ORNAMENTAL WEED CONTROL
Category 6c
A Study Guide for Commercial Applicators
Acknowledgements

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Thank You!

Pictures and information

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- Bugwood.org
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Chapter 1

THE LEGALITIES FOR PESTICIDE APPLICATORS

Learning Objectives

- Know the Federal Laws regulating pesticides
- Know the State Laws regulating pesticides
- Know what the role is for an applicator working in the Ornament Weed Control industry
- Learn about recordkeeping and what the applicator should know
- Protection of the environment
- Use, handling, and storage of pesticides
- Understand the meaning of a pesticide-use category definition
- Why we have an EPA approved State Plan
- The applicator’s responsibilities
- Know what a category definition is
- Learn about exams, what is required, how to check results, etc.
- Understand the recertification process, what it is, and how it works
- Know what it means to be a licensed commercial applicator
- What’s new

FEDERAL LAWS

The federal laws include the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), Occupational Safety and Health Act (OSHA) and Endangered Species Act.

FIFRA — is the basic federal law administered by the US Environmental Protection Agency, (USEPA) that regulates pesticides — their use, handling, storage, transportation, sale, disposal, etc. The Ohio Department of Agriculture (ODA) has a cooperative agreement with the USEPA to enforce some parts of FIFRA. Selling or using a pesticide before registration is a violation of the law.

Pesticides are either “general-use” or “restricted-use”. Anyone can buy and use general-use pesticides. You can only buy or use restricted-use pesticides with an active license.

FIFRA also stipulates that people who use pesticides “inconsistent with the pesticide label” will be subject to penalties.

Figure 1.2 Eagle image courtesy of Lenz Design, Decatur GA

Endangered Species Act — This act requires the USEPA to make sure that endangered or threatened plant and animal species are protected from pesticides. It requires each pesticide label to limit its use in areas where it is harmful to these species. The Ohio Department of Natural Resources (ODNR) Division of...
Wildlife maintains the federal and state endangered to threatened species lists. Ohio applicators need to be sure that they are complying with the law. They must take the initiative to consult with the ODNR or check the lists to be sure that there are no endangered or threatened species in their application area.

STATE LAWS
The Ohio Revised Code (ORC) and Ohio Administrative Code (OAC) are the regulations and laws that allow ODA to control who uses pesticides, how pesticides are mixed, loaded, applied, and the disposal process.

The Ohio Pesticide Law — This legislation gives the director of ODA authority to license private and commercial applicators. He also prescribes standards for licensing. Category 6c applicators are commercial applicators. There are two subclasses for Commercial applicators.

**Subclass A** — Any licensed person who applies, uses or supervises the use of general-use or restricted-use pesticides (RUPs) for their employer or for hire.

**Subclass B** — Any person who is a trained serviceperson and (1) applies pesticides under direct supervision of a licensed applicator in the course of their employment, or (2) applies a pesticide under direct supervision of a licensed pesticide applicator for hire.

The ODA regulates pesticides by taking complaints from the public and investigating said complaints. ODA also does required federal and state inspections of application businesses, pesticide dealers and pesticide applicators for compliance.

THE ROLE OF A PESTICIDE APPLICATOR
Pest application can be complex. It is a matter of using the right tools. This requires special equipment and safety measures. To do well in Ornamental Weed Control applications it must be effective. Applications should not have a negative affect on people or the environment. What is the environment you might ask?

Environment is the air. It is the water. It is the soil. Simply, it is everything around us.

![Image Pesticide Applicator](image)

Figure 1.3 Image Pesticide Applicator

The number and variety of pesticides have increased. Pesticide applicators need to know more about safety and proper use than ever before. For these reasons, many state laws, federal laws and regulations help protect the public. They also protect the environment, pesticide applicators, and handlers from the possible bad effects caused by pesticide use.

Applicators certified in Category 6c are responsible for ornamental weed control around structures including but not limited to homes, schools, hospitals, businesses, warehouses. It is important that category 6c applicators understand and keep up to date with the laws that regulate pesticide applications. Ignorance of the law is never an accepted excuse for a violation.

**Protection: The applicator’s responsibility** — Responsibility for protecting the environment from the possible bad effects of pesticide use rests on the applicator. Preserving the natural variety of our planet by protecting the environment contributes to the quality of life. Each plant and animal is part of a complex food chain. If you break one of the links then others are badly affected. One vanishing plant can affect up to 30 other species that depend on it. This includes insects, higher animals and even other plants. Applicators may see their normal
work as unlikely to affect the environment, but spills and leaks while mixing, loading, and transporting, or incorrect disposal can lead to pesticides in ground or surface water or in the home of non-target organisms. Applicators often service parks, schools and other sensitive areas.

Use, Handling, and Storage: The applicator’s responsibility —
It is the applicator’s job when applying or handling pesticides to follow all label instructions and requirements. You need to apply and not cause harm to the environment, human life, animal life or plant life.

The applicator should READ THE LABEL. They must understand what personal protective equipment (PPE) is, how and why it is used in order to perform a safe application. Remember: THE LABEL IS THE LAW! An example of PPE would be long pants. Long pants would protect the legs of an applicator from dermal (skin) exposure.

Storage requirements for pesticides are on the label as well as additional requirements by the USEPA and OAC 901:5-11-11. See the laws and regulations in the Core Material.

What does this mean to you?
You may or may not do the handling, loading, or storage for your applications. This does not exempt you from knowing the requirements. Also knowing how to deal with them in case you might handle, mix, load, or store pesticides in the future. It is your responsibility to keep informed about the laws and regulations of pesticides.

Record keeping: The applicator’s responsibility — The ORC and OAC establishes the types of licenses and applicators. They expand the record-keeping requirements. All commercial applicators shall maintain records of the pesticide use for a time not less than three years.

All pesticide application records according to 901:5-11-10 of the OAC shall include the following information:

- Name and business address of responsible commercial applicator and names of the trained servicepersons applying pesticides under the commercial applicator’s direct supervision
- Name and address of person contracting for service
- Date of application
- Type of crop or area to be treated
- Location or field identification number of treatment if different than the address in (b) above
- Trade name (brand name) and EPA registration number of pesticides used
- Total amount of each pesticide product used and the rate at which each pesticide product was applied
- Time of day at beginning of application

The applicator shall submit, within ten days following the date of completion, a copy of each record required under paragraphs (A)(1) and (A)(2) of this rule to the registered pesticide business location from which the application was conducted or the commercial applicator’s employer if the employer is not a pesticide business.

What does this mean to you?
The applicator who actually applies the pesticide is the responsible party. The records must have all the information required by the law. An ODA inspector will call on you from time to time and check records. If your record keeping files are incomplete, you have violated the ODA Law. You will be subject to actions from a letter of warning to license revocation.

PESTICIDE-USE CATEGORY DEFINITION
The pesticide-use categories are found in the Ohio Administrative Code section (901:5-11-01).

The pesticide-use category definition for category 6 is “Ornamental pest control” which means the application of pesticides to
ornamental plants or areas for the control of any pests except vertebrates.

