Category D: Ornamental and Turf Pest Control

Ornamental and Turf Pest Control Learning Objectives

THIS CATEGORY IS AVAILABLE ONLY TO NON-PRIVATE APPLICATORS BY TAKING A SEPARATE CATEGORY EXAM.

After studying this section, you should be able to:

- ✓ **Describe the principles of Integrated Pest Management for Ornamentals and Turf.**
- ✓ **Describe the factors affecting pesticide application effectiveness.**
- ✓ **Describe the most common ornamental and turf insect pests and methods to control them.**
- ✓ **Describe the most common ornamental and turf diseases and methods to control them.**
- ✓ **Describe the different control methods available for weed management in ornamental plantings and turf areas.**
- ✓ **Describe the most common vertebrate pests that impact ornamentals and turf and control strategies for each.**

Category D: Ornamental and Turf Pest Control

Ornamental and turf pests occur in landscaping found around commercial establishments (hotels, casinos, resorts, restaurants), industrial parks, private and public golf courses, city and county parks and recreational areas, and residential properties (private homes, apartments, condos).

Plants in these locations are often chosen for their aesthetic qualities, not for their pest resistance. Some of these areas are also used by and under scrutiny from the public. Thoughtful planning and implementation of pest

Category D, Ornamental and Turf Pest Control, is the category concerned with pests in landscape or turf areas.

control measures is required to maintain public health and a visually pleasing landscape.

The single most important factor in ornamental and turf pest control, as for all pest control, is to identify the pest. Before considering control measures, pest managers must also understand the pest's life cycle.

Landscapers must become licensed if they are doing any of the following:

- Advertising pest control or soliciting for pesticide applications, including bidding for maintenance contracts that involve pesticide applications.
- Operating as a commercial (for hire) pest control company.
- Conducting any pesticide applications on commercial, public or residential properties.

For further information or clarification, go to Nevada Department of Agriculture Pest Control website, https://agri.nv.gov/uploadedFiles/agrinvgov/Content/Plant/PEST/landscaper_licensing_flier_r3_Final.pdf.

Principles of IPM:

- **Identify the pest.**
- **Monitor the pest population.**
- **Establish an action threshold.**
- **Evaluate control options.**
- **Implement control options.**
- **Monitor results.**

Ornamental and Turf Integrated Pest Management (IPM)

The principles of Integrated Pest Management can be applied to controlling insect pests, weeds, diseases and vertebrate pests of ornamentals and turf.

- **Pests, their hosts and beneficial organisms must be positively identified.** The pest problem and associated plant species must be correctly identified. If you can't identify the pest, collect samples and submit them to the University of Nevada, Reno Extension or the Nevada Department of Agriculture for identification. Once the pest is identified, determine the pest's life cycle, growth cycle and reproductive habits. Pest managers should also be able to identify all life stages of beneficial organisms, such as the lady bird beetle, a beneficial insect predator.
- **Establish monitoring guidelines for each pest species.** Routine monitoring of both pests and natural enemies (beneficial species) is a critical part of IPM. Methods of monitoring include visual inspection, pheromone and sticky traps, and sweep nets. Document and track both pest and beneficial organism population numbers. The ratio of natural enemies (usually insects) to pests should be considered before a pesticide is applied.
- **Establish an action threshold for the pest**. A fundamental concept of IPM is that a certain number of individual pests can and should be tolerated. **Consider: What will happen if no action is taken?** Will the pest cause unacceptable damage to the value of the lawn or landscape?

Sometimes the action threshold is based on economics. The **economic threshold** is defined as the pest population level that produces damage equal to the cost of preventing damage by controlling the pest. The threshold is the pest density, or population level, at which a control application should be made.

Urban landscapes are judged on their appearance and whether the presence of a pest presents a health or safety issue. The aesthetics and healthful condition of an individual plant or a whole landscape may be affected by pests. The presence of pests and their damage, though not serious, may be intolerable or annoying to some, yet readily accepted by others. Ornamental and turf IPM strategies are developed with emphasis on aesthetic thresholds. It is often the appearance of a pest or the damage it causes that triggers control actions. This is called the **aesthetic threshold**. The aesthetic threshold varies from person to person, making it difficult to establish control criteria for most landscape pests.

Sometimes, the action threshold is based solely on the emotions of the property owner. This is referred to as an **emotional threshold**. For many people, a single mouse, cockroach or spider is unacceptable. Many people fear pests, and this triggers their need to implement control actions.

- **Evaluate and implement control tactics.** Select tactics that will be the most effective and economical and have the least impact on non-target species and the environment. Select controls that will impact beneficial organisms as little as possible while suppressing the pest. If a pesticide is one of the selected management tools, beneficial enemies (usually insects) will likely also be killed.
- **Monitor, evaluate and document the results.** This allows you to adjust to improve the effectiveness of future pest control strategies.

Pest Thresholds:

- **Economic:** Point at which the pest infestation causes enough economic damage to justify the cost of treatment
- **Aesthetic:** Point at which the infestation causes enough visual damage to justify treatment
- **Emotional:** Point at which the pest infestation causes enough emotional trauma to justify treatment

Factors Affecting Pesticide Application Effectiveness

If the decision has been reached to apply a pesticide, there are many factors that affect the success of the application. Early detection can increase success. For example, applying herbicides to annual weed seedlings is far more effective than applying herbicides to mature plants. Mature plants are much larger, require more herbicide and are harder to control. It is important to regularly inspect the areas in your care and look for signs and symptoms of pests.

Correct timing and a thorough application of pesticide are necessary for good control. Pesticide applications should be timed to coincide with the

Use the correct pesticide, one that is labeled for use on the plant and/or site and that will be effective on the identified pest.

Consider the weather, including temperature, wind speed and the potential for precipitation.

