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Some Like it Hot!

Influence of Species and Soil Temperature on N-form Preference and Uptake

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Nutrient Dynamics of Planted Forests

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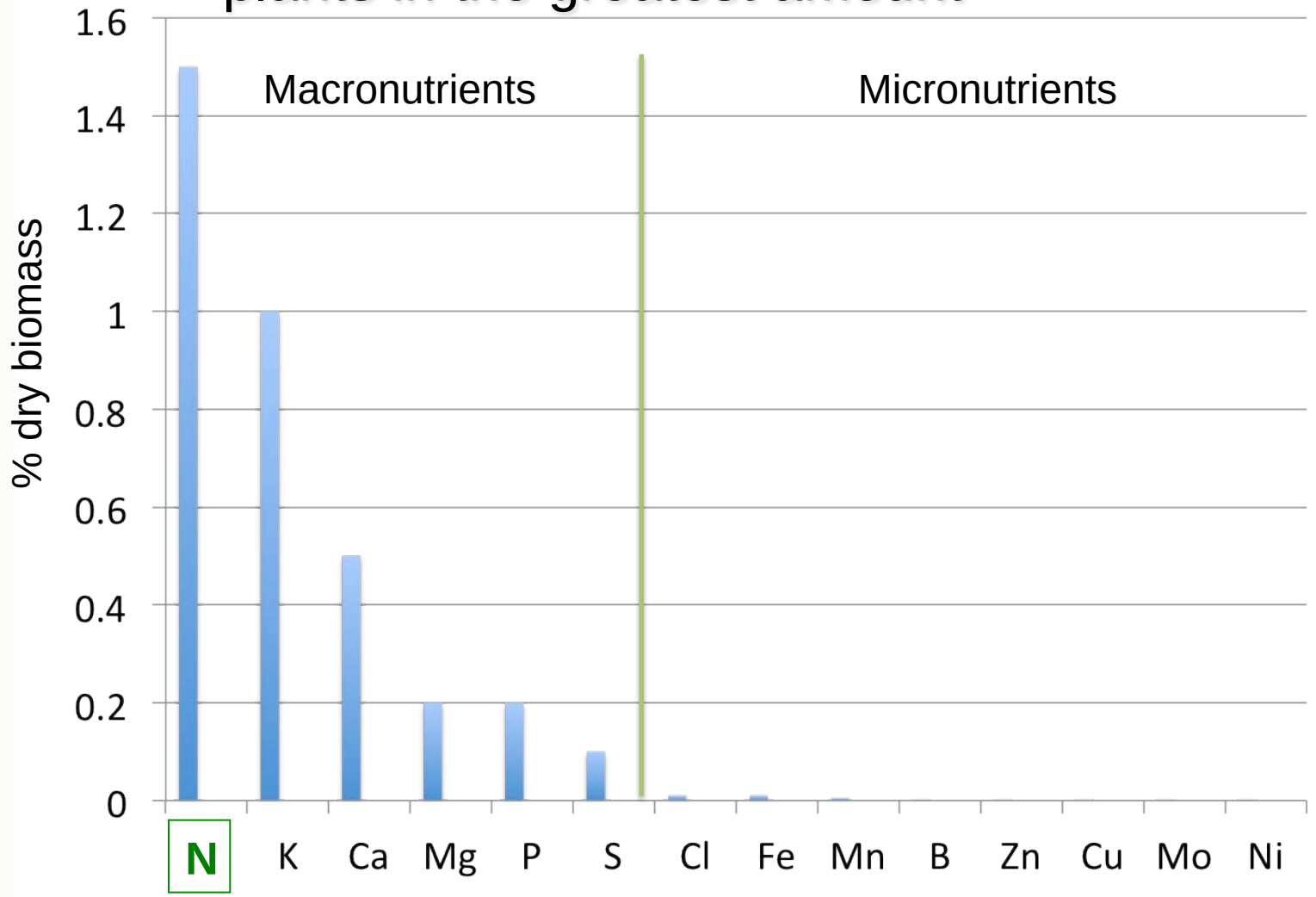
Nitrogen is the mineral element required by plants in the greatest amount



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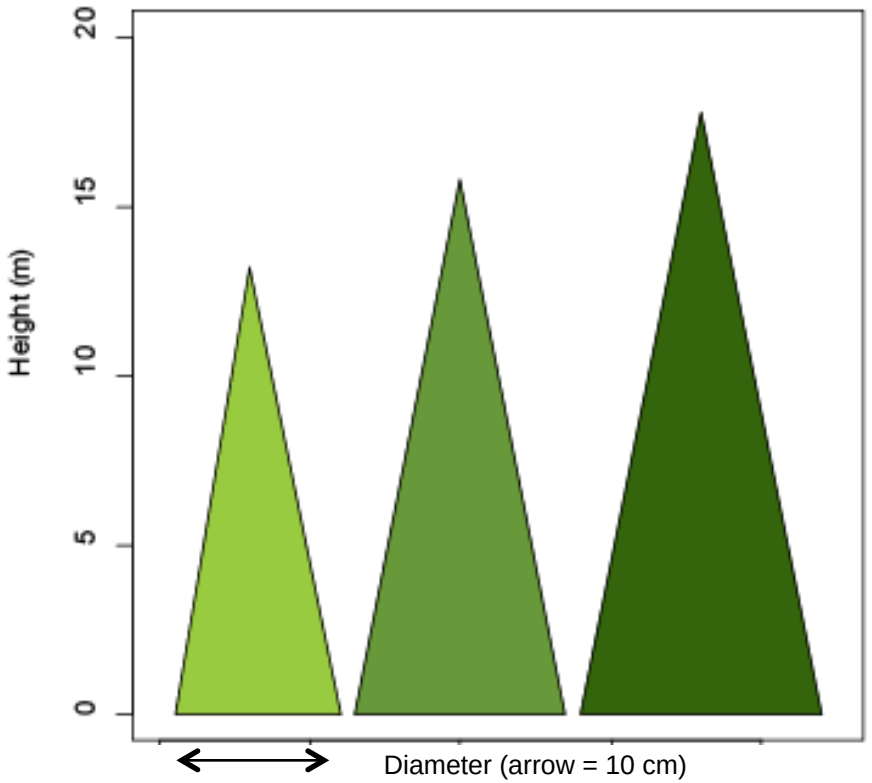
N availability in forest soils limits tree growth



Fertilization & thinning effects on a Douglas-fir ecosystem at Shawningan Lake: 15-year growth response. 1990. E.R. Gardner. BC-X-319

