
SLU
SCIENCE AND EDUCATION FOR SUSTAINABLE LIFE

# Root development under fluctuating soil physical stress – plastic and elastic responses

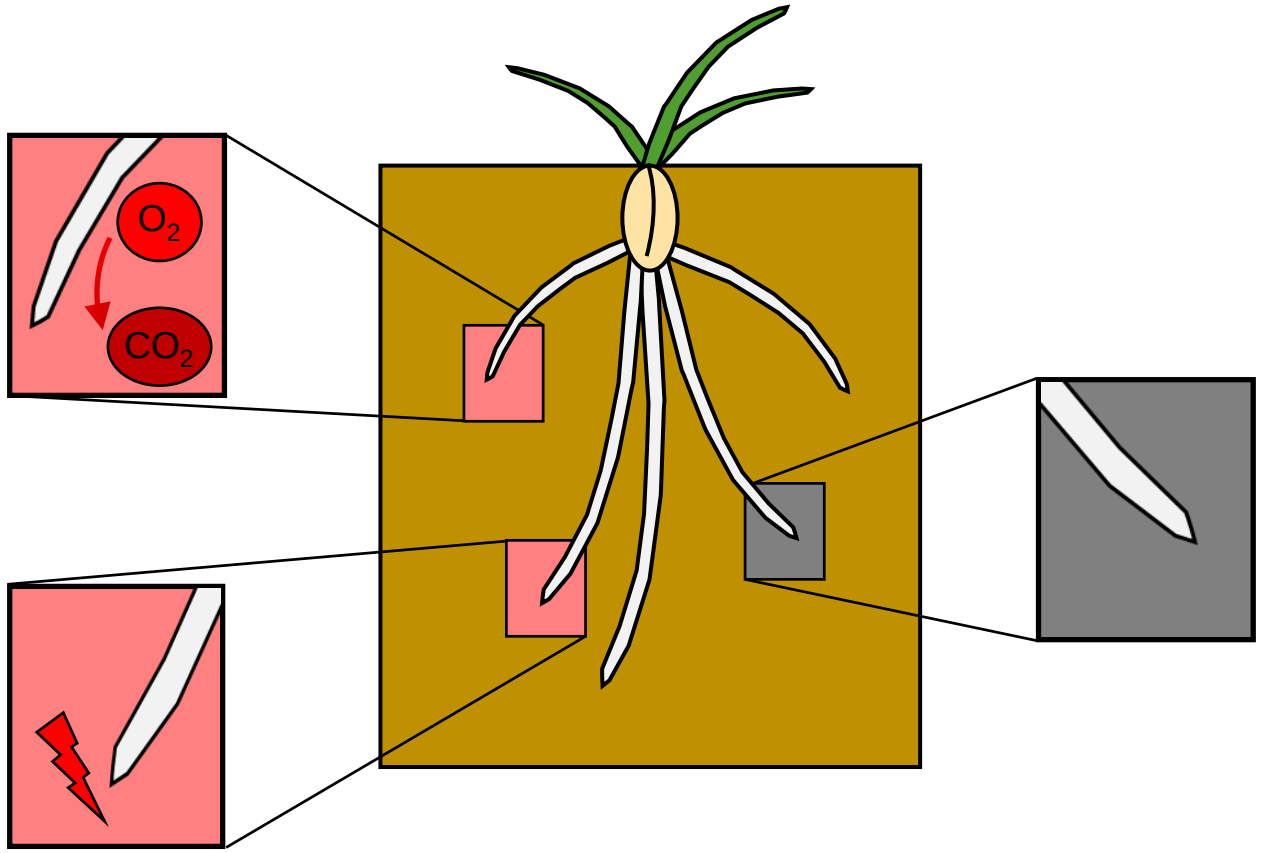
**Tino Colombi**[1], Hanna Sjulgård[1], Daniel Iseskog[1], Thomas Keller[1,2]
[1]Department of Soil and Environment, Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden
[2]Department of Agroecology and Environment, Agroscope, Zürich, Switzerland

