

# Tomentosus Root Rot Forest Health Stand Establishment Decision Aid

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## Introduction

Tomentosus root rot (hereafter referred to as “tomentosus”) is ubiquitous in the sub-boreal and boreal spruce and pine forests of British Columbia. Caused by the fungus *Onnia tomentosa*, its widespread distribution is attributed to the organism’s ability to spread by airborne spores (Gibson 2005) and to its persistence on a site from one rotation to the next. As a result, high-risk ecosystems may sustain relatively high levels of infection. The prime host is interior spruce species, with lodgepole pine being moderately susceptible. Other species can be affected but usually to a much lesser degree. Tomentosus can reduce productivity and harvestable yield in infected stands through mortality, growth reduction, and butt rot. Infected trees are also highly susceptible to windthrow and may be susceptible to insect damage. In young stands, it can reduce stocking 10% by the age of 20 years, although it rarely results in unacceptable stocking because of the typically scattered and light levels of infection in most stands. The purpose of this stand establishment decision aid (SEDA) is to help guide forest management in stands where tomentosus root rot is likely to be a significant issue. The following pages describe susceptible stand types, tomentosus biology, hazard ratings, forest productivity considerations, and appropriate management practices. A resource and reference list that readers can use to find more detailed information is also included.



Figure 1. *Onnia tomentosa* fruiting bodies. Photo credit: Richard Reich]

**KEYWORDS:** forest health; forest productivity; host species; management practices; *Onnia tomentosa*; stand establishment decision aid; susceptibility; tomentosus root rot



## Hazard Ratings\*

BEC zone <sup>a</sup>	Subzone											
BWBS	dk	mw1	mw2	wk1	wk2	wk3	vk					
CWH	ws1											
ESSF	All											
ICH	dk	dw	mc	mk	mm	mw	vc	vk	wc	wk	xw	
IDF	dc	dk	dm	dw	mw	ww	all x					
MS	dc	dk	dm	dv	mw	xk	xv					
PP	All											
SBPS	dc	mc	mk	xc								
SBS	dh	dk	dw	mc	mh	mm	mk	mw	vk	wk1	wk2	wk3
SWB	All											

### Hazard Rating Key

	High
	Medium
	Low

\* Hazard denotes relative average severity on spruce. Hazard increases on higher hazard site series, which may be drier or hotter than the zonal site series. Ratings are based on expert opinion, known disease biology, and current climatic conditions.

<sup>a</sup> See Meidinger & Pojar (1991) for an explanation of the Biogeoclimatic Ecosystem Classification (BEC) zone, subzone, and variant abbreviations.

## General information

- Tomentosus is widespread in the sub-boreal and boreal spruce and pine forests of British Columbia but is only problematic enough to warrant management on relatively few sites.
- Most affected stands have a low incidence of tomentosus and thus do not require any root disease management.
- Stands with high incidence of tomentosus are preceded by infected stands that regenerated to a species composition of mostly spruce, and are on sites with coarse soils and (or) warm slopes, which can result in growing season moisture stress.
- Infection centres typically consist of one unique clone of *Onnia tomentosa*; small, individual centres may eventually coalesce to form larger, more genetically diverse centres.
- The occurrence of tomentosus generally decreases with increasing stand elevation, becoming relatively uncommon above 1200 m in the Central Interior even though the primary host remains common throughout this elevation range.
- Dry sites, normally dominated by fire-origin lodgepole pine, typically do not contain a high level of inoculum because of the absence of spruce stumps. Plantation management can change this balance by establishing unnaturally high levels of spruce, which may provide hosts for new infections by spores and allow a build-up of tomentosus inoculum. This is primarily a concern when spruce is planted off site.
- The mortality and windthrow that tomentosus causes is usually quite evident in affected stands; growth reduction



and stem decay in surviving trees often goes unnoticed even though these effects account for most of the volume loss to the disease.

### Host information

- Highly Susceptible: white, Engelmann, and black spruce
- Moderately Susceptible: lodgepole pine
- Tolerant: Douglas-fir, subalpine fir, western white pine
- Resistant or Immune: western redcedar, western hemlock, broadleaf species
- Pines, if infected, tend to die more quickly than spruce as their cambium are more extensively colonized.
- Douglas-fir and most other conifer species are typically not infected even when growing in close contact with infected spruce or when planted on sites with a history of tomentosus. The more vertical rooting habit (and therefore fewer root contacts) of many of these other species may be an important component of their tolerance.

### Biology and recognition

- Spreads relatively slowly by root contact and can also be spread by airborne spores.
- During stand development, possibly as relative humidity increases with crown closure, infection by spores likely increases and thereby intensifies the spread. Infection centres become detectable within 20–30 years.
- Spatial distribution of disease at the stand level typically consists of small aggregated centres.
- The overall spatial pattern of infection centres is thought to be a function of spore infection, whereas the increasing dimensions of centres is the result of disease spread by root-to-root contact.

