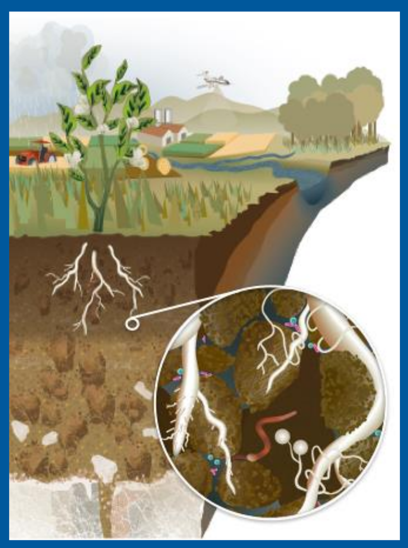

Combination of X-ray micro tomography and soil solution studies to analyse root system development and soil chemistry *in situ* as a response to different N-forms

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1 Introduction and Background

- **Urea** is the most widely used nitrogen (N) fertilizer worldwide and undergoes rapid hydrolisation in soil, after which the **ammonium is oxidized to nitrate**.
- Due to the use of **nitrification inhibitors**, the importance of **NH_4^+ as N source** for plant nutrition has increased.
- Because fertilizer is applied as **granules**, nutrient rich **patches** with high concentrations of **local N**, especially ammonium, are created.
- **Systemic repression** of lateral root (LR) growth by **high N status** of the plant and **local stimulation/inhibition** of LR growth by availability of **NO_3 / NH_4** occur.
- These responses have been shown in **gel and hydroponic** systems and are controlled by **external & internal signals**, associated with local & systemic **signalling pathways** in the plant.

2 Aims

- **Combination** of *in situ* analysis of **root system development** in the **soil** with **soil chemical studies** (e.g. pH & N-dynamics in **soil solution)**.
- Increase understanding of **temporal and spatial** dynamics of **root response** to **non-uniform** supply of N *in situ.*

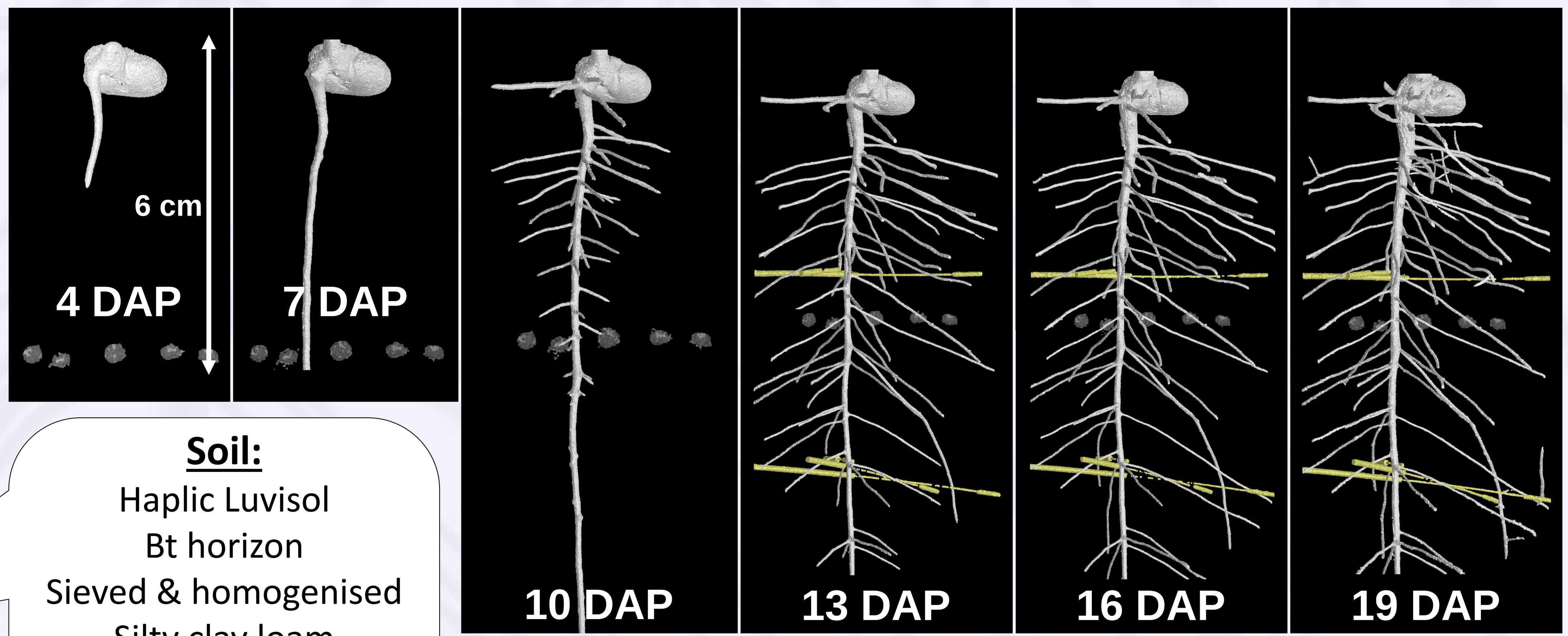
3 Methods

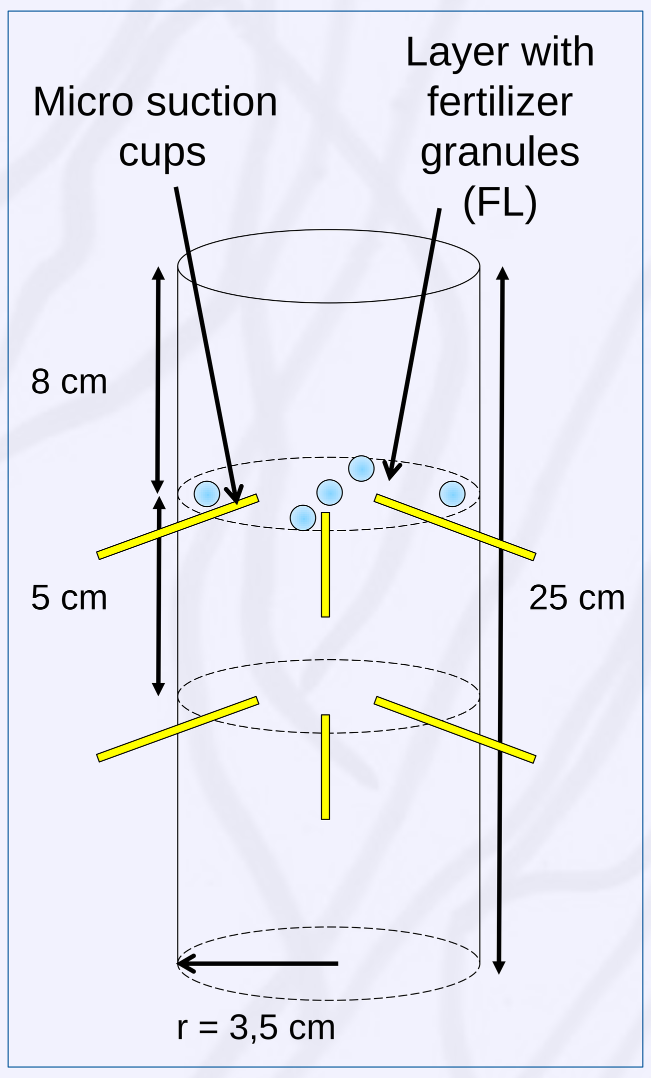
- Use of **urea granules** with and without **inhibitors** for nitrification (NI) to create **different N forms** (NO_3 / NH_4) in the **soil.**
- **Visualization** and **characterization** of **root system development** *in situ* by X-ray CT.
- Monitoring of **soil solution composition** with micro **suction cups**.
- Verification of **root parameters** by destructive sampling (WinRHIZO).

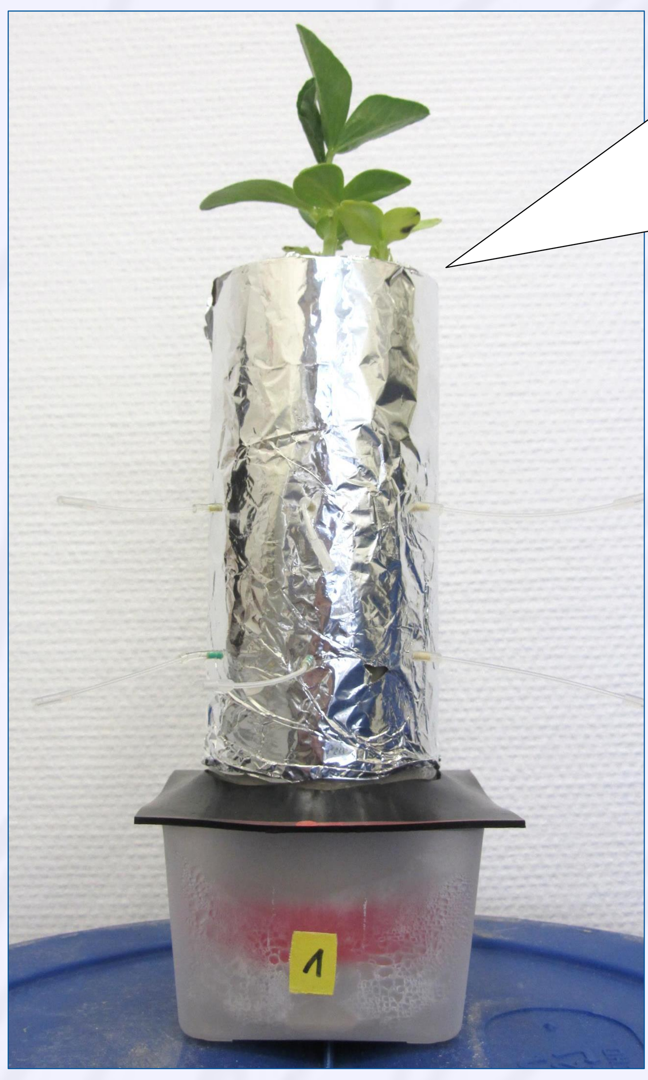
4 Preliminary results of X-ray CT and soil solution chemistry with faba bean (*Vicia faba)*

X-Ray Tomography:

- NIKON XTH 225
- Spatial resolution = 40 µm
- 140 kV, 286 µA = 40 W
- 0.5 mm Cu filter, 1000 projections
- Cumulative dose of about 9 Gy

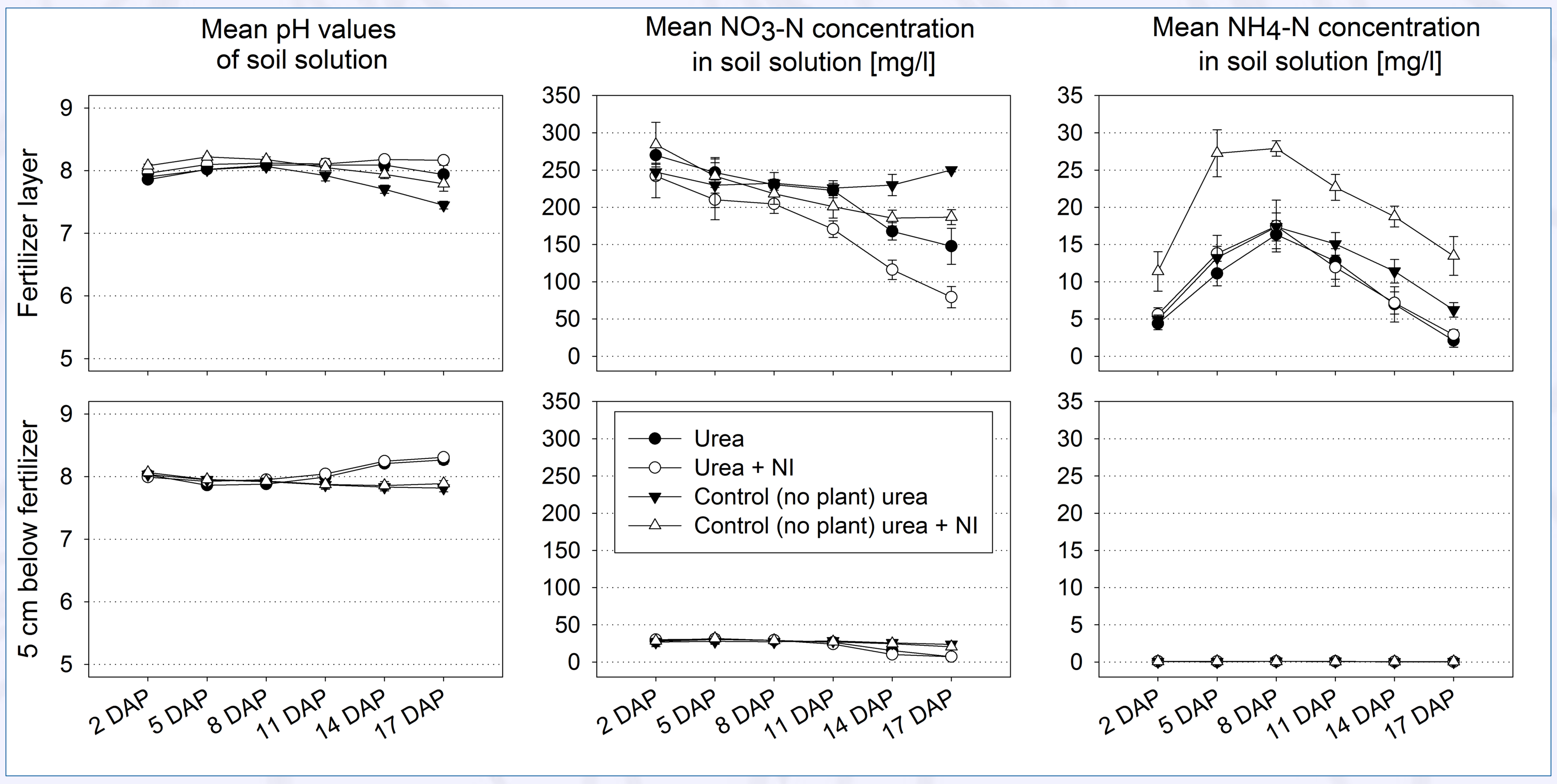






Soil:
Haplic Luvisol
Bt horizon
Sieved & homogenised
Silty clay loam
(4% sand, 68% silt, 28% clay)
Aggregated texture
Low background-N

Same temporal resolution!



Soil Solution Chemistry:

- 6 „MicroRhizons" per soil column
- Two sampling depths
- Vacuum chambers at -400 hPa
- Analysis of extracted soil solution (e.g. pH, NO_3-N, NH_4-N)

5 Conclusions

- Combination of X-ray CT and soil solution studies within the same temporal resolution improves understanding of root growth dynamics as a response to soil chemical conditions *in situ*.
- Known distances between roots, suction cups and site of granulated fertilizer application improve interpretation of data in respect to their 3D interaction.
- For the present soil, analysis of exchangeable ammonium is underway.

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