



Christmas Tree Notes

Management of *Phytophthora* Root Rot in Fraser Fir Christmas Trees

CTN-022

Introduction. *Phytophthora* root rot is the only serious disease of Fraser fir Christmas trees in western North Carolina. It is caused by a fungus that inhabits the soil and infects many woody plants through the roots. It can lie dormant in the soil for several years waiting for a susceptible host such as Fraser fir and the right environmental conditions, including warm soil temperatures (above 54 degrees F) and soils saturated with water, to infect plant roots.

Symptoms of *Phytophthora*. The above-ground symptoms of *Phytophthora* root rot on Fraser fir include yellow-green needles, wilting, slow growth, dead branches, and tree death. The needles remain on dead branches and turn cinnamon brown. Roots of affected trees are also cinnamon-colored to black and lack white growing tips. The outer surface of the root can be pulled away from the inner core. Feeder roots are absent. Cutting into the bark of the trunk of the tree may reveal butterscotch colored wood. Many of these symptoms may initially be present on only one side of the tree or on lower branches since the fungus first infects a root and grows toward the trunk on that side. Eventually the entire tree will die. Infected trees are usually found grouped together in a field or bed. Unfortunately, a tree may be infected with the fungus months to years before the above-ground symptoms are seen.

The Fungus. *Phytophthora* root rot is caused by several species of *Phytophthora*. In western North Carolina, the most important species is *P. cinnamoni*. Often called a water mold, *P. cinnamoni* produces spores in response to near-saturated soils. The fungus may remain dormant in the soil for many years as mycelium (fungal threads) in infected root pieces or as chlamydospores, a thick-walled resting spore. During the growing season when soils are warm and wet, mycelium or chlamydospores produce sporangia, which in turn liberate zoospores that can swim short distances by means of flagella as they are attracted to root tips where infection occurs.

Reducing the Risk. Controlling *Phytophthora* root rot requires an Integrated Pest Management approach. No single control strategy will prevent or control this disease. As with most plant diseases, the best control is through healthy seedlings and transplants, and proper site selection. If trees become infected with *Phytophthora*, management should change to practices that reduce the spread of the disease and minimize financial loss. Each step outlined in this note will help reduce the risk of getting and spreading this disease.

FIRST STEP: CLEAN SEEDLINGS/ TRANSPLANTS

Phytophthora root rot spreads quickly in seed beds or transplant beds because the seedling roots grow closely together, allowing the fungus to grow from one tree to another. The fungus can be carried to the field on or in infected transplants. Unfortunately, a transplant can appear healthy for several months after it has been infected.

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To ensure the cleanest transplants possible, follow these steps:

1. Select the site for seedling or transplant beds where there has never been an incidence of *Phytophthora* root rot. Beds should be located in an area where they will not be flooded, where water will not drain through the beds, and where soil is not tight or clayey.
2. Prepare raised beds that are 6-8 inches in height to increase water drainage. Soil should be carefully prepared to break up all clods and allow plant material to decay.
3. Fumigate the soil before sowing or planting with methyl bromide or some other labeled soil fumigant. This will reduce the amount of fungus in the soil. For any treatment, label directions must be followed.
4. Use Subdue MAXX fungicide in the spring and fall to prevent disease development. Apply 2 1/2 pints Subdue MAXX in at least 50 gallons of water per acre in seed beds and 5 pints Subdue MAXX in at least 50 gallons of water per acre in transplant beds. Consider rotating with another fungicide such as Aliette. Aliette should be applied to the foliage until run-off using 5 pounds of product per 100 gallons of water. (Note: Waiting to use Subdue MAXX until after trees start dying from *Phytophthora* will only give you a false sense of security. Subdue MAXX will protect living tissue as long as the dosage remains in the plant. However, when it wears off, the plant is again at risk. Subdue MAXX will not eliminate *Phytophthora* from the soil or from dead roots. Once the trees are moved to the field and are no longer being treated with Subdue MAXX, the fungus will become active again and trees may start to die).

If you start to see yellowing or dying seedlings or transplants, contact your county Extension agent to determine if *Phytophthora* root rot is the cause. These symptoms can also be caused by white grubs, transplant shock, drought, over-watering, fertilizer burn, and other causes. If *Phytophthora* is diagnosed and diseased seedlings are isolated to one corner or section, you may be able to use plants in the rest of the bed or adjacent beds. Contact your county Extension agent to help you determine if it is safe to use plants from unaffected parts of a bed. Remember that an apparently green and healthy plant may be infected.

Only purchase seedlings and transplants from a reputable dealer. Don't purchase plants from beds that have dead or dying plants.