There are four sub-categories for 6. This study guide relates to sub-category c that is “Ornamental Weed Control” which means the application of pesticides to exterior ornamental areas such as landscape beds, tree and shrub plantings, sidewalks, driveways, or similar areas for the control or eradication of unwanted vegetation. If this is not the category (6c) that you need or want, please contact the Ohio Department of Agriculture – Pesticide and Fertilizer Regulation to get the category you need. Pesticide and Fertilizer Regulation information is as follows, phone numbers are (614) 728-6987 or (800) 282-1955 or contact us by email pesticides@agri.ohio.gov.

REQUIREMENTS OF COMPETENCY
ODA receives the Requirements of Competency from the State Plan for Ohio mentioned earlier in this chapter. The standards of competency for category 6c are as follows:

(6c) Ornamental Weed Control - Commercial applicators shall demonstrate a practical knowledge of:

- The common pesticides registered against these pests, their functional classifications, and modes of actions
- Rates, methods, and timing of applications
- Methods to prevent or minimize pesticide damage to cultivated plants, humans, pests and other non-target areas
- Physiogenic disorders of plants resembling pest injury or herbicide damage
- Application and safety equipment
- Information necessary for safe and adequate application of pesticides

What does this mean to me?
These standards used in development of the study guides and competency exams are for people who want to become licensed applicators. Competency exams have questions about subjects such as common pests, exposures etc. You should learn all you can from the guides.

Knowledge will help you pass your exams and be a competent applicator. The more knowledge of a topic, the better equipped you are to pass your exams.

DEMONSTRATION OF COMPETENCE AND PESTICIDE EXAM REQUIREMENTS
OAC 901:5-11-08
(A) Each applicant for a pesticide applicator license shall show, by passing a general Core examination and an examination for each applicable pesticide-use category, that the applicant possesses adequate knowledge of general pesticide application principles and competence to apply pesticides and, in the case of commercial applicators, adequate knowledge and competence to conduct diagnostic inspections within the pesticide-use categories for which the applicant seeks licensure.
(1) Opportunity to take examinations will be provided at such times and places as determined by the director in consideration of the number and location of requests.
(2) A pesticide applicator may apply to broaden their license to include a new pesticide-use category at any time.
(3) In establishing the standards for training and examination of pesticide applicators, the director will be guided by the standards set forth in the “State Plan for Certification of Applicators” as approved by the administrator of the United States Environmental Protection Agency.
(4) Each applicant for licensure as a commercial applicator in the category of wood-destroying insect diagnostic inspection shall submit a valid certificate verifying that they have completed the Ohio wood-destroying insect inspection program.
(5) Applicants who fail to pass an examination may apply to be re-tested at a pre-arranged time and location, but no earlier than five business
days after a previous examination except by special permission of the director.

(6) Applicants must pass a core examination and a pesticide-use category examination to be issued a license. If an applicant fails either the core or all pesticide-use category examinations they have taken, the applicant shall not receive a license until both the core and at least one pesticide-use category examination have received a passing score. The applicant has one year from the date of the first examination for which the applicant has obtained a passing score to obtain licensure. If the applicant is unable to obtain licensure within that year, the applicant must pass anew both a core examination and a pesticide-use category examination, even if the applicant had previously received a passing score on either the core or a pesticide-use category examination.

(B) Re-examination shall be required at three-year intervals, except that a pesticide applicator may be exempted from re-examination if they have participated in the minimum amount of approved training during the three years prior to the date of their scheduled re-examination. Notwithstanding the minimum number of hours set forth below, a licensee shall participate in at least one-half hour of training for each pesticide-use category in which they are licensed in order to avoid re-examination in that particular category.

(1) For commercial applicators, the minimum amount of approved training required shall be five hours. Of the five hours, at least one hour shall consist of core training material and at least one-half hour shall consist of training material specific to the pesticide-use category in which the commercial applicator is licensed.

(2) For private applicators, the minimum amount of approved training required shall be three hours. Of the three hours, at least one hour shall consist of core training material and at least one-half hour shall consist of training material specific to each pesticide-use category in which the private applicator is licensed.

(C) In no case shall an applicant be permitted to take an examination or a re-examination unless the applicant has presented at the time of the examination or re-examination current government-issued photographic identification to the ODA representative administering the examination or re-examination. This paragraph shall not apply to an applicant whose religion does not permit the applicant to be photographed.

Requirements to become a licensed pesticide applicator are 1) pass a core exam, 2) pass at least one category exam and 3) submit an application and fee. Once these requirements are met, a license will be issued to you.

A very important note: passed exams are only valid for one year from the date you passed the exam(s) unless you are issued a license at that time. If you do not meet the requirements within that year of the valid exam, the exam will become void and you will have to retest. Exams for licensed pesticide applicators are valid as long as the license is valid.

You can review your exam status on ODA’s web site www.agri.ohio.gov. Then choose Online Services, look for Plant Industry, then Pesticides, then exam results search.

**RECERTIFICATION REQUIREMENTS**

OAC 901:5-11-08

The requirements of the law are: (B) Re-examination shall be required at three-year intervals, except that a pesticide applicator may be exempted from re-examination if they have participated in the minimum amount of approved training during the three years prior to the date of their scheduled re-examination. Notwithstanding the minimum number of hours set forth below, a licensee shall participate in at least one-half hour of training for each pesticide-use category in which they are licensed in order to avoid re-examination in that particular category.

(1) For commercial applicators, the minimum amount of approved training required shall be five hours. Of the five hours, at least one hour shall consist of core training material and at least one-half hour shall consist of training material specific to each pesticide-use category in which the commercial applicator is licensed.
What does this mean to me? This means that you are responsible to either retest or get recertification (continuing education) credits to keep your license active. You should know what credits you need, how many credits you need, and what date you need the credits.

As the Pesticide Law states, a recertification period is for three years from the date that you first receive a license and become a licensed applicator. Recertification cycles after that are at three-year intervals as long as you have an active license. You can only earn credits for the current recertification period. Credits earned over the minimum requirements DO NOT carry over to the next cycle.

You can lookup your recertification status on ODA’s web site www.agri.ohio.gov. Then choose Online Services, Plant Industry, then Pesticides, then recertification information.