Most pesticides are not effective below 50 F, and many tend to volatilize above 85-90 F.

times the pest is most susceptible. This could be the time of day, the time of year or the life cycle stage of the pest, or a combination of these factors. Applying pesticides in the wrong place or at the wrong time is a waste of time and money and has the additional potential to harm the environment.

Use the correct pesticide, one that is labeled for use on the plant and/or site. Make sure the pesticide will be effective on the identified pest. Use the correct amount applied by the correct method using the correct equipment. Consider the weather, including temperature, wind speed and the potential for precipitation. Most pesticides are not effective below 50 F and many tend to volatilize above 85-90 F. Applying pesticides in windy conditions increases the risk of pesticide drift and reduces the amount of pesticide reaching target plants. Many pesticides require a drying period, so applying them when rain is forecast can be a waste of time and money. All these factors can diminish pesticide effectiveness and increase the potential for drift or other environmental damage.

Ornamental and turf applications are near human habitation, so applicators need to plan pesticide applications to minimize hazards to humans, pets and other domestic animals, surface and groundwater, and the environment. In landscape situations, the risk of phytotoxicity to non-target plants is greater due to the proximity of individual plants to one another. Phytotoxicity is damage to plants caused by chemicals, fertilizers or pesticides. Another concern in landscapes is the persistence of pesticides beyond the intended period of pest control, which may interfere with subsequent landscape plans. Careful planning is required prior to a pesticide application to ensure long-term plans for the site are considered. Review the Guidelines for the Safe Use of Pesticides chapter and the Pesticide Use and the Environment chapter of this manual for further information.

Insect Pests

Not all insects are injurious; most are benign, and many are beneficial. Identifying the insect first will reduce the chances of destroying a beneficial insect.

The insect pest and the degree of infestation should be determined before control measures are implemented. What insect is present and how many are there? What plant species is affected? It may be more expensive to apply a pesticide than to simply replace the plant(s) with a different type that is less likely to be damaged by insects. In some cases, the easiest and most effective control may be simply spraying water on the plant to remove insect pests. For example, aphids may be removed from plants by spraying them with a strong jet of water. This interrupts their life cycle and can reduce pest

numbers significantly. While this method is often used on small- or medium-sized plants, it would not be as effective on large trees.

Knowing the life cycle of the insect pest helps you to identify when it is most susceptible to a pesticide. Some insects produce one generation per year, and others may produce multiple generations each year. If multiple generations are likely, you may have to apply pesticides more than once each year. Review the insect section in General Knowledge: General Pest Problems in this manual for more information on insect life cycles.

It is important to consider what would happen if you did nothing at all. During the field inspection, did you identify predators or parasites that will provide biological control for the insect pest? If the infestation is small, it may be managed (but not eradicated) by letting nature take its course.

What are some indications that there may be an insect infestation? For ornamental plants, there are many. The following signs and symptoms may indicate an insect pest problem:

- Webbing, silk shelters or silk enclosures on foliage, indicating mites or caterpillars.
- Insect or mite remains, such as eggshells, shed skins, cocoons, trails of silk or excrement.
- Scale or aphid protective coverings, generally waxy substances.
- Honeydew, a sticky liquid excreted by some insect pests. Black, sooty mold may grow on the honeydew.
- Sawdust, wood chips or pitch balls found either on tree trunks or at the base of the tree trunk, indicating bark beetles or wood borers.
- Decline of the plant.
- Feeding damage.
- Holes in any part of the plant.

For above-ground turf insect pest infestations, damage to grass blades or stems can indicate an infestation. This damage may be due to sod webworms, army worms or cutworms.

Below-ground turf insect pest infestations are more difficult to identify. If you can grab a handful of grass and easily pull it up, it indicates the roots are damaged. Identification of what is damaging the roots is more difficult and generally requires cutting and pulling up a portion of the sod. If no insects are present, the damage may be caused by one or more poor cultural practices: excess thatch, poor nutrition, inappropriate soil, lack of water, mowing too short or over-fertilizing, causing fertilizer burn. Disease may be the cause, as may dog urine spots and/or pesticide damage.

Knowing the life cycle of the insect pest helps you to identify when it is most susceptible to a pesticide.

Indications you may have an insect pest:

- **Webbing or silk**
- **Insect remains**
- **Waxy protective coverings**
- **Honeydew**
- **Sawdust, wood chips or pitch balls**

Spider mites are very small and are usually identified by the presence of fine, delicate webbing on the plant leaves, stems and trunk.

Most aphids are plant-family specific.

Aphid

Scale

Common Invertebrate Pests

Mites: Mites are not insects. They are arachnids, related to spiders. They have eight legs, no wings, no antennae and two body parts. They are very small and are usually identified by the presence of fine, delicate webbing on the plant leaves, stems and trunk. Mites often appear under dry conditions. Mite damage often appears as bronzing of the foliage, which can give the foliage a dusty appearance. Severe infestations may lead to leaf drop. Cleaning up garden debris is important to reduce overwintering populations, reducing pressure on next season's crop. Mites can be controlled with insecticidal soaps, horticultural or "dormant" oils, and acaricides. It may be wise to alternate chemical control methods to reduce the chance of developing pesticide resistance in the mites.

Aphids: These small, soft-bodied insects are common problems. There are many species of aphid, and most are plant- or plant-family specific. They have piercing-sucking mouth parts and can be disease vectors. They can be green, black or red in color, and some excrete a white, waxy coating that obscures them from sight. A good portion of the sap they ingest may pass through them undigested and is then excreted on the plants. This liquid, known as honeydew, makes leaves sticky and can also host a black, sooty mold. Some aphids will also cause leaves to pucker, curl or twist. Small infestations may be reduced or controlled by a strong spray of water that knocks the adults off plants and interrupts their life cycle. The effect of naturally occurring pest predators should not be discounted and thoughtfully considered when selecting pesticides for controlling aphids. Parasitoid wasps, minute pirate bugs, lacewings, syrphid flies and ladybird beetles all prey on aphids. Large infestations can be controlled with insecticidal soaps, horticultural or "dormant" oils, and many other insecticides. Read and follow label instructions.

