

Nutritional Factors Associated with Decline in Canada

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Abstract

Forest decline in eastern Canada was particularly severe in the early 1980's and is still prevalent in some areas (Bowers and Hopkin 1997). Early public and scientific opinions on the causes of forest decline were often not based on sound scientific knowledge. Factors such as acidic precipitation and ozone were most often mentioned as direct causes of forest decline in the early stages. Although standards of nutrition for sugar maple (*Acer saccharum* Marsh.) were not known at the time, some common nutrient deficiencies were identified: K in the Eastern Townships, Mg on some sandy soils, and P on some sites with mull humus. More than 10 years after the onset of decline, we now have a better understanding of the nutritional problems associated with forest decline. The problem was complex as many combinations of nutrients were found to be deficient. Most common combinations of deficient nutrients were in descending order of importance: K+Ca (31%), K+N (23%), K+Ca+N (11%), K (9%), P (8%), and K+Ca+Mg+N (3%).

Nutrient deficiencies were corrected through diagnostic fertilization. Diagnoses were usually made using DRIS indices. Typical application rates ranged from 400 to 800 kg ha⁻¹. Fertilizers were applied manually or by air. Terrestrial applications were slightly more efficient. Fertilization was found to have long-term effects (> 5 years) in many instances. The use of diagnostic fertilization rather than the use of general fertilizer guidelines should be favored in declining stands as nutrient imbalances can easily be exacerbated with an inappropriate fertilizer mixture.

As mentioned before, the forest is still declining in some areas. Based on nutrient status, our results suggest that many forest stands are "walking on a tight rope" in that most of their nutrients are at critical levels. Any perturbation of the nutrient cycle in these stands is likely to trigger nutrient imbalances and deficiencies in one or more nutrients. This is in agreement with the recent publication of the critical loads

for eastern Canada (Bowers and Hopkin 1997) which suggests that large tracts of forest have soils that are susceptible to nutrient leaching and soil acidification via acidic deposition.

Forest management can also lead to soil acidification. Some species are known to improve soil fertility. Birch (*Betula* spp.) and basswood (*Tilia americana* L.) are well known as soil improvers. Sugar maple, which has been favored in most sugar bushes to the detriment of other hardwoods, has leaf litter characteristics that suggest a strong potential for soil acidification (Côté and Ouimet 1996). Among all common hardwoods of eastern Canada, red and sugar maple have the most acidic leaf litters and their C:N ratios are high. Leaf litter N concentrations are low in maples and other nutrients are generally lower than in basswood. Clear evidence of soil acidification under maple was provided by comparing soil acidity under 27 year-old plantations of white pine (*Pinus strobus* L.), white spruce (*Picea glauca* (Moench) Voss), yellow birch (*Betula allegheniensis* Brit. and maple (*Acer* spp.) (France et al. 1989).

Although forest decline does not make the news anymore in Canada, it is still present and many sites are in a precarious state with regard to nutrient status. Some ecosystems may require a bit of help to fully recover and become more resilient to natural and anthropogenic stress factors. Diagnostic fertilization and sound management of forest composition may be what is required.

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