The black cutworm is a leaf feeding insect. These types of insects are more vulnerable to biological control products such as parasitic nematodes than subsurface inhabiting pests like grubs.

Biological insect control products have had limited success. Industry and university researchers continue their quest to find the best agents and application techniques.

by Harry Niemczyk, Ph.D., Ohio State University

Insecticides still remain the most effective means of controlling established populations of insects causing damage to turf. Interest in—and expectations for—biological means of controlling cool season insect pests of turfgrasses is at an all-time high.

Naturally occurring biological agents, such as parasites, predators, entomogenous (insect parasitic) nematodes, fungi and bacteria, remain important suppressors of insect populations (both beneficial and harmful) in turfgrasses. However, with the exception of the development of endophyte-enhanced perennial ryegrasses and turf-type tall fescues, and chinchbug resistant varieties of St. Augustine grass, the artificial introduction of cultured biological agents, such as nematodes and parasitic bacteria, has met with limited success, at best.

Despite the general impression that these agents are effective, the collective scientific data obtained to date simply does not support this conclusion.

The current strong desire for effective biological controls for turfgrass insect pests has led to expectations that far exceed those realistically achievable at this time.

The search continues

Researchers in industry and at state universities are not discouraged by the limited success of biological control agents. In fact, research in this area has intensified in all quarters. Major chemical companies are interested in and have obtained development and other rights to certain biological agents. This is an encouraging sign. Both industry and university researchers are working on new application tehnologies for more precise placement of biological control agents in order to bypass some of the natural bariers to effectiveness, such as desiccation, ultraviolet light and the thatch

The TOP 10 Cool Season Insect Targets

Pest	Spring April-May	Summer June-August	Fall-early winter Sept.-Dec.
1 Chinch bugs 	In northern zones, chinch bugs overwinter as adults in thatch or sheltered sites near buildings. They can become active during warm days in March. Infestations occur in zoysia, Kentucky bluegrass and fine fescues. As the warm days of spring approach, movement of chinch bugs increases rapidly. Generally, egg laying begins the first week of May, but can begin in mid-April if spring arrives early. Generally, application of insecticides to prevent infestations of chinch bugs should be completed by the first week in May. Applications may begin as early as the last week of March. Such applications must be made before significant numbers of eggs are laid. This time may vary as much as a week or more, depending on spring weather.	Chinch bug eggs continue to hatch into June. Bright red nymphs with a center white band appear. The number of chinch bugs increases rapidly in June. Their populations peak in July and August, when northern lawns can receive severe damage. This damage is often masked by summer dormancy of turf caused by drought. Hot, dry conditions are ideal for chinch bugs. During August, the nymphs molt into adults that mate and lay eggs, thus producing a second generation. Some northern areas have only one generation per year.	In the northern U.S., the second generation of chinch bug is at peak numbers in September. Nymphs complete their development to adults in late October. Most chinch bugs overwinter in the turf, but some move to protected areas before winter. Generally, infestation levels at this time are not high enough to warrant the use of insecticides. Early fall rains and infection by a parasitic fungus (*Beauveria app.*) usually provide sufficient control.
2 Billbugs 	Billbugs overwinter as adults in thatch or sheltered sites near buildings. They become active during warm days in March. Infestations also occur in zoysia, Kentucky bluegrass and fine fescues. Generally, application of insecticides to prevent infestations of billbugs should be completed by the first week in May. Applications may begin as early as the last week of March. Such applications must be made before significant numbers of eggs are laid. This time may vary as much as a week or more, depending on spring weather.	Bluegrass billbug larvae feed on grass stems during June and move to the plant crowns, roots and rhizomes during July. This feeding pattern causes brown spots that frequently resemble the symptoms of some fungus diseases. Symptoms are also masked when the turf is dormant from drought. The larvae usually move deeper into the soil under dry soil conditions. During late July and August, the larvae burrow deeper into the soil to pupate and transform into adults.	During September, billbug adults that developed from summer larvae are often seen on sidewalks, driveways or other paved surfaces. Before winter, these adults seek shelter in thatch, along sidewalk edges or near foundations and overwinter. Many, if not most, overwinter in turf. In some areas a partial second generation may occur. Larvae of this generation have been known to cause visible damage in September and October.
3 Sod webworms	Overwintered larvae of the sod webworm begin feeding as soon as the grass begins to grow. Usually damage is insignificant, but areas frequently have probe holes from starlings feeding on larvae. Moth flights begin in May in northern areas. Young larvae are usually present about two weeks after the spring moth flight peaks, so treatment of young larvae can be done in May in some areas.	Damage from sod webworm larvae occurs occasionally in most of the cool-season turf region. Injury is more common in Midwestern states, usually in July and August. Older sod fields or areas with heavy thatch are good candidates for infestation. There are generally one or two generations per year, depending on the species. 	Northern sod webworm larvae are small and cause little if any damage in the fall. Late in the fall the larvae construct a cocoon-like shelter in which they overwinter. The most common sod webworm species overwinter as larvae in the thatch or upper inch of soil. Feeding does not resume until hibernation (dipause) is broken by early spring warmth.
4 Cutworms 	Moths of cutworms blown north on the winds aloft begin laying eggs on golf course greens and other turf areas in the spring. These eggs hatch, producing larvae that feed on grass blades during the night. The black cutworm is the most common species on cool-season turf. While visible damage is uncommon on home lawns, damage can be significant on golf course greens in late May.	Cutworm larvae continue to cause damage to golf course greens from June through August. These larvae pupate in the soil or thatch and emerge as moths that lay eggs for additional generations.	Damage to golf course greens may be seen in September, but is not common. This insect does not overwinter in any known stage in the northern states.
5 Ants 	Various species occur in turf. Colonies located three or more feet under the surface. Nest cleaning and general activity resumes in April. New mounds begin to appear in late April and May. A single colony may have may surface openings, each with a mound of soil.	Nuisance mounding and foraging continues through the summer, paticularly in areas of sandy soils. Colony queens produce a steady flow of more ants. Mounds of soil two to three inches tall are replaced rapidly, causing damage to mowing equipment as well as shading out turf to cause small dead spots.	Mounding, foraging and production of more ants continues until late fall. Some species culture aphids in their colonies by placing them on turf roots. The ants feed on the sweet fluid produced by the aphids.
6 Greenbug aphid 	The only stage of the greenbug known to overwinter in northern states is the egg. Shiny black eggs deposited in the previous fall may be found adhering to grass blades, fallen tree leaves or other debris. Greenbug eggs begin hatching as early as April, but significant infestations do not develop until later in the year. Greenbugs are also brought into the region from the south on upper air winds. Aphid numbers are too low to detect in lawns at this time.	Damaging populations of greenbugs can occur from June-August. Populations and incidents of damage frequently vary from area to area, even within the same city. Symptoms of injury include turf under the dripline of trees and in open areas having a burnt orange color. When symptoms are apparent, numerous ashids (40or more) may be seen on a single grass blade. Close examination of damaged turf is necessary because the aphids are small. If left untreated, a heavy infestation can kill the turf.	Damage to golf course greens may be seen in September, but is not common. This insect does not overwinter in any known stage in the northern states.