LICENSING REQUIREMENTS ORC 921.06
(A)(1) No individual shall do any of the following without having a commercial applicator license issued by the director of agriculture:
(a) Apply pesticides for a pesticide business without direct supervision;
(b) Apply pesticides as part of the individual’s duties while acting as an employee of the United States government, a state, county, township, or municipal corporation, or a park district, port authority, or sanitary district created under Chapter 1545., 4582., or 6115. of the Revised Code, respectively;
(c) Apply restricted use pesticides. Division (A)(1)(c) of this section does not apply to a private applicator or an immediate family member or a subordinate employee of a private applicator who is acting under the direct supervision of that private applicator.
(d) If the individual is the owner of a business other than a pesticide business or an employee of such an owner, apply pesticides at any of the following publicly accessible sites that are located on the property:
(i) Food service operations that are licensed under Chapter 3717. of the Revised Code;
(ii) Retail food establishments that are licensed under Chapter 3717. of the Revised Code;
(iii) Golf courses;
(iv) Rental properties of more than four apartment units at one location;
(v) Hospitals or medical facilities as defined in section 3701.01 of the Revised Code;
(vi) Child day-care centers or school child day-care centers as defined in section 5104.01 of the Revised Code;
(vii) Facilities owned or operated by a school district established under Chapter 3311. of the Revised Code, including an education service center, a community school established under Chapter 3314. of the Revised Code, or a chartered or nonchartered nonpublic school that meets minimum standards established by the state board of education;
(viii) Colleges as defined in section 3365.01 of the Revised Code;
(ix) Food processing establishments as defined in section 3715.021 of the Revised Code;
(x) Any other site designated by rule.
(e) Conduct authorized diagnostic inspections.
(2) Divisions (A)(1)(a) to (d) of this section do not apply to an individual who is acting as a trained serviceperson under the direct supervision of a commercial applicator.
(3) Licenses shall be issued for a period of time established by rule and shall be renewed in accordance with deadlines established by rule. The fee for each such license shall be established by rule. If a license is not issued or renewed, the application fee shall be retained by the state as payment for the reasonable expense of processing the application. The director shall by rule classify by pesticide-use category licenses to be issued under this section. A single license may include more than one pesticide-use category. No individual shall be required to pay an additional license fee if the individual is licensed for more than one category. The fee for each license or renewal does not apply to an applicant who is an employee of the department of agriculture whose job duties require licensure as a commercial applicator as a condition of employment.
(B) Application for a commercial applicator license shall be made on a form prescribed by the director. Each application for a license shall
state the pesticide-use category or categories of license for which the applicant is applying and other information that the director determines essential to the administration of this chapter. (C) If the director finds that the applicant is competent to apply pesticides and conduct diagnostic inspections and that the applicant has passed both the general examination and each applicable pesticide-use category examination as required under division (A) of section 921.12 of the Revised Code, the director shall issue a commercial applicator license limited to the pesticide-use category or categories for which the applicant is found to be competent. If the director rejects an application, the director may explain why the application was rejected, describe the additional requirements necessary for the applicant to obtain a license, and return the application. The applicant may resubmit the application without payment of any additional fee. (D)(1) A person who is a commercial applicator shall be deemed to hold a private applicator’s license for purposes of applying pesticides on agricultural commodities that are produced by the commercial applicator. (2) A commercial applicator shall apply pesticides only in the pesticide-use category or categories in which the applicator is licensed under this chapter.

What does this mean to me? Once you have submitted your application, fee, and passed your exams, your license is issued. This will allow you to perform applications.

A Commercial Applicator applies pesticides for hire. They apply for a pesticide business without direct supervision. They perform diagnostic inspections. They apply for their employer a governmental or state agency. They apply on the property of their employer on any of the following publicly accessible sites:
- food service operations
- retail food establishments
- golf courses
- rental properties of more than 4 apartment units at one location
- hospitals or medical facilities
- child day-care centers, or school day-care centers
- facilities owned or operated by school districts education service centers
- community school
- chartered or non-chartered non-public school.

The licensing fee of $35.00 is good for all categories. There is no charge for adding additional categories to your license. Contact ODA at 614-728-6987 or 800-282-1955 and tell them you would like to add a category to your license. They will send you study guides. When you are ready to take the exam, call to schedule or go to our on-line exam registration and schedule there.

The licensing year for commercial applicators is October 1st through September 30th. A commercial applicators license has to be renewed each year because it is a one-year licensure. We send a renewal for the next year to every active commercial applicator in July for the next year.

Your responsibility as a commercial applicator is to keep ODA informed of any changes to your address (i.e., moved, changed jobs, etc.). If you wish to get the required information from ODA, we need your current address.

THE PESTICIDE BUSINESS LICENSE
A pesticide business license is required if you own a business that does pesticide applications for hire. This means if you have clients that pay you, or you bid on jobs, and receive payment, etc.

The pesticide business has a yearly licensure with a fee of $35.00; this license is separate from the applicators license, which is $35.00 as well. If you are a licensed pesticide applicator and you own a pesticide business in Ohio, you need both licenses. The cost to you each year will be $70.00 for licenses: the applicator and the business. The renewals are usually on different color paper so make a mental note of this fact.
DEFINITION OF A WEED
The definition of a weed is, "any plant that grows where it is not wanted." A clump of clover growing in a pasture setting is not normally considered a weed. However, if that clump of clover were growing in a perennial garden or an ornamental landscape it would definitely be considered a weed. Some plants are regarded as weeds because they are hazardous, a nuisance, or cause injuries to people or pets. Some weeds are poisonous to humans and cause skin irritations or infections. This type of weed is considered a noxious weed. Whatever the case may be, weeds are not very popular.

WHY WEEDS GROW WHERE THEY DO
Weeds only grow where the conditions are suitable for their growth. If the soil has been disturbed enough or cultivated, the weed seed will germinate and grow. Weeds quickly become problems in ornamental beds. When established, weeds produce large numbers of seeds which is a guarantee of their survival.

Depending on the species of weed, seeds can remain dormant in the soil from a period of a few months to many decades. This long seed viability helps guarantee weed survival. Because weeds can produce high numbers of seeds, and many weed seeds can survive in the soil for years, weed management is usually a long-term process.

HOW WEEDS SPREAD
Weeds spread when seeds or growing plant parts (stems, roots, and rhizomes) move into a new territory. Some invading species have evolved special seed shapes or structures to aid the movement by wind, water, or animals. Many plants have vegetative parts that resprout new roots or shoots. If these plant fragments are carried into new areas, they may grow and start new infestations.

Wind carries many seeds to new areas. Some weeds, like dandelions, have a parachute-like attachment that carries the seed in the wind.
Water from rain, irrigation, and surface runoff also transports many seeds. Some seeds have an oily coating or an air bladder for air flotation. Rivers, streams, and irrigation canals move large numbers of seeds. Mammals, birds, and humans carry seeds on their bodies dropping them into new areas. Plant seeds have shapes of burs, hooks, and barbs that cling to feathers, hair, and clothing. Wild or domestic animals ingest and excrete some seeds that survive and germinate after passing through an animal’s digestive tract.

If you need help with identification, there are people and resources to help identify plants or weeds through the universities, county extension programs, and noxious weed programs.

Plants are divided into groups according to their structural characteristics common to all plants in each group. Weeds are usually divided into two groups: grasses and broadleaves.

Two Major Plant Groups
Grasses have only one seed leaf. The leaves are narrow and upright. Leaf veins run parallel to leaf margins. The roots are fine and branching (fibrous).

Sedges differ from grasses because they often have triangular-shaped stems rather than round or oval ones, and the leaves extend in three directions. Sedges are grass-like but not true grasses. Crabgrass, Quackgrass, and Barnyardgrass are typical weedy grasses.

Broadleaf plants, trees, and shrubs have two seed leaves. Leaves are generally broad with net-like veins. The root system is coarse, often with a strong taproot. Plants may be herbaceous (no woody tissue; die back to ground) or woody (shrubs and trees). Dandelion, knotweed, and plantain are typical herbaceous broadleaf weeds. Shrubs have several stems and rarely grow taller than 10 feet. Blackberries and common woody weeds are also broadleaves. Trees usually have a single stem (trunk) and generally grow taller than 10 feet; these are considered broadleaves as well.

Weed Seed Dissemination (spread)
People unintentionally move and introduce weeds over long distances. Equipment carries seeds to new sites. Some weeds develop from seeds introduced in contaminated topsoil, manure, compost, mulch, grass seed, or sod.

