of moderately poisonous pesticides which are easily absorbed or inhaled may be very hazardous. Sometimes formulations of highly toxic pesticides which are not easily absorbed or inhaled are fairly safe. Choose the safest formulation available to do the job. (See Chapter XIV, Formulations.)

Concentration and Dosage. A highly toxic pesticide which is very dilute can be fairly safe. A moderately toxic pesticide which is very concentrated can be more hazardous. Using a gallon per acre of a slightly toxic pesticide can be more risky than a pint per acre of moderately toxic pesticide.

Type of Pesticide. Some moderately poisonous pesticides are hazardous to the environment because they build up in animals. Dieldrin and other chlorinated hydrocarbons for example are known to build up in animals. Some of these long lasting sprays are relatively safe, however, when used inside buildings or homes. Other pesticides, such as many organophosphates, are highly toxic but break down quickly in the environment. These are not as hazardous to the environment but are very hazardous in buildings or around people.

Applicator. A skilled, experienced applicator using a highly toxic material may be less a hazard to himself and others than the homeowner who spreads ant and roach bait around his house. A certified applicator should have the skill and knowledge to handle all pesticides safely. Otherwise he is a hazard to himself, others, and the environment.

Synergism is the action of two materials of the same type which used together produce a greater effect than the sum of the materials when used alone. One of the materials when used alone may not affect the pest, but greatly increases the total effect of the two when used together. Example: Chemical A kills 60%, Chemical B kills 20%, Chemical A and B together kill 98% of the pests. Synergism may increase control or require less chemical. It may also be more harmful to a non-target organism.

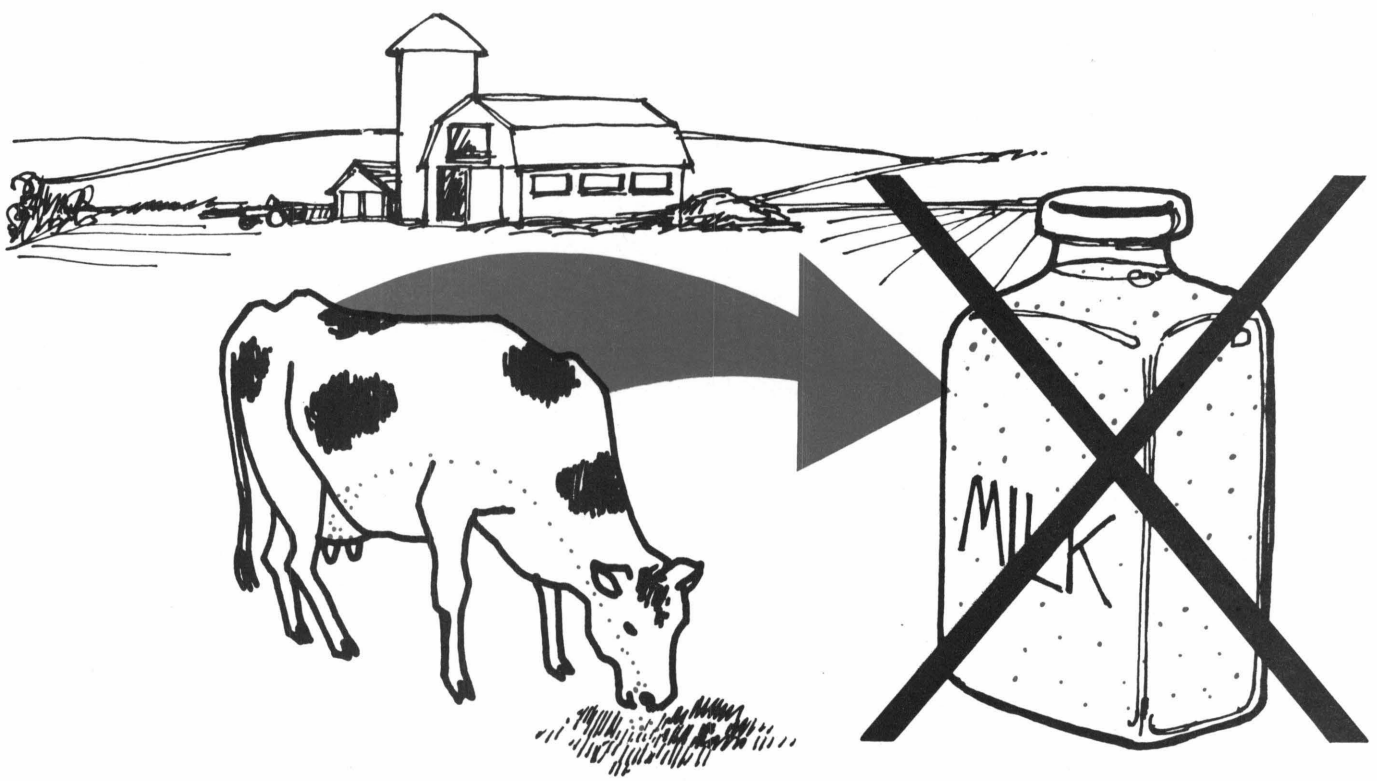
All pesticides are hazardous if misused. Use caution whenever you handle them!

Wrong

Right

chapter V
Residue, Tolerance, Registration

The use of pesticides on both food and non-food crops 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 even stricter. The amount of pesticide remaining on the crop at harvest must be carefully regulated.



Residues

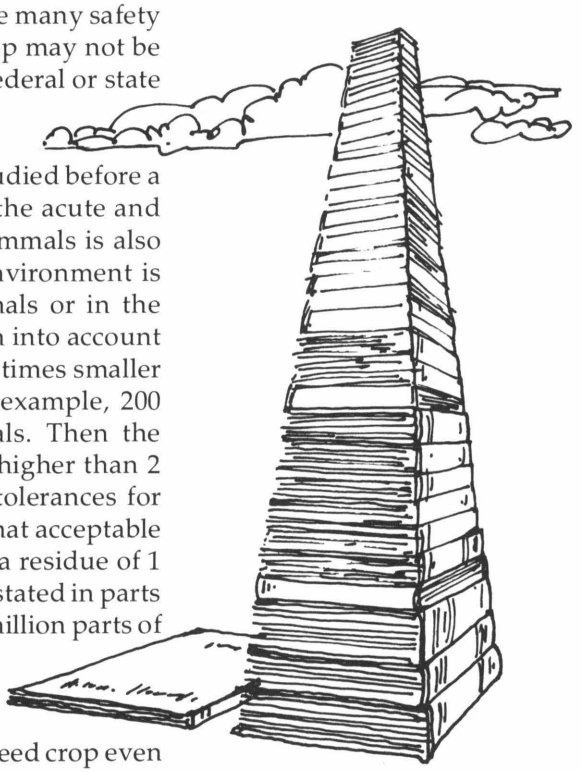
The pesticide which is on the leaves or skin or other surface right after application is the **deposit.** Sometimes the deposit can be easily seen, as with many dusts or wettable powders. Other times it cannot be seen with the naked eye. If the pesticide deposit remains on the surface for a period of 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. 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. 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.

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 use of each pesticide. 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 of 1 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.]



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

Negligible Residue Tolerances. A residue may be on a food or feed crop even though no pesticide was ever directly applied on 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. In order for a pesticide to be used on anything to be eaten, a tolerance must have been set, unless it is exempt from tolerance.

Days to Harvest

Many pesticides break down in the environment. As they break down, the residue on the crop or animal grows 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 to 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

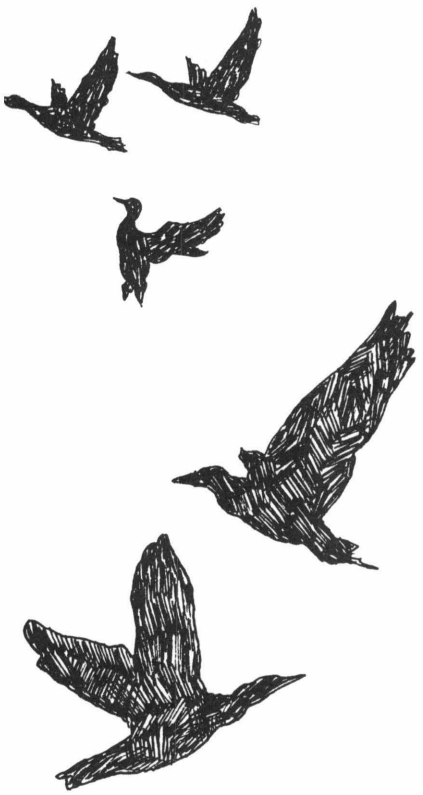
Even though a tolerance is set for a pesticide on a specific crop, it still **cannot** be legally used until registered. Every pesticide **and every use** must be registered federally by the Environmental Protection Agency (EPA). EPA reviews all the required information on the pesticide. This includes toxicity studies, wildlife and environmental studies, breakdown and residue studies, chemical studies, etc. Registration will be granted only if the proposed use will control the target pest **and** protect public health and the environment. EPA reviews and registers all statements which appear on the pesticide label, too. (See Chapter XIII, 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 applicators, to help make sure that all food is safe to eat. You, only, can be sure that no illegal residues remain on food crops. Follow label directions carefully. Don't be responsible for seizure of your customer's or his neighbor's crop!

chapter VI
Ecology and Environmental Considerations

The words "environment" and "ecology" have been increasingly in the news for the past few years. Man has suddenly begun to fear that his resources — air, water, soil — are running out or becoming unfit for use. As a result, pesticide practices are being closely examined. As pesticide applicators many of you feel the accusing finger pointed in your direction. You are often blamed for environmental abuse.

Why Protect the Environment?



Man needs a place to live with clean water and air, food which is not harmful, and an environment which will not threaten his health and safety. Most people find pleasure in the out-of-doors and enjoyment in observing wildlife. Most want to preserve our environment.

Water is one of our greatest resources. Its unusual properties and abundance make it necessary for all life. Polluted water can fill many of our needs but not the most basic ones. Man and wildlife need **clean** water for drinking and bathing. Most fish and other marine life can survive only slight changes in their water environment. Farmers must use uncontaminated water for their livestock and irrigation practices to prevent plant or animal poisoning or illegal residues. Clean water is essential.

Soil has become more important as the need for food increases. In order to feed the numbers of people, fertile and healthy soil is a must. Poor soil practices and misuse cause poor yield and second class crops, especially if root vegetables or forage crops are being planted. Overdoses of pesticides which remain for long periods in the soil may limit planting to only a few crops which will not be harmed by the chemicals.

Air must be available for any plant or animal to live. It is the source of oxygen for breathing and receives the carbon dioxide waste. Air has the ability to move particles a long way before letting them go. Most of the time this ability aids the farmer. It causes rain, for example. Unfortunately for the pesticide applicator, this same ability is the cause of drift. Pesticides carried by the air may be harmful to man and wildlife's health and safety. Pesticides in the air are not controllable and may settle into waterways, wooded areas or barnyards. Drift must be avoided.

Honeybees and other pollinators are necessary for good farming and food production. In many cases when there is no pollination there is no crop. Unfortunately bees are very sensitive to many insecticides. Whenever possible do not spray any pesticide when these or other helpful insects are likely to be in the area.

Wildlife. Fish, birds, and mammals are assets to man. Land which is used only as farmland does not have to be a wildlife refuge. However, care should be taken to protect surrounding wooded areas and waterways when applying any pesticide. Fishing and hunting are very popular sports. If pesticides are carelessly used, these sports can disappear. Pesticide-kills of mammals, birds, and fish in large numbers, have already cut down on fishing and hunting activities in some areas. High levels of pesticides in some of these animals have made their meat unfit for man to eat.

Pesticides in the Environment

Pesticides are a help to the environment when they are used carefully and wisely. For years they have been used to control pests which could be harmful to man. Rats carrying plague or mosquitoes carrying malaria are good examples. These control programs today are necessary, especially in crowded cities and countries with large numbers of people. However, pesticides can harm the environment, too. Any pesticide which is off-target is a pollutant and can be dangerous. All of the benefits of pesticides can be cancelled through misuse or carelessness.

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. Less land must be tilled to feed the people. More land is free for wildlife and recreational purposes. Good farm land may become unfit for crops, though. 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 be over the set tolerance at harvest. Or the pesticide may kill all or most plant life and make the land useless for farm or recreational use.

Recreation. Pesticides can be used to preserve outdoor activities in our parks and camping areas. Fly and mosquito control programs give relief from the annoying pests. Without control programs, outdoor activity is extremely limited for most people. However, drift and overdoses can destroy wildlife, cause trees to lose leaves and ruin recreation areas. Runoff, spills or drift into streams can cause fish kills and make the water unfit for swimming, fishing, or even boating. Drift and overdose can injure or kill birds and mammals. Parks and camping areas with leafless trees, dying plants, and no wildlife are not acceptable as recreation areas.

Livestock. Pesticides also protect livestock from harmful and annoying pests. Otherwise the penned animals could not escape from constant irritation. The quantity and quality of livestock products—milk, meat, etc.—is improved when the pests are controlled. Pesticide drift onto forage and pasture land or into drinking water can injure livestock. The animals may be poisoned by eating contaminated forage and grasses. Once eaten, these pesticides can also lead to illegal residues in the meat and byproducts of the animals. They may be unfit for humans to eat.

Runaway Pests and Useful Insects. Pesticides aid in controlling insects or diseases that get into an area for the first time. Often these pests have few natural enemies in the new environment. Without a good pesticide program, they can rapidly overrun an area. Gypsy moth and Japanese beetles are good examples of runaway pests. Careless use of wide range pesticides can destroy natural enemies (such as predators and parasites) in an area. Runaway insect or pest populations can result. Pesticides misused in this way may actually help the pests! Honeybees and other useful insects are often injured when pesticides are used carelessly.

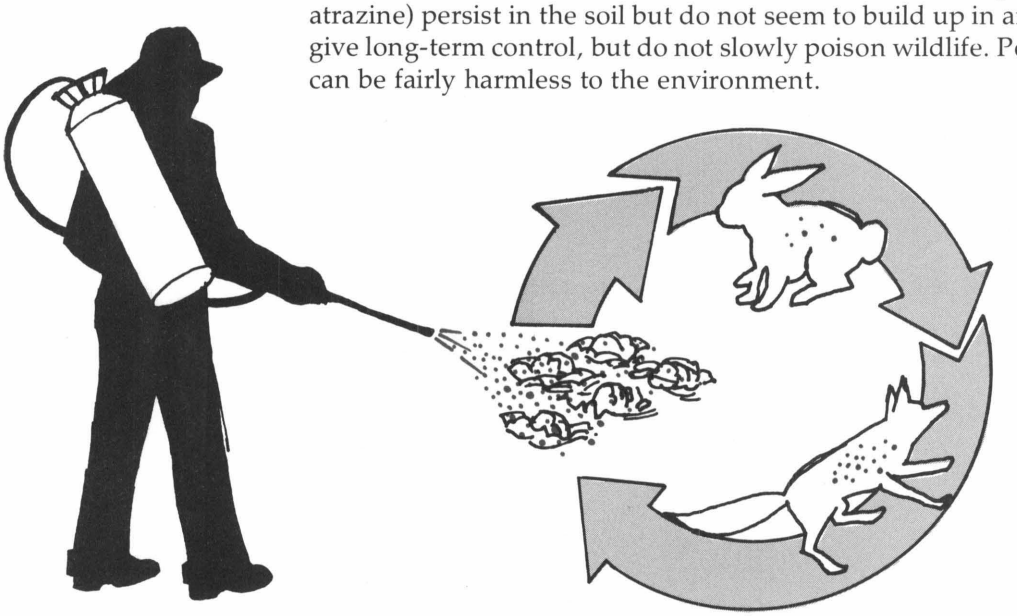
WILDLIFE. Pesticides can be harmless to wildlife when used carefully and on target. Sometimes chemicals can aid wildlife by controlling runaway or annoying pests which could harm the animals. Pesticides can also be poisonous to wildlife. Some chemicals are highly dangerous to wildlife but others are fairly harmless. The toxicity of every chemical to every animal is not known. A pesticide that is only slightly toxic to one living thing may be very toxic to another. A pesticide that is relatively **harmless** to birds may be highly poisonous to fish or mammals.

Food Chain. Wildlife are also important because of their place in the food chain. Food chain is a way of describing how all animals depend on each other. Each animal has a place in the chain depending on the type of food it eats. Animals which eat only plant materials are at the bottom of the chain. Animals which eat these plant-eaters are on the next level. The animals which eat meat are at the top of the chain. In this complex food chain, each animal has an important place. The loss of any animal disrupts the whole chain.

Accumulative Pesticides. Some pesticides can build up in the body of animals (including man). These are called accumulative pesticides. The chemicals can build up in an animal's body until they are harmful to it. These pesticides also accumulate (build up) in the food chain. Meat-eaters feeding on other animals with built up pesticides may receive high doses of pesticides. If they feed on too many of these animals, the meat-eater can be poisoned without ever directly contacting the pesticide! The build up through the food chain can injure animals which aid man. In fact, man as one of the meat-eaters at the top of the chain could get very high doses of pesticides in this way.

Nonaccumulative Pesticides. Many pesticides do not build up in the body of animals or in the food chain. These are nonaccumulative pesticides. These chemicals usually break down rapidly into other, relatively harmless materials. Organophosphate pesticides, for example, may have high toxicity at first and may cause local kills. But they do not accumulate so they are not as dangerous to the environment. Usually pesticides which break down quickly in the environment are the least harmful to it.

Persistent Pesticides. Persistent pesticides stay in the environment without change for long periods of time. Persistent pesticides do not necessarily accumulate in animals' bodies or in the food chain. Some pesticides (example: atrazine) persist in the soil but do not seem to build up in animals. Thus, they give long-term control, but do not slowly poison wildlife. Persistent pesticides can be fairly harmless to the environment.



PLANTS. Pesticides are often used on plants to protect them from pests. Insecticides and fungicides are often used on ornamentals and forest trees to control runaway pests or other serious insects and diseases. These chemicals aid in keeping forests, parks, and lawns green and enjoyable. However, pesticides can injure plants. The injury can range from slight burning or browning of the leaves to death of the whole plant. This injury is called phytotoxicity. Phytotoxicity accidents can result from carelessness or from use of a pesticide which is highly hazardous to plants and trees. Hazard may depend on:

Type of Pesticide. All kinds of pesticides—insecticides, fungicides, herbicides, etc.—may injure or kill plants. Herbicides are especially hazardous because they are designed to kill or control plants. Non-target plants can be severely damaged from drift or misuse of herbicides. Always be very careful when you apply these chemicals near desirable plants.

Movement. Some pesticides and some formulations tend to move off target readily. These chemicals can be a great threat to desirable plants and trees. Pesticides which drift off target during application are a big hazard. Care must be used to avoid drift onto sensitive plants and trees. But pesticides can move in other ways too. Some are carried off target by rain and runoff water and injure plants in the water's path. Other pesticides may move through the soil to surrounding areas and cause phytotoxicity there. Certain formulations of pesticides vaporize (become gases) easily and the vapor can drift a long way. This vapor can settle on desirable plants and trees and cause severe damage. If plant injury could be a problem, try to choose a pesticide and formulation which tends to remain on the target area.

Dosage. The amount of pesticide which is applied on or near desirable plants can be important. Pesticides which are safe at low rates can injure plants severely at higher rates. Sometimes the dosage listed on the label which can safely be used is not very far below the dosage level which could cause injury. Be especially careful not to overdose when plant injury could be a problem.

Persistence. Some pesticides remain on the target area for a long time. These pesticides could injure or kill plants which are planted there at a later date. Persistent pesticides can be very useful for long-term insect, disease or weed control. But follow label instructions carefully if future crops or other plants and trees will be planted in the area.

The label will state whether phytotoxicity will be a problem and what plants can be injured. Follow the label instructions carefully and cautiously if you wish to avoid injuring desirable plants.

Do your part to aid the environment; your surroundings are worth protecting.

chapter VII
Safety Precautions

(See Chapter VIII on Highly Toxic Materials)

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

Before Application

Many safety precautions can be taken before you begin applying a pesticide. Many applicators are dangerously exposed to pesticides while getting ready to spray, not just during the spraying. Don't ever decide to spray until all factors are favorable to protect you, others and the environment.

Plan Ahead. Be sure that plenty of soap and/or detergent and water are nearby for emergencies or cleanup. Check the label and wear all the protective gear necessary. Choose a time when weather conditions are right (Chapter XIX). Choose the safest, effective pesticide available. Always be sure that the intended use is on the label.

Move Pesticides Safely. Carelessness in moving pesticide poisons can result in broken containers, spills and contamination. Never carry pesticides inside your car or truck cab. Spills on seat covers are very hard to remove. The pesticide could even spill on you or your riders. Place the containers so they cannot shift, roll or bounce around. Do not put groceries or livestock feed and mash near the poisons. You could poison the food and have a serious accident. Never allow children to ride on or near the pesticides. A spill could cause injury or death.

Protective Clothing. The need for protective clothing depends on the pesticide being handled. High toxicity is not the only factor; some other factors are formulation, application equipment and degree of exposure. When concentrated, highly toxic pesticides are handled you must use rubber gloves, a respirator, and any other protective gear called for. However, this type of gear is more protection than necessary or practical for applying many pesticides of low or moderate toxicity. The label will give the precautions necessary for the pesticide being used.

Some pesticides will require no protective clothing. However, most applicators who apply pesticides regularly wear either a company uniform, coveralls, or some other type of protective clothing. When this is the case there are some common sense rules to follow. If you are exposed to downward drift, you should wear a wide brimmed, waterproof hat that will protect the back of your neck as well as your eyes, mouth, and face. A face shield is useful to further protect the eyes and face. If ordinary coveralls will wet through, some type of lightweight waterproof covering is called for. Lightweight, unlined rubber boots are not uncomfortably heavy or hot and will not absorb pesticides like canvas or leather footwear. Cotton gloves will protect the hands from abrasions which increase absorption of pesticides through the skin. However, they should be changed and laundered before they wet through. If you change into special spray clothes, be sure your "street" clothes are kept well away from the pesticides. Do not hang them in the storage or mixing area.

Mixing and Filling. Protective gear is especially important during mixing and filling. Consider using rubber gloves, goggles and a respirator when handling moderately toxic materials even if the label doesn't call for them. Plan your application so that you mix only what you will use. Use no more than the amounts called for to prevent injury to exposed plants and/or animals and to prevent illegal residues in food. Do not combine pesticides unless the combination is called for on the label or you have consulted an authority. Open packages carefully with a knife or sharp instrument to avoid splashes, spills or drift. If a concentrate is spilled or splashed on your clothing, wash and change clothes immediately. If a concentrate is spilled on the floor or ground, clean it up. Some chemicals in the concentrated form will remain in toxic quantities in

the soil for many months. Always stand with your head well above the fill hole of the spray tank to keep pesticides from splashing in your face or eyes. Stand with wind from right or left when pouring or mixing.

Equipment. Carefully choose the method of application that will do the job economically and safely. Check your equipment thoroughly before you begin. Be sure it is working properly and calibrated correctly. Use the correct nozzles, pressure, and droplet size to avoid drift. Use separate equipment when applying hormone-type herbicides (such as 2,4-D). Such herbicides cannot easily be washed out of application equipment and even slight residues may kill sensitive plants.

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. Do not work in drift, spray, or runoff unless properly protected. Do not wipe your hands on your clothing if chemicals have been spilled on your gloves. This will contaminate your clothing and may soak through to your skin. Do not blow out clogged hoses, nozzles, or lines with your mouth. Never eat, drink, or smoke when handling pesticides; wash your hands and face thoroughly first. When working with pesticides day after day even moderately toxic chemicals can poison you. Consider using protective equipment especially a respirator, even if the label doesn't call for it.

Watch out for others too. Supervise your employees and be sure they follow all safety precautions. Always work in pairs when handling hazardous pesticides. Watch your buddy carefully for unusual behavior or actions. If you feel sick, don't try to "finish up" the job. Get out of the area fast and get help. Keep children, unauthorized persons and pets out of the area to be sprayed. Do not let children or pets play around sprayers, dusters, filler tanks, storage areas, or old pesticide containers. Use the proper rates. Overdoses won't kill pests twice, but may injure humans, crops, or wildlife and are misuses.

Avoid Sensitive Areas. Avoid spraying near apiaries, lakes, streams, pastures, houses, schools, playgrounds, hospitals, or sensitive crops whenever possible. If you must spray, avoid windy days and always spray downwind from the sensitive area. Consider spraying areas near living quarters in the early morning or evening when people and pets are least likely to be exposed. Notify beekeepers and residents when you plan to spray in their area and urge them to take special precautions. Never spray directly into or across streams, ponds, or lakes. Whenever you spray in residential areas, take every precaution. Be sure toys and pet dishes are removed or covered and children are inside.

