Winter chemical leaching from deciduous tree branches as a function of branch inclination angle in central Massachusetts

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EXTENDED ABSTRACT[3]

Leaching is an important process in the biogeochemical cycling of nutrients from aboveground vegetative surfaces to the forest floor. Little is known about winter leaching from deciduous tree species and the influence of branch inclination angle on leachate chemistry. Branch inclination angle has not previously been considered in relation to leachate concentrations and quantities. The research objectives were to experimentally assess (1) the influence of branch inclination angle and species on leachate chemistry; and (2) the influence of branch inclination angle on branchflow generation. The null hypothesis is that branchflow volumes expressed as percentages of incident gross precipitation and the quantity of nutrients leached from a set of field-based isolated branches of three deciduous species positioned at different inclination angles will not differ significantly. Rejection of the null hypothesis would mean that branch inclination angle and species may be a factor influencing the transfer of water and nutrients from leafless canopy trees to the forest floor with implications for the spatial heterogeneity of nutrient inputs to the forest floor.

Field-based isolated branches harvested from mature crowns of *Betula lenta*, *Carya glabra*, and *Quercus rubra*, were used to test the null hypothesis. Leachate concentrations were significantly greater from branches inclined at 20E than 5E or 38E. Absolute nutrient inputs were also greatest for branches inclined at 20E. The significantly enriched branchflow and greater total nutrient input from branches inclined at 20E were attributed to increased residence time of intercepted precipitation with the branch surface, the lower probability of branch drip than branches inclined at 5E, and only minimal differences in branchflow quantity compared to branches inclined at 38E. Branchflow was more enriched from all three branch angles during precipitation events of longer duration and lower intensity than shorter, intense events. The leachate quantities of K^+ and Ca^{2+} differs significantly among species. *C. glabra* and *Q. rubra* leached more K^+ than *B. lenta*. All three species leached significantly different amounts of Ca^{2+}, with *Q. rubra* leaching the most and *C. glabra* the least.

Differential leaching among species in the branch inclination experiment was likely attributable to differences in tissue chemistry and bark thickness. The relatively thin bark of *B. lenta* dried faster than the thicker bark of *C. glabra* and *Q. rubra* and may have accounted for its lower branchflow concentrations. Branches of *Q. rubra* may have leached the most K^+ because its thick bark remained wet longer than the thinner bark of *B. lenta.* Although no known studies have specifically examined the influence of bark wetness on leachate quantity, some researchers have

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reported that the longer foliar tissue remained wet the greater the leaching losses. The results of our experiment suggest that those trees with a greater proportion of moderately inclined branches will experience greater dormant season branchflow leaching losses than trees with more gently or steeply inclined branches. Winter leaching from the aboveground woody surfaces of leafless canopy trees may influence tree vigor and the competition for aqueous nutrients in early spring. Recapturing nutrients from aboveground vegetative surfaces may stimulate the growth of fine roots and increase net primary productivity. Further study is necessary to determine the long-term effects of winter leaching on individual canopy trees.

Keywords: winter; leaching; branch inclination angle; branchflow; stemflow