WEED IDENTIFICATION, CLASSIFICATION AND LIFE CYCLES
Accurately identifying weeds is the first step to an effective weed control program. You should know if you are treating grasses or broadleaves. Understanding a weeds life cycle will help you select a proper control method.

Identifying weeds is one of the first steps in effective weed control. You may recognize the common weeds but new weed species may be difficult to recognize. You can get help from your business, the internet, horticultural books, local extension office, or local university horticulture departments.

Curly Dock Water
Dandelion Air
Bull Thistle Animals

Quackgrass Grass
Spurge Broadleaf
Plant life cycle is another classification. There are certain times when plants are more vulnerable to control strategies. The effectiveness of weed management plans often depends on targeting certain plant growth stages (seedling, vegetative, flower, maturity). Plants are classified by their life cycle: annuals, biennials, or perennials.

**Annual plants** complete their life cycle in less than one year (12 months). Normally annuals are the easiest weed type to control. However, they are a continual problem because of an abundance of dormant seeds, fast growth, and high seed production. There are two types of annual plants: summer and winter.

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<td>Barnyardgrass</td>
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<td>Henbit</td>
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<td>Common purslane</td>
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**Examples of common annuals**

**Summer annual plants** germinate (sprout from seed) in the spring or summer. They grow, flower, set seed, and die before winter. The seeds lie dormant in the soil until the next spring or several springs later when the cycle repeats.

**Winter annual plants** usually germinate in the late summer to early winter. They overwinter in a vegetative state. In the spring or early summer, they flower, set seed, mature, and die living for less than one full year. The seeds lie dormant in the soil during the summer months.

**Biennial plants** complete their life cycle within two years. In the first year, the plant forms basal leaves (rosette) and a large root system (taproot). The second year the plant flowers, matures, and dies. There are not any biennial grasses or sedges.

Sometimes people confuse biennials with winter annuals. The winter annual life cycle extends from one calendar year into the next, but they complete their life cycle in less than 12 months. Biennial weeds usually are easier to kill in their first year, but their rosette stage is overlooked easily.

**Perennials** live more than two years. Some may live almost indefinitely. They resprout from vegetative plant parts. These persist from sprouting tap roots, underground stems (rhizomes), and stolons (stems that grow on ground and take root), tubers, and plant fragments. Perennials spread quickly and are hard to control. Herbaceous perennials die back to the ground during winter. Then they resume growth from buds on the rootstock the following spring. To avoid these problem weeds, do not let perennial seedlings become established.
Spread by rhizomes or 
creeping roots

Spread by 
stolons

Vegetative Propagation by 
Creeping Perennials

Examples of Common Perennials

<table>
<thead>
<tr>
<th>Simple</th>
<th>Creeping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common dandelion</td>
<td>Ground ivy</td>
</tr>
<tr>
<td>Curly dock</td>
<td>Canada thistle</td>
</tr>
<tr>
<td>Buckhorn plantain</td>
<td>Quackgrass</td>
</tr>
<tr>
<td>Broadleaf plantain</td>
<td>Yellow nutsedge</td>
</tr>
</tbody>
</table>

Simple perennial plants resprout from crown buds on the taproot and spread by seed. The roots are usually fleshy and may grow very large. Dandelion and plantain are common examples. If you cut dandelion or plantain off below ground level, the plants resprout from the taproot.

Creeping perennials reproduce by creeping roots, creeping above ground stems (stolons), or creeping below ground stems (rhizomes). In addition, they can reproduce by seed. Canada thistle and field bindweed sprout new shoots from creeping roots. Ground ivy sprouts new plants from above ground runners or stolons. Quackgrass and Johnsongrass sprout new growth from rhizomes or underground stems. Yellow nutsedge also produces rhizomes, but the rhizomes end with underground tubers that sprout new plants.

An infested area with creeping perennials is probably the most difficult group to control. During one growing season, you may need a combination of herbicides and management options to control perennials.
COMMON LANDSCAPE WEEDS

Learning Objectives
- Be able to identify weeds by name
- Distinguish what type of weed (i.e., annual etc.)
- How the weed continues by (i.e., seeds, taproots, etc.)

WEEDS

Broadleaf Plantain and Seeds

3.1 Image courtesy of John Cardina, Ohio State University, Bugwood.org

Description: Cool season perennial, which reproduces by seeds. The form is a spreading or upright right basal rosette of broadly oval leaves with fibrous roots. They normally appear in rural landscapes, driveways, and almost anywhere.
Leaves: The leaves are broad-oval, dark green. The leaves are up to 10 inches long, the margins are wavy, and the veins are prominent and parallel.
Flowers: They are attached to the ends of the flowering stalk and appear like fingers or rat tails. They grow 8 to 10 inches tall during May to September.

Buckhorn Plantain and Seed Pod

3.2 (Top) Image courtesy of Ohio State, Bugwood.org
3.3 (Bottom) Image courtesy of Richard Old, Bugwood.org
**Description:** A narrow-leaved perennial that forms a rosette. This weed is very common in maintained turf and ornamental plantings.

**Leaves:** Leaves are 3-10 inches long and less than 1 inch wide. They arise from a thick, shallow taproot.

**Seeds:** Seed capsules are 1-3 inches long appearing on a leafless stalk.

**Common Chickweed**

**Description:** Common chickweed is an invasive annual weed with small, broad leaves and white flowers. Chickweed spreads by seeds, roots, and forms a dense mat. Chickweed is a winter annual weed that blooms from March to December but sprouts in the fall.

**Leaves:** Smooth pointed leaves

**Flowers:** Star-like white flowers with five split petals that look like ten petals instead of five.
**Common Dandelion**

*Description:* This perennial weed has milky sap. It spreads by seeds and broken roots. Found mostly in lawns. For this reason they can invade landscape beds as well.

*Leaves:* Broad and jagged at the base of plants

*Flowers:* Single yellow blooms at the end of stems in spring, and fall. Fluffy seeds will result and these can be seen floating through the air like little parachutes.

*Roots:* Tough taproot that may go down one meter deep in the soil

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**Crabgrass**

*Description:* Annual grass sprouts roots at the nodes as it creeps in the landscape. Crabgrass turns purple later in the season but dies out in the fall.

*Leaves:* Coarse-textured leaves

*Flowers:* Spiked seed heads shoot up from the center of the plants. The seeds will germinate next spring.

*Roots:* Shallow

---

**Ground Ivy**

*Description:* Perennial with creeping stems that root at the nodes and foliage that emits a mint-like odor. Primarily a weed of landscapes and turfgrass

*Leaves:* Opposite nearly round in outline or sometimes kidney-shaped or long petioles. Margins have large rounded teeth and leaf veins arise from the same point. Stems are square, trailing, and rooting at the nodes mostly without hair.
**Roots:** Rhizomes occur and fibrous roots are produced at the base at each node of the trailing stem.

**Morning Glory**

![Image](image1.png)

**Description:** These are perennial weeds with deep extensive roots, and white or colored bell-like flowers. They creep like a vine in the lawn and into other plants. They spread by seeds and roots.

**Leaves:** Arrow-shaped with two pointed or rounded lobes.

**Flowers:** White or pinkish flowers shaped like a funnel bloom from June to September. Seeds can survive in the soil for many years (up to 30).

**Roots:** Cord-like and fleshy roots grown up to 5 meters deep in the soil.

**Oxalis**

![Image](image2.png)

**Description:** Perennial weeds with small yellow flowers and exploding seedpods are found in lawn and ornamental landscapes.

