A research update: Sulphur

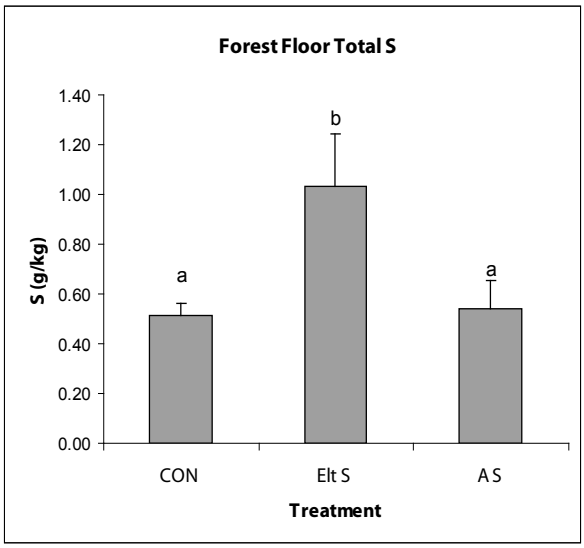

Figure 1. *Total S concentrations in forest floors sampled in 2003 from selected 1990 treatments at Cluculz Creek (CON = control; Elt S = 100 kg/ha S (elemental-S) + 400 kg/ha N (urea); AS = 100 kg/ha S + 400 kg/ha N ($(NH_4)_2SO_4$)). Error bars indicate standard deviations. Values for treatments labelled with the same letter are not significantly different (Fisher's LSD, $P < 0.05$).*

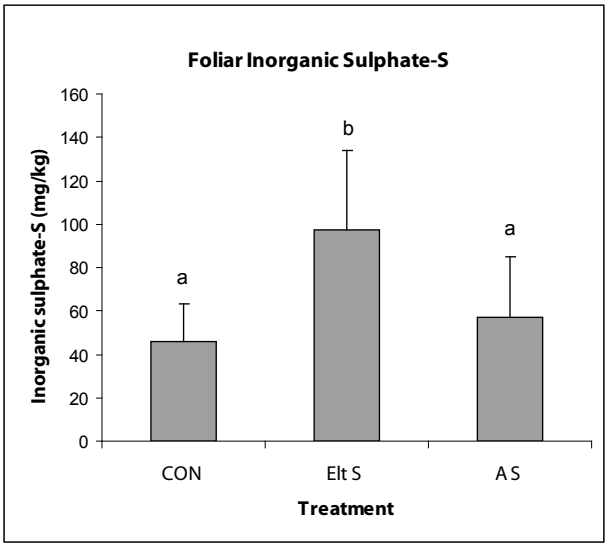

Figure 2. *Sulphate-S concentrations in 2002 current-year lodgepole pine foliage from selected 1990 treatments at Cluculz Creek (treatment codes as for Figure 1).*

Taken together, these findings suggest that a single elemental-S addition can make a lasting improvement to soil S availability.

Paul Sanborn, University of Northern British Columbia and Rob Brockley, BC Ministry of Forests and Range, Kalamalka Research Station

Although nitrogen deficiencies are widespread, fertilization research has shown that many lodgepole pine stands in the Central Interior respond better when sulphur (S) is included with nitrogen (N) in fertilizer blends. The issue now under study is choosing the most suitable form of S.

In the Spring 2004 issue of *LINK*, we gave readers some background on the widespread occurrence of S deficiencies in British Columbia's interior forests. Improved decision aids are now available to assist in interpreting pre-treatment foliar nutrient analyses and to develop appropriate fertilizer prescriptions (Brockley 2001; Thompson *et al.* 2001). These findings are of particular practical value to silviculturists who wish to accelerate the development of young lodgepole pine stands in areas affected by the mountain pine beetle after the current outbreak subsides.

We are now conducting research to determine the best form of fertilizer S. Current large-scale aerial fertilization treatments use a blend of urea and ammonium sulphate (10% S) that provides immediately available soluble sulphates. Elemental-S is an abundant by-product of the natural gas industry, but is a slower-release S source because soil microbes must first oxidize it to sulphate before plants can use it. However, field trials show that six years after N + S fertilization, both elemental-S and soluble sulphate-S provide similar benefits to lodgepole pine growth (Brockley 2004).

We recently re-sampled soils and lodgepole pine foliage in a 1990 fertilization trial at Cluculz Creek, in the Sub-Boreal Spruce (SBS) biogeoclimatic zone approximately 50 km southwest of Prince George (Sanborn and Brockley 2005; Sanborn *et al.* 2005b). Forest floor samples collected more than a decade after treatment with 100 kg/ha S, as elemental-S, showed significantly higher total S concentrations than those from either control or ammonium sulphate-treated plots (Figure 1). A similar pattern occurred for foliar sulphate-S concentrations (Figure 2). When we incubated these forest floor samples in the laboratory, we found that rates of sulphate-S production in samples from the elemental-S treatment were dramatically higher than in the other two treatments. Taken together, these findings suggest that a single elemental-S addition can make a lasting improvement to soil S availability.

nutrition of lodgepole pine

In 2002, with funding from the BC Ministry of Forests, Forest Science Program, we established a new type of fertilization trial at sites near Prince George and Fraser Lake. Through our collaborator, **Dr. Bernhard Mayer** of the Isotope Science Laboratory at the University of Calgary, we are using stable isotope tracer methods to compare the uptake and transformation of sulphate-S and elemental-S fertilizers. Partial results from soil and foliar sampling in 2003 and 2004 indicate, as expected, that applying the sulphate-S fertilizer resulted in a much more immediate increase in S availability on these sites. However, the isotopic data also suggested that the sulphate-S fertilizer was not strongly retained in the litter and forest floor material. Additional analyses, including those of foliage sampled in the fall of 2005, are in progress and we hope to report more detailed findings over the next 1–2 years.

More complete background to this study, including a comprehensive review of S behaviour in forests and forest soils, is given in the BC Ministry of Forests and Range establishment report (Sanborn *et al.* 2005a).

For more information contact:

Paul Sanborn
University of Northern British Columbia
3333 University Way
Prince George, BC V2N 4Z9
Tel: 250-960-6661
Email: ***sanborn@unbc.ca***

Rob Brockley
BC Ministry of Forests and Range
Kalamalka Research Station
3401 Reservoir Road,
Vernon, BC V1B 2C7
Tel: 250-260-4768
Email: ***Rob.Brockley@gov.bc.ca***

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