Can You Spot

Evergreen Diseases

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E VERGREENS have long been considered relatively free of insect and disease problems as compared with shade and ornamental trees and shrubs. Low maintenance costs in the nursery as well as in the permanent planting site have provided a positive stimulus leading to the extensive, and at times overenthusiastic, use of evergreen varieties in landscape plantings. Intensive cultivation of large numbers of evergreens over the past 20 to 30 years, however, has resulted in a tremendous increase in diseases and insect pests. Measures to control them are frequently required to realize a profit on evergreens in the nursery, landscaping and arborist industries.

Although research on control of pests has lagged behind both production of evergreens and introduction of new varieties and selections, effective control measures have been worked out for many evergreen pests and should be employed wherever possible. The effective use of proven pest control practices will not only benefit the plants being injured but will aid in preventing the buildup of disease organisms and insect populations. This, in turn, will help prevent the spread of these pests to other potential host plants. Control recommendations for many plant pests may be obtained from state and federal research organizations and are usually based on scientific experimentation. Such recommendations, if followed closely, will give better results in the long run than hit-or-miss measures suggested by the untrained or poorly informed.

Because of similarities in symptoms and control measures, diseases of evergreens may be separated into four categories: leaf or needle diseases, twig and stem diseases, root diseases, and diseases or injuries not resulting from disease-causing organisms. Control practices for specific diseases within each category are usually quite similar, and some of the practices are effective on several diseases within the group.

Many needle diseases of evergreens are common and widely distributed; others rarely occur except when climatic conditions are optimum for disease development. Some cause little damage and are of interest only on specimen plants, whereas others can result in severe injury and loss of desirable plants. Nurserymen, landscapers, and arborists alike should become familiar with most of the common needle diseases and their control measures. Those evergreen diseases which occur most frequently in the Midwest will be discussed in this paper.

Cedar-apple and cedar-hawthorn rust are two of the most prevalent and widespread evergreen diseases in the Midwest. Cedar-quince rust also occurs, but is less common.

Woody Galls Formed

The cedar rust fungi invade the needles of susceptible juniper varieties. As the disease progresses, small to large, green, woody galls are formed by the cedar-apple and cedar-hawthorn rust fungi, and pustules are formed on stems by the cedar-quince rust fungus. Occasionally the galls or pustules enlarge and stem tissues are invaded by the fungus to the point where the stem is girdled. When this happens, the portion of the branch extending outward from the girdle dies.

During moist periods in the spring, bright orange, sticky spore horns form on the galls, giving them a striking, unsightly appearance. When the spore horns dry up, masses of spores are released and may be blown to alternate pomaceous hosts, such as susceptible crabs and hawthorns, causing leaf spot and defoliation. Alternate infections of evergreen and pomaceous hosts are necessary for the cedar rust fungi to complete their life cycle.

Several measures are useful in controlling the cedar rust fungi. One simple but effective meas-
Diplodia tip blight symptoms on young shoots of Norway spruce.

Lophodermium needle cast fungus fruiting bodies on needles of Pinus contorta.

White pine blister rust canker caused by the fungus Cronartium ribicol(a.

ure is to pick or prune the galls or pustules from affected evergreens in late fall or early spring before the spore horns form. This will not only get rid of the unsightly galls, but will prevent spread of the rust fungi to the alternate hosts. If many diseased plants are involved, as in nursery or large juniper plantings, or if this method is impractical for other reasons, affected plants may be sprayed with cycloheximide (Acti-dione as Acti-Spray tablets) following the recommendations on the package. One spray should be applied in the spring, usually sometime in May, when spore horns are beginning to swell on the galls and are about \( \frac{1}{2} \) inch long. This spray prevents spore horn formation and consequent spread to the alternate hosts.

