Chapter 19

Diagnosing Ornamental Plant and Turf Problems

Kris Braman
Jean Williams-Woodward
Alfredo Martinez
Mila Pearce

Learning Objectives

After you complete your study of this chapter you should be able to:

- Be familiar with common ornamental plant disorders and their causes.
- Be able to recognize insect-related injury in the landscape and lawn.
- Know some common insects and diseases affecting turfgrassand ornamentals in Georgia.
- Understand how to prevent or control insect damage to turfgrass and ornamentals.

DIAGNOSING ORNAMENTAL PLANT PROBLEMS

Diagnosing plant problems is often a difficult task since there can be many different causes for a given symptom. Soil nutrition and texture, weather conditions, lighting, and many other environmental and cultural conditions influence a plant's overall health. Insect damage can sometimes be confused with plant diseases caused by microorganisms or other factors.

It is difficult to construct a foolproof key for diagnosing plant problems. Even with specialized laboratory equipment, it is often impossible to determine the exact cause of a plant's decline. The following tables provide a key to some common problems of landscape plants. This key was originally constructed for homeowners to help with diagnosing common problems on landscape ornamentals and turf. This key is not comprehensive and other resources will be needed to supplement the diagnostic process.

The key should help homeowners and landscapers ask the right questions to determine the cause of a problem, or at least, narrow down the possibilities. For example, since both dry weather and excess fertilizer can cause marginal leaf burn, it would be important to consider recent weather conditions and fertilizer application. Or, since wilt can result from both dry and waterlogged soil, one must consider both rainfall and how well the soil drains.

It is also necessary to examine damaged plant tissues correctly in order to reach a reliable diagnosis. For example, a plant specimen should be examined in the early stages of deterioration to make an accurate disease diagnosis. Once it has decayed, secondary organisms invade the tissue and evidence of the disease organism is obscured.

In many cases, you will not be able to determine what caused the problem. Sometimes it is enough to know that you are dealing with a fungal leaf spot, for example, or aphids. Many county extension offices are equipped with digital diagnostic equipment to assist in problem diagnosis either using office resources or with the aid of a specialist. Frequently the services of a diagnostic laboratory will be necessary. Samples can be submitted to the University of Georgia Homeowner IPM Clinic for diagnosis. If you can narrow down the possibilities and mention these when you send the sample to the laboratory, you will save the diagnostician a lot of time.

IPM Strategies

The control recommendations listed in the diagnostic key are abbreviated to conserve space. A more complete explanation of each control is provided in the following paragraphs. Many of the cultural controls such as plant rotation, removing old plant debris, and planting in well-drained soil are repeated many times throughout the key. These are good general integrated pest management practices. Pesticide use is listed only for problems where a pesticide is registered for legal use in Georgia. Pesticide recommendations can be found in the Georgia Pest Control Handbook and label directions should always be followed.

Rotate—Plant flowering annuals or biennials in a different area every two to three years. This practice helps reduce the amount of disease organisms that survive in the soil or on plant debris. It is best to grow plants of a different family in the area where plants were removed or rotated due to disease. Some diseases will infect several plant species within the same family. Obviously, rotation of woody plants and perennials is not practical.

Remove Plant Debris—Remove diseased or insect-infested plant debris during the season and destroy it by burning or burying. Composting old, diseased plant debris should kill any surviving disease organisms; however, if the compost is not turned properly to keep the pile hot, these organisms will survive and may infect other plants. Burying old plant debris deeply works for some disease organisms that do not survive in the soil, but burning is best for stem and root diseases, and for insect-infested woody plant stems and branches.

Remove Affected Plants—It is important to remove plants immediately to prevent the spread of a disease or insect pest to unaffected plants. This often is recommended for viral and soilborne diseases, and some scale pests.

Use Registered Pesticides—Use a pesticide (fungicide, bactericide, insecticide, miticide, or herbicide) according to the label. The name of the plant must be listed on the label for legal use. Remember that most fungicides act as a physical barrier to infection and must be applied on a regular basis to be effective. They should be applied more often during rainy periods both because rain washes the chemical off and because most disease organisms are more active during rainy weather.

Resistant Varieties—Use plants that have been developed for resistance to certain pests. Very few resistant varieties have been bred for the landscape, although resistant varieties of some flowering annuals are being developed. Remember, a resistant variety is not resistant to all pests but only to those for which it has been developed. Also one must understand that a variety sold as "resistant" is not immune, and can, under certain circumstances, become infected with the disease organism, nematode, or insect to which it is resistant.

Pruning—Cut out affected plant parts to control cankers, stem galls on trees, and insect borers in stems and branches. Disinfect pruning tools with diluted liquid bleach (1 part bleach to 9 parts water) or rubbing alcohol between cuts. Make cuts back to live tissue. Cut back to a node or to the branch collar and do not leave stub cuts. Bury or burn pruned branches if burning is permitted in your area.

Soil Test—Submit a soil sample for analysis. Most soil analysis laboratories will test for pH, major nutrients and magnesium. Soluble salt levels and tests for minor elements are usually considered special tests and must be requested. Remember that lack of nutrient availability is caused by improper pH. Apply lime, sulfur or fertilizer as recommended.

Weed Control—Weed control is important for controlling virus diseases as weeds can harbor carriers of certain virus diseases. Insects can spread viruses to garden plants. Control weeds with mechanical cultivation or registered herbicides.

Insect control—Controlling insects is not only important for controlling damaging pests, but can also be important in controlling plant diseases. Viruses, viroids, mycoplasmas, bacteria and even fungi can be spread by insects.

Mulching—Mulching helps control diseases by reducing plant stress due to moisture fluctuations, and it creates a physical barrier against disease organisms surviving on infected fallen plant litter. Mulch keeps moisture in the soil and prevents leaves and flowers from coming into direct contact with soil disease organisms. The mulch layer should not be more than 3 to 5 inches thick (3 inches for pine bark nuggets and 5 inches for pine straw) and should not be placed right up against the plants.

Submit Sample for Laboratory Diagnosis—The disease may be difficult to diagnose from symptoms or information alone and more sophisticated techniques, such as microscopy or culturing are necessary to diagnose the problem. Remember that a good specimen and adequate information are of utmost importance to the diagnostician. It is not worth the mailing cost to send a dead twig, a few shriveled leaves, or a diagnostic form without such critical information as when symptoms were first noticed, how much of the plant is affected, etc. The diagnostician does not have the advantage of being able to see the plant in its own environment, so it is very important to submit good specimens. Your local county extension office can provide you with the forms for submitting a damaged plant specimen or an insect sample to The University of Georgia diagnostic facilities.

It is helpful to know that certain problems are more likely to occur on specific plants (kind of a guilt by association). Several tables follow in this chapter to give you some of the most common problems.

This chapter is comprised of the following sections:
- Common Problems of Annual and Perennial Flowers, Trees and Shrubs
- Insects of Ornamentals
- Diseases of Herbaceous and Woody Ornamentals
- Diseases of Turf
- Insects of Turf

General Problems Common to Many Annual and Perennial Flowers

SYMPTOMS	POSSIBLE CAUSES	CONTROLS & COMMENTS
Wilting and Overall Poor Vigor		
Plants wilt; flowers may drop and leaves may turn yellow.	Dry soil; water logged soil; transplant shock.	If dry, supply water; if too wet, improve drainage and water less frequently. Do not transplant in the heat of the day; water regularly after transplanting.
Leaves may turn yellow; plant wilts and dies.	Root, stem or crown rot (fungal or bacterial disease). Weather injury (drought). Mechanical injury. Improper fertilization. Natural gas injury.	Remove affected plants and surrounding soil. Do not overwater. Use of registered pesticides as soil drench when replanting may be beneficial.
Seedlings wilt. Stems turn brown and soft and may be constricted at the soil line.	Damping-off (fungal disease).	Remove affected plants and surrounding soil. Do not overwater. Improve soil drainage. Use of registered pesticides as soil drench when replanting may be beneficial.
Leaf and Flower Problems		
Plant fail to flower; foliage looks healthy.	Wrong season. Cool weather or insufficient light. Too much nitrogen (causes excessive vegetative growth). Immature plants. Undersized bulbs.	Some plants have specific daylength requirements for flowering. Do not plant sun-loving plants in shade. Do not overfertilize(nitrogen stimulates foliage, not flower production). Biennials and perennials often do not flower the first year.
Too many small flowers.	Plants not debudded.	Some flowers, e.g., chrysanthmums need to have some buds removed to produce large flowers.
Tall, "leggy" plant; stem and foliage pale or yellow. Insufficient light.	Pay attention to light requirements of plants.	
General yellowing of leaves; yellowing may be interveinal; plant may be stunted; no wilting.	Nutrient deficiency. Viral disease.	Soil test. Submit sample for laboratory diagnosis.
Grayish-white powdery growth on leaves or stems and flowers.	Powdery mildew (fungal disease).	Usually affects new growth. Remove heavily infested leaves and stems. Use resistant varieties if available. Rake up an remive fallen leaves to reduce fungal organisms. Use registered fungicide at the first sign of disease.
Blister containing orange, yellow or brown powdery substance on underside of leaves. Yellow areas opposite of pustules seen on upper surface.	Rust (fungal disease).	Remove infected plants. At very least remove infected leaves. Avoid long durations of leaf wetness; do not water late in the day. Use resistant varieties. Rake and remove fallen leaves. Use registered fungicide to prevent infection.
Random, brown, dead spots on leaves.	Fungal, bacterial, or leaf nematode disease (any of several).	Submit sample for laboratory diagnosis. Avoid long durations of leaf wetness; do not water late in the day. Remove affected leaves. Fungicides are ineffective on bacterial or leaf nematode diseases.

General Problems Common to Many Annual and Perennial Flowers

SYMPTOMS	POSSIBLE CAUSES	CONTROLS & COMMENTS
Leaf and Flower Problems (Continued)		
Uniform, brown, dead areas on margins of leaves.	Scorch due to hot, dry weather. Salt injury due to improper fertilization. Chemical injury. Poor planting site or improper planting depth. Mechanical injury.	Supply water. Fertilize properly. Do not allow fertilizers or "winter" salt to accumulate in soil. Replant in soil with proper aeration and at proper depth. Avoid mechanical damage to plant during maintenance procedures.
Flowers wilt or fail to open; grayish mold appears on flowers in damp weather.	Gray mold (fungal disease).	Pick off and destroy affected flowers. Avoid durations of plant wetness. Remove spent blooms and yellowing leaves.
Yellow and green mottle or mosaic pattern on the leaves.	Viral disease (any of several).	Plants are seldom killed. Affected plants may need to be removed. Do not touch healthy plants after touching diseased ones. Control insects that spread disease.
Black sooty growth on leaves and stems.	Sooty mold.	Control honeydew-secreting insects (aphids, soft scales, mealybugs, and some leafhoppers).
Tiny white flecks or white interveinal areas on leaves.	Ozone injury. Spider mites.	For spider mites, use registered miticide.
Clusters of insects on stems or undersides of leaves; leaves may be curled or distorted.	Aphids or scale insects.	Remove heavily infested leaves and stems. use registered insecticide.
Leaves chewed or completely eaten.	Various chewing insects. Slugs and sowbugs.	Submit insect for laboratory identification. Use commercial slug bait.
Light-colored tunnels or blotches in leaves.	Leafminers.	Use registered insecticides.
Leaves stippled with tiny white spots.	Spider mites. Thrips.	After positive pest identification, use registered miticide or insecticide.
Tiny, white-winged insects on udersides of leaves.	Whiteflies.	Use yellow sticky cards to monitor infestation. Use registered insecticide as directed on label.
White, cottony masses on leaves or stems.	Mealybugs.	Use registered insecticides.

General Problems Common to Many Ornamental Trees and Shrubs

SYMPTOMS	POSSIBLE CAUSES	CONTROLS & COMMENTS
Damage to Bark		
Large areas of split bark; no decay evident.	Freeze cracks.	Frost can split trunks (especially thin-barked trees; maples, elms); use tree wrap to protect bark from sun to prevent temperature extremes.
Reduced vigor; scraped or split bark.	Sunscald. Mechanical injury. Lightning injury can cause a tree to explode along the path of the lightning to the ground.	Thin-barked trees, e.g., young ones, split when exposed to intense sunlight. Use tree-wrap or block sun with boards on bright winter days. Avoid heavy fertilization in late summer or fall. Remove grass around trunk and replace with mulch to avoid mowing close to the tree. Use lightning rod.
Large areas of split bark; decay evident in wood.	Secondary decay of any of the wounds described above. Fungal or bacterial canker (any of several).	No adequate controls. Water and fertlilize tree at appropriate times. Severely affected trees may become a hazard and should be removed.
Sour-smelling sap oozes from cracks in bark.	Slime or alcoholic flux (bacterial disease). Bacterial canker.	No control. Tree may need to be removed.
Damage to Twigs, Branches and Roots		
Many small twigs broken off.	Squirrel damage. Wind breakage. Twig pruner, twig girdler (insects).	Usually not serious. Squirrels prune twigs for nest-building and often prune more than they need. If insect pests are suspected, rake up and destroy fallen twigs.
Large corky swellings on roots; plants are weak.	Crown gall (bacterial disease).	Fertilize and water properly. Reduce plant stress. Remove affected plants and surrounding soil. Replant with disease-free plants.
Large corky galls at base of tree.	Crown gall (bacterial disease).	Some galls can be pruned out but it is best to consult an arborist. Trees may live for years in spite of galls.
Galls on branches.	Fungal disease (any of several). Various insects. Secondary crown gall (bacterial disease).	Submit sample for laboratory diagnosis; prune out galled branches. Most insect-induced galls are harmless.
Proliferation of branches at specific points on the plant, forming a "witches' broom" effect.	Insect injury. Fungal, viral or mycoplasma damage.	Submit sample for laboratory diagnosis.
Large dead areas in center of trunk or large scaffold limbs.	Heart rot (fungal disease).	Prune out diseased limbs where possible. Fertilize and water properly. Reduce stress. If severely affected, especially if on the main trunk, the tree may be a hazard and should be removed.
Sunker cankers (lesions) on trunk or branches. Plant may wilt or have poor growth.	Primary fungal disease. Sometimes bacterial disease.	Submit sample for diagnosis. Prune out affected branches at least 6 inches below canker into healthy wood. Disinfect pruning shears between each cut, especially for bacterial cankers.

General Problems Common to Many Ornamental Trees and Shrubs

SYMPTOMS	POSSIBLE CAUSES	CONTROLS & COMMENTS
Damage to Twigs, Branches and Trunk (Continued)		
Oozing sap on trunk.	Natural causes. Environmental stress. Mechanical injury. Insect borers. Fungal or bacterial diseases.	Some trees naturally ooze sap. Drought or waterlogging can causes trees to ooze excessively. Prevent lawnmower and string trimmer injury. Use registered pesticide if insects have been identified as the problem. There are no controls for fungal or bacterial disease affecting this part of the tree.
Large gathering of caterpillars on tree trunk.	Spring cankerworm.	Handpick and destroy. Use registered insecticide.
Silk webs containing caterpillars in crotches of tree.	Eastern tent caterpillar.	Use registered insecticide; spray surrounding foliage on branch and penetrate web with spray.
Tiny fish-like scales tightly attached to leaves, twigs or branches.	Various scale insects.	Submit sample for diagnosis. Use dormant oil during late winter. Apply registered insecticide when scales are in the "crawler" or mobile stage.
Brown, gray, green, or yellow crusty, leaf-like growths on trunk and branches.	Lichens.	Lichens are a combination of algae and fungi. They do not harm the plant. Often indicates poor vigor or health of tree.
Dense bunchy growth on lower limbs; growth is gray-colored; leaves are narrow.	Ball moss.	Prune out dead wood. Scrape out moss and or spray with fungicide containing copper in late February or early March.
Gray growth which hangs down from the limbs.	Spanish moss.	No control suggested. Seldom becomes dense enough to cause damage.
Leaf Problems		
Grayish-white powdery growth on leaves; leaves may be distorted.	Powdery mildew (fungal disease).	Improve air circulation around plant by selectively pruning branches or increase plant spacing. Use resistant varieties. Use registered fungicide at first sign of disease.
Black, sooty growth on leaves and/or stems.	Sooty mold (fungus grows on honey-dew substance secreted by aphids and other insects).	Identify insect pest. Remove heavily infested leaves or stems. Control with registered insecticide.
Uniform, brown dead areas on leaf margins.	Leaf scorch, caused by insufficient transport of water to leaves. Cold injury. Chemical injury. Salt injury.	Water deeply during dry periods. Scorch is usually caused by hot dry weather, but root rots and other root damage can also be involved. Chemical injury to trees and shrubs is common on home lawns where herbicides are used too close to root zones of shrubs or trees. In regions where salty water is used to irrigate, deep watering is recommended to leach salts out of root zone; do not use chemically softened water on plants.

General Problems Common to Many Ornamental Trees and Shrubs

SYMPTOMS	POSSIBLE CAUSES	CONTROLS & COMMENTS
Leaf Problems (Continued)		
Interveinal yellowingof leaves; no wilting	Yellowing caused by nutrient deficiency or imbalance. Water-logged soil, resulting in poor transport of nutrients to leaves.	Treat leaves with spray of chelatediron. Improve drainage.
Blister containing yellow, orange, or black powdery substance on leaves; mostly on underside.	Rust (fungal disease).	Avoid long durations of leaf wetness; avoid late-day overhead irrigation. Ramove infected leaves. Rake and remove fallen plant leaves. Use registered fungicide to protect new growth from infection.
Browning of tips of conifers.	Ozone injury.	No controls.
General browning of leaves or needles.	Drought. Salt injury. Gas leak. Root-feeding nematodes. Water-logged soil. Transplant shock. Girdling roots. Plant is root bound and root ball center stays dry. Dog urine injury.	Water deeply during drought. Do not use de-icing salt on sidewalks or road near trees or shrubs. Flush soil with water. Check soil around roots for gray, crumbly appearance and foul smell indicative of gas leak. Submit soil sample for nematode analysis. Improve drainage. Water regularly after transplanting. Be sure main roots are not wrapped around trunk. Cut root ball several places before transplanting. Flush away dog urine with fresh water whenever possible.
Yellow and green mottle or mosaic pattern on leaves; leaves may be distorted.	Viral disease.	No controls; removal of plant may ne necessary if virus is easily spread.
Random, brown leaf spots; spots seen on both side of the leaf.	Fungal or bacterial disease (any of several).	See section on specific disease or submit sample for laboratory diagnosis.
Uniform leafspots; spots on one side of leaf.	Chemical injury.	Avoid using some products under hot, dry conditions. See pesticide label.
Leaves completely chewed or eaten.	Various caterpillars, sawflies, leaf beetles, etc.	Use registered insecticide while insects are small and before damage is extensive.
Silk webs containing caterpillars covering cluster of leaves at tips of branches.	Fall webworm.	Remove and destroy webs. Use registered insecticide; spray surrounding foliage on branch and penetrate web with spray.
Young leaves puckered, curled or distorted; clear, sticky substance on leaves; clusters of small insects on undersides of leaves.	Aphids	Use registered insecticide.
Leaves off-color with tiny white or yellow spots; may appear dirty because of fine webbing and dust that collects on leaves.	Spider mites.	Use registered miticide.
Leaf galls (abnormal growth on leaves, stems or other tissues)	Various insects or mites. Various fungal diseases.	There are no chemical controls for gall insects. Plants are seldom harmed by insect galls. Prune affected leaves or pick off galls for fungal disease control.

INSECTS OF ORNAMENTALS

Insects and related pests (mites, slugs, etc.) often reach damaging levels on ornamentals in Georgia. Homeowners who have only one or two shrubs eventually become familiar with major pests and are prepared to take preventive and/or corrective actions. For well-landscaped grounds with a large variety of plants, it becomes more difficult to predict problems.

Nature of Damage

Hardly a season passes without pest outbreaks that require control measures to prevent injury to plants. The type and extent of damage to ornamentals by insect pests depends on the pest and ornamental involved. Several insect pests suck plant juices and cause stippling of foliage, stunting, and leaf drop. Pests with chewing mouthparts cause large holes in leaves or chew through stems and petioles. Other pests bore into plant tissue and tunnel through leaves and stems.

Effective management of insect pests of ornamentals requires proper diagnosis of the problem. Often we can make reliable diagnoses based on damage that insects cause. The most reliable diagnosis requires identification of the insect or mite itself. Diagnosis based on symptoms can be divided into damage categories as follows:

- Tattered leaves or flowers
- Stippled, bleached or bronzed foliage
- Die back of plant parts
- Evidence of insects themselves

Pests responsible for each category include:

- Tattered leaves or flowers can be caused by grasshoppers, caterpillars, adult or immature beetles.

- Stippled, bleached or bronzed foliage may be caused by insects with piercing mouth parts such as lace bugs or plant bugs. Mites or thrips may also cause this type of damage.

- Die back of plant parts is often caused by scale insects or by beetles or moth larvae that bore inside the stems.

- Evidence of insects themselves may be webs, tents, cases, flocculence (cottony material), frass (fecal material), sawdust.

Specific damage symptoms caused by each pest are described in a following section, “Pest-Damage and Identification.”

Management of Pests

In order to grow attractive pest-free plants, homeowners should utilize a pest control program that includes pest prevention, early detection, correct pest identification, proper selection of control materials, and proper application methods. All steps in the control program are interrelated and none can be omitted without jeopardizing control efforts.

Prevention

The most important step in managing insect pests is prevention. Avoid selection of plant materials that are prone to mite or insect problems. Choose plant materials wisely to avoid trouble later. Insects which become established on plants can reproduce rapidly.

Any measures taken to exclude pest establishment will be helpful. Soil sterilization or the purchase of a pest-free potting medium is essential to the exclusion of soil insect pests from potted houseplants. For homeowners who enjoy propagating their own ornamentals, the use of clean stock plants is an important step in preventing plant damage. For example, poinsettia stock plants are often infested with whitefly that are capable of causing serious damage to many plants. On hobby greenhouses, screens on doors and vents are helpful in avoiding highly mobile insect pests such as adult leafminers and moths. Weed control around and within landscaped areas and hobby greenhouses reduces the chances of pest population outbreaks. Initial build-up of mites, flea beetles, aphids and thrips often occur on weeds and grasses.

Do not overlook the benefits of good cultural plant practices in avoiding pest problems. Healthy, vigorous shrubs and flowers can tolerate light infestations of insect pests without becoming unattractive. For example, flushes of new growth on woody shrubs during spring and early summer may totally mask damage symptoms of a light insect infestation so that chemical controls are not needed. Good cultural management, including optimum fertility and moisture, allows plants to reach maximum tolerance to insect damage. Information on proper cultural management of ornamentals is presented in other sections of this reference manual. Rouging or removal of infested plants or plant parts can quickly reduce an insect infestation and the chances for spread of insects from one plant to another. When plants are inspected for pests, remove and dispose infested leaves and old decaying flowers. Never toss infested plant material on the ground at the base of plants.

Early Detection is Critical—Since the numbers and kinds of insect pests vary considerably, frequent inspection of plants for pest damage is important. During spring and summer some pest species reproduce so rapidly that close visual inspection of plants should be made every other day. Make a general inspection of the plants for loss of color, stunting, or holes in leaves. To detect some of the more unnoticeable pests also exam the undersides of several leaves on each plant.

Correct Identification—Early detection and correct identification of pests are the first two steps to an effective insect management program on ornamentals. Unless an insect is correctly identified, one cannot be certain that the insect found is actually a pest. Consequently, selecting an appropriate control measure becomes difficult. Homeowners should consult county Extension personnel for assistance in identifying unfamiliar insects. It is not unusual to find an unsuspecting homeowner attempting to control beneficial insects! Only after an insect has been correctly identified can one determine if, when, and how it should be controlled.

Proper Selection of Control Materials—Control materials for insect and related pests are listed in separate publications available from county Extension offices. No single pesticide is capable of controlling all major pests without damaging sensitive plants. As new products and research data become available, revisions of control recommendations are made. Consult your county Extension office to be sure you have the latest recommendations.

Correct Application Methods—Regardless of how quickly a pest is detected and how effective the selected pesticide is, pest control will be no better than the method of pesticide application. Pesticides are applied to ornamentals in every conceivable manner. Growers use aerosols, mists, smokes, fogs, dusts, sprays, drenches and granules. For control of foliage feeding pests, most insecticides are applied as sprays. For best performance, an insecticide should be applied at the proper rate and at a time when pests are present and most vulnerable. Sufficient spray volume to permit good and thorough coverage of the upper and lower surfaces of leaves should be used. Spray equipment that produces small diameter droplets provides such coverage.

Due to the difficulty in detecting many of the major ornamental pests, insecticide sprays are occasionally made to prevent damaging infestations of insects. Homeowners should try to detect developing infestations on plantings outside the home as early as possible. Visual inspections should be made twice each week. Examine both sides of the leaves, as well as new growth and stems. During early spring, when scale crawlers are emerging, a hand lens is helpful in detecting the immatures. By examining plants often, homeowners can reduce the use of insecticides. To control pests which are common and abundant in a predictive cycle (for example, a juniper which has mite problems every July), preventive sprays may be the best line of defense.

Aphids

Identification and Biology—Adults may be winged or wingless. The size of most mature aphid species varies from 1/16 to 1/8 inch long. The body is oval to pear-shaped with two tube-like cornicles on the abdomen. Colors are usually green, yellow, orange, red, black, or white. Aphids have several generations a year and overwinter on plants as eggs. Feeding aphids excrete honeydew on which black, sooty mold may grow.

Host Plants—Some aphid species only feed on one plant species, while others may be general feeders. Most deciduous trees and shrubs, as well as conifers are subject to attack by aphids. Many species alternate host plant species between cold and warm seasons. High nitrogen fertilizer rates can increase aphid reproduction.

Damage Symptoms—Aphids sucking fluids from buds and leaf veins may cause stunting, deformation, discoloration, and leaf death. They do not cause stippling of green tissue. Aphids rarely cause obvious plant injury, but large populations may cause objectionable levels of honeydew (sticky substance) and sooty mold. Leaves damaged early in the season on indeterminately growing plants usually are hidden by healthy leaves produced later in the season after aphid populations decline.

