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MINNESOTA EXTENSION SERVICE
UNIVERSITY OF MINNESOTA
AGRICULTURE

Homeowner Pest Management

A Guide for Garden Center Sales Personnel

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Teaching
Research
Extension

University TRE Nursery Program

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Homeowners desiring beautiful landscapes may encounter weeds and other pests that must be controlled or eradicated. Integrated Pest Management (IPM) is the most important pest control method. This involves several methods of control including but not limited to species selection, cultural practices, biological controls and chemical controls. When chemical controls are warranted, it is necessary for garden center personnel to have a basic knowledge of pesticide composition, usage, and safety in order to properly inform or educate their customers.

Important pest control information to provide to homeowners includes:

* Properly diagnose the problem and determine the most effective control, if any, to implement.

* If a chemical control is determined to be the most effective, select the **appropriate product** for the specific pest problem and insure that proper timing is employed in its application to the proper plant.

* Beware that there are risks in the use of any pesticide, whether it is inorganic, organic, natural, or synthetic in origin. It is imperative to **read and follow the label directions.**

* Purchase and store all pesticides in their original containers. **Keep out of the reach of children at all times.**

It is very important that garden center personnel learn the names of the active ingredients in the products carried for sale. With this knowledge, proper recommendations can be made, laws and regulations can be adhered to, and more sales can occur when a product being requested can be recognized across trade or brand names. When consumers request additional information on pesticide use, direct them to read the entire label, to contact their county extension agent, to call Dail-U at 1-976-0200 ($2.50 charge), or to request publications from the Distribution Center, 3 Coffey Hall, University of Minnesota, St Paul, MN 55108.

SAFETY EQUIPMENT

Some product labels will require that the homeowner use **protective clothing** during each pesticide application. It is recommended that the homeowner wear protective clothing during all chemical applications. It is also, therefore, recommended that garden centers carry the following products and display them near pesticide products:

1. Unlined rubber, neoprene or disposable gloves

2. Unlined rubber, neoprene or disposable boots

3. Medical quality dust or face mask

4. Disposable (Tvek) or rubber body suit, coveralls or apron

5. Goggles (preferred over safety glasses)

PESTICIDE STORAGE

The following are recommendations for advising the consumer on proper pesticide storage:

1. Store all products in a clean, dry, **locked area or cabinet.**
2. **Date** all containers upon receipt.
3. Store pesticides only in their **original containers.**
4. **Properly dispose** of empty pesticide containers.
5. **Recommended storage duration:**
   a. Liquids and flowables: 1-2 years, allow no freezing (less than 32°F) or exposure to high temperatures (over 90°F).
   b. Granules, powders and dry flowables: 2-4 years.

APPLICATION EQUIPMENT

Garden centers should display pesticide application equipment within or near aisles where pesticides are sold to encourage safe chemical application by the homeowner. It is important that the garden center sales personnel strongly recommend that the consumer read and understand the operating instructions for safe operation of all pesticide equipment and safe application of all pesticides.

The following equipment is recommended for the homeowner:

1. Pump-Type Sprayers
   The homeowner should own two 1- to 3-gallon pump-type sprayers calibrated at 1/2 gallon increments. Sprayer recommendations include:
   a. Plastic, stainless steel, or tri-poxylined tanks (galvanized tanks are not safe with some chemicals).
   b. Hand-held rather than back-pack styling.

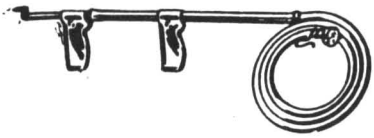
c. Adjustable nozzle.
d. Hooded nozzle for herbicides.
e. The sprayers should be labeled as follows: **"Insecticides & Fungicides Only"** and **"Herbicides Only"**.

2. Granular Fertilizer Spreader
This component can be rented or sold to homeowners. Both of the following spreaders require proper calibration and adjustment:
   a. **Drop spreader** for weed and feed products.
   b. **Whirly-bird spreader** for straight fertilizer products.

3. Garden hose-on applicators
When recommending hose-on products, alert the homeowner to:
   a. Hose-on applicators vary in accuracy of application.
   b. Use for **insecticide and herbicide application only.**
   c. **Beware of back flow** or siphoning back of chemicals into domestic water supply and family used hoses.
   d. **Be aware of backflow preventor requirements** of local area.