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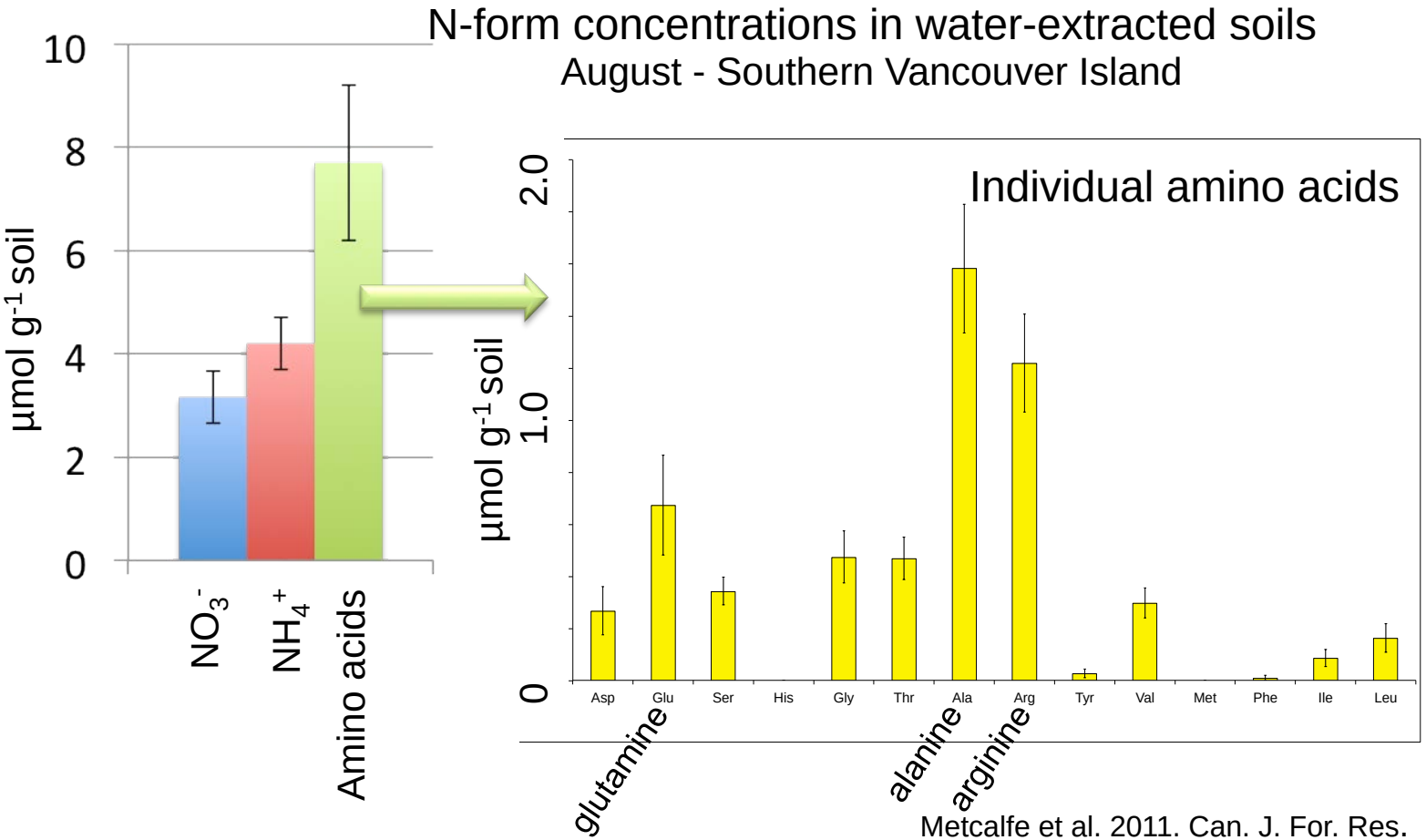
N in soils exists in inorganic and organic forms
Organic N may be > 50% of available N



Metcalfe et al. 2011. Can. J. For. Res.

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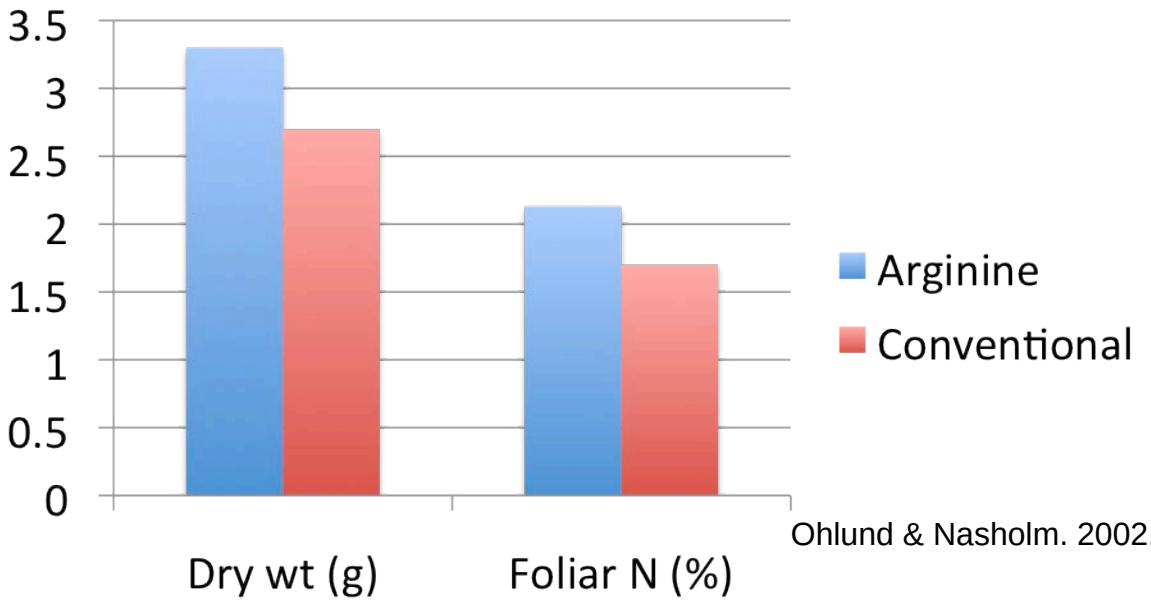
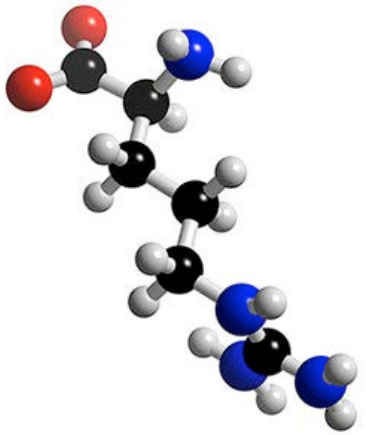
Trees can utilize amino acids as a source of N

Sweden: Arginine fertilizer = arGrow





Ohlund & Nasholm. 2002. Envir. Sci. Tech.

Arginine retained in soil longer than inorganic N

SweTree Technologies
Innovators in Forest Biotechnology

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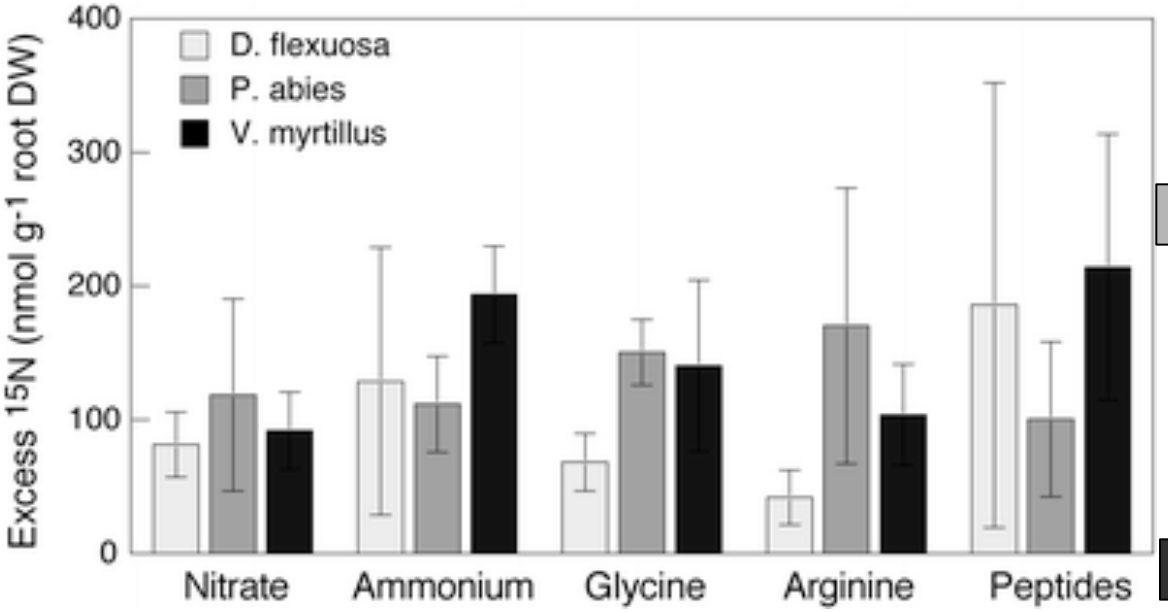
Plants utilize amino acids and small peptides as a source of N in the field.



