Right-of-Way Pest Management A Training Manual For Commercial Pesticide Applicators (Category 6)

Michigan State University
Cooperative Extension Service
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Preface

This manual is intended to prepare commercial pesticide applicators in right-of-way control (category 6) for certification under the Michigan Pesticide Control Act of 1976 as amended. The "Commercial and Private Applicator Core Manual: Initial Certification" (formerly E-2195), which explains safety considerations, pesticide laws, and integrated pest management principles, should also be studied to prepare for both certification and recertification.

Some suggestions for studying the manual are:

1. Find a place and time for study where you will not be disturbed.
2. Read the entire manual through once to understand the scope and form of presentation of the material.
3. Study one section of the manual at a time. You may want to underline important points in the manual or take written notes as you study the section.
4. Write answers to the review questions at the end of each section. These questions help you learn and evaluate your knowledge of the subject. They are an important part of your study.
5. Reread the entire manual once again when you have finished studying all of the sections. Review with care any sections that you feel you do not fully understand.

After completing your study of this manual and the "core" manual (formerly E-2195), take the core exam and category 6 exam administered by the Michigan Department of Agriculture to become a certified commercial pesticide applicator for right-of-way control.

Acknowledgements

Cooperative Extension Service publications from Cornell University and the University of Wisconsin were invaluable resources for this manual. The following illustrations were printed with permission from NCR 281 *Weeds of the North Central States: Chicory, Goldenrod, Wild Carrot, Poison Ivy, Canada Thistle, and Musk Thistle*. We also thank the Michigan Category 6 Committee for initiating and supporting the development of this manual.

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CHAPTER 1

PRINCIPLES OF PEST MANAGEMENT

Rights-of-way are the areas involved in common transport. They include:

- federal, state, county, and township highways and roads
- utilities including transformer stations and substations
- pipelines including pumping stations
- public surface drainage ways
- railroads
- public airports
- bicycle, bridle, snowmobile and other recreational paths

Plant growth and insects and diseases attracted to the plants along the right-of-way are managed to make sure the right-of-way is safe, usable, attractive, economical to maintain, and not harmful to the environment of the surrounding area.

This chapter will explain the steps to planning pest management programs for rights-of-way.

Integrated Pest Management

Integrated Pest Management (IPM) is the use of all available tactics or strategies to manage pests so that acceptable control can be achieved. The control methods must be economically feasible with the least disruption to the environment. An IPM program considers the complex biological system in which we must manage pests, and seeks to use pesticides and other management tools more effectively.

In right-of-way pest management herbaceous and woody plant species are the major pests. Occasionally, insects, disease, and vertebrate pests require control measures. Unlike other IPM programs, right-of-way management cannot easily define a crop-pest relationship such as, corn and the corn root worm or cotton and the boll weevil. It is easier to understand in these situations that a large population of pests can damage the crop plant and result in an economic loss to the farmer. Weeds and woody plants are managed on rights-of-way for safety, access to facilities, decrease maintenance costs, reliability of service, and for other benefits such as aesthetics, wildlife, and environmental protection. The "crop" of rights-of-way is the services the right-of-way provides. To obtain the desired results, right-of-way managers must consider the impacts weed control will have on these various concerns. A good right-of-way management program utilizes the IPM principles to consider all available alternatives when designing a pest management strategy. This way, the services provided by the right-of-way can be maximized with the least harm to the right-of-way environment.

The major components of right-of-way IPM are:

- pest identification
- monitoring
- determination of site specific requirements
- development and implementation of control strategies
- evaluating control strategies for effectiveness

These components relate closely to the steps for developing an IPM program as described in the "Commercial and Private Applicator Core Manual." We have modified those steps here to more closely reflect the needs of rights-of-way.

The first component is **pest identification**. It is important to recognize the pest species so that appropriate measures can be considered and so that the right-of-way manager is not surprised by an unchecked pest problem in the future. Identifying pests involves more than recognizing the pest species' name; it is the gathering of necessary information to develop an effective and cost-efficient control strategy. Pest life cycles, physiology, reproductive potential, and past control results are examples of the kinds of information included in pest identification.

Applicators can enhance control effectiveness by **monitoring** pest populations to determine their size and resulting damage. By frequently checking control areas and knowing the common pests, you may detect pest infestations before they become a significant problem. Also, monitor the pest's life cycle and use control measures when the pest is at its most vulnerable developmental stage.

Examine the site to identify site specific requirements.

Defining **site specific requirements** is especially important since rights-of-way tend to cross many different areas that may require special considerations.

Obviously treating brush along a rural powerline or drainage ditch is much different than treating brush through a suburban neighborhood. Some examples of different sites are:

- urban, suburban, or rural areas,
- dry upland or lowland and wetland areas,
- popular tourist, scenic areas or recreational areas,
- wildlife habitat such as critical nesting habitat or winter feeding grounds.

Although a formal prescription does not need to be developed for each parcel of land, you should consider the special nature of each area as you develop pest management strategies.

Once the pest species are identified and specific site requirements are defined, you can begin to **develop control strategies**. Select the appropriate strategies that will provide effective, practical, economical and environmentally-sound control. The last of these criteria is no less important than the first three. Proper selection requires that you be thoroughly familiar with all available control methods and that you fully evaluate the benefits and risks of each of the following: biological controls, cultural controls, mechanical controls, and chemical controls.

Lastly, results of your **controls should be recorded and evaluated** so that adjustments can be made when necessary. Ineffective, costly or environmentally adverse treatments must be eliminated or changed. Records should include:

- control measures and the starting date for each
- rate for any pesticides that were applied
- identification of equipment and crew
- environmental conditions
- evaluation of effectiveness
- problems encountered or complaints reported
- any damage claims

Techniques Used in Right-of-Way Pest Management

There are four categories of control methods that should be considered for your management strategy. These groups are:

- biological control
- cultural control
- mechanical control
- chemical control

Biological controls focus on enhancing the effects of natural enemies of pests. There are perhaps thousands of naturally-occurring species of insects, mites, nematodes and disease agents which are predators and parasites of right-of-way pests. Be sure to select control measures that will preserve these natural enemies. **Allelopathy** (a type of biological control) is a phenomenon that may offer good weed control in the future. Allelopathy is the production by plants of chemical compounds that inhibit the growth of other nearby plants. Some weeds actively eliminate competition by producing toxins that enter the soils and prevent the normal growth of other plants. Examples include quackgrass rhizomes and common sunflower. Highly competitive vegetation is also being evaluated as a means to lower the density of undesirable vegetation.

Cultural control methods create optimal growing conditions for the plants you want to preserve or unfavorable conditions for the pests. These control strategies include standard management practices such as fertilizing and planting a variety of desirable plants. Cultural controls are most practical in rights-of-way that include plantings. Several examples are given here:

- Time of Planting. Turfgrass and crops planted in the spring compete well against winter annual weeds. Sometimes the planting date can be delayed until after weeds have sprouted and have been removed by cultivation or by herbicides.
- Nurse Crops. Annuals are sometimes planted with a perennial crop to provide competition with weeds and allow the perennial to become established. The nurse crop is then harvested or removed. For example, oats are sometimes used as a nurse crop to help establish alfalfa or clover. Annual ryegrass is sometimes used in mixtures to serve as a nurse crop for perennial rye, fescue, or bluegrass.
- Controlled Burning. Fire may control limited infestations of annual or biennial weeds. It destroys only the above-ground plant parts and is usually not effective against many herbaceous perennials. Burning creates atmospheric pollution and should be replaced by mechanical control when possible.
- Mulching. Mulching prevents light from reaching weed seeds, thus preventing weed growth between rows, and around trees and shrubs.
- Shading. Aquatic weeds are sometimes controlled by shading them with floats of black plastic, adding dye to water, or similar methods of shading out sunlight.
- Sanitation. It is important to use seeds with as little weed-seed contaminant as possible. If you plant seeds in the right-of-way be sure to use clean seed.

Mechanical control measures may be mechanical or manual. Heavy equipment such as hydraulic-operated brush "mowers" capable of cutting six- to eight-inch trees are often used. Sometimes "tree shears" are used, or even tractor-mounted, pto-driven brush-hogs. Manual treatments are done using hand tools or hand-held power tools such as a chain saw. Mowing grass is a mechanical control. It reduces competition between weeds and desirable plants, and prevents flowering and seeding of annual or biennial weeds. To be most effective, the mowing height must be adequate to ensure control of weed plants and encourage desired vegetation.

Chemical control (pesticides) offers flexibility because of the various selective herbicides and the many options in application equipment and techniques. There are draw backs such as "brown out", limited season of application, and concerns and perceptions from the public which must be considered. Pesticide applications can be timed so that there is less visual disruption or so that undesirable vegetation does not spread or sprout back to pretreatment levels.

If pesticides are necessary, the information collected about site specific requirements and identification of the pest species will help determine:

- which pesticide to use
- the application technique
- season of year for application
- type of equipment needed
- mixing rate and additives needed.

Keep in mind as you plan control strategies that in recent years attitudes have changed as to what is undesirable vegetation. In the past, all woody vegetation was considered undesirable; now a more selective approach is taken in that only certain species are undesirable and the others are usually left on the right-of-way for other benefits.

Special Environmental Concerns

Early surveys of Michigan determined that the state was one-third wetlands. By 1955, the wetlands occupied less than one-tenth of the land. Wetlands can include swamps, marshes, bogs, and hardwood forest bottomlands: all areas that you may encounter in the right-of-way work. Wetlands are valuable resources ecologically, recreationally, and aesthetically. They provide wildlife habitat, minimize bank and shoreline erosion along rivers and lakes, improve downstream water quality, provide recreational activities, and act as a water storage area during flooding (because water is released slowly from wetlands, flood damages are reduced). Be sure that your pesticide application practices do not harm wetlands and other surface water. Take measures to keep the chemicals out of the water. Use an anti-backflow device if you must siphon water directly from a pond or stream to fill your sprayer.

Review Questions: Chapter 1

Write the answers to the following questions. When you are satisfied with your answers, see if they are correct by checking them with the chapter text.

1. _____is the use of all available tactics or strategies to manage pests so that acceptable control can be achieved.

2. Why must weeds and woody plants be managed on rights-a-way?

3. The first component of an effective pest management program is pest identification. *(True or false?)*

4. When identifying the pest, what other information should be collected about the pest?

5. List several examples of different sites that might have site specific requirements.

6. Why should you monitor your control strategies? What information should be recorded?

7. List the four categories of control methods and briefly explain each.

8. How does shading work as a cultural control? Where is it often used?

9. How have public attitudes changed about vegetation and its control in rights-of-way?

10. Why is it important to protect wetlands?

CHAPTER 2

WEED PLANTS AND TREES

Any plant can be considered a weed when it is growing where it is not wanted. To effectively manage weeds, you must be able to correctly identify each weed pest and understand its development. This chapter will address weed identification and growth. Illustrations of some of the most common right-of-way weed pests are included.

Developmental Stages and Plant Types

All plants have four stages of development.

1) **Seedling** – small, vulnerable plantlets.
2) **Vegetative** – rapid growth producing stems, roots, and foliage. The plant's uptake and movement of water and nutrients is rapid and thorough.
3) **Seed production** – energy directed toward production of seed. The plant's uptake of water and nutrients is slow and is directed mainly to flower, fruit, and seed structures.
4) **Maturity** – little or no energy production or movement of water and nutrients.

The developmental stage of the weed pest will affect how it responds to control measures. For example, a seedling is less established and is often easier to control. A plant in a vegetative stage will uptake a herbicide more quickly than a mature plant.

Another important factor when planning control methods is to identify the pest plant type. The three plant types are:

1) **Annuals**. Plants that grow from seed, mature, and produce seed in one year or less. They are grass-like or broadleaved and may be winter or summer annuals.
2) **Biennials**. Plants with a two-year life cycle.
3) **Perennials**. Plants that live more than two years and may live indefinitely.

Classification of Land Plants

Classification of right-of-way weeds on land can be grouped into broad categories: grasses, sedges, herbaceous broadleaves, vines, brush and trees, and ferns. These plants, except for ferns, reproduce primarily through seeds. Ferns reproduce by spores.

Grasses. Grass seedlings have only one leaf (monocotyledon or *monocot*), which is narrow with parallel veins. Most grasses have fibrous root systems. The growing point on seedling grasses is sheathed and located below the soil surface. Some grass species are annuals; others are perennials. Examples: foxtail, Johnsongrass, and Bermudagrass.

Sedges. Sedges are similar to grasses except that they have triangular stems and three rows of leaves. Like grasses, the leaves are narrow and have parallel veins. Sedges are often listed under grasses on the pesticide label. They are perennial weeds that produce rhizomes and tubers. Examples: yellow and purple nutsedge.

Herbaceous Broadleaves. Broadleaf seedlings have two leaves as they emerge from the seed (dicotyledon or dicot). The leaves have a net-like venation. Broadleaves usually have a taproot and a relatively coarse root system. All actively growing broadleaf plants have exposed growing points at the end of each stem and in each leaf axil. Perennial broadleaf plants may also have growing points on roots and stems above and below the surface of the soil. Broadleaves include species that are annuals, biennials, and perennials. Examples: dandelion, wild carrot, pigweed.

Vines. Woody and herbaceous vines have many characteristics similar to broadleaves: two leaves at germination, broad leaves with net-like venation, and a taproot. These perennial plants have vigorous sprouting habits and are therefore difficult to control. Examples: Japanese honeysuckle, blackberry, and poison ivy.

Brush and Trees. Brush and shrubs are woody plants with several stems and are less than 10 feet tall. Trees are woody plants usually with a single stem (trunk) and are over 10 feet tall. These perennial plants may sprout by seed or sprouting roots. Examples: red maple, sumac, and various pines.

Ferns. These perennial plants do not produce seed but reproduce by spores and creeping rhizomes. They prefer moist soils. Examples: bracken fern, common horsetail, scouring-rush.

Parasitic Seed Plants. Parasitic seed plants live on and get their food from host plants. They can severely stunt and even kill the host by using its water, food, and minerals. These plants reproduce by seeds. Some can also spread from plant to plant in close stands by vining and twining. Examples: dodders, broomrape, witchweed.

Classification of Aquatic Plants

Many aquatic plants are similar in structure to land plants. Most are perennials and are classified as described in this section.

Emergent. The bulk of these plants extend above the surface. Examples: cattails, reeds, bulrushes.

Floating. All or part of the plant floats on the surface. Examples: water-lilies, duckweed, waterlettuce.

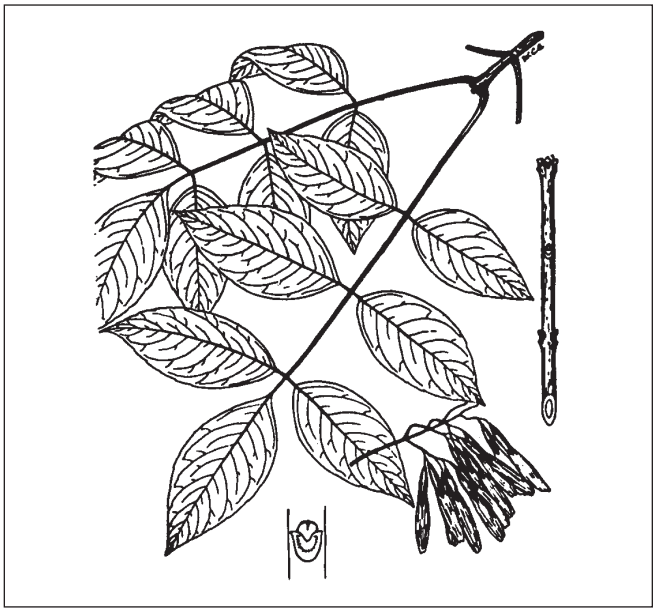
Submergent. All of the plant grows beneath the water surface. Examples: watermilfoil, elodea, coontails.