Monitoring Techniques—In spring, look at new growth for curled, discolored leaves. Aphids typically cluster on the top side of curled leaves where white shed skins may be seen more easily than the aphids themselves. In summer, light-colored aphids feed on veins on the lower surface of mature leaves. Look for honeydew and sooty mold. If these are present, but aphids are not on leaves, examine the bark for dark-colored aphids. Also look for the presence and relative numbers of predators and parasitized aphids (mummies).

Control Strategies—By early summer, aphids are usually controlled in the landscape as a result of the actions of predators and parasites. If excessive honeydew is objectionable, use oil or soap sprays when predators and parasites are present on most

terminals and leaves are not curled. Residual or systemics insecticides may be sprayed if leaf curl becomes objectionable, but the use of these insecticides may eliminate beneficials for some time. Dormant oil sprays may be applied when large numbers of overwintering eggs are detected.

Azalea Bark Scale

Identification and Biology—Adult females may be 1/8 inch long. In May, they begin secreting a white, feltlike sac that encloses their bodies and eggs. Overwintering nymphs are about 1/16 inch long, gray, and usually are found in twig forks. Males emerge in early spring, mate, and die. There are two generations a year in Georgia. Immatures overwinter on bark.

Host Plants—This imported scale insect prefers azalea and rhododendron, but also has been found on andromeda (Pieris), maple, arborvitae, fremontia, willow, poplar, and hackberry.

Damage Symptoms—Azaleas tolerate low levels of this scale without showing symptoms. Honeydew, sooty mold, leaf yellowing, and dieback have been observed on plants with large populations of this scale insect. Continuous heavy infestations may kill plants in a few years.

Monitoring Techniques—Look for sooty mold on leaves, yellowing leaves, and twig dieback. Stippling of leaves does not occur with this pest. Examine twigs for white egg sacs and the presence of reddish crawlers in May and June. Examine egg sacs closely for holes which indicate the presence of parasites. Look for predators. In light infestations, the scales are found in twig forks. In heavy infestations, they occur anywhere on bark.

Control Strategies—In situations where there are a few egg sacs or scales but no leaf yellowing or sooty mold, do not spray. Beneficial insects usually control this insect. Dormant oil may be used to control overwintering nymphs on twigs. Summer oil or insecticidal soap may be used to control crawlers.

Azalea Caterpillar

Identification and Biology—Adult moths are 1 inch long and brown. Mature larvae may be 2 1/2 inches long. They have reddish brown legs, head, and “neck” area. The body is black with rows of white or pale yellow spots. The larvae feed from late summer through early fall. There is one generation a year. Pupae overwinter in soil.

Host Plants—This native moth prefers azalea but it has been reported on witchhazel, sumac, apple, red oak, and andromeda (Pieris).

Damage Symptoms—The caterpillars feed together when young and then disperse as they mature. Defoliation of entire branches and plants may occur with large populations.

Monitoring Techniques—Observe host plants for signs of defoliation in late summer and fall. Look for black caterpillars with white spots.

Control Strategies—Hand pick caterpillars from plants when only a few are present. Apply Bacillus thuringiensis if caterpillars are numerous and less than 3/4 inch in length. Apply residual insecticides on larger caterpillars.

Azalea Lace Bug

Identification and Biology—Adults are 1/8 inch long. The transparent wings are held flat on the back. Their wings are lacy with two grayish-brown cross-bands connected in the middle. Nymphs are mostly black and spiny. The flask-shaped eggs are partially embedded in leaf tissue and often are covered with a black tar-like secretion. There are four generations a year. Eggs overwinter in leaf tissue. Lace bug adults and nymphs live and feed on the underside of leaves.

Host Plants—Deciduous and evergreen azaleas.

Damage Symptoms—Nymphs and adults feed on plant juices through leaf tissue, causing white stippling of leaves. Nymphs and adults deposit black excrement spots that stick to the bottom surface of leaves. In heavy infestations, plants are aesthetically damaged and may die back.

Monitoring Techniques—Look for the first signs of damage on plants in full sun or in protected areas beginning in March and continuing throughout the summer. Look for white stippling on older leaves. Turn stippled leaves over to find lace bug stages and black fecal spots. Examine lace bug eggs with a hand lens for signs of parasitism (a round hole in the top of the egg) and look for predators.

Control Strategies—Plant azaleas in partial shade. Time insecticide applications for the presence of the first generation nymphs. Insecticidal soap or horticultural oil sprays will give adequate control if sprayed on the underside of leaves. Beneficials usually are unable to control this pest when host plants are located in sunny locations.

Azalea Leafminer

Identification and Biology—Adult moths are about 3/8 inch long with wings folded. They are yellowish brown with purple markings on the wings and stand at a 60° angle when at rest. Mature larvae are about 1/2 inch long and yellowish brown. There are two generations a year. Pupae overwinter in leaf mines (tunnels the larvae create when they feed on tissue between leaf surfaces).

Host Plants—Azalea appears to be the only plant attacked by this leafminer. It may be a problem in greenhouses, as well as nursery and landscape settings.

Damage Symptoms—Young larvae form elongate brown blotch mines, usually near the leaf midrib. Older larvae curl the tips of leaves with silk and feed inside the curl. Large populations cause leaves to turn brown and drop prematurely.

Monitoring Techniques—Look for leaf mines in April or May. Curled leaf tips in June indicate completion of the first generation. Second generation leaf mines begin in July. Shake plants in late June and August to make adults fly and to estimate their numbers.

Control Strategies—Since larvae of this pest feed in leaf mines or in curled leaves, systemic insecticides are preferred. Treat in May if numerous developing leaf mines are observed. Evaluate the second generation in July and re-treat if needed. Rake and destroy leaves in fall.

Bagworms

Identification and Biology—Adult male moths are about 3/4 inch long and black. Adult females do not develop wings. They remain inside their bags Males mate with females in their bags. Larvae and their bags are 1 to 2 inches in length. Larvae begin construction of their bags soon after hatching. Their silken bags are covered with plant parts. One generation occurs each year.

Host Plants—This native bagworm moth seriously damages northern white cedar, red cedar, arborvitae, juniper, and other conifers. Boxelder, sycamore, black locust, willow, elm, poplar, oak, maple, and persimmon may harbor reservoir populations.

Damage Symptoms—Damage is most serious and obvious on foundation conifers, such as arborvitae and juniper, where individual branches and even whole plants are completely defoliated. On large deciduous trees and shrubs, defoliation is less evident.

Monitoring Techniques—In May and June, begin looking for new bags on host plants, especially where large, old bags are present. Closely examine outer foliage of plants in full sun. In fall and winter, search for and manually destroy bags, which may contain up to 1,000 overwintering eggs.

Control Strategies—In light infestations, hand pick and destroy bags. In heavy infestations on many plants, spray with Bacillus thuringiensis between May and June. Apply residual insecticides in June and July.

Bark Beetles (Pine)

Identification and Biology—Adult Ips beetles are brown and vary from 1/8 to 1/4 inch in length. The head is bent downward, and the wing covers have posterior spines. Larvae are C-shaped, legless, and white, with brown heads. There are three to four generations a year. Larvae overwinter in galleries under bark.

Host Plants—Most pines grown under stressed conditions are susceptible to attack.

Damage Symptoms—Adult beetles boring into relatively healthy trees cause sticky white pitch tubes to form. Brown, sawdust-like material may be evident from entrance holes in severely stressed trees. Weeks or months later, entire tops of infested trees turn yellowish red and die, usually because of a blue-stain fungus introduced by the beetles.

Monitoring Techniques—Look on bark for the first signs of brown dust or white pitch tubes from late March through October. Note the crowns of pines in the area for early warning of a local bark beetle outbreak. Check under bark of dying trees for signs of galleries, larvae, and blue stain.

Control Strategies—Trees should be watered during drought periods to prevent stress. Prevent beetles from building egg galleries by monitoring trees frequently and treating branches and trunks with a residual insecticide when the first pitch tubes appear. Heavily infested or dying trees should be destroyed immediately to prevent adult beetle emergence.

Boxwood Leafminer

Identification and Biology—Adults are orange-yellow mosquito-like flies about 1/8 inch long. They swarm around boxwoods for about two weeks in mid-March

to early April after new growth has flushed on the shrubs. The yellow maggots overwinter in leaf mines. There is one generation a year.

Host Plants—This imported gall fly may damage most boxwood species, but Buxus sempervirens 'Argenteo-variegata,' 'Pendula,' and 'Suffruticosa' usually are not seriously infested. English boxwoods are less susceptible than American varieties.

Damage Symptons—Larvae feeding inside the leaves cause blisterlike blotch mines to appear on the bottom side of infested leaves. Heavily mined leaves turn yellow and prematurely drop.

Monitoring Techniques—Beginning in mid-March, periodically sample boxwood plants to detect flying adults. Examine the underside of the previous year's leaves to easily detect active mines. Look for presence of pupal cases sticking out of mines and the orange-colored adults. Mines of the current season do not become obvious until fall. Most damage is done in fall and late winter.

Control Strategies—When adults are detected and are active, apply a contact insecticide. If numerous mines are found in the summer or fall, apply a systemic insecticide. Replace susceptible cultivars with resistant cultivars.

Boxwood Psyllid

Identification and Biology—The light green adults are about 1/8 inch long and resemble miniature cicadas. Nymphs are green and rather flattened, with posterior fluffy white wax. They feed inside cupped terminal leaves. There is one generation a year. Orange eggs overwinter beneath bud scales.

Host Plants—American boxwood cultivars, except 'Suffruticosa', are preferred and most seriously damaged by this imported psyllid. English boxwoods rarely receive serious damage.

Damage Symptoms—The terminal shoots of infested plants develop cupped, stunted leaves.

Monitoring Techniques—Look inside cupped terminal leaves in early spring for nymphs and white wax. Examine plants in early summer for adults. Shrubs usually outgrow damage by mid-summer.

Control Strategies—Use horticultural oil or soap sprays to control nymphs when detected in early spring. Use a residual insecticide to control adults that are discovered later in the growing season if the level of damage is intolerable.

Cottony Maple Scale

Identification and Biology—Adult females are about 3/16 inch long. They are black, flat, and oval. The 1/4-inch white cottony ovisac, or egg sac, is deposited on bark. Crawlers appear in June and immatures in summer on the underside of leaves. There is one generation a year. Immatures overwinter on twigs.

Host Plants—This native soft scale may feed on many different shade trees. Preferred hosts include maple, elm, hawthorn, dogwood, sycamore, poplar, and linden.

Damage Symptoms—Heavy infestations that encrust branches may cause leaf yellowing, stunting, and dieback. Moderate to heavy infestation levels will cause objectionable honeydew (sticky substance secreted on leaves) problems to structures under trees, but usually do not damage trees.

Monitoring Techniques—Look for white eggsacs on bark in early spring. During the summer, look on underside of leaves for flat, yellow immatures sucking sap from leaf veins where honeydew and sooty mold are found on the host plant.

Control Strategies—If infestations are light, honeydew and sooty mold are not objectionable, or if beneficials are abundant, it may not be necessary to treat. Reevaluate the situation within two weeks. If infestations are heavy and stunting or honeydew and sooty mold are objectionable, apply dormant oils to bark to kill overwintering nymphs. Horticultural oil or insecticidal soap can be applied to leaves during the summer to control crawlers.

Dogwood Borer

Identification and Biology—The adults are clearwing moths about 3/8 inch long. They have two gold bands on a bluish-black abdomen. The larva which grows to 1/2 inch long is white with a brown head and has two reddish-brown spots on the back, near the head. There is one generation a year. Larvae overwinter under bark. Adult emergence peaks around early to mid-May, but occurs continually from April to October because eggs are laid for several months.

Host Plants—This native clearwing moth primarily attacks stressed or wounded dogwoods. Other landscape trees, such as apple, oak, hickory, cherry, birch, willow, and ash may be attacked.

Damage Symptoms—Larvae bore under bark, causing it to crack. Brown frass around bark cracks usually indicates borers are active. Repeated multiple

infestations may cause dieback on large trees, and small trees may be killed.

Monitoring Techniques—Look for brown frass around wounds and bark cracks. Remove loose bark with a knife. Larvae may be found in short tunnels under bark near wounds.

Control Strategies—Plant trees in proper location. Protect tree trunks with mulch bands to prevent wounds from lawn mowers. An early April application of a long residual insecticide to the bark should prevent infestation. An additional application may be necessary in late May. Kousa dogwood appears to be resistant to this borer.

Dogwood Clubgall Midge

Identification and Biology—Adult midges are about 1/8 inch long. They superficially resemble mosquitoes. Mature larvae are yellowish-orange maggots. The oval galls are found at branch terminals. There is one generation a year. Pupae overwinter in soil under trees.

Host Plants—This native gall fly infests the flowering dogwood, Cornus florida, from New England to Florida.

Damage Symptoms—In spring, newly hatched maggots infest growing tips and cause oval or somewhat tubular green galls to form. Associated terminal leaves slowly wilt and die, and the galls turn brown in summer. Heavily infested young trees are stunted.

Control Strategies—Look for the newly forming green galls in May on terminal twigs of flowering dogwood. Dead terminals with brown galls from the previous year indicate the possibility of an infestation.

Prune out and destroy newly formed green galls in spring. There are no insecticides labeled for control of this minor pest.

Eastern Tent Caterpillar

Identification and Biology—Adult moths are about 1 inch long. They are light brown with two white diagonal stripes across each forewing. Mature larvae may reach a length of 2 inches or more. This is the only common caterpillar with a white stripe down the back. There is one generation a year. Pupae overwinter in cocoons in debris on the ground.

Host Plants—Preferred hosts include wild cherry, crabapple, and apple. In peak years, ash, birch, black gum, willow, maple, oak, poplar, cherry, and plum are attacked.

Damage Symptoms—Silken webs in tree forks at budbreak are indicative of this pest. In peak population years, preferred hosts can be defoliated.

Monitoring Techniques—Look for the black 3/4 inch-long egg masses on preferred hosts in the dormant season. Look for silken webs in the branch forks of preferred hosts in early March.

Control Strategies—Prune out the egg masses during the dormant season. Mechanically destroy the web contents when first discovered. Time insecticide application for the presence of young larvae. Spray Bacillus thuringiensis onto foliage where larvae are found feeding.

Euonymus Scale

Identification and Biology—Covers of adult females are about 1/8 inch long, brownish-black, and are oyster shell shaped. Male covers are smaller, thinner, and white. Crawlers are yellowish-orange and are most often found on new growth. Fertilized adult females overwinter. There are four overlapping generations a year.

Host Plants—This imported armored scale attacks and frequently kills most species of evergreen Euonymus. E. kiautschovica is relatively resistant, as are deciduous Euonymus species. Celastrus (Bittersweet) also may be severely attacked.

Damage Symptoms—Light infestations on bark cause no obvious damage. In heavy infestations, the white covers of males are easy to spot on the leaves and the leaves develop yellow spots. After two to three years, even large Euonymus japonica usually dieback if intervention does not occur.

Monitoring Techniques—Look for dieback and white male covers on leaves. Look for off-color, yellow-spotted leaves on unthrifty plants. Always examine Euonymus japonica to discover infestations before they cause damage. Carefully examine bark on a few stems to detect light infestations. Examine plants for presence of predators and parasites.

Control Strategies—Replace susceptible Euonymus varieties with resistant or tolerant species where possible. Dormant oil sprays should control light bark infestations. For heavy leaf infestations, remove and destroy heavily infested branches and then follow with an application of a systemic insecticide. Time application of horticultural oil, insecticidal soaps, or other contact insecticides for the presence of crawlers.

Do not use contact insecticides if there are numerous predators or parasites present.

Fall Webworm

Identification and Biology—Adult moths are about 3/4 inch long with wings folded. Wings are all white or white with black spots. Bases of front legs are orange-yellow. Mature larvae are about 1 inch long and may occur in two color forms: those with black heads are yellowish-white and those with red heads are brown. Both forms have paired black tubercles running down the back. They are covered with long, silky gray hairs. There are four generations a year. Pupae overwinter in flimsy cocoons in protected places.

Host Plants—More than 100 species of deciduous forest and shade trees may be attacked by this native tiger moth caterpillar. Preferred hosts include mulberry, walnut, hickory, elm, sweetgum, poplar, willow, oak, linden, ash, and apple and other fruit trees.

Damage Symptoms—The caterpillars produce a "web" of fine silk over terminals. They feed inside the silken web, which they enlarge to take in more foliage as they grow. The webs are aesthetically distracting but rarely is enough terminal foliage consumed to affect tree growth. The dry webs can increase in number over a season and hang on terminals into the winter.

Monitoring Techniques—In early spring, examine the south side of tree crowns for the first signs of webbing over terminals. Continue to monitor host trees throughout the growing season for the presence of webs.

Control Strategies—Prune out webbed terminals as they are detected in the course of regular monitoring visits. When large infestations are present, Bacillus thuringiensis, horticultural oil, or insecticidal soap may be used to control young larvae. Use of these products will also protect the numerous species of predators and parasites that normally keep this pest below damaging levels. Insecticides must penetrate the "webs" to provide good control.

Flatheaded Appletree Borer

Identification and Biology—Adults may reach 1/2 inch in length. They are oval, flattened beetles, metallic greenish-bronze above and brassy below. The wing covers have wavy, light-colored indentations. The white larvae, commonly called flatheaded borers, are expanded just behind the true head, which is black. There is one generation a year. Larvae overwinter in galleries inside the host plant.

Host Plants—Preferred hosts include sycamore, red maple, silver maple, willow, oak, tuliptree poplar, elm, beech, hickory, apple, pear, dogwood, and black walnut. Newly planted trees are susceptible to these borers until root systems are established.

Damage Symptoms—Larvae bore fairly large, irregular cavities in phloem tissue of the main trunk and larger branches. Young trees and trees under stress are particularly attractive to this pest. Larvae are usually found boring into the base of trees. Small trees often are killed.

Monitoring Techniques—Frequently examine newly transplanted and stressed trees for signs of dieback on branches. Closely examine bark for galleries where cracking and weeping are seen. Adults run over bark and are quick to fly. They are most active on exposed, sunny bark of weakened trees from early March through May and early September through October.

Control Strategies—Plant trees on the proper site. Maintain vigor through use of good cultural practices. If numerous adult beetles are noted on bark, spray the trunk and major branches with an approved residual insecticide. Cut back infested branches below signs of infestation.

Greenstriped Mapleworm

Identification and Biology—Adult moths are about 1 inch long. The front wings are pink with a central yellow band. Mature larvae are about 1 1/2 inches long, pale green with a reddish head, two black thoracic horns, and seven longitudinal greenish black stripes. There are two generations a year. Pupae overwinter in soil.

Host Plants—This native giant silkworm moth prefers maples, especially red maple, sugar maple, and silver maple. It also feeds on boxelder and oaks where they grow mixed in with maples.

Damage Symptoms—The mature caterpillars are capable of devouring leaves down to the midrib. Feeding usually begins on the lower branches. Heavy infestations may strip small trees.

Monitoring Techniques—Look for damage on foliage of lower branches of susceptible maples in early summer. Shake lower branches to knock down camouflaged larvae. Larvae feed singly on leaves. Adults are easily trapped in black light traps.

Control Strategies—Treatment of trees usually is impractical because effective coverage is hard to

achieve without special equipment. Bacillus thuringiensis may be effective when caterpillars are young.

Native Holly Leafminer

Identification and Biology—Adult flies are about 1/8 inch long and black. The larvae are 1/8-inch long yellow maggots that tunnel through leaves, creating serpentine mines. Eggs are usually deposited in the midrib or leaf margin and early mining occurs there. There is one generation a year. Larvae overwinter in mines.

Host Plants—The native holly leafminer produces mines primarily on American holly. Other Phytomyza species infest japanese, Chinese, English and yaupon hollies.

Damage Symptoms—Summer to fall mining occurs in the midrib. The obvious, linear, yellowish-green mine in the leaf surface occurs the following spring. Several mines per leaf cause premature leaf drop. Adult females of this imported fly puncture tender new holly leaves to feed on plant juices. Parasites often control this pest if insecticide use can be eliminated.

Monitoring Techniques—Look for short mines in late summer. Look at leaves on the south side of holly for expanding yellowish mines in Jan./Feb. Look for adult flies on new terminal leaves beginning in March. Look for numbers of feeding punctures on the underside of new leaves as an indication of fly population size. Adults may be present from March through April.

Control Strategies—In light infestations, pick and destroy mined leaves before March. In heavy infestations, use systemics for larvae in March or late summer. Contact insecticides may be used for adults in early April, but this is the least desirable technique because beneficial parasites may be killed.Typically 70-85%of mines will be parasitized.

Japanese Beetle

Identification and Biology—Adults are nearly 1/2 inch long, broadly oval, thick bodied, with coppery brown wing covers and a metallic green body. Mature larvae are nearly 1 inch long and white, with brown heads. They resemble several other scarab beetle larvae, but may be identified by the shape of the raster (an area of bare spots, hairs, and spines on the underside of the last abdominal segment). There is one generation a year. Larvae overwinter in soil.

Host Plants—Adults of this imported scarab beetle feed on the flowers and leaves of many plants. Preferred plants include rose, crape myrtle, maples, sycamore, birch, cottonwood, linden, mountain ash, and elms.

Damage Symptoms—Adults prefer tender young leaves, which they may skeletonize completely. Trees may be defoliated in heavily infested areas. Larvae may damage lawns and the roots of small plants seriously. Flowers, such as roses, may be destroyed by large adult populations.

Monitoring Techniques—Look for adults on preferred hosts from early June through August. Examine turfgrass in late summer for presence of grubs. Use a spade to cut three sides of a strip of turf 1 foot square by 2 or 3 inches deep. Force the spade under the sod and lay it back, using the uncut side as a hinge. Use a trowel to dislodge soil from the overturned roots. Count the grubs in the exposed soil, then replace the strip of sod. Treatment of turf is suggested if there are more than six to eight grubs per square foot.

Control Strategies—Milky spore disease is available for control of Japanese beetles grubs. Results with this product have been inconsistent in Georgia. Application of residual insecticides applied to turf in late August or early September has provided more reliable control. Weekly application of residual or contact insecticides to host plants in June through July will provide only partial adult control. Traps usually are counterproductive and most often call in more beetles than they trap. Use traps to time insecticide application for adults. Do not use traps for control.

Juniper Scale

Identification and Biology—Mature female covers are circular, white, and about 1/16 inch in diameter. Male covers are smaller, elongate, oval, and white. Shed skins incorporated into the cover are yellow. There is one generation a year. Adult females overwinter on needles.

Host Plants—This imported armored scale insect prefers juniper, but has also been collected from Leyland cypress and cedar. Yellow crawlers are present in late spring.

Damage Symptoms—Light infestations cause no apparent symptoms. Heavy infestations (ten or more scales per 1/2 inch of twig) cause the foliage to turn yellow and if there is no intervention from beneficial insects or insecticide application, dieback can occur.

Monitoring Techniques—Look for off-color foliage. Examine needles closely for minute, white, circular scale covers. Examine infested plants closely for

evidence of parasite and predator populations and their activities. Scales usually build up first on the south side of shrubs or on the side against a building.

Control Strategies—Dormant oil spray will reduce the number of adults that successfully overwinter, but usually does not provide adequate control. Use horticultural oil or insecticidal soap to control crawlers in late spring. Systemic insecticides may be used to reduce heavy populations of scales in late summer and fall.

Longtailed Mealybug

Identification and Biology—Adult bodies are about 1/8 inch long. The body margin is ringed with white wax filaments. The last pair is over one-half of the length of the body. The wax filaments are short on crawlers. There are two to three generations a year. Immatures overwinter on bark.

Host Plants—This distinctive, cosmopolitan mealybug is a general feeder. It is usually found in protected locations on pyracantha, holly, yew, and rhododendron.

Damage Symptoms—Moderate to heavy infestations produce much sticky honeydew that fosters a dense growth of sooty mold, and terminal leaves may become yellow and distorted. A heavy layer of sooty mold on leaves of heavily infested plants reduces food production and, therefore, plant vigor.

Monitoring Techniques—Look for honeydew and sooty mold on dense plants growing in sheltered locations. Examine plants closely for active ants and/or presence of honeydew. Examine plants above the areas containing the most honeydew/sooty mold for mealybugs. Mealybugs will be found on the underside of leaves and stems.

Control Strategies—A dormant oil spray will reduce the overwintering population. Summer oil sprays will suppress growing populations. Systemics are preferable if plantings are dense and/or if the pest population is high. Ant control may be indicated if the mealybug problem persists in the presence of ants.

Maple Bladdergall Mite & Maple Spindlegall Mite

Identification and Biology—Adults of these two eriophyid mites are not visible without a hand lens. They live in circular and spindle-shaped galls. They are white to clear in color, 0.15 mm long, cigar-shaped with only four anterior legs. There are several generations a year. Adult forms overwinter in bark cracks.

Host Plants—The maple bladder gall mite prefers red maple; the maple spindle gall mite prefers silver maple and sugar maple.

Damage Symptoms—Infested leaves develop small circular or spindle-shaped galls in spring that turn from green to red to black in one month. The galls are on the top side of the leaf, but the opening is on the bottom side of the leaf. Most infestations cause no other symptoms and are not a serious threat to the health of the host plant.

Monitoring Techniques—Look at new leaves for gall formation in spring as leaves expand. Look at mature leaves in summer to estimate the abundance of galls. Galls can be of cosmetic concern but do not damage plant.

Control Strategies—Control measures usually are not necessary.

Nantucket Pine Tip Moth

Identification and Biology—Adult moths are 1/4 inch long with wings folded and silvery gray with rust-colored patches. Mature larvae are about 3/8 inch long and tan with dark-brown heads. Pupae are brown and overwinter in shoot tips. There are four generations a year. Pupae overwinter on shoots.

Host Plants—This native moth feeds on all pines except eastern white pine and longleaf pine. Mugo, loblolly, pitch, Virginia, scotch, Austrian, and Japanese black pines are preferred.

Damage Symptoms—Newly hatched larvae bore in needles, then buds, and finally into the stem, causing the terminal shoot to die and turn brown. Pines less than 6 feet high that grow in full sun receive the most damage. This pest may prune back, but rarely kills, established pines.