Scales: These are also small, soft-bodied insects. Scale insects protect themselves by producing a waxy shell. The life cycle of these insects starts after hatching with an immature, crawler stage. The insects then find a likely plant host, lose their legs, excrete a waxy covering, and live out their lives in that spot. Plants infested with scales appear sickly and lack vigor. Some scale insects produce honeydew. Control is best achieved during the crawler stage, before they produce the protective shell. A second treatment two to three weeks after the first is often recommended. Scales can be controlled with insecticidal soaps and many insecticides during the crawler stage. Control during the adult stage is more difficult. Horticultural or dormant oils will smother adult scale insects. Read and follow label instructions.

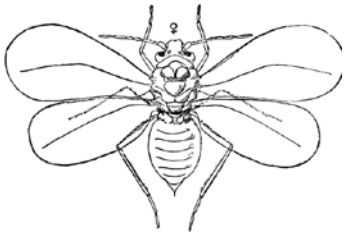
Whiteflies: These small white insects look like tiny moths. The larval stages of whiteflies are similar in appearance to scale insects. When an infested plant is disturbed, the adult insects will fly up and then settle back down. Both larval and adult whiteflies suck sap from leaves. Infested plants turn yellow, wilt and may die. These insects can also produce honeydew, which can make the leaves sticky and can also host a black, sooty mold. They can be controlled with insecticidal soaps and many insecticides. Read and follow label instructions.

Thrips: Thrips are tiny, slender insects with rasping-sucking mouth parts. Adults can be yellow, brown or black and have two sets of feathery wings that are held flat on their backs. Immature thrips resemble adults but are lighter in color and have no wings. They feed on foliage and flowers. Thrips-infested plants may have streaked or silvered foliage. Flowers may be deformed, and flower petals may show brown edges. The flower buds may drop off the plant or fail to open. Thrips are also vectors of a number of plant viruses. Control is difficult because thrips continually migrate and re-infest plants. Thrips are known vectors of some plant diseases. They are difficult to control, but some control can be achieved with insecticidal soaps, many insecticides and biocontrols. Read and follow label instructions.

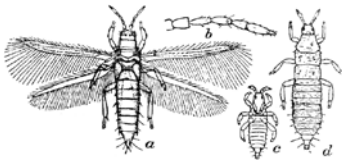
Beetles: Beetles belong to the order Coleoptera, which is the largest order of insects. Beetles have two pairs of wings. The front pair is generally hard or leathery, and the wings meet in a straight line down the center of the back. Beetles may attack any part of a plant, and they may do damage at any stage in their life cycle. Some beetles do damage as adults, some as larva (grubs), and some do damage at all life stages, but on different parts of a plant. Some feed only at night, and some feed during the day. Because there is such a wide variety of beetles, it is very important to identify the beetle and its life stage. Read and follow label instructions when using insecticides.

Japanese beetles are less than ½-inch long, with shiny brown wing covers over a metallic green body. Tufts of white hair rim each side of its body, sticking out from under its wings. The larvae are small. White grubs have brown heads and dark tail ends. The adults chew the flowers, leaves and fruit of hundreds of ornamentals and fruit-producing plants. The larvae feed on the roots of most plants, seriously damaging lawns, landscapes and gardens. They have not been reported in Nevada to date but are designated as an "Alert" organism. If they are found, a sample must be taken, and the discovery must be reported to the Nevada Department of Agriculture State Entomologist.

Bronze birch borers target all species of birch. The adult beetles are ½-inch long, hard-shelled and slender. They are brown with a greenish tint. The



Whitefly



Thrips

Because there is such a wide variety of beetles, it is very important to identify the beetle and its life stage.

Japanese beetle
ag.purdue.edu

Bronze birch borer
oardc.osu.edu

Emerald ash borer on paperclip for scale. Kenneth R. Law, USDA APHIS PPQ, Bugwood.org.

larvae are creamy white, slender and flattened. The larvae are responsible for damage to trees. They bore through the bark to the cambium layer, creating long, winding galleries. Feeding results in raised bumps or welts on the surface of the bark. The feeding larvae damage tissues, interrupting the flow of water and nutrients in the tree. This causes yellowing and thinning of the leaves in the upper crown or marginal burning or browning of the leaves on affected branches. Eventually, the affected tree dies. The larvae pupate within the trunk and large limbs of the birch tree. They emerge as adults through a 1/8-inch D-shaped hole they cut in the bark. The best control strategy is prevention. Maintain healthy trees, as the borers target stressed trees. Mulch to moderate soil temperatures and conserve soil moisture. Woodpeckers and a Chalcid wasp (*Phasgonophora sulcata*) are biological controls. Pesticides may be applied to kill egg-laying adults and larvae before they enter the bark. Once the larvae enter the bark, systemic pesticides are the only effective chemical control. Affected limbs can be removed from the tree. Remove and destroy dead trees or pruned limbs.

Emerald ash borers (EAB) are exotic beetles that attack ash trees. Adult beetles are metallic green and about ½ inch long. The larvae feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients. Adults leave a D-shaped exit hole in the bark when they emerge in spring. Adults remain active until the end of summer.

Emerald ash borer is thought to have arrived in the United States on solid wood packing material carried in cargo ships or airplanes originating in its native Asia. As of October 2018, it is now found in 35 states, and the Canadian provinces of Ontario, Quebec, New Brunswick, Nova Scotia and Manitoba. Part of the spread of the EAB is through moving firewood.

