Some Like it Hot!
Influence of Species and Soil Temperature on N-form Preference and Uptake

B.J. Hawkins
Centre for Forest Biology
University of Victoria
Victoria, BC, CANADA

bhawkins@uvic.ca
Nitrogen is the mineral element required by plants in the greatest amount.
N availability in forest soils limits tree growth

N in soils exists in inorganic and organic forms
Organic N may be > 50% of available N

N-form concentrations in water-extracted soils
August - Southern Vancouver Island

Individual amino acids

Trees can utilize amino acids as a source of N

Sweden: Arginine fertilizer = arGrow

Arginine retained in soil longer than inorganic N

Plants utilize amino acids and small peptides as a source of N in the field.

N is taken up via transporters in root cell membranes

Amt/MEP protein
N is taken up via transporters in root cell membranes

N transporter families: AMT1 & AMT 2  NRT1/PTR & NRT2
Diversity of:
- forms of N available
- types of N transporters
- plant species

Variation in N form “preference”.


---

![Graph showing ion influx (μmol g⁻¹ h⁻¹) vs. ion concentration (mM) for NH₄⁺ and NO₃⁻ influx in white spruce.](image-url)
Niche partitioning of N forms

Species dominance is correlated with uptake of the most common N form

% NPP 3 40 10 15 15

Plasticity in N form use

Superior competitors exhibit higher resource use plasticity.

N form “preference” in trees

Interior spruce: Higher rates of ammonium uptake

Miller & Hawkins. 2007. Tree Physiol.
N form “preference” in trees

Douglas-fir: Greater growth with > 40% $\text{NO}_3^-$.

N form “preference” in trees

Douglas-fir and lodgepole pine – uptake of nitrate ≥ ammonium

A. Douglas-fir

B. Lodgepole pine

pH affects N form “preference”

Douglas-fir

Lodgepole pine
Does temperature affect N form “preference”? 
Yellow cypress

Douglas-fir
Dry biomass (g)

Douglas-fir

10 °C
16 °C
22 °C

Engelmann spruce

Dry biomass (g)

Amino acids, \( \text{NH}_4^+ \), \( \text{NO}_3^- \)

Root

Shoot
Measure net N ion flux with microelectrodes
NH₄⁺ efflux at higher temperatures

High efflux: influx ratio also observed at high root temperatures in balsam poplar

Data courtesy:
L. Kalcsits & R. Guy
UBC Forest Science
Will changes in species’ N-form preference affect their relative response to warmer climates?
Acknowledgements

Funding:

NSERC, NSERC CREATE, BC FSP

Students and collaborators:

S. Boczulak, H. Boukcim, K. Everett, T. Gaudet, R. Metcalfe, B. Miller, C. Plassard, S. Robbins

Invaluable assistance:

many, many summer students and research assistants.