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DISEASE PROBLEMS IN CONNECTICUT CHRISTMAS TREE PLANTATIONS 2006-2007

Many Christmas tree plantations throughout Connecticut were challenged by the wet, cool 2006 growing season. Fungal diseases and weather-related stresses were visible in many plantations. Repeating (autoecious) spruce needle rust was widespread and severe on plantation as well as landscape trees throughout the state. Needlecasts, blights, and root rots also continued to be problematic for several types of conifers. Last year's wet, dry growing season, a relatively mild winter, a cool, wet spring, and a wet summer all contributed to tree problems during the 2006 growing season.

Diseases caused by fungi are characteristically more serious during cool, wet spring and summer weather, ***exactly*** the conditions of this growing season. Since the conditions were favorable for fungal diseases this spring, depending upon the prevalence and severity of a particular disease(s) in a plantation, it might be prudent to allow extra time to scout for symptoms during late winter and early spring in order to anticipate possible problems and the need for early-season sprays for control during the upcoming 2007 season.

CURRENT DISEASE PROBLEMS:

The key problems observed on conifers in 2006 are listed as follows.

A. Abiotic (caused by nonliving agents)

- Winter Injury
- Excess Water

B. Biotic (caused by living agents)

- Autoecious (Repeating) Spruce Needle Rust
- Botrytis Blight
- Sirococcus Blight
- Rhabdocline Needlecast
- Rhizosphaera Needlecast
- Phytophthora Root Rot

A. ABIOTIC PROBLEMS: (caused by nonliving agents)

Synopsis of this Season's Weather:

This spring and early summer were quite a contrast to last year's extremely hot and dry conditions. Cool, cloudy, wet conditions prevailed throughout May and into early summer. These conditions resulted in free moisture on the developing needles and shoots and satisfied the requirements for many types of fungal infections. Budbreak was also prolonged by cool temperatures in May so tissues were extremely susceptible to infection for longer than usual.

Also problematic for many trees were the October 2005 rains after the drought of the 2005 growing season. These fall rains resulted in problems with dormancy for many trees. These conditions were followed by quirky winter weather with sudden drops in temperature, extreme fluctuations in temperature, periods of prolonged low temperatures, and drying winds. All of these conditions resulted in some damage to trees of all ages.

I. WINTER INJURY

The winter of 2005-2006 was fairly mild and characterized by a few prolonged periods of extremely cold temperatures contrasted by record high temperatures in January. Winter injury or drying results from factors that contribute to a water deficit in the tree. Water evaporates from the needles on windy or warm, sunny days during winter or early spring. This water is not replaced since the roots are not able to obtain sufficient water from cold soil nor can they absorb water from frozen soil. Prolonged periods of extremely cold temperatures also result in winter injury, specifically injury to bark and cambial tissues. This injury can be lethal and is visible as dieback or browning of branches in late winter or early spring as trees begin to flush. Injury can also be "sub-lethal." When this occurs, branches on affected trees suddenly collapse or develop brown branches in the middle of the growing season. In these cases, damage to the bark and cambium is not evident in spring but once demands for water and nutrients are placed on the injured tissues in mid to late-summer, affected tissues collapse.

1. Symptoms:

Symptoms of winter injury include tipburn, chlorotic mottling or uniform yellowing of needles, and tip or branch dieback. Damage often appears on one side of the tree or on one branch, usually the side facing prevailing winds. In many cases, one-third to one-half of each needle is often browned. All species of conifers are susceptible, but newly transplanted trees are especially susceptible. Depending on the extent of the damage, visible symptoms often do not appear until the following spring or even into the summer. In some years, a distinct line is visible in a plantation where the snow cover has protected the lower branches of the trees from drying and injury. Winter injury and desiccation also weaken trees and make them more susceptible to needlecasts, blights, root diseases, and opportunistic pests.

