

ASSESSMENT OF SUGAR MAPLE GROWTH IN RELATION TO XYLEM CHEMISTRY AND MOBILITY OF TOXIC ELEMENTS

Simon Bilodeau Gauthier* Environment Canada, Université du Québec à Montréal

Daniel Houle Environment Canada, Ministère des Ressources Naturelles et de la Faune du Québec

Christian Gagnon Environment Canada

Benoît Côté McGill University

Christian Messier Université du Québec à Montréal

Abstract

Mobility of elements in tree xylem has been a growing concern for dendrochemists seeking to monitor long-term changes in soil chemistry, because it would contradict the basic premise that concentrations in tree-rings are representative of past environmental conditions. Although a previous work (Bilodeau Gauthier et al., 2008, *J. Env. Qual.* 37(3): 871-879) revealed that aluminium (Al) had been generally found in large part in a residual, immobilized form in sugar maple xylem, its more mobile fractions (water- and acid-soluble) were significantly enhanced on very acid soils, while other potentially phytotoxic metals in xylem - cadmium (Cd) and manganese (Mn) - were also increasing with soil acidity. This paper presents an in-depth investigation of soil-wood relations on a wide range of soil conditions, as well as the influence on tree growth. It was hypothesized that the growth of sugar maples would be impeded by acidic metals mobilized at high soil acidity, which would also translate as greater xylem concentrations of those elements. Sugar maple trees ($n = 55$) from six different watersheds in southern Quebec were analysed for base cations (Ca, K, Mg) and acidic metals (Al, Cd, Mn) in xylem. Sequential chemical extractions were used to selectively displace elements contained in the water-soluble, acid-soluble and residual fractions. Soil samples were taken at the base of each tree in order to represent the tree's immediate environment. Generally, tree growth was positively correlated to concentrations of base cations in wood and soil, and negatively correlated to concentrations of acidic metals in wood and soil. However, these relations differed depending on which element fraction was considered. Since acidic metals are more mobile in tree xylem at high soil acidity, a further worry emanates from their potential toxicity should they move upward in the tree stem and reach the physiologically active leaves.

Key words: Aluminium, base cations, cadmium, manganese, metal toxicity, sequential extractions, soil acidity, sugar maple, tree growth.