Project *brief*

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Impacts of drought stress on the wood anatomy of Scots pine (*Pinus sylvestris*)

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- **Trees, such as Scots pine, respond to water availability with anatomical changes**
- **Drought-induced formation of resin channels reduces wood quality**
- **Climate change, with increasing drought, could have a detrimental effect on the timber industry**

Background and objectives

In times of climate change, timber constructions are gaining increasing importance in the building industry. However, the availability and properties of wood as a resource are highly dependent on climate itself.
The adaptability of trees to their environment can be seen in the varying, site-specific expression of growth characteristics and wood anatomy. Climate change represents a shift to which trees respond by altering the properties of their wood. The aim of this study was to investigate the influences of precipitations and temperature on the growth and wood anatomy of Scots pine (*Pinus sylvestris*).

Approach

Investigations were carried out on twelve cross-sections of pine trunks from the Britz intensive monitoring area. Data from the measuring devices there were available for comparing climate data and investigation results. First, we performed a tree-ring analysis by measuring the width of the earlywood and latewood. This distinction is important because earlywood and latewood perform partially different functions in the tree, and their relative proportions influence the mechanical properties of the building material.

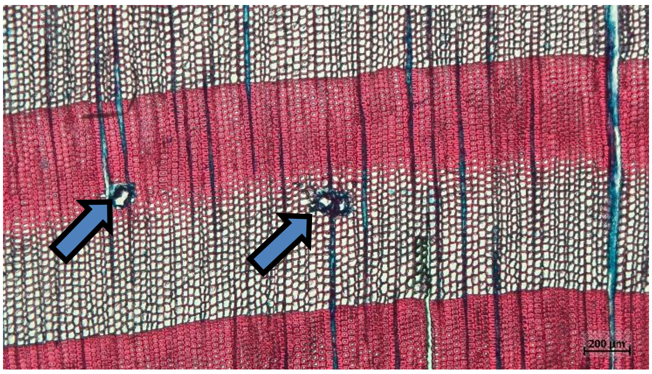

Figure 1: Resin canals in the annual ring; latewood red, earlywood grey, arrows point to resin canals (Source: Thünen Institute/Justus Neugebauer).

The second characteristic examined was the average number of resin canals per millimeter of each annual ring. A resin canal is an elongated, tube-like cavity in the wood, lined with resin-secreting cells that release resin into the cavity.

Small blocks were cut from five log sections, and thin sections were made perpendicular to the fibers. After staining, the sections were evaluated under a microscope (Fig. 1). In three samples of latewood, we chemically disintegrated the wood structure to measure the separated fibers (tracheids) under a microscope. Twenty fibers per annual ring were measured in each case.

Results

In order to compare and display all measured parameters despite their different units and dimensions, the percentage deviations of the values from their mean values (as decimal numbers) were determined.

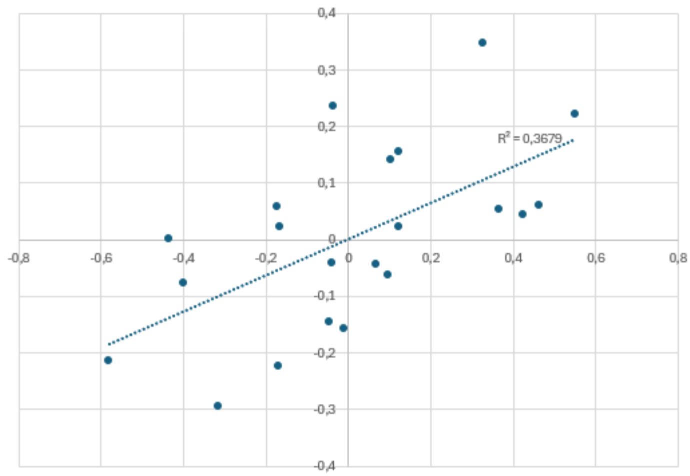

Figure 2: Latewood width correlates positively with annual precipitation; period 2002-2020 (Source: Thünen Institute/own representation)

A strong correlation was observed between precipitations and latewood width (Fig. 2). Latewood width was greater in years with higher precipitation. This can be clearly seen by comparing the trends in latewood width and precipitation, particularly between April and September (Fig. 3). A weaker correlation was also found between total tree ring width and precipitation.

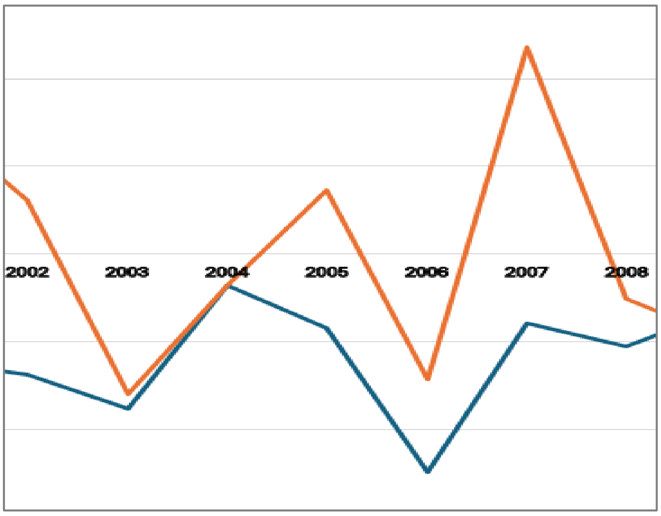

Figure 3: Excerpt from the chronological progression (here 2002-2008) of precipitation amounts (orange) and the development of latewood (blue) (source: Thünen Institute/own representation).

When comparing the key indicators of precipitation and the number of resin canals, we observed an opposing trend over many years. More resin canals were frequently formed in years with low precipitation.
In some years, a correlation between temperature and the number of resin canals was also observed. In some cases, temperature affected the growth in the same year, while in others it only affected the growth in the following year. An analysis of monthly values could provide more detailed results.

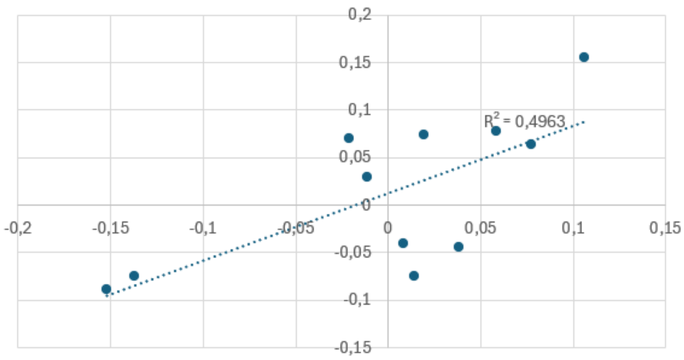

Figure 4: Tracheid length correlates positively with the average annual temperature (Source: Thünen Institute/own representation).

Furthermore, it should be noted that temperature and precipitation are not independent factors. Larger amounts of precipitation naturally accompany heavier cloud cover, less solar radiation, and therefore lower temperatures.
The length of the tracheids correlated most strongly with the average annual temperature. Longer fibers were formed in years with higher temperatures (Fig. 4).

Conclusions

Our results demonstrate the effects of various abiotic influences on wood anatomy. Lower rainfall and longer periods of drought are associated with a reduction in annual ring width and the formation of a greater number of resin canals.
For the timber industry, this development, typically associated with climate change, would mean less wood volume and increased workability. While longer wood fibers could make the wood more stable, the amount of latewood, which is highly dependent on rainfall, would also decrease. This would lead to a significantly lower wood density and a general deterioration of wood properties.

Further Information

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Publications

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