FAUPE – Root phenotyping

FAUPE Goal

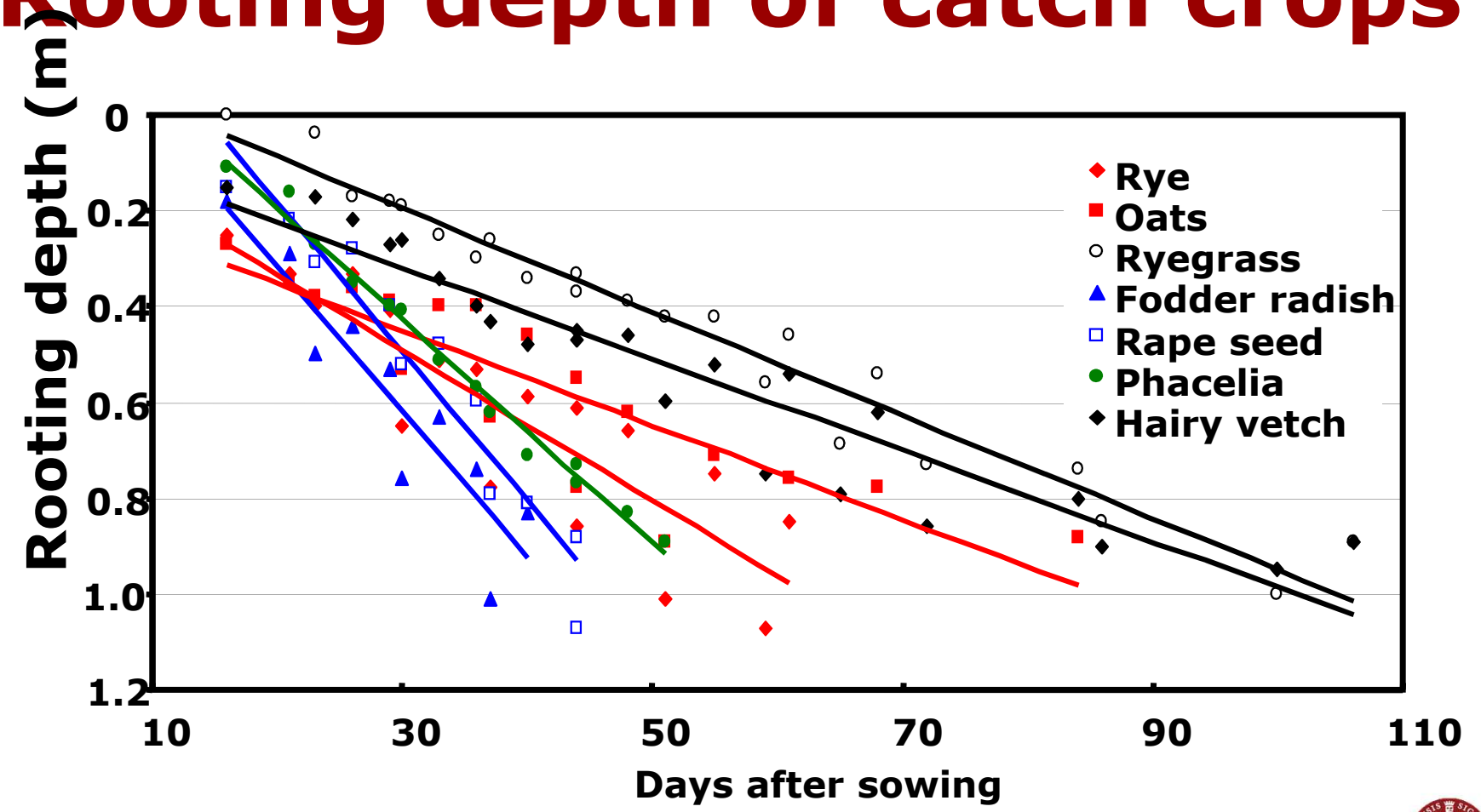
New, Fast and effective screening techniques to identify breeding material with improwed nutrient use efficiency (NUE) and tolerance to drought.

Main goal to reduce workload for screening

Rooting depth!