# A root in its physical environment

*Heterogeneous and often (but not always!) unpleasant*

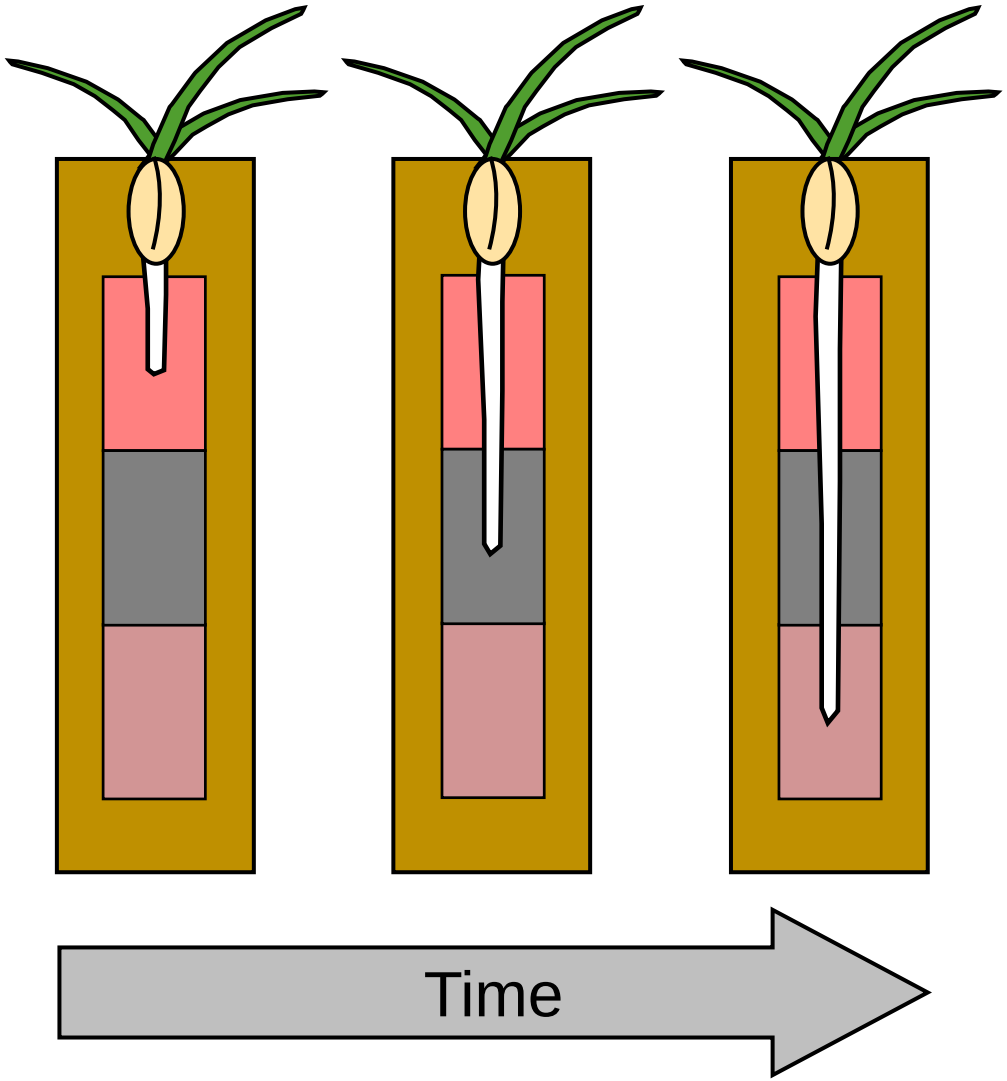
High biological activity
→ **Hypoxia**

Compaction, dry spots
→ **High pene-tration resist.**