Avoid Spills, Runoff and Drift. Pesticides which fall anywhere but on the target area can injure crops, people, and the environment. Avoid applying chemicals when drift or runoff are likely to occur. High winds and heavy rains favor drift and runoff. Choose application equipment, formulations and adjuvants that will minimize drift and runoff hazard. Spills can be avoided by using care and caution.

Avoid Equipment Accidents. Your application equipment can help you use pesticides safely. But poor maintenance and careless use can add to the hazard.

- Be sure there are no leaks in the pump or tank. Check for leaky hose connections and worn spots in hoses that could burst and splash you or others

with poisonous spray. If belts, pulleys, or drive chains are exposed, put guards around them so that 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 so that spray materials will not leak onto the ground.

- When the tank is being filled you should stay with the machine. A tank that is not watched often runs over and causes a pesticide spill on the ground or into a stream.
- If you are working at the end of the spray hose some distance from your equipment, have someone near the sprayer so that children or others will not get caught in or injured by the machinery. The machinery should be shut down if you find it necessary to adjust or repair any moving parts. If nozzles, hoses or lines clog, do not blow them out with your mouth. Even dilute spray mixtures can be toxic.

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, spray it on other targets at the recommended dosage. If you spray the extra on a crop be sure the crop is on the label! Never leave partly filled equipment in the field after an operation. When the tank is empty, release the pressure from your application equipment. Close the outlet valves. Return the equipment to the special storage area. Wash off the outside so that people touching it do not get exposed to the pesticides.

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

Clean Up. At the end of each day take a shower. Wash your body and scalp thoroughly with soap and water. Spray clothing should be changed daily. If your clothes were exposed to pesticides, place them away from other clothes. Keep them well away from the family laundry. Do not allow children to play in the contaminated clothing. The pesticides on your spray clothes could harm other people who touch them. Warn the person who will be washing your spray clothes of possible dangers. Do not allow the clothes to be washed in streams or ponds. The pesticides could contaminate the water and cause fish kills.

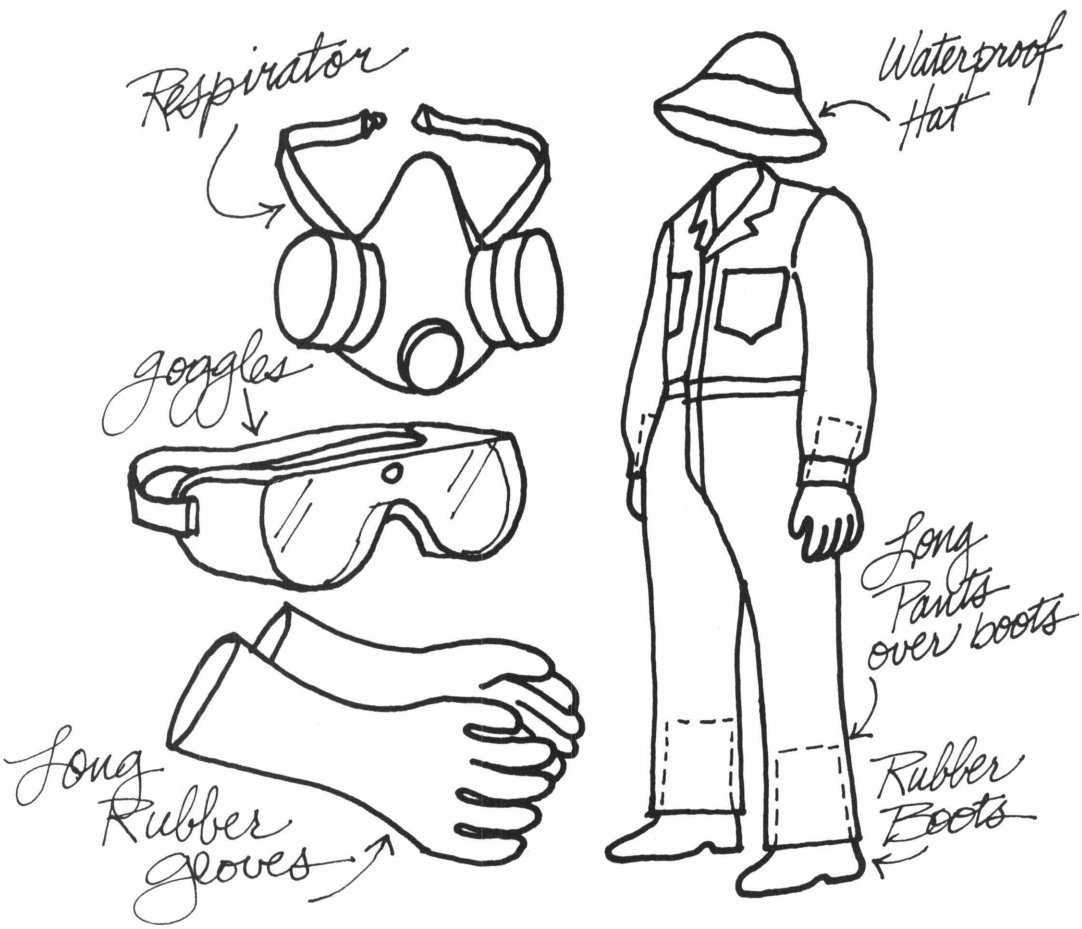
Reentry. Safe reentry times may be on the label. Do not allow farm workers, children or other persons to reenter the sprayed area until this time has passed. Even with the safest materials wait at least until the spray has dried. When no reentry times are available, use good judgement in allowing people to reenter sprayed areas. If you must reenter an area soon after spraying, be sure to wear all the necessary protective clothing as called for on the label. (See Chapter III for laws regarding reentry times.)

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!

chapter VIII

Safety Precautions for Handling Highly Toxic Pesticides

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. 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. But 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.)



Gloves

Always wear unlined, elbow length rubber gloves when handling organophosphates, carbamates or other chemicals with "Poison" or "Warning" labels. The elbow length gloves will protect your wrists and prevent pesticides from running down your sleeves into your gloves. Be sure your sleeves are **outside** your gloves. Check closely for holes by filling the gloves with water and gently squeezing. Discard the gloves if any holes appear. Never use cotton or leather gloves. These can be more hazardous than no protection at all because they hold the pesticide close to your skin for long periods of time. Follow the suggestions on the label when using other pesticides. When you are finished spraying, wash your gloves with detergent and water **before** you remove them. Then you will not contaminate your hands.

Coveralls

Wear clean dry coveralls which cover your entire body from wrists to ankles for ordinary application of highly toxic chemicals. If you (or your helper) will be in a mist or spray or your coveralls will be wet through for any reason, wear a waterproof suit. If heavy rubber rainsuits will be too hot, try the new lightweight waterproof suits. After every use wash your clothes with a detergent and water.

Boots

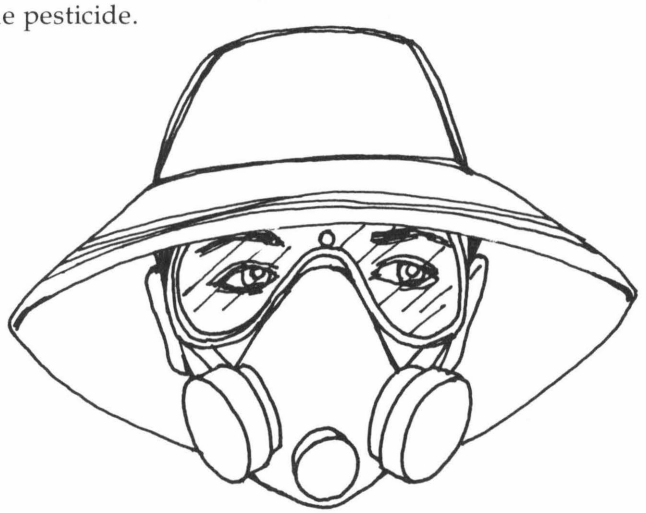
Wear lightweight, unlined rubber boots which cover your ankles when handling or applying highly toxic pesticides. Remember to put your pant legs **outside** the boots, otherwise the pesticide can drain right into the boot. The boots should be washed often and dried thoroughly inside and out to remove any pesticide residue. It is wise to keep two pair of boots on hand in case of accidental contamination.

Goggles or Face Shield

Wear tight-fitting, non-fogging goggles or a full face shield whenever the chemical could contact your eyes. Always wear them when you are pouring or mixing concentrates or working in a highly toxic spray or dust. Clean them often. 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 rubber strap. If possible, wear the strap under your head covering.

Head and Neck Coverings

The hair and skin on your neck and head must be protected too. Rubber or plastic rainhats, wide brimmed hats, bill caps, and hard hats which can be washed are good. In cool weather, waterproof parkas with hoods and a bill cap are also good. Avoid cotton or felt hats, they absorb the pesticide.



Respirators

Respirators protect you from inhaling toxic chemicals.They should be worn whenever the more toxic organophosphate (TEPP, parathion, Guthion, Di-Syston, Thimet, Phosdrin) or carbamate (Furadan, Temik) pesticides are applied. The label will tell if a respirator is needed. They are especially necessary whenever you are handling concentrated highly toxic pesticides. Always wear a respirator while mixing or filling highly toxic pesticides. Applicators who will be constantly exposed to small amounts of toxic pesticides for a day or several days, should also wear a respirator.

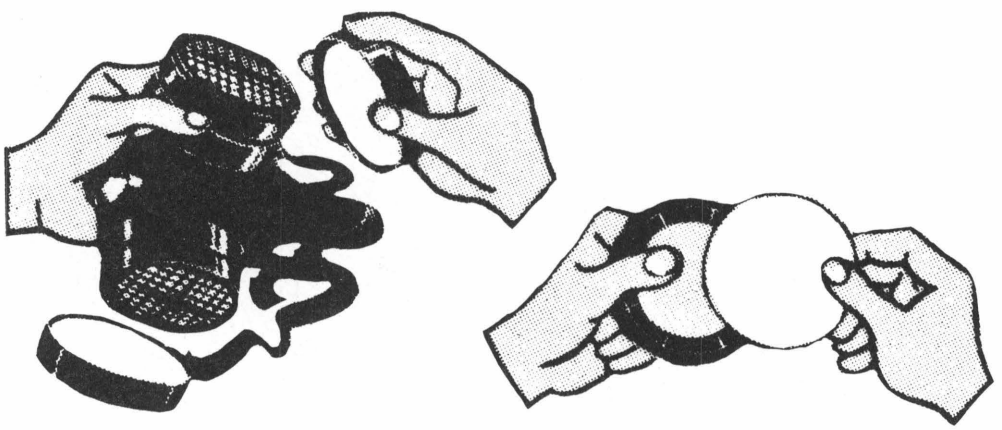
Cartridge Respirators. The cartridge respirator is usually a half-face mask which covers the nose and mouth only. It contains one or two "cartridges" which absorb toxic fumes and vapors of chemicals and filter the air you breathe. These respirators are used either for relatively short exposure periods to concentrated chemicals or for a long exposure period to low concentrations of toxic chemicals. Goggles, if necessary, are worn separately. The main limitation of this type of respirator is the leakage which usually occurs around the face shield. Make sure the correct replacement cartridge is used.

Gas Masks. Gas mask respirators cover the entire face and protect your eyes as well as your nose and mouth. They contain better filters and more absorbing material to cleanse the air than the cartridge respirators. Gas masks are used when the applicator intends to be exposed to toxic fumes in heavy concentrations or for long periods of time.

Some gas masks are connected to an independent oxygen supply and none of the contaminated outside air is used. These are useful when applicators are exposed to unknown vapors as a result of accidents, fires, or reentering fumigated areas.

Use the Respirators Correctly

- The respirator should fit properly on your face. It should be worn tightly enough to form a seal all around your face. Do not wear the headband too tightly or headaches and/or dizziness may result.
- 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 (8) hours of use. If you notice a pesticide odor first check to be sure the respirator is sealed on your face. If the odor persists change the cartridge immediately.
- After each use wash the face piece with detergent and warm water. Rinse thoroughly and wipe dry with a **clean** cloth. Store the respirator, filters, and cartridges in a clean, dry place away from pesticides. A tightly closed plastic bag works well for storage.



Use Common Sense

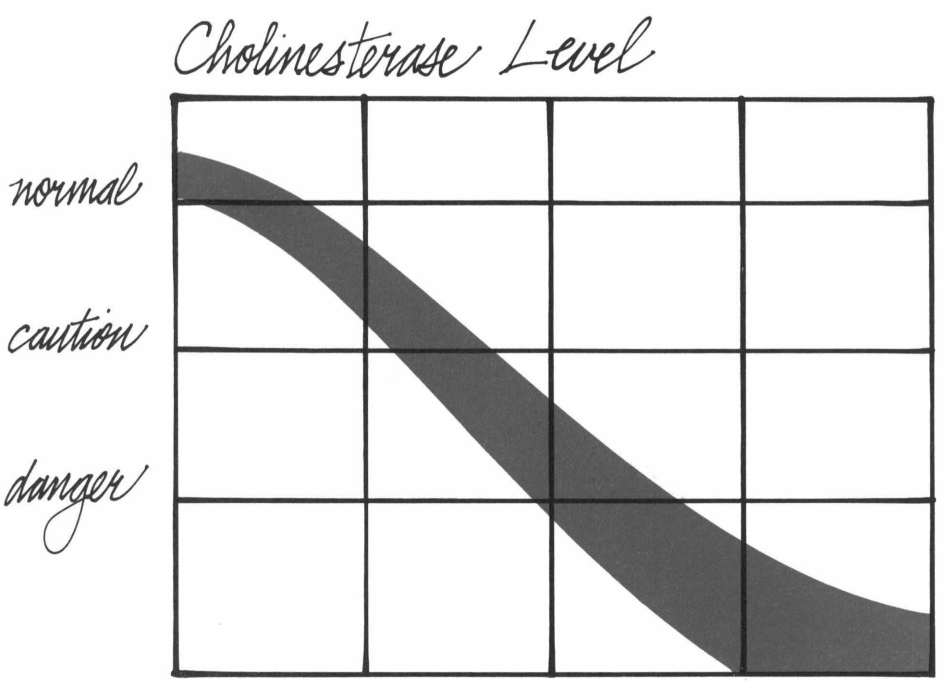
Always work in pairs when handling highly toxic chemicals. Watch your buddy carefully for unusual behavior or actions. Remind him (and yourself) to wash his face and hands before eating, drinking or smoking. Never use the toilet before washing your hands. It is important to avoid getting toxic pesticides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

Wait a resonable period of time before returning to the field or area that has been treated. Do not allow others to reenter these areas either, unless they are wearing proper protective gear. (See Chapters II and III.)

Cholinesterase Tests

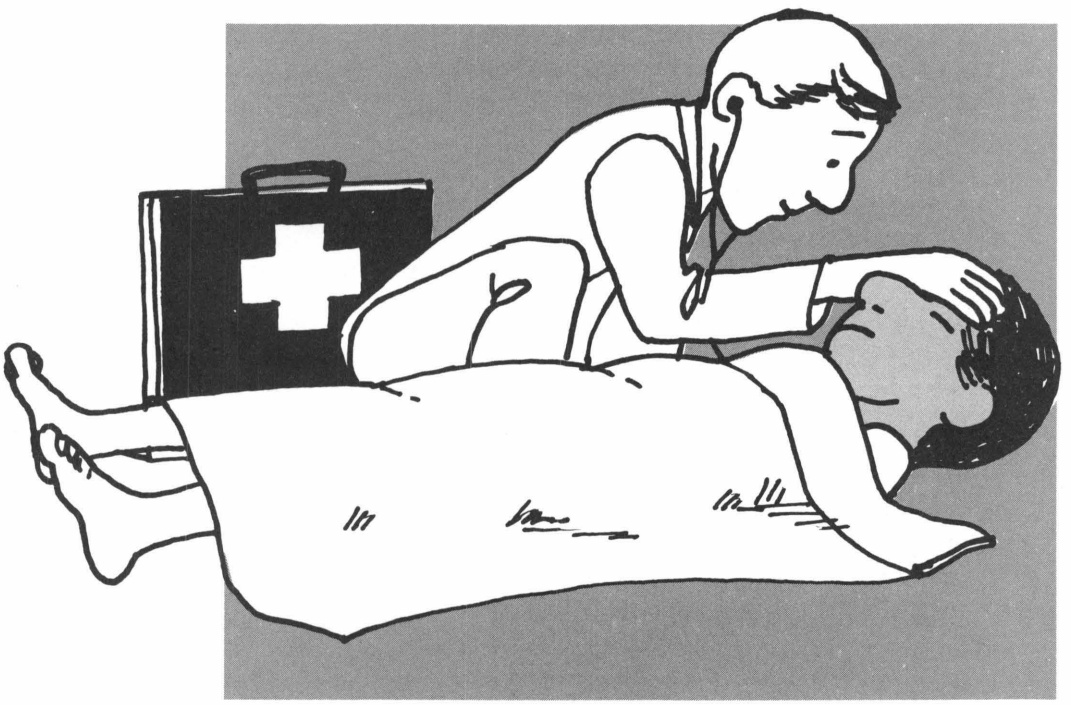
Consider getting your blood tested to find your normal or base level of a chemical called cholinesterase. This chemical is necessary for your nervous system and without it you will die. Both carbamate and organophosphate pesticides attack this chemical in your blood and make it useless. Once your base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

Don't take chances with Highly Toxic Chemicals; you are gambling on your life.



chapter IX
Symptoms of Pesticide Poisoning

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.



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. Or they may 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 may be delayed.

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

Medical Doctors Should Be Warned Ahead of Time

Most medical doctors are not 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 have the antidotes on hand.

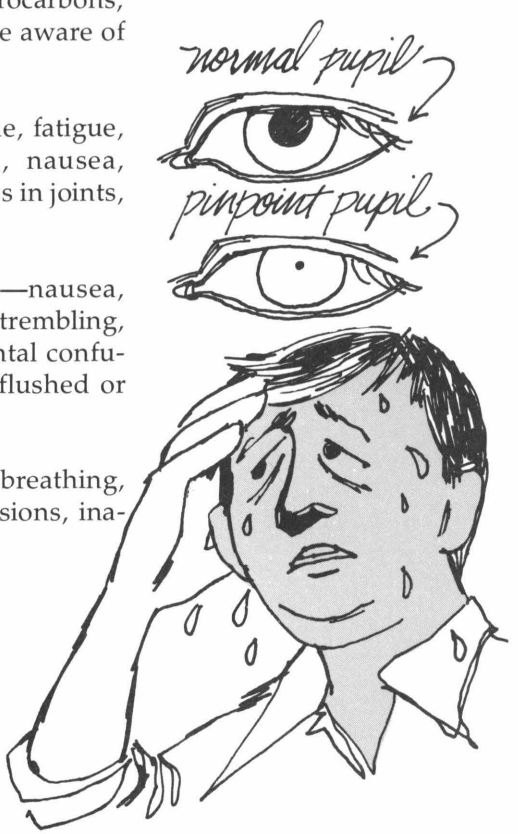
General Symptoms

Unfortunately all pesticide poisoning symptoms are not the same. Each chemical family, i.e., organophosphates, carbamates, chlorinated hydrocarbons, 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 nose and throat.

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

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



Chemical Families

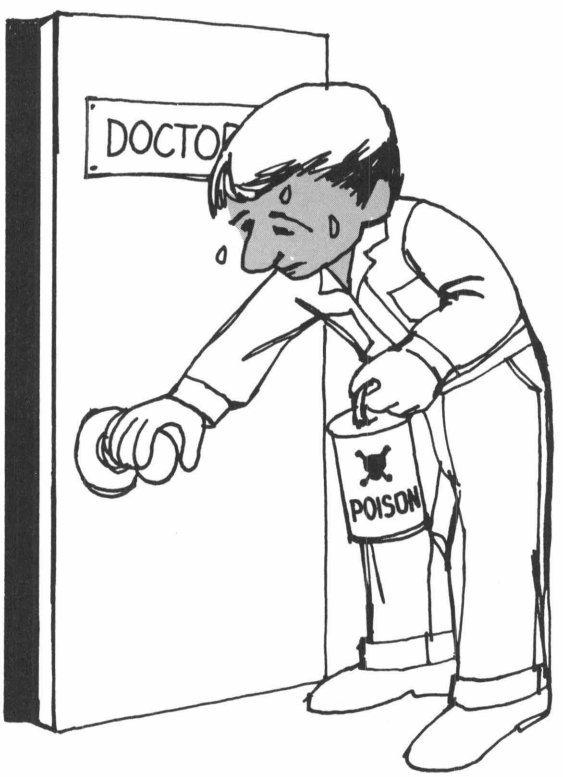
Pesticides which are chemically similar to one another are often grouped together into "families." Each pesticide in a family attacks a pest in a similar way. Treatment and antidotes for poisoning are also the same within each family. It is important that the doctor know which chemical family is involved.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

Organophosphates. Many organophosphates are highly toxic orally, dermally, and through inhalation. These include: parathion, TEPP, Phosdrin, Thimet, Systox, Di-Syston, Guthion, phosphamidon, Monitor.

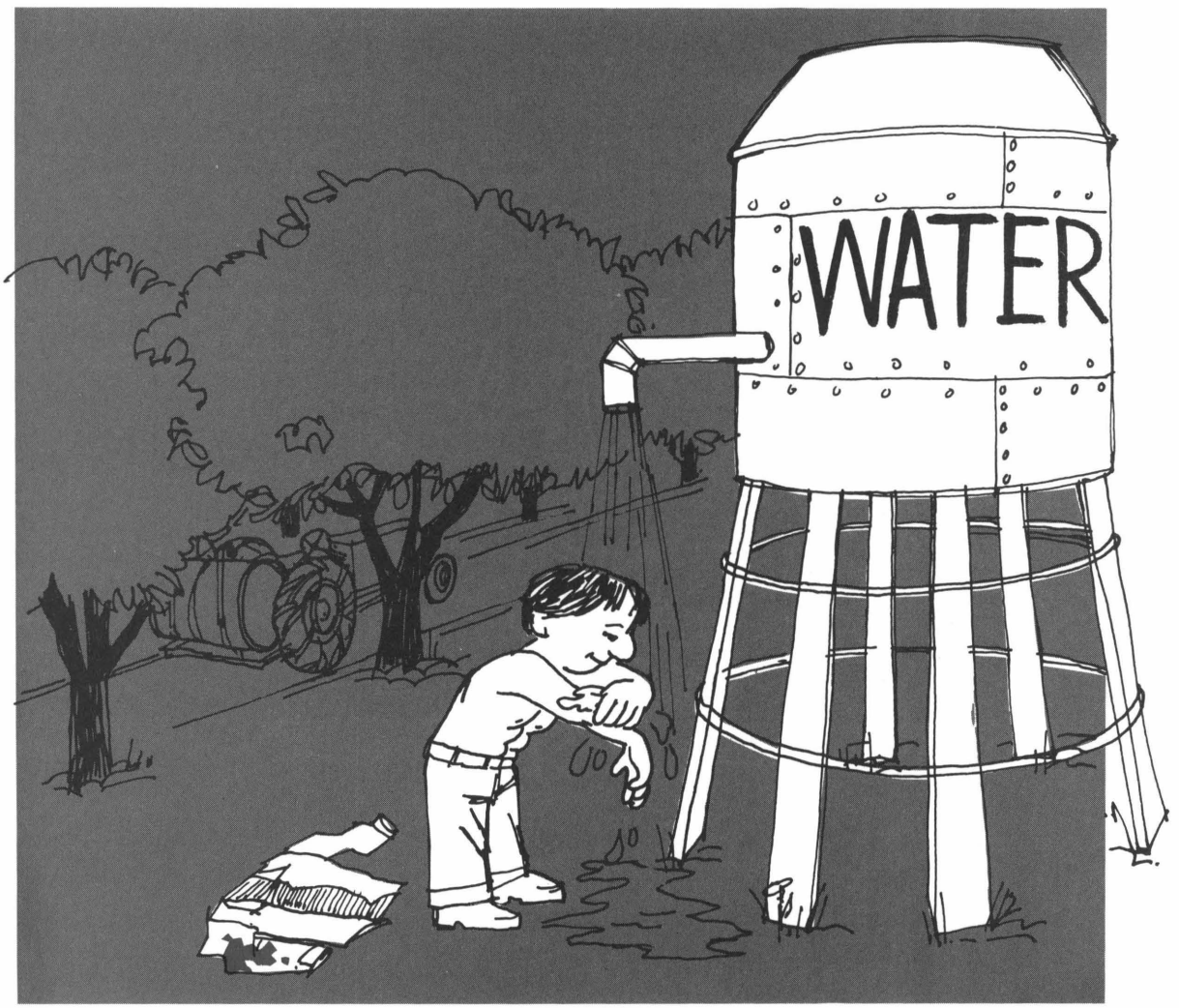
Carbamates. Many carbamates are only moderately or slightly toxic. However, some are highly toxic, orally, dermally or through inhalation. These include Temik, Furadan, Zectran, Carzol SP, Lannate.