**Leaves:** Leaves are clover like, heart-shaped, smooth and thin. The leaves contain oxalic acid and have a sour taste.

**Flowers:** Usually small yellow flowers with five petals. They bloom all summer. Cucumber-shaped light green seedpods will explode when touched, and spread seeds in all directions.

**Roots:** Shallow fibrous roots

**Prostrate spurge**

![Image](image3.png)

**Description:** Spurge is a late-germination, low growing, and mat-producing summer annual. Spurge is often found in un-irrigated mulch. It is common to tree islands, crevices, and sidewalk cracks. Spurge will tolerate some shade, but thrives in harsh full-sun baked sites. The reddish somewhat hairy stem of spurge will produce milky-white latex when broken or injured (similar to dandelion).

**Flowers:** Form in the axils of the leaves

**Leaves:** Leaves are opposite and oblong; leaves have a conspicuous thumbprint. Stems are reddish-green with hairs.

**Roots:** Spurge has a shallow taproot with secondary fibrous roots.
**Purslane**

*Description*: Annual weeds with fleshy leaves and stems form a dense stem mat. Stems have a reddish-brown color, and they will sprout roots where they touch the soil. Purslane found in the summer in landscapes and lawns.

*Leaves*: Thick, rubbery and fleshy

*Flowers*: Usually small and yellow flowers with 5 parts. They bloom all summer.

*Roots*: Main tap-root with shallow fibrous secondary roots.

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**Quackgrass**

*Description*: A perennial grass weed which its rhizomes size can be up to 3 ½ feet in length. Quackgrass is a common weed of Turfgrass and landscapes.

*Leaves*: Leaves rolled in the bud are about 1.5 to 12 inches long and 1mm long.

*Flowers*: Seed head is a long narrow spike that has many individual spikes arranged in two rows of the stem.

*Roots*: Rhizomes and fibrous root system

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**Yellow Nutsedge**

*Description*: Nutsedge is a perennial from rhizomes and tubers that can reach ½ feet in height. The stems are 3-sided triangular.

*Leaves*: Yellow to green in color and have distinctly shiny appearance. Leaves are 5 to 8 mm wide. Leaves are produced in groups of three.

*Seeds*: seedlings rarely occur. Most plants arise from rhizomes and/or tubers.

*Flowers*: Spikes grow at the ends of the single stems in a cluster where flower stalks begin. Spikes are brown to yellow in color.

*Roots*: Rhizomes and tubers grow on the same plants. Yellow nutsedge produce solitary tubers that grow either from the basal bulb or from a rhizome.
HERBICIDES 101 THE BASICS

Learning Objectives
- Types of herbicides
- How herbicides work
- How herbicides are applied
- When to apply herbicides
- Weed growth stages and herbicides
- Resistance weeds and herbicides

To select the best herbicide for a particular weed in an ornamental planting you must understand how herbicides
- are applied,
- are absorbed by plants,
- kill or control plants, and
- can be used to kill only the targeted weeds and not desirable plants (selective control).

HERBICIDE CLASSIFICATION
Herbicides are either applied: 1) directly to the plant foliage, or 2) to the soil where germinating seedlings and weed roots or shoots absorb the herbicide.

**Foliar applied** herbicides are sprayed into the foliage of the plant, including leaves, stems, shoots, and buds.

**Soil applied** herbicides are either granules or sprays. They are applied to the soil and incorporated into the soil by water (irrigation, rain) or mechanical means (rotary tillage, raking). Soil-applied herbicides target germinating seedlings and inhibit seedling growth. Or, kill the plants by herbicides absorbed by plant roots and shoots and moved (translocated) throughout the plant.

**Commonly Used Herbicides in Ornamentals**

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Application</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basagran</td>
<td>Foliar-applied</td>
<td>Contact</td>
</tr>
<tr>
<td>Roundup</td>
<td>Foliar-applied</td>
<td>Systemic</td>
</tr>
<tr>
<td>2,4-D</td>
<td>Foliar-applied</td>
<td>Systemic</td>
</tr>
<tr>
<td>Gallery</td>
<td>Soil-applied</td>
<td>Inhibits seedlings</td>
</tr>
<tr>
<td>Casoron</td>
<td>Soil-applied</td>
<td>Systemic</td>
</tr>
<tr>
<td>Preen</td>
<td>Soil-applied</td>
<td>Inhibits seedlings</td>
</tr>
</tbody>
</table>

Plants absorb herbicides into their tissues, but herbicide movement and action can vary by the chemical used and the target plant. **Herbicides need to kill only the shoots of annuals or biennials, but to kill perennials they must move to the roots.**
Contact herbicides (foliar-applied) are applied directly to growing plants. They kill only the plants and plant parts they contact. They do not move throughout a plant. They kill any green areas on the plant leaves, stem, and shoots. This may include tree and shrub bark that is thin or green. They generally rupture cell membranes so the cell contents leak out. Activity is often very quick with visible damage happening in a few hours. **Contact herbicides need uniform spray coverage over the entire weed.** The only areas that die are the areas where the chemical contacts.

Contact herbicides affect only those plant tissues they touch.

Contact herbicides effectively control targeted annual weeds. However, they only kill the shoots of perennial weeds, leaving the underground roots to resprout. Repeated application to perennial weeds may drain the food reserves in the underground plant parts causing death. Ornamental weed control applicators use very few contact herbicides.

Systemic herbicides (foliar-applied), sometimes called translocated herbicides are absorbed through the foliage, or shoots, and move throughout plants. These herbicides move with the water or sugar transport systems from the roots to the tips of the plants. For example, glyphosate applied to the foliage enters the conductive tissues in plants and moves to actively growing plant parts like shoot tips and roots. You usually see injury first at growing points. Death of the plant happens later, days or weeks after the application. Good control needs actively growing plants, which are moving the herbicides through the plants. If the plant is stressed or not actively growing, little herbicide movement happens. Therefore, poor weed control may result.

Because they move within the plant, some of these systemic chemicals effectively control perennial weeds and you do not need to apply them uniformly over the whole plant to produce good results. Most foliar-applied herbicides used in ornamentals are systemic herbicides. Examples include 2,4-D, MCPA, glyphosate, dicamba.

Seedling and root inhibition herbicides (soil-applied) are referred to as “residual herbicides.” You apply them to the soil and they generally inhibit cell division or root and shoot growth in germinating seedlings.

Herbicides applied to the soil surface must move into the weed’s root zone or the zone where weed seeds germinate to become available for absorption by the weeds. They must be present in the soil-water solution to be available for plant uptake. You can move herbicides into the soil solutions by adding water to the soil, by mechanical-incorporation with tillage equipment, or by injecting herbicide directly into the soil. Although several products work well in dry soil after you mechanically incorporate, it is best to avoid applying herbicides until moisture is, or will soon be available.

These chemicals typically are active in the soil for extended periods. The length of their soil residual activity depends on the specific **Systemic herbicides move to the leaf and stem tips (a) Or more upward or downward in the plant within the conductive tissues (b)**
herbicide, the rate of application, soil type, rainfall, and susceptibility of weed species. Long-term residual herbicides have the potential to remain active for greater than one year.

