I. Three Main Objectives of Pest Control 2

II. Home, Yard, and Garden Pesticides 2

III. Pest Control Methods 2

IV. Herbicides 2

V. Insecticides 3

VI. Fungicides 4

VII. Pesticide Labels 4

VIII. Pesticide Categories 4

IX. Pesticide Formulations 4

X. Pesticide Hazards 5
   A. Pesticide Toxicity 5
   B. Pesticide Formulation 6
   C. Exposure to Pesticides 6
   D. Pesticide Poisoning 6
   E. Pesticide Spills 7
   F. Pesticide Storage 7
   G. Pesticide Disposal Options 7

XI. Pesticide Law 7

XII. Pesticide Recommendations 8

Further Reading 8
I. Three Main Objectives of Pest Control
   A. Prevention—Keep a pest from becoming a problem.
   B. Suppression—Reduce pest numbers or damage to an acceptable level.
   C. Eradication—Destroy an entire pest population.

II. Home, Yard, and Garden Pesticides
   Pesticides are used to prevent or reduce damage caused by weeds, diseases, insects, mollusk, or vertebrates. **Before** you use a pesticide you should:
   A. Identify the pest. Remember various pests cause similar symptoms; environmental conditions may cause similar symptoms to pests. **Be a detective.** Ask questions to focus in on the most likely possibilities.
   B. Know what other control measures are available (mechanical, chemical, and biological).
   C. Evaluate the benefits and risks of each method of control.
   D. Choose the methods that are most effective and that will cause the least harm to people and to the environment.
   E. Use the methods correctly.
   F. Observe local, state, and federal regulations that apply to the situation.
   G. Observe precautions, restrictions, and preharvest intervals noted on the label.

III. Pest Control Methods
   A. Many factors influence or affect pest control.
      1. Climate.
      2. Natural enemies.
      3. Topography.
   4. Food and water.
   5. Water supply.
   6. Host resistance.
   7. Cultural control by mechanical sanitation or crop rotation.
   8. Chemical control.

B. The term “pesticide” refers to any substance that is used to control organisms considered to be pests. The following are some of the classes of pesticides available to homeowners:
   1. Herbicides—Vegetation control.
   2. Insecticides—Insect control.
   3. Fungicides—Fungus control.
   4. Rodenticides—Rodent control.
   5. Acaricides—Mite control.
   7. Molluscicides—Snail and slug control.
   8. Repellents—Birds, mammals, and insect control.
   10. Disinfectants—Bacteria and fungi control.

IV. Herbicides
   A. Plant life cycle dictates which chemical to use and when to use it.
      1. Annual—1-year life cycle.
         a. Winter annuals: Examples are annual bluegrass, henbit, cheatgrass.
         b. Summer annuals: Examples are crabgrass, pigweed, lambsquarters.
3. Perennials: Live more than 2 years. Example: Canada thistle.

B. Types of Herbicides
1. Selective—Specific to certain weeds or groups of weeds.
2. Nonselective—Kills all vegetation.

C. How Do Herbicides Kill?
1. To be effective an herbicide must reach and stick to the leaf, penetrate the surface, move to the site of action, and disrupt a vital process.
   a. Only 1 percent of the herbicide reaches the plant surface.
   b. Surfactants help an herbicide stick to the leaf and penetrate the surface.
   c. Herbicide movement depends on plant age and life cycle and on the mobility of the herbicide.
   d. Many herbicides are taken up by the roots. Example: triazines.
   e. Other herbicides are “pre-emergent.” They kill the emerging seedling. To be effective, these herbicides must form a barrier against emerging plants. They will not work if that barrier is disturbed. They will not hurt plants already out of the ground.

2. Nutrient/water movement at various stages of plant growth: In young plants movement is from the roots upward; in older plants movement is from the roots upward and from the leaves downward. In most mature plants, the movement is downward.