Source: Dr. Niemczyk

The TOP 10 Cool Season Insect Targets

Pest	Spring April-May	Summer June-August	Fall-early winter Sept.-Dec.
7 Winter grain mite 	Damage from this mite is often first noted in March or April, when turf areas are receiving spring fertilizer applications. Winter grain mites are identifiable by eight bright red legs and a dark body. By late May, the mites will have laid their eggs and died. Mites do not appear again until the eggs hatch in October.	Mite is in the egg stage and not active at this time.	Spring laid eggs begin hatching in October. Occasionally, damage may be seen in December.
8 Clover mite 	Incidents of visible damage to home lawns are often seen in April in Ohio cities and Denver. Usually a nuisance pest in and around homes, the clover mite occurs in large numbers (5,000 per square foot) across entire lawns and on turf next to building foundations. Symptoms of injury were the same as the winter grain mite. Turf next to foundations may be killed. The clover mite has a slightly pink body and eight pale-colored legs. The first pair of legs is extremely long and protrude well out in front of the mite. The absence of bright red legs distinguishes the clover mite from the winter grain mite.	Adult mites lay eggs. Occasionally, some eggs hatch, giving rise to a summer gerneration.	Eggs hatch. Adults feed in turfgrasses, next to buiilding foundations and often enter buildings in large numbers. Turf next to foundations may be killed. Treatment of turf prevents damage.
9 Grubs 	Overwintered grubs return to the surface and begin feeding on turfgrass roots in April. Increased activity and damage from birds, moles, skunks and raccoons foraging on grubs can also be expected and continues through May. Treatment should be delayed uhtil the grubs are in the top one inch of soil. Irrigation or rain-fall should follow such applications to aid in moving the insecticides to the target grub as soon as possible following application. Although milky disease products for control of Japanese beetle grubs may be applied any time there is no frost in the soil, spring is a good time for such applications. The soil is open, and frequent rains move the disease spores into the soil and thatch. Milky disease products are primarily effective against Japanese beetle larvae. Ineffectivity against other species is low. Incidents of large grub infestations (June bug larvae, for example) have been increasing in cool-season areas. Locations of such infestations should be identified because reinfestation is likely every three years. Eggs are laid in May and June. Therefore, treatment should be made in late summer, early fall of that year or the next spring while larvae are small. Later applications against full-grown larvae have given inadequate control in past studies.	By June, grubs have stopped feeding and are in the pupal stage, three to four inches in the soil. Beginning mid-June and continuing through mid-July, the adults of various species emerge and burrow into the soil to lay eggs. Hatching and appearance of young larvae occur during July and August. Extreme heat and drought during the summer may cause some grubs to move deepeer in the soil. Under such conditions, irrigation several hours before treatment, and a thorough soaking afterward is adviseable. 	Most species of grubs are in the third of their three stages of development, and are feeding actively. When soil temperatures decrease in late October, the larvae burrow deeper into the soil to overwinter. If soil temperatures remain warm, larvae stay at the surface and continue feeding. Severely cold winters have little effect on survival. The larvae of this group of pests normally overwinter six inches or deeper in soil. If spring comes early, grub activity can be expected along with skunks and raccoons, which tear up the turf in search of them. Moles, which feed on grubs and earthworms, also become active at this time.
10 Black turfgrass ataenius	This golf course pest overwinters as an adult in the soil under debris in roughs or other protected areas. A few may be seen flying about on warm afternoons in early March, Usually this activity begins when crocus starts blooming and intensifies as the bloom of fed bud appears. Adults of the black turfgrass ataenius can be seen "at wing" in April and are often found in grass catchers after early mowing of golf course greens. These adults begin laying eggs in early May, or about the time Vanhoutte spirea first comes into bloom. Dursban applied to a fairways at this time kills adults and prevents summer infestation of larvae. Check with local extension entomologists for the precise time if needed. A second application, two weeks after the first, may be needed to successfully prevent infestation.	Eggs laid by beetles during May hatch in June and the larvae immediately begin feeding on turf roots and thatch. From late June to mid-July, symptoms of injury include wilting in spite of irrigation. In July, larvae move deep into the soil, pupate and emerge as adults. These adults lay eggs during August, producing a second generation in some states. The second generation larvae are capable of damaging turf. States farther north have only one generation.	By September, adults of the current generation begin to fly into protected areas, such as golf course roughs, to overwinter. Larvae that have not completed development to adults before the first frost are killed.

