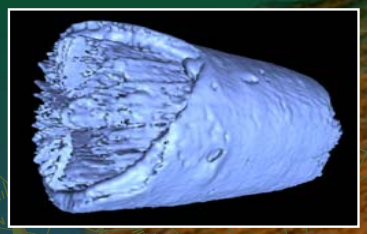
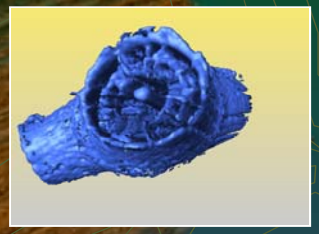
Wound response in beech investigated by 3D MRI





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Aim of our research:

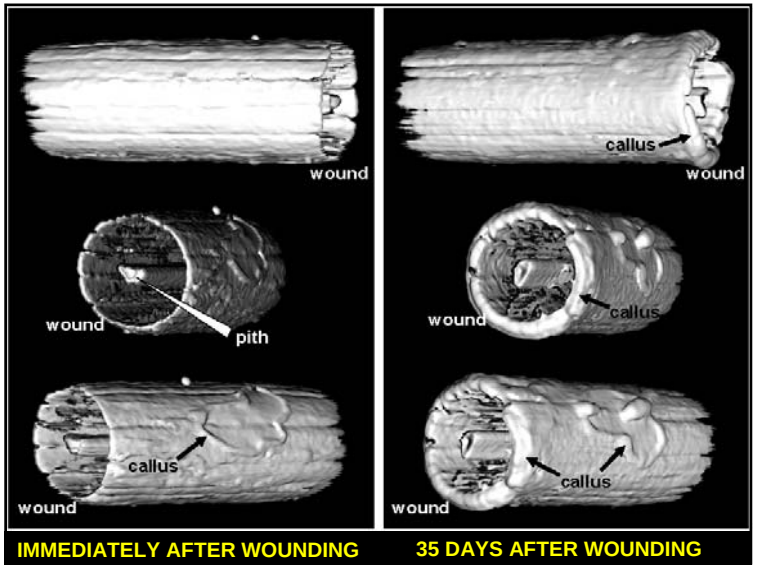
- to reveal structural and water changes in the tree tissues after wounding

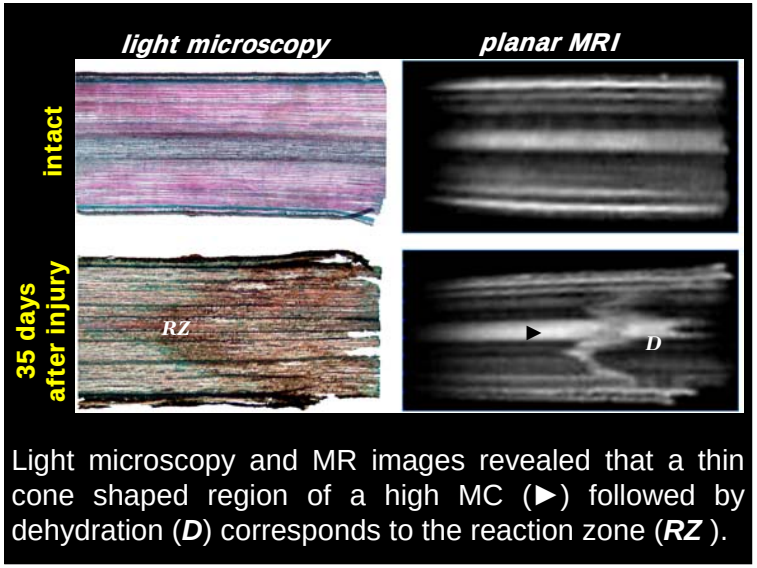
Methods:

- 3D spin-echo magnetic resonance imaging (MRI) and
- traditional light microscopy .