Monitoring Techniques—Look for stunted, brown terminals. Depending on your location, hang a pheromone trap in late February to mid-March, depending on temperature, and replace it in mid-June. Monitor every one to two days, and record first catch. For a more accurate method, use heat units in combination with trap data to determine egg hatch (i.e., a degree-day model).

Control Strategies—In small plantings, destroy brown terminals in the dormant season to kill overwintering pupae. In large plantings, apply a spray to terminals ten days after the first moths are trapped, using pheromone trap catch data.

Oak Lecanium Scale

Identification and Biology—Fully developed adult females are about 1/4 inch long. They are oval to almost circular, highly convex and light to dark brown. Crawlers are pale yellow. There is one generation a year. Immatures overwinter on twigs.

Host Plants—This native soft scale is believed to be restricted to the beech family (Fagaceae), especially oak and chinquapin.

Damage Symptoms—Heavily infested twigs commonly exhibit stunted leaves and dieback due to feeding activities of developing females in the spring. Crawlers spend the summer feeding on leaf veins but usually produce no symptoms of damage.

Monitoring Techniques—Examine host twigs in the dormant season for dead females of the previous season and for immatures that will begin to enlarge and mature in the spring. Look for immatures feeding on leaf veins from mid-June through the fall.

Control Strategies—Use horticultural oil as a dormant spray or as a crawler spray in mid-June. Using oil will reduce impact on parasite activity that peaks with crawler activity. If damage symptoms are evident in July or August and crawlers are present, repeat the oil application to the foliage.

Obscure Scale

Identification and Biology—Fully enlarged adult female covers may reach 1/8 inch in diameter. They are circular, brown to gray, slightly convex, with central skins that are black when rubbed. Male covers are smaller and broadly oval. This species develops in overlapping clusters. There is one generation a year. Immatures overwinter and crawlers appear in July.

Host Plants—This native armored scale feeds on eastern oak species, especially black oaks, and on pecan. In landscapes, pin and willow oaks are frequently damaged by this pest.

Damage Symptoms—Heavy infestations commonly cause branch dieback on oak trees. Pin oak branches may become gnarled where many scale aggregations depress the bark.

Monitoring Techniques—Look on three to four-year-old branches for overlapping gray scale covers. Scrape off covers to determine viability of a population because covers of dead scales may remain attached. In midsummer, live adult female scales are light purple. Scout in mid-July to determine amount of crawler activity. Look under covers in the dormant season for the small, yellow immatures to see if dormant sprays are needed. Look for holes in covers to estimate level of parasitism.

Control Strategies—Concentrate dormant oil sprays on three- to four-year-old growth to reduce overwintering populations. Spray summer oil in late July to kill newly settled crawlers. Over-fertilization tends to result in increased scale insect populations. Several parasite species are active when the scale crawlers appear in July. Avoid synthetic insecticide sprays at this time.

Orangestriped Oakworm

Identification and Biology—Adult moths are about 1 1/4 inches long with wings closed. They are reddish brown, translucent, with a submarginal dark stripe and a white spot on each forewing. Mature larvae are about 1 1/2 inches long. They are black with eight orange-to-yellow stripes and two black spines behind the head. There are approximately two generations a year in Georgia. Adults first appear in early summer. Pupae overwinter in soil.

Host Plants—This moth caterpillar prefers to feed on oaks, but it also attacks hickory and birch.

Damage Symptoms—The caterpillars are gregarious and the young feed by skeletonizing the leaf surface. Older caterpillars are defoliators and may consume all but the leaf midrib. Defoliation usually occurs one branch at a time when populations are small.

Monitoring Techniques—Look for signs of localized skeletonization turning to defoliation on host tree branches. Where this species is a serious problem, a black-light trap can be used to determine the first adult appearance and the relative size of each generation.

Control Strategies—Manually destroy aggregations of young larvae when they are detected on small trees. Application of Bacillus thuringiensis or horticultural oil will control young larvae. Contact insecticides often are required to control large caterpillars.

Pine Needle Scale

Identification and Biology—Adult female covers are about 1/8 inch long. They are white, oystershell-shaped, and only found on needles. Male covers are similar but smaller. There are two generations a year, with reddish crawlers found in May or June, and July. Red eggs overwinter under scales.

Host Plants—This native armored scale feeds on most needle-bearing conifers, including spruce, fir, pine, hemlock, and Douglas fir. White, Mugo, Scots, and Austrian pines are preferred.

Damage Symptoms—Conifers are tolerant of light infestations of this pest. In heavy infestations, several scales per needle may cause yellowing, stunting, and eventual dieback. Trees along roads and against buildings often suffer severe attacks.

Look for obvious white scale covers on green needles.
Monitoring Techniques—In May and June, turn over scale covers and examine with a hand lens to determine if eggs or crawlers are present. Look for holes in covers that indicate the presence of parasites or predators. Look for active, reddish crawlers and translucent, yellow, settled, and feeding crawlers.

Control Strategies—Many predators and parasites attack this pest. Apply a dormant oil to reduce overwintering populations. Apply a horticultural oil or insecticidal soap when crawlers are present. Application of a long residual insecticide is warranted if no beneficials are found in a scale population that is high enough to cause needle yellowing.

Pine Spittlebug

Identification and Biology—Adults are about 1/4 inch long. They are tan with two irregular whitish bands on each wing. Nymphs are mostly black except for whitish abdomens, and they are covered with frothy honeydew called spittle. There is one generation a year. Eggs overwinter on bark.

Host Plants—This native spittlebug prefers Scots pine, but also attacks pine, eastern white, Virginia, jack, slash, loblolly, Japanese, and Mugo pines, as well as Norway, white, and red spruces, balsam fir, larch, eastern hemlock, and Douglas fir.

Damage Symptoms—Both adults and nymphs suck sap from twigs. This feeding activity may cause twig and branch dieback and even tree death. Some flagging injury is due to the fungus Diplodia pini, which may enter pines through feeding punctures of spittlebugs in hot spring weather.

Monitoring Techniques—Look for nymphs under spittle on twigs in early spring. Look for adults feeding in the same locations in early summer without a covering of spittle. Nymphs are slow-moving and may be collected by hand. Adults are active and may be swept from twigs with an insect net.

Control Strategies—Light spittlebug infestations on small pines may be removed manually. Light infestations have little effect on trees, and chemical control usually is not warranted.

Redhumped Caterpillar

Identification and Biology—Adult moths are about 1 inch long. They are grayish brown with black markings. Fully grown spiny larvae are about 11/4 inches long with many black and yellow longitudinal stripes, a reddish head, and reddish humps on abdominal segments 1 and 8. There is one generation a year. Prepupae overwinter in cocoons in leaf litter.

Host Plants—This native moth is a general feeder attacking plants in the rose family as well as many shade trees, such as poplar, elm, willow, hickory, walnut, sweetgum, persimmon, birch, redbud, and dogwood.

Damage Symptoms—These caterpillars feed together in clusters. When young, they skeletonize the underside of leaves. Older larvae consume leaves to the midrib. On large trees, individual branches may be defoliated. Small trees may suffer complete defoliation.

Monitoring Techniques—Look for the distinctive caterpillars feeding in clusters when branches of host plants show skeletonization beginning in June. Later in the summer, defoliation will become obvious as larger larvae consume leaves.

Control Strategies—On small trees and low branches on large trees, prune out clusters of larvae when they first appear. In heavy infestations, spray young caterpillars with Bacillus thuringiensis or horticultural oil. Use contact insecticides for older larvae.

Rhododendron Borer

Identification and Biology—Adult moths are about 1/4 inch long. The wings are mostly clear and the body is black with three gold abdominal bands. Fully grown larvae are about 1/2 inch long and white with a brown head and five pairs of short ventral prolegs. There is one generation a year. Larvae overwinter in tunnels in branches.

Host Plants—This native clearwing moth prefers to feed on rhododendron, but occasionally attacks deciduous azalea and mountain laurel.

The boring activities of larvae in branches may cause the bark to crack, revealing tunnels and frass. Heavy

infestations girdle branches, causing wilting and eventual branch dieback.

Damage Symptoms—Look for wilting rhododendron leaves and dieback. Prune off suspect branches and dissect them longitudinally to see if larvae are present. Pheromone traps may be used to determine the flight and egg-laying period.

Control Strategies—Prune out and destroy wilting branches in late summer or early spring. Hang a pheromone trap in May and treat branches of host plants with a systemic insecticide when the first males are trapped, usually in early summer.

Rhododendron Lace Bug

Identification and Biology—Adults are about 1/8 inch long. The body is pale yellow. The lacy, transparent wings have two dark spots and are held flat on the back. Nymphs are black and spiny. Eggs are partially buried in leaf tissue along the midvein. Eggs overwinter in leaves and there are four generations a year in Georgia.

Host Plants—This native pest prefers rhododendron species, but occasionally attacks andromeda and mountain laurel.

Damage Symptoms—Nymphs and adults suck chlorophyll from leaves, causing a coarse, yellowish stippling. Both stages deposit black excrement spots that stick to the underside of leaves. In severe infestations, most leaves turn yellowish brown.

Monitoring Techniques—Look for first signs of stippling damage on plants in full sun. Beginning in early spring and continuing throughout the summer, examine plants closely for signs of stippling on older leaves. Examine the underside of stippled leaves for lace bug stages and black fecal spots.

Control Strategies—Horticultural oil or insecticidal soap will provide control if carefully sprayed on the underside of leaves. Time application for early spring when the first generation of the insect is present. Application of a contact or systemic insecticide may be necessary to control heavy infestations that are present late spring through the fall.

Sawflies

Identification and Biology—Adults resemble bees or small wasps. Larvae resemble caterpillars, except they have more than five pairs of abdominal prolegs. Most species have one to two generations a year, and pupae overwinter in soil. Most sawfly larvae are 1/2 to 1 inch long. Most are external feeders on foliage. Some eat needles, some eat entire leaves, while others only skeletonize leaves of shrubs and trees. Cocoons may be formed on foliage, twigs, or in the ground.

Host Plants—As a group, sawflies have a wide host range. They feed on conifers, as well as various oaks, roses, black locust, azaleas, ash, black walnut, elm, and other woody ornamentals.

Damage Symptoms—Most sawflies are gregarious feeders. In light infestations, damage may appear as skeletonization or defoliation on leaves or needles of individual branches or shoots. Heavy infestations may cause complete defoliation of conifers and deciduous trees and shrubs.

Monitoring Techniques—Look for symptoms of localized defoliation or skeletonized leaves on exposed branches and shoots of coniferous and deciduous trees and shrubs. Look for clusters of spotted or striped larvae in the vicinity of damage symptoms.

Control Strategies—Small infestations may be manually removed and destroyed. Large infestations of young larvae may be sprayed with horticultural oil. Nearly mature larvae may be sprayed with a contact insecticide. Sawfly larvae are not caterpillars; Bacillus thuringiensis formulations for caterpillar control will not affect these pests.

Southern Pine Beetle

Identification and Biology—Adults are about 1/8 inch long. They are reddish brown to black, cylindrical, with a median vertical groove in the front of the head. Fully grown larvae are about 3/16 inch long. They are white, legless grubs with reddish-brown heads that feed in S-shaped galleries under bark. Larvae overwinter in galleries under bark of dying pines, and there are three to nine generations a year, depending on the length of the growing season.

Host Plants—This native bark beetle prefers shortleaf, loblolly, Virginia, and pitch pines. Other yellow pines may be attacked, as well as eastern white, red, and spruce pines, and red and Norway spruce.

Damage Symptoms—When adult beetles bore into pines to lay eggs, vigorous trees repel them with white liquid pitch. Unhealthy trees produce a dryish yellow pitch that forms tubes. Tree crowns turn yellow, then reddish brown as they die from effects of larval girdling and the introduction of a blue stain fungus carried by the adult beetles.

Monitoring Techniques—Examine the trunks of mature pines from May through September for holes in bark exuding white, sticky pitch or dry, yellowish pitch tubes, especially in stressed yellow pines over 15 years of age. Scan the crowns of pines in nearby woods for yellowing and dieback to anticipate a bark beetle attack on landscape pines. Use the oldest, most stressed pines as indicator trees to monitor.

Control Strategies—Maturing pines should be protected from stress factors like drought, flooding, disease, crowding, and site disturbance. Heavily infested and dying pines should be destroyed immediately to reduce beetle reproduction. Spray healthy pine trunks with a residual insecticide at the first sign of pitch tube formation, which usually begins in May.

Southern Red Mite

Identification and Biology—Adults are 0.5 mm long, oval, purplish, or reddish, with eight legs. The red eggs overwinter on the undersides of leaves. There are several generations each year. Most activity occurs in spring and fall.

Host Plants—This imported spider mite has a wide host range, but prefers broad-leaved evergreens. It is common on azalea, rhododendron, mountain laurel, holly, rose, viburnum, firethorn, and yew.

Damage Symptoms—In light infestations, sap sucked from leaves results in white stippling usually concentrated along the midrib on the lower leaf surface. In heavy infestations, stippling is produced on upper and lower leaf surfaces, and leaves turn gray or brown and die. Lower leaf surfaces often appear dusty because of the numerous egg shells and shed skins.

Monitoring Techniques—Examine plants closely for signs of stippling and the various mite stages on the lower and upper leaf surfaces of broadleaved evergreens in early spring and the fall. When stippling is noticed, tap leaves over white paper to dislodge and count mites, as well as the beneficial insects and predaceous mites. Predaceous mites have longer legs than the southern red mite and move much faster. Look for red overwintering eggs on the lower surface of leaves from November through early spring.

Control Strategies—Application of a dormant oil to the lower surface of leaves when overwintering eggs are numerous will help reduce spring populations. In light infestations, the use of a horticultural oil or insecticidal soap will control these mites with minimal impact on beneficial organisms. When heavy infestations of mites are present, the application of residual miticides often is necessary.

Spruce Spider Mite

Identification and Biology—Adults are about 0.5 mm long. They have eight legs and are yellowish-green when young. When mature and fully fed, they are grayish-black with a tan area behind the mouthparts. Immature forms are smaller and lighter in color. Eggs are oval to circular and reddish brown. There are several generations a year. Eggs overwinter on bark and needles.

Host Plants—This cosmopolitan pest prefers spruce, pine, hemlock, and arborvitae. Cedar, yew, larch, cryptomeria, dawn redwood, fir, Douglas fir, and false cypress also may be attacked.

Damage Symptoms—These spider mites suck chlorophyll from needles, leaving minute yellowish stipples or flecks at the feeding sites. In heavy infestations, the stipples coalesce and needles turn yellow, then brown. Small trees may be killed, and large trees may suffer dieback. Most damage occurs during the cooler temperatures of the spring and fall.

Monitoring Techniques—At the first sign of stippling on needles, tap branches over white paper and count the dark, slow-moving spider mites. Note the presence of white, fast-moving predatory mites and the minute, black lady beetle mite predators. Concentrate monitoring activities from March through June and September through November.

Control Strategies—Spraying is not recommended unless stippling damage exceeds ten percent of green foliage; more than ten spider mites, on the average, are tapped from a tree's branches; and beneficial mites and beetles are not found in all branch samples. Use dormant oil sprays when overwintering eggs are abundant. In the growing season, use summer oil or insecticidal soap sprays if predator populations are present.

Thrips

Identification and Biology—Adult thrips are tiny (1/20 inch long), slender insects that have long fringes on the margins of their wings. Adults are commonly yellowish or black and shiny. Nymphs are clear to yellowish and smaller than adults. Females lay eggs within leaf tissue or in curled, distorted foliage caused by feeding nymphs and adults. Thrips have several generations per year.

Host Plants—Thrips attack a wide range of herbaceous and woody landscape plants.

Damage Symptoms—Feeding from adults and nymphs can stunt growth and cause leaves to become stippled and distorted. Infested terminals can become discolored and drop leaves prematurely. Thrips can cause blotches on flowers and in severe infestations buds are distorted and may abort. Thrips can transmit diseases to plants.

Monitoring Techniques—Monitor for thrips by beating branches or shaking foliage or flowers onto a sheet of paper. Adult populations can be monitored using bright yellow or blue sticky traps.

Control Strategies—Healthy woody plants can usually tolerate thrips damage. Provide cultural care to keep plants vigorous. Prune and destroy infested terminals, flowers and buds when possible. When heavy infestations of thrips are present, the application of contact or residual insecticides is often necessary.

Twolined Spittlebug

Identification and Biology—Adults are about 1/4 to 1/2 inch long, smoky brown to black in color, broadly oval, convex, with prominent eyes. They have two bright orange stripes across their wings. Adults sometimes are called froghoppers. Nymphs are smaller, usually pale greenish-yellow, and covered by frothy bubbles called spittle. Two generations occur per year.

Host Plants—The immature stages are found in turfgrass and adults may be found on numerous woody ornamentals, especially hollies.

Damage Symptoms—Both nymphs and adults may feed on plant sap. Their feeding destroys plant tissue, causing stunting, distortion, and death of tissues.

Monitoring Techniques—Look for the frothy spittle masses in turf beginning in early spring. The second generation of nymphs usually appears in late summer. Look for active adults beginning in early summer. The second generation of adults usually appears in September.

Control Strategies—Don’t allow a heavy thatch layer to accumulate in the lawn. Avoid locating host plants that attract adults, especially Japanese holly, near susceptible turfgrasses. Time insecticide treatment to heavily infested areas of turf for July. Mow and irrigate the grass several hours before applying treatment late in the day.

Twospotted Spider Mite

Identification and Biology—In the growing season, adults are about 0.7 mm long - a little larger than a period on a page. They have one oval body segment with eight legs. They are greenish-yellow with a black spot on each side of the body. Eggs are white to yellow. Reddish-orange adult females overwinter in bark cracks.

Host Plants—Spider mites have a very broad host range. They feed on conifers (see spruce spider mite, above), deciduous trees and shrubs, as well as herbaceous plants.

Damage Symptoms—Spider mites suck leaf juices, causing minute white-to-yellow stipples to appear. When large spider mite populations feed, the stipples coalesce and leaves may turn white to yellow to grayish-brown and then die. Some plants are particularly susceptible to spider mite toxins, and even low populations may cause leaves to die.

Monitoring Techniques—Look for early signs of stippling with the beginning of hot summer weather. Examine the underside of damaged leaves or tap them over white paper and look for spider mites with two spots on the body. Also look for predators, such as phytoseiid mites and lady beetles, and note their relative abundance in relation to the number of mites present.

Control Strategies—In dry, hot, sunny locations, this spider mite may produce one generation a week. Use horticultural oil or insecticidal soap sprays for low mite populations to conserve any beneficials present. When damage becomes objectionable, mite populations are high, and there are no beneficials, consider using a residual miticide spray. Reevaluate in one week.

Wax Scales

Identification and Biology—Adult females are about 1/4 inch long and reddish. They are covered with a gummy, white wax that looks like a dunce cap. Immatures resemble cameos with the developing areas of white wax not yet completely covering the reddish body. There is one generation a year. Adult females overwinter on bark.

Host Plants—Wax scales feed on many shrubs and trees, but Japanese holly, Chinese holly, euonymus, boxwood, firethorn, spirea, barberry, and flowering quince are preferred.

Damage Symptoms—Light to moderate infestations may produce nuisance levels of honeydew and sooty mold. Heavy infestations may cause early leaf yellowing and premature leaf drop. Plants become unthrifty with leaves confined to terminals. Eventually dieback occurs.

Monitoring Techniques—Large numbers of foraging bees, wasps, hornets, and ants on dense shrubs may indicate wax scale. Look for honeydew and sooty mold. Look on twigs and small branches for all wax scale stages. Crawlers begin hatching in early summer in Georgia.

Control Strategies—Beginning in May, examine female wax scales on leaves and branches every one to two weeks and determine when eggs begin to hatch. Remove heavily infested twigs or branches. Infested twigs and branches must be sprayed thoroughly with horticultural oil, insecticidal soap, or a contact or systemic insecticide may be used after egg hatch and when crawlers are present on the plant to achieve effective control.

Whiteflies

Identification and Biology—Adult whiteflies range from 1/16 to 1/8 inch in length. Most species resemble tiny white moths. Identification is easiest using the scale insect-like pupal stages.

Host Plants—Whiteflies have numerous hosts, including rhododendron and azalea, ash, dogwood,sycamore, sweetgum, honey- and black locust, barberries, redbud, roses, and herbaceous plants like hibiscus and verbena, among others.

Damage Symptoms—Medium infestations may produce objectionable levels of honeydew and sooty mold. Heavy infestations may cause leaves to turn yellow and drop prematurely. All stages feed on the underside of leaves.

Monitoring Techniques—When honeydew, sooty mold, or leaf yellowing is observed, examine the underside of leaves for feeding adult and immature stages of whiteflies. Ants foraging on leaves may indicate the presence of whiteflies.

Control Strategies—Rake up and destroy fallen leaves. If honeydew or damage are objectionable, spray the underside of leaves with soap or oil to conserve beneficials. Remove heavily infested leaves. Predators and parasites usually keep these pests at low levels in the landscape.

White Pine Weevil

Identification and Biology—Adults are about 1/4 inch long. They are oval and brown with a long snout and two white spots that often run together on the back of the wing covers. Larvae are about 1/8 inch long. They are C-shaped, legless, and white with brown heads. There is one generation a year. Adults overwinter in duff under trees.

Host Plants—This native bark weevil may feed and breed in many native and exotic pine and spruce species.

Damage Symptoms—Adults chew holes to feed on leaders near terminal buds, causing pitch flow. Eggs are laid in holes and the resulting larvae bore in the leader, causing it to stunt, flag, and die. Small trees may be killed. Large trees develop irregular forms.

Look for adults feeding and laying eggs within 12 inches of terminal buds on pines and spruces from March through May.

Monitoring Techniques—Look for infested terminals beginning to flag in June, forming a characteristic “shepherd’s crook.” Remove and split terminals to be certain weevil larvae, and not diseases, are the problem.

Control Strategies—Prune out and destroy flagging terminals on small trees in June. In heavy infestations, spray terminals in March or April with a residual insecticide when adults are feeding, but before they begin laying eggs.

DISEASES OF ORNAMENTALS

Introduction

Plant disease is defined as any deviation from normal plant functions. Disease, therefore, can be caused by “biotic” or “abiotic” agents. However, traditionally plant diseases are caused by biotic agents called pathogens, whereas disorders are caused by abiotic agents. Abiotic disorders are those problems not caused by a biological organism and often result from poor site preparation and soil drainage, poor or excessive fertilization or irrigation, or chemical damage such as misapplied pesticides or salt uptake. Diseases on the other hand are biotic, and are the result of biological agents called pathogens, including fungi, bacteria, nematodes, viruses, and phytoplasmas.

This section will describe general ornamental diseases, as well as outline diseases commonly found on woody and herbaceous landscape plants in Georgia. Ornamental plants in the landscape are subject to many diseases. However, in order for a disease to develop, three components are absolutely essential. These include: 1) a susceptible plant (referred to as a "host plant"), 2) a virulent pathogen (one that is capable of causing disease on the host plant), and 3) a favorable environment for disease development. These three components are often referred to as the "disease triangle." Time also is an important component since disease development usually requires a pathogen to be present on its host for a period of time in a conducive environment before infection takes place. For example, for leaf-spotting fungi to infect susceptible leaves, water must be present on the leaf surface for several hours. If water is not present for the required time, infection does not take place. See the chapter on Basic Plant Pathology for more information on disease development.

When diagnosing plant diseases, act like a detective. Don't limit yourself to looking only at blighted or discolored leaves. Look at the surroundings that the plant is growing in. Ask yourself questions like: Does the soil feel very wet or dry? When did it last rain or when was the last watering? Is the problem affecting the whole plant or just a few leaves? Is the problem affecting both sides of the leaf? Is there a pattern to problem? Does it affect all plants equally or only a few? Answers to questions like these give you clues to the problem and help you formulate disease control recommendations. In general, abiotic disorders will have very uniform symptoms. The whole plant will be affected or the entire leaf margin will be discolored. Diseases typically show random symptoms. Spots are randomly distributed on the leaf surface or only a few leaves or branches are affected.

This chapter addresses, separately, the effect of host, environment, and pathogen on common disease problems, as well as describes symptoms associated with specific pathogens and gives general control recommendations for commonly seen woody and herbaceous ornamental diseases.

Host Plant

A "happy" plant is a healthy plant. A plant growing under ideal conditions that meet its specific growth requirements is less likely to have a disease (or disorder). Plants that are stressed such as those planted out of its USDA hardiness zone or is planted in the wrong location (too little or too much light or water), as well as injured plants from improper pruning or lawnmowers are more susceptible to diseases because the plant's defenses are weakened and injuries provide a direct entry point for a pathogen into the plant.

A general decline of a plant such as yellowing leaves, thinning foliage, reduced flowering or growth (stunting) may be the result of improper site location or root problems including root rots and nematodes. Often the problem cannot be correctly diagnosed without digging the plant. Sometimes sacrificing one plant may save many, and if the plant is not diseased, it can be replanted.

Some plants also are more susceptible to infection than others. In selecting vegetables, many seed catalogs list whether a particular cultivar is resistant to a disease. Unfortunately with ornamental plants, selection and breeding of cultivars is often based upon flower color, flower size, or other aesthetic qualities rather than disease resistance, but this is changing. For example, there are many crape myrtle and phlox cultivars that are resistant to powdery mildew disease, the primary disease problem on these two hosts. Look for disease resistance information on plant tags and labels when shopping for new plants. Planting a disease resistant plant is the easiest was to avoid or lessen disease problems in the landscape.

Environment

Again, a "happy" plant is a healthy plant. Everything mentioned in the host section can be restated here. In addition, providing plants with proper horticultural needs such as fertilization, water, and pruning will reduce the risk of disease. See specific sections on plant care throughout this book.

Most pathogens require moisture to infect plant tissues. Therefore, anything that reduces the length of time water is present on leaves or roots will reduce pathogen infection. For ornamentals, improving ventilation around plants by selectively pruning or thinning branches of woody ornamentals and increasing plant spacing of herbaceous ornamentals will enable wet plant tissue to dry rapidly. Also, manipulating the environment by watering early in the day so that plants have plenty of time to dry before nightfall reduces the length of time the leaves may be wet and reduces disease.

