

## Extension Note

# BC Journal of Ecosystems and Management

## British Columbia's Northern Interior Forests

# Dothistroma Stand

# Establishment Decision Aid

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## Introduction

Dothistroma needle blight, also known as red band needle blight, is caused by the fungus *Dothistroma septosporum*. It affects over 60 species of pine in 45 countries and is considered the most destructive pine needle disease in the world. All pine species native to British Columbia are susceptible and the fungus is widely distributed wherever host species can be found. Infection is caused by rain splash and air dispersal of the spores. In the southern hemisphere, it has been a major problem for decades. In British Columbia, however, damage levels from this pathogen have historically been low. Recent widespread defoliation, mortality (including mature tree mortality), and plantation failure caused by *Dothistroma* in the northwest portion of the province may be a result of changing climatic conditions that allow the fungus to develop in a way that was not previously possible.

The Stand Establishment Decision Aid (SEDA) format has been used to extend information on a variety of vegetation and forest health concerns in British Columbia. The two-page SEDA presented in this extension note was developed to summarize information that provincial forest managers will need to mitigate the impacts of *Dothistroma* needle blight. The first page provides information on susceptible stand types, disease biology, hazard ratings, and appropriate management practices. The second page outlines forest productivity considerations and risks to human health. A resource and reference list that readers can use to find more detailed information is also included. Most reference material that is not available online can be ordered through libraries or the Queen's Printer at: [www.qp.gov.bc.ca](http://www.qp.gov.bc.ca)

## Acknowledgements

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**KEYWORDS:** *climate change, Dothistroma needle blight, Dothistroma septosporum, forest health, red band needle disease, tree species deployment.*

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## Dothistroma Needle Blight – Northern Interior Forest Region



Dave Weaver

*Dothistroma*-infected lodgepole pine needles with characteristic red bands

### Characteristics of susceptible stands

- All pine species native to British Columbia are susceptible.
- Non-native pine species established in the province (e.g., Monterey pine and bishop pine) are highly susceptible.
- The most severe infections have occurred in northwest British Columbia in managed plantations of lodgepole pine (up to 30 years old). Mortality has also been observed in mature lodgepole pine in this area.
- Cold air ponding sites and areas along major watercourses are typically the areas worst affected.

### Description and biology

- Crowns tend to be thin and tufted in appearance. The lower crown is often most severely affected.
- In severely affected stands, crowns are thin with extensive red foliage making it appear as though a fire has been through the stand.
- Needles of all ages are susceptible.
- Spots and bands appear on the needles and turn reddish brown (see the left side of the photo above), although the base of the needles often remains green.
- The best time of year to identify the disease is in the spring when needles that were affected the previous year show up most clearly. Needles that have been killed 1–2 years earlier are best for positive identification (dark red bands on straw-coloured needles – see right side of photo above).

### Hazard ratings<sup>1</sup>

BEC Zone <sup>a</sup>	Drier subzones			Wetter subzones							
BWBS		dk1	dk2								
CWH		xm	ds	dm	mm	ws	wm	vm	vh		
ICH	xw	dw	mw	mk	mm	wk	mc	wc	vk	vc	
PP		xh	dh								
SBS		dh	dw	dk	mh	mw	mm	mk	mc <sup>b</sup>	wk	

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

<sup>b</sup> In areas adjacent to the ICH.

#### Hazard Rating Key

Low hazard	Moderate hazard	High hazard

<sup>1</sup> Ratings represent expert opinion based on known biology and current climatic conditions. Climate change will affect these rankings (see Hamann and Wang 2006). If a biogeoclimatic unit is not listed, *Dothistroma* is not considered to be a significant hazard.

- Spores are released from previously infected needles and infections can occur throughout the growing season provided temperatures are above 5°C and moisture is present. Temperatures between 15 and 20°C during extended periods of moisture are optimal for infection.
- Spores can be transported long distances in moisture-saturated air (e.g., mist or cloud). If spores land on host material during periods of high humidity, these can germinate and penetrate the unaffected needles.
- The fungus goes through a period of vegetative growth within the needle. This growth produces a toxin that causes the red pigmentation in diseased needles. Fruiting bodies (pseudothecia) form on dead needles and appear as small, dark structures that break through the epidermis (see right side of photo above).
- During periods of high humidity, mature fruiting bodies release new spores to complete the life cycle. Depending on climatic conditions and other factors, this can take 1–2 years.
- Recent research indicates that a strong correlation exists between infection levels and the frequency of warm rain events (i.e., daily high temperatures exceeding 18°C for 3 or more consecutive days in July or August). In north-central British Columbia, the frequency of such events is increasing.

