CHAPTER 6
Pesticide Use and Safety

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Pesticide Use and Safety

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Pesticides may be useful when nonchemical methods fail to provide adequate control of pests and when pest populations reach a level of economic injury. The suffix “-cide” literally means kill. The term pesticide refers to a chemical substance that will kill pests. Since it is physically impossible to eradicate an entire population of pests, pesticides are used as a tool to control or manage pest populations to a level of tolerance. Because of government regulations, chemicals used to attract or repel pests and to regulate plant growth or function are also classed as pesticides. Also, some biologicals are also classified as pesticides.

Understanding the proper use of pesticides is imperative to their effectiveness and to your safety.

Terminology

The wording “insecticides and pesticides” is incorrect because insecticides are pesticides.

Types and functions of pesticides include the following:

<table>
<thead>
<tr>
<th>Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insecticides</td>
<td>control insects</td>
</tr>
<tr>
<td>Miticides</td>
<td>control mites</td>
</tr>
<tr>
<td>Acaricides</td>
<td>control mites, ticks, and spiders</td>
</tr>
<tr>
<td>Nematicides</td>
<td>control nematodes</td>
</tr>
<tr>
<td>Fungicides</td>
<td>control fungi</td>
</tr>
<tr>
<td>Bactericides</td>
<td>control bacteria</td>
</tr>
<tr>
<td>Herbicides</td>
<td>control plants (herbicides kill plants, not just weeds)</td>
</tr>
<tr>
<td>Rodenticides</td>
<td>control rodents</td>
</tr>
<tr>
<td>Avicides</td>
<td>control birds</td>
</tr>
<tr>
<td>Piscicides</td>
<td>control fish</td>
</tr>
<tr>
<td>Molluscicides</td>
<td>control mollusks, such as slugs and snails</td>
</tr>
<tr>
<td>Predacides</td>
<td>control pest animals</td>
</tr>
<tr>
<td>Repellents</td>
<td>keep pests away</td>
</tr>
<tr>
<td>Attractants</td>
<td>lure pests</td>
</tr>
<tr>
<td>Growth Regulators</td>
<td>stop, speed up, or otherwise change normal plant or insect processes</td>
</tr>
<tr>
<td>Desiccants, Defoliants</td>
<td>used to remove or kill leaves and stems</td>
</tr>
<tr>
<td>Antitranspirants</td>
<td>reduce water loss from plants</td>
</tr>
<tr>
<td>Antidesiccants</td>
<td>used to protect plants from winter damage, drought, wind burn, and transplant shock (effectiveness is being questioned by recent research)</td>
</tr>
</tbody>
</table>
Pesticides can be grouped according to how they work. Many work in more than one way.

Contact poisons: Kill pests simply by touching them.

Stomach poisons: Kill when swallowed.

Systemics: Kill best by being taken into the blood of the animal or sap of the plant upon which the pest is feeding.

Translocated herbicides: Move from the point of initial application to circulate throughout the plant. The circulation of toxin ensures the kill of the entire plant.

Fumigants: Gasses which kill when they are inhaled or otherwise absorbed by pests.

Selective pesticides: Kill only certain kinds of plants or animals, for example, 2,4-D used for lawn weed control, kills broad leaved plants but does not harm grass.

Nonselective pesticides: Kill most plants or animals.

The following terms describe when to apply pesticides:

Pre-emergence: Use before plants emerge from soil.

Pre-plant: Use before crop is planted by applying to the soil.

Post-emergence: Use after the crop or weeds have germinated.

Terms which describe how to use pesticides:

Band: Application to a strip over or along each crop row.

Broadcast: Uniform application to an entire, specific area by scattering.

Dip: Immersion of a plant in a pesticide.

Directed: Aiming the pesticide at a portion of a plant, animal or structure.

Drench: Saturating the soil with a pesticide.

Foliar: Application to the leaves of plants.

In-furrow: Application to or in the furrow in which a plant is growing.

Sidedress: Application along the side of a crop row.

Spot treatment: Application of a pesticide to a small section or area of a crop.

Pesticide Formulations

The formulation describes the physical state of a pesticide and determines how it will be applied. Pesticides are rarely applied full strength. The chemical in the pesticide formulation that actually kills the pest(s) is termed the active ingredient. The added chemical(s), those which make the product easy and safe to formulate or apply, are termed the inert ingredients. Common pesticide formulations follow.

Emulsifiable concentrates (EC or E) The active ingredient is mixed with an oil base (often listed as petroleum derivatives) forming an emulsion which is diluted with water for application. ECs are common in the home garden trade, being easy to mix and use. They can cause a minor surface bronzing of light-colored fruit. They should be protected from freezing temperatures which can break down the emulsifier.

