Boron Nutrition Studied in Black Spruce Forests

By M.K. Mahendrappa and P.O. Salonius

Boron (B) deficiency may play an important role in growth and development of black spruce stands in eastern Canada. Research is continuing to substantiate possible nutrition problems and treatments.

IN EASTERN CANADA, it is quite common to observe waviness (wobbles) in the expanding terminal shoots of conifers during the early summer months. Such waviness, or sinuosity, is reported as typical signs of B deficiency in radiata pine (Pinus radiata) in Australia and New Zealand. In eastern Canada, however, these wobbles disappear during the later part of the year after the secondary growth sets in. This phenomenon can be observed almost anywhere in eastern Canada. During the fast shoot elongation period, temporary deficiency of B is suspected to be partly responsible for the wobble. Possibly due to continuing uptake of B throughout the growth period, the sinuosity corrects itself by the time the new shoot growth starts during the following year.

Other than the possibility that these temporary symptoms are B related, no



SPEED WOBBLE (sinuosity) has been observed in radiata pine with boron deficiency in Australia and New Zealand.

classical symptoms of B deficiency have been noticed in eastern Canada. Reported here is the unique symptom of premature needle drop black in spruce plantations, related to low levels of B in the foliage and high levels of some other micronutrients associated with the symptom.

In the northern hemisphere, B nutrition of forest trees is not studied as much as some of the other micronutrients. General symptoms of B deficiency in trees include loss of terminal dominance, multiple shoots (rosette formation), dieback and sinuosity of stems. In forestry, the occurrence of B deficiency appears to be spatially and temporally random and is controlled by several factors. Conventional analysis of plant tissues and soil samples collected at one point in time does not necessarily provide any clues on the status of B nutrition. Numerous factors that affect the occurrence of B deficiency or toxicity symptoms in forest trees are known.

Black spruce (*Picea mariana*) is one of the most important commercial tree species in eastern Canada. In some plantations, from different origins, premature needle loss has been observed in recent years. The loss of only 1-year-old needles is a strange phenomenon which has never been reported or documented before. This condition may be related to B deficiency. It occurred at the time of crown closure in the plantations.

To evaluate the possible causes of this phenomenon, efforts were made to characterize nutrient dynamics in the affected and unaffected trees. Branches of trees were clipped during 1988 shoot expansion

The authors are with Forestry Canada-Maritimes Region, Fredericton, New Brunswick.



Figure 1. The observed trends in B concentrations in the current (1988) and year-old foliage from a black spruce plantation in eastern Canada.

and the year-old and current foliage were analyzed for nutrients. In most areas with trees exhibiting symptoms, the common factor seems to be low foliar B concentrations (**Figure 1**).

The line graphs in **Figure 1** represent B concentrations in the current and year-old black spruce foliage in healthy trees and in the trees that showed symptoms of pre-



LACK of terminal dominance and rosette formation may be signs of boron deficiency in radiata pine. Necrosis of older needles is associated with rosette formation.

mature needle drop. The length of the expanding new shoot plotted on the X-axis represents the growing period starting from the first week of June. Therefore, the data represent the effects of needle age. The solid lines represent B concentrations in the current foliage while the dotted lines represent the data for year-old foliage.

The following conclusions can be drawn from the graph.

- Boron concentrations in the black spruce foliage vary with the needle age and time of the growing period. Thus, it is tenuous to draw any conclusions based on a one-time sampling of foliage.
- The current foliage had a higher B concentration than the year-old foliage throughout the sampling period. Mixing or combining foliage of different age groups will therefore affect the results.
- In the black spruce plantations sampled, the B concentrations were somewhat higher in healthy trees than in the trees that exhibited symptoms of premature needle drop. It should also be noted that the concentrations of aluminum (Al) and manganese (Mn) in the year-old foliage from the trees with premature needle drop symptoms were consistently and significantly higher than in the foliage from the unaffected trees.

In summary, there are suggestions that B deficiency may play an important role in the growth and development of black spruce stands in eastern Canada. None of the classic B deficiency symptoms described in the literature were observed here. Chemical analyses of foliage samples from affected (premature needle drop) and healthy trees suggest the B deficiency may be one of the possible factors responsible for the unique symptoms observed. Boron fertilization work is under way to substantiate these observations and clarify the role of B nutrition in eastern Canadian plantations and its role in causing premature loss of year-old foliage. 🔳