Chapter 7

WEEDS

Weeds are a common problem in turf and other landscapes areas. To use an IPM approach, you must be able to identify weeds, know their life cycles, and their biology. To choose proper treatments, it is important to know how they work. The following section provides information on weed biology and treatments. A sample IPM program for broadleaf weeds in turf is included.

A weed is any plant that is growing where it is not wanted. Some weeds (mainly introduced species) are considered noxious weeds under provincial law. They can cause harm by contaminating farm crops and grazing areas. Some weeds (e.g., ragweed) cause allergies in people.

Landscape weeds are problems when they:

- Compete for light, water or nutrients and slow the growth of desirable plants
- Detract from ornamental beds and lawns
- Reduce visibility around intersections, roadsides, and signposts
- Choke ditches and drainage swales, (a shallow troughlike depression that carries water mainly during rainstorms or snow melts).

Learning Objectives

Completing this chapter will help you to:

- Know common problem weeds.
- Know how to manage them using IPM.
- Know what affects the effectiveness of herbicides.

Life Cycles of Weeds

To develop an IPM program for weeds, you must know the weed species and its life cycle. Weeds can be classified by how long they live:

- **Annuals** complete their life cycle within a year. Most produce a large number of seeds to ensure survival. Summer annuals germinate in the spring. Winter annuals germinate in the fall.
- **Biennials** live more than one, but less than two years. They grow from seed that often germinates in the spring. During the first year, they store food (often in short fleshy roots). Foliage grows into a rosette of leaves. The plant uses the stored food in the next season. It quickly grows and sends up flower stalks. It produces seed in the summer or fall. It then dies.
- **Perennials** live more than two years. During the first year, the plants grow and store food reserves. Often, they do not produce seed the first year. In most cases, seed is produced in the second year and every year after that. Most perennial weeds spread using seeds. Many also spread using creeping stems or stolons, creeping roots, rhizomes, or bulbs. Perennials can be shallow or deep-rooted.

Identifying Weeds

To identify weeds you must look at a number of plant parts:

- **Leaf** shape and arrangement on the stem can be used to help identify species. Leaves may be compound (made up smaller leaflets) or simple. Edges of leaves may be smooth or toothed. The surface of the leaf may be smooth, hairy, or have prickles or spines. Leaves may be arranged on the stem in opposite pairs. Leaves may alternate on the stem or be found in whorls. For seedlings, the cotyledons (seed leaves) can be used in identification.
- **Stems** may be woody (e.g., shrubs) or herbaceous (soft, not woody). Plants may have upright or branching stems. The branching habit may be upright or spreading.

- **Flowers** may be arranged on a stem as single flowers or as a number of blossoms in spikes or flat heads. Other patterns of flower arrangement also exist. It is important to note the:
    - Number of petals and sepals
    - Shape and characteristics of reproductive parts, known as pistils and stamens
    - Shape and appearance of seeds

- **Roots** may be fibrous or tuberous. Weeds can have single taproots, highly branched fibrous roots or creeping jointed rhizomes.

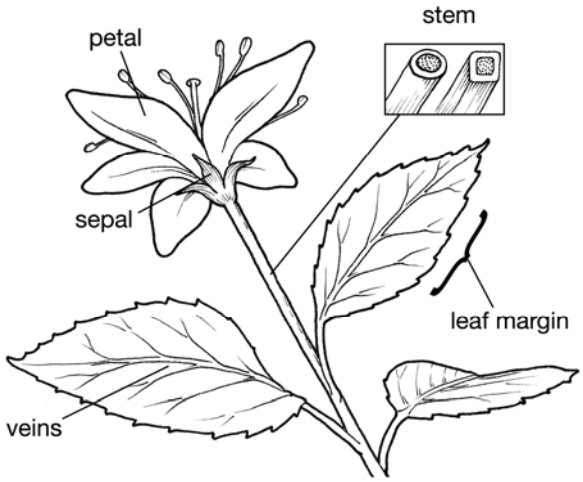

Figure 7-1: Weeds are identified by looking at a number of plant parts.

