Eastern CANUSA Forest Science Conference

Impact of increased inorganic nitrogen deposition on the mycorrhizal community

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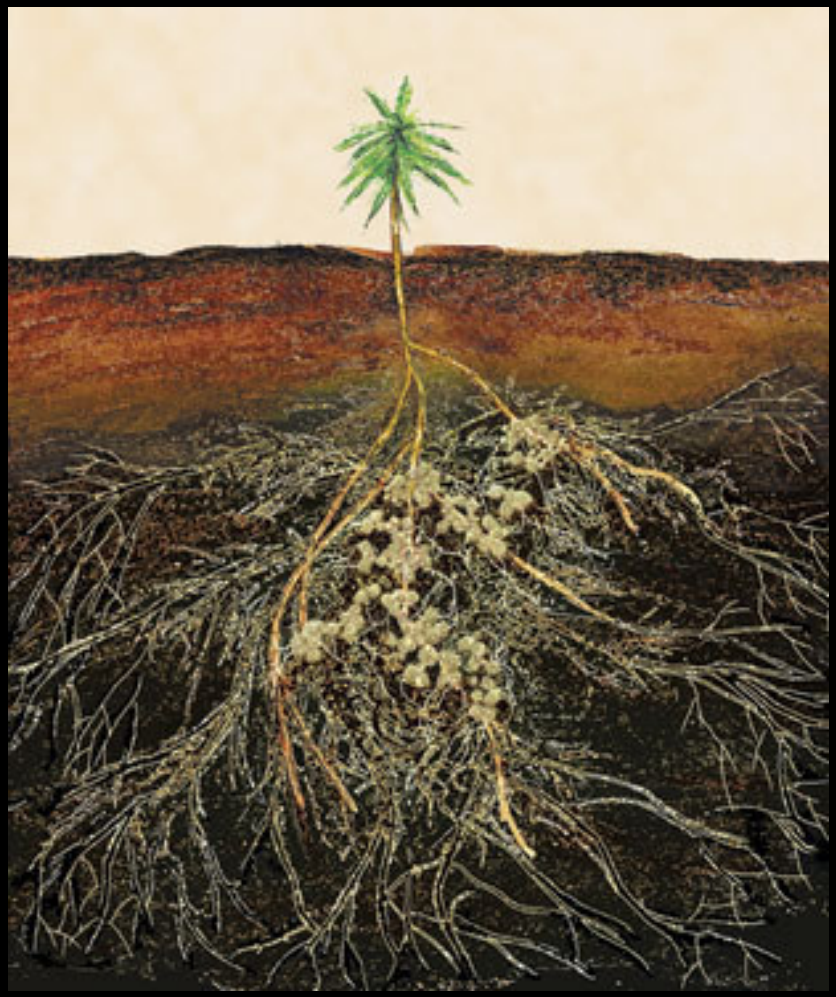
Ectomycorrhiza

- Symbiotic relation between fungi and root tips
- Symbiosis with trees (spruce, pine, fir, beech, oak, eucalyptus…)
- Sugars to the fungus
- Water and nutrition for the plant