Prevention measures include a ban on moving firewood from areas with an infestation. Monitor for this pest. New infestations are difficult to detect, as damage to the tree may not be apparent for up to three years. Symptoms of an infestation can include branch dieback in the upper crown, excessive suckers or water sprouts forming on the tree trunk, and vertical bark splits. Woodpeckers like EAB larva, so heavy woodpecker damage on ash trees may be a sign of infestation. There are several different types of chemical controls that may be effective, including systemic insecticides applied as a soil drench, soil injections and truck injections. New formulations are being tested for effectiveness against EAB; consult with your pesticide dealer for the latest formulations. Read, understand and follow label directions. For more information and to track the spread of EAB, go to the EAB Information Network at http://www.emeraldashborer.info/.

True bugs: True bugs belong to the order Hemiptera. Their wings form an "X" when folded on their backs. This group is very diverse and includes many

beneficial predatory insects. They have piercing-sucking mouth parts and go through simple metamorphosis, which means they have a nymph stage that looks very similar to the adult stage, but without wings. This group includes boxelder bugs, elm seed bugs and stink bugs.

Boxelder bugs are nuisances that cause little actual damage. They can make outdoor living and entertaining difficult, and they may also try to move into homes as the weather cools in the fall. They prefer boxelder or maple trees. They feed on tree litter, especially seed pods, and will overwinter in yard litter. Good sanitation can help reduce the population of boxelder bugs during the following year.

Box elder bug
extension.umn.edu

Elm seed bugs attack elm trees, as their name implies. Elm seed bugs use their piercing-sucking mouth parts on elm seeds and to suck sap from the veins of elm leaves. The threat to landscape plants is minimal. Elm seed bugs become pests when they congregate on homes and landscape plants in great numbers. They also become pests when they move into homes, especially in mid-summer during hot, dry weather. Elm seed bugs do not bite or sting. They do not feed on houseplants, stored foods, furniture or clothing. They do emit an odor when crushed that is described as over-ripe cantaloupe mixed with turpentine; needless to say, many homeowners find this unpleasant.

Elm seed bugs go through three life stages: egg, wingless nymphs and winged adults. The newly hatched nymphs are bright red and 1/20th of an inch long. Elm seed bug nymphs go through five increasingly large instars. The adults are 1/3-inch long and dark brown with reddish highlights. A very distinctive feature is a dark, backwards-facing triangle located on the abdomen, near the thorax. Additionally, adults have small white bands on the outer edges of the abdomen. They have a single generation per year.

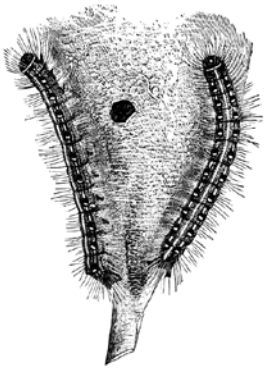
Elm seed bug. Emilie Bess, USDA APHIS PPQ, Bugwood.org.

Control measures include bug-proofing homes and other structures to keep the elm seed bugs out: Weather-strip around loose-fitting doors, caulk around windows and repair torn window screens. Bugs in landscapes or those that make it inside can be vacuumed up and disposed of in sealed containers to prevent reinfestation. Raking and disposing of elm seeds can discourage infestations, as it will reduce their food source. Inspect firewood before bringing it inside. Broad-spectrum outdoor barrier insecticide treatments on foundations may aid in preventing infestations in the home. Follow label instructions for application methods and limitations. These products cannot be used in the home. Do not spray an entire landscape to control these insects, as that would cause numerous non-target insect deaths, including beneficial insects and pollinators, and may be harmful to humans, pets, livestock and wildlife in the area.

Stink bugs: There are several varieties of **stink bugs**. They feed on a variety of plants, resulting in seedling death and stunting of plants. As they feed on

Adult brown marmorated stink bug. Dr. Janos Bodor, Calphotos.

Brown marmorated stink bug eggs and nymphs. Dr. Janos Bodor, Calphotos.



Caterpillars

plants, they leave a brown liquid called frass, a mixture of excrement and honeydew, which dries to brown spots. They overwinter on plants and in plant debris, so sanitation can help reduce populations.

One species of stink bug, the **brown marmorated stink bug (BMSB)**, is causing problems in the eastern United States. It has been found in Nevada and adjacent states. It is 1/2 to 3/4 inches long, marbled brown, and shield shaped. Its antennae have white bands, and the edges of its abdomen have alternating light and dark markings. Like most stink bugs, they stink when crushed. BMSB attacks over 170 species of plants, including fruit trees. Their piercing-sucking mouth parts cause a variety of damage symptoms, depending on the plant or crop. Additionally, they emit aggregation hormones in the fall and overwinter in homes: attics, crawl spaces, etc. BMSB controls, and basically all stink bug controls, include exclusion from homes and debris clean-up to prevent overwintering sites. There are light and pheromone traps that may be effective. Biological controls include birds that eat adults and beneficial insects, such as ladybird beetles and lacewings that will consume the eggs. Stink bugs are difficult to control using pesticides. For more information on BMSB, go to www.stopbmsb.org.

Caterpillars: Caterpillars are the worm-like larval stage of moths or butterflies. They have distinct heads and several pairs of fleshy legs on their bodies. They may be fuzzy, smooth or spiny. They are primarily foliage-feeders, so damage consists of irregular holes, ragged edges or entirely stripped leaves. They tend to damage tender new growth. They may also form protective shelters or coverings out of silk or fine webbing. The shelters may harbor the caterpillars continuously, or they may feed outside the shelters and return to the shelters for protection from weather, predators, etc. Caterpillars are also referred to as webworms, tent caterpillars, leaf rollers, leaf folders, bagworms or leaf miners. When only a few caterpillars are present, hand-picking is an effective method of control. Larger infestations may call for chemical controls. A single treatment applied when the caterpillars are young usually gives very effective control.