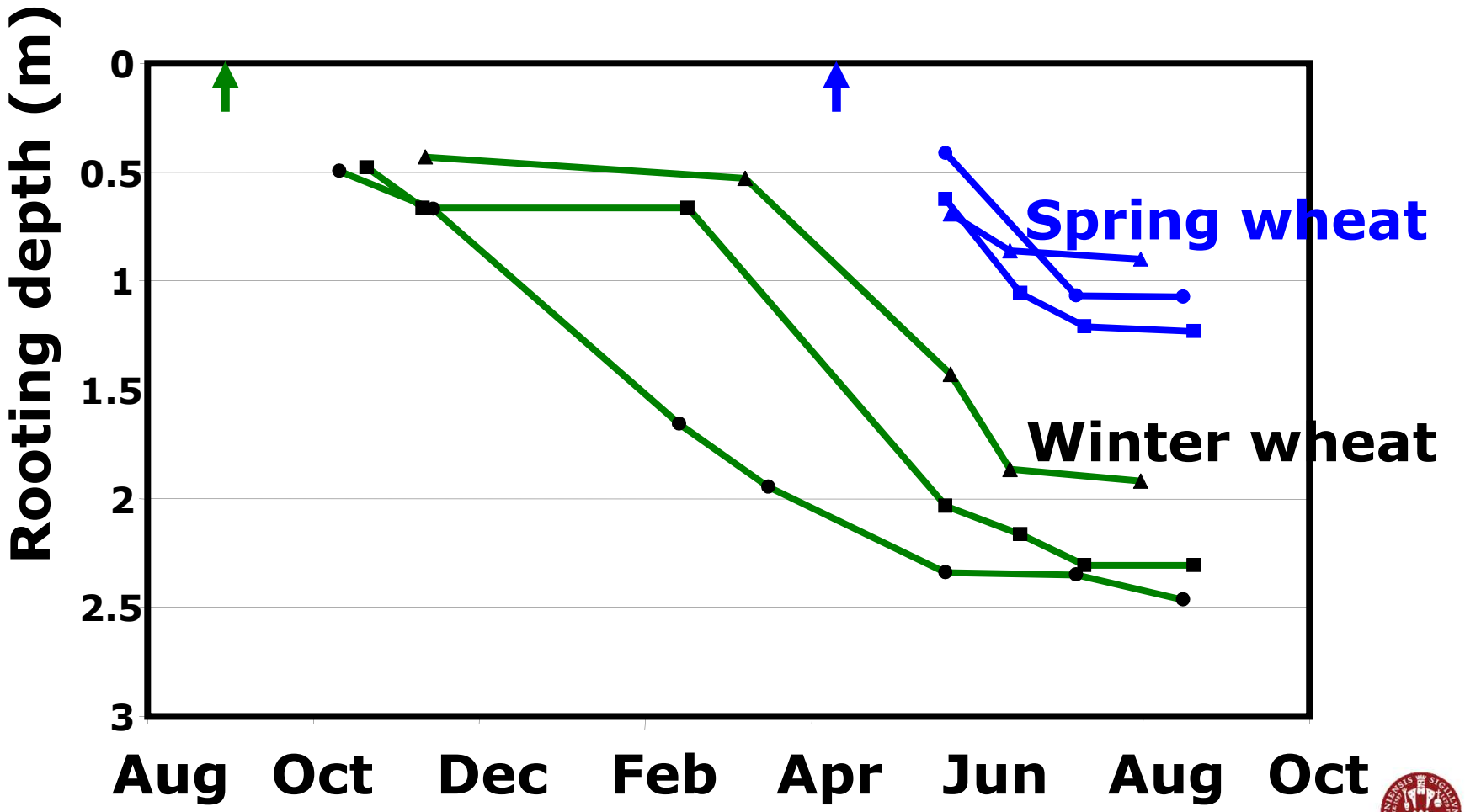
Kristian Thorup-Kristensen
University of Copenhagen
Department of Plant and Environmental Sciences

Rooting depth of catch crops



Rooting depth development of winter- and spring wheat

-results from three years



Methods for ”higher througput” screening

- **Work (deep) in soil**
  - Access is difficult and laborius
  - Visibility is zero
- **In the field soil**
- **In pots (tube rhizotrons)**
- **Observation methods**
  - Direct
    - Visual root observation
    - Various aspects of image analysis
  - Indirect
    - Sensors show root effect on soil, water content, conductivity…
    - Tracars showing effects on plants

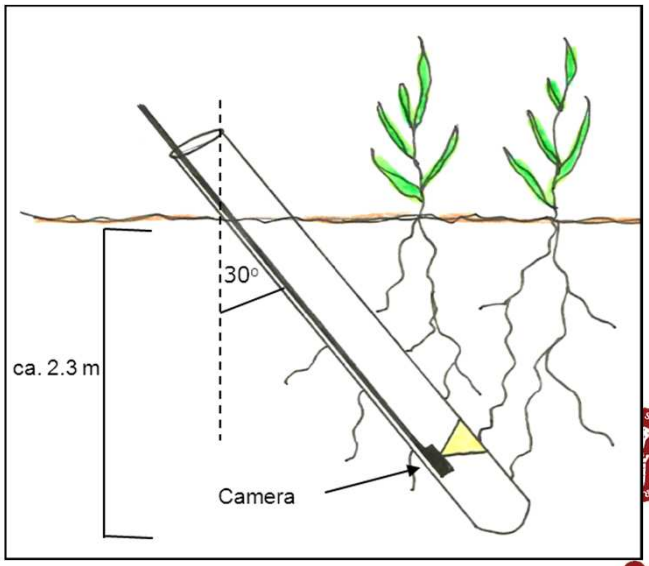
Root Screening in the field – Minirhizotrons and in-situ sensors

Wheat plots in the field with 3 m long rhizotrons for root observation installed.

