# WooD+

**ERASMUS+**

## Wood Anatomy Lab

MENDELU
Faculty of Forestry
and Wood
Technology

# Interdisciplinary, collaborative learning and teaching for resilient wood resources and innovations in a digital world (WooD+)

- Call: ERASMUS+ KA203-80172F36 (Strategic Partnership)
- Duration: 36 months  (1/9/2020 – 31/8/2023)
- Consortium: 4 partners
- Project number: 2020-1-CZ01-KA203-078483.
- Budget: 219 064 EUR

Co-funded by the Erasmus+ Programme of the European Union

With **WooD+** Objectives are targeted, Opportunities are taken and make a Difference under the ERASMUS+ umbrella.

MENDELU
Faculty of Forestry and Wood Technology

# Consortium

- **4 Partners**

Mendel University in Brno (MENDELU) – CZ (Coordinator)

Universitaet Fuer Bodenkultur Wien (BOKU) - AT,

Universität Hamburg UHAM - DE,

Univerza v Ljubljani (UL) – SI

- **1 Associated partner**

InnovaWood

# Monitoring the xylem & phloem formation of LKWS

**Workshop content:**

- **Less know wood species (LKWS), theoretical background, sampling, methods & techniques, seasonal dynamics of the cambial activity, xylem & phloem formation, Laboratory instruments & devices**

**Other activities**

- **Science Café with Petr HORÁČEK - World of the Wood Microstructure**

**Further information & Registration: https://wood.ldf.mendelu.cz/**

## 29 September – 1 October 2021

## Brno, Czech Republic

Co-funded by the Erasmus+ Programme of the European Union

**This workshop has been funded with support from the European Union. Project number: 2020-1-CZ01-KA203-078483.**

MENDELU
Faculty of Forestry and Wood Technology

# Science Café with Petr Horáček

**Topic: World of the Wood Microstructure**

**Science Café is an open forum where members of the public can meet scientists to discuss topical issues. It is an opportunity for everyone to ask questions and express their opinions about the topic.**

**Online: Lesnická a dřevařská fakulta MENDELU - YouTube**

**In-person: Central Library MENDELU**

## 29 September 2021 at 17:30

Co-funded by the Erasmus+ Programme of the European Union

south moravian region

**This event has been funded with support from the European Union. 2020-1-CZ01-KA203-078483.**

MENDELU
Faculty of Forestry and Wood Technology

# WO1 PROGRAM

**29 September 2021**

| | | | |
|---|---|---|---|
| 8:30– 8:45 | Welcoming – Tour de table | | Lecture room |
| 8:45 – 9:15 | Presentation | Wood anatomy | Lecture room – theory/method |
| 9:15 – 9:30 | Presentation | Wood formation | Lecture room – example research |
| 9:30 – 10:00 | Transfer to Soběšice | | |
| 10:00 – 12:00 | Microcores - fieldwork | Methodology | Sobesice |
| 12:00 – 13:00 | Lunch Break | | |
| 13:00 – 14:30 | Step 1 - Paraffin blocks | Methodology | Laboratory |
| 14:30 – 15:00 | Coffee Break | | |
| 15:00 – 17:00 | Arboretum MENDELU | | Arboretum MENDELU |
| 17:30 – 18:30 | Science Café with Petr HORÁČEK | | MENDELU Library |
| 19:00 - …. | Join dinner in ERA | | |

MENDELU
Faculty of Forestry and Wood Technology

# WO1 PROGRAM

**30 September 2021**

| | | | |
|---|---|---|---|
| 8:30 – 10:00 | Lecture | Wood Chemistry | Lecture room |
| 10:00 – 10:30 | Coffee Break | | |
| 10:00 – 12:00 | Step 2 – Cutting blocks | Methodology | Laboratory |
| 12:00 – 13:00 | Lunch Break | | |
| 13:00 – 15:00 | Step 3 – Rotary microtome | Methodology | Laboratory |
| 15:00 – 15:30 | Coffee Break | | |
| 15:00 – 15:15 | Presentation | WooD+ project | Lecture room |
| 15:15 – 15:45 | Presentation | UL research examples | Lecture room |
| 15:45 – 17:00 | Step 4 – Staining slides | Methodology | Laboratory |
| 17:00 – 19:00 | Brno sight seeing | | Brno |

# WO1 PROGRAM

## 1 October 2021

| | | | |
|---|---|---|---|
| 8:30 – 9:00 | Presentation | Wood formation | Lecture room – example research |
| 9:00 – 10:00 | Step 5 – Monitoring phenological phases (Light microscopy) | Methodology | Laboratory |
| 10:00 – 10:30 | Coffee Break | | |
| 10:00 – 11:00 | Digital microscope demonstration | Methodology | Laboratory |
| 11:00 – 12:00 | SEM demonstration | Methodology | Laboratory |
| 12:00 – 13:00 | Lunch Break | | |
| 13:00 – 13:15 | Presentation | ASFORCLIC PROJECT | Lecture room |
| 13:15 – 15:00 | Practicing the technique | Methodology | Laboratory |
| 15:00 – 15:30 | Coffee Break | | |
| 15:00 – 17:00 | Summarizing/ Q&As | Methodology | Laboratory |

# Mendel University in Brno


The Mendel University in Brno is in the eastern part of the Czech Republic.

Brno is the 2nd largest city in the Czech Republic by population and area.

It lies at the confluence of the Svitava and Svratka rivers and has about 400,000 inhabitants.

