

Sugar maple (*Acer saccharum*) and American beech's (*Fagus grandifolia*) Regeneration Success in Seedlings According to Soil Quality and Canopy Openings

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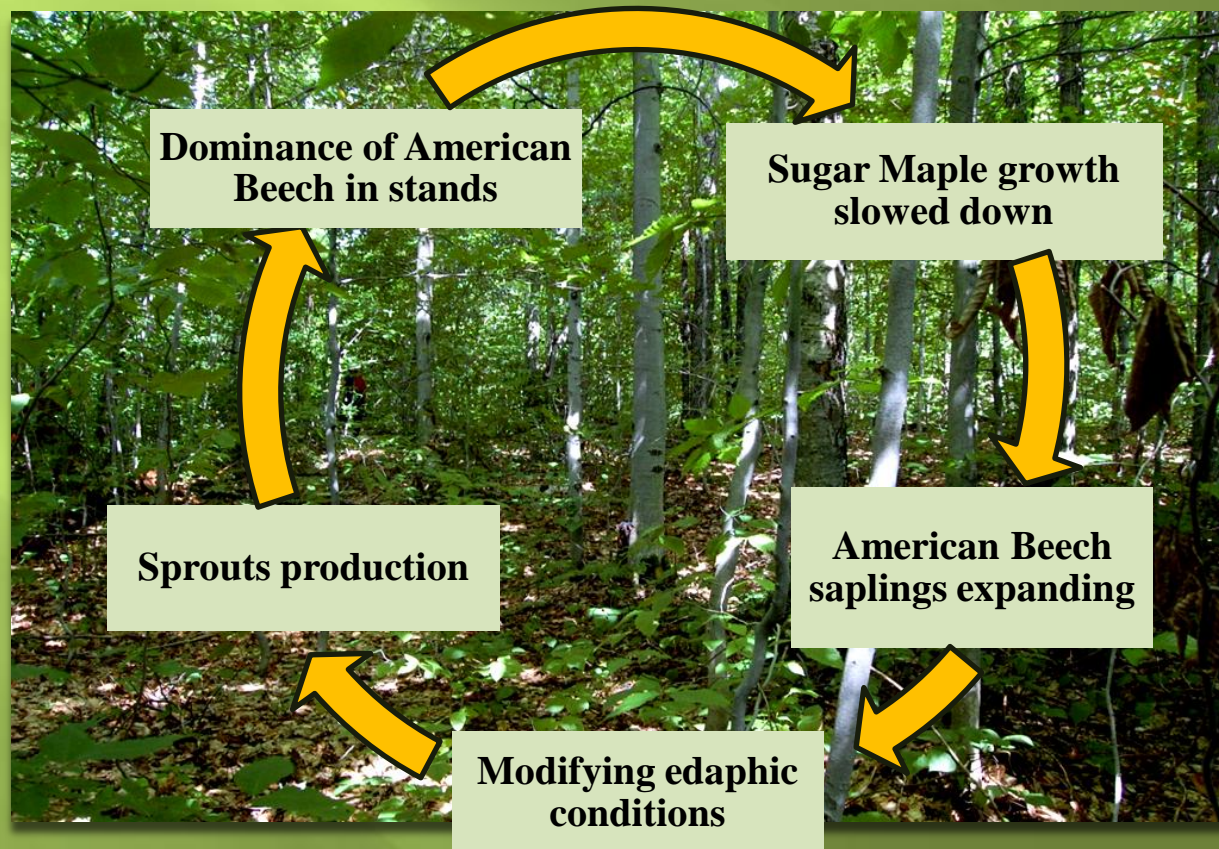
Problematic

- ▣ The replacement patterns in forest are known but the effects of managed forests are changing these process where the American Beech understorey overgrowth is higher.
- ▣ **2 factors** are playing major part on growth and vigour of Sugar maple: light availability and soil fertility.
- ▣ **American beech:** very shade tolerant (can establish <30% of light).

Problematic

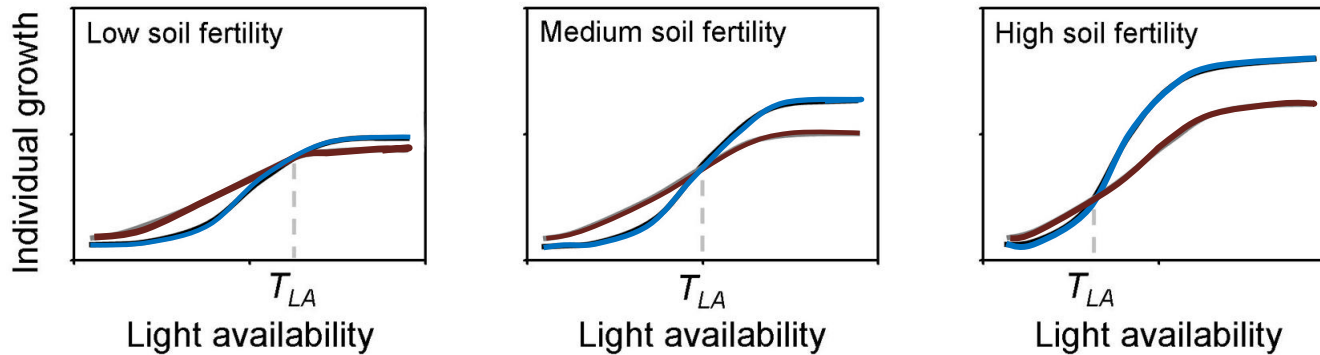
- ▣ **Sugar maple:** when receiving $>30\%$ of light \rightarrow poor sites; when repetitive forest disturbances \rightarrow dominate stands...