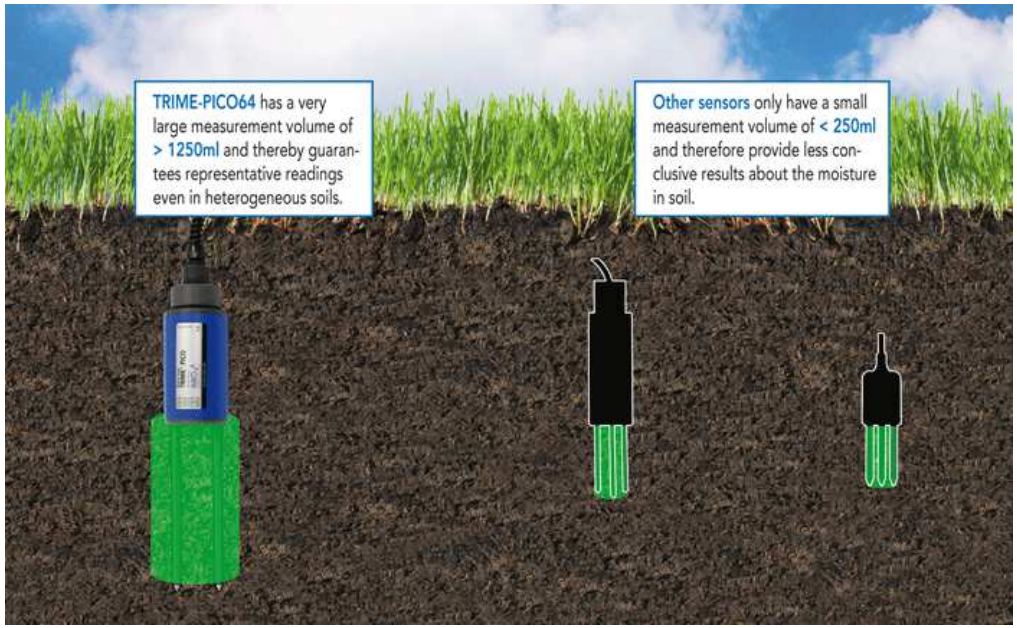
Sensors to detect root activity in a soil profile.

Insertion of a minirhizotron

Camera inspection of root growth



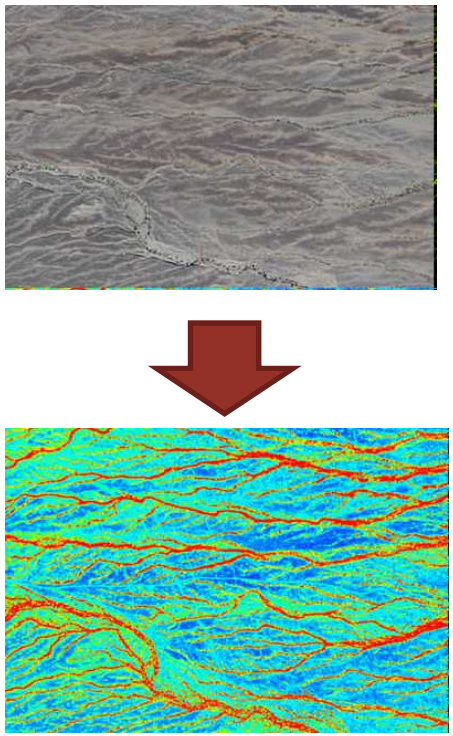
A range of probes available for soil moisture



