Forest Fertilization in British Columbia

The most recent outbreak of the mountain pine beetle *(Dendroctonus ponderosae)* has caused widespread mortality of lodgepole pine throughout the British Columbia Interior. Mountain pine beetles have infested 8.7 million hectares of lodgepole pine forests, and by fall 2005, over 400 million cubic metres of timber had been killed. The high mortality and time-limited value of dead lodgepole pine have led to an accelerated harvest of beetle-killed pine to recover the maximum economic value. The government's Mountain Pine Beetle Action Plan is designed to mitigate the economic impacts of the infestation on forestry-dependent communities in B.C.'s Interior. This includes taking actions to offset the falldown in the mid-term timber supply expected in 10 to 80 years. One option forest managers are pursuing is fertilizing Interior forests now to help them become merchantable sooner.

Why Fertilize Our Forests?

As with all plants, conifer trees rely on a range of vital nutrients to grow. Over two decades of research have clearly shown that nutrient deficiencies are widespread throughout the British Columbia Interior, and young forests respond favourably to fertilization with nitrogen and other nutrients, such as sulphur and boron. Although the nutrition and fertilization response potential of lodgepole pine is well-documented (Brockley 1996, 2001), Interior spruce and Douglas-fir forests also respond to nutrient additions. In fact, recent research shows that young spruce forests may be highly responsive to repeated fertilization treatments (Brockley and Simpson 2004, Brockley 2006).

Silviculture strategies for Interior management units use forest-level analysis to identify silviculture investments for improving timber quality and quantity. Research results and financial analyses provide stand-level criteria (e.g., tree species, site quality, age and density) to select stands that will respond positively to additions of fertilizer. At the stand level, forest fertilization projects are based on an initial analysis of the conifer needles to determine the growth-limiting nutrients (Ballard and Carter 1986). After a forest is fertilized, the trees take up the nutrients through their roots and first grow longer needles from the higher concentration of available nutrients in their foliage. Then, two or three years after fertilizing, more needles are produced. The increased foliar mass from the longer and more abundant needles increases photosynthesis, enabling the trees to increase wood production on their stems and branches.

What Are the Benefits Of Fertilization?

A single fertilizer treatment can be expected to add about 15 cubic metres of wood per hectare within 10 years. Fertilization is considered one of the most effective treatments to maximize volume production and financial return.

There are benefits to the forest understory as well. Shrubs and forage plants absorb some of the nitrogen not taken up by conifers, providing nutritional benefits to wildlife and livestock. Understory plants with commercial value for floral arrangements have greener and brighter leaves from the increased nitrogen.

Since fertilization increases tree biomass accumulation, it increases carbon storage. Research in Ontario shows that a single application of nitrogen fertilizer to jack pine stands would store an additional 4.9 tonnes of carbon per hectare over 10 years (Colombo et al. 2005). Although greenhouse gases generated by the production, transport and application of inorganic fertilizer could offset 5 to 10 per cent of the carbon storage gain, the net carbon gain would be at least 4.5 tonnes per hectare.

Fertilization treatments have been conducted in British Columbia on an operational scale since 1978, starting with coastal Douglas-fir. Fertilization programs began in the Interior during the mid-1980s. To date, over 150,000 hectares have been fertilized.

In response to the mountain pine beetle infestation, government and the forest industry are planning to fertilize about 130,000 hectares of spruce and Douglas fir in B.C.'s Interior over the next five years. It is estimated these treatments will add 2 million cubic metres of wood fibre over the next 10 to 15 years. This increase will help mitigate the expected timber supply decline once beetle-killed stands are harvested.

Related Resources

Forest Fertilization Guidebook
www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/fert/ferttoc.htm

Ministry of Forests and Range, Research Branch, Fertilization
www.for.gov.bc.ca/hre/standman/trtfert.htm

Natural Resources Canada, Pacific Forestry Centre, Lodgepole Pine Foliar Nutrient Diagnosis and Fertilizer Advisory System
www.pfc.forestry.ca/silviculture/lodgepole/index_e.html

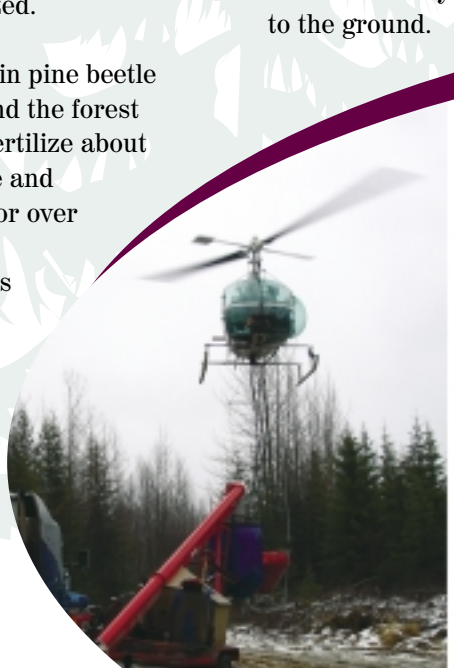
Fertilizing Eastern Washington Forests: A Guide for Non-Industrial Private Forest Landowners
cru.cahe.wsu.edu/CEPublications/eb1874/eb1874.pdf

Visual Deficiency Symptoms
www.pfc.forestry.ca/silviculture/lodgepole/visual%5Fdeficiency%5Fe.html

TFL 52 Type II Forest Level Silviculture Strategy
www.for.gov.bc.ca/hfp/silstrat/pdffiles/TFL52T2PSSReportFINAL.pdf

How Are Forests Fertilized?

