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High throughput phenotyping of interactions between plants and microorganisms, associated devices. Phenotyping Platform for Plant and Plant Micro organisms Interactions (4PMI, INRA Dijon)

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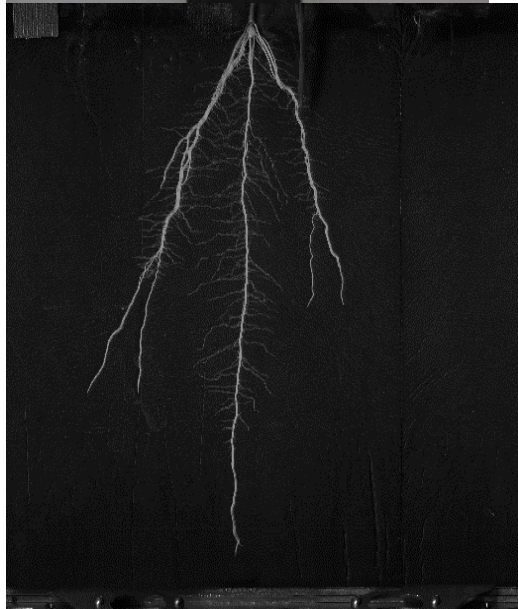


High throughput phenotyping of interactions between plants and microorganisms, associated devices
Phenotyping Platform for Plant and Plant Microorganisms Interactions
(4PMI, INRA Dijon)

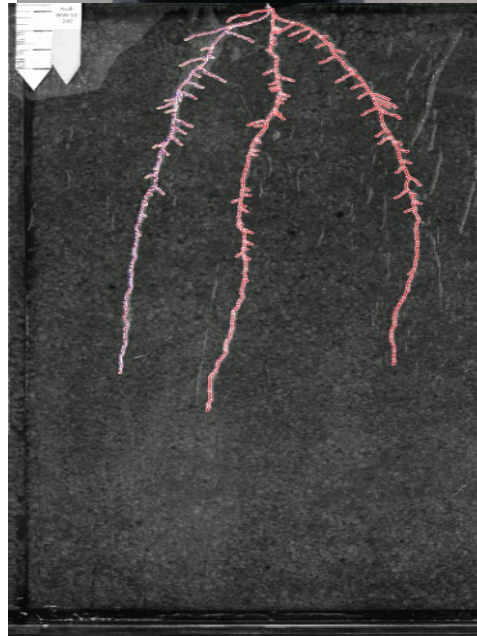
Christophe Salon

UMR 1347-AgroSup/INRA/uB, 17 rue Sully - BP 86510 - 21065 Dijon - France

Achievements: Shoot phenotyping



Maize

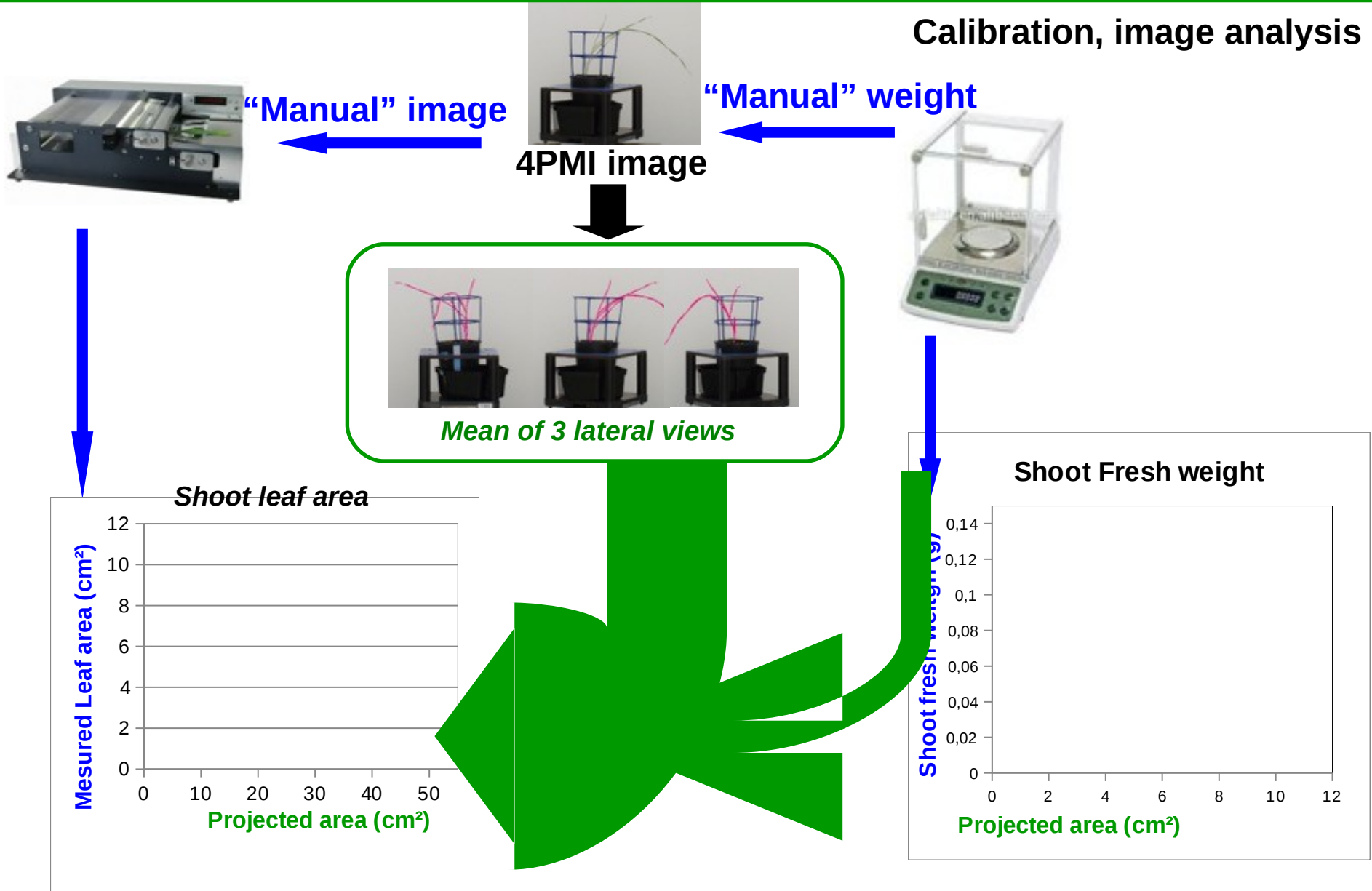


Wheat



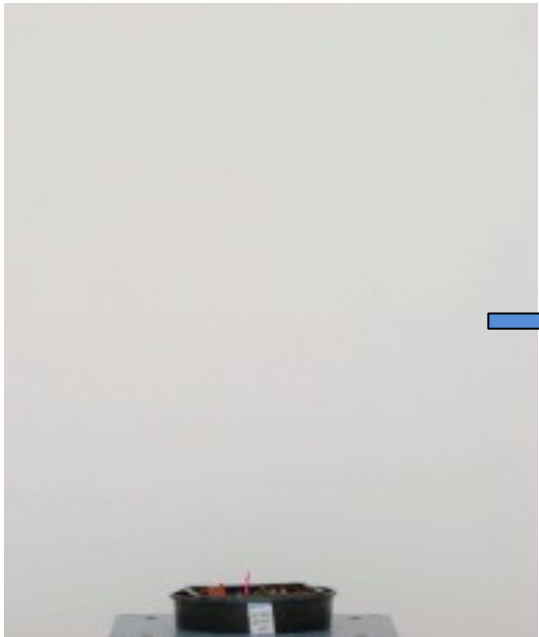
Pea

Achievements: Shoot phenotyping

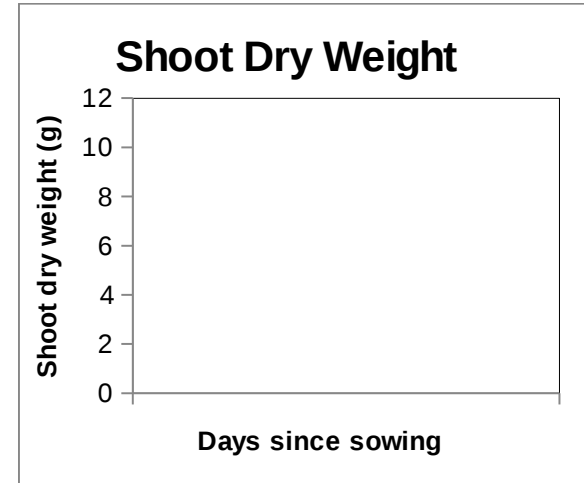
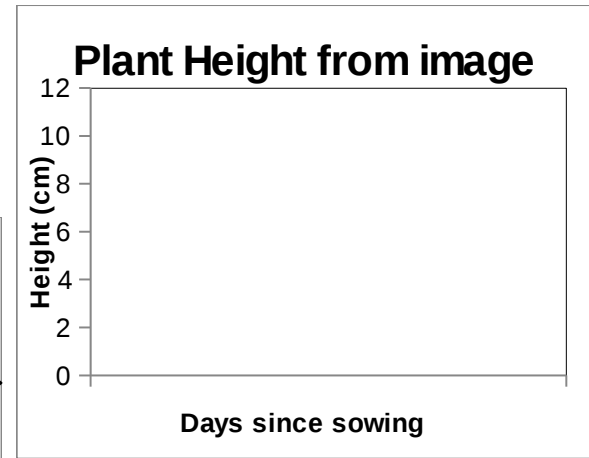
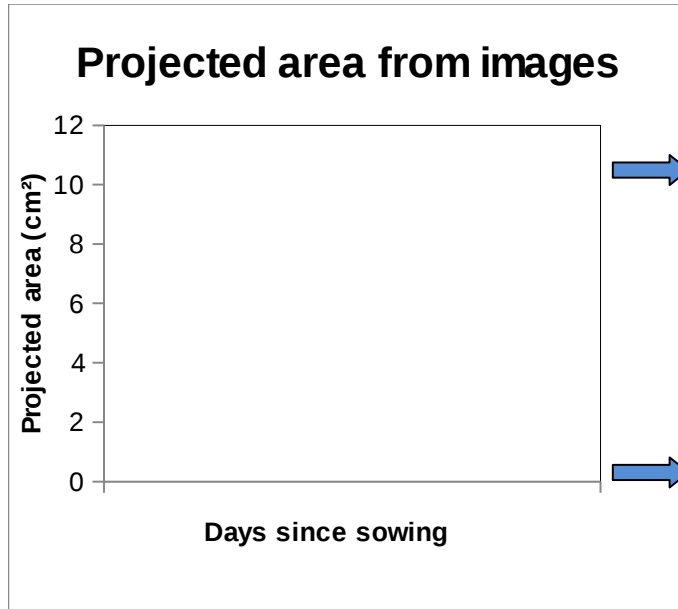


Choice of best image acquisition model !

