Dr. Sharon M. Douglas
Department of Plant Pathology and Ecology
The Connecticut Agricultural Experiment Station
123 Huntington Street, P. O. Box 1106
New Haven, CT 06504

Phone: (203) 974-8601
Fax: (203) 974-8502
Email: Sharon.Douglas@po.state.ct.us

COMMON TREE HEALTH PROBLEMS

There are a number of diseases that can be considered of general importance or common occurrence for many different tree species. This fact sheet covers most of the common abiotic and biotic problems and provides a general description of the symptoms of each disease and the general strategies for managing each problem.

COMMON ABIOTIC PROBLEMS:

1. Drought

Symptoms of drought stress can occur on woody plants in the landscape, in natural woodlots, and in forests. Prior to 2003, weather records from the Experiment Station's Lockwood Farm in Mt. Carmel indicated that a trend for abnormally low levels of precipitation had been occurring since 1995, which was characterized as the worst drought in 30 years and as the driest summer since 1944. With a pattern of several consecutive dry seasons, many woody plants including drought-sensitive as well as species that are normally considered drought-tolerant can exhibit symptoms of drought stress. When trying to define a "drought year," the pattern and frequency of precipitation is more important than the total amount of precipitation recorded for the year. Total precipitation levels can be deceiving when interpreted solely on the basis of yearly amounts rather than on a month-by-month basis. This is because one or two significant precipitation events or storms in a year could account for much of the total precipitation recorded for that year. Therefore, it is the amount and frequency of precipitation rather than yearly totals that are important to the long-term health, growth, and vigor of woody plants. This is especially true during the growing season when water demands are the greatest. Up-to-date information on precipitation levels recorded at the Experiment Station's Lockwood Farm can be found on the CAES web site (http://www.caes.state.ct.us/).

Drought or dry soil results in damage and death of the roots. The root system of a woody plant has four types of roots: 1) framework roots consisting of primary and secondary woody roots, 2) transport and storage roots, 3) non-woody feeder roots, and 4) root hairs. Almost 99% of this root mass is in the top three feet of the soil. The feeder roots and root hairs, which are in the top 12 inches of the soil, are responsible for uptake of water and nutrients. Unfortunately, they are the first portion of the root system to be affected by drought since they are very sensitive to drying. When feeder roots and root hairs become nonfunctional, a water deficit develops in the plant because these roots can no longer provide sufficient water to the top of the plant. In addition to direct damage to the root system, drought triggers metabolic changes. Among these

are changes in hormone levels and other physiological factors (e.g., factors that influence the number of leaves that will emerge the next year or that are responsible for the closing of stomates).

SYMPTOMS:

Symptoms of drought are manifest in many different ways depending on the plant species and the severity of the water deficit. One important aspect of drought is the fact that the symptoms are often not evident in the top of the tree or shrub until sometime after the event has occurred--**even as much as one to two years later**. Symptoms include loss of turgor in needles and leaves, drooping, wilting, yellowing, premature leaf or needle drop, bark cracks, and twig and branch dieback. Leaves on deciduous trees often develop a marginal scorch and interveinal necrosis whereas needles on evergreens turn brown at the tips. Trees and shrubs can also exhibit general thinning of the canopy, poor growth, and stunting. In extreme cases, drought can result in plant death.

In addition to direct root damage, a significant secondary effect of drought is that it weakens plants and predisposes them to secondary invaders and opportunistic pests such as fungal tip blights, vascular wilts, root rots, and needlecasts. Many drought-stressed plants also show increased sensitivity to de-icing salts, air pollutants, and pesticides to which they are exposed. Native plants growing naturally in woodlots or forested areas are usually adapted to regional and seasonal fluctuations in the amount of precipitation and only *unusually* severe drought causes problems for them. However, planted landscape trees and shrubs often show symptoms of drought and severe water stress. Planting practices are frequently key sources of this problem since we often plant in unfavorable sites, don't prepare the rootball properly, plant too deep or too shallow, or mulch so thickly that water doesn't penetrate into the soil.

