

# Cereal morphology through proximal stereo vision

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**ECPA**  
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# What was our goal ?

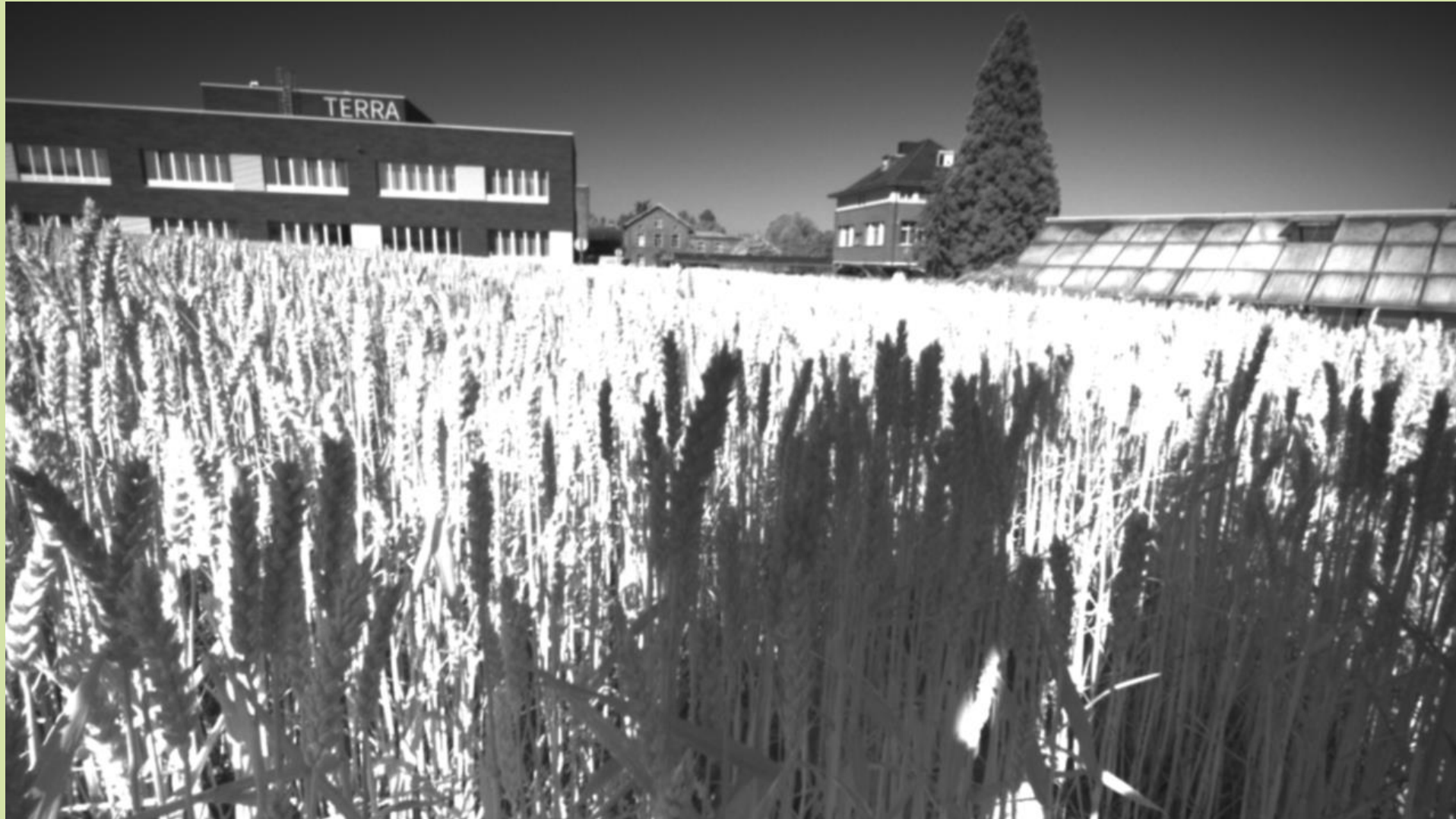
Develop a **phenotyping tool** to measure **cereal canopy architecture** in a **non-destructive way**