Leaf Stages

It is important to be able to identify desirable plants and weeds in the leaf stage. Many herbicides are only effective at certain stages of growth. If applied too early, there may not be enough leaf area for the herbicide to work. If applied too late, the weed may survive or set seed. Size and number of leaves can quickly increase. You must check weeds regularly when using a herbicide that only works at certain stages of the weed's growth.

Leaf Stages of Broadleaf Plants

The leaf stages of broadleaf plants are as follows:

- **Cotyledons** are the first leaves that emerge from a seed and are often different in shape from true leaves. They may quickly dry up and disappear. On a few plants, they stay beneath the soil. The timing of herbicide applications may be based on the average number of leaves on the plants. When counting leaf numbers to plan a herbicide application, do not include cotyledons.
- **True leaves** are the leaves that appear after cotyledons. These can be used to identify plant species.

LEAF ARRANGEMENT

Leaves are arranged along the stem in patterns. The following are common patterns:

- **Alternate leaves** emerge from alternate sides of the stem. They are not directly opposite each other.
- **Opposite leaves** grow in pairs from the same point on the stem. They appear across the stem from each other.
- **Whorls** of leaves emerge as three or more leaves sprouting from the same stem point on the stem.

When counting leaf numbers, count each true leaf (unless your identification guide refers to the number of whorls or leaf pairs)

Some plants (e.g., clover) have compound leaves. Compound leaves are made up of a number of leaflets. When identifying weeds, do not count the leaflets of a compound leaf as separate leaves. Each grouping of leaflets compound leaf is counted as one compounds leaf.

Leaf Stages of Grassy Plants

Leaf stages of grassy plants are as follows:

- **The coleoptile** is the first leaf. It is a single protective sheath. It stops growing when the tip breaks through the soil surface.
- **True leaves** are the next to emerge. These are used to identify plant species. They emerge alternately along the stem.

- **Tillers (or stolons)** are secondary shoots of a grass plant. They emerge from the base of the plant.

When counting leaves of grassy plants, count the leaves on the main shoot. Do not include the coleoptile or tillers in a leaf count.

Managing Weeds

The following section outlines a general IPM program for weeds. It includes prevention, identification, monitoring, injury and action thresholds, treatments, and evaluation. For more information on IPM, see the **Applicator Core Manual Chapter 7: Integrated Pest Management.** Manage landscape weeds by preventing them. Long-term control is often based on removing or changing conditions that allow weeds to grow. The effect on non-target plants should be taken into account when planning treatments. It is important to also consider the impact on desirable plants, the environment, and human safety.

Prevention

Prevention methods disrupt the life cycles of weeds. This makes growing conditions poor for weeds. Weed problems can be prevented with the following:

- Design hard surface areas. This eliminates areas where weeds can grow. Fill cracks and spaces where weeds germinate. Install paved or mulched strips under fence lines. These eliminate the need for herbicides.

- Do not bring weed seeds into sites. Control weeds in nearby areas that may spread seeds. Clean machinery and footwear before moving from a weedy area to a clean area. Use only well-composted manure or soil amendments that are free of weed seeds.

- Ensure plants are provided with the proper growing conditions**.** This allows them to compete with weeds. Water, fertilize, and manage plants to ensure that they are healthy.

- Use ground-cover plants or mulches that compete with weeds. These cover the soil surface and prevent germination of weed seeds. Use low

ground covers or mulches under shrubs. Sow grass or wildflower mixtures in disturbed areas and along roadsides. Use nurse plants (e.g., clover or annual grasses) to cover the soil and shade out germinating weeds while turf grasses are being established.

Monitoring

Weeds in turf are usually checked once or twice a year using the methods on the following page. Weeds in other locations (e.g., hard surfaces, shrub beds, borders) can be monitored by doing the methods that follow. The monitoring schedule for weeds in hard surface and landscaped areas depends on site visibility, classification and maturity. Newly established landscape beds may require more frequent monitoring and treatment until the plants are established.