Emergent and floating plants have a thick outer layer on their leaves and stems which hinders herbicide absorption. Submergent plants have a very thin outer layer on their leaves and stems and are very susceptible to herbicide injury.

Algae. Algae are aquatic plants without true stems, leaves, or vascular systems. For control purposes, they may be classified in three categories: plankton algae, filamentous algae, and macroscopic freshwater algae.

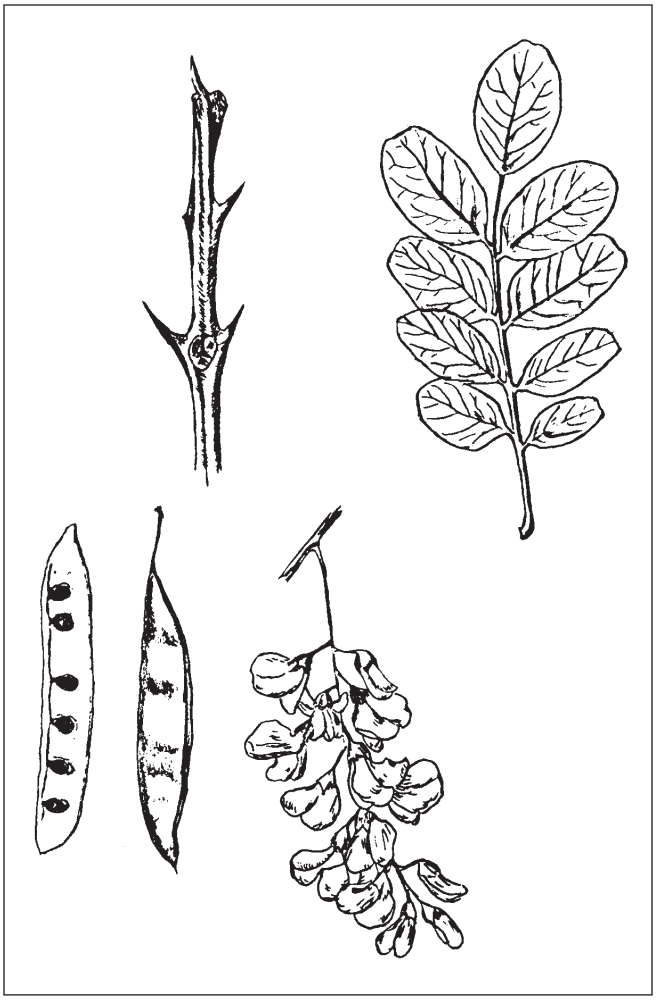
You must obtain a permit from the Department of Natural Resources and Environment (DNRE) to apply pesticides to aquatic plants. (No permit is necessary if the pond is less than two acres, has no outlet, and the pesticides are not restricted use.) To apply for the permit, call the Inland Lakes Management Unit of DNRE's Land and Water Management Section at 517-241-7734. You will receive a packet that includes a permit application and information about common aquatic pests and the appropriate measures to control them. The permit is free.

To control land or aquatic weeds that are growing near desirable plants, you must take advantage of the differences between the weeds and the desired species. Be sure that the plants you are trying to protect are not susceptible to the weed control method. A plan to control weeds may include biological, cultural, mechanical, and chemical controls. Chapter 1 explained biological, cultural and mechanical methods. The following chapter will cover the chemical controls: herbicides and growth regulators.



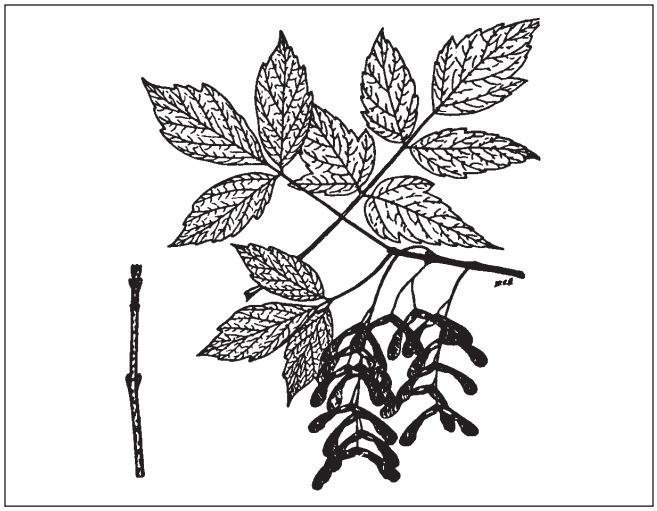
Ash (Black, White, Green)

Leaves: opposite, simply compound, 8 to 12 inches long, 5 to 9 leaflets, 3 to 5 inches long, entire, dark green. **Fruit**: August-September, drooping clusters of single-winged seeds. **Bark**: twigs, dark-green at first becoming gray to light-brown gray. The bark is deeply furrowed with narrow ridges.
Other Characteristics: Rich moist soil, rapid growth, 50 to 75 feet tall, 2 to 3 feet diameter, pyramidal crown. A white ash is shown in this illustration.



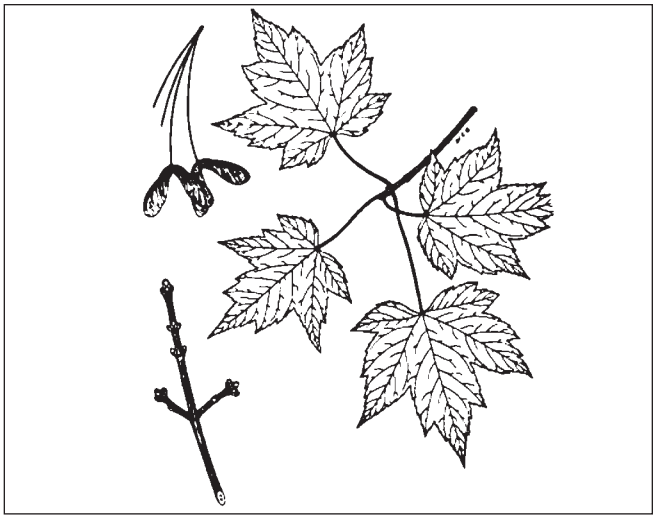
Black Locust

Leaves: alternate, simply compound, 8 to 14 inches long, 7 to 12 leaflets, 1 to 2 inches long, entire, dull green. **Fruit**: late autumn, smooth, dark brown, flat pod, 3 to 4 inches long, 4 to 8 small, flattish brown seeds. **Bark**: twigs, smooth green, somewhat rough dotted, armed with prickles; old trunks, deeply fissured. **Other Characteristics**: rich, moist soil, rapid growth, 30 to 60 feet tall, 1 to 2 feet diameter, shortlived, irregular oblong crown.



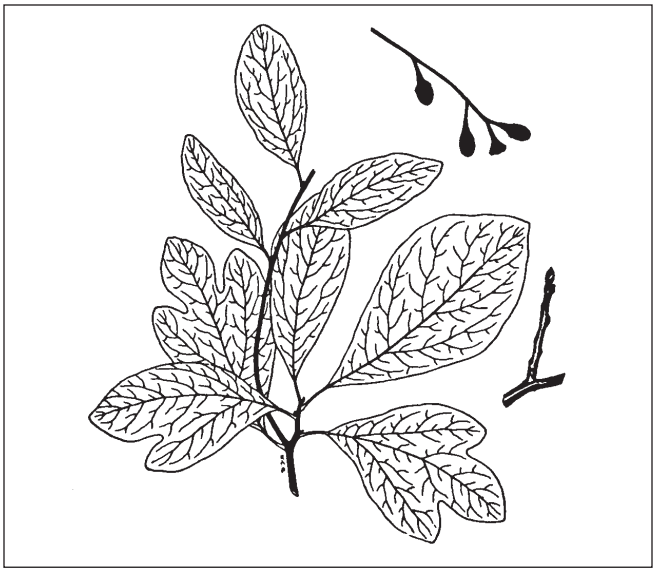
Boxelder (Ash-leaf Maple)

Leaves: opposite, simply compound, 6 to 10 inches long, 3 to 9 leaflets, 2 to 4 inches long, coarsely serrate, dark green. **Fruit**: early summer, narrow, flat-winged seeds, in pairs, form drooping clusters. **Bark**: twigs, greenish to purple; trunk, pale gray to light brown with broad ridges. **Other Characteristics**: moist soil, 30 to 50 feet tall, 1 to 2 feet diameter, rapid growth, forks close to ground, wide-spreading crown.



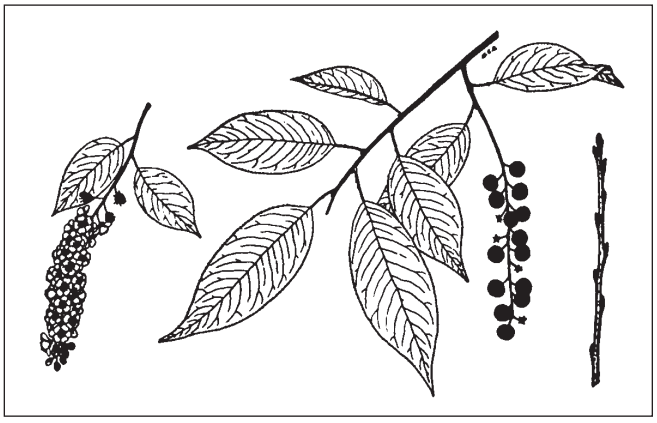
Red Maple (Soft Maple)

Leaves: opposite, simple, 3 to 4 inches long, 3 to 5 lobed with sharp indentations, green above, whitish beneath. **Fruit**: May–June, on long drooping stems with paired wings at right angles. **Bark**: twigs are slender and bright red in the winter turning light gray; old trunks are dark gray and ridged with plate-like scales. **Other Characteristics**: 40 to 75 feet tall, upright branches form narrow, rounded crown, prefers swamp and stream banks.



Sassafras

Leaves: alternate, simple, 3 to 6 inches long, three shaped leaves—unlobed, 3-lobed, 2-lobed or mitten shaped. Dull dark green, lighter green beneath. **Fruit**: September–October, lustrous, dark blue berry, 3/8 inch long, borne on bright red base and stem. **Bark**: twigs, lustrous, green, becoming red-brown, aromatic; dark red-brown, orange when cut with knife. **Other Characteristics**: 20 to 40 feet tall, contorted, horizontal branches, open crown, prefers well-drained soils.

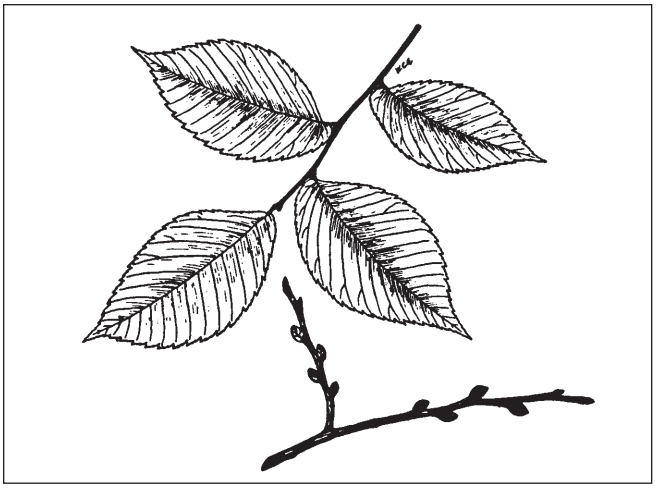


Wild Black Cherry

Leaves: alternate, simple, 2 to 5 inches long, oblong, finely-toothed, dark, shiny green above, pale beneath. **Fruit**: August–September, small pea-shaped cherry, dark purple to black, 1/3 to 1/2 inch diameter, slightly bitter, edible. **Bark**: twigs, red to red-brown; young trunks, smooth dark red-brown; old trunks, black, rough, broken plates. **Other Characteristics**: 40 to 60 feet tall, few branches form spreading crown, prefers rich, moist soils, but can be found in dry, sandy soils.

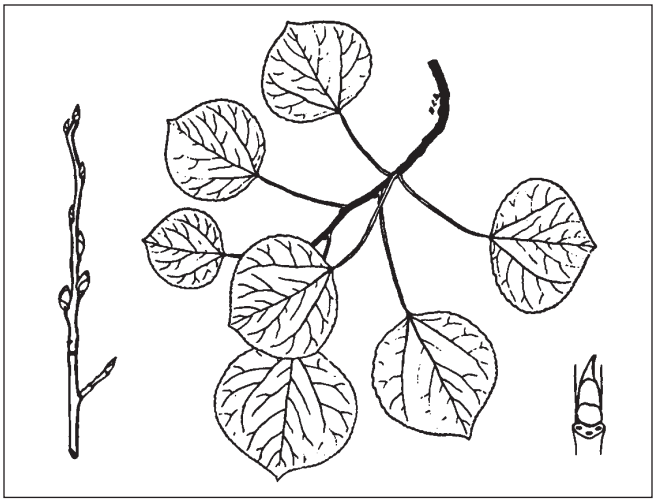
Black Willow

Leaves: alternate, simple, 3 to 6 inches long, lance-shaped, long, pointed, finely-toothed, bright green. **Fruit**: June, capsule, 1/8 inch long, containing many seeds, carried on white cottony-like hairs. **Bark**: twigs, bright red-brown, darkening with age; trunks, nearly black with broad, flat ridges. **Other Characteristics**: 30 to 60 feet tall, short trunk, spreading branches, open crown; found on stream banks and lake shores.



American Elm

Leaves: alternate, simple, 4 to 6 inches long, oblong, coarse, double-toothed edges, dark green and rough. **Fruit**: May, small winged fruit with one seed, 1/2 inch long, borne in clusters. **Bark**: twigs, light green and downy, turning red-brown then gray; trunks, dark gray with deep, scaly ridges. **Other Characteristics**: 40 to 100 feet tall with upward rising branches forming an umbrella-shaped tree; prefers deep, rich, moist bottom lands.

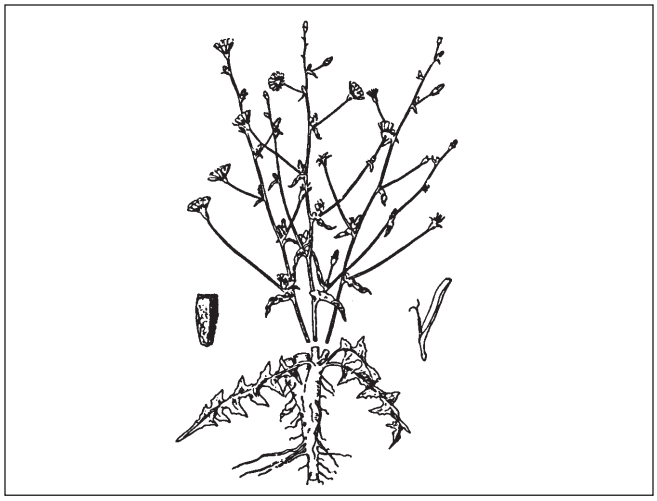


Trembling Aspen (Quaking Aspen, Poplar)

Leaves: alternate, simple, 1 to 3 inches, round, dark-green above, dull pale beneath, on flat stems. **Fruit**: May–June, small, oblong capsules, 1/4 inches long with light-brown cottony seeds. **Bark**: twigs, shiny red-brown, turning grayish then greenish and smooth; old trunks, black with ridges.
Other Characteristics: 30 to 50 feet tall with loose, rounded crown, preferring moist, sandy soils along hillsides.

Cattail

Perennial. **Leaves**: long, flat. **Stem**: erect, grow to 6 feet or more. **Flowers**: long, brown, fuzzy, grow on stalks taller than the leaves. **Other Characteristics**: grow in wet soil up to a water depth of 3 feet and must have leaves and flower spikes above water.