2. Management:

While there is no cure for this disorder, steps to help minimize the effects of winter injury include:

- Select an appropriate site for planting and use good planting techniques to ensure maximum root growth.
- Maintain tree vigor by following sound cultural practices.
- Give trees, especially new transplants, a deep watering before the ground freezes in the fall and mulch around the base of the trees to maintain moisture in the root zone.

- Fertilize at the proper time and rate as determined by a soil test--avoid excessive nitrogen and late-summer and early-fall fertilization.
- Prune dead or weakened branches prone to secondary problems.

II. EXCESS WATER OR WET SOIL

The October 2005 rains after a long dry spell created problems for root health. This was compounded by numerous periods of prolonged rainfall during the 2006 growing season. Waterlogged soils limited growth of new roots and inhibited the ability of existing roots to absorb water. The waterlogged conditions in October came when temperatures were warm enough for sporulation, spread, and infection by *Phytophthora.* These conditions may have contributed to new infections of highly susceptible species such as Fraser fir. Refer to section on Phytophthora root rot that follows.

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. Feeder roots are particularly sensitive to flooding and are frequently the first ones damaged. When roots are damaged, they are unable to provide water to the top of the plant. Damage can be sudden or gradual, depending upon the species and the flooding conditions. This can occur on plants in obviously wet sites and on those in marginal sites or soils such as in areas where high clay content in the soil impedes drainage. Most trees cannot grow in waterlogged soils for very long and can die if flooded for only a few days during the growing season.

1. Symptoms:

Symptoms include dwarfing of needles, general chlorosis, wilting, needle drop, and dieback. These symptoms are often not evident until considerably after the damage has occurred, especially when the root damage is gradual. Seedlings and new transplants are more sensitive than established plants. Top symptoms may not develop until water demands increase during the hot summer months. Other evergreens appear to lose vigor and slowly decline over a period of years. This can occur on trees that have been otherwise "healthy" for 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 root rot pathogens and other opportunistic pests.

2. Management:

Strategies for minimizing wet soil problems include following some *preventative* measures.

- Select an appropriate site and use proper planting practices.
- Follow cultural practices that maintain plant vigor and stimulate growth.
- Select appropriate species for soil and site conditions: intermediately water-tolerant (e.g., balsam fir) vs. water-intolerant (e.g., hemlock, white pine, blue and white spruce).
- Prune dead or dying tissues to minimize secondary invaders.

B. BIOTIC PROBLEMS: (caused by living agents such as fungi or bacteria)

During the 2006 season, a needle rust, two tip blights, several needlecasts, and one root disease were diagnosed in Christmas tree plantations in Connecticut. These fungal diseases were autoecious (repeating) spruce needle rust, Botrytis blight, Sirococcus blight, Rhabdocline needlecast of Douglas-fir, Rhizosphaera needlecast of spruce, and Phytophthora root rot. The wet conditions and relatively high frequency of some of these diseases during the 2005 season

provided key sources of overwintering inoculum for spring 2006. Since we had a recurrence of many diseases during the 2006 season, we can expect some level of overwintering inoculum in many plantations. As a consequence, it might be wise to scout for symptoms in late winter and early spring of 2007 so you can anticipate the need for fungicide sprays. This will be especially important for trees that will be ready to sell in 2008.

I. AUTOECIOUS (REPEATING) SPRUCE NEEDLE RUST

1. **Causal Agent: *Chrysomyxa weirii***
2. **Key Hosts: blue and white spruce**
3. **Symptoms and Spread:**

Unusually severe and widespread outbreaks of this rust occurred on spruce trees in landscapes, production nurseries, and plantations during the 2006 season. This fungal disease has been present in the state for years but it reappeared in 1996 and its incidence and severity have been on the increase over the past few years. This needle rust is autoecious and does not require any additional hosts in order to complete its life cycle. Infected trees are rarely killed but the primary damage results in extensive needle discoloration and drop, which reduces the marketability of the infected trees. One of the key features used to distinguish repeating needle rust from other needle rusts is the timing of symptom development. Symptoms appear in early spring whereas those of the heteroecious Chrysomyxa rusts appear in mid to late-summer. Blue spruce is highly susceptible to this disease.