For root diseases, improving drainage will reduce the risk of developing root rot and nematode damage. Drainage in heavy clay soils can be improved by placing drainage tile under gardens to redirect and remove water or by incorporating pine bark mulch into the soil. The ratio of pine bark to soil should not exceed 25-30% (1 part pine bark to 2-3 parts soil).

Other organic amendments such as compost and peat moss also can be used, however, their beneficial effects on improving soil porosity and drainage is short-lived and requires incorporation on a yearly basis.

Another observation to be aware of is that plants will often show the same symptom for opposing environmental conditions. For instance, a plant may wilt if it receives too little or too much water. Root rot disease develops when soils are overly wet. The disease collapses the root, so the roots cannot absorb and translocate water through the plant. Therefore, the plant wilts. If you water the wilting plant thinking that it is wilting because it is dry, you would actually be increasing the spread and development of the root rot disease. Be aware of the plant's environment. Don't just treat the symptom, treat the cause for the symptom.

Pathogens

Fungi, bacteria, nematodes, viruses, or phytoplasmas can be pathogens of ornamentals. Many are ubiquitous and are naturally found in soil, vectored by insects or carried on the wind. If environmental conditions favor the pathogen on a susceptible host, disease develops. Other pathogens are introduced via planting of infected plants or re-use of contaminated soil.

Fungi

The most common pathogens of ornamentals are fungi. Symptoms caused by fungal infections are leaf spots and blights, petal blights, cankers, vascular wilts, and root and crown rots. Fungal spores (the fungal reproductive unit capable of infecting and causing disease) are disseminated over long and short distances by air movement (wind) and splashing water either from rain or sprinklers.

Fungal leaf spots and blights are favored by leaf wetness and high humidity. A variety of fungi can cause leaf spots including Alternaria, Septoria, and Cercospora. Some common leaf spot diseases of ornamentals are black spot of rose (caused by Diplocarpon rosae) and spot anthracnose on dogwood (caused by Elsinoe corni). Typically, fungal leaf spots have a tan to gray center surrounded by a darker reddish, brown or black border. They may be concentrated along the leaf margin and veins. Often the spots will grow together (coalesce), sometimes forming concentric rings of dead, brown tissue. Within the dead tissue, black pimple-like fungal fruiting bodies can sometimes be seen. Leaf spots are termed "blights" when the entire leaf or stem is affected. Often infected leaves drop prematurely. Leaf-spotting pathogens survive on fallen leaf litter and on dead branches or cankers. Leaf spot diseases rarely kill infected plants, however, they can be aesthetically displeasing.

Powdery mildew is another type of fungal leaf blight. It is probably one of the most troublesome diseases of ornamentals. Plants are rarely killed, but it can cause premature defoliation under high disease pressure. Powdery mildew diseases look the same regardless of host, but the fungi are host specific, meaning that a powdery mildew pathogen on rose is specific to rose and will not infect crape myrtle and vice versa. Leaves develop patches of frosty, white fungal growth primarily on the upper leaf surface and stem. Often the infected tissue is distorted and discolored. Unlike other fungal leaf pathogens, powdery mildew fungi are not favored by wet leaves. Instead symptoms occur under dry conditions in mid to late summer and when humidity is high with warmer daytime and cooler nighttime temperatures.

Rust fungi also cause leaf spots and blights. Pale yellow spots appear on the upper leaf surface while pustules containing rusty, reddish-brown powdery spores break through the lower and sometimes the upper leaf surfaces. These spores are easily rubbed off with your fingers or paper. Pustules develop as individual spots or as concentric rings similar to a bulls-eye pattern in which an inner pustule is surrounded by an outer ring. This type of ring pattern symptom is especially prominent on geraniums, zinnias, and snapdragons. Rust fungi are host specific. Rust also can be "autoecious" or "heteroecious." Autoecious rusts are those that produce all their spore stages on one host, such as rose, geranium, or snapdragon rusts. Heteroecious rusts are those that produce their spore stages on two different host plants; a primary and an alternate host. For example, cedar-apple rust produces leaf spots and pustules on apple and crabapple (the alternate host), but produces hard, gall-like structures on cedars (the primary host). In the spring, the cedar galls rupture producing orange, jelly-like extensions (similar to tentacles) which release spores that infect apples and crabapples. The spores produced on the apple are then released to re-infect cedars during the summer months. These rusts have very complicated life cycles, but are truly very interesting and fascinating pathogens.

Petal blights are primarily caused by the fungus, Botrytis spp. The gray, fuzzy fungus often found covering old strawberries is Botrytis and is the same fungus that infects leaves, stems, and flowers of numerous ornamentals. This fungus is favored by wet, humid conditions, and under these conditions, the fungus produces an abundant amount of grayish,

fuzzy spores that are easily seen and spread by water, wind, and human activity in the garden. Blighted flowers have darkly colored spots that appear water-soaked. Eventually, the flowers disintegrate. Other petal blights are common on landscape azaleas and older plantings of camellia. These blights cause the flowers to brown and disintegrate shortly after blooming. Hard, black fungal structures (sclerotia) are produced that can be easily seen embedded in the blighted petals.

Cankers are dead portions of plant stem tissue. When the canker is at the end of a branch or shoot, it is referred to as "dieback." Cankers are brown or blackened areas that become shrunken with time as the healthy adjacent tissue grows around it. Within old cankered tissue, black pimple-like fruiting bodies are often seen. Both bacteria and fungi cause cankers. These pathogens enter the stem through wounds made by hail, insects, or mechanical damage from pruning and lawnmowers. As the canker grows, stems are girdled, which causes wilting and death of the tissue above the canker. A common fungal canker is "Bot" canker caused by the fungus, Botryosphaeria, that infects numerous hosts, in particular leyland cypress and rhododendron.

Vascular wilts occur when the vascular (water- and nutrient-conducting) tissues are infected by fungi and sometimes bacteria. Obvious symptoms of these diseases are wilting because of water stress caused by the pathogen or its by-products produced during the disease process which cause blockages in the water-conducting vessels of infected plants and death of plant sections. Other foliar symptoms include yellow or scorched leaves and stunting. Sometimes, as with the fungus Verticillium spp., wilt pathogens infect the root and move upward to the leaves producing symptoms that appear on only one side of the plant or on one half of a leaf. A lengthwise cut across infected stems shows dark streaks within the vascular tissue. These pathogens are often introduced into gardens from infected plants. Symptom expression is favored by plant stress associated with high temperatures and drought.

Root and crown rots are caused by numerous soil fungi including Pythium, Phytophthora, Rhizoctonia, and Sclerotium. These fungi have broad host ranges, meaning they are capable of infecting a wide variety of herbaceous and woody ornamentals. Most of these pathogens are favored by cool, wet soil conditions. Pythium and Phytophthora are classified as "water molds." These pathogens produce a motile spore (zoospore) that can swim in water. The fungi inhabit soil naturally, and under stressful conditions for plant growth such as over watering, over fertilization, and poor soil drainage they infect the feeder roots. Roots are discolored brown or black. Often small feeder roots are sloughed-off greatly reducing the plant's ability to uptake water and nutrients. Above-ground foliar symptoms are similar to those produced by an unhealthy root system such as yellowing of older leaves, stunting, and general decline of the plant. Often root rot symptoms mimic nutritional deficiencies.

Bacteria

Bacteria are single-celled microscopic organisms. Symptoms caused by bacterial pathogens are leaf spots and blights, cankers, and soft rots. Bacteria are disseminated by splashing water, insects, pruning tools, and human activity in gardens. In most cases, bacterial diseases are more serious in hot weather because high temperatures favor bacterial growth. Generally, fungi are most active in cooler weather such as in the spring and fall.

Bacterial leaf spots are not easily distinguished from fungal leaf spots by visual examination. Bacterial infections are characterized as "water-soaked" spots. Often brown, dead leaf spots will be surrounded by darker water-soaked tissue. Yellow halos sometimes border the spot margin. Spots, tan to black in color, can be irregular in shape along leaf margins or angular and contained within leaf veins. Some of the most common bacterial pathogens are Xanthomonas campestris causing leaf spots on zinnia, begonia, oak-leaf hydrangea, and geranium and Pseudomonas spp. causing leaf spots on delphinium, poinsettia, and impatiens.

Bacterial cankers can occur on woody landscape plants. The most common bacterial canker is fireblight caused by Erwinia amylovora. This disease commonly affects flowering pear, crabapple, quince, cotoneaster, Photinia, Indian hawthorne, and pyracantha during warmer, wet conditions in the spring. Wetwood or slime flux also is a bacterial disease that is characterized by sweet-smelling, sometimes bubbly, ooze from older tree trunks. The disease develops as a result of an internal heart rot. Secondary organisms, including yeasts and bacteria, colonize the internal cavity and their metabolic activity creates gas pressure that is released through a wound or crack in the tree. Sap then flows from the crack, often staining the tree trunk as it runs down the tree over time.

Bacterial soft rot is another common disease on rhizomatous or bulbous herbaceous ornamentals including iris, hosta, and daylily. Soft rot is caused by the bacterium, Erwinia carotovora. The bacterium quickly dissolves the rhizome, bulb or corm in

warmer, wet conditions. The infected, soft tissues often produce a diagnostic foul, “dead fish” odor.

Nematodes

Nematodes are microscopic, non-segmented roundworms. Plant parasitic nematodes usually feed on plant roots, however, some such as the foliar nematode (Aphelenchoides spp.) feed on leaf and stem tissue. Symptoms of nematode infestation in the roots are similar to root rots and include stunting, wilting, yellowing of leaves, and nutritional deficiencies. The most easily diagnosed symptom of nematode infestation is galls or knots on the roots caused by the root-knot nematode, Meloidogyne spp. Another major nematode pathogen of ornamentals, especially boxwoods, is the root lesion nematode, Pratylenchus. The feeding of this nematode causes dark brown to black lesions on the secondary roots, often killing the root system. Leaf symptoms of foliar nematode infestations include wedge-shaped dead areas bordered by the leaf veins that initially appear reddish or yellowish, but turn brown as the tissue dies. Removal of infected leaves reduces the spread of the nematode within the plant and to adjacent plants.

Nematode control is difficult since infestations often go unnoticed until symptoms are severe. There are no chemical (nematicide or fumigant) control alternatives for landscape garden beds. These products are highly toxic and it is illegal to use the products in residential areas. The best control is to avoid the problem by purchasing healthy, vigorous plants and providing good horticultural conditions that meet the plant’s needs. Some plant cultivars are less susceptible to nematodes and should be used if nematodes, particularly root-knot nematodes are established in a landscape. Dwarf yaupon and inkberry hollies (Ilex vomitoria and I. glabra, respectively) can be used as a replacement for the very root-knot nematode-susceptible boxwood or Japanese holly (I. crenata).

Viruses

Viruses are particles of protein and genetic material (RNA and DNA) that are so small that they cannot be seen with ordinary light microscopes. They live and reproduce within living plant cells. Viruses are spread via infected plant material, seed, man, and insect vectors such as aphids, thrips, and leafhoppers. Some viruses have a wide host range, whereas others may only infect one or two hosts. Some of the more common viruses in ornamentals are tobacco mosaic virus (TMV), tomato spotted wilt virus (TSWV), impatiens necrotic spot virus (INSV), and cucumber mosaic virus (CMV). Symptoms of virus infection are easily distinguished from other biotic diseases, but are often confused with abiotic disorders such as herbicide injury or nutrient imbalance. Typical foliar symptoms are mosaic, mottle, or ring spot patterns on the leaf where bright yellow or white areas within the leaf are bordered by darker than normal green areas. Leaf and stem distortions such as cupping and twisting of leaves and thickening of leaf veins also are common symptoms of virus infection that can be confused with 2,4-D or other growth-regulating herbicide damage.

Once a plant is infected with a virus, any new plants vegetatively propagated from it will carry the same virus. In addition, a virus-infected plant in a garden is the source of inoculum for future spread of the virus by insect vectors. Removal of infected plants and controlling insect pests are the only ways to control the spread of the viral pathogens.

Phytoplasmas

Phytoplasmas are similar to bacteria in shape and structure, but cause virus-like symptoms in plants. The most common phytoplasma affecting ornamentals is aster yellows. Aster yellows is vectored by a leafhopper. Symptoms are often dramatic yellowing and proliferation of adventitious leaf and stem buds into a bushy “witches-broom.” Flowers also are affected and show the most obvious symptoms, including small flowers and petals that are partially or wholly green. Control of phytoplasmas is the same as for viruses; remove and destroy infected plants as soon as they appear and control insect pests.

Cultural Disease Control

Prevention—The first step in controlling diseases of ornamental plants is to prevent the disease from developing. Prevention is the key. Purchase only healthy plants from reputable dealers, practice the good horticultural methods discussed elsewhere in this publication, and avoid environmental conditions that favor disease development. If pathogens are favored by wet leaves and high humidity like bacteria and fungi, reduced the amount of time water is present on leaf surfaces by avoiding overhead sprinkler irrigation and directing water to the base of the plant. Watering in the morning or earlier daylight hours allows plant surfaces to dry quickly and reduces the likelihood of plants having wet leaves in the evening or overnight. Humidity can be reduced by increasing air circulation around plants through increased plant spacing, thinning of overgrown areas, and trellising. Selectively pruning lower branches to allow air circulation within the plant canopy can greatly reduce leaf spot diseases.

Improving soil drainage by installing French drains (tiling) or incorporation of organic material will reduce the risk of developing root and crown rots and nematode problems. Avoid replanting in areas where these diseases have been a problem. Redesigning the garden and replanting these areas with grass may reduce disease and alleviate frustration on the part of the homeowner.

Rotation of plants, such as different flowering annuals, from year to year can reduce the build-up of host specific pathogens. Also, use resistant plant varieties where available. Many plants have powdery mildew, rust, and virus resistance bred into them. Fireblight can be reduced by planting resistant crabapple and pear varieties. In addition, control insects and weeds. Insects vector many diseases and weeds can be infected by the same pathogens on ornamentals and serve as a reservoir of inoculum for future infections.

Good care of ornamental plants will prevent many growth difficulties. Remember that perennials (vines, shrubs, and trees) live for many years and their susceptibility to disease is influence by climatic and environmental conditions, both past and present. Improper management, abuse (from lawnmowers, compaction, or construction injury), and lack of care (water and fertilizer) are the most important factors that contribute to plant decline and disease development. Many problems can be traced back to earlier abuses such as improper site location and preparation, planting too deep (plants should be planted no deeper than what they are growing in the root ball or container), or natural or man-made wounds to the stem or roots.

Sanitation

Sanitation is another key component in disease control. Removal and destruction of infected plant material, either infected leaves or whole plants, as soon as it is detected will reduce disease spread. Collection and removal of fallen leaf litter in the fall also reduces disease potential for the following year. Composting of severely infected material is not recommended for the home gardener unless the compost pile is properly cared for and it reaches temperatures in excess of 140° F.

Prune out dead or cankered branches. Make cuts at least 3 to 4 inches below the extent of the canker into healthy tissue for fungal cankers and at least 8 inches below the canker for bacterial cankers like fireblight. Disinfest pruning tools between each cut by dipping the tool in 70% rubbing alcohol or a 1 part household bleach to 9 parts water solution for 10 seconds or spraying liberally with Lysol disinfectant spray. Immediately wash metal tools after use when using bleach as bleach can damage and discolor the tools.

When propagating or dividing plant material, take cuttings from healthy, non-infected plants. Cut and remove any diseased or discolored portions. Tubers, corms, rhizomes, and bulbs should be inspected before planting and storage for signs of infection. Rotted and diseased corms and bulbs should be discarded. Rotted sections of rhizomes and tubers can be cut away and wounded areas should be treated with a fungicide dust. Store bulbs, etc. in a cool, dry place.

Always use fresh potting mixes when repotting plants. Never re-use old mixes since they may be contaminated with soil pathogens. Package, soil-less potting mixes cause the least amount of disease problems. Natural soils contain numerous fungi and bacteria that may initiate disease under the right environmental conditions. Disinfest all old pots, flats, and other supplies with a bleach solution (1 part bleach in 9 parts water) before re-use. Change solution every 30 minutes if disinfesting a large number of pots because the chlorine in the bleach volatilizes and the solution loses its effectiveness over time.

Chemical Disease Control

Home gardeners have few alternatives for chemically controlling plant diseases. Prevention and sanitation are the most practical approaches to disease control. Chemicals are not available for control of most bacteria, nematode, virus, and phytoplasma diseases. Fungicides for controlling fungal pathogens are the most widely available chemicals. Copper-containing fungicides (copper sulfate or Bordeaux mixture) have some activity against bacterial pathogens. In some cases fungicide application may be worthwhile, but for the home gardener, generally the cost of application exceeds the plant's value. If fungicides or any other pesticide are used, be sure to read and follow the pesticide label precisely. Do not apply more chemical than recommended. The "aspirin" approach where "one tablespoon is good, but two is better," does not apply for pesticides. Over application of some chemicals can injure plants or even kill them. Consult your local county Extension agent for specific chemical disease control recommendations.

Fungicide Classification—Fungicides are classified as either "protectant" or "systemic." Protectant fungicides including Captan, chlorothalonil (Daconil 2787), and mancozeb are applied before infection occurs when conditions are favorable for disease development. These products remain on the leaf surface, they do not penetrate into the leaf tissue, and therefore can be

washed-off by rain or sprinkler irrigations. These products must be reapplied often, generally every 7 to 10 days. Complete coverage of the plant foliage is essential in protecting the tissue from infection. Systemic fungicides such as triadimefon (FungAway) or myclobutanil (Immunox) are applied before infection occurs when conditions favor disease development or at the first sign of infection. Systemics enter into plant tissue. These products, however, cannot move throughout the entire plant. They are locally systemic, meaning that the fungicide sprayed onto a leaf will move through that leaf, but it is unlikely that it will move into adjacent leaves. Therefore, thorough covered of the plant material is necessary. Because the fungicides are within leaf tissue, they are not reapplied as often as protectant fungicides, usually every 14 days.

Fungicide Formulations—Fungicide formulations for ornamentals are either sprays or dusts. In general, fungicide sprays are superior to dusts for foliar application and disease control. Sprays provide better coverage, are less likely to drift, and stay on the plant longer. Dusts do give protection, but they are less effective because they don't adhere as well to the plant surface and are more difficult to target accurately. Most fungicides for the home gardener are purchased as prepared mixtures and need no further mixing. Others are concentrated and the user must mix the proper amount of fungicide with water.

Preparing Fungicide Solutions—When preparing a wettable powder for spraying in a compressed air or pump-type applicator, first place the required rate of fungicide into a quart jar half filled with water. Make a homogenous slurry. Next pour the slurry into the sprayer tank containing 3/4 of the necessary water volume; then top off the tank with the necessary amount of water. Shake tank thoroughly before spraying and agitate it frequently while spraying to keep the fungicide in suspension. Apply to foliage until it drips off; cover all surfaces. Make only enough fungicide solution as you will use because, once mixed, the fungicide cannot be stored. Discard the remainder of the unused fungicide in accordance with the pesticide label recommendations. The entire sprayer should be cleaned after use by triple rinsing. Do not use the same sprayer for fungicides and herbicides. Herbicide residues can remain in the sprayer and can injure plants.

For mixing fungicides for hose-end applicators, place the required amount of fungicide and a small amount of water into the reservoir jar of the applicator. Stir until thoroughly mixed. Fill the unit to the desired volume, agitate, and spray according to directions. Keep mixture agitated during spraying. After use, clean and store properly.

For root and crown rot pathogens, fungicides need to be applied to the soil. This can be done using soil drenches or granules or dusts. Dry fungicide formulations (dusts or granules) are incorporated into the soil with a rototiller. Drenches are mixed by adding the required amount of fungicide and water in a bucket. Create a small dike 3 to be 4 inches high around the bed area or just beyond the leaf drop zone (drip-line) of the plant and pour the fungicide solution over this area. This dike should help to be keep the solution within the desired area. Fungicides to control root rot diseases are often not packaged in small quantities for home use, and therefore are generally not recommended. Root rot diseases can be effectively controlled by changing the environmental conditions that are favoring the root rot disease such as over watering and poorly draining soils.

Fungicide Timing—Timing of fungicide applications is an important component in chemical disease control. Fungicides are applied when conditions favoring disease development are present. They protect plants from becoming infected and therefore must be present before infection occurs. Fungicides do not have any curative activity. A diseased leaf will never recover from infection. For example, fungicides applied after powdery mildew is present on a leaf will not return the leaf to be its original green color. The leaf and the resulting white fungal growth will remain unchanged. All fungicides can do, if applied after infection takes place, is to be protect new growth from becoming infected. So, the plant with the existing powdery mildew infection will show symptoms of powdery mildew on lower, older leaves, but most likely the newer, upper leaves will not be infected.

Rainy, foggy, warm, humid weather conditions generally favor disease development. Whenever possible, spray schedules should be adjusted to be provide fungicide protection before rainy periods and fungicides should be reapplied after heavy rains.

REMEMBER WHEN USING ANY PESTICIDE
1. Observe all directions, restrictions, and precautions on pesticide labels.
2. Store all pesticides in original containers with labels intact and behind locked doors. Keep pesticides out of the reach of children.
3. Use pesticides at correct label dosage and intervals to avoid illegal residues or injury to plants.
4. Apply pesticides carefully to avoid drift or contamination of non-target areas.
5. Dispose of surplus pesticides and containers in accordance with label instructions.

General Diseases Common to Many Plants.

DISEASE	SYMPTOM DESCRIPTION	SUGGESTED PRACTICES FOR CONTROL
A. Fungal leaf spots (Septoria, Cercospora, Alternaria)	Randomly distributed definitive spots on leaf surfaces. Spots have a tan to gray center with a darker border; fungal fruiting structures seen within center of spot.	Use protective fungicides when disease symptoms are first seen. Promptly remove and discard diseased leaves. Severely diseased plants should be discarded. Keep leaf surfaces dry, especially at night.
B. Root and stem rot (fungi; Pythium, Thelaviopsis, Rhizoctonia, Phytophthora)	Plants wilt; blackish discoloration of lower stems. Roots are soft and appear light to dark brown. Stems may pull easily from the crown.	Improve soil structure and drainage by incorporating compost, pine bark or other organic material. Avoid setting transplants too deeply. Do not over water or over fertilize plants.
C. Vascular wilts (bacteria and fungi: Fusarium, Verticillium)	Sudden wilting or slow stunting of plants. Vascular tissue is usually discolored brown; can be seen by cutting across stem.	Follow proper sanitation practices. Use either sterile soil or soil-less media. Avoid splashing water. Select resistant cultivars if available.
D. Powdery Mildew	White to gray powdery patches on leaves, flowers, and new growth.	Lower humidity by increasing air circulation around plants; increase plant spacing. Spray with a protectant fungicide at the first sign of disease.
E. Botrytis blight or "gray mold" of leaves, stems, and flowers	Dark, water-soaked blight of leaves, petioles and flowers. Gray to buff colored, powdery fungal growth may occur on diseased plant tissue.	Remove and destroy dead plant parts promptly. Increase air circulation around plants. Keep foliage dry, especially at night. Fungicides are generally not needed in landscapes.
SPECIFIC HOSTS AND DISEASES		
African Violet - See A, B, D, and E under General Diseases		
Ring spot(Physiological)	White, yellow or brown rings on leaves.	Use tepid water when watering; avoid wetting leaves.
AMARYLLIS - See B under General Diseases		
Red blotch or Stagnospora leaf spot (fungus)	Red, sunken, spots develop on leaves, often in a bulls-eye (zonate) pattern, especially in the spring.	Remove affected leaves. Keep foliage as dry as possible, especially at night. Apply fungicides to protect new growth and reduce disease spread.
BEGONIA - See A, B, C, D, and E under General Diseases		
Bacterial leaf spot (Xanthomonas)	Small translucent spots enlarge, coalesce to form irregular brownish areas on leaves.	Remove infected leaves. Avoid wetting leaves when irrigating.
Foliar Nematodes(Aphelenchoides)	Bronzing of upper leaf surface followed by death of tissue often in wedge-shaped pattern.	Remove infested leaves.Keep foliage dry. Avoid overhead sprinkler irrigation. Discard badly infested plants
CHRYSANTHEMUM - See A, B, C, D, and E under General Diseases		
Ascochyta stem and ray blight	Flowers have browned, deformed petals which usually occur on one side. Brown lesions on stem.	Must apply fungicides on a regular schedule. Avoid wet leaves at night.
Foliar Nematodes	See Begonia.	

Herbaceous Ornamentals Specific Hosts and Diseases (Continued)		
HOST & DISEASE	**SYMPTOM DESCRIPTION**	**SUGGESTED PRACTICES FOR CONTROL**
CONEFLOWER (ECHINACEA) - See A, B, and D under General Diseases		
Aster Yellows (phytoplasma)	Flower parts remain green and may develop additional flowers, leaves or stems from floral parts.	Discard infected plants to reduce disease spread. Disease spread is slow via insect vector (leafhoppers). Do not propagate from infected plants.
COREOPSIS - See B and D under General Diseases		
Downy mildew (fungus)	Lower leaves are purplish or yellow. Whitish, fuzzy fungal growth can be seen on leaf underside during wet, humid, cool weather of spring and fall.	Do not purchase infected plants. Remove affected foliage and discard away from the garden. Keep foliage as dry as possible, especially at night. Avoid overhead sprinkler irrigation.
CYCLAMEN - See A, B, and E under General Diseases		
Stunt (fungus: Ramularia cyclaminicola)	Stunted plants, extreme dwarfing of flower stems, blooms below leaves.	Discard infected plants.
DAHLIA - See B, D and E under General Diseases		
Mosaic (Stunt or Dwarf) (Virus)	Mottled leaf color. Pale green bands of color along midribs. Veins are larger than ordinary and plant may stunted with many shortened lateral shoots.	Dig up and burn diseased plant. Plant only tubers from healthy plants. Control aphids with Common approved insecticides.
Ringspot(Virus)	Scattered areas of yellow or light green tissue in the leaves. Ring pattern develops	Control thrips with approved insecticides.
DAYLILY (HEMEROCALLIS) - See A, B, and E under General Diseases		
Rust (fungus)	Yellow, raised spots to streaks develop in leaves in the spring and fall. Bright orange spores erupt from pustules on the leaf underside.	Remove infected foliage and discard. Apply fungicides to protect new growth. Plant resistant cultivars.
Leaf streak (fungus:Aureobasidium)	Tan to brown, sunken lesions develop at leaf tip. Spots coalesce. And eventually a brown streak develops along the leaf midrib.	Remove affected foliage. Typically affects weakened foliage (drought, nutrition, etc.). Keep foliage as dry as possible; avoid overhead sprinkler irrigation.
DELPHINIUM OR LARKSPUR - See A, B, and D under General Diseases		
Black leaf spot (bacterium Pseudomonas);	Black irregular spots on upper leaf surface, stems, petioles, and flowers. Lower leaves infected first; disease progresses upward until the entire stalk is killed.	Remove and destroy infected plants and old residue.
Bud and crown rot (bacterium; Erwinia carotovora)	Rapid wilting of the whole plant; plant dies. Softened tissues have a strong offensive odor.	Avoid planting in low, poorly drained areas. Avoid overhead, sprinkler irrigation.