Symptoms of drought can develop on a wide range of deciduous and evergreen trees and shrubs and are particularly severe on seedlings and new transplants. This is because their roots occupy the uppermost layers of soil where the most rapid drying occurs. In addition, recent transplants typically lose important feeder roots during the transplant process. For example, balled and burlapped trees are estimated to contain only 5-20% of their original root mass after digging. For container-grown ornamentals, the medium in which the transplant is growing can be a key factor--many of the soilless mixes used for container stock are highly porous, dry out very quickly, and are very difficult to re-wet. This situation creates moisture stress in the rootball regardless of the availability of water in the surrounding soil. This problem often continues until the roots grow beyond the rootball. Contrary to popular opinion, it often takes woody transplants two years to become completely established in a new site. Thus, these plants should be given extra care and attention during periods of drought. Established trees and shrubs are also affected by drought, especially those in marginal sites, i.e., with pavement over their roots, street trees, in pockets of soil on ledges, or in sandy soils. Problems have also been observed on apparently established trees and shrubs that have survived despite improper planting. Once stressed by drought, these trees quickly decline and often die.

MANAGEMENT STRATEGIES:

While there is no cure for this problem, the effects of drought can be minimized by following some preventative measures:

- Water in periods of low soil moisture: trees and shrubs require approximately one inch of water per week. This is best applied at one time as a slow, deep soaking to a depth of approximately 12-18 inches. The length of time required to "deep-water" will vary depending on soil type and water pressure: clay soils usually require more time than sandy soils. Frequent, light, surface watering will ***not*** help the tree and can actually cause harm by promoting growth of surface roots. A deep soaking just before the ground freezes in the fall will also help the winter hardiness of drought-stressed plants.
- Select an appropriate site and follow good planting practices; drought stress can magnify even subtle improper planting practices.
- Select native plants or match plant species to site conditions: drought-sensitive (dogwood, some oaks, arborvitae) *vs.* drought-tolerant (most pines, many *Prunus*, larch, junipers).
- Mulch to maintain soil moisture.
- Prune any dead or weakened tissues to avoid secondary problems.
- Maintain plant vigor by following good cultural practices.

2. Excess Water

Excess water can be a serious problem for many woody ornamentals. Roots in flooded or waterlogged soils are damaged and die from oxygen deficiency. In addition to this direct damage to the root system, flooding has also been associated with inciting physiological changes in woody plants that influence their growth and other processes. The feeder roots, which are non-woody and important for uptake of water and nutrients from the soil, are particularly sensitive and are frequently the first ones damaged by waterlogged conditions. Woody roots are more tolerant than non-woody roots to flooding. When feeder roots are damaged, they are unable to provide water to the top of the plant and a water deficit develops. Damage can be sudden or gradual, depending on the plant and the flooding conditions. This can occur on plants in obviously wet sites and on those in marginal sites or soils with more subtle water problems such as along city streets or in areas where high clay content in the soil impedes drainage. Most trees and woody shrubs cannot grow in waterlogged soils for very long and can die if flooded for only a few days during the growing season. Visible symptoms are *often* not evident until considerably after the damage has occurred, especially when the root damage is gradual.

SYMPTOMS:

Symptoms of excess water depend on the plant and are highly variable. These include epinasty or downward rolling of leaves, stem swelling, chlorosis or yellowing of the foliage, oedema, reduced and stunted growth, twig dieback, leaf drop, root death and, in extreme cases, whole plant death.

Seedlings and new transplants are more sensitive to excess water problems than are established plants. This can be attributed to the lack of an established root system and to feeder root damage during transplanting. Needled evergreens are generally considered more sensitive to waterlogged soils than broadleaved deciduous plants. Symptoms of waterlogging may not develop in a woody ornamental until water demands on the root system increase, typically during the hot summer months when the canopy is actively losing water through transpiration.

This is sometimes exhibited as a sudden collapse of the tree or shrub. Other trees appear to lose vigor and slowly decline over a period of years. This can occur on trees that have been otherwise "healthy" for 10-15 years but are growing in poor sites or heavy soils. Dormant plants generally appear to tolerate flooding longer than those in active growth. In addition to direct root damage, trees in flooded soils are predisposed to secondary pathogens and other opportunistic pests such as the fungal root rots caused by *Phytophthora* and *Armillaria*.