The city is a significant administrative centre with a great number of state authorities, including the Constitutional Court.

Brno is also an important centre of higher education, with 33 faculties belonging to 13 institutes of higher learning and about 89,000 students.

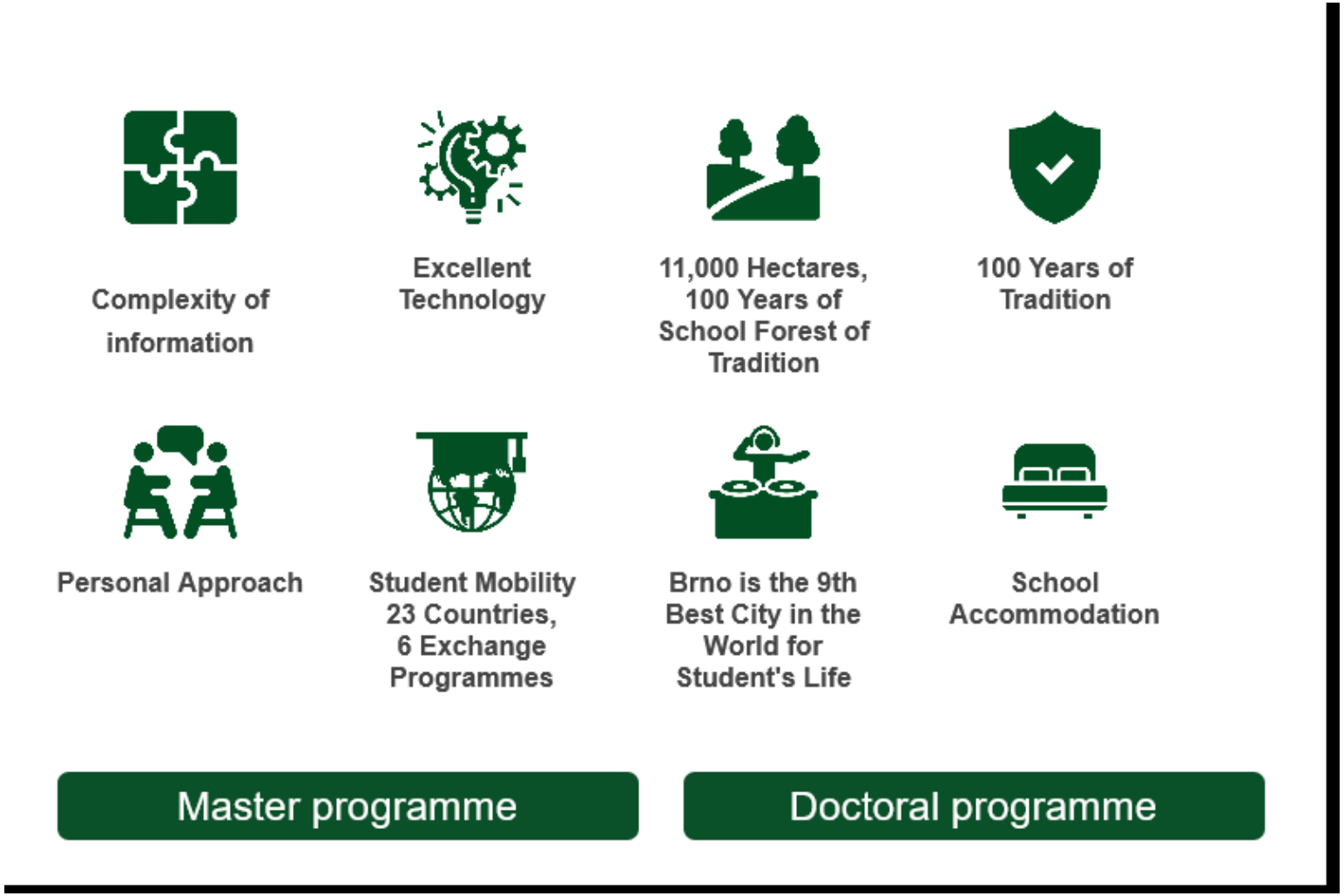
# Mendel University in Brno - FFWT

Since 1919

- Department of Mathematics
- Department of Geology and Soil Science
- Department of Forest Botany, Dendrology and Geobiocoenology
- Department of Forest and Wood Products Economics and Policy
- Department of Landscape Management
- Department of Engineering
- Department of Forest Protection and Wildlife Management
- Department of Silviculture
- Department of Forest Management and Applied Geoinformatics
- Department of Furniture, Design and Habitat
- Department of Wood Science and Technology
- Department of Forest Ecology

MENDELU
Faculty of Forestry and Wood Technology

# STUDY






MENDELU
Faculty of Forestry
and Wood
Technology

**Bc. Studies:**

- Forestry
- Furniture Design and Technology
- Landscaping
- Timber Structures and Constructions
- Wood Technology
- Arboristics

**MSc. Studies:**

- Forestry Engineering
- Furniture Engineering and Design
- Landscape Engineering
- Wood Technology Engineering
- European Forestry (in English)

**Ph.D. Studies (3-year programmes):**

Applied Geo-informatics

Forest Ecology (in English)

Forest Phytology (in English)

Forest Management

Forest Protection

Furniture Technology

Game Management

Landscaping and Landscape Conservation

Renewable Resources Economics and Management

Silviculture

Technology and Mechanization in Forestry

Wood Processing and Timber Technology

**Laboratory of Wood Anatomy – Brno Team**

(Vladimír Gryc, Hanuš Vavrčík, Kyriaki Giagli, Dimitrios Tsalagkas)

