



# How much loss does DRA cause?

A 20-tonne link belt excavator fitted with a modified articulating clamshell attachment allows the operator to remove trees from the soil and not damage the stem, crown, or roots.



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Armillaria root disease, caused by *Armillaria ostoyae*, occurs throughout the southern one-third of British Columbia and has its highest incidence in the Interior Cedar–Hemlock zone (ICH). A collaborative team is working on a project to quantify the growth losses attributable to sub-lethal *Armillaria* root disease (DRA) in Douglas-fir plantations in the ICH, with funding from the Forest Investment Account, Forest Science Program and collaborators (Canadian Forest Service; B.C. Ministry of Forests Research Branch, Victoria and Southern Interior Forest Region; J.S. Thrower & Associates; Ramsoft Systems

for volume determination, and the root systems are taken to the lab for mapping and dissection of infections. Detailed sampling on the crown and boles of a subset of diseased and disease-free trees in greater than 30-year-old plantations provides quantitative descriptions of how DRA affects foliage distribution, crown expansion, and bole increment, leading to new TASS parameters. Losses are estimated by comparing the growth of healthy trees against diseased trees.

By the end of this year, we will have completed 10 widely dispersed stands within the ICH. Despite their wide separation, the stands have similar infection characteristics. In the plantations completed to date, the incidence of trees with below-ground infection ranged from 23–59% (average 35%). It is important to note that only about 20% of diseased trees show above-ground symptoms. Interim results to date indicate that individual-tree volume growth losses for diseased juvenile Douglas-firs average 35% 10 years after infection. Stand growth losses range from about 7–16% for juvenile stands. The analysis also indicates that time since infection is a more important factor than infection intensity, and that stem radial growth is affected more than height growth. This is important because even small infections can reduce growth, which indicates that our fastest-growing trees and best sites may not reach their full potential due to DRA. Mortality losses range from 0.5–2% annually in this species and ecosystem.

The unique data being collected allows the calculation of a new biologically-based DRA-specific Operational Adjustment Factors (DRA OAFs are not related to OAF1 and OAF2). These new factors are based on data collected over the past 35 years from destructive sampling and permanent sample plots in stands up to age 100. First approximations of DRA-specific OAFs are already available within TIPSYP Version 3.2 for managed Douglas-fir in the ICH. The potential effect of the new OAFs on harvest flows has been demonstrated in a recent analysis completed for the Arrow Timber Supply Area (Stearns-Smith *et al.* 2004<sup>2</sup>), and was considered in a recent determination.<sup>3</sup>

The infection status of impacted stands will not diminish, because the pathogen remains on the stumps left behind, infecting the next stand. Calculating the impacts of DRA is an essential first step toward evaluating the economic efficacy of treatment options, maintaining site potential, and ensuring sustainable forestry is practised. 

## References

<sup>1</sup>Pedersen, L. 1995. Kootenay Lake timber supply area rationale for allowable annual cut determination. B.C. Ministry of Forests.  
<sup>2</sup>Stearns-Smith, S., G. Neinaber, M. Cruickshank and A. Nussbaum. 2004. Demonstrating growth and yield adjustments (TIPSYP OAFs) for *Armillaria* root disease in a timber supply analysis. Stearns-Smith and Associates, Victoria, B.C.  
<sup>3</sup>Timber Supply Analysis for the Arrow TSA: [www.for.gov.bc.ca/hts/tsa/tsa01/index.htm](http://www.for.gov.bc.ca/hts/tsa/tsa01/index.htm)

Ltd.; Southern Interior Growth and Yield Coop; and Southern Interior Licensees). The Chief Forester has identified an urgent need to assess the impact of DRA (Pedersen 1995<sup>1</sup>). The primary target audiences for results from this project are regulators and forest management practitioners conducting timber supply analyses, determining growth and yield, developing sustainable forest management plans, and writing silviculture prescriptions. The goal of the project is to provide the biological data required to estimate disease impacts. From this, the B.C. Ministry of Forests' TASS/TIPSYP growth and yield model suite will be adjusted to account for effects of *Armillaria* root disease in managed Douglas-fir stands in the ICH.

In 10 plantations aged 18–32 years, about 1000 trees in 20–25, 10 m radius plots are removed from the soil by an excavator and the root systems are examined carefully for infection by *A. ostoyae*. A minimum of 150 healthy and infected Douglas-fir trees per site are sampled, stem discs are measured