Soil-applied residual herbicides depend on proper placement or incorporation into the soil to activate. They must be available where the weed seeds or roots are located. Take care not to place herbicide where it can contact desirable vegetation (roots and shoots). Soil residual herbicides generally have little effect on plants when sprayed on foliage. The main effects happen when the plants absorb the herbicide by the underground shoots or roots.

**Growth Regulators** disrupt the hormone balance and protein synthesis (blend) in plants. This imbalance causes abnormal growth in plants. Growth regulators selectively kill broadleaf weeds in grasses. Grasses usually tolerate these chemicals. However, damage can occur if applied at the wrong growth stage, or at high rates. These herbicides move to the growing points of the plants, and injury symptoms appear in new plant tissue. An early symptom often is abnormal bending or twisting of shoot tips. Most growth regulators enter the plant through leaves but with some, root uptake is possible.

This type herbicide moves through the plants from the soil or foliar applications. Symptoms of activity include stunting, yellowing (chlorosis), or purpling of leaves.

**HERBICIDE SELECTIVITY**

An advantage of chemical weed control over some tillage or mechanical operations is that some herbicides will kill only targeted weeds. Herbicides that control weeds while doing little or no damage to desirable plants are selective herbicides. Nonselective herbicides kill or control almost all plants including weeds as well as desirables. A plant is either “susceptible” (injured or killed) or “tolerant” (survives without injury).

Selective herbicides depend on many interrelated factors for their selectivity. It is influenced by the kind and amount of herbicide applied, as well as how and when applied, and under what environmental conditions. Closely related plants may respond differently to applications of the same herbicide. Selectivity may be lost through applicator mistakes or by applying herbicides when desirable plants have been under stress or are at a vulnerable growth stage. **You must understand the reasons for herbicide selectivity to avoid injuring desirable plants.** Two groups of selectivity factors exist: 1) plant factors, and 2) chemical and application factors.

**Plant Factors** - The uniqueness of each plant species is the result of its particular combination of structures and chemical processes (physiology). The extent an herbicide affects any plant species depends on structure and physiology.

**Structure** - Foliar applied herbicides to be effective must remain on the plant leaves and stems in order to enter the plant. Leaf angle, size, hair, thickness, wax, and cuticle affect the retention and absorption of foliar herbicides. Plants that have upright leaves, extremely hairy leaves, or hard-to-wet leaves (waxy leaves) are less likely to retain herbicide spray. These characteristics may help make a plant either susceptible or tolerant to herbicides.

**Plant Physiology** - Selectivity depends on how the plant responds after the herbicide enters it. To kill susceptible weeds, the herbicide interferes with vital plant processes. Certain plant species can alter herbicides into non-harmful chemicals naturally. This alteration is known as metabolism or detoxification. As the plant metabolizes an herbicide, it uses the breakdown products to make new materials. If a plant cannot metabolize the herbicide fast, injury or death occurs.
Susceptibility varies by plant species. Product labels list desirable plant species that are tolerant of the herbicide as well as the weeds they control. Check the label carefully for restrictions concerning the use of herbicides on specific ornamentals.

**Chemical and Application Factors** - Several physical factors affect herbicide selectivity:
- How much herbicide is applied
- The particular formulation used
- When it is applied
- Where it is applied
- The addition of adjuvants

**Application Rate** - Some herbicides are selective at lower rates of application. However, when you apply the same herbicide at a higher rate the herbicide becomes non-selective. Selective herbicides may have a relatively small margin of safety. The margin of safety is the difference between the dose that is required to control weeds and the dose that is harmful to desirable plants.

**Formulation** - The herbicide active ingredients as well as the formulation influences selectivity. For example, granular formulations allow the herbicide to bounce or roll off desired plants and fall to the soil. It then becomes available for uptake from the soil by emerging weed seedlings or roots. Liquid formulations of the same herbicide may not have the same selectivity advantage as the granular formulation. In fact, they may harm desirable plants when the leaves are contacted.

**Application Timing** - Many herbicides are effective only if applied at the proper time. The label may state the time of application in terms of the growth stage of the desirable plants or weed. You must understand the following label terms as they relate to application timing.

**Preplant treatment** is any application made before seeding or transplanting desirable plants. Preplant-soil-incorporated treatments mix herbicides into the soil zone where weeds germinate. This is a common application in agriculture settings but can be used in ornamentals. Some soil-applied herbicides are quite volatile (evaporate) or photodegradable. These must be immediately incorporated into the soil by water or mechanical means.

**Preemergence treatment** is usually made before weeds emerge. The most common used herbicides in ornamental plantings are preemergent. They are active to germinating seedlings when applied to the soil. They do not affect established plants if handled properly. Landscape managers use preemergence herbicides in plantings of woody ornamentals, ground covers, and bedding plants.
Selectivity is achieved by keeping herbicide above the tree and shrub root zone where weed seeds germinate.

Soil condition is important when using preemergent herbicides. Many provide better weed control when applied to a clean soil surface. Material on the soil surface (established plants, leaves, mulch, etc.) can bind the herbicide and reduce its ability to move into the soil.

*Postemergence treatment* is made after the weeds have emerged usually after the desirable plants are growing as well. These may be either selective or nonselective in their action. Handle them with care to avoid damage.

*Accurate placement* of nonselective herbicides can minimize or prevent injury to desirable plants. Target the weed or weed seed while protecting or avoiding contact with desirable plants.

- Place herbicides in the soil above the root zone of desirable plants, as previously discussed.
- Keep herbicide off desirable vegetation when spraying.

You can control herbicide placement by using different kinds of application equipment that employ shielding devices, directed sprays, and wiper, or roller treatments.

**Directed sprays** limit herbicide contact with the desirable plant. Usually applicators direct the spray to the lower part of the plant stem or trunk to keep herbicide off the desirable plant leaves while spraying small weeds.

**Wiper or rope-wick treatments** apply contact or systemic herbicides directly to weeds. Wicks made of rope rollers covered with carpet or absorbent pads (made of sponge or fabric) are kept wet with herbicide solution and brought into direct contact with the weeds. You wipe the herbicide onto the weeds, but it does not touch desirable plants.

**MODES OF ACTION**

Although you will not need to know the modes of action for the new applicator exam, as you gain experience on the job you should learn about how herbicides work.

To understand how herbicides control weeds can help you choose and apply the proper product for a particular weed. It will also help you identify herbicide injury in desirable plants. Herbicides differ in how they control plant growth. Some interfere with growth, and others interfere with photosynthesis.
ENVIRONMENTAL INFLUENCES ON HERBICIDE AVAILABILITY AND UPTAKE
The environment influences herbicide activity in two ways. First, the herbicide must be available for absorption. Second, the environment influences how actively plants grow, thus how actively they take up the herbicide.

Environmental factors such as soil and climate affect herbicide availability. Soil properties and climatic factors like temperature, humidity, and precipitation are the dominant environmental factors affecting performance.

Soil Factors - Different properties of soils and how that may interact with different herbicides follow:

Adsorption - Some herbicides have electrical charges and tend to bind on soil particles and organic matter. Adsorption is the attraction of herbicide molecules to the soil particle surface. This is similar to the attraction of iron filings to a magnet or lint to a nylon surface.

Herbicide molecules adsorbed to the soil are inactive. The roots and germinating seedlings of plants can only absorb herbicide molecules that are present in soil water. Molecules tightly bound to soil particles cannot be absorbed by plant roots or degraded by microorganisms.

