Trends in Growth Rates of Vermont Sugar Maples from 1953-1992 in Relation to Stand Nutrition

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Abstract

Growth of sugar maple (*Acer saccharum* Marsh.) in 7 northern Vermont stands managed for sap production and 22 unmanaged stands distributed around the state was studied for the period 1953-1992 in relation to stand nutrition and other site factors. In 4 managed stands where at least 25% of the trees had 10% or greater crown dieback, average annual basal area increment (BAI) for 1953-1992 in codominant trees averaged 17.5 cm^2 compared to 32.3 cm^2 in 3 managed stands where less than 10% of the trees had 10% or greater crown dieback. Soil surface horizons of slower growing stands were characterized by significantly lower pH and Ca, ($p < 0.05$) marginally lower Mg and marginally higher Al than faster growing stands, while soil P and K were not different. Foliar Ca was lower ($p < 0.01$) in slower growing stands (6,400 mg kg^{-1}) than faster growing stands (12,200 mg kg^{-1}) but other foliar nutrients did not differ significantly. No other stand characteristics, including age, basal area, stem density, elevation or aspect were apparently related to differences in growth rates and crown condition between these two groups. A 49% decline in BAI of the faster growing trees from the mid-1970's to 1992 was noted, but the small sample size precluded interpreting this as a region-wide growth decline.

In a second study, 22 hardwood stands composed of at least 1/3 sugar maple, and not thinned since 1943 were identified on state and federal lands in the Green Mountains and the Vermont Piedmont east of the mountains. Twelve sugar maples per stand 27 cm in diameter or greater were cored in 1993, and surface soil horizons were sampled around each tree. Average annual stand BAI for the period 1953-1992 ranged from 8.9 cm^2 to 26.9 cm^2. Stand growth rates were not correlated with stand basal area (range = 20.7 - 28.3 m^2 ha^{-1}), tree density (range = 197 - 388 stems > 15 cm dbh ha^{-1}) , slope (range = 5 - 69%) or elevation (range = 195 - 807 m). There was a negative correlation between soil pH and average stand dieback ($p < 0.01$), but, unlike the managed stands in northern Vermont, base cation availability and soil pH in soil upper horizons were not well correlated with growth rates on either a stand or tree basis, although soil P was negatively correlated with stand growth ($p < .05$). Other site factors that were not examined, such as soil depth, water-holding capacity, and soil nutrient pools in deeper horizons may have had an overriding influence on stand growth rates.

A moderate growth decline over the period 1979-1992 was observed across most of the 22 unmanaged stands. Average annual BAI for trees that were canopy codominants in 1953 (30-46 cm DBH) was approximately 22 cm^2 between 1953 and 1977, but declined to 15.6 cm^2 by 1992. A period of defoliation by forest tent caterpillar (*Malacosoma disstria* Hubner) over much of the state from 1978-1982 was a likely inciting factor in this decline, as was an outbreak of pear thrips (*Taeniothrips inconsequens* Uzel) in 1988. Records from Vermont weather stations did not indicate long-term changes in growing season precipitation between 1953-1992. Continued monitoring is needed to determine whether this change in growth rate was due to stand closure or other factors, and if growth rates will recover to previous levels. It is notable that the average annual BAI of nearly 15 cm^2 in 1992 for all trees at all sites was near or above the average growth rate for sugar maple reported from other parts of its range.

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