Chicory

Perennial. **Taproot**: large, deep, and fleshy. **Stem**: erect, branched, smooth with a milky sap. **Leaves**: basal and along the stems. Basal leaves forming a rosette, 6 to 8 inches long, lobed, and resembling those of a dandelion. Leaves on stems, smaller and either less lobed or entire. **Flower heads**: of ray flowers only, bright blue, about 1 inch across, formed at ends of branches in the axils of leaves of upper part of plant. Flowers are most conspicuous in the morning and close later in the day. **Seeds**: dark brown, wedge-shaped, about 1/8 inch long.

Goldenrod (Gray Golden Rod)

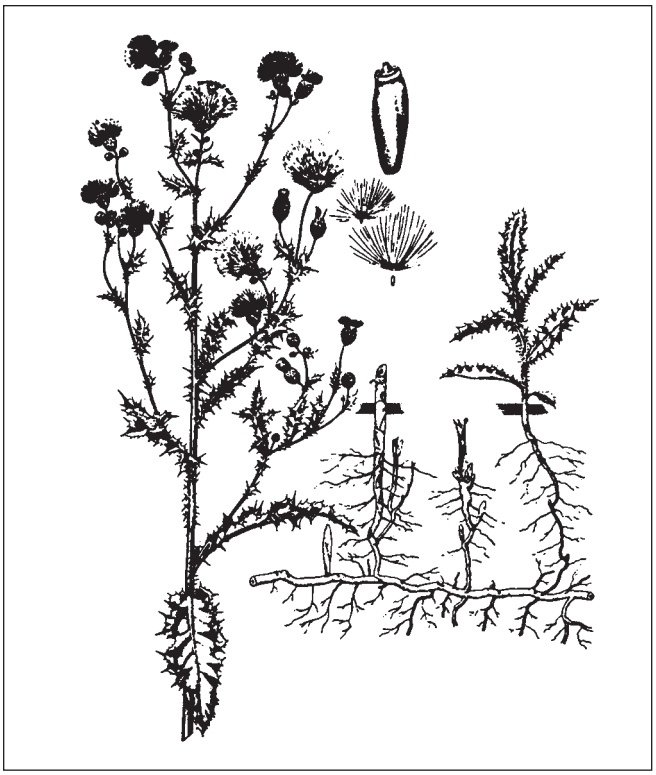
Perennial. Found in recently abandoned fields, fence rows, and open woods especially on dry sites. **Stems**: 6 to 10 inches tall, hairy, grayish. **Leaves**: on lower plant, petioled and tongue-shaped. Upper leaves are smaller, oblong, grayish and hairy.
Flower heads: small and cylindrical in a slender curving one-sided cluster. 2 to 8 inches long. Ray flowers few, small, yellow; disk flowers few, small and yellowish. **Seeds**: oblong, about 1/16 inch long, bearing a tuft of white bristles on the top.

Wild Carrot (Queen Anne's Lace)

Biennial. **Stems**: (second year) erect, 1 to 3 feet tall, hairy, stout, and branched at top. **Leaves**: alternate, finely pinnately divided, hairy with distinct carrot-like odor. **Flowers**: small, with 5 white petals, borne in umbels at ends of branches. **Seeds**: 1/8 inch or less long, one side flattened, the other rounded and showing 4 heavy, long-bristled ridges with smaller ones between. Outside seed-bearing stalks curve in sharply as they mature.

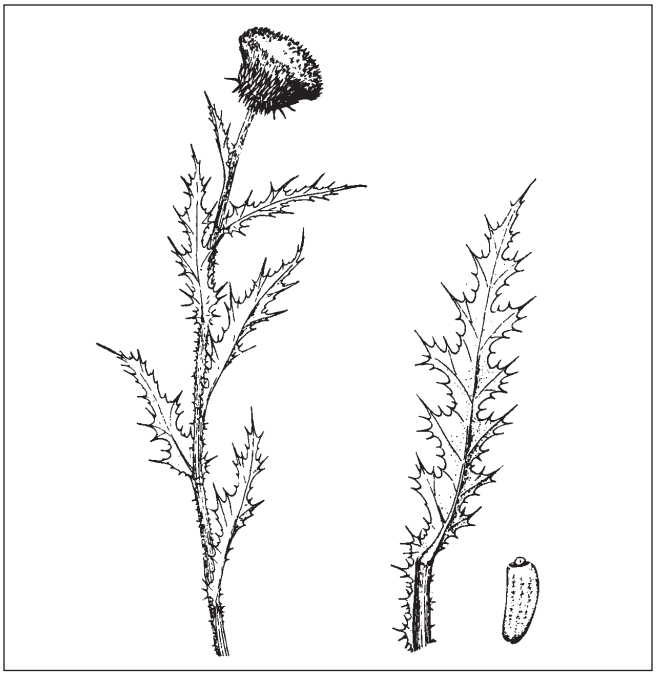
Poison Ivy

Woody perennial. Either a low shrub or a vine. **Leaves**: consist of 3 large, shiny leaflets each 2 to 4 inches long, pointed at tip. Leaflet edges either smooth or irregularly toothed. **Flowers**: small, green, 5-petaled borne in a head 1 to 3 inches long. Berries small, white, round and hard.



Canada Thistle

Perennial. Roots: extend several feet deep and some distance horizontally. **Stems**: 2 to 5 feet tall, grooved, branching only at top, slightly hairy when young, increasingly hairy as they mature. **Leaves**: usually with crinkled edges and spiny margins, somewhat lobed and smooth. **Flower heads**: numerous, compact, about 3/4 inch or less in diameter, of lavender disk flowers only. Surrounded by bracts (leaf-like plant parts located either below a flower or on the stalk of a flower cluster) without spiny tips. Male and female flowers usually in separate heads and borne on different plants. **Seed**: brown, smooth-coated, slightly tapered, about 3/16 inch long and with a ridge around the blossom end. Seed attached to tannish down that is easily broken off.



Musk Thistle

Biennial. **Stem**: erect, spiny with spiny wings, 3 to 6 feet tall, lower portion branched. Stems and branches densely covered with short hairs. **Leaves**: alternate, coarsely toothed, extending down the stem, very spiny. **Flower heads**: as much as 2 inches across, on the ends of long, nearly naked stems, frequently drooping or nodding; flowers purple or lavender; spiny-tipped bracts surrounding the head. **Seeds**: about 3/16 inch long, glossy yellowish-brown, pappus hairlike.

Purple Loosestrife

Perennial. **Stem**: 2 to 4 feet tall. **Leaves**: stalkless, downy, opposite or in three's. **Flower heads**: slender spikes of 6-petaled blossoms that carpet swampy meadows with a magenta color.

Phragmites

Perennial. **Stem**: a stout reed that grows 6 to 12 feet tall. **Leaves**: long, tapering to a sharp point. **Other Characteristics**: Swamps and wet shores, tolerant of salt, seldom producing seed.

Review Questions: Chapter 2

Write the answers to the following questions. When you are satisfied with your answers, see if they are correct by checking them with the chapter text.

1. List the four stages of weed development and briefly describe each.

2. List the three plant types and briefly describe each.

3. What is the difference between a monocot and dicot plant?

4. Grasses may be annual or perennial. *True or false*?

5. How does a sedge differ from a grass?

6. All actively growing broadleaf plants have _____ at the end of each stem and in each leaf axil.

7. Trees are annual plants. *True or false*?

8. How do ferns reproduce?

9. _____ plants live on and get their food from host plants.

10. What are the classifications of aquatic plants?

11. Do you need a permit from the Department of Natural Resources to control aquatic plants?

12. Identify the following trees:
    - ❏ What tree has dark-brown, flat pods that are 3 to 4 inches long?
    - ❏ What tree has slender, bright red twigs in the winter that turn light gray and prefers swamps and stream banks?
    - ❏ What tree has 3 different shaped leaves? The bark is dark red-brown, orange when cut with a knife.
    - ❏ What tree has round leaves with flat stems that are said to "quake" in the wind?

13. Identify the following weeds:
    - ❏ What perennial has a taproot, a bright blue flower and smooth milky sap?
    - ❏ What weed smells like a carrot?

14. Which thistle is a perennial and has a greater root system: Canada or musk thistle?

15. Cattails must have their leaves and flower spikes above water to survive. *True or false*?

CHAPTER 3

HERBICIDES AND WEEDS

Herbicides are pesticides that control weeds. Plant, soil, and climatic conditions, as well as the method of application can influence herbicidal action. This chapter looks at the factors to consider when selecting herbicides and explains how herbicides work.

As you consider the variables that impact your selection of chemicals for weed control, remember that the product label defines the legal uses and application for that product. Legal action may be taken against you if you improperly use these products.

Factors Affecting Herbicidal Action

Many factors affect how a plant will respond to an herbicide: plant characteristics, the climate, and the characteristics of the herbicidal action. To select the most effective herbicide, all of these factors must be considered.

Herbicidal Action Characteristics

How a particular herbicide works within a plant is one factor that will determine if it will successfully control a weed. Common characteristics of herbicides are explained in this section.

Foliage-absorbed or Root-absorbed. Foliage-absorbed herbicides enter the plant through the leaves (postemergence). Root-absorbed herbicides enter the plant through the roots and are generally more effective when applied preemergence.

Contact or Translocated (Systemic). Contact herbicides kill only the green portion of the plants where the herbicide directly contacts the weed. Most are nonselective and are effective in controlling annual and biennial weeds, and provide temporary suppression of perennials. Translocated (or systemic) herbicides move throughout the plant, whether foliar- or root-absorbed. These herbicides are especially useful for perennial weed control because they move into the roots.

Persistent or Nonpersistent. Persistent herbicides remain active in the environment for an extended period of time whereas the action of nonpersistent herbicides is relatively short-lived. The degree of persistence is greatly influenced by temperature, sunlight, moisture, soil type and rate of application.

Selective or Nonselective. A selective herbicide kills specific weed pests and does not kill surrounding vegetation. Non-selective herbicides remove most or all vegetation. Selectivity can also be influenced by the application method or rate and the timing of application.

In the right-of-way industry, vegetation management is often defined as either selective or nonselective. For this reason, separate sections later in this chapter will more closely examine herbicides grouped as selective or nonselective.

Plant Characteristics

Knowledge of plant biology and life cycles will help you understand how plant characteristics of the particular pest may impact the action of an herbicide. Several of these plant characteristics are listed below.

Growing Points. If the plant's growing points are sheathed or located below the soil surface, they will not be reached by contact herbicide sprays.

A variety of vegetation grows in rights-of-way. Learn plant biology and life cycles to effectively and efficiently control weeds.

Leaf Shape. Herbicides tend to bounce or runoff narrow, upright leaves. Broad, flat leaves tend to hold the herbicide longer.

Wax and Cuticle. Foliar sprays may be prevented from entering the leaf by a thick wax and cuticle layer. The cuticle is the top layer of leaf cells and is covered by wax.

Leaf Hairs. A dense layer of leaf hairs holds herbicide droplets away from the leaf surface, allowing less chemical to be absorbed into the plant. In contrast, a thin layer of hairs allows the chemical to stay on the leaf surface longer, therefore more chemical is absorbed.

Deactivation. Certain plants can deactivate herbicides and are less susceptible to injury from the chemicals.

Stage in Life Cycle. Seedlings are highly susceptible to most control practices. Plants in vegetative and early bud stages are very susceptible to translocated herbicides. Mature plants are the least susceptible to weed control.

Timing of Stages in the Life Cycle. Weeds that germinate and develop at different times than the plant species you want to protect, may be susceptible to carefully timed herbicide applications.

Climatic Factors

The climate where you are applying the herbicide can have considerable impact on its effectiveness. Consider the factors listed here when selecting and applying herbicides.

Relative Humidity. A foliar-applied herbicide enters leaves more easily and rapidly at higher relative humidity. Under such conditions, the weed leaf is more succulent, may have less of a wax layer and thinner cuticle, and the cuticle is hydrated with water. Herbicides work best when plants are actively growing: high relative humidity usually enhances active growth.

Light. The presence or absence of light can affect how fast the herbicide acts. Light breaks down some herbicides if they remain on the soil or plant surface for a long time.

Precipitation. Soil moisture and rain affect the way herbicides work and how long they stay on the soil and plants. Too much soil moisture may keep the herbicide from contacting and being absorbed by soil particles. Heavy downpours or large amounts of rain can cause soluble herbicides to leach through the soil or run-off the site. However, light rain can be beneficial after root-absorbed herbicides have been applied because it carries them down into the soil surface where they can be absorbed by the roots of the target vegetation.

Wind. Sprayed herbicides can be blown by wind off-site during application. However a light wind is preferred over no wind because fine droplets can remain suspended in the air and moved off-site when the calm breaks. Hot dry wind may make foliar herbicide penetration more difficult because droplets will dry rapidly.

Temperatures. Temperature generally does not affect weed control results but may affect the time required for the herbicide to work. Generally, as temperatures increase so does the herbicidal action. High temperatures enhance herbicide volatility. Warm temperatures also create warmer soils with increased microbial activity, which reduces the persistence of residual, soil-active herbicides.

During early morning and late evening, the difference in the air temperature at ground level and at some distance above ground is considerably less than during the middle of the day. As the ground warms up, the air temperature near the ground becomes significantly higher than the air above it. This warmer air rises and may set up convection and thermal air currents which lift small particles; these suspended particles may be carried some distance before they settle out. For this reason, and because wind speeds are frequently lower, *it is often better to apply pesticides either in the early morning or in the evening*. **Note**: Calm conditions with a **temperature inversion** (ground air two to five degrees cooler than the air above it) may result in the smallest spray droplets remaining suspended as a dense cloud in a layer of undisturbed air. The entire cloud may move out of the area before coming to rest, resulting in relatively high drift deposits. Sufficient turbulence should be present in the atmosphere to disperse clouds of small drops when the spray is applied.

Length of Growing Season. Longer growing seasons result in warmer soils and reduced herbicide persistence.

Selective Herbicides

Selective *broadleaf weed* control is used in right-of-way areas such as roadsides, interchanges, flood control dikes, and public trails. Controlling broadleaf weeds will encourage a grassy cover, reduce mowing, improve visibility, control noxious weeds, prevent erosion, improve drainage and possibly the appearance of the right-of-way.

Controlling *brush and woody vegetation* that sprouts from stumps of trees and seedlings in the right-of-way is the largest single cost of maintaining utility rights-of-way. It is also an important factor in maintaining railroad and road rights-of-way and drainage courses. Tree and brush control along roadsides is required to maintain visibility, increase highway safety and reduce shading and uneven thawing and drying of the pavement in winter. Brush also blocks ditches and drainage ways, causing crop lands and residential areas to drain poorly. Trees along utility corridors can damage equipment, cause power failures, start forest fires, and present a severe threat of electrical shock or death to the public and utility workers.

Selective herbicide applications are used in these areas to control unwanted weeds and brush. The treatment methods can be categorized as:

- Foliage spraying
- Basal spraying
- Granular or pellet
- Spotgun or exact dosage
- Cut surface herbicide

There are many variations in application methods which will be discussed in more detail under each of these five groups.

Foliage Spraying Methods

Foliage treatments can be done successfully from full leaf expansion in late spring to leaf color change in the fall. However, some herbicides work best only in the latter half of the season. Ordinarily, foliage spraying should stop after the first hard frost. Be sure to consult label directions for timing guidelines.