Chlorinated Hydrocarbons. Most chlorinated hydrocarbons are considered hazardous because they persist in the environment. However, some are highly toxic dermally and orally. These include endrin, dieldrin,Thiodan, aldrin, and lindane.

If you are in doubt whether poisoning has occurred, let a doctor decide!



chapter X
First Aid for Pesticide Poisoning



Call a Doctor

First Aid is just that. It 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 the 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 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 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 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 as quickly but as gently as possible.
- Hold eyelids open, wash eyes with a gentle stream of clean running water.
- Continue washing for 15 minutes or more.
- Do not use chemicals or drugs in wash water. They may increase the extent of the injury.

Inhaled Poisons (Dusts, Vapors, Gases)

- If victim is in an enclosed space, do not go in after him without 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 patient as quiet as possible.
- If patient 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 alcohol in any form.

To Vomit or Not to Vomit (should you make the victim vomit?)

The most important choice you have to make when aiding a person who has swallowed a pesticide is to vomit or not to 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:

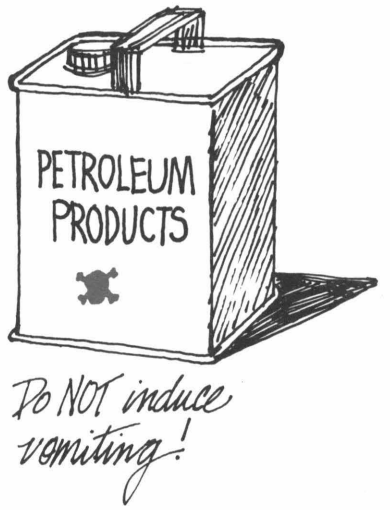
- **Never** induce vomiting if the victim is unconscious or is in convulsions. The victim could choke to death on the vomitus.
- **Never** induce vomiting if the victim has swallowed a corrosive poison. Find out what poison the person has ingested. A corrosive poison is a strong acid or alkali such as dinoseb. The victim will complain of severe pain and have signs of severe mouth and throat burns. A corrosive poison will burn the throat and mouth as severely coming up as it did going down.
- **Never** induce vomiting if the person has swallowed petroleum products (that is kerosene, gasoline, oil, 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.

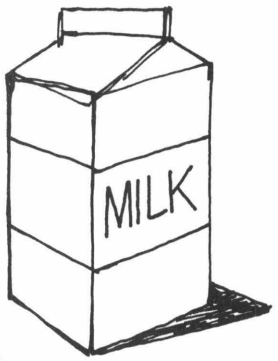
How to Induce Vomiting

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 amounts 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.
- Induce vomiting by putting your finger or the blunt end of a spoon at the back of his throat. Do not use anything which is sharp or pointed! A glass of soapy water or strong salt water will also cause the victim to vomit.
- Collect some of the vomitus for the doctor; he may need it for chemical tests.

Swallowed Poisons





For acids or alkali (base)!

For acids only!

For alkali only!

The best first aid is to dilute the poison as quickly as possible and to neutralize the acid or alkali causing the burns. It is very important that the victim get to a hospital without delay.

- For acids or alkali (base) give patient water or preferably milk. One to two cups for victims under five years; up to a quart for patients over five years. Milk is better than water because it dilutes and helps neutralize the poison. Water only dilutes the poison.
- For Acids only. If you are sure that the poison is an acid give the patient milk of magnesia (one tablespoon to one cup of water), baking soda, or chalk in water.
- For Alkali only. If you are sure that the poison is an alkali give the patient lemon juice or vinegar.

"Universal Sponge"

Use these "sponges" to absorb excess poisons only after first aid suggestions for the Corrosive or Noncorrosive poisons are followed.

Activated Charcoal—it absorbs many poisons at a high rate. Mix it with water into a thick soup for the victim to drink. Activated charcoal is found in aquarium filters or is available from a drug store.*

Homemade Absorber—a homemade "universal" sponge for poison is a mixture of four tablespoons of toast (burnt black), two tablespoons of strong tea (instant ice tea mix will do), and two tablespoons of milk of magnesia. This is used to absorb and/or neutralize most poisons.

Atropine

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. Or 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 doctor's directions.**

*Grosafe—A commercial preparation of activated charcoal is sold for use on pesticide spills or overdoses on crops and soil. In a poisoning emergency this product may be substituted for a pharmaceutical grade of activated charcoal and fed to the victim. Grosafe is distributed in the northeast by farm service and supply stores.

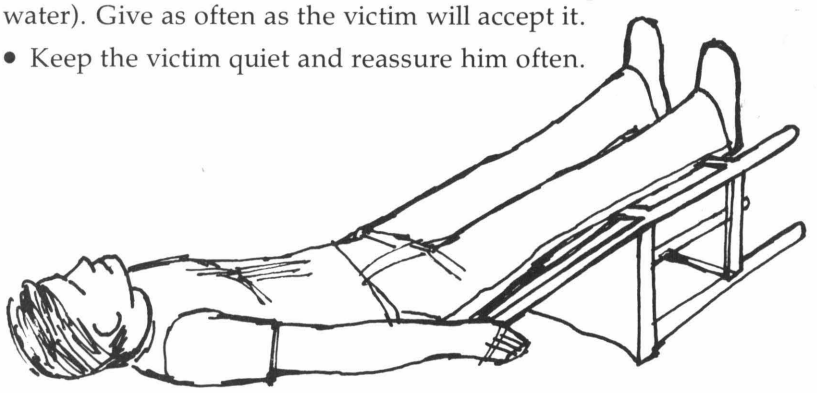
Shock

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

Symptoms

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

- Unless he is vomiting, keep the victim flat on his back with his legs up 1-1½ feet above his head.
- Keep the victim warm enough to prevent shivering. Do not overheat.
- If the victim is conscious and has not swallowed any poison, give small amounts of water or a dilute salt solution (½ teaspoon of table salt to 1 quart of water). Give as often as the victim will accept it.
- Keep the victim quiet and reassure him often.



Warning

- Never try to give anything by mouth to an unconscious victim.
- In an emergency use any source of fairly clean water such as irrigation canals, lakes, ponds, watering troughs, etc. Don't let the victim die while you worry about how dirty the water is.

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 plastic container of **Salt.** Salt is used with water to induce vomiting or to aid a person in shock.

3. A box or plastic container of **Baking Soda** or a bottle of **Milk of Magnesia.** These mixed with water will neutralize acidic chemicals that have been swallowed.

4. A plastic bottle of **Lemon Juice** or **Vinegar.** These are used with water to neutralize basic or alkali chemicals which have been swallowed.

5. A small package or bag of **Activated Charcoal.** Mixed with water and swallowed, activated charcoal acts as an absorber of all pesticides.

6. **A Shaped Plastic Airway** for mouth-to-mouth resuscitation.

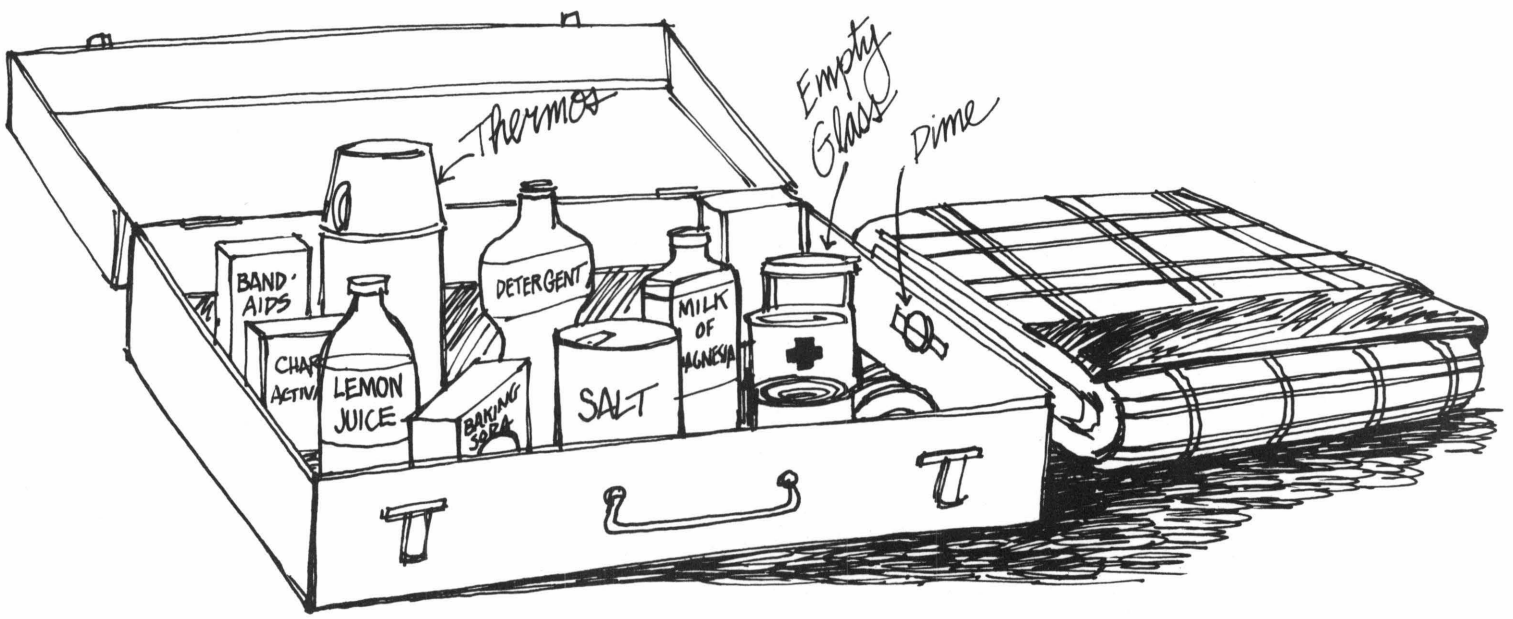
7. A thermos or large plastic bottle (at least one pint) of **Clean Water.** If there is no clean water in an emergency use any pond or stream water available.

8. Simple **Band Aids, Bandages** and **Tape.** All cuts and scrapes should be covered to prevent pesticides from easily entering the body.

9. A **Blanket** is very useful. It should be kept in a place where it will not be contaminated by pesticides.

10. A **Dime** should always be taped to the inside cover of the first aid kit. It is for an emergency phone call.

11. 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 be used for collecting vomitus to take to the doctor.



Medical Antidotes for Pesticide Poisoning

(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, Meta-Systox-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).**

Group III
Chlorinated Hydrocarbons

endrin, dieldrin, aldrin, lindane, endosulfan (Thiodan).

Antidotes:

1. **Barbiturates** for convulsions or restlessness.

2. **Calcium Gluconate** give 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.

(Continued on next page)

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 Poisions Such As: warfarin, Fumarin, Pival, PMP (Valone), diphacinone (Diphacin).

Antidotes:

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

Group VII
Fluoroacetates

For Poisons Such As: sodium fluoroacetate (1080).

Antidotes:

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

Group VIII
Dinitrophenols

For Poisons Such As: DNOC, DNOCHP, dinoseb (DNBP, Premerge).

Antidotes:

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, silvex (2,4,5-TP), monuron (Telvar), diuron (Karmex), Hyvar-X, endothall, Diquat, Paraquat.

Antidotes:

1. None.
2. Maintain life supports.

A Checklist for Preventing Pesticide Accidents

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

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

Yes No **Store Your Pesticides Safely**

- ☐ ☐ Do you have a separate space to store pesticides?
- ☐ ☐ Do you keep it locked and are the windows tight, barred or boarded over?
- ☐ ☐ Do you keep all your pesticides in this storage rather than in the garage, feed room, basement, porch, kitchen or refrigerator?
- ☐ ☐ Do you store herbicides separately from other pesticides?
- ☐ ☐ Are there signs on your storage so firemen and others are warned?
- ☐ ☐ Do you check periodically for leaking containers?

Keep in the Original Container So the Label Is There!

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

Use the Recommended Clothing and Protective Equipment

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

Yes No **Spills and Splashes of Concentrates can be Very Hazardous!**

- ☐ ☐ Do you know what to do if you should spill a pesticide on yourself while mixing?
- ☐ ☐ Do you wear adequate footgear with your pant cuffs on the outside so pesticides won't run into your footgear?
- ☐ ☐ Do you have sawdust, vermiculite, kitty litter or some other absorbent on hand to soak up spills?
- ☐ ☐ Do you always watch your sprayer tank when filling so it won't run over and spill on the ground?
- ☐ ☐ Do you have a check valve or other device on your equipment to prevent back-siphoning into the water supply?
- ☐ ☐ Is your application equipment well maintained so it doesn't leak and leave toxic puddles or piles of pesticide on the ground?
- ☐ ☐ Do you avoid draining leftover spray mix on the ground?
- ☐ ☐ Do you discard old high pressure hose instead of patching it and hoping no one will be nearby when it bursts?
- ☐ ☐ Do you clean nozzles with a brush, by rinsing, etc., instead of blowing them out with your mouth?

Poor Container Disposal May Cause Bad Accidents!

- ☐ ☐ Do you rinse each "empty" liquid container at least three times and dump the rinsings into the tank?
- ☐ ☐ Do you keep your used containers in your storage area until disposed?
- ☐ ☐ 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 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 spray 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?

☐ ☐ 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?

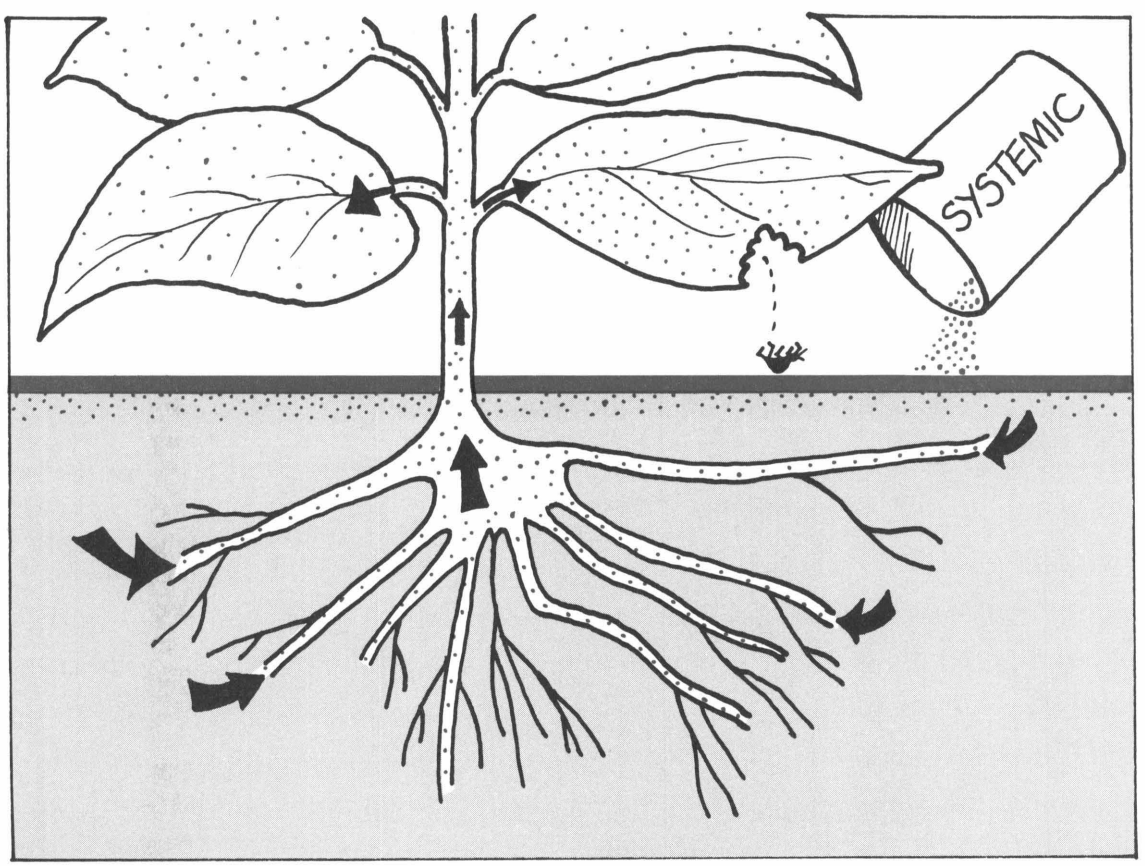
☐ ☐ Do you remove, turn over or cover up pet dishes, sand boxes, plastic pools, etc., before spraying a private property?

☐ ☐ Do you make sure that children and pets are out of the area and stay out until the spray dries?

Part 2

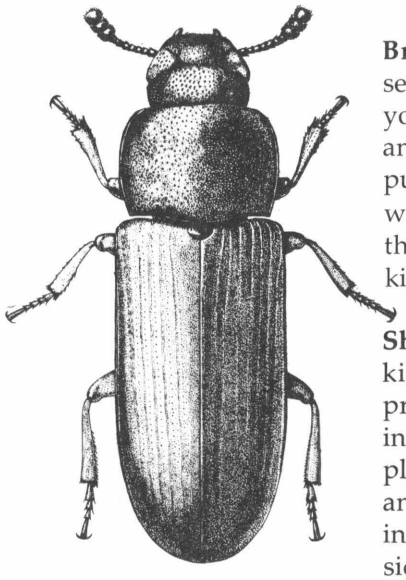
chapter XI
Types of Pesticides

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., all are 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 than as a surface spray.



Insecticides

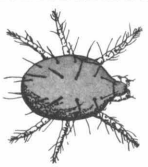
Insecticides are chemicals used to control insects. Often the word "insecticide" is confused with the word "pesticide." It is, however, just one of many types of pesticides. An insecticide may kill the insect by touching it or it may have to be swallowed to be effective. Some insecticides kill both by 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 eats 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 kill beneficial insects in the area. Many more 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 one varies on the kinds and numbers of insects it controls.

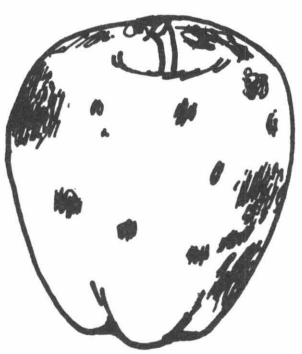
Short Term vs. Residual. Insecticides also vary in how long they last as a killing agent. Some break down almost immediately into nontoxic by-products. These "short term" chemicals are very good in situations where the insects do not return or where long-term exposure could injure non-target plants or 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 control problem and where they will not be an environmental hazard. For example, residuals are often used for fly control in livestock buildings or for termite control in wooden structures.

Miticides



Miticides (or Acaracides) 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 chemical kills both insects and mites. The terms "broad spectrum," "short term," and "residual" are also used to describe miticides.

Fungicides



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

Protectant vs. Eradicant. There are two basic approaches in the use of fungicides. One is designed to prevent the plant from getting the disease. These fungicides are used as "protectants" and are similar in purpose to polio and smallpox vaccinations for humans. They are applied before the disease gets a start. This type of fungicide is very useful when a particular disease or group of diseases is very 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.

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 causes damage and is often difficult to get rid of. 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. 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. Some herbicides kill every plant they contact, while others kill only certain plants.

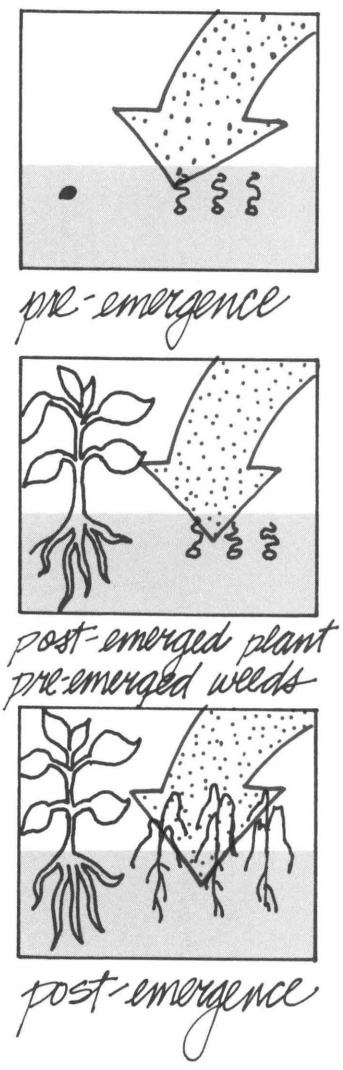
Nonselective herbicides are toxic to all plants. These are often used when no living plant is wanted in an area. For example, nonselective herbicides could be used for clearing under guardrails or for total control of weeds in industrial areas.

Selective herbicides kill some plants with little or no injury to other plants. Usually selective types will kill either most broad-leaved plants or most 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 herbicide applications is important. Care must be used to get the job done effectively without hurting desirable plants. The directions on the label will state 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 or 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."

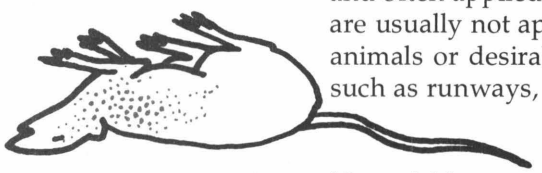
When the herbicide treatment is made after the crop or weeds appear, it is called **Postemergence.** Postemergence applications must be very selective. They must control the weeds but leave the crop unharmed. Often the chemical will be applied postemergence to the crop, but preemergence to the weeds.



Growth Regulators, Defoliants, Desiccants

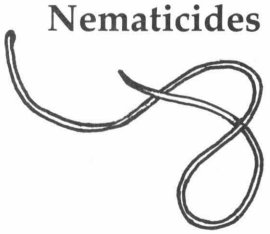
These chemicals are used to alter the crop itself. A **Defoliant** causes the leaves of a plant to drop off early. A **Desiccant** draws moisture from a plant causing it to wither and die. Defoliants and desiccants are often used to make crops easier to harvest. A **Growth Regulator** (or Plant Regulator) increases, decreases, or changes the normal growth or reproduction of 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 crop.

Rodenticides



Rodenticides are chemicals used to control rats, mice, other rodents, and bats. Chemicals which control other mammals, birds, and fish are also grouped in this category by regulatory agencies. Most rodenticides are stomach poisons and 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 too, are usually applied in limited areas such as runways, known feeding places, or as baits.

Nematicides



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

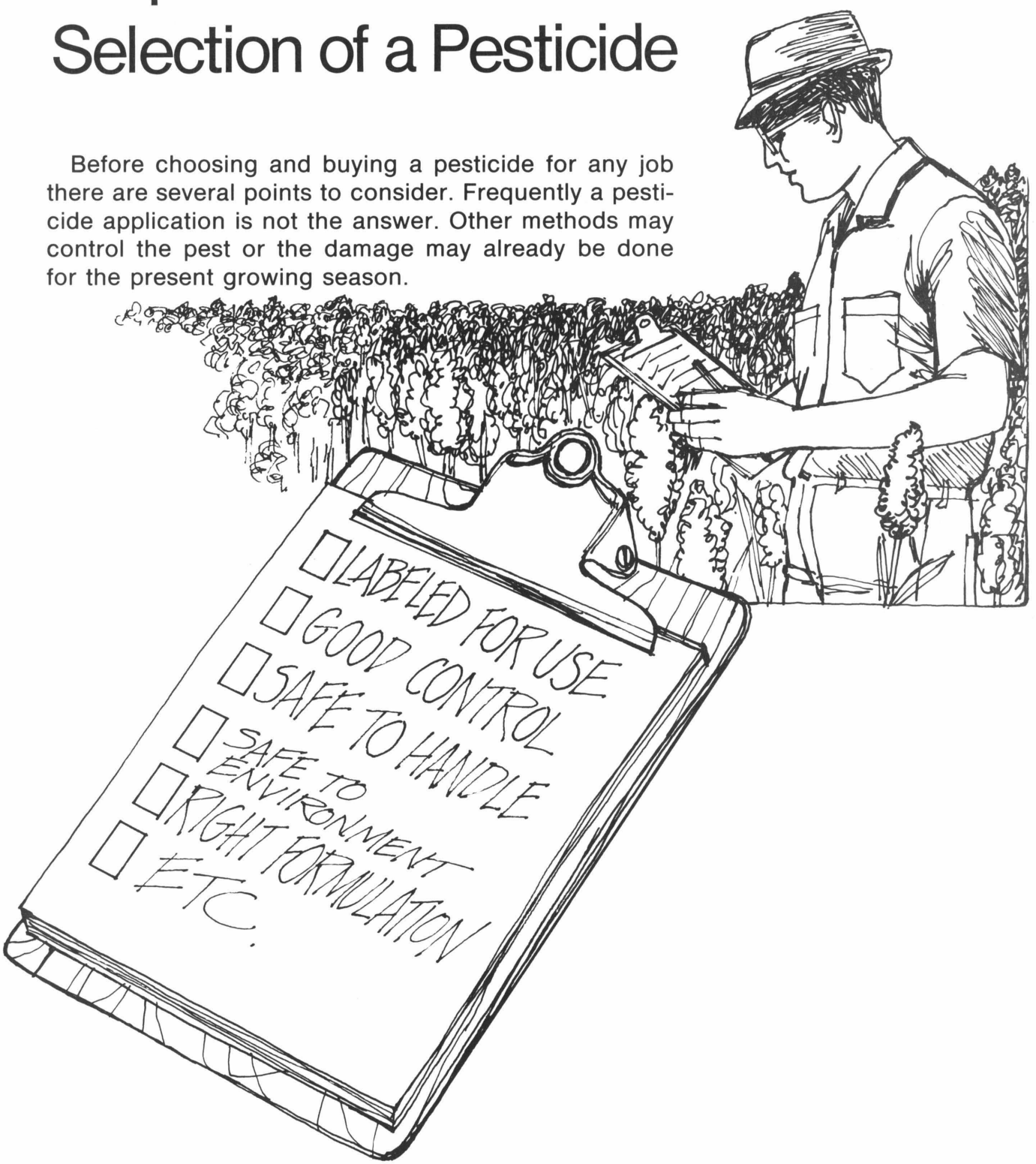
Molluscicides

Molluscicides are chemicals used to control snails and slugs. Usually the chemicals must be eaten to work. Thus, baits are often used to attract and kill many snails or slugs in an area.