MANAGEMENT STRATEGIES:

Strategies for minimizing wet soil problems include:

- Select an appropriate site and follow proper planting practices.
- Follow cultural practices that maintain plant vigor.
- Select the appropriate species for soil and site conditions: water-tolerant (red maple, larch, green ash) *vs*. water-intolerant (crabapple, spruce, hemlock, yew, white pine).
- Prune dead or dying tissues to minimize secondary invaders and opportunistic pests.

3. Winter Injury

Weather conditions during the past few winters in Connecticut have been conducive to plant injury. The impact of these conditions is evident in ornamental plantings in the landscape as well as in woodlands throughout the state. The factors that cause this type of injury are diverse and problems often don't appear on woody ornamentals until the spring and summer. In addition, the extent and severity of the injuries that develop are often more extreme on plants weakened from drought stress.

Winter injury results from many environmental factors that have little in common other than that they occur during the winter. Examples of these diverse factors include late spring frosts, cool summers followed by warm autumns and sudden drops in temperature, dramatic temperature fluctuations, freeze-thaw cycles, lack of snow cover, reflected heat from snowcover, unusually warm midwinter temperatures, extended periods of extreme or abnormally cold temperatures, and drying winds. For example, when freezing conditions follow a gradual drop in temperature, they are seldom harmful to most woody ornamentals provided the tissues are mature and have started to go dormant. However, if plant tissues are not mature or have not entered dormancy, they are unable to withstand freezing conditions and injury results. The injury is often confined to the immature, succulent shoots and the damage appears as a dieback of the terminals once growth begins in the spring.

Winter injury is important in and of itself but it also predisposes and weakens plants and subsequently makes them more vulnerable to secondary or opportunistic pests. Among these secondary problems are unusually high incidences of branch and twig diebacks such as those caused by *Botryosphaeria* spp. and *Phomopsis* spp., fungi that are normally not considered to be aggressive pathogens. Another important characteristic of winter injury is that quite often the symptoms are not evident until sometime **after** the injury has occurred. This can make accurate diagnosis very difficult. For example, winter damage to sapwood of lilacs may not be evident until spring or early summer when branches suddenly collapse and die.

Winter injury can occur on a wide range of plants. However, it is often particularly problematic on evergreens in the landscape. This includes broadleaved evergreens such as rhododendron, mountain laurel, and holly and needled evergreens such as hemlock, arborvitae, chamaecyparis, pine, and juniper. Deciduous trees and shrubs such as flowering cherry and almond, maple, and dogwood are also damaged by winter injury as are ground covers such as ivy and pachysandra.

SYMPTOMS:

Symptoms of winter injury are quite variable and depend on the type of plant. Woody plants that are damaged by winter injury will often show tip and branch dieback, foliar browning, sunscalding, and bark splitting. One type of winter injury is excessive drying. This is quite common on evergreens and results from factors that create a water deficit in the plant. This type of injury occurs when water evaporates from leaves or needles on windy or warm, sunny days during the winter or early spring. Drying occurs because this water is not replaced since the roots cannot take up enough water from cold or frozen soil. On broadleaved evergreens such as rhododendron and mountain laurel, the most familiar leaf symptom is characterized by a marginal browning and longitudinal rolling along the midvein. In some cases, entire branches or shrubs can be affected. Needled evergreens exhibit a slightly different symptom with browning of the tips or center portions of needles, chlorotic flecking, needle drop, and tip and twig dieback. In extreme cases, an entire shrub or tree may turn brown or appear off-colored.

On deciduous trees and shrubs, bark may be injured or split by cold weather. Cracks and dead areas appear in the bark and the bark begins to peel away from the trunk as the tree grows in spring and summer. This type of damage is common on many of the thin-barked species such as crabapples, cherries, and maples. Frost cracks during dormancy result from the expansion and shrinkage of bark and wood, which causes internal mechanical stress and cracking and splitting of wood and slipping of bark at the cambium layer. Extremely cold winter temperatures also result in damage to flower and leaf buds. Buds can also be damaged by periods of unusually warm winter temperatures, which trigger them to begin to break dormancy. When the normal temperatures return, these tender buds are injured. As a consequence of both types of injury, deciduous trees and shrubs may not flower or may fail to leaf out properly in the spring. Cold temperatures occasionally cause sub-lethal or lethal damage to cambial tissues. This type of injury usually doesn't appear early in the season but causes new branches to suddenly wilt and begin to die back by early to midsummer. Injured tissues apparently cannot keep up with the water demands of actively growing plants and the plants collapse.