Symptoms first appear as yellow spots or flecks on needles in late winter and early spring. These spots eventually develop into pustules or blisters (telia) and burst open to reveal masses of yellow-orange spores (teliospores). The teliospores then produce another type of spore (basidiospores) that are readily blown by wind and splashed by rain onto needles of the same tree or onto those of adjacent trees. Infection occurs when needles first emerge and are tender and immature. The following spring, yellow spots and blisters develop on the infected needles and the disease cycle starts again. Blisters of *C. weirii* can appear on both 1st and 2nd year needles and heavily infected trees can appear distinctively yellow-orange from a distance. As with most diseases that are not fatal but result in needle drop, repeated defoliation may retard growth and reduce marketability.

4. **Management:**
   a. Use healthy stock and maintain tree vigor. Fertilize at the proper time and rate as determined by a soil test--avoid excessive nitrogen and late- summer and early-fall fertilization.
   b. Rogue and remove heavily infected trees to reduce inoculum.
   c. Fungicide sprays.
      - in all cases, **coverage and timing** are **very** important;
      - although rust is not specifically listed on the label, chlorothalonil (Daconil 2787, Daconil Ultrex, Daconil Weather Stik, Bravo) is labeled for spruce and is effective for control;
      - the label contains information on dosage rates and safety precautions;
      - the first application should be made when 10% of the trees have broken some buds; applications should then be made at weekly intervals until needles are mature or until symptomatic needles have dropped to the ground; this is usually 3 sprays but in years where budbreak is slow and the weather is cool

and there is enough free moisture on the needles for infection (as in May 2005), up to 5 sprays may be necessary.

II. BOTRYTIS BLIGHT

1. **Causal Agent:** ***Botrytis cinerea***
2. **Key Hosts: all conifers, especially spruce and fir**
3. **Symptoms and Spread:**

Botrytis blight appeared on a number of conifers in both plantations and landscapes but white and blue spruce and Douglas-fir were particularly affected. *Botrytis* was observed on tender, succulent tips that had emerged during the extended cool, relatively moist May weather of 2006.

Botrytis blight can infect most conifers but is particularly problematic on seedlings, young trees, and trees that have been weakened, but not necessarily killed, by frost or freeze injury. It is also prevalent during periods of extended cool weather when shoots are elongating and immature tissues are present for longer periods than usual. This spring, many conifers exhibited symptoms of *Botrytis* infection. Affected tissues initially appear water-soaked and then turn brown. Brown lesions girdle the shoots and cause them to wither and die. As the disease progresses, infections are identified by the gray, fuzzy, cottony growth of the fungus on the surface of needles and shoots. The fungus usually moves from the needles to the shoots and into the stems. With the exception of weak trees, infections usually do not extend beyond the current-season's growth and are often confined to tissues that have been damaged by frost. Botrytis blight is a more serious problem on seedlings or young trees than on established trees. On established trees, infected shoots are walled-off and usually drop. On seedlings, young, or weak trees, the fungus can spread into shoots or the main stem where it causes cankers that eventually girdle and kill the shoot or tree. Refer to the fact sheet *Diseases of Christmas Tree Seedling and Transplant Beds* for more details. The fungus is an aggressive saprophyte so infections often begin on shaded, senescent needles, and in other plant debris at the base of a tree.

