Visual Identification Series

Pest Management in the Landscape

AN INTRODUCTION

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Importance of Pests and Pest Management of Trees and Shrubs

Introduction

Pests of trees and shrubs can cause problems that range from simply being a nuisance to causing the loss of an entire stand of plants in large areas. Reliably diagnosing tree and shrub problems can be a daunting task to anyone entering the landscape or arboricultural field. In fact, diagnostics can be a challenge even to experienced professionals! However, each plant or pest problem requires accurate diagnosis before any treatment is considered or started.

In urban environments, tree and shrub problems that are caused by environmental or cultural (management) factors are as common, if not more common, than those caused by insects or disease pathogens. Yet many people believe when a problem develops that a treatable insect or disease is the cause. Clients may also expect that a chemical remedy is available for most pest problems.

Importance

- The top concerns of landscape clients are the health and insect pests of their plants, according to a survey by the International Society of Arboriculture (Figure 1).
- Ability to determine the health status of plants is the first step toward answering a client's questions, attempting a diagnosis and making recommendations for treatments.
- Failure to diagnose pest problems can delay proper treatment.
- Improperly used pesticide treatments can make some pest problems worse. For example, some pesticides can harm beneficial insects and mites and lead to secondary outbreaks of aphids or mites after the initial treatment.

Specific Information and Categories

Integrated Pest Management (IPM) is an approach that was first developed in agricultural crops. IPM emphasizes multiple management techniques and focuses on economic injury thresholds to determine whether treatment is required. Plant Health Care (PHC) was developed specifically for managing landscape plants because they are often treated for many reasons other than economic damage. For example, PHC may be used to reduce aesthetic or other damage that reduces the visual appeal of a plant.

PHC incorporates a holistic approach which considers improving plant health through managing both the environment and pests. The foundation of PHC is proper identification of pest problems and selection of management practices that have minimal impact on the environment. This may include cultural practices that increase plant health so they are more resistant to pests, or providing an environment that is less conducive to development of pest problems.

Application

- PHC treatments in the landscape may be used to both manage damaging pests and to maintain or improve plant aesthetics.
- Minimizing pest problems using PHC employs multiple tactics to keep plants healthy.
- PHC relies on having a knowledgeable person on a property who knows how to enhance plant health and identify pest problems before they become serious.

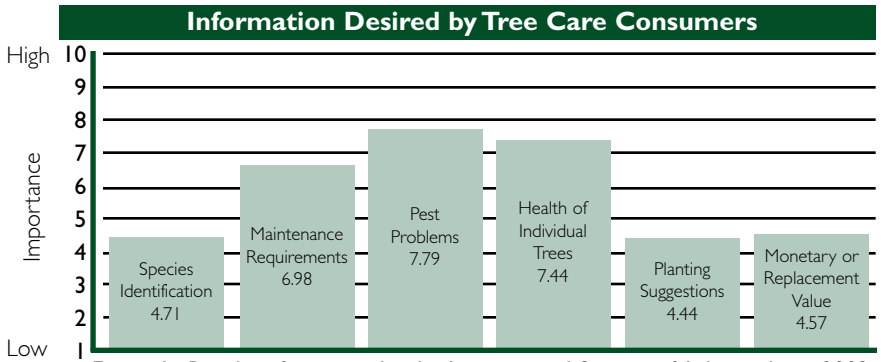

Figure 1. Results of a survey by the International Society of Arboriculture 2002 that identifies the importance to clients of knowing pests and plant health in the landscape. [Source: International Society of Arboriculture.]

Photo 1. Clients want to know the health of their plants,what to do to create healthy plants and how to avoid pests (decay, testing).

Photo 2. Proper diagnosis is needed for determining the correct treatment approach, including when to treat and what to treat with. For example, treatment of scale insects with most pesticides is ineffective when eggs are present (pine, pine needle scale). [Photo courtesy of Doug Caldwell.]

Photo 3. We often lack effective treatment options for pest problems, and encouraging plant health is the only management tool. For example, other than pruning, there are no chemical treatments to stop Cytospora canker of spruce (spruce, Cytospora canker).

Photo 4. Many pests do not require treatment because they do not measurably impact tree health even though the symptoms may appear threatening, such as leaf blotch of horsechestnut, shown here (horsechestnut, leaf blotch).

Photo 5. Some pests can cause death of large trees or can cause considerable widespread damage such as Dutch elm disease of an American elm shown here (American elm, Dutch elm disease).