**”Optimal”** growth conditions

# Fluctuating physical conditions during growth




Stressed

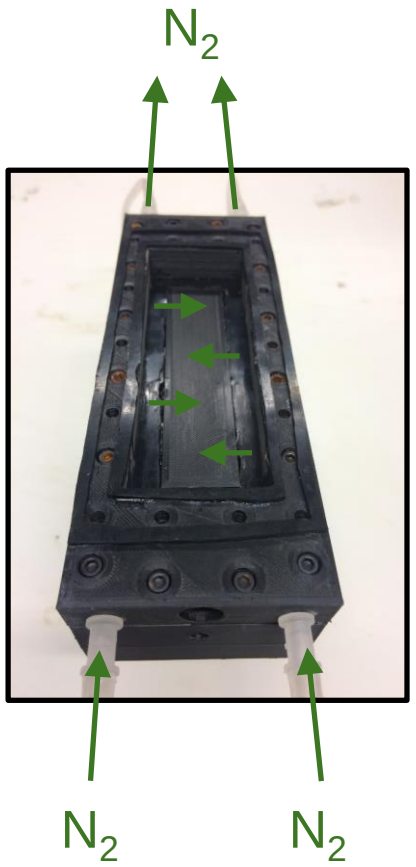
Not stressed

Stressed

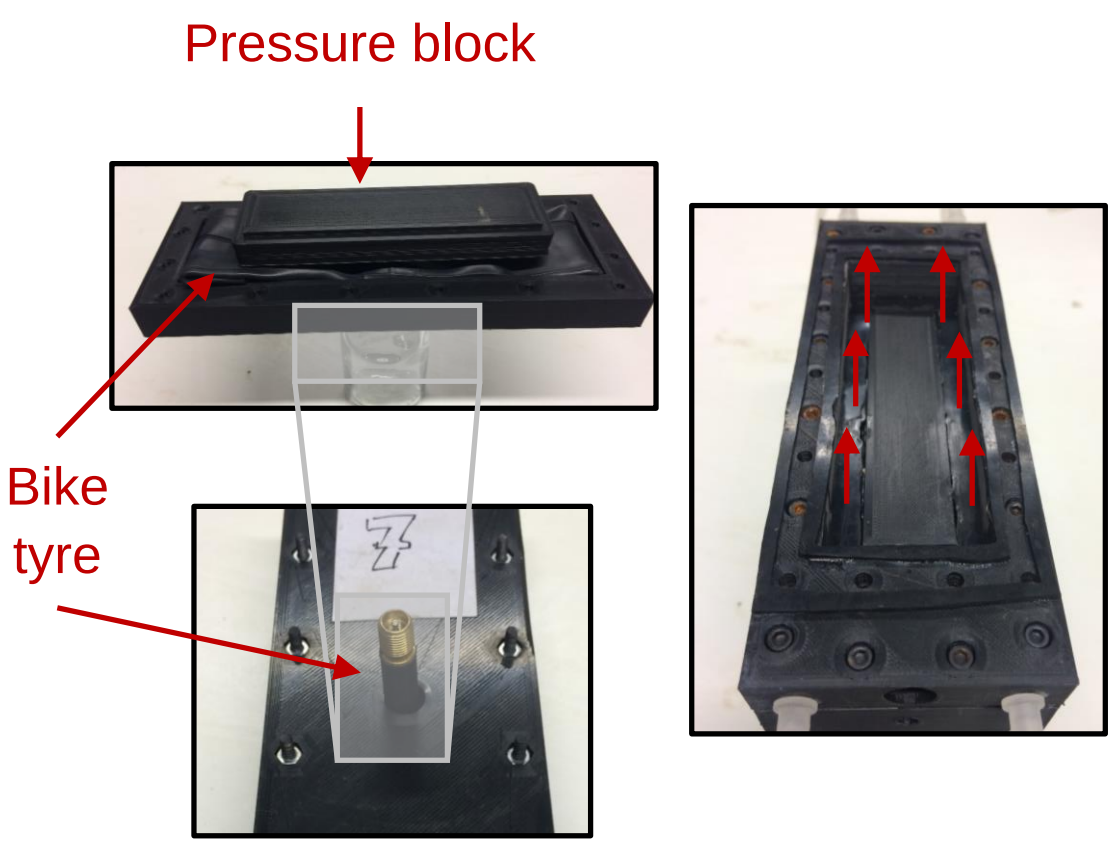
How does root development respond?