Solutions (S) These formulations are premixed, ready to use. They are often used in household pest products.

Flowables (F or L) A flowable, or liquid, can be mixed with water to form a suspension in a spray tank.

Aerosols (A) These are very low-concentrate solutions, usually applied as a fine spray or mist. They are generally sold in aerosol cans and are a very expensive source of pesticide.

Dusts (D) Made by adding the active ingredients to a fine, inert powder or talc; generally used dry.
Granules (G) Granular formulations are made by adding the active ingredient to coarse particles (granules) of inert material like fired clay particles.

Wettable powders (WP or W) Wettable powder formulations are made by combining the active ingredient with a fine powder. They look like dusts, but they are made to mix with water. These formulations need continuous agitation to maintain a suspension and are thus difficult for home gardeners to use. When mixing a WP, first mix the measured quantity with a small amount of water, forming a slurry, (a paper cup with a popsicle stick makes a good disposable mixing container) then add it and the additional water to the spray tank. The spray tank must be frequently shaken to maintain the suspension.

Soluble powders (SP) Made of an active ingredient in powder form; dissolves in water.

Baits (B) A bait formulation is made by adding the active ingredient to an edible or attractive substance. Baits are often used to control slugs, snails, ground-dwelling insects, and rodents.

Gardeners often attempt to compare a spray with a dust. It should be noted that dusts are a type of formulation, but sprays are not a formulation; they are one means of applying several different formulations such as wettable powders or emulsifiable concentrates that are mixed with water.

**Surfactants, Additives, or Adjuvants**

When added to a pesticide, a surfactant reduces the surface tension between two unlike materials, such as a spray film and a solid surface. For example, by adding a surfactant to a spray, oil and water will mix and can be sprayed on plant surfaces. With increasing emphasis on safe application of pesticides, such factors as droplet size, spray pattern, and pesticide drift have focused more attention on surfactants to give ideal coverage for pesticides. However, surfactants can sometimes increase the phytotoxicity of a pesticide. Sometimes, surfactants are already added to the formulation.

Surfactants include: activators; compatibility agents; deflocculators; detergents; dispersants; emulsifiers; foam and drift suppressants; and spreading, sticking, and wetting agents. These materials are added to a spray mix to help keep the pesticide in suspension; improve cohesiveness and dispersion of the spray; and increase the wetting (or coverage) of the leaves, fruits, and stems.

This section focuses on surfactants that act as spreading, sticking, and wetting agents. They are most useful when spraying the hard-to-wet foliage of such plants as azalea, boxwood, camellia, carnation, conifer, euonymus, gardenia, gladiolus, holly, iris, narcissus, peony, rose, and yew. Whether a spray rolls off or sticks to a plant surface depends on the physical and chemical properties of the spray mixture and the physical properties of the surface itself. If the surface tension of the mixture is high, or if the plant surface is waxy, the spray droplets will roll off.

A spreader or film extender (spread-activator) is a substance that, when added to a pesticide mix, increases the area that a given volume of spray will cover and improves the contact between the pesticide and the plant surface. A spreading agent builds spray deposits and improves weatherability. Most wettable powder insecticides benefit from the addition of a spreader.

A sticker or adhesive is a material that, when added to a spray mix or dust, improves the adherence (tenacity) to a plant surface rather than increasing the initial deposit. Commercial sticking agents are oily in consistency and increase the amount of suspended solids retained on plant surfaces by coating the particles with a resin or varnish-like film. Most fungicides, especially wettable powders, benefit greatly from the use of stickers. Stickers may be judged in terms of resistance to wind and water, length of adherence, and mechanical or chemical action.

A wetting agent is a material that, when added to a pesticide, lowers the interfacial tension between a liquid and a solid; in this case, a plant surface. Effectiveness is measured by the increase in spread of a liquid over a solid surface and the ability of the spray film to make complete contact with it. When a wetting agent reduces surface tension, spreading naturally occurs.
The pesticide label should state whether a surfactant is needed or should be added to a spray mix for certain applications and should indicate restrictions in the selection of compatible surfactants. In many cases, surfactants have been designed specifically for use with fungicides, insecticides, or herbicides.

All commercial spreading, sticking, and wetting agents should be mixed strictly according to label directions. Adding more surfactant than recommended may cause excessive runoff, resulting in a poor spray deposit and reduced pest control. In general, if the spray mix contains one or more pesticides produced or formulated by the same company, use a surfactant sold or recommended by that company. Surfactants are sold separately from pesticides and are not subject to EPA registration.