### Management considerations

Until recently, the damage caused to pine species in British Columbia by *Dothistroma* needle blight was of little concern. With changing climate and the potential for *Dothistroma* to spread into drier areas such as the Sub-Boreal Spruce (SBS) zone, more effort will be needed to prevent and control this disease if management for lodgepole pine continues to be a priority. Some treatment options are described below by stage of management intervention.

#### Harvesting

- Ensure silviculture prescriptions for moderate- and high-hazard areas require establishment of a species mix; pine should not be favoured in high-hazard areas.
- If the intention is to re-establish pine, avoid clearcutting in potential cold air ponding sites in high-hazard areas.

#### Stand establishment

- Regeneration with a tree species mix is imperative. The proportion of regenerated pine should not exceed 20% in high-hazard areas. By the year 2025, the northern portion of the SBS zone is predicted to experience a shift in climatic conditions that will more closely resemble the Interior Cedar–Hemlock (ICH) zone (see Hamann and Wang 2006). Such a shift will make these areas a high hazard for *Dothistroma* in the future.
- Consider establishing Douglas-fir as a replacement for pine even in some of the warmer BEC subzones where it is not currently listed as an acceptable species. Subzones in which Douglas-fir might be acceptable must be chosen carefully with consideration given to both anticipated changes in climate and root disease hazard.
- Consider establishing a breeding program in which *Dothistroma*-resistant provenances of lodgepole pine are identified and developed. In other locations, host-resistance trials with ponderosa, radiata, and Austrian pine have shown promise. The *Dothistroma* fungus itself shows some genetic diversity; further genetic research may help managers identify and create conditions to minimize infection and spread.

## Dothistroma Needle Blight – Northern Interior Forest Region

### Management considerations (continued)

#### Plantation maintenance

- Although broad spectrum copper fungicides have been used to control Dothistroma on radiata pine in the southern hemisphere since the early 1960s, this treatment is not recommended in British Columbia. Unlike radiata pine, which is susceptible to age 15, lodgepole pine remains susceptible throughout its life, which would require a spray program for most (or all) of the rotation. Other non-timber resources, such as the wild mushrooms common in high-hazard areas, could also be damaged by such treatments. In British Columbia, most high-hazard areas are capable of supporting numerous acceptable crop species; resource managers should ensure that sites are not managed for a single species.
- If conducting spacing or brushing treatments, favour non-susceptible species as leave trees. In high-hazard areas, pine trees should not be felled, but their presence should not preclude leaving other trees (i.e., treat the pine as ghost trees).
- No existing biological controls have been proven effective with Dothistroma. Although research continues, new measures are unlikely to be available in the near future.

#### Damage and impact on productivity

- Dothistroma infects pine needles of all ages resulting in premature leaf mortality and reduced photosynthetic capacity.
- Wood yield loss is proportional to the volume of needles affected.
- Outbreaks vary greatly from year to year depending on weather conditions, which affect spore production, release, and germination.
- Repeated severe attacks lead to growth loss and mortality.
- In northwest British Columbia, extensive plantations of lodgepole pine along with a marked increase in the frequency of weather events favourable to the disease have resulted in unprecedented levels of Dothistroma infection.
- Reconnaissance flights over approximately 40 000 ha of pine plantations in province's northwest, revealed that 92% show some signs of Dothistroma infection (varying from low levels to almost 100% mortality). Nine percent of the plantations are so severely defoliated that recovery seems unlikely. In monitored stands, mortality of individual trees is close to 7%.

#### Risk to human health

- Dothistroma needle blight produces a toxin, dothistromin, that is closely related to the potent carcinogen, aflatoxin. Studies have shown that dothistromin is a weak mutagen and clastogen and is, therefore, a potential carcinogen. Despite this, the risk to forest workers is considered to be very low because the toxin must be ingested. It is prudent for forest workers to wash their hands before eating if working in Dothistroma-infected stands.

### Resource and reference list

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## Test Your Knowledge . . .

### *British Columbia's Northern Interior Forests: Dothistroma Stand Establishment Decision Aid*

How well can you recall some of the main messages in the preceding Extension Note?

Test your knowledge by answering the following questions. Answers are at the bottom of the page.

1. New infections are likely to be highest:
  - A) In the fall, when it is cool and moist
  - B) In the summer during cool dry periods
  - C) During warm, humid conditions in the growing season
2. Only the current years' pine needles are susceptible.
  - A) True
  - B) False
3. The best strategy for avoiding Dothistroma infections on dry sites is to:
  - A) Avoid clearcutting
  - B) Plant an exotic pine species
  - C) Spray the area with copper fungicides
  - D) Plant Douglas-fir
  - E) Plant a mix of pine, spruce, and Douglas-fir

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**ANSWERS**

1. C 2. B 3. E