A caterpillar pest causing damage in forest and landscape trees in Nevada is the **white satin moth**. The caterpillar of white satin moth causes damage by feeding on poplar, cottonwood, aspen, willow, and sometimes oak and crabapple trees. The caterpillar will skeletonize leaves by feeding on the leaf tissue between leaf veins. Extensive infestations can cause defoliation and branch dieback. Severe infestations can cause tree death.

Adult moths are about 1 inch in length and may have a wingspan of up to 2 inches. They have a silvery-white body and satin-like wings. Caterpillars vary in color from pale to medium grayish-brown to black. Full sized caterpillars are 1.75 inches long. They have a very distinctive pattern of markings on

their back. A row of yellowish or milky white circular shapes runs down the length of its back, with rows of reddish-brown circles in pairs on either side of the yellowish or milky-white circular shapes. Additionally, tufts of reddish-brown hairs stick straight out of its sides and back.

The life cycle of the white satin moth is unusual. It overwinters as a caterpillar, emerging to feed in the spring. Early summer, they spin cocoons and the moths emerge shortly afterwards. The moths lay egg masses until late summer, and young caterpillars feed in late summer to early fall. For this reason, the full-sized caterpillars are detectable in the early spring, while the newly hatched caterpillars are detectable during late summer/early fall.

Scout regularly for these pests. Keep landscape trees healthy by managing water and pruning properly. Biological controls include birds, parasitic wasps, lacewings, predatory mites and some beetle species. A microbial insecticide, *Bacillus thuringiensis kurstaki* (Btk), can be effective on the caterpillar stage of the white satin moth. This material must be ingested by the caterpillars as they feed on the leaves. Repeated application may be required as the application may wash off. Chemical controls include several foliar-applied insecticides. Some of these insecticides are toxic to beneficial insects and pollinators, so applications should not be made when the trees are blooming. These are foliar applications, not systemics insecticides, so large trees may be difficult to completely treat. Systemic insecticides are not effective. New insecticide formulations are being developed all the time; consult with your pesticide dealer for the latest formulations that may be effective for white satin moth control. For more information go to https://forestry.nv.gov/uploads/missions/20210302_AMT_2019_White_Satin_Moth_Fact_Sheet.pdf.

Gypsy moth (aka spongy moth): There are two varieties, European gypsy moth and Asian gypsy moth. They both have a voracious appetite and will attack more than 300 species of trees and shrubs. They both overwinter as eggs, which are laid in sheltered areas, such as underneath the bark of trees, eaves of homes and other structures or outdoor objects. Eggs hatch in the spring. Caterpillars are striking, with five pairs of blue dots followed by six pairs of red dots along their backs. The body of the caterpillar is dark-colored with light brown hairs. The older caterpillars are 1.5 to 2 inches long. In early summer, the caterpillars pupate, with the moths emerging 10-14 days later. Female moths have a tan-colored body and white to cream-colored wings. Females have a 2-inch wingspan. European gypsy moth females cannot fly; Asian gypsy moth females are capable of flight. Male gypsy moths are smaller than females, with a 1.5-inch wingspan. The males are darker-colored and have feathery antennae. Both have distinctive markings on the wing: an inverted V shape that points to a dot on the wings. The gypsy moth has one generation per year.

White satin moth. Perry Hampson, Bugwood.org.

White satin moth caterpillar. Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org.

Gypsy or spongy moth caterpillar. USDA Forest Service- Region 8 - Southern, Bugwood.org.

Gypsy moth female (white) and male (gray). USDA APHIS PPQ, Bugwood.org.

Sawfly larva

Early detection and rapid elimination of infestations in Nevada have prevented large infestations of gypsy moth from developing. States with infestations have found the following control measures useful:

- Mass trapping with pheromone-baited traps
- Release of sterile male gypsy moths
- Mating disruption with a registered synthetic version of the pheromone disparlure in products such as Disrupt®II, Luretape Gypsy Moth®, and Luretape Plus®
- Diflubenzuron (Dimilin®), an insect growth regulator
- Bacillus thuringiensis kurstaki (Btk), a microbe that is a natural disease agent of caterpillars. Several registered Btk products are available for use

For more information on Gypsy or Spongy moth go to:
https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5187452.pdf

https://www.fs.usda.gov/foresthealth/docs/fidls/FIDL-162-SpongyMoth.pdf

Sawflies: Sawflies are wasp-like insects that lack the very constricted abdomen. They are related to bees, wasps and ants. The larvae of sawflies resemble naked caterpillars. Some even appear slug-like, such as the pear slug and rose slug. Depending on the species, the larvae are foliage-feeders, consuming the whole leaf, or skeletonizers, consuming the portion of the leaf between the major veins. Other species are wood borers or leaf miners. When only a few sawfly larvae are present, hand-picking is an effective method of control. Larger infestations may call for chemical controls. A single treatment applied when the larvae are young usually gives very effective control.

Bees and wasps: These are mostly beneficial insects that can become a nuisance if they set up housekeeping too close to human habitation.

Plant Diseases

Good management is the best way to prevent plant disease. This is extremely important to remember when dealing with ornamentals and turf. Unlike production agricultural crops, plant breeding and selection for ornamental plants has been based more on specific horticultural characteristics than on disease resistance. Most management techniques are designed to achieve some selected norm for each ornamental and turf species. Review the general sections of the manual for a full description of plant pathology principles and concepts.

There are six major principles of plant disease management:

- Exclusion

- Eradication
- Protection
- Resistance
- Therapy
- Avoidance

These six principles are discussed in detail in the General Knowledge: General Pest Problems section of this manual.