- Infection can be relatively uniform across a stand in high-risk ecosystems where long-term spore spread is highly effective.
- Infection in a root system often begins in small-diameter roots, with cottony white mycelia spreading through the bark and cambium.
- Roots greater than 2.5 cm in diameter typically show evidence of resistance at the cambium, resulting in callus formation.
- Mycelia penetrate to the heartwood in small roots (< 2.5 cm diameter), potentially using fine feeder roots to access this wood. Spread continues through the heartwood, which lacks active defenses, to the bole of the tree.
- As the disease progresses and roots begin to lose vigour, the decay progresses outward, eventually killing the sapwood and cambium, resulting in root mortality.
- Most infected roots are significantly decayed before death; infected trees are often windthrown while still green because of root weakness; other diseased trees die standing.
- Tan-coloured, leathery fruiting bodies develop from infected roots in summer to early fall unless it is very dry, which restricts fruiting. These fruiting bodies are diagnostic but not produced commonly enough to be a reliable assessment tool during surveys. *Onnia tomentosus* fruiting bodies can be confused with those of closely related *O. circinata*, which are usually considerably larger, have a thicker cap that is usually laterally attached to the stem or roots, and are generally found on lodgepole pine. *Onnia circinata* is relatively uncommon, and treatment would be similar even if present, although regeneration with pine would not be recommended.
- Fruiting typically does not occur every year or on all trees (even in an abundant year).



- Diagnosis of tomentosus is usually done initially by examining the sheared-off roots of windthrown trees, or by chopping or drilling into roots of suspect-infected, standing dead or live trees.
- Roots of windthrown, tomentosus-infected trees often snap off at a distance of 30–60 cm from the stem, leaving few fine roots and little soil clinging to the root wad.
- Advanced, pitted tomentosus decay, visible in broken root ends and in the cross-sectional view of heartwood, is honeycombed in appearance. Pits are typically 1.5–2 mm in diameter and may contain bleached white cellulose fibres. In longitudinal view, the pits are canoe-shaped. Incipient (initial) decay is usually pink to dark red before pits develop.



**Figure 2: Tomentosus-caused honeycomb pitting in sheared-off structural root.**  
Photo credit: Richard Reich.

- Tomentosus decay is classified as a white rot, indicating that both the cellulose and lignin are decomposed, eventually resulting in hollow decay pits. Care must be taken to avoid confusion with several other white rots, primarily red ring rot (*Phellinus pini*), which has a similar decay pitting but doesn't occur in aggregated disease centres. At higher elevations (> 1200 m), confusion may occur with *Phellinus nigrolimitatus*, a stem decay that produces very large diameter pitting. Confusion may also occur with pitted sap rot (*Trichaptum abietinum*), which causes a very finely pitted decay to the sapwood of dead standing trees and blowdown.
- Trees windthrown because of wet or shallow soils usually will not have pitted heart rot in the roots; their entire, upturned root pans will also be evident.
- In young stands, mortality of spruce and pine can occur at an early age, although this will not likely be noticed because of scattered and low levels of mortality.
- Spread in plantations is initially closely associated (< 2 m) with colonized stumps, which can cause new infections of plantation trees for 20–30 years.
- Infection centres in second-growth stands typically consist of small clusters of one to three dead trees and one to two symptomatic trees within 2 m of an infected stump that displays honeycomb pitting at its top.
- The symptoms of reduced leader growth and a thinning crown or stress cone crop, which typically precede mortality, can be subtle but distinguishable by experienced observers. The elapsed time from infection to mortality depends on the size of the infected tree but usually takes many years.
- Diagnosis involves examining roots of symptomatic or dead trees for red stain and pitted decay.



## Characteristics of susceptible stands

- Stands with highly susceptible conifer species (e.g., spruce) growing on sites prone to growing season moisture stress.
- High-hazard sites, typified by lower-elevation, drier and warmer sub-zones within the Sub-Boreal Spruce (SBS) zone, and also within the Boreal White and Black Spruce (BWBS), Montane Spruce (MS), Interior Cedar–Hemlock (ICH), and Interior Douglas-fir (IDF) zones.
- In general, warmer and drier spruce-dominated ecosystems are at greatest risk.
- The wettest site series, where soils become mottled and gleyed, have the least incidence.
- Well-drained soils do not maintain soil moisture during periods of stress and therefore may result in compromised tree defenses.
- Incidence generally increases with increasing dryness of site series until the abundance of spruce drops low enough to limit root contact between individuals, thereby reducing spread by root contact.

## Harvest considerations

- Before developing a harvest plan, assess for the presence of root disease.
- If a visual assessment indicates that more than 5% of trees are affected by root disease, consider conducting a formal post-harvest survey to determine root disease distribution and severity.
- Pre-harvest surveys for tomentosus are very expensive, owing to the time required to expose and chop into roots; such surveys are more easily conducted immediately after harvest.
- Alternatively, the simplest assessment method is to tally the number of affected butts at the log decks during harvesting, since approximately 90% of infected root systems have stain or decay at the stump top and log butt.