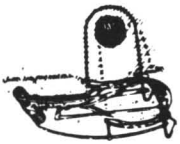
4. Duster, Puffer and Shaker Applicators
These applicators may have limited use due to projected unavailability of dusters and puffers. Problems include:
   a. **Shakers are not accurate** in application as significant over application usually occurs.
   b. Shakers do not allow application to **lower side of leaves.**

5. Trombone Applicators
Trombone applicators have limited use (stock one brand); however, they are useful to obtain **height coverage.**



6. Aerosols Applicators
These applicators are useful for small areas. Therefore the garden center inventory need not be large. Their limitations include:
   a. The aerosols should not contain a **petroleum-based propellent.**
   b. One should be aware that they can contribute to damage of the earth's **ozone layer.**

7. Pheromone Traps (Insect Hormones/Attractants)
These are required only if a particular problem exists. Sell traps separate from pheromones, as this will allow the use of any pheromone with any trap.

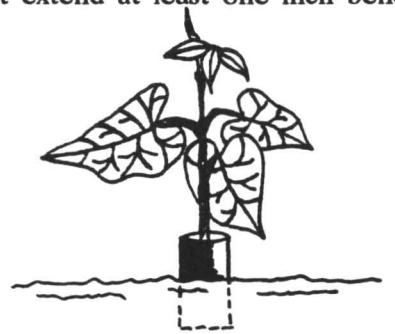


8. Sticky Spheres or Sticky Yellow Sheets or Stick-ems
   These products contain a **special adhesive compound** and are effective in a local area only (i.e., within a tree for apple maggot).

ADDITIONAL PEST MANAGEMENT INFORMATION

1. Wire mesh or a fine chicken wire
   Place properly around the base of trees to reduce winter rodent and rabbit damage.

2. Mechanical Cutworm Control
   Recommend and/or give away paper towel or toilet tissue cores, or frozen juice containers to be placed at planting time around the base of each seedling. To be most effective, the edges of containers must extend at least one inch beneath the soil.



3. Medicaps
   This product is **not recommended** for homeowner use.

4. Ross Root Feeders
   This product should **not be used by homeowners for insecticides,** but **can be used as fertilizers and for deep irrigation of trees and shrubs.**

5. Tree Wraps
   Products such as Kraft Paper, White spiral, or snap-around plastic wraps are satisfactory for winter protection of trees, but should be **removed each spring. Tree Skin should not be removed each year as it will last 2-3 years during which time it will biodegrade. Black wraps should not be recommended.**

FUNGICIDES

Active Ingredient/Chemical Name	Common/Brand/Trade Name	Type	General Use
Benomyl Tersan 1991	Benlate	Systemic/ Contact	Anthracnose, rots, blossom blight, *Botrytis*, blackleg, crown rot, dollar spot, *Fusarium*, mildew, apple scab, *Septoria*, *Thielaviopsis*, turf diseases, root rots.
Calcium Polysulfide scab,	Lime sulphur Dormant Disease Control	Contact	**Dormant season disease control**; Anthracnose, apple blotch, brown rot, canker, maple gall, leaf curl, mildew, rust, scab, shot hole.
Captan Orthocide	Captan	Contact	*Alternaria*, leaf spot, Anthracnose, *Botrytis*, brown patch, damping-off, downy mildew, fruit rots, *Fusarium*, heart rot, *Helminthosporium*, *Phomopsis*, root rots, rust, scab.
Chlorothalonil	Daconil 2787 Bravo 500 or 720	Contact	*Alternaria*, Anthracnose, *Botrytis*, blight, dollar spot, mildew, early and late blight, molds, *Helminthosporium*, leaf curl, melting out, needle-cast, *Pythium*, *Phytophthora*, *Rhizoctonia*, rust, scab, shot hole, many lawn, vegetable, fruit, and ornamental diseases.
Copper or Copper Sulfate	Tri-Basic Basic Copper Sulfate Basicop Kocide 101 Phyton 27	Contact	Alternaria, leaf spots, Anthracnose, apple scab, bacterial diseases, blossom rot, mildew, late blight, Phomopsis, shot hole, rust.
Copper sulfate + Lime sulfur	Bordeaux mixture Bordo	Contact	Leaf spots, Anthracnose, bacterial diseases, crown gall, mildew, scab, shot hole, rust, early blight, late blight; fruit, vegetable and tree diseases.
Ethylene-bis-dithiocarbamate (EBDC) **NO FOOD CROPS**	Dithane M-45 Fore **NO FOOD CROPS** Manzate 200 Maneb Mancozeb (tomatoes only)	Contact	Mildew, rusts, sooty blotch, *Alternaria*, Anthracnose, bacterial spot, algae, *Botrytis*, *Rhizoctonia*, *Fusarium*, *Helminthosporium*, *Pythium*, slime mold. **NO FOOD CROPS**.
Etridiazole	Terrazole Truban	Contact	Damping-off, Fusarium, Phytophthora, Pythium, stem rot, Thielaviopsis, root diseases.