Large-scale forest fertilization treatments are conducted using helicopters. Fertilizer is manufactured into small pellets about 3 millimetres in diameter that are heavy enough to fall relatively straight down to the ground.

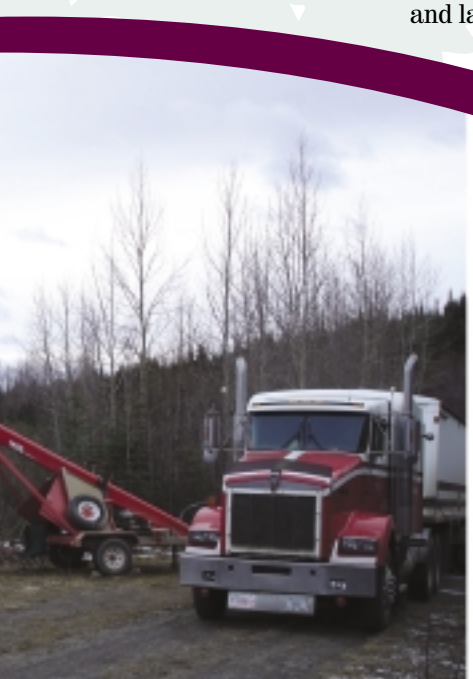


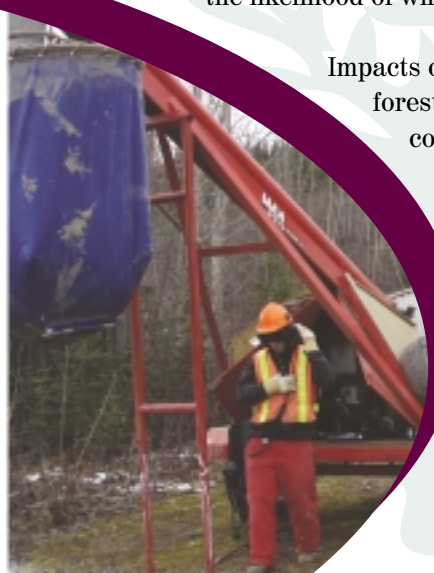
The fertilizer is applied with a pilot-controlled spreader that hangs below the helicopter. This allows for over 100 hectares to be fertilized in a typical day. Helicopters are equipped with a global positioning system (GPS) so that their precise location is known throughout the application process. The treatment block boundaries are entered into the GPS along with the positions of any sensitive sites, such as streams and waterbodies. No fertilizer is applied within 10 metres of these sensitive sites.

Where Will Treatments Be Carried Out?

The current forest fertilization program in the British Columbia Interior focuses on treating stands of Douglas-fir and spruce that range from about 20 years of age up to 70 years or older. Forest managers may consider fertilizing lodgepole pine stands in the future when mountain pine beetle populations have declined. Not all age-appropriate fir and spruce stands are fertilized, however. Candidate stands must be well-stocked, but stand density must be low enough that the tree crowns can expand after fertilization, which is necessary for increased tree growth. Provincial stand selection guidelines also require the consideration of the site's natural productivity, the trees' current amount of foliage, and other biological factors.

Logistics are also important. The location of the potential site will have an impact on transportation costs, both in trucking in the fertilizer, and later, hauling out harvested timber to manufacturing plants and markets. Likewise, factors such as the stand's layout around a central loading area and the general terrain should be considered.





Who Will Conduct This Work?

The fertilization program is a co-operative effort among the provincial government, forest licensees and private silviculture contractors. Through the Forest Investment Account and the Forests for Tomorrow program, the Ministry of Forests and Range provides strategic guidance and coordination. Individual projects are managed by forest companies using funding administered by PricewaterhouseCoopers.

How Are Other Concerns Addressed?

As part of the planning process for fertilization treatments, forest managers give consideration to protecting forest values, and addressing the potential concerns of other forest users. Fertilizer is applied carefully to minimize run-off to waterbodies, and fertilization in community watersheds is stringently managed. As well, at all loading areas, fertilizer pellets are cleaned up and not left for wildlife or livestock to consume.

Project timing can also mitigate concerns: late fall applications reduce the possibility that wildlife or cattle may ingest the fertilizer, as cattle are off the range by then and a light snow cover at the time of treatment reduces the likelihood of wildlife ingestion.

Impacts of fertilization on forest health are also considered. For example, the potential growth benefits from fertilizing young spruce forests must be weighed against the risk of increased susceptibility of fertilized stands to leader damage by the

white pine weevil *(Pissodes strobi)*. Trial results show that the beneficial effects of fertilization on the growth of planted spruce likely outweigh the negative effects associated with increased incidence and severity of leader damage from the white pine weevil (vanAkker et al. 2005).

Related Resources

White Pine Weevil Management: Fertilization and weevil attack
www.pfc.forestry.ca/entomology/weevil/fertilization%5Fe.html

Summary

The experience of British Columbia forest managers with forest fertilization gives the province a promising option for mitigating the upcoming timber supply shortfall caused by the mountain pine beetle. The expanded fertilization program will help to supplement the mid-term timber supply and support forestry-based communities through this critical phase.

References

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Important Websites

BC's Mountain Pine Beetle Action Plan
www.gov.bc.ca/pinebeetle/

Forests For Tomorrow
www.for.gov.bc.ca/hfp/fft/

Forest Investment Account
www.for.gov.bc.ca/hcp/fia/

Photo Credit

Forest Fertilization project photos by Al Hunter, West Fraser Timber

Ministry of Forests and Range

June 2006
www.for.gov.bc.ca