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FIFTY YEARS OF CONNECTICUT CHRISTMAS TREES: A PLANT PATHOLOGIST'S PERSPECTIVE

During the last fifty years, many changes have occurred in the types of conifers grown as Christmas trees in Connecticut and in consumer preferences for particular tree species. These changes have led to modifications in growing practices to continue production of attractive, marketable trees. When asked to prepare a review of diseases on Christmas trees during this fifty year period, I started by examining The Connecticut Agricultural Experiment Station's *Record of the Year* back to 1960 for reports on diseases. This seemed a good source, since the Connecticut Christmas Tree Growers Association (CCTGA) and the Experiment Station have maintained a relationship of mutual support over the years. As part of this relationship, Station scientists assist Christmas tree growers on issues from tree selection and culture, to weed, insect, and disease management, and growers provide trees, land, and assistance with Station experiments. Looking through the records, I noted that there were very few disease reports until the early 1980's. This surprised me, since I have seen growers challenged by a number of different diseases during my 28 years at the Station.

Was there a reason why diseases were not reported in the early years? What was different about 1960 when compared to

2010? A good start to answering these questions is to consider the types of conifers grown for Christmas trees and the changes that have occurred over the years. Spruces, particularly white and Norway spruce, comprised the dominant species grown in the state until the 1970's. These trees were, and continue to be, relatively problem-free, so quality issues associated with diseases were likely not a concern for most growers. However, once blue spruce entered the picture and more acres were planted to this species, disease became a recurring concern for growers--blue spruce is more susceptible than other spruces to diseases such as repeating spruce needle rust and *Rhizosphaera* needlecast.

Along with blue spruce's popularity was a rise in the popularity of Douglas-fir, and increased acreages of it were planted throughout the state. The Lincoln strain of this species was popular because of its form and rate of growth, despite being highly susceptible to *Rhabdochline* needlecast (Figure 1). In fact, the first mention of diseases on conifers that appeared in the Station's *Record of the Year*, was a report on *Rhabdochline* in 1980. By 1983, this disease was reported to have dramatically increased throughout the state.



Figure 1. Rhabdocline needlecast of Douglas-fir.

In addition to changes in tree species, other factors influencing the prevalence of diseases were: 1) changes in consumer and market demands and 2) increasing competition between real Christmas trees and artificial trees. Christmas tree growers made adjustments to meet these new expectations by looking for species with superior post-harvest needle and moisture retention characteristics. Savvy consumers began to demand trees with long needle retention, perfect shape, and unblemished needles. This resulted in tremendous increases in plantings of Fraser fir. This species is considered by many to be the world's best Christmas tree because of its wonderful fragrance, soft needles, and strong branches. Connecticut growers learned how to grow this desirable species, but also learned that they had to deal with its high susceptibility to *Phytophthora* root rot.

As demands from consumers and wholesalers increased, Connecticut choose and cut growers and wholesale growers began to explore exotic tree species to increase the variety and quality of trees that they offered. The introduction of many of these species into the state led to issues associated with hardiness and increased vulnerability to stress-related diseases such as *Rhizosphaera* needlecast and *Armillaria* root rot. Other diseases problematic to these

new tree hosts started to appear, such as *Uredinopsis* needle rust of concolor fir (and occasionally grand, balsam and Fraser fir) and current season needle necrosis of grand fir.

Environmental and cultural issues also contributed to the prevalence and severity of diseases on many species—with *Diplodia* blight and *Armillaria* problematic after drought, and *Phytophthora* root rot associated with poorly drained soils and excess rainfall. In addition to these biotic diseases, abiotic conditions like the extended rainy weather of the last two years affected tree growth and vigor, and the ability of trees to withstand the challenges of plant pathogens.

Over the years, new diseases continued to appear and in 1998, *Canavirgella* needlecast was first diagnosed on white pine in Connecticut. This followed the first report of this disease in the U.S. published from Pennsylvania in 1996. In 2009 and 2010, *Canavirgella* needlecast was widespread on white pines in plantations and landscapes throughout the state (Figure 2).