4. **Management:**
   a. Follow sound cultural practices to keep trees as healthy as possible. Weak and frost-damaged tissues are particularly susceptible to infection so it is important to select appropriate planting sites. Fertilize at the proper time and rate as determined by a soil test--avoid excessive nitrogen and late- summer and early-fall fertilization.
   b. Avoid overcrowding to allow for good air circulation.
   c. Avoid overhead irrigation or water early in the day so the foliage has a chance to dry.
   d. Practice good sanitation.
      - spores can be spread from tree to tree by tools so shear healthy trees first or disinfest tools between cuts with household bleach (1 part bleach: 9 parts water) or 70% alcohol;
      - avoid shearing when the foliage is wet to reduce spread of disease;
      - diseased tissues should be removed as soon as they are evident in seedling beds;

   e. Fungicide sprays are usually not necessary for established trees. However, they can help to minimize damage to seedlings and new transplants.

- among the compounds registered for use in Connecticut are: ferbam (Ferbam), mancozeb (Protect), chlorothalonil (Daconil, Bravo), chlorothalonil + fenarimol (TwoSome), thiophanate methyl (Cleary's 3336), and copper sulphate pentahydrate (Phyton 27);
- the labels contain information on dosage rates and safety precautions;
- applications can be made when new shoots emerge and are continued as necessary since additional applications may be necessary in years with excessive rainfall.

III. SIROCOCCUS BLIGHT

1. Causal Agent: *Sirococcus conigenus*

2. Key Host: many conifers including Douglas-fir and blue and white spruce

3. Symptoms and Spread:

Higher than usual incidences of Sirococcus blight were observed on Douglas-fir and blue spruce in plantation and landscape trees this year. This level of disease was likely associated with the weather this spring. Young trees are usually more susceptible although trees of any age can be infected. Sirococcus blight rarely kills trees but can disfigure and reduce marketability. However, repeated infections of young trees can result in tree death.

Symptoms first appear on succulent shoots and occasionally 1-year-old twigs in midsummer. Affected shoots often appear at random within the canopy of a tree. This disease is often confused with Botrytis blight but Sirococcus usually shows up later in the season. However, symptoms are sometimes more pronounced in the lower portions of older trees. This is because low light levels increase the susceptibility of tissues to infection. Blue spruce is highly susceptible and 1-year-old shoots are commonly killed. The fungus attacks at needle bases, girdles the shoot, and results in tip dieback. Infected shoots turn brown and often develop a diagnostic shepherd's crook appearance. Pinpoint, brown fruiting structures of the fungus called pycnidia develop at the bases of infected needles or on infected shoots in mid to late-summer or early-fall. These are often visible with a hand lens. The fungus overwinters in these killed shoots and in cone scales. Spores of the fungus called conidia are spread by splashing rain or water during spring and into summer. Infections occur when conidia land on succulent tissues of newly emerging shoots during periods of wet weather and when tissues are wet for 24 hours or longer at 10-25°C (50-75°F). The longer the tissues are wet, the more severe the infection. These were exactly the conditions throughout Connecticut this spring. Infections result in stunting or disfigurement of the growing tips.

4. Management:

a. Use healthy stock and maintain tree vigor with good weed control, proper fertilization, and attention to planting site.

b. Rogue severely symptomatic trees.

c. Prune and remove any dead or dying branches when the bark is dry.

d. Practice good sanitation.

- spores can be spread from tree to tree by tools so shear healthy trees first or disinfest tools between cuts with household bleach (1 part bleach: 9 parts water) or 70% alcohol;
- avoid shearing when the foliage is wet to reduce spread of disease;

e. Use less susceptible varieties, when possible.

- blue spruce is highly susceptible;

f. Fungicide sprays.
   - in *all* cases, coverage is **very** important!
   - chlorothalonil (Bravo, Daconil 2787, Daconil Ultrex, Daconil Weather Stik), chlorothalonil + fenarimol (TwoSome), and thiophanate methyl + chlorothalonil + mancozeb (Spectro 90 WDG), and azoxystrobin (Heritage) are registered for use;
   - the label contains information on dosage rates and safety precautions;
   - begin applications before new growth is approximately ½" long and repeat at label intervals depending on rainfall. Sprays should continue until shoots are fully elongated and conditions are no longer favorable for disease.