Wheat

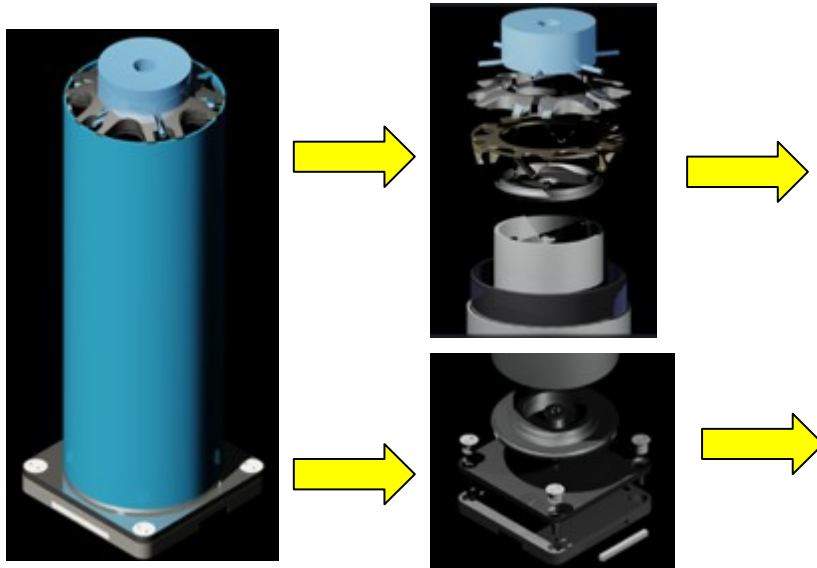


4PMI image



Prototyping approach: Partnership with SMEs (Inoviaflow and Shakti):

- very innovative rhizotrons (European patent) called RhizotubeHD,
- associated imaging cabins (Rhizocab and Rhizocab-HT) and software,
- irrigating, potting depotting tools.

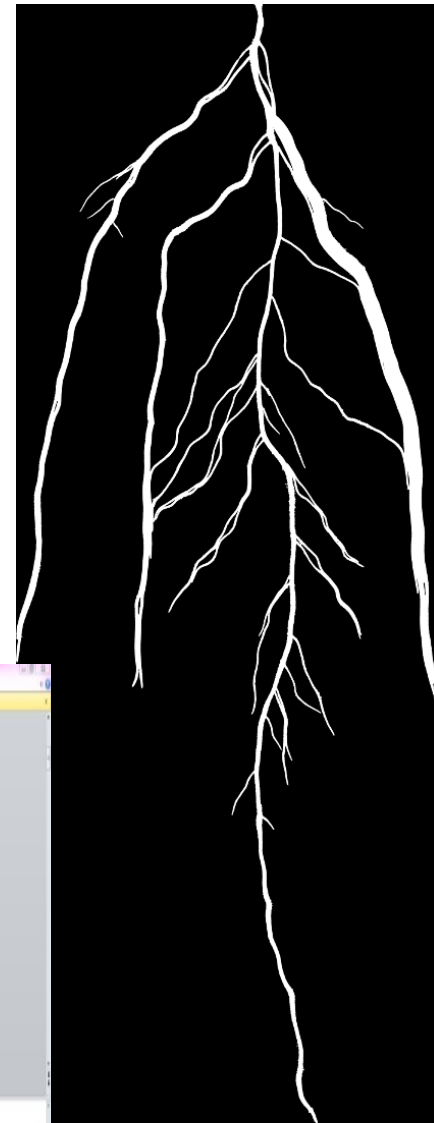
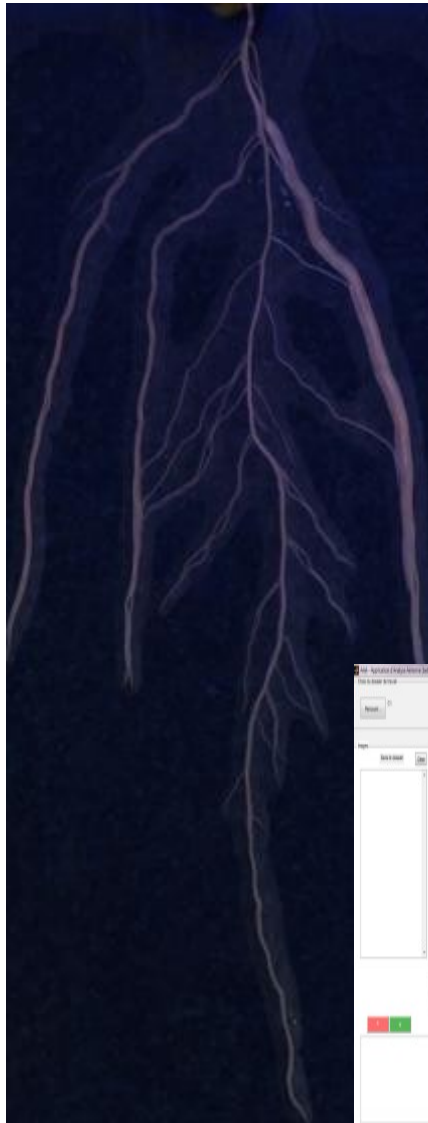


PHENOME
Réseau Français
Phénomique végétale
F P P N



**EU Patent INRA InoviaFlow,
World licence distributions
ongoing (INRA-Inoviaflow)**

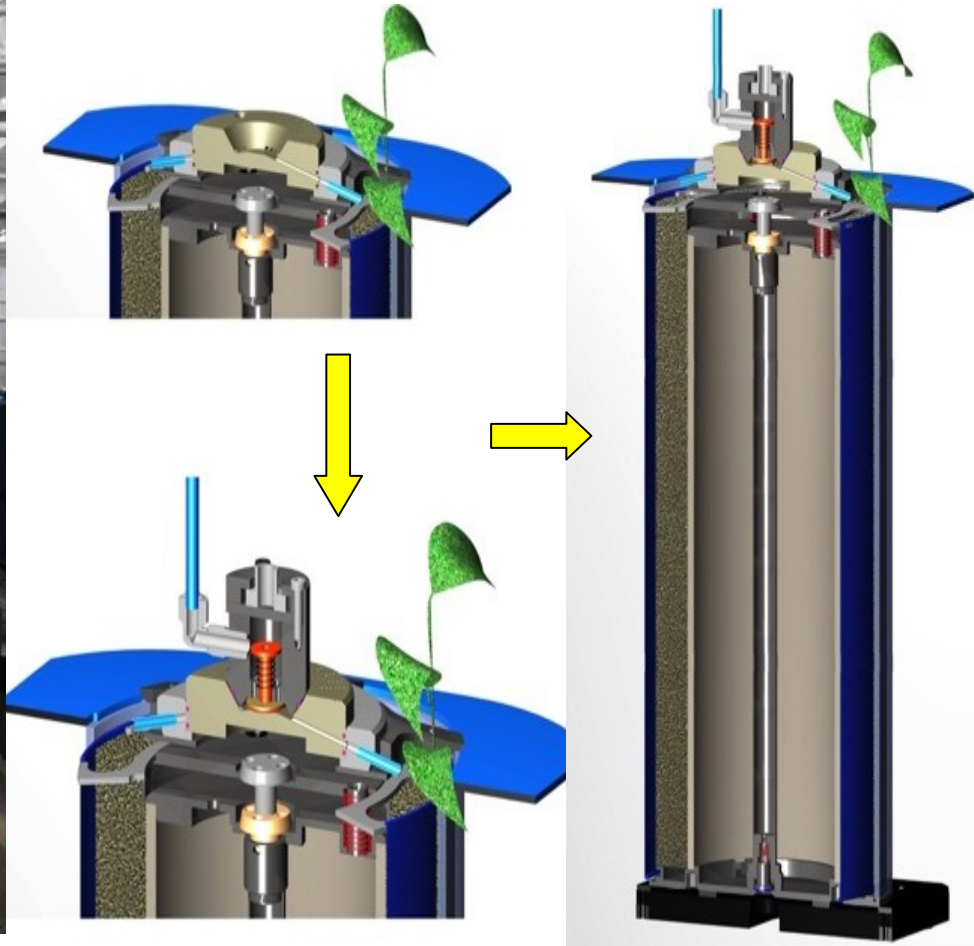
Segmentation software



A screenshot of a software interface for image segmentation. The interface is divided into several panels. On the left, there are control panels for 'Image' and 'Segmentation', each with a color bar and various sliders and buttons. The central display area shows a grayscale image of a tree trunk and branches, with a yellow circle highlighting a specific region. On the right, there is a panel titled 'Limites éventuelles (analyse d'image)' which displays a list of 'Limites éventuelles' (Possible boundaries) and a 'Recapitulatif' (Summary) section. The bottom of the interface features a status bar with the text 'En attente' (Waiting).

Irrigation arm

Shell

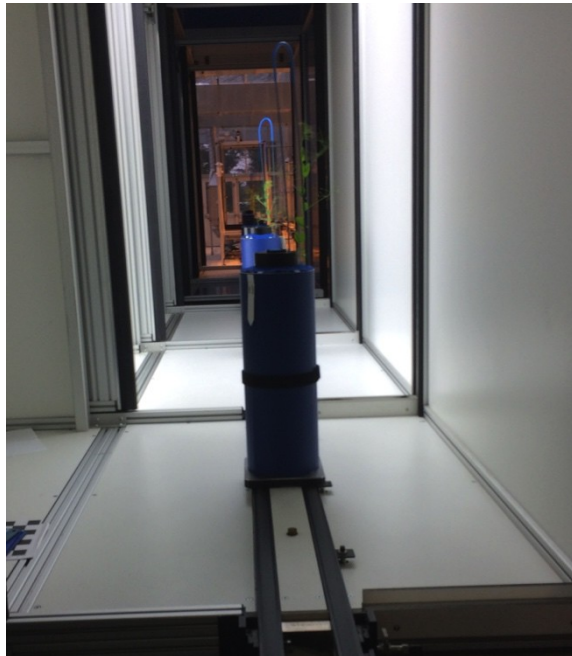
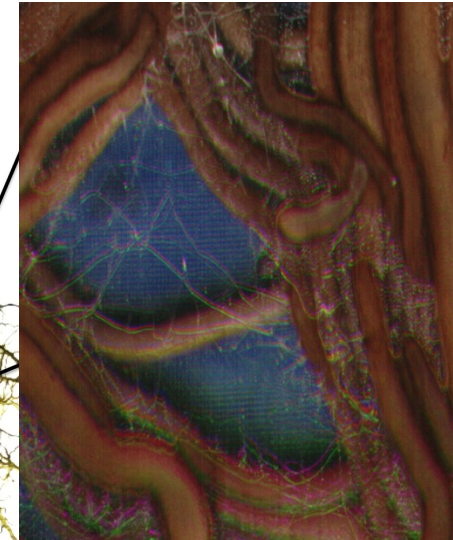
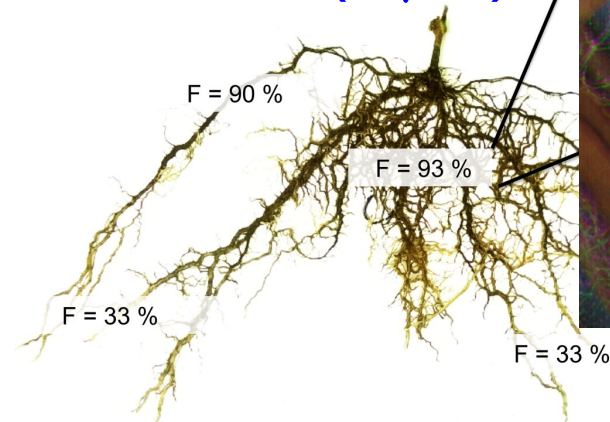


Ok for small amount of nutritive solutions
Drainage hole

RhizoCab HT development



Low throughput:
50 RT/day, 45s/RT
Very high resolution (7 μm)



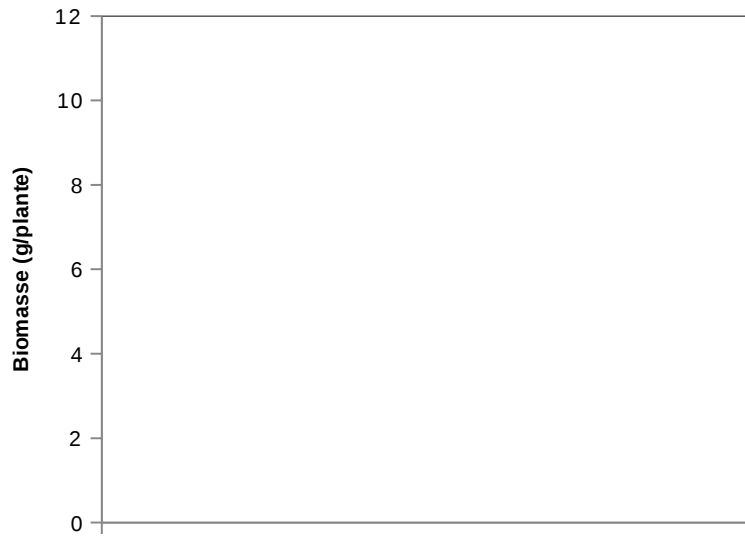
High throughput:
100ds/day
15s/RT
Medium resolution (42 μm)





BOM: RhizoTubes vs Pots ?