Source: Dr. Niemczyk

Cool Season Insects - Control Product Strategies

Pest	Spring April-May	Summer June-August	Fall-early winter Sept.-Dec.
Chinch bugs 	When summer damage is expected, preventive application of liquid or granular Dursban (1lb. Ai/acre); Triumph[1] (1lb. Ai/acre) may be used as soon as the insects become active. Preventative applications of insecticides should be completed by the first week in May.	Treat before injury is severe with Dursban (1lb. Ai/acre), diazinon** (2.5-5.5lbs. Ai/acre), or other labeled insecticides.	Treat if necessary, but generally, infestation levels are not high enough to warrant using insecticides.
Billbugs	Same as for chinch bugs. 	Treat infestations at same rates as grubs with Triumph[1], diazinon**, Turcam, Mocap or Sevimol. Application in mid-late June most effective. Irrigate following application.	Treatment is usually not appropriate at this time.
Sod webworms	Overwintered larvae can cause damage in April or May. When necessary, apply diazinon** (5lb. Ai/acre), Triumph[1] (1lb. Ai/acre), Dylox or Proxol (6-8lb. Ai/acre). Orthene (1-2lb. Ai/acre). Use flush of water-liquid detergent solution to determine level of infestation.	Make application when damage is seen, or larvae are present. Use Dursban (1lb. Ai/acre), Triumph[1] (1lb. Ai/acre), Diazinon** (5lbs. Ai/acre), Sevin-Sevimol (6-8lbs. Ai/acre), Proxol-Dylox (6-8lvs. Ai/acre), or other labeled insecticides.	Larvae are small and generally cause little damage at this time. Treatment in September reduces population and damage potential for next spring. 
Cutworms	The insecticides effective against sod webworm are also effective against cuworms. Apply late in the afternoon. Do not irrigate following liquid applications unless specified on label.	Use Orthene (1-3lbs. Ai/acre), Dursban (1lb. Ai/acre), Triumph[1] (1lb. Ai/acre), Proxol-Dylox (8lbs. Ai/acre) or Sevin-Sevimol (2-4lbs. Ai/acre). Do not irrigate following liquid applications unless specified on label.	Same as for summer. 
Ants 	If more than a nuisance, Dursban (1lb. Ai/acre) or Triumph[1] applied when ants first become active (April) provides control for about 30 days.	Retreatment likely to be necessary to control ants and mound building. Follow label instructions.	Treatment usually not necessary. Dursban (1lb. Ai/acre) may be used.
Greenbug aphid 	Aphid numbers are too low to detect.	Use Orthene (1lb. Ai/acre) or Dusban (1lb. Ai/acre) or Diazinon** (2.5lbs. Ai/acre).	Severe infestations may occur as late as December. Use the same insecticides as in the summer.
Winter grain mite	If needed, use spring treatment. 	If treatment is necessary, use liquid diazinon** (2-3lbs. Ai/acre) or Dursban (1lb. Ai/acre). Avoid repeated us of Sevin-Sevimol.	Infestations may develop in December under snow. Treatment is not appropriate.
Clover mites 	Liquid diazinon** (2.5lbs. Ai/acre) or Dursban (1lb. Ai/acre) may be used.	Treatment usually is not necessary. Mite is in egg stage.	Treat as needed, with liquid diazinon** (2.5lbs. Ai/acre) or Dursban (1lb. Ai/acre).
Grubs 	If treatment of overwintered grubs is necessary, apply only when all grubs are in the first two inches of surface soil. General or spot treatment with Triumph[1] (2lbs. Ai/acre), Mocap (5lbs. Ai/acre) or Turcam (2-4lbs. Ai/acre) may be used. Irrigate as soon as possible after application. Green June beetle larvae are difficult to control at this time. Sevimol (2-4lbs. Ai/acre) may be effective.	Existing infestations found in July or August may be treated with Triumph[1], Dylox, Proxol, Turcam, Oftanol, Sevin-Sevimol or Mocap. Apply at label rates. If soil and/or thatch is dry, irrigate thoroughly before and as soon as possible after application. Treat green June beetle with Sevin (2-4lbs. Ai/acre).	Treatment can be made as late as mid-late September, as long as grubs remain in the first inch of surface soil. Triumph[1], Mocap, Dylox, Proxol at labeled rates may be effective.
Black turfgrass ataenius	Dursban (1-2lbs. Ai/acre) applied to fairways in April for control of overwintered, egg-laying adults, reduces the potential for summer larval infestations. Retreatment after two weeks may be necessary.	If preventative applications were not made, spot or generally treat with Triumph[1] (2lbs. Ai/acre), Proxol-Dylox (8lbs. Ai/acre) Turcam (2-4lbs. Ai/acre), Sevin-Sevimol (8lbs. Ai/acre) or Mocap (5lbs. Ai/acre), as needed.	Undeveloped larvae die with development of ground frost.