bunchgrass

Norway spruce

bilberry

Persson et al. 2003. Oecologia

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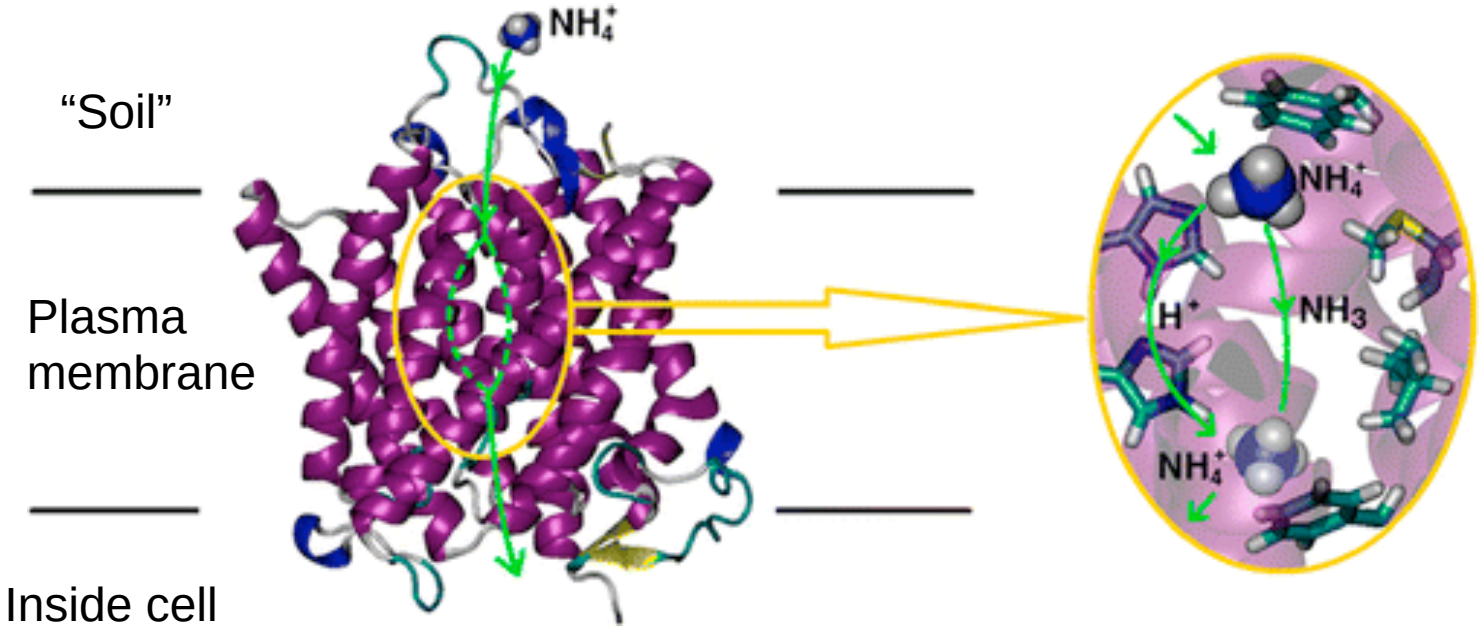
N is taken up via transporters in root cell membranes



Amt/MEP protein

Wang et al. 2012. *J. Am. Chem. Soc.*

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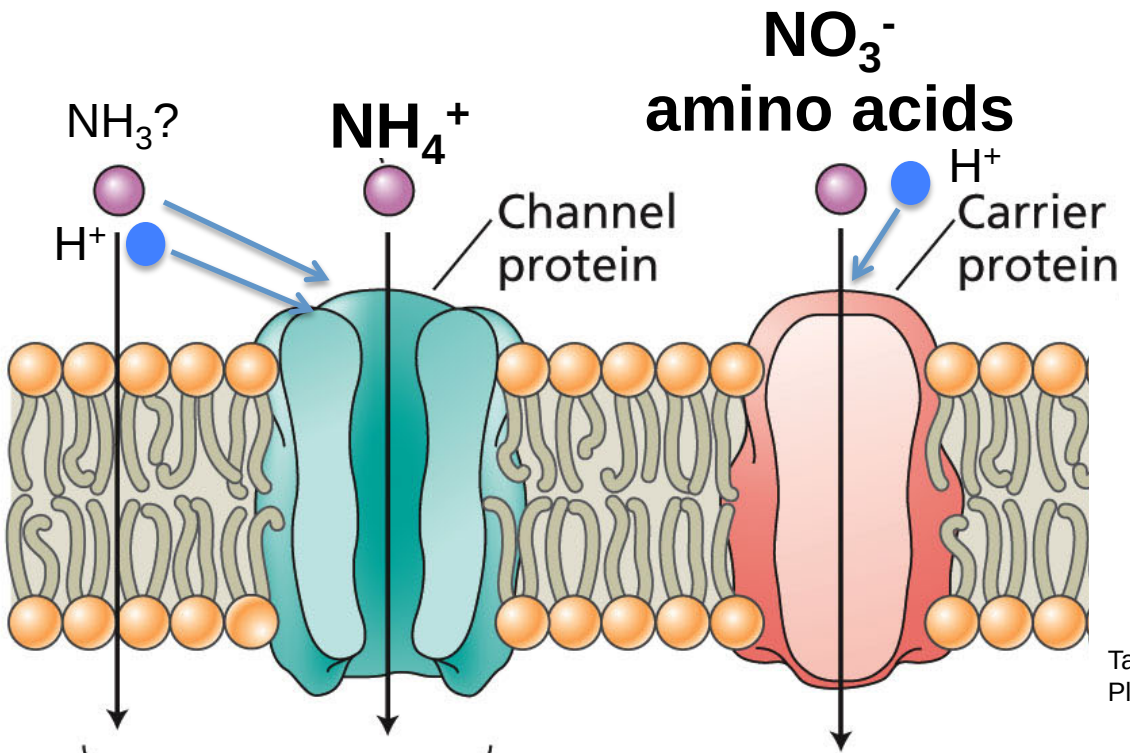
N is taken up via transporters in root cell membranes



Taix & Zeiger
Plant Physiology

N transporter families: AMT1 & AMT 2 NRT1/PTR & NRT2

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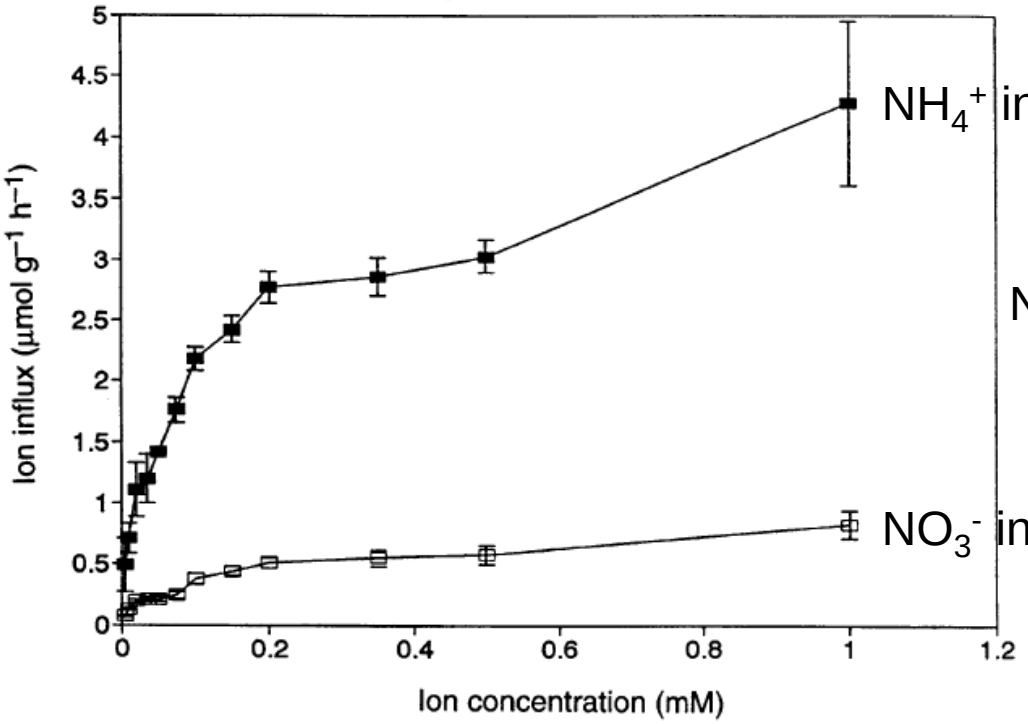
Diversity of:

- forms of N available
- types of N transporters
- plant species

Variation in N form “preference”.