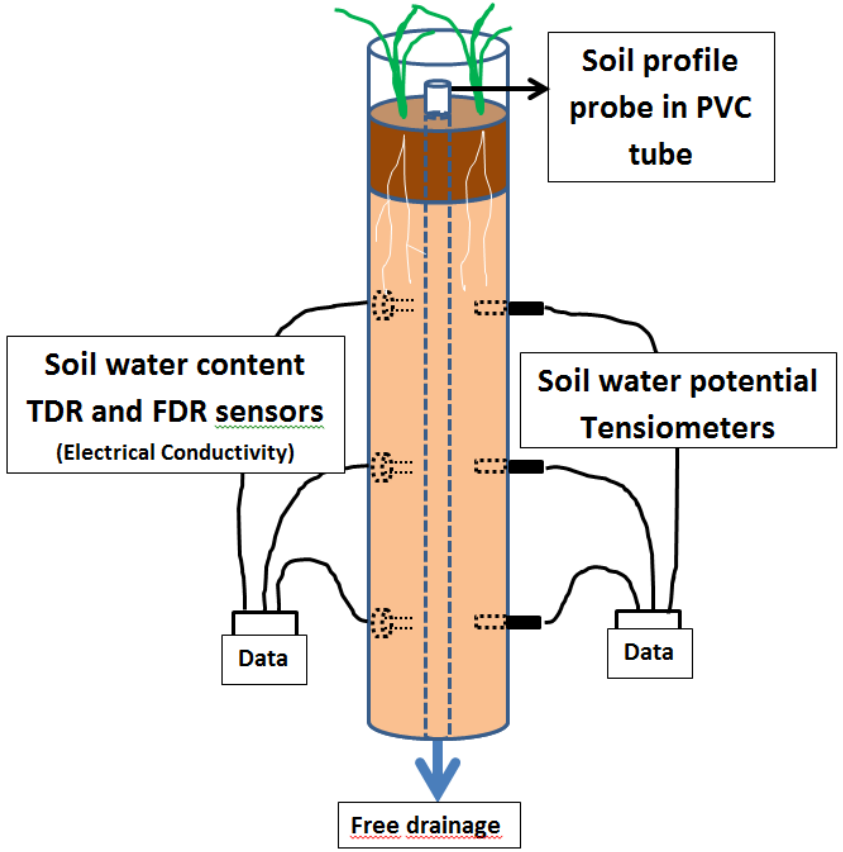
2014 Minirhizotron and sensor experiments

Improve image analysis of minirhizotrons images:

Multispectral image analysis in coopertaion with videometer



Test in-situ soil sensor technology to identify root activity. Sensing soil water and nurtient uptake by roots



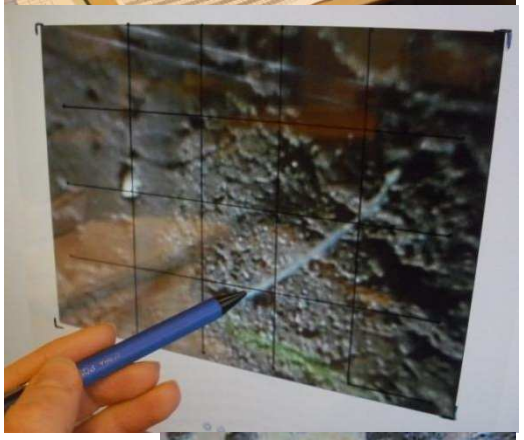
Method development for field root phenotyping platform (DeepRoot)

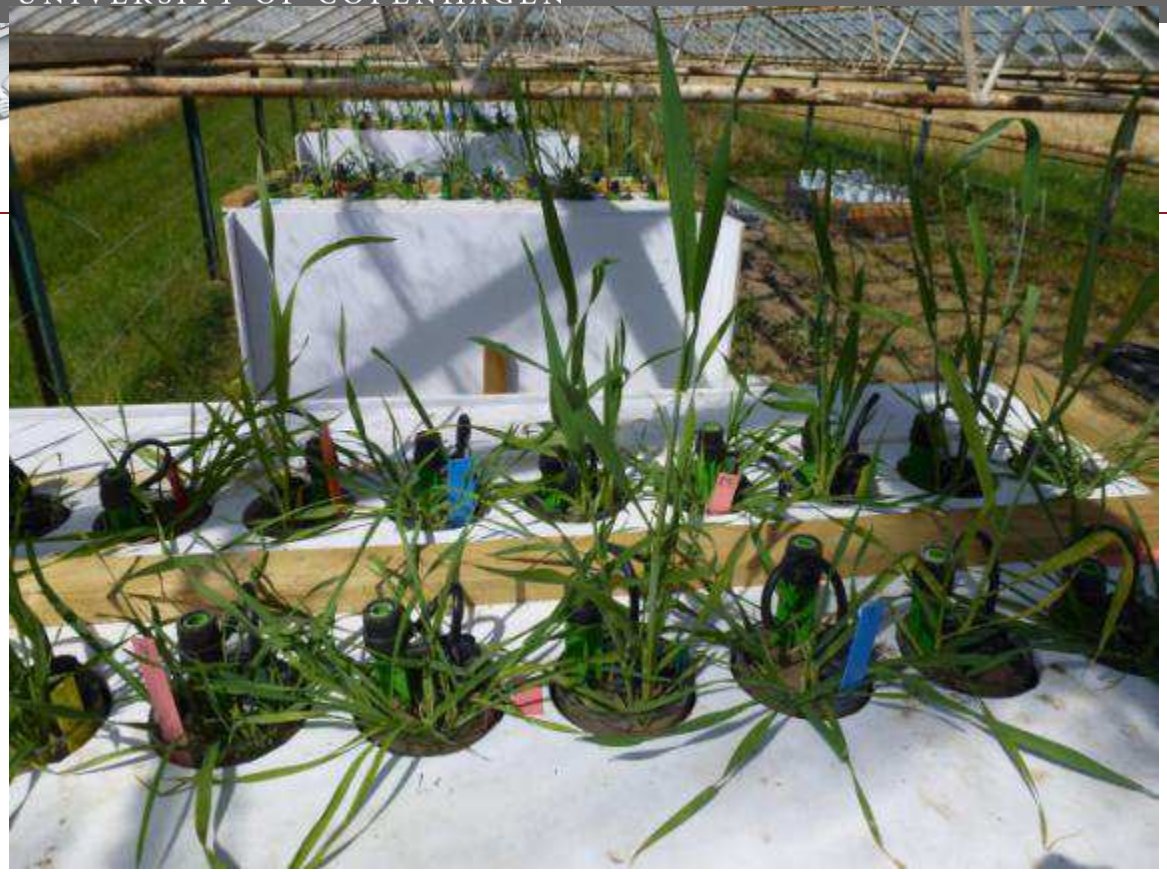
Sensors for root activity (water and N uptake)