There are three basic foliage spray treatments used in right-of-way maintenance:

- low volume ground foliar
- high volume ground foliar
- aerial

Low Volume Ground Foliage Treatments. This treatment may be applied with equipment ranging from backpack sprayers to boom sprayers to specialized boomless sprayers. It requires a certain amount of herbicide delivered in 10 to 100 gallons of water per acre. Target plants are not treated to the point of runoff of the spray mixture, but thorough coverage is necessary. Spot treatments and selective spraying of individual stems is to the point of coverage and not runoff. Excess spray from the runoff could control non-target species. In boom spraying, an even distribution of the mixture is applied over the target area. Generally a greater concentration of herbicide is used than in high volume foliage spraying.

Right-of-way foliage spraying.

Advantages of this treatment method are the speed at which an area can be treated and uniform coverage.

Disadvantages include over application through broadcast applications that may not be necessary over the entire treatment area. Vegetation characteristics, site conditions and equipment limitations may limit areas that can be treated.

Drift is probably the greatest disadvantage with this treatment method because of the higher concentration of herbicide in the mixture. Observe the following precautions to avoid drift:

- Use equipment that is designed to minimize drift, such as low pressure sprayers, large orifice size nozzles, etc.
- Use low-volatile herbicide formulations.

- Use appropriate adjuvants to lessen drift potential.
- Avoid spraying near crops or sensitive residential areas (e.g. gardens, swimming pools, landscaping, pet houses).
- Only spray during proper weather and wind conditions.

Other potential problems are handling leftover spray mix and runoff of residual herbicide. Carefully, estimate your needs before mixing the last load and use any leftover material according to label directions on the application site.

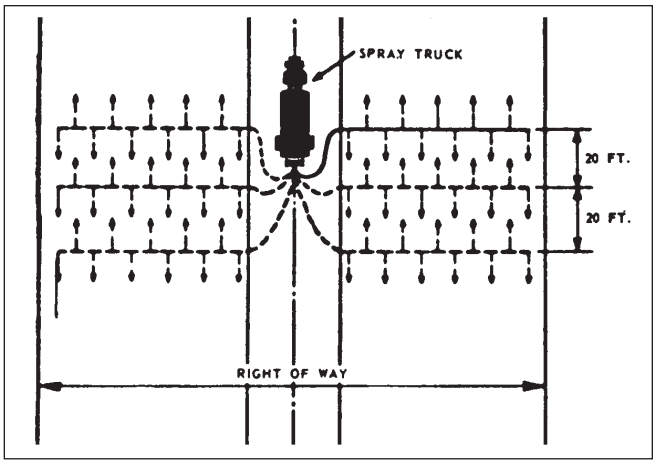
High Volume Ground Foliage Treatments. High volume ground foliage treatments are a major method used on utility rights-of-way and along roadsides and drainages to control brush. Usually these treatments are done with a high pressure sprayer mounted on a truck, tracked vehicle, or skidder.

High volume foliage spraying is different from low volume foliage spraying in these respects:

- A specific concentration of herbicide is applied instead of a rate per acre.
- Foliage is sprayed to the point where additional spray begins to drip off of the treated foliage, commonly called "spray to drip."
- Larger volumes of mix are used to treat individual stems.
- Depending on brush size and density, the amount of herbicide applied per acre will vary considerably.

This treatment works well on tall brush species and in areas where brush is particularly dense. Brush is treated individually by the applicator using a high pressure handgun. Normally opposite sides of the tree should be treated to ensure complete foliage coverage. The "H-pattern" illustrated on this page is a good method to ensure coverage and avoid non-target damage. An applicator using the H-pattern walks out from the truck to the edge of the right-of-way. The spraying then begins at the edge of the right-of-way. While spraying a swath that is parallel to the truck, the applicator returns to the truck. Spraying always begins at the outer edge of the right-of-way and ends at the truck.

The major concerns with this treatment are avoiding drift and spraying of non-target plants. Take the following precautions:



"H" PATTERN: This is the proper pattern for treating brush from both sides.

- Do not treat excessively tall brush when you cannot control the spray.
- Avoid extending your spray pattern too high or too far.
- Use as low a pressure as possible.
- Use appropriate adjuvants to lessen drift potential.
- Avoid spraying next to crops and sensitive residential areas.
- Avoid spraying during unfavorable weather conditions.
- Spray parallel to the edge of the right-of-way or towards the center of the right-of-way.

Aerial Application. Aerial applications on rights-of-way are most often conducted by helicopters using a microfoil boom-type sprayer. (*Each pilot must be certified in the aerial standard in addition to the right-of-way category to make right-of-way aerial applications.*)

Rights-of-way are sprayed aerially in remote areas or those inaccessible to ground equipment. Terrain and site characteristics such as steep hills, or wet areas are often better suited to aerial applications. Vegetation that is too tall or too dense for ground equipment may also be sprayed aerially.

Basal Spray Methods

Basal treatments, applying herbicide to the lower portion of the plant, can be made at any time of year except when snow or ice prevent spraying at the groundline. A proper application will give satisfac-

tory results. This type of treatment lengthens the application season, can be used close to susceptible crops and is very selective. Care should be exercised near crops and other sensitive areas to avoid vapor drift from volatile formulations.

Two application methods widely used are conventional basal and low volume basal. Low volume basal is a relatively new treatment method that is quickly growing in popularity.

Conventional Basal Spraying. Conventional basal spraying thoroughly wets the entire lower portion of individual stems of the plants. All exposed roots should be treated but no attempt is made to spray the top of the plants. A sufficient amount of herbicide mixture is applied to cause "run down" to the root crown.

Conventional basal treatments are applied to the lower portion of the plant.

Successful basal treatments are accomplished with backpack or power basal sprayers and can be done on brush up to 6 inches in stem diameter. There must be an adequate amount of mixture applied. Normally, No. 2 fuel oil or its equivalent is used as a carrier for the herbicide and helps to penetrate the bark of woody species. Dilution ratios generally range from one to four percent and are given on the product label. Conventional basal has lost popularity in recent years due to high oil prices, public objection to the carrier's odor and the advantages of low volume basal spraying.

Low Volume Basal Spraying. Low volume basal treatments are similar to conventional basal treatments. In low volume basal a more concentrated herbicide mixture is used to conserve the amount of carrier applied per stem. Common mixes range from 20 to 30 percent herbicide or one gallon of herbicide plus three to four gallons of oil diluent. New basal oil diluents are available that are effective bark penetrators. Stems are treated 12 to 24 inches from groundline, completely encircled and sprayed until wet but not rundown. Large oil volumes and big equipment are not necessary with low volume basal, an applicator carrying a five-gallon backpack can work all day without refilling.

Equipment for low volume basal spraying consists of backpacks and special low volume wands with a very small opening at the tip which changes the spray pattern to a fine mist, rather than a steady stream. Some wands have a positive shutoff at the tip of the wand which eliminates dripping. This application is much like spray painting without drips and runs. Low pressure (less than 20 psi) is used to lessen the potential for off-target drift.

Granular and Pellet Application Methods

Granular and pellet formulations are applied directly by hand, using hand-operated spreaders, or with mechanical spreaders.

Direct hand application and hand-operated application equipment is often used on rights-of-way to treat small areas and areas with sparse populations of target vegetation. Hand-operated equipment can be either motorized such as a modified, backpack mist blower or hand-powered "cyclone" spreader. Direct hand applications are most suited to treating individual stems or clumps of brush and trees and treating around sign posts, poles and tower bases.

This applicator is using a hand-held pellet applicator sometimes referred to as a belly grinder.

(Be sure that protective gloves are worn with these treatments.) Hand-held equipment works well on small areas not large enough for vehicle-powered spreaders but too large for direct hand applications. Hand-held equipment is more accurate than direct hand applications because it applies a more uniform pattern at a constant rate.

Mechanical spreaders provide uniform coverage of the treatment area if the vegetation does not interfere with the dispersion of the granules. Advantages include a faster application time per acre and more uniform results. However, broadcast applications of granular herbicides can cause damage to non-target vegetation such as trees and shrubs along the edge of the right-of-way.

Exact Dosage "Spotgun" Applications

While not widely used for right-of-way vegetation control, the spotgun application method should not be overlooked. Spotguns are a type of hand-held or backpack sprayer that deliver a pre-measured dose of concentrated herbicide to the base of target

These applicators are loading a granular mechanical spreader. Their hats are good protective clothing although they should also be wearing gloves.

vegetation. The herbicides commonly used are soil-active and kill the target vegetation through root uptake of the herbicide. The idea behind spotgun applications is that a concentrated dose of herbicide is placed in the root zone of the target plant creating a localized "hot spot." Root uptake of the herbicide in this hot spot eventually kills the target plant but does not affect nearby plants whose roots do not extend into the hot spot.

In effect this treatment is very similar to the individual stem treatment using a granular formulation except that a liquid formulation is used. This application method is a very efficient in sparse vegetation where non-target vegetation will not be affected by root uptake. Carefully avoid treating brush too close to the edge of the right-of-way or near desirable vegetation.

This tree trunk has received a cut surface treatment known as frilling or hack and squirt.

Cut Surface Herbicide Treatments

Cut surface treatments are commonly called descriptive names such as; cut stump treatment, stump treatment, frilling, hack and squirt, girdling, etc. All of these treatments involve cutting through the bark that encircles the trunk of woody trees to aid the uptake of herbicide. Generally, amine salt formulations of herbicides are used because they are water soluble and easily introduced into the tree's vascular system. The two most common treatments are treating stumps of hardwood trees to prevent sprouting and treating the frilling wounds of brush to kill the root system.

Trigger bottles and compressed air sprayers are the most common application equipment used in cut surface treatments, but backpack sprayers and even paint brushes can be used to apply the herbicide to the cut surface.

The most frequent mistakes made by applicators with this method are applying too much chemical to the cut surface, making improper frilling or girdling cuts, and applying too close to desirable vegetation.

Only the outer edge of a stump needs to be treated since the herbicide is transported through the vascular system and the cambium layer, which is located just inside the tree's bark. Improper frilling can leave avenues of cambium and vascular tissue untreated, causing poor results. Lastly, many of the herbicides used for cut surface treatments can remain active in the soil for several months and damage nearby vegetation through root uptake when applied incorrectly.

Non-Selective Herbicides

Non-selective vegetation control may be necessary around substations, pole yards, storage areas, guardrails, parking lots and other areas. Vegetation in these areas can be a fire hazard, public nuisance, health hazard, breeding area for rodents and can reduce public safety and facility security.

Non-selective residual herbicides are pesticides that control most plant species and may prevent plant regrowth for a year or more, depending on the active ingredient and the rate used. These herbicides act on a wide variety of plants, although most non-selectives do not affect all plants equally well. Non-persistent systemic herbicides may control existing vegetation but do not provide long term control against plant regrowth.

Factors Affecting Non-Selective Herbicides

Non-selective systemic herbicides move internally within the plant and kill both foliage and roots. Non-selective soil residual herbicides remain active in the soil for a relatively long time, keeping it free of re-growth. Frequently different types of herbicides are combined to kill foliage and provide on-going control of roots and seedlings. Specific factors that affect non-selective herbicides are discussed here.

Soils. Herbicides react differently with different soil types. Light sandy soils tend to hold herbicides less than heavier clay soils. Herbicides applied to sandy soils tend to control weeds quicker but the duration of effective weed control is usually short. Certain heavy soils or soils high in absorptive materials, such as organic matter, charcoal, cinders, or sawdust, tie up chemicals more readily and reduce the immediate weed-killing effect. Label directions often have application rates for different soil types to optimize control.

Moisture. Water is important to help transport herbicides to the weed's root system. Adequate soil moisture must be present before non-selective chemicals can enter the root system of plants. If heavy rainfall occurs, water can leach the herbicide from the upper surfaces of the soil and reduce its effectiveness as well as threaten non-target species. Or a heavy rain may cause the herbicide to runoff into non-target areas. Light rainfall is often beneficial as it incorporates the herbicide into the upper layer of the soil and facilitates root uptake.

Vegetation Types. The type and species of vegetation also influence chemical selection because different plants have different tolerances for chemicals. Annual weeds and grasses originate from seeds in the soil surface and can be controlled with low rates of residual herbicides. Perennial vegetation has root systems that live from year to year in the soil so that either translocated specific herbicides or non-selective chemicals at higher dosages are required for control.

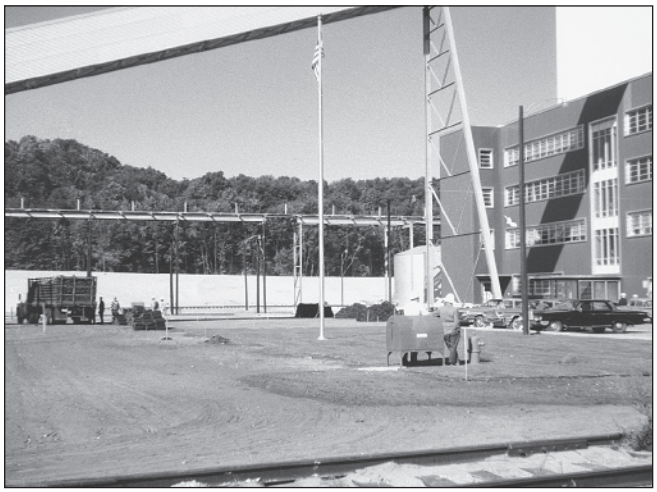
Soil Microorganisms. Bacteria and fungi in soil break down pesticides and shorten their period of effectiveness. Microorganisms attack some pesticides as a food source.

Application Methods

Non-selective herbicides can be either contact or systemic herbicides and are applied to foliage, or soil-active herbicides applied to the soil and roots. The particular situation determines which herbicide to use. If the problem weeds are on a slope, use of a contact killer would temporarily control the foliage but leave the living roots to prevent erosion. If you want to kill existing vegetation and immediately replant with ornamentals, a systemic herbicide with a short residual life in the soil would be preferable. Sometimes combinations are used to obtain the desired results, that is, a foliar active material is used with a soil residual formulation. Always check the product label to learn if pesticides can be safely combined. Some herbicides are both foliar and soil active and can be used in place of combinations.

The best results from soil residual herbicides are achieved in early spring before the weeds emerge or when they are small. If herbicides have leached or runoff the target area (lateral movement) in former years, a lower rate should be applied later in the spring with a contact foliar herbicide. Continuous year after year applications of the same herbicide

can lead to a build up in the soil of the herbicide and may promote the development resistent or tolerant weeds. The built-up herbicide may also reach groundwater and contaminate it. Therefore, alternate herbicides every few years to avoid these problems. As with broadleaf weed control, evaluate the work at the end of the season.



Non-selective applications are made around areas such as this substation.

Application Precautions for Non-Selective Herbicides

- Do not apply where the root systems of nontarget trees or shrubbery may extend into treated areas.
- Do not apply to frozen ground. The material will-not be absorbed into the soil and will probably runoff to an undesirable area.
- Use extreme caution in applying soil-residual herbicides on slopes. Heavy rain may cause the herbicide to runoff and damage adjacent areas or pollute streams, rivers, or other bodies of water.
- Use low pressure. High pressure applications often drift causing severe damage.
- Choose non-corrosive materials when applying around machinery, fences, tanks or other metallic equipment. Be sure the herbicide is not detrimental to other materials stored in the area.

Other Chemicals for Control

Some chemicals, such as plant growth regulators, defoliants, and desiccants, alter normal plant processes. These chemicals are subject to the same laws and regulations as are pesticides. A **defoliant** causes leaves to drop from plants without killing the plants. A **desiccant** speeds up the drying of plant leaves, stems, or vines. A **plant growth regulator** speeds up, stops, retards, prolongs, starts or in some other way influences vegetative or reproductive growth of a plant. Because growth regulators are commonly used in rights-of-way a separate chapter will address this topic.

Review Questions: Chapter 3

Write the answers to the following questions. When you are satisfied with your answers, see if they are correct by checking them with the chapter text.

