COST Action E52: Evaluation of Beech Genetic Resources for Sustainable Forestry

How is the genotype influencing photosynthetic response to elevated CO_2 of *Fagus sylvatica* L. from Italy and Germany ?

Linking ecophysiology and genetics

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European beech *(Fagus sylvatic*a L.) is one of the most important broad-leaves trees in Europe The ecophysiological response to environmental changes differs among the populations. The genetic variations of photosynthesis of beech from Italy and Germany and their response to elevated CO_2 were investigated under controlled environmental conditions. Changes in photosynthesis will be later related to gene activity.

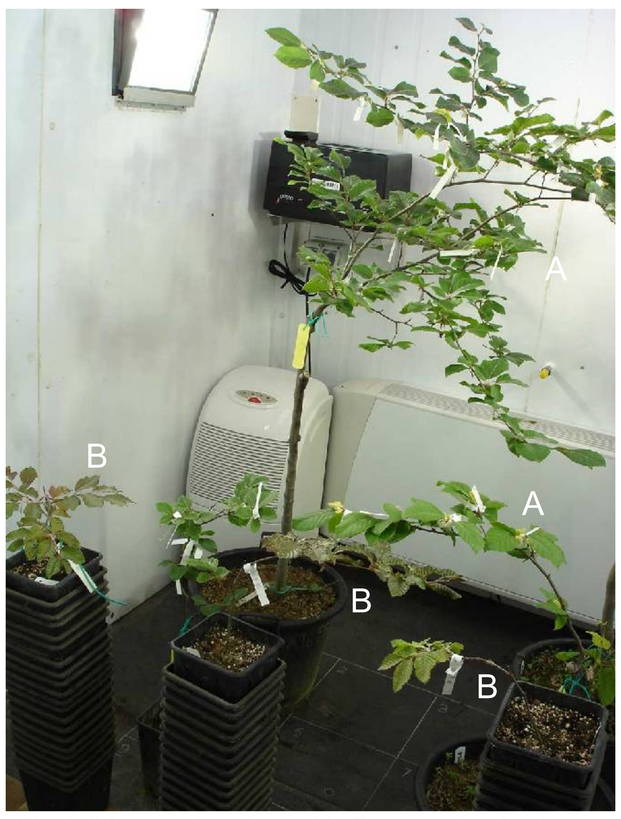

Fig.1 Climate chamber with *Fagus sylvativa* from Italy (A) and Germany (B).

The experiment

Fagus sylvatica (Montierzi (GR), Italy) and *F. sylvatica* f. purpurea were grafted on *F. sylvatica* rootstocks. Plants were grown under controlled conditions in a climate chamber (Fig. 1). Air temperature were 22-25°C and humidity 50% during light period and 15°C and 80% at night,. In each chamber 18 36W fluorescent lamps are placed. The photosynthetic active photon flux density (PPFD) was 250 µmol m^{-2} s^{-1} in plant height. CO_2 level were ambient concentration (approx. 380-400 ppm) and 1000 ppm, respectively.

A PAM modulated fluorescence system (PAM-2000, Heinz Walz GmbH, Effeltrich, Germany) with a 6 mm diameter standard fibre optic was used for the measurements of the *in vivo* photosynthesis (Fig.2). Light response curves were recorded up to a light intensity of 420 µmol m^{-2} s^{-1}.

Fig.2: Chlorophyll fluorescence measurements with a Walz PAM-2000

Results – Chlorophyll fluorescence

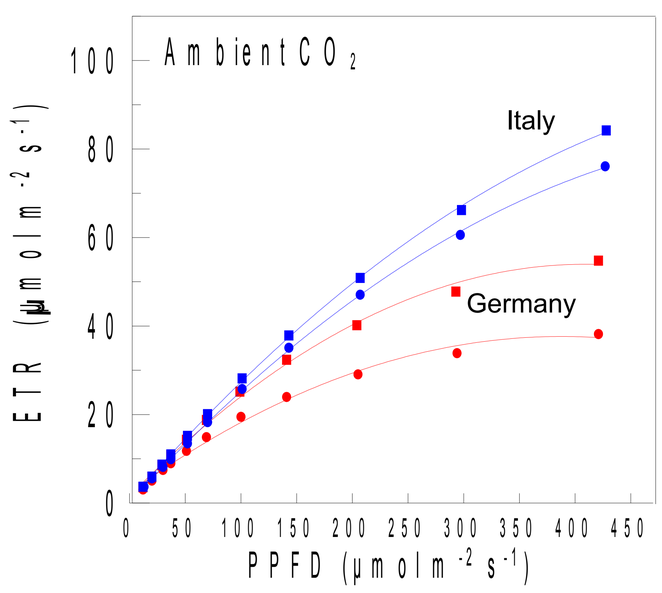

Fig.3: Under ambient conditions photosynthesis (expressed as electron transport rate ETR) was higher in the Italian compared to the German genotype