- **Wood identification:** paleoanatomy (description of fossils wood), cooperation with Charles University in Prague
- **Archaeological wood**
- **Recent wood** (private customers, companies, government institutions)

- **Wood formation:** Cambial activity, Influence of temperature and precipitation to radial growth
  - **Norway spruce and European Beech plots:** Rájec-Němčice
  - **Pinus sylvestris plots**: Soběšice

# Wood anatomy


The leading hypothesis

# Environmental information is permanently registered in the tree-ring structure

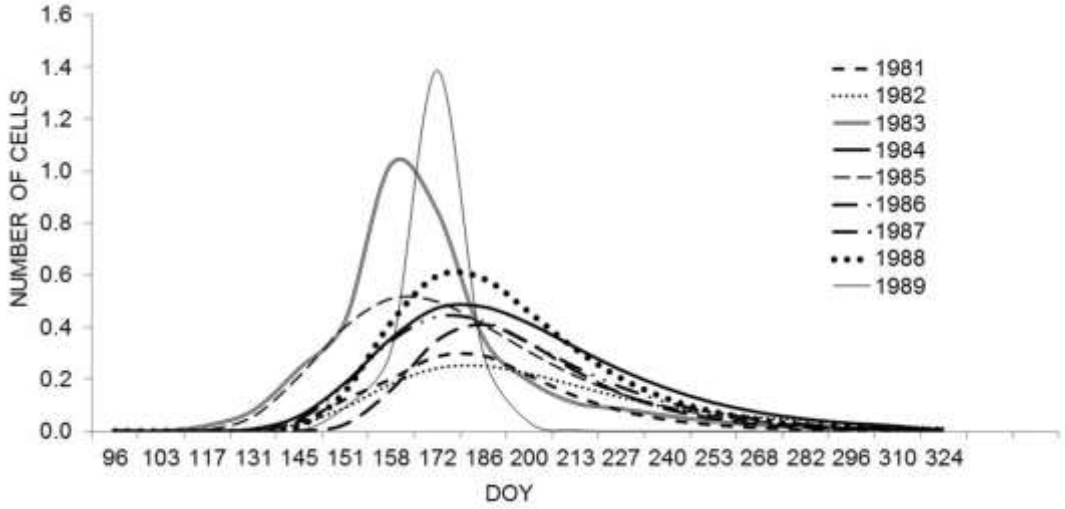
The relationship between the seasonal dynamics of xylem formation and environmental factors

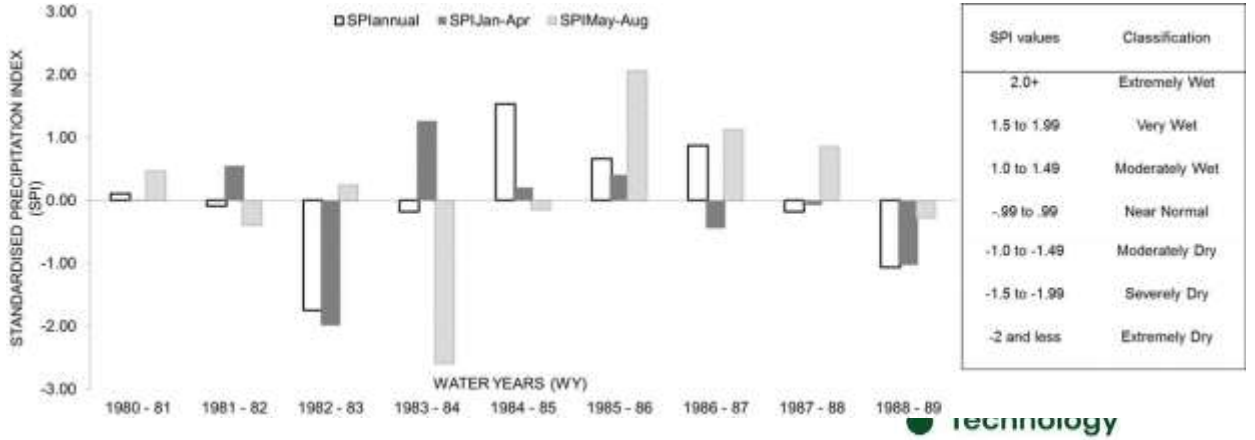
Estimation of the influence of anticipated climate change scenarios on