Product label supercedes all other recommendations

FUNGICIDES (CONT.)

Active Ingredient/Chemical Name	Common/Brand/Trade Name	Type	General Use
Etridiazole + a systemic	Banrot	Contact/ Systemic	*Fusarium*, *Phytophthroa*, *Pythium*, *Rhizoctonia*, *Thielaviopsis*, root rots.
Fe-dimethyl-dithio-Carbamate **NO FOOD CROPS**	Ferbam **NO FOOD CROPS**	Contact	Fusiform rust, rust, scab, sooty blotch. **NO FOOD CROPS.**
PCNB	Terraclor	Contact	Root rots.
Sulphur blotch.	Dusting sulphur Wettable sulphur Flotox Nutonex Garden Fungicide	Contact	Brown rot, powdery mildew, scab, mites, sooty
Thiram	Thiram Arasan	Contact	Seed treatment, apple scab, cedar apple rust.
Triforine	Funginex Valent Triforine	Systemic	Diseases of landscape plants and roses.

BACTERICIDES

Active Ingredient/Chemical Name	Common/Brand/Trade Name	Type	General Use
Copper	Copper Oleate	Contact	Bacterial diseases
Copper Sulfate + Lime Sulfur	Bordeaux Mixture	Contact	Fireblight, leaf spots, late and early blight.
Streptomycin (Limited Shelf Life)	Agri-strep	Contact	Bacterial diseases, fireblight

Product label supercedes all other recommendations

INSECTICIDES

Active Ingredient/ Chemical Name	Common/Brand/ Trade Name	Type	General Use (Key use is underlined)
Acephate	Orthene	Systemic	Aphids, army worms, bagworm, scales, plant bugs, birch leafminor, cankerworms, wasps, whiteflies, cutworms, tent caterpillar, fall webworm, grasshoppers, leafhoppers (insects with piercing, sucking mouthparts)
Bacillus thuringiensis	Dipel, Javelin, Sok-BT, BT, Bactobac, Thuricide Bactispene, Bactur, Biotrol Larvo BT, M-one	Stomach	Bagworm, budworm, cabbage looper, fall webworm, tent caterpillar, gypsy moth, spruce budworm, tomato fruitworm (Limited time of effectiveness)
Benzopyran	Rotenone	Contact/ Stomach	Ants, potato beetle, beetles, slugs, Japanese beetle, loopers, cabbageworm, mosquitoes, thrips, fleas, lice, flies
Boric acid	Roach Pruf	Stomach	Cockroaches, ants
Carbaryl	Sevin D-Bug (Bait)	Stomach	Apple maggot, armyworms, bedbugs, bees, boxelder bugs, scale, cankerworms, chiggers, chinch bug, potato beetle, cucumber beetle, cutworms, spruce gall aphid, tent caterpillar, eriophyid mites, crickets, grasshoppers, green June bug, hornets, housefly, leafhoppers, leaf rollers, sowbugs, spittlebugs, strawberry leaf roller, tomato fruitworm, tomato hornworm, Tussuck moth, wasps, harmful bees (insects with chewing mouth parts)
Chlorpyrifos	Dursban (Commercial use only)	Contact	Ants, aphids, apple maggot, armyworm, bagworm, borers, chiggers, corn rootworm, crickets, cutworms, elm bark beetle, fall webworm, grasshoppers, leafminers, leafrollers, mealybugs, mosquitoes, plum curculio, scales, silverfish, sod webworm, thrips, ticks, whiteflies, white grubs (ready-to-use-for-household-pests)
Diazinon	Diazinon DZN Knox Out	Contact	Ants, apple maggot, bagworm, chich bugs, codling moth, potato beetle, corn earworm, cottony cushion scale, cutworms, crickets, armyworms, grasshoppers, silverfish, sod webworm, spittlebug, spiders, whiteflies, white grubs, woolly apple aphids, structural pests
Dicofol	Kelthane Pentac	Contact	Apple rust mite, strawberry mites, two-spotted mite