Herbaceous Ornamentals Specific Hosts and Diseases (Continued)		
HOST & DISEASE	**SYMPTOM DESCRIPTION**	**SUGGESTED PRACTICES FOR CONTROL**
FOLIAGE HOUSE PLANTS - See A, B, C, D, and E under General Diseases		
Oedema - (Physiological problem)	Leaf cells swell, burst, and become scab-like on underside of leaf.	Too much water and high fertility cause problem. Reduce humidity, watering and fertilizer.
Foliar Nematode	Tan to black, wedge-shaped lesions (bordered by leaf veins) develop on infected leaves	Promptly remove and discard affected leaves. Keep foliage as dry as possible.
Soft Rot (bacteria; Erwinia)	Tissue is soft, water- soaked, mushy, and may have a foul odor.	Discard plants; avoid splashing water; keep stems, foliage dry; use clean potting mix.
Root knot nematode	Roots are galled. Plants are stunted and often show nutrient deficiencies.	Discard plants.
GERANIUM - See A, B, C, D, and E under General Diseases		
Oedema (Physiological)	Same as foliage house plants above.	Remove infected foliage and discard. Apply fungicides to protect new growth. Plant resistant cultivars.
Rust	Brown to rust colored powdery pustules in cluster or bulls-eye pattern on leaf undersides. May be on stems or petals.	Remove and discard infected leaves. Spray with fungicides at weekly intervals until rust spots are no longer evident.
Bacterial leaf spot (Pseudomonas and Xanthomonas)	Small brown spots surrounded by large yellow areas. Spots may grow together.	Remove and destroy infected leaves. Keep foliage dry. Avoid overhead sprinkler irrigation.
GLADIOLUS - See E under General Diseases		
Corm Rots (Fungi)	There are several corm rot diseases; all produce similar, brown, sunken lesions on the corms. Leaf spots or rotted stems may later develop.	Avoid injury when digging. Store at 35o to 40oF in a dry location. Treat corm with fungicide dust prior to planting.
Cucumber Mosaic Virus (CMV)	Mottling of leaves, whitish streaks and color break in flowers.	Destroy diseased plants. Control insects, especially aphids.
Rust	Small, brown spots on leaf underside. Bright yellow or orange spots with reddish centers on upper surface.	Remove affected foliage and discard. Spray new growth with a protective fungicide.
Bacterial leaf spot (Xanthomonas)	Brown to black angular spots with yellow margins on lower section of leaves.	Remove and destroy infected foliage. Keep foliage dry. Avoid overhead sprinkler irrigation.
GLOXINIA - See A, B, C, D, and E under General Diseases		
Bud rot (Botrytis cinerea)	Buds brown to black, fail to open. Gray fungus growth may be present	Provide good air circulation and low humidity. Remove dead buds and leaves promptly.
Crown Rot (Pythium, Rhizoctonia, and Phytophthora,	Leaves, petioles and roots blackened and water-soaked.	Avoid use of natural soil in pots. Use non-soil potting mixes. Fungicide drenches after proper diagnosis.
Ring Spot	See African Violet above	

Herbaceous Ornamentals Specific Hosts and Diseases (Continued)

HOSTA - See A, B, and E under General Diseases		
Anthracnose (fungus)	Large, irregularly shaped tan spots with brown borders. Leaves may appear water-soaked and yellow to tan in color. Leaf edges are tattered.	Keep foliage dry. Use a protectant fungicide spray under wet and humid conditions.
Sun scorch (Physiological)	Leaf margins brown or yellow associated with die back of plants.	Avoid direct, full sun exposure. Provide adequate water during dry periods.
Foliar nematode	Yellow to tan lesions bordered by the veins; looks like tan streaks on the leaf.	Remove affected foliage and discard away from garden.
Crown and stem rot (fungus: *Sclerotium rolfsii*)	Petioles wilt and collapse in mid-summer. Petioles pull easily from the crown. White fungal threads (hyphae) can be seen on the rotting petiole end. Mustard-seed sized, tan, round, hard sclerotia (survival structures) can be seen on tissues and on soil surrounding affected plant.	Dig and remove infected plants. Discard immediately away the garden. Turn soil at least 8-inches deep to bury sclerotia to reduce disease development in the same area. Don't purchase infected plants.
IMPATIENS - See A, B, D, and E under General Diseases		
Impatiens necrotic spot virus (INSV)	Black to tan colored ring spots in bulls-eye pattern on leaf surface; can cause color breaks, distortion, and leaf puckering on New Guinea impatiens.	Discard severely infected plants
Crown rot (Rhizoctonia)	Causes collapse of entire plant. Lower stem and crown tissue discolored stem lesions.	Remove infected plants and soil around plants. Fungus may survive in soil for many years.
Bacterial leaf spot (Pseudomonas)	Discrete small, tan circular spots on leaves with purple margins.	Remove and destroy infected leaves. Keep foliage dry. Avoid overhead sprinkler irrigation.
IRIS - See A, B, and E under General Diseases		
Crown Rot (fungus: *Sclerotium rolfsii*)	Tips of outer leaves die, moving downward until entire leaf is dead. As rot progresses inward at base of plant, the leaves collapse. White fungus growth (later brown) may be seen between leaves near soil line. Rhizomes are not destroyed but weakened. Light tan to brown bodies, the size of mustard seed, may be found on rhizomes.	Do not overcrowd plants. Thin plants and discard infected plants. Turn soil at least 8-inches deep to bury sclerotia (fungal survival structures) and reduce disease in the same location. Fungus is capable of surviving in location in absence of a host plant for seven years.
Leaf Spot or "Fire" (Didymellina or Heterobasidium)	Small brown leaf spots, surrounded by water-soaked margin. The spots enlarge, killing the entire leaf. Centers of older spots turn gray and are dotted with small black spore clusters.	Cut off old leaves at the soil line in fall and discard or burn them. Spray with a fungicide in spring to protect new growth. Keep foliage as dry as possible.
Soft Rot (bacterium; Erwinia carotovora)	At first, leaves wilt slightly, later become limp and die. Rhizome shows a soft slimy rot and later turns dry and granular, finally decaying entirely. Often associated with wounds or injuries caused by insects, freezing, or plant division.	Do not overcrowd plants. Dig out infected rhizomes and cut out rotted areas.
Rust	Reddish-brown rust pustules generally appear on lower leaf surface.	Plant rust-resistant varieties. Thin plants to improve air circulation. Avoid wetting foliage. Spray with protective fungicides.

Herbaceous Ornamentals Specific Hosts and Diseases (Continued)

HOST & DISEASE	SYMPTOM DESCRIPTION	SUGGESTED PRACTICES FOR CONTROL
LILY - See A under General Diseases		
Botrytis blight (Fire) (*Botrytis elliptica*)	Orange to red leaf spots. Brown spots on flowers.	See E under General Diseases.
Root & Bulb rots	Soft, brown decay of roots and bulb scales. Plants stunted.	Discard severely affected bulbs.
IVY, ENGLISH - See A under General Diseases		
Bacterial leaf spot and stem canker (Xanthomonas)	Leaf spots that are brown or black with yellow margins. Spots look greasy when viewed from underneath. Leaf stems are black and shriveled. Canker forms in the woody portion of vine.	Remove infected plant material. Avoid planting in areas where temperatures may become high or soil too moist. Avoid splashing water and sprinkler irrigation. Keep foliage dry. Apply copper- based fungicides in warm, wet weather.
Anthracnose	Spots are round and similar to above.	Same as above. Spray with a protective fungicide.
MARIGOLD - See A, B, C, D, and E under General Diseases		
Aster yellows (phytoplasma)	Infected plants develop distorted witches=-broom growth. Leaf color yellow; abnormal flower color and growth.	Remove and destroy infected plants.
PACHYSANDRA - See A and B under General Diseases		
Leaf and stem blight (fungus: Volutella)	Circular brown blotches on leaves that progresses to a blight. The rest of the leaf turns yellow. A brown stem rot with orange-brown visible spore pustules.	Remove diseased plants. Improve air circulation by thinning plants. Apply a protective fungicide.
Dieback	Terminal buds and leaves turn brown, roll up and droop. Cankers found on small branches.	Prune out infected twigs.
PANSY - See A, B, D, and E under General Diseases		
Downy mildew	Grayish fungal growth on the leaf undersides. Upper leaf surface discolored yellow.	Keep foliage dry. Increase air circulation around plants. Remove infected plants or plant parts.
PEONY - See B and E under General Diseases		
Leaf Blotch	Glossy dark purple spots on top of leaf, dull brown color below. Problem during moist weather.	Spray with a fungicide. Destroy old infected foliage at the end of the season.
Phytophthora blight	Blossoms and succulent growing tips are blighted and become dark brown to black and somewhat leathery. Usually more severe in wet springs or where plants are shaded or crowded. May invade crown, causing a root rot.	Remove and destroy all infected parts as soon as they are detected. Cut off tops at the ground line in fall and burn. Spray foliage with a fungicide. Remove infected plants and soil. Improve drainage of planting site and plant in mounds.
PETUNIA - See A and E under General Diseases		
Impatiens necrotic spot virus (INSV)	Circular black spots, may be in ring pattern on lower leaves.	Remove and destroy infected plants. Control insects, especially thrips.

Herbaceous Ornamentals Specific Hosts and Diseases (Continued)

HOST & DISEASE	SYMPTOM DESCRIPTION	SUGGESTED PRACTICES FOR CONTROL
POINSETTIA - See A, B, and D under General Diseases		
Bract and leaf spots (fungus: Corynespora)	Brown spots on leaves and bracts.	Keep foliage dry. Remove and destroy infected plant tissue.
Root and stem rots	Plants wilt; blackish brown discoloration of lower stem. Roots rotting.	Improve soil structure and drainage. Avoid setting transplants too deep.
RUDBECKIA - See A, B, and D under General Diseases		
Foliar nematode	Purplish, angular leaf spots, often concentrated along the veins.	Promptly remove and discard affected leaves away from the garden.
Downy mildew (fungus: Plasmopara)	Purplish discoloration across leaf. Grayish to white fuzzy growth on leaf underside in humid, wet, cool weather.	Do not purchase infected plants. Remove infected plant tissue. Keep foliage dry, especially at night. Avoid overhead sprinkler irrigation.
SALVIA - See A, B, and D under General Diseases		
Downy mildew (fungus)	Angular, purple to black spots develop on leaves during cool, humid, wet weather (spring and fall).	Do not purchase infected plants. Remove and discard infected foliage and/or plants. Avoid overhead sprinkler irrigation and keep foliage as dry as possible.
SNAPDRAGON - See A, B, C under General Diseases		
Downy mildew (fungus)	Grayish patches appear on lower leaf surface. Upper leaf surface has yellowish discolored patches.	Remove infected plant tissue. Keep foliage dry, especially at night. Avoid overhead sprinkler irrigation.
Rust (fungus)	Yellow blotches appear on upper leaf surface. Dark brown, dusty pustules on leaf undersides.	Remove infected plant tissue. Keep foliage dry. Improve air circulation. Apply protective fungicide spray.
Impatiens necrotic spot virus (INSV)	Round tan necrotic ring spots on leaves in bulls- eye pattern.	Remove and destroy infected plant. Control insects, especially thrips.
TULIP - See A under General Diseases		
Botrytis blight or "fire"	Black, pin-head size sclerotia bodies on brown bulb husks, yellow to brown lesions on the bulb. Small, yellowish water-soaked spots on leaves. These may enlarge, turn gray, become covered with a gray mold. White to light brown spots on some blossoms, others may blight before or after emergence.	Remove outer husks. Sort bulbs carefully and discard diseased ones before planting. Remove infected plants soon after they come up. Remove and destroy all plant debris after blooming. If bulbs are to remain in the soil, cut yellowed tops below ground and burn them. Dust bulbs prior to storage or planting with fungicide. Spray foliage with appropriate fungicide. Practice sanitation
VERBENA - See A, B, and D under General Diseases		
Powdery mildew (fungus)	The most common disease on verbena. Whitish growth occurs on leaves, stems, and flowers. Leaves may have purplish appearance.	Remove affected foliage from the plants. Increase air circulation around plants by thinning foliage. Apply fungicides to protect new growth at the first sign of disease.

Herbaceous Ornamentals Specific Hosts and Diseases (Continued)

HOST & DISEASE	SYMPTOM DESCRIPTION	SUGGESTED PRACTICES FOR CONTROL
VERONICA (SPEEDWELL) - See B and D under General Diseases		
Downy mildew (fungus)	Angular, yellow to purplish lesions develop on the leaves during cool, wet, humid weather (spring and fall). Whole leaves may turn purple. Disease can become systemic causing whole plants to be distorted, stunted, with abnormal small new growth in the spring.	Do not purchase infected plants. Remove infected foliage and/or infected plants if the disease has become systemic. Keep foliage as dry as possible. Avoid overhead sprinkler irrigation.
Foliar nematode	Angular, purplish to black spots develop on leaves, especially along leaf veins. Spot color shades range from very light to very dark on the leaf underside.	Remove infected leaves and discard away from the garden. Keep foliage as dry as possible. Avoid overhead sprinkler irrigation.
VINCA (CATHARANTHUS) - See A, B, and D under General Diseases		
Phytophthora aerial blight (fungus)	Stems brown or blacken, wilt, and collapse. Typically occurs in mid-summer.	Remove infected plants. Avoid over watering and overhead sprinkler irrigation. Do not plant annual vinca in area for one year.
ZINNIA - See A, D, and E under General Diseases		
Bacterial leaf spot (Xanthomonas)	Angular to irregularly circular brown spots are produced on leaves. Spots are surrounded by a prominent yellow halo.	Avoid water splash. Change seed source. Treat seed with a 1 in 5 dilution of household bleach for 10 minutes.
Aster yellows (phytoplasma)	Flowers are greenish and distorted with excessive petal formation. Witches-broom growth habit.	Remove and destroy infected plants.

DISEASES OF WOODY ORNAMENTALS

Ornamental Plants in the landscape are subject to many diseases and disorders. Diseases are caused by five groups of pathogens: fungi, bacteria, nematodes, viruses, and phytoplasmas. By far, fungi cause the greatest number of diseases in ornamental plants, and most disease control practices or products are directed at control of fungi.

Three main components must be present for a disease to occur:
- Susceptible plant (host)
- Pathogen
- Environment favoring disease development

Disease control relies on breaking this disease triangle in some way. Removing the plant is not always possible or desirable. Choosing and growing disease-resistant varieties or not stressing non-disease-resistant varieties can greatly reduce the occurrence of disease and the need to use pesticides. The pathogen can be reduced by removing the infected plant parts that could spread the disease. Changing the

DISEASE	SEASONAL OCCURRENCE	SYMPTOM DESCRIPTION
	ARBORVITAE (THUJA)	
Bot canker *(Botryosphaeria obtusa, B. dothiodea)*	March-October	Poor growth on some branches. Always associated with a wound on plant from pruning, mechanical damage, freeze cracks, etc. or natural opening (lenticels) following a stress event such as drought. Wounds will sometimes ooze sap and is a possible indicator of canker development. Foliage above canker will die. Black, pimple-like fruiting bodies seen on branches.
	ASH	
Anthracnose (*Apiognomonia errabunda*; syn. *Discula* sp.)	April-June; peak in May	Irregular-shaped, light colored spots often with a dark border or chlorotic halo. Spots concentrated along leaf margin and veins. Blotching and distortion of young leaves and shoots. Excess defoliation can occur. Cool, wet weather favors infection.
	AZALEA and RHODODENDRON	
Leaf gall *(Exobasidium vaccinii)*	April-June; peak in May	Leaves become distorted with pale green, thickened, fleshy-like galls. As galls mature, they turn white, then brown, dry, and fall to the ground. Spores are released when the gall is white. Disease only affects new growth, older leaves are resistant to infection. Infection is favored by cool, moist spring weather. Under dry conditions and in sunny locations, the disease is seldom seen.
Petal blight *(Ovulinia azaleae)*	March-May; peak in April	Mostly a problem on azalea. Tiny, round pale spots that rapidly enlarge to irregular blotches are produced on infected flowers. Flowers quickly (1-day after infection) turn brown, limp, and mushy. Under humid conditions, affected flowers are covered in a white mold growth. Affected blooms hang on plants for weeks, even months. Hard, black survival and fruiting bodies (sclerotia) are produced on the affected blooms. Blossoms eventually drop from the plant.
Phomopsis canker and die back (*Phomopsis* spp.)	April-October; peak in July-August	Mostly a problem on Southern Indica type azalea. Death of leaves and stems; reddish-brown discoloration of wood on diseased stems. Enters plants through wounds, especially pruning wounds. Stressed plants most susceptible.

environment, such as avoiding overwatering and extended periods of wetness and increasing air circulation around plants, can reduce disease.

Disease management relies on an integrated use of cultural and chemical controls. Reliance on chemicals alone for diseases control will not be sufficient. In this section you will find a list of diseases commonly found on numerous plants, symptom descriptions, and control practices that include cultural and chemical suggestions. The fungicides listed are provided for reference only and it is up to the user of the product to read and follow all label directions for use on a particular plant. Seasonal occurrence information is based on "average" years for USDA zone 7 and may need to be adjusted forward or backward for use in other hardiness zones.

This section will provide general information on both general diseases common to most plants and diseases specific to certain plants.

SUGGESTED CONTROL PRACTICES	FUNGICIDES USED
ARBORVITAE (THUJA)	
Prune infected branches at least 4-6 inches below the infected tissue. Avoid plant stress; promote good plant growth. Avoid wounding plants. No fungicides are effective once infection occurs. A protective fungicide application when the injury occurred can reduce possible infection.	Mancozeb
ASH	
Fungus survives on infected leaves and in dead twigs and branches. Collect and remove fallen leaf litter before new growth appears in spring. Fungicide application rarely warranted on large, landscape trees. If used, apply to completely cover tree beginning at bud break and continuing through cool, wet weather.	Chlorothalonil, mancozeb, thiophanate methyl
AZALEA and RHODODENDRON	
Pick off or prune affected leaves from the plant before they turn white. Applications of fungicides after the galls are present will have no effect in controlling the disease. Applying fungicides before and as the leaf buds open and expand in early spring can reduce infection, but timing is critical and sprays are usually not necessary.	Chlorothalonil, triadimefon
Rake and remove flower debris from underneath bushes. Remove old flowers from plants. Mulch around base of plants. Fungicides can be applied to base of plants to prevent sporulation from sclerotia, but this is marginally effective. On large azalea plantings, make fungicide applications beginning just before blooming and continue at 1-week or less intervals during entire bloom period.	Chlorothalonil, mancozeb, myclobutanil, PCNB, propiconazole, thiophanate methyl, triadimefon
Prune wounded, damaged branches. Prevent moisture stress and stem splitting from cold. Mulch plants.	None

DISEASE	SEASONAL OCCURRENCE	SYMPTOM DESCRIPTION
	AZALEA and RHODODENDRON (Continued)	
Web blight (*Rhizoctonia solani)*	May-September; peak in July-August	Very rapid symptom development under humid, wet conditions. Small necrotic leaf spots rapidly enlarge, become dark brown to black and advance along leaf margin and midrib. Affected leaves abscise but remain attached to the plant due to the fungus. Leaves are matted or clumped together. In the fall, infected leaves drop as the fungus dies and plants look defoliated.
Phytophthora dieback (*Phytophthora cactorum*, P. *nicotianae var. parasitica,* P. *citricola*)	June-September, peak in July-August	Brown, irregular-shaped lesions on leaf margin that progresses along midrib through the petiole into the stem. Brown discoloration extending up and down the stem. Infection only on current season's growth, but slowly moves through plant.
Botryosphaeria die back (*Botryosphaeria dothidea*, B. *ribis*)	April-October	Mostly affects rhododendron. Leaves on affected stem droop and roll inward. Reddish-black, sunken canker girdles affected stem. Infection develops at pruning wounds, leaf scars, and flower cluster attachment.
	BIRCH	
Anthracnose (*Discula betulina*; syn. *Gloeosporium betulinum*)	May-September; peak June-July	Large tan spots or blotches with brown to dark black margin and yellow halos. Affected leaves fall prematurely, often when much of the leaf is still green.
Cylindrosporium leaf spot (*Cylindrosporium betulae*)	June-October; peak in August-September	Small tan to brown to purple spots with no definite margin.
	BOXWOOD	
Volutella blight (*Volutella buxi*)	June-October; peak August-September	Pinkish sporulation seen on leaves and twigs, especially on dead or dying tissues. Discoloration and death of current year's growth.
Root-knot nematode (*Meloidogyne* spp.)	March-November	Chlorosis and bronzing of foliage, reduced leaf size and eventual defoliation. Root galling and decay. Plants are stunted and slowly decline, often one branch at a time.
	CAMELLIA	
Canker and stem die back (*Glomerella cingulata*)	April-September; peak in May-July	Sudden wilting of leaves. Leaves turn brown and remain attached to young twigs. Elliptical and sunken cankers form on infected branches. The bark and wood of infected branches turns brown. Pinkish-orange spore masses may be seen around the cankers during extended periods of wet weather.

SUGGESTED CONTROL PRACTICES	FUNGICIDES USED
AZALEA and RHODODENDRON (Continued)	
Crowded, close-growing azaleas are most susceptible (e.g. 'Gumpo' azaleas). Avoid prolonged plant wetness; do not water late in the day. Increase plant spacing to prevent plant-to-plant infection. Apply protective fungicide beginning in mid-June when temperatures warm to 80 F.	chlorothalonil, iprodione, mancozeb, PCNB, thiophanate methyl
Avoid prolonged plant wetness; do not water late in the day or evening. Prune affected shoots. Excess shade and nitrogen fertilization increases disease susceptibility. Susceptibility varies from cultivar to cultivar. Fungicides can reduce disease incidence.	etridiazole, fosetyl aluminum, mefenoxam (none are labeled for home landscape use)
Prune stems below the cankered, discolored area. Disinfect pruning tools. Avoid drought stress or freeze injury which predisposes plants to infection. No resistant cultivars or fungicide treatments are known.	None
BIRCH	
Collect and remove fallen leaf litter before new growth appears in spring. If small or newly transplanted tree, apply fungicide spray when leaves begin expansion and repeat twice at 10-14 day intervals.	Mancozeb
Collect and remove fallen leaf litter before new growth appears in spring. Fungicides not usually necessary. Disease is worse in wet weather.	None
BOXWOOD	
Prune affected stems below diseased tissue. Heavy pruning of plants promotes infection. Dieback of branches is often due to root rot or other factor that affects good root growth (poor soils, compaction, over watering, poor nutrition, etc.)	Mancozeb
Improve drainage; promote good plant growth through horticultural practices. No post-plant chemical treatment available.	None
CAMELLIA	
Prune infected branches four inches below the infected area into healthy tissue and burn or discard disease branches. Disinfect pruning tools in 10% bleach solution or wipe blades with rubbing alcohol between each cut. Fungicides will provide limited effectiveness and can be applied to pruning cuts and wounds.	Chlorothalonil, mancozeb

DISEASE	SEASONAL OCCURRENCE	SYMPTOM DESCRIPTION
	CAMELLIA (Continued)	
Leaf gall (*Exobasidium camelliae*)	April-June; peak in May	New expanding leaves are larger, thickened, and pinkish-green in color on the upper leaf surface and the lower leaf surface will eventually turn white when the fungus is releasing spores. Infected leaves dry and turn brown to black in late spring. Infection is most severe under cool, moist weather conditions as the leaves expand in the spring.
Petal blight (*Ciborinia camelliae*; syn. *Sclerotinia camelliae*)	February-April; peak March	Small brown, irregularly-shaped spots appear on expanding petals. Spots enlarge rapidly toward the center of flower until the entire flower is dead and brown. Venation is pronounced giving the flower a "netted" appearance in early stages of disease development. This distinguishes petal blight from frost or wind injury. Blighted flowers drop and the fungus produces dark, hard, survival structures (sclerotia) within the tissue which then releases spores and infects flowers the following year.
Algal leaf spot (*Cephaleuros virescens)*	April-November; peak in July-August	Velvety green, brown or reddish spots develop on the upper leaf surface under wet conditions. Older infections become greenish-gray and lichen-like in appearance.
Yellow mottle or ring spot viruses	April-September	Irregular yellow or white spots (mottling) or ring spots appear on infected leaves. This is often seen on older winter injured leaves. Affected leaves may drop, but plants are rarely killed.
Oedema (*edema*) - Not a disease. It is a physiological disorder.	November-June	Tannish-brown, corky or scabby appearance to leaves.
	CHERRY (FLOWERING)	
Black knot (*Plowrightia morbusa*; syn. *Dibotryon morbosum*)	January-December	Dark-brown to black, hard swellings form on twigs and branches. At first galls are small, but enlarge each year. In spring galls are covered with dark olive-green felt-like growth. Branches may be girdled and die. Affects numerous *Prunus* sp.
	CRABAPPLE (FLOWERING)	
Fire blight (*Erwinia amylovora*)	April-June; peak in May-June	Young twigs and branches die from the terminal end and appear burned or deep rust colored. Branch may be bent, resembling a shepherd's crook. Dead leaves and fruit generally remain on the branch. Infection occurs during blooming and is favored by wet conditions.
Apple scab (*Venturia inaequalis*)	April-October; peak in April-June	Dull, olive-green, velvety fungal growth develops on upper leaf surface in spring. Leaves yellow and fall prematurely. Trees bare by mid-season. Infected fruit have circular rough spots on surface. Infection is favored by cooler temperatures and prolonged leaf wetness.