# Customized growth boxes to induce fluctuations

## Soil hypoxia

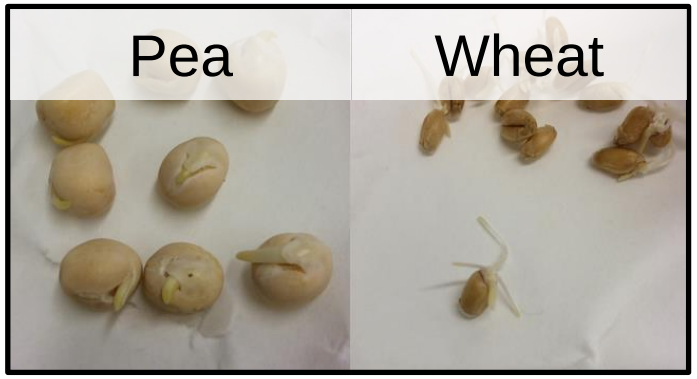



## Penetration resistance



# Experimental set-up

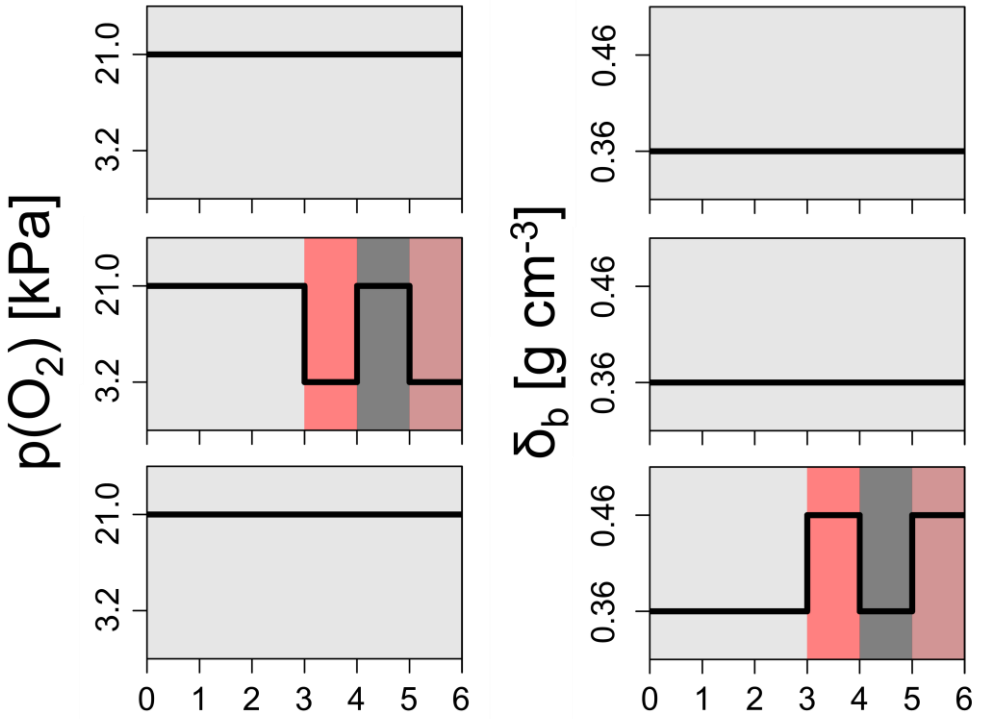
## Plant material




## Growth substrate

## Treatments

**Optimal (3 d)** → **Stress (1 d)** → **Optimal (1 d)** → **Stress (1 d)**




Control (Ctrl)

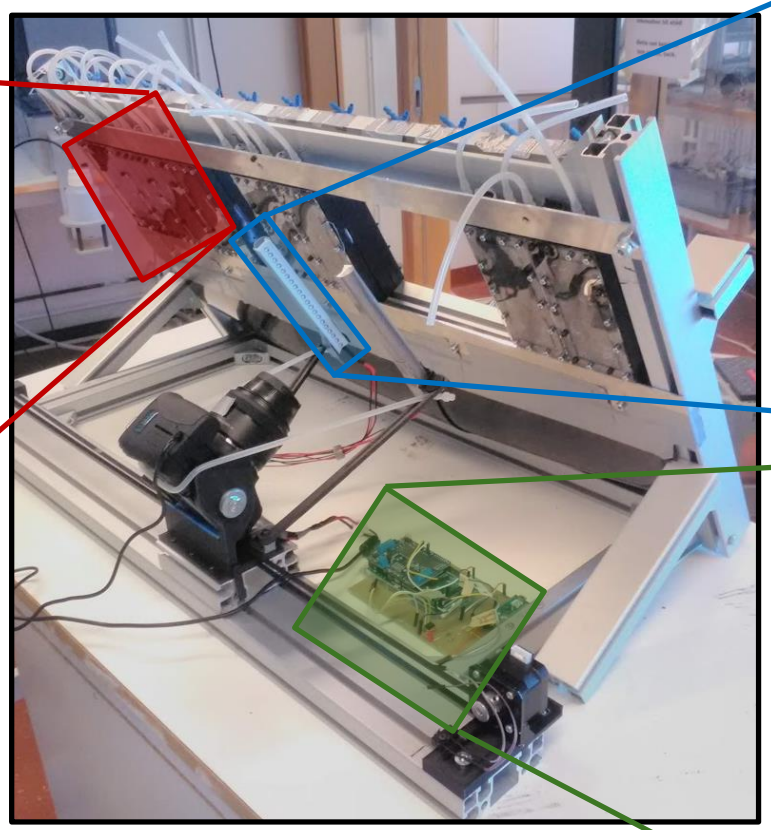
Hypoxia (HpOx)