- Conductivity sensors
- TDR

Automated root image analysis

- Picture comparison over time, analysing for changes (due to root growth and/or activity)
- Picture analysis for root recognition based on different Wavelenths

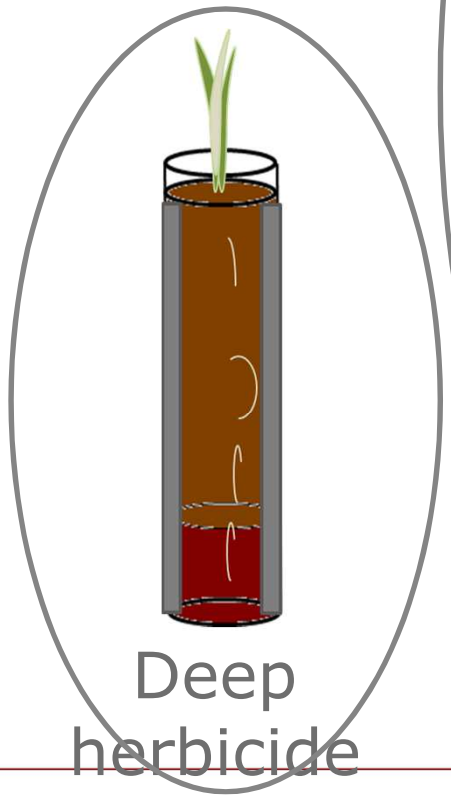




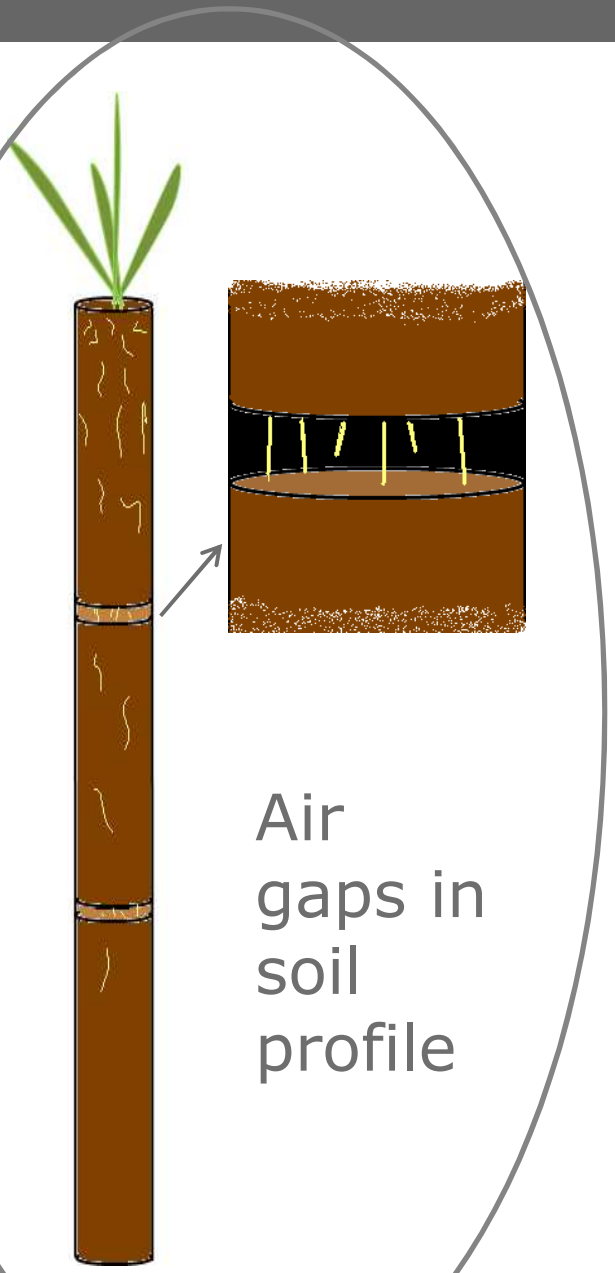
Root screening in aboveground Tube-Rhizotrons