MANAGEMENT STRATEGIES:

Although the weather cannot be controlled and there are no "cures" once the damage is done, there are steps that can minimize the effects of winter injury. These include: Select the appropriate site for planting and maintain optimum growth by following sound cultural practices.

- Select native plants or match plants to the site; for example, avoid planting broadleaved evergreens in open, windy locations where they will be subjected to drying winter winds.
- Provide sufficient moisture to the root zone before the soil freezes--this can be accomplished by giving the trees (esp. evergreens) a deep watering before the ground freezes in the fall; mulching also helps to increase moisture retention in the winter.

- Avoid late summer and early fall fertilization, which may stimulate and encourage growth late in the season that may not harden-off properly for the winter.
- Prune and remove any dead twigs or branches, which can serve as sites for secondary invaders or opportunistic pests.
- Provide physical protection from water loss and drying winds--this is especially important for new transplants or plants in exposed locations; burlap wraps and sprays of anti-transpirants can be used.

4. De-Icing Salts

De-icing salts used to maintain ice-free roadways, driveways, and sidewalks cause damage to woody ornamental trees and shrubs in several ways. Although there has been increasing concern about the environmental impact and adverse effects of de-icing salts in recent years, these issues have been overshadowed by concerns for public safety. In fact, as much as 40-80 tons of salt per lane mile are applied to many highways for ice and snow control each year. The two most commonly applied de-icing salts are sodium chloride (rock salt) and calcium chloride. Although calcium chloride is a better material for melting ice, sodium chloride is used more extensively since it is less expensive and easier to handle. Unfortunately, sodium chloride is also more damaging to vegetation than calcium chloride. Salt can injure plants at anytime but applications in late winter (March) are thought to be more damaging than early- to midwinter applications since there is less time for winter snow and precipitation to leach the salts from the root zones.

DAMAGE AND SYMPTOMS:

De-icing salts cause damage through direct contact of salt solutions with plant foliage (referred to as "spray zone" injury) and through chemical and physical modification of the soil as a result of accumulating salt and uptake of salt ions by plant roots. Spray zone injury results from the deposition of salt water on plant foliage and subsequent uptake of the salt by that foliage. Salt enters plant cells or the spaces between plant cells directly and can affect the hardiness of buds and small twigs. In the soil, dissolved salts separate into sodium and chloride ions that chemically and, to a certain extent, physically modify the soil. The chloride ions are readily taken up by the plant roots and transported to growing tips and foliage where they accumulate to toxic levels. In needles and leaves, these toxic accumulations result in marginal scorch or “burn” symptoms. The sodium ions also cause damage by competing with other ions in the soil. When high levels of sodium ions compete with lower levels of magnesium and potassium ions, it often results in selective uptake of sodium at the expense of the other two important nutrients. When this occurs, plants may develop deficiency symptoms, particularly those associated with potassium deficiency.

Symptoms of de-icing salt injury resemble those associated with root damage or drought stress. They vary with salt concentration, length of exposure, and plant species. Common symptoms include foliar browning, tip necrosis, marginal scorch, leaf and needle drop, tip and branch dieback, premature fall coloration (deciduous species), death of vegetative buds as well as flower buds, and in extreme situations, outright tree death. One diagnostic feature of salt injury is that symptoms are often confined to the side of the tree or shrub facing the road and usually occur within 30-50 ft. of the road. Additionally, a gradient of damage can often be seen with trees closer to the road showing more damage than those farther back.

Woody ornamentals show considerable variation in their relative tolerance to de-icing salts. However, research has demonstrated that trees and shrubs that have been weakened by drought stress are more sensitive to de-icing salts than their healthy counterparts. Among those with high tolerance are Norway maple, autumn olive, white ash, white oak, honeylocust, Japanese black pine, white spruce, and yew. Moderately tolerant species include black cherry, green ash, American elm, Scots pine, and red cedar. Salt-sensitive species include winged euonymus, viburnum, sugar maple, dogwood, little-leaf linden, sycamore, eastern white pine, balsam fir, and Canadian hemlock. More extensive lists are available upon request.