Penetration resistance (PR)

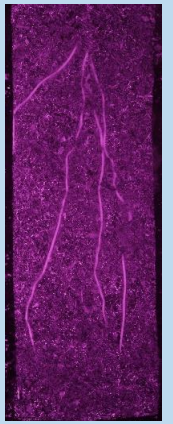
***Mild stress***

# Time-lapse imaging to monitor root growth

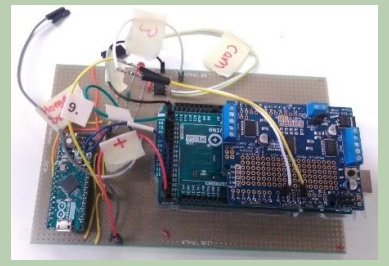
X 12



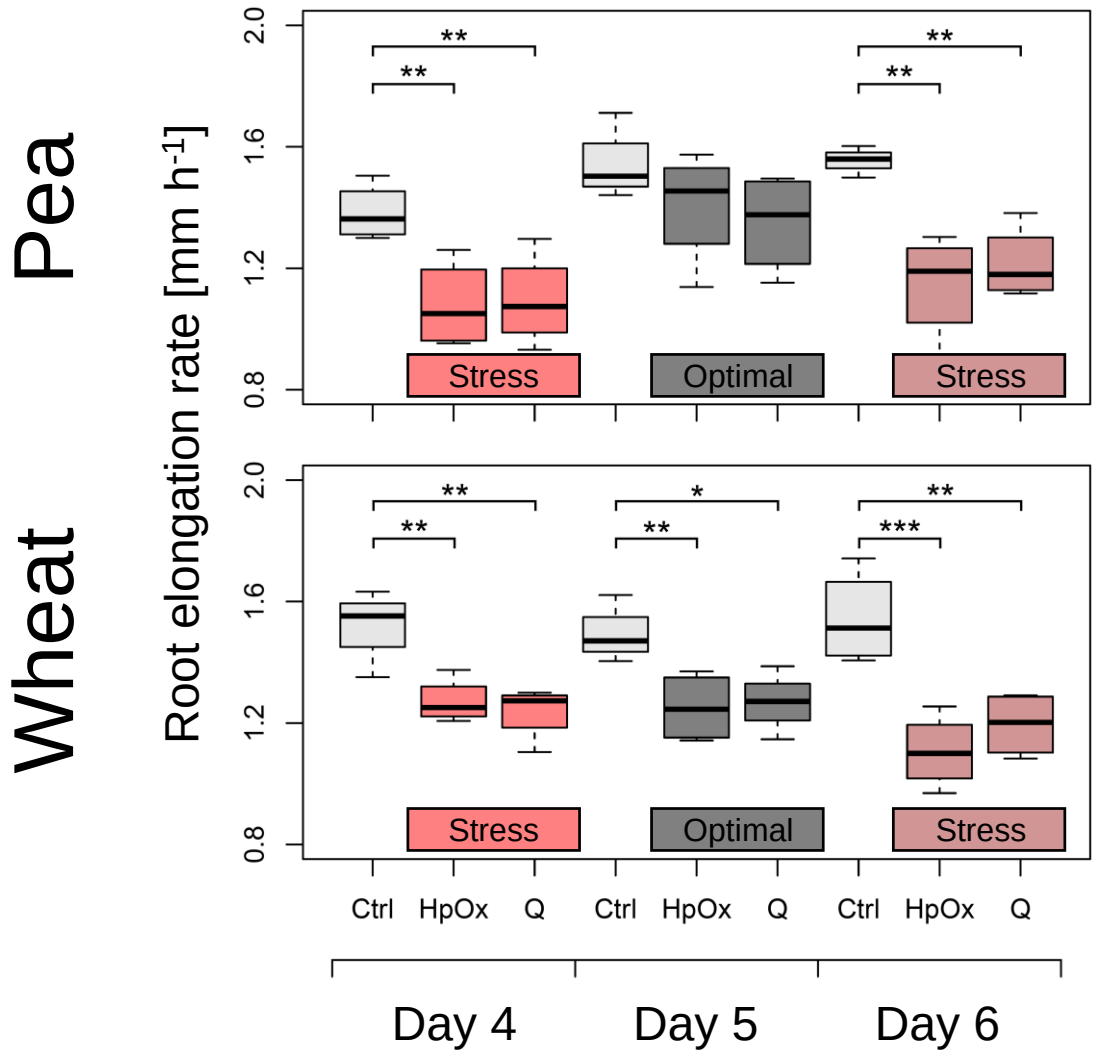
**830 nm LED**
→ Near infra-red



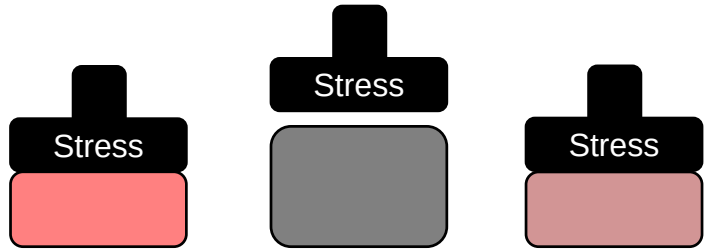
**Arduino ®**
→ Shutter, timer



