

natural insecticides, their effectiveness is reduced by heat, sun, and dry conditions. Microbial products that control disease are also available. These organisms are living and include beneficial fungi and bacteria. Examples of these organisms are the fungus *Trichoderma harzianum* and the bacterium *Bacillus subtilis*.

All natural products must be used according to the label on the container. They are most effective when used in an integrated pest management (IPM) program that includes sanitation, proper cultural or maintenance practices, mechanical controls, use of resistant plant varieties, and biological control.

Pesticides

Pesticides may be required to control pests when they reach damaging levels on ornamental plants. A pesticide is any material (natural, organic, or synthetic) used to control, prevent, kill, suppress, or repel pests (Figure 7-19). Pesticide is a broad term that includes ***insecticides*** (for insect control), ***herbicides*** (for weed control), ***fungicides*** (for control of fungus), ***rodenticides*** (for rodent control), ***growth regulators*** (to inhibit growth and development of insects or plants), and other materials like ***miticides*** (for mite control), or products that kill snails and slugs (***molluscicides***).



Figure 7-19. Commercial pesticide products.

Many pesticides kill pest organisms outright; others control pests by repelling them or by inhibiting reproduction or normal development. Most synthetic pesticides are formulated to affect specific pests or pest groups, rather than a broad range of pests. This characteristic allows landscape and nursery managers to control target pests without destroying beneficial insects.

Pesticides are designed to kill by direct contact with the organism, act as stomach poisons when ingested, or to provide barriers on plant surfaces against initial infestations. Some move into and through plant tissues (systemics); others exert a fumigating or vapor action under certain conditions.

Products should be selected that will effectively control the pest without injuring the plant, resulting in another pest outbreak, or killing beneficials and other nontarget organisms. Soil types must also be considered when applying pesticides, as sandy Florida soils can leach chemicals into groundwater more easily than denser soils like clay. Finally, state and federal laws exist that require training and certification for anyone handling pesticides. More information about these laws and licenses can be found in the *Business Practices* chapter.



Figure 7-20. Sample pesticide label illustrating basic sections.

Pesticide Labels

Chemical pesticides are very useful for the horticulture and landscape industries. However, they must be applied according to federal and state regulations. Pesticide product labels (Figure 7-20) provide critical information about how to safely and legally handle and use pesticide products. Unlike most other types of product labels, pesticide labels are legally enforceable, and all of them carry the statement: "It is a violation of Federal law to use this product in a manner inconsistent with its labeling." In other words, the label is the law.

The label provides directions, requirements, and restrictions for the safe use of a pesticide product, along with ways to minimize environmental risks and the buildup of resistance. Read the label (Figure 7-21) before buying the pesticide. Follow the label each time you mix and use the pesticide, and follow the label when storing or disposing of the pesticide. Remember, *use of any pesticide in any way that does not comply with label directions and precautions is illegal*. It may also be ineffective for pests if used incorrectly and, even worse, pose risks to users or the environment.



photo by nw district, university of florida, ifas

Figure 7-21. Read the label when selecting, mixing, applying, storing and disposing any pesticide.

A pesticide label must include the following information (as numbered in Figure 7-22):