N uptake in white spruce

Kronzucker et al. 1997. *Nature* 385: 59-61

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Carex bigelowii


Eriophorum vaginatum

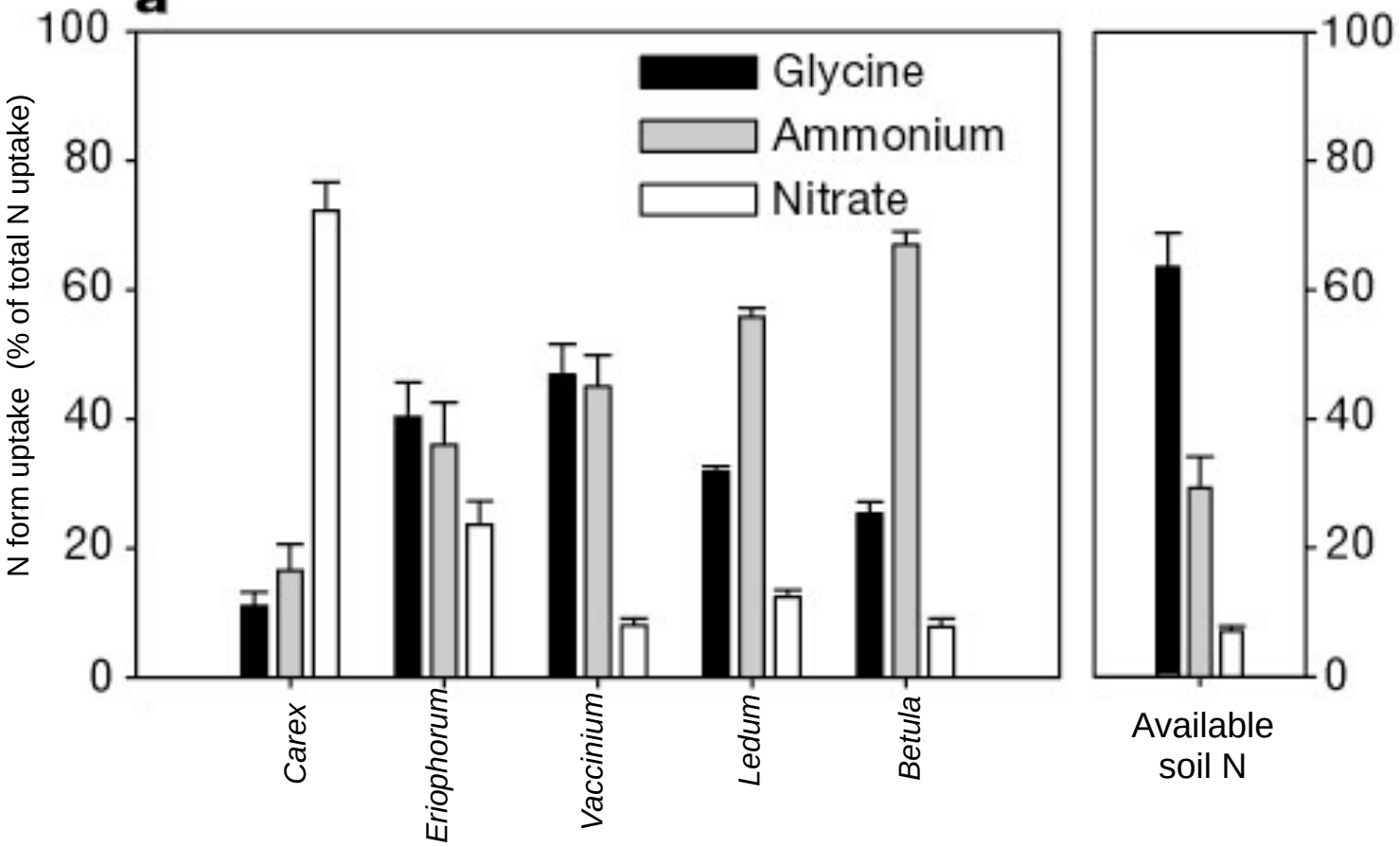

Vaccinium vitis-idaea


Ledum palustre


Betula nana

Niche partitioning of N forms

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



% NPP	3	40	10	15	15

McKane et al. 2002. *Nature* **415**, 68-71

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Plasticity in N form use

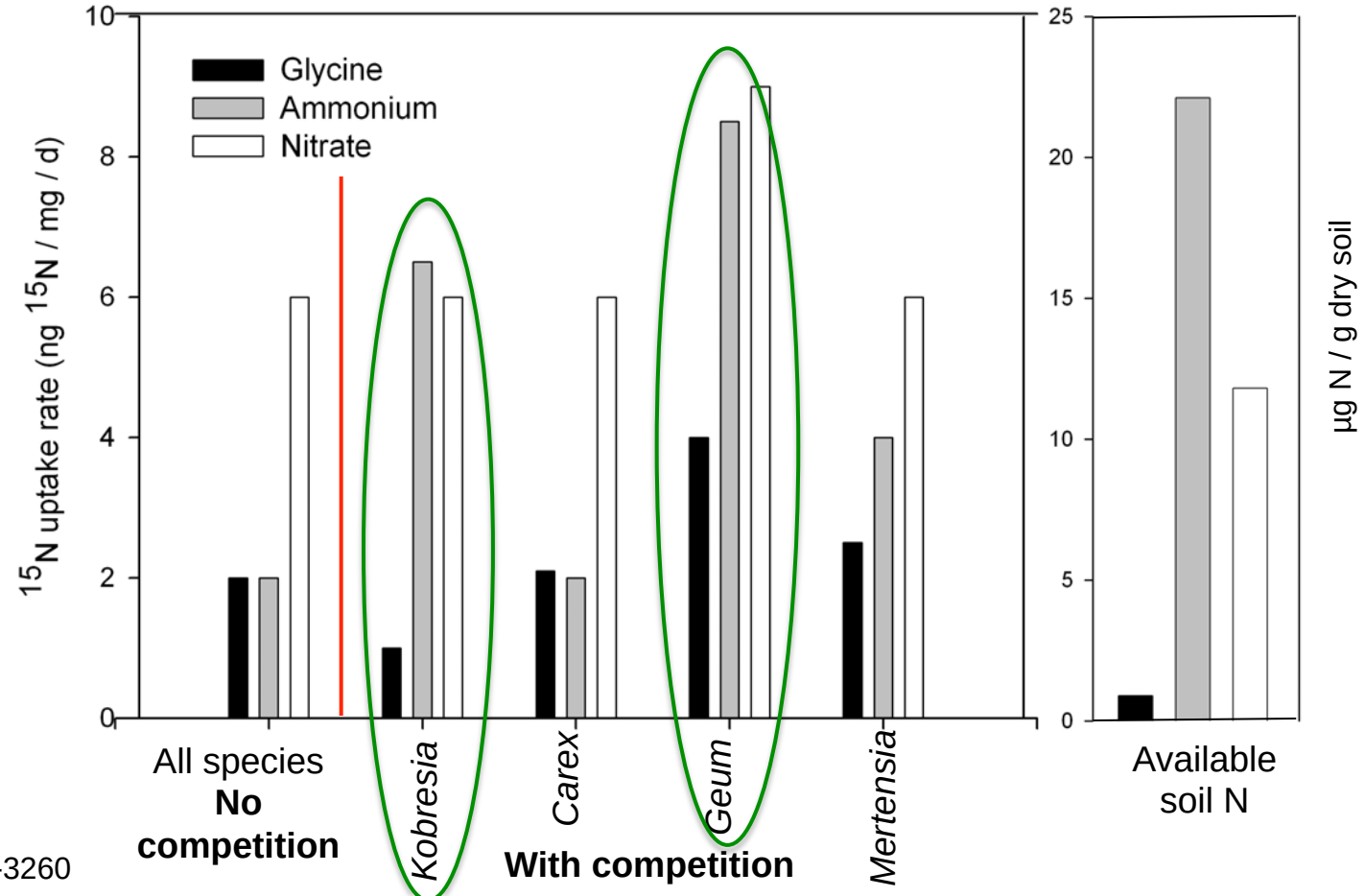
Kobresia myosuroides

Carex rupestris

Geum rossii

Mertensia lanceolata

Superior competitors exhibit higher resource use plasticity.