Although choosing an effective surfactant to accompany a specific pesticide is no simple task, the label will state whether a surfactant is needed and the brand that should be used.

The Pesticide Label

All the printed information including the label on the product, brochures, and flyers from the company or its agent about a pesticide product is called labeling. The label printed on or attached to a container of pesticide will tell how to use the product correctly and what special safety measures need to be taken. Specific parts of the label include the following:

**Brand name:** Each company uses brand names to identify its products. The brand name shows up plainly on the front panel of the label.

**Type of formulation:** The same pesticide may be available in more than one formulation.

**Ingredient statement:** Each pesticide label must list the names and amounts of the active ingredients and the amount of inert ingredients in the product.

**Common name and chemical name:** Pesticides have complex chemical names derived from their chemical composition. Some have also been given a shorter name, or common name, to make them easier to identify. Pesticides may be sold under several brand names, but you may find the same common name or chemical name on all of them.

**Net contents:** The net contents tells how much is in the container. This can be expressed in gallons, pints, pounds, quarts, or other units of measure.

**Name and address of manufacturer:** The law requires the maker or distributor of a product to print the name and address of the company on the label.

**Registration number:** A registration number must be on every pesticide label. It shows that the product has been approved by the E.P.A. for the uses listed on the label.

**Establishment number:** The establishment number tells which factory made the chemical.

**Precautionary statements:** A section with a title similar to “Hazards to Humans and Domestic Animals” will tell the ways in which the product may be poisonous to man and animals. It will also describe any special steps necessary to avoid poisoning, such as the kind of protective equipment needed. If the product is highly toxic, this section will inform physicians of the proper treatment for poisoning.

**Environmental hazards:** The label tells how to avoid damage to the environment. Some examples are: “This product is highly toxic to bees exposed to direct treatment or residues on crops.” “Do not contaminate water when cleaning equipment or when disposing of wastes,” and “Do not apply where runoff is likely to occur.”

**Physical and Chemical Hazards:** lists specific fire, explosion, or chemical hazards that the product may have.

**Signal words and symbols:** Some pesticides may be hazardous to people. You can tell how toxic a product is by reading the Signal Word and Symbol on the label.

<table>
<thead>
<tr>
<th>Signal Words</th>
<th>Toxicity</th>
<th>Approx. Human Lethal Dosage</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danger</td>
<td>Highly toxic</td>
<td>A taste to a teaspoonful</td>
<td>Skull and Crossbones</td>
</tr>
<tr>
<td>Poison</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warning</td>
<td>Moderately toxic</td>
<td>A teaspoonful to a tablespoonful</td>
<td>none</td>
</tr>
<tr>
<td>Caution</td>
<td>Low toxicity; relatively nontoxic</td>
<td>An ounce to more than a pint</td>
<td>none</td>
</tr>
</tbody>
</table>
Highly toxic pesticides are generally not sold in the lawn and garden trade. All products must bear the statement “Keep Out of Reach of Children.” In some pesticide literature, the term LD50 is used to give an indication of toxicity. LD50 stands for lethal dosage necessary to kill 50% of a test population of animals. The LD50 values are measured from 0 up. The numbers after the 50 represent the milligrams (mgs.) of the substance per kilogram (kg.) of body weight necessary to kill 50% of the test population. The lower the LD50 value the more poisonous a pesticide is, for example an LD50 of 5 is more poisonous than an LD50 of 20 because only 5 mgs. per kg. of body weight are necessary to kill 50% of the test population.

**Statement of practical treatment:** If swallowing or inhaling the product or getting it in the eyes or on the skin would be harmful, the label contains emergency first aid measures and states types of exposure requiring medical attention. The pesticide label is the most important information you can take to the physician when someone has been poisoned. Without the label, it is difficult for the physician to help.

**Directions for use:** These instructions will explain several important items -

- The pests the product will control
- The crops, animals, or other item the product can be used on safely
- How the product should be applied
- How much to use
- Where and when the material should be applied
- Application to harvest periods

When used on fruits or vegetables, there may be a period of time that must pass from the time of application until it is safe to pick and use the crop. Known as the application to harvest period and expressed as “days to harvest,” this is the time required for the residue to drop to safe levels. It is often listed as a number in parentheses following the crop name. It is a mistake to assume that a residue can be washed off.

**Misuse statement:** This section will remind you that it is a violation of Federal law to use a product in a manner inconsistent with its labeling.

**Storage and disposal directions:** Every pesticide should be stored and disposed of correctly. This section will tell you how to store and dispose of the product.