Photo 6. Failure to recognize some pest problems early in their development can delay treatment and result in extensive damage. Bleeding canker can kill a mature European beech if not controlled (European beech, phytophthora bleeding canker).

Three major groups of agents cause problems on landscape plants including biotic agents (living agents such as insects and pathogens), abiotic agents (non-living agents such as site, weather and poor cultural practices), and declines (usually caused by both abiotic and biotic agents).

1. Abiotic agents such as the iron chlorosis on oak shown here are a very common cause of problems on landscape plants (oak, iron chlorosis).

2. Declines, which usually have multiple agents involved, are unique to woody plants (bur oak, decline).

3. Pathogens such as the fungus that caused this canker are another common biotic agent (maple, canker).

4. Insects are a common cause of damage to plants in the landscape (eastern tent caterpillar, cherry).


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Photo 3. Symptoms are what is seen that is wrong with a plant, or the deviation from normal. Most plant problems have more than one symptom. Sycamore anthracnose causes leaf blighting or killing, (left) witches' brooms (right), and other symptoms on leaves and stems (American sycamore, anthracnose). [Right photo courtesy of Len Burkhart, Jr.]

Photo 4. Signs are evidence of the actual casual agent and are more common with the biotic agents or insect, mite and disease pathogens. This fungus on the side of the tree is a sign of internal wood decay (maple, northern tooth fungus).

Photo 5.
Disease is the continuous disruption in the normal functioning of a plant. A canker, or a fungal infection of a tree trunk, may persist in a tree for many years (maple, eutypella canker).

Photo 6. Injury is caused by events that are short in duration such as a lightning strike. Injuries may open up a tree for subsequent invasion by insects or disease agents. Decay fungi infected the lightning struck area on the oak on the right (cottonwood and oak, lightning strike).

Insect Orders and Identification (continued)

Coleoptera

This is the largest insect order, with more than 350,000 species. It includes the beetles and weevils. Both have chewing mouthparts and undergo complete metamorphosis. The front pair of wings in the adults is hardened into a protective shell and is called the *elytra* (singular *elytron*). The hind pair of wings, which is used for flight, is folded under the elytra when the insect is at rest. Weevils resemble beetles, but differ in that they possess an elongated snout at the front of the head.

While some beetle species are predaceous on other insects, others damage plants. Examples of the latter are Japanese beetles, elm leaf beetles and black vine weevils. Japanese beetle adults attack ornamental plants in early summer. They feed on the leaves and flowers of such hosts as purple leaf plum, roses, pears, linden and many others. Adults lay their eggs in the soil and grubs damage turfgrass roots. They overwinter as grubs in the soil and complete development the following spring.

Black vine weevils are secretive insects that are *nocturnal* (active at night). All adults are females and lay eggs without the need for fertilization by males, a phenomenon called *parthenogenesis*. They feed on plants such as rhododendron, Japanese holly, yew and others. Adult feeding is a nuisance and causes distinctive notching along the edges of the leaves. Damage from larval feeding is more serious, as they feed on roots and can girdle stems at the soil line. There is one generation per year.

Also in this order are many of the insect pests called the borers. These are pests that feed in the cambium, or growth layer, under the bark, thus disrupting movement of water and nutrients. Some borers also tunnel deeper into the sapwood of trees. If the attacked stem is girdled (the borer larvae feed on the entire circumference), the plant will die. Borers are usually attracted to weakened or stressed trees and often contribute to their further decline in the landscape. Therefore, it is important to avoid factors that lead to tree stress to prevent borer attacks. Once borers infest a tree, it is almost impossible to control them. Common examples of borers in the landscape include pine bark beetle, two-lined chestnut borer of oak and beech and bronze birch borer.

Orthoptera

Members of this order include grasshoppers, crickets and katydids. They possess chewing mouthparts and undergo incomplete metamorphosis. Grasshoppers occasionally feed on perennial plants, but generally are not a problem in the landscape. They may become a pest on agricultural or range crops. Katydids may be encountered in the landscape where they cause minor chewing damage on plant leaves.

Lepidoptera

This order includes the butterflies and moths. They undergo complete metamorphosis and the larva is the damaging stage. Feeding by the larvae, which have chewing mouthparts, may result in skeletonizing or defoliation of the plant. Adults do not cause damage and possess siphoning mouthparts which they use to feed on nectar from flowers. Examples of these pests include the gypsy moth, eastern tent caterpillar, fall webworm, cankerworms and bagworms. Some Lepidoptera larvae are also borers that attack shoots and stems of trees.