Since the presence of both hosts is required for the cedar rust fungi to complete their life cycle, the best control measure is to remove the alternate hosts. If neither removal of the alternate hosts nor use of resistant varieties is practical, susceptible junipers may be protected from rust infection by three sprays applied in July and August at 3-week intervals using 2 pounds of ferbam in 100 gallons of water. Several fungi may cause needle blights of evergreens, especially if a plant is weakened by drought, winter injury, transplanting shock, a poorly drained site, or low nutrition. Most healthy evergreens, such as spruce, fir, and pine, can be protected from needle blights by applying several sprays in the spring using one of the organic mercury fungicides or a copper-containing fungicide such as Bordeaux mixture.

One of the needle blight fungi, *Scirrhia pini* (*Dothistroma pini*), is of considerable importance, since infected trees often show extensive defoliation and dieback and occasionally die. This disease may affect several species of pine but is most severe on *Pinus nigra* (Austrian pine), *P. ponderosa* (Ponderosa pine), and *P. thunbergi* (Japanese black pine) in Illinois. Yellow to tan spots appear on 1- to 2- and 3-year-old needles in late fall or early spring. By April or early May in Illinois, fruiting bodies of the fungus appear on the spots. Often a band is formed around affected needles and the portion of the needle beyond the band dies. On severely diseased trees all but the current season’s needles may defoliate, resulting in weakened trees which may succumb to winter injury or other causes. The disease is most severe on pines growing in sheltered locations, groves, or windbreaks. For this reason one of the recommended controls is to thin out groves and provide better air circulation which often reduces the severity of damage.

Although spraying of both diseased and healthy needles in the spring with a copper-containing fungicide such as Bordeaux mixture has been reported to give good results, *Scirrhia* or *Dothistroma* needle blight is difficult to control, and further work on the effectiveness of fungicide spray programs is needed. Con-
siderable variation among individual Austrian pines in susceptibility to the disease has been observed in Illinois. Resistant varieties or clones may someday provide the best solution to control of this disease.

A large group of fungi may cause defoliation or needle cast on evergreens. Needle casts are not usually of enough consequence to warrant control measures, but under optimum conditions for disease development a fungus such as Lophodermium pinastri can cause considerable damage. Control measures are the same as for needle blights and consist of spraying in the spring with organic mercuries or copper-containing fungicides.

Needle rust of pine, usually found on Pinus resinosa (red pine), occurs commonly in the Midwest. White to orange pustules, fruiting bodies of the fungus Coleosporium, appear on infected needles in the spring and can result in stunting and defoliation in young seedlings. However, the disease is seldom of any importance on older plants, and therefore control measures are not often recommended. Control can be achieved by removing all goldenrod and asters in the area, which serve as alternate hosts for the rust fungus.

The fungus Botrytis cinerea may cause a mold or blight on foliage and succulent stems of evergreens under conditions of high humidity. Seedlings and cuttings in the greenhouse are often attacked by this fungus, but Botrytis mold on plants in the field is rare and usually occurs only during periods of extremely wet weather. Control has been achieved through the use of copper fungicides, but a new fungicide, Botran, may prove to be much more effective. Weekly spraying of foliage with Botran as soon as Botrytis blight appears should give satisfactory control.

Mildew Fungi Are Regular

Mildew fungi appear frequently on the foliage of evergreens, particularly on the broad-leaved plants such as Euonymus and holly. Disease severity, which varies from year to year, depends on weather conditions. In addition to an unattractive appearance, mildew can cause leaf curling, defoliation, and general weakening of infected tissues, resulting in increased dieback due to severe weather conditions. Control measures consist of spraying at 10-day intervals with Karathane, sulfur, or cycloheximide (Acti-dione PM), beginning when mildew first appears on the foliage.

Organisms causing twig and stem diseases on evergreens are often found on plants low in vigor or weakened in some way. Many disease organisms found

(Continued on page 30)
Evergreen Diseases
(from page 14)

ing. Wounds should be treated with a good wound dressing. Pruning tools should be sterilized between cuts with alcohol, Chlorox, or formaldehyde, and pruning should be done only in dry weather, since spores of the fungus are readily transferred to healthy tissues under moist conditions.