1. Root-absorbed herbicides are generally more effective when applied postemergence.
   True or false?

2. What is the difference between a contact and systemic herbicide?

3. Temperature, moisture, soil-type and rate of application influence the persistence of a herbicide.
   True or false?

4. What is temperature inversion and how can it affect pesticide drift?

5. What is the difference between a selective and non-selective herbicide?

6. If a plant's growing points are below the soil surface, which type of herbicide will provide better control: *contact or systemic*?

7. How can plant leaf shape affect herbicidal action?

8. Which is more susceptible to herbicides: seedlings or mature plants?

9. What climatic factors affect herbicidal action?

10. Do herbicides work more quickly in warmer or cooler temperatures?

11. What are the five categories of selective herbicide applications?

12. What are the three basic foliage spray treatments used in right-of-way management?

13. What are the basic differences between low volume ground foliage and high volume ground foliage treatments?

14. How can you limit the potential for drift when using low volume ground foliage treatments?

15. What steps can you take to avoid drift and accidental spraying of non-target plants when using high volume ground foliage treatments?

16. Each pilot must be certified in the aerial standard in addition to right-of-way category to make aerial applications on rights-of-way. *True or false*?

17. What is the difference between conventional basal spraying and low volume basal spraying?

18. In low volume basal spraying, stems are completely encircled and wet to rundown. *True or false*?

19. What are the advantages and disadvantages of granular and pellet applications?

20. What are "spotgun" applications?

21. "Stump spraying" and "hack and squirt" are names for cut surface herbicide treatments. *True or false*?

22. What are the most common mistakes made by applicators using cut surface herbicide treatments?

23. Non-selective chemicals must be have moisture to enter plant root systems. *True or false*?

24. If you want to completely kill existing vegetation and immediately replant with ornamentals, you should use a _____ herbicide that is short lived in the soil.

    a) systemic

    b) contact

25. When are the best results from soil residual herbicides achieved?

26. List the five precautions recommended for non-selective herbicide applications.

27. What is the difference between a defoliant and a desiccant?

CHAPTER 4

PLANT GROWTH REGULATORS

A plant growth regulator is a chemical that alters a plant's vegetative growth or reproductive characteristics. These chemicals can be used to control and manipulate plants and are gaining wider use in the right-of-way industry.

There are two groups of plant growth regulators currently being used in right-of-way pest control. The first group alters the ability of plant cells to elongate (lengthen) during the growing season. This group is commonly referred to as **anti-gibberellins** or **gibberellin inhibitors**. The second group, **auxin type**, accelerates cell growth and reproduction. Other plant growth regulators act to quicken abscission or ripening or inhibit the plant cell's ability to divide and multiply. However, these types of growth regulators have not found much use in right-of-way management. This chapter will look at the first two groups of plant growth regulators and the factors to consider when using these pesticides.

The first group of growth regulators (anti-gibberellins) inhibits the production of the plant's gibberellic acid, the hormone that initiates cell elongation. By introducing an anti-gibberellin into the tree's system, you block production of gibberellic acid and developing cells will not fully elongate. Therefore, the tree does not appear to "grow" as much, branches are shorter and leaves are smaller. This type of growth regulator is increasingly being used by utility companies to decrease the frequency and amount of tree trimming required around power lines. Highway departments are also finding it useful on roadside turf to inhibit seedhead formation and reduce vegetative growth which in turn reduces mowing frequency.

A second group of growth regulators (auxin type) mimic naturally-occurring plant hormones. These chemicals are either very similar to naturally-occurring hormones or are synthetic versions of the actual plant hormone. Several auxin type herbicides such as 2,4-D, dicamba, and glyphosate mimic plant growth hormones and actually cause the plant to grow itself to death. When applied at lower (sub-lethal) doses these compounds can act as growth regulators. This type of chemical must be applied at precise rates to achieve the desired result.

Growth regulators are controlled by the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). Store, handle and apply growth regulators using the same precautions and procedures as used with pesticides.

Tree Growth Regulation

Gibberellin inhibitors that block cell elongation are used on trees near utility distribution lines and telephone or cable TV lines. They are injected into the tree xylem, the woody tissue that conducts moisture and provides structural support. They may also be applied to the soil or injected into the soil at the tree's root zone. Check the product label for specific application directions.

The inhibitors move upward into the tree canopy through xylem water movement to the growing points in the crown where they reduce branch growth and leaf size. Because of the specialized

These applicators are preparing to make a tree injection.

nature of this type of chemical, additional applicator training is recommended.

The activity of these compounds will vary according to the tree species, application rate, environmental conditions, and trimming severity. Generally, growth regulation will not have much effect until the next growing season and will likely last for several years. Because these types of compounds are usually formulated with an alcohol carrier, trunk injection in the north should be done only from bud break in the spring to leaf drop in the fall. This will reduce the possible phytotoxic effect alcohol carriers may have on the tree's phloem and cambium tissues.

Growth regulators are also used in many asphalt-based tree wound dressings (tree paint). These products, which are applied to the wounded surface of trees branches after pruning, inhibit the production of branching—water sprouts or suckers.

Roadside Turf Regulation

Growth regulators used on turf suppress the plant seedhead development. Roadside turf generally consists of coarse types of grasses designed for hardiness as well as aesthetics. The most common species of turfgrass found in northern regions of the U.S. are tall fescue, smooth brome, and bluegrass varieties. Most treatments combine regulators to provide the desired level of growth regulation based on species diversity. Usually regulators are applied after the turf greens-up in the spring and before seedheads form.

All turf growth regulation compounds are applied by broadcast treatment. Applications before seedhead formation (April/May) will reduce growth for two to six weeks. Turf that has been treated with a growth regulator will appear a deeper green color during summer months. Specific tank mix and rate recommendations are given on product labels and should be followed carefully to avoid potential overdose and subsequent turf injury. Remember, the label is a legal document and you must conform with its directions.

Combining broadleaf herbicides with growth regulators provides two benefits with one application. (Check label recommendations for combining specific herbicides and regulators.) Since most applications are applied broadcast, fine-tuning of the rate may be necessary to allow for predominant species mix. If broadleaf herbicides are combined with the regulator, it will be necessary to consider both product types for the best time of application.

Industrial turf regulators are commonly used on utility substations, distribution and transmission ROW, generating stations, urban freeways, interchanges, boulevards, rest parks, interstates, toll roads, steep embankments on depressed highways, high traffic intersections where mowing equipment may dangerously impair traffic, rural highways and blind corners.

The darker turf at right in the photo has been treated with a growth regulator. Note that the "lighter," untreated turf has gone to seed.

When selecting and using a growth regulator, consider:

- the results from the type of regulator you choose
- rates must be determined for a given species
- results will vary with the timing of the application
- stage of growth of the given species will affect results
- the impact of environmental conditions.

Treatment rates are crucial because whether the chemical acts as a growth regulator or a lethal herbicide often is determined by only small changes in rate.

Species mix in the treatment area must be determined before application so the proper rate will address the predominant species. Finally, all growth regulators behave differently so it is very important to follow label directions.

Review Questions: Chapter 4

Write the answers to the following questions. When you are satisfied with your answers, see if they are correct by checking them with the chapter text.

1. Which group of growth regulators inhibits production of plant hormones that control cell elongation?

2. Which group of growth regulators accelerates cell growth and reproduction?

3. Growth regulators are not pesticides and therefore are not regulated by FIFRA. *True or false*?

4. Growth regulators are also used in some asphalt-based tree wound dressings. *True or false*?

5. Because most gibberellin inhibitors are formulated with an alcohol carrier, trunk injection in the Northern U.S. should only take place between _____ and _____.

6. Growth regulators used on turf suppress _____.

7. What are the most common species of turfgrass found along roadsides in the Northern U.S.?

8. Most turf treatments are a combination of regulators. *True or false*?

9. All growth regulators on turf are applied by _____treatment.

10. Growth regulators should be applied on turf before seedhead formation, usually the months _____and _____.

11. What are the five factors to consider when selecting and using a growth regulator?

12. Why are treatment rates crucial when applying growth regulators?

CHAPTER 5

OTHER RIGHT-OF-WAY PESTS

The major pest species on rights-of-way are plants. However, occasionally other pests such as insects, disease-causing pathogens, and vertebrates must be controlled. Insect outbreaks can seriously damage cover crops used for erosion control or aesthetics along roadsides or desirable screening plants. Disease may also damage or kill desirable right-of-way plant species. Vertebrate pests such as burrowing animals, beavers or gnawing animals can harm drainage courses, turf and desirable vegetation. This chapter discusses some of the control strategies for these pests. More detailed information about a specific insect, disease, or vertebrate pest can be obtained from your local Cooperative Extension Service office.

Insect Pest Management

Insects can severely damage or destroy desirable plants. They damage plants in many ways—by defoliating branches, sucking sap, or by boring and invading bark and wood. To control these pests it is necessary to understand their biology and life cycle.

Periodically inspect for insects and signs of their damage. An insect's mouthparts are important in diagnosis and identification of the pest since the mouth-parts initiate much of the plant damage. There are four basic types of mouthparts: chewing, piercing-sucking, sponging, and siphoning. Only the first two are of importance in right-of-way pest management.

Chewing Mouthparts

Grasshoppers and beetles are examples of insects with **chewing mouthparts**. Signs of damage from chewing insects are leaves which are skeletonized between the veins or which have portions of the normal leaf or needles missing, or complete defoliation of the plant. These insects cause most of their damage in spring and early summer.

Most boring insects have chewing mouthparts and usually are detected by a general decrease in plant vigor. A borer problem can be better identified by evidence of borer holes in the affected plant stem. Often a woody frass of "sawdust" will occur in conjunction with the bore holes. Plants in poor health or under some form of stress will attract boring insects.

Soil insects such as grubs are indicated by a general decrease in plant health, yellowing leaves, poor growth, or dying branches. Lawns, row crops or wild grasses are often attacked by these chewing insects which live in the soil.

Piercing-Sucking Mouthparts

Insects with piercing-sucking mouthparts such as aphids, scales, and spittlebugs, drink plant sap and may transmit certain diseases. Aphids secrete honeydew, which causes sooty mold to develop on leaf surfaces. Plant limbs may be completely encrusted with scales, which are sucking insects that are covered by a protective shell. Spittlebugs on some pines can easily be identified by the white foam they exude to protect themselves from the summer sun and heat. These foamy masses appear at the ends of branches.

Managing Insects

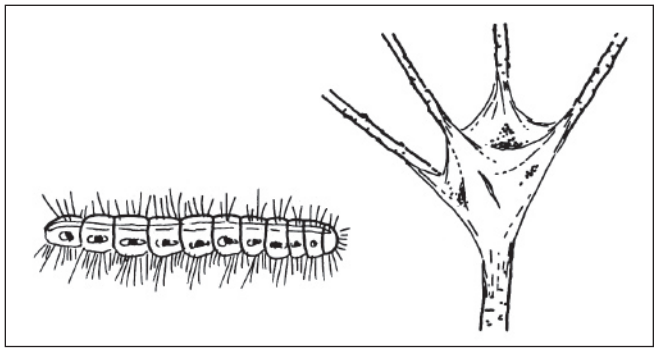
When a vegetation or turf problem has been identified as caused by an insect infestation, follow the principles of IPM (described in Chapter 1) to determine if a control technique is warranted.

The key to successful control of insect pests is knowing which stage(s) of their life cycle is the most vulnerable. The series of changes through which an insect passes in its growth from egg to adult is called **metamorphosis**. The degree of change varies in different insects. These variations identify the insect's classification of metamorphosis:

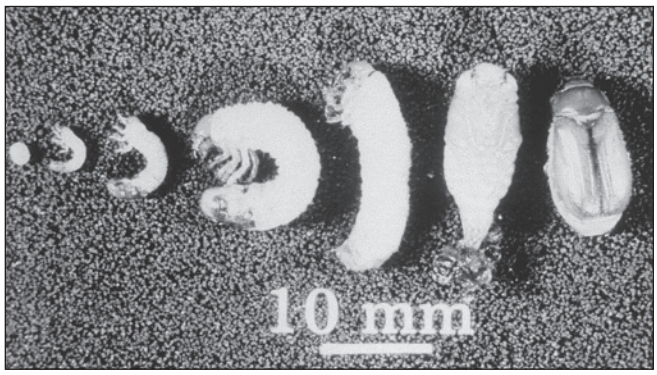
- **No metamorphosis**. Body proportions and internal organs of these primitive insects remain similar after each molt (shedding of old skin).
- **Gradual metamorphosis**. Changes are slight and gradual. The young or nymphs resemble the adults and feed in the same habitat. The insect's wing development is external.
- **Complete metamorphosis**. Drastic alterations including egg, larval, pupal (an active, resting stage) and adult stages. This classification includes the majority of insects.

When the young first hatches from an egg, it is either a larva, nymph, or naiad. After feeding for a time, the young molts and new skin is formed. The number of these stages, called instars, varies with different species. The heaviest feeding generally occurs during the final two instars.

It is generally difficult to control insects in either the egg or pupal stage, because these stages are inactive. Controlling insects in the late instar and adult stages is moderately successful. The best control is usually achieved during the early larval or nymphal stages when the insects are small and vulnerable. Control methods for insects include: host resistance, biological control, cultural control, mechanical control, sanitation, and chemical control.



The larvae of the eastern tent caterpillar construct a silken tent, usually in the crotch of smaller tree limbs. This pest feeds on many trees including wild cherry, birch, beech, willow barberry, oak, and poplar. The larvae consume foliage within the tent and also leave in the mornings and evenings to strip foliage from branches. The full-grown larva is a brownish-black, hairy caterpillar that is 40 to 50 mm long. A long, white stripe runs down the back with blue oval dots running along its side.



The European chafer is a grub that attacks grass. Small larvae can be found feeding on grass roots in August while larger larvae are present in the root zone in September and late April to June. This grub leaves patches of dead grass with the entire root system chewed off. The damaged grass can be lifted like a carpet.

Many insect species attack plants in a weakened or stressed state. Problems from these insects may be avoided with proper plant maintenance practices. When practical, desirable vegetation should receive adequate fertilization and watering to maintain plant vigor and avoid conditions which cause stress in plants.

Proper plant selection is also important. Insect resistant varieties and varieties better suited to the local environmental conditions should be considered when planning or designing right-of-way plantings. Remember, a healthy vigorous plant can often resist or withstand an insect attack without the need for chemical treatments.

Disease Pest Management

Disease control on trees and ornamental shrubs is a common part of a grounds maintenance program. Pest management for diseases should discourage disease problems by proper vegetation management and possible application of chemicals that prevent or inhibit infection. Here again, the Cooperative Extension Service can advise you as to the best types of treatments and the proper time to apply them.

Diseases are caused by a number of pathogens or agents. **Fungi** are the major cause of most plant diseases but **bacteria, viruses, pollutants and environmental agents** can cause or enhance plant diseases problems. Be aware that application equipment that is not cleaned between sites can transport disease agents from one site to the next spreading the disease.

Most diseases are classified by symptoms and named accordingly: wilts, blights, rots, cankers, rusts, etc. The problem of treating plant diseases is properly identifying the agent or pathogen causing the disease since more than one agent may cause similar symptoms. The three main plant responses to disease are:

- over-development of tissue such as galls, swellings, and leaf curls.
- under-development of tissue such as stunting, lack of chlorophyll, and incomplete development of organs.
- death of tissue such as blights, leaf spots, wilting, and cankers.

If you need assistance in diagnosing disease problems, contact your county Cooperative Extension office or other knowledgeable sources.

Remember that the best treatment is proper prevention. Select disease resistant plant varieties well-suited for the local environmental conditions. Choosing the wrong plant species or variety can lead to ongoing disease problems year after year. Maintain healthy plants and plants that are vigorous, since many diseases attack plants under stress or plants under attack by other diseases or insects.