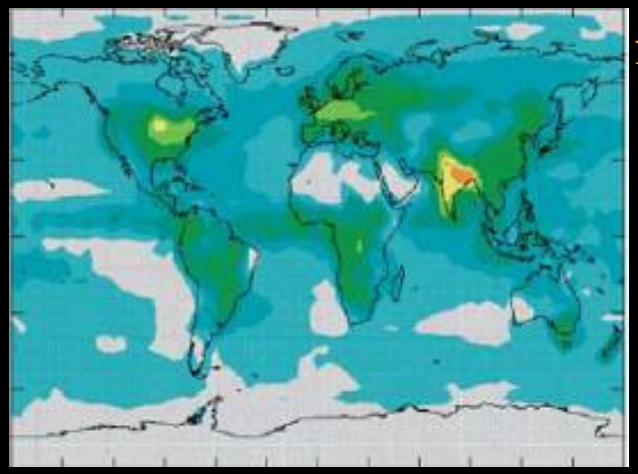




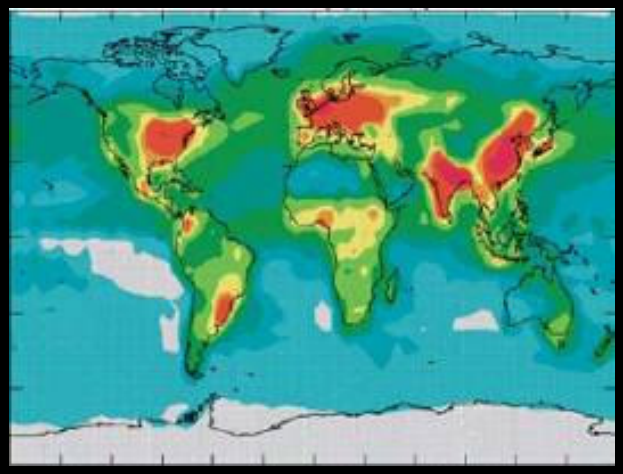


Nitrogen depositions

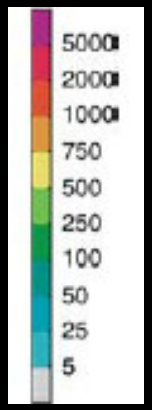
- Nitrogen depositions remain high in North America
  - Transport and midwest farming



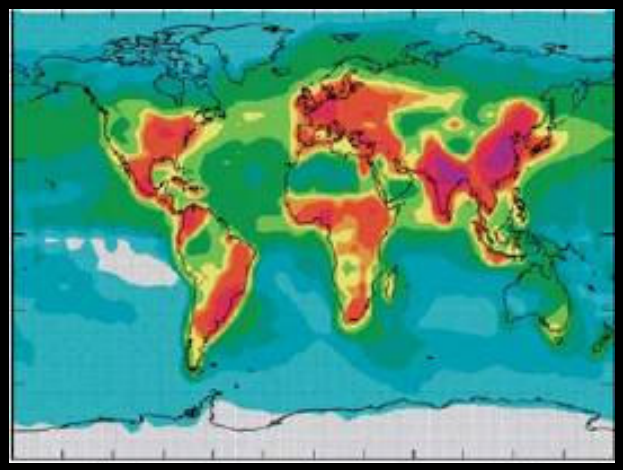
1860



1990



mg N m^{-2} y^{-1}



2050

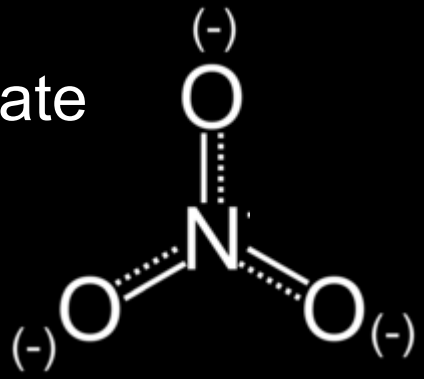


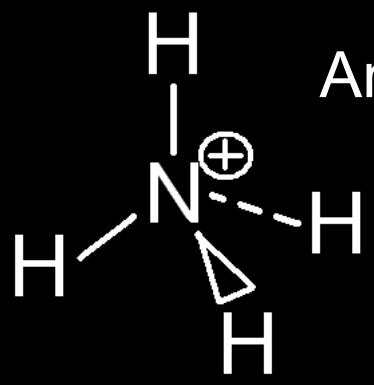


Nitrogen deposition

- Many forests show signs of nitrogen saturation in northeastern US
- N highly retained in most watershed in eastern Canada
- Forests have a high C:N ratio
- Low N residence time (<1 day)

Nitrate





Ammonium





Communities

- How ectomycorhizal (ECM) communities will react to the cumulative effect of high nitrogen depositions?
  - Little information on the eastern ECM communities
  - Biodiversity loss
  - Impact on tree growth ?

Nitrogen effects

- ↓ Diversity
  - Long-term nitrogen deposition (Lilleskov et al. 2002)
  - Nitrogen gradient (Lilleskov et al. 2009)
  - Nitrogen gradient (Taylor et al. 2000)
- ↑ Diversity
  - Nitrogen gradient (Kranabetter et al. 2009)
- No effect
  - Nitrogen gradient (Twieg et al. 2009)

Key factors

- Host

- Soil conditions
  - pH
  - Moisture
  - N, P, K, Ca…





Nitrogen cycle

Complex N molecules
Ex. proteins

ECM

Simple N molecules
Ex. amino acids

ECM

Ammonium (NH_4^+)

Trees





Nitrogen cycle

Complex N molecules
Ex. proteins

ECM

Simple N molecules
Ex. amino acids

ECM

?