Other canker diseases, such as *Pseudonectria* canker of boxwood and *Nectria* canker of Euonymus and other plants, occasionally occur, usually on weakened plants. Control measures for these and other canker diseases of evergreens are the same as for *Cytospora* canker. Applying organic mercury sprays in the spring to susceptible plants may provide some degree of protection against cankers.

**White Pine Blister Rust Is Very Destructive**

For many years the most destructive disease of white pine forests and plantings in the United States has been blister rust caused by the fungus *Cronartium ribicola*. Losses from this disease have been so severe that federal funds are regularly appropriated for its control. Fortunately, blister rust is not known to be of consequence in ornamental plantings because of quarantine regulations against plantings of susceptible currants and gooseberries which serve as alternate hosts for the fungus. In addition, blister rust is seldom found on white pines in the southern regions of the Midwest.

Where blister rust does occur, the fungus invades and kills needles on white pines and then moves into the bark of twigs and branches; there it produces swollen cankers which may girdle the stem. Spores produced in these cankers infect the leaves of susceptible currants and gooseberries on which spores are produced that cause further infection of pines. The best control recommendation in ornamental plantings is the removal of dead and dying branches at their point of attachment and the eradication of alternate hosts in the area. In addition, white pines should not be planted in frost pockets or low, swampy areas where conditions of high moisture occur.

A stem disease which has a wide host range and is familiar to almost everyone who works with woody ornamental plants is bacterial crown gall. The bacteria are soil-borne and enter plants through wounds. Small to large, woody galls form on roots or at the crown of infected plants. Several species of *Euonymus* such as *E. fortunei* and *E. japonicus* are extremely susceptible to crown gall and are seldom found without galls. Extensive gall formation can cause girdling and death of stems. Galls may become inactive after the first year or they may persist and increase in size each year until the stem is girdled and killed.

To control this disease, all infected material should be removed and burned. Pruning tools should be disinfected to prevent spread of the bacteria. Susceptible varieties should be handled with extreme care to prevent infection of healthy plants through wounds. Whenever possible, infested soil should be planted with species or varieties of ornamentals which are resistant to crown gall.

Shoot tips of pines, firs and spruces, which lack vigor or have been weakened by insects, diseases, adverse weather conditions, drought, or unfavorable planting sites may be attacked by the tip blight fungus, *Diplodia pinea*. Typical symptoms are wilting or drooping and eventual browning and dying of affected shoot tips. Diseased shoots should be pruned off and burned, and affected plants should be kept well watered and fertilized, since vigorous plants are less susceptible to attack. Some protection of susceptible plants can be provided by three spray applications at 2-week intervals with one of the organic mercury fungicides. The first spray should be applied when new growth first appears.

Twig blight, caused by the fungus *Phomopsis juniperovora*, attacks arborvitae and many juniper varieties as well as cypress and false-cypress. The disease fungus invades and kills the bark, and in time cankers form on diseased stems. As the cankers enlarge, affected stems die and needles turn brown. Damage caused by *Phomopsis* blight varies from year to year, but when optimum weather conditions for disease development prevail, as in 1966 in Illinois, the disease may reach epidemic proportions and can result in the loss of many valuable plants.

Since fruiting bodies containing spores of the fungus form on cankers during wet weather and provide a source of inoculum for further spread, all diseased twigs and branches should be removed and burned during dry periods. Pruning or shearing equipment should be disinfected periodically to prevent spread of the fungus to healthy tissues. When available, resistant varieties such as Hill's juniper, Keteleer red cedar, and spiny Greek juniper may be planted. Susceptible varieties may be protected against *Phomopsis* blight with five sprays of organic mercury fungicide at 10-day intervals beginning as soon as shoot growth starts in the spring.

Most stem diseases can be prevented or reduced by keeping plants healthy and vigorous. Sterilizing wounds and pruning tools and careful handling of plants to avoid wounding will help prevent the spread of the disease organisms to healthy tissues.