Investigated trees

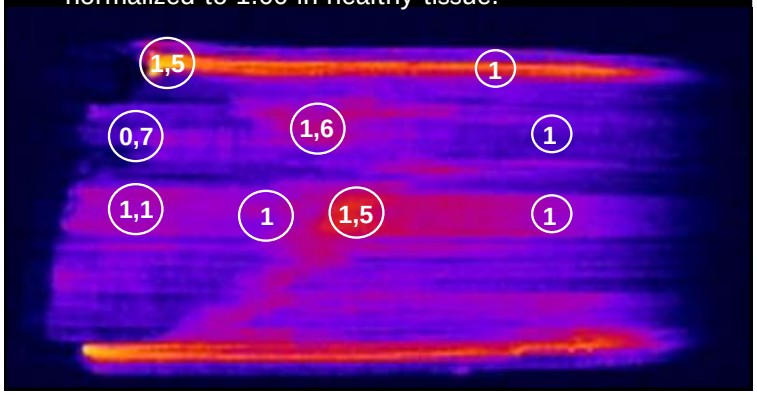
- 3 m high beech (*Fagus sylvatica* L.) was transplanted into a portable pot
- branch of 5 mm in diameter was pruned and imaged immediately, as well as 35 days after wounding *in vivo*
- branch was inserted into a RF coil and positioned in the centre of a horizontal (2.35 T) superconductin magnet
- experiment was repeated at 3 excised branches

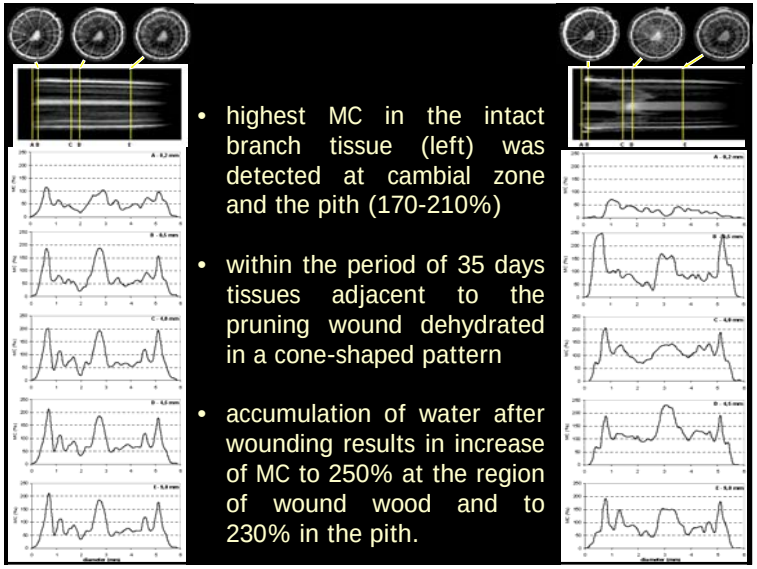




Light microscopy and MR images revealed that a thin cone shaped region of a high MC (►) followed by dehydration (***D***) corresponds to the reaction zone (***RZ***).

Normalized MC of individual tissues was expressed as a quotient between the gravimetrically determined MC and the average pixel intensity value.
Ratios of MC derived from MRI experiments were normalized to 1.00 in healthy tissue.





- highest MC in the intact branch tissue (left) was detected at cambial zone and the pith (170-210%)
- within the period of 35 days tissues adjacent to the pruning wound dehydrated in a cone-shaped pattern
- accumulation of water after wounding results in increase of MC to 250% at the region of wound wood and to 230% in the pith.

Conclusions:

- **In the margins of wounded beech wood cell wall alterations as well as an intensive water accumulation probably represent integral part of the protective mechanism for the underlying sound wood.**

- **3D MR microscopy is definitely capable of achieving sufficient resolution to distinguish topography, anatomy and water content in selected intact and mechanically wounded tree tissues.**

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- Average moisture content (av.MC) of imaged branches was determined gravimetrically from parallel samples:

$$av.MC(\%) = (m_{green} - m_0)/m_0$$

m_{green} = *weight of green wood*
m_0 = *weight of absolutely dry wood*

3D Magnetic Resonance Imaging

- Branches were imaged by a 3D spin echo MR microscopy technique at:
  - **field of view (FOV): 25 x 12.5 x 12.5 mm^3,**
  - **imaging matrix: 256 x 128 x 128,**
  - **echo time (TE): 2.4 ms,**
  - **repetition time (TR): 600 ms and**
  - **at 8 averages.**
- Spatial resolution of images was 100 μm isotropic and total imaging time was 22 hours.
- MRI data were processed and analyzed by Image J (NIH, USA) computer software.