For every control job be sure you know which type of pesticide you need to use and how to apply it effectively.

chapter XII
Selection of a Pesticide

Before choosing and buying a pesticide for any job there are several points to consider. Frequently a pesticide application is not the answer. Other methods may control the pest or the damage may already be done for the present growing season.



Identify the Pest

An applicator cannot wisely choose the right pesticide for a job until he has identified the pest. Sometimes an insect or disease which is very noticeable is blamed for damage it did not cause. Or sometimes damage from small, obscure insects or diseases is thought to be caused by weather conditions or other pests. For example, damage from scale insects on ornamentals may be mistaken for injury from lack of water. However, watering the shrub does not clear up the injury. The scale must be identified, then controlled. If help in identifying the pest is needed, it may be obtained from local county extension agents, local pesticide dealers, state colleges or reference bulletins that are available.

Besides knowing what the pest is, it is also important to know at what stage and time it can best be controlled. Usually a pest can be controlled best during one particular stage of its development. Unfortunately this stage is not the same for all pests. Therefore, to choose the best method of control for each pest, the applicator must know what the pest is, when it can best be controlled, and which chemicals, if any, will control it.

Determine if Control Is Necessary

Not all insects or diseases that are seen on trees, shrubs or crops are pests. Insects may simply be resting on the plants. Or they may be feeding on other insects that are pests. If damage does show, the pest which caused it may have already left the area or may not be causing any further damage. Sometimes the damage may appear too late in the season to be important. Plant diseases or insect pests may be present, but the damage may not be as great as the cost of the pesticide application.

Consider the Alternatives to Pesticide Application

Methods of control may be used that do not require a chemical treatment. Cultivation may control weeds as well or better than herbicides can. Mosquitoes in an area can be permanently controlled if their breeding areas are drained or filled with dirt. Leaf diseases on trees or shrubs may be lessened by collecting and destroying diseased leaves. Damage from crop pests such as seed corn maggot can be greatly reduced by changing the date of planting. A pesticide treatment is not always necessary or economical. Check all possibilities before deciding to spray.

Consider Integrated Control

Sometimes two or more methods are used to control a given pest. This system is called "integrated control." Natural enemies of the pest such as predators and parasites may be used in such a program. Also, numerous cultural methods have been found which help control some pests. These include fall planting, changing planting dates, rotation of crops or the use of plants that have a repellent effect on the pest. Often cultural methods, natural enemies, and careful use of selective pesticides are used for a successful integrated control program. For example, a simple integrated control program could be used on a golf course for grub proofing against Japanese beetle larvae. A chemical pesticide would be used to protect the more valuable sodded areas of the fairways. Milky disease spores which are a commercially produced biological control for Japanese beetle larvae would be applied in the roughs. The chemical pesticide would give immediate protection of the sodded areas while the milky disease becomes established in the rough. Then as the chemical breaks down in the more valuable areas, milky disease would move in. Once milky disease is established, no more chemical treatment is usually needed to protect the turf.

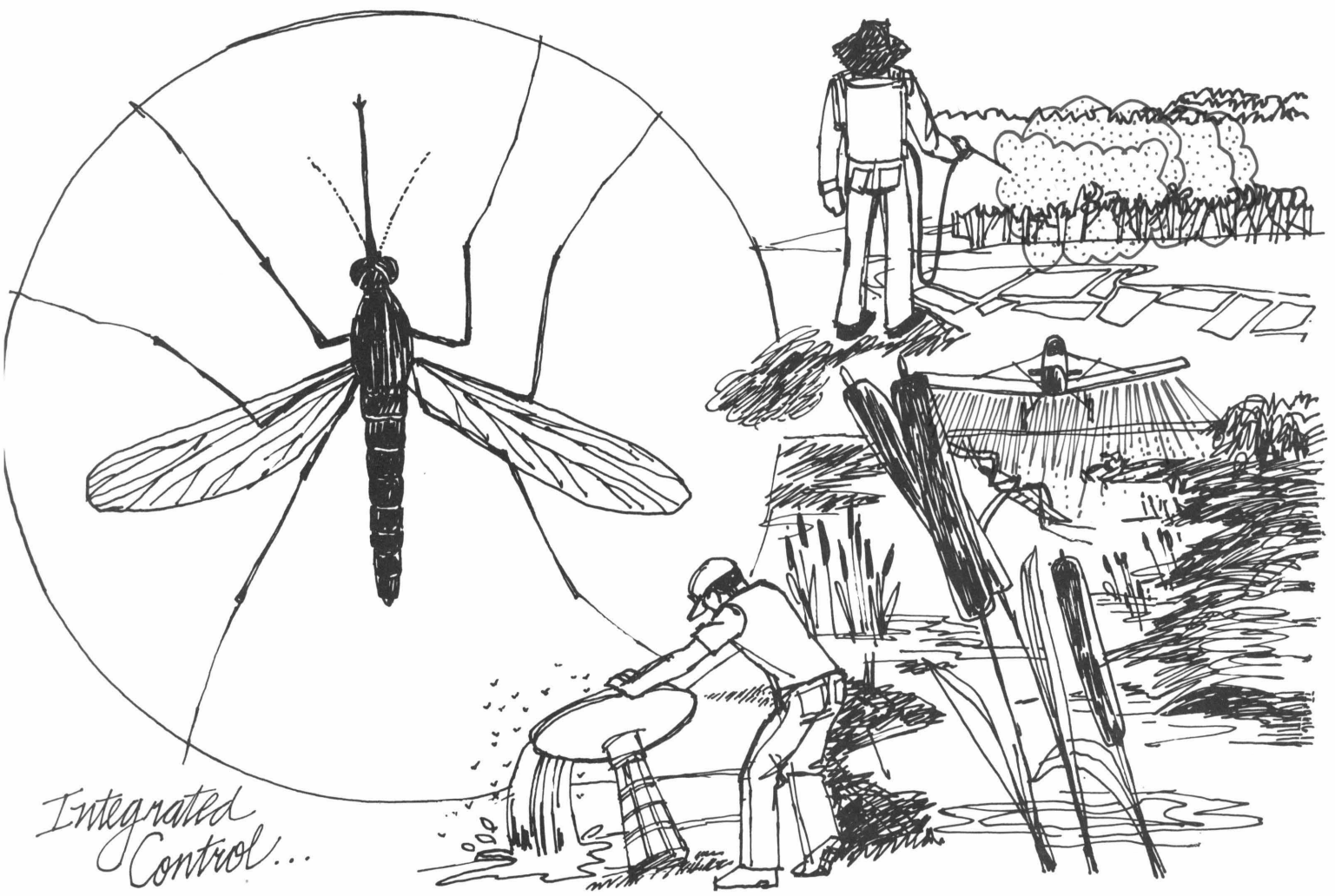
How to Choose the Right Pesticide for the Job

After the certified applicator has identified the pest, determined that a control measure is necessary, and considered other methods of control, he may decide that the only practical method is to use a pesticide. He now must choose the best pesticide for the job. He must choose a pesticide that:

- Is effective against the pest.
- Has directions on the label for the intended use.
- Will not cause injury to the plant (phytotoxicity) or other surface to which it is applied.
- Will cause the least damage to beneficial organisms (bees, parasites and predators) within the treated area.
- Will not move off the treated area and persist in the environment to harm fish and wildlife.
- Is the right type (formulation) to work well in the machinery that the applicator intends to use.

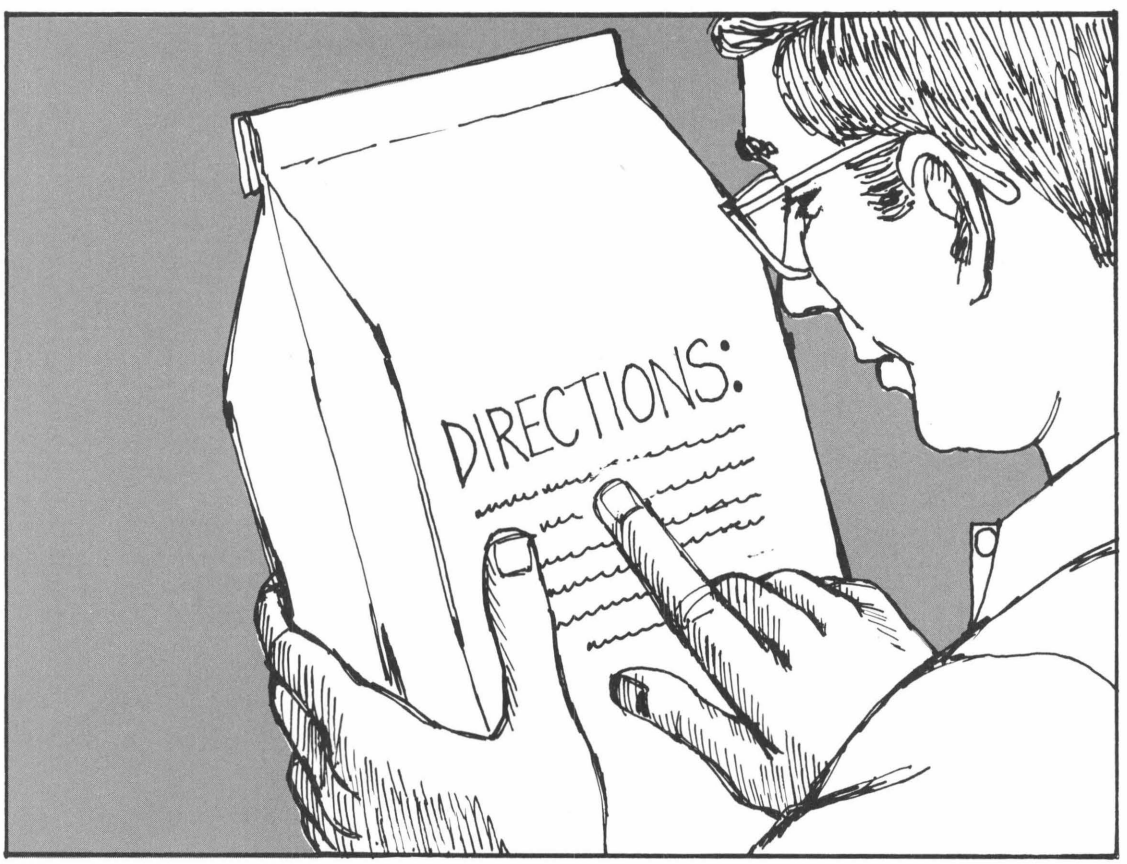
A pesticide that meets these qualifications may not turn out to be the cheapest to buy, but may very well be the most economical in the long run.

Don't apply pesticides more often than they are needed. Look at the damage to see if there are enough pests to make it worth your time and money to apply a poison.



chapter XIII
The Label

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



Identifies the 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 suggestions 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 be taken to 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 dosages permitted by law. However, local conditions may not require maximum doses to achieve good control of the pest. You should use no more pesticide than is needed.

Compatibility

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

Phytotoxicity

The label will also tell whether injury to plants is likely. Some plants are more sensitive than others to pesticide chemicals. The injury to the 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.

Label Law

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 toxicity warnings come from tests required by the government. The pesticide and the label are registered by EPA only when the applicators, consumers, fish and wildlife will be protected. If the label statements are carefully followed no illegal residues will be found on any crop. Getting a single pesticide ready for registration and use usually costs the chemical company $7-10 million dollars. Surely if it costs that much, the label is worth reading!

What Is on the Pesticide Label?

❶ **Name and Address of the Chemical Company**

❷ **Trade Names:** These almost always are on the label in large print and may not be used in the "active ingredient" section. Such names as Sevin, Karathane, or Benlate are trade names.

❸ **List of All Active Ingredients**

- Official Common Name: A well-known name accepted by the Pesticide Regulation Division of EPA. Laws require that officially approved common names, not the chemical name, appear in the "active ingredient" section of the label. Not all pesticides have an official common name. Examples of common names are carbaryl, atrazine, and dinoseb.
- Chemical Name: A scientific name telling the contents or formula of the actual poison. When an accepted common name is not available, the chemical name must be used in the "active ingredient" section of the label. However, if the chemical name is too long and complex, another name describing the poison is allowed.

❹ **Type of Pesticide:** insecticide, herbicide, fungicide, etc.

❺ **Kind of Formulation:** dusts, wettable powders, granules, sprays, baits, pressurized cans (bug bombs), emulsifiable concentrates.

❻ **EPA Registration Number**

❼ **Storage and Disposal Precautions**

❽ **Hazard Statements:** All pesticides have on the label a statement "Keep Away from Children." Pesticides have been grouped into categories according to their toxicity to animals, people, and environment. Special words on the label tell which group they are in.

- **Category I—Highly Toxic**

DANGER—POISON printed in red and a skull and crossbones must be on all labels for highly toxic materials. Such labels also have directions for handling plus an antidote statement and the sentence "Call a Physician Immediately."

- **Category II—Moderately Toxic**

WARNING is the special word which must be on labels for moderately toxic products. Directions on how to handle the pesticide must also appear. These are still dangerous, even in small amounts.

- **Category III—Slightly Toxic**

CAUTION must be on all labels for slightly toxic materials. Instructions for avoiding the main danger are also required.

- **Category IV—Relatively Non-toxic**

CAUTION must be on all labels for relatively non-toxic products. Other precautions might appear. Even in this group there is no pesticide which is completely safe.

❾ **Directions for Use**

How to protect the crop
How to apply the chemical
How to control the pest
Compatibility

❿ **Net Contents**

❾ DIRECTIONS FOR USE

GENERAL USE PRECAUTIONS:

- *READ ALL LABEL DIRECTIONS BEFORE USING!*
- *COMPATIBILITY. Golden-Grow is compatible with most other herbicides.*
- *GOLDEN-GROW should be used only for recommended purposes and at recommended rates (DO NOT OVERDOSE).*
- *GOLDEN-GROW may cause serious injury to crops if directions are not followed.*
- *Do not apply in combination with fertilizer, insecticide or fungicide.*
- ❼ *Do not store near seeds or fertilizers. Keep away from heat.*
- *FOR ALL USES GOLDEN-GROW must be THOROUGHLY mixed into the soil. Do not use drags such as logs or chains for soil mixing.*
- Keep container closed when not in use.

Application: Use standard low-pressure (20-50 psi) boom spray equipment. Spray equipment should be carefully calibrated before use and checked frequently during application to be sure nozzles are free from clogging and delivering a uniform spray pattern. Apply UNIFORMLY the recommended rate of Golden-Grow in 20-100 gallons of water per acre. Avoid overlaps that will increase Golden-Grow dosage above recommended limits because plant injury will occur.

CAUTION

Harmful if swallowed.
Avoid contact with skin and clothing.
Wash thoroughly after use.
Avoid contamination of food and feed stuffs.

To avoid injury to desirable plants, do not allow Golden-Grow spray or spray drift to contact foliage or roots of such plants including lawns, or other desirable turf and similar non-agricultural land.

Marvel Chemicals

❷ GOLDEN-GROW® 6–E

❺ EMULSIFIABLE CONCENTRATE

❿ NET CONTENTS 5 GALLONS

❹ A SELECTIVE HERBICIDE

❸ ACTIVE INGREDIENT:

monopon (2,6-Dichlorphenoxyacetic phenol)	76.8%
Inert Ingredients	23.2%
	100.0%

Contains 6 lbs. Active Ingredient per Gal.

❻ *E.P.A. Registration No. 983-726*

Reg. TM of Marvel Chemical Co.

❽ CAUTION

Keep Out of Reach of Children

See Side Panel for Additional Cautions

❶

Made in U.S.A. by Marvel Chemical Company
Marvel, NY 14320

⓫ RECOMMENDATIONS

FOR CONTROL OF ANNUAL GRASSES, BROADLEAF WEEDS, JOHNSON GRASS SEEDLINGS IN ALL CROPS LISTED BELOW. FOR OTHER DETAILS SEE DIRECTIONS FOR USE.

CROP	WHEN TO APPLY	DOSAGE GALS./ ACRE	REMARKS
Alfalfa *Birdsfoot Trefoil* *Clovers* *Lespedeza*	Before Planting	½–⅔	Temporary stunting may occur if conditions for germination and growing are not optimum. Do not graze livestock on or cut hay from treated fields within 60 days of treatment.

WEEDS CONTROLLED

Annual Grasses Growing From Seed

Annual Broadleaf Weeds: Chickweed (common). Deadnettle (Henbit), Hairy Nightshade (ground Cherry). Lamb's-Quarters, Nettle-leafed Goosefoot, Purslane (Pusley), Red-root Pigweed.

Johnson Grass Seedlings: (From Seed). Golden-Grow will not control Johnson Grass from rhizomes.

⓫ Recommendations for Use

What specific pests does it control
What crops can it be used on
When should it be applied and how many days to harvest should you wait
How much should you use
Other ideas and suggestions
Phytotoxicity

When Should You Read the Label?

Before You Buy the Chemical to Determine:

- If this is the chemical you need for the job. Never purchase or select a pesticide based on the color of the label or product name (Raid, Ortho etc.). Labels of the same color and general makeup may contain widely different active ingredients.
- Whether this material is too toxic or hazardous to be used safely under your conditions.
- Concentration in percent or pounds per gallon of active ingredient.
- If the formulation is suitable for your equipment and the situation in which it will be applied.

Before You Prepare the Material for Use to Determine:

- Protective equipment necessary when handling it.
- Warnings and antidotes, when required.
- What you can mix with it (compatibility).
- How much to use.

Before Applying, to Determine:

- Safety measures necessary for applicator.
- To what it can be applied.
- When to apply (including waiting period on crops and animals).
- How to apply.
- Rate of application.
- Restrictions of use.
- Special instructions.

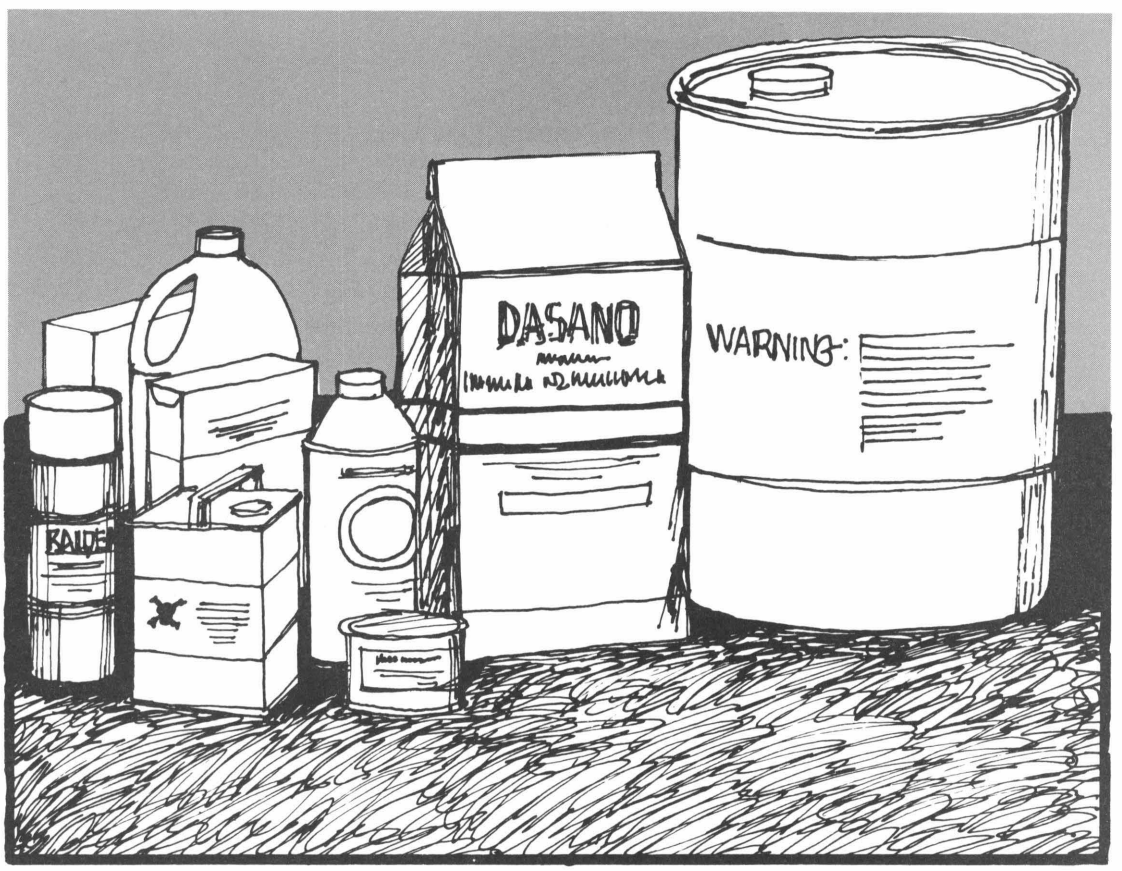
Before Storing or Disposing of the Pesticides and/or Pesticide Containers, to Determine:

- Where and how to store.
- Where it should **not** be stored.
- What it should **not** be stored with.
- How to decontaminate and dispose of the container.
- Where to dispose of leftover pesticides or their containers.

Surely, if it costs millions of dollars to develop, the label is worth reading!

chapter XIV
Formulations

A pesticide chemical can only 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 machinery 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.



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 machinery; danger of drift and runoff; and possible injury to the protected surface. Abbreviations are sometimes used to describe the type of formulation involved. These abbreviations are often 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; SC for spray concentrate.

Pressurized Cans

Pressurized cans (aerosols, "bug bombs") contain a small amount of pesticide or a combination of pesticides that is 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. Pressurized cans 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. Pressurized cans 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. 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 the cans.

Principal Uses. Pressurized cans 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 materials, and they usually are refillable.

Dusts

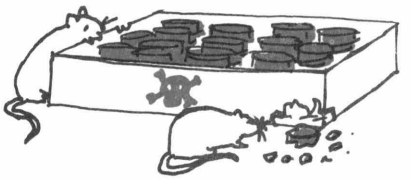
A prepared dust is a finely ground, dry mixture combining a low concentration of the pesticide with an inert carrier such as talc, clay or volcanic ash. There is a wide range in size of the dust particles in any one formulation.

Advantages. Dusts are ready to use as purchased so 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 crops, pastures, and wild 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 they drift badly, 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 parasites on pets and farm animals.

Poisonous Baits



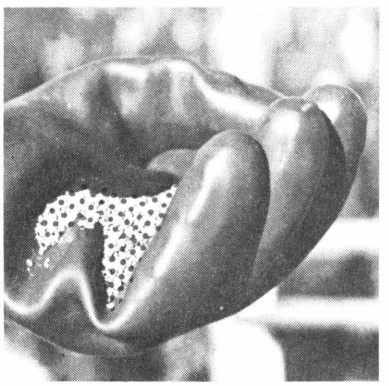
A poisonous bait is a food or other substance mixed with a pesticide that will attract and be eaten by pests and cause their death.

Advantages. Baits are useful for controlling pests such as flies, rats or blackbirds 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 kitchens, 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 environmental pollution is minimized.

Disadvantages. Within the home, baits are often attractive and dangerous to children or pets and 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 baits, so the baits may be ineffective. When larger pests are killed by baits the bodies must be disposed of. If not, they may cause an odor problem in houses. Other animals feeding on the poisoned animals may 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, some insects, and blackbirds (under government supervision).

Granules (pellets)



Like dusts, pesticide granules are dry, ready to use, low concentrate mixtures of pesticide(s) and inert carriers. However, unlike dust 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 table 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 multipurpose, equipment such as seeders or fertilizer spreaders. Also they 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 or insecticides, or both, 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 cover of foliage over the water.