Diseases affecting the roots of
evergreens fortunately do not appear frequently, for once a root disease becomes established, it is usually impossible to save or cure the infected plant. Control measures must be designed to prevent initial infection. Plants subject to root diseases should be handled with care to prevent root wounding. Only resistant species or varieties should be placed in a site which has a history of root infection, since root disease fungi are usually soil-borne and difficult, if not impossible, to eradicate. Under certain conditions soil fungicides can be of value in controlling root diseases.

Root Rot Of Pine
Usually Only In Forests

Although considered a disease which is usually confined to forest plantings, root rot of pine caused by the fungus Fomes annosus has been found on a wide range of hosts and may eventually appear in ornamental plantings. The disease causes extensive damage in thinned pine plantations, but is rarely a problem in the Midwest on unthinned plantings. The disease fungus enters the host through wounds or cut stumps and spreads readily to adjacent healthy plants through root contacts or grafts. Trees affected by this disease appear suddenly to turn brown and die, although the fungus may have been present in the trees for one or more years before symptoms showed up. In late fall, fruiting bodies or conks of F. annosus may appear around diseased trees underneath the duff or leaf litter.

Some control has been achieved in affected pine plantings by treating cut stumps with urea at the rate of 2 pounds in 100 gallons of water with a Dexon-Terraclor fungicide mixture. Some control of root rot in the field with Dexon or Dexon-Terraclor has been reported. All diseased plants in the field should be destroyed, and all benches and the soil of apparently healthy plants should be drenched immediately at the rate of 2 pounds in 100 gallons of water with a Dexon-Terraclor fungicide mixture. Control in the field is more difficult, and resistant species or varieties of conifers should be used where this fungus is present.

Many Types Of Trees Hurt

The fungus Armilaria melea attacks a wide range of plants including many deciduous species and a few evergreens such as Douglas fir, pine, rhododendron, and yew. Affected trees are usually stag-headed and are easily blown over or uprooted by high winds because of their rotten roots. Black fungus strands called shoestrings may be found in the duff or soil around diseased trees, and white fungus fans or dark red, rootlike strands are present beneath the bark. Since weakened and injured plants are most susceptible to this disease, such plants should be fertilized and watered to protect them from Armilaria infection. No control is known to be effective once infection has taken place.

Wilting, dieback, and decline of a large number of plant species and varieties is caused by the fungus Verticillium alboatrum. Although most of the hosts are deciduous, occasionally an evergreen such as Viburnum lento tago may be seriously damaged. The most obvious symptoms of Verticillium wilt are wilting and dieback, usually occurring over a period of several years. Most plant species infected with this fungus show discoloration in the sapwood. Since the fungus is soil-borne, control measures in the field are difficult. Root wounding should be kept to a minimum to prevent infection, and resistant species should be

ornamental species, particularly yews and azaleas. In Indiana, where considerable loss of yews in nursery fields has been observed, diseased plants became light green at first, and then dried out and died. In most cases brown streaking was found in the sapwood of the crown and larger roots.

In southern areas of the Midwest where azaleas are grown in the field and in greenhouses where potted azaleas are grown, Phytophthora root rot can become a serious problem. The foliage of affected plants becomes sparse and thin and tends to wilt with increasing frequency until permanent wilting and death occur. The wood of diseased plants usually show brown discoloration.

Potted plants may be kept free of P. cinnamomi with sterilized soil and disease-free planting stock. In addition, all benches and implements should be kept clean, and tools should be sterilized frequently wherever possible. If P. cinnamomi is found, all diseased plants should be destroyed, and all benches and the soil of apparently healthy plants should be drenched immediately at the base of the plants.

Symptoms appear as root rot, discoloration of crown and root tissues, and crown cankers resembling those of heat injury. Since the fungus is soil-borne, sterilization of seedling beds is recommended. Control in the field is more difficult, and resistant species or varieties of conifers should be used where this fungus is present.