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## Application Equipment

Using the same sprayer equipment for weed control and then for insect control is neither safe nor desirable. No matter how well a tank is rinsed after use of a herbicide, a residue will be left in the tank and in the gaskets, hoses and parts. If the same tank is then used with an insecticide to spray a plant, it is possible to kill the plant with the herbicide left in the tank. The wisest policy is to maintain two sprayers, one for herbicides and another for insecticides and fungicides. Have them clearly labeled according to use. Always wash after each use.

Pesticide application equipment comes in all shapes, sizes, types, and prices. Select equipment according to common sense.

**Proportioner or Hose-End Sprayer:** These inexpensive small sprayers are designed to be attached to a garden hose. A small amount of pesticide is mixed with water, usually no more than a pint, and placed in the receptacle attached to the hose. A tube connects this concentrate to the opening of the hose. When the water is turned on, the suction created by the water passing over the top of the tube pulls the pesticide concentrate up and into the stream of hose water. The stream can reach into medium-high trees if water pressure is high. Problems are encountered from poor spray distribution and clogging of nozzles. The metering out of the concentrate into the stream of hose water is very inaccurate, since it is determined by the water pressure. Propioners put out an excessively high volume of spray for most needs, using excessive pesticide. These sprayers are popular due to low cost, but the low purchase price is quickly negated by the cost of excessive pesticides used. All hose-end proportioners should be equipped with an anti-siphon device to prevent back-siphoning of toxic chemicals into the water system.

**Trombone Sprayer:** The trombone sprayer is a medium-sized, hand-held piece of equipment. A spray mixture in the correct dilution is prepared in a container such as a bucket. The intake tube of the sprayer is inserted into the mixture in the bucket. Pump pressure is created by operating the sprayer in a trombone-like motion. The pesticide is pulled up the hose and out the end of the sprayer. A uniform concentration of the spray can be maintained, since the pesticide is mixed with a known quantity of water. When using a wettable powder, agitate the spray mixture frequently to keep it in suspension. Trombone sprayers are excellent for spraying trees and shrubs, are easy to wash and keep clean, but require some effort to operate.
Compressed Air Sprayer (backpack or tank sprayer): Spray is mixed in a small tank (generally 1 to 5 gallons) and the tank is carried over the shoulders. A hand-operated pump supplies pressure during application. A uniform concentration spray can be maintained since the pesticide is mixed with a known quantity of water. Frequent agitation of the spray mixture is necessary when using a wettable powder formulation. Applicator has excellent control over coverage, making this sprayer a good choice for treating dwarf fruit trees, vegetables, and ornamentals. Spray will not reach into tall trees. As water weighs approximately 8.23 lbs per gallon, small tanks are easier to use than large tanks.

Small Power Sprayers: These have the advantage of being motor-driven, so the operator does not have to stop to pump up the tank. They are lightweight, since the spray in the tank is concentrated and diluted with air as it is sprayed. Power sprayers provide uniform pressure, but are generally too expensive for home garden use.

Hand Duster: The duster may consist of a squeeze tube or shaker, a plunger that slides through a tube, or a fan powered by a hand crank. Uniform coverage of foliage is difficult to achieve with many dusters. Dusts are more subject to drift than liquid formulations due to their light weight and poor sticking qualities.

Calibrating Sprayers and Spray Patterns

The usual approach consumers use when applying a pesticide over a given area is to mix a tablespoon or two of a certain pesticide and apply it to a problem area. This is acceptable if the label gives recommended rates in teaspoons or tablespoons per gallon. But some pesticides, specifically herbicides and insecticides for lawns, do not give rates in tablespoons or teaspoons per gallon. Instead, they give rates of application in teaspoons or tablespoons per 100 or 500 square feet. Unfortunately, the consumer all too often solves this problem by guessing how much to use. This can be dangerous; too concentrated may be too toxic; too little will not control the problem. It is irresponsible of the consumer to apply chemicals at improper rates. It is dangerous to him/herself, neighbors, and the environment.

A better approach is to calibrate the sprayer. The calibration of a home sprayer is relatively easy. Once it has been done, it has been done for the life of the sprayer, provided the nozzle remains unchanged, clean, and adequate pressure is used. It must be kept in mind that the rate at which the liquid is applied varies with the pressure and size of the opening in the nozzle. High pressure and a large opening in the nozzle permit more liquid to be applied over a given area than low pressure and/or smaller nozzle. For calibrating a sprayer, the procedure is as follows:

1) Fully pressurize the sprayer and determine delivery time. This is done by spraying water through the sprayer into a pint jar. Mark this delivery time on the sprayer for future use.