IV. RHABDOCLINE NEEDLECAST

1. Causal Agent: *Rhabdocline* spp.

2. Key Host: Douglas-fir

3. Symptoms and Spread:

Outbreaks of Rhabdocline needlecast of Douglas-fir were spotty and sometimes severe throughout the state in both Christmas tree plantations and in landscape plantings again this spring. In some plantations, the disease was so severe that blocks appeared distinctly reddish-brown from a distance. The slow but steady increase in Rhabdocline over the past few years is probably the result of the buildup of inoculum over several growing seasons. This year, the combination of the elevated levels of inoculum from symptomatic trees and optimum conditions for infection may have resulted in significant infections of newly developing needles in some plantations. If you had outbreaks of Rhabdocline this season, be sure to scout for symptoms in winter and in early spring 2006 in order to be ready to spray to manage this disease.

Rhabdocline needlecast was first reported in the 1920's and has steadily increased in both incidence and severity for the past eight years. This increase can be attributed to a number of factors including the weather, increased planting of Douglas-fir and associated seed sources, and environmental stress. The primary damage associated with this important disease is defoliation that leads to suppressed growth and to value loss in Christmas trees.

Symptoms of Rhabdocline first become apparent in late fall or early winter as yellow spots or flecks on one or both surfaces of current-season needles. (These symptoms can be confused with feeding damage from the Cooley spruce gall adelgid.) These chlorotic spots gradually turn reddish-brown and can range from 1-2 mm or can encompass the entire needle. A distinctive diagnostic characteristic is the sharp border between the healthy green tissue and the infected brown tissue. Discolored needles are most conspicuous in early spring. Symptoms are often most severe on the lower portion of the tree where air circulation is poor. Although some of the heavily infected needles drop before or during budbreak, most will persist for several months. In late spring, fruiting structures of the fungus develop beneath the epidermis on the lower surface of the needle. The epidermis eventually ruptures and splits open, usually in two longitudinal lines, and exposes the spores of the fungus. These spores are carried by rain and wind to newly expanding needles. When the spores land on immature needles they germinate, penetrate the cuticle, and begin to grow within the needle. Even though the fungus has infected the needle, no obvious external symptoms are evident until considerably later, by fall or winter. There is only one infection period per year and infection is favored by cool, moist weather and periods of rain. Rhabdocline needlecast is most damaging in plantations where weed growth, close spacing of trees, or dense foliage induced by shearing impede air circulation and prolong

wetness on lower branches.

4. Management:

a. Use healthy stock and maintain tree vigor. Fertilize at the proper time and rate as determined by a soil test--avoid excessive nitrogen and late-summer and early-fall fertilization.

b. Select the appropriate planting site (slopes with good air drainage) and maintain good weed control to promote good air drainage and dry conditions on lower branches.

c. Rogue severely symptomatic trees.

d. Prune and remove any dead or dying branches. There is no need to remove prunings from the plantation floor since the fungus cannot mature on branches once they are cut.

e. Practice good sanitation.

- spores can be spread from tree to tree by tools so shear healthy trees first or disinfest tools between cuts with household bleach (1 part bleach: 9 parts water) or 70% alcohol;
- avoid shearing when the foliage is wet to reduce spread of disease;

f. Use resistant varieties when possible.

- seed sources and individual trees ***vary greatly*** with regard to susceptibility;
  most resistant- Shuswap, Pillar Lake;
  moderately resistant- Santa Fe, Silver Creek, Coville;
  most susceptible- San Isabel, Lincoln, Apache, Cibola, Kaibob, Coconino;

g. Fungicide sprays.