For example, glyphosate binds so tightly to clay particles it does not have any soil activity at all. Herbicides that lack electrical charges tend to leach through the soil profile more readily. The strength of binding between the herbicide molecule and soil particle strongly affects herbicide movement or lack of movement in the soil and the availability for root absorption.

Soil texture refers to the particle size of different soils. Different soil types have different capacities to bind herbicides.

Sand is coarse and does not have many charge or binding sites,

Silt is intermediate and has more adsorptive sites than sand but far fewer than clay and organic matter.

Clay is fine and has a large surface area per given volume of soil resulting in more adsorptive sites than sand or silt. Herbicides do not move as readily through the soil profile.

Organic matter has far more adsorptive sites to tie up both positively and negatively charged herbicides. Organic matter is like a magnet and has more influence on herbicide adsorption than any other factor in the soil.

Remember sandy soils have few adsorptive sites to tie up herbicide molecules, and more herbicides leach through a sandy soil profile. Soils with clay and organic matter tie up and hold herbicides.

Whether you are doing soil residual work or selective weed control with soil-applied herbicides, you must know the soil properties and follow the herbicide label direction as they pertain to them.

- Most herbicides readily leach through sandy soils, diluting the herbicide. Leaching can injure deep-rooted plants. Diluting the herbicide reduces weed control.
- Selectivity may be lost in loamy sand and sandy loam soils because a high concentration of herbicide may leach to a depth where it kills both desirable plants and weeds.
- Loam and silt loam soils usually hold the herbicide near the soil surface. Deeply rooted plants are not injured and weeds are controlled.
Organic soils may tie up so much herbicide near the soil surface that not enough is available to control weeds. You may need to use a higher rate of herbicide.

Clay soil properties range between those of silt loam and organic soil.

**Climatic factors** including temperature, humidity, precipitation, and wind influence weed control and environmental safety.

**Temperature** - Always read the herbicide to see if monitoring temperature is necessary before applying the herbicide. These statements are usually found under “Directions for Use” or “Use Precautions”. The directions might read “Do not apply if temperature is below 40°F”, or “Do not apply if temperature is above 90°F”. High and low temperatures can stress plants. This can affect their growth and ability to tolerate herbicides. Many herbicides produce the same weed control regardless of temperature. However, some herbicides become volatile or form a liquid into a gas at high temperature. Do not apply volatile herbicides such as 2,4-D or dicamba during high temperatures. Volatility increases with temperature increases.

**Precipitation** - Rainfall occurring soon after a foliar-applied herbicide treatment may wash the chemical off and reduce control. Some herbicide labels indicate a “rain free” period. Rain moves most soil-applied herbicides into the soil. However, excess rainfall can leach herbicide through or past the target area. When the herbicide moves through as a concentrated front below the target area weeds may grow above the herbicide zone.

Water stressed weeds are less susceptible to foliar-applied herbicides. This may be due to a thicker wax layer on leaves or a slow down in the plant’s metabolism. The more actively a weed is growing, the easier it is to control with herbicides.

**Humidity** - Under humid conditions, a foliar-applied herbicide enters the leaf of a plant more easily and rapidly than at low humidity. Under high humidity, the weed leaf is more succulent and has a thinner wax layer and cuticle. Low humidity slows the herbicide penetration into the plant.

**Wind** can magnify the effects of drought and high temperature stress. Hot dry winds trigger leaf surfaces to thicken and wax layers to harden. The factors make it harder for herbicides to penetrate into leaves.

**WEED GROWTH STAGE INFLUENCES ON HERBICIDE ACTIVITY**

The weed growth stage strongly influences uptake and systemic movements of herbicides. Weeds develop through four growth stages: seedling, vegetative, flowering, and maturity. One growth stage is usually more vulnerable to different types of weed control strategies. If you do not apply the herbicides during the optimum growth stage, you may need to change the control method. An example might be an increase in the rate (but not over the label rate). In general, most plants are susceptible to postemergence herbicides 1) as seedlings when rapid growth takes place, or 2) as perennials when a period of rapid growth has ended and the plant makes and replaces food for the roots.

The seedling and young actively growing growth stage is susceptible in all weeds, annuals, biennials, or perennials. Most weeds start from seed. Small and succulent seedling weeds are easier to control than any other growth stage. This is true for mechanical or chemical control.

**ANNUAL PLANTS**

**Vegetative** - During the vegetative growth stage, plants are using most of their energy to produce stems, leaves, and roots. Control is possible but
more difficult than at the seedling stage. Control usually requires more herbicide.

**Flowering** - Most of the weed’s energy resources go into seed production during this time. It is most difficult to kill these older annual plants with chemicals. Foliar herbicide application at this stage may prevent seed production.

**Maturity** - Maturity and seed set complete the life cycle of annuals. Chemical control is not effective or practical at this stage.

**BIENNIAL PLANTS**
The best way to control biennial weeds is at seedling stage. Control of the rosette stage is second best. Control decreases as the plant starts to bolt its flower stalk and decreases further as the plant flowers.

**PERENNIAL HERBACEOUS PLANTS**
Perennial weeds vary in their growth habits. They differ in development rate, root reserve depletion, dieback of shoots after flowering, and regrowth after flowering. Control is easier at certain growth stages which depends on the weed and the herbicide used. A general rule of thumb for controlling perennial weeds is as follows. Exceptions occur for specific weeds and herbicides. The herbicide label states the best application timing for many perennial weeds.

Successful control of established perennial plants requires translocation of herbicide into the perennial plant’s underground system (roots, rhizomes, tubers). Two key facts help you understand perennial weed control:

1. Plants store sugars in their roots during winter. In the spring, they use the sugars to grow shoots, depleting the root reserves. In the summer and fall after flowering, the plants restock the roots with sugars for next year’s growth.

2. Systemic herbicides move with the flow of plant sugars. Therefore, to move herbicides into the roots, apply herbicides when the flow of sugars is downward into the roots, usually during the summer and fall growth.

**Vegetative** – Season-long chemical control is generally poor during this stage but improves as the weed approaches bud stage. To support new growth most of the plants sugars move up the stem. If herbicides are applied little gets to the roots. However, a few herbicides work during this stage.

**Flowering** – The plant’s energy goes into production of flowers and seeds at this stage. Food is transported and stored in the roots, which continues through maturity. Chemical control is most effective just prior to flowering (bud stage) with 2,4-D, and similar materials. However, on some species of weeds glyphosate
is most effective during early or mid-flowering. Check the label for recommendations.

**Maturity** – After they set seed, the shoots of many perennials either die or become fairly inactive. Most herbicides are ineffective at this stage. The underground roots and stems remain alive through the winter months and send up new plant growth the following spring.

**Fall Regrowth** – Some perennials produce short shoots in the fall. These shoots make more sugars for storage in the roots. Applying herbicides to fall regrowth is effective.

The best herbicide control to established perennial broadleaf weeds is to treat at bud and fall regrowth stages with systemic herbicides. Control of fall regrowth is important. Apply herbicides to foliage before a killing frost to ensure chemical translocation.