Successful plant disease management considers all the potential control methods:

- Prevention
- Cultural controls
- Physical or mechanical controls
- Biological controls
- Chemical controls

Most plant disease management plans include a combination of two or more control methods. Chemical controls are often used to manage diseases in ornamental plants and turf and include both soil treatments and/or treatment of growing plants.

A disease is defined as any impairment of plant health or condition of abnormal functioning. Plant diseases manifest as a number of symptoms:

- **Rot** is decay or disintegration of plant tissue. It can be caused by hundreds of different bacteria or fungi.
- **Blight** is any plant disease that results in withering and killing of leaves, flowers and shoots.
- **Canker** is a disease of woody plants that causes localized damage to the bark of the plant. It can be caused by fungi or bacteria.
- **Gall** is an abnormal outgrowth of plant tissues. This disease can be caused by fungal or bacterial infections or insects.
- **Wilts** are plant diseases characterized by drooping and shriveling, usually caused by vascular pathogens, such as Fusarium.
- **Rusts** are plant diseases that produce reddish-brown pustules on leaves and stems. Rusts are caused by various rust fungi.
- **Smuts** are destructive diseases of plants, especially cereal grains, that produce black, powdery masses of spores. Smuts are caused by fungi.

Ornamental plant diseases

- **Root rot:** This is a common problem in ornamental plants. Root rot is caused by several different fungal species or single-celled fungus-like organisms called *Phytophthora* or *Pythium*. Although root rot is caused

A disease is defined as any impairment of plant health or condition of abnormal functioning.

Root rot and crown rot problems are very common on shade trees and on many conifers used as ornamentals. In most cases, these problems occur due to mismanagement.

Fire blight
extension.usu.edu

by microbial infection, the condition is almost always associated with poor cultural practices that result in waterlogged plant roots. These practices include inadequate drainage, improper planting depth and/or incorrect water management. Correcting cultural practices must be part of the management plan, along with other controls, including chemical controls.

- **Crown gall:** This disease is caused by bacteria and affects many ornamentals. The bacteria are present in the soil and can remain viable for years. It causes abnormal growth on the roots and trunks or stems of infected plants. Mechanical injuries, such as lawn mower or string weed trimmer damage, create an entry site for this disease. Prevention strategies include minimizing injury to limit entry sites for the disease and managing plants to reduce stress. Chemical controls are also available.
- **Fire blight** occurs in several plant species, but is very common in roses, apples and pears. It is a bacterial disease that is spread by pollinators and rain splash. It first appears in the blossom clusters as wilting and collapse of the cluster. Diseased tissue produces brownish, sticky exudates. The tips of the infected young succulent growth shoots curve into a characteristic shepherd's hook and appear to have been burnt. Warm, wet spring weather is ideal for disease development. Remove diseased plant parts and prune back to healthy wood. Dispose of infected plant materials. Use streptomycin or copper spray formulations during bloom to help prevent infestation.
- **Verticillium wilt** is a fungal disease that plugs the water-conducting tissues, causing premature yellowing and death of the foliage. Look for a tan discoloration of the vascular tissues in cut stems of infected plants. This fungus infects the root system through root hairs and wounds. Wounds can be mechanical or caused by insect or nematode injury. Planting resistant cultivars, controlling insects and nematodes and good sanitation will help control this disease. Fungicide treatment offers effective control.
- **Leaf spots:** Fungal leaf spots, also known as anthracnose, scab, leaf blotch or shot hole, affect many ornamental plants. The disease manifests differently in each plant species, but some generalizations can be made. Many spots are brown or black in color. Many have a distinct margin and are surrounded by a yellow halo. The spots may be circular or irregular in shape. The disease may progress to affect the entire leaf. Leaf drop can occur. Infected leaves that fall and remain in place provide a habitat for fungal spores to overwinter. Leaf spots first occur on the lower leaves, generally in the spring or fall when moisture is high. The

disease is spread through wind and rain splash. Cultural controls include cleaning up leaf debris to remove infected leaves, removing diseased plant parts and planting resistant varieties. Foliar applications of fungicides can aid in controlling established infections.

- **Powdery mildew:** This fungal disease affects almost all ornamental plants, with some species being more susceptible than others. Infected plants commonly show a white or gray layer of fungus on the surface of the leaves, stems and flower bracts. Powdery mildew is a common disease of roses, oaks, lilacs and many other ornamental plants. The disease flourishes under moist, cool conditions. Spores can be spread by wind and rain splash to new plants. The fungus can overwinter in plant debris. Cultural controls include planting resistant varieties, good sanitation (cleaning up and removing plant debris) and avoiding overhead watering. Chemical controls include foliar applications of fungicides.

Turf diseases

Turf areas present their own problems in landscapes, golf courses or recreational areas. Vigorously growing turf is usually less severely damaged by diseases and recovers more quickly from them. Good cultural practices help to limit most turf diseases. Whenever possible, plant disease-resistant varieties of turf. Thatch and aerate to reduce stress and favor vigorous turf growth. Water deeply and infrequently to promote deep root growth. Try to water early in the morning rather than in the afternoon or evening. Inspect turf often to identify problems early when they are more easily managed. Rotate the use of fungicides to reduce the possibility of developing fungicide-resistant strains of pathogens.