- Count the number of plants along a transect (see the following section: **Methods for Counting Weeds in Turf**).
- Note the portion of ground or pavement that is covered with weeds.
- Monitor the height or rate of growth of the weeds.
- Note the weeds stage of growth (e.g., newly germinated, forming flowers, seed heads, etc.).
- Note the species of weeds present, especially any noxious or invasive species.

Methods for Counting Weeds in Turf

There are a number of methods for counting weeds in turf. Examples include:

- **Transect Method:** To count weeds, use a rope or string to stake out a 10 meter transect (straight line) through an area of turf. Walk along the line. At each of 10 points, record the number of plants seen in a 10 cm^2 area. The line can be marked or knotted to show where to count. Counts can also be done by checking weeds at each large stride along the transect. Check 10 or more transects per site. Determine the average number of weeds per counting line

Transect Method Example:
Total # of plants found at 10 different points along transect

5+0+2+3+0+0+0+2+10+2 = 24 plants

Average # of weeds = Total # ÷ 10
= 24 ÷ 10 = 2.4 weeds/m^2

- **Grid (Quadrat) Method:** Make a one metre square wire or wood frame. Drop it randomly on turf. Count all weeds inside the frame. Count at least 10 squares per site. Average the scores to get an estimate of the number of weeds per square meter.

Grid (Quadrat) Method Example:
Total # of plants found in 10 different grids or quadrat

5+10+12+3+0+6+0+0+0+2 = 38 plants

Average # of weeds = Total # ÷ 10
= 38 ÷ 10 = 3.8 weeds/m^2

Visual Estimation:

- **Weed** cover can also be ranked high medium or low based on visual estimates of weed density. For example high > 50% weeds, medium 20-50 % weeds and low < 20% weeds

In an IPM program site specific threshold levels are established for the various areas being managed and weed counts are compared to threshold to determine if and when treatment is needed.

Injury and Action Thresholds

Injury thresholds for weeds can be based on:

- The number of weeds per square metre (e.g., turf) or number per length of row (e.g., in a display bed or along a fence line)
- Plant height (e.g., visibility in natural areas or roadsides)
- Plant species present (e.g. noxious, tall-growing or invasive species must be controlled.)
- Percent weed cover

The following are examples of common injury thresholds for broadleaf weeds in turf. These are given by category of site area as outlined on page 5 of this chapter:

- **Class A sites** are often meant to be "weed free". Site users perceive turf with up to 5-10% weed cover as weed-free. A common treatment threshold for herbicides on a Class A site is 10-15% weed cover.
- **Class B sites** are seen in many municipalities where 20% to 50% weed cover for turf is acceptable, as long as use of the site is not affected.
- **Class C sites** may exceed 50% weed cover. Thresholds can be based on height (e.g., for mowing) or when there is risk of fire or impairment of sight lines (e.g., on roadsides and corners).

Note: The threshold may be zero on all classes of sites for noxious weeds or weeds which present a safety or visibility hazard

Treatments

A number of treatment methods are described in the **Applicator Core Manual** and below. Use treatments singly or together. Treatments must be properly timed to be effective.

Physical and Mechanical Controls

There are a number of physical and mechanical controls for weeds. These include mulches, mechanical cultivators or mowers, and heat applicators.

- **Mulches** smother germinating weeds and shade the soil so that seeds cannot germinate. Mulches can be organic or synthetic. Organic mulches (e.g., leaves, straw, shredded bark, wood chips, etc) must be at least 10 cm deep to prevent weed growth. Synthetic mulches (e.g., geotextiles and weed mats) allow moisture and air into the soil. They block light from the soil.
- **Mowers and cultivating equipment** are commonly used to control weeds. This includes soil cultivators that destroy seedlings, and mowers that remove plant tops before seeds set. Brush saws, flails, and heavy mowers can also be used to cut back woody plants.
- **Heat Applicators:** Heat applicators kill weeds by damaging the plant tissue. A number of systems use heat to destroy plant foliage. The heat does not go into the soil and kill the roots of established weeds. A number of applications may be needed to deplete the energy stored in the roots of established plants. Heat application works best when the heat is applied for a very short time to stress plants. This works better than heating plants until damage can be seen. Heat application equipment includes the following:

    - **Flamers** range from small hand-held propane devices to tractor-mounted flamers.