**3D**



# What is stereo vision ?

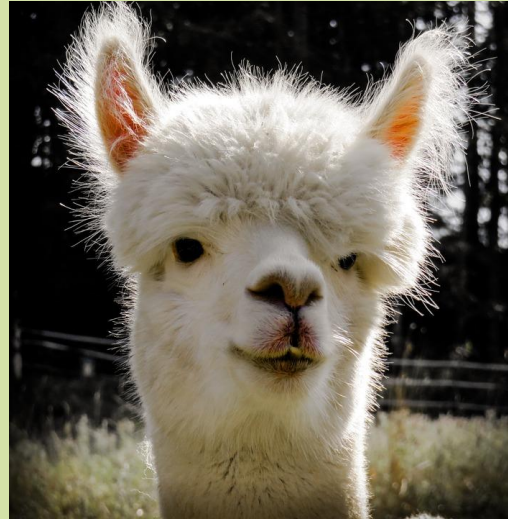


# What is stereo vision ?



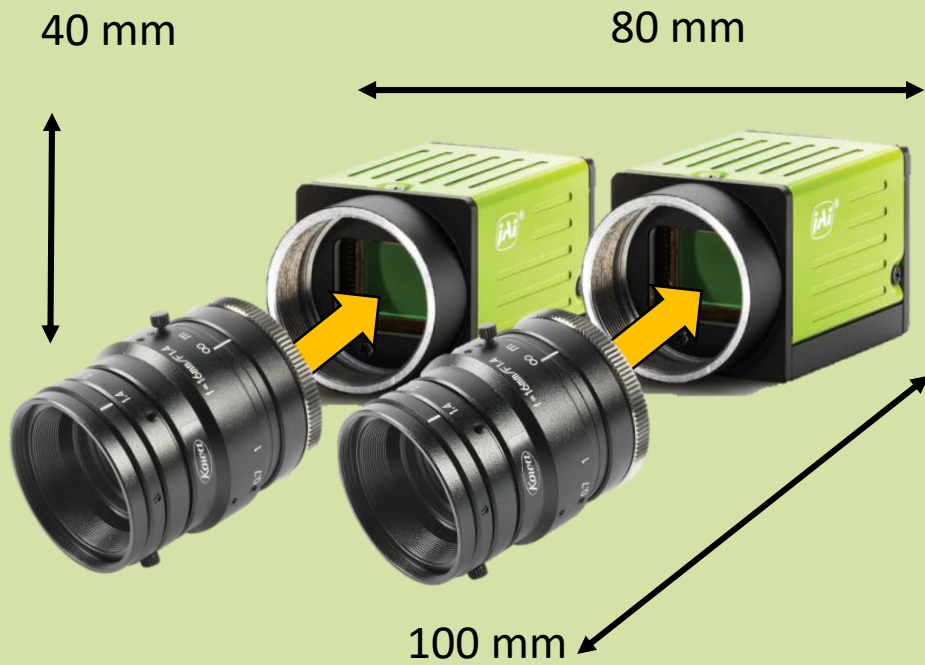


# For who ?



# Why choosing stereo vision ?

COMPACT



LOW COST



150 – 2000 €

IMAGE

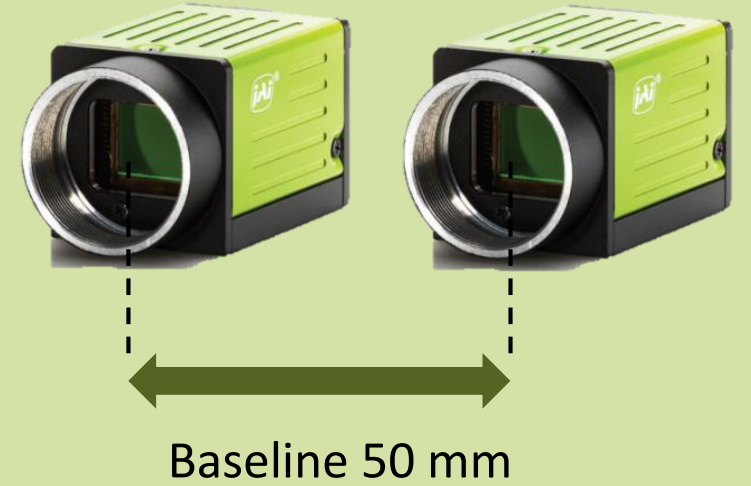




