

Diameter shrinkage on spruce (*Picea abies* L.) and oak (*Quercus petraea* L.) as a response to drought stress in the summer 2003

Joachim Block and Friedrich Engels

Method

Objects to the study were a stand of sessile oak approximately 200 years old with beech in the understorey, and a spruce stand at an approximate age of 125 years. The first being located in the Palatinate Forest (Merzalben) on a Triassic sand stone site, the second one being located in the Hunsrueck (Leisel) on a loamy soil covering quartzite material.

In order to assess the response of spruce and oak to drought stress associated with the drought of the summer of 2003, girths were measured on an hourly base for ten dominant and codominant trees in each stand. In addition data on the soil water content was collected at different levels using TDR probes.

Based on these measurements the diameter shrinkages as a reaction to the drought, in relation to the relative soil water availability (soil water content down to root depth as a percentage of the plant-available field capacity) could be assessed.

At both sites the climatic water balance was much lower in 2003 than in previous years (Tab. 1).

| Monitoring plot | Tree species | Root depth | Available field capacity down to root depth (nFK) | Climatic water balance | |
|-------------------------|------------------------------|------------|---|------------------------|----------------|
| | | | | 2003 [mm] | 1998-2002 [mm] |
| Leisel / Hunsrück | Norway spruce | 70 | 111 | + 101 | + 739 |
| Merzalben / Pfälzerwald | Sessile oak / European beech | 90 | 206 | - 38 | + 583 |

Characteristics of water budget on the monitoring plots Leisel and Merzalben

Results

In the year 2003 a rapid decrease of the content of plant-available water in the soil took place at the beginning of June already. The minimum values on both sites were reached on August 27th and decreased to 8 % of the available field capacity at the oak site Merzalben and 17% at the spruce site Leisel respectively.

Obviously the beech understorey came into a severe drought stress indicated by an almost total loss of leaves at the end of August. Approximately 15 % of these beeches died-off later on.

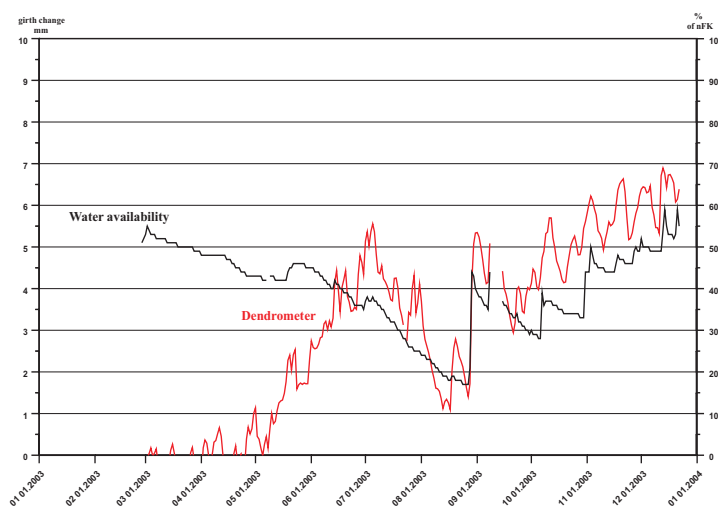
Not earlier than from beginning of October at both sites the soil water storage was refilled gradually by the precipitation and reached the level of the previous year at the end of December. At both sites the trees showed an unimpaired growth by July 5th, although the soil water availability at this time had already decreased to 40 % of the field capacity, for a short period even to less than 30%.

In the following weeks the girth decreased by 2mm to 9mm, proportional to the water availability. The decrease therefore accounted for up to two thirds of the diameter increment within this period. Both tree species and all trees investigated reacted almost identically. The growth of the trees and the water status in the trunk was thus impaired at both sites from the beginning of July up to the beginning of October.

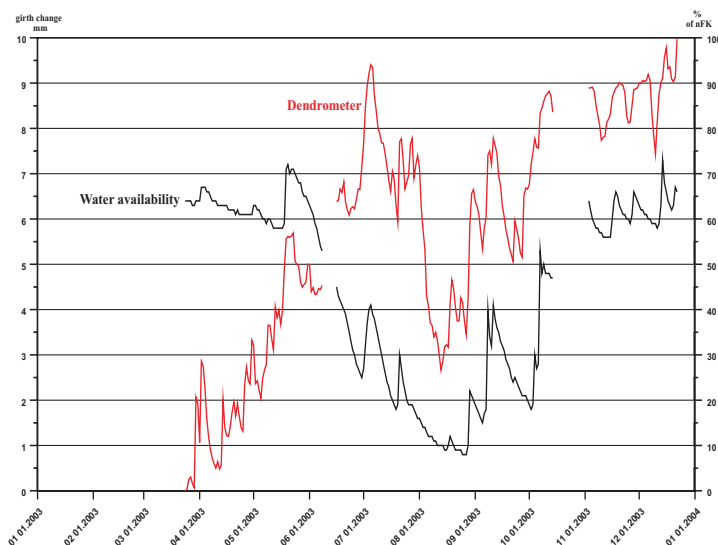
As a consequence of the drought stress of 2003, the rate of trees in the oak stand dying-off of the infestation with *Agrilus biguttatus* is presently increasing.



Dying dominant oak at the Merzalben site. In this stand all dying trees show an infestation with *Agrilus biguttatus*



Girth change (red line) in breast height of a 125 year old spruce at the Leisel site in relation to decreasing soil water availability (in % of available field capacity-nFK-down to root depth) in summer 2003 (black line)



Girth change (red line) in breast height of a 200 year old sessile oak at the Merzalben site in relation to decreasing soil water availability (in % of available field capacity-nFK-down to root depth) in summer 2003 (black line)