    - **Hot water or low-pressure steam applicators** are often mounted on small trucks or trailers. Smaller hand-held versions are coming into the market.

    - **Infrared radiation applicators** burn propane and radiate heat. They range from hand-held applicators (used for dandelion spot treatments in turf) to tractor-mounted units.

Biological Control

Insects and disease organisms can be used to control weeds. Many insect species have been released in Canada to control introduced (non-native) weeds. These are often released by provincial and federal agencies over a large area or region. Most are used to control weeds that harm grazing livestock or take over grazing lands. An example is the cinnabar moth that was released in the Atlantic Provinces to control tansy ragwort. **Contact your provincial regulator to determine what additional permits are required prior to importing any species.**

Some plant disease organisms are being investigated to control weeds in Canada. Research is ongoing to commercialize a fungus that controls dandelions.

Use of Herbicides

Herbicides are pesticides that are used to kill, prevent, or alter the growth of plants. They can be natural or synthetic. Herbicides are classed by selectivity, mode of entry, timing of application, and residual effectiveness.

SELECTIVITY

Selective herbicides only kill or damage certain plants. Examples include 2,4-D, dicamba, and mecoprop. These affect broadleaf weeds but not grasses. Non-selective herbicides (e.g., glyphosate) kill or damage all plants in a treated area. Some herbicides can be selective or non-selective depending on the application rate that is used.

MODE OF ENTRY (HOW THE HERBICIDE ENTERS THE PLANT)

- **Contact herbicides** (e.g., fatty acids or acetic acid) kill plant parts that contact the herbicide. There is little or no movement of herbicide in the plant. Contact herbicides work against annual weeds, but only "burn off" the tops of perennials.
- **Systemic Herbicides** include glyphosate, amitrole, bromacil, and simazine. These herbicides enter the roots or aboveground plant parts and move (are translocated) within the plant. Effects may not show for a week or more after treatment. If the herbicide is too concentrated, it may kill cells too quickly when it contacts the leaf or stem tissue. This prevents movement of herbicide to the site of action in a plant. This will reduce effectiveness.

Timing of Application

Not all herbicides should be applied at the same time. Read the pesticide label for instructions on a given herbicide.

- **Pre-plant herbicides** (e.g., dicamba) are applied to soil before the desired plants are seeded or transplanted. These herbicides are often incorporated into the soil.

- **Pre-emergence herbicides** include borate, dichlobenil, or simazine. These herbicides are applied to soil after planting, but before either the desired plants or target weeds emerge. They control weeds before or soon after they emerge.
- **Post-emergence herbicides** (e.g., glyphosate or amitrole) are applied after the desired plants or target weeds have emerged. They control established weeds. Application may be soon after emergence, or up to a given height or leaf number.

RESIDUAL EFFECTIVENESS

- **Non-residual herbicides** quickly lose their effect in the soil after application. They do not affect future plantings. Examples include acetic acid herbicides, fatty acid herbicides, and products containing glyphosate.
- **Residual herbicides** (e.g., dicamba and simazine) break down slowly. They can control weeds for a number of weeks or even years. Caution should be taken when choosing to use a residual herbicide as nearby desirable plants can be affected by the herbicide through leaching, erosion, or runoff .
- **Soil sterilants** are a special group of residual herbicides. Examples include amitrole or bromacil. These are non-selective, residual herbicides. They are applied to soil to prevent plant growth for a long time (months to years). They do not sterilize the soil of all microorganisms or seeds. Soil sterilants are sometimes used on parking lots or roadways in landscaped areas. The use of soil sterilants is not covered under the Landscape Pesticide Applicators Certification. **Contact your provincial regulator to determine what additional certifications and/or permits are required prior to use of soil sterilants.**