tree performance,

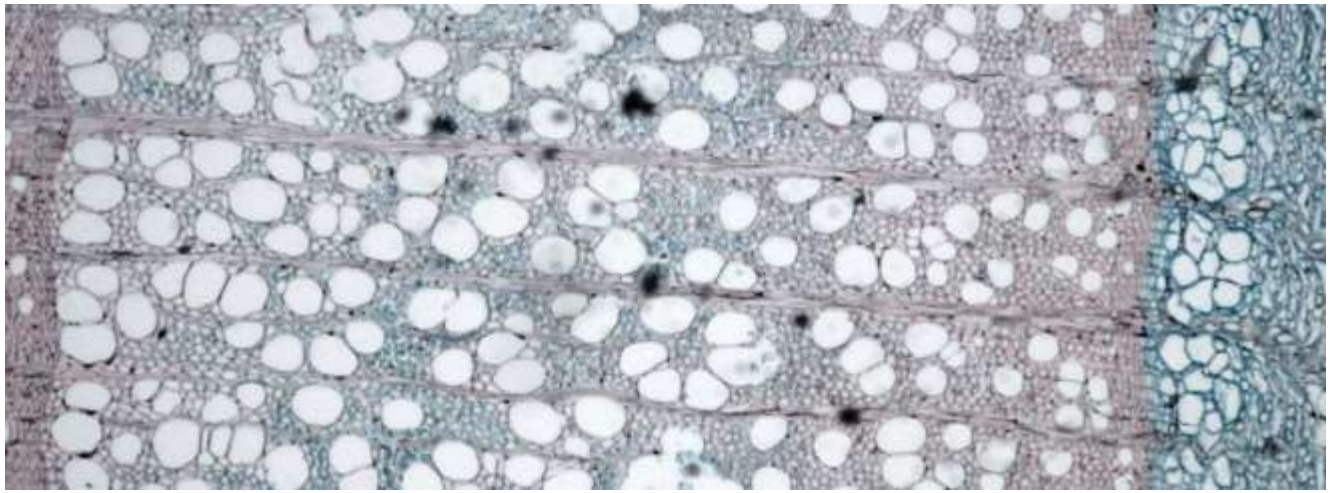
wood structure and

adjustment to future weather conditions.

