Ecophysiological adaptability and growth response of European beech provenances (*Fagus sylvatica* L.) to climate variability

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Introduction

The expected climate change will increase temperature by 1.5-2.5 K in the next decades. For Central Europe, future climate scenarios also indicate a decrease of mean precipitation and an increased frequency and severity of drought events. Already in recent years, drought periods affected the ecosystems in Western Europe. In 2003, spring and summer were characterised by extremely low precipitation accompanied by high temperature (Bissolli & Müller-Westermeier 2004). For a better understanding of the responses of beech to environmental changes, the ecophysiological adaptability and growth response has to be linked to genetic differences between populations.

Site description, plant material and methods

The study site is located at Schädtbek near Kiel, Schleswig-Holstein, North Germany. European beech seed material from different autochthonous provenances in Europe representing in particular differences in annual rainfall, were collected and cultivated under similar conditions at the BFH. Saplings were planted in 1995 to test climate response of the trials under comparable environmental conditions (Kriebitzsch et al. 2005). Transpiration and leaf conductance to water vapour diffusion were determined with a steady-state Li-1600 porometer system (Li-Cor, Lincoln, Neb., USA). Electron transport rates (ETR) were measured with a PAM 2100 fluorescence system (Heinz Walz GmbH, Effeltrich).

Results

Mean leaf conductance, mean transpiration and mean ETR (Fig. 1) of the six provenances differ strongly. The provenance Kladaska/Czech Republic had the lowest values, whereas the provenances Oderhaus/Harz/Germany and Anguiano/Spain had the highest. Mean leaf conductance and mean ETR of the respective provenance are closely correlated.

Until 2002, mean yearly basal area increment of all provenances increased continuously. The provenances from Anguiano/Spain and Gransee/Brandenburg/Germany are characterised by high values. During these first years, the Beius-Beihor/Romanian provenance had the lowest yearly increment rates. The dry summer 2003 caused a significant decrease of basal area increment in nearly all provenances. Only the provenances Harz/Germany and Romania show no or only a reduced decline until 2006. In contrast to the period before the dry year 2003, where relative basal area increment was rather synchronous, increment curves showed a wide spread between all the six provenances. While the relative basal area of the provenances Oderhaus/Harz/Germany and Romania continuously increased, the rise of the curves of the other ones, especially of the provenances from Brandenburg and Czech Republic, was partly extremely reduced.

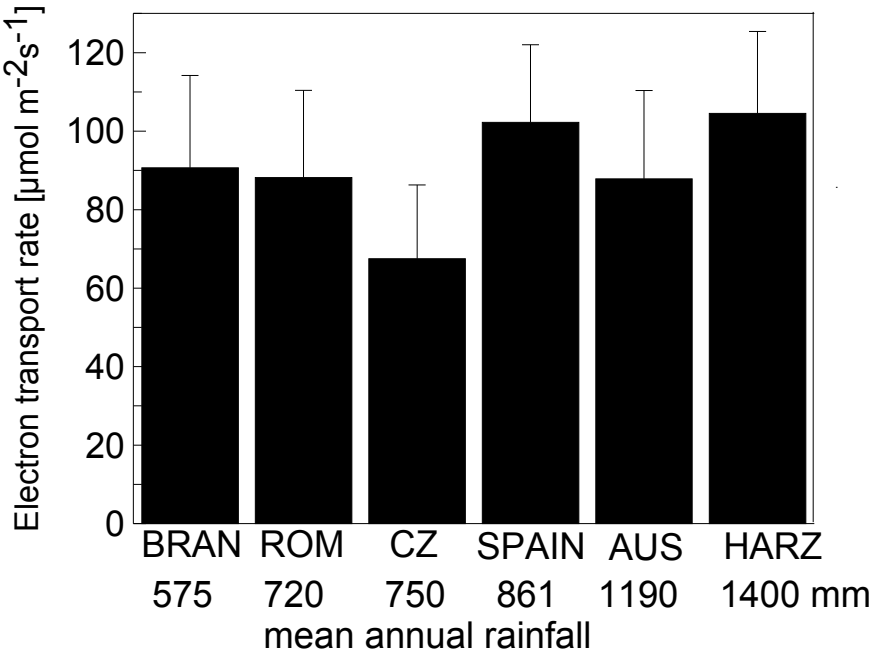

Fig. 1: Mean electron transport rate (ETR) of the investigated European beech provenances from Gransee, Brandenburg (BRAN), Romania (ROM), Czech Republic (CZ), Spain (SPAIN), Austria (AUS) and Oderhaus, Harz (HARZ) (for details of the provenances see Kriebitzsch et al. 2005)

Conclusions

There are significant differences between the six provenances with regard to photosynthesis performance, transpiration (including leaf conductance for water vapour) as well as the increment development (Kriebitzsch et al. 2008). At least in the year 2006 after a drought period of several weeks, the three provenances originating from sites with low precipitation are characterised by low leaf conductance and ETR-values compared with the provenances originating from sites with high precipitation. Leaf conductance as expression of stomata opening obviously influences the increment development. For some provenances, extreme dry periods like in summer 2003 caused in the following year a small stomata opening and therefore low biomass increment. Therefore, the sensitivity of these provenances against all kinds of stress appears higher in the following years after dryness than those of other provenances. Hence, in future an increased frequency and severity of drought events may contribute to a destabilisation of our forests.

References

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