3. Types of chemicals.
   a. Immobile.
   b. Xylem mobile.
   c. Phloem mobile.
   d. Ambimobile (xylem and phloem mobile).

V. Insecticides
A. Classes
1. Organophosphates.
2. Chlorinated hydrocarbons.
3. Carbamates.
4. Botanicals.
B. How do insecticides work?
1. Organophosphates—Affect nervous system.
2. Chlorinated hydrocarbons—Affect nervous system.
   a. Are not broken down rapidly in animals, so are stored in fatty tissues.
   b. Are more persistent in plants and soils than other groups of pesticides. Some remain for several years in the soil and for weeks or months in plants. They are not readily attacked by enzymes in plants or microorganisms in the soil.
3. Carbamates—Affect nervous system.
   a. Some carbamates are systemics.
   b. They are rapidly detoxified and eliminated from the animal’s system. Carbamates are not known to accumulate in fat.
   c. Persistence varies in soils and plants, from a few hours to several weeks.
4. Botanicals—Derived from plants. Examples: pyrethrum, nicotine (highly toxic), and rotenone (will kill fish). Use same handling and safety precautions for these as you would for any pesticide (see Section X, “Pesticide Hazards,” on page 8-5 and Section XI, “Pesticide Law,” on page 8-8).
5. The timing of insecticide application depends on the life cycle stage of the insect you are trying to control and on what kind of insecticide you use (systemic or contact).
a. Example: Aphids feeding on a maple tree. A contact chemical (labeled for aphids on maple) applied directly to the aphids will kill any aphids not in the egg stage.
b. If a systemic is used, the sap in the tree must be moving to the leaves where the aphids are feeding in order to kill them. Example: A systemic would not kill the adult stage of the leaf skeletonizer because the adult does not feed on the tree. The larval stage does.

Note: You must know the insect life cycle, the plant life cycle, and the “mode of action” of the insecticide you are using to accomplish the most effective and safe control.

VI. Fungicides
A. Ingredients—Sulfur, captan, triforine, Daconil 2787.
B. How do they work? By suppression or smothering?

VII. Pesticide Labels
A. All home, yard, and garden pesticides are made up of materials from one of two categories:
   1. Active ingredient(s)—This component consists of the ingredient that will prevent, destroy, repel, or mitigate any pest.
   2. Inert ingredients—This component consists of a wide variety of materials that do not have any biological effect upon the pest. Some common inert ingredients are petroleum distillates, emulsifying agents (detergent-like materials), spreaders, stickers, clay particles, and even water.
B. Pesticide labels are required by law to provide the buyer with a list of active ingredients in a product, and a description of the percentages of the total that those active ingredients make up.
C. Pesticide labels must also state the pest that the product will control and at what rate the product should be applied for safe control of that pest on that plant.
D. Pesticide labels must also give information about storage, disposal, precautions during use, symptoms of poisoning, physical hazards, environmental hazards, preharvest intervals, signal words (caution, warning, danger), and first-aid information. These items will be discussed later in this chapter.

VIII. Pesticide Categories
All pesticides are classified as either “general use” or “restricted use.”
A. General Use Pesticides—Considered minimally hazardous when used according to label directions. All home, yard, and garden pesticides are general use.
B. Restricted Use Pesticides—Deemed excessively hazardous to the environment or to the applicator.
   1. In Idaho, restricted use pesticides may only be used by those people who have been trained and tested by Idaho Department of Agriculture personnel. These people must show a valid applicator’s license to a chemical dealer before purchase of this category of pesticides.
   2. Application of restricted use pesticides by unlicensed personnel is a violation of Idaho law.
   3. Application of restricted use pesticides in or around the home is risky business, given the high toxicity or wide range of action these chemicals have.