SUGGESTED CONTROL PRACTICES	FUNGICIDES USED
CAMELLIA (continued)	
Remove and destroy (burning or discarding) diseased leaves as they appear in early spring before the lower leaf surface turns white. This will reduce the inoculum source for next year's infection. Do not leave infected leaves or branches on the ground after pruning because spores can still be liberated from the infected clippings. Fungicide applications are seldom necessary and will only provide limited control. Applications must be made as the leaf buds swell in the spring. Spraying after seeing the galls will have no effect on this or next year's infection.	mancozeb, triadimefon
Remove and destroy infected flowers as they appear. Rake and remove fallen blossoms and other plant debris underneath bushes. Apply a fungicide prior to flower blooming to the soil beneath plants and in an area 10 feet beyond each bush.	captan, chlorothalonil, PCNB, triadimefon
Usually does not harm the plant. Fungicides can reduce disease incidence.	chlorothalonil, mancozeb
There is no control for virus diseases, except removing affected plant. Pruning and removing branches showing symptoms does not control viruses.	None
No control is necessary. The problem is favored by high humidity, cloudy weather, poor soil drainage, and excessive watering.	None
CHERRY (FLOWERING)	
Prune and destroy galls, cutting several inches below gall during plant dormancy. Usually not necessary to apply fungicides.	None
CRABAPPLE (FLOWERING)	
Prune out branches 6 inches below the signs of damage. Disinfect pruning tool in 70% isopropyl alcohol (rubbing alcohol) or 10% bleach solution between each cut. Avoid heavy nitrogen fertilization, especially in summer. Avoid splashing water. Plant resistant varieties.	Copper hydroxide, copper sulphate
Plant scab-resistant cultivars. Rake and remove fallen leaves and fruit. Beginning at bud break, apply fungicides at 7-10 day intervals. Make 5 to 8 applications through early to mid-June.	chlorothalonil, mancozeb, myclobutanil, thiophanate methyl

DISEASE	SEASONAL OCCURRENCE	SYMPTOM DESCRIPTION
	CRABAPPLE (FLOWERING) (continued)	
Cedar-Apple rust (*Gymnosporangium juniperi-virginiana*)	May-August; peak in July	Bright yellow, yellow-orange spots form on leaves. On upper surface of spot, small dark fungal fruiting structures form. Later on underside of infected leaves, clusters of cup-shaped structures with fringed edges are observed.
	CRAPE MYRTLE	
Powdery mildew (*Erysiphe lagerstroemiae)*	May-October; peak in June-July	White, powdery spots appear on leaves, stems, flowers. May cause distortion of new growth and suckers.
	DOGWOOD	
Spot anthracnose *(Elsinoe cornii)*	March-September; peak in May	Small, reddish spots first appear on flower bracts. Reddish spots on leaves; leaves distorted from infection in bud stage. May cause leaves to drop.
Dogwood anthracnose *(Discula destructiva)*	March-September; peak June	Medium to large purple-bordered leaf spots develop into large, scorched, tan blotches that enlarge and may kill the entire leaf. Infected leaves cling to stems after normal leaf drop in fall. Symptoms start in the lower crown and progress up the tree. Numerous shoots form along the main stem and on major branches. The shoots frequently become infected and die. Cankers form on main trunk at junction of dead twig or shoot. Trees may die within 2-3 years following infection. Disease is less severe on trees planted in open, sunny sites.
Septoria and Cercospora leaf spots (*Septoria cornicola; Cercospora cornicola)*	June-October peak August-September	Uniform, medium purplish spots on leaves; spots may be angular. Center of spot turns gray, but spots retain the deep purple border. May cause leaf drop. Mostly seen in late summer/early fall prior to leaf drop.
Algae/Lichens	January-December	Greenish-gray spots or crusty to feathery growths on stems and branches. Not a disease. Indicates stressed tree.
	EUONYMUS	
Powdery mildew *(Microsphaera euonymi-japonici)*	May-October; peak in May-June	Small patches of white to gray powdery growth on leaves and stems. Mostly seen on new growth. Infection is favored by high humidity, poor air circulation and cool night temperatures. Most common in early summer and late to early fall.
Crown gall (*Agrobacterium tumefaciens*)	March-October	Roots and base of stems infected with golf-ball sized, knobby galls. Secondary galls sometimes seen on branches. Mostly introduced into the landscape through infected nursery stock. May be spread by cutting tools. Infection is favored by wounds and wet conditions.

SUGGESTED CONTROL PRACTICES	FUNGICIDES USED
CRABAPPLE (FLOWERING) (continued)	
Remove unwanted junipers/cedars from the area. Remove galls from junipers during dormancy. If disease is frequent and severe, apply a fungicide when crabapple flower bud tissue can be seen and again at petal fall.	chlorothalonil, mancozeb, myclobutanil, propiconazole, triadimefon
CRAPE MYRTLE	
Plant resistant varieties ("Indian"-named; Acoma, Tuskeegee, Zuma, etc.). Prune infected sprouts and new growth from plant. Apply fungicides at the first sign of disease (if plants are small). Do not wait until entire leaf is covered.	Myclobutanil, propiconazole, triadimefon
DOGWOOD	
Rake and remove fallen leaves. Disease will not cause significant damage to tree. Fungicides applied at swollen bud stage for flowers and leaves can reduce infection, but are only recommended for young, newly-transplanted trees. Kousa variety moderately resistant to disease.	chlorothalonil, mancozeb , propiconazole
Prune and destroy any dead wood from tree before it reaches the main trunk. Avoid plant stress. Remove severely infected trees and fallen leaf litter and destroy them. Fungicides are often ineffective. In some cases, they may provide some control if applied as buds break in the spring and at least twice there after as the leaves expand.	chlorothalonil, propiconazole
Chemical control not usually recommended. Disease causes little damage to the tree. Stressed trees more susceptible to the disease. Avoid plant stress.	chlorothalonil, mancozeb, propiconazole, triadimefon
Improve conditions causing stress.	None
EUONYMUS	
Remove affected stems or leaves from the plant. Improve air circulation around plants by increasing plant spacing or thinning branches. Apply a fungicide at the first sign of infection. Do not wait until the entire leaf is covered with mildew. Reapply 10-14 days later.	myclobutanil, propiconazole, triadimefon
Destroy heavily infected plants. Prune out galls, if few present on some branches and lower stems. Disinfect pruning tools between each cut with 70% isopropyl alcohol (rubbing alcohol) or 10% bleach solution. *E. elatus* not susceptible to infection.	None

DISEASE	SEASONAL OCCURRENCE	SYMPTOM DESCRIPTION
	GARDENIA	
Canker or Galling (P*homopsis gardeniae;* syn. *Diaporthe gardeniae)*	January-December; peak April-June	Perennial cankers or cankerous rough-surfaced galls that enlarge and girdle stems; commonly found near the soil line. Diseased branches lose vigor, may wilt, drop leaves, and die back. Enters plant through wounds.
Algal leaf spot *(Cephaleuros virescens)*	April-November; peak July-August	Velvety green, brown or reddish spots develop on the upper leaf surface and stems under wet conditions.
	HOLLY	
Web or thread blight (*Rhizoctonia solani, R. ramicola)*	May-September; peak in July-August	Very rapid symptom development under humid, wet conditions. Small necrotic leaf spots rapidly enlarge, become dark brown to black and advance along leaf margin and midrib. Affected leaves abscise but remain attached to the plants, matted together, due to the fungus.
Sphaeropsis gall or knot (*Sphaeropsis tumefaciens*)	Not certain	Affects American and dahoon hollies in the South. Young twigs swell, forming galls with witches'-brooming of new, leafless shoots from the galled tissue. Infects primarily wounds and can be spread on pruning tools.
Black root rot (*Thielaviopsis basicola; Chalara elegans)*	January-December; peak in April-July	Chlorotic, stunted foliage. Death of feeder roots. Black lesions seen on washed roots. Dieback of individual bracnhes.
Anthracnose (*Glomerella cingulata*; syn. *Colletotrichum gloeosporioides*)	March-November; peak in May-June	Irregular leaf spots; scorching along leaf margin. Sunken stem cankers. Die back of branches. Most serious on stressed or weakened plants.
Spine spot (Not a disease)	January-December	Small gray spots with purple halos caused by puncturing of leaves by spines of adjacent leaves or insects.
	HYDRANGEA	
Cercospora leaf spot *(Cercospora hydrangeae)*	May-October	Randomly distributed leaf spots with a tan center and a dark purplish red border. Spot size may range from small purplish spots to about 1/4 inch across. Infection is favored by cooler temperatures and extended periods of leaf wetness, usually in late spring.
Bacterial leaf spot (*Xanthomonas campestris, Pseudomonas* spp.)	March-September; peak April-June	Irregularly-shaped reddish spots bordered by leaf veins. May cause leaves to pucker. Infection is favored by extended periods of leaf wetness, poor air circulation, and warmer temperatures. Usually seen in early summer.
Clitocybe root rot (*Armillaria tabescens*; syn. *Clitocybe tabescens)*	April-November; peak in August-October	Plants decline over time. Leaves scorch or wilt. Bark sloughs at trunk base at soil line. White fungal thread-like material (mycelium) seen under sloughing bark. Root rot is usually associated with older plants under root stress and poor site conditions (poor drainage, over watering, etc.).

SUGGESTED CONTROL PRACTICES	FUNGICIDES USED
GARDENIA	
Prune affected branches from the plant.	None
Usually does not harm the plant. Fungicides can reduce disease incidence.	None labeled for use on gardenia.
HOLLY	
Crowded, close-growing hollies are most susceptible (Compacta, Helleri, Dwarf Yaupon, etc.). Avoid prolonged plant wetness; do not water late in the day. Increase plant spacing to prevent plant-to-plant infection. Apply protective fungicide about mid-June when temperatures warm to ~80 F.	chlorothalonil, imancozeb, PCNB
Disinfect pruning tools between cuts. Prune affected branches below (4-6 inches) galls.	None
Remove affected plants. Improve soil drainage. Fungicide drenches marginally effective	thiophanate methyl
Avoid prolonged plant wetness; do not water late in the day. Avoid plant stress. Prune affected branches from plant if cankers evident. Fungicides are of little benefit and needs to be applied as the leaf buds swell and begin expansion. Repeat applications at 7-10 day intervals are necessary until leaf fully expands.	chlorothalonil, mancozeb
Prune plants to thin growth and prevent injury. Control insects.	None
HYDRANGEA	
Avoid prolonged periods of leaf wetness. Remove heavily infected leaves. Remove leaf litter under plants. Apply fungicide sprays beginning in early spring as leaves emerge. Repeat application every 10-14 days.	chlorothalonil, mancozeb
Usually does not cause significant damage to plants. Remove heavily infected leaves. Avoid wetting foliage during irrigations. Mulch under plants. Chemical control usually ineffective.	copper sulphate
Remove affected plants because they will not recover. No fungicides effective against this disease. Improve site conditions.	None

DISEASE	SEASONAL OCCURRENCE	SYMPTOM DESCRIPTION
	INDIAN HAWTHORNE (RHAPHIOLEPIS)	
Entomosporium leaf spot (*Entomosporium mespili*; syn. *Fabraea maculata*)	January-December; peak in February-April and August-October	Small reddish spots on leaves. Older spots have a tannish center with a purple red border. In some cultivars severe defoliation can occur.
	IVY	
Anthracnose *(Colletotrichum trichellum)*	April-October; peak in August-September	Round to large, irregularly shaped, tan to brown spots that have numerous tiny, dark brown, pimple-like fungal fruiting structures within spot. Spots often have zonate appearance. Spots may coalesce causing leaf blight.
Bacterial leaf spot (*Xanthomonas campestris* pv. *hederae*)	April-October; peak in June	Leaf spots are brown to black with yellow halos. Spots look greasy when viewed from underneath. Spots may coalesce causing extensive blighted areas. Leaf stems blacken and shrivel. Cankers may form in woody portion of vine.
	JUNIPER AND EASTERN RED CEDAR (*JUNIPERUS*)	
Tip blight (*Phomopsis juniperovora*)	April-September; peak in May	New branch tips turn brown and die. Older, mature growth is resistant to infection. Infections are seen in late spring and early summer following growth flushes. Infected tissue turns gray and black fungal fruiting bodies can be seen on the infected tips.
Cercosporidium needle blight (*Cercosporidium sequoinae* var. *juniperi*)	April-September; peak June	Progressive browning and loss of foliage beginning on lower branches close to the stem and moving upward and outward until plant dies or only tufts of green shoots remain on upmost branches.
Seiridium canker *(Seiridium unicorne)*	February-December; peak April-May	Yellowing and browning of old foliage precedes fading and death of twigs and branches. Sunken, long cankers develop at wounds or bark openings. Bark is darkened and resin exudes from margins of cankers. Needles on affected branches will fall off easily when rubbed with your hands.
Cedar-apple rust (*Gymnosporangium juniperi-virginianae*) Cedar-hawthorne rust (*Gymnosporangium globosum*)	March-May; peak in April-May	Hard dark brown galls formed in winter. In spring, galls exude reddish, jelly-like "tentacles" of spores (telial horns) that infect apple and crabapple. Infects mostly eastern red cedars and horizontal junipers. Hawthorne rust similar to cedar-apple rust, telial horns are short and blunt.
Cedar-quince rust (*Gymnosporangium clavipes*)	March-May; peak in April-May	Young shoots infected causing spindle-shaped swellings that encircle twigs and small branches. Bright orange pustules expand from diseased bark in early spring. Diseased twigs and branches often die.

SUGGESTED CONTROL PRACTICES	FUNGICIDES USED
INDIAN HAWTHORNE (RHAPHIOLEPIS)	
Plant leaf spot resistant varieties (ex. Eleanor Tabor, Olivia, Georgia Petite, Georgia Green). Fungicide application may reduce disease, but it must be reapplied at 10-14 day intervals from spring to late summer.	chlorothalonil, mancozeb
IVY	
Remove infected plant material. Avoid splashing water and sprinkler irrigation. Keep foliage dry. Apply protective fungicide in early summer and reapply at 10-14 day intervals.	copper hydroxide, copper sulphate pentahydrate, mancozeb
Remove infected plant material. Avoid planting in areas that will stress plants (full sun, poor soil conditions, excess water). Avoid splashing water and sprinkler irrigation. Keep foliage dry. Apply copper-based fungicides in warm, wet weather.	Copper hydroxide, copper sulphate pentahydrate
JUNIPER AND EASTERN RED CEDAR *(JUNIPERUS)*	
Prune affected branches when plants are dry. Remove clippings from the area. Avoid wetting plants late in the day or evening hours. Fungicide applications when new growth is present in spring or after pruning can reduce infection. Plant resistant or tolerant juniper varieties.	mancozeb, thiophanate methyl
Avoid plant stress. Apply fungicides in early to mid-summer can help reduce disease. Remove severely affected plants.	chlorothalonil, mancozeb
Avoid plant stress and wounding. Irrigate trees during periods of drought. Avoid drought injury. Fungicides ineffective once infection takes place.	None
Usually does not harm junipers. Prune out galls when noticed. See control on crabapple if necessary.	None
Prune affected branches and twigs from cedar trees. Fungicides have limited effectiveness on reducing rust on cedar. Apply fungicides to hawthorne, flowering quince, pear when leaf buds swell and expand.	None

DISEASE	SEASONAL OCCURRENCE	SYMPTOM DESCRIPTION
LEYLAND CYPRESS (*x CUPRESSOCYPARIS LEYLANDII*)		
Bot canker *(Botryosphaeria dothidea, B. obtusa, Sphaeropsis, Macrophoma*)	February-November; peak in April-May	Bright rust colored branches most often visible in spring and fall. Infection always associated with wound from pruning, mechanical damage, freeze cracks, etc. or natural opening (lenticels) following a stress event such as drought. A canker develops at the infection site and may ooze sap. Canker darkly discolors cambial tissue. All foliage above canker will die.
Cercosporidium needle blight *(Cercosporidium needle blight)*	June-November; peak in August-September	Foliage in the lower third of tree thins from the inside outward and the bottom upward. Individual needles progressively yellow, brown, then gray, and eventually fall from the tree. Typically infects one-year-old and older growth, however, current season's growth can also be infected. Branches often look bare with tufts of green growth at the branch tips.
Seiridium canker *(Seiridium unicorne)*	February-November; peak in April-May	Yellowing and browning of old foliage precedes fading and death of twigs and branches. Sunken, long cankers with a reddish tinge develop at wounds or bark openings. Bark is darkened and resin exudes from margins of cankers. Infection seems to occur from the lower branches and up and from the inside out. Infected trees look thinly branched.
LIGUSTRUM (PRIVET)		
Cercospora leaf spot (*Cercospora* spp.)	April-October; peak in May and September	Irregularly shaped tan lesions surrounded by a dark brown border. Often lesions develop on leaf margin or tip. Spots may become sunken with age. Most common leaf spot disease. Infection is favored by prolonged leaf wetness. Rarely causes harm to plants.
MAPLE		
Tar spot (*Rhytisma acerinum*)	April-October; peak in June-July	Raised, black tar-like spots develop on the upper side of mature leaves in mid to late summer. Infected leaves may drop prematurely.
Phyllosticta leaf spot *(Phyllosticta minima)*	April-October; peak in May-June	Small, round, light colored leaf spots with purple borders. Pycnidia (fungal fruiting bodies) form in a circular pattern within the spot. Infected leaves may drop prematurely.
Anthracnose *(Apiognomonia errabunda* or *Kabatiella apocrypta)*	April-October; peak in May-June	Necrotic, irregular, tannish to reddish-brown spots concentrated along leaf veins. Fungal fruiting bodies (acervuli) prominent on upper surface of spots. Scorching pattern along leaf margin (Japanese maples).
Verticillium wilt *(Verticillium dahliae, V. albo-atrum)* (Not commonly found in Zones 7-10)	April-October; peak in July-August	Small, yellow foliage with marginal scorching or browning. Defoliation and die back of individual shoots and branches. Often, the foliage on one or more branches suddenly wilts. Greenish-brown streaking in the vascular tissue or wood.

SUGGESTED CONTROL PRACTICES	FUNGICDES USED
LEYLAND CYPRESS (*x CUPRESSOCYPARIS LEYLANDII*)	
Prune affected branches 6 inches below the infected tissue. Avoid plant stress; promote good plant growth. Avoid wounding plants. Avoid planting Leylands too close together (should be planted on at least 8 foot centers or more). No fungicides are effective once infection has occurred. A protective fungicide application when the injury occurred may reduce possible infection.	mancozeb
Avoid planting Leylands too close together to allow for air circulation around trees. Fungicides can help reduce ifnection and disease spread. Begin applications to the lower third of the tree by July 1 and continue at 7 to 10 day intervals through September. Keep foliage as dry as possible to reduce disease spread and development. Avoid using sprinkler irrigation to water trees. The disease may not progress or severely damage landscape trees.	chlorothalonil, mancozeb, copper hydroxide
Avoid plant stress and wounding. Keep plants well-irrigated during periods of drought. If possible, prune affected branches 6 inches below the canker before infection reaches the main stem. No fungicides are effective in controlling disease once infection takes place.	None
LIGUSTRUM (PRIVET)	
Avoid prolonged leaf wetness. Selectively prune dense hedges to improve air circulation around plants. Fungicide control not necessary since disease does not significantly harm plants.	chlorothalonil, mancozeb
MAPLE	
Rake and remove fallen leaves. Disease does not cause significant damage to trees. No chemical control recommended.	None
Control is often not necessary. Disease cause little damage to trees. Rake and remove fallen leaves.	chlorothalonil, mancozeb
Control usually not necessary, except in wet years when severe defoliation can occur. Apply fungicides as leaves swell and expand from the buds. Repeat applications every 7-10 days until leaves fully expanded. Rake and remove fallen leaf litter.	chlorothalonil, mancozeb, thiophanate methyl
Fungicides will not cure infected trees. Infected trees should be removed. Plant resistant or immune trees and shrubs in the affected area because the fungus survives in the soil.	None

DISEASE	SEASONAL OCCURENCE	SYMPTOM DESCRIPTION
	OAK	
Oak leaf blister *(Taphrina caerulesence)*	May-June	Bulging, blister-like spots on leaves, may cause leaf distortion. Underside of leaf turns brown following spore production. Can be confused with eriophyid mite or midge damage. Affected leaves drop prematurely.
Anthracnose *(Apiognomonia quercina*; syn. *Discula quercina)*	April-September; peak in May-June	Young leaves brown and shrivel. Large necrotic areas develop on expanding leaves. Infection of fully mature leaves develop as small necrotic spots. Twigs die back. Infected leaves drop prematurely.
Hypoxylon canker or oak decline (*Hypoxylon* spp.)	May-October; peak in July-August	Slow growth; chlorotic leaves or leaf scorch; wilting of foliage; "flags" of brown foliage; die back of branches and major limbs. Corky outer bark sloughs exposing smooth, tan to silver gray colored stromata. Old stromata loses its silvery surface and appears black.
Rust (*Cronartium quercum* causes pine-oak gall rust; *C. quercum f. sp. fusiforme* causes fusiform rust on pines)	May-July; peak in June-July	Small yellow spots with brown centers on the upper leaf surface. Hair-like brown telia (spore tendrils) on the leaf under side.
Oak wilt *(Ceratocystis fagacearum)*	May-October; peak in May-June	Leaves become chlorotic or bronze along leaf veins, often with leaf tip necrosis. Diseased trees defolaite and show progressive die back of twigs and branches. Affected trees may wilt in late spring to late summer. Disease spreads primarily through root grafts and secondly by beetles.
	PEAR (FLOWERING)	
Fire blight *(Erwinia amylovora)*	April-June; peak in May-June	Young twigs and branches die from the terminal end and appear burned or deep rust colored. Branch may be bent, resembling a shepherd's crook. Dead leaves and fruit remain on the branch. Infection occurs in early spring during flowering and is favored by wet conditions. Pear cultivar Bradford is moderately resistant to fire blight, but it can be infected. Bradford's do not get typical Fire blight symptoms. Infected Bradford leaves are rust colored, scorched, or spotted. Portions of the leaf remain green.

SUGGESTED CONTROL PRACTICES	FUNGICIDES USED
OAK	
Disease seldom causes significant damage. Apply fungicide spray when leaf buds swell in the spring and reapply at 7-10 day intervals until the leaf fully expands to reduce disease.	Chlorothalonil
Rake and remove fallen leaf litter. Fungicides may be beneficial to small, newly-transplanted trees. Apply as buds swell in spring and reapply at 7-10 day intervals until leaves fully expand.	Chlorothalonil, mancozeb, propiconazole
Only infects stressed trees. Remove infected trees because it can spread via spores and root grafts with adjacent trees.	None
Disease is insignificant on oaks. Damage is primarily on the alternate host (2- and 3-needled pines.)	Chlorothalonil, mancozeb, triadimefon
Wilting or recently wilted trees should be removed. Mechanical barriers using a vibratory plow can break-up root grafts. Avoid wounding or pruning trees when beetles are active, typically April-June. Fungicide injections may reduce disease.	Propiconazole (only for commercial applicators)
PEAR (FLOWERING)	
Prune out branches 6 inches below signs of damage. Dip pruning tool in 70% isopropyl alcohol (rubbing alcohol) or 1 part bleach to 9 parts water solution between each cut. Avoid heavy nitrogen fertilization, especially in summer. Avoid splashing water. Plant resistant varieties.	Copper hydroxide, copper sulphate

DISEASE	SEASONAL OCCURENCE	SYMPTOM DESCRIPTION
	PEAR (FLOWERING) (Continued)	
Alternaria leaf spot *(Alternaria alternata)*	May-October; peak July-August	Small, round, tan to brown spots develop on leaves about mid-summer. Spots often have zonate appearance. Spots may coalesce and blight leaf. Severely infected leaves drop prematurely. Infection is favored by prolonged leaf wetness, warm temperatures, high humidity and poor air circulation.
	PHOTINIA (RED TIP)	
Entomosporium leaf spot (*Entomosporium mespili*; syn. *Fabraea maculata*)	February-November; peak in March-April	Small reddish leaf spots initially. As spots age, center is grayish with a dark purple border. Leaf spots may coalesce causing severe leaf blight. Severely infected leaves drop prematurely. Over time severely infected plants die. Infection is favored by poor air circulation and prolonged periods of leaf wetness.
Colletotrichum leaf spot/blight *(Collectotrichum gloeosporioides)*	May-October	Rust colored spots on leaf that coalesce to cover large areas of the leaf. Often concentrated along leaf margin and edge. Leaves may appear scorched along the leaf margins. Infection is favored by prolonged leaf wetness and typically occurs in early spring or late summer.
	PINE	
Needle rust (*Coleosporium* spp.)	March-May; peak in April	White shelf-like projections from the needles. Orange rust spores produced within and rupture through white covering. Affected needles may drop.
Pitch canker *(Fusarium moniliforme* var. *subglutinans)*	January-December; peak August-October	Resin-soaked lesions on twigs and cankers on larger branches and trunk. Diseased bark turns dark reddish-brown. Shoot or limb dieback. Needles yellow then brown and remain on tree glued with crystalline resin.
Fusiform rust *(Cronartium quercum f.* sp. *fusiforme)*	April-May; peak April	Stem swellings and spindle-shaped galls on branches. Multiple shoots causing witches'-brooming grow from galls. Blister-like yellow protrusions from bark in spring. Pine bark dies resulting in cankers.
Needle cast *(Lophodermium pinastri)*	March-May; peak in April-May	Yellowing and shedding of older needles. Do not confuse with fall needle drop.
	PYRACANTHA (FIRETHORN)	
Fire blight *(Erwinia amylovora)*	April-June; peak in May-June	Young twigs and branches die from the terminal end and appear burned or deep rust colored. Branch may be bent, resembling a shepherd's crook. Dead leaves and fruit remain on the branch. Infection occurs in early spring during flowering and is favored by wet conditions.
Scab *(Spilocaea pyracanthae)*	April-June; peak in May	Fruits covered with scabby lesions and turn black. Velvety, olive-green sooty spots form on leaves. Infected leaves turn yellow and fruit and leaves drop prematurely.