Ammonium (NH_4^+)

Trees

?

Nitrate (NO_3^-)





Objective

- To compare ECM communities at contrasting nitrogen deposition levels
  - Root tip vitality
  - ECM presence
  - ECM diversity





Site

- Black spruce forest
- Mean temperature: 1,2 °C
- Annual precipitation: 823 mm
- Forest age: 60 years
- Origin: Fire
- Annual N deposition: 3,0 kg ha^{-1} y^{-1}
- C:N 49

Site

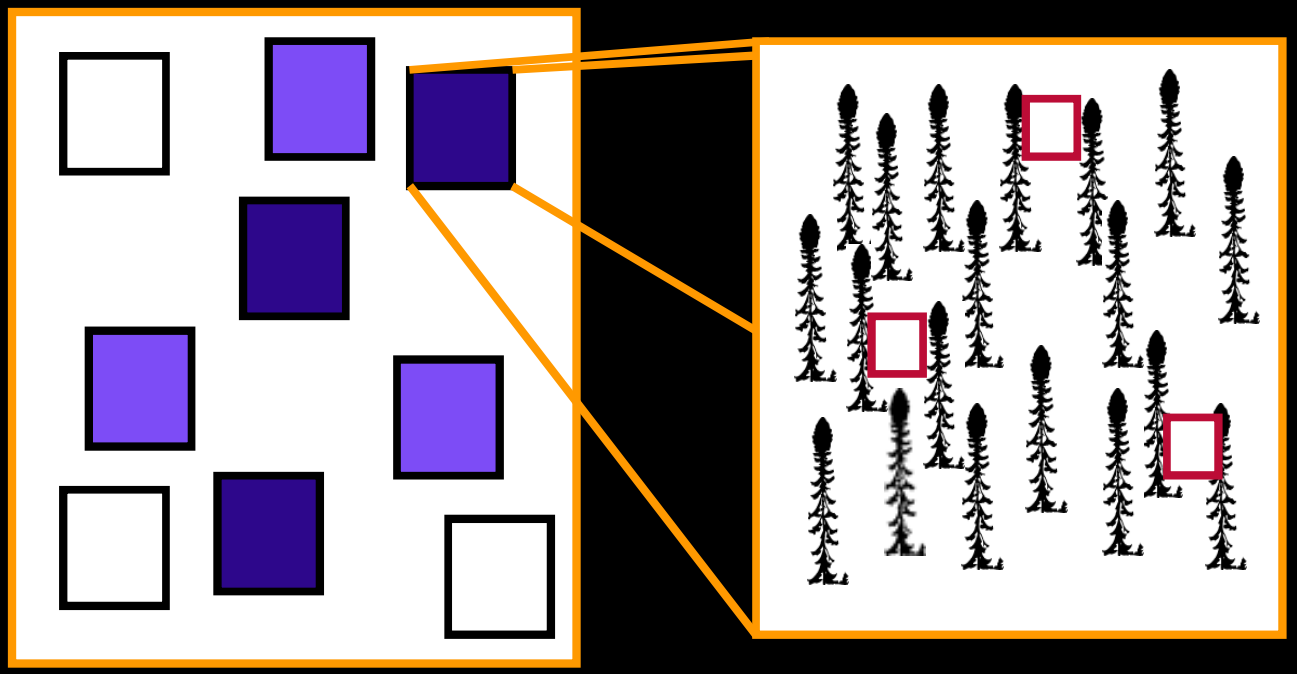
- 8 years
- Ammonium nitrate
- Every two weeks from may to october

Sites

- [N] applied represents 3 and 10 fold annual nitrogen deposition
- 3 quadrats (10m x 10m) per treatment
- 3 samples per quadrat

	3 fold N (LN)	10 fold N (HN)
Lake Tirasse (EPN)	9 kg ha^{-1} y^{-1}	30 kg ha^{-1} y^{-1}

Design



Control (C)

10 fold N (HN)

3 fold N (LN)