IX. Pesticide Formulations
Pesticide formulations are classified according to the composition of active and inert ingredients and the intended use.
A. Pesticide formulations requiring no dilution in water. These products include:
   1. Dusts—Active ingredient combined with inert materials such as fine clay particles, talc, etc.
   2. Granules—Active ingredient combined with inert materials such as coarse clay particles, marble chips, or corn cob grit.
   3. Baits—Active ingredient combined with an attractant such as food or scent.
   4. Pest strips—Active ingredient impregnated in a plastic strip that slowly releases pesticide into the atmosphere.
   5. Aerosols—Active ingredient combined with petroleum distillates and propellant gas in a pressurized can.
6. Ready-to-use liquids—Active ingredient already diluted with water at the proper use rate.

B. Pesticides requiring dilution in water. These products include:
1. Emulsifiable concentrates (EC)—Water-insoluble active ingredient, usually in petroleum distillate with emulsifiers. When the distillate is combined with water, it forms an emulsion. Agitation is needed to provide an even distribution of the chemical in water. Emulsifiable concentrates are the most dangerous formulations to handle.
2. Wettable powders (WP)—Water-insoluble active ingredient sprayed on very fine solid particles, usually clay or talc. Add wetters and other adjuvants to aid in the dispersion and suspension of the particles in water. The powders need agitation to mix.
3. Water-soluble liquids (WS)—Active ingredient is dissolved in a concentrate containing alcohol or water. The mix forms a true solution and needs little or no agitation after mixing thoroughly.
4. Dry flowable (DF)—The active ingredient is packaged in granular form. The chemical may or may not be water soluble. DF’s are as easy to measure as a liquid and are less likely to contaminate body, clothing, or work area and to be inhaled than either WPs or dusts.

X. Pesticide Hazards
The degree of hazard associated with pesticide use is determined by various factors. The primary concern, however, must be the hazard to the health and welfare of humans. The major factors that determine the hazard of a pesticide to humans, other mammals, and other animals include the following:

A. Pesticide Toxicity (The degree to which a chemical tends to be poisonous)
1. The toxicity of any substance is expressed in terms of dosage.
   a. Hazardous doses vary with such factors as age, sex, health, and body weight.
   b. Dosages are normally expressed in milligrams (mg) of toxicant per kilogram (kg) of body weight (1 kg = 2.2 lb; 1 mg = one millionth of a kg).
2. The toxicity of a pesticide is determined by subjecting test animals (usually mice or rats) to the pure active ingredient.
   a. A common measure of the estimated toxicity of a pesticide is the dose required to kill half the animals treated with a pesticide. This dose is termed to be the $LD_{50}$ (lethal dose to kill 50 percent).
   b. An $LD_{50}$ is always expressed as mg/kg or g/kg. An $LD_{50}$ of 3 mg/kg means that a dose of 3 mg of pure toxicant per kg of animal body weight will normally be lethal to half of the test animals.
3. Pesticide classifications based upon $LD_{50}$ ratings are listed in Table 1. Almost all home, yard, and garden pesticides are category III or IV chemicals. Nicotine has an $LD_{50}$ of 50 to 60 mg/kg so is a class II chemical. Pyrethrum’s $LD_{50}$ rating is 1,500 mg/kg.

B. Pesticide Formulations
1. As previously described, almost all pesticides are marketed in formulations that contain considerably less than 100 percent of the active ingredient. The hazard, therefore, of even a category I chemical in a typical home, yard, or garden formulation would be small.

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Table 1. Pesticide classifications based upon $LD_{50}$