Low Concentrate Liquids

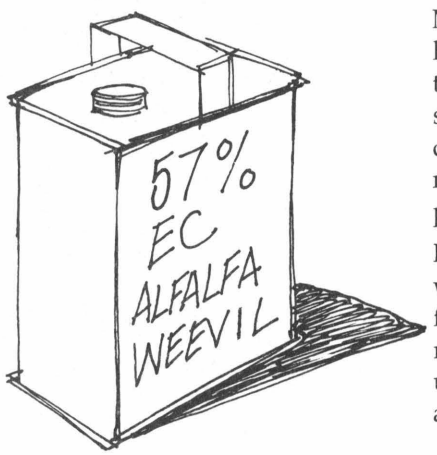
These preparations are usually solutions in highly refined oils that contain low concentrations of the pesticide. They are generally used as purchased.

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 rather 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. In the field they are used as prepared sprays for mosquito control and shade tree insect control.

High Concentrate Liquids, Spray Concentrates



These preparations are usually solutions containing a high concentration of the pesticide. Most of them are designed to be mixed with water (emulsifiable concentrates) or oil and so contain wetting agents, stickers, and other additives. They may contain as much as eight or more pounds of the pesticide per gallon of concentrate. Ultra low volume (ULV) concentrates are designed to be used without further dilution and contain little other than the pesticide itself.

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 grounds 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 and handle a large bulk of chemical for a particular job.

Disadvantages. It is easy to underdose or overdose because of the high concentration of pesticide if directions for mixing are not carefully followed. Mixtures of emulsifiable concentrates may be phytotoxic. Also because of the high concentration and liquid form which is usually easily absorbed through the skin, there may be hazard to the applicator. The hazard of improperly stored concentrates can also be high. Because of their solvents, most liquid concentrates cause rubber hoses, gaskets, and pump parts to deteriorate rapidly unless they are made of neoprene rubber. Some formulations cause pitting in car finishes.

Principal Uses. High concentrate liquids can be diluted and used in many ways—on fruit, vegetables, shade trees, for residual sprays, on farm animals, for structural pests. They are adaptable to many types of application equipment ranging from household sprayers to dilute hydraulic sprayers, low volume ground sprayers, mist blowers, low volume agricultural aircraft sprayers, and ultra low volume sprayers (usually on aircraft).

Flowables

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 high concentrate liquids and are used in the same way. Flowables do not usually clog nozzles and require only moderate agitation.

Wettable Powders, Soluble Powders

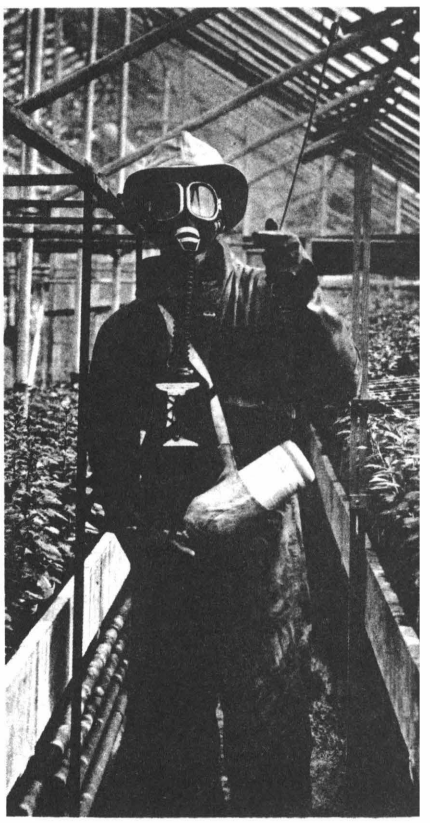
Wettable powders and soluble powders are dry preparations containing a relatively high concentrate of pesticides. Wettable powders are mixed with water to form suspensions. Soluble powders dissolve in water to form solutions. The amount of pesticide in these powders varies from 15% to 95%.

Advantages. As is true with liquid concentrates, the pesticides in wettable powders are relatively low in cost and easy to store, transport, and handle. They are safer to use on tender foliage and usually do not absorb through the skin as rapidly as liquid concentrates. They are easily measured and mixed when preparing spray suspensions.

Disadvantages. Wettable powders may be hazardous to the applicator if he inhales their concentrated dust while mixing. They require good agitation (usually mechanical) in the sprayer tank and will settle out 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.

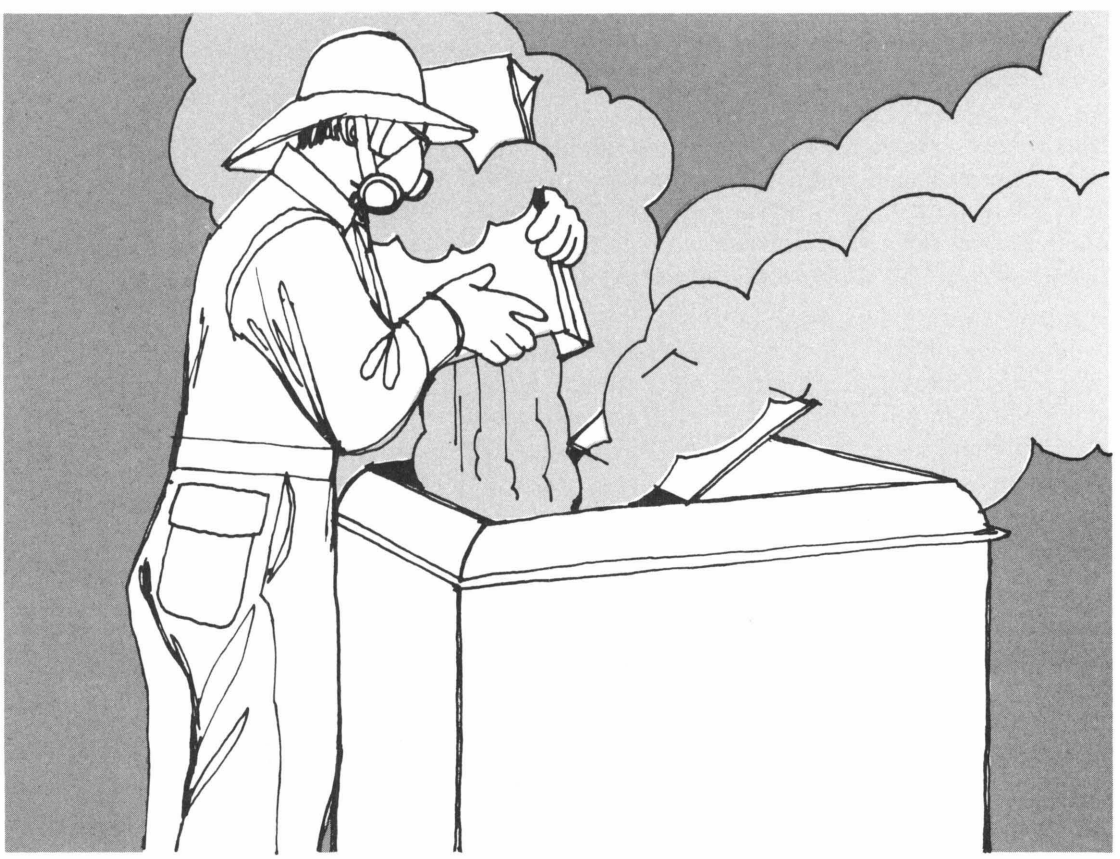
Disadvantages. The area to be fumigated almost always must be enclosed. Even in outdoor treatments the area must be covered by a tarp or the fumigant incorporated into the soil so it doesn't escape. Frequently fumigants are highly toxic, so proper techniques and all recommended protective gear must be 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 the state borders for treatment of plants and other materials to prevent 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.

Choice of the right formulation can make the difference between a successful control job with minimal hazard to the environment or a failure that does more harm than good.

chapter XV
Filling and Mixing

Some pesticides are used just as purchased. These include baits, garden dusts, dry granular materials, those contained in pressurized cans, 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. The pesticide(s) is added to the sprayer tank during filling or at the area to be treated.



When to Mix

Whenever possible 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 expected, you are not faced with the use or disposal of a tankful of the wrong pesticide for the problem. On the other hand, a pest control operator treating an apartment should not carry any concentrate into the apartment. Therefore he may 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 he is handling the concentrated forms. He may splash liquid concentrates on his skin or in his eyes unless they are protected. He may spill them on his clothing where they may soak through to the skin, or expose whoever handles the clothing later on. He may breathe particles from highly concentrated wettable powders or from granules or dusts. He may contaminate his hands and then unintentionally carry the pesticide to his mouth when smoking, eating, or just rubbing his lips or eyes. It is especially important that all safety precautions called for on the label be followed during mixing. 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.

Protect the Environment

The environment is also easily harmed by careless mixing and filling procedures. If suction hoses are not equipped with good anti-siphoning devices such as check valves, the spray mixture from the tank may escape down the hose into the water source—stream, pond, or well. 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. The applicator should never leave a piece of equipment unattended that is being filled.

Empty and Rinse

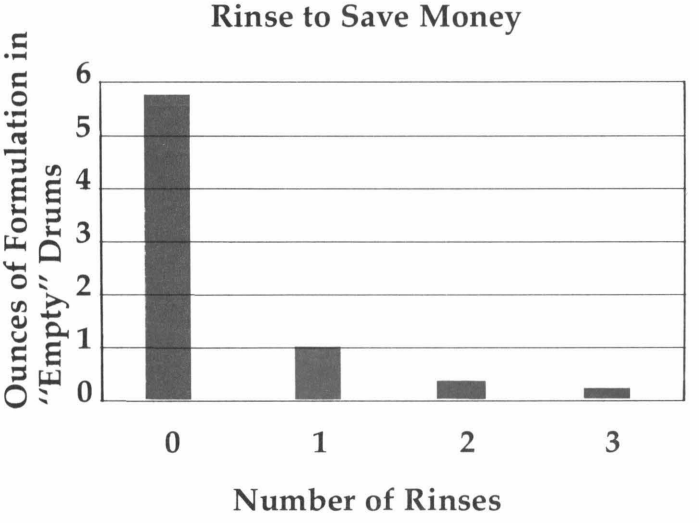
"Empty" pesticide containers are not truly empty. As soon as they are emptied, containers with liquid pesticides should be rinsed. Rinse the measuring cup too! Rinse them at least three times with the same liquid that the tank is being filled with. Then empty the rinsings into the sprayer tank. All containers must be accounted for and properly disposed of. Otherwise they too may end up in the water source or poison other people or animals. Rinsings can save you money, too!

Empty to Save Money

Amount of Residue	$ Loss at:	
	$20/Gal.	$30/Gal.
6½ Oz. (5 Gal.)	$1.00	$1.50
34 Oz. (55 Gal.)	$5.00	$7.50

An Easy Way to Cut Costs!

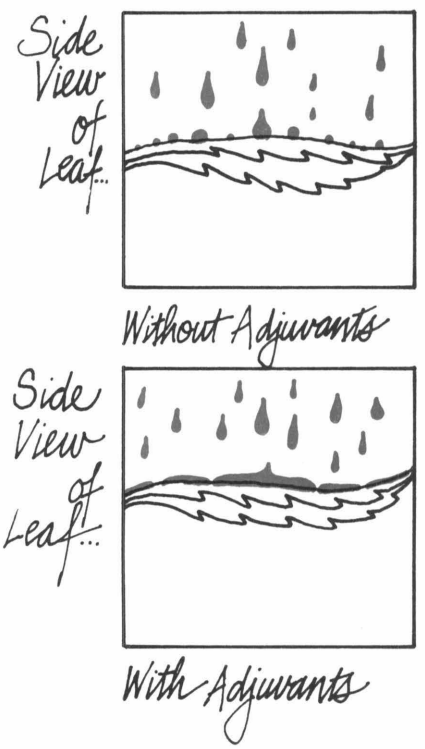
Rinse to Save Money



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. The pesticides may be **chemically** incompatible. A chemical reaction between them may result in loss of pesticidal activity, increased toxicity to the applicator, or injury to the treated surface. Or the pesticides may be **physically** incompatible. 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 college recommendations, pesticides trade publications, etc. It is better to mix liquids with liquids, or wettable powders with wettable powders rather than a liquid with a wettable powder. If you do not know whether two pesticides are compatible, it is wise to mix a small portion of the pesticides together in a glass jar with water to see if any problems appear.

Adjuvants

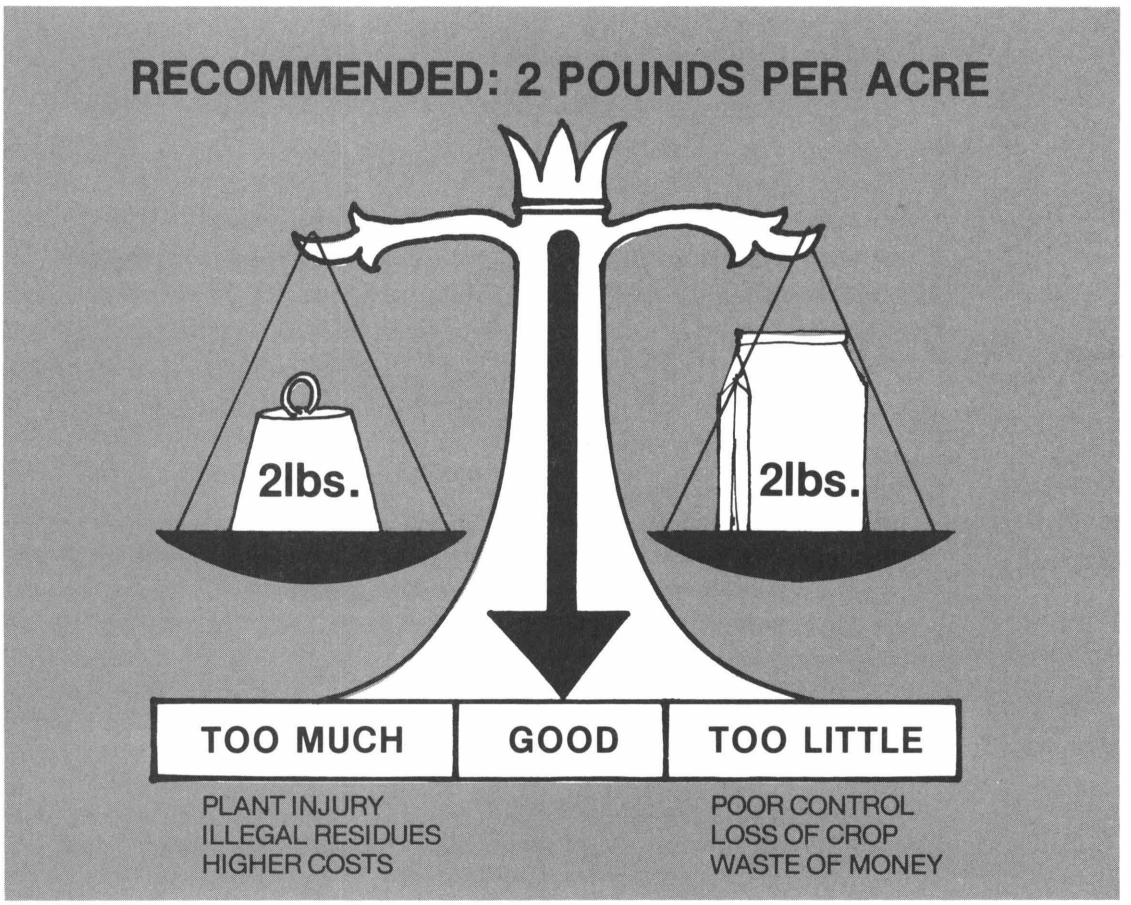


An adjuvant is a chemical added to a pesticide mixture that helps the active ingredient do a better job. Most pesticide formulations include a small percentage of adjuvants (additives). Wetting agents and emulsifiers are needed so that the pesticide chemical will mix with water. Spreaders and stickers 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 in 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, invert emulsifiers, and foaming agents.

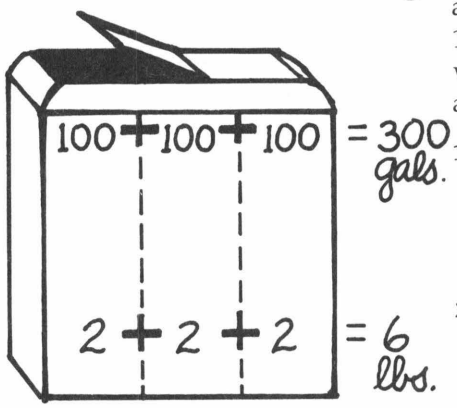
Special caution during mixing and filling are well worth your time and effort. Your reward will be safety for you, others and the environment and perhaps saving a little money, too.

chapter XVI
Calculations

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 on food crops, or unnecessary expense. Directions for mixing are given on the label and only very simple calculations are necessary.



Wettable Powder Mixing



You may be given directions to add 2 pounds of pesticide in 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

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

   So, 20 gallons is 1/5 of 100 gallons.

2. Therefore you must add 1/5 of 2 pounds of pesticide to your finished spray.

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

   1/5 of 32 oz. = 32 divided by 5

$$5\overline{)32.} = 6.4 \text{ oz.}$$

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

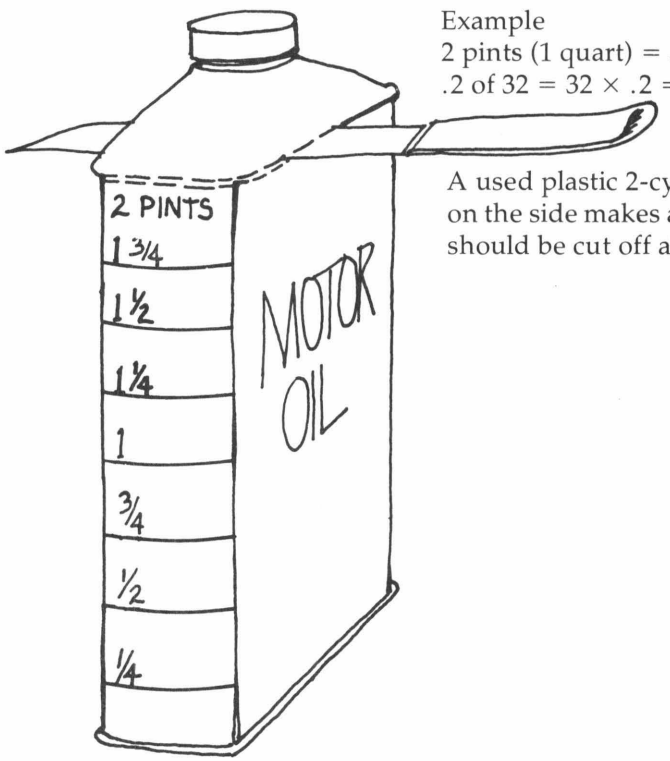
$$\frac{2 \text{ lb.}}{100 \text{ gal.}} = \frac{.2 \text{ lb.}}{10 \text{ gal.}}$$

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

Liquid Mixing

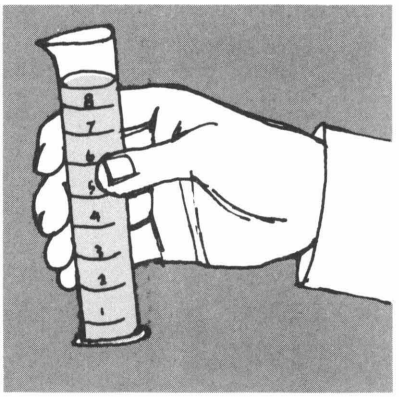
Liquids are mixed in the same manner. If your directions call for 2 pints emulsifiable concentrate per 100 gallons, 300 gallons will take 6 pints, and 20 gallons will take .2 (two tenths) of 2 pints.

Example
2 pints (1 quart) = 32 fluid ounces.
.2 of 32 = 32 × .2 = 6.4 fluid ounces.



A used plastic 2-cycle engine oil container with fluid measurements stamped on the side makes a good measure for liquid amounts up to one quart. The top should be cut off above the 1 quart mark for easy filling and pouring.

Percentage Mixing



Sometimes you will find directions telling you to make a finished spray of a specific percentage, for instance a 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 (1¾ 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 amount of wettable powder to add to get a given percentage of active ingredient (actual pesticide) in the tank:

$$\frac{\text{(gallons of spray wanted)} \times \text{(\% active ingredient wanted)} \times \text{8.3 (pounds/gallon)}}{\text{(\% active ingredient in pesticide used)}}$$

Example

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

$$\frac{\text{50 (gallons wanted)} \times \text{3.5 (\% wanted)} \times \text{8.3 (pounds/gallon)}}{\text{80 (\% active ingredient)}} = \frac{1452.5}{80}$$

$$= 18.1 \text{ pounds } 80\% \text{ WP}$$

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.

$$\frac{\text{(gallons of spray wanted)} \times \text{(percent active ingredient wanted)} \times \text{8.3 (pounds/gallon)}}{\text{(pounds of active ingredient per gallon of concentrate)} \times 100}$$

Example

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

$$\frac{\text{100 (gallons wanted)} \times \text{1 (\% wanted)} \times \text{8.3 pounds/gallon}}{\text{2 (lbs. active)} \times 100} = \frac{830.0}{200}$$

$$= 200\overline{)830.00}\ 4.15$$

$$\begin{array}{r} 800 \\ \hline 300 \\ 200 \\ \hline 1000 \end{array}$$

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

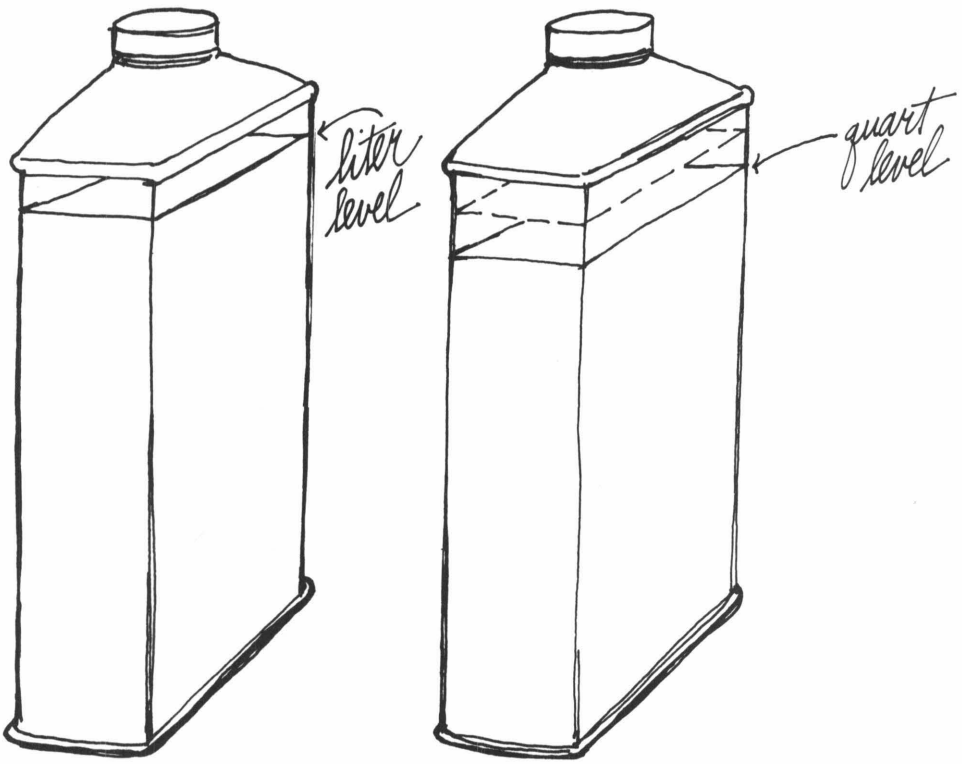
*One gallon of kerosene weighs 6.6 pounds. One hundred gallons weighs 660 pounds.

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 XVIII.