Aston et al. 2010.
Ecology 91: 3252-3260

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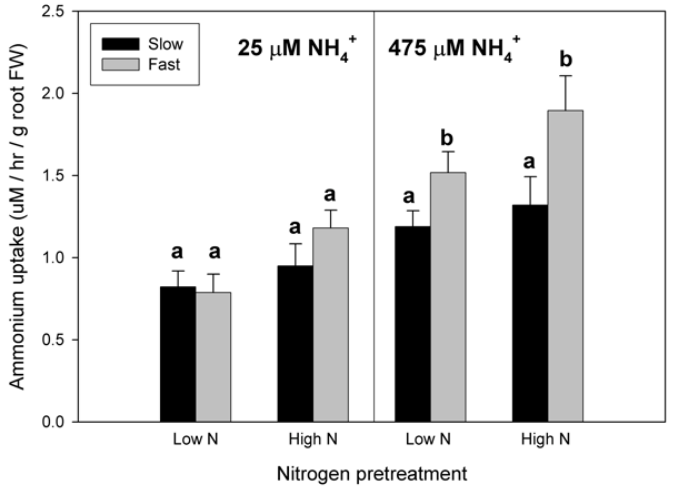
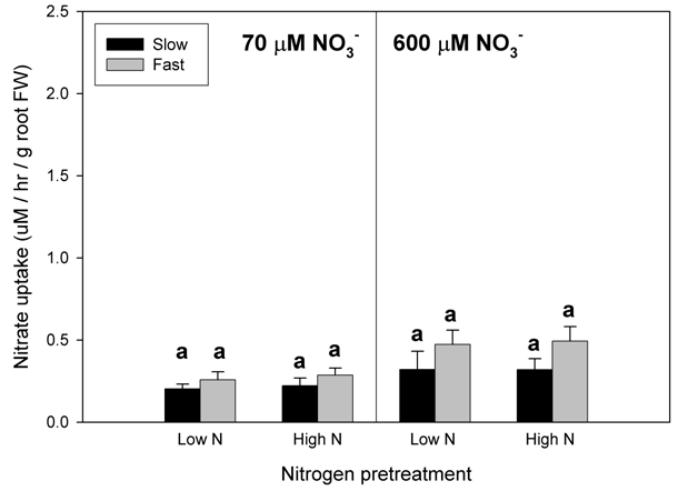
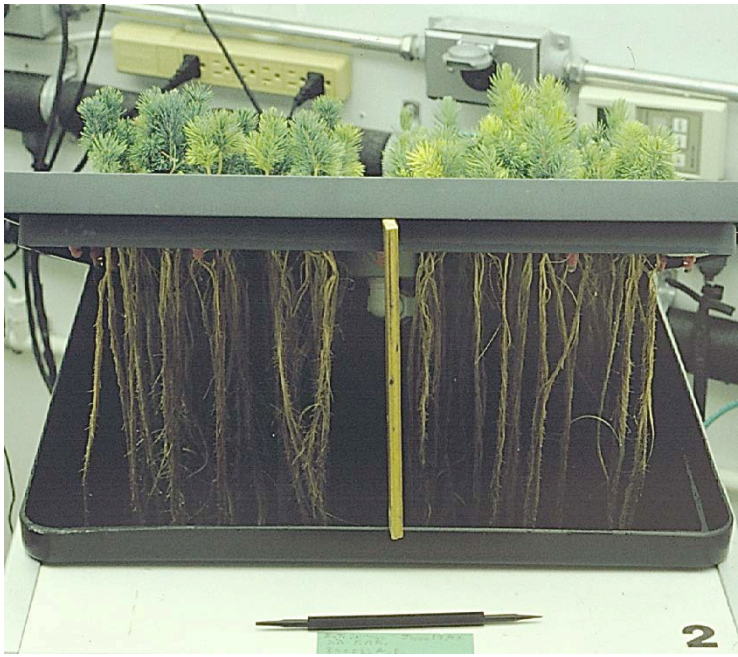
N form “preference” in trees

Interior spruce: Higher rates of ammonium uptake







Miller & Hawkins. 2007. Tree Physiol.

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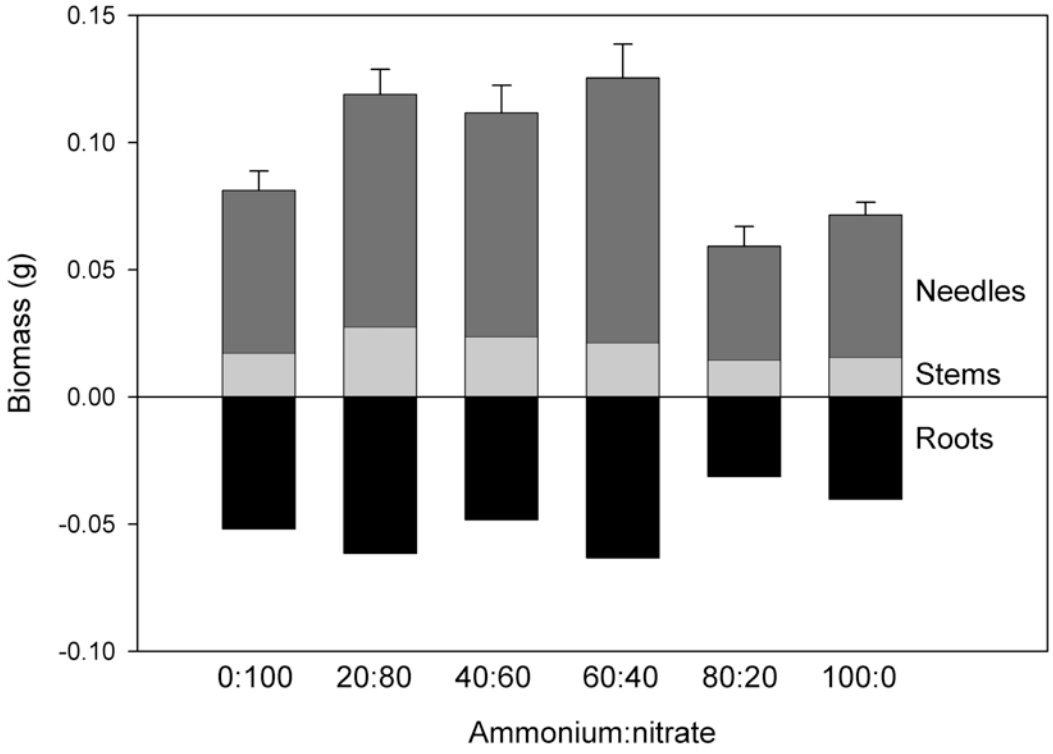
N form “preference” in trees

Douglas-fir: Greater growth with > 40% NO_3^-.



Everett et al. 2010. J. Plant Nutr.