- **Brown patch (*Rhizoctonia solani*):** Brown patch is a common fungal disease of grasses, especially fescues and perennial ryegrasses. The disease generally starts from the top of the leaf blade and moves downward. It occurs in light brown patches in lawns, from a few inches to several feet in diameter. The edges of the dead area may have a gray "smoke ring" appearance. Brown patch is favored when daytime highs exceed 80 F and nighttime lows are in the mid-60s F. High humidity and large amounts of nitrogen also favor the disease. Plant resistant turf varieties, control fertilizer applications and maintain a healthy lawn to prevent infestation. For chemical control, use fungicides. Read, understand and follow label instructions.
- **Sclerotinia dollar spot (*Sclerotinia homeocarpa*):** Dollar spot affects a wide range of grasses. It is active throughout the growing season, especially when there is low soil moisture and an excess of dew or fog. It

Powdery mildew
www.ipm.iastate.edu

Chemical formulations change all the time. Consult your local dealer for recommendations for the specific pest and site.

Vigorously growing turf is usually less severely damaged by diseases and recovers more quickly from them.

Good cultural practices help to limit most turf diseases.

Pink snow mold
William M. Brown, Jr., Bugwood.org

most commonly occurs in the spring. The disease commonly forms small white patches, 1-inch to 3-inches in diameter. Individual grass blades show spots that are tan with reddish edges and start at the leaf margins. The lesions may grow across the grass blade, forming girdling lesions that kill the blade tip. To prevent infestation, control soil moisture and maintain a healthy lawn. Chemical controls include fungicides. Read, understand and follow label instructions.

- **Melting-out (*Dreschlera ssp.* and *Bipolaris ssp*.):** Another common fungal turf disease in Nevada is called melting-out disease. From a distance, the affected patches of turf appear yellowed, as if they are drought-stressed. The disease starts as eye spot lesions on individual grass blades in the spring when temperatures are cool. As the weather becomes warmer and drier, the roots and crowns of grass plants can be affected, with patches of turf dying off or "melting out." Cool, wet weather during the spring followed by drought in the summer favors development of this disease. Prevent this disease by controlling soil moisture and maintaining a healthy lawn. Fungicides provide chemical control. Read, understand and follow label instructions.
- **Pink snow mold (*Monographella nivale)*:** Pink snow mold is a fungus that grows under cool, wet conditions. It can begin growing under snow cover in turf areas, hence the name "snow mold." It is active across a wide range of cool temperatures (32 F to 65 F), but temperatures above 70 F inhibit the growth of the fungus. The disease first appears as a small circular area that rapidly expands. The crown or basal area of the dead stems appears pink or purple, and grass blades may take on a pinkish cast in early morning light. The mycelia of the disease are pink to white. The fungus survives in plants and plant debris as dormant mycelia. Prevention consists of good sanitation, controlling soil moisture and maintaining a healthy lawn to prevent infestation. Fungicides provide chemical control. Read, understand and follow label instructions.
- **Fairy ring *(Marasmius oreades* and *Lepiota* spp.):** Fairy ring appears as a discolored circular patch of grass with a dark-green outer band. The dark-green band is darker than the grass in the center of the ring and the unaffected grass outside of the ring. The grass inside the dark green ring commonly dies. The mycelium of the fungus responsible for this disease is water-repellant. The mycelia grow through the pores in the soil, preventing water from reaching the turf roots. As a result, the turf roots dry out, and eventually the affected turf dies. The dark green color of the grass in front of the brown, dead or dying turf results from nitrogen the fungus releases as it decomposes organic matter in the soil. A second type of fairy ring may show only a ring of mushrooms (the fruiting

structures of the fungus) and no discoloration of the lawn inside the ring. Prevention consists of providing adequate soil moisture, as the fungus prefers to grow in dry soil. Maintain a healthy lawn to prevent infestation. Do not bury lumber, stumps or other wood products in lawn areas, as these materials promote fungal growth. Mechanical control consists of drilling or aerating the affected patch and adding water and, if possible, a wetting agent to keep the soil moist. Fungicides provide only partial control of fairy ring.

Fairy ring
Wendy Hanson Mazet, UNCE

Weeds

General information on weeds is covered in the General Knowledge: General Pest Problems chapter of this manual. Please refer to that chapter for a discussion of the stages of plant development and plant life cycles.

It is impossible to describe and discuss every weed you may encounter in Nevada in this publication. However, it is essential to identify the weed, its lifecycle and its stage of growth in order to formulate an effective weed management plan. There are many resources available to help you identify weeds. The Nevada Department of Agriculture and the University of Nevada, Reno Extension can help identify weeds. Many books contain photoss and descriptions of weeds. There is great variability in Nevada's climate. Weeds found in southern Nevada can be very different than those in northern Nevada. Not all weeds that occur in the Las Vegas area occur at Lake Tahoe, and vice-versa. It is best to consult sources specific to your geographic area. There is a wealth of information available on weed identification on the Internet, but use caution and only trust information from reputable sources. Most University resources have been peer-reviewed for accuracy.

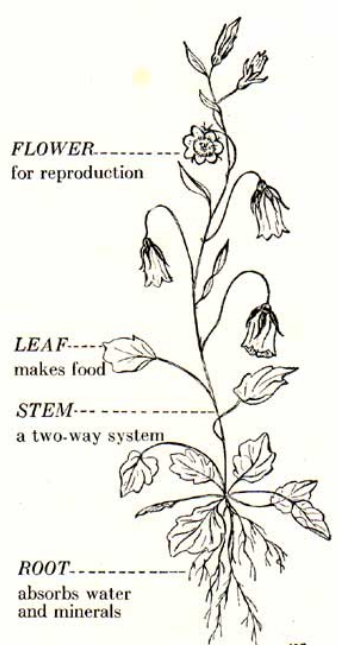
It is important to understand some of the living dynamics of plant growth to understand how herbicides work and the different ways they may affect plants. Plants consist of roots, stems or trunks, and leaves. Water movement in most plants is from the roots upward through the trunk or stem and into the leaves, where transpiration occurs. Plants produce their own food or carbohydrates through photosynthesis. Movement of this "food" is from the leaves downward through the trunk or stem to the roots.