Sample

Methods

- Sampling in october 2009

Mineral

Organic

Identification

Soil analysis

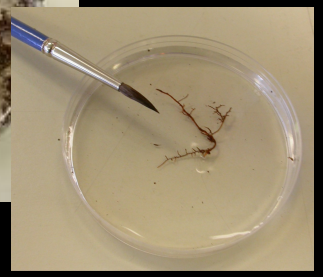
Identification

Soil analysis

Identification

- First cleaning
- 15 fines roots per sample

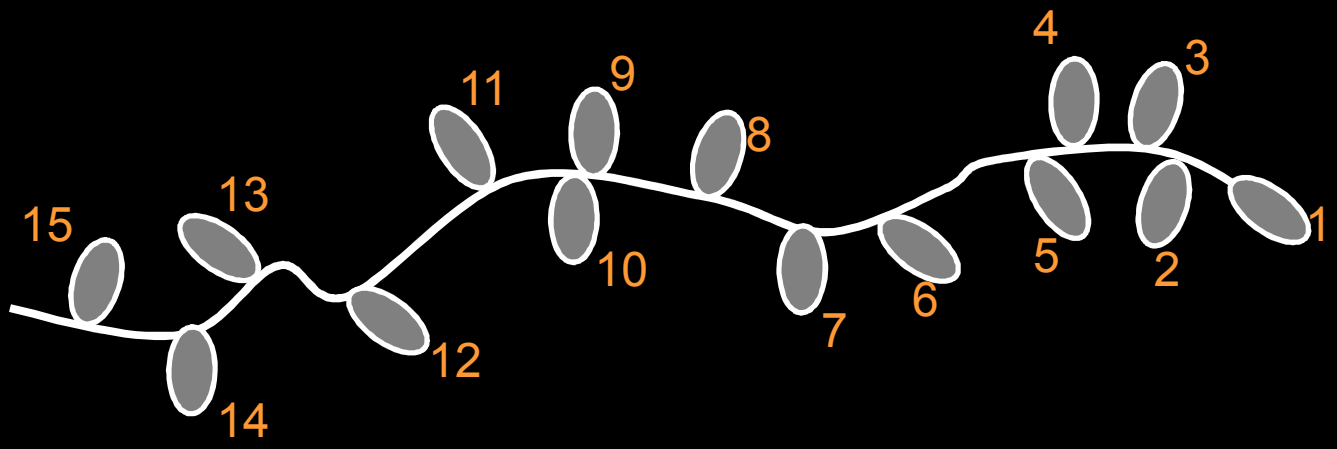
•Second cleaning



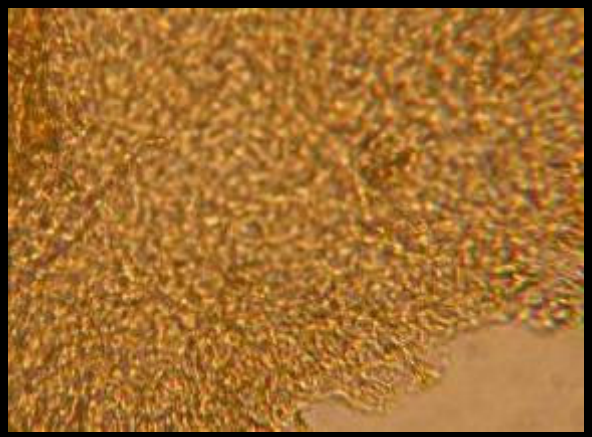