[1] For use only by commercial lawn pest control personnel, and only on golf couses tees, greens and aprons, and on sod farms. See soil restrictions. Use only 2lbs. Ai/acre per year.

** Diazinon *may not* be used on golf courses or sod farms.

Source: Dr. Niemczyk

New equipment such as the Dol Overseeder (DOL Ltd., Canada) for granular products, and Rain Saver Jr. (Rain Saver, Walla Walla, Wash.) for liquids, will increase the success potential for biological control agents. The agents are placed directly into the pests' zone of activity.

layer. Some of this equipment is now in use and more will be available for testing.

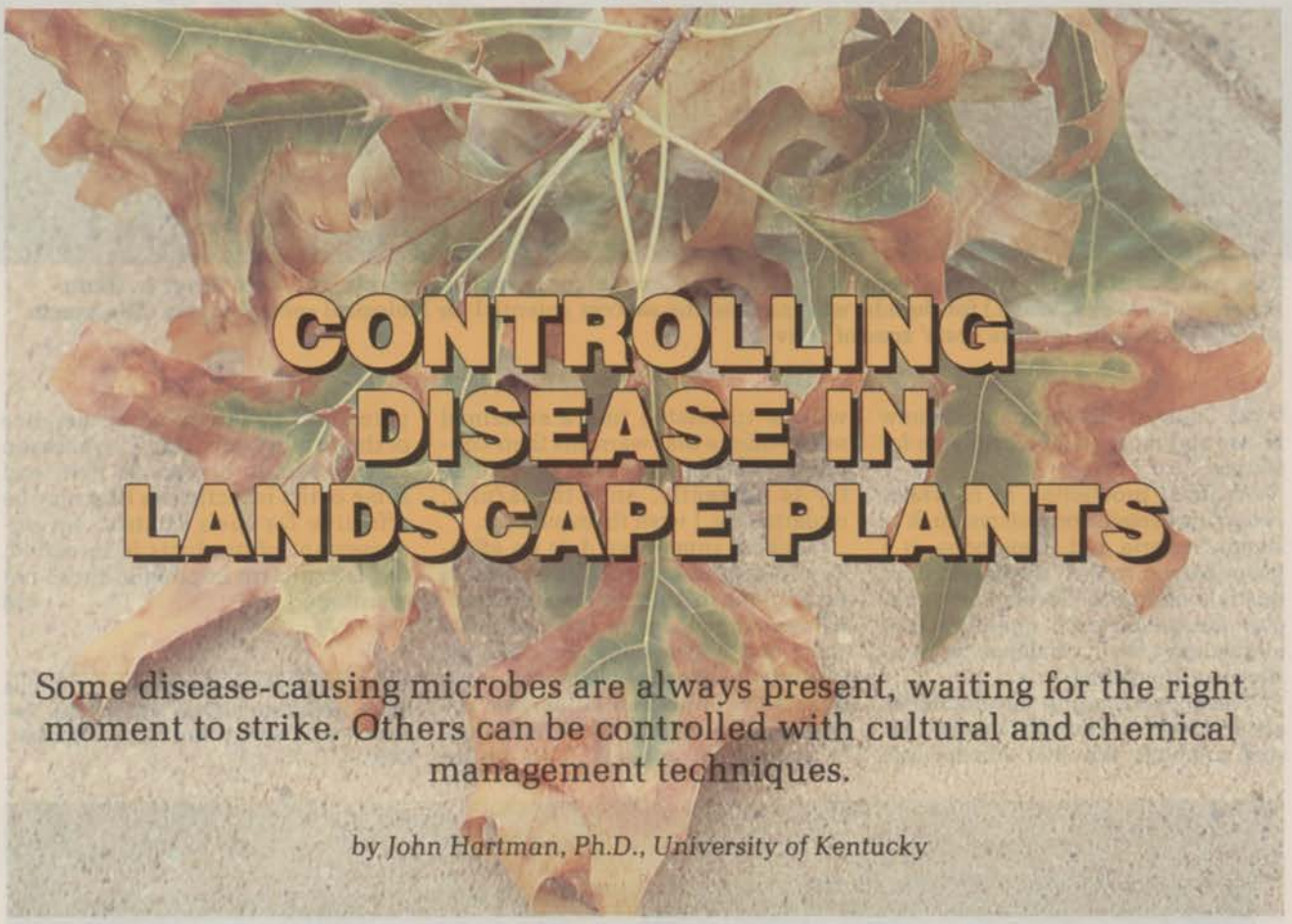
Artifcial production of naturally occurring parasitic organisms, such as fungi, bacteria and nematodes, is a major barrier to their availability. Industry's efforts to develop commercial means of such agents while maintaining their virulence as parasites has intensified.