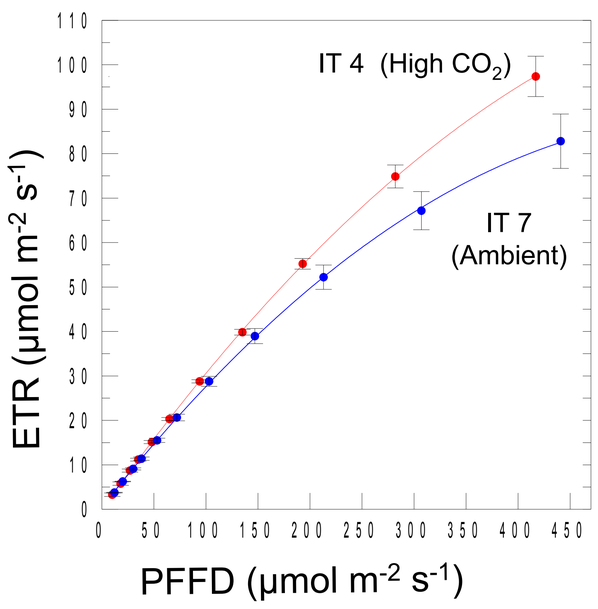

Fig.4: After 4 days under elevated CO_2 (1000 ppm) electron transport rate increased compared to the plants growing under ambient CO_2.

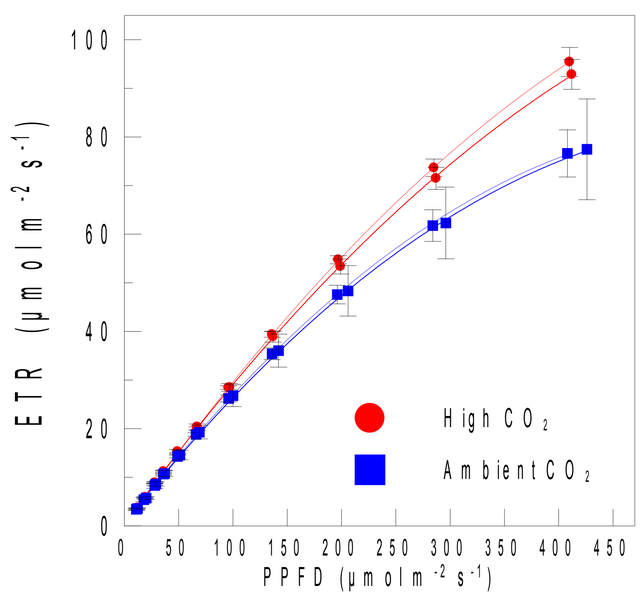

Fig.5: Photosynthesis of plants (Italy) adapted to high CO_2 decreased immediately after been exposed 2 hours to ambient CO_2.

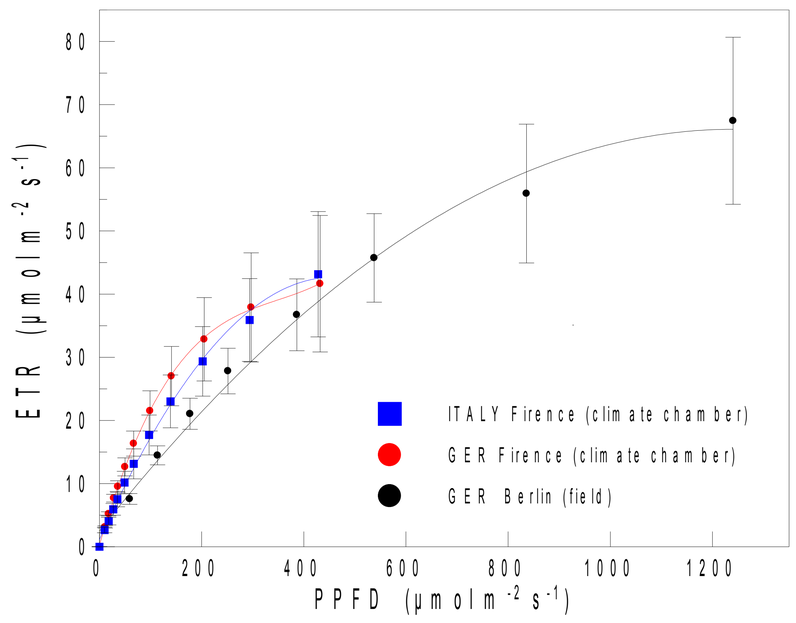

Fig.6: Plants growing in the climate chamber showed a higher photosynthesis at lower light levels compared to plants in the field experiment in Berlin (Fig. 7). Field grown plants are sun-adapted, while plants in the climate chamber are shade adapted.

Fig. 7: *F. sylvatica f* „purpurea in the Botanical Garden of Berlin

Conclusions

- Photosynthesis was higher in the Italian compared to the German genotype
- Photosynthesis of the plants in the climate chamber are comparable to shade adapted leaves under field conditions
- No down-regulation of photosynthesis could be observed in leaves at high CO_2 level.

Next steps

- Investigation of genes involved in the response to CO_2 with microarrays andquantitative PCR
- Correlation between gene activity and ecophysiology of photosynthesis