Shoots over root biomass ratio



Mean Nodule weigth

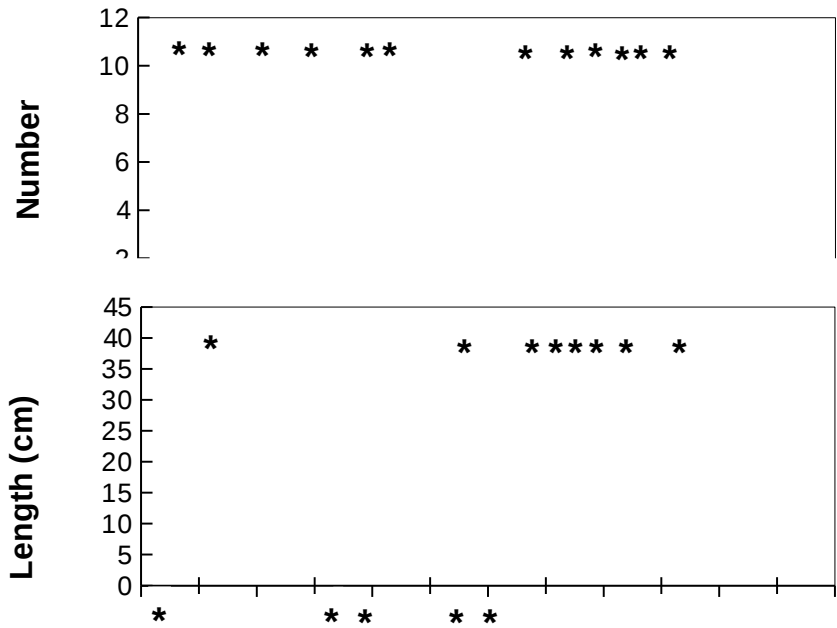


*Similar plant compartments and
nodule traits*



BOM: RhizoTubes vs Pots ?

1st order lateral roots

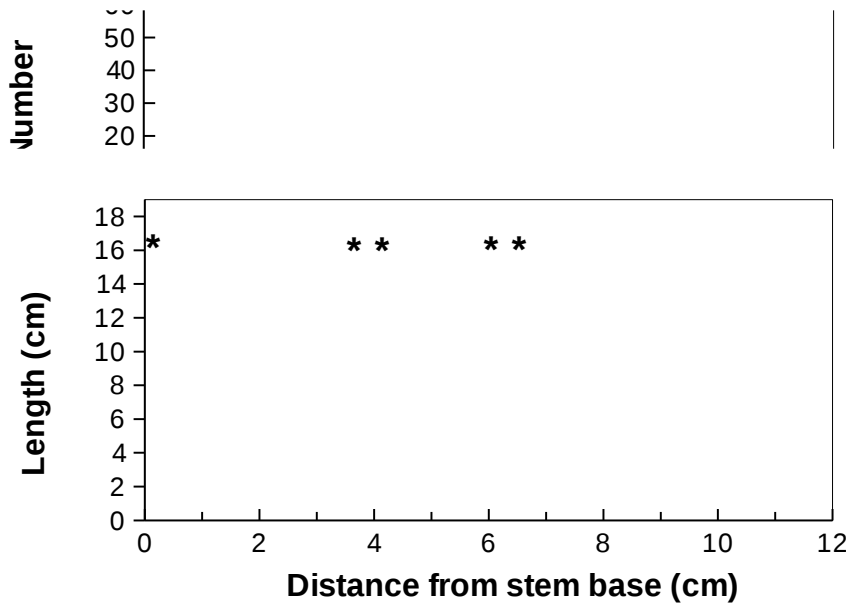


○ Pot ● RhizoTube

Same length upper

... but pot vs RhizoTube depth !

2nd order lateral roots

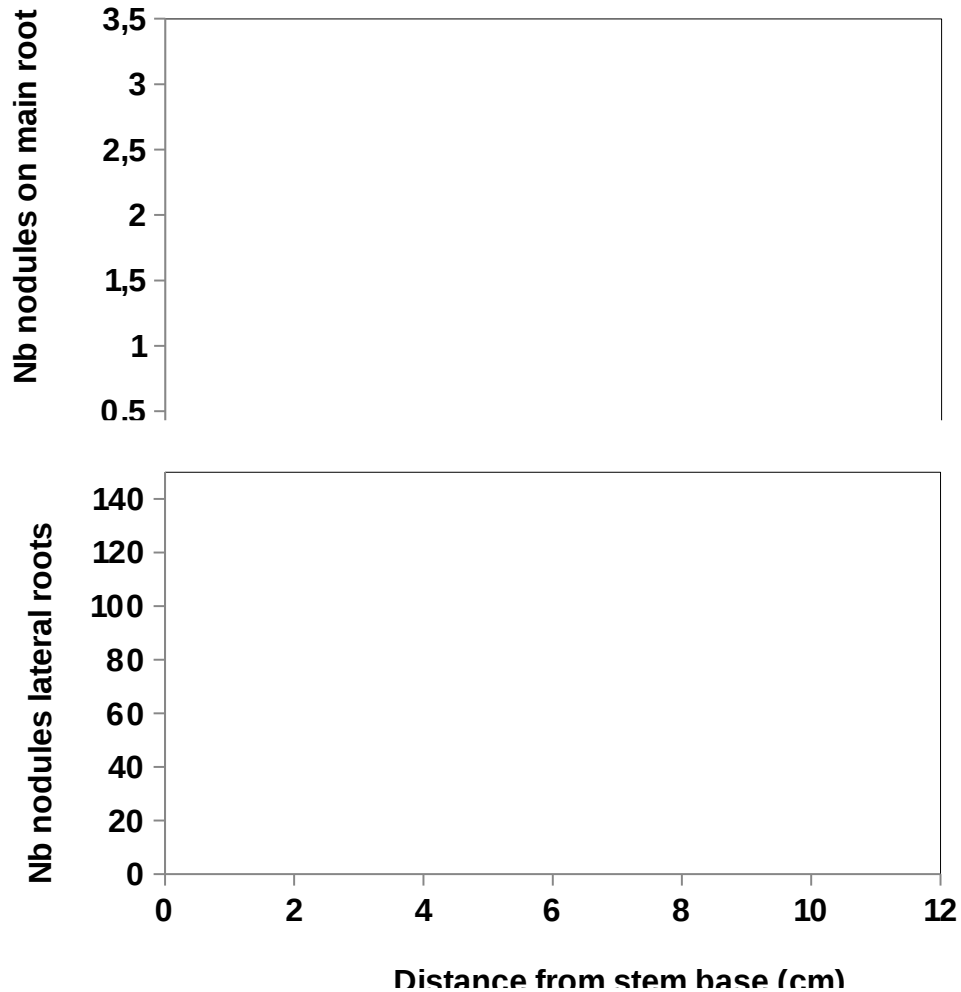


Same number and distribution of roots on 2nd order laterals



BOM: RhizoTubes vs Pots ?

- *Pot*
- *RhizoTube*



Same nodule profile distribution, shifted

cm

Length main root

Length (cm)