These encouraging developments are driven by the current demand for such products. Whether this demand will be translated into a sustained sales volume that warrants their continued availability is a risk that industry is currently, and, thankfully, undertaking. I wish them success.

Lacking supportive data on effective biological controls, the controls mentioned in this guide are insecticides. Knowledge of the pest's life cycle and determining the need for treatment, based on evaluation of population levels at a vulnerable period in the insect's life cycle, is the key to successful control. This guide points out the seasonal occurrence of the 10 most important cool-season insect pests to beware in 1991, and some of the insecticides that may be effective for their control. No endorsement of products is intended, nor is criticism implied of those not mentioned. **LM**

Dr. Niemczyk is an entomologist at the Ohio State University's Ohio Agricultural Research and Development Center, Wooster, Ohio.

Chinch bug damage is most severe during July and August.



CONTROLLING DISEASE IN LANDSCAPE PLANTS

Some disease-causing microbes are always present, waiting for the right moment to strike. Others can be controlled with cultural and chemical management techniques.

by John Hartman, Ph.D., University of Kentucky

Landscape plants represent a substantial investment in the aesthetic appearance of the home and commercial landcape. Plant diseases can severely affect the survival or aesthetic value of these plants. Landscape managers are acutely aware that preventive maintenance to control diseases of costly plantings is preferable to affording the cost of replacements.

Invisible culprits

The causes of landcape plant diseases are often misunderstood. This is because they may be caused by microbes that are not easily seen, and because the diseases result from complex interactions between the landscape plants, the disease-causing pathogens, and the environment affecting the interactions.

Landscape managers need to be aware of several important concepts regarding plant diseases:

- Landscape plants differ in their disease susceptibility or resistance. Furthermore, susceptibility of these plants to disease can be altered by the growing conditions.
- Many pathogens such as fungi and bacteria, are living microbes, and cause infections and disease. However, some "diseases," such as iron deficiency, dieback, and decline are caused by adverse growing conditions. Disease-causing microbes often exist unseen in a dormant form, waiting for the right conditions to occur before beginning an infection. Some microbes that cause disease are almost always present, no matter how the landscape is managed, while others can be kept out of the landscape by intelligent management.
- Management of the landscape environment can have a profound effect on whether or not a disease will occur, and how damaging it will be. In general, rainy, foggy weather and poor drying conditions favor foliar diseases, and wet soils favor most root decay diseases. Almost any change in the way the landscape is managed will alter the disease situation, sometimes for benefit, and sometimes for harm.

Biological and cultural control

There are many reasons why biological and cultural practices are preferred for landscape disease management. Reduced uses of chemical pesticides have evident environmental, worker safety, and public health value. Landscape diversity lends itself to custom tailoring of site specific disease control methods, which often favors biological and cultural techniques. Some cultural practices provide broad-spectrum disease management.