RESIDUAL HERBICIDES – ADDITIONAL COMMENTS

Care is required when using residual herbicides. Residual herbicides can damage trees and shrubs with roots that extend into the treatment area. A buffer zone between the application site and nearby woody vegetation should be given on the label. If it is not given, the buffer width should be no less than two times the height of the desired woody vegetation. For further information on buffer zones see the **Applicator Core Manual.**

Do not apply residual herbicides in areas with a high water table or coarse-textured soil. These can lead to groundwater contamination.

Residual herbicide use can limit the future use of treated areas. A residual herbicide should only be used if present use will continue for a longer time than the residual period of the herbicide. The persistence of residual herbicides may vary. (See **Chapter 4: Table 4-1** of this manual) Persistence depends on the product, rate, formulation, concentration, weather, and soil conditions. Avoid using residual herbicides on steep slopes or areas subject to erosion and runoff. Movement of herbicide-contaminated soil can cause off-site damage.

Factors Affecting Herbicide Efficacy

- **Leaf Characteristics:** The shape and surface of leaves can affect the effectiveness of herbicides. Thin upright leaves are hard to cover with spray. Hairy or waxy leaf surfaces can repel herbicides or reduce herbicide contact. Additives (surfactants) can be put in the spray mix. These allow herbicides to adhere to and penetrate the leaves. **Additives can only be used if recommended on the herbicide label.**
- **Weather:** Temperature, humidity, rain, and wind can all affect herbicide performance. Moderate weather conditions are better than extremes. Check the herbicide labels to find out which weather conditions to avoid. Cool or dry conditions slow the production and movement of food in plants. This impedes the movement of systemic herbicides. Hot, dry weather can cause a herbicide to quickly evaporate from leaves. This reduces effectiveness. With high temperatures, plant cells harden. This makes it difficult for herbicides to enter plants. Rain during or after an application can wash foliar herbicides off plants. Some soil applied herbicides require irrigation or rain after application. Wind can cause drift and damage desirable plants. It can also prevent the herbicide from reaching the target.
- **Age of the Weeds:** Consider the following ways that the age of the weed will effect herbicide effectiveness:
    - Herbicides often work best on young, rapidly growing plants. Systemic herbicides (which move within plants) move faster through young, quick-growing tissues.

  - Herbicides are less likely to kill weeds that are in full flower or producing seed. At this stage, sap movement within the plant is much slower.
  - Broadleaf perennial weeds often become more resistant to herbicides as they age. They may become more susceptible again in the bud or early flowering stage. At this stage, the herbicide may move with carbohydrates to be stored in the roots.
  - Herbicides for grassy perennial weeds work best in spring when plants have 4-5 leaves. They also work well in the fall when nutrients are being moved to underground parts of the plants.

- **Soil Types and Characteristics:** Higher application rates may be needed for soil-active herbicides on organic (peat or muck) or fine-textured soils (clay or silt). These soils hold (adsorb) more herbicide on the soil particles. This cuts down on the amount of herbicide available for weed control. Sandy soils often need less herbicide. Read the herbicide label to find minimum and maximum rates. There is an increased risk of lateral (sideways) movement of water and herbicide in clay and compacted soils.
- **Soil Moisture:** Soil-applied herbicides often work best in warm, moist soil. Soil moisture helps the herbicide move to the weeds. Systemic herbicides also work best on weeds that are growing in moist soils.
- **Cultivation:** When establishing new areas, cultivating before a herbicide application can increase or decrease its effectiveness. The effect of cultivation depends on the weed and the herbicide. Some weeds may be easier to control when they are weakened by cultivation. Other weeds may be broken into pieces and become harder to control with systemic herbicides. Read label directions before cultivating. This will identify whether it is helpful to do so. Cultivation may help weed seeds to germinate. The resulting weed seedlings will be easier to kill with later cultivation, or by using heat or herbicides.
- **Herbicide Resistance:** There are increased reports of agricultural weeds developing resistance to herbicides. These resistant weeds can also become a problem in landscapes. See **Applicator Core Manual** for resistance management information.