0 _____

Date _____

Number

Number of nodule

0 _____

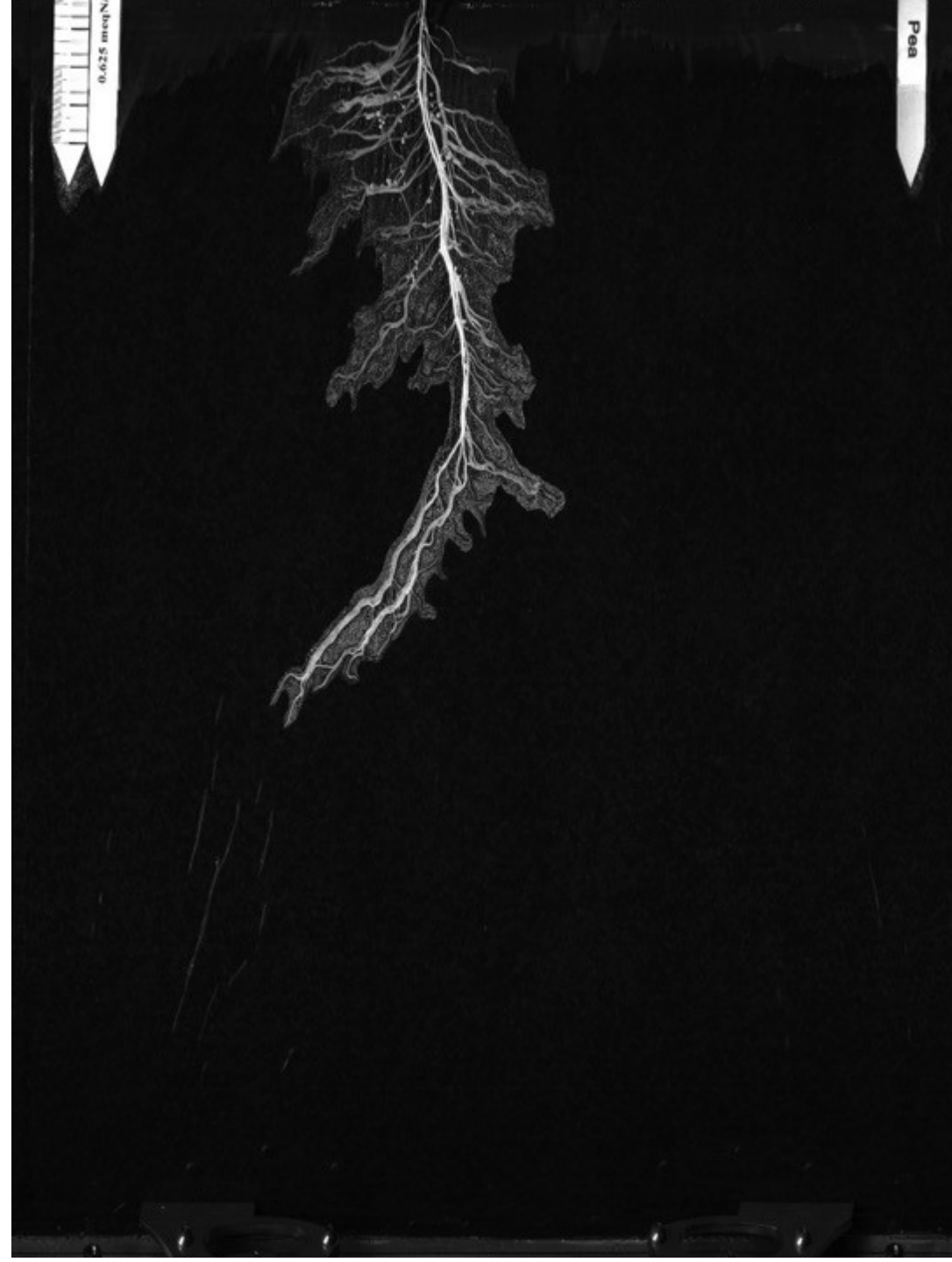
Date _____

Number

Number of laterals

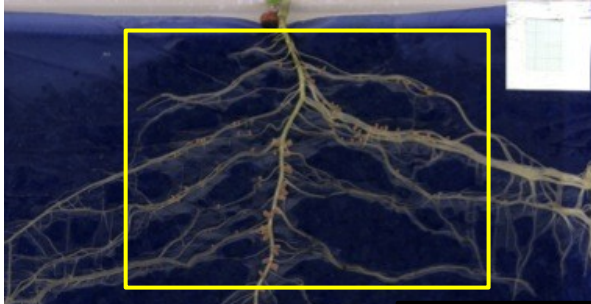
0 _____

Date _____

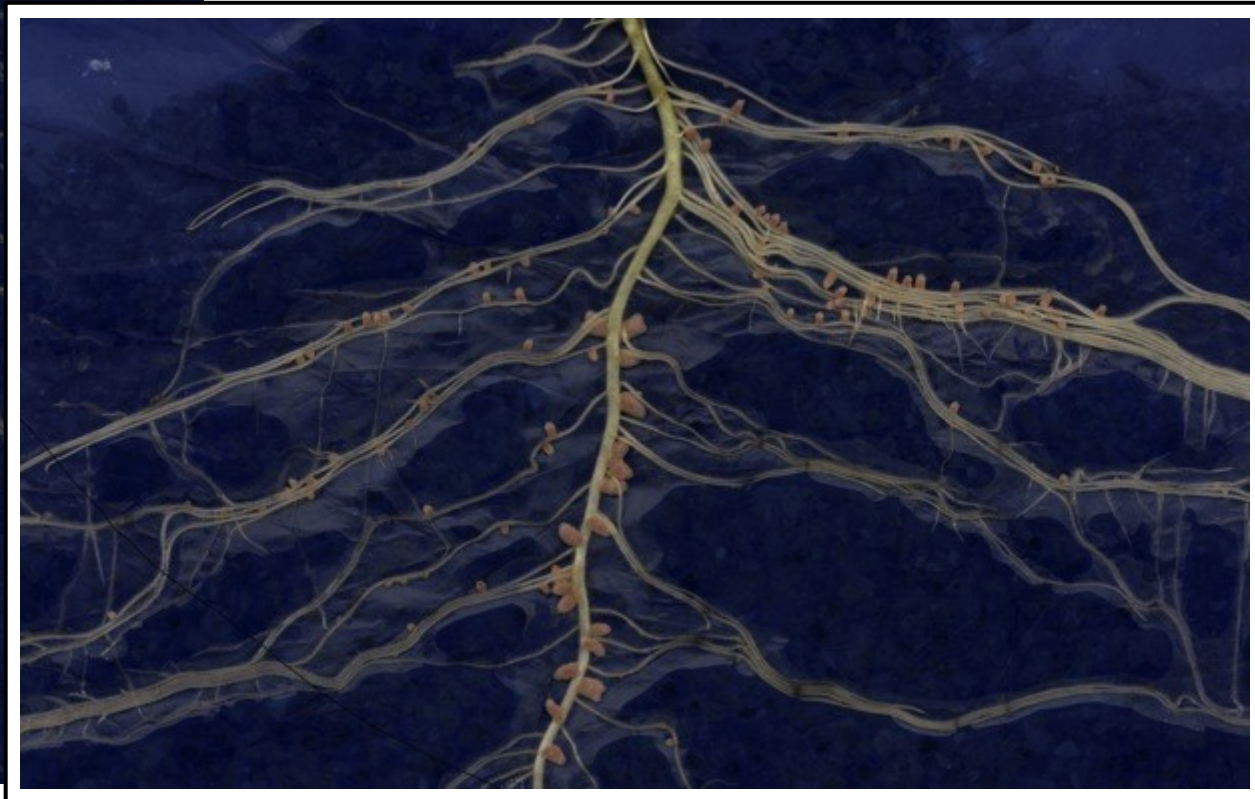


Phenotypic traits: examples

Nodules: Number, projected surface, position, color

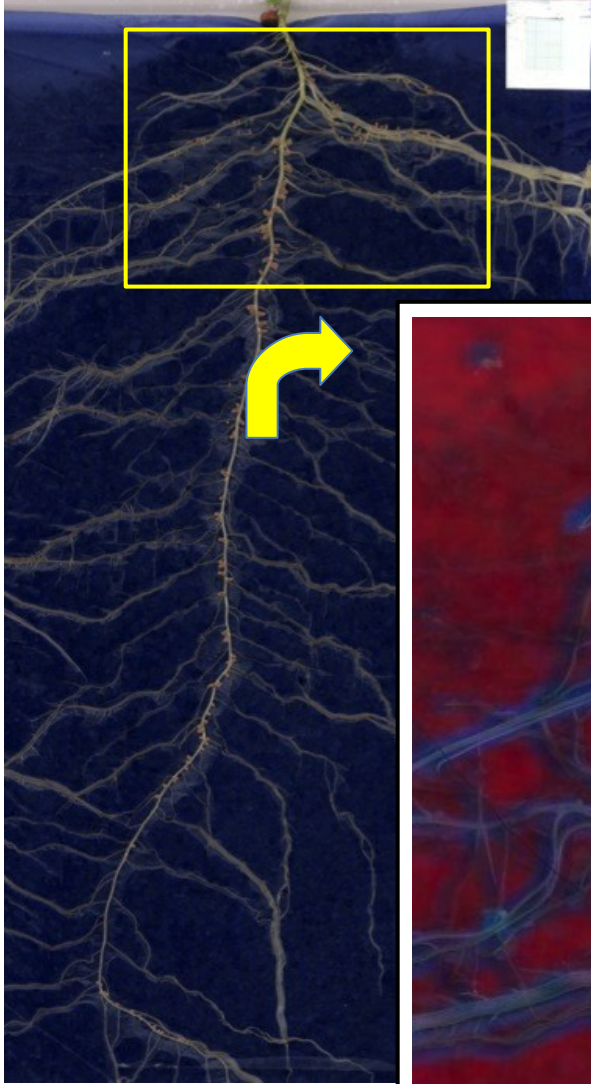


Focus on image



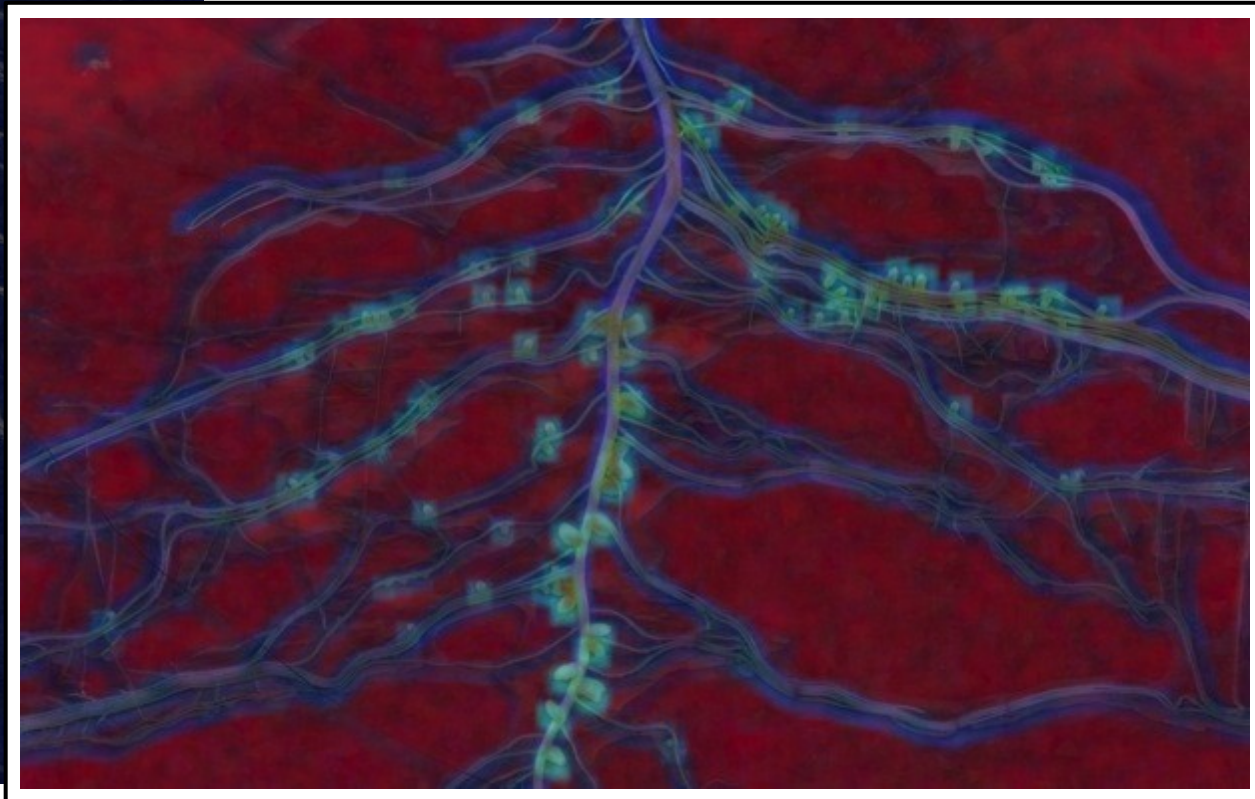
Phenotypic traits: examples

Nodules: Number, projected surface, position, color



Hybrid spaces (color + texture)

(Cointault et al, 2008)