- 1) **Use classification statement** (if applicable). Restricted use pesticides (RUPs) have the potential to cause unreasonable adverse effects on the environment and injury to applicators or bystanders without added restrictions. The phrase "Restricted Use Pesticide" restricts a product, or its uses, to a certificated pesticide applicator or under the direct supervision of a certified applicator. This means a license is required to purchase and apply the product.
- 2) **Brand name (trade name)**. The brand or trade name is the name on the front panel of the label commonly used to identify the product, such as Roundup® or Sevin®. It is a proprietary name that is typically trademarked.
- 3) **Formulation**. The mixture of active and inert ingredients is called a pesticide formulation. This formulation may consist of the **active ingredient** that controls the target pest; the **carrier**, such as an organic solvent or mineral clay; **adjuvants**, such as stickers and spreaders; and other ingredients, such as stabilizers, safeners, dyes, and chemicals that improve or enhance pesticidal activity. A formulated product is usually mixed with water or oil for final application. However, some, such as granules or dusts, are ready for use without additional dilution. The formulation may be named, or the label may show an abbreviation, such as F for flowable, G for granule, or WDG for water dispersible granule. Common abbreviations and their interpretations are listed in the *Abbreviations for Pesticide Formulations* table that follows in Figure 7-23.
- 4) **Mode of action**. The mode of action classification number appears on the front panel of some pesticides. This provides pest management professionals with a guide to the selection of pesticides for use in resistance management strategies. Pesticides with the same classification number have similar modes of action because they are within the same chemical family.

- 5) **Ingredient statement.** Every pesticide label has an ingredient statement that provides the amount of active ingredients the manufacturer claims have effects on the targeted pests. **Active ingredients** are the chemicals in the pesticide that kill or control the target pest(s). This section provides the **chemical name** of each active ingredient, the percentage by weight of each active ingredient, and the percentage by weight of all inert ingredients. Because chemical names of active ingredients are usually complex, many may be given shorter, simpler **common names**. Knowing the chemical and common names, rather than the brand name alone, assures users of the ability to compare products and a certainty of choosing the right product for a given need.
- 6) **Other ingredients** (often called **inert ingredients**) are substances added to the active ingredients to formulate the

final usable product and improve the effectiveness or safety of a pesticide. Examples of inert ingredients include emulsifiers, solvents, carriers, aerosol propellants, fragrances and dyes.

- 7) **Net contents.** The pesticide label must show how much product is in the container. This is expressed as ounces or pounds for dry formulations and as gallons, quarts or pints for liquids.
- 8) **EPA registration number.** This number must appear on all pesticides, except those designated by EPA as minimum risk pesticides. The EPA registration number indicates the pesticide product has been registered and its label approved by EPA. This number indicates that EPA has reviewed the product and determined it can be used with minimal or low risk if the directions on the label are properly followed.

Restricted Use Designation 1 | RESTRICTED USE PESTICIDE
For retail sale to and use only by certified applicators, or persons under their direct supervision and only for those uses covered by the certified applicator's certification.

Trade Name 2 | **VAPORIZE WP**

Formulation 3 | GROUP 10 INSECTICIDE

Mode of Action 4 | GROUP 10 INSECTICIDE

Active ingredients 5 | ACTIVE INGREDIENT: By Wt.
Vaporin .. 12.0%

Other ingredients 6 | OTHER INGREDIENTS: 88.0%

Net Contents 7 | NET CONTENTS 5 lb

EPA Reg. No. 8 | EPA Reg. No. 123-4567 EPA Est. No. 123

Manufacturer 9 | AGRICULTURAL CHEMICAL COMPANY
1234 Industrial Drive
Logan, UT 84321

Signal Word 10 | CAUTION

Keep out of Reach of Children 11 | KEEP OUT OF REACH OF CHILDREN

First Aid 12 |

FIRST AID	
If swallowed:	Call a poison control center or doctor immediately for treatment advice. Do not induce vomiting unless told to do so by the poison control center or doctor.
If in eyes:	Hold eye open and rinse with water for 15-20 minutes.
If inhaled:	Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration.

13 Precautionary Statements

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
Harmful if swallowed. Avoid contact with skin and eyes.

PERSONAL PROTECTIVE EQUIPMENT (PPE)
All applicators and other handlers must wear:
• Long-sleeved shirt and long pants.
• Shoes plus socks
• Chemical resistant gloves

USER SAFETY RECOMMENDATIONS
Wash hands before eating, drinking, or chewing gum
Wash PPE separately from other laundry.

ENVIRONMENTAL HAZARDS
This product is toxic to aquatic invertebrates. Do not apply directly to water. Do not apply this product to blooming crops or weeds while bees are actively foraging.