MANAGEMENT STRATEGIES:

Although ***preventing*** problems with de-icing salts is certainly the best solution, it is not always practical or possible. However, the damage associated with de-icing salts can be managed or minimized using a number of different strategies. These include:

- **Washing salts off foliage**- Excess salts can be washed off foliage and should be done as soon after exposure as possible.
- **Minimizing snow piles**- Avoid piling snow containing salt around plants or in places where the runoff will affect desirable plants. It is also helpful to alter road or walkway drainage patterns away from desirable plant species.
- **Removing sand**- Since de-icing salts are often used in combination with sand, buildup of sand can sometimes present additional problems. Sweeping, "brooming," or any other method that physically removes sand that has accumulated on the soil surface will be helpful. Since the type of sand applied to roads is extremely sharp, it is not a desirable addition to native soil. Thick layers of sand will also inhibit gas exchange and water penetration into the root zones of desirable plants.
- **Leaching salts-** To whatever extent possible, salts should be leached from the root zones of affected plants as soon as the ground is no longer frozen. *This is probably the most effective way to minimize soil salinity problems.* Repeated applications of fresh water will help to flush the salts down into the soil profile, below the root zones. The amount of water required to leach the salts will depend on the salinity level. Leaching of excess salts can, however, be difficult in heavy clay soils, which do not have good internal drainage.
- **Amending soil**- Additives to the soil such as organic matter, activated charcoal, and gypsum can help with rectifying soil salinity problems. However, these are not quick fixes and if the salinity levels are extremely high, no amendments will reverse the situation. All additives, regardless of the material used, need to be incorporated into the soil, usually to a depth of at least 6 inches. This need to incorporate the amendment is one of the limiting factors in using soil additives to counter road salt problems. Although a few reports suggest surface applications can be helpful (particularly for gypsum), the general consensus maintains that the additives need to be fully incorporated in order to be effective. Since plants growing in soils rich in organic matter show increased tolerance to salt, a program to increase organic matter in areas prone to road salt is a good preventative plan. Gypsum ($CaSO_4 \cdot 2H_2O$) is the most common additive used to counter salinity problems associated with sodium chloride, the most common de-icing salt. Gypsum separates into calcium and sulfate in the soil. The sulfate forms sulfuric acid in the soil and helps to neutralize any effect that calcium may have in raising the soil pH. The calcium replaces the sodium on the cation exchange sites. The

sodium and sulfate form sodium sulfate ($NaSO_4$), which is a product that can be leached from the soil with water. Rates for gypsum applications depend on the salinity of the soil. However, rates in the range from 10-50 lbs. per 100 sq. ft. are commonly suggested.

- **Determining salt levels**- If concerned about the level of salt with which you're dealing, a soil test can help. Soil salinity is determined by measuring the electrical conductivity of the soil solution. This can be done with soil samples taken from the root zones of the areas in question. Testing for soluble salts is not part of the normal soil test performed by The Connecticut Agricultural Experiment Station. However, soluble salt levels can be tested *when requested at the time the soil sample is submitted for analysis.*
- **Selecting plants**- In areas where de-icing salt is likely to be a chronic problem, it is important to select and plant salt-tolerant species.
- **Maintaining plant vigor**- Maintain overall plant vigor by following sound cultural practices, which include watering during periods of drought and pruning of dead or weakened branches or twigs, in order to minimize problems with secondary or opportunistic pests.

4. Misapplied Pesticides

Injury from misapplied pesticides, mostly herbicides, has increased dramatically over the past few years. In part, this increase can be attributed to widespread use of broadleaved weed controls applied to turf in addition to careless application methods or misapplication of herbicides in the root zones of woody ornamentals. The symptoms vary with compound and plant species and can develop several days to weeks after exposure and, in some cases, even the following spring. Symptoms on broadleaved and deciduous trees include chlorosis, necrotic spotting, marginal scorch, leaf cupping, curling, bud death, tree dieback, decline, deformed leaves, and sometimes death. On conifers, symptoms include needle browning, drop, dieback, bud death, twisting, growth abnormalities and, in extreme cases, tree death. Plant species vary with regard to their reaction to specific pesticides and lists of the relative sensitivities of various species are available.