Landscape managers need to be aware of new plant disease outbreaks or changes in patterns of old diseases to effectively oversee the health of plantings. The following section describes a few diseases of woody plants that should be of concern to landscape managers.

Pine tip blight

Severe branch dieback of pines in

BIOLOGICAL AND CULTURAL CONTROLS FOR LANDSCAPE PLANT DISEASES

DISEASE MANAGEMENT PRACTICE	DISEASES OR PATHOGENS AFFECTED
Altering plant susceptibility	
Use disease resistant cultivars and species. This biological control act is the safest and most effective way to control diseases. Many nurseries provide disease resistance information for their cultivars.	Resistant cultivars can be used for: juniper tip blight; flowering crababble scab, fire blight, cedar-apple rust, powdery mildew; horsechestnut leaf blotch; Dutch elm disease, and hawthorn rust. Examples of diseases controlled using resistant species: Verticillium wilt and crown gall.
Fertilize based on soil tests. Avoid excess nitrogen which promotes rapid growth and increased susceptibility.	Fire blight of flowering crabapple and pear, cotoneaster, and pyracantha; powdery mildews.
Dip roots of roseaceous plants, euonymous, and other susceptible plants in Galltrol-A or Norbac-84 (a suspension of *Agrobacterium radiobacter*) before planting.	This biological control for crown gall, used in nurseries, could be practical where large numbers of these plants are to be used in the landscape.
Keep trees and shrubs well watered, use mulch around the base of plants.	Dogwood anthracnose, shade tree declines.
Aerify compacted soil throughout the root zone, avoid salt applications, avoid construction injuries to roots.	Shade tree declines.
Avoid unnecessary injury to stems, trunks, and branches.	Dogwood anthracnose, wood decays, various canker diseases.
Protect plants from winter injury.	Boxwood canker, leaf spot.
Modifying the landscape environment	
Select well-drained planting sites. Because of the threat of root and crown rots, sites in which water tends to remain standing are not suited for most landscape plantings.	Phytophthora crown and root rot of azalea, rhododendron, and dogwood.
Select unshaded sites with good air movement for establishment of new plantings. Increase plant spacing and thin tree and shrub canopies to improve air movement and drying. Irrigate early in the day, and avoid the use of overhead irrigation. Control large weeds and nearby vegetation to speed foliage drying.	Rose black spot, flowering crabapple scab, dogwood anthracnose, powdery mildew of various plants.

Source: Dr. Hartman

some landscapes is a symptom of diplodia tip blight, or pine tip blight. This is caused by the fungus *Sphaeropsis sapinae*. Austrian pines of cone bearing age are especially hard hit. Although the disease is normally more severe on stressed trees in the landscape, it has been very destructive to trees that seem to be growing in relatively good sites. Landscapers need to reconsider the uses being made of pines susceptible to tip blight.

Symptoms that characterize the disease include:

- stunted, straw-colored shoots with partly grown needles;
- crystallized, white resin on the infected shoot and on foliage below;
- tiny, black pycnidia (fungal fruiting bodies) on the base of dead needles;
- killed cones, showing abundant pycnidia on the scales; and
- individual dead lower branches.

Annual infections of buds, succulent candles, and immature needles occur in spring. These annual infections, which destroy the buds and shoots, cause a gradual decline of pines in the landscape. Austrian pine is very susceptible, however, mugo and Scots pine are also susceptible. White pine is much less susceptible and tip blight normally does little damage to it.

Prune out all infected twigs and branches before spring. Prune out all cones, even those on green, healthy branches, because they are an important source of fungal inoculum. If spraying is needed, use benomyl, Bordeaux mixture, or fixed copper fungicides. Timing of the three sprays is very important. Spraying should be done at bud break, as candles are beginning to elongate, and as needles are emerging from needle sheaths.

Use a spreader sticker to enhance fungicide retention on the foliage. Consider using better-adapted pines when replanting.

Bacterial leaf scorch

Bacterial leaf scorch of landscape trees, caused by *Xylella fastidiosa*, has been a problem for oak, maple, sycamore, mulberry and elm trees in the Atlantic and Gulf coast states from New York to Texas. Recent reports suggest that the disease has now made inroads into the Midwest, affecting pin and red oaks.

Symptoms typical of bacterial leaf scorch include premature leaf browning and defoliation, and leaf marginal

Diplodia tip blight is advanced on this Austrian pine. If spraying is needed, use benomyl, Bordeaux mixture or fixed copper fungicides.

necrosis. These symptoms appear in late summer or early fall, and are associated with development of the pathogen, xylem inhabiting bacteria.

The disease is difficult to diagnose, and can be mistaken for other causes or water shortage. New diagnostic techniques, such as serological assays (ELISA test), special culture procedures, and electron microscopic observation are needed to detect and diagnose the disease.