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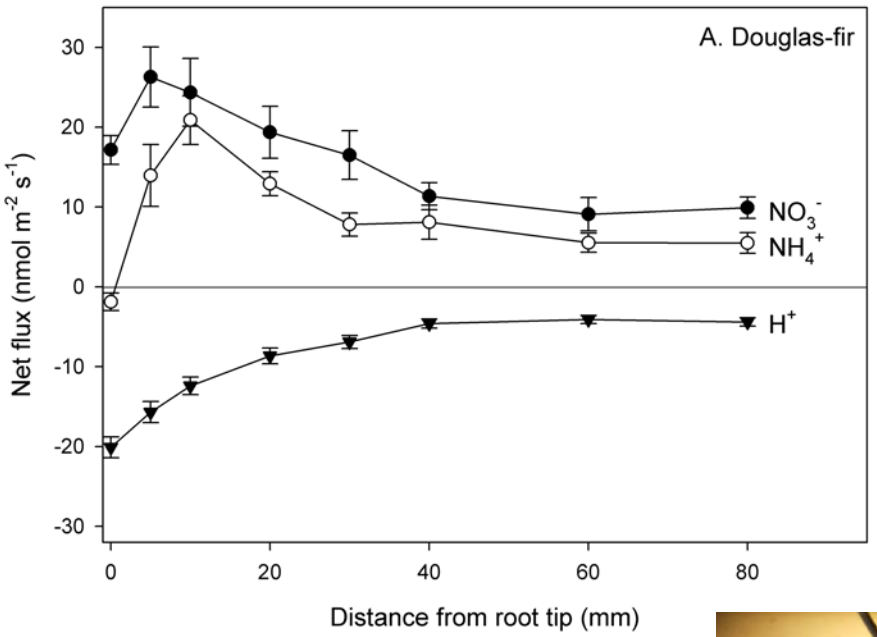
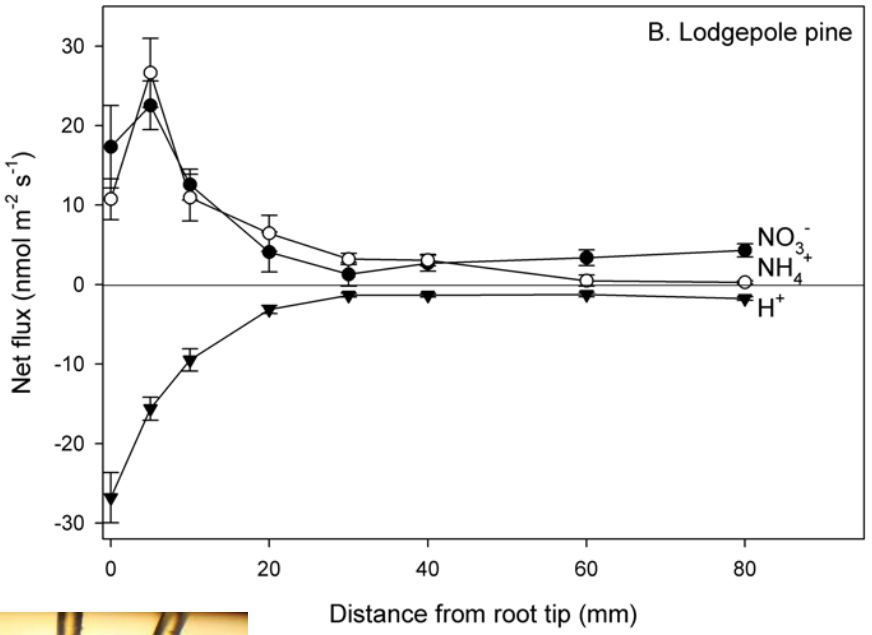
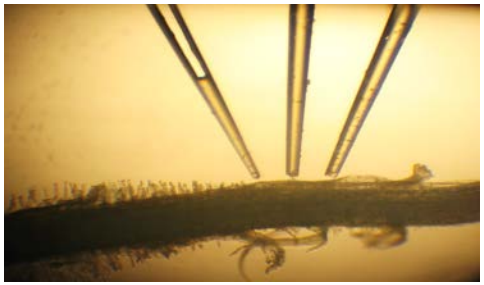
N form “preference” in trees

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







Hawkins et al. 2008. Plant Cell Envir.

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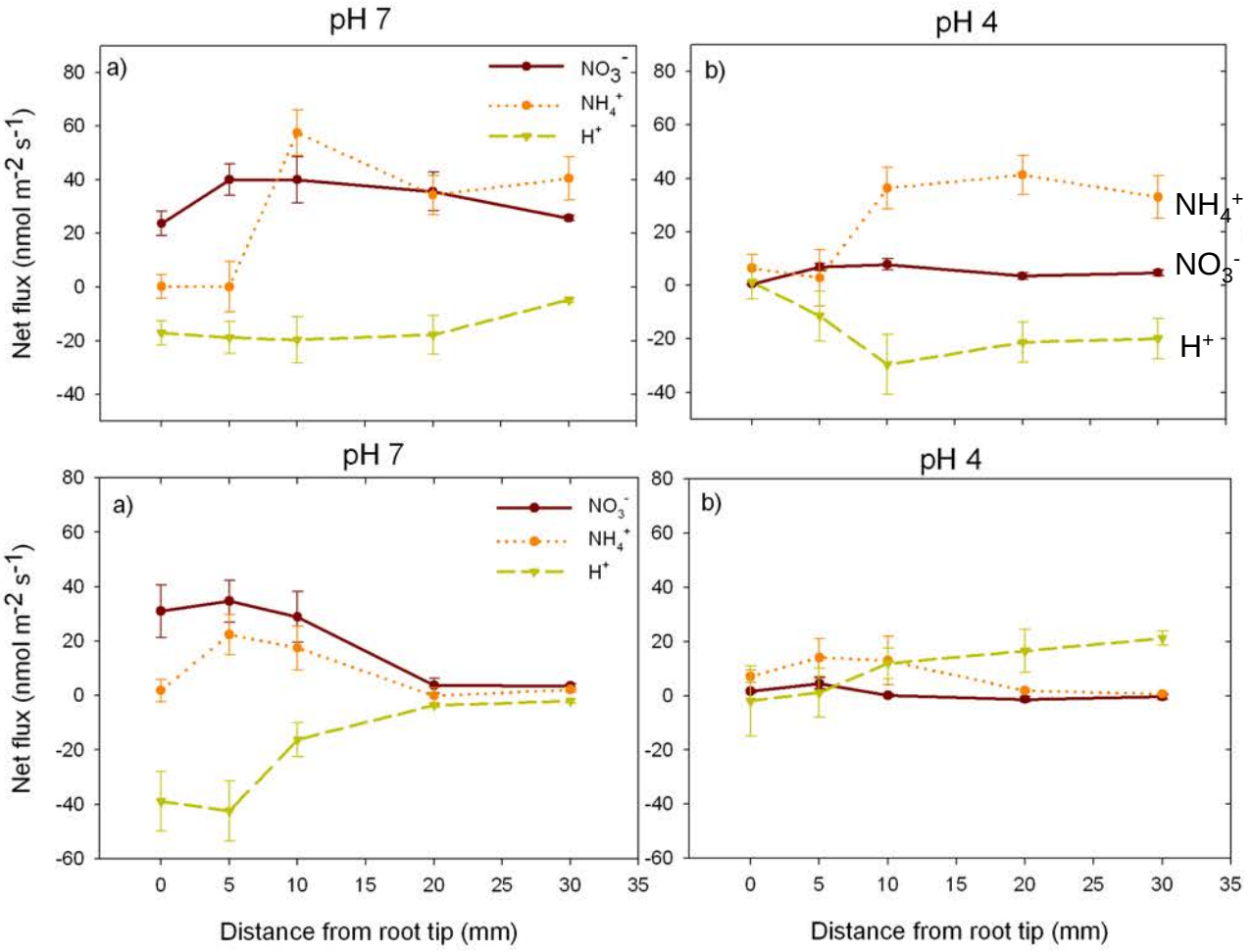
pH affects N form “preference”



Hawkins & Robbins. 2010. Physiol. Plant.

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Does temperature affect N form “preference”?