- Stereomicroscope

Identification

- 15 fines roots per sample
- 15 tips per root
- Morphotyping



Identification



Methods

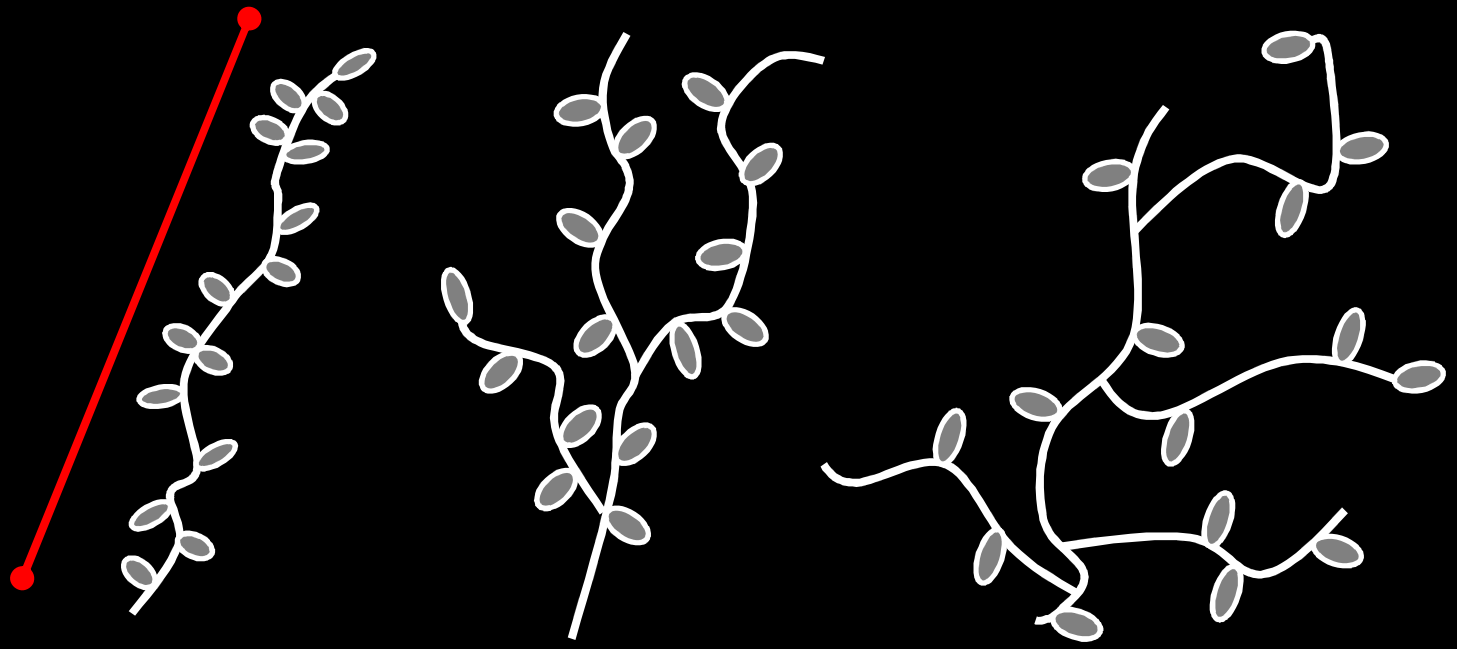
Vital

Non vital

Mycorrhizal

Non mycorrhizal

Methods



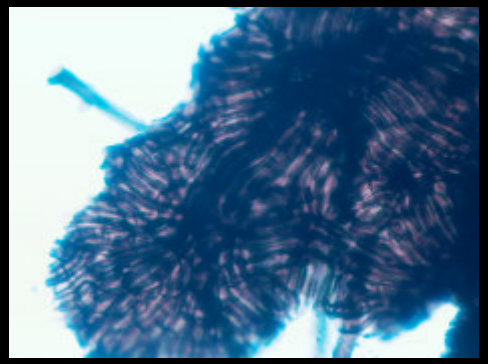
No branching

2 branchings