In most cases, the disease progresses slowly, and infected trees decline gradually, giving the landscape manager time to begin growing replacements.

In addition, the disease, although spread by leafhopper insects, does not seem to spread rapidly from one tree to another. Recently, however, more rapid decline and death of sycamores from scorch is being reported.

Bacterial leaf scorch is difficult to control. Symptom remission in some trees will occur following injection with an antibiotic, but the remission is only temporary. For now, until new

BIOLOGICAL AND CULTURAL CONTROLS FOR LANDSCAPE PLANT DISEASES

DISEASE MANAGEMENT PRACTICE	DISEASES OR PATHOGENS AFFECTED
Reducing the available pathogen	
Before planting, insist on clean stock. Use disease-free plants from a reputable nusery.	Crown gall, Phytophthora root rot, dogwood anthracnose.
Avoid using planting sites that might be contaminated with pathogens and avoid adding contaminated compost or soil to the landscape.	Crown gall bacteria, nematodes, soil-borne fungi such as *Verticillium*, *Phytophthora*, and *Thielaviopsis*.
When replanting, avoid setting new trees and shrubs in the same spot where the previously sick or dead plant once grew.	Crown gall, Verticillium wilt, black root rot, Phytophthora root rot, root knot nematode.
Prevent movement of equipment, water, or people that might carry soil contaminated with disease-causing fungi, bacteria, or nematodes. Remember that irrigation water can carry pathogens.	Crown gall, Verticillium wilt, black root rot, Phytophthora root rot, root knot nematode.
Rogue out and destroy dead and dying plants.	Dutch elm disease, oak wilt, pine wilt nematode, Verticillium wilt of various plants.
Remove and destroy alternate host plants which may harbor the pathogen.	Cedar-hawthorn, cedar-quince, cedar-apple rust, pine needle rust, eastern gall rust.
Prune out and destroy all dead twigs and branches from trees and shrubs and remove fallen branches from the landscape. Prune diseased branches only when the foliage is dry, and if possible, during the dormant season.	Dogwood anthracnose, pine tip blight, juniper tip blight, fire blight of roseaceous plants, black knot, various twig and branch cankers. Therapeutic pruning for Dutch elm disease.
Cut roots between adjacent plants to stop root graft disease spread.	Dutch elm disease, elm yellows.
Rake up and destroy infected fallen leaves in autumn.	Maple anthracnose.

Source: Dr. Hartman

SOME CHEMICALS USED TO CONTROL DISEASES IN THE LANDSCAPE

CHEMICAL/TRADE NAME	USES AND REMARKS
benomyl/Benlate	Fungicide with some systemic properties; effective against many diseases. Tolerant strains of gray mold, rose powdery mildew, and apple scab fungi now exist. Alternate or tank mix with other fungicides.
bordeaux mixture, fixed copper	General protectant fungicide for leaf spots and blights. Available in many formulations. Be cautious of possible phytotoxicity.
captan	General protectant fungicide for leaf spots.
chlorothalonil/Daconil 2787	Broad spectrum protectant foliar fungicide used for flower blights, anthracnoses, leaf spots and blights, and needle casts.
copper sulphate pentahydrate/ Phyton 27	Systemic fungicide and bactericide for Dutch elm disease and oak wilt control via trunk injection and several leaf spots and blights via foliar sprays.
ethoprop/Mocap	Nematicide for pre-and postplanting applications.
fenarimol/Rubigan	Locally systemic folear fungicide for black spot, rusts, powdery mildews, and scab.
ferbam	General protectant fungicide. Available in several formulations. May leave a black spray deposit on plant materials.
fosetyl-Al/Aliette	Systemic fungicide for Phytophthora root rot control.
iprodione/Chipco 26019	Broad spectrum locally systemic fungicide for Botrytis blight, and leaf spots.
mancozeb, maneb	General foliar disease protectant fungicide. Available in several formulations.
MBC phosphate/Correx, Lignisan Fungisol, others	Soluble systemic fungicide injected into tree trunks for Dutch elm disease control.
metalaxyl/Subdue	Systemic soil drench fungicide for Phytophthora disease control.
methyl bromide	General soil fumigant; usually combined with chloropicrin.
methyl isothiocyanate + chlorinated hydrocarbons/Vorlex	General soil fumigant.
propiconazol/Banner	Systemic fungicide with eradicant properties. Used for apple scab, leaf spots, blights, powdery mildews, and rusts.
streptomycin	Antibiotic effective against bacterial diseases such as fire blight. Available in several formulations.
sodium methyldithio-carbamate/ Vapam, Busan	General soil fumigant; also used to prevent root graft transmission of Dutch elm disease.
sulfur	Powdery mildew fungicide.
thiabendazole/Arbotect	Systemic fungicide injected into tree trunks for anthracnose and Dutch elm disease control.
thiophanate-methyl/Topsin-M	Systemic foliar fungicide having properties similar to benomyl.
thiophanate-methyl + mancozeb/Zyban	Broad spectrum foliar systemic and protectant fungicide combination.
thiram	Foliar protectant fungicide. Many formulations available.
thiadimefon/Bayleton	Systemic foliar fungicide for rusts, powdery mildews, and some flower and leaf blights.
triforine/Funginex	Systemic fungicide for powdery mildews, black spot, and rusts.
vinclozolin/Ornalin	Protectant fungicide for Botrytis disease control.
zineb	General protectant fungicide. Several formulations available.