The herbicides 2,4-D, MCPP, and dicamba most frequently cause problems. These compounds act as plant hormones that disrupt normal growth processes in affected plants. Doses can be lethal (when trees are killed as a result of exposure) or sub-lethal (when trees recover over time). Trees are injured in basically three ways: 1) from spray drift--direct plant contact from droplets containing the compound; 2) from vapor drift--direct plant contact through gaseous, vaporized compounds, usually associated with highly volatile pesticides or with high temperatures; and 3) from root absorption--herbicides are leached into the soil and root zones of non-target plants.

MANAGEMENT STRATEGIES:

- **Prevention** through careful application is the best control.
- Avoid drought stress since drought-stressed plants are more vulnerable.
- Select less sensitive species in areas where continued herbicide use is necessary.

COMMON BIOTIC PROBLEMS

1. Foliage Diseases

These comprise the most common of all plant diseases that we encounter in the landscape. In most cases they are considered to be more aesthetic than life-threatening problems although they can result in significant premature leaf drop. These diseases are typically most serious during wet springs since free water on leaf surfaces is usually necessary for infection. The causal agents include a wide range of fungi and bacteria. Hosts are a broad range of deciduous and broadleaved evergreen trees and shrubs.

Leaf Spots: These are the most prevalent of all plant diseases. Leaf spots appear as dead areas scattered over the leaf surface. The size, color, and shape can vary with host and pathogen although they usually have definite margins. Leaf spots can result in substantial premature defoliation. Examples include Tar Spot of Maple, Scab of Crabapple, and Oak Leaf Blister.

Anthracnoses: These appear as necrotic areas that are often V-shaped and defined by the veins. Symptoms can appear as blotchy, dead areas or as discrete leaf spots. Severe infections can result in significant defoliation and, occasionally, in twig and branch dieback. Anthracnoses are most serious during wet, cool springs. Examples include Anthracnoses of Sycamore, Maple, Dogwood, and Ash.

Needlecasts: Infected trees are characterized by browning and chlorosis of the needles and by premature and often severe needle drop. Symptoms can also be associated with branch and twig dieback. Examples include Rhabdocline Needlecast of Douglas-Fir, Rhizosphaera Needlecast of Spruce, and Canavirgella Needlecast of White Pine.

Powdery Mildews: Symptoms appear as grayish or white, powdery growth, usually first evident on the upper surface of the leaf but it can occur on both leaf surfaces. Symptoms can vary with each host and can result in minimal or extensive, premature fall coloring, browning, and defoliation. Powdery mildews usually develop mid to late in the growing season. Examples include Powdery Mildew of Dogwood, Maple, Oak, and Elm.

Rusts: These are recognized as brightly-colored, often yellow to red or orange, raised blisters or pustules that develop on leaves. The pustules break open to reveal the orange to rusty-brown spores for which these diseases are named. On evergreens, symptoms can also develop as galls or swellings on twigs and branches. Examples include Cedar-Apple Rust, Hawthorn Rust, and Spruce Needle Rusts.

MANAGEMENT STRATEGIES:

- Maintain tree or shrub vigor by fertilization and watering during periods of drought.
- Rake and remove symptomatic fallen leaves in autumn.
- Prune out dead branches or twigs in spring.
- Use resistant cultivars when available.
- Most foliage diseases are not serious enough to warrant chemical control; however, there are exceptions with regard to the value of the plant or tree, the specific host and type of leaf spot involved, the nature of the host-associated damage, and the timing of defoliation; most available fungicides are protectants and must be applied to developing foliage **before** symptoms appear; the number of sprays required for control will vary with weather

conditions; check pesticide labels for plant host, pathogen, dosage rates, and safety precautions.

2. Blight and Dieback Diseases

These diseases are characterized by sudden and conspicuous leaf and growing tip damage, blackening or wilting of growing tips, and death of shoots and growing tips. They are often more severe during wet weather or on plants that have been stressed by other factors. The causal agents commonly include a wide range of fungi and bacteria that are capable of infecting a broad range of deciduous and evergreen trees and shrubs. Examples include Sphaeropsis Tip Blight of Pine and Fire Blight.

MANAGEMENT STRATEGIES:

- Avoid plant stress and maintain vigor.
- Protect plants from winter injury.
- Use resistant cultivars when available.
- Prune, remove, and destroy diseased portions of plants, especially spent flowers and leaf debris.
- Fungicides are helpful in some host-pathogen combinations; many are protectants and need to be applied before symptoms appear and the effectiveness and number of sprays required for control will vary with weather conditions.