4 branchings

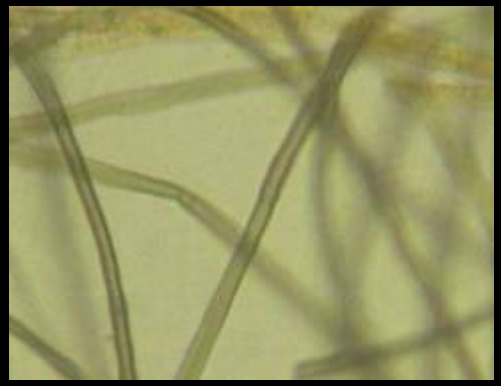
Methods

- Mantle

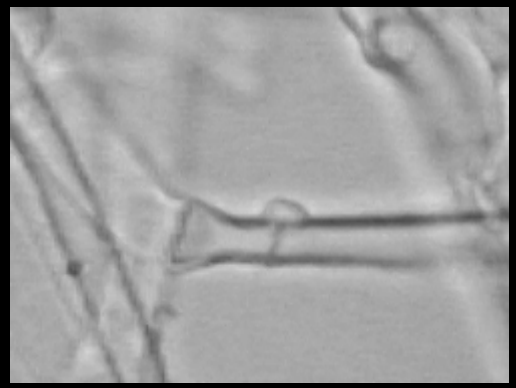


- Rhizomorph

- Hyphae



- Clamps

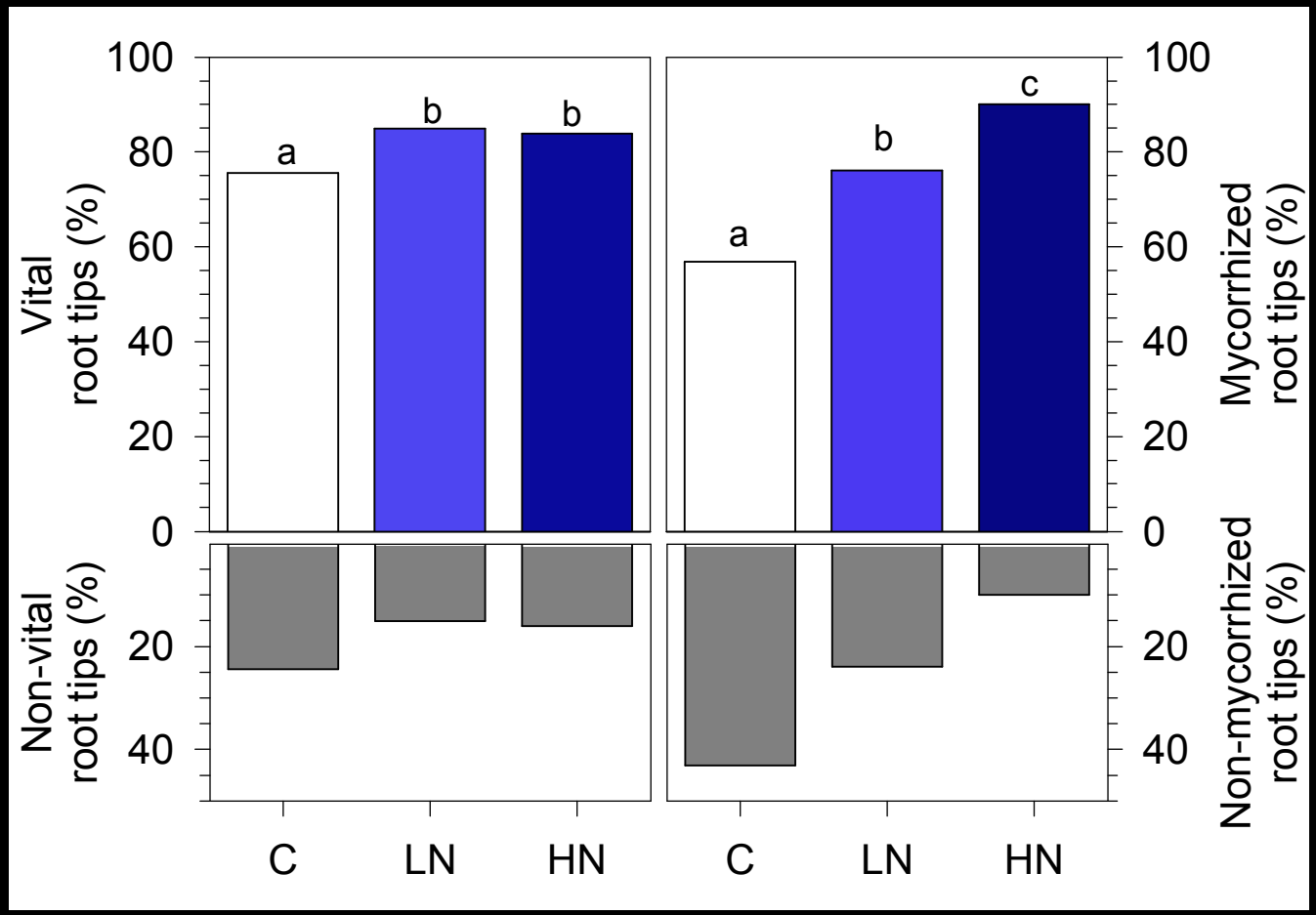






Preliminary results

- Root tip vitality and ECM frenquency increase with N application **(SAS, Glimmix proc)**