SUGGESTED CONTROL PRACTICES	FUNGICIDES USED
PEAR (FLOWERING) (Continued)	
Avoid prolonged leaf wetness and wetting leaves during irrigation. Rake and remove fallen leaf litter. Apply protective fungicide applications in early summer and continue through fall.	Chlorothalonil, mancozeb
PHOTINIA (RED TIP)	
Selectively prune plants to improve air circulation through plant. Increase plant spacing. Avoid wetting foliage. Apply protective fungicide applications when leaves emerge in spring and continue at 10-14 day intervals throughout growing season.	Chlorothalonil, mancozeb, propiconazole
Rake and remove fallen leaf litter. Avoid wetting foliage. Increase plant spacing or selective prune plants to improve air circulation through plant canopy. Apply protective fungicides in spring and reapply at 10-14 day intervals.	Chlorothalonil, mancozeb
PINE	
Rarely causes significant decline. Eliminate alternate host (*Asteraceae* family; goldenrod). Fungicides not recommended.	Chlorothalonil, mancozeb, myclobutanil, propiconazole, triadimefon
Avoid wounding plants.	None
Remove affected branches or trees. Usually causes minor damage to landscape trees. Fungicides generally not recommended.	Myclobutanil, triadimefon
Weak pathogen. Rarely cause damage in landscape trees. Fungicides generally not recommended.	None
PYRACANTHA (FIRETHORN)	
Prune out branches 6 inches below signs of damage. Dip pruning tool in 70% isopropyl alcohol (rubbing alcohol) or 1 part bleach to 9 parts water solution between each cut. Avoid heavy nitrogen fertilization, especially in summer. Avoid splashing water. Plant resistant varieties; P. coccinea cv. 'Sensation', P. koidzumil cv. 'Santa Cruz Prostrata' and hybrids 'San Jose' and 'Shawnee'.	Copper hydroxide, copper sulphate
Plant scab-resistant varieties; 'Shawnee', 'Rutgers', Fiery Cascade'. Avoid wetting foliage when irrigating. Apply fungicide sprays in the spring as leaves emerge.	Chlorothalonil, mancozeb, propiconazole, thiophanate methyl

DISEASE	SEASONAL OCCURRENCE	SYMPTOM DESCRIPTION
	ROSE	
Black spot (*Diplocarpon rosae*; syn. *Marsonnina rosae*)	January-December; peak in March-June and August-October	Two stages of the disease may be present. 1) Black, round to irregular spots with fringed margins mainly on the upper leaf surface. Tissue around spots turn yellow; causes premature defoliation. Infection is favored by prolonged leaf wetness, poor air circulation and high humidity. It occurs throughout the growing season. 2) Reddish sunken lesions develop on the young canes or on canes overwintering from the fall. These lesions are the primary source of spores to initiate leaf infection in early spring.
Powdery mildew (*Sphaerotheca pannosa* var. *rosae*)	January-December; peak in April-July, November	White to grayish patches appear on the leaves, flowers, and stems. Patches enlarge rapidly and may cover the entire leaf. Affected leaves dry and drop prematurely.
Downy mildew *(Peronospora sparsa)*	April-July; peak May	Purple irregularly shaped lesions develop on the upper leaf surface. Spots often concentrated along veins and midrib. Grayish, fuzzy growth seen on the leaf underside opposite purple leaf spots in wet weather. Infection is favored by cooler, wet weather. Mostly seen in late spring and sometimes early fall.
Rose Mosaic Virus	May-October	Yellow or white mosaic pattern or patches on the green leaf. Does not significantly harm plants. Affected leaves may scorch or drop prematurely.
Common stem canker *(Coniothyrium fuckelii; Leptosphaeria coniothyrium)*	March-October; peak in June-July	Often develops on the canes at the pruning wound. Young cankers are yellowish or reddish. With age, cankers turn brown, sunken, and cracked. Center turns light gray-brown with dark border; numerous pycnidia (fruiting structures) develop beneath its upper surface.
Rust (*Phragmidium* spp.)	April-July; peak in June	Bright orange to rust colored pustules develop on the underside of leaves. Yellow spots develop on upper side of leaf. Severely infected leaves drop prematurely. Infection most common in early summer during periods of prolonged leaf wetness, warmer day and cooler night temperatures.
Crown gall *(Agrobacterium tumefaciens)*	March-October	Galls form at the soil line, but also can form on branches or roots, are initially white, spherical, and soft. Galls darken with age as the outer cells die.
	SYCAMORE	
Anthracnose *(Apiognomonia veneta)*	April-June; peak in May	Dead twigs and branches have sunken cankers. Bud death followed by new bud formation and death gives witches-broom-like proliferation of branch ends. Black fungal fruiting structures visible in spring on bark of newly killed twigs. Leaves, especially in lower and inner branches, are blighted in spring with tan dead areas expanding along leaf veins. Large and irregularly shaped areas are killed along the leaf margins and between the veins.

SUGGESTED CONTROL PRACTICES	FUNGICIDES USED
ROSE	
Use sanitary measures by destroying infected leaves and canes of the previous year. Mulch under plants. Avoid wetting leaves. Prune canes to allow for better air circulation through the plant. Begin a fungicide spray program before the disease appears in early spring and continue at 7-10 day intervals throughout the growing season.	Chlorothalonil, mancozeb, propiconazole, thiophanate methyl
Apply protective fungicides at the first sign of infection and reapply at 10-14 day intervals. Mulch under plants. Remove old fallen leaf litter. Increase air circulation around plants.	Myclobutanil, propiconazole, thiophanate methyl, triadimefon
Remove affected leaves. Mulch plants and remove fallen leaf litter. Avoid wetting foliage. Apply a protective fungicide application at the first sign of the disease and repeat application 10-14 days later or as label directs.	Fosetyl aluminum, mancozeb
No control necessary. Pruning will not remove virus from plant. Symptoms may show up more when the plant is stressed (water, cold temperatures).	None
Avoid wounding plants. Prune cankers when observed and apply protective fungicide to pruning cut. Avoid wetting foliage and sprinkler irrigation.	Chlorothalonil, mancozeb
Remove fallen leaf litter. Mulch plants. Apply fungicides at the first sign of disease and reapply at 10-14 day intervals.	Myclobutanil, propiconazole, triadimefon
Purchase and propagate gall-free plants. Avoid wounding plants, especially at the soil line. Disinfect grafting tools with 70% isopropyl alcohol (rubbing alcohol) or 10% bleach solution. Remove severely infected plants.	None
SYCAMORE	
Prune and destroy dead twigs and branches during dormancy, cutting 3-4 inches below the canker. Plant resistant cultivars that have been propagated from 'Liberty', 'Bloodgood', or 'Columbia' clones of London plane trees. These London plane tree clones are resistant to this disease. Tree injection in the fall before leaf drop has provided some protection.	None provide good control.

DISEASES OF TURF

Introduction

Turfgrasses are an essential part of home landscapes and recreation areas. Attractive lawns make ideal settings for homes, adding beauty to the neighborhood. Turfgrasses also reduce dust, glare, heat and noise, and prevent erosion and surface runoff. Turfgrasses can also increase the value of properties. Due to Georgia's increasing population, range of climates, and wide variety of turf choices, the popularity of turfgrass has increased tremendously. However, due to the warm and humid weather of Georgia, disease problems can occur in lawns. The key to disease control is a healthy plant. Under proper turfgrass management, disease causing conditions are reduced and a healthy turf is maintained. The following management practices will help produce a vigorous, healthy turf and reduce turfgrass disease problems.

a) Prepare the soil properly. The key to successful turf establishment is proper soil preparation.
- Take soil samples to determine proper fertilizer requirements.
- Remove all debris such as rocks, tree stumps and other wood debris.
- Provide proper water drainage. The area should be graded to prevent surface water collection.

b) Plant locally adapted turfgrass species. Obtain information for recommended varieties for the area.

c) Purchase high quality disease free seed, sod or sprigs. Plant material certified for varietal purity and freedom from noxious pests is recommended when available. Nematodes and disease problems can be brought in on springs and sod.

d) Follow proper irrigation practices.
- The single most cost effective practice that enhances turf growth is proper irrigation.
- Apply water only at the first signs of moisture stress dull and bluish green color, leaf blade folding or rolling, and footprints remaining after walking over the area.
- If the soil becomes compacted, loosen it through cultivation such as core aeration, so the water can penetrate into the soil.
- Irrigate early in the morning. Late afternoon irrigation will encourage disease development during the night. Irrigation after dew development and before sunrise is most efficient and will not increase disease problems. Irrigate deeply and infrequently.

e) Apply fertilizer according to soil analysis recommendations.
- Disease incidence is increased by improper fertilization.

f) Mow at the recommended cutting height.
- Mow turfgrasses no more than 1/3 of the plant. If more plant material is removed, the grass will become stressed and more susceptible to disease causing organisms.
- Keep mower blades sharp. Dull blades shred leaf tips, causing turf to use more water, undergo undue stress, and provide pathogen infection entrances.
- Raise the mowing height during stress periods such as drought.

g) Remove excess thatch.
- Excess thatch reduces water infiltration, creates shallow rooted turf, and encourages insect and disease problems. If the lawn is not mowed, irrigated, and fertilized correctly, thatch accumulation could create a problem. Disease causing organisms survive and multiply in thatch. Excess nitrogen is a major cause of thatch accumulation.
- If excess thatch accumulates, the lawn will feel soft and spongy. If the thatch layer is thicker than ½ inch, de-thatching is needed.

h) Allow for adequate light and air movement in shaded areas.
- In heavily shaded areas, excessive moisture on grass blades can be a problem.
- Prune trees and shrubs, and design landscape plantings so humidity is reduced by light penetration and air movement.
- Raise the mowing height in shaded areas to help the plant absorb the limited light penetrating the tree canopy.
- Reducing fertilizer amounts by 20 to 50 percent in full areas also helps the grass better cope with the limited light.

i) Follow recommended disease, insect, and weed control practices.
Chemicals are not the answer to disease problems. Proper management practices will reduce pest problems and reduce the need for chemicals.

Specific Diseases in Georgia Turfgrasses

Disease—Brown Patch
Causal agent—Rhizoctonia solani, R. zeae, R. oryzae
Susceptible turfgrasses—Brown patch can infect all species of warm and cool season turfgrass in Georgia, including St. Augustine grass, zoysiagrass, bentgrass,

ryegrass, centipede and bermudagrasses. It is one of the most common turfgrass diseases in the state.
Symptoms—The symptoms of brown patch can vary depending on grass cultivar, soil, and climatic conditions. This disease typically causes rings and/or patches of blighted turfgrass that measure 5 inches to more than 10 feet in diameter. It also causes leaf spots and "smoke rings", which are thin, brown borders around the diseased patches that appear most frequently in the early morning. After the leaves die in the blighted area, new leaves can emerge from the surviving crowns. On wide bladed species, leaf lesions develop with tan centers and dark brown to black margins.

Conditions Favoring Disease Development—The most favorable conditions for disease development usually occur from late April through October. Brown patch is favored by high relative humidity and temperatures of over 80°F during the day and over 60°F at night. This disease can be quite active on warm season grasses in the spring and fall. It also occurs in areas that experience more than 10 hours a day of foliar wetness for several consecutive days. Brown patch infestation is more severe when the turf is cut to a height less than the optimum for the turfgrass being grown. Heavy nitrogen applications increase susceptibility to brown patch.

Control—Management plays an important role in brown patch control.
- Use low amounts of nitrogen, moderate amounts of phosphorous, and moderate to high amounts of potash.
- Avoid nitrogen application when the disease is active.
- Increase the cutting height.
- Increase the air circulation.
- Minimize the amount of shade.
- Irrigate turf early in the day to allow the foliage to dry as quickly as possible.
- Improve turf drainage.
- Reduce thatch.
- Remove dew early in the day by dragging a hose or mat over the turf.
- Fungicides are available to control the disease. Consult the current "Georgia Pest Management Handbook."

Disease—Dollar Spot

Causal Agent—Sclerotinia homoeocarpa
Susceptible turfgrasses—All species of warm and cool season turfgrass. Tall fescues, bentgrass, zoysiagrass and bermuda hybrids are particularly susceptible.
Symptoms—Dollar spot causes sunken, circular patches that measure up to few inches on turfgrass. The patches turn from brown to straw color and may eventually coalesce, forming irregularly shaped areas. Infected leaves may display small lesions that turn from yellow green to straw color with a reddish brown border. The lesions can extend the full width of the leaf. Multiple lesions may occur on a single leaf blade. Abundant white fungus growth may be seen in these areas during periods of severe disease development.

Conditions Favoring Disease Development—Dollar spot is favored by temperatures between 59°F to 86°F, continuous high humidity, and low soil moisture. This disease is particularly favored by warm days, cool nights, and intense dews. It also infects areas with low levels of nitrogen and becomes more severe in dry soils. Dollar spot is more common during the spring and fall months.

Control—Management practices helpful in controlling this disease include the addition of nitrogen and providing sufficient soil moisture.
- Use an adequate level of nitrogen, particularly in the spring and early summer.
- Mow grass at regular intervals.
- Irrigate turf early in the day to allow the foliage to dry as quickly as possible.
- Reduce thatch.
- Increase the air circulation.
- Irrigate turf deeply and as infrequently as possible to avoid drought stress.
- Remove dew from the turf early in the day.
- Fungicides can be used to help bring the disease under control once it is established. Consult the current "Georgia Pest management Handbook."

Disease—Pythium root rot

Causal Agent—Pythium spp.
Susceptible Turfgrass:
Annual bluegrass, tall fescue, perennial ryegrass and varieties of bentgrass, bermudagrass, centipedegrass, zoysiagrass and St.Augustinegrass. Pythium root rot is common on highly maintained turf and is becoming more widespread in Georgia. This may be attributed to increased watering.

Symptoms—Pythium root rot is common on highly maintained turf. Although symptoms of Pythium root rot are typically non distinctive, this disease can appear as yellow, irregularly shaped patches. The affected turfgrass is thin, off color and slow growing, while the root system is stunted with reduced volume and vigor.

Conditions Favoring Disease Development—Wet conditions are required for Pythium blight development. Some Pythium species favor temperatures between 32°F and 50°F while others thrive in temperatures between 70°F and 90°F. In

Georgia the disease is most favored by warm temperatures. Cool season grasses, (ryegrass, fescue, and bentgrass) are usually seeded in the fall when temperatures are favorable for disease. Regular irrigation is required following seeding, and this watering may promote disease development. Grasses are somewhat more susceptible in the young seedling stage, so Pythium occurs most often in the fall and on warm winter days on cool season grasses. Pythium root rot also infects locations with low mowing height and excessive wear.

Control—Use treated seed. Delay overseeding until the start of cool weather or as late as possible. In Georgia, generally mid October is the key overseeding period.
- Increase the cutting height.
- Apply optimum amounts of nitrogen, phosphorous and potassium.
- Reduce mowing frequency and use lightweight mowers.
- Avoid over watering.
- Apply low amounts of nitrogen in the spring when roots are forming.
- Minimize the amount of shade.
- Improve turf drainage.
- Reduce soil compaction through aerification by using lightweight equipment.
- Fungicides are available to control the disease. Consult the current "Georgia Pest Management Handbook".

Disease—Fairy Rings

Causal Agent—Basidiomycetes of more than 40 species can cause fairy ring; causal agents include: Agaricus campestris, Chorophyllum molybdites, Collybis spp., Hygrocybe spp., Lepiota sordida, Marasmius oreades, Psalliota spp., Scleroderma spp., Tricholoma spp., and Lycoperdon clitocybe.

Susceptible Turfgrass—All species of warm and cool season turfgrass. The disease is particularly damaging on centipede and St. Augustinegrass in south and coastal Georgia.

Symptoms—The first indication of a fairy ring is a circular or semicircular band of stimulated grass a few inches wide. The band of grass forming the ring is usually greener than the grass in the center. The stimulation of the grass is due to the availability of nutrients resulting from the decomposition by the fungus of organic matter in the soil, and various toxins produced by the fungus itself. Grass inside the ring area may be in a state of decline. In young rings, there may be a dead band of grass a few inches to several feet wide forming a partial or complete ring. The green stimulated ring gradually enlarges, forming an even larger circle. The most characteristic symptom associated with fairy ring is the presence of mushrooms in the stimulated grass ring during rainy, moist periods, but it is not an essential diagnostic character.

Conditions Favoring Disease—While fairy rings typically occur in the summer, this disease can also occur on cool season turfgrass in mild winter climates. Once the mushroom fungus becomes established, it can grow and increase the size of the ring in moist, warm weather. The mushroom fungi produce toxins that inhibit turfgrass growth. The fruiting structures appear during very wet periods, usually in the spring or fall.

Control—Avoid using root zone mixes with high levels of un decomposed organic materials.
- Reduce thatch by vertical cutting.
- Aerate soil.
- Irrigate deeply.
- Use nitrogen fertilizer to mask symptoms on some types of fairy ring.
- Use soil wetting agents to help penetrate hydrophobic areas.
- Fungicides are available to control the disease. Consult the current "Georgia Pest Management Handbook".

Disease—Fading Out or Melting Out

Causal Agent—Curvularia spp., Drechslera spp. and/or Bipolaris spp.

Susceptible Turfgrass—Perennial ryegrass, Tall fescue and all varieties of bentgrass, bermudagrass, zoysiagrass and centipede.

Symptoms—Leaf spot (melting out) causes purplish brown to black spots with tan centers on the leaf blade and sheath. The lower leaves of the infected plants become shriveled and blighted. When melting out infection is severe, almost all of the leaves and tillers die, causing severe thinning of the stand—or melting out. On cool weather turfgrass, melting out typically follows the appearance of leaf spots.

Conditions Favoring Disease Development—Disease favors temperatures between 40°F and 80°F. It occurs in areas that experience more than 10 hours a day of foliar wetness for several onsecutive days. It also favors high amounts of nitrogen and a low mowing height. It also becomes more severe in dry soils.

Control—
- Reduce turf stress by using lightweight equipment.

- Increase air circulation to speed turf's drying process.
- Avoid the application of high rates of water soluble nitrogen in the spring.
- Minimize the amount of shade.
- Irrigate turf deeply and as infrequently as possible.
- Reduce thatch in the early spring or fall for cool season turfgrass, and in the summer for warm season turfgrass.
- Avoid using systemically translocated fungicides, plant growth regulators, and herbicides.
- Fungicides are available to control the disease. Consult the current "Georgia Pest Management Handbook".

Gray leaf Spot

Causal Agent—Pyricularia grisea

Susceptible Turfgrass—St. Augustinegrass, Perennial ryegrass, Bermudagrass, Centipedegrass, Bentgrass and various species of Fescue.

Symptoms—The symptoms of gray leaf spot vary depending on the grass cultivar. On St. Augustinegrass, gray leaf spot first appears as small, brown spots on the leaves and stems. The spots quickly enlarge to approximately ¼ inch in length, become bluish gray in color, and oval or elongated in shape. The mature lesions are tan to gray in color and have depressed centers with irregular margins that are purple to brown in color. A yellow border on the lesions can also occur. In cool season turfgrass, the symptoms are similar to those of melting out.

Conditions Favoring Disease Development—Gray leaf spot is favored by temperatures between 80°F to 90°F. It is also found in areas with high nitrogen levels that are also stressed by various factors, including drought and soil compaction. This disease is most severe during extended hot, rainy, and humid periods. The disease is often severe under semi shade when frequent showers occur or when frequent irrigation produces high relative humidity.

Control—
- Avoid medium to high nitrogen levels during mid summer.
- Irrigate turf deeply and as infrequently as possible to avoid water stress.
- Allow water to remain on leaves for only a short period of time.
- Reduce thatch by vertical cutting.
- When possible, plant turfgrass that is resistant to gray leaf spot.
- Avoid using herbicides or plant growth regulators when the disease is active.
- Fungicides are available to control the disease. Consult the current "Georgia Pest Management Handbook".

Take all Root Rot

Causal Agent—Gaeumannomyces graminis var. graminis.
Susceptible Turfgrass: Varieties of bentgrass, St. Augustinegrass, bermudagrass and centipedegrass. Bluegrass and fescues are rarely affected in Georgia.

Symptoms—Take all root rot causes wilted circular patches that are brown or bronze colored and measure up to several feet in diameter. Infected plants have dark brown roots. Take all patch is common on newly established turf.

Conditions Favoring Disease development—Take all root rot typically occurs in wet conditions and in areas with a high (alkaline) soil pH being most severe at pH 6.5 or above. This disease is more severe on less fertile and sandy soils.

Control—
- Use acidifying fertilizers.
- Apply moderate to high levels of phosphorous, potash and minor elements where these nutrients are depleted from the soil.
- Improve the drainage of the turf.
- Reduce thatch.
- Fungicides are available to control the disease.

Slime Mold

Causal Agent—Mainly Physarum spp. and Fuligo spp. There are other species causing slime mold.

Susceptible Turfgrass—Warm season grasses.

Symptoms—Large numbers of pinhead sized fruiting bodies of these fungi may suddenly appear on grass blades and stems in circular to irregular patches 1 30 inches in diameter. Affected patches of grass do not normally die or turn yellow, and signs of the fungi usually disappear within 1 2 weeks. These fungi normally reproduce in the same location each year. The fungi are not parasitic, but they may shade the individual grass leaves to the extent that leaves may be weakened by inefficient photosynthesis.

Conditions Favoring Disease Development—Slime molds are favored by cool temperatures and continuous high humidity. An abundance of thatch favors slime molds by providing food directly in the form of organic matter.
Management Tips—

- Remove slime mold by mowing.
- Raking and disposing of the slime mold is usually all that is required.
- The slime mold will go away in warm dry weather conditions.

Disease—Centipede Decline

Causal Agent—Several Factors

Symptoms—Yellowing or chlorosis is one of the first symptoms which may indicate centipede decline. This is the result of a lack of iron which may be caused by pH or fertility problems. If:grass appears to be spongy, excessively thick, and can be slightly lifted from the soil surface by pulling on the foliage, this is indicative of a poor root system which is generally due to excess thatch, compacted soil, drought, or nematodes. Advanced stages of centipede decline will appear to be randomly placed, irregular dead areas in an otherwise healthy lawn.

Conditions Favoring Disease Development—Factors which contribute to centipede decline include improper nutrition, cultural practices, and soil and water conditions. The nutrient requirements for centipede are quite different from most other turf grasses. As the pH goes above 5.5, the amount of available iron decreases. Iron deficiency causes the grass to become chlorotic or yellow. Centipede naturally is a lighter green than most other turfgrasses. Centipede is a low growing grass which responds to mowing 1 to 1 1/2 inches. If the grass is mowed often enough so that no more than 1/4 to 1/3 of the leaf is mowed, the clippings do not have to be collected. During stress periods such as summer heat or the coming of winter, it is a good idea to raise the mowing height slightly. The brown grass present after winter should be removed in the spring at or just before new growth begins to appear. Removal can be completed by lowering the mowing height 1/4 to 1/2 inch, scalping and collecting the dead plant material.

Care should be taken not to remove too many runners from which growth may occur. If excessive thatch is a problem, two to three years may pass before satisfactory results can be obtained from vertical mowing or de thatching. Use proper water management practices. Proper watering is very important to the vigor of Centipede because it has a limited root system. This grass should only be watered just before it wilts. Water should be applied to soak the soil to a depth of 5 to 7 inches. This may require leaving the sprinkler in one spot for 2 to 3 hours. If the grass does not receive adequate water during summer dry periods, it may enter the winter weakened and more subject to winter injury.

INSECTS OF TURF

Importance of Pests

Home lawns in Georgia are commonly infested with insects and related pests. Several species cause serious damage, while others are simply a nuisance. These pests can be divided into two groups based on where they are found: soil inhabitants and thatch inhabitants. Both groups can destroy turf. Knowledge of pest biologies, life histories, and habits is needed before effective control programs can be implemented.

Nature of Damage

Damage to turfgrass from insect pests takes many forms. Damage caused by soil inhabitants such as white grubs, ground pearls, and mole crickets usually shows up as patches of wilted, dead, or dying grass. Damage to turf by thatch inhabitants such as sod webworms, armyworms, and cutworms is apparent when grass blades show evidence of chewing or have been cut off close to the ground. Damage by chinch bugs or spittlebugs is similar to damage caused by soil inhabitants. Irregular spots of yellowish turf and dead spots may occur where chinch bug or spittlebug infestations go uncontrolled.

Management of Pests

In Georgia, most insect pests of turf can be controlled when damaging populations are found. However, remember that the first step to management of lawn pests is prevention.

Good cultural practices are essential to prevent insect pests from destroying turf. Use approved methods of fertilization, watering, mowing, etc., to keep grass healthy and growing vigorously. A healthy lawn can tolerate light insect infestation; rapidly growing healthy turf will quicly erase signs of insect damage.

Thatch removal is one means of preventing insect outbreaks. Heavy thatch accumulation, particularly in St. Augustine lawns, provides an ideal environment for chinch bugs, spittlebugs, and caterpillars. Thatch also interferes with insecticidal control.

The next step to management of turfgrass pests is early detection. This is the weakest link in pest management programs for lawns. Pests are difficult to see until damage is observed. There are, however, several techniques which are useful in detection and monitoring insects in turfgrass.

The sweep net is a useful tool for finding caterpillars, aphids and chinch bugs. The net frame should be sturdy and the net bag should be of solid cloth. Sweep the net back and forth across the turf in areas where you suspect pests. After several sweeps, turn the bag inside out to dump the contents into a container for inspection.

Floatation can be used to detect the presence of chinch bugs. Remove the bottom from an oil can, coffee can, or similar container. Push the can one to three inches deep in the turf in an area of suspected chinch bug infestation. Fill the can with water and hold the water level above the grass for about five minutes. If chinch bugs are present they will float to the surface.