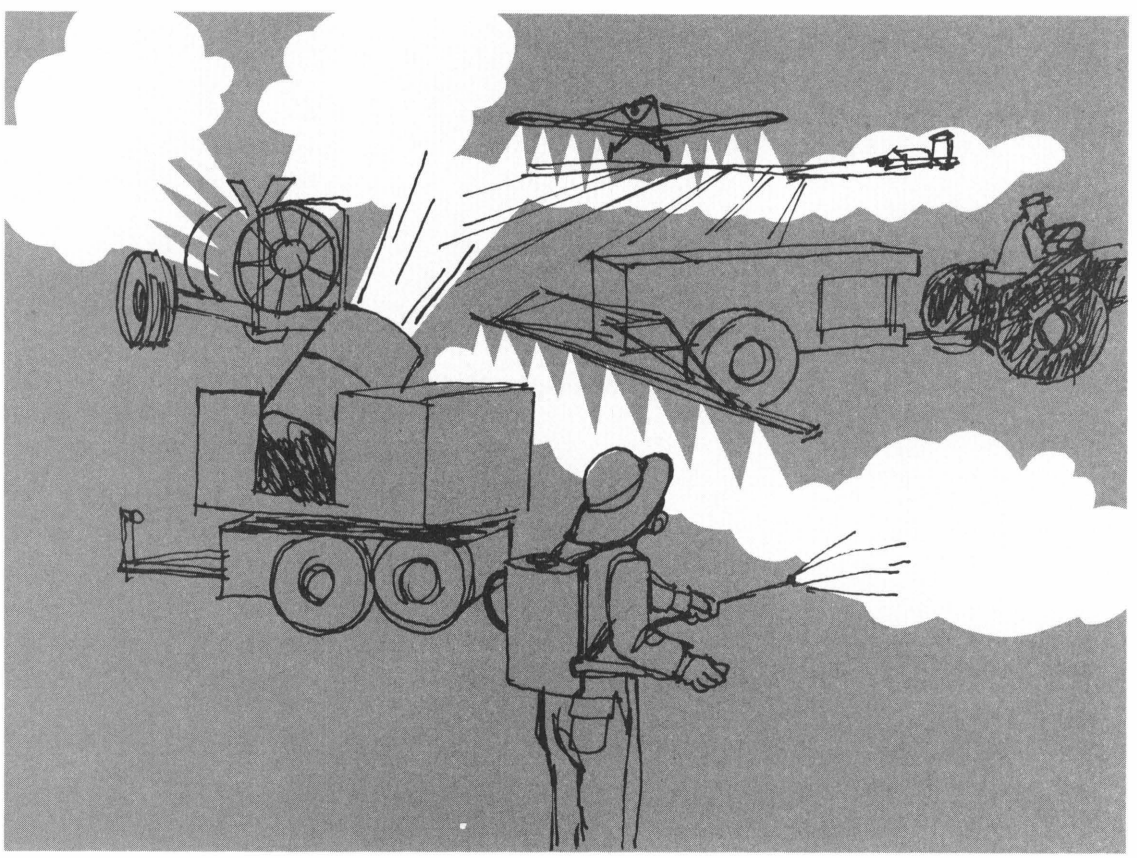
Useful Facts to Remember

- 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).
- 1pint emulsifiable concentrate per 100 gallons = 1 teaspoon per gallon.



chapter XVII
Equipment

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.



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 custom 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 different from either. 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.

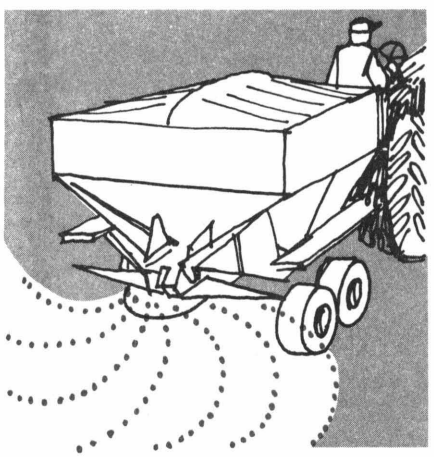
Dusters

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, for instance, 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 small areas. In some areas dusts are still applied by air.

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, therefore dusters are less desirable for most crops or large outdoor jobs.

Granule Spreaders

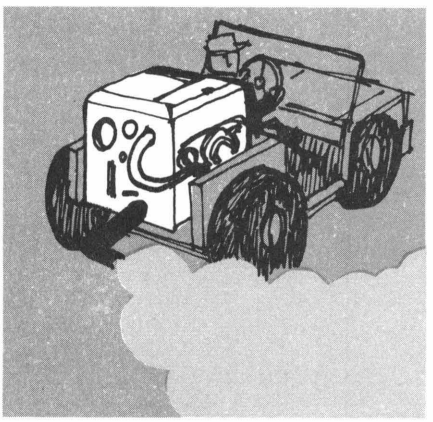


Granular equipment is designed to apply coarse, dry particles that are uniform in size to soil, water, and, in some cases, foliage. Spreaders may work in several different ways including air blast (mist blowers), whirling discs (seeders, fertilizer spreaders), multiple gravity feed outlets (lawn spreaders,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

Advantages. Granular equipment like dusting equipment is light, relatively simple and no water is needed. Because granules are uniform in size, flow easily, and are relatively heavy, seeders and fertilizer spreaders can be used to apply granules, often without any rebuilding.

Disadvantages. Because granular materials do not generally stick well to foliage, granule spreaders are not usually used on plants. Therefore the applicator will need other machinery for controlling most leaf feeding insects and most plant diseases.

Aerosol Generators or "Foggers"



Aerosol generators break certain pesticide formulations into very small, fine droplets (aerosols). One droplet cannot be seen. But 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 by such means as 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 will 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 the area. Therefore foggers using fairly safe formulations 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 places. Because they blanket an area, it is difficult for pests to escape exposure. When a building or an area is treated, it can be ventilated and then reoccupied without harmful exposure to the pesticide.

Disadvantages. Since most of the droplets produced by aerosol generators do not stick, little if any, 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 will carry the aerosol harmlessly over the pests and out of the area. There must be little or no wind or the pesticide may be flushed from an area before it can be effective.

Sprayers

More pesticides are applied by sprayers than by 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); these usually have simple rotary 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.

Hand Operated Sprayers

Hand operated sprayers are most commonly used by individuals for their own relatively small pest problems. However, the custom 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 on small jobs in hard-to-get-at areas where the spray equipment must be carried in.

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 as to direction, drift, etc., because relatively little spray is used usually at low pressure.

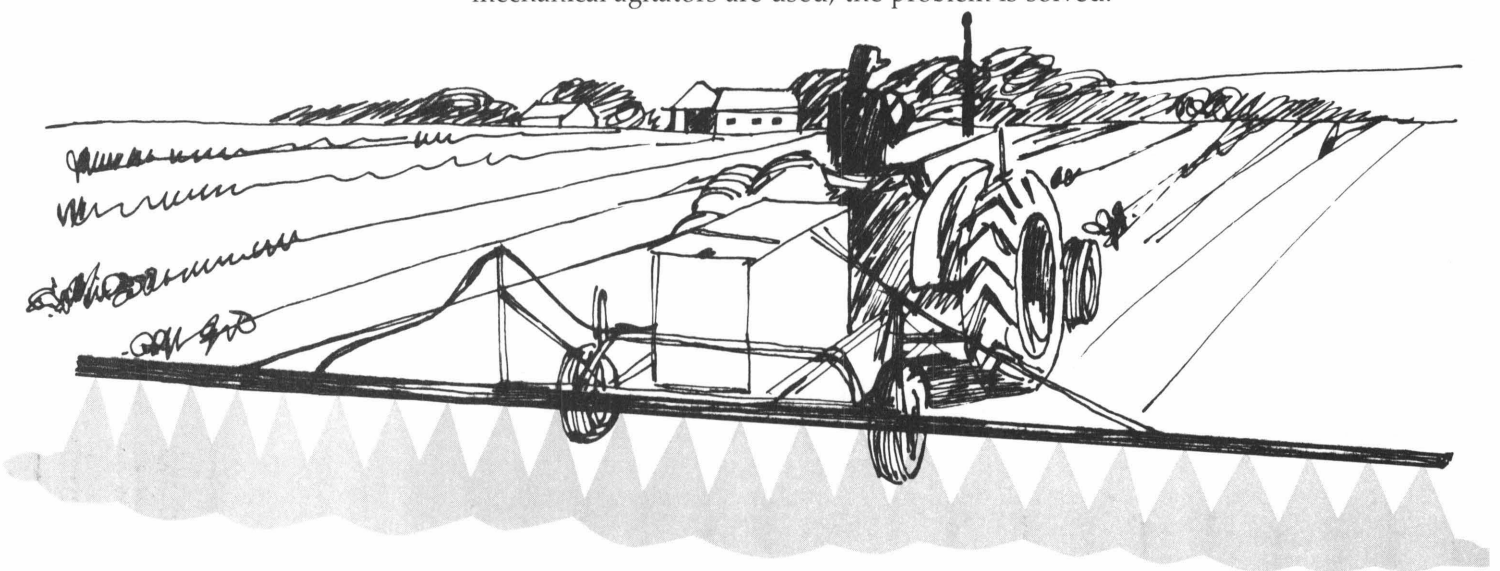
Disadvantages. Hand sprayers are efficient and practical for small jobs only. Wettable powders tend to clog regular nozzles and agitation is frequently poor.

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 applied at 30-60 pounds pressure.

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

High pressure sprayers are often called "hydraulic sprayers." They operate with dilute sprays with changeable pressures up to several hundred pounds. When fitted with booms they can do any work done by a low pressure boom sprayer. They are used for spraying shade trees and ornamentals, livestock, orchards, farm buildings, unwanted brush, commercial crops, etc.

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 by gritty or abrasive materials. Mechanical agitators are also standard and keep wettable powders well mixed in the tank. With a long hose trees, shrubs, or other targets in hard-to-get-at places 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 so are heavy and costly. They usually use large amounts of water and thus require frequent filling.

Air Blast Sprayers (Mist Blowers)

Air blast sprayers use air rather than water to deliver the pesticide to the surface to be treated. They use high performance fans (blowers) to make a high speed air blast into which concentrated liquid pesticides are pumped. The rushing air shatters the liquid into tiny droplets that are carried to the target by the air blast.

Advantages. Because air carries the pesticide to the surface to be treated, only a concentrate spray tank must be filled. Thus a little water covers a large area and very little operating time is lost in refilling. A concentrate tank is relatively small so the machines are relatively lightweight. They are usually less tiring to operate than hydraulic sprayers and are particularly adapted to applying sprays over a large area.

Disadvantages. Since the pesticide is carried by an air blast, mist blowers must operate under calm conditions. Windy conditions interfere with the normal pattern of application of the blower. Wind also causes the small fine particles of concentrate to drift into surrounding areas where they may do damage. Larger models may not be able to treat hard-to-get-at areas. Inexperienced applicators may easily injure crops or wildlife by overdosing with concentrated pesticides.

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. Equipment, including hoses, should be flushed out with water after use. It should then be drained and stored under cover. Pumps and other equipment that will be stored in below freezing weather should be thoroughly drained, or better yet, alcohol should be circulated through the equipment. Nozzles should be removed, cleaned, and stored. (Refer to Chapters XX and XXI, Disposal and Storage.)

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

chapter XVIII
Calibration

Even if you have the right mixture in your spray tank, you can still apply the wrong amount of pesticide. You need to know at what rate your equipment is applying the pesticide to the target. When you have found the rate per minute of your machine, you have calibrated your machine. Then you can decide how long (minutes, seconds, miles per hour) you must spray to get the right dosage on each target.

Why Calibrate?

Some pesticide equipment does not need to be calibrated. For example, with a hydraulic sprayer you apply the correct mixture until the spray begins to drip from the surface (to the point of runoff). You are applying the correct dosage as long as you have covered the target completely. However, with a mist blower you do not apply to the point of runoff. You cannot tell by looking when you have applied enough pesticide. Instead you must calibrate the mist blower to find its pumping rate (amount of spray put out per minute). Then, using the correct spray mixture, you time your application to get the right dosage on the surface.

Pumping Rate

To find the pumping rate of any sprayer, you must find the amount of spray being pumped through the nozzles each minute. Fill the spray tank completely full of water. Then, with the vehicle in neutral and the throttle setting you have chosen, open the spray valve. Let the sprayer pump for 5 full minutes. Close the valve, shut down, and measure the amount of water needed to refill the tank. Divide this figure by 5 to find the amount the sprayer pumps in one minute. The reason for using 5 minutes is to get a more exact measurement. The amount sprayed in one minute may be too small to measure accurately. The reason for running the sprayer while standing in neutral is so water will not slosh out of the tank and affect the measurement of refill water.

$$\frac{10 \text{ gallons}}{5 \text{ minutes}} = \frac{2}{5/10} = 2 \text{ gallons per minute}$$

To find the pumping rate of a mist blower, completely fill the blower tank with water. Then bring the blower up to operating speed and pressure. Open the valve, run it for 5 full minutes, then close the valve and shut down. Repeat as above.

Field Sprayers

You need to know more than the pumping rate when a small amount of pesticide must be applied accurately and evenly to a relatively large area, for example, treating a field with an herbicide at the rate of one half (.5) pound per acre of actual pesticide (active ingredient). This job is usually done with a tractor or truck mounted sprayer equipped with a folding boom having several nozzles. In order to apply the pesticide evenly and accurately your sprayer must move at a constant speed over the field and be pumping at a constant pressure. Each nozzle must be clean, at the proper height from the ground, and applying the same amount of spray as each other nozzle. Choose the speed, pumping pressure and nozzles that you wish to use. Then you must calibrate your sprayer so that you know the total amount of spray it will apply to an acre.

No Arithmetic—More Work. One accurate method of calibrating your sprayer does not require any arithmetic. You just mark out an acre. (An acre is an area 209 feet on a side or 100 feet by 436 feet or a similar mark off totalling one acre.) Then fill the spray tank with water and spray the acre as if you were applying the pesticide. Measure the amount of water needed to refill your tank. That 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.

Gallons Per Acre—In Less Time. You may not wish to spray over a whole acre to calibrate your equipment. It is not necessary if you know a few basic facts and do some simple figuring. One method of calibration is shown below but there are several others. The facts you must know for this method are:

1. One acre = 43,560 square feet.
2. The distance your sprayer moves in one minute at the speed and throttle setting you are using.
3. The width of your spray boom.
4. The pumping rate of your sprayer.

Example

Suppose your sprayer's boom is 20 feet wide, that it travels 440 feet in one minute and that it pumps 2 gallons each minute.

Figure the area that the sprayer covered in one minute (the distance traveled × boom width)

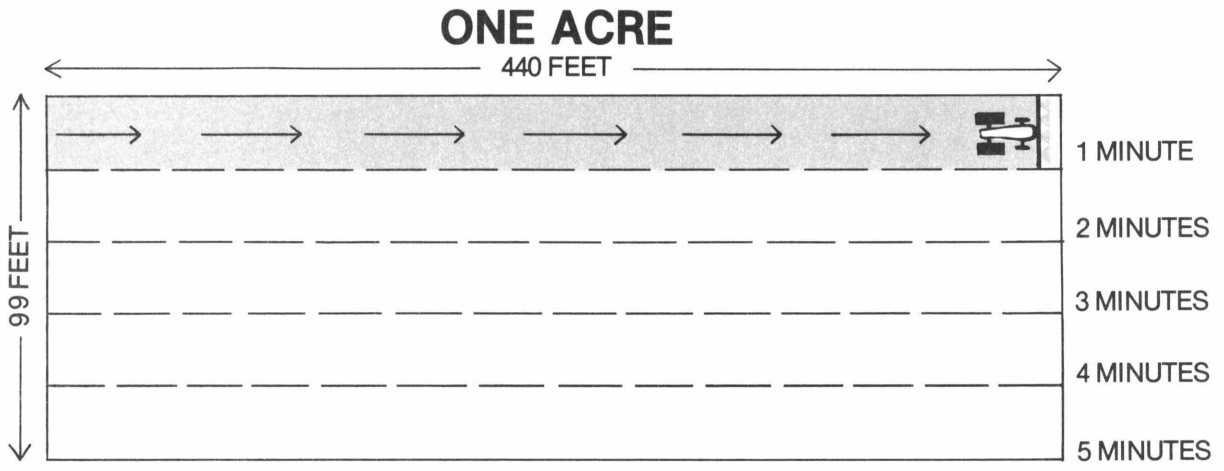
440 feet per minute × 20 feet = 8800 square feet per minute

Then figure how many minutes it would take to spray one acre. One acre = 43,560 square feet. Divide 43,560 square feet/acre by 8800 square feet/minute.

$$\frac{\text{43,560 square feet/acre}}{\text{8800 square feet/minute}} = 8800\overline{)43560} = \text{about 5 minutes per acre}$$

$$\begin{array}{r} 4.95 \\ 43560 \\ \underline{35200} \\ 83600 \\ \underline{79200} \\ 44000 \\ \underline{44000} \end{array}$$

Finally, figure the amount of spray pumped per acre
2 gallons per minute × 5 minutes per acre = 10 gallons per acre.



20 foot boom
440 feet per minute traveled
2 gallons per minute pumped

5 minutes per acre x 2 gallons per minute = 10 gallons per acre.

How Much Pesticide in the Tank

You now know how many gallons of spray per acre your equipment will apply. Next you must find out how much pesticide to put in the tank to apply the correct dosage of pesticide. You need to know two more facts.

1. How many gallons your sprayer tank holds.

2. The recommended amount of formulation you wish to use per acre. Recommended doses will be listed on the label and in Extension publications.

OR

The amount of active ingredient per gallon of formulation and the amount of active ingredient you want to apply per acre. Look on the label.

Example #1

Suppose your tank holds 80 gallons of ready-to-use spray (finished spray) and you wish to apply one pint of formulation on each acre. You have already found that your sprayer applies 10 gallons per acre. First find the number of acres one tank load will spray. Divide 80 gallons (what your tank will hold) by 10 gallons per acre.

$$\frac{80 \text{ gallons per tankful}}{10 \text{ gallons per acre}} = 8 \text{ acres per tankful}$$

Then find the amount of formulation you must add to your tank, so you can spray 8 acres with one pint per acre. Multiply 1 pint per acre by 8 acres (the number of acres one tank load will cover).

1 pint per acre × 8 acres per tankful = 8 pints per tankful.

You must add 8 pints to each tankful.

Example #2

Suppose the formulation of a pesticide contains 4 pounds active ingredient per gallon and you want to apply ½ pound of active ingredient per acre. Your tank covers 8 acres.

First find how much formulation in pints is needed to apply ½ pound active ingredient per acre. You know there are 4 pounds of active ingredient in 1 gallon. One gallon = 4 quarts. Therefore there are 4 pounds in 4 quarts and 1 pound in 1 quart. One quart = 2 pints. So there is 1 pound in 2 pints and ½ pound in one pint.

$$\frac{4 \text{ pounds}}{1 \text{ gallon}} = \frac{4 \text{ pounds}}{4 \text{ quarts}} = \frac{1 \text{ pound}}{1 \text{ quart}} = \frac{1 \text{ pound}}{2 \text{ pints}} = \frac{\frac{1}{2} \text{ pound}}{1 \text{ pint}}$$

So, 1 pint contains ½ pound active ingredient.

Then figure how much formulation is needed per tankful. Multiply 1 pint per acre times 8 acres per tankful.

1 pint per acre × 8 acres per tankful = 8 pints per tankful.

So you will add 8 pints to your spray tank in order to apply ½ pound active ingredient per acre.

How to Calibrate a Hand Sprayer

1. Lay out one square rod; this is an area 16½ by 16½ feet.
2. Ready the sprayer and determine the time it takes to spray the area.
3. Collect the spray from the nozzle for the same length of time needed to spray the square rod, and measure it in pints.
4. Gallons per acre $= \dfrac{\text{no. of pints collected} \times 160 \text{ (160 square rods} = 1 \text{ acre.)}}{8}$

Check for Mistakes

Even after your sprayer is calibrated, you should recheck it often. Be sure you are spraying the same number of acres for each tankful as you figured on. If you find that you are spraying more acres or less acres than you figured for, you should stop spraying immediately and recalibrate. If you have figured wrong or your sprayer changes its delivery rate, you will be able to catch it before you make a major mistake.

Changing Delivery Rate

If your sprayer is delivering less or more spray to each acre than you want it to, you can change the rate by three methods:

1. You can change the pump pressure. Lower pressure means less spray delivered; higher pressure means more spray delivered. This is not usually a good method because a pressure change will change the nozzle pattern.
2. You can change the speed of your sprayer. Slower speed means more spray delivered, faster speed means less spray delivered. This may be practical for small changes in number of gallons, but not for large delivery changes.
3. 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.

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

chapter XIX
Weather Wise Application

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, more time, and thus more money must be used to control the pests in the target area.

Avoid Windy Days

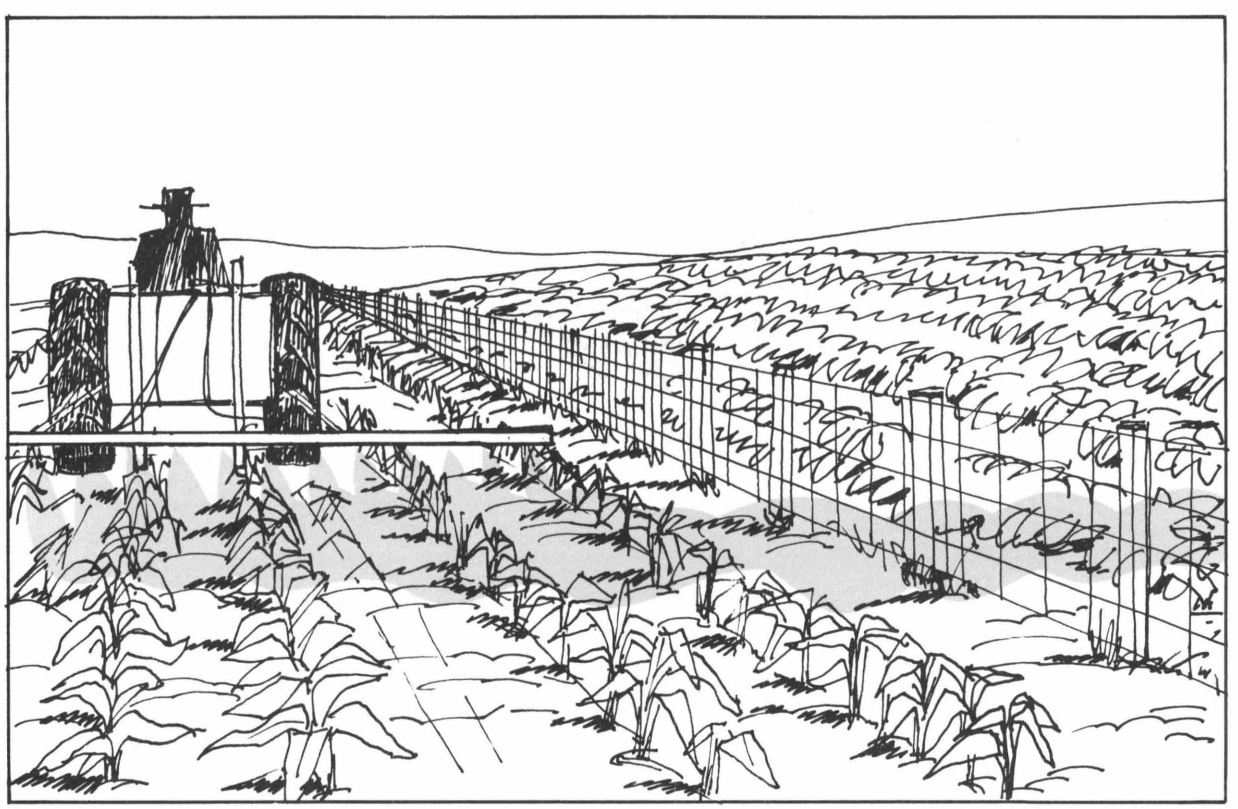
High winds increase drift and result in loss of the pesticide on treated areas. Drifting pesticides increase the possibility of injury to wildlife, pollinators and domestic animals. They may settle on forage, pasture or wildlife areas or contaminate water. Pesticide application on quiet days reduces 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 on crops due to pesticide drift onto non-target areas. Don't take a chance by spraying in the wind.

Avoid Application Just Before Heavy Rains

Spray applications should not be made just before a heavy rain, because the pesticide washes off and the pests are not controlled. Some protectant fungicide sprays are put on the leaves before and during a rain. Heavy rains cause runoff and tend to wash the pesticide away from the target areas. The runoff can carry the pesticide into sensitive areas where crop injury may result. Runoff often reaches farm ponds, streams and waterways causing contamination, fish kills, or injury to domestic animals such as dairy cows.