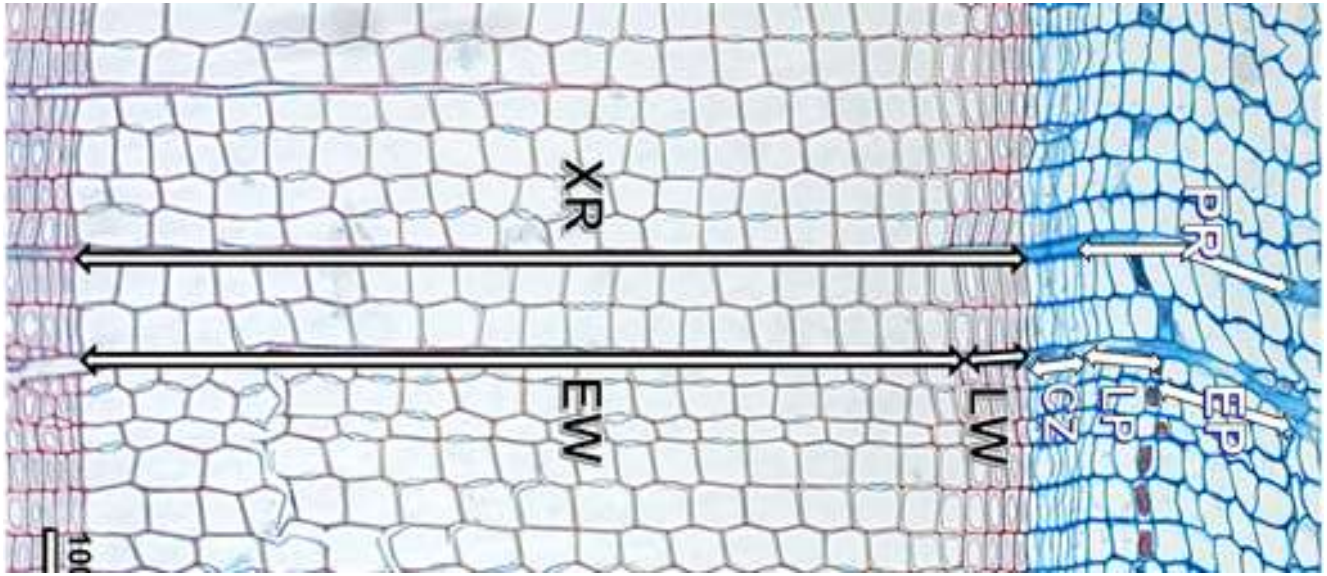


# The tree ring



*Hardwood (European beech)*



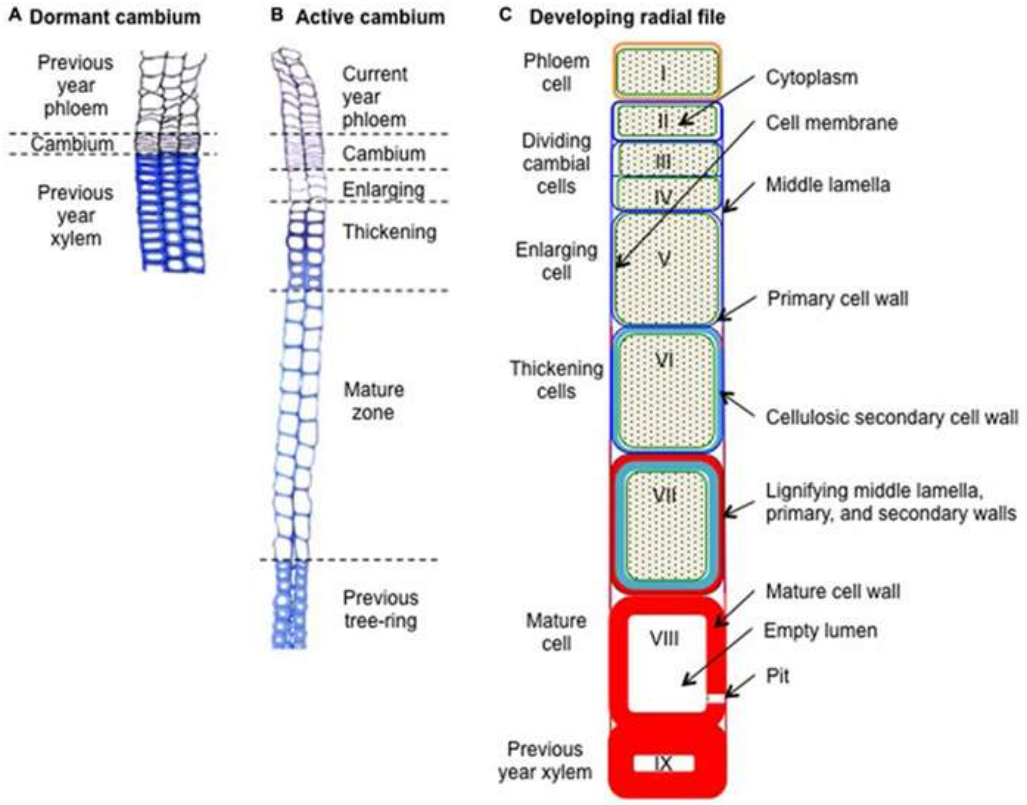

*Softwood (Norway spruce)*

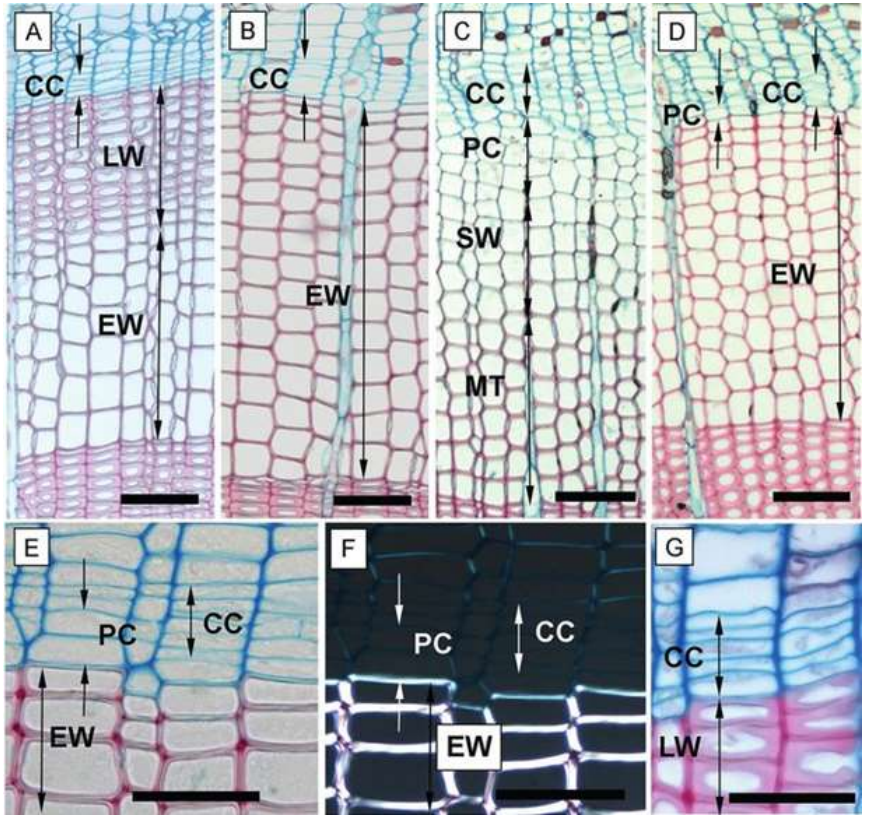
Under the microscope

The radial stem growth is a complex process which includes cell division, cell expansion, cell wall thickening, lignification and programmed death.

The formation of a xylem element can be divided in five major steps:

(1) the periclinal division of a cambial mother cell that creates a new daughter cell;
(2) the enlargement of the newly formed xylem cell;
(3) the deposition of cellulose and hemi-cellulose to build the secondary cell wall;
(4) the impregnation of the cell walls with lignin; and finally,
(5) the programmed cell death



# *Laboratory microcore processing for wood formation monitoring*

**Workshop Wood+**

Monitoring the xylem & phloem formation of LKWS

29th September – 1st October 2021

Faculty of Forestry and Wood Technology

Mendel University

Brno, Czech Republic

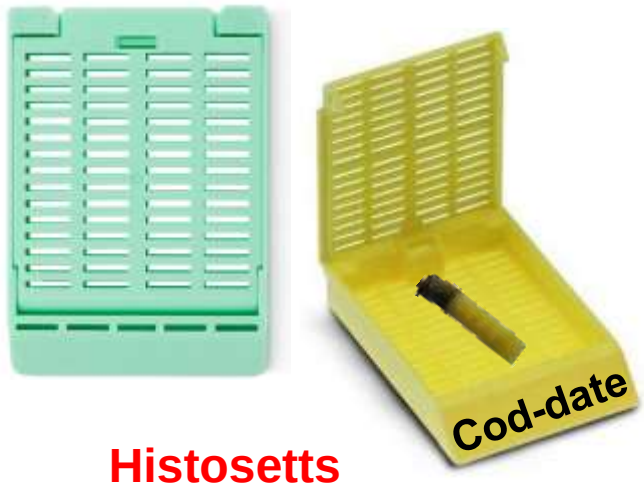
This workshop has been funded with support from the European Union. Project number: 2020-1-CZ01-KA203-078483.