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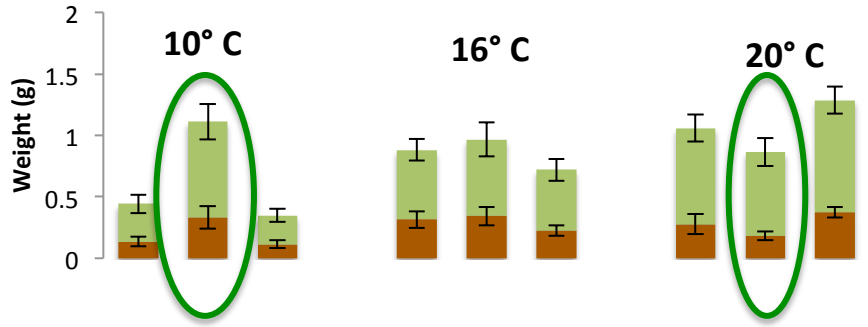
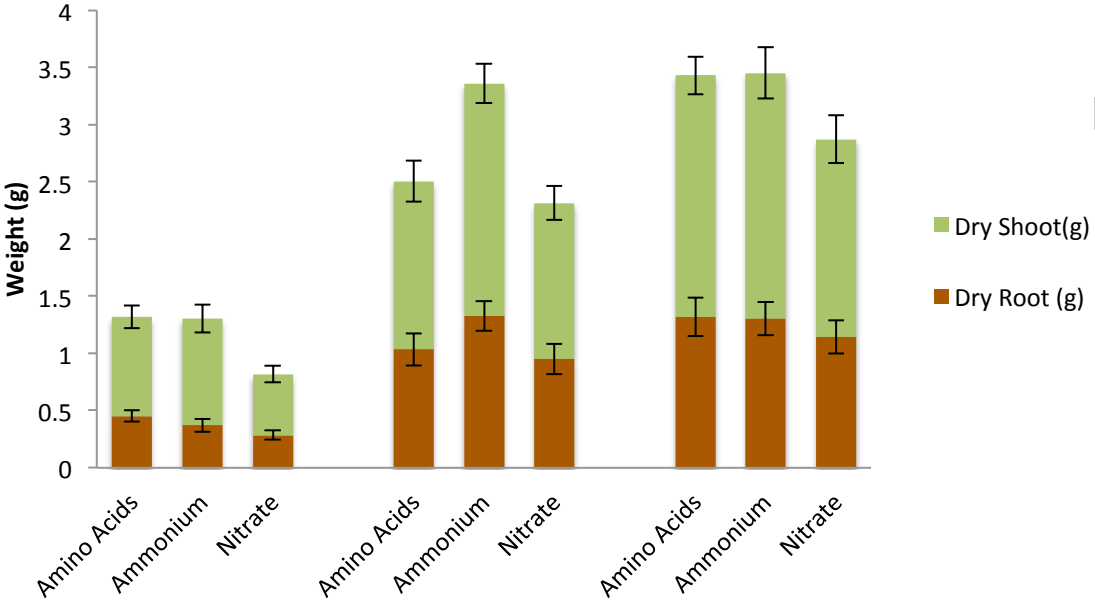


Yellow cypress



Douglas-fir

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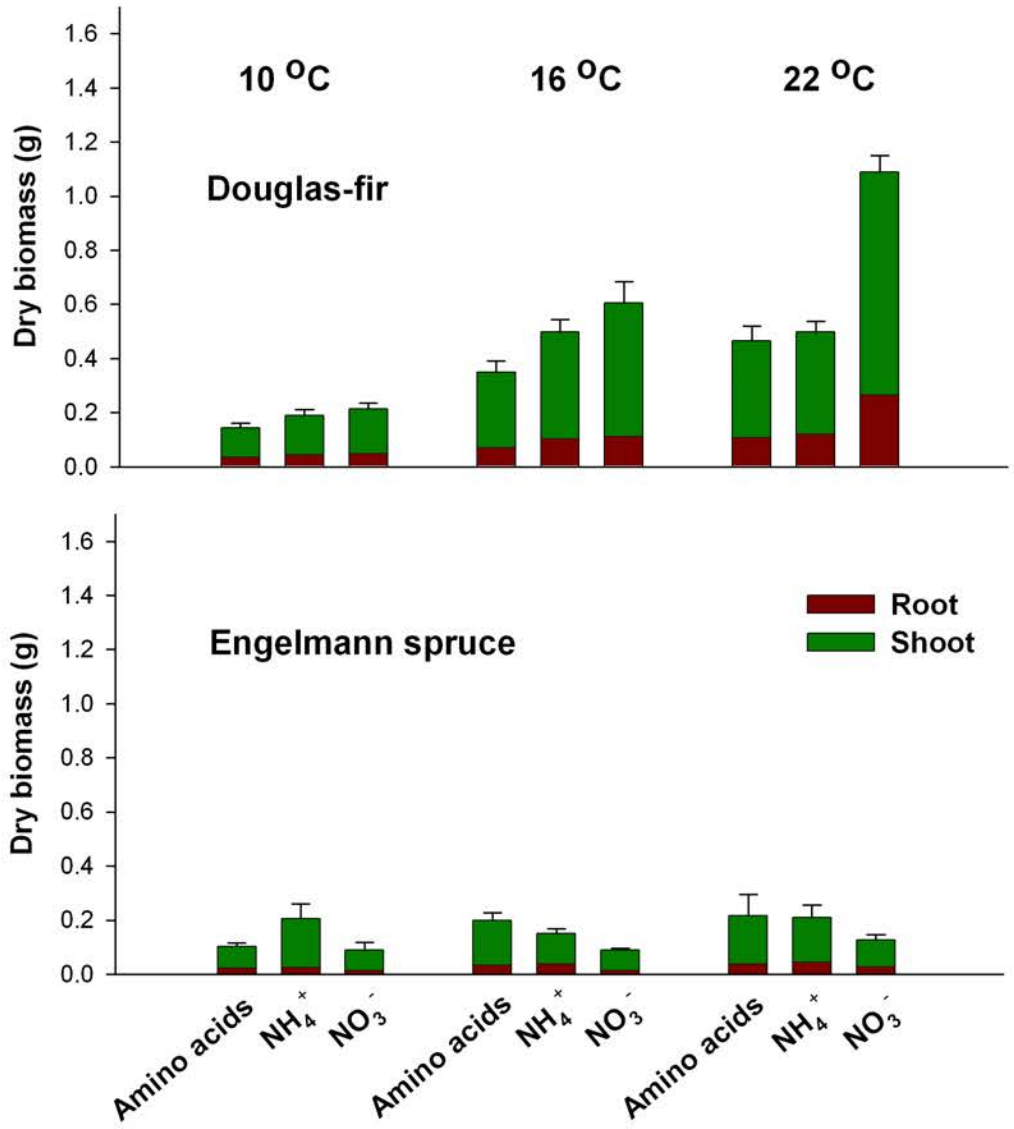