- in *all* cases, coverage is **very** important!
- chlorothalonil (Bravo, Daconil 2787, Daconil Ultrex, Daconil Weather Stik), chlorothalonil + fenarimol (TwoSome), and mancozeb (4 Flowable Mancozeb, Protect T/O) are registered for use;
- the label contains information on dosage rates and safety precautions;
- begin applications before new growth is approximately ½" long and repeat for additional sprays at 7-14 day intervals depending on rainfall. Sprays should continue until needles are fully elongated and conditions are no longer favorable for disease.

V. RHIZOSPHAERA NEEDLECAST

1. Causal Agent: *Rhizosphaera kalkhoffii*

2. Key Hosts: blue spruce, occasionally white spruce

3. Symptoms and Spread:

Rhizosphaera needlecast of blue and white spruce was also prevalent in 2005 in plantations and landscapes, especially on trees that had been stressed. The situation with this disease is similar to that of Rhabdocline needlecast. The symptoms this spring (2006) were the result of last year's infections during the wet spring 2005 conditions.

This needlecast fungus has been causing increasing damage on spruce, especially blue spruce, throughout Connecticut. One reason for this dramatic increase can be explained by the fact that Rhizosphaera needlecast is more severe in drought stressed trees. Although some trees are killed, the primary damage has been premature needlecast. The fungus attacks needles on the lower branches first and gradually progresses up the tree. On severely diseased trees, the

infected needles usually fall during their second summer, leaving only the current-season's growth on the bottom half. Under epidemic conditions, lower branches may be killed by the fungus.

Current-year needles become infected in May and June but symptoms do not appear until late fall or the following spring. Diagnostic symptoms may develop in early September but typically occur in spring: infected needles turn a distinctive lavender or purplish-brown. At that time, pinpoint black fruiting bodies of the fungus appear in the stomata of the infected needles. These can be seen with a hand lens and appear as fuzzy, black spots instead of white stomates. During periods of rain and wet weather, spores of the fungus are released and are rain-splashed onto newly developing needles where infection occurs. The infection period for this disease can be quite long since infections begin in spring and can continue until autumn.

Rhizosphaera needlecast is often first evident in stands that are naturally moist or that have poor air drainage or in stands adjacent to taller trees that reduce wind-drying of the foliage. *Rhizosphaera* typically infects newly grown needles of the current-season but can attack needles of any age that are dying or stressed by other plant pests or environmental factors.

4. Management:

a. Use healthy stock and maintain tree vigor with good weed control, proper fertilization (as determined by a soil test), and attention to planting site.

b. Prune and remove any dead or dying branches. Remove *all* prunings from the plantation floor since the fungus can mature on branches that are cut.

c. Practice good sanitation.

- spores can be spread from tree to tree by tools so shear healthy trees first or disinfest tools between cuts with household bleach (1 part bleach: 9 parts water) or 70% alcohol;
- avoid shearing when the foliage is wet to reduce spread of disease;

d. Use resistant varieties, if possible.

- blue spruce is most sensitive, white spruce is intermediate, and Norway spruce is relatively resistant;

e. Fungicide sprays.

- in *all* cases, coverage is **very** important!
- chlorothalonil (Bravo, Daconil 2787, Daconil Ultrex, Daconil Weather Stik), chlorothalonil + fenarimol (TwoSome), chlorothalonil + thiophanate methyl (Spectro), elemental copper (Basicop), mancozeb (Protect), and copper hydroxide (Kocide) are registered for use;
- refer to the label for information on dosage rates and safety precautions;
- applications can be made when new shoots are approximately 1½" long and again 3 weeks later;
- additional applications may be necessary in years with excessive rainfall.