Product label supercedes all other recommendations

INSECTICIDES (CONT.)

Active Ingredient/ Chemical Name	Common/Brand/ Trade Name	Type	General Use (Key use is underlined)
Dimethoate	Cygon De-fend Rebelate	Contact/ Systemic	Aphids, bagworms, pine shoot moth, grasshoppers, mites, midges, thrips, scales, whiteflies, Zimmerman pine moth, iris borer
Disulfoton	Di-Syston	Systemic/ Contact	Aphids, birch leaf miner, elm leaf beetle, potato beetle, leafhopper, mealy bug, mites, rootworms, scabs, thrips, whiteflies
Malathion	Malathion Cythion	Contact/ Stomach	Aphids, armyworms, bagworms, cabbage looper, codling moth, cucumber beetle, curculio, grasshoppers, lace bugs, leafhoppers, mealybugs, mosquitoes, soft scale, spittlebug, squash vine bores, strawberry leaf roller, tent caterpillars, ticks
Metaldehyde	Bug-geta	Contact/ Stomach	Slugs, snails
Methaprene	Precor	Contact	Fleas
Methiocarb	Mesurol Slug-Geta	Contact/ Stomach	Aphids, plum curculio, slugs, snails; Do not use on or around food plants
Methoxychlor	Methoxychlor	Contact/ Stomach	Apple maggot, armyworm, asparagus beetle, cabbageworm, cankerworm, cherry fruit worm, codling moth, potato beetle, cucumber beetle, gnats, leafhoppers, plum curculio, rose chafer, spittlebug, squash vine borer, strawberry weevil, tent caterpillars, webworm, wasps
Nicotene Sulfate	Black Leaf 40	Contact/ Stomach	Aphids, thrips, white flies
Oxydemeton-methyl	Meta-systox-R	Systemic	Aphids, lace bugs, leafhoppers, leaf miners, mealybugs, mites, scales, thrips, whiteflies
Permethrin (Pyrethoid)	Pramex, Ambush, Pounce	Contact	Ants, apple aphids, armyworms, bean leaf beetle, cabbage looper, codling moth, potato beetle, corn borer, crickets, flies, leafhoppers, gnats, leaf miners, mosquitoes, plum curculio, spiders, whiteflies

Product label supercedes all other recommendations

INSECTICIDES (CONT.)

Active Ingredient/ Chemical Name	Common/Brand/ Trade Name	Type	General Use (Key use is underlined)
Petroleum oil	Dormant or Summer Oils Saf-T-Oil Volck Supreme Spray Safer Ultra-fine Spray Oil	Contact	Aphids, scales, mites, codling moth, leaf rollers, lichens, mealybugs, red spider mites, whiteflies, plant pests that overwinter on the plant. Check UR rating, the higher the rating, the better the oil; also check speed.
Potassium salts	Safer's soap	Contact with no residual	Wide range of pests
Propoxur	Baygon (Bait)	Contact	Ants, billbugs, centipedes, chinch bugs, cockroaches, crickets, fleas, sowbugs, millipedes, hornets, midges, millipedes, mole crickets, mosquitoes, silverfish, sod webworms, sowbugs, spiders, ticks, wasps
Propoxur	Wasp Aerosols	Contact	Wasps
Pyrethin	Pyrethrin In Aerosols	Contact	Ants, aphids, centipedes, dog fleas, hornets, mosquitoes, moths, plant bugs, roaches, silverfish, sowbugs, spiders, spittlebugs, thrips, wasps, white flies
Resmethrin	Resmethrin (Generally found in combination with other products)	Contact/ Fumigant	Ants, aphids, centipedes, dog fleas, hornets, mosquitoes, moths, plant bugs, roaches, silverfish, sowbugs, spiders, spittlebugs, thrips, wasps, whiteflies
Soap	Dreft, Dawn, Tide 1/2-1/3 cup/gallon	Contact	Boxelder bugs