SECOND STEP: FIELD SITE SELECTION AND FIELD CLEARING

Soils may only need to be saturated for several hours for *Phytophthora* to infect roots. Fraser fir should only be planted in fields where water drains quickly down through the soil as well as drains quickly off the field. Examine a potential field site for any areas where water collects or drains. Are there wet weather springs? Does a culvert drain onto the field? Be sure when placing field roads that problems with water drainage aren't created. It may be necessary to go to a site during a heavy rain to observe water drainage.

Examine the soil at potential field sites to determine how easily water will drain down through the soil profile. A high clay content decreases water flow and holds water longer. Not only is clay in the topsoil a potential problem but also clay in the subsoil. Hardpans and shallow soils will slow water flow. Compacted soils also hold more water and slow water flow down through the soil. In the largest field study of Fraser fir of over 250 sites conducted by NC State University, clay content of the subsoil and shallow soil depth were the two most important site factors to determining *Phytophthora* incidence.

If fields are to be cleared of brush with heavy equipment, special care should be taken to reduce soil compaction and the loss of topsoil since this will increase the risk of *Phytophthora* root rot. Do not use heavy equipment when the soil is wet. Do not push topsoil off the site. Sow a cover crop in the field to help repair soil structure after clearing before trees are set.

Phytophthora can infect several hundred species of plants including red bud, dogwood, rhododendrons, mountain laurel, white pines, and honeysuckle. There is a slight possibility that woodlands cleared for Fraser fir already have the fungus in the soil. Also, growers setting Fraser fir in old apple orchards or where apple trees were growing in old pastures have had problems with *Phytophthora*. Several species of *Phytophthora* are associated with apple roots and appear to infect Frasers planted nearby. Grass and clover are not hosts and *Phytophthora* should not be present in old pastures.

THIRD STEP: KEEPING ROOTS HEALTHY

The *Phytophthora* fungus is attracted to wounded roots. Keeping roots healthy may help reduce *Phytophthora* development. *The following measures will improve root health:*

1. Do not set Fraser fir transplants deeper than 1 inch above the root collar. Forcing a large root system into a small planting hole will cause the roots to grow in the shape of a J, weakening root growth. Avoid excessive root pruning when planting.
2. Spread fertilizer evenly. Piles of fertilizer on the ground will damage roots growing directly underneath.
3. Limit use of Simazine. High rates of Simazine will damage roots.
4. Allow ground covers to grow between trees to keep the soil cool. Fraser fir roots will grow closer to the surface of the soil where there is more oxygen and less water. Contact your county Extension agent to learn more about ground cover management through the use of suppressive rates of post-emergent herbicides.

FOURTH STEP: WHAT TO DO IF PHYTOPHTHORA DEVELOPS

Even with care, *Phytophthora* root rot can develop, especially after heavy rainfall or flooded conditions. *The following steps may reduce disease spread and tree loss:*

1. Quarantine areas of the field where trees are dying with *Phytophthora*. Soil from these infested areas can carry the fungal spores. When working in trees, visit infected areas last. Don't carry mud on boots or equipment to areas of the field where trees are not dying. Wash soil off of boots or equipment with water and chlorine bleach when moving from contaminated to clean farms. Keep a ground cover on quarantined areas to reduce the

spread of soil infested with the fungus to clean locations.

2. Water which drains through a field should be diverted, if possible, to reduce disease spread.
3. Early harvesting near affected areas may reduce financial losses. Selling trees when they are smaller than you intended is better than leaving those trees to die.
4. Trees immediately surrounding diseased trees may be treated in the field with Subdue MAXX at the rate of 1 1/4 to 2 1/2 gallons per acre in a minimum of 50 gallons of water per acre, Subdue 2G applied at 125 to 250 pounds per acre spread evenly to infested areas, and/or Aliette applied to the foliage at 5 pounds/100 gallons. Apply these products in the early spring and again in late summer. Application should be made 1 to 3 days before a predicted rain. Never apply Subdue MAXX to fir growing on bottom lands or poorly drained soils, or near surface water since it may contaminate streams. This treatment is expensive and may not be cost effective if the trees are more than a year from harvest.
5. Do not replant Fraser fir on sites where Frasers have died because of *Phytophthora* root rot. Alternative species may be used including Colorado blue spruce, and Norway spruce. White pines may also be grown where Frasers have been killed by *Phytophthora* root rot. However, white pines are also a host, and if fungal populations are high or the site is poor, they may die, too. There are current field trials to determine if Fraser fir grafted onto the roots of more resistant fir species can survive in areas where Fraser fir has died.

The best way to manage *Phytophthora* root rot is to never get it. Disease-free seedlings and transplants, and site selection and sanitation continue to be the mainstays of *Phytophthora* root rot management.

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Original Christmas Tree Note written February 1, 1995. Updated November 1995, January 2004

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