Fungi Cause Damping-Off

Several fungi cause damping-off or seedling blights. The most common ones are species of Fusarium, Pythium, Phytophthora, Rhizoctonia, and Botrytis. These organisms most frequently attack seedlings or cuttings, killing the tissue of roots and stems near the ground line and often causing affected plants to fall over. The standard control procedure for these diseases is soil sterilization, either by steam or fungicidal chemicals. Damping-off and seedling blights are common in seedling and cutting beds but occur only rarely under field conditions.

A fungus which can cause not only seedling blight but also death of young conifers in the field is Cylindrocladium scoparium. Spruce and red pine are most commonly affected. Symptoms appear as root rot, discoloration of crown and root tissues, and crown cankers resembling those of heat injury. Since the fungus is soil-borne, sterilization of seedling beds is recommended. Control in the field is more difficult, and resistant species or varieties of conifers should be used where this fungus is present.

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WEEDS TREES AND TURF, August, 1967

31
planted where Verticillium wilt has become a problem. In some cases diseased plants may recover following fertilization.

Practically all plants, including evergreens, may be damaged by a group of microscopic roundworms known as nematodes. In the past if a plant did not show symptoms of the nematode disease known as root knot, it was thought to be nematode-free. Recent investigations have shown, however, that many species of nematodes other than those causing root knot feed on the roots of ornamental plants and can cause damage. Symptoms of nematode attack may range from almost undetectable stunting to chlorosis; slow decline; increased susceptibility to diseases, insects, and winter injury; and death of affected plants.

The importance of nematodes is increased by the fact that injury or wounds caused by their attack may provide points of entrance for soil-borne disease organisms. In addition, some nematode species have been shown to transmit virus diseases. The true significance of nematodes in the culture of evergreens and other ornamental plants awaits further investigation, but all the facts point to nematodes as a cause of considerable concern to the entire ornamental plant industry. Increasing research in this field is already under way.

In addition to losses caused by disease organisms, many evergreen troubles are caused by adverse weather, nutrient deficiency, mechanical damage, and chemical injury. No standard set of procedures can prevent or control such a variety of troubles; consequently each has its own control recommendations.

Yellowing or chlorosis of evergreens may result from many different causes. Any disease, insect, or mechanical injury may bring about yellowing of foliage, but in most cases other symptoms are also present.

Chlorosis Remedied By N

Chlorosis most frequently results from the lack of an adequate amount of some nutrient, such as nitrogen or iron, in the soil. Nitrogen deficiency usually appears as a general yellowing and stunting of the plant and is easily remedied by the application of a standard high-nitrogen fertilizer.

Iron deficiency, on the other hand, appears as chlorosis or yellowing of interveinal tissues, while veins remain green. Iron deficiency chlorosis is most pronounced on the youngest growth and increases in severity with each new flush of growth. Although iron may be present in a soil, it becomes chemically bound under alkaline conditions, and some species of plants are not able to obtain it from the soil. For example, yews may be dark green and healthy in a soil with a pH rating of 7 or higher, whereas adjacent azaleas in the same soil are highly chlorotic. The ability to obtain iron is genetically controlled and the process is not well understood.

To combat iron-deficiency chlorosis, iron-containing com-

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Weeds, Trees and Turf, August, 1967
Insect Report

WTTS compilation of insect problems occurring in turfgrasses, trees, and ornamentals throughout the country.

Turf Insects

A BILLBUG
(Sphenophorus venatus vestitus)
Florida: Adults, probably this species, active at night and causing very light damage to zoyja grass golf greens in Miami, Dade County.

GRASS BUGS
Utah: Iribia pacifica ranges 25-300 per sweep on severely discolored Great Basin wildrye at Beaver Dam, Box Elder County. Iribia sp. badly discolored 200 acres of intermediate wheatgrass at 7,000 feet elevation above Peterson; this area severely damaged in 1966.

