

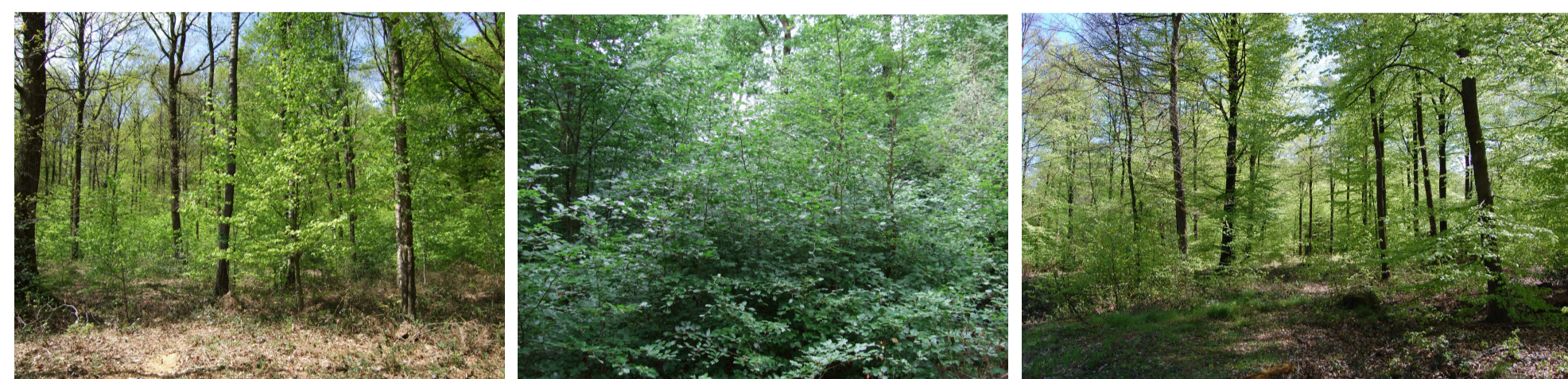
“Investigate the reactivity of seedlings of different sizes to the canopy closure, for two contrasting shade tolerance species”

Introduction

Development of ‘close-to-nature’ silviculture

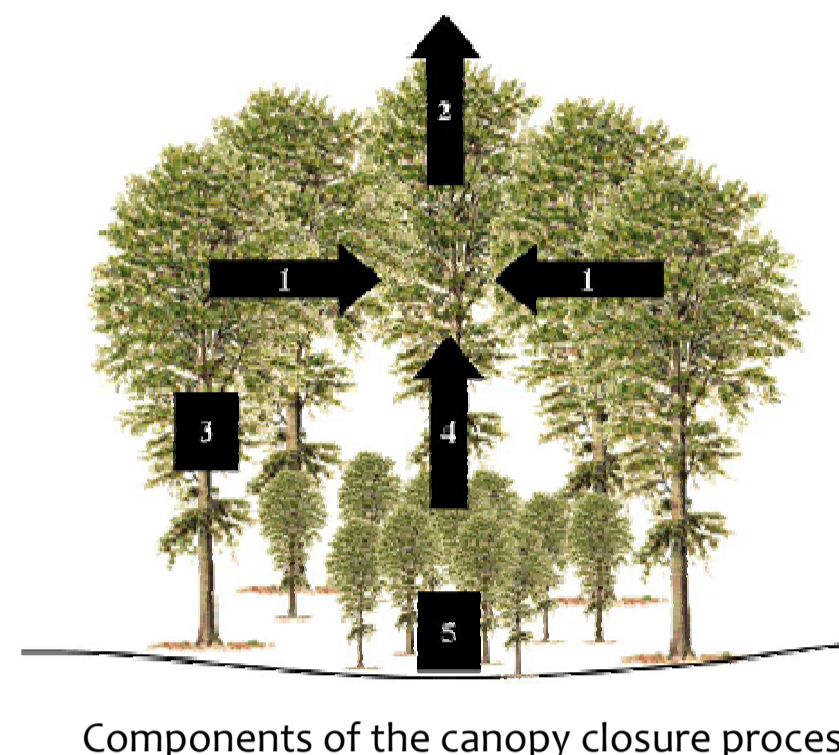
Due to ecological and economic advantages, the *natural renewal* of temperate deciduous forests is currently promoted in the forest management.

The *installation of regeneration* is one of the statements of these principles. This phase is generally carried out within *regeneration gaps* or in the understory thanks to the *shelterwood method*.



Light dynamic

In these systems, the light regime is influenced by the *canopy re-closure* process. Seedlings established in the understory are consequently subjected to variable light availabilities which naturally tend to decrease.



Components of the canopy closure process

Plant acclimation

Shade tolerance is defined as the ability of a species to survive under low light levels. This tolerance is expressed, at different tree-scale, by physiological and morphological traits. Beech (*Fagus sylvatica* L.) is known as one of the most shade tolerant species of temperate deciduous species.

Compared to other species, the beech presents a high competitive strength and can threaten in the long term the *mixture of stands*, particularly the *oak-beech* stands.

The area of the Walloon oak stands was reduced by 40-50% during the 70 last years.

Materials and Methods

34 Shade clothes ...

- supported by metal structures,
- installed during 3 years in forest in two study sites,
- to test the effect of light and tree size independently,
- above dense naturally regenerated tickets of
- beech and sessile oak seedlings,
- of initial sizes from 1 to 4 meters tall.



Example of a shade cloth on beech regeneration

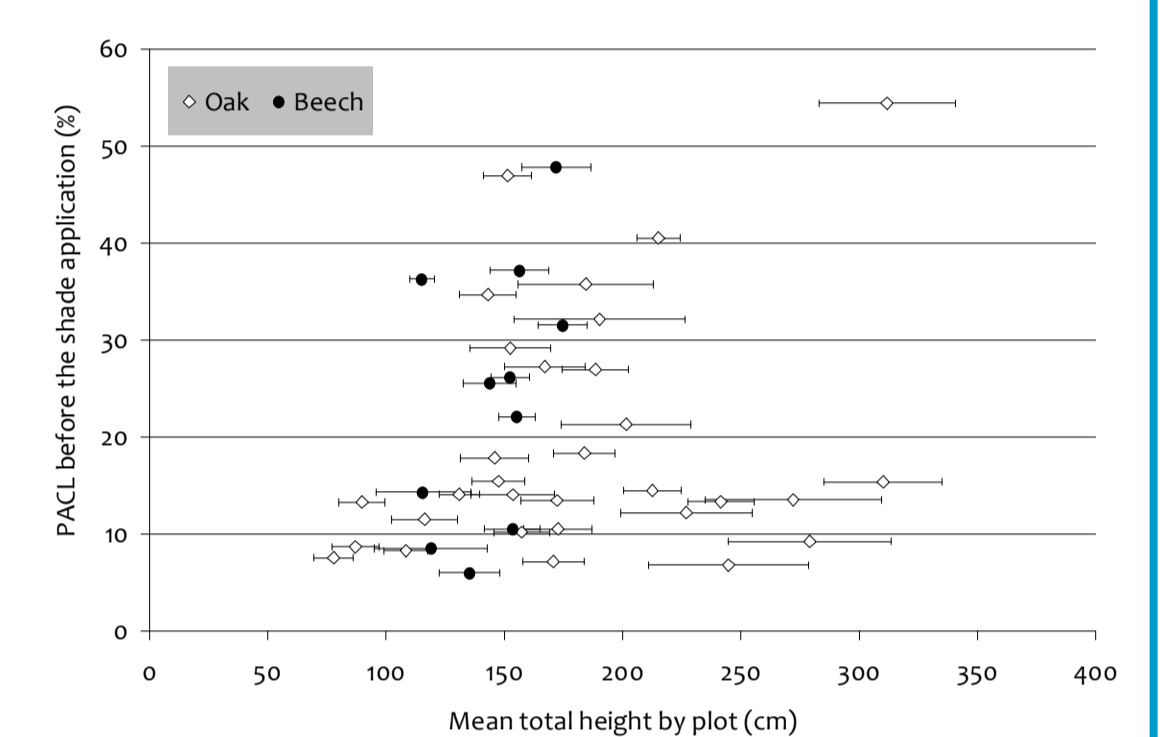


Map of Belgium and localization of the two study sites

Light availability was monitored via PAR-sensors ;

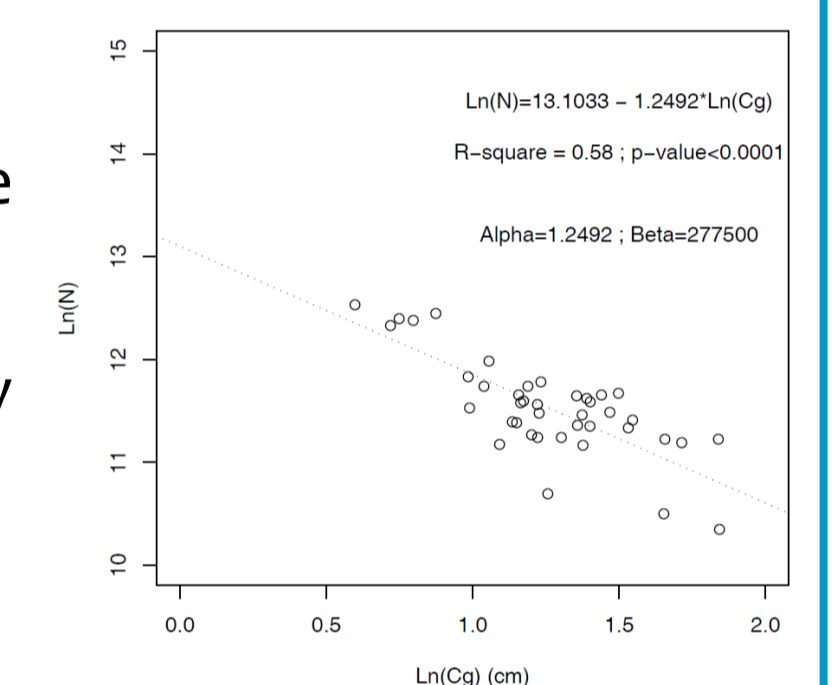
The gradient of percentages of above canopy light (PACL) decreased from 7 – 57 % (before the treatment) to 1 – 15 % within the shade clothes.

No initial relation exists between the mean height of the plot and the PACL before the shade treatment.



Regeneration plots densities were closed to the theoretical maximum density.

The densities are not correlated to the light availability before the experiment.



Response variables

- Survivorship at the end of the growing season for 1 to 3 years of shading
- Foliar characteristics and carbon allocation : specific leaf area (SLA, cm²/g), nitrogen and carbon content (g.g⁻¹) and leaf area index (cm².g⁻¹).

Results and discussion

Survivorship

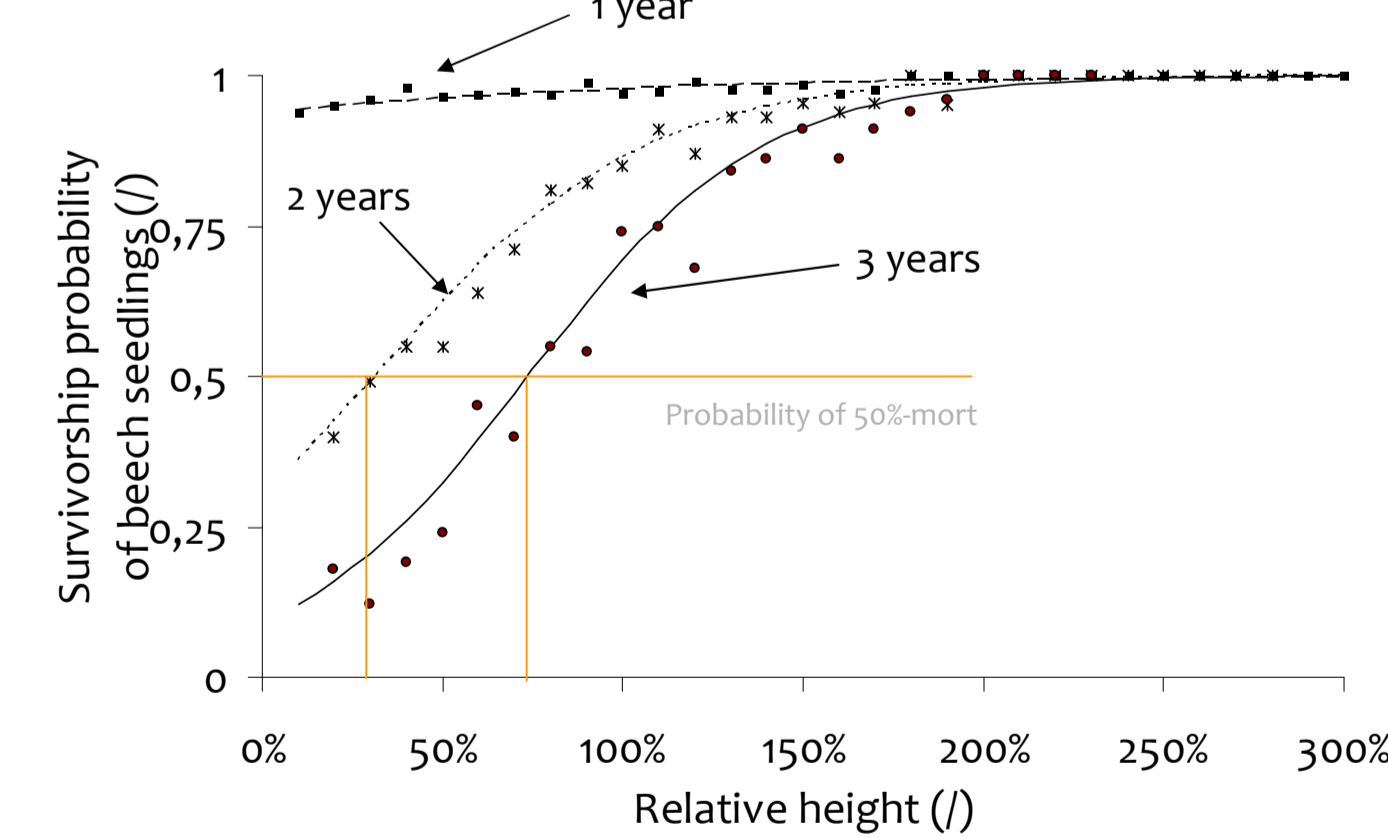
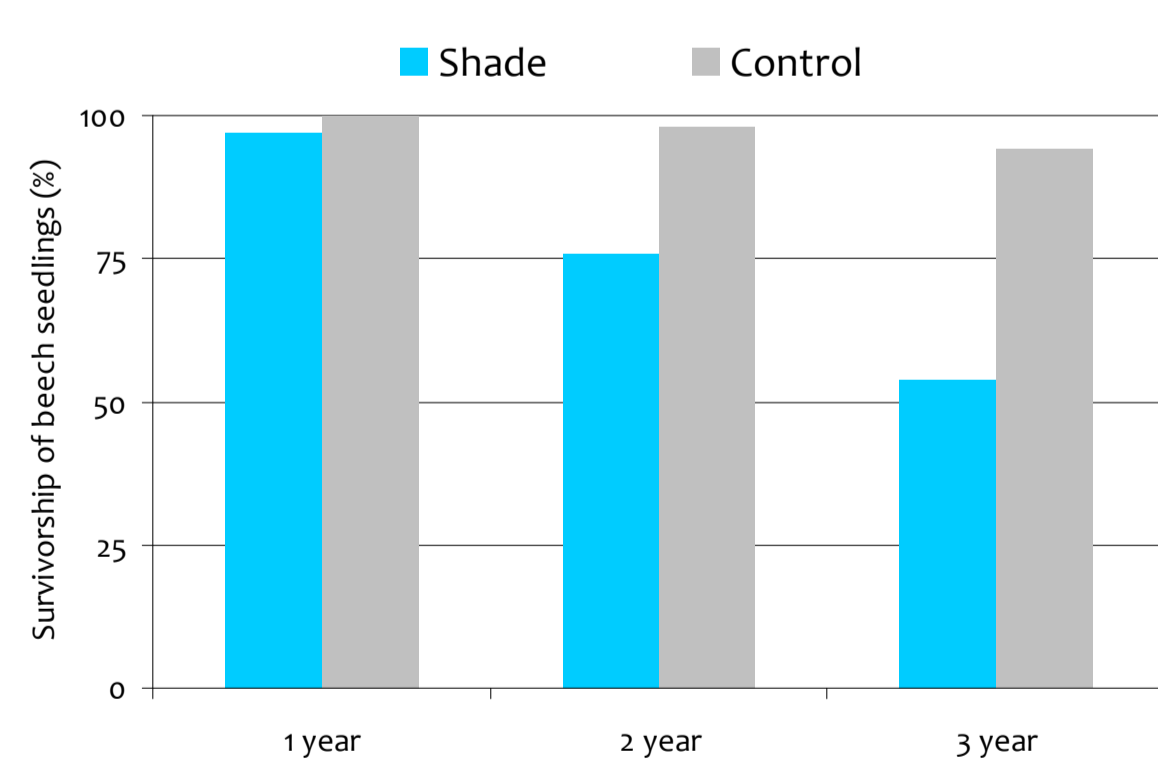


Short-term inter-specific response: oak-beech.

After one year of shading, significant mortality for the oak species only (44 % ; range 15 - 70 %) in the shaded plots. No mortality for the beech.

For the beech, in the shaded plots, the cumulative survivorship decrease significantly from the first to the third year.

The individual social status – expressed as the relative height – is a powerful predictor of the cumulative survivorship (ROC values of 0.71 and 0.74 for the 2nd and 3rd year of treatment).



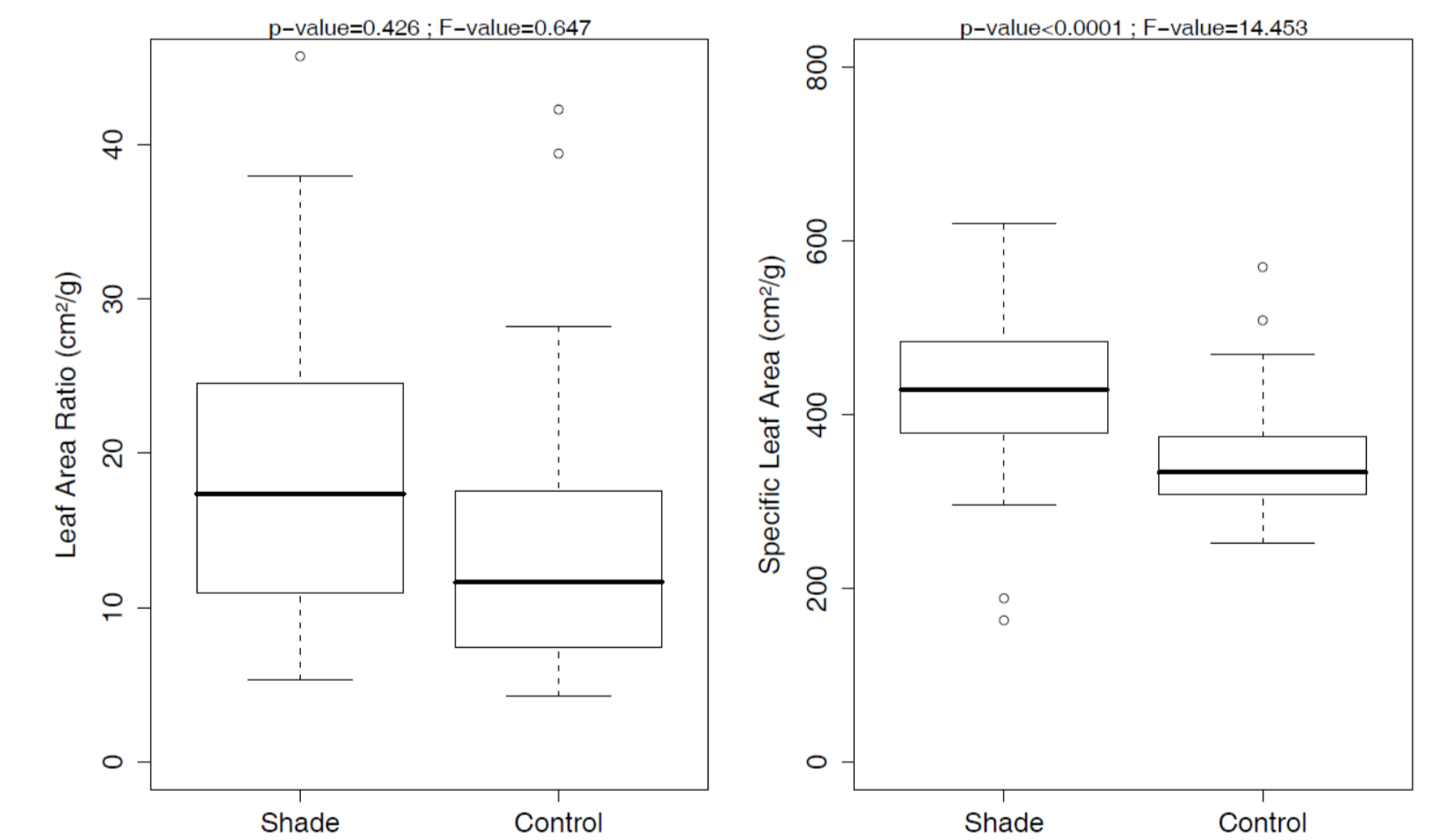
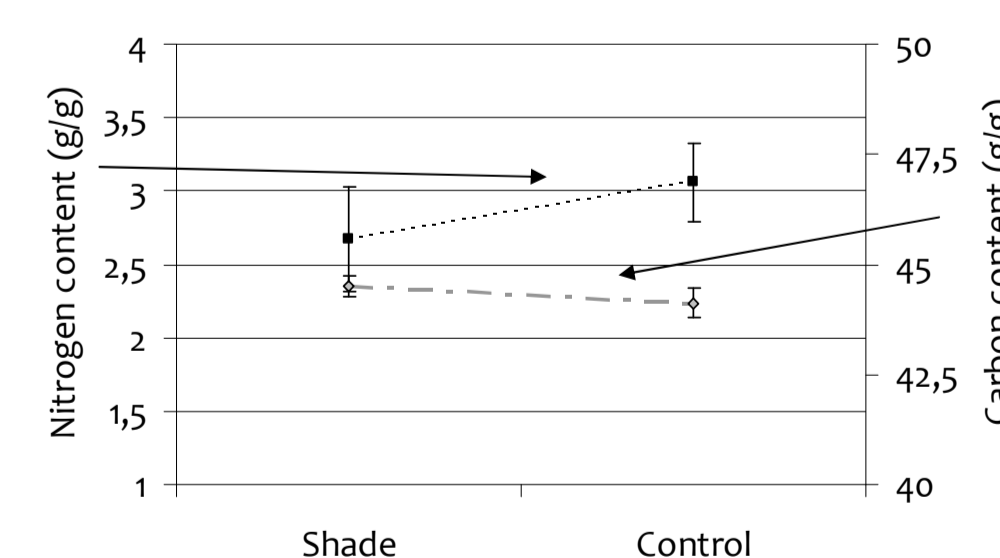
Beech leaf properties and carbon allocation



After three years of shading, the carbon allocation of the trees did not differ according to the treatment. The leaf area ratio (LAR) of the shaded trees were slightly higher than the control ones but not significantly (p-value=0.43).

The shade treatment has affected significantly (p-value<0.0001) the specific leaf area (SLA) of beech seedlings. The mean SLA in the treated plots is 465 cm².g⁻¹ vs. 404 cm².g⁻¹ in the control plot. No effect of the tree size could be highlighted on the SLA.

Carbon and nitrogen contents (% weight) did not change significantly with the treatment (p-values of 0.38 and 0.09 respectively).



- Sudden and significant mortality of the oak seedlings ;
- Ability of the beech seedlings to survive under levels of light close to 1% PACL ;
- Importance of the social status for the prediction of the survivorship, for both species ;
- For the beech seedlings, high correlation between the total height and the social status. For the oak, this relation is less clear (not shown).

- Due to the shade treatment, the leaves expressed traits of adaptation to the shade by increasing the leaf area compared to the foliar biomass ;
- At the tree-scale, we did not find any significant differences in terms of carbon allocation (expressed by the LAR ratio).