Irritation is another method of sampling for turf insects. It is particularly useful in mole cricket surveys. Lemon scented dishwashing detergent is a good inexpensive irritant. Mix the detergent with water and pour over a small area of turfgrass. The detergent irritates sensitive soil inhabiting pests causing them to quickly come to the surface. Use one ounce liquid detergent per gallon of water. Use one gallon of water to sample a one square yard area of turfgrass. Pyrethrin is also a good flushing agent when used at a concentration of one to three percent in water.

Close observations are useful for early detection of potential pest outbreaks. For example, the most critical time for turf damage by chinch bugs is July and August. During this period the turf is frequently under moisture stress and the feeding activity of chinch bugs is greatest. Early stages of chinch bug nymphs are not easily seen and damage symptoms are not severe enough to be noticed. Close observation of susceptible turf during early June is critical in detecting chinch bugs before damage occurs. St. Augustine lawns as well as bermudagrass and zoysiagrass should be closely monitored for the presence of chinch bugs if the pest has been observed during previous years.

Damage symptoms on grasses, sod uprooted by animals feeding on insects, the presence of moths flying over turf areas at night, and birds frequenting a particular area of the lawn are all clues that indicate the presence of lawn pests. By detecting insect pests early, we have sufficient time to correctly identify the pests, choose an appropriate control, and apply controls before the turf is damaged severely.

Correct Identification—Insect pests must be identified correctly before the appropriate method of control can be chosen. The biology and life cycle of identified pests will provide information on control methods.

Proper Selection of Control Materials—Materials labeled for insect control on home lawns are available in several formulations: baits, emulsifiable concentrates, wettable powders, soluble powders, and granules. The formulation selected, as well as the specific insecticide chosen, determine the level of control. For example, bait formulations are superior in spring and fall for mole cricket control, whereas sprays or granules give better control in the summer.

Correct Application Methods—Application methods are extremely important in turf insect control. The homeowner may use the most effective insecticide available, but if the method of application is poor, the level of insect control will be disappointing.

Distribution—When treating turfgrass, liquid materials should be applied as coarse sprays. Sprays with fine particles may drift and evaporate. The volume of water needed for proper application will vary according to the situation. The greater the thatch accumulation, the higher the spray volume needed. In addition, large volumes of spray are needed for the soil inhabiting pests, such as mole crickets and white grubs. Generally, use of higher spray volumes results in more uniform distribution of insecticide.

Irrigation Requirements—Timely use of irrigation will improve results of application of insecticides for soil inhabiting pests. During dry weather irrigating the turf prior to treatment will help the insecticide penetrate through grass blades and dry thatch. An additional half inch to one inch of irrigation water after treatment will carry the insecticide down through thatch and into the soil to the root zone. Delays in irrigating after insecticide application will greatly reduce the chances of good control.

Pest Identification, Life Cycle and Diagnosis

Turfgrass pests may be classified by the part of the turfgrass environment that they inhabit.

SOIL INHABITING INSECTS

Ground Pearls

Identification—These are scale insects that live in the soil. The immature stages are spherical and range in size from a grain of sand to about 1/16 inch in diameter. They are usually yellowish purple in color. The adult female is 1/16 inch long and pink and has well developed forelegs and claws. Adult males are tiny gnat like insects.

Eggs are laid in the soil during spring. The young (nymphs) hatch and feed on fine grass roots. Nymphs cover themselves with hard, globular shells that look like tiny pearls, hence the name “ground pearls.” The time required for development from egg to adult is one to two years.
Damage—These insects suck juices from underground parts of warm season grasses. Centipede grass is most commonly attacked. Severely infested grass turns yellow, then brown.
Control Strategies—Good cultural practices including proper watering, fertilitzer management, and appropriateturf selection. Unnecessary applications of broad spectrum insecticides may supress natural predators including ants.

Billbugs

Identification—Adult billbugs (a) are weevils 1/5 to 3/4 inch long. The reddish-brown to black adults have a pair of jaws at the tip of a long snout or “bill.” The young (b) are white, legless grubs about 3/8 inch in length with the rear end wider than the head. The “hunting billbug” is the most common type found in Georgia. It occurs throughout the state.

Life Cycle and Biology—Adults feed above ground and deposit eggs in the stems of host grasses. Hatching larvae feed within the stems; larger larvae feed on the crown; mature larvae feed on the roots of the turf. One generation occurs annually, but adults and larvae may be found at any time of year.

Damage—Zoysiagrass and bermudagrass are most often injured, but feeding may occur on many grasses. When infestations are heavy, roots of grass are destroyed and the turf is killed in irregular patches. Early damage resembles dollar spot disease—small spots of dead or dying grass. The most damage occurs in June and July. Damage from billbugs differs from white grub or mole cricket injured turf in that infested soil usually stays firm.

Control Strategies—Varieties of turf resistant to billbug damage are available and should be considered when establishing a new lawn in an area with a history of billbug problems. Maintaining constant soil moisture and moderate fertility levels during the fall months into winter helps mask damage by low-moderate infestations. An insecticide application in mid- to late-May and repeated in June can help reduce adult activity.

Mole Crickets

Identification—Mole crickets (a) are light brown, up to 1 1/2 inches long, have short, stout forelegs, spade-like front legs, and large eyes. The young (b) resemble the adults except that they are much smaller, have no wings, and are sexually immature.

Three species occur in Georgia. Two, the tawny mole cricket and the southern mole cricket, are pest species. Mole crickets occur primarily in the sandy soils of the Coastal Plain.

Life Cycle and Biology—Adults lay eggs in underground cells in the spring. The eggs hatch in two to four weeks, depending on the weather. Nymphs feed and grow through the summer and mature into adults in the late fall or winter. Mole crickets spend the winter deep in the soil, but come to the surface to feed during warm periods. Adult crickets leave the soil on warm spring nights to fly around, sometimes in huge numbers, looking for mates and egg-laying sites. There is one generation per year, and most adults die by early summer.

Tawny mole cricket mating flights occur in March and early April; southern mole cricket flights occur later in April and in early May. Cold or wet spring weather may delay flights.

Damage—The most damaging species of mole crickets feed on grass. Other species don’t feed directly on grass, but their tunneling activity damages turf. Both young and adults burrow beneath the soil and make tunnels similar to, but much smaller than, those made by moles. This loosens the soil and causes it to dry out quickly. It also clips the roots of the grass plants. Left unchecked, mole crickets will build up in an area and completely destroy the grass, leaving bare ground.

Control Strategies—Insecticidal control of mole crickets is most effective in summer (late June or early July) when most of the mole cricket eggs have hatched and nymphs are still small. Granular or spray insecticides are the formulations of choice for summer

White Grubs

Identification—These grubs (a) are plump, C-shaped insects with three pairs of legs. They are whitish with dark areas near the rear. They have a distinct, brown head. The adults are beetles (b) commonly referred to as chafers, May beetles, June beetles, Japanese beetles or green June beetles. They occur throughout the state of Georgia.

Life Cycle and Biology—Adult female beetles lay their eggs in the soil. The grubs hatch and spend most of their life beneath the soil feeding on underground plant parts. Most have rather long life cycles. The grub

stage can last from several months to two or three years. Most species of grubs found in Georgia have a one year life cycle.

Damage—Grub feeding destroys roots, leaving the tops to wither and die. In heavy infestations, roots are pruned off to the extent that turf can be rolled back like a carpet. Symptoms of grub damage include yellowing or browning of the grass and signs of drought stress when moisture levels are good. Grass may feel spongy when infestations are heavy.

Control Strategies—White grub occurence is sporadic, so applying pesticides for anticipated grubs is not recommended. However, where adult activity has been observed, preventative applications may be warranted. Field trials show preventative insecticides perform best when applied before mid-August, or during egg laying.

Where Japanese beetles are common, do not plant susceptible plants such as roses, grapes, and crape myrtles near high maintenance turf areas. Most white grub species require moist soil for eggs to hatch. The young larvae are very susceptible to dessication so if turf can stand some moisture stress, consider withholding water in June, early July and when eggs and larvae are apresent. Moderate (fewer than 10 per square foot) grub infestation can sometimes be grown out if adequate water and fertilizer is applied in July-August and in April when grubs are feeding. This approach will not work during irrigation bans and where animals dig up grubs.

No registered insecticide is 100% effective; they usually kill 75% to 90% of grubs. Re-applications may be necessary if populations get very high. Apply pesticide when grubs are small amd actively feeding. Reduce thatch and irrigate after pesticide application.

LEAF, STEM AND THATCH INHABITANTS

Spittlebugs

Identification—Spittlebug adults (a), commonly called froghoppers, are about 3/8 inch long, dark brown or black, and have two orange stripes across their wings. The nymph is ivory-colored with a brown head. Nymphs (b) live inside masses of spittle or froth, hence the name “spittlebug.” They occur throughout Georgia.

Life Cycle and Biology—Adult females deposit orange eggs in bits of hollow stems and other debris. Nymphs hatch in about two weeks and begin to feed immediately by sucking juices from the grass. They cover themselves with a frothy mass known as spittle. There may be one or several nymphs in each spittle mass. The masses are found from just below the soil surface to a few inches above it. Two generations occur annually in Georgia. Overwintering eggs hatch in March and April. This generation reaches maturity by June. Adult activity is also noticeable in August and September, when the second generation matures.

Damage—Spittlebugs are associated with heavy thatch. A heavily infested area will feel “squishy” when you walk across it due to numerous spittle masses. Centipede grass is especially prone to spittlebug infestation; zoysia, bermudagrass, and bahiagrass also are susceptible. Populations often begin and increase in shady areas. The second generation appears to cause more injury. Populations, and therefore, damage, can be especially high during years with high spring and summer rainfall.

Control Strategies—Don’t allow a heavy thatch layer to accumulate. Adult spittlebugs feed on a number of shrubs and other plants, so avoid locating host plants that attract the adults, especially Japanese holly, near susceptible turfgrasses. Time insecticide treatment in heavily infested areas for July. Mow and irrigate the grass several hours before applying treatment late in the day.

Chinch Bugs

Identification—Adults are about 1/5 inch long and light in color with small black triangular patches on the wings. The wings are carried folded over the back. The nymphs are from 1/20 to 1/5 inch long and vary in color from reddish with a white band across the back to black as they near adult size. Chinch bugs occur throughout the state.

Life Cycle and Biology—The eggs are laid in leaf sheaths or crevices in nodes and other protected places. The young develop into adults in four to six weeks. There are three to four generations a year. The bugs insert their slender beak into the grass and suck the plant juices.

Damage—Typical injury appears as spreading patches of brown, dead grass. St. Augustine grass is the most seriously injured, but other lawn grasses, including zoysia, bermuda, bahia, and centipede grasses, also are subject to attack. Chinch bug infestations and damage are most often first noticed during hot dry periods in sunny areas of the lawn.
Control Strategies—A common method of determining population levels of chinch bugs is the “flotation technique.” A coffee can, or similarly sized can, with its ends cut away, is pushed two to three inches down into turf in a suspected area of chinch bug infestation. The can is filled with water and kept

full for about five to seven minutes by adding more water, as necessary. All stages of chinch bugs, if present, will float to the top. A threshold level of 20 to 25 chinch bugs per square foot can cause damage.

This monitoring technique should be repeated in several spots at the edge of the suspected area to increase chances of finding the bugs. Treat if populations are at or above the damage threshold. Pesticides should not be applied to turf in dry soil to avoid potential chemical injury. Several hours on the day before treating, irrigate the lawn.

Sod Webworms

Identification—Sod webworms (b) are caterpillars of small brown to dull gray moths (a). Webworms grow to a length of nearly 3/4 inch and vary in color from pinkish white to light green to yellowish brown with a light to dark brown or black head. They are covered with fine hairs. The moths (a) have a wingspan of about 3/4 inch. They fold their wings closely about their bodies when at rest and have a prominent forward projection on the head. Sod webworms are found throughout Georgia.

Life Cycle and Biology—Moths hide in shrubbery or other sheltered spots during the day. They fly over the grass in early evening. The female scatters eggs over the lawns as she flies. Two to three generations occur each year. Sod webworms feed only at night.

Damage—Damaged grass blades appear notched on sides and are chewed raggedly. Irregular brown spots are the first signs of damage. Large areas of grass may be damaged severely, especially under drought conditions. A heavy infestation can destroy a lawn in only a few days. Damage tends to become visible in mid to late summer and in highly maintained lawns. Sod webworms are partial to newly established lawns.
Control Strategies—Sod webworm populations (and those of other soil-inhabiting insects) can be monitored using the “irritation technique.” One ounce of lemon dish detergent is mixed with one gallon of water and the solution is poured over a one square yard area where an infestation is suspected. The detergent irritates the insects, causing them to come to the surface quickly. Damage thresholds vary in different areas. A rough guide is 15 or more larvae per square yard.

Insecticide application should be timed for treatment two weeks after peak moth activity and should be made during early evening hours when caterpillars begin feeding.

Armyworms

Identification—Armyworms (b), which attain a length of 1/2 inch, are also caterpillars of moths. Their bodies are greenish when small, but become brown when fully grown. Several stripes usually are apparent, extending from the head to the rear. The adult (a) is a mottled brownish-gray moth with a wingspan of nearly 1 1/2 inches. Armyworms occur throughout Georgia.

Life Cycle and Biology—Armyworm caterpillars pupate in the soil. The moths emerge within a couple of weeks. They are active mainly at night. There are three to six generations a year in Georgia. Female moths lay clusters of eggs on grass blades, lawn furniture, white or light colored walls, and other objects near lawns. Caterpillars hatch and begin to feed on the turf.

Damage—Damaged turf appears ragged with individual blades showing signs of chewing damage. When numerous, armyworms may devour the grass down to the ground. Young larvae skeletonize grass blades; older larvae feed on entire blades.

Control Strategies—The irritation technique described above for sod webworm also is effective for sampling armyworm populations. Populations tend to increase after drought conditions; maintain a consistent soil moisture level to help manage this pest. As with sod webworms, time insecticide applications to control armyworms during the early evening when caterpillars are feeding.

Cutworms

Identification—Cutworms, also the caterpillar stages of certain moths, grow to a length of 1 1/2 to 2 inches. The caterpillars (b) are mottled, dull brown, gray, or nearly black and usually appear plump and greasy. If disturbed, the caterpillar usually curls into a C-shaped ball. The front wings of the moth (a) are dark brown to gray, are mottled or streaked, and have a wingspan of 1 1/2 to 2 inches. Cutworms also occur throughout the state.

Life Cycle and Biology—Eggs are laid on grass and weed stems or behind the leaf sheath of such plants. Caterpillars usually remain below the ground surface, under clods, or other shelters during the day; they feed at night. Cutworms pupate in the soil. Three to as many as seven generations occur each year. Cutworms can be active all year.

Damage—Foliage or stems may be cut off (hence the name cutworm) by the caterpillars. Circular spots of

dead grass or sunken spots are indicative of cutworm infestation.

Control Strategies—The irritation technique described above for sod webworm also is effective for determining cutworm population levels. Insecticide treatment should be made when this technique flushes three to eight larvae per square yard. Due to their nocturnal behavior, it is best to time control measures for early evening when caterpillars are feeding. Do not irrigate turf after treatment is applied for control of caterpillars. For these pests, you want the material to remain at the surface rather than have it move down into the soil.application. In late summer, mole cricket baits or insecticides with longer residual activity will be more effective.

Effective control in spring and fall is difficult because of unpredictable weather, cricket activity, and their large dispersal flights. At these times of year, treat only severely damaged areas where grass is dying out. Spot treat with an appropriate insecticide. Bait formulations are most effective in spring and fall.

INHABITANTS WHICH DO NOT USUALLY DAMAGE TURF

Cicada Killer Wasp

Identification—This wasp is about 1 ½ inches long. It is marked with yellow and black markings on its body. Life Cycle and Diagnosis— The wasps dig burrows in the ground and mound the soil at the entrance. The female paralyzes a cicada by stinging it, then places it in the burrow and lays an egg on it. The larval stage of the wasp then feeds on the cicada. Cicada killer wasps usually appear in late July and August when adult cicadas are abundant. Although they generally have a mild disposition they can sting if molested. They cause no primary damage to lawns. Their presence is sometimes unnerving and their burrows may detract from the appearance of a well manicured turf.

Earwigs

Identification—Earwigs are reddish brown beetle like insects. They are narrow and elongated. Earwigs have a prominent pair of “pinchers” at the rear of their body.

Life Cycle and Diagnosis—Adult females lay their eggs in nests in the soil. The nymphs are cared for by the mother until they are ready to leave the nest. They may become quite numerous in lawns and begin to enter homes, where their presence is objectionable. Some species feed on young roots of plants, however, their value as scavengers and predators of other insects probably outweighs the harm they do.

Millipedes and Centipedes

Millipedes (thousand legged worms) and centipedes (hundred legged worms) are closely related to insects. They are slender, worm like creatures that are dark brown and have many body segments. They differ from insects in the number of legs they have (1 to 2 per body segment). Millipedes and centipedes cause no damage to lawns. Occasionally millipedes migrate from turf areas to inside the home where they become a nuisance pest. Their food is chiefly decaying vegetable matter.

Sowbugs and Pillbugs

Sowbugs and pillbugs, are similar to millipedes and centipedes and are closely related to insects. Sowbugs and pillbugs are brown to light gray in color. They are nearly ½ inch long with segmented bodies and seven pairs of legs. When disturbed, pillbugs roll up into tiny balls.

Sowbugs and pillbugs are usually found on damp ground under stones, boards, or dead leaves. They feed on organic matter in the soil, and sometimes on grass and other plants.

DISCUSSION QUESTIONS

1. What is the most common disease of turfgrasses in Georgia developing during periods of high humidity, high temperature and contributed to by high nitrogen applications?

2. Which turfgrass disease occurs in areas with high soil pH (alkaline soils), poor fertility and sandy soils?

3. What is the cause of most plant diseases?

4. Most crown and root rots of plants are caused by what pathogen?

5. What are some methods of scouting for turfgrass pests?

6. List the most common damage symptoms on ornamental plants.

7. What are the categories of insect pests of turfgrasses?

8. List 3 general diseases common to many plants.

TERMS TO KNOW

Abiotic - Nonliving; also refers to plant problems caused by nonliving agents, such as drought, lawn mowers, string-trimmers and so forth.

Acervulus (acervuli) - A saucer-shaped fungal structure bearing spores.

Avoidance - A disease-management strategy in which using disease-free plants or planting in sites unfavorable for disease development keeps disease problems from occurring.

Bacterium (bacteria) - A normally single-celled microorganism having a cell wall but no organized nucleus.

Bactericide - A chemical compound that is toxic to bacteria.

Biotic - Alive; caused by living agents. Usually a reference to diseases caused by living microorganisms.

Blight - A symptom or disease in which plant parts such as leaves, flowers, and stems are rapidly killed.

Bronze - A brown discoloration of many small, light, or tan spots caused by spider mite feeding.

Cambium - The thin layer of cells in the inner bark that gives rise to the conductive tissues, xylem, and phloem.

Canker - A localized dead area on woody tissue, often sunken, on a twig, branch, or stem, that can enlarge over time.

Causal agent - Either a biotic or an abiotic agent that causes a disruption of a plant's normal growth or physical properties.

Chlorosis - Whitish or yellowish discoloration of normally green plant material due to the lack of chlorophyll.

Chlorotic - Plant tissues that appear pale-green to yellow.

Clone - Asexually produced organisms that are genetically identical.

Conidium (conidia) - A fungal spore.

Conk - The large spore-bearing structures of wood-decay fungi.

Copper compounds - Pesticides containing copper that are used to manage fungal and bacterial diseases.

Cultivar - A cultivated variety of a plant. A named plant selection from which identical or near-identical plants can be produced, usually by vegetative reproduction or cloning.

Defoliate - To lose leaves.

Diagnosis - The process of determining the cause of a disorder.

Dieback - The gradual death of tissues beginning at the tips of branches that can kill part of or entire branches or groups of branches.

Disease - Any disturbance of a plant over some period of time that interferes with its normal structure, function, or economic value and that induces symptoms.

Disorder - Any disease caused by a noninfectious (non-living) agent.

Distortion - Abnormal shape.

Dormant - A state in which growth of seeds or other plant organs stops temporarily.

Eradication - Removal and destruction of diseased plants or plant parts.

Flagging - A disease or disorder symptom manifested by the leaves on a branch wilting, turning brown, and clinging to the branch for an extended period instead of falling off immediately.

Frost cracks - Longitudinal cracks in the stems of trees and shrubs that run parallel to the wood grain and extend to the center of stems and branches. Usually associated with extremely cold temperatures and previous wounds.

Fruiting structure, or **fruiting body** - A fungal structure made of mycelium and containing spores.

Fungicide - A chemical compound that is toxic to fungi.

Fungus (fungi) - A multicellular lower plant without chlorophyll. The fungus normally consists of strands called mycelium and reproduces through the dispersal of spores.

Gall - An abnormal swelling or growth of plant tissue that is initiated by a pathogen, insect, or mite.

Girdle - To remove the bark and cambium, exposing the inside of a plant stem. Plants that are girdled completely without any intact bark connecting the roots to the shoots usually die.

Hardiness zones - Distinct geographic regions delineated by isotherms of average minimum winter temperature.

Herbaceous - A vascular plant that does not develop persistent woody tissue above ground.

Honeydew - The sugary liquid excrement of sucking insects.

Host - Plant attacked by a pest or pathogen.

Hypha (hyphae) - A single filament of a fungus.

Infection - Process in which a pathogen enters, invades, or penetrates and causes disease with a host plant.

Infectious - Able to spread from plant to plant. For example, disease caused by living pathogenic microorganisms is infectious.

Injury - Physical removal, discoloration, or distortion of a plant part.

Inoculum - The part of a pathogen, or collection of individual pathogens, that can cause disease.

Leaf scorch - Leaf browning associated with rapid water loss.

Leaf spot - A discrete dead area on a leaf.

Lesion - Wound or delimited diseased area.

Marginal necrosis - Browning (death) of green tissue around the outer edges of a leaf.

Mildew - A plant disease in which white mycelium and spores

of the causal fungus are visible on the plant surface.

Mosaic - A pattern of yellow-and-green tissue intermingled on a leaf; typical of many virus diseases.

Mulch - Any material - such as straw, sawdust, leaves, plastic film, or loose soil - that is spread on the surface of the soil to protect the soil and plant roots from the effects of raindrops, soil crusting, freezing or evaporation, or to control weeds.

Mushroom - The fruiting structure of many wood-decay fungi, consisting of a rounded cap on a cylindrical stalk.

Necrosis - Localized death of tissue, usually characterized by browning and desiccation.

Necrotic - Showing varying degrees of dead areas or spots. Often used to describe brown spots left by insects or diseases that kill leaf tissue.

Nematicide - A chemical compound that is toxic to nematodes.

Nematode - A microscopic, wormlike animal that can be parasitic on plants.

Ooze - A sticky liquid composed of bacterial cells and the polysaccharides they produce.

Pathogen - A microorganism capable of causing disease.

Phytoplasma - A microorganism without a cell wall or organized nucleus that causes yellows diseases in plants.

Pustule - A small swelling similar to a blister or pimple.

Pycnidium (pycnidia) - An asexual rounded or flask-shaped fruiting structure.

Resistance - The ability to overcome or to slow the development of disease.

Ringspot - A circular area of chlorosis or necrosis with a green, healthy-appearing center.

Rot - Tissue breakdown.

Sanitation - The process of removing and destroying old or dead plants or plant parts from a site.

Saprophytic - Describes any organism that lives on dead or decaying matter.

Sclerotium (pl. sclerotia) - Hard, usually darkened and rounded mass of dormant fungal thread-like material with hard-cell walls that permit survival in adverse environments.

Scorch (leaf) - Dead (necrotic) tissues on the margins of leaves or between veins that results in browning and shriveling of foliage.

Soluble - Will dissolve in a liquid.

Solution - A mixture of one or more substances in another, in which all ingredients are completely dissolved.

Sooty mold - One of several species of fungi with black fruiting bodies that grow on the sugary liquid excrement of sucking insects.

Spore - The reproductive or propagative unit of a fungus, which can be formed from a sexual recombination or from cell division.

Spot treatment - Application of pesticide to restricted area or areas of a whole unit. For example, the treatment of spots or patches within a larger field.

Stress factor - An external force, such as drought, nutrient deficiency, air pollution, pathogen, or insect defoliation, that limits the ability of plants to acquire essential nutrients, such as water and carbon dioxide, from the environment.

Stroma (stromata) - A compact mass of hyphae that usually contains fruiting structures.

Stunt - To abnormally reduce growth of stems, branches, leaves, flowers, fruit, or roots of plants.

Stunting - Abnormally small size, dwarfing.

Sunscald - The term applied to dead or injured bark and cambial tissues. Sunscald results from cold bark temperatures followed warm bark temperatures. This condition usually occurs when thin bark tissues are warmed well above air temperatures in the winter months due to bright, sunny exposures. When temperatures suddenly drop from passing clouds or the onset of evening, freezing injury to the warmed tissues occurs. Also called frost cankers.

Susceptible - Capable of being injured or killed.

Symptom - A plant's reaction to a disorder resulting from a causal agent.

Systemic - Describes the property of insecticides or fungicides that penetrate and disperse throughout a plant; synonymous with translocated herbicide.

Telial gall - A swollen mass of host and fungal tissue formed by certain rust fungi on which spores are produced.

Tolerance - The ability of a living thing to withstand adverse conditions, such as pest attacks, weather extremes, or pesticides. The amount of pesticide that may legally remain in or on raw farm products at time of sale.

Venation - The distribution or arrangement of veins.

Virus - A submicroscopic pathogen consisting of a nucleic acid surrounded by a protein coat.

Wilt - The loss of water turgor pressure in a leaf, causing it to droop or curl or to lose a degree of its normal color.

Witches' brooms or **witches' brooming** - The broom like growth or mass proliferation of buds and shoots caused by a dense clustering of branches formed by simultaneous development of side shoots. Results from many causal agents, ranging from deicing salts, to insects, to fungi.

Yellow - A leaf discoloration that occurs when the green chlorophyll pigment degrades. Associated with sucking injury or leaf aging.