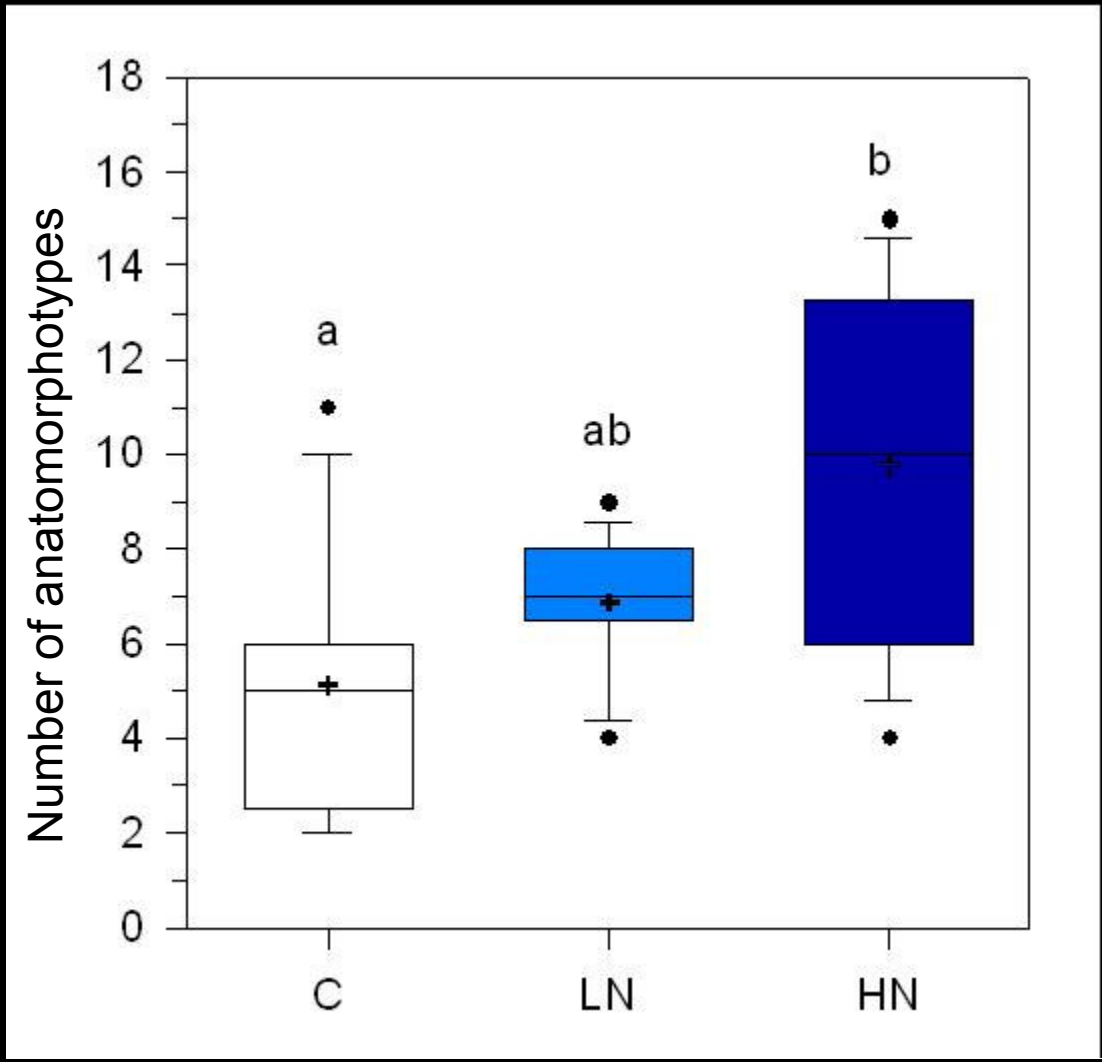






Preliminary results

- Morphotypes increase with N application **(SAS, GIm proc)**



Discussion

- ECM communities doesn't act as a whole
- Each morphotype vary independently
  - Specialisation
  - ↓ Overlap
- Functional groups
- Site initial state
- Scale effect

- **Need to know more about ECM ecological traits and ECM species themselves**

Acknowledgment

- FQRNT
- Ministère des ressources naturelles et de la faune
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Questions and comments