Figure 2. *Canavirgella* needlecast of white pine in 2010.

Today, the major types of trees commonly available in Connecticut are true fir (Fraser, Canaan, concolor, and balsam), Douglas-fir, spruce (white, blue, and Norway), and Eastern white pine (Table 1).

There are also a number of other species (e.g., Nordmann spruce, Meyer spruce, grand fir, Nikko fir, Turkish fir), but these are usually being grown in smaller quantities or on a trial basis.

Table 1. Major tree species and common diseases in Connecticut.

Tree Species	Common Diseases
True firs (Fraser, concolor, balsam)	<ul style="list-style-type: none"> • Phytophthora root rot
Spruce (blue, white)	<ul style="list-style-type: none"> • Armillaria root rot • Repeating needle rust • Rhizosphaera needlecast
Douglas-fir	<ul style="list-style-type: none"> • Diplodia blight • Rhabdocline needlecast
White pine	<ul style="list-style-type: none"> • Canavirgella needlecast • Diplodia blight
All species	<ul style="list-style-type: none"> • Armillaria root rot • Diplodia blight • Phytophthora root rot

As follows are brief descriptions of key diseases of Christmas trees in the state, with ratings on the potential for damage and outbreaks to occur. This list is not all-inclusive, since there are many other diseases present in the state.

NEEDLE DISEASES

Needle diseases present the most consistent threat to quality loss because of their ability to increase under environmental conditions conducive to infection, mainly rainfall, especially as new growth is emerging in spring. These diseases are most serious within 2-3 years of anticipated harvest.

RHABDOCLINE NEEDLECAST

- 1. Causal Agent:** *Rhabdocline* spp. (fungi)
- 2. Key Host:** Douglas-fir
- 3. Outbreak and Damage Potential:** High
- 4. Brief Description:**

Rhabdocline needlecast is the most common disease of Douglas-fir in Connecticut. It was first reported in the 1920's and has increased in incidence and severity over the years. This increase can be attributed to factors that include weather, widespread plantings of susceptible seed sources of Douglas-fir such as Lincoln in plantations and landscapes, and environmental stress. The primary damage is defoliation, which leads to suppressed growth, occasional deformity, and value loss in Christmas trees.

RHIZOSPHAERA NEEDLECAST

- 1. Causal Agent:** *Rhizosphaera kalkhoffii* (fungus)
- 2. Key Hosts:** blue spruce, occasionally white spruce (Douglas-fir, true fir, and pine have been reported as hosts)
- 3. Outbreak and Damage Potential:** Moderate
- 4. Brief Description:**

This needle cast fungus causes recurring damage on blue spruce throughout Connecticut, especially on trees under drought stress. Although trees can be killed, the primary damage is premature needlecast. Under epidemic conditions, lower branches may be killed. The fungus attacks needles on the lower branches first and gradually progresses up the tree. Early defoliation leads to suppressed growth, occasional deformity, and reduced marketability.

CANAVIRGELLA NEEDLECAST OF WHITE PINE

- 1. Causal Agent:** *Canavirgella banfieldii* (fungus)
- 2. Key Hosts:** Eastern white pine
- 3. Outbreak and Damage Potential:** Moderate

4. Brief Description:

This needlecast was first identified in Connecticut in 1998, but was widespread in 2009 and 2010. Infected trees appear distinctly off-colored and brown from a distance in spring. Symptoms develop on one-year-old needles. Although infected trees are rarely killed, the damage results in extensive needle discoloration and drop, which reduces the marketability of the infected trees. Last year's extended periods of free water on the needles was highly favorable for infection.

AUTOECIOUS (REPEATING) SPRUCE NEEDLE RUST

1. **Causal Agent:** *Chrysomyxa weirii* (fungus)
2. **Key Hosts:** blue (and occasionally white spruce)
3. **Outbreak and Damage Potential:** High
4. **Brief Description:**

This disease is considered to be a relatively new problem for Connecticut, since it was first reported with any severity and frequency in 1996. However, it has probably been present in the state prior to 1996. This is an autoecious rust that does not require any additional hosts in order to complete its life cycle. Infected trees are rarely killed, but damage results in extensive needle discoloration and drop that reduces the marketability of infected trees, especially when it occurs shortly before harvest.