Product label supercedes all other recommendations

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HERBICIDES

Active Ingredient/Chemical Name	Common/Brand/Trade Name	Type	General Use
2,4-D (Amine or Acid form only)	2,4-D Super Weed-No-More	Post-emergent Systemic Selective	Broadleaves only
2,4-D, MCPP and Dicamba	Tri-Mec	Post-emergent Systemic Selective	Broadleaves
Benefin	Balan	Pre-emergent Selective	Crabgrass and other annual grasses
Bensulide	Betasan	Pre-emergent	Crabgrass
Boric Acid	Borate Borax	Contact Post-emergent Nonselective	Bindweed, Canada thistle, leafy spurge, most annual weed, poison ivy, poison oak
Bromacil	Hyvar Hyvar-x	Soil Sterilant	Do not use or stock in store
Chlorothal	Dacthal DCPA	Pre-emergent	Annual bluegrass, barnyard grass, carpetweed, chickweed, crabgrass, dodder, foxtail, goosegrass, groundcherry, lambsquarters, pigweed, purslane, sandbur, spurge
Dicamba	Banvel	Post-emergent Systemic	Many annual and perennial weeds, toxic to most trees, shrubs and flowers, can be absorbed by roots
Fluaziprop-butyl	Fusilade Grass-B-Gone	Systemic Post-emergent Selective	Most grasses, no broadleaves, toxic to some junipers
Glyphosate	Roundup Rodeo (Aquatic use) Kleanup Accord Blot-Out	Systemic Post-emergent Non-selective	Toxic to all plant material Must have DNR permit to apply to aquatic areas
Mecoprop	MCPP	Post-emergent Systemic	Chickweed, clover, ground ivy, knotweed, lambsquarters, mustard, pigweed, plaintain, ragweed, shepherds purse

Product label supercedes all other recommendations

HERBICIDES (CONT.)

Active Ingredient/Chemical Name	Common/Brand/Trade Name	Type	General Use
Metolachlor	Pennant	Pre-emergent	Most grasses, yellow nutsedge, pigweed, nightshade
Napropamide	Devrinol	Pre-emergent	Many annual grasses and broadleaves. Apply late fall or early spring only.
Oxadiazon	Ronstar	Pre-emergent	Many grasses and broadleaves except chickweed. Safe on most woody plants. May thin out Fescue grasses.
Oxyfluorfen	Goal	Pre-emergent	Most grasses and broadleaves. Use on evergreens only, but not on new growth of evergreens.
Pendimethalin	Stomp Pendamethalin	Pre-emergent Selective	Crabgrass and annual grasses in established turf
Potassium salts of Saturated Acids	Sharpshooter Weedkiller	Contact	Many grasses and broadleaves.
Sethoxydim	Poast	Post-emergent Systemic, Selective	Most grasses, no broadleaves, toxic to potentilla
Siduron	Tupersan	Pre-emergent	Crabgrass, foxtail, barnyard grass. This is the only pre-emergent herbicide that can be used at seeding time.
Triclopyr Systemic	Turflon Amine in turf	Post-emergent Selective	Oxalis and other broadleafed weeds
Trifluralin	Treflan Team EZE Garden Weed Preventer	Pre-emergent Selective	Crabgrass, most annual grasses

Many natural and synthetic mulches are effective in weed control and moisture conservation.