Source: Dr. Hartman

GENERAL CHEMICAL CONTROL ADVICE FOR LANDSCAPE PLANTINGS

CONTROL PRACTICE	DISEASES OR PATHOGENS AFFECTED
Inspect the landscape regularly to detect disease outbreaks. Effective use of fungicides on an "as needed" basis requires close monitoring.	Any disease not being controlled with a regular spray schedule.
Be most attentive to early fungicide applications. For many diseases, the fugicides applied from bud break until full leaf which reduce primary inoculum are more important than fungicides applied in full leaf.	Sycamore, ash, and maple anthracnose, pine tip blight, dogwood anthracnose, flowering crabapple scab, many fungal leaf spots.
Diseases are traditionally controlled using protectant fungicides, however landscape managers need to know the capabilities of the new eradicant fungicides for destroying infections that have just begun.	Rose black spot, flowering crabapple scab, rust diseases of various plants, powdery mildew of various plants, Phytophthora root rot of various plants.
Use forecasting systems, if possible, so protectant sprays can be applied prior to infections, and eradicants before infections have gotten out of control. Monitor the weather and determine when infections have occurred or are likely to occur.	A good forecasting system has been developed for apple scab disease control. Remember that leaf moisture provides conditions favorable for many foliar diseases. Be prepared to spray more in rainy seasons, less in dry seasons.
Disinfect tools regularly when pruning to control disease.	Fire blight, Dutch elm disease.
Control insect vectors that carry disease-causing fungi, bacteria, nematodes, and viruses.	Pine wilt nematode, Dutch elm disease, and bacterial leaf scorch of trees.
Treat cankers with a soil-water paste.	Chestnut blight.

Source: Dr. Hartman

controls are developed, we just simply have to live with the disease.

The underground disease

Black root rot infects roots of many landscape plants, the most valuable being Japanese holly, blue holly, inkberry, yaupon holly, and American holly. Other ornamentals known to be susceptible include begonia, cyclamen, geranium, gloxinia, oxalis, phlox, poinsettia, sweet pea, verbena, and viola.

The first symptoms of black root rot include yellowing and marginal scorch of the foliage. Later, twigs or stems may die back and eventually the entire plant may die. The root system of the declining plant is stunted and decayed. Black lesions on the infected roots contrast sharply with the adjacent healthy white portions. Lesions may appear on the tips of feeder roots or elsewhere along the root. Symptoms on infected plants can sometimes be suppressed when plants are growing under high maintenance (plenty of fertilizer and water) regimes.

Black root rot is caused by *Chalara elegans* (formerly *Thielaviopsis basicola*). This fungus can persist indefinitely in the soil or it can survive as a saprophyte on plant debris.

- Plant only disease-free plants in the landscape. If new plants show blackened roots, the presence of *C. elegans* can be confirmed through microscopic examination or laboratory assay.
- Avoid planting susceptible plants in soils known to be infested with the fungus. Be aware that infected annual flowers grown in a bed the previous season can leave enough inoculum to infect new flowers or hollies.
- Badly-infected plants should be removed and the site replanted with a non-suseceptible host.
- There are no effective fungicide drenches available for controlling black root rot in the landscape.
- Good cultural practices may enable some plants to continue to grow in spite of the disease. Plants in the early stages of infection should be well-fertilized and watered.

Dogwood anthracnose threat

Dogwood anthracnose, also called lower branch dieback, is caused by a species of the fungus *Discula*. This disease has received a great deal of publicity during recent years. It affected landscape and forest flowering dogwoods in the Northeast for many years (simultaneously infecting Pacific dogwoods in the Northeast.) Recently, the disease moved rapidly through the mid-Atlantic states to the Southern Appalachian region. There is some concern that it could move into the mid-South and Midwest.

Dogwood anthracnose causes purple-bordered leaf spots which coalesce to form tan blotches. The fungus infects twigs and branches, causing stem cankers, and can eventually move to the trunk. Eventually, infected trees may decline and die.

Maintain good growing conditions by watering, mulching, and avoiding unnecessary injury. Prune out diseased twigs and branches and trunk sprouts. Purchase plants only from a reputable nursery. Never transplant dogwood trees from the wild. Fungicides such as chlorothalonil may help to protect trees from infection.

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