A Sample IPM Program for Broadleaf Weeds in Turf

The parts of an IPM program include:

- Prevention
- Identification
- Monitoring
- Injury and action thresholds
- Treatments
- Evaluation

Prevention

Weeds are the most common and most visible pest problem in lawn areas. They can also be a problem in sports and recreational turf. Weed problems usually begin in areas where the turf is in poor condition, the soil is compacted, or the turf has been heavily damaged by insects or disease. This causes thin or bare areas and allows the weed seeds already present in the soil to quickly germinate and grow. Healthy turfgrass plants can easily compete with weeds in the turf. Maintaining healthy turf is the best way to prevent broadleaf weed problems.

Before seeding or laying sod:

- Make sure soil is deep enough for healthy turfgrass (e.g., 15-20 cm deep).
- Add lime and soil amendments to correct pH and soil fertility.
- Correct soil compaction and drainage problems.
- Choose turfgrass cultivars and mixtures that are suited to conditions and planned use.

Deplete the weed "seed bank" in the soil. Allow weed seeds to germinate in bare soil. Cultivate to destroy the sprouting seedlings. Repeat the process. Make each cultivation shallower than the one before. This avoids dragging more seeds into the germination zone.

In existing lawns, weed seeds can germinate and fill in bare spots or where turf is thin from mowing too short. Dense turf, mowed to a height of 5 to 9 cm, shades the soil. This prevents weed seeds from germinating. It also prevents weed seedlings from getting enough space and light to survive. Different mowing heights may be needed, depending on the time of year. Summer mowing heights should be set high.

Turf management programs should be reviewed and corrected when broadleaf weed numbers increase. To help turf to compete with weeds:

- Use proper fertilization for soil conditions (e.g., avoid over-fertilization with soluble nitrogen).
- Mow correctly. Set the mower blade high for most turf (5 cm is a minimum, 8-9 cm is better).
- When possible, leave cuttings on the turf to add nitrogen and organic matter. Do not do this during wet conditions and times of excess growth (e.g., early spring).
- Correct soil compaction and poor drainage.
- Irrigate correctly for the soil type and time of year. Avoid shallow, frequent watering. Infrequent, deep watering promotes deep root growth.
- Manage thatch. It Maintain a moderate (1-2 cm) layer of thatch. Note: Thatch is the layer of matted partially decomposed dead leaves and shoots between the base of the turf plant and the soil surface.
- Overseed following any de-thatching operations, bare areas from de-thatching can provide spaces for weed growth.
- Prevent thin areas by distributing foot traffic evenly over the turf surface. Where practical, keep traffic off lawns and turf that is very wet or very dry. Permanent paths should be considered for areas receiving constant traffic.
- Repair and re-seed any thin areas as quickly as possible to avoid weeds an opening.

Identification

It is important to know the weed species present in the area being managed. This information is used to select and plan treatments. Provincial or local weed guides are a useful resource when identifying weeds. See references listed at the end of chapter 8.

Common broadleaf weeds that infest lawns, golf courses and playing fields include:

- Dandelion
- Broad-leaved plantain
- Dock
- Ground ivy
- Hawkweed
- Creeping buttercup
- Prostrate knotweed
- Chickweed

Of these, dandelions are often the easiest to see when not controlled. Bright yellow flowers and large seed heads are unappealing to many members of the public. This chapter outlines an Integrated Pest Management (IPM) program for broadleaf weeds in turf, including dandelions. Grassy weeds such as couchgrass or crabgrass often require different approaches.