2) Calculate the area to be treated. Measure the area that is to be sprayed. Multiply length times width to determine the area of a rectangle. The area of a triangle is calculated by multiplying the base times the height and dividing by 2. Most areas can be calculated by combining rectangles and triangles or subtracting triangles from rectangles.

3) If the area is large, divide it into sections equal to the size of the delivery area.

4) Spray an area with water, at normal working speed, for 30 seconds. Measure the area sprayed. This tells how much area can be sprayed in 30 seconds and therefore the amount that is applied over that area (see item 1). For example, assuming that it has been established: 30 seconds of spraying delivers ½ cup and 30 seconds of spraying will cover 100 square feet; then 1000
square feet require 5 cups spray (.5 x 10) delivered or, 1 quart + 1 cup or, 40 ounces (If the label calls for 3 tablespoons of pesticide for 1000 square feet). Then, 3 tablespoons of pesticide must be mixed with 40 ounces of water to achieve proper spray coverage. Many commercial-type chemicals are given in pounds to the acre or quarts to 100 gallons of water. To convert rates to equivalents used by a consumer, consult the pesticide conversion chart at the end of this chapter.

Either compressed-air sprayers or hose-end sprayers can be used. Hose-end sprayers do not meter out the pesticide as evenly as compressed-air sprayers. However, compressed-air sprayers do not maintain pressure as evenly as hose-end sprayers unless frequently pumped. Some hose-end sprayers will not continue to spray pesticide if the thumb hole is not covered. Other hose-end sprayers use a trigger device to control the spraying.

The spray pattern best used to cover an area of ground is one which will give uniform coverage with little spray overlap. Overlap can be a problem, causing certain areas to end up with an extra dose of pesticide. The spray pattern used to apply the pesticide should be continuous and uninterrupted. If an herbicide is being applied, the sprayer should not be slowed down or stopped at each weed. If the herbicide has been mixed correctly and the sprayer is properly calibrated, the continuous uninterrupted flow of chemical will be sufficient for good control.

The spray pattern should be directed so that the applicator does not walk through it while spraying. The spray pattern should form an arc no more than 3 to 4 feet on either side of the operator. The sprayed area should have a small amount of overlap to ensure coverage. There can be a time when overlap may be beneficial. If good spray coverage is questionable such as when using hose end sprayers, cut the application rate in half and apply the pesticide first in an east-west pattern, then in a north-south direction. This gives better coverage with devices typically poor in their metering capabilities.

When the mixture on the label is in teaspoons or tablespoons per gallon and the plants are upright such as shade trees, fruit trees, shrubs, and vegetables, spray the leaves until pesticide solution drips from the leaves. Don’t forget to spray the underside of leaves for good coverage.

Spray Pattern with a Single Application (A) and a Double Application (B)

Proper Application

When applying pesticides, wear the protective clothing and equipment the label recommends. To prevent spillage of chemicals, always check application equipment for leaking hoses or connections and plugged, worn, or dripping nozzles before adding pesticide. Before spraying, clear all people, pets, and livestock from the area. To minimize drift, apply pesticides only on days with no breezes. If moderate winds come up while you are working, stop immediately. Reduce drift by spraying at a low pressure and using a large nozzle opening. Generally, the safest time of day to spray to reduce the hazard of drift is early morning.

Vaporization is the evaporation of an active ingredient during or after application. Pesticide vapors can cause injury. High temperatures increase vaporization. Choose pesticide formulations that do not evaporate easily, and spray during the cool part of the day to reduce vaporization. Some products, like 2,4-D, are very volatile and can move for miles under favorable conditions. They should not be used near highly sensitive plants like grapes and tomatoes. Do not apply when it is windy nor when temperatures following application will reach above 85 degrees F.

Cleaning Equipment

Thoroughly clean all equipment immediately after use. Pesticides should not be stored mixed. If you have excess pesticide mixed which cannot be used, spray it over an area that it will not harm. Check the pesticide label to determine safe areas. Thoroughly clean all spray equipment inside and out with clean water. Don’t forget to flush the hoses and nozzles. Be careful that the cleaning water does not damage crops. Do not dump the rinse water in one place where it will be concentrated and may become a pollutant. Spray the rinse water over a broad area so that the pesticide will be further diluted. NEVER RINSE PESTICIDES DOWN THE DRAIN!
To clean 2,4-D type herbicides from hand spray equipment such as a 3-gallon garden sprayer, use household ammonia. Thoroughly rinse the equipment with fresh water after spraying. Fill the spray equipment with an ammonia solution, using ½ cup of ammonia to 3 gallons of water. Let the equipment soak for 18 to 24 hours. Always spray part of this mixture through the pump, hose, and nozzles at the beginning and end of the soaking period. NOTE: 2,4-D cannot be completely removed from a sprayer once used in it. **DO NOT USE THIS SPRAYER TO APPLY OTHER PESTICIDES TO DESIRABLE PLANTS.**