Phenotypic traits: examples

Nodules: Number, projected surface, position, color

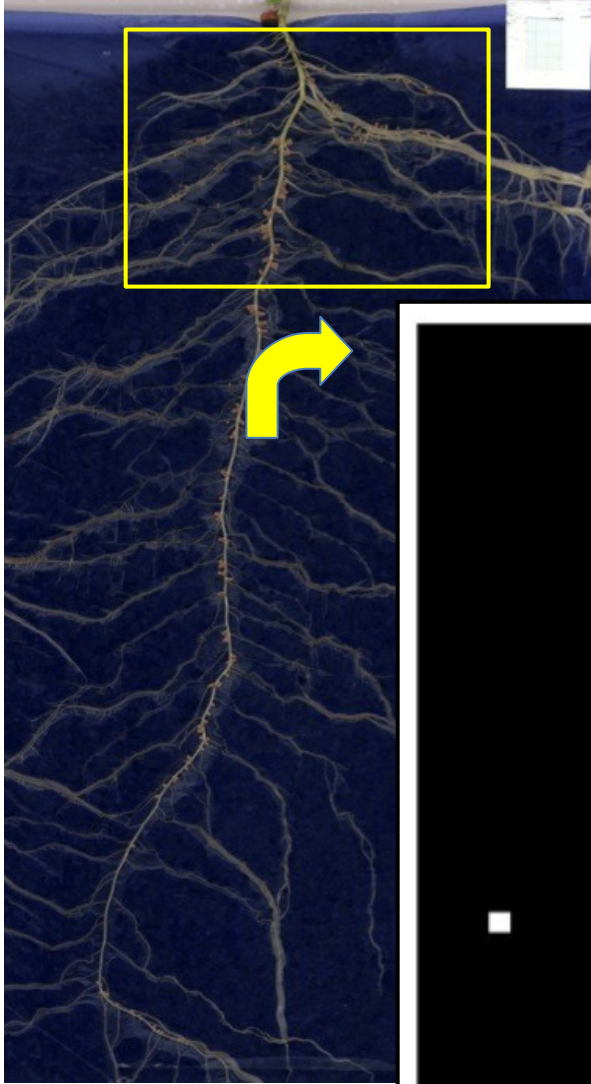
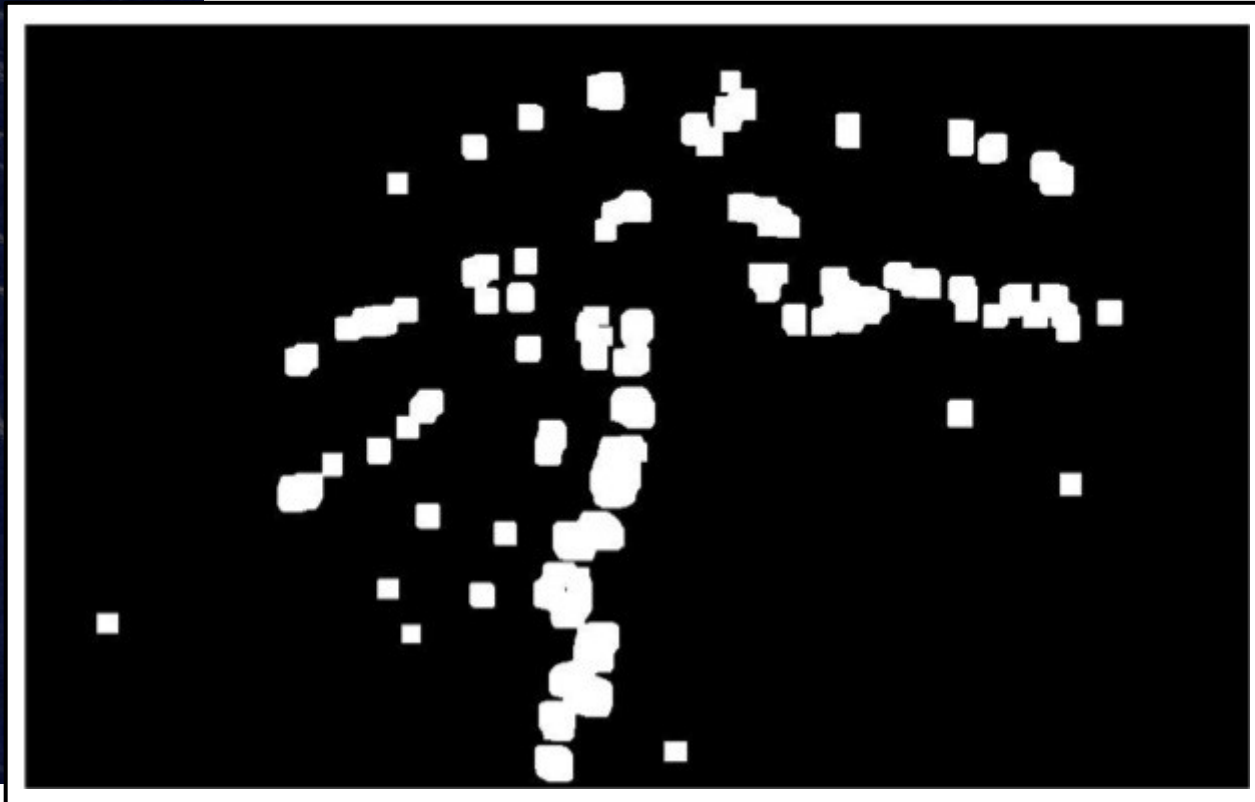
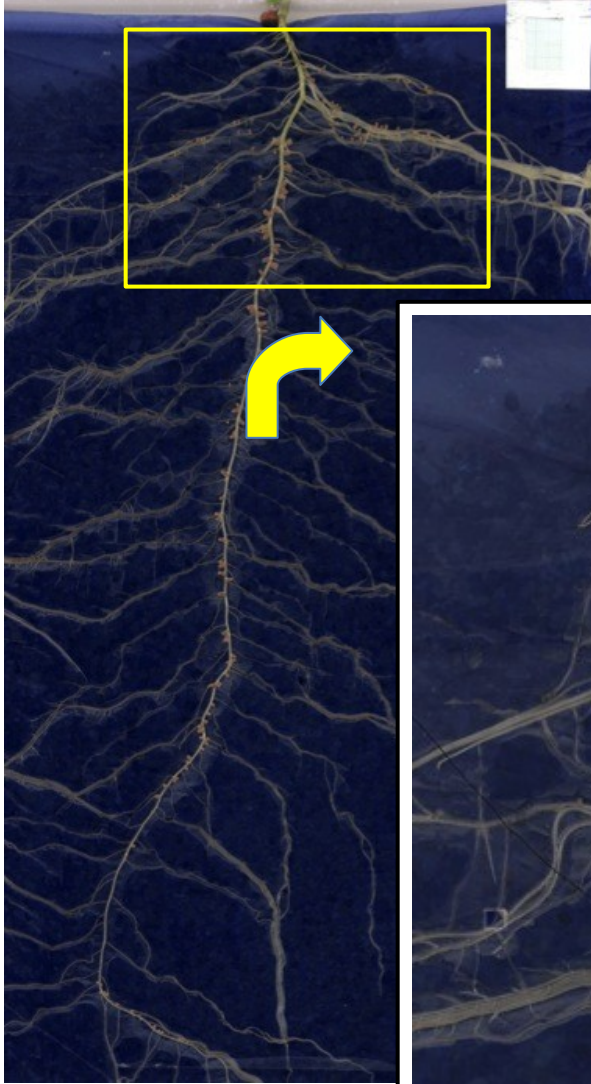