PHYSICAL OR CHEMICAL HAZARDS
Combustible - Do not use or store near heat or open flame.

14 Directions for Use

DIRECTIONS FOR USE
It is a violation of Federal law to use this product in a manner inconsistent with its labeling

AGRICULTURAL USE REQUIREMENTS
Use this product only in accordance with its labeling and with the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 12 hours

15 Storage and Disposal

STORAGE AND DISPOSAL
Pesticide Storage
Do not store in or around home. Keep out of reach of children. Store in a cool, dry place.

Pesticide Disposal
Do not reuse or refill this container. Wastes resulting from the use of this product must be disposed of on site or at an approved waste disposal facility.

Figure 7-22. Pesticide label components. Numbers correspond with text explanations.

Abbreviations for Pesticide Formulations

Abbreviation	Interpretation	Abbreviation	Interpretation
A	Aerosol	P or PS	Pellets
B	Bait	S	Solution
D	Dust	SP	Soluble powder or soluble packet
DF	Dry flowable	ULV	Ultra low volume
E or EC	Emulsifiable concentrate	W or WP	Wettable powder
F	Flowable (liquid)	WDG	Water dispersible granules
G	Granules	WS	Water soluble
L	Liquid (flowable)	WSG	Water soluble granules
LC	Liquid concentrate or low concentrate	WSL	Water soluble liquid
M or ME	Microencapsulated	WSB or WSP	Water soluble bag, water soluble powder or water soluble packet

Adapted from *Pesticide Formulations*, Publication PI231, University of Florida IFAS Extension.

Figure 7-23. Listing of common pesticide formulation abbreviations found on labels.

- 9) **Manufacturer name and address.** The law requires the product manufacturer to include the company name and address. This allows the purchaser to know who made or sold the product in case specific questions about the product arise.
- 10) **Signal words and symbols.** Most pesticides must include a signal word (Figure 7-24). DANGER, WARNING, and CAUTION are the three signal words used on pesticide labels to indicate highly toxic, moderately toxic, and slightly toxic pesticides, respectively. This important designation gives the user an indication of the relative acute human toxicity. Knowledge of the product's hazard helps applicators choose proper protective measures for all who may be exposed. The signal word will be found in large letters on the front panel of the pesticide label. Pesticides with very low toxicity are no longer required to display a signal word, although many manufacturers still include a CAUTION signal word on the label of these products. More information on signal words and pesticide toxicity ratings is found in the *Safety* chapter of this text.
- 11) **Child hazard warning.** EPA requests pesticide manufacturers place "Keep Out of Reach of Children" on a separate line above the signal word on the label (Figure 7-25).
- 12) **Statement of practical treatment.** The label provides recommended first aid treatments in the event of accidental pesticide poisoning. These instructions include steps to take in case of contact with skin or eyes, if inhalation occurs or if the pesticide is swallowed. Remember, these recommendations are only first aid. ALWAYS call the emergency number listed on the label, a doctor, or the poison control center (1-800-222-1222), if someone is accidentally poisoned by the pesticide. The person may have to be taken to a hospital right away after first aid is given. Remember to take the pesticide label or safely secured container to ensure quick and correct treatment.



Figure 7-24. Common pesticide signal words and symbols.



Figure 7-25. Child hazard warning statement.

13) **Precautionary statements.** Labels contain statements intended to protect applicators, other persons or animals and the environment during pesticide use. Sometimes these statements are listed under the heading “Hazards to Humans and Domestic Animals” or may be included in other sections of the label. The statements are directly related to the toxicity of the pesticide product and the route or routes of entry that must be protected. They recommend specific action to prevent poisoning accidents. Additional information can be found on pesticide safety data sheets (SDS).

a) **Personal Protective Equipment (PPE).** The Worker Protection Standard requires that each label give information on the personal protective equipment (PPE) that applicators and other handlers must wear.

b) **Environmental hazards.** This section indicates if the product can cause environmental damage or if it is harmful to

wildlife, fish, pollinators, endangered plants or animals, or waterbodies such as ponds, lakes, rivers and wetlands.

c) **Physical and chemical hazards.** This section describes any special fire, explosion, or chemical hazards the product may pose.