- An incidence tally can be conducted at the log decks, and the distribution mapped in the field (if warranted). The amount of long-butting at the landing may be estimated by examining slash piles; this estimate can then be used to adjust the tally, since long-buttended log ends at the log deck would lack evidence of infection.
- In addition, some confusion may occur if *Phellinus pini* is present. Confirmation of tomentosus involves a walkthrough to confirm that affected stumps are clustered and have decay in their roots.
- Disease distribution is important: aggregated infection centres may be stratified for treatment, whereas adjacent areas might not require treatment.
- Treatment strategies are usually based on either inoculum reduction (e.g., stump removal) or (most commonly) the planting of less susceptible species.

## Silvicultural considerations

### Site preparation

- Consider inoculum reduction through stump and root removal only on level to gently sloping, high-quality sites with coarse-textured soils where machinery can work without risk of degrading soils. Consider treatment during winter after some frost has entered the ground but before frost penetrates deeply.
- Push-falling of spruce and pine is an acceptable form of inoculum reduction and enables the harvesting of slightly more volume through bucking closer to the root collar. Whole trees can be skidded to landings where stumps can be bucked off and used as a fibre source or piled and burned.

### Planting

- Where inoculum removal is not the preferred option, consider planting species that are immune or have low susceptibility to tomentosus.



Planting a higher percentage of less susceptible species will help reduce the risk when a move away from spruce is undesirable (i.e., when the risk of *Dothistroma* to pine is low to moderate but risk of *tomentosus* is moderate).

- Susceptible species planted near a colonized stump may be infected and killed within a few years. Avoiding the planting of susceptible species within 5 m of colonized stumps can be effective if these stumps can be marked before planting. This requires the planting of an immune or less susceptible species within the avoidance zones.

### Plantation maintenance

- Before developing a stand management prescription for intensive silviculture, assess the presence of root disease.
- If mortality from root disease is high and widely distributed, do not proceed with the stand management prescription.
- Before thinning a stand where the disease is clearly aggregated, consider whether sufficient stocking would remain if susceptible trees in disease centres and a 5 m adjacent buffer were removed. Do not proceed if stocking levels would be compromised.
- Record the data from any root disease assessments in the RESULTS database.

### Potential productivity implications

- Productivity and harvestable yield in infected stands will be reduced through mortality, growth reduction, and butt rot.
- Infected trees are highly susceptible to windthrow and may also be susceptible to insect damage. At endemic population levels, spruce beetle-caused mortality (and beetle reproduction) is more successful in trees showing early-stage symptoms (e.g., light crown thinning, reduced leader growth).

- Stocking in young stands may be reduced by up to 10% by the age of 20, owing to disease spread from colonized stumps to crop trees; however, mortality levels in stands are usually not high enough to result in a declaration of insufficient stocking during free-growing surveys. Nevertheless, long-term spread may result in significant impact to growth and yield by the end of a rotation.

### Other effects and associations

- *Tomentosus* is an indigenous disturbance agent that creates positive ecosystem and stand structural diversity, coarse woody debris, and wildlife habitat.
- The fungus creates canopy gaps that provide growing space for less susceptible conifers and immune hardwoods and shrubs. These canopy gaps collect more snow in the winter and increase the amount of precipitation reaching the ground.
- *Tomentosus* root rot can co-occur in stands and on individual trees with other root diseases and stem decays (e.g., *Armillaria* root disease, and red belt fungus, *Fomitopsis pinicola*).



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# Test Your Knowledge

How well can you recall the main messages in the preceding article?  
Test your knowledge by answering the following questions.

TOMENTOSUS  
ROOT ROT FOREST  
HEALTH STAND  
ESTABLISHMENT  
DECISION AID

Reich, Lewis, &  
Wiensczyk

## **Tomentosus Root Rot Forest Health Stand Establishment Decision Aid**

1. What is the distinguishing characteristic of tomentosus decay?
  - a) White, fan-shaped mycelia felts
  - b) Red or black rhizomorphs
  - c) Honeycomb decay pitting
  - d) Pink to red stain in heartwood
2. In which biogeoclimatic zone is tomentosus hazard considered to be the highest?
  - a) ICH
  - b) BWBS
  - c) SBS
  - d) MS
3. Which of the following main treatments (options) to deal with tomentosus are not recommended?
  - a) Planting species that are immune or have low susceptibility to tomentosus
  - b) Avoid planting susceptible species within 5 m of colonized stumps
  - c) Inoculum reduction through stump and root removal
  - d) Use of aerial herbicide to remove deciduous hosts that may act as bridge trees
4. What are the two confirmed methods of spread of tomentosus?
  - a) Root contact
  - b) Ground water movement
  - c) Mass wasting
  - d) Airborne spread of spores