If you use the same sprayer to apply fungicides and herbicides, be sure that you thoroughly clean to remove all traces of herbicides before loading the fungicide. Herbicide residue in the sprayer could harm the fungicide's target plant.

Fungi and Insects in Wood Structures

Wood structures such as utility poles, guard and sign posts, and bridge structures, are exposed to infestation by wood-destroying fungi and insects. Usually wood pole beams and structures have been initially treated with chemicals to prevent fungus invasion but after various lengths of time the initial treatments will lose their effectiveness and the wood must be retreated, usually in place. To treat wood structures on rights-of-way, you must be commercially certified to apply pesticides in Category 2A. Contact the local Michigan Department of Agriculture, Pesticide and Plant Pest Management Division for more information.

Vertebrate Pest Management

Vertebrates are animals that have a backbone. Occasionally they become pests which may require the right-of-way manager to use some method of control. Burrowing animals may damage drainage courses or lagoon dikes. Gnawing animals may damage turf or landscape plants and beavers often dam up small streams causing flooding of low lying land. On rare occasions other vertebrate pests such as birds, bats or raccoons may also require control.

Unlike most plant or insect pests, state laws may prohibit the killing or trapping of some animals. The Michigan Department of Natural Resources and Environment (DNRE) regulates the trapping of animals. To trap or handle wildlife in Michigan, you must first obtain a Pest Control Operator's Permit from the law enforcement division of the DNRE. For information about permits, contact:

Michigan Department of Natural Resources and Environment
P.O. Box 30028
Lansing, MI 48909
(517) 353-1230

To trap or handle migratory birds and protected or endangered species, a federal permit is also needed from:

U.S. Fish and Wildlife Service
Law Enforcement Division
District 3
Box 45
Federal Building, Fort Snelling
Twin Cities, MN 55111

Some of the options for vertebrate control are described here.

Mechanical control. These methods include barriers, traps, and shooting. Barriers such as fences, rock riprap and screens prevent pests from passing through an area. Several types of traps are available including; leg-hold traps, body-gripping traps, and live traps. Traditional leg-hold traps have the disadvantage of being relatively non-selective and may injure non-target animals. Body-gripping traps such as the "conibear" kill the trapped animal by crushing its body between powerful springs. Body-gripping traps are even less selective than leg-hold traps and almost always cause death. Live traps are more desirable, allowing the pest to be either destroyed or transported out of the area. Non-target animals can be released relatively unharmed. Shooting is time consuming, but very selective and is a good method of controlling larger animal pests. Check with the DNRE before shooting any vertebrate pests.

Sanitation control. Removing the food source is often the best way to control some vertebrate pests. Rodents living in an embankment may travel 200-300 feet to a dumpster or other food source. Improving cleanup around dumpsters may eliminate the problem. Survey the area for other ways to improve sanitation.

Chemical controls. Pesticides such as poisonous baits, retardants, etc., will control rodents but may also be highly toxic to humans and other animals. Secondary poisoning can occur when the animal that eats the bait is then eaten by another animal. Use extreme caution to ensure that only the desired pest will come in contact with the poison. Selecting an appropriate bait and placing it where the pest is known to frequent is important for effective baiting. Follow all label directions.

Review Questions: Chapter 5

Write the answers to the following questions. When you are satisfied with your answers, see if they are correct by checking them with the chapter text.

1. A plant with skeletonized leaves or that has portions of the normal leaf or needles missing is probably infested with a:
   a) chewing insect
   b) sucking insect
   c) sponging insect
   d) siphoning insect
2. What is metamorphosis?
3. What is molting?
4. What type of insect leaves honeydew or sooty mold on leaf surfaces?
5. What type of insect creates holes in plant stems with woody frass near the holes?
6. What are the indications of a soil insect problem?
7. What can you do to discourage insect infestations?
8. Who can you contact for help in identifying plant diseases?
9. List some causes of plant diseases.
10. What precautions help prevent plant diseases?
11. Can an applicator who is certified in only Category 6 treat wood structures for wood-destroying fungi and insects?
12. What is a vertebrate animal?
13. Who regulates the trapping of animals?
14. Describe several mechanical control methods for vertebrate pests.
15. Removing the food source is a type of _____ control for vertebrates.
16. What are the important factors to make a bait effective?
17. What is secondary poisoning?

CHAPTER 6

EQUIPMENT AND CALIBRATION

The equipment used in applying pesticides varies depending on the target, the type of application, the pest to be controlled and the pesticide formulation. There are many different types, including granule spreaders, boom sprayers, mist blowers, and aircraft. These types all have one requirement in common; they must apply the right amount of pesticide equally over the target area and the applicator must know what rate the equipment is applying. You know this as calibration.

This chapter describes the various application equipment used on rights-of-way and how to maintain and calibrate it properly. Remember to read and follow pesticide label directions to obtain the desired control without harming the environment.

Too little, uneven, or too much deposit are all inefficient use of material resulting in insufficient control, spotty control or excessive residue. Proper adjustment and calibration of the equipment can prevent needless waste of pesticide chemicals by depositing the required amount on the target.

The total deposit laid down on the target, excluding effects of drift or evaporation depends on:

- The concentration of pesticide in the tank. When spraying with a single nozzle or gun to the point of runoff, this is the important consideration.
- The rate of discharge.
- The speed at which the equipment travels.
- The area covered, such as the swath width on turf and roadsides, or, for aerial and ground applications to utility right-of-way, the height and density of brush.

All these factors must be carefully controlled if the desired deposit is to be obtained.

Application Equipment Components

Your core manual describes the principal types of pesticide application equipment. This section will describe some of the parts of application equipment used in highway, railroad, utility and pipeline maintenance. Determine your needs, then check manufacturer's specifications to obtain the right equipment for the right job.

Tanks

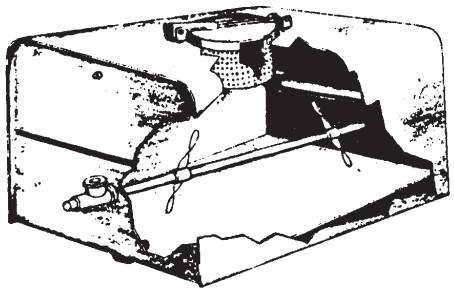
The tank, a major component of a sprayer, should be large enough to avoid frequent refilling. (If your nozzle discharge is 10 gpm, a 100-gallon tank will last only 10 minutes). But, too large a tank can be wasteful if it is seldom filled and completely used.

Stainless steel and fiberglass are considered the best tank materials because of their corrosion resistance, but they are expensive, so the buyer must weigh the need for durability against cost.

Every spray tank should have shut-off valves so that any liquid in the tank can be held without leaking out of the pump, strainers, or other parts of the system which are serviced most frequently.

Agitators

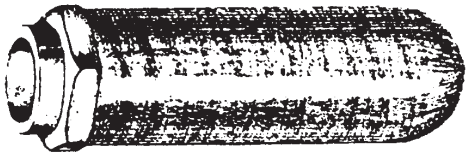
The type of chemicals applied determines if agitation is necessary. Liquid concentrates, soluble powders, and emulsions require little agitation—usually the flow from the by-pass hose is enough.



Wettable powder suspensions, however, require vigorous agitation to prevent settling out. Tanks with square corners require better agitation than round tanks. There are two methods of agitating the spray material in the tank. **Mechanical agitation**, the most positive method, is provided by paddles or propeller.

Hydraulic agitation is provided by the return flow from the pump. When hydraulic agitation is used to suspend wettable powders, a simple by-pass line from the relief valve is not enough. There should be a separate agitator line from the pressure side of the pump to the bottom of the tank. Metal or plastic tanks, simple plumbing and a large filler hole for easy access are desirable.

Strainers

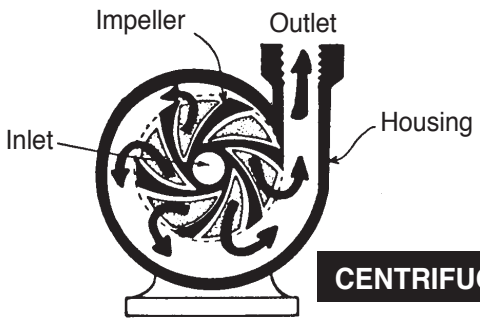


Strainers are used to prevent scale, rust flakes and other foreign material from plugging the nozzle or other working parts of the sprayer. They may be installed as necessary on the pressure line. When purchased as a part of the nozzle, an additional strainer should be placed on the intake line. The small strainers located directly behind the nozzles are not a substitute for the larger pressure line strainer.

Pumps

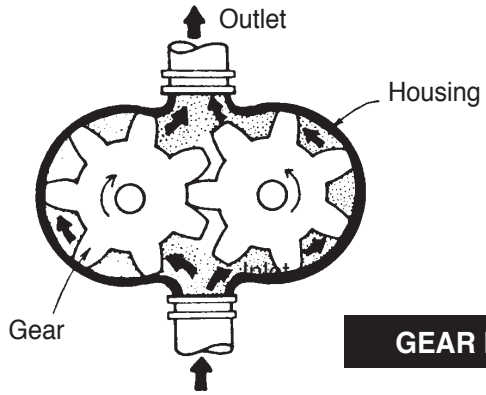
A good spray pump must deliver the required pressure and volume within its normal working capacity so it is not constantly working at its limit. If abrasive materials are used, it must be able to pump them over a long period of time without much loss of performance. The metal parts must be resistant to corrosion if corrosive materials are used. Choose gaskets, plunger cups and impellers that are resistant to swelling or chemical breakdown when using most liquid pesticides. If wettable powders are used, the pump must be abrasion-resistant.

Centrifugal sprayer pumps use an impeller to give high volumes at low pressures, although two-stage centrifugal pumps now used on some orchard and vegetable sprayers develop pressures in excess of 200 psi. The power requirement is relatively low and the operating speed is relatively high. They are the only sprayer pumps in general use that are not positive displacement pumps, so pressure regulators or release valves are not essential. Pressure depends on the RPM of the pumps. Because the impeller does not contact the pump housing, most centrifugal pumps are satisfactory for pumping abrasive mixtures such as wettable powder suspensions, even when they are concentrated. Centrifugal pumps are not self-priming, so they must be mounted below the tank outlet or a priming system must be built in. They are relatively inexpensive and satisfactory for many types of applications.



CENTRIFUGAL PUMP

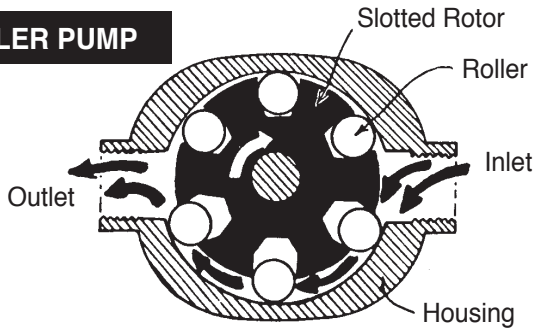
Gear pumps are simple, low-priced positive discharge pumps that are used on agricultural sprayers for operating pressures of up to 100 pounds. They are satisfactory for pumping liquids or emulsions, but wear rapidly if suspensions are used. They are self-priming when in good condition, but may lose that ability when worn. Depending on size, they deliver low to moderate volumes of liquid. They are not affected by solvents since all the parts are metal. Some are cast iron with stainless steel impellers; others are bronze to resist corrosion. Gear pumps are commonly used on mist blowers and boom sprayers. They require more power than centrifugal pumps, but it is still relatively low. When a gear pump becomes worn it usually cannot be satisfactorily rebuilt.



GEAR PUMP

Roller pumps are commonly used for low pressure and boom sprayers. They are positive displacement, self-priming pumps with a slightly higher power requirement than gear pumps. They are also generally more costly but still relatively inexpensive. The rollers, made of nylon or rubber, are more abrasion resistant than the gears in gear pumps and can be replaced when worn or swollen. However, suspensions will wear the rest of the pump out after

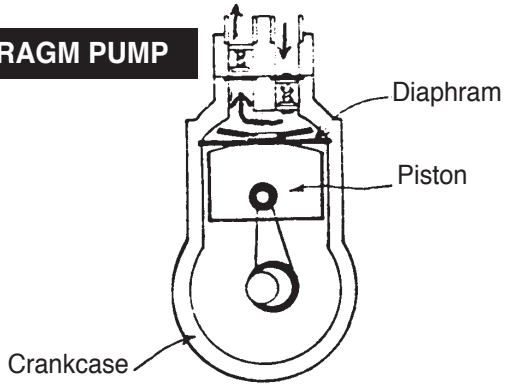
ROLLER PUMP



extended use. Roller pumps are capable of higher pressures than gear pumps, but sustained operation at maximum pressures will often cause the seals to blow out. They should be satisfactory at pressures around 200 psi.

Diaphragm pumps have been similar to gear pumps in volume and pressure characteristics. New models are now available that produce volumes up to 60 gallons per minute and pressures up to 850 pounds per square inch. Since the spray mixture

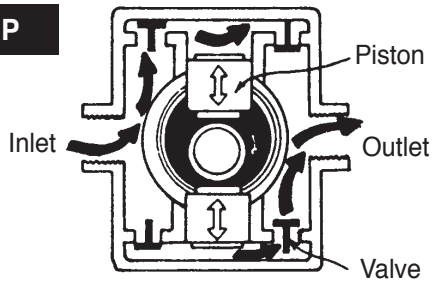
DIAPHRAGM PUMP



does not come in contact with any moving metal parts except the valve assembly, these pumps are extremely abrasion-resistant. The neoprene diaphragm may be injured by some solvents. These pumps are probably the best choice for abrasive spray suspensions.

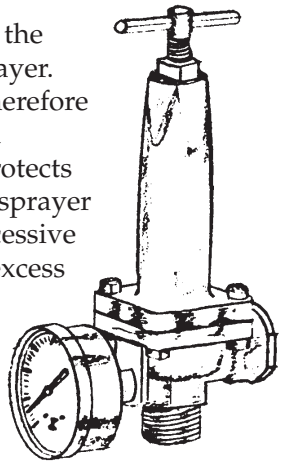
Well-made **piston pumps** are probably the most reliable of the commonly used sprayer pumps. They are heavily built and the larger ones are capable of pressures of 600 psi or more. They deliver moderate

PISTON PUMP



to high volume depending on the pump capacity. The better quality pumps have replaceable plunger cups made of leather, neoprene or nylon fabric, so they are abrasion-resistant, easily rebuilt and capable of handling wettable powder suspensions year after year. The piston pumps require more power than other pumps. For low pressure sprayers a piston pump is not usually needed, but they are excellent where higher pressures are required or where both low and high pressures are needed.

Pressure Regulators

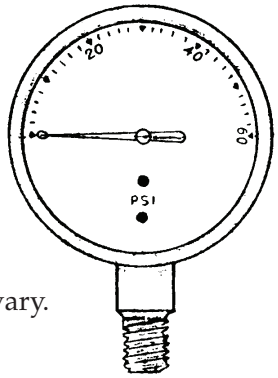


A pressure regulator is one of the most important parts of a sprayer. It controls the pressure and therefore the quantity of spray material delivered by the nozzles. It protects pump seals, hoses, and other sprayer parts from damage due to excessive pressure and it bypasses the excess spray material back to the tank.

There are two types of pressure regulators, simple relief valves and pressure unloaders. The relief valves are simple by-pass valves that require the pump and engine to keep working just as though one were spraying, whereas the unloaders maintain working pressure on the discharge end of the system but move the overflow back into the tank at lower pressure, thus reducing strain on the engine and the pump.