Weed control strategies

Most effective weed management plans include two or more control strategies. Weed control can be split into five separate categories.

- **Prevention:** Prevention includes such practices as using certified weed-free seed, hay, transplants, amendments and mulches. To prevent the spread of weed seed and weed plant parts from one area to another,

Proper identification is essential when managing weeds. Contact the University of Nevada, Reno Extension or the Nevada Department of Agriculture for help in identifying weeds.



www.plant-care.com

Successful weed management considers all the control methods available:

- **Prevention**
- **Cultural**
- **Physical / Mechanical**
- **Biological**
- **Chemical**

A noxious weed is a plant that has been defined as a pest by law or regulation.

clean equipment between uses. Prevention also includes removing weeds before they can form seedheads or spread by other methods. It is more difficult to prevent weed seeds from blowing in from adjoining properties.

- **Cultural controls:** Cultural controls are management practices that reduce the incidence of weed infestations. Cultural controls include using proper planting times and planting rates, planting materials that are well-adapted to Nevada's climate, and managing fertilization and irrigation to favor desired plants rather than weeds. Another cultural practice that will help control weeds in turf areas is to mow the grass high. Mowing high shades grass plant roots and helps to conserve soil moisture. It also prevents weed seeds from sprouting and growing and encourages deeper root growth. All these factors contribute to healthier lawns.
- **Mechanical/physical controls:** These controls include tillage, hoeing, mowing, hand-pulling, mulching, etc.
- **Biological controls:** Biological control is the use of a living organism to control a pest. Success depends upon selectivity, reproduction, adaptation and ability of the organism to reach a high level of effectiveness.
- **Chemical controls:** Chemical control is the use of pesticides, in this case, herbicides, against a target pest (weeds). Many herbicides are available. In order to be effective, a herbicide:
  - Must contact the plant (leaves, stems, trunks, roots, etc.).
  - Must remain on the plant surface long enough to penetrate or be absorbed.
  - Must reach a living site to disrupt a vital process or structure.
  - Must be able to kill the target weed.

Noxious Weeds

A noxious weed is a plant that has been defined as a pest by law or regulation. This designation requires that landowners control noxious weeds growing on their property. If a plant is found to be detrimental or destructive and difficult to control or eradicate, the Nevada Department of Agriculture can recommend to the state board of agriculture that the plant be designated as noxious. Nevada's noxious weed list can be found at http://agri.nv.gov/Plant/Noxious_Weeds/Noxious_Weed_List/.

For help identifying noxious or other problematic weeds, contact the Nevada Department of Agriculture, 775-353-3600, or the University of Nevada, Reno Extension, 775-784-4848. The following publications may help in identifying

noxious weeds: Nevada Noxious Weed Field Guide, available by weed name at the University of Nevada, Reno Extension website at https://extension.unr.edu/publications.aspx and Nevada Nuisance Weed Field Guide, https://naes.agnt.unr.edu/PMS/Pubs/1399_2019_01.pdf. Hard copies of both publications are available at most University of Nevada, Reno Extension offices throughout the state.

Vertebrate Pests

Vertebrate pests are those pest animals that have backbones. Specific control measures vary for different species and are discussed individually in the General Pest Problems chapter of this manual.

Common vertebrate pest control practices:

- **Exclusion:** Keep the pest out or away from crops by using barriers, such as fencing and row covers.
- **Sanitation:** Eliminate food and water sources. Store food and animal feeds, grain and seed in rodent-proof containers. Repair leaky pipes.
- **Trapping:** There are several types of kill traps and live traps available for most vertebrate pest species. Choosing the proper trap and learning the correct way to use it is critically important. **Live trapping and releasing is not acceptable or legal.** Individuals who release live-trapped animals are moving the pest problem and sometimes diseases like rabies, distemper or plague along with them. Live trapping followed by an approved method of euthanasia is recommended. The American Veterinary Medical Association has specific guidelines for euthanasia.
- **Repellents:** Repellants may be applied to valuable vegetation or can be used in areas where pests are known to frequent. They often don't work the way people expect them to work. Sunshine can break down the repellent, and sprinklers and rain can wash away the product. New growth on plants must be retreated and animals may simply get used to the repellent.
- **Rodenticide baits:** Baits like seeds, grains and vegetation treated with rodenticides are used to control several types of vertebrate pests. Most baits must be applied in bait stations or underground within animal burrows to lessen the risk of killing of non-target species. Pesticide labels describe methods for applying the bait. Pesticides used include strychnine, zinc phosphide and various anticoagulants. Strychnine may only be applied underground.
- **Fumigants:** To purchase, apply or supervise the use of this pesticide,

For the latest noxious weed listing, go to http://agri.nv.gov/Plant/Noxious_Weeds/Noxious_Weed_List/

Common vertebrate pest control practices:

- **Exclusion**
- **Sanitation**
- **Trapping**
- **Repellent**
- **Rodenticide baits**
- **Fumigants**

applicators must successfully pass the Category L2: Non-Soil Fumigation exam.

Specific Vertebrate Pests: Please refer to the vertebrate pest section of the General Knowledge: General Pest Problems chapter in this manual.

Conclusion

Pest mangers should identify the pest, understand its life cycle and identify other host plants before they try to control a pest.

The most important factor in ornamental and turf pest control is to identify the pest. This is true for all pest control activities, regardless of the pest or site. Pest managers should identify the pest, understand its life cycle and identify other host plants before they try to control it. Another important consideration is the goals for the landscape. A low-maintenance landscape will have different management strategies than an arboretum or park.

Unless otherwise noted, all line drawings are from Clipart ETC, Florida's Educational Technology Clearinghouse, University of South Florida, http://etc.usf.edu/clipart/index.htm.

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