But success could reverse if conditions are not met...



Proposed Model

Growth potential at the individual level



(Nolet, Bouffard et al, 2008)

Sugar maple (AS): —————

American beech (FG): —————

T_{LA} : Threshold light availability

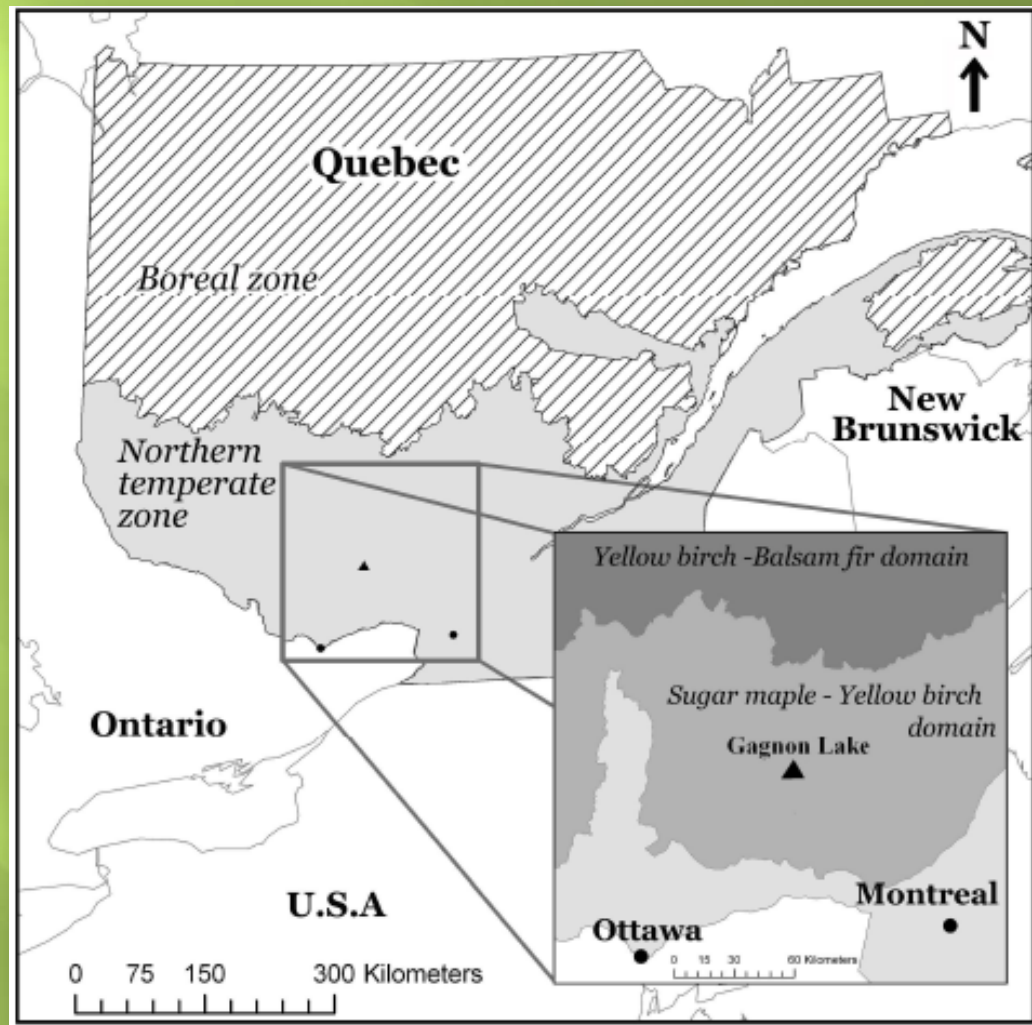
Objective

- ▣ To quantify the critical light threshold from which we observed a reversal in the regeneration success between the American beech (FG) and the Sugar maple (AS) seedlings according to soil fertility.

Ultimate Hypothesis

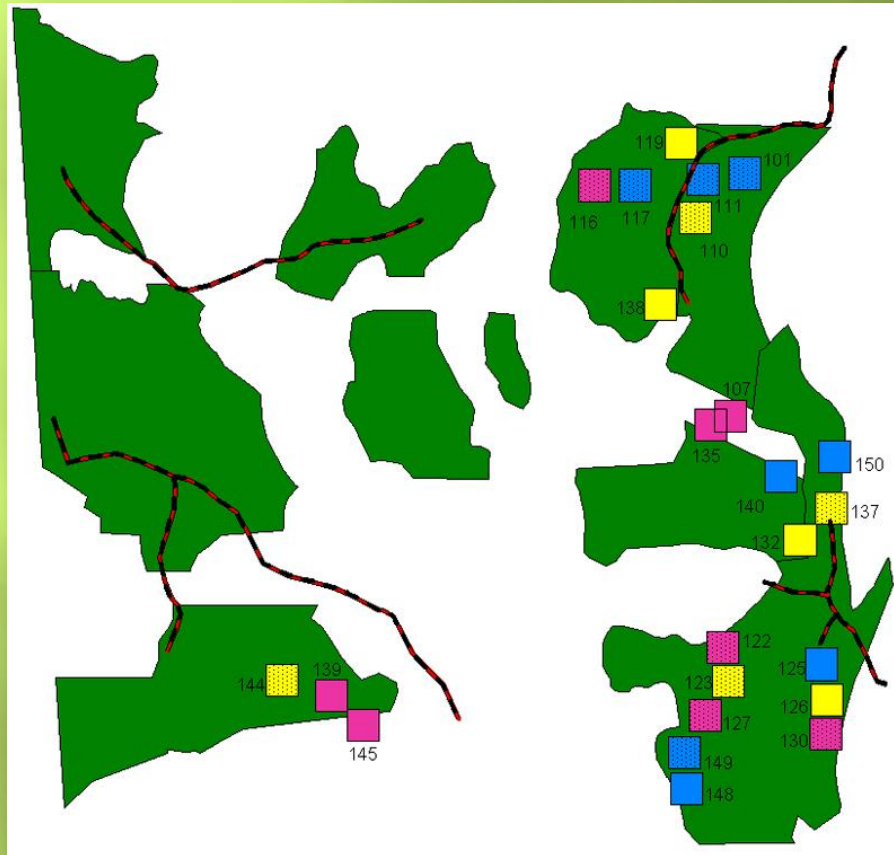
- ▣ 1) ↓ soil fertility combined with ↓ light availability → negative effect on the regeneration success of AS seedlings compared to FG seedlings.
- ▣ 2) ↑ soil fertility combined with ↑ light availability → positive effect on the regeneration success of AS seedlings compared to FG seedlings.