<table>
<thead>
<tr>
<th>Toxicity category</th>
<th>Signal word</th>
<th>Toxicity</th>
<th>Oral $LD_{50}$ (mg/kg)</th>
<th>Amount needed to kill an adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>DANGER POISON (fatal)</td>
<td>Very high</td>
<td>50 or less</td>
<td>A taste to a teaspoon</td>
</tr>
<tr>
<td>II</td>
<td>WARNING (may be fatal)</td>
<td>High</td>
<td>51 to 500</td>
<td>A teaspoon to a tablespoon</td>
</tr>
<tr>
<td>III</td>
<td>CAUTION</td>
<td>Moderate</td>
<td>501 to 5,000</td>
<td>An ounce to a pint</td>
</tr>
<tr>
<td>IV</td>
<td>CAUTION</td>
<td>Low</td>
<td>Greater than 5,000</td>
<td>A pint to a quart or more</td>
</tr>
</tbody>
</table>
2. Some formulations pose a lower hazard than others, simply because of their physical state. For example, a granular pesticide will normally pose a lower hazard than an emulsifiable concentrate because it is more difficult to ingest or absorb through the skin.

C. Exposure to Pesticides

1. Pesticides can enter the body through one of three methods:
   a. Through the digestive tract (ingestion).
   b. Through the respiratory system (inhalation).
   c. Through the skin (dermal absorption).

2. The hazard of unnecessary exposure to a pesticide can be reduced by following these guidelines:
   a. Replace leaky hoses, valves, and connections on sprayer before application. Never use your mouth to blow out clogged lines or nozzles.
   b. Calibrate and clean application equipment to ensure accurate and safe application.
   c. Always read the entire label before using a pesticide.
   d. Pesticide handling and mixing should be done outside. Watch out for wind when mixing or applying pesticides. Avoid breathing dust, and watch out for the splash of liquids or the drift of fumes.
   e. Refrain from smoking, eating, or drinking while working with pesticides.
   f. Wear clothing that covers the entire body, including a nonabsorbent hat.
   g. Wear unlined rubber gloves and eye protection whenever mixing pesticides.

D. Pesticide Poisoning

1. People vary considerably in their susceptibility and reactions to pesticides. Children are particularly susceptible because of their small size and weight. A dose that might make an adult sick could be fatal for a child. In addition, a child’s body is often less able than an adult’s to detoxify some compounds.

2. The common symptoms of pesticide poisoning are headaches, giddiness, nausea, blurred vision, and chest pains. Anyone complaining of these symptoms within 12 hours after exposure to a pesticide should be sent to the nearest medical facility.

3. Emergency first-aid procedures for pesticide poisoning:
   a. Pesticide in the eyes: Flush eyes with a gentle stream of tap water for at least 15 minutes.
   b. Pesticide in the mouth: Flush mouth out with tap water for 15 minutes.
   c. Pesticide spilled on clothing: Remove clothing; wash skin with soap and water.
d. Pesticide swallowed: Read and follow the first-aid directions on the label. If there are no directions, go directly to the nearest medical facility.

**Note:** Drinking water or milk will rarely increase the problem and may reduce the potential damage by diluting the chemical.

### E. Pesticide Spills

1. **Liquids.**
   a. The spill should be covered with any substance that will absorb the pesticide (kitty litter, sawdust, sand, dirt, or even disposable diapers).
   b. After the pesticide has been absorbed, the material should be swept up and placed in a plastic garbage bag within another garbage bag. If the pesticide is a home, lawn, or garden formulation, the bag may be disposed of via your standard garbage collection service.
   c. The spill area should then be washed with detergent or an ammonia solution. Call Chem Trec toll free at 1-800-424-9300 to find out what to use. Using the wrong solution could generate toxic gases. Prevent any contaminated soil from running into storm drains or open bodies of water.

2. Dry pesticides should be swept up and used or disposed of in accordance with the label instructions. The spill area may also require washing with detergent or a chlorine or ammonia solution.

### F. Pesticide Storage

1. Store pesticides in a cool, well-ventilated place that is inaccessible to children and pets. The area should be away from food, feed, and seeds, and should be locked.

2. Store pesticides in their original containers. Never store pesticides in soft drink bottles or other containers that may be confused with foodstuffs. Always maintain a label on the container.

**Note:** It is illegal to store chemicals in anything other than their original containers.

### G. Pesticide Disposal Options

1. The best way to dispose of excess pesticides is to use them up in accordance with label directions. Buy small quantities—only the amount you can use up in one season.