# Different patterns in root growth rate

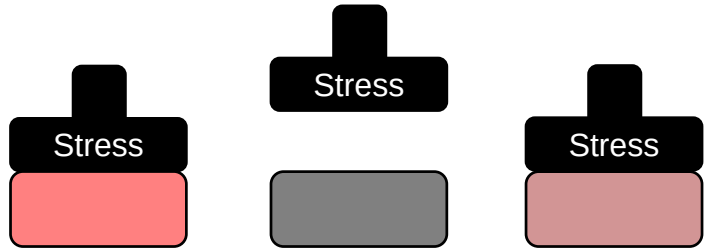



Recovery from stress



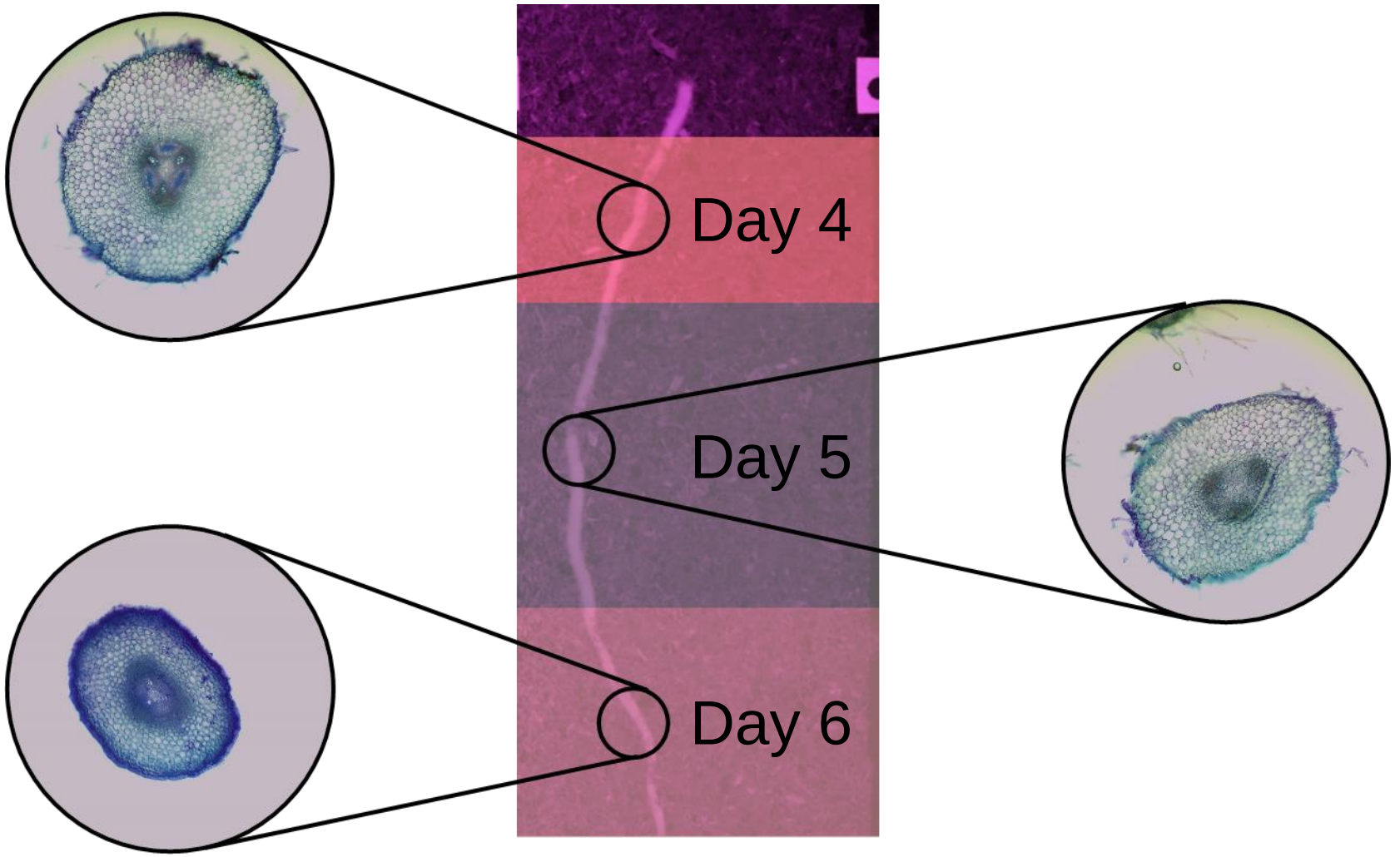

→ **Elastic response**

No recovery from stress



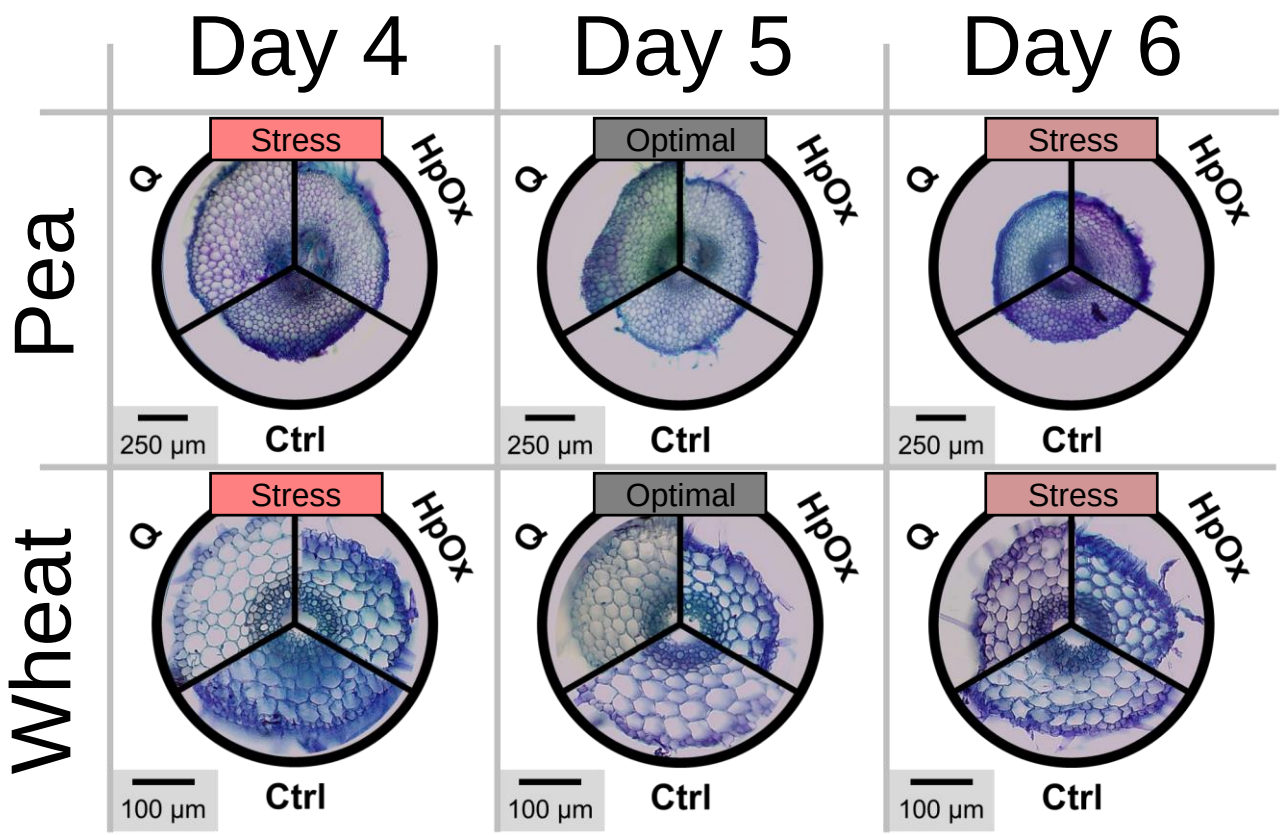

→ **Plastic response**

# Root morphological and anatomical adjustments




- Root diameter
- Cortical thickness
- Cortical cell size

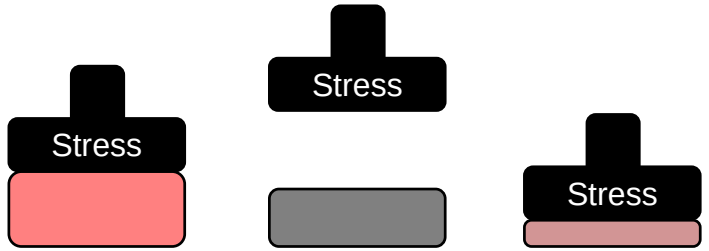