Storage and Disposal

Gardeners should store all pesticides in their original containers, in a locked cabinet. **NO EXCEPTIONS IF YOU ARE CONCERNED ABOUT CHILDREN’S LIVES!** They should be protected from temperature extremes, some can be damaged upon freezing, others can be altered by heat. Do not store pesticides in the home! Empty containers must be triple rinsed before being placed in refuse cans destined for a sanitary landfill. Wrap containers in newspaper and secure before disposal. Some states have special chemical dumps for pesticides; however, N.H. does not have such dump sites. The bottle should be rinsed out first, pouring the rinse water into the spray tank. Rinse three times, allowing 30 seconds to drain between each rinse. Never use empty pesticide containers for other uses, never allow children to play with empty containers. If possible, break the containers before disposal. Do not burn paper containers.

Using Pesticides Safely

Protective Clothing

If special protective clothing is required, the label will tell you the kind of protection to use. Pesticides sold in the home garden trade generally do not require special protective clothing. Many professionally used and highly toxic chemicals do. Anytime you handle pesticides, you should wear a long-sleeved shirt and long-legged trousers (or a cover-all-type garment) and shoes. Additional protection is available by wearing unlined neoprene or rubber gloves, a wide-brimmed plastic hard hat that covers the back of the neck, and goggles or face shield to protect the eyes. Rubber gloves and goggles are particularly important when mixing or pouring pesticides. Toxic commercial pesticides may also require neoprene boots, chemical cartridge respirators, face masks, neoprene suit, or even gas masks. These more toxic chemicals should not be used in a home garden setting. After using any pesticide, wash your hands and arms thoroughly with soap and water. Never eat, drink, or smoke before washing your hands. If you have been doing a lot of spraying or dusting, remove your clothes, take a shower, and put on clean clothes. Clothing should be laundered separately from the family wash. The washer should be run empty with detergent after cleaning pesticide-contaminated clothing. If you get sprayed, change and shower immediately. Use first aid procedures if necessary.

Safety Precautions

Most pesticides can cause severe illness, or even death, if misused. But every registered pesticide can be used safely. Many accidental pesticide deaths are caused by eating or drinking the product, particularly by young children. Some applicators die or are injured when they breathe a pesticide vapor or get a pesticide on their skin. Pesticides can poison you in two ways. Acute poisoning, or toxicity measured by an LD50 number, can kill or injure you after one exposure. Chronic toxins, on the other hand, will not produce an effect until there have been a sufficient number of exposures. However, the number of exposures necessary to produce an effect varies with the kind of pesticide and the health and size of the person exposed. LD50 is not a measure for chronic toxicity. If an applicator uses organophosphate (diazinon, malathion) or carbamate (carbaryl, furadan) insecticides with any regularity, it would be wise to ask a physician about a test to check the cholinesterase level of the blood. These pesticides destroy this enzyme, which is necessary to carry nerve impulses to the brain. Although chronic toxicity is not poisonous immediately, over the long run it can be serious. Always use safety precautions and treat all pesticides with respect. To prevent accidents with pesticides, use and store pesticides away from children, keep pesticides in their original containers, and take care to always follow label directions.
Symptoms of Pesticide Poisoning
Awareness of the early symptoms and signs of pesticide poisoning is important. Unfortunately, all pesticide poisoning symptoms are not the same. Each chemical family (organophosphates, carbamates, chlorinated hydrocarbons, etc.) attacks the human body in a different way. Fumigants and solvents can make a person appear to be drunk. The symptoms are poor coordination, slurring of words, confusion, and sleepiness. Common pesticides like organophosphates and carbamates injure the nervous system. The symptoms develop in stages, usually occurring in this order:

Mild Poisoning or Early Symptoms of Acute Poisoning: Fatigue, headache, dizziness, blurred vision, excessive sweating and salivation, nausea and vomiting, stomach cramps or diarrhea.

Moderate Poisoning or Early Symptoms of Acute Poisoning: Unable to walk, weakness, chest discomfort, muscle twitches, constriction of pupil of the eye, earlier symptoms become more severe.