Most of the Lepidoptera species overwinter as eggs, but some overwinter as pupae in the soil or under plant debris. In the spring, the larvae feed on leaves and may defoliate a tree if populations are high. They molt several times and then pupate, after which the adult moth or butterfly emerges to mate and lay eggs. Some species undergo one generation per year, while others may have several generations.

Photo 1. Beetles, such as these Japanese beetles, have chewing mouthparts. It is common for both adults and larvae to damage plants (rose, Japanese beetle).

Photo 2. Black vine weevil adults chew notches along leaf edges. This damage is cosmetic. The larvae feed on the roots and base of the stem. This damage is more serious, as the larvae can girdle and kill the plant (Photinia, black vine weevil adult, damage). [Photo courtesy of Len Burkhart, Jr.]

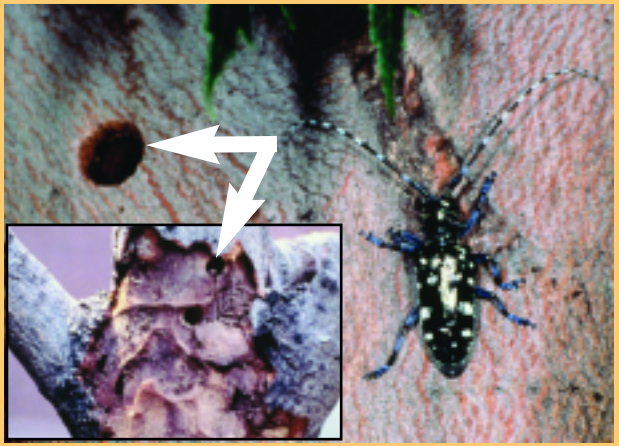

Photo 3. Borers feed under the bark and kill the tree by destroying the vascular cambium, such as this Asian longhorned beetle. Note the adult's exit holes (arrow) (maple, Asian longhorned beetle). [Photo courtesy of Phil Nixon.]

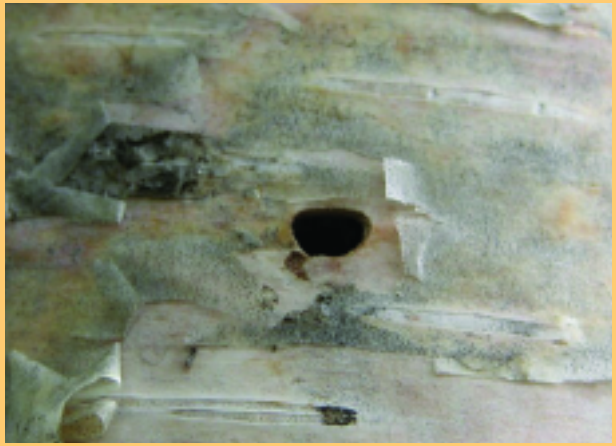

Photo 4. Exit holes in the trunk are often an indication of borer activity from beetle larvae. This D-shaped hole was caused by the emergence of a borer adult (weeping birch, bronze birch borer). [Photo courtesy of Len Burkhart, Jr.]

Photo 5. Caterpillars are common Lepidopteran pests in the landscape. Fall webworm caterpillars make a silken nest which they use as a shelter. They expand the nest as they grow larger (cherry, fall webworms).

Photo 6. Plant damage from moths and butterflies occurs during their larval stage. Adults usually feed on flower nectar and do not damage plants. Larvae, such as these gypsy moths, chew the foliage and can cause significant damage when populations are high (oak, gypsy moth adult and egg mass; larva).

Disease Cycles

Introduction

The life cycles of many disease-causing agents would go virtually unnoticed if it were not for the disease symptoms they cause on their landscape host. Life cycles of insect pests are easier to observe than disease cycles because insects are larger and exhibit visual differences among the stages. However, disease-causing agents also have distinct stages in their life cycles that they must complete to survive in nature.

Importance

- Knowledge of the disease life cycles is needed to determine what conditions lead to disease outbreaks and how the development of a disease can be minimized by altering these conditions.
- Familiarity with disease life cycles is important because the critical periods for applying treatment often occur only once a year or the treatments must be made at specific times during the development of the disease and host.
- Treatment of most diseases usually has to be made before the disease infects its host, making knowledge of life cycles and treatment times of critical importance.
- For diseases, the timing of treatment applications cannot be easily determined as is the case with treatments for insect pests.
  - →It is common that treatment may be too late by the time a disease outbreak is apparent.