Product label supercedes all other recommendations

RODENTICIDES AND ANIMAL CONTROL

Active Ingredient/Chemical Name	Common/Brand/Trade Name	Mechanism	Animal	Use
Ammonia, rosin, and fatty acids	Hinder	Repellent	Deer, rabbits	For use on trees and shrubs
Biodegradable webbing	Vexar Naltex	Physical barrier	Deer, rabbits, mice	For use on trees and shrubs
Brodifacoum	Talon Weatherblock	Poison bait	Rats, mice	Bait
Bromadiolone	Maki One Shot	Poison bait	Rats, mice	Bait
Chlorophacinone	Gopher Gone	Poison bait	Gophers	Underground use only
Colored mylar tape	Flash Tape Magic Circle	Scares birds String between posts at 1 and 2 feet off the ground makes a barrier to birds	Geese	For use around areas in which geese graze or congregate
Denatonium saccharide	Ropel	Repellent (Taste)	Deer	For use on trees and shrubs
Lime and Sulfur	Lime Sulfur	Repellent	Rabbits, mice	Use to prevent rabbit and mice winter damage on trees and shrubs
Paradichlorobenzene, Ziram, Thiram, and Aklyl puridines	Repel	Repellent (odor)	Dogs, cats, and other animals	For use on trees and shrubs
Polyethylenes and Polybutylenes	Roost No More Bird Tanglefoot	Sticky irritant	Pigeons Starlings	For use on platforms where birds congregate
Porcupine wires	Nixalite Cat Claw	Irritating wires prevent roosting	Pigeons Starlings Sparrows	For use on areas where birds roost or congregate

Product label supercedes all other recommendations

RODENTICIDES AND ANIMAL CONTROL (CONT.)

Active Ingredient/Chemical Name	Common/Brand/Trade Name	Mechanism	Animal	Use
Putrescent egg solids	Deer Away BGR (Big Game Repellant)	Repellent	Deer	For use on trees and shrubs
Strychnine (on milo)	Gopher Getter Bait	Poison bait	Gophers	For underground use only
Tabasco Sauce	Miller's Hot Sauce	Repellent	Dear, rabbits	For use on trees and shrubs
Thiram and antitranspirant	Rabbit and Deer Repellant	Repellent	Deer, rabbits	For use on trees and shrubs
Thiram and sticker	Spotrete-F	Repellent	Deer, rabbits	For use on trees and shrubs
Translucent tubes	Correx-Plus Tubex	Physical barrier	Deer, rabbits, mice	For use on trees and shrubs
Warfarin	D-Con	Poison bait	Mice, rats	For covered use only

Product label supercedes all other recommendations

GROWTH REGULATORS

Active Ingredient/Chemical Name	Common/Brand/Trade Name	Type	Use
2-chloroethyl-phosphoric Acid	Ethrel Florel	Abscission Accelerator	Defoliant, dis-budding agent, increase lateral branching
6-Benzyl Adenine	Pro-shear	Growth Stimulant	Increase lateral buds on pine
6-Benzyl Adenine (BA) + $GA_{4/7}$	Promalin	Growth Stimulant	For use on apple crops to improve fruit color, shape and size. Increase lateral bud break on trees.
Chlormequat	Cycocel	Growth Retardant	Reduce shoot growth, induce flowering
Chlorophenyl dimethyl triazol	Prunit	Growth Retardant	For use on trees
Dikegulac	Atrimmec	Growth Retardant	Retard growth on trees, shrubs
Gibberellic Acid (GA_3)	Pro-Gibb Wonder Brel Tomato Set	Growth Stimulant	Thinning agent for grapes, Increase tomato fruit set
Indolebutyric Acid (IBA)	Hormodin	Rooting Compound	Promote Root Initiation on cuttings
Indolebutyric Acid (IBA) + Naphthalene Acetic Acid (NAA)	Rootone	Rooting Compound	Promote Root Initiation on cuttings
Mefluidide	Embark No activity on turf after application	Growth Retardant	Reduce tree, shrub, turf growth
Naphthalene Acetic Acid	Spray-Gard	Growth inhibitor	Inhibit sprouting on trees

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Understanding Pesticide Toxicity

Jim Cink and Phil Harein

For centuries pesticides have been used to control a variety of pest problems. The Romans used burning sulfur to control insects, while in the ninth century the Chinese used arsenic mixed with water. In the early 1800s pyrethrum insecticides were first used. Organophosphate pesticides began commercial production in the 1950s in addition to the development and production of carbamate pesticides.