# Similar patterns in root morphology and anatomy




*p(days after transplanting) < 0.001*

HpOx and Q:

Progressive root (cortex) thinning

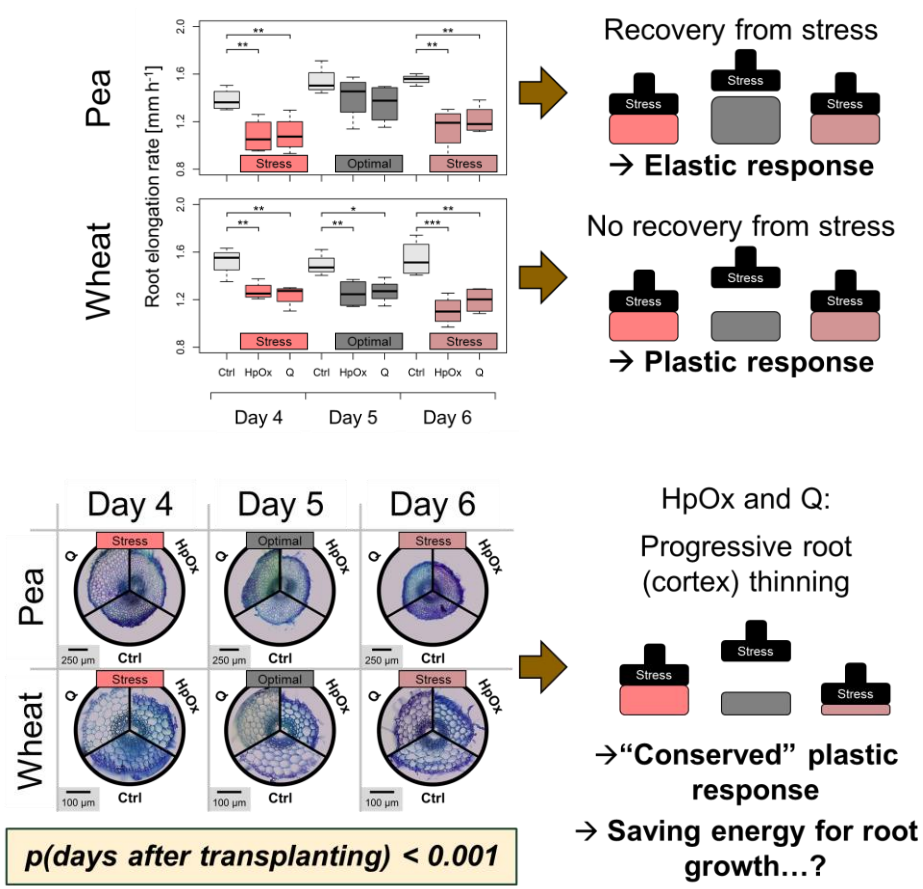



**→"Conserved" plastic response**

**→ Saving energy for root growth…?**

@ColombiTino
@SoilManage_SLU

# Summary and outlook




- Contrasting stress responses in root growth between species
- Similar morphological and anatomical adjustments to stress between species ("Energy conservation")

➢ Plants respond in various ways to "mild" (periodical) soil physical stress

➢ Implications for whole plant growth?

➢ Implications for soil structure dynamics (bioturbation, SOM input)?

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