CANOPY ION EXCHANGE MECHANISMS
- 1992 -

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Cooperators:

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Objectives:

The broad goal of this work is to better understand mechanisms controlling foliar ion exchange (foliar leaching and uptake) in forest canopies. This is important in order to properly assess effects of changing atmospheric chemistry and climate on nutrient cycling processes in forests. Specific objectives of this project include: (1) characterizing the ion exchange rates in sugar maple during artificial precipitation events, (2) identifying the relative importance of possible sources of and sinks for exchanging ions, (3) relating tissue ion concentrations to ion exchange rates, and (4) developing a mechanistic model predicting canopy ion exchange rates.

Methods:

Integrated field and laboratory experiments were conducted with sugar maple during two growing seasons. In 1991, the objective was to identify the relative importance of foliage *vs* stems in canopy ion exchange. This was done by comparing the chemistry of foliar leachate from normal and artificially-defoliated branches, and evaluating the kinetics of ion exchange in each. Details of methods and significant findings for this portion of the study can be found in the 1991 VMC Annual Report. Also in 1991, laboratory studies examined the ion transport properties of isolated leaf cuticles from the field foliage in order to calculate ion permeability rates. These data will be used to compare ion flux between cuticle and whole-branch levels, and will be incorporated into canopy ion exchange models.

In 1992, a second experiment designed to evaluate the contribution of leaf surface deposits to canopy ion exchange was performed. This was done by comparing the chemistry of leachate from sugar maple foliage on small branches that had been previously washed with an acidic solution at pH 3.3 (deionized water adjusted to pH 3.3 with HCl), deionized water, or left unwashed. Specifically, each of 30 sugar maple branches chosen from four trees growing at the Proctor Maple Research Center in Underhill were prewashed with either the acidic solution, deionized water, or were left unwashed, and then misted with the artificial

precipitation solutions at pH 3.8 or 5.3. Branches receiving the acidic solution or deionized water prewashes were rinsed afterward with deionized water and allowed to dry prior to misting. A total of six treatment combinations (3 prewashes x 2 acid mists) were used and the experiment was replicated five times for a total of 30 branches treated. Leachate samples were collected sequentially from each chamber over 15 min. intervals during the first hour and over 30 min. intervals during the second hour for a total of six leachate samples per chamber per replicate. The same branch misting chamber design and collection method used in 1991 was used for misting in this experiment. All prewash and rinse solutions were also collected and saved for chemical analysis. Following misting, all treated branches, as well as untreated control branches from each tree, were collected for leaf and stem area determination and chemical analyses. Relationships between ion concentration in the leachate and foliage tissues will be examined. Leaf cuticles were also collected from treated foliaged for additional measurement of cuticular ion permeabilities. Leachate samples were analyzed for major ions at the Institute of Ecosystem studies in Millbrook, NY. and foliage samples were analyzed at the UVM Agriculture Testing Laboratory.

Significant Findings:

Because of an unavoidable delay in completing the chemical analyses, we do not have results available to report at this time, but will be reporting results from this experiment in 1993.

Future Plans:

In 1993, we will complete our chemical and data analyses and begin work on a manuscript describing this study and our results.

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