MENDELU
Faculty of Forestry and Wood Technology

# A. Microcore sampling extraction (at the forest / research field)

Trephor tool

- Weekly microcore sampling, at breast height, healthy dominant trees (unless others research purposes).
- Select a sampling point and remove the excess bark (when necessary) with a ***chisel***. Sampling points distance minimum 10 cm.
- Hold and ***hammer*** the piercing head of ***Trephor tool*** against the sampling position, rotate the tool to separate the microcore from the xylem.




Histosetts

MENDELU
Faculty of Forestry and Wood Technology

# A. Microcore sampling extraction (at the forest / research field)

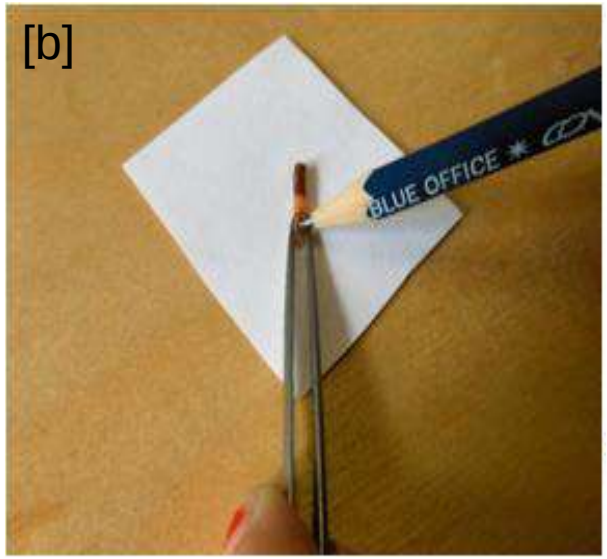
- ***Place the microcores*** (two in each sampling point) ***directly into the histosetts and transfer them into a bottle filled with FFA*** (ethanol-formalic acetic acid) solution, for maximum a week.



MENDELU
Faculty of Forestry
and Wood
Technology

# B. Microcore Tissue Processor (TP) preparation

- **The transverse plane of the microcores is identified**
  **and marked with a pencil** (Image b).
- Histosetts with the one microcore are temporarily placed into ethanol solution (Image c) and then transferred to the ***tissue processor (TP)*** basket.
- Back up microcores are stored with ethanol solution in microtubes (Image d).




MENDELU
Faculty of Forestry and Wood Technology

# C. Microcore Tissue Processor (TP)

**TP**: dehydrates and infiltrates microcores with ***successive immersions*** in various ethanol solutions, Bioclear and liquid paraffin
The whole procedure lasts around 22 h.
***After TP the microcore samples can be embedded in paraffin blocks***

MENDELU
Faculty of Forestry and Wood Technology

# D. Microcore embedding in paraffin blocks

- During embedding treatment histosetts and metal moulds should be kept in the ***oven*** at around 60 °C


- ***Paraffin dispenser with a heated plated and integrated heatable forceps (60 °C)***

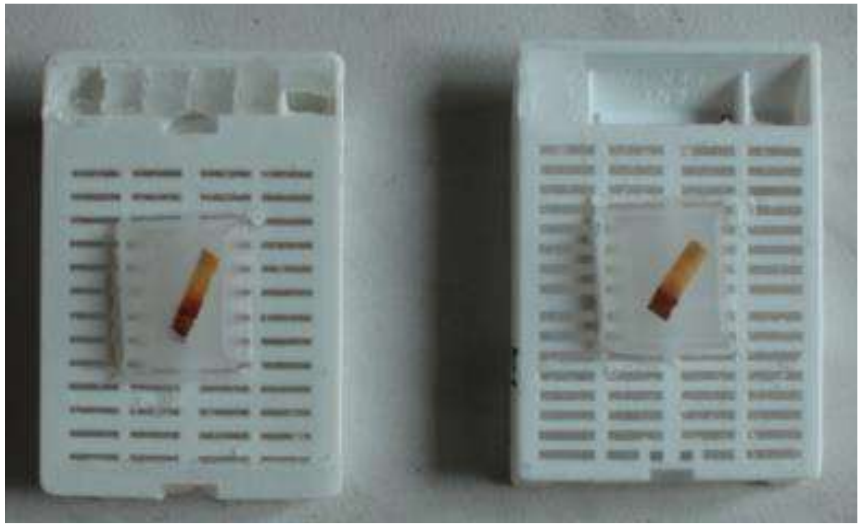
- ❑ Place the microcore sample (histoset from the oven) with a metal mould on the heated plated.
- ❑ Find the transverse section of the microcore and place it into the mould (which is slightly filled with paraffin).
- ❑ Place mould into a petri dish (few seconds) and then fast fill the mould with paraffin.

**Attention: microcores should be orientated with an angle inside the metal mould**

MENDELU
Faculty of Forestry
and Wood
Technology

# D. Microcore embedding in paraffin blocks

- The metal moulds containing the embedded with paraffin microcore samples are cooled down at room temperature or the refrigerator