Monitoring

Visual Inspections

Yearly checks of low maintenance sites may be enough to tell if sites are in good condition. Sites with higher levels of maintenance may need to be checked twice a year. If dandelions and other visible flowering plants are the main weeds, they are easy to see during bloom. Photographs can be taken during bloom times. These can be compared from year to year. This will let you see if weeds are increasing or decreasing.

Counting Methods

Weeds can be counted using any of the following methods, as discussed previously in this chapter:

- The transect method
- The grid or quadrant method
- Visual estimation

Injury and Action Thresholds

The preferences of site users or customers should be taken into account when setting thresholds. Some people like small flowers mixed in with turfgrass (e.g., violet, prunella, white clover). Others find even a few dandelion flowers unappealing. Weeds such as buttercup in a lawn may be unappealing due to the spreading, upright growth habit. In general, a lawn with 5 - 10% weed cover, may appear "weed free" to most people. It may also be possible to increase people's tolerance to some weeds such as dandelion by mowing more frequently during the bloom period. This removes flower heads and maintains an even green appearance.

Treatments

Physical and Mechanical Controls

HAND WEEDING

Hand weeding should be done in a way that disturbs the turf very little. It can be a very effective control method for low weed densities on high value turf such as golf greens and tees. Long handled weeding tools are available and can increase worker comfort when spot weeding.

It is important to note that every opening in the turf allows weed seeds to germinate. When weeds are removed the hole should be filled back in with a mixture of seed and soil.

FLAME WEEDING

Specialized flame weeding tools or "flamers" are available from some equipment suppliers. Broadleaf weeds are more prone to heat damage than grasses. A heat resistant sheath protects growing tips of grasses. With care and practice, flamers can be passed quickly over weedy turf areas. This will selectively control the broadleaf weeds without damaging the grasses.

INFRARED WEEDING

Hand-held infrared weeding tools are sold in Canada. These tools can be used to control dandelions and other weeds. They burn propane fuel from a backpack tank. This provides a radiant heat source that is delivered to the plant by a probe. The probe tip is pushed into the growing point of the weed to kill it.

Chemical Control

A number of selective herbicides can be used to control broadleaf weeds in turf. These include 2,4-D, mecoprop, MCPA, dicamba, and mixtures of these. Herbicides should only be used where required. Spot-treating weedy areas instead of using broadcast applications will provide good control.

Herbicides must be applied at the correct time of the year to get good weed control. Knowing the weed populations at your site and their lifecycles will help you determine when to apply herbicides. Always follow the directions on the pesticide label.

Before applying herbicides, consult the provincial regulator for certification, permit, or license requirements. In some municipalities, bylaws on pesticide use may be in place. Consult your municipality for details.

Avoid using combination herbicide and fertilizer products. This spreads herbicide over an entire area each time the turf is fertilized. Weedy and weed-free areas are both treated with herbicide. This goes against the goals of an IPM program. It also causes a great deal of pesticide use that is not needed. In some provinces, public outcry against unnecessary pesticide use on turf has resulted in municipal bylaws that restrict their use.

Evaluation

At the end of each season review all aspects of the IPM program, consider the results obtained and identify changes that can be made to improve the program's effectiveness. Before the next season starts, determine if there are new products and tools that could be used in the program.

Summary

A weed is any plant that is growing in the wrong place. Weeds are a common problem in turf and landscapes. To use an IPM approach, you must be able to identify weeds, know their life cycles, and their biology. Weeds are identified by looking at a number of plant parts. It is important to properly identify weeds and determine their stage of growth before planning control treatments. An IPM program for weeds often begins with dividing the area to be managed into categories or classes based on the level of weed infestation that can be tolerated.

Weeds are then monitored and controlled using a variety of methods including:

- **Cultural (e.g., correcting growing conditions, over-seeding)**
- **Physical (e.g., hand weeding, use of flame or infrared weeders)**
- **Chemical (e.g., herbicides)**

Self-test Questions

Answers are located in Appendix A of this manual.

Self-test questions for chapters 5, 6, 7, and 8 can be found at the end of chapter 8.