Image with nodules

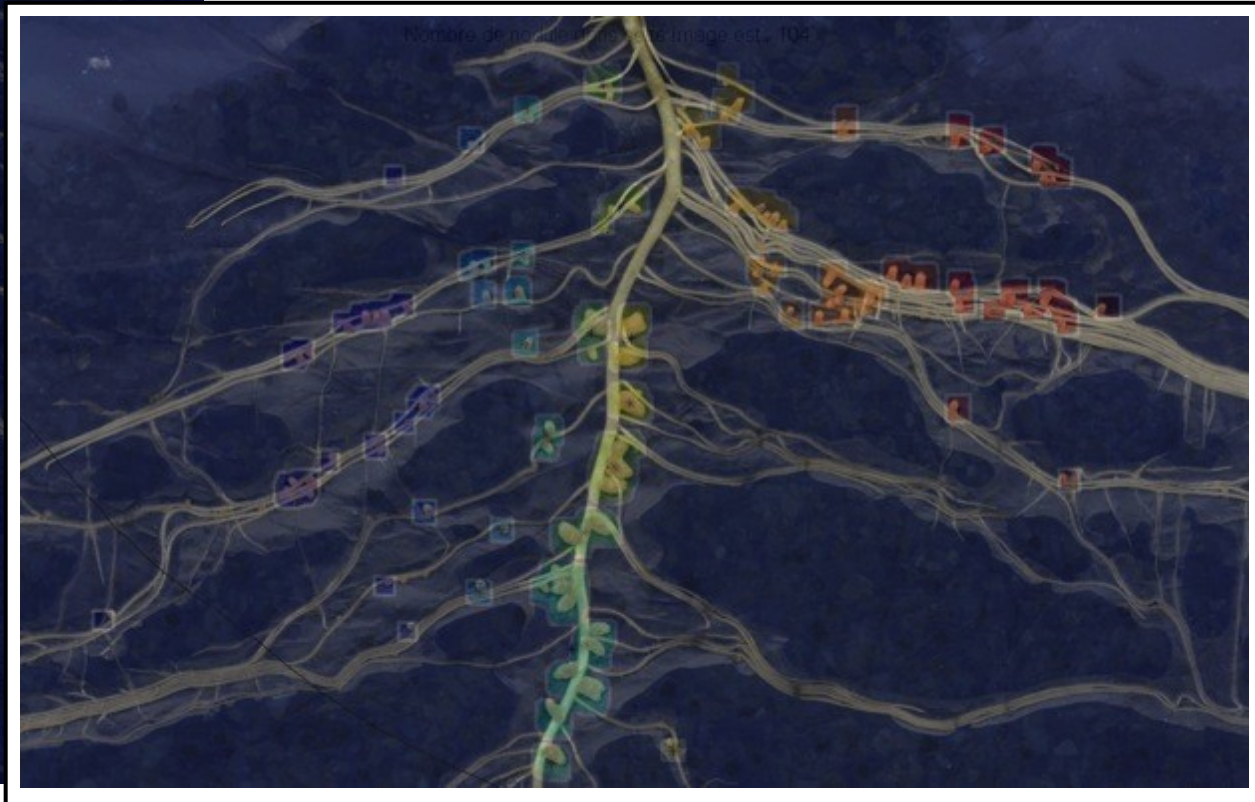


Phenotypic traits: examples

Nodules: Number, projected surface, position, color

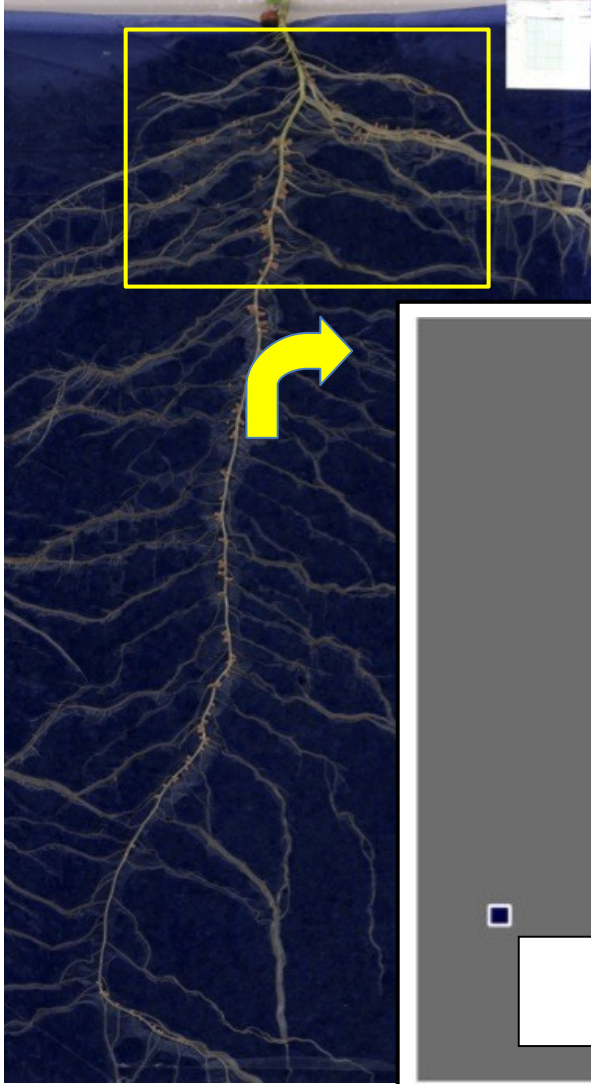


Original image + superimposed nodules

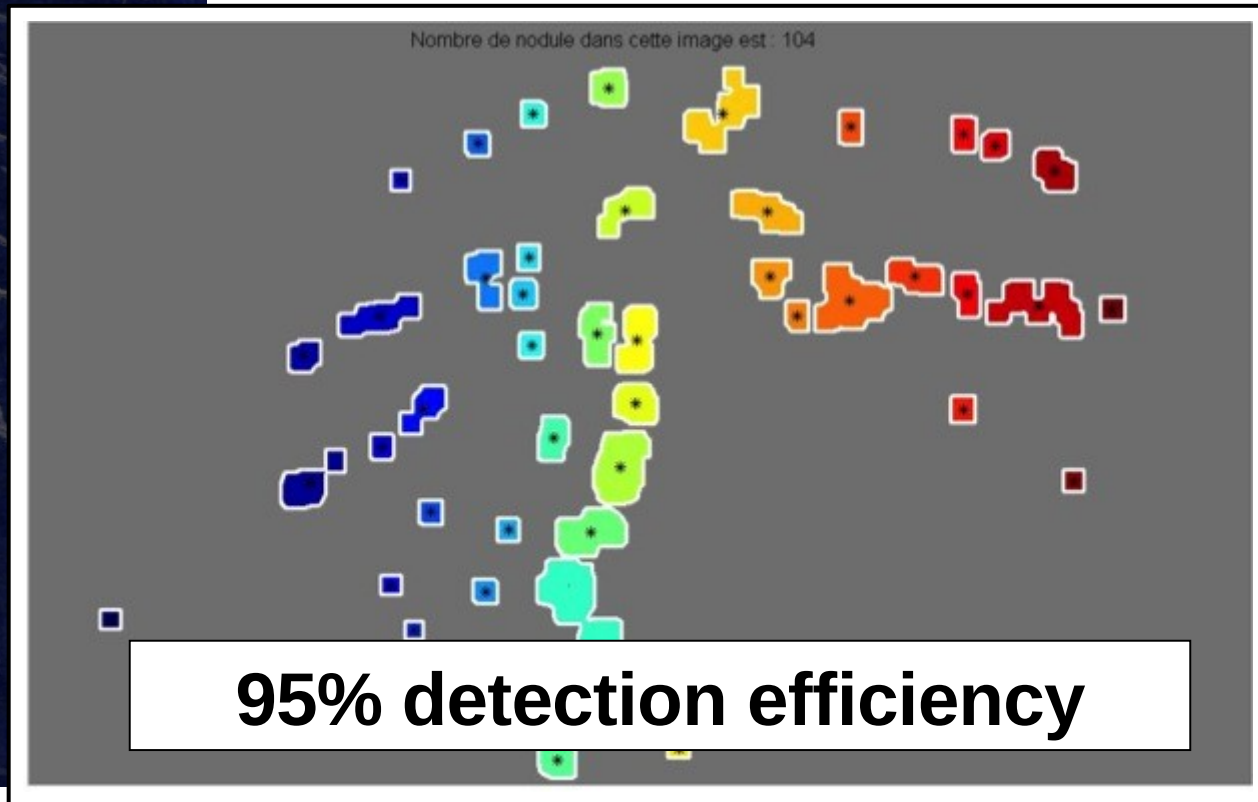


Phenotypic traits: examples

Nodules: Number, projected surface, position, color



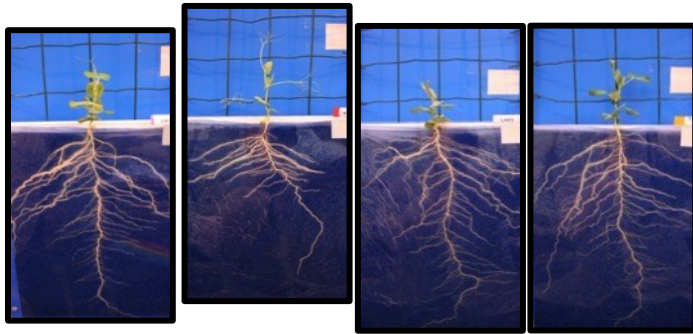
Nodules automatically detected



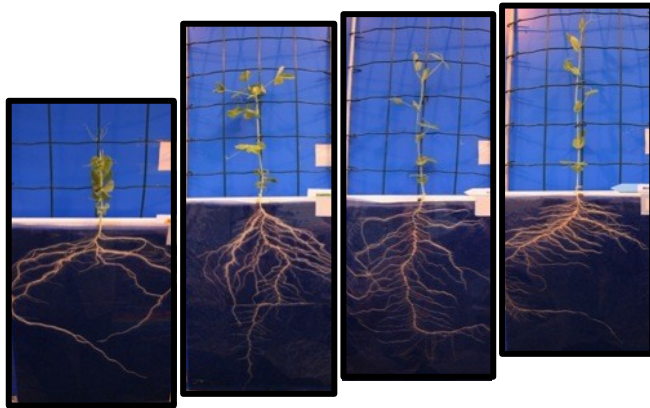
Phenotypic traits: examples

Nodules: Number, projected surface, position, color

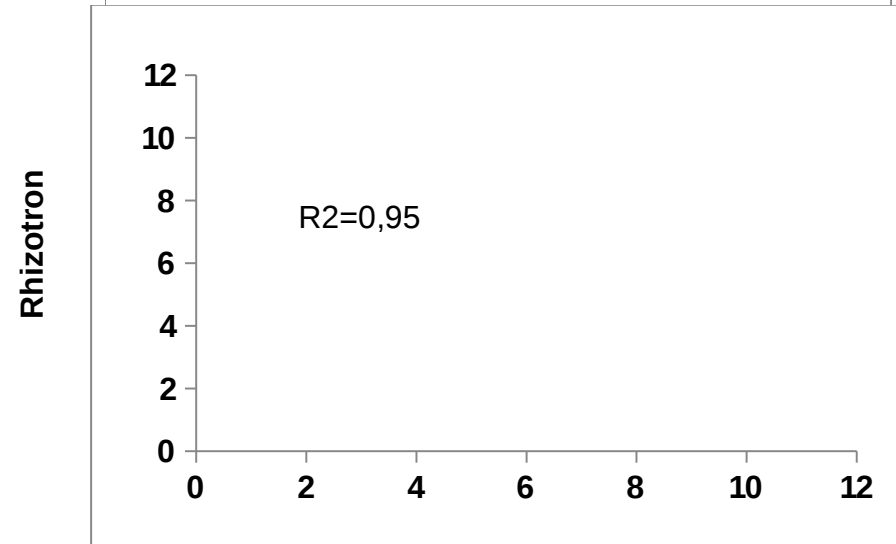
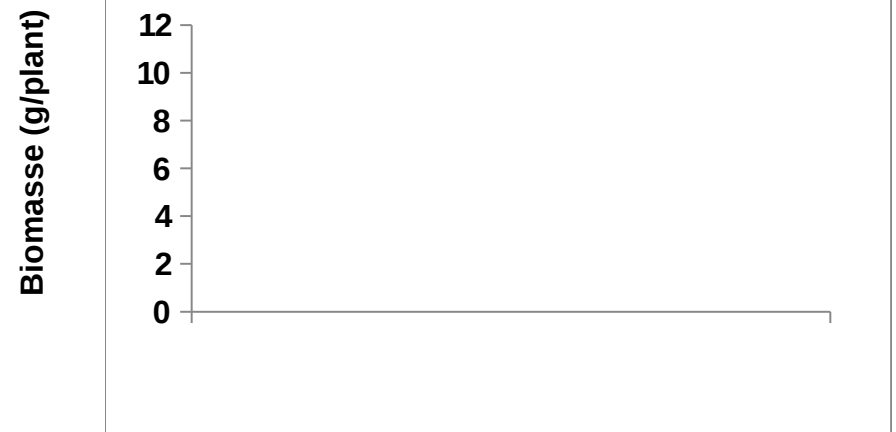
Pea core collection