In the past almost all high pressure sprayers were equipped with unloaders, but now, probably as an economy move, the trend is toward relief valves. When selecting a pressure regulator, be certain that the flow capacity on the regulator matches that of the pump being used.

Pressure Gauge



A pressure gauge is essential on any sprayer. Without one, the operator cannot tell how the sprayer is functioning. If the pressure does not remain constant, the amount of liquid coming out of the nozzle will vary.

The gauge should always be mounted so that the operator can easily see it. Pressure gauges often

wear out because they become clogged with solid particles of spray material. A glycerine-loaded diaphragm gauge is more expensive, but will last indefinitely.

Hoses

There are four main points to consider in selecting sprayer hoses:

1) Composition (chief liner material)
2) Construction (reinforcement, rigidity or flexibility)
3) Working pressure
4) Size

High quality hoses and fittings are expensive but economical when used over a long period of time. The hose liner should be resistant to chemical action of the spray materials. The working pressure of the hose should be equal to the maximum pressure the pump delivers. If the hose is too small (inside diameter), the sprayer will not operate properly. If the hose in the suction line is too small, the pump will starve. If the hose in the pressure line is too small, there will be excessive drop in volume at the nozzle(s).

Nozzles

A complete nozzle assembly consists of the body, screen, cap, and tip or orifice plate. The function of the nozzle body is to attach the screen and tip to the boom. Several different nozzle body designs are available. All designs perform adequately, but each has advantages for specific spraying jobs.

A nozzle is an atomizing device that spreads the liquid droplet in a definite direction to form the spray pattern. Nozzles are made to accommodate a variety of replaceable tips or discs to meet different spraying requirements. Manufacturers of sprayer nozzles can supply data sheets for the delivery rate (usually in gallons/minute at different pressures for their nozzles). The application rate **cannot** be specified on these data sheets unless the forward speed of the sprayer and the spraying pressure are specified.

WARNING—Never operate nozzles at high pressures to compensate for selecting the wrong nozzle size. Unnecessarily high pressures increase the rate of nozzle wear and the potential for drift.

Nozzle tips and discs are made of aluminum, brass, ceramic, plastic, nylon, stainless steel, or tungsten carbide. Tungsten carbide discs and stainless steel tips are more resistant to abrasive wettable powders, but they are more expensive than steel discs and brass tips. No single material is the least expensive, most corrosion resistant, and most durable for spraying all agricultural chemicals.

Nozzles commonly used to apply herbicides to rights-of-way with ground equipment include flat fan, off-center (OC), bootless and whirling disc.

The **regular flat fan nozzle** is used for broadcast spraying such as broadleaf weeds on turf. The pattern is a narrow oval with lighter edges. When a series of these nozzles is properly mounted on a boom and overlapped 30 to 50%, the spray material is more evenly distributed than with other types of nozzles. At 30 to 60 psi the flat fan nozzle delivers small to medium droplets that do not drift excessively.

The most commonly used regular flat fan nozzles have a spray angle of 65, 73, or 80 degrees; the most common used pressure is 40 psi. For most herbicide spraying done with a relatively short boom (20 to 35 feet), the 80-degree nozzle is best. It is possible to keep the boom relatively low to reduce the drift hazard, and give a uniform distribution of spray material over the entire length of the boom.

Note that when using any wettable powders, it is *essential* to calibrate the sprayer frequently, because as a nozzle wears, the quantity of spray material delivered *increases*.

Low pressure sprayers with specialized booms or **off-center nozzles** are widely used for roadside and railroad maintenance. Specialized booms include those used to spray under guard rails and around other obstructions.

Off-center nozzles throw a wide-swath, off-center, flat spray pattern that is reasonably uniform across its width. Thus, a spray truck can move along a highway and apply herbicides to a wide roadside right-of-way or a hyrail truck can treat multiple railroad tracks with a single pass.

Bootless sprayers, a modification of OC nozzles, have a central nozzle or cluster of nozzles that are designed to produce a very wide spray pattern that results in a wide swath similar to that laid down by a boom sprayer. Deposit is fairly uniform over the swath but the pattern is easily distorted by a slight wind.

Rather complex **whirling discs** used in conjunction with adjuvants that reduce fine droplets have also been developed for wide swath application without using a boom. These are used on both ground and aerial equipment and have even been developed as small hand-operated units for use on turf. Their use on helicopters has lessened since the Microfoil Boom has come into use.

Sprayers For Right-of-Way Maintenance

Sprayers used for applying pesticides to right-of-ways vary from simple backpack models to sophisticated and specialized aircraft. Each piece of equipment has a preferred area or areas in right-of-way maintenance, but in some cases the same piece of equipment can be used in several different situations. However, the same sprayer used to apply herbicides to turf or brush should not be used to apply insecticides or fungicides to ornamentals. Many herbicides are very difficult to wash completely out of the sprayer and may injure valuable ornamentals. If you do not have enough ornamental work to justify the use of a separate sprayer you should choose a sprayer that is easy to clean.

Even repeated flushing with water is not a dependable method to remove herbicide residues from any spray tank, pump, hose, boom and by-pass system. Emulsifiable formulations such as esters and oil soluble amines are more difficult to remove than water soluble metallic and amine salts. Wood tanks are almost impossible to decontaminate. If you must decontaminate, circulate a solution of household ammonia or detergent (1 quart to 25 gallons of water, preferably warm) through the sprayer at operating pressure, including hoses, booms, and nozzles. Let stand for several hours, drain, flush, add more water. Test your sprayer for residues by spraying sensitive plants such as bean or tomato seedlings. Injury will usually appear in two to seven days if the sprayer is still contaminated.

Portable Sprayers

Compressed air knapsack sprayers are small and have limited capacity but may be used in right-of-way maintenance. They are useful for making basal applications to small brush or stumps, for selective spraying along rights-of-way, for occasional insect or disease control on valuable ornamentals, for limited work in areas inaccessible to large machinery and for spot spraying of small areas of noxious weeds like poison ivy.

Various hand sprayers.

The powered backpack mist blower also has the advantage of access to places that are hard to reach. Also, since it uses concentrated sprays, one can cover a much greater area per tankful of concentrate than is possible with the dilute spray used in the knapsack or compressed air sprayers. There is greater chance for drift with mist blowers than with the dilute portable sprayers. Backpack mist blowers are handy for occasional insect or disease problems and because of the simplicity, are easier to clean and decontaminate than hydraulic sprayers.

Sprayers Carried by Truck, Tractor, or Other Vehicle

The conventional **high pressure sprayer** is used to apply brush killers to taller trees or dense brush where brownout is not a concern. This type of sprayer is commonly used with an adjustable handgun and length of hose adequate for the particular needs. Because of its high pressure, coverage of the target vegetation can be thorough. Even a sprayer equipped with a small to medium size pump can reach 20 to 30 feet vertically. One can spray selectively, avoiding those plants that are desirable.

When using herbicides that do not translocate, the applicator can chemically trim low hanging branches that interfere with moving traffic or branches that interfere with visibility without harming the rest of the tree. This capability is particularly valuable in maintaining little used back roads where the town or other municipality cannot budget for mechanical cutting. The hydraulic sprayer is also valuable for controlling woody seedlings along a roadside or other such right-of-way following a brush cutting and stump killing program by one or two years. With one person driving the spray truck and the other using an adjustable single outlet gun, new woody seedlings up to one or two feet high can be quickly and easily sprayed with scarcely any notice-

able brownout resulting. One tank-load of spray will cover many miles of roadside when used in this manner.

The high pressure sprayer can also be used with conventional or modified spray booms mounted on tractors or trucks. Usually pressure should be lowered when used this way. They are also very effectively used for insect and disease control on valuable right-of-way ornamentals.

Low pressure boom sprayers are useful in selective spraying of turf along roadsides, dikes and other rights-of-way where grassy cover is needed. There are several models designed to be carried on tractors with a three-point hitch. These are easily mounted and dismounted, relatively light in weight and capable of operating in areas of limited accessibility. They are also trailer- or jeep-mounted, or carried on trucks. When using a boom, it is essential to have some means of protecting the boom from damage if a tree or other obstacle is encountered. The most common boom is made in three sections: one rigid section in the middle of the machine and a folding section out on each side. These outer sections are hinged at their inner ends and are supported from the center of the machine by a rope of light chain. This construction gives a 20- to 35- foot boom adequate support, and provides the versatility necessary in irregularly shaped areas and the mobility required when moving the sprayer through narrow gateways.

The height of the sprayer boom must be easily adjustable so the nozzles can deliver the chemical uniformly. Boom supports should be made so the boom can be set at any height from 12 to 48 inches above the surface being sprayed.

There are four variables that you can adjust to govern the amount of spray delivered by boom sprayers. These are:

- nozzle spacing on the boom
- nozzle tip orifice size
- pressure
- ground speed of the sprayer

Usually your equipment will already be set up to meet your local needs, so you will make minor changes in spray delivery by changing the speed or pressure, and major changes by using larger or smaller nozzle tips. Routine checks of your sprayer should be made to make sure that the nozzles are not badly worn and have uniform output, uniform appearance of spray pattern and equal fan angle.

This applicator is using a mistblower. He should be wearing a hat for personal protection.

Replace any nozzle tips having a flow of 10% more or less than required or having obviously different fan angles or patterns.

Roadside shade trees and ornamentals are quickly and easily treated for insects and some diseases with truck- or trailer-mounted **mist blowers**. Because they are relatively light weight, the vehicle carrying the blower need not be large and one tank-load of concentrated spray will treat many trees. Keep in mind that the large number of smaller droplets of concentrated spray produced by a mist blower are more likely to cause drift problems than the low concentrate and relatively lower number of small droplets produced by a hydraulic sprayer.

Aerial Sprayers

Aerial application of herbicides to utility rights-of-way is a fast, efficient, economical method of controlling the growth of undesirable woody vegetation. To apply pesticides aerially on the right-of-way, the pilot must be certified in the aerial standard and in the right-of-way category.

Since most rights-of-way are restricted in width, and may run through a variety of terrain, it is imperative that the proper equipment and techniques be utilized. Both planes and helicopters may be used for aerial applications.

The helicopter readily lends itself to this job because of its slow flying characteristics and maneuverability. It is capable of flying at or below treetop level. This limits the distance the chemical must fall before reaching the right-of-way, thereby reducing the possibility of wind drift. Pilot visibility is excellent from the helicopter which further assists in controlling the application.

Calibration

Proper calibration is essential for an effective application. Calibration has several advantages that should not be overlooked:

- It ensures the most effective control of the pest by applying the correct amount of pesticide.
- It saves money by eliminating over-application chemical costs and keeps you from unintentionally exceeding the legal and recommended rate of the chemical.
- It saves money by avoiding cost of retreatment from under-applications and costs associated with the loss of control.
- It reduces the potential for off-target movement of pesticides.

Calibrating Boom Sprayers

The following calibration steps are recommended for boom and "boomless" sprayers.

1. Check to be sure that you are using the same nozzles throughout the boom or the manufacturer recommended nozzle setup on boomless sprayers.
2. Thoroughly clean all screens and nozzles.
3. Partially fill the sprayer tank with water and check the uniformity of the spray patterns of all the nozzles. Check the volume of delivery of each nozzle by placing containers under each nozzle and measuring the amount of water each nozzle delivers in the same period of time. Replace worn nozzles so that the amount of spray delivered from each nozzle and the spray patterns are relatively uniform.
4. Select an operating tractor speed (generally 1 to 3 mph). Note the tachometer reading and the gear used.
5. Select an operating pump pressure. Adjust the pressure to the desired psi while the pump(s) are operating at normal speed and water is actually flowing through the nozzles. Be sure you have adequate by-pass flow into the spray tank to ensure proper agitation on sprayers that do not have mechanical agitators.
6. Measure and record the swath width covered by the sprayer.
7. Measure and record the amount of water being delivered from the boom (all nozzles) in a minute's time.
8. Determine the amount of time it will require to cover one acre using the equation:

$$\text{minutes per acre} = \frac{1}{\text{tractor speed (mph)} \times \text{swath width (feet)} \times .002}$$

9. Convert the amount of water recorded in step 7 to gallons per acre using the following equation:

   gallons per acre = gal/min from step 7 x min/acre from step 8

For example, 4 gallons of water were collected from the boom in one minute. The tractor speed is set at 2 mph and the swath width is 20 feet wide. The amount of spray mixture applied per acre is calculated as follows:

$$\text{minutes per acre} = \frac{1}{2 \times 20 \times .002}$$

minutes per acre = 12.5 minutes
gallons per acre = 4 gal/min x 12.5 min/acre
gallons per acre = 50 gallons per acre

If this volume per acre is satisfactory then you have a calibrated sprayer.

If the estimated amount of spray mixture delivered per acre is too little, it can be increased by one or a combination of the following:

- Increase pump pressure
- Decrease tractor speed
- Use larger size nozzles

If the estimated amount of spray mixture delivered per acre is too much, it can be decreased by one or a combination of the following:

- Decrease pump pressure
- Increase tractor speed
- Use smaller size nozzles

Be sure to complete another calibration check if any of the adjustments are necessary.

Calibrating Granular and Pellet Spreaders

Calibrating granular spreaders is much like calibrating boom sprayers. In essence, the only dif-

ference is the material being applied is in a dried granular or pellet form, as opposed to a liquid spray. The other major difference is many granular applications are made by hand-operated spreaders and thus speed is controlled by how fast the operator walks. There are however, tractor-mounted or trailer-type granular spreaders that can requlate speed much the same as a tractor with a boom sprayer.

To calibrate a granular spreader the following steps should be taken:

1. Measure off a distance of approximately 300 feet or more. The longer the distance the more accurate the calibration.
2. Place a bag or some similar device on the spreader to catch the material as it is applied. Pretend to apply the granular material along the measured distance catching the material in the bag attached to the spreader.
3. Measure and record the swath width of the spreader. Many spreaders have an adjustment that can narrow or widen the swath width to better meet the needs of the site.
4. Multiply the measured distance times the swath width and divide by 43,560. This will give you the area covered in acres, usually this is a part of an acre.

$$\frac{\text{measured distance (feet) x swath width (feet)}}{43{,}560}$$

5. Weigh the material you captured in your bag when walking the measured distance.
6. Divide the number from step 5 by the number calculated in step 4. This will tell you the amount of material you are applying per acre.

$$\frac{\text{weight collected in step 5}}{\text{number calculated in step 4}}$$

To adjust your calibration:

- Increase your pace if the amount of material per acre calculated in step 6 is more than the desired amount per acre.
- Decrease your pace if the amount of material per acre calculated in step 6 is less than the amount-desired per acre.
- Re-check your adjusted calibration by repeating step 1 through 6.

For example, you wish to apply 50 pounds of a granular material per acre. Your swath width is 12 feet and you captured 4 pounds of material in your catch bag when walking the measured 300 feet.

Therefore, you cover 12 feet x 300 feet or 3,600 square feet. Divide 3,600 by 43,560 to give you .083 acres covered.

Divide 4 pounds (the amount captured in the bag) by .083 (the acreage covered). This will give you 48.2 pounds per acre, very close to your desired amount of 50 pounds per acre.

Many granular materials are also used for spot treatment of select target species. This is especially true for pellet formulations. Follow the label directions. Most of these treatments are done by hand and do not use any equipment or measuring device. Directions may state for example; so many pellets per inch dbh (diameter at breast height) for brush species.

Dosage-Regulated Applications

In right-of-way pest control many applications are not measured as a rate per acre. They can more accurately be described as dosage-regulated, that is, the amount of material applied to the target species is determined individually based on size of the target pest and the concentration of the material you are using. Examples of such applications are high-volume ground foliar applications that use a prescribed mixture of herbicide to water carrier and is sprayed to the point of run-off on the leaves (commonly called "spray to drip"). Other examples of dosage-regulated applications are low volume basal spraying, conventional basal spraying, spot-gun or exact dosage soil applications, and frill and cut stump treatments.