TIP AND SHOOT BLIGHTS

Tip and shoot blights can be occasional problems, but they can result in severe damage. In addition, they are usually very difficult to manage, especially on trees under stress.

DIPLODIA BLIGHT

1. **Causal Agent:** *Diplodia pinea* (fungus)
2. **Key Hosts:** Douglas-fir, white pine, and blue, Norway, and white spruce

3. **Outbreak and Damage Potential:** High

4. **Brief Description:**

Diplodia blight can be a destructive and devastating disease of conifers, especially when growing under conditions of stress, particularly drought stress. This fungus has a broad host range and widespread distribution, so sources of inoculum are common. Although it is a pathogen, the fungus can also survive as a saprophyte. Therefore, it can be present on trees for many years without causing symptoms. In cases where disease is severe, shoots can be blighted and trees deformed. Repeated infections can kill weak trees.

ROOT DISEASES

Roots diseases are probably the most difficult diseases that growers encounter. If left unchecked, they usually result in tree death. Diagnosis can be difficult and management is challenging because the causal agents can survive for many years in the soil.

ARMILLARIA ROOT ROT

1. **Causal Agent:** *Armillaria spp.* (fungi, complex of species)
2. **Key Hosts:** all types of conifers, as well as hundreds of other woody plants
3. **Outbreak and Damage Potential:** Moderate, depending on drought stress
4. **Brief Description:**

This disease is also known as shoestring root rot and honey mushroom root rot, and is one of the most common and potentially damaging diseases of forest, plantation, shade, and ornamental trees worldwide. Part of this destructive potential is the ability of the fungus to live for many years in decaying wood in the soil. The fungus can also take advantage of weakened or stressed trees, particularly trees under drought-stress, growing on shallow or "boney" sites. Trees with J-roots are highly susceptible. Patterns of damage within a plantation are often

focused around old tree stump so diseased trees often occur in groups. Once infected, trees eventually die.

PHYTOPHTHORA ROOT ROT

- 1. Causal Agent:** *Phytophthora* spp. (fungus-like organism)
- 2. Key Hosts:** most conifers, especially true firs such as Fraser fir
- 3. Outbreak and Damage Potential:** Moderate to High (depending on rainfall, soil type, and drainage)
- 4. Brief Description:**

This disease has become a widespread and serious problem in the past 20 years, and can be correlated with the increasing number of susceptible trees, particularly highly susceptible Fraser firs, grown in the state. It is often associated with drainage problems and wet sites and can develop after 2-3 rotations (crops) of susceptible species grown in the same field. This soil borne pathogen (previously called a “water mold”) produces motile spores that readily move in water. Aboveground symptoms include suppressed growth, poor vigor, yellowed or undersized needles, premature needle drop, branch dieback, wilt, and death of trees at any time during the season. This disease can occur in plantations and in seedling and transplant beds.

CONCLUSIONS

Many of the challenges that Christmas tree growers face today are similar to the ones they faced in 1960. Diseases associated with the most popular trees species, which are currently Douglas-fir and true firs, continue to be troublesome. As new tree species are introduced into the state, new diseases will continue to appear.

An important additional challenge is managing these diseases, which relies on a limited number of fungicides that are labeled, cost-effective, and efficacious for Christmas trees. Today, chlorothalonil is the

most effective and widely used fungicide in Connecticut Christmas tree plantations, seconded by mancozeb, and then by thiophanate methyl. Widespread use and reliance on such a limited number of fungicides has the potential to cause the development of fungicide resistance, which to my knowledge, has not been found yet in Connecticut. For some root rot diseases (Armillaria) fungicides are not effective, whereas for others (Phytophthora) they have limited efficacy and are very expensive.

Looking at the next fifty years of managing diseases in plantations, I see a need for continued research to identify or develop consistent sources of disease-resistant planting stock with desirable aesthetic qualities in order to make disease management more eco-friendly and cost-effective.

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