Severe or Acute Poisoning: Unconsciousness, severe constriction of pupil of the eye, muscle twitches, convulsions, secretions from mouth and nose, breathing difficulty, death if not treated. Illness may occur a few hours after exposure. If symptoms start more than 12 hours after exposure to a pesticide, you probably have some other illness. Check with your physician to be sure.

First Aid Procedures
Read the “Statement of Practical Treatment” on each label. The directions listed can save lives. If a pesticide gets on the skin, remove the substance as quickly as possible. Remove all contaminated clothing. Prompt washing may prevent sickness even when the spill is very large. Detergents work better than soap in removing pesticides. Don’t forget the hair and fingernails. If a pesticide is inhaled, get to fresh air right away. Loosen all tight-fitting clothing. If needed, give artificial respiration immediately -- do not stop until victim is breathing well or medical help arrives. Get the victim to a physician. Do not administer anything to a poison victim unless you are trained in first aid, otherwise you may compound the injury.

In case of poisoning, call a physician and give the following information: describe the victim by name, age, and sex, and identify yourself and your relationship to the victim. Have the package or poison in your hand and identify what the victim took and how much was taken. Keep calm -- you have enough time to act -- but don’t delay unnecessarily. Poisoning information is available by contacting your local poison control center.

Pesticides and the Environment
Direct Kill
Fine mists of herbicides can drift to nearby crops or landscape plants and kill them. Bees and other pollinators can be killed if a crop is treated with a pesticide when they are in the field. The natural enemies of pest insects can also be killed by pesticides. Life in streams or ponds can be wiped out by accidental spraying of ditches and waterways, runoff from sprayed fields, and careless container disposal. If more than one pesticide will control the pest, choose the one that is the least hazardous to the environment and most useful for the situation. To protect beneficial insects, avoid excessive use of insecticides -- spray only when crop and pest populations require.

Protecting Insect Pollinators
Gardeners should give special consideration to protecting insect pollinators, such as the honey bee, from insecticide poisoning. Insecticides highly toxic to bees have restricted application times when being applied to crops frequented by honey bees. Bees are not active in late evening and early morning. Do not apply insecticides when temperatures are unusually low because residues will remain toxic much longer.

Persistence and Accumulation
Although most pesticides break down quickly, remaining in the environment only a short time before being changed into harmless products, some pesticides break down slowly and stay in the environment for a long time. These are called persistent pesticides. Some persistent pesticides can build up in the bodies of animals, including man. These pesticides are called accumulative. Most persistent pesticides have very limited usage or have been removed from the market. For example, chlordane is a persistent pesticide and its use was limited to termite and fire ant control but it is now off the market.
Pesticides Move in the Environment

Pesticides become problems when they move off target. This may mean drifting off the target if in the form of dust or mist, moving with soil particles by erosion, leaching through the soil, being carried out as residues on crops or livestock, or evaporating and moving with air currents.

Safe Use Precautions

Following safety precautions and using common sense can prevent harm from pesticides. Here are the minimum safety steps you should take.

- Before buying a pesticide, identify the pest to be controlled. Then find out which pesticide will control it. If there is a choice of several, choose the least hazardous product.
- Before purchase, read the label of the pesticide you intend to buy to ensure that the host plant (and pest) are listed on the pesticide label and that the pesticide is not phytotoxic to the plant being protected. Also check safety conditions for use, such as special equipment, protective clothing, restrictions on use, and environmental precautions needed.
- Before applying the pesticide, read the label again be sure of proper application and safety measures, including protective clothing and equipment needed, the specific warning and precautions, with what it can be mixed, mixing instructions, application to harvest period for fruit and vegetables, crops to which it can or cannot be applied, and other special instructions.

Compatibility

Compatibility occurs when two or more pesticides can be mixed together without reducing their effectiveness or harming the target. For instance, carbaryl (Sevin) is often combined with a miticide such as Kelthane in order to kill both insects and mites at one time. 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 nontarget organism. A synergistic effect can also be undesirable, causing death or damage to the organism that is being protected. It should be stressed that no chemicals should be mixed together unless the label specifically says they are compatible.

Resistance concerns over insects developing immunity can often be reduced by switching to a different type (chemical group) of pesticides.

Home Garden Versus Commercial Pesticides

Some pesticides are packaged specifically for home garden use. These products are packaged in small quantities, i.e., pints, quarts, ounces, or pounds. They are seldom highly toxic pesticides and are usually in low concentrations. The label rate is given in spoonfuls per gallon or pounds per 1000 square feet.