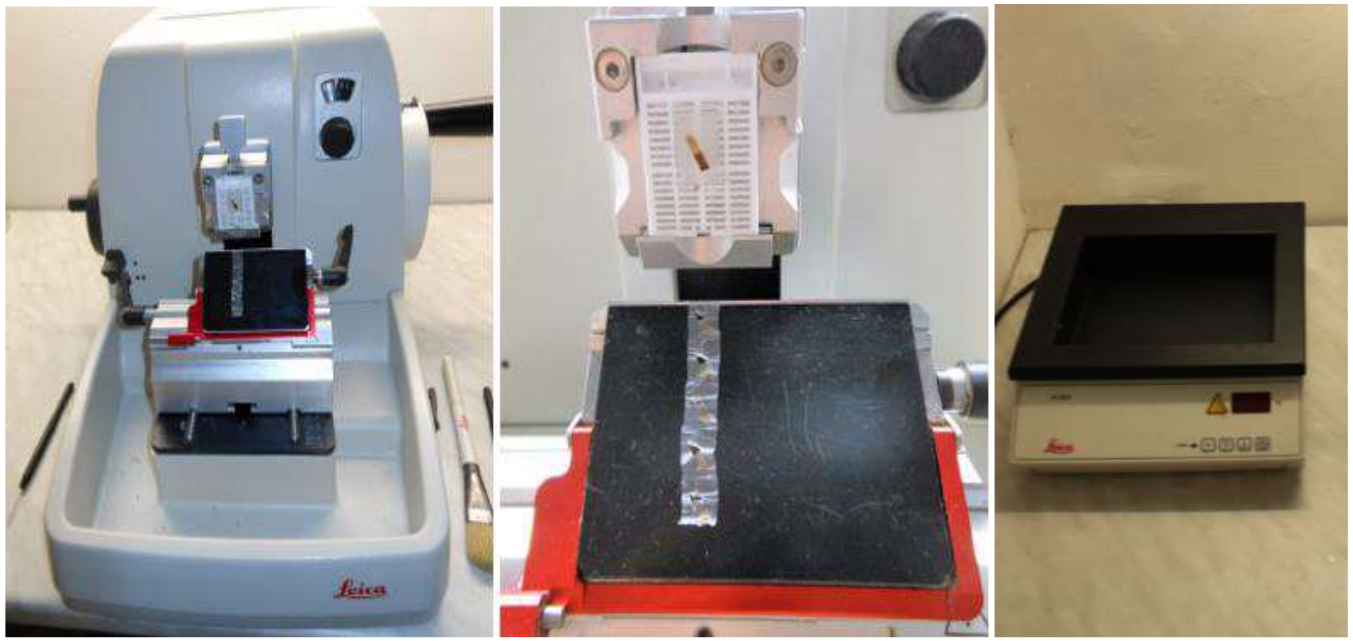


- Following the embedding wood tissue blocks are ***trimmed into a trapezoid shape to ensure the smallest possible surface***

❑ Before sectioning with the microtome, the paraffin blocks are trimmed to reveal the wooden surface and then placed overnight into distilled water to smooth the wooden tissue.

MENDELU
Faculty of Forestry and Wood Technology

# E. Cutting in a half-automatic rotary microtome



- **Gluing**

  Put a drop of Glykerin Albumin on a microscope glass slide and spread the adhesive on it.

- **Cutting**

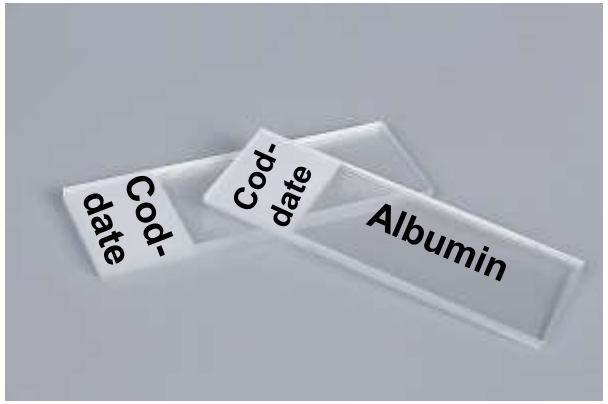
  Clamp the microcore paraffin blocks into the microtome holding head with phloem side facing down and produce a series of thin sections.

- **“Fishing”**

  Move the thin sections from cold to warm water (≈ 41 °C) to stretch them and put the paraffin film containing the sections on the glued microscope slides