Specific Information and Categories

Life cycles of disease-causing agents are usually significantly affected by temperature and weather. For example, rainy or wet weather conditions are conducive to development of many fungal diseases. Bacterial diseases usually thrive in damp, warm weather, and nematodes in soil require lighter or sandier soils and adequate soil moisture to survive.

The life cycles of disease causing agents usually occur in a number of discrete steps. These include: infection of the host, invasion of host tissues, reproduction and sporulation and dissemination or spread. Each of these stages may be affected to varying degrees by weather and host related factors that can increase or suppress the development and spread of a particular disease.

A common disease life cycle is that of the leaf disease fungi of deciduous trees. Most of these fungi overwinter in infected leaves that fall to the ground. In the early spring, sexual reproduction takes place and tiny fruiting structures develop that contain microscopic spores. These spores are forcibly released into the wind and serve to infect new leaves. Most of the spores are released during periods of rain and after the leaves of the host tree have begun to emerge from their buds. Infection of foliage is usually followed by a secondary spore stage that develops on the foliage. Spores from the secondary spore stage can cause more infections of foliage, usually during periods of rainy weather. Infected leaves then drop to the ground and serve to overwinter the fungus and re-start the cycle the following spring.

Not all disease cycles are as straightforward as the leaf disease cycle. Some involve multiple hosts of different tree or shrub species. Yet others involve insects that are needed for spread of the pathogen. Life cycles of some fungi, such as the ones that decay the wood of living trees, may take many years to complete.

Application

- Most treatments for diseases require knowing the specific life cycle of the disease so foliage or stems can be protected before infection.
- Most treatments for diseases are seldom effective by the time symptoms appear on a plant.
  - →Knowledge of a problem from a previous year is often needed to develop future disease management treatments.
- Specific information about the life cycle of a disease is needed so conditions that lead to disease outbreaks or spread can be altered.
  - →Changing the environment and removal of diseased tissues are common disease management practices.

Photo 1. Many leaf pathogens (arrow) overwinter on fallen leaves and begin their life cycle unnoticed in early spring when trees and shrubs are just beginning to emerge from dormancy (maple, tar spot).

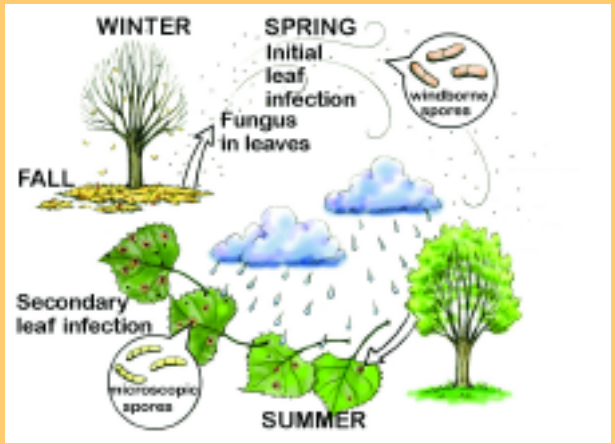

Photo 2. Understanding life cycles of diseases and other pests is important to developing management strategies (leaf diseases life cycle). [Line drawing by Nancy Lane.]

Photo 3. Management of diseases with pesticides requires familiarity with the life cycle of the disease. Pesticide applications for cedar apple rust on crab apple are effective only when the rust is sporulating on cedars in the spring (crab apple, cedar apple rust).

Photo 4. Some fungi have life cycles that require two hosts to complete. For example, white pine blister rust alternates between white pine and ribes (white pine, blister rust). [Photo courtesy of Ryan Burkum.]

Photo 5. Insects are involved in the life cycle of many diseases. Insects spread the pathogen to new hosts in the landscape. Horntail wasps transmit a wood decay fungus during the egg laying process that then develops in decaying wood (maple, horntail wasp).

Photo 6. The life cycles of some diseases, such as wood decay fungi, may go unnoticed and take many years to complete. The sexual fruiting structure, or conk, shown here develops only after years of decay (pine, conk).

Application

- The presence of one or more symptoms of a decline does not automatically indicate that a decline is the cause.
  - →Identification of declines usually requires elimination of other primary causes along with careful study of the problem, its symptoms and the primary and secondary agents present.
- Soil modification treatments have been successfully used recently to treat trees with decline symptoms. These techniques may not work if the tree has been extensively damaged by secondary agents.

Photo 1. A reduction in shoot growth may be an initial symptom of a decline disease. Notice the dead middle shoot (arrow) and the poor growth on the remaining shoot (maple, poor growth).