The major factors that can affect results, or cause off-target damage are:

- Improperly measuring and mixing the pesticide. Mixes are usually expressed as gallons or quarts of the pesticide (usually herbicides) to 100 gallons of carrier. The carrier is usually water for foliage applications or various kinds of oil for basal applications.
- Over-application can result from "hosing down" the target species. Spray to drip means you stop applying the herbicide to the plant's foliage as soon as you see the mixture begin to runoff the plant's leaves. Additional material will continue to runoff and not be of any benefit. Furthermore, excessive drip from an over-application can cause injury or death to understory non-target species through unintentional root pick-up of excessive herbicide in the soil.

Review Questions: Chapter 6

Write the answers to the following questions. When you are satisfied with your answers, see if they are correct by checking them with the chapter text.

1. What factors (excluding drift or evaporation) impact the amount of chemical that is deposited on the target?

2. Why should a spray tank have a shut-off valve?

3. What are the two types of agitators?

4. Why do sprayers have strainers?

5. Explain the differences between centrifugal sprayer pumps, gear pumps, roller pumps, diaphragm pumps and piston pumps.

6. What does a pressure regulator control?

7. Why should you use a different sprayer to apply herbicides from the one you use to apply insecticide or fungicides to ornamentals?

8. Which sprayer is best for basal applications to small brush or stumps or for limited work in areas inaccessible to large machinery?

9. Which sprayer is best for applying brush killers to taller trees or dense brush where brownout is not a problem?

10. What are the four variables you can adjust to control the amount of spray delivered by boom sprayers?

11. Mistblowers are more likely to create drift than a backpack sprayer. (*True or false*?)

12. If you purchase the wrong size nozzle, a safe way to compensate is to operate the nozzles at a higher pressure. (*True or false*?)

13. Why should you calibrate the sprayer frequently when using wettable powders and a flat fan nozzle?

14. Where would you use off-center nozzles to spray?

15. What are the advantages of regularly calibrating your equipment?

16. How much spray mixture is applied per acre if 3 gallons of water are collected from a boom sprayer in one minute? The tractor speed is 3 mph and the swath width is 20 feet wide.

17. How would you increase or decrease the amount of spray delivered in question 16?

18. How many pounds of granular material are you applying per acre if your swath width is 12 feet and you capture 5 pounds of material in your catch bag (during calibration) while walking 300 feet?

19. What are the major factors that can affect the results of dosage-regulated applications?

CHAPTER 7

PUBLIC RELATIONS

Right-of-way operations, whether on utilities, highways or railroads, are highly visible to the public and because of this, may be unusually open to criticism. However, much of the potential criticism can be avoided if the applicator is considerate of public concerns, is knowledgeable and informative, and uses extra care in pesticide applications. This chapter discusses ways to work effectively with the public.

Differences in Perception

There may be a difference in perception between applicators and those who complain about their work. Applicators perceive browning of certain species as a verification that they have done their job properly, while the adjacent property owners view the browning on the right-of-way as a violation of the "green" space that they consider an extension of their own property. Property owners may realize that right-of-way maintenance does take place, but may have no understanding as to why it is necessary or how it is done. They are concerned about the visual impacts of the applicators' activities and their personal safety, for example, whether the herbicides will contaminate the well or garden vegetables.

Do not patronize property owners. They are not impressed by applicators who say that they know what they are doing, or that there is no law requiring them to tell the property owner what they are doing. The best way to deal with the majority of the concerns addressed by the public before or during treatment is to answer their questions and to respond to their concerns as clearly and as directly as possible. Be professional, view such questions as an opportunity to improve communications with the concerned public.

Carelessness

Often problems of pesticide application are best resolved by improving operational practices. Most operational problems are within the control of the applicator; they are not "unavoidable accidents." Commonly occurring violations or misuses result in significant and visual off-target impacts. These misuses include careless mixing or transferring of pesticides with resulting spills; roadside disposal of left-over spray mixture at the end of the day; contamination of surface water through drift, spills or improper disposal; and injury to off-target vegetation due to drift, volatility or lateral movement of pesticides.

Misuses relating to actual application are usually due to carelessness. It is possible to follow label instructions and still be careless. You are being careless:

- if you do not become familiar with the area to be sprayed prior to treatment
- if you do not take all possible steps to avoid drift
- if you do not use the proper pesticides or equipment for the job
- if you do not regularly check application equipment to make sure it is in working properly
- if you do not wear proper personal protective-equipment.

The applicator who does not follow these precautions is taking unnecessary risks.

Other Areas of Concern

Nearly all parts of a right-of-way are in some form of drainage system. Drainage ditches are easily recognized, but greenways, contour and overflow areas can be less obvious. Pesticide treatments must be designed to have minimal or a neutral impact on these areas. Follow label directions and precautions where right-of-way runoff water flows into sensitive areas or where the water is used for irrigation or for livestock to avoid any adverse impacts.

The applicator should be aware of potential problems with toxic plants. Cherry leaves can contain hydrocyanic (prussic) acid while curing. Herbicide applications, cutting or seasonal leaf drop will cause cherry leaves to wither and die. If the leaves are eaten by livestock during that time, they can become sick or die. Applicators should avoid spraying

cherry with herbicides during the foliage season in pasture areas. If cherry must be controlled in pasture areas during the growing season, it should be cut and removed from the pasture.

Sometimes an applicator can cause problems for a landowner without realizing it. Do not cross tiled fields with heavy equipment when the ground is soft. Avoid crossing one hog lot or chicken yard into another without first cleaning the mud off of the equipment's tires. Communicable diseases such as hog cholera can be spread from one area to another by unwittingly tracking contaminated soil. If the death or injury of an animal is blamed on a pesticide application, the animal should be examined by a veterinarian. If investigation shows that compensation is justified, make sure you respond fairly and promptly.

It is not uncommon to observe marijuana growing on utility rights-of-way in rural areas. When observed, it should be reported to the proper authorities. These areas should be bypassed until the marijuana has been destroyed. Use extreme caution in these areas and watch for growers' booby-traps.

People occasionally object to the "brown-out" associated with right-of-way spraying to control unwanted vegetation. While this is a direct result of the intended purpose of the spray, the applicator should limit the "brown-out" effect wherever possible. This can be done by leaving buffer strips of untreated vegetation at road crossings and vista areas. Aesthetically sensitive areas should be selectively treated or treated in the dormant season.

Avoiding Problems on the Job

If you represent a company or governmental unit (such as a county highway department) that uses contractors to carry out your vegetation management program, you should take the following precautions.

- *Choose your contractors carefully*. Remember that as far as the public is concerned, the people working on your municipality or company's right-of-way represent your organization. Review your bidding lists periodically and eliminate those contractors that have caused regulatory or public image problems or that have been careless in their use of pesticides or in the carrying out of the conditions of their contracts. Make sure that the contractors get the message that an extremely low bid will not compensate for poor practices or for hiring employees who will work cheaply but not carefully. Review how the crew is trained and supervised and how public complaints are handled. Be sure that applicators are certified or registered. Check to see if the contractor has a history of pesticide misuse violations.
- *Make sure that your contract outlines very specifically your expectations for the consultant or contractor's representative*. If you are subject to notification requirements, how do you expect the consultant to meet the notification requirements under the law? What is to be provided to the landowners as notification? What products are to be used, how are they to be used? Is the consultant expected to deal with people who have complaints or questions regarding the treatment? If so, how are they to handle these matters?
- *Have a consistent policy that applies to all contractors working for your company.* Do not vary your standards from contract to contract. Make sure that company employees who supervise contractors use a common standard to evaluate the acceptability of the contractor's work.
- *Let the contractor know about any complaints that you receive.*
- *Review the contractor's hiring criteria and training program.*
- *Choose a management program that relies on selective vegetation management.*
- *Educate the public about the necessity of your management program and the ways in which you are managing the right-of-way to avoid undue visual or other negative environmental impacts.* Explain your efforts to use integrated pest management strategies.

If you are a contractor, you should:

- *Remember that part of what you are selling is your reputation*. Do not bid lower than you feel is truly reasonable to do the job properly. Let someone else cut corners; there is no surer way to run into problems.
- *Choose your employees carefully and train them with equal care*. There is a direct correlation between the experience and training of the crew and the number of problems that can be expected on the job. Some of the problems associated with an inexperienced or poorly-trained crew may simply cost you money, others may cost you an enforcement record.

- *Make sure your employees know who your client is and what that client expects*. It may appear that it will cost you less not to train crew members, but it will cost you more in the long run if you lose your position on a bid list because your employees didn't meet the standards of the contracting agent.

If you have field staff working on right-of-way maintenance programs, whether you are a contractor or not you should:

- *Train new employees how to safely and accurately use materials and equipment*. This training can be a refresher course for experienced employees. Teach your employees in the pest management program to be sensitive to the concerns of the public. If your work is in resort or outdoor recreation areas, keep in mind that the public will view any visible maintenance impacts as interfering with their enjoyment of the outdoors. If you are in suburban areas, remember that vegetable and flower gardens may border the areas to be treated. If you are in more heavily populated areas, consider that the right-of-way may be the only open space nearby and may be the prime recreation area of the local children. Make sure your applicators are aware of the local concerns and are alert to any conflicts that may develop as a result.
- *Establish policies for your employees that outline exactly what is expected of them when they are in the field*. Make sure that those policies are enforced and that there is a system for dealing with any employee who does not conform to those policies.
- *Remember that foremen and supervisors should be with crews at all times or make regular inspections of mixing and application procedures*. When supervisors are not with crews, they should be within easy reach of each crew. Direct supervision by a certified applicator is required when using restricted use pesticides. Supervisors must check application techniques and sprayer calibration regularly for safety as well as to ensure good results.
- *Keep in touch with the state regulatory agency* (Michigan Department of Agriculture). Make sure that you know what the latest requirements are for conducting your business. Ignorance of the law is no defense. Some of the sources for information are:
  - – labels and Material Safety Data Sheets (MSDS)
  - – Cooperative Extension Service
  - – field demonstrations
  - – chemical company staff
  - – industry publications
  - – applicator training seminars
- *Let your regulatory agency know where and when you are working*. This helps them respond to inquiries and gives them the opportunity to come out to the site and see what is going on. It lets them become familiar with your operations and you with theirs. You benefit because the agency can help identify potential problems before they become serious.
- The basic rule for safe pesticide applications is "follow the label and use common sense." Common sense dictates that you remember that you or the people who work for you are using potentially dangerous chemicals. Your objective should be to make sure that they are used properly and carefully. Don't be your own worst enemy by tolerating carelessness in your operations.

Safety Measures

Use of pesticides to control brush and other pests causes concern for some people. Typically these concerns involve what products are being used and whether or not they are safe.

On average, it takes about seven years and six to ten feet of data in notebooks to register a new product in the United States. Generally, $30-40 million must be invested to bring a new compound to market and safety considerations constitute about 25 percent of these costs.

Tests required by law before a product can be marketed in this country include those on acute and chronic toxicity, carcinogenicity, reproductivity, impacts on wildlife (mammals, birds, fish and other aquatic animals) and tests on environmental fate, including the movement, persistence, dissipation and metabolism of the potential product in animals, plants and soil. Where needed, establishment of tolerances on food and determination of an acceptable daily intake are requirements as well.

Most compounds do not make it through the screening process and never are marketed as pesticides. Those that do have undergone extensive review — a review that will continue throughout the product's life. Detailed Material Safety Data Sheets (MSDS sheets) and concisely stated product labeling outline conditions of safe use established by extensive research and assist the applicator in performing operations safely.

Be professional and responsible: wear the appropriate safety equipment.

Applicators on the job should:

1) Have available product information
   – sample label
   – MSDS sheet
   – literature

2) Respond to public inquiries
   – get name, address and phone number
   – do not spray without landowner's permission
   – distribute literature
   – resolve complaints in a timely manner

3) Be professional
   – maintain equipment
   – dress properly and appear neat
   – be polite

Often, a landowner's questions concerning pesticide applications go unanswered or are not answered to their satisfaction. This generally results in a formal complaint and polarized viewpoints. Landowners feel the applicator is hiding "something" and the crew supervisor may view the questions as a nuisance. A simple solution to this problem is to know the answer to the landowner's question before it is asked. A quick, direct response to the public's concerns facilitates better communications and a more enjoyable working environment. Be prepared to respond to commonly asked questions such as these:

- What are herbicides and why are they used?
- Do herbicides affect birds?
- If my garden becomes contaminated, is it safe to eat the vegetables?
- Is it safe to eat wild berries from areas that have been sprayed?
- What kind of precautions are taken to make sure that pesticides don't get into groundwater supplies?
- Do herbicides and other pesticides pose any risk to me and my family?
- What happens if herbicides wash from the treated area into my pond — how does it affect the fish?
- If my cattle graze on treated rights-of-way, will they be harmed?
- If a cow grazed on a treated rights-of-way, is the milk and meat safe to consume?

Review Questions: Chapter 7

Write the answers to the following questions. When you are satisfied with your answers, see if they are correct by checking them with the chapter text.

1. The best way to deal with the concerns of adjacent property owners is to:
   a) tell them there is no law requiring that applicators tell property owners what they are doing.
   b) tell them you know what you are doing.
   c) take the opportunity to educate them and improve communication with the public

2. What are some of the common violations and misuses that create negative public response to pesticides?

3. What precautions can an applicator take to avoid carelessness?

4. Why must precautions be taken when dealing with cherry leaves?

5. How could an applicator spread hog cholera?

6. What steps can you take to lessen the chances that your employer's contractors will create problems with the public?

7. What steps can contractors take to improve public relations?

8. If you have field staff working on rights-of-way what steps should you take to improve public relations?

9. Most new compounds make it through the screening process and are then marketed as herbicides. (*True or false*?)

10. What product information should the applicator have available on the job to respond to the public?

11. A _____ Sheet is usually referred to as a MSDS.

12. Answer each of the questions at the end of this chapter (before the review questions) beginning with "What are herbicides?" You need to know a correct response for each.

PESTICIDE EMERGENCY INFORMATION

For any type of an emergency involving a pesticide, immediately contact the following emergency information centers for assistance.

Current as of January 2010

Human Pesticide Poisoning

POISON CONTROL

From anywhere in the United States, call

1-800-222-1222

Special Pesticide Emergencies

Animal Poisoning

Your veterinarian:

_____
Phone No.

or

Animal Poison Control Center ($55 consultation fee per case)

****1-888-426-4435***
www.aspca.org

Pesticide Fire

Local fire department:

_____
Phone No.

and

****911***

Traffic Accident

Local police department or sheriff's department:

_____
Phone No.

and

****911***

Pesticide Spill

District Michigan Department of Natural Resources and Environment (MDNRE) Office Phone No.

1-800-662-9278

and

MDNRE Pollution Emergency Alerting System (PEAS):

****1-800-292-4706***

also

Michigan Department of Agriculture Spill Response

(for fertilizer, pesticide, and manure spills)

****1-800-405-0101***

Pesticide Disposal Information

Michigan Clean Sweep, Michigan Department of Agriculture Environmental Stewardship Division.

Monday – Friday: 8 a.m.–5 p.m.

1-517-241-3933

National Pesticide Information Center

Provides advice on recognizing and managing pesticide poisoning, toxicology, general pesticide information and emergency response assistance. Funded by EPA, based at Oregon State University

7 days a week; excluding holidays

6:30 a.m. – 4:30 p.m. Pacific Time Zone

1-800-858-7378
FAX: 1-541-737-0761
Web: npic.orst.edu

**** Telephone Number Operated 24 Hours***

Revised by Sue Risley, *Pesticide Safety Education Program, Michigan State University Extension*

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