To understand what pesticides are and why they are used, it should first be understood which chemicals are designated as pesticides. The ending of the word pesticide, "cide," is derived from the Latin word "cida," meaning killer or destroyer: a pesticide is any chemical or substance used to kill or destroy a pest. This definition can be used to describe virtually any chemical or substance.

Pesticides are grouped together based on their use. These groupings help to understand which pests a chemical will control.

Avicide	Birds
Fungicide	Fungi
Herbicide	Weeds
Insecticide	Insects
Miticide	Mites
Molluscicide	Snails, Slugs
Nematicide	Nematodes
Piscicide	Fish
Predacide	Animals (wolves, etc.)
Rodenticide	Rodents (mice, rats)
Silvicide	Trees and woody vegetation
Bactericide	Bacteria
Algicide	Algae
Growth Regulator	Inhibit insect or plant growth
Sterilant	Insects, plants, animals
Repellents	Insects, birds, pets, and other animals

Not all pesticides kill pests. Growth regulators stop or control how insects or plants develop; sterilants keep pests from reproducing; repellents ward off insects, birds, pets, or other animals. Although these chemicals or substances are not pesticides, they are regulated by the same laws affecting pesticides.

Many chemicals or substances used as pesticides have other uses as well. Boric acid, used as an insecticide to control cockroaches, can also be used as a disinfectant in eyewash solutions, and act as a flame retardant when applied to clothing. Common table salt has been used as a herbicide to control cactus in the Southwest United States; ordinary beer has been used to control garden slugs.

Although pesticides are designed to control pest problems, they can be toxic or poisonous to desirable plants and animals, including humans. It is important for anyone using a pesticide to understand how pesticides may affect them.

How Pesticides Enter the Body

There are three major routes of entry for pesticides into the body.

- **Oral Exposure:** Oral exposure refers to the intake or absorption of a pesticide through the mouth or digestive system. Generally, the oral intake of a pesticide is due to an accident such as trying to blow a plugged spray nozzle clean; drinking from a container (such as a pop bottle) which should never be used even temporarily to store a pesticide; or failing to wash after handling a pesticide and this contaminates the food being eaten.
- **Dermal Exposure:** Dermal or skin exposure accounts for about 90 percent of the exposure a pesticide user receives. It may occur any time a pesticide is mixed, applied or handled, and is often undetected. Dry materials such as dusts, wettable powders, and granules, as well as liquid pesticides, can be absorbed through the skin. The seriousness of dermal exposure depends on (1) the dermal toxicity of the pesticide, (2) rate of absorption through the skin, (3) the amount of pesticide on the skin, (4) the size of the skin area contaminated, and (5) the length of time the pesticide is in contact with the skin.

Rates of absorption through the skin are different for different parts of the body (figure 1). Compared to dermal absorp-

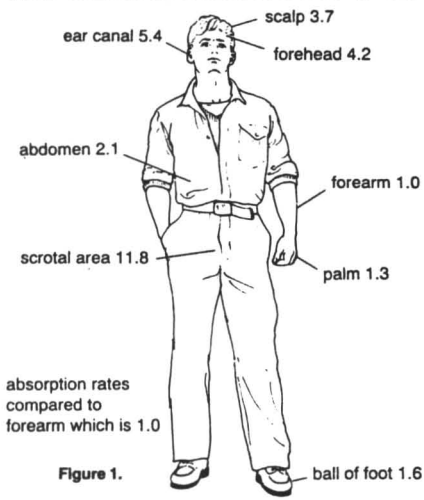

Figure 1.

tion rate through the forearm (absorption rate of 1) absorption through the lower groin area would be more than 11 times faster.

Absorption continues to take place on all of the affected skin area as long as the pesticide is in contact with the skin. The seriousness of the exposure is increased if the contaminated area is large or if the material remains on the skin long enough to allow for absorption.

- **Inhalation Exposure:** Inhalation exposure results from breathing in pesticide vapors, dust, or spray particles. As in the previous types of exposure, inhalation exposure is more serious with some pesticides than with others, particularly fumigant pesticides.

Inhalation exposure can occur when protective equipment is not worn and a person breathes in the vapors or spray mist while mixing and/or applying pesticides. Exposure can also occur from breathing in smoke from burning pesticide containers or the smoke from pesticide contaminated smoking materials (cigarettes, cigars, etc.).