Photo 2. Small-branch dieback and sparse foliage on the top of this sugar maple are the initial symptoms of decline. These symptoms are often associated with reduced growth rates (maple, decline).

Photo 3. Early or premature fall coloration during the summer is a common initial symptom of decline. Also note the thinning canopy and branch dieback (maple, decline).

Photo 4. More advanced decline symptoms showing large branch death and extensive yellowing of foliage. Advanced decline symptoms are difficult, if not impossible, to reverse (maple, decline).

Photo 5. A sugar maple in the final stages of decline. Note the large branch death and tufted foliage. Pests that attack weakened trees often appear in the later stages such as Armillaria root rot, right (maple, Armillaria, decline).

Photo 6. In most cases, declines are difficult to reverse. Recently, the use of air tools to modify soils and add organic matter sometimes slows decline progression (soil modification).

Photo 1. Some pest management practices may have multiple impacts on the pest. For example, removing rust galls early may eradicate the disease present, prevent spores from forming and avoid infection of other hosts (red cedar, cedar apple rust).

Photo 2. Removing gypsy moth egg masses can help reduce defoliation the following year on individual trees in landscape settings if populations are low (oak, gypsy moth).

Photo 3. Sanitation pruning of fungal cankers is often the only available management practice. This should be done early because a single canker infection can ruin the tree (left, oak, dothiorella canker; right, maple, eutypella canker).

Photo 4. Stump grinding is a physical method of management that eliminates the potential for wood decay and canker fungi to sporulate and spread to other trees (stump grinding).

Photo 5. Eradication is the removal or elimination of a pest from a host or an area. Pruning out this fall webworm nest is an effective eradication measure (cherry, fall webworm nest).

Photo 6. Cleaning up and destroying infected leaves in the fall is a physical method of managing foliar diseases. Most of the fungi that cause leaf disease overwinter on fallen leaves (maple, tar spot).

Cultural Methods

Introduction

Cultural practices are the maintenance and management practices used in growing or culturing trees and shrubs. Cultural methods used in the maintenance of plant health can directly impact pests or reduce the potential for their development. Improperly delivered cultural practices are frequently the direct cause of poor tree or shrub health in the landscape.

Importance

- Cultural practices can be particularly important in avoiding or reducing the impact of plant problems caused by abiotic agents.
- Good cultural practices function within a PHC program with the intent of avoiding many types of plant problems by culturing the healthiest plants possible.
- Some pest problems may develop as a result of poorly applied cultural practices or failure to meet the management needs for a particular plant.
  - →For example, planting a shade-tolerant species such as flowering dogwood in full sun or exposed locations often results in dogwood borer problems.
- Cultural practices can be used to directly reduce specific pest problems. For example, monitoring soil moisture, irrigation practices and depth of mulch can avoid some root diseases that require saturated soils.

Specific Information and Categories

Site-Host Selection

Plants differ considerably in their ability to tolerate different levels of sun and shade, types of soil textures, pH levels and amounts of soil moisture and nutrient levels. Some plants prefer full sun, such as crape myrtles; while others prefer partial shade, such as flowering dogwood. If a plant is placed in an unfavorable location, it will be subjected to continuous stress. This can dramatically increase its susceptibility to pests. Careful evaluation should be made of the site and soil conditions, plant size at maturity, and distance from electrical lines, buildings and other plants. In addition, determining the inherent resistance of a plant to pests, before the plant is selected and placed in the landscape, is critical to future plant health.

Conducting a full site and soil assessment, and matching the plant to the site are extremely important but are frequently ignored when planting trees and shrubs in urban landscapes. Resistance to known pests should be considered before trees or shrubs are planted as installation of susceptible plants often results in unnecessary pesticide applications. Cultural requirements for growth and characteristics of various cultivars are presented in several well known tree and shrub identification books (See Appendix).

Management of Soil Fertility

Providing a balanced fertilization program is an integral part of a PHC program. Excessive nitrogen fertility levels have been linked to increased incidence of certain insect and mite pests. Slow-release nitrogen fertilizers are generally preferred over quick-release nitrogen sources such as urea or ammonium sulfate. The latter fertilizers have the potential to leach into ground water and to burn roots, especially in warm temperatures. Testing for *macro-* (those nutrients required in relatively larger amounts) and *micro-*nutrients (those nutrients required in smaller amounts) is often necessary. If nutrient deficiency symptoms are noted, a soil test, and if necessary a tissue analysis test, should be conducted to pinpoint the required element(s) that might be needed to gain acceptable plant growth rates, color and resistance to pests.