AMINO KAYANNE L1073 CAMEOR



ISARD CUZCO LIVIOLETTA PI186093



Hydroponique et substrat

Some root example



Pois



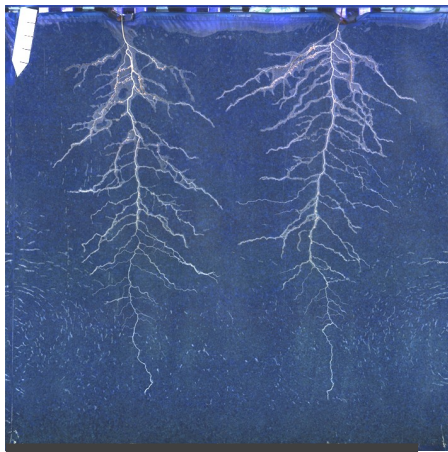
Féverolle



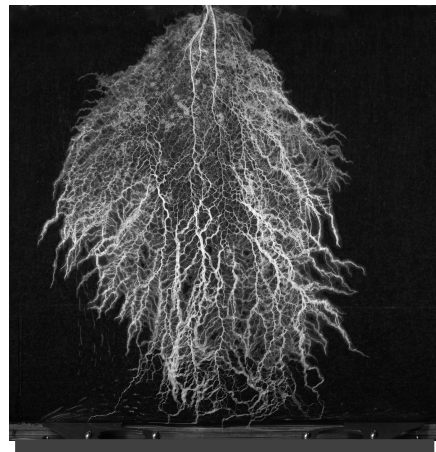
Lupin



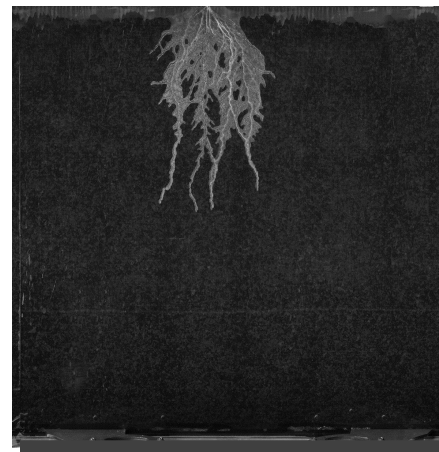
Haricot



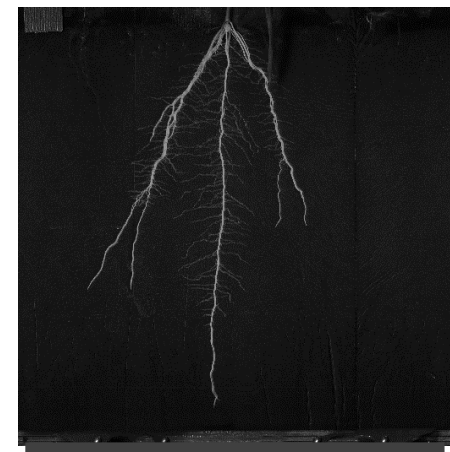
Vesce Commune



Colza

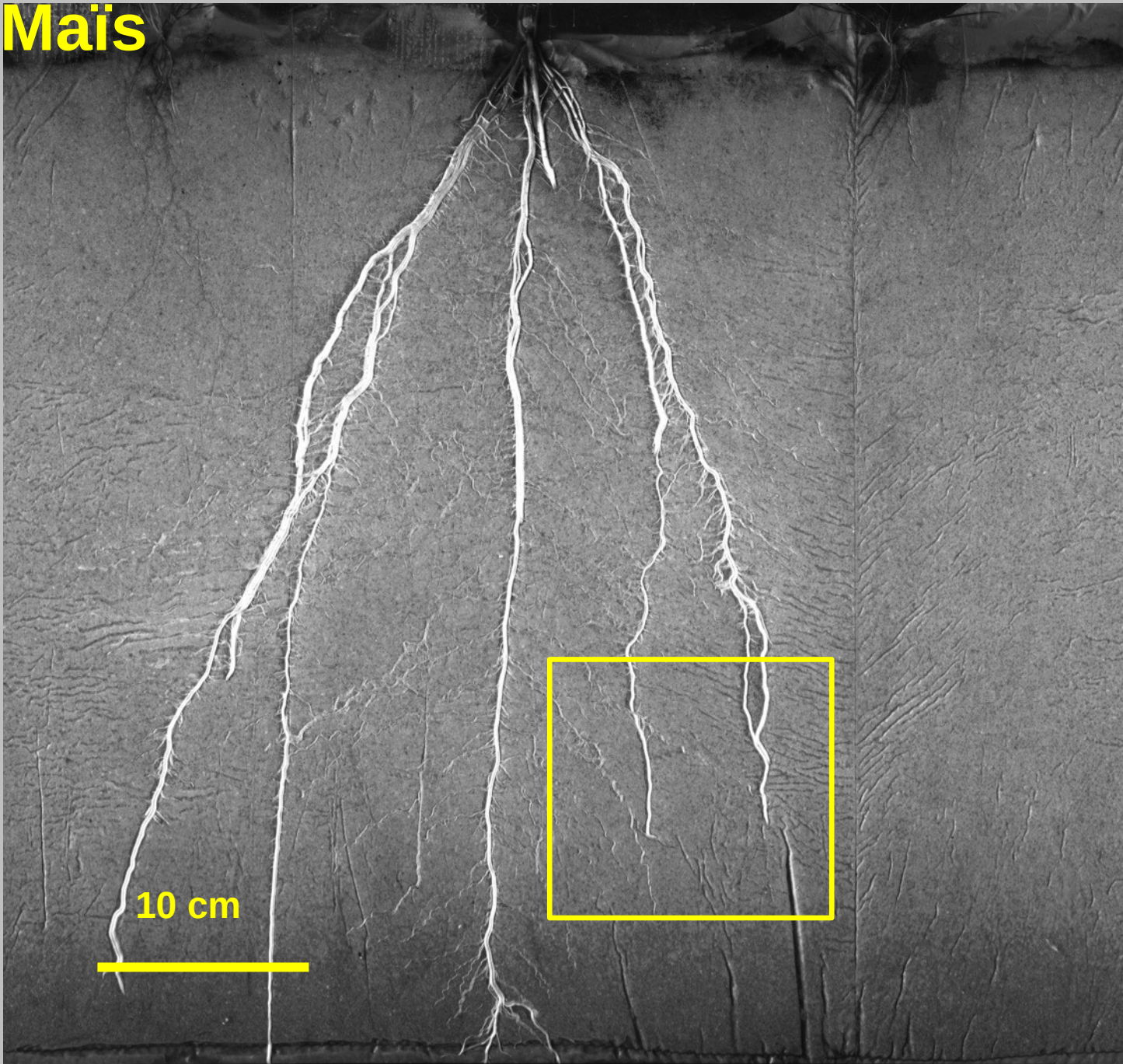


Vulpie



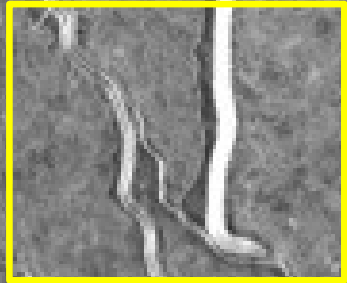
Maïs

Mais

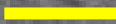


10 cm

Mais

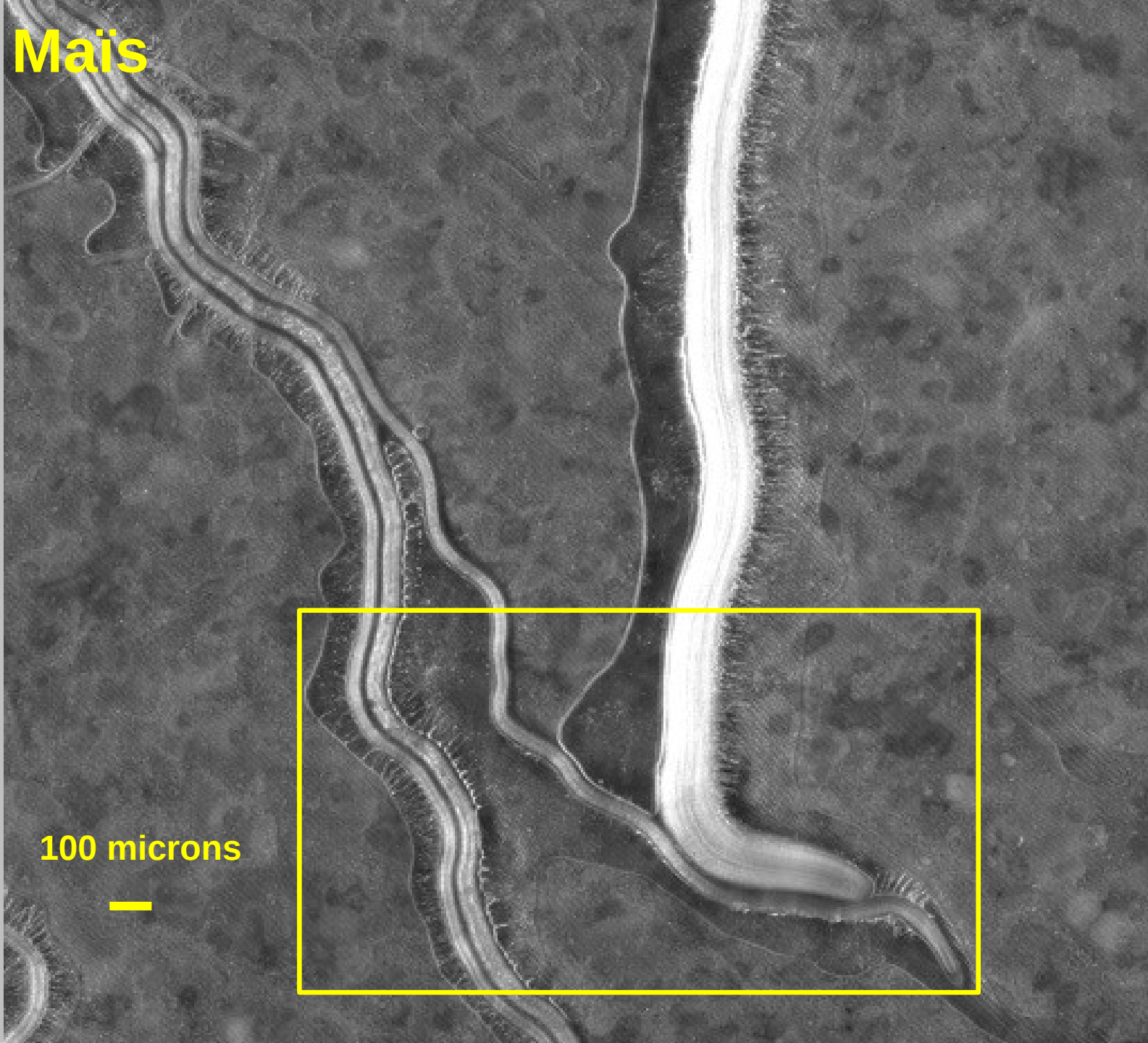


1 cm



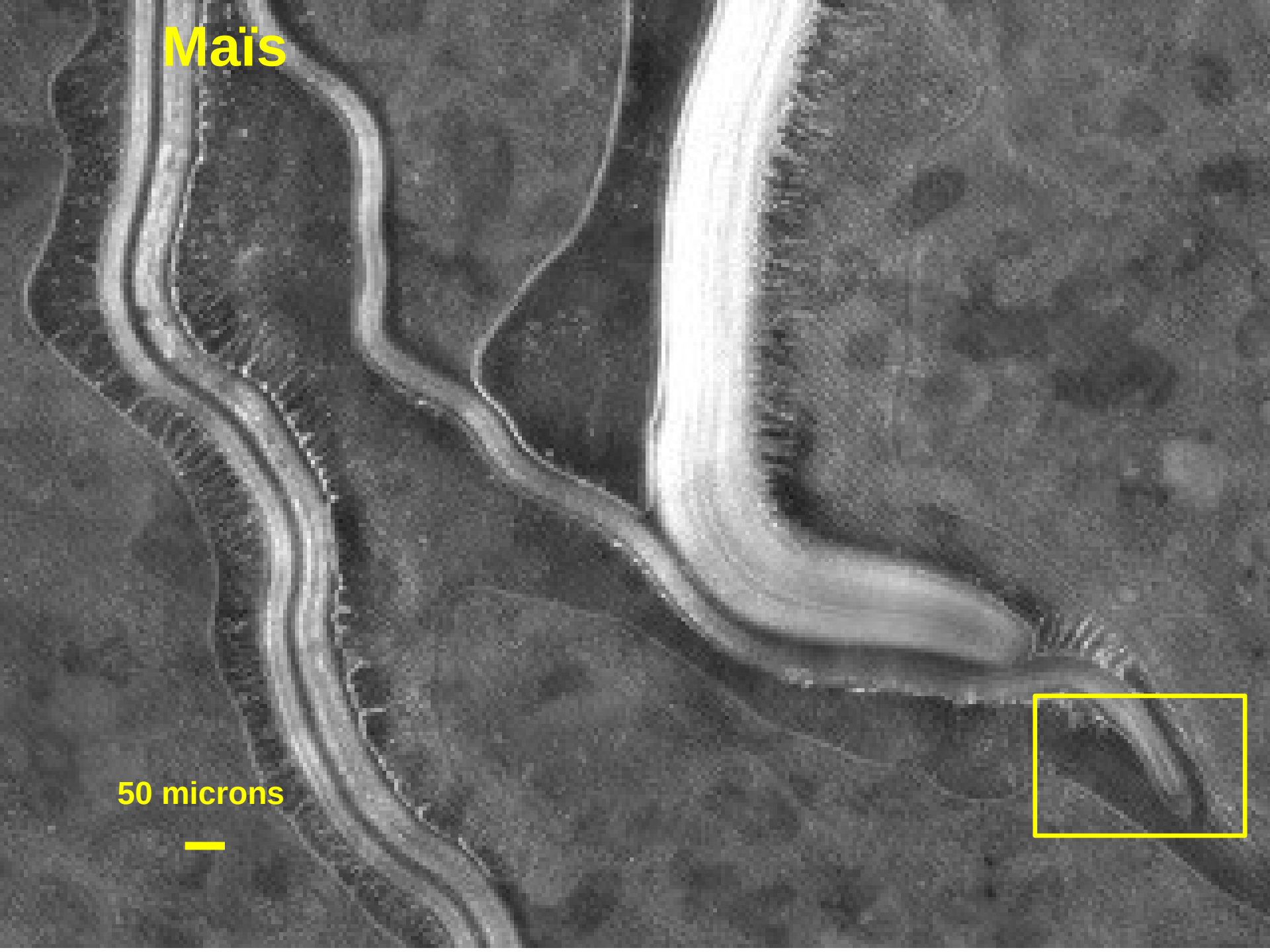
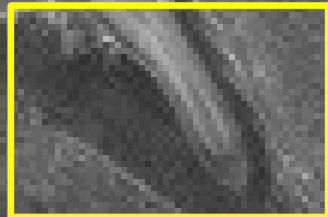
Mais