Study Area



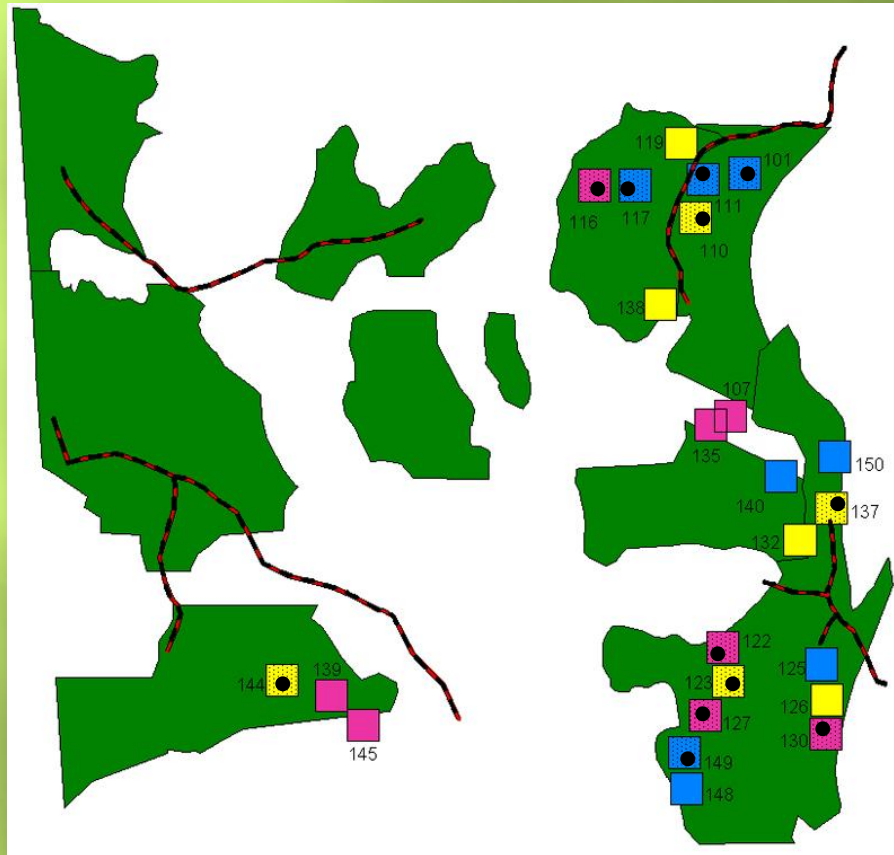
(Delagrange, Nolet et al, 2008).




Study Sites



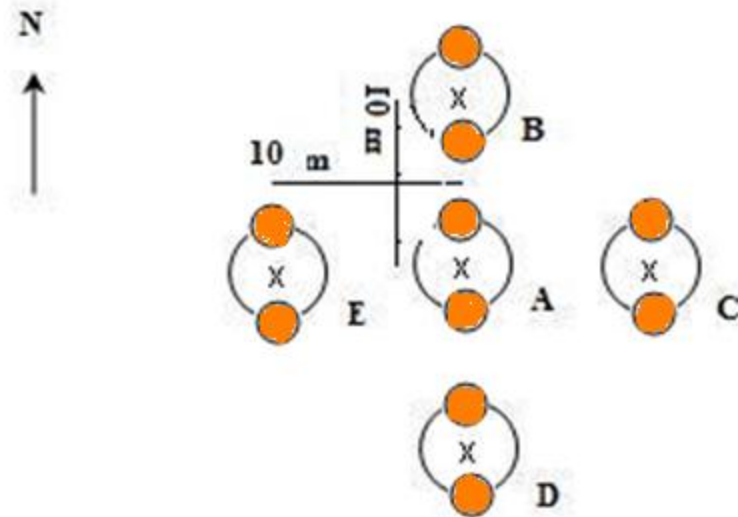
- Unmanaged forest (UF)
- Partial Cut (PC)
- Clear Cut (CC)

Study Sites



-  Unmanaged forest (UF) + limed soil
-  Partial Cut (PC) + limed soil
-  Clear Cut (CC) + limed soil

Experimental design



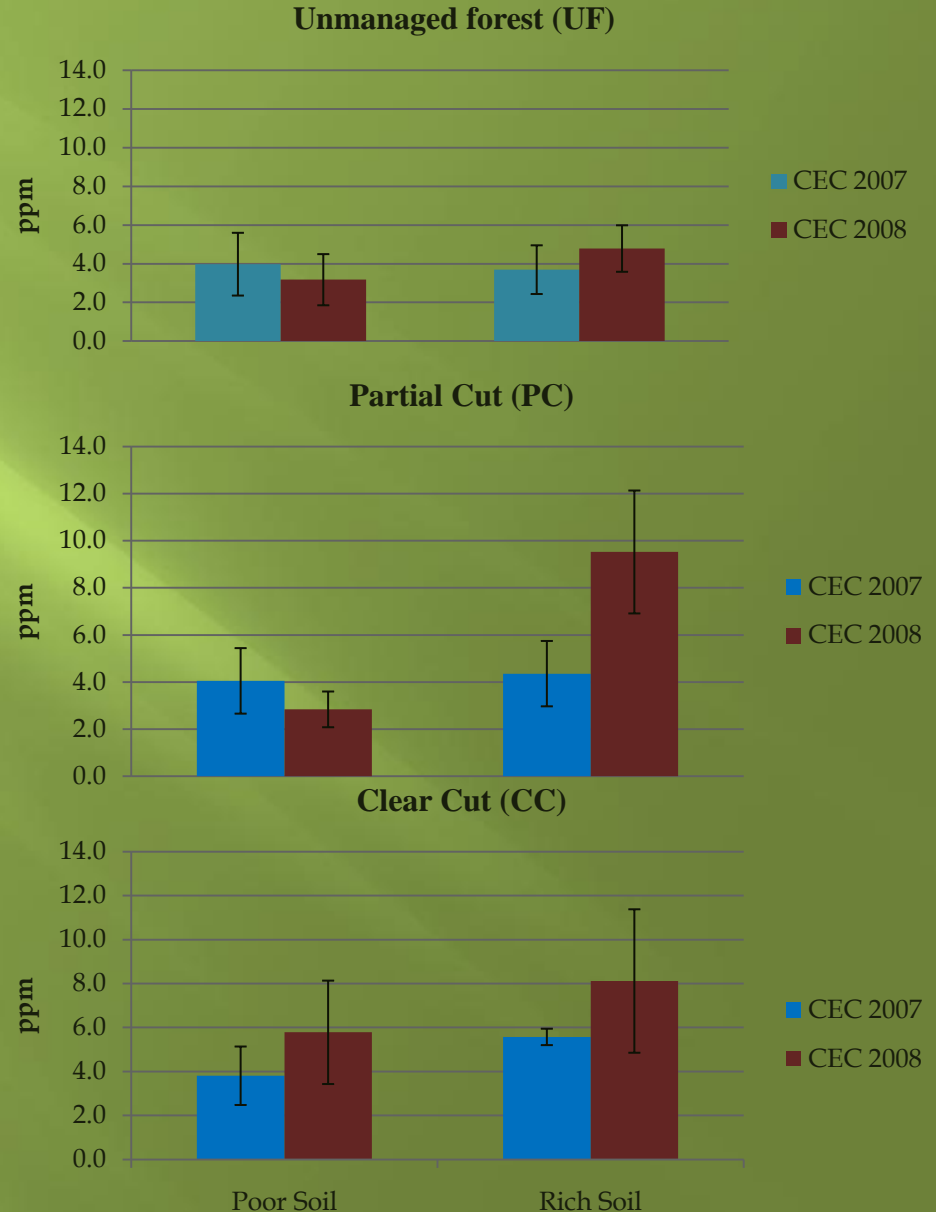
Measurements

- ▣ Seedlings density taken in each micro-plot
- ▣ Soil Analysis (2008)
- ▣ Estimate of the seedlings' performance of each species
 - Growth (total height according to each year)
 - LMA (Leaf Mass per area)
- ▣ Leaf Vigor
 - SPAD (Chlorophyll concentration)
- ▣ Statistical Analysis
 - 3-way Anova with Split-Plot (sp)
 - Post-hoc Tukey's test

Results

- ▣ Soil Analysis in 2008
- ▣ Cation Exchange Capacity (CEC)
- ▣ Positive effect between first and second year

CEC in Soil within each stand treatment



Results

Absolute Abundance

- ▣ Nb of seedlings in a ha

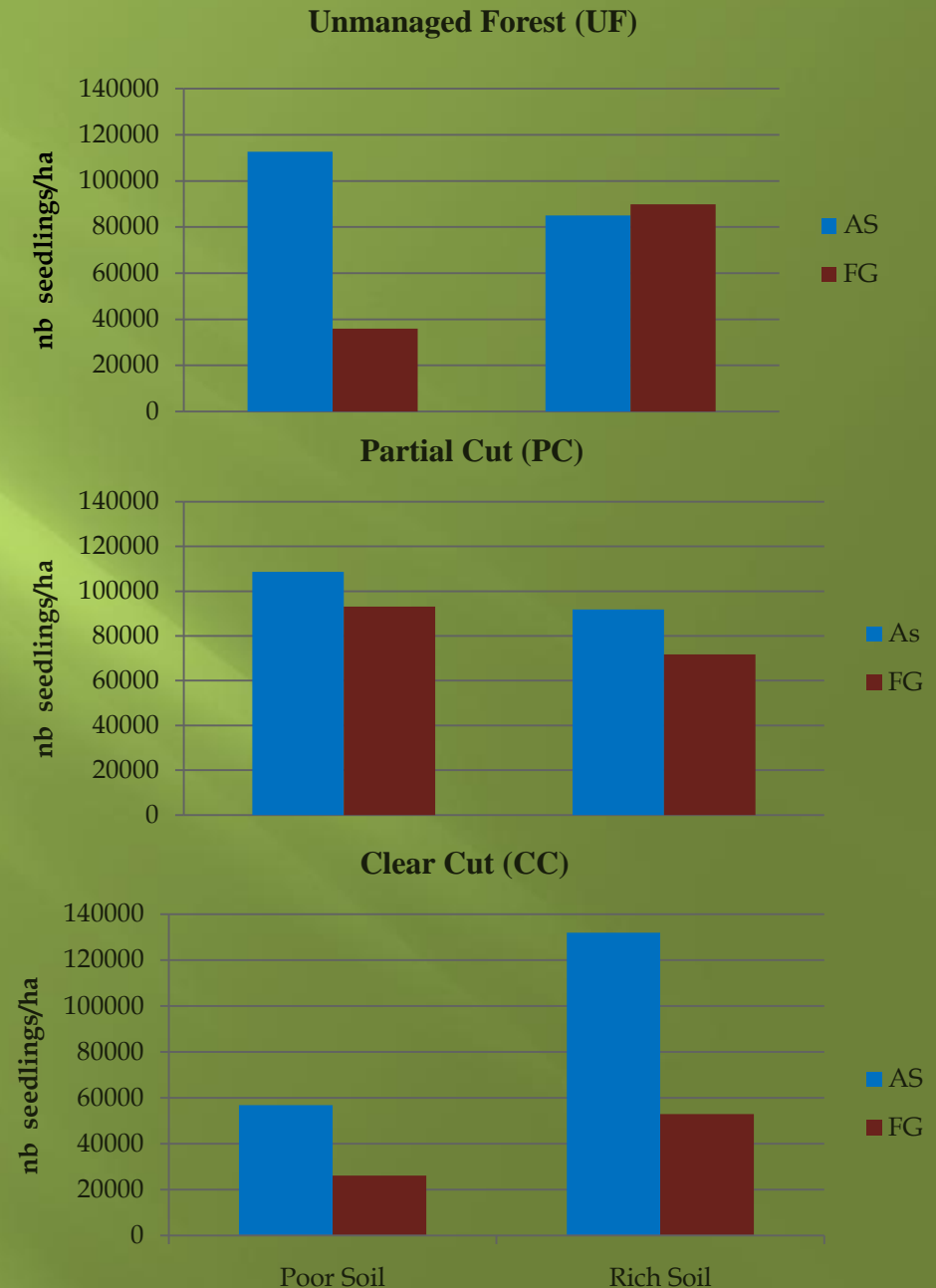


Results

Absolute Abundance

- ▣ Not significant
- ▣ Mostly because of high variability

Absolute Abundance of *Acer saccharum* (AS) and *Fagus grandifolia* (FG) seedlings withing each stand



Results

Growth response in 2007

- ▣ Growth response before soil fertilization.
 - Total height of stem
- ▣ Uncontrolled factor got involved in CC = Raspberry bush
 - Which species adapted better to this factor

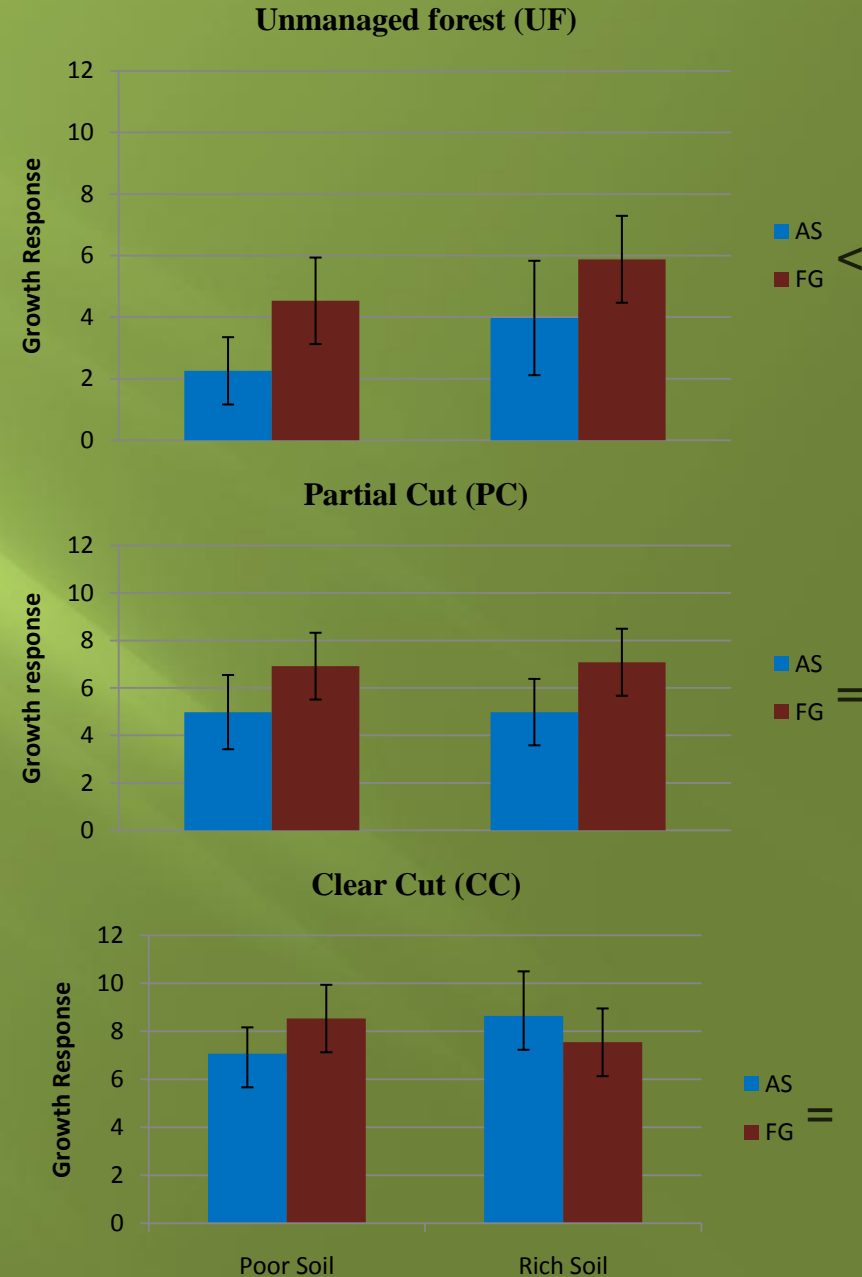


Results

Growth response in 2007

- ▣ Significant source of variation:
 - Sp –Canopy Opening

- ▣ 2 sp did have a better growth with opening canopy but Sugar maple responded better.

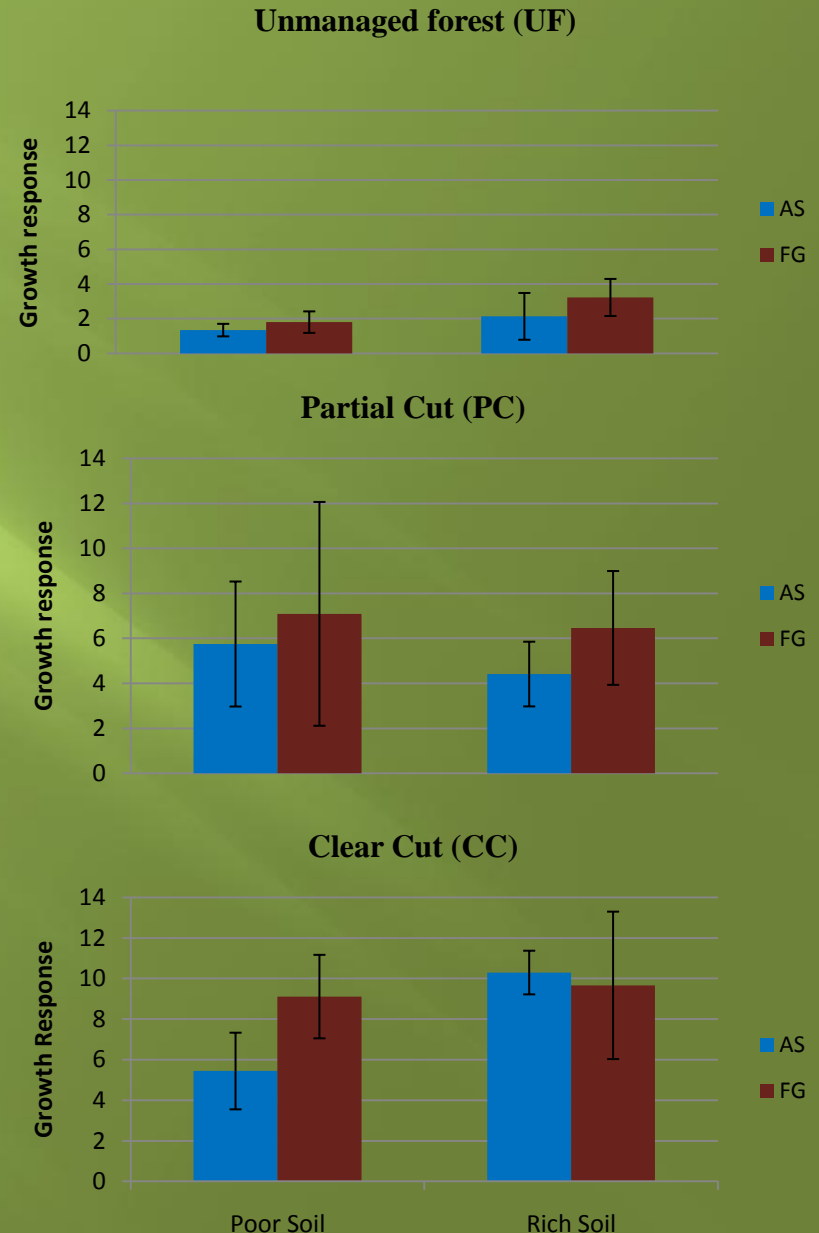


Results

Growth Response 2009

- ▣ Significant source of variation:
 - Sp-Canopy opening-Soil
- ▣ No matter what the treatment combination, American beech's growth took advantage.
- ▣ Sugar maple had better growth in CC and rich soil combined.

Growth response of *Acer saccharum* (AS) and *Fagus grandifolia* (FG) seedlings in 2009



Results

Leaf mass per area (LMA)

$$\text{LMA} = \frac{\text{Total leaf dry weight(g)}}{\text{Leaf area (cm}^2\text{)}}$$

- ▣ 240 seedlings in total

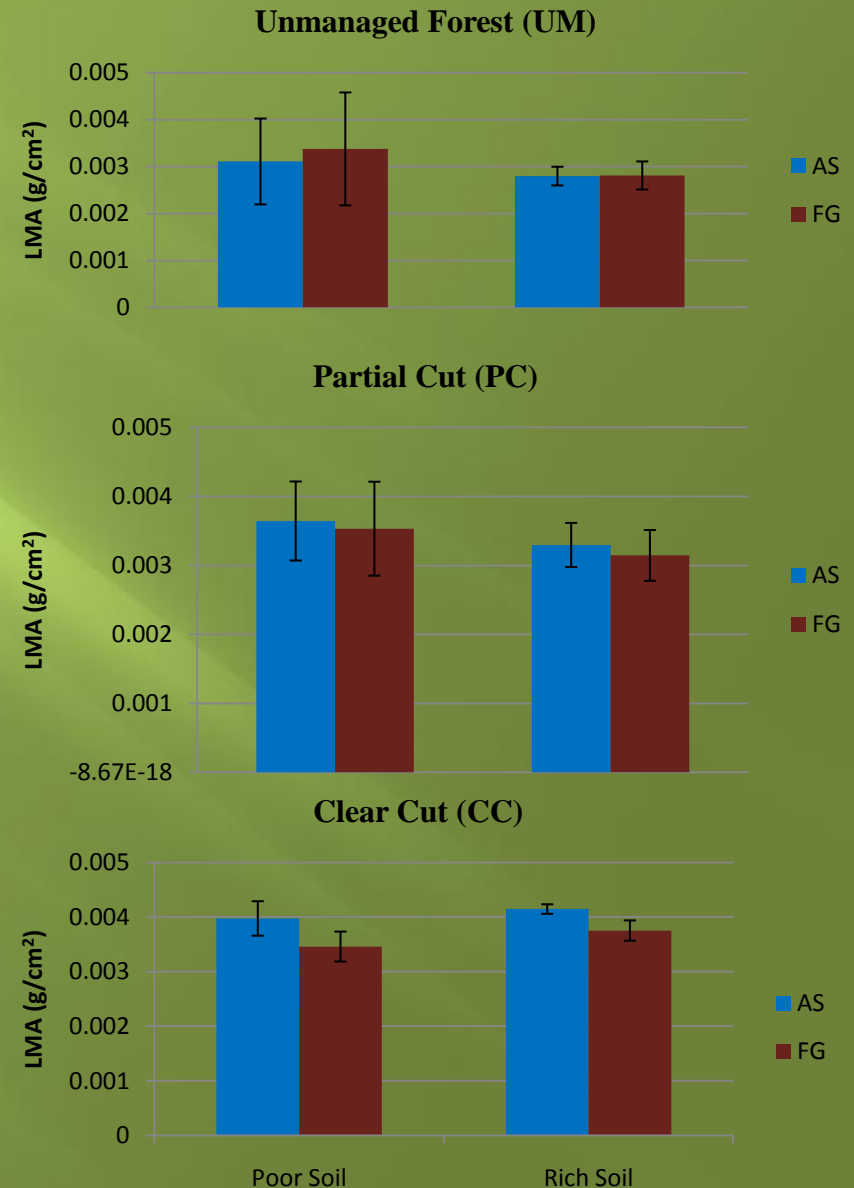


Results

Leaf mass per area (LMA)

- Significant source of variation:
 - Opening Canopy
- Both species increase their leaf performance
- Tendency where AS would have responded better in the CC than FG.

LMA of *Acer saccharum* and *Fagus grandifolia* seedlings within each stand



Results

Chlorophyll

- ▣ SPAD
 - Measures chlorophyll concentration in leaves

- ▣ 240 seedlings



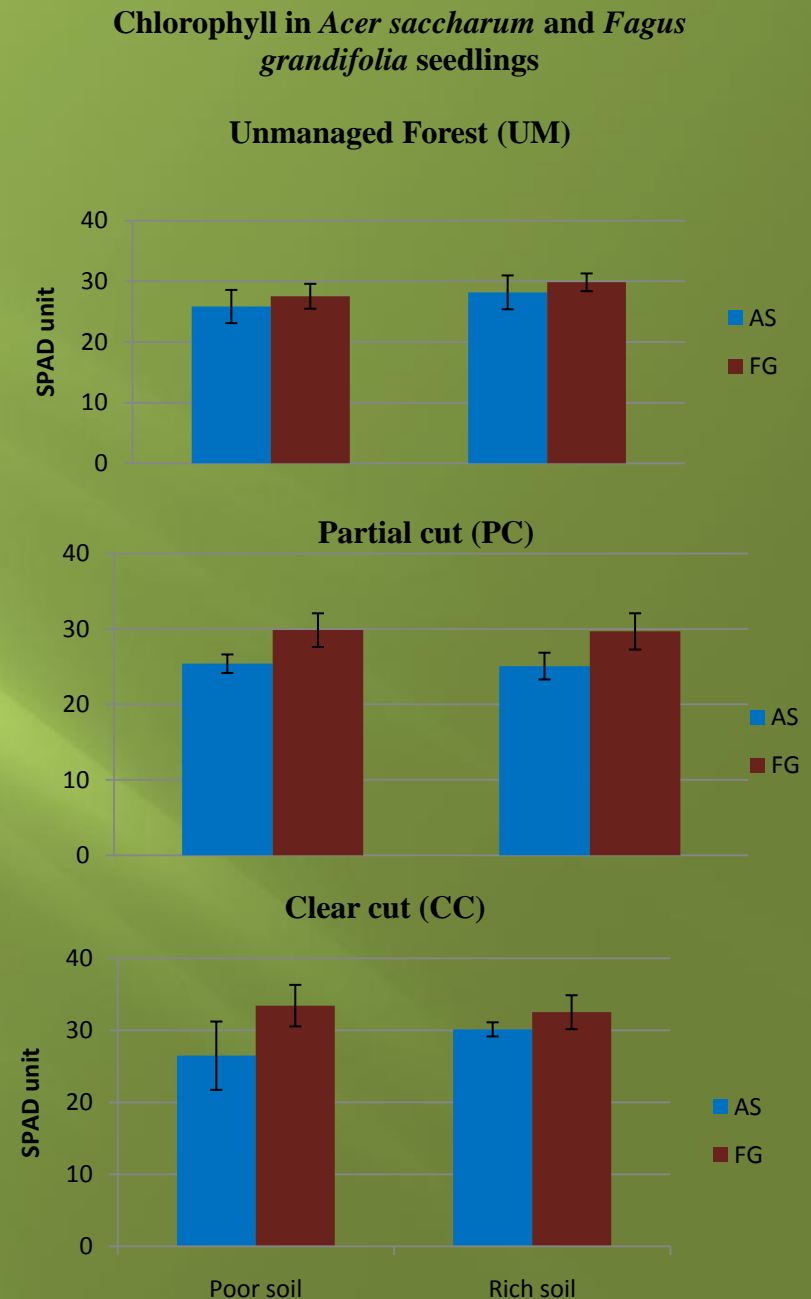
Results

Chlorophyll

- ▣ Significant difference between:
 - Sp
 - Canopy Opening

- ▣ Within the 2 sp, chlorophyll increased according to canopy openings.

- ▣ Higher chlorophyll concentration in FG.



Conclusion – sp à species, AS, FG,

- ▣ Abundance (pas en parler... car pas significatif)
 - Not significant but relative proportion of Sugar maple seedlings increased .
 - On limed soil in CC, differences between the 2 species tended to be higher.
- ▣ Growth
 - Significant difference between the growth of the 2 sp according to canopy opening.
 - Significant growth response for Sugar maple in CC on rich soils.
- ▣ Performance
 - Tendancy = better leaf performance for AS than FG in canopy opening treatment.
- ▣ Leaf Vigor (+général)
 - Chlorophyll increased in both sp according to canopy openings.

Synthesis

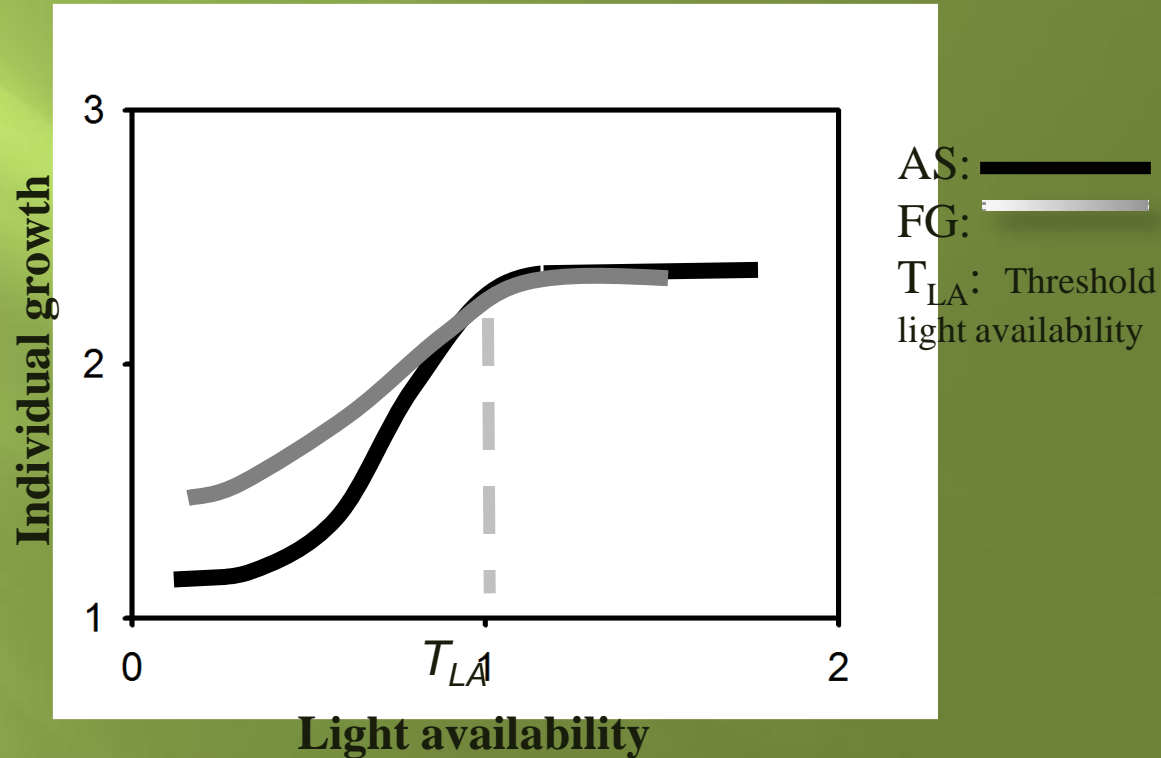
Growth potential at the individual level

The existence of a critical light threshold **did not exist**.

American beech seemed to be **advantaged** regardless of the environmental conditions.

Gradient influence had a **global effect** for both species.

Sugar maple seemed to **benefit** more from it, allowing it to **catch up**.



Questions?