3. Vascular Diseases (Wilts)

Wilts are characterized by loss of rigidity, wilting, yellowing of foliage, and drooping of plant parts. These are often followed by premature defoliation and gradual dieback or "flagging." With flagging, one limb or branch becomes symptomatic at a time. Infected trees will occasionally produce a heavy crop of seed and have leaves that are smaller than normal. Depending upon the causal agent, infected branches may develop characteristic brown, greenish, or yellow streaks in the vascular tissues. Phytoplasmas and several types of fungi can cause wilts. Depending on the causal agent, **many** tree species can be infected. However, trees under drought, nutrient, or salt stress are generally more sensitive. Examples of wilt diseases caused by phytoplasmas are Ash Yellows and Elm Yellows. The most common fungal wilts are Verticillium Wilt *(Verticillium* spp.) and Dutch Elm Disease *(Ophiostoma ulmi* and *O. novo-ulmi).*

MANAGEMENT STRATEGIES:

- Prune and remove affected branches or limbs as soon as symptoms are evident; cuts should be made well below visible symptoms.
- Plant resistant species where possible.
- Maintain plant health by following sound cultural practices.
- Avoid tree stress by selecting an appropriate planting site.
- Some success has been achieved with fungicide injections.

4. Branch and Stem Canker Diseases

Canker infections may appear as definite areas that vary in color from the surrounding healthy bark. These can be necrotic, often sunken or swollen lesions on twigs, branches, limbs, or the main trunk. When cankers girdle the twig or branch, leaves wilt, drop, and the distal portion of the branch dies. Causal agents include a wide range of fungi and bacteria and sometimes small fruiting structures of these causal fungi may be evident in the canker. Hosts include a wide range of hardwoods and conifers. Examples include Cytospora Canker of Spruce, Black Knot of Cherry, Coral Spot Canker, and Botryosphaeria Canker.

MANAGEMENT STRATEGIES:

- Prune and remove symptomatic branches; in some cases, trunk cankers can be surgically excised during dry weather.
- Maintain tree vigor.
- Avoid wounds and pay careful attention to pruning techniques.

5. Root Diseases

Root diseases are associated with symptoms that are usually nonspecific. Leaves turn yellow, wilt, and droop, twig and branch dieback may occur, trees exhibit general decline, reduced or stunted growth, and trees may die. The causal agents are varied but fungi are the most common. A wide range of hardwoods and conifers can be infected, however, plants under stress, especially from excess water, are more susceptible. In most cases, once trees are infected they cannot be cured. Examples include Armillaria Root Rot, Phytophthora Root Rot, and Crown Gall.

MANAGEMENT STRATEGIES:

- Protect plants from soil moisture extremes (drought or flooding).
- Maintain tree vigor.
- Remove and destroy affected trees; removing stumps and woody roots is often prudent and necessary.
- Plant resistant species, where possible.
- When available and applicable, biocontrol agents or fungicides can be applied to protect healthy trees nearby.

PROBLEMS OF UNDETERMINED CAUSE:

"Decline" Syndromes

Tree decline is characterized by progressive deterioration due to loss of vigor and health. Trees can decline for **many** reasons and although one factor may be responsible, in most cases decline results from several factors. These factors, which are often both biotic and abiotic, can act singly or in combination. A key aspect of tree decline is that the causal factors are active **over a period of years**. Symptoms of decline are highly variable and are dependent upon cause(s) and tree species. They include slow growth, sparse canopy and undersized leaves, premature leaf drop and fall coloration, excessive fruit set, and dieback of twigs and branches. Causal factors are many and include a wide range of abiotic (e.g., extremes of heat or moisture, girdling roots, construction damage or injuries) and biotic (e.g., primary pathogens such as *Verticillium* and phytoplasmas, opportunistic pathogens, insects causing defoliation) factors. Any tree or shrub

can be affected by decline but some species are more frequently affected. In Connecticut these include ash, oak, and maple (Ash Decline, Oak Decline, and Maple Decline).

MANAGEMENT STRATEGIES:

- Select plants appropriate for the site.
- Maintain vigor with special attention to watering during drought.
- Avoid physical, mechanical, and chemical injuries.
- Prune and remove any dead or dying branches or limbs.

January 2005