100 microns



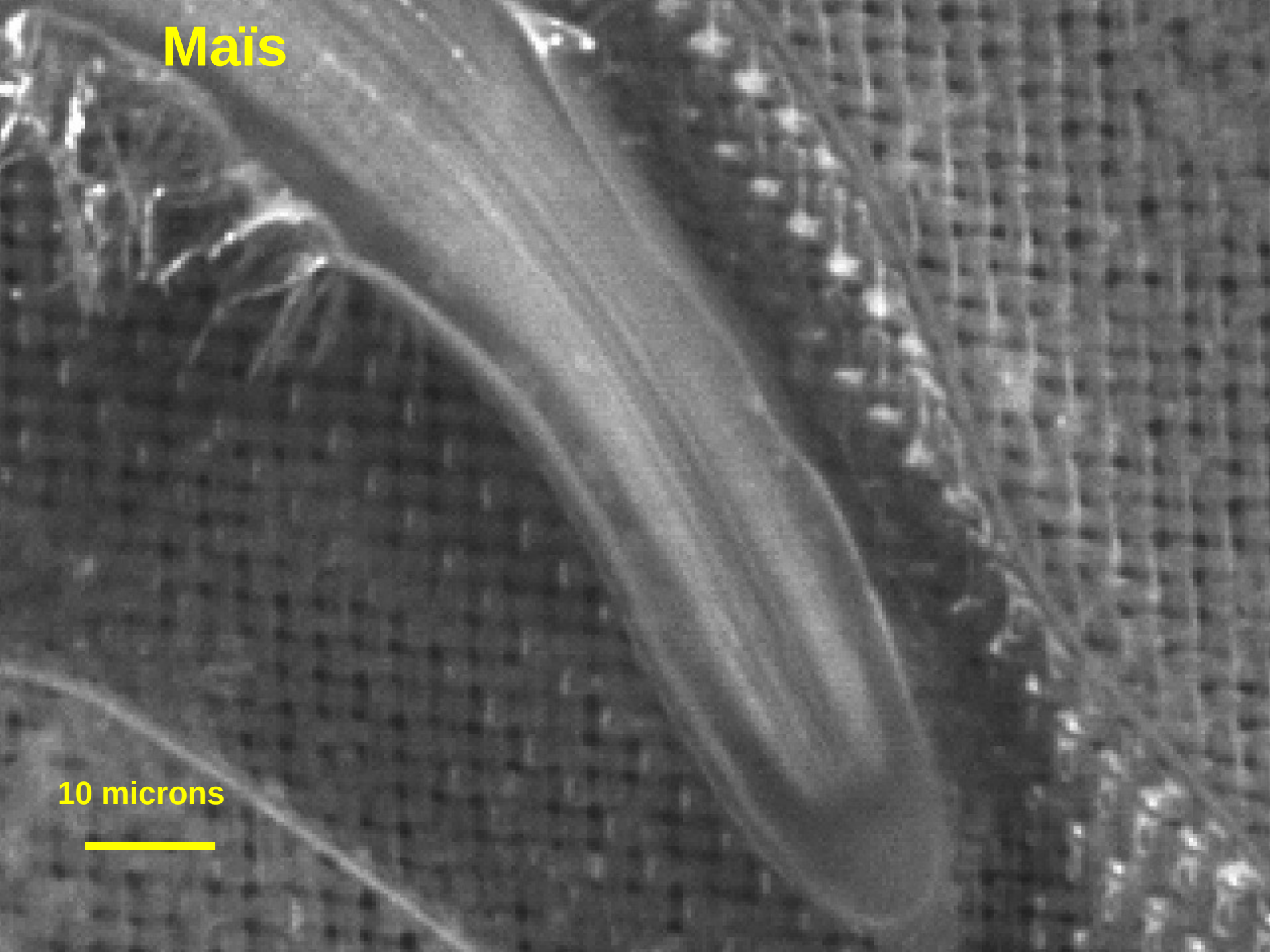
Mais

50 microns

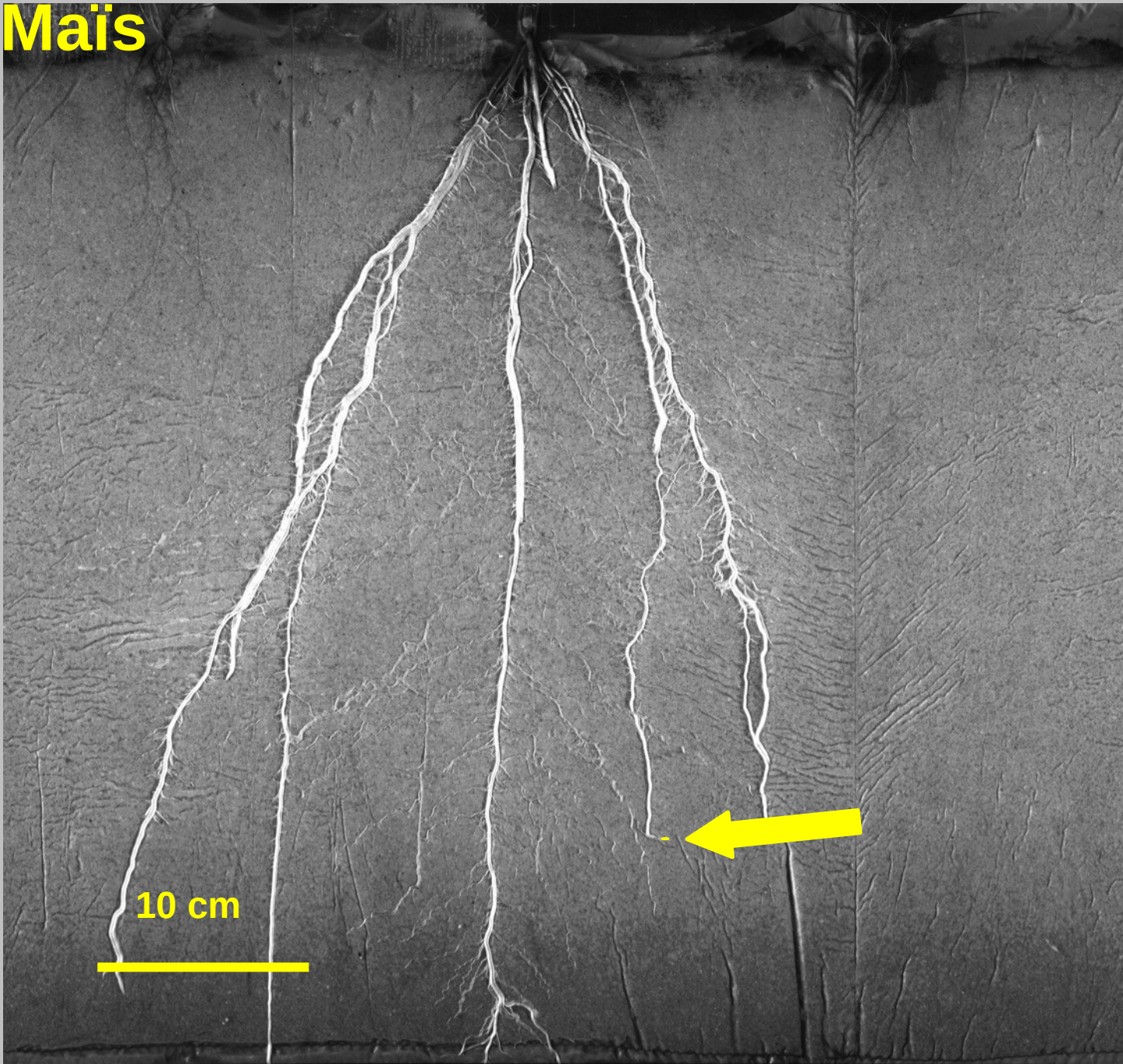


Mais

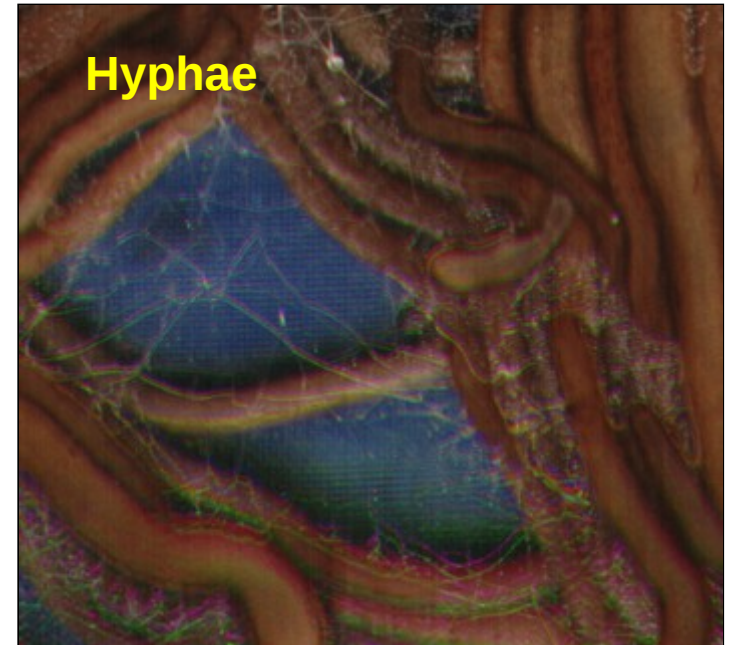
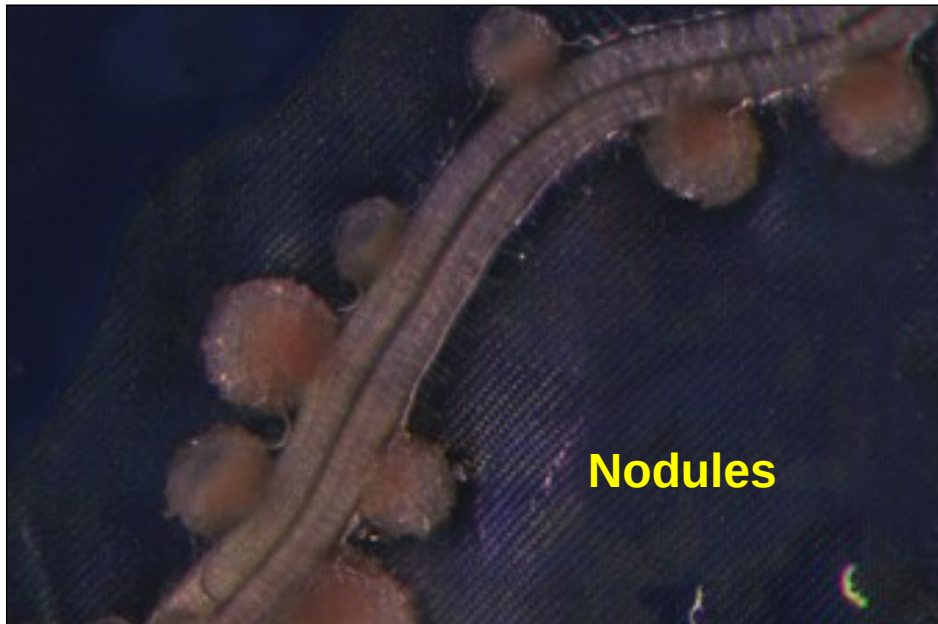
10 microns



Mais



Root phenotyping: High resolution



Down to 7 microns



Merci pour votre attention!