14) **Directions for use.** The directions for use on a pesticide label describe how the product may legally be used and how the product must not be used. It is illegal to use a pesticide in any way not permitted by the labeling. A pesticide may be used only on the plants, animals, or sites named (Figure 7-26). Higher dosages, higher concentrations, or more frequent applications cannot be used. All directions for use must be followed, including directions concerning safety, mixing, diluting, storage, and disposal. *The use directions and instructions are NOT advice, they are requirements.* Make sure the product is labeled for use against the pest(s) needing control and in the location the pest(s) is found. For example, products



Figure 7-26. This pesticide is approved to control fungal diseases in turf. It cannot be used in locations not listed on the label.



Figure 7-27. Pesticide storage area. Pesticides are stored in original containers according to label directions.

labeled to control aphids in the landscape cannot be used to control aphids in the greenhouse. Products labeled to control mole crickets in turfgrass cannot be used to control whiteflies on ornamentals. The pest(s) and the site of application *must* be listed on the label. It is a violation of Federal law to use a product in any manner inconsistent with its labeling.

- 15) **Storage and disposal.** This section explains pesticide storage and how to dispose of the remaining pesticides and/or the container. Always keep products in the original container and out of reach of children, in a locked cabinet, shed or designated pesticide storage area (Figure 7-27). Disposal of pesticide containers in a manner not listed by the label could lead to contamination of the environment or harm to other people.

Other parts of the label provide additional important information about pesticide use.

Reentry statement. The restricted entry statement includes the amount of time that must elapse after a pesticide has been applied and before it is safe to enter the treated area without wearing full protective clothing and equipment. If a pesticide label has an *Agricultural Use Requirements* box (see Figure 2-21 in Chapter 2), then some or all of its uses are subject to the federal Worker Protection Standard. It is illegal to ignore the restricted entry interval (REI). If no REI appears on the label, then entry without protective clothing can only be made after sprays have dried or dusts have settled.

Before using a pesticide, consider the following points:

- 1) **Select the right product.** Only use a pesticide that is recommended to control the target pest and is safe for the host plants.
- 2) **Use the labeled or recommended amount.** Too little will not control the pest; too much is illegal and may injure the plant. Certain pesticides have specialized

label instructions intended to avoid phytotoxicity and maintain efficacy. Read the container label carefully.

- 3) **Apply the product correctly.** Thorough coverage of the leaves (especially the underside), stems and branches is essential. The pesticide must reach the area of the plant where the pest is active. Most pest control failures result from incorrect application, not product failure. The addition of a spreader sticker to the spray mixture is sometimes suggested when spraying ornamental plants. A **spreader sticker** is a material or combination of materials added to pesticides that causes the spray to spread and to stick to the sprayed foliage. It helps the pesticide adhere to leaves longer and improves coverage for better control. Some formulations of pesticides are prepared with spreader stickers already in the product.
- 4) **Always check the label** to determine whether anything can or should be mixed with the product. Some pesticide labels specifically warn against mixing certain pesticides together or combining them with fertilizers.
- 5) **Avoid irrigating treated areas** for at least 24 hours after application.

The ultimate goal is to select the least toxic material that will satisfactorily and economically control the pest problem in the least disruptive but most effective manner possible. Products should be selected after consulting the most current research and recommendations available from the University of Florida at <http://edis.ifas.ufl.edu>.

Evaluation

The final step in an IPM program is to evaluate management strategies by assessing their cost, efficacy, and overall value. This will help identify areas that work well or those that need improvement. An effective IPM program is continuously evolving to address old and new challenges in landscape and nursery pest management.