2. Neutralize the pesticide if there are directions on the label for doing so.

3. Do not dump pesticides into a public sewage system via the sink or the toilet. Do not dump them into a street gutter that drains into open water. Sprayers should also not be drained near a well, pond, irrigation ditch, or stream.

4. Do not discard pesticide or containers where soil, crops, water, or animals can become contaminated.

5. Before disposing of a pesticide container, triple rinse it. The pesticide contaminated water (rinsate) should be used in your sprayer. Never dump rinsate onto the ground, into a drain, or into a gutter.

6. Puncture or crush empty metal containers (except aerosol cans), and bury them in an approved landfill. Do not burn.

7. Empty and triple rinsed containers may be wrapped in newspaper and disposed of via your local garbage collection service. Rinsate should be used for diluting more pesticide, if possible.

8. Anyone wanting to dispose of unused pesticides should contact their local health department for proper disposal instructions.

### XI. Pesticide Law

The primary law homeowners should be aware of regarding safe use of pesticides is the Fed-
eral Insecticide, Fungicide, and Rodenticide Act (FIFRA).

A. This law regulates all pesticides from the time of their manufacture until their ultimate degradation.

B. The most important part of this law, as it pertains to homeowners, involves the actual use of any pesticide. **FIFRA states, “any use of a pesticide in a manner inconsistent with label instructions is a violation of this Act.”**

C. All pesticide users should be aware that they are subject to the provision of FIFRA.

**XII. Pesticide Recommendations**

Before recommending the use of any pesticide, consider the following:

A. It is illegal to use a pesticide on any site or crop other than those listed on the pesticide label. It also is illegal to recommend a pesticide on a site or crop other than those listed on the pesticide label.

Example: A client asks if it is all right to eat a vegetable that was sprayed with a particular insecticide. You find that the pesticide in question is not labeled for use on this garden product. You tell your client that you cannot recommend eating that vegetable, even though you may feel that the hazard is minimal.

B. **In your capacity as a Master Gardener, your pesticide recommendations must be made in accordance with the pesticide guidelines provided on the pesticide label.** Extension publications and the Pacific Northwest pest control guides are based on pesticide labels.

C. Your pesticide recommendations must be limited to home, yard, and garden pest control. Pesticide recommendations for agricultural or commercial pest problems may be made only by licensed consultants.

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**Further Reading**

<table>
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<tr>
<th>Books, Booklets, and Pamphlets</th>
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<tbody>
<tr>
<td><strong>University of Idaho Extension</strong></td>
</tr>
<tr>
<td>Pacific Northwest Insect Management Handbook</td>
</tr>
<tr>
<td>Pacific Northwest Plant Disease Management Handbook</td>
</tr>
<tr>
<td>Pacific Northwest Weed Management Handbook</td>
</tr>
<tr>
<td>PNW 320 Calibrating and Using a Backyard Sprayer</td>
</tr>
<tr>
<td>PNW 512 Farm Safety Series (English)</td>
</tr>
<tr>
<td>PNW 512S Farm Safety Series (Spanish)</td>
</tr>
<tr>
<td>PNW 278 First Aid for Pesticide Poisoning</td>
</tr>
<tr>
<td>CIS 781 Laundering Pesticide-Contaminated Clothing and Safety Equipment</td>
</tr>
<tr>
<td>CIS 1019 Pesticides for the Home Garden and How to Use Them</td>
</tr>
<tr>
<td>CIS 861 Pesticides in Idaho Groundwater: Monitoring, Protection, and Prevention</td>
</tr>
<tr>
<td>CIS 865 Pesticides and Their Movement in Soil and Water</td>
</tr>
<tr>
<td>CIS 1030 Storing and Disposing of Home and Garden Pesticides</td>
</tr>
</tbody>
</table>

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