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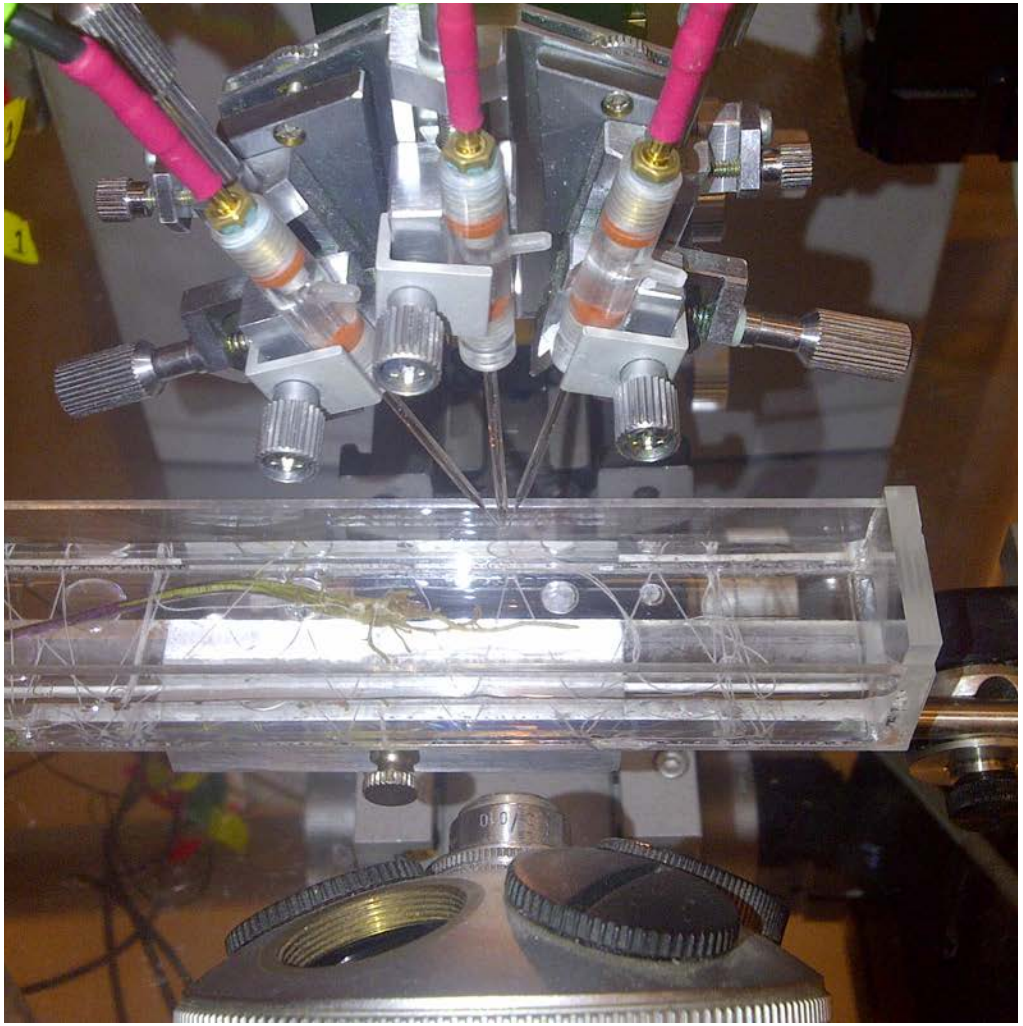
Measure net N ion flux with microelectrodes



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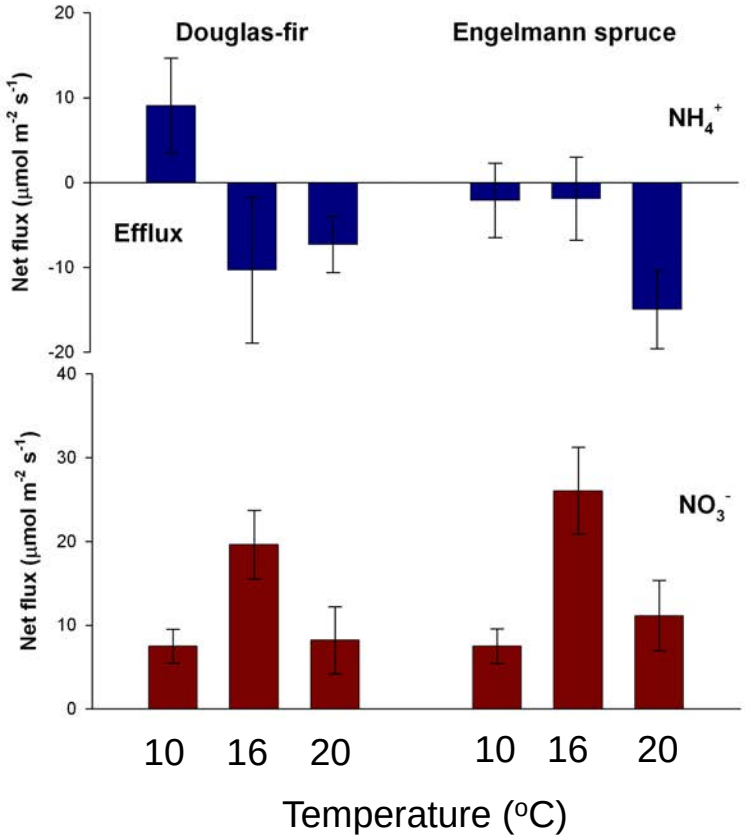
NH_4^+ efflux at higher temperatures



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

Data courtesy:
L. Kalcsits & R. Guy
UBC Forest Science

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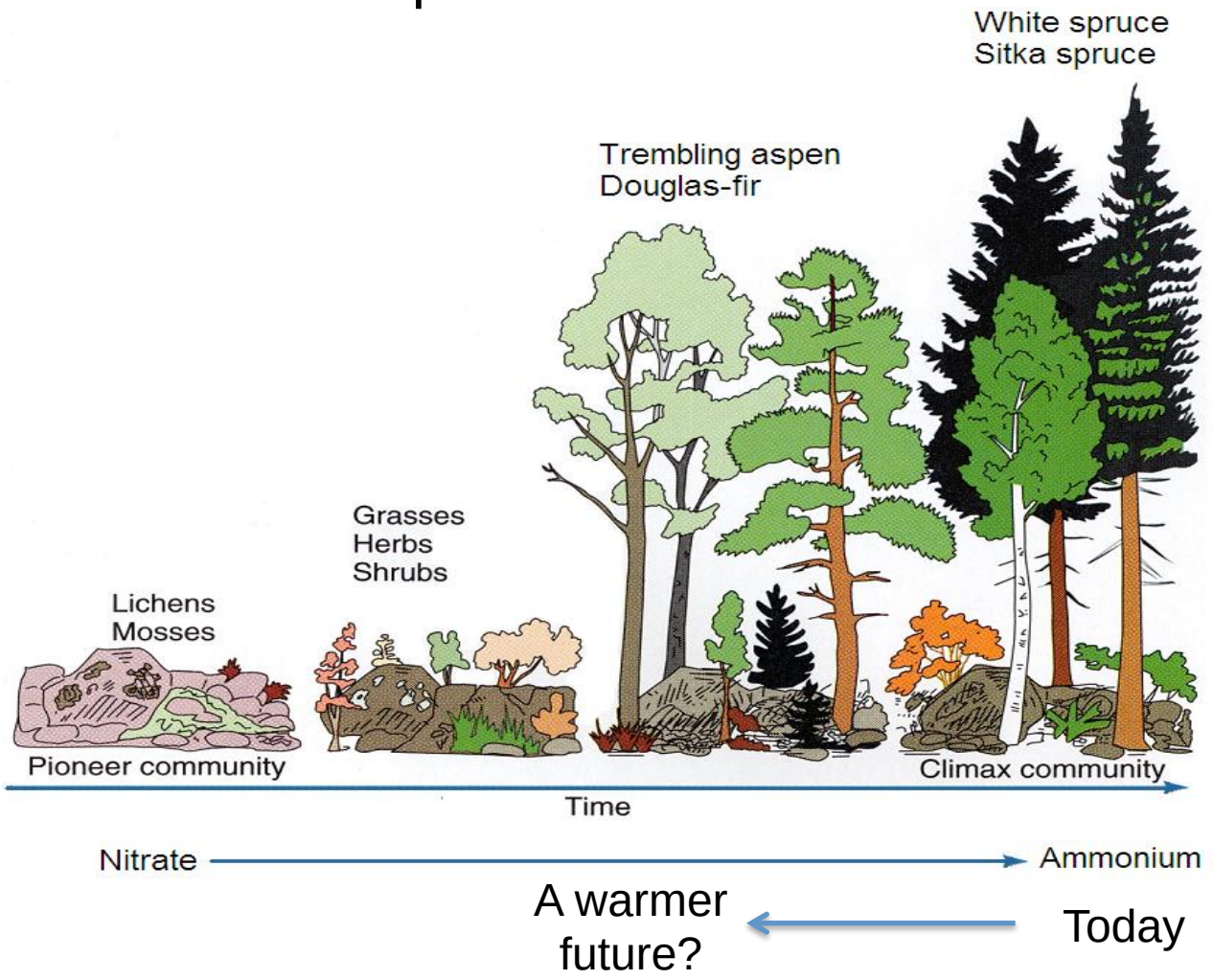
Will changes in species' N-form preference affect their relative response to warmer climates?



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