VI. PHYTOPHTHORA ROOT ROT

1. Causal Agent: *Phytophthora* spp.

2. Key Hosts: hundreds of woody plants including most conifers, especially true firs such as Fraser fir

3. Symptoms and Spread:

The combination of dry conditions of 2005 followed by the October rains of 2005 provided optimum conditions for this disease, especially on highly susceptible species like Fraser

fir. Aboveground symptoms of this disease are not very distinctive, a characteristic typical of most root rot diseases. Included among the symptoms of Phytophthora root rot are suppressed growth, poor vigor, yellowed or undersized needles, premature needle drop, branch dieback, wilt, and death of trees at any time during the season. Diagnostic symptoms can usually be seen at the base of the infected tree, either as extensive resin-flow on the outer bark or cracking in the root-crown area. A characteristic and distinctive cinnamon-brown discoloration is usually evident when cuts are made into the wood in this area.

Phytophthora root rot is often associated with drainage problems and wet sites. This soilborne pathogen (previously called a "water mold") produces motile spores that readily move in water. As a consequence, declining trees often follow drainage patterns in plantations, especially those sited on hills: an infected tree at the top of the drainage pattern can effectively inoculate the trees below. *Phytophthora* can be dormant in soil for many years as mycelial strands or as chlamydospores. When these dormant structures are subjected to warm and saturated soils, even for a few hours, this pathogen can be activated. These were the conditions present during and after the October rains of 2005 when soil temperatures were still greater than 54°F.

Root rot can be severe in young Christmas tree plantations since young, newly planted trees are the most susceptible. Fortunately, trees become more resistant, but not immune, with age. Phytophthora root rot can also be a problem in seedling and transplant beds. When seedlings are infected, the root appear distinctly cinnamon brown in color and lack feeder roots. Refer to the fact sheet *Diseases of Christmas Tree Seedling and Transplant Beds* for more details.

4. Management:

a. Use healthy stock. Carefully inspect transplants from seedling beds prior to planting.
b. Avoid planting in poorly drained sites or take steps to modify or improve drainage.
c. Maintain vigor by proper fertilization (based on soil tests) and planting practices; avoid excessive irrigation.
d. Rogue and remove symptomatic trees.
e. Fungicides:
   - ***NOTE:*** fungicides cannot be used in a curative fashion- infected trees cannot be cured.
   - healthy, uninfected plants adjacent to symptomatic plants can be *protected* with fungicides; fosetyl-Al (Aliette), mefenoxam (Subdue MAXX), and phosphorous acid or mono- and di-potassium salts of phosphorous acid (Alude, Magellan, Fosphite);
   - refer to the label for information on dosage rates and safety precautions.

OTHER DISEASES:

Numerous other diseases that can occur in Connecticut Christmas tree plantations are not covered in this handout. Please refer to previous editions of *Disease Problems in Connecticut Christmas Tree Plantations* for more detailed information about many of these diseases. Copies are available upon request. This handout is updated on a yearly basis.

SELECTED REFERENCES:

There are a number of good reference books on diseases and insect pests of Christmas trees and conifers. As follows is a selection of moderately priced (i.e., affordable) ones with the

bonus of having good, color photographs.

Christmas Tree Pest Manual, 2nd Edition. 1998. D. G. McCullough, S. A. Katovich, M. E. Ostry, and J. Cummings-Carlson. Michigan State University.

143p. $20.00
Extension Bulletin E-2676
Order From: MSU Bulletin Office
10-B Agricultural Hall
Michigan State University
East Lansing, MI 49924-1039
517-355-0240

Christmas Tree Diseases, Insects, & Disorders in the Pacific Northwest: Identification and Management. 1997. G. A. Chastagner. Washington State University.

154p. $25.00 + $4.00 shipping
Bulletin MISC0186
Order From: Washington State University Cooperative Extension
Bulletin Office
P. O. Box 645912
Pullman, WA 99164-5912

Compendium of Conifer Diseases. 1997. E. M. Hansen and K. J. Lewis. APS Press, St. Paul, MN. 124p. $49.00

ISBN 0-89054-183-3
Order From: APS Press
The American Phytopathological Society
3340 Pilot Knob Road
St. Paul, MN 55121-2097
1-800-328-7560
Website- http://www.shopapspress.org

December 2006 (revised)