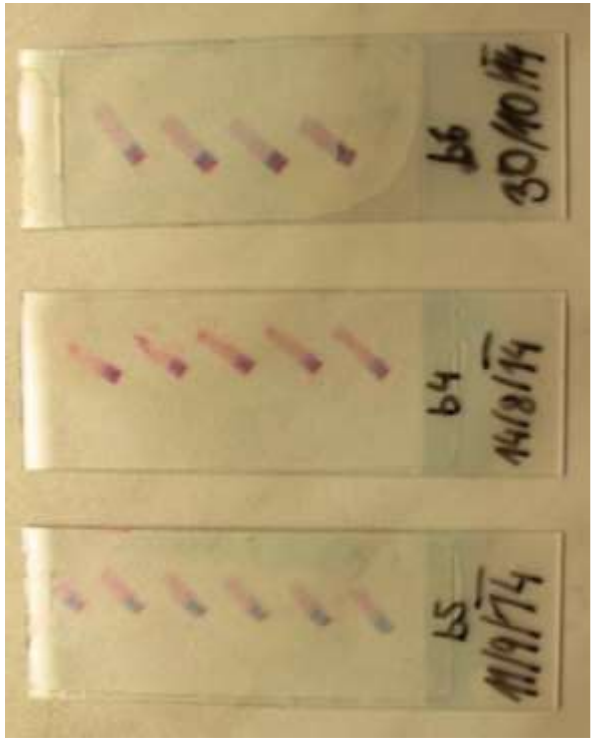
- **Drying**

  Dry the microscope slide with the paraffin films in an oven for 3 h at 60 °C




MENDELU
Faculty of Forestry
and Wood
Technology

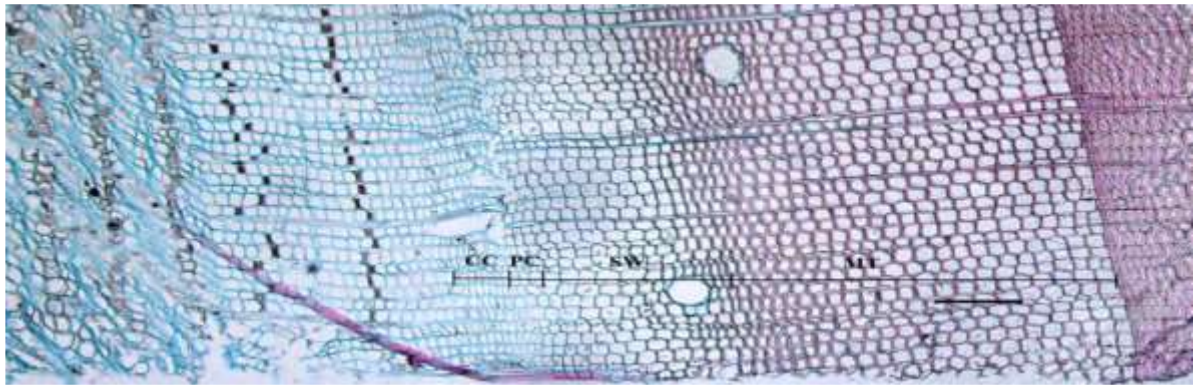
# F. Staining (preparation for microscope analysis)

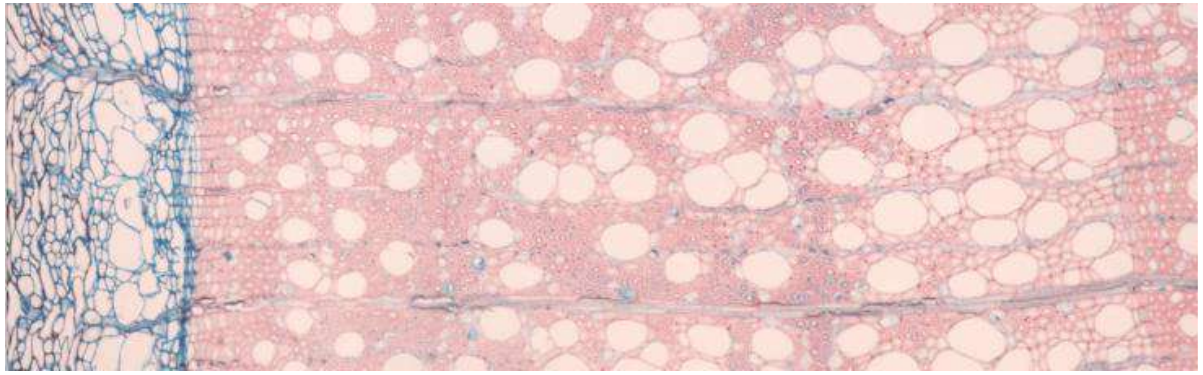



- Clearing the slides from paraffin with successive Bioclear, ethanol solvents
- Staining with safranin-astra blue mixture
- Mounting with Euparal medium and cover them with a cover glass

MENDELU
Faculty of Forestry and Wood Technology

# G. Microscope analysis



Observe the sections under the optical microscope and identify the phenological phases and number of the developing xylem and phloem cells

MENDELU
Faculty of Forestry and Wood Technology

# Recent Publications


Fajstavr M*, Giagli K, Vavrčík H, Gryc V, Horáček P, Urban J (2020). **The cambial response of Scots pine trees to girdling and water stress**. IAWA 41: 159 – 185. DOI: https://doi.org/10.1163/22941932-bja10004

Fajstavr M*, Paschová Z, Giagli K, Vavrčík H, Gryc V, Urban J (2018). **Auxin (IAA) and soluble carbohydrate seasonal dynamics monitored during xylogenesis and phloemogenesis in Scots pine**. iForest 11: 553 – 562. DOI: 10.3832/ifor2734-011

Martinez del Castillo E*, Prislan P, Gričar J, Gryc V, Merela M, Giagli K, de Luis M, Vavrčík H, Čufar K (2018). **Challenges for growth of beech and co-occurring conifers in a changing climate context**. Dendrochronologia 52: 1 – 10 DOI: org/10.1016/j.dendro.2018.09.001

Fajstavr M*, Giagli K, Vavrčík H, Gryc V, Urban J (2017). **The effect of stem girdling on xylem and phloem formation in Scots pine**. Silva Fennica 51 (4): 22 (article ID 1760). DOI: org/10.14214/sf.1760

Giagli K*, Gričar J, Vavrčík H, Gryc V (2016). **Nine-year monitoring of cambial seasonality and cell production in Norway spruce.** iForest - Biogeosciences and Forestry 9: 375 – 382.

Kolář T*, Giagli K, Trnka M, Bednářová E, Vavrčík H, Rybníček M (2016). **Response of the leaf phenology and tree-ring width of European beech to climate variability.** Silva Fennica 50(2): 18 (article ID 1520). DOI: org/10.14214/sf.1520



MENDELU
Faculty of Forestry and Wood Technology

# Thank you very much!

MENDELU
Faculty of Forestry
and Wood
Technology