Toxicity

Toxicity can be simply defined as any adverse effect resulting from exposure to a chemical. The toxicity of a pesticide is usually one of two types: acute or chronic, based on the number of exposures to the pesticide and the time it takes for symptoms of poisoning to occur or develop. The adverse effects produced by chemicals range from slight symptoms (acute) such as headaches, nausea, or dizziness to more severe symptoms like convulsions, coma, or even death. Most acute toxic symptoms are reversible and do not cause permanent damage if there is prompt medical treatment. The chronic toxicity of a pesticide, however, can cause irreversible (permanent) damage.

Acute Toxicity

The acute toxicity of a chemical refers to its ability to do damage (internal, external or both) as a result of a one-time or short term exposure to a relatively large amount of the chemical. The acute toxicity of a pesticide is expressed by its median lethal dose or LD_{50}. The LD_{50} is the milligrams of active ingredient per kilogram of body weight that will kill 50 percent of the test population. This means that the lower the LD_{50} value the greater its toxicity and the higher the LD_{50} the less toxic the pesticide. However, a pesticide with a high LD_{50} can be deadly even if a very small amount is absorbed.

The signal word on a pesticide label (table 1) is based on the acute toxicity of the pesticide. Acute toxicity may be measured as acute oral (through the mouth), acute dermal (through the skin), and acute inhalation (through the lungs).

Table 1. Categories of acute pesticide toxicity

Signal word	Category LD_{50}	Acute oral LD_{50}	Acute dermal LD_{50}	Acute inhalation LD_{50}
Danger-Poison	I	0-50	0-200	0-2,000
Warning	II	50-500	200-2,000	2,000-20,000
Caution	III	500-5,000	2,000-20,000	>20,000

Chronic Toxicity

Chronic toxicity refers to harmful effects produced by long-term, low-level exposure to pesticides. Less is known about the chronic toxicity of pesticides, not because it is of less importance, but because chronic toxicity is much more complex and subtle in how it presents itself. In the past greater emphasis was placed on the acute rather than the chronic, toxic effects of pesticides. However, today, increased emphasis is being given to the chronic effects of pesticides. While situations resulting in acute exposure (a single large exposure) do occur, they are usually the result of an accident of careless handling. On the other hand, persons may be routinely exposed to small amounts of pesticides while handling, mixing, loading, and applying pesticides or while working in areas where pesticides have been applied.

Label Identification of Acute and Chronic Toxicity

To alert pesticide users to risks associated with the acute toxicity of a pesticide, a signal word must appear on the label (table 1). Signal words alert the user as to whether the chemical is highly toxic, moderately toxic or slightly toxic. These signal words are usually based on the acute toxicity of the active ingredient(s). The signal word is used to represent the greatest risk category for that chemical. For example, if a pesticide has an acute oral toxicity level that would place it in the slightly toxic category, but if its dermal toxicity is highly toxic, then the signal word on the label would reflect the toxicity risk posed by dermal exposure. Skin and eye irritation can also influence the signal word on a pesticide label.

Unlike the signal words used to express the acute toxicity of a pesticide, there are no signal words to express the chronic toxicity of that chemical. Instead, the label will state the specific chronic toxicity problem. Such a statement might read, "This product contains (name of chemical) which has been determined to cause tumors or birth defects in laboratory animals."

The recommendation to wear protective clothing together with a description of the type of protective clothing to be worn, is based on both the acute and chronic toxicity of the pesticide. Exposure to the pesticide can be minimized, if not eliminated, by following the protective clothing recommendations.

The Pesticide Label

Any chemical can be hazardous if misused, no matter what its toxicity. The pesticide label usually outlines how and when the chemical should be used, the pest it will control, and application procedures designed to protect non-target organisms and the environment. These guidelines are based on the effects currently known about the pesticide. As further information is gained, the label is modified to continue protecting human health and the environment. Pesticides are continuously being evaluated by both private and governmental agencies. It is through this scrutiny that only those pesticides which prove to pose a low risk to the health of humans and wildlife will continue to be registered by the Environmental Protection Agency (EPA).

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