

Hubbard Brook Ecosystem Study

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Watershed 1 calcium addition: response of sugar maple

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Element budget studies using the small watershed approach at the HBEF demonstrated the magnitude of soil calcium depletion from these forest ecosystems that resulted from the combination of forest harvest and acid deposition during the 20th century. As a result, surface water acidification has occurred and over the past 25 years tree growth appears to have declined. In October 1999 0.85 Mg Ca/ha was added to experimental Watershed 1 in the form of the silicate mineral wollastonite (photos, right), with the objective of returning the calcium status and pH of the soil to pre-20th century levels over the following decade. By summer 2002 the treatment had raised the pH of the Oa horizon soil (humus layer) from 3.9 to 4.2.

Foliar Ca concentration of canopy sugar maples in W1 increased markedly beginning the second year after treatment and by 2005, the crown condition of sugar maple was much healthier in the treated watershed as compared with untreated reference watershed (W6). Following high seed production in 2000 and 2002, the density of sugar maple seedlings increased significantly on W1 in comparison with W6 in 2001 and 2003. Survivorship of the 2003 cohort through July 2005 was much higher on W1 (36.6%) than W6 (10.2%). Sugar maple germinants on W1 were about 50% larger than those in reference plots and foliage and fine root Ca concentrations were roughly twice as high. Mycorrhizal colonization of seedlings also was much greater in the treated (22.4% of root length) than the reference sites (4.4%). These results reinforce and extend other regional observations that sugar maple decline in the northeastern United States and southern Canada is caused in part by anthropogenic effects on soil Ca status, but the causal interactions among inorganic nutrition, physiological stress, mycorrhizal colonization and seedling growth and health remain to be established.

Recent publications

Juice, S.M., T.J. Fahey, T.G. Siccama, C.T. Driscoll, E.G. Denny, C. Eagar, N.L. Cleavitt, R. Minocha and A.D. Richardson. 2006. Response of sugar maple to calcium addition to northern hardwood forest at Hubbard Brook, NH. *Ecology* 87(5):1267-1280.

Peters, S.C., Blum, J.D., Driscoll, C.T. and Likens, G.E. 2004. Dissolution of wollastonite during the experimental manipulation of Hubbard Brook Watershed 1. *Biogeochemistry* 67: 309-329.



Pelletized wollastonite



Helicopter distributing wollastonite

Siccama, T.G. T.J. Fahey, C.E. Johnson, T.W. Sherry, E.G. Denny, B. Girdler, G.E. Likens and P.A. Schwarz. 2006. Population and Biomass Dynamics of Trees in a Northern Hardwood Forest at Hubbard Brook. *Can. J. For. Research*, in press.