Because of the small label size, home garden products may not list all of the plants and/or pests for which the product may be registered for use. For example, one manufacturer sells Diazinon 25% EC as Fruit and Vegetable Insect Control and Diazinon Insect Spray. Both are basically the same product, but plants and pests listed vary greatly. This situation causes some confusion in pesticide application and stimulates the purchase of excessive amounts of pesticides.

Products packaged for the commercial grower may appear to be less expensive, but consumers should not be tempted to use them. They are generally more toxic than those for home use and require special protective clothing and equipment for application. These products are more concentrated and in larger containers than the consumer could expect to use or safely store, and are much more difficult to calibrate and mix correctly, since rates are usually based on a per-acre system.

A few products extremely toxic to humans or the environment are classified by the E.P.A. as RESTRICTED USE PESTICIDES. The label will state “restricted use pesticides for retail sale to and application only by certified applicators, or person under their direct supervision.” A license from the State Department of Agriculture is required by law for purchase and use of restricted use pesticides. Restricted pesticides cannot be sold to home gardeners.
Pesticides and Organic Gardening

Although it is questionable whether we could raise all crops without the use of pesticides, it is certainly true that we can reduce the amount of pesticides we use by careful and efficient use. There are some steps to consider before automatically turning to a pesticide. First, determine if control measures are really needed. Is the problem severe enough to warrant treatment? If the cost of treatment is less than the predicted loss, the economic threshold has been reached, and treatment is necessary. Consider alternative control measures. Some examples are cultivating instead of using an herbicide, and removing and destroying diseased plant parts rather than using a pesticide.

The next step is integrated control. This is probably the best answer to pest control. In this situation, the wise use of pesticides is combined with alternative methods, such as conservation practices, to encourage natural enemies of the pest. For example, a simple integrated control program could be used on a garden. Some pests can be picked off by hand. A biological, Bacillus thuringiensis, can be used for caterpillars. Chemicals can be used to spot treat the worse areas showing some damage.

Pesticides and the Law

The registration and use of pesticides are governed by the E.P.A. and the NH Department of Agriculture. Under the amended Federal Insecticide, Fungicide, and Rodenticide Act (Federal Environmental Control Act of 1972) it is illegal to use a pesticide on a crop unless the crop is listed on the label. You may not exceed the given rate of application on the label. Fines and other penalties change and vary according to laws broken.

Under the law you are liable for misuse of pesticides on your property. Recent court rulings extend your liability to include misuse by commercial applicators you hire. Serious misuse by gardeners usually results from drift, leaching of a pesticide onto non-target plants, or the direct treatment of the plant by a wrong pesticide. If you sell your crop, you must have a pesticide license. For more details call the N. H. Pesticide Control Division at 271-3550.

Pesticide Conversion Chart

The measurements given below are approximate and should be used as a general guideline if the directions for mixing small quantities are not given on the pesticide label.

**Liquid Measure:**

<table>
<thead>
<tr>
<th>Amount per 100 gallons</th>
<th>Amount per gallon</th>
</tr>
</thead>
<tbody>
<tr>
<td>¼ pint</td>
<td>¼ teaspoon</td>
</tr>
<tr>
<td>1 pint</td>
<td>1 teaspoon</td>
</tr>
<tr>
<td>1 quart</td>
<td>2 teaspoons</td>
</tr>
<tr>
<td>1 gallon</td>
<td>2½ tablespoons</td>
</tr>
<tr>
<td>2 gallons</td>
<td>5 tablespoons</td>
</tr>
<tr>
<td>4 gallons</td>
<td>1/3 pint</td>
</tr>
<tr>
<td>11 gallons</td>
<td>7/8 pint</td>
</tr>
</tbody>
</table>

**Dry Weight:**

<table>
<thead>
<tr>
<th>Amount per 100 gallons</th>
<th>Amount per gallon</th>
</tr>
</thead>
<tbody>
<tr>
<td>½ pound</td>
<td>1/12 ounce</td>
</tr>
<tr>
<td>1 pound</td>
<td>1/6 ounce</td>
</tr>
<tr>
<td>2 pounds</td>
<td>1/3 ounce</td>
</tr>
<tr>
<td>3 pounds</td>
<td>1/2 ounce</td>
</tr>
<tr>
<td>4 pounds</td>
<td>2/3 ounce</td>
</tr>
<tr>
<td>6 pounds</td>
<td>4/5 ounce</td>
</tr>
<tr>
<td>16 pounds</td>
<td>2 3/5 ounce</td>
</tr>
<tr>
<td>20 pounds</td>
<td>3 1/5 ounce</td>
</tr>
</tbody>
</table>