A MILLIPED
(Pleuroloma brunes)
Arkansas: Taken in st. Augustine-grass in Desha County. This is same species that hibernated heavy in city of Paragould, Greene County.

TWO-LINED SPITTLBUG
(Prosapia bicincta)
Alabama: First adults noted throughout central and southern areas. Becoming common on lawn and other grasses; no damage reported.

Insects of Ornamentals

BAGWORM
(Thyridopteryx ephemeraeformis)
Oklahoma: Heavy on juniper at Stillwater, Payne County, and Perry, Noble County; moderate in Beckham and Cleveland Counties.

SPIDER MITES
California: Eurytetranychus buxi heavy on boxwood hedges generally in Ontario, San Bernardino County. Tetranychus telarius medium on boxwood nursery stock in Escondido, San Diego County.

A FLATID PLANTHOPPER
(Anormenis septentrionalis)
Alabama: Numerous nymphs feeding on new growth of azaleas, camellias, dahlias, and many other plants throughout southern, central, and much of northern areas; damage not serious. Growers and homeowners concerned for several weeks in Mobile, Lee, Bibb, Franklin, Winston, and other counties. Mostly adults as far north as Winston County.

ARMORED SCALES
California: Hemiberlesia lataniae adults heavy on Japanese maple nursery stock in San Diego, San Diego County. Florida: Pinnaspis aspidistrae adults severe on 15 percent of 2,000 liriope plants at nursery in Dover, Hillsborough County.

GLOBOSE SCALE
(Lecanium prunastri)
Delaware: Young crawlers on ornamental plum in New Castle County area.

WEEVILS
Maryland: Apion longirostre adults heavy on hollyhock at University Park, Prince Georges County. Rhode Island: Brachyrhinus sulphatus pupating in North Kingstown, Washington County.

Tree Insects

A SHIELD BEARER
(Coptodisca sp.)
Arizona: Larvae severely defoliated many cottonwood trees in Yuma and Maricopa Counties.

BLACK TURPENTINE BEETLE
(Dendroctonus terebrans)
Alabama: Adults and larvae active on isolated pine trees in Lee, Baldwin, and other counties.

ENGRAVER BEETLES
(Ips spp.)
Maine: Numbers and damage of I. pini heavy on white pine at Falmouth Foreside, Cumberland County; injured trees transplanted last fall. Heavy sap flow prevents insects from being established. Nebraska: Heavy in Nebraska National Forest near Halsey.

ELM BORER
(Saperda tridentata)
North Dakota: Heavy larval populations damaged elm at Walhalla, Pembina County; pupae present.

CANKERWORMS
New York: Peak descent from trees at Riverhead, Suffolk County. Numbers medium in Nassau County.
Pennsylvania: Mainly Alsophila pometaria heavily defoliated oak and other hardwoods at Schickshinny, Luzerne County.

TENT CATERPILLARS
(Malacosoma spp.)
Maine: M. americanum infestations and damage evident in most areas. New Hampshire: Pupating at Durham. Utah: M. disstria damaged bitterbush, serviceberry, chokecherry and wild rose in ranch area of Blacksmith Fork Canyon, Cache County.

A SPIDER MITE
(Oligonychus milleri)
Missouri: Collected and det., at Columbia, Boone County. Light to heavy on new growth of shortleaf pine.

Compiled from information furnished by the U. S. Department of Agriculture, university staffs, and WTTS readers. Turf and tree specialists are urged to send reports of insect problems occurring in their areas to: Insect Reports, WEEDS TREES AND TURF, 1900 Euclid Ave., Cleveland, Ohio 44115.
Ohio Turfgrass Foundation Turf-National Aerial Applicators Association

National Fertilizer Solutions Association

Annual Turfgrass Field Days, Virginia Polytechnic Institute, Blacksburg, Va., Nov. 15-17.

Penn State 1967 Field Day, Pennsylvania State University, University Park, Aug. 16-17.

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