**HERBICIDE TOLERANCE AND RESISTANT WEEDS**

Herbicide tolerance (naturally tolerant) is similar to herbicide resistance (recently evolved tolerance), but they are very different when discussing herbicides. Any plant historically not affected by an herbicide is tolerant. Grasses are tolerant to 2,4-D, but many broadleaves are susceptible. The reason many postemergence herbicides are used to control grasses in ornamental plantings as ornamentals are tolerant and target weeds are not.

Herbicide labels often list tolerant desirable plants, and susceptible target weed species. Since beds of ornamentals usually contain different species, avoid applying an herbicide to plants not on the label. Herbicides can cause severe damage to ornamentals not listed on the label. The age of a plant and the time since transplanting can influence plant tolerance or susceptibility.

**Herbicide Resistance** is similar to tolerance except weeds survive an herbicide application. Resistant weeds have recently evolved tolerance to a repeatedly used herbicide. The resistant weed species is also resistant to other herbicides in the same herbicide family, or with the same mode of action. Herbicide-resistant weeds are a problem that is increasing.

Resistant weeds result from natural genetic variations in a weed population that an herbicide will not affect. The number of resistant individuals may be very few; maybe only one among a million plants of that particular weed species.

An effective herbicide may control 999,999 plants out of a million, but one plant survives. That plant produces resistant seeds. The seeds germinate and their plants produce more seeds that are resistant. The susceptible populations of weeds are controlled by the herbicide in following seasons, but the resistant weed population continues to grow. To make matters worse resistant weeds can survive high rates of certain herbicides and resistance is genetically dominant. Fortunately, it is possible to find an herbicide with a different mode of action, which the weeds are susceptible.

The following resistance management strategies are effective for minimizing the development of herbicide resistant weeds.
• Use other methods of weed control along with herbicides like hand pulling, tilling, mulch papers, or mulches to control weeds.
• Rotate use among herbicide families. Do not always use herbicides with similar or same modes of action.
• Do not use higher rates when weed control starts to decline. If the uncontrolled individuals in the population are genetically resistant, increasing the dosage will not kill them. Using higher than normal rates may actually make resistance develop faster.

• Use herbicide combinations. Applicators generally use herbicide combination to increase the number of weed species controlled. Using a combination from different classes slows resistance development. Rotating herbicides that have different modes of action will slow resistance development as well.

Use the procedures mentioned in the bulleted statements above before resistance becomes a problem. If large amounts of resistant seeds are introduced to the soil, control will be a problem now and in the future.
APPENDIX A
GLOSSARY
Glossary of terms for Commercial Ornamental Weed Control

**ADSORPTION** - The binding of molecules or particles to a surface.

**AMINO ACID SYNTHESIS INHIBITORS** - Prevent the production of amino acids.

**ANNUAL PLANTS** - Complete their life cycle in 12 months.

**APPLICATION RATE** - The amount of product or active ingredient used to control weeds.

**BIENNIAL PLANTS** - Complete their life cycle within two years.

**CELL MEMBRANE DISRUPTERS** - Destroy plant tissue by rupturing plant cell membranes.

**COMPETENCY** - Is standards by which applicators demonstrate practical knowledge.

**CONTACT HERBICIDES** - Need to contact the plant to work and they only kill the portion of the plant that they contact. They do not kill the roots.

**DIRECTED SPRAYS** - Limit herbicide contact with desirable plant.

**FIFRA** - The federal law by with the US Environmental Protection Agency (USEPA) regulates pesticides.

**FLOWERING GROWTH STAGE** - When annual plants energy resources go into seed production.

**FORMULATION** - Means a type by which the active ingredient is delivered. The active ingredients could be liquids, solid, or gases.

**GENERAL USE PESTICIDE** - Anyone can buy and use general-use pesticides for example homeowners, and non-licensed applicators.

**GROWTH REGULATORS** - Disrupt the hormone balance and protein synthesis (blend) in plants.

**HERBICIDE** - A pesticide used to control weed plants.

**HERBICIDE SELECTIVITY** - Herbicides that control unwanted plants while doing little or no damage to desirable plants.

**LIFE CYCLE** - The different stages of growth of weeds.

**LIPID INHIBITORS** - Prevent the production of fatty acids.

**MAMMALS** - Birds and humans carry seeds on their bodies dropping them in new areas. Wild or domestic animals spread seeds by excretions.

**MATURITY** - Maturity and seed set complete the life cycle of annuals.

**MODE OF ACTION** - How weeds are controlled by an herbicide.

**OHIO DEPARTMENT OF AGRICULTURE** - The state agency that regulates the use, sales, and regulation of pesticides.

**PREMERGER TREATMENT** - Is usually made before weeds emerge.

**PERENNIALS** - Live more than two years and some live almost indefinitely.

**PESTICIDE LABEL** - The pesticide label is the LAW. The label is the vehicle that allows the USEPA and the Ohio Department of Agriculture to conduct enforcement actions against violators of the label.

**PESTICIDE APPLICATOR** - Is the licensed person who applies pesticides for hire or during the course of his/her employment.

**PESTICIDE BUSINESS LICENSE** - Is a license for businesses who apply pesticides for hire.

**PESTICIDE USE CATEGORY** - Is determined by the site, which the pesticide is applied, and for what pest.

**PHOTOSYNTHESIS INHIBITORS** - Interfere with photosynthesis (conversion of water and carbon dioxide to sugar in the presence of sunlight).

**PLANT GROUPS** - Grasses and Broadleaves

**POSTEMERGENCE TREATMENT** - Is made after the weeds have emerged.

**PREPLANT TREATMENT** - Is any application made before seeding or transplanting desirable plants.

**RECERTIFICATION** - Is continuing education that an applicator attends and receives credit for in lieu of retesting every three years.

**RECORD KEEPING** - Is a requirement of Ohio Administrative Code. Each pesticide applicator that applies pesticides will produce an applicator record for each application that he/she performs.

**RESTRICTED-USE PESTICIDE** - As the name implies, ONLY applicators that are licensed by the Pesticide and Fertilizer Regulation Section of the Ohio Department of Agriculture are able to purchase or use these pesticides. An exception would be a trained serviceperson working under the direct supervision of a licensed applicator.

**SEEDLING GROWTH INHIBITORS** - Interfere with new plant growth.

**SOIL TEXTURE** - The particle side of different soils.
STATE PLAN - Is the document that designates the Ohio Department of Agriculture as the state lead agency and The Ohio State University as the land grant university. This plan governs the way we conduct business of the Certification and Training Section of Pesticide and Fertilizer Regulation.

SUMMER ANNUALS - Germinate in spring then grow, flower, set seed, and die before winter.

SYSTEMIC HERBICIDES - Are absorbed through the plant foliage. These herbicides move through the plant from the roots to the tips.

TRAINED SERVICEPERSON - Can apply general and restricted use pesticides for hire or the course of employment under the direct supervision of a licensed applicator.

VEGETATIVE GROWTH STAGE - When annual plants are using most of their energy to produce stems, leaves, and shoots.

WATER - from irrigation and surface runoff transports seeds.

WEED - Is any plant that grows where it is not wanted.

WIND - Carries many seeds to new areas.

WINTER ANNUALS - Germinate in late summer to early winter. They overwinter in a vegetative state. Then in the spring or summer they flower, set seed, mature, and die.

WIPER OR ROPE-WICK TREATMENTS - Apply contact or systemic herbicides directly to the weeds.