Consider Early Morning or Evening Application

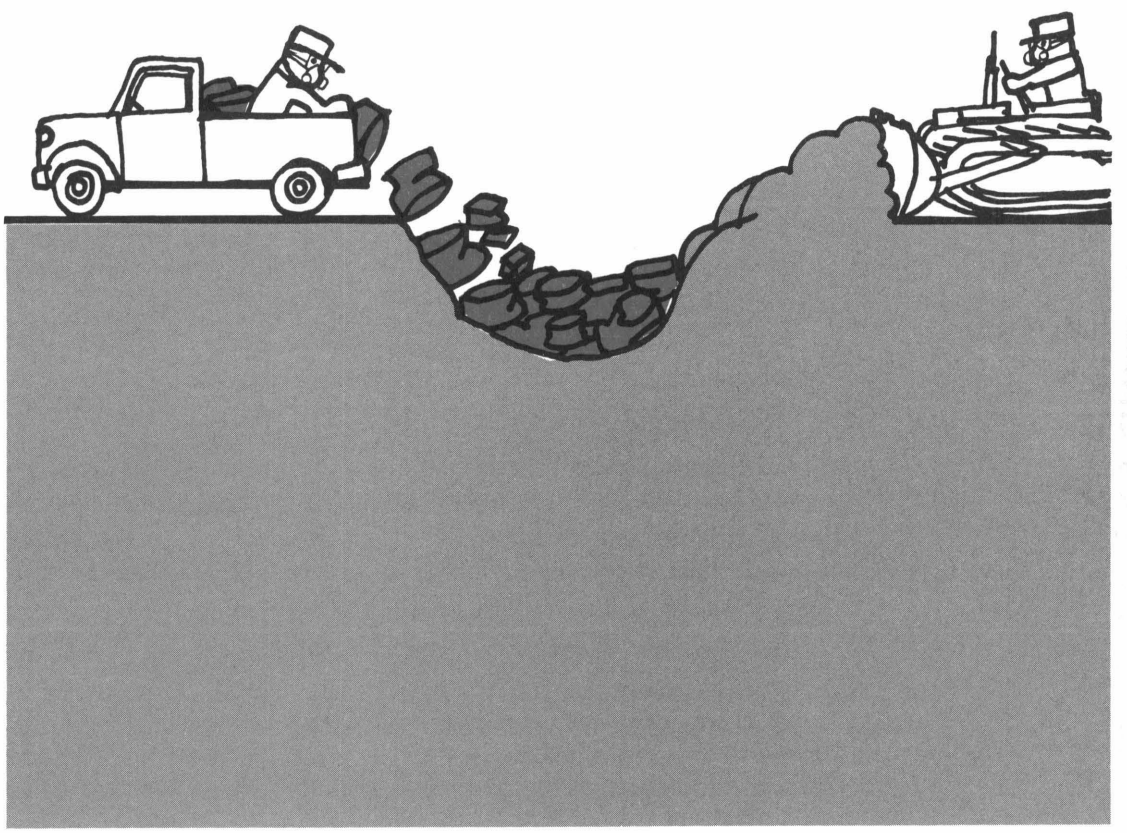
Wind speed is usually lowest at these times each day and drift hazard is greatly reduced. Children and domestic animals are less likely to be in sprayed areas during these hours. Avoiding full daylight hours lowers the contact danger to wildlife—birds, mammals, pollinators—who often visit crop lands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



chapter XX
Disposal

(See Chapters II and III for State and Federal Laws)

As a custom applicator you have two disposal problems. First you must safely dispose of surplus pesticides — concentrated or tank mixed — that you have no use for. 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. Never give them to homeowners, children or uninformed persons for *any* purpose.



Surplus Pesticides

There are several ways in which you may end up with surplus pesticides. The government may cancel registration on the chemical 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. Sometimes you cannot avoid having surplus pesticides. However, there are ways to cut down on pesticide surplus. Always check to be sure the pesticide is fully registered and is effective against the pest before you buy it. Estimate your needs and buy only what you need for one year. This will reduce carryover and the chance of spills, damaged containers, and loss of strength of the pesticide. Avoid mixing the pesticide in the tank until after you have checked out the job. Then you are not faced with the disposal of a tankload of the wrong pesticide for the problem. Mix only enough pesticide for the job at hand so that you end up with an empty tank or hopper. Preventing pesticide surplus is the best way to take care of your disposal problem.

What to Do with Surplus Pesticides. If you have pesticides which you cannot use or do not want, you must take steps to safely get rid of them. Pesticides which are still in the original container or still in concentrated form may be returned to the manufacturer. Check with the company and see if they will take your surplus back. If you mix too much pesticide for a job, try to find other areas with the same problem and use up any extra tank mix or rinse water on these. Otherwise spray small amounts of extra tank mix over an area where you are sure it can't do any harm. Add Clorox or lime to the surplus tank mix before spraying to aid in breaking the chemical down quickly. If the manufacturer won't take back your concentrates and/or you cannot use up your pesticides, you must find other safe ways to dispose of your surplus. Store your extra pesticides in your regular locked storage area while you are waiting to dispose of them legally. Keep them in their original containers with the label if possible. Otherwise 55 gallon steel drums with clamp covers make good storage containers for smaller empty containers or other surplus pesticides.

Empty Pesticide Containers

Empty pesticide containers are not really "empty." They still contain small amounts of pesticide even after they have been rinsed out properly. Never toss them in streams, ponds, fields or empty buildings. Be able to account for every 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, those that contain mercury, lead, cadmium, arsenic or inorganic pesticides. All empty containers regardless of their type should be rinsed three times before disposal. The rinse water should be dumped in the tank if possible. Otherwise you must treat it like a surplus pesticide and dispose of it properly. Never dump rinse water out on the ground!

Burnable Containers are usually wood, cardboard or paper. Small quantities of these may be burned if local laws allow burning in your area. 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.

Non-Burnable Containers are usually metal, glass or plastic. Some of these may be sent back 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 the pesticide storage area for disposal. Glass containers may be carefully broken and stored. Plastic containers may be cut apart to take up less room. An empty 55 gallon drum makes a good storage container for smaller empty containers. Be sure to cover the drum tightly with a clamp-type cover. Store the drum in a special "disposal" section of your pesticide storage area.

Containers with mercury, lead, cadmium, arsenic or inorganic pesticides must be handled differently from other pesticide containers. The containers may be wood, cardboard, paper, metal, plastic or glass. They are special because the type of pesticide they contained is very persistent and hazardous in the environment. 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. You may wish to store your empty containers of this type while waiting to dispose of them. They can be crushed and placed in a 55 gallon drum. Keep these containers in a different drum than the one containing regular non-burnable pesticide containers. Do not burn empty containers which held mercury, lead, cadmium, arsenic or inorganic pesticides. Wood, cardboard and paper containers of this type should be crushed and stored in the 55 gallon drum with the other containers.

Methods of Disposing of Pesticides and Pesticide Containers

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

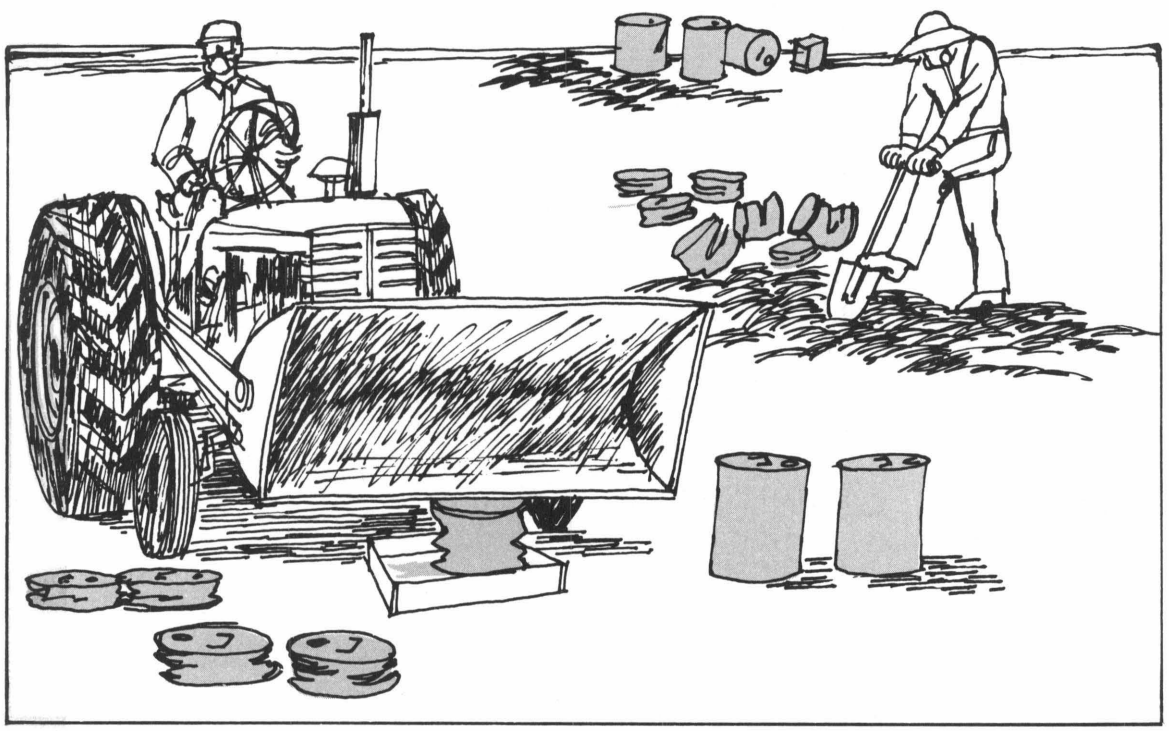
Incineration. Burning pesticides and containers in special high temperature pesticide incinerators is one safe method of disposal. These incinerators are specially designed so that the pesticides will be reduced to harmless gases and solid ashes. This method may not be used for pesticides or pesticide containers with mercury, lead, cadmium, arsenic or inorganic pesticides. Do not confuse this special incineration method with open burning or ordinary incineration. To find the pesticide incinerator nearest your operation, contact your county extension agent, state college, state regulatory officials or your regional Environmental Protection Agency office.

Burial. Burying pesticides and containers can also be an effective method of disposal. The burial site should be chosen in an area where public health and the environment will not be harmed. Surface and underground water systems should be carefully protected. Check to see if there is a special pesticide land fill in your area. Do not bury pesticides or containers with mercury, lead, cadmium, arsenic or inorganic pesticides unless special precautions are taken. Encapsulation is one method of keeping these compounds from getting into the environment.

Chemical Degradation. Sometimes pesticides can be chemically degraded into non-toxic materials. These methods are specific for each chemical and cannot be described here. Check with the manufacturer or local Environmental Protection Agency officials for specific methods.

Soil Injection. Disposal of surplus pesticides through soil injection is a fairly new method. "Soil injection" means plowing the pesticide into the soil over a large area in normal tillage practices. The effect of this method on the environment is not fully known. Use soil injection methods only when recommended by state or federal regulatory officials.

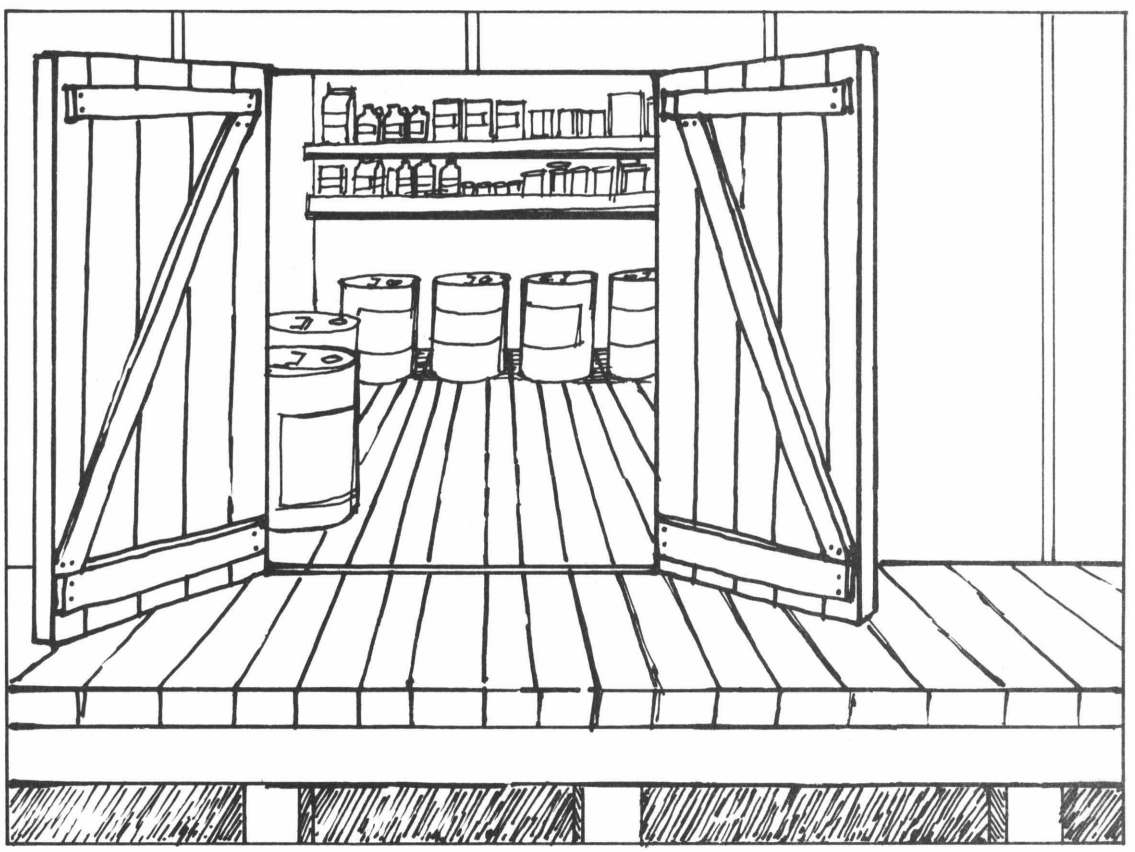
Take the extra time and effort to dispose of surplus pesticides and empty containers safely. It's well worth your while!



chapter XXI
Storage

(See Chapters II and III for State and Federal Laws)

No job is really finished until the pesticides, the containers, and your equipment have been put away properly. Get into the habit of storing all your materials safely away 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 protective clothing you used on the job. Consider wearing gloves even if they weren't recommended on the label. Spills and accidental contamination often occur during storage procedures.



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, you may decide to build a special storage building just for your pesticide needs. Before you start the building you may wish to look into suggestions and plans for pesticide storages which are put out by the state colleges, chemical companies, county extension agents, etc. When you are setting up any new storage area, you should check federal, state and local regulations on storage areas. Use a separate building for your pesticide storage if possible. If you do not have a separate building, choose a wing or corner on the first floor of a building.

Choosing the Best Site. Whether you are choosing 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. The site should also be chosen where windblown pesticide dusts and particles would not cause problems. There should be no chance that runoff or drainage from the site could contaminate surface or underground waters.

Setting Up the Storage Area. Pesticides should be stored in a cool, dry, airy room or building which is fireproof. 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. These should say something like: DANGER—PESTICIDES. KEEP OUT. Windows are good so that fire hoses and other fire fighting equipment can be used through them in case of fire. They should, however, be barred so that children and other curious people cannot get in. A drainage system should be built to collect any runoff water. 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 underground water. Dikes, collecting pools and washing slabs with sumps would provide a proper drainage system. 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. Absorptive 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 sodium hypochlorite (Clorox or other bleach) should also be on hand to neutralize the pesticide in an emergency. A shovel, broom and dust pan and a fire extinguisher are other "musts" in any storage area.

Arranging Your Storage Area

A pesticide storage area, whether it is a room or whole building, should be used only for pesticides and pesticide equipment. Never store or use food, drinks, silverware, tobacco or smoking equipment in the storage or loading area. Livestock feed, living plants and seeds should not be stored with or below pesticides either.

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. Heat will cause the liquid to expand so that the contents will be under pressure. When the container is opened the pesticide may splash out on you. No pesticides should be allowed to become overheated. Some formulations will catch on fire if they get too hot. Others lose their strength and break down when they are exposed to heat.

Special Areas. Herbicides should be stored in a special place apart from other pesticides. Some herbicides can vaporize (become a gas) and get into other pesticides nearby. When the contaminated pesticide is used, the herbicide vapors in it may injure or kill crops and sensitive plants. All highly toxic pesticides should be stored together in a special area, too. 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 according to how you plan to dispose of them and plainly labeled. This will help prevent mixups resulting in improper disposal and even accidental reuse.

Handling Pesticide Containers

Pesticide containers should be stored with the label in plain sight. They should be stored up off the floor especially if they can be injured by dampness. Rigid containers should always be set in an upright position so they cannot spill easily. All containers should be placed in orderly rows with enough room to allow you and your helpers to walk between them.

Damaged Containers. All pesticide containers should be checked often for corrosion, leaks, loose caps or bungs. You must correct these dangerous conditions immediately. Pesticides should be stored in their original container if possible. Other containers often are not properly labeled with dosages, uses and safety precautions. If containers are damaged, however, you should put the pesticide in a sturdy container which can be sealed. Be sure to label the new container. Sometimes you can take the label from the damaged container and firmly fasten it to the new container. Unlabeled pesticides are worthless since you don't know what they are or how to use them. They should be treated as surplus pesticides and held for disposal. Partly empty pesticide containers should be resealed and returned to storage. If their container is damaged, place the pesticide in a tight container and carefully label it. Paper drums or plastic bags placed within another container are handy for this purpose. Opened containers of chlorates (often used as weed killers) should not be stored. They can burst into flames at any time.

Improper Containers. Never store pesticides in anything used as a food or drink container even for a short time. Pesticides stored in a coke bottle, fruit jar, milk carton, etc. are a common cause of accidental pesticide poisoning. Customers may ask for a small amount of the pesticide you are using. Unless you have a small package with the manufacturer's whole label on it, don't give them any. **Never** dump a little of your tank-mix in a jar and hand it to your customers. You will not be doing them a favor.

Pesticide Equipment Storage

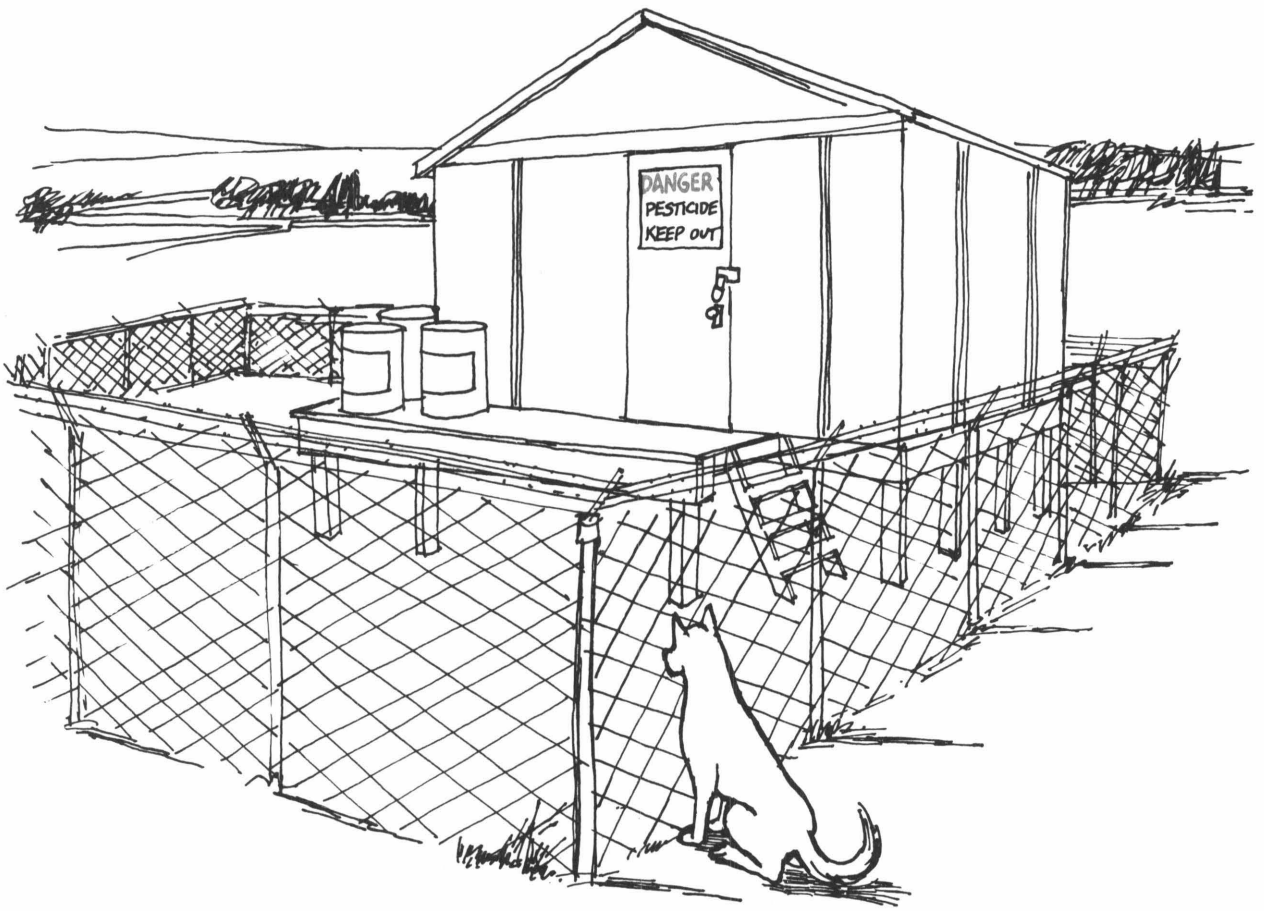
All pesticide application equipment should be stored in a special area, too. Often the equipment is contaminated with pesticides. Never let children or uninformed people play on or around your machines. They could pick up a harmful dose of pesticide. Always wash your equipment carefully before you store 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 be rinsed thoroughly and stored too.

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 the rules.

Protect Yourself and Others:

1. Do not allow children, pets or uninformed persons into the storage area.
2. Wear gloves when you are handling containers of pesticide concentrates. Use more protective clothing if the label says to.
3. Do not put your fingers in your mouth or rub your eyes while you are working.
4. Do not store or use tobacco, food, or drinks in areas where pesticides are present.
5. Wash your hands carefully before eating, drinking, smoking or using the toilet. Wash them as soon as you are finished handling the pesticides, too.
6. Do not handle pesticide containers roughly; they are not meant to be thrown, dropped or abused. Check all containers for leaks before you handle them.



Spills. In spite of all safety precautions, accidents will 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 him change clothes, get out of the area and see a doctor if necessary. Clear the storage area except for a small clean-up crew. Be sure the crew wears the proper protective equipment.

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, then sweep or shovel it directly into a large drum. (Absorbent materials are not useful for dry spills.) Next cover the area with hydrated lime or sodium hypochlorite (bleach) to neutralize the pesticide. 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 over 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 too. 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 rubber 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 give fire department officials a floor plan of the storage area, if possible. Keep all people without protective gear away from the fire. Everyone who might contact the smoke, fumes, or contaminated surfaces must be removed from the area. All water used in fire fighting should be contained in the storage area drainage system for safe disposal. It can be poisonous too.

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.

Make it a habit! Store your pesticides and equipment away properly before you clean up and go home or on to the next job.

chapter XXII
Record Keeping

Besides just meeting the requirements, keeping records of pesticide usage is a wise precaution. Records can establish proof of proper use in damage suits. 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 help you save money. They allow you to compare the results obtained from different pesticides. You can improve your pest control practices and efficiency too. They help to reduce pesticide misuse. Careful records from year to year guide you in buying only the amounts of pesticides you will need. You can reduce winter carryover.

SPRAY RECORD SHEET FOR CERTIFIED APPLICATORS

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	Ciovap 10g./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	Jeep weed sprayer	2, 4-D 4 lbs./gal. Chipman #457-4	3 gal.	160 gal.	12 acres Arts Quad	Broadleaved weeds, No wind, sunny, dandelions 3" across Driver-REP

What Are the Requirements?

The more information which is 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 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)

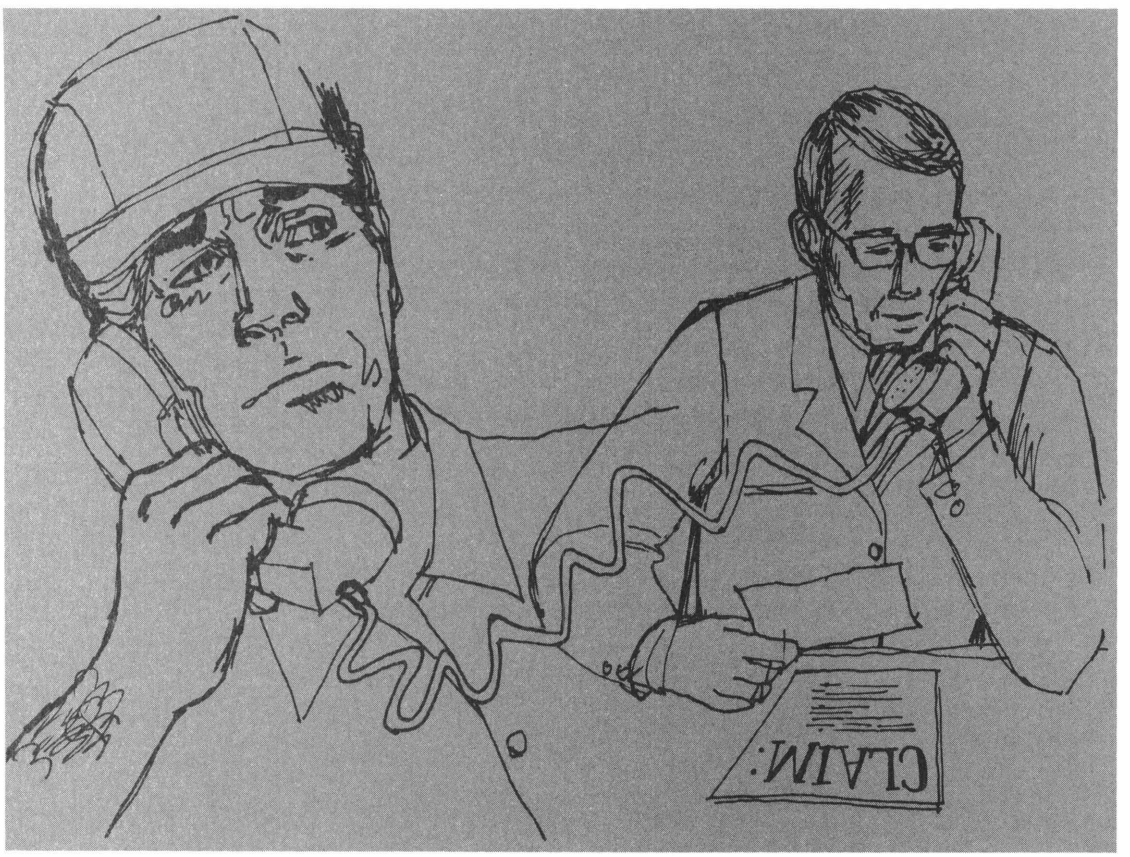
Total Formulation added to tank or hopper
Amount of Mixture Used
Amount or Numbers Treated (acres, trees, sheep, etc.)
Additional Comments
- Location
- Weather
- Applicator
- Severity of Infestation

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.

The job is never finished until the paper work is done.

chapter XXIII
Liability

Almost all pesticides are considered hazardous. Even the most careful applicators sometimes have claims for damages against them. The usual claims are for non-performance or for injury to crops being treated or to crops in nearby fields. It is important for all licensed applicators to be informed of the most common claims made against them.



Drift

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

Crop Injury

Claims of injury to the crop 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 crop. The party in error must accept the blame and pay damages. Applicators must make sure that all the pesticides they use are recommended on the label for that purpose. Then the blame may be the manufacturer's.

If the crop injury was not great or total, the grower 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.

Personal Injury

The application of pesticides is considered an especially dangerous or, in legal terms, an "ultrahazardous" 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. Pest control operators or exterminators are sometimes a special case. The liability in most cases involving personal injury or death depends on proving the applicator negligent.

Wrong Field

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 overtolerance occurs or that the owner just didn't want the area treated, the applicator may be charged with trespass. Defense is very difficult. Double check on addresses, field locations, and all landmarks before you treat an area. Applying pesticides to the wrong field can be costly.

Bees

Honeybees are very important to the farmer and often he has his own colonies or hives. Unfortunately bees are insects and are very susceptible to many pesticides. If the bees in hives are killed as the result of drift from nearby fields, the applicator is usually held legally responsible. Often he must pay damages.

However, if the bees contacted the pesticides while in the sprayed fields, the applicator is not usually liable. 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.

Attractive Nuisance

The rulings on "attractive nuisance" usually involve cases when children are attracted to ground equipment or aircraft and injure themselves. The owner and/orapplicator are held liable for leaving the "nuisance" where a child could be "attracted" to it. In one case, a young boy, seeing a small airplane parked in the corner of an airport, took his ax and chopped the plane into several pieces. Unfortunately at one point, the hatchet hit the plane, then slipped and cut his foot. The court under the "attractive nuisance" claim awarded the boy $5,000 from the airplane's owner.

Therefore, beware! Do not leave ground equipment with exposed drive belts, drive wheels, gears, or any moving parts alone in areas where children can get to them. Aircraft should never be parked where curious children can find them. Empty containers and aerosol cans are also attractive **and** dangerous to children. Store or dispose of them properly!

Noise

Recently claims have been brought against applicators for noise damage. Owners of mink, poultry, turkey and occasionally cattle ranches claim injury to their animals from fright caused by noise of aircraft and ground equipment operating above or near their ranch. They must prove direct loss of property due to noise from machinery operated carelessly or negligently. In some cases the ranch owner will claim that an applicator made an unlawful flight over his property without his permission. This is especially important in aerial applications when pullups over nearby property are necessary. Successful defense is possible when the applicator can show that the noise wasn't the cause of injury or that no injury occurred.

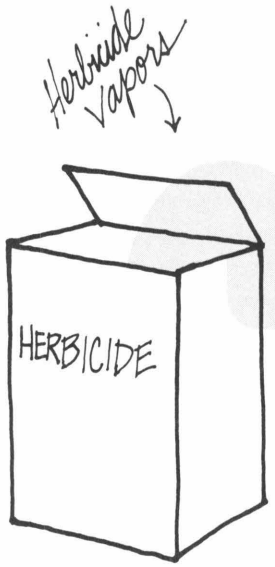
Cross Contamination

Every year there are cases where a pesticide container has not only the pesticide named on the label but another pesticide also. The materials in the container may damage the crops being treated. There are three main ways this may occur.

1. The manufacturer may make a mistake in labeling or formulating the product.

2. The applicator may err in mixing or filling in the spray tank. Or he may not have removed from the tank all the pesticide left over from the last application.

3. Open containers of herbicides such as 2,4-D can vaporize (become a gas) and penetrate other pesticides which are stored nearby. When the other pesticides are applied the 2,4-D contamination can seriously injure the crops.



The applicator must know which container of pesticide was used on the crop 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 formulation error. The courts must decide who is to blame.

NOTE: All applicators should write on the label of each pesticide container the location and the date it was applied. They should also record the lot number in case of cross-contamination.

What To Do When You Are Involved

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 at once.

- 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, carry-over effect from other materials or herbicides, and age of crop.
- Photograph any adverse condition found with color film at a sufficiently close focal length so that the symptoms can be examined by an expert.
- Save the container from which the product was removed that was used in the job. If it is not practical to save the whole container, use close-up color photography to record the label.
- Notify your insurance company and do so immediately.
- If you do not have insurance for the loss involved, request permission to have an expert examine the crop or the property, in order that you may have the benefit of his opinions.
- If a chemical company is involved, notify them immediately. They will probably want to send their experts to the site too.
- Obtain the names and addresses of all witnesses who might testify as to the nature of the operation, conditions of the crop before and after. In the event that the crop is perennial, examine the USDA aerial photographs to ascertain the condition of the orchard or other perennial planting in years prior to the year of alleged injury.

Insurance

To protect himself and his business, the applicator should have insurance for possible pesticide mishaps. There are many different types of insurance plans ranging from bodily injury, property damage, restricted chemical liability and comprehensive chemical. The plan you choose should fit your needs and your business. If you are in a relatively low risk position from a legal standpoint (such as golf course superintendent) then minimum coverage may be enough. On the other hand, aerial applicators will probably need more insurance. Be sure to explore the costs, benefits, and drawbacks of insurance before you buy. You need to know exactly what you are covered for. An insurance agent who specializes in pesticide insurance is the best person to advise you on your individual (special) insurance needs.

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

chapter XXIV
Pests

There are many kinds of pests. Each crop or animal has some. 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 late and do more harm than good. (See Chapter XII, Selection of a Pesticide.)

If you know the general pattern of the pest's life (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.

Do not guess at your pest problems.

Glossary of Pesticide Terms as 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 pumps and nozzles down quickly.

ABSORB — To take a pesticide into a plant, animal or the soil.

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 How poisonous a pesticide is to an animal (or man) after a single dose or exposure.

ADHESIVE An adjuvant which helps the pesticide stick to the treated surface.

ADJUVANT-ADDITIVE Something added to the pesticide mixture to help the active ingredient do a better job. Examples: wetting agent, spreader, adhesive, emulsifying agent, penetrant.

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.

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.

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 target to kill pests or prevent damage by them.

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.

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.

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. Examples: 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.

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 in a mixture.

CONDEMNATION The act of removing a crop or product which does not meet legal standards for tolerances on foods 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 pesticide container or in a poorly cleaned sprayer.

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 moistures (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 microorganisms 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.

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 used, too, so that the pesticide can be diluted, usually with water.

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.

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 distributors 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

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 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.

FLUID Liquid

FOAMING AGENT Chemical substance which causes the pesticide mixture to form a thick foam. It is used to reduce drift.

FOGGER Aerosol generator; a piece of pesticide equipment that breaks some pesticides into very fine droplets (aerosols or smokes) and blows or drifts the "fog" onto the target area.

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.

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.

GROWTH REGULATOR — A pesticide chemical which increases, decreases or changes the normal growth or reproduction of a plant.

HAZARD — The risk of danger; the chance that danger or harm will come to the applicator, bystanders, consumers, livestock, wildlife or crops, etc.

HERBICIDE — Pesticide that is used to control unwanted plants.

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 at high pressure and volume 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 — Not able to be mixed or used together.

INCORPORATE — To work or blend a pesticide into the soil completely.

INERT INGREDIENTS — Inactive part of a pesticide/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.

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.

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. See Chapter VIII–The Label.

LC_{50} The concentration of a pesticide in air which would kill half of the test animals exposed to it. The *lower* the LC_{50} value, the *more poisonous* the pesticide. It is often used as the measure of acute inhalation toxicity.

LD_{50} The dose or amount of a pesticide which would kill half of a large number of test animals if eaten or absorbed through the skin. The lower the LD_{50} value, the *more poisonous* the pesticide. LD_{50} values are the commonly used measure of acute oral and acute dermal toxicity.

LETHAL Deadly, toxic.

LIABLE-LIABILITY Legal responsibility for.

LIMITATION Restriction, the most that is allowed.

LITER A unit of volume in the metric system equal to a little more than one quart.

MARINE Having to do with animals and plants which live in the ocean.

MATERIAL A substance, often used to mean a pesticide chemical.

MAXIMUM DOSAGE The largest amount of a pesticide chemical that is safe to use without resulting in excess residues or damage to whatever is being protected.

MECHANICAL AGITATOR A device which keeps the pesticide and any additives thoroughly mixed in the spray tank by paddling, swirling or stirring.

METRIC A system of measurement which is used by most of the world except the U.S. and Canada and which 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.

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 Acaracide, 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.

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.

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. (See Chapter V).

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.

NON-SELECTIVE PESTICIDE A pesticide chemical that will control a wide range of pests.

NON-TARGET Any plant, animal or other organism that a pesticide application is *not* aimed at, but may accidently be injured by the chemical.

NON-VOLATILE A pesticide chemical that does not evaporate (turn into a gas or vapor) at normal temperatures.

OPERATING SPEED The steady rate 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.

ORIGINAL CONTAINER — The package (bag, can, bottle, etc.) which 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. (See Chapter V.)

PENETRANT — A kind of additive or adjuvant which aids the pesticide to get through the outer surface (leaf, root, skin) and into the plant.

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 materials 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 A chemical or other agent that will destroy a pest or protect something from a pest.

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 death of a large number of non-target organisms.

PETROLEUM PRODUCTS Anything which contains gasoline, kerosene, oil or similar products.

PHYTOTOXICITY Injury to plant life caused by a chemical or other agent.

PLANT DISEASES Sicknesses which affect plant life and are 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.

POINT OF DRIP OR 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 poisonings.

POLLINATORS — Bees, flies and other insects which visit flowers and carry pollen from flower to flower for 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.

POST-EMERGENCE — After young plants push up through the soil.

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.

PRE-HARVEST The time period just before a crop is ready to be picked, cut or dug.

PRESSURE The amount of force on a certain 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 thing.

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 GEAR Clothes and equipment that guard a person against injury or death when using poisonous pesticides. They would include gloves, apron, shoes, coveralls, hat, cartridge, respirator and gas mask.

RATE The amount of a 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 or 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.

REENTRY INTERVAL Period of time between a pesticide application and when workers can safely go back into an area without protective clothing.

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.

RESPIRATOR A face mask which filters out poisonous gases and particles from the air so that a person can breathe and work safely.

RESTRICTIONS Limitations.

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 the Latin or Greek languages.

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 a lot of 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.

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 another liquid to be applied.

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 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 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. Examples: dogs or chickens or German cockroaches.

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. Examples: detergent, emulsifier, wetting agent.

SUSCEPTIBLE Can be killed or injured by the pesticide at the rates used.

SUSPENDED A pesticide use 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 usually 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 of a disease or poisoning in a plant or animal or man.

SYSTEMIC A pesticide that is taken up by one part of a plant or animal and moved to another section where it acts against a pest.

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.

.TRA-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.

\AUTHORIZED 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 which are located beneath the soil surface which wells get their water from.

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.

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.

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.

Questions for Self Study

Toxicity of Pesticides — chapter IV

1. Pesticides may enter the body in three different ways. Name them.
2. Can some pesticides be as dangerous when absorbed through the skin as when taken by mouth?
3. Some areas of the body absorb pesticides more quickly than other areas. Name three areas which absorb pesticides quickly.
4. Which two routes of entry are likely to be the most important to the pesticide applicator?
5. Explain the difference between acute toxicity and chronic toxicity.
6. Do LD_{50}'s and LC_{50}'s give the exact toxicity of each pesticide or are they useful only in establishing the toxicity of one pesticide in relation to another?
7. Acute oral toxicity and acute dermal toxicity are measured in LD_{50}'s. The *higher* the LD_{50} number the ___(more or less)___ toxic is the pesticide.
8. How many parts per million is 6 milligrams per kilogram? How much pesticide would it take to kill a test animal with this LD_{50} rating?
9. How is chronic toxicity measured?
10. What type(s) of toxicity are label signal words and warning statements based on?
11. What signal word(s) are required on the label for Highly Toxic pesticides? Moderately Toxic? Slightly Toxic? Relatively Non-Toxic?
12. Is there a difference between toxicity and hazard?
13. Is a highly toxic material always very hazardous?
14. What are some of the factors which are involved in determining hazard?

Residues, Tolerances and Registration — 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 which the Environmental Protection Agency reviews before registering a pesticide?

Ecology and Environmental Considerations — chapter VI

1. Can most fish and other marine life survive great changes in their natural water environment?
2. Why must farmers use uncontaminated water?
3. How do overdoses and other pesticide misuse affect crop planting and growth?
4. What unique ability does air have which is the cause of pesticide drift?
5. Why should honey bees be protected?
6. Can careless use of pesticides affect hunting and fishing sports?
7. Do some mammals, fish and birds already contain high pesticide residue levels making their meat unfit for human consumption?

8. Are pesticides ever an asset to the environment or are they always harmful?
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. Is there any danger due to over-applications of pesticides? What can happen?
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? Why or why not?
14. If a particular pesticide is highly toxic to mammals, is it always highly toxic to birds and fish?
15. What is the name given to the complex prey-predator relationship in which all animals (including man) take part?
16. Can pesticides actually "build-up" from level to level in the food chain?
17. Where is man's level in the food chain?
18. Can man receive very high concentrations of pesticides through the food chain?
19. Explain the difference between Accumulative and Persistent pesticides.
20. Do persistent pesticides necessarily accumulate?
21. Can persistent pesticides be relatively harmless to the environment?
22. Do some pesticides accumulate through the food chain?
23. Can one animal receive harmful doses of a pesticide by feeding upon tissues of other animals?
24. Can pesticide residues slowly build up in one animal or do they build up only through the food chain?
25. Why are organophosphates often low environmental dangers?
26. Pesticides which _____ (slowly or quickly) _____ degrade in the environment are the least hazardous.
27. What is Phytotoxicity? What usually causes it?
28. What four main areas must the careful applicator watch out for when applying a pesticide on or near desirable plants?
29. Why are pesticides sometimes hazardous to plants some distance away from the target area?

Safety Precautions — chapter VII

1. What should you consider when planning ahead for using pesticides?
2. Why not carry pesticides in the back of a truck with groceries, livestock feed and children?
3. Where should you look to find what protective clothing is necessary when you want to handle a pesticide?
4. Why should you wear a wide brimmed, waterproof hat and not a cap when you will be exposed to downward drift?
5. Do you need to wear protective clothing while mixing and filling or just when you will be exposed to downward drift?
6. Why is a concentrated pesticide which has spilled on the ground dangerous if not cleaned up?
7. How should you stand when you are filling a spray tank?
8. Is it all right to use the same pesticide equipment for all pesticide applications, even hormone-type herbicides? Why?
9. Name five ways of avoiding exposure while applying pesticides.
10. If you or your buddy feel sick on the job should you leave the work half done or try to "finish-up"?
11. If the pesticide is not too toxic can you let children and pets play in the area while you are spraying there?
12. When you are spraying near houses, playgrounds and bee colonies is it up to the owners to keep out of your way or should you warn them and then take every precaution?
13. Name three ways to cut down accidents commonly caused by equipment.
14. Why stand there and watch your tank fill when you have many other things to do?
15. Name four procedures to follow with your equipment after the job is finished.
16. Why can't you wash your spray clothes right in with family laundry?
17. Explain what "reentry" means. Why wait at least until the spray has dried?

Safety Precautions for Handling Highly Toxic Pesticides — chapter VIII

1. What is the most common cause of pesticide poisoning for applicators?
2. When should you wear elbow length rubber gloves?
3. Why not use cotton or leather gloves when handling highly toxic pesticides?
4. Must you always wear a waterproof 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. When are gas masks used?
17. When should gas masks with an independent oxygen supply be used?
18. Should you try to fit the respirator so that some air can leak in around your face?
19. When should you replace the filter on your respirator?
20. How often should the cartridges on your respirator be changed?
21. How should you safely clean and store a respirator?
22. Is it safe to work alone when you are handling highly toxic pesticides?
23. If you are careful is it all right to have a snack or a chew of tobacco while you are on the job?
24. Should you wear your pesticide soaked clothing again as soon as it dries and launder it once or twice a week?

25. Cholinesterase tests show whether you have been overexposed to _____ or _____ pesticides.

Symptoms of Pesticide Poisoning — 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?
3. Are the symptoms for all 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

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 is the best first aid for corrosive poisons — a glass of milk or causing the person to vomit?
7. Can activated charcoal and other absorbers be used for any type of swallowed poison? When is it used?

8. Why shouldn't workers carry atropine?
9. Describe shock. What can be done for it?
10. Where do you get the water you need for pesticide first aid?
11. What are Poison Control Centers?

Types of Pesticides — chapter XI

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 pesticide?
5. What are the advantages of short term pesticides? Residual pesticides?
6. Miticides are very similar in action and use 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 often important?
12. Explain preplant, preemergence, 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?

Selection of a Pesticide — chapter XII

1. Where can a pesticide applicator get help in identifying a pest?
2. Beside knowing what the pest is, what else must a good applicator know about a pest?
3. Name three conditions that would make control of a pest not worthwhile.
4. What are some of the alternatives to pesticide application for pest control?
5. What is meant by integrated control?

6. What are some of the points an applicator must consider when choosing the right pesticide for the job?

The Label — chapter XIII

1. What are the ways in which mistaken use of pesticides can be expensive to the applicator?
2. Does the label specify the protective equipment necessary for cautious use of each pesticide? If so, how?
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 your client loses his crop, 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. Does the official common name have to appear on the ingredient section of the label?
10. Is there any official difference between an official common name and a trade name?
11. What is a technical name describing the composition or formula of the actual toxicant?
12. What two words and diagram must appear on all labels for *highly toxic* products? The word "WARNING" may also appear.
13. What labels must carry an antidote statement and the sentence "Call A Physician Immediately"?
14. Is the signal word WARNING required on labels for *moderately toxic* products?
15. All labels for slightly toxic materials must carry the word_____. The word "WARNING" may also appear.
16. What directions for use can you find on the label?
17. What other recommendations are on the label?
18. Name the four different times you should read the label and give the reasons why for each time.

Formulations — chapter XIV

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 households, 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 take no chances 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 applicator than most because it is highly concentrated and is absorbed by the skin easily?
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.

Filling and Mixing — chapter XV

1. Which two main pesticide formulations must be diluted before they are applied?
2. When is usually the best time to add the pesticide to the spray tank? Why?
3. Why is mixing the time 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 is it worthwhile to rinse it out?
7. How many times should you rinse an "empty" pesticide container and the measuring cup?
8. Can you mix any two pesticides together without any problem?
9. What does compatibility mean?
10. Where can a pesticide applicator find out whether 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?

Calculations — chapter XVI

1. Why is it so important to add the correct amount of pesticide to the mix?
2. If your recommendations calls for 3 pounds of wettable powder per 100 gallons of finished spray, how much do you put in a 450 gallon tank? (Answer - 13.5 pounds). Show your calculations.
3. How much do you put in an 80 gallon tank at 3 pounds per 100 gallons?

   3 pounds $= 3 \times 16$ ounces $= 48$ ounces.

   80 gallons is $\frac{80}{100}$ of 100 gallons $= \frac{4}{5}$

   $\frac{4}{5} \times 48 = \frac{192}{5} = 38.4$ ounces $= \frac{38.4}{16} = 2.4$ pounds in 80 gallons.

   Try it at 4 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? (Answer – 9 pints or 1 gallon and 1 pint.) How much do you put in a 50 gallon tank? (Answer – 1½ pints.)
5. If one pound of WP is recommended per 100 gallons of water, how many tablespoons of WP would you add in one gallon?
6. If two pints of EC are recommended per 100 gallons of water, how many teaspoons of EC would you add in 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? (Answer – 2 gallons.)
   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 × 24 gallons water = 48 gallons water

   2 × 1 gallon pesticide = 2 gallons pesticide.
9. How many pounds of 25% wettable powder must you add to 100 gallons of water to get a 1% active ingredient mixture? (Answer – 33.2 pounds.)
   100 gal = 830 pounds = 1% of 830 pounds = 8.3 pounds active ingredient needed.

   1 pound active ingredient = 4 pounds 25% wettable powder.

   4 × 8.3 = 33.2 pounds 25% wettable powder.

Equipment — chapter XVII

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 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 a 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?

Calibration — chapter XVIII

1. When you have the right mixture in your spray tank, can you still apply the wrong amount of pesticide?
2. Does all pesticide equipment need to be calibrated?
3. What does *to the point of runoff* mean?
4. What is the *pumping rate?*
5. Explain how you would calibrate your sprayer.
6. Once your sprayer is calibrated does it always remain the same or should you recheck it often?
7. If your sprayer is delivering less spray to each acre than you want it to, how would you usually change the rate?

Weather-wise Application — chapter XIX

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 of crops — who is legally responsible — the applicator or the farmer?
7. Why must spray applications dry on before a heavy rain?
8. What harm can pesticide runoff do?
9. What are two advantages of early morning or evening application?

Disposal — chapter XX

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 in one season?
3. If you have surplus pesticides that are in concentrated form and still in the original container, what should you try to do with them?
4. What should you try to do with excess tank mix? Should you add anything to the tank mix first?
5. If you can't dispose of your surplus pesticides right away, what should you do with them?
6. If you have rinsed an empty pesticide container out three times, can you toss them aside or give them to children to play with?
7. What should you do with the rinse water if you can't add it to the tank mix?
8. If you have a couple of empty cardboard fungicide containers, how should you dispose of them?
9. If those cardboard containers had held 2,4-D would you still dispose of them the same way?
10. What should you try to do with empty metal, glass, or plastic containers?
11. If you can't dispose of a metal drum right away what would you do with it?

12. Why must containers which held mercury, lead, cadmium, arsenic or inorganic pesticides be handled differently from other empty pesticide containers?
13. What does *encapsulation* mean?
14. *Incineration* is an acceptable method of pesticide disposal. Does that mean you can throw them in a hot wood stove or trash fire?
15. How should you choose a site to bury surplus pesticides and empty containers?
16. Can you incinerate or bury surplus pesticides or containers that have mercury, lead, cadmium, arsenic or other inorganic chemicals in them?
17. What is meant by soil injection?
18. Do federal and state laws regulate pesticide disposal methods?

Storage — chapter XXI

1. Why wear protective clothing while you store your pesticides, containers and equipment?
2. When you are setting up a pesticide storage area, what are the regulations you should check into?
3. Name several points you need to consider when choosing a storage site.
4. Why bother putting in windows if they are barred?
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. Is the storage area a good, safe 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 place apart from other pesticides?
12. How should you organize the *disposal* section of your storage area?
13. What should you do when you discover 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 homeowner asks for a little left over 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. Why not use pesticides that have had other pesticides spilled on them?
20. In case of fire in your storage area, what should firefighters wear?

Record Keeping — chapter XXII

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 XXIII

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 crop you applied a pesticide to is injured even though you followed the directions and dosages on the label, who is probably 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 field or place 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. Which pesticide applicators really need insurance for their business?
9. Who can best advise you on your insurance needs?

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