2014: Improve the experiemental set up

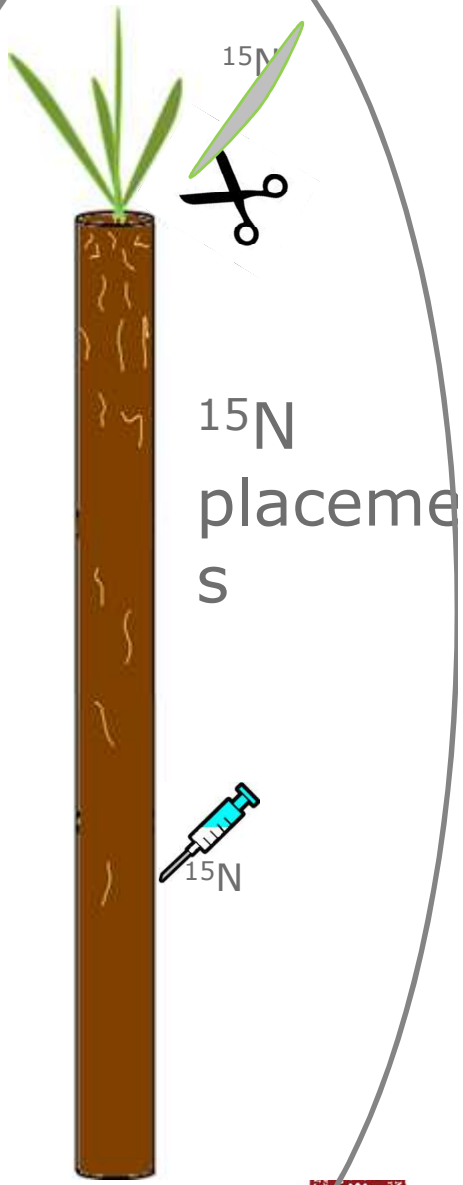
Focus: depth penetration rates



Deep herbicide



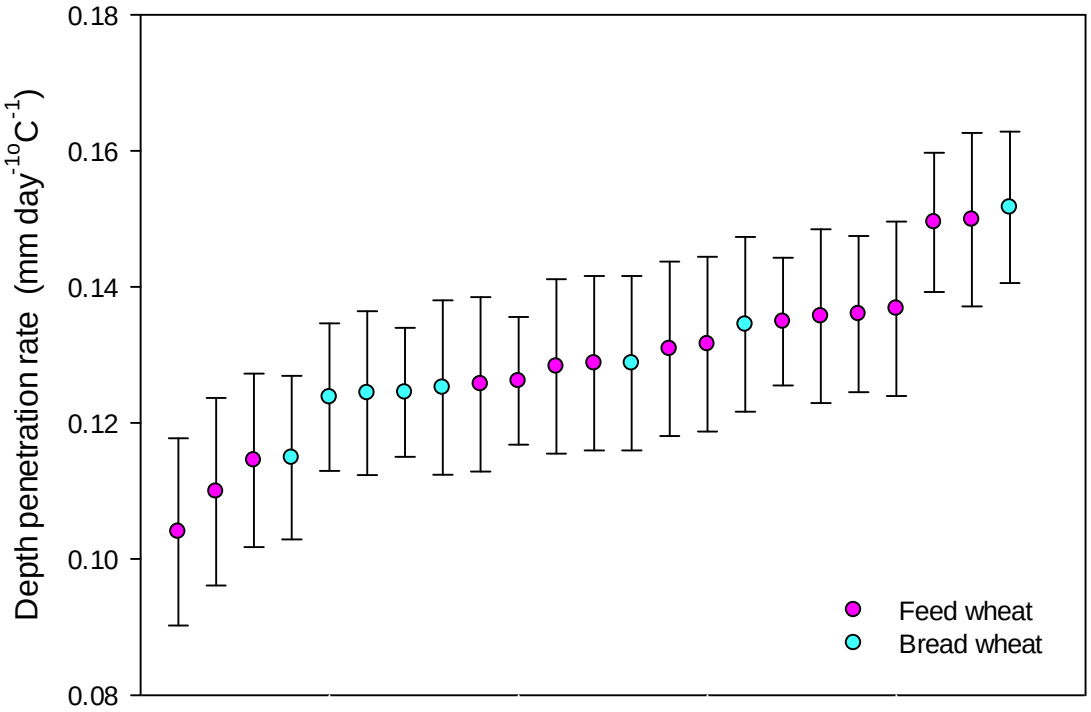
Air gaps in soil profile



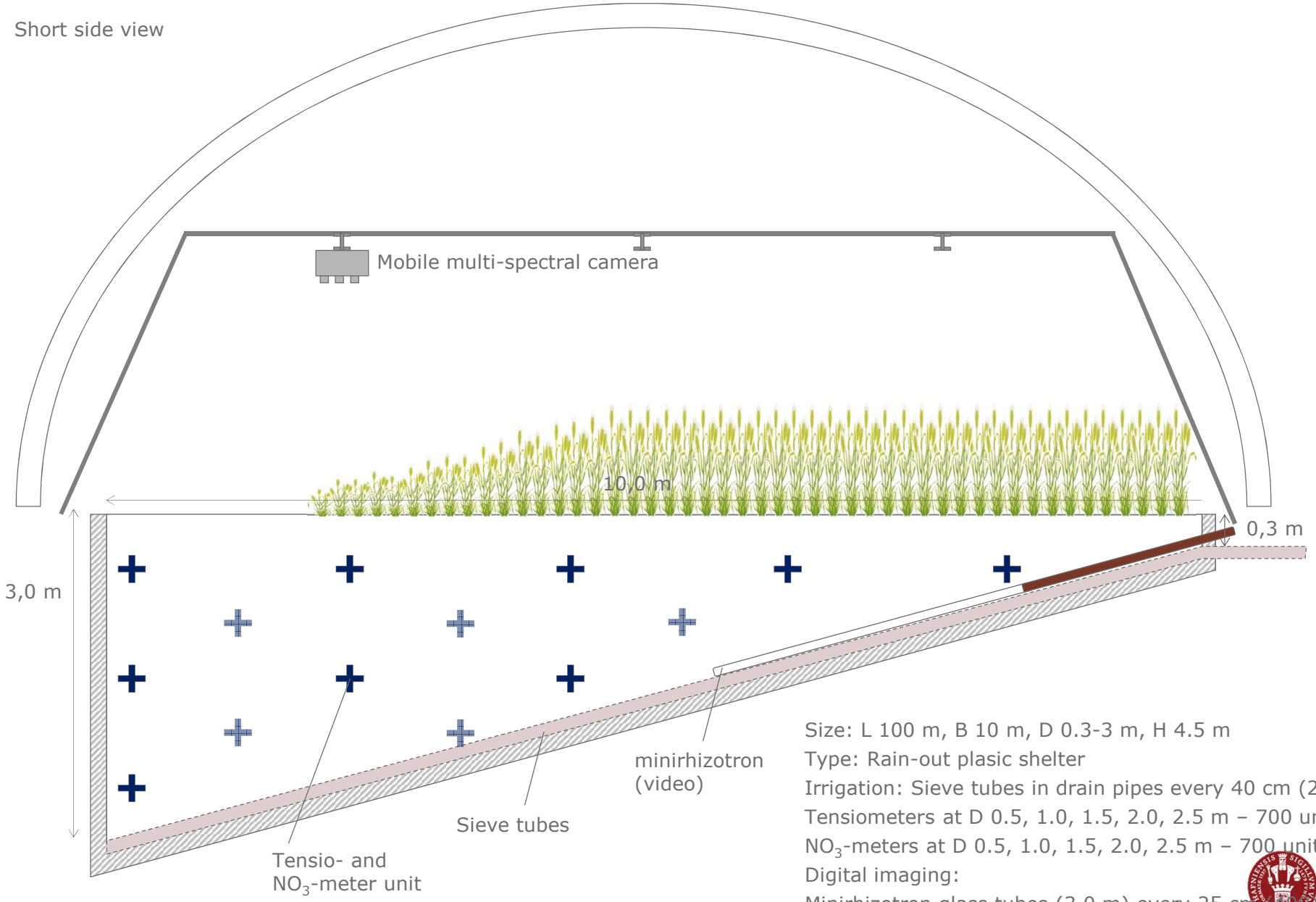
15N placeme s

15N

Differences in depth penetration rates

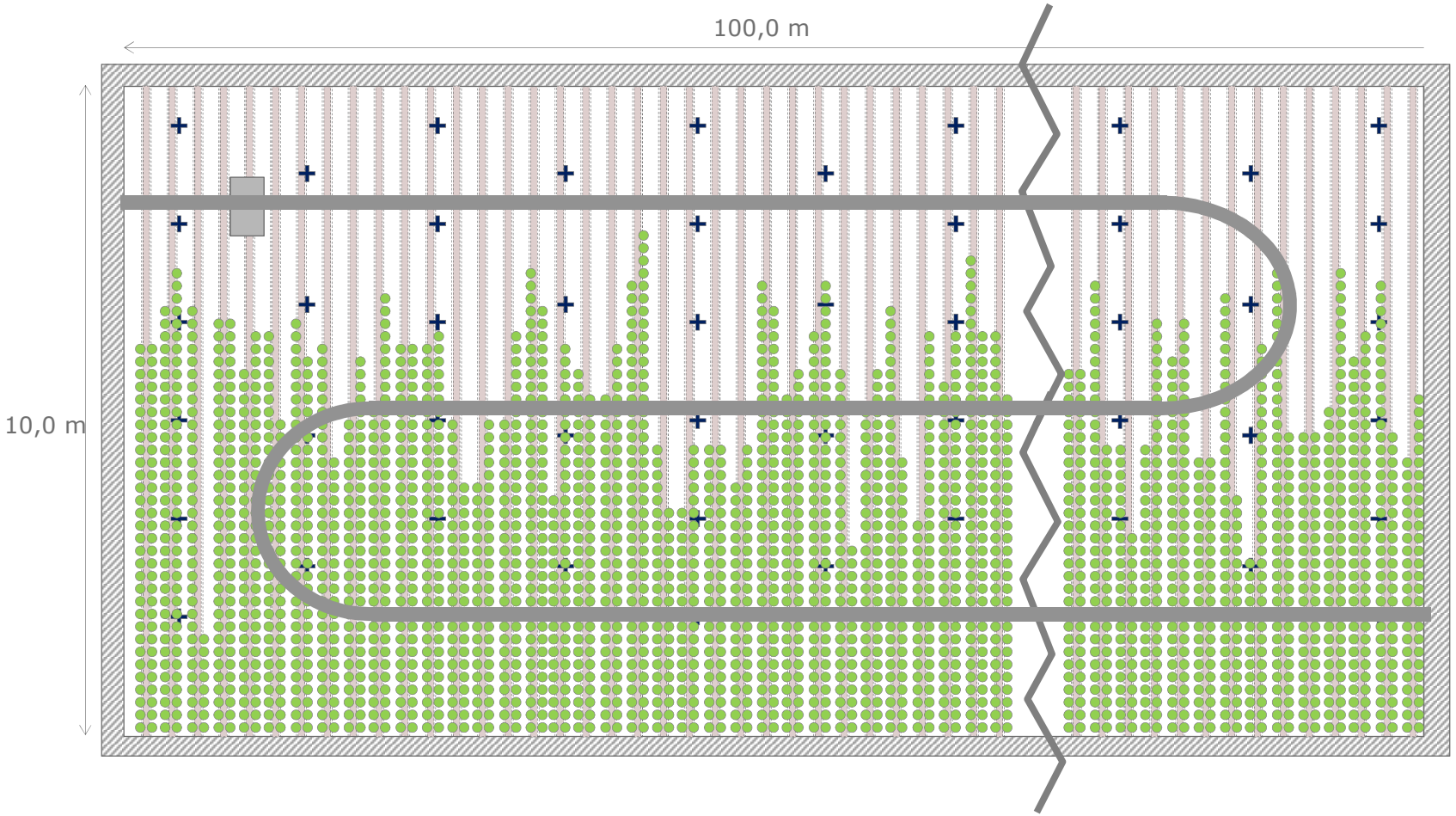


Short side view



Size: L 100 m, B 10 m, D 0.3-3 m, H 4.5 m
Type: Rain-out plasic shelter
Irrigation: Sieve tubes in drain pipes every 40 cm (250,
Tensiometers at D 0.5, 1.0, 1.5, 2.0, 2.5 m – 700 units
NO_3-meters at D 0.5, 1.0, 1.5, 2.0, 2.5 m – 700 units
Digital imaging:
Minirhizotron glass tubes (3.0 m) every 25 cm (400)
Mobile multispectral camera (6 eyes)

Top view



Size: L 100 m, B 10 m, D 0.3-3 m, H 4.5 m

Type: Rain-out plasic shelter

Irrigation: Sieve tubes in drain pipes every 40 cm (250, changable)

Tensiometers at D 0.5, 1.0, 1.5, 2.0, 2.5 m – 700 units

NO_3-meters at D 0.5, 1.0, 1.5, 2.0, 2.5 m – 700 units

Digital imaging:

Plastic tubes (3.0 m) every 25 cm (400)

Mobile multispectral camera (6 eyes)

Milestones in 2014

April: Setup of field trial with minirhizotrons for root phenotyping and where this can be combined with multispectral imaging for aboveground phenotyping . Simple experiment with spring barley and N levels, to create differences to study.

May: Setup tests with soil sensors (conductivity, TDR, others?) allowing datalogging of root activity in soil

October: Presentation of preliminary results from root v.s. aboveground phenotyping in barley experiment

December: Sugestions for improved experimental setup for aboveground root phenotyping facility presented

December: Pilot test with multispectral imaging for detection of roots and root growth finished and presented

December: Present results on improved protocols/methods for root phenotyping and canopy phenotyping