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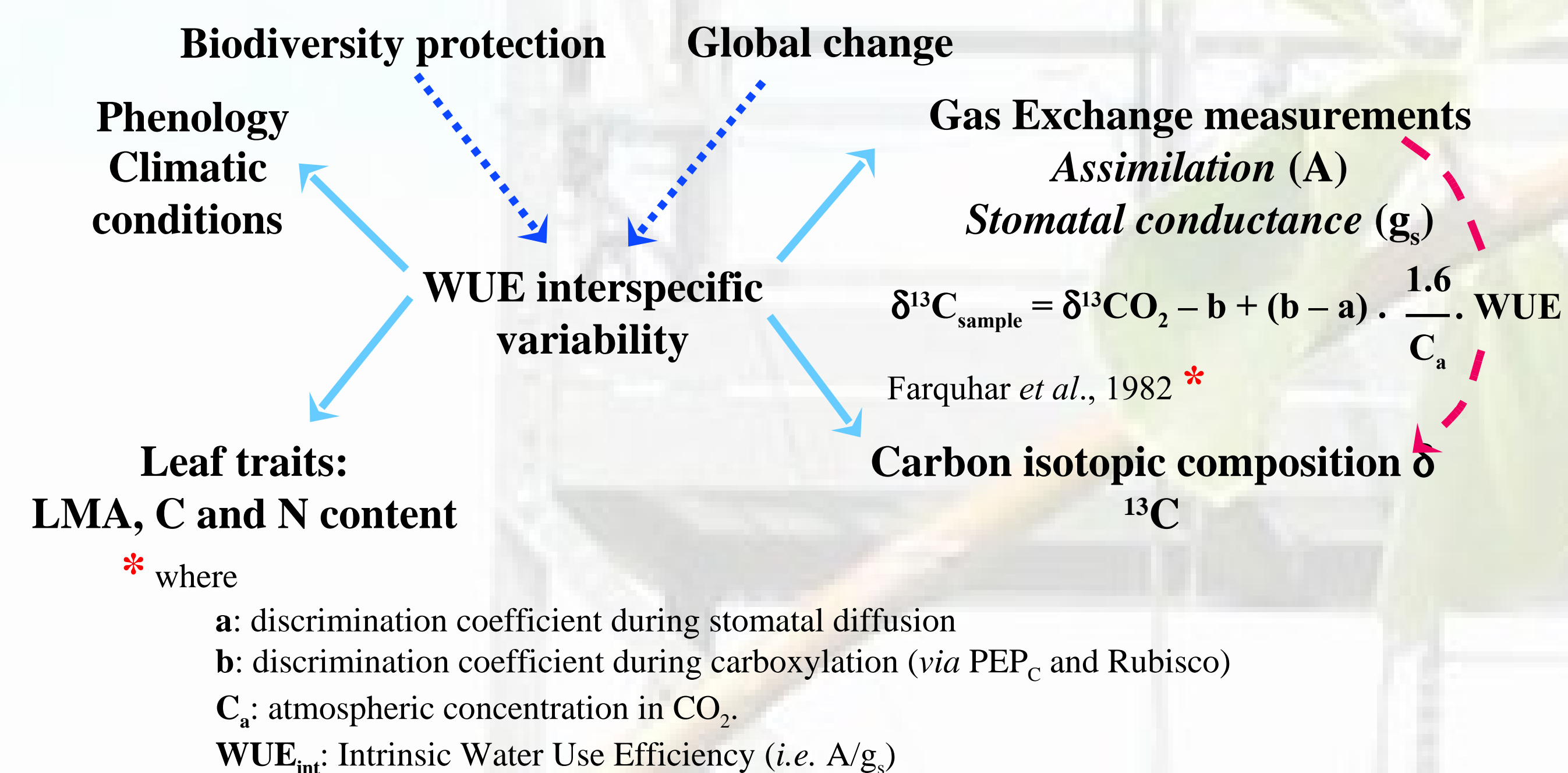
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Inter and intra-specific variability of carbon isotope composition ($\delta^{13}\text{C}$) and Water Use Efficiency in 5 deciduous tree species growing in a mixed stand in North Eastern France.

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Introduction

- Little information is yet available on **response of mixed stands to climate change**
- Intrinsic Water Use Efficiency (WUE)**, *i.e.* the ratio between assimilation rate (A) and stomatal conductance (g_s), is a trait that reflects tree functioning, especially at the leaf level
- WUE can be estimated indirectly at leaf level, using **carbon isotopic composition ($\delta^{13}\text{C}$)** of leaf material (Farquhar *et al.*, 1982)
- We analysed WUE, phenology and other foliar traits on **five deciduous european tree species** to
 - * compare variability of these traits among species
 - * link trait differences to functional ecological groups (shade tolerance)



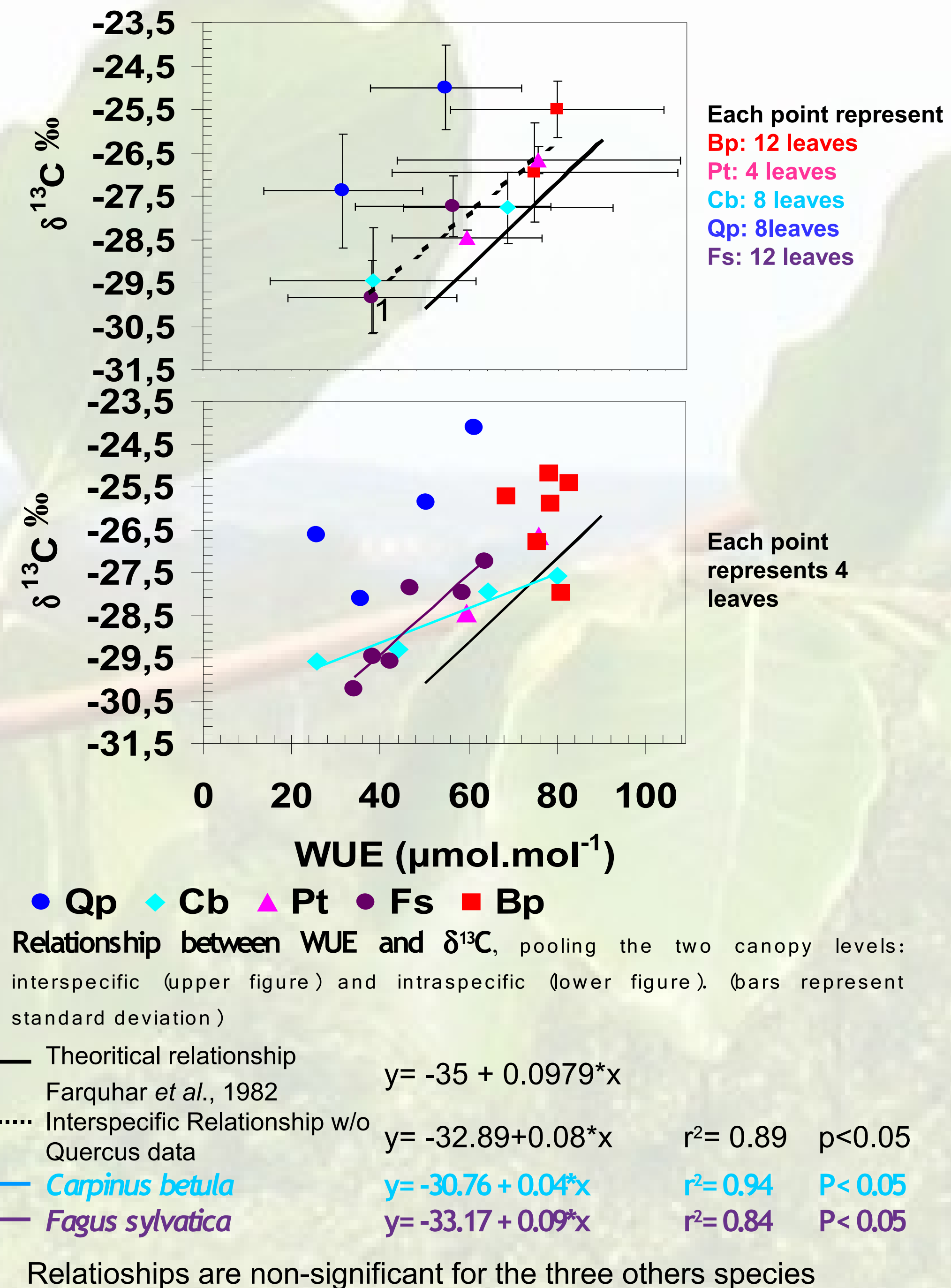
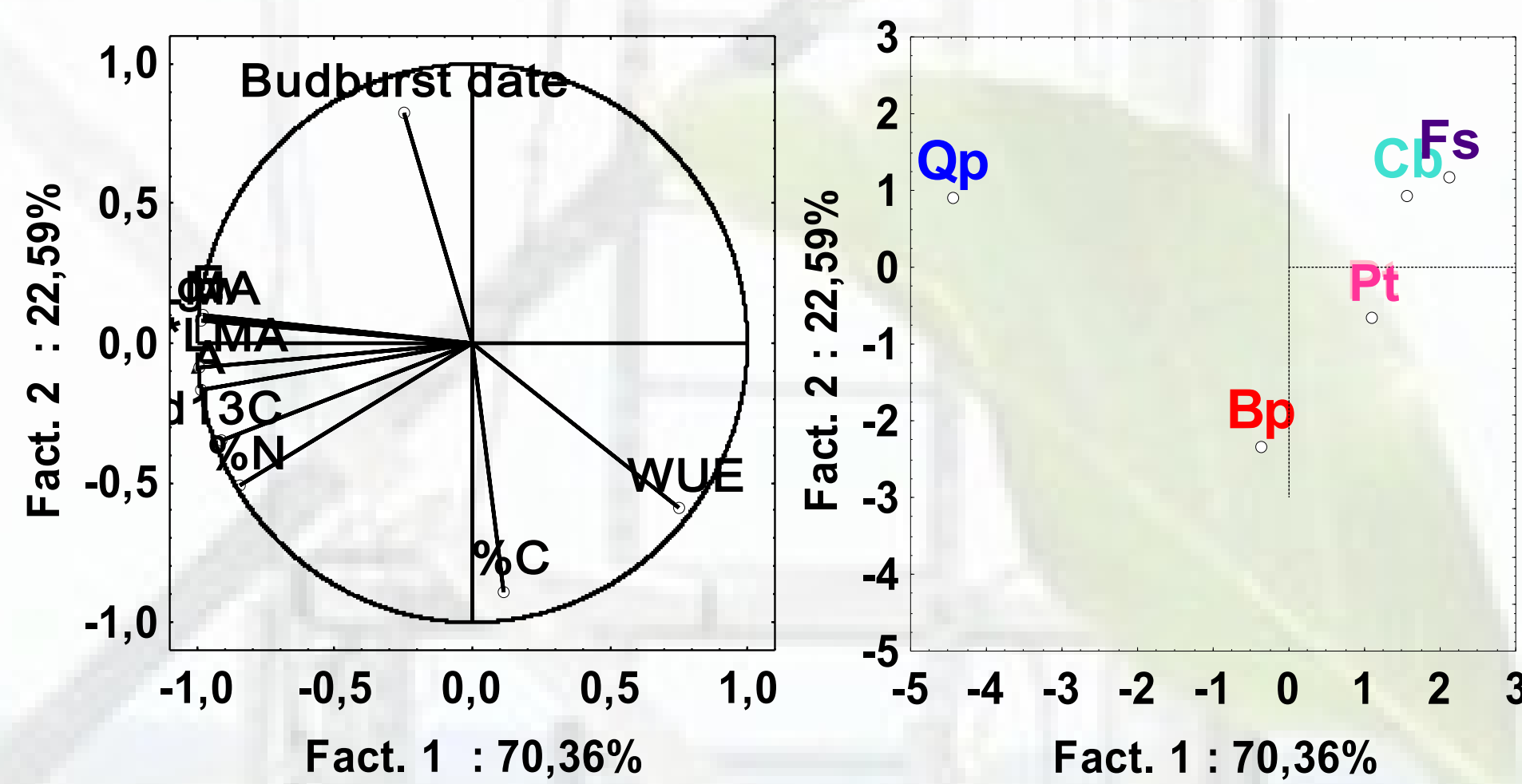
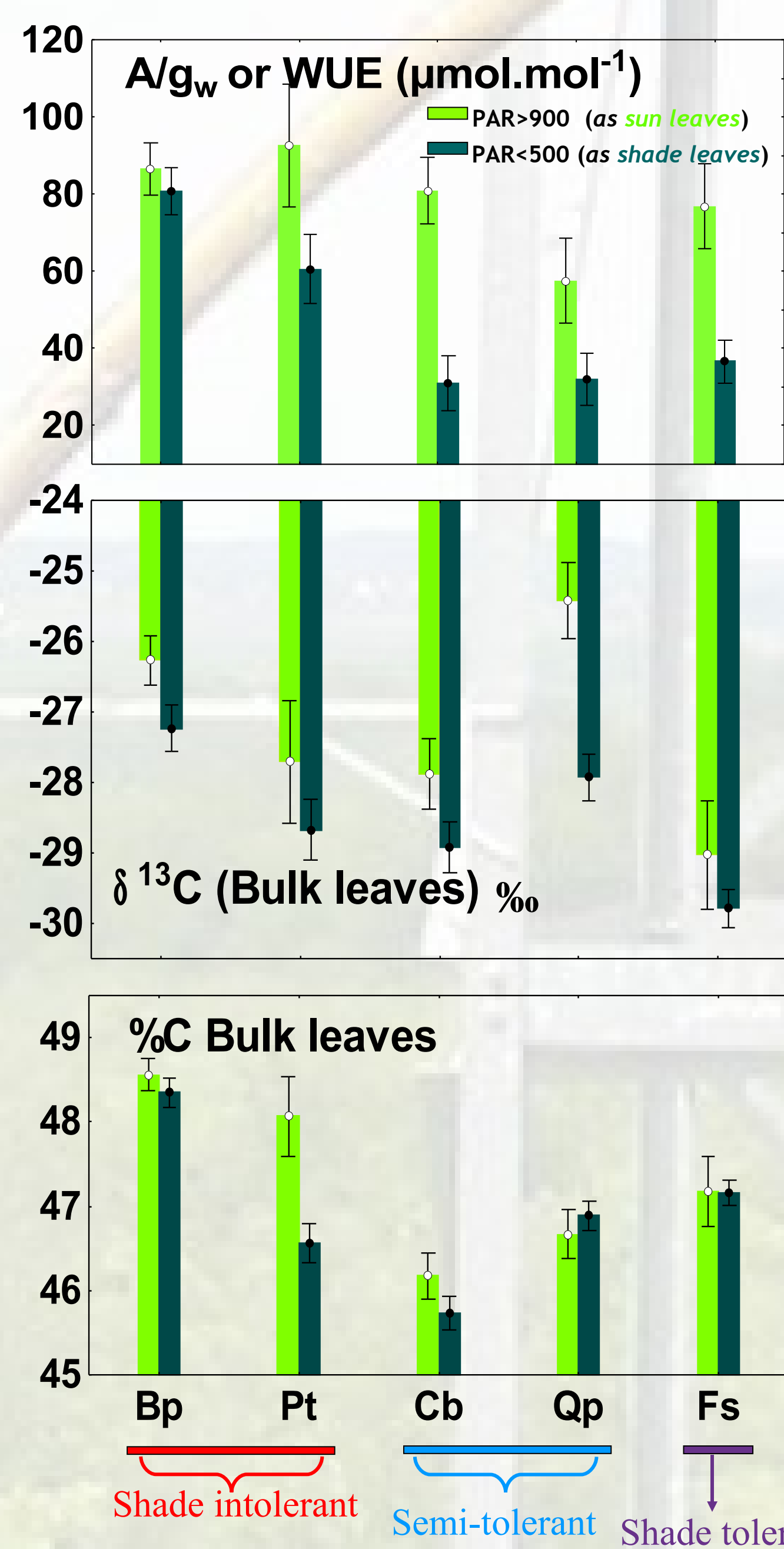
Material and Methods

- Experimental site : Hesse forest, a 15-25 years old broad-leaved mixed stand in North Eastern France (N 48°40'27"; E7°03'53"; Elevation 305m), belonging to the international networks CARBOEUROPE and FLUXNET.
- A portable photosynthesis system (LI-6200, Licor, Lincoln, USA) was used to measure leaf gas exchange (A, g_s , WUE).
- Foliar and soluble sugar $\delta^{13}\text{C}$, carbon (%C: $\text{gC/g}_{\text{dry matter}}$) and nitrogen (%N) leaf content were determined using a continuous flow isotope ratio mass spectrometer (Delta S; Thermofinnigan, Bremen, Germany) coupled with a nitrogen-carbon elementary analyser (Na 1500 Carlo Erba, Italie).
- Measurements were performed during late spring-early summer (2005).
- Measurements were carried out at 2 levels in the canopy, in sun and shade leaves.
- Phenology was followed during spring bud break;
- LMA (Leaf Mass Area) is the ratio between foliar dry mass and leaf area
- The studied species belong to contrasted functional types of light tolerance:

3 Silver birches	Bp	Betula pendula	Pioneer	shade intolerant
1 European Aspen	Pt	Populus tremula	Pioneer	shade intolerant
3 Hornbeams	Cb	Carpinus betula	Post pioneer	semitolérant
3 Sessile oaks	Qp	Quercus petraea	Post pioneer	semitolérant
3 European Beeches	Fs	Fagus sylvatica	late successional	shade tolerant



Results



Interspecific variability and difference between **lower canopy** (shade leaves) and **upper canopy** (sun leaves) of $\delta^{13}\text{C}$, WUE and bulk leaves %C

Confidence Interval

Discussion and conclusions

- Clear differences in soluble sugar $\delta^{13}\text{C}$ and WUE were found among the investigated species, independently of the leaf location in the canopy
- Within each tree species:
 - shade leaves had lower WUE, and more negative $\delta^{13}\text{C}$ than sun leaves;
 - variability among trees was low compared to among species
- No trait alone clustered the functional types, except %C and phenology, This was mainly due to the Birch trees, which had a higher carbon content and an earlier bud break compared to the other species
- linear relationships were found between WUE and $\delta^{13}\text{C}$
 - * At the **intra-specific level** for *Fagus sylvatica* and *Carpinus betula*.
 - * At the **inter-specific level**, when omitting the *Quercus* data
The *Quercus* leaves were non-mature (only 30 days when measurements occurred) (Morecroft and Roberts, 1999), while in the *Fagus* species the full maturity time is shorter (about 30 days, Granier *et al.*, 2000)
 - * Difference to theoretical relationship (Farquhar *et al.*, 1982) mainly due to differences in intercept

Differences among the species' WUE/ $\delta^{13}\text{C}$ -relationships might be species-specific and could be caused by differences in:

- * **Isotopic composition of air within the canopy (here -8‰ was used)**
- * **dark respiration, photorespiration and leaf internal resistance to CO_2 transfert**
- * **the proportion of PEPc in total CO_2 fixation (b)**

Aknowlegment

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