

# Measuring Stress and Recovery in Limed Sugar Maple on the Allegheny Plateau of North-Central Pennsylvania

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## Abstract

A long-term study to evaluate the effects of lime fertilization on growth, crown vitality, and flower and seed production in declining sugar maple was established in stands in the Susquehannock State Forest on the Allegheny Plateau in north-central Pennsylvania in 1985. A single application of commercial pulverized dolomitic limestone (Ca=21%, Mg=12%, CaO equivalent=58.8) was applied at 22.4 Mg/ha<sup>-1</sup> to plots in four stands on the forest. Recent evaluations of these study plots for growth and crown vitality in 1993 indicated that liming had a significant and positive effect on these health variables. This positive response of sugar maple to liming offered a unique opportunity to evaluate other indicators of tree stress/vitality and determine if they also indicated a positive response to lime additions. Foliar polyamines (low molecular weight organic polycations), starch and soluble sugar concentrations in root tissues, and cambial electrical resistance (CER) measured with a Shigometer were evaluated. Polyamines were measured in July 1997 and 1998. Root tissue for starch and sugar analyses was collected in November 1997 when starch concentration was anticipated to be highest and sugar levels lowest; starch in root wood was measured both visually and chemically. CER was measured in July 1998. We hypothesized that all measures would indicate an increase in vitality for trees in the limed plots; values of all stress indicators confirmed this hypothesis. Polyamine levels in the foliage, soluble sugar concentration, especially glucose and fructose, and CER decreased and starch content in both root bark and wood tissue increased. These changes were correlated with increases in tree vitality as measured by increased growth (dbh) and improved crown condition. Indicator levels were also significantly correlated with changes in soil and foliar cations in response to liming. Polyamines, soluble sugars, and CER decreased and starch content increased as concentrations of Ca and Mg and molar ratios of Ca/Al and Mg/Mn increased and as concentrations of Al and Mn decreased in both soil and foliage. Favorable changes in these stress/vitality indicators were also linked to an increase in soil pH. Our study confirms the beneficial effects of lime additions on sugar maple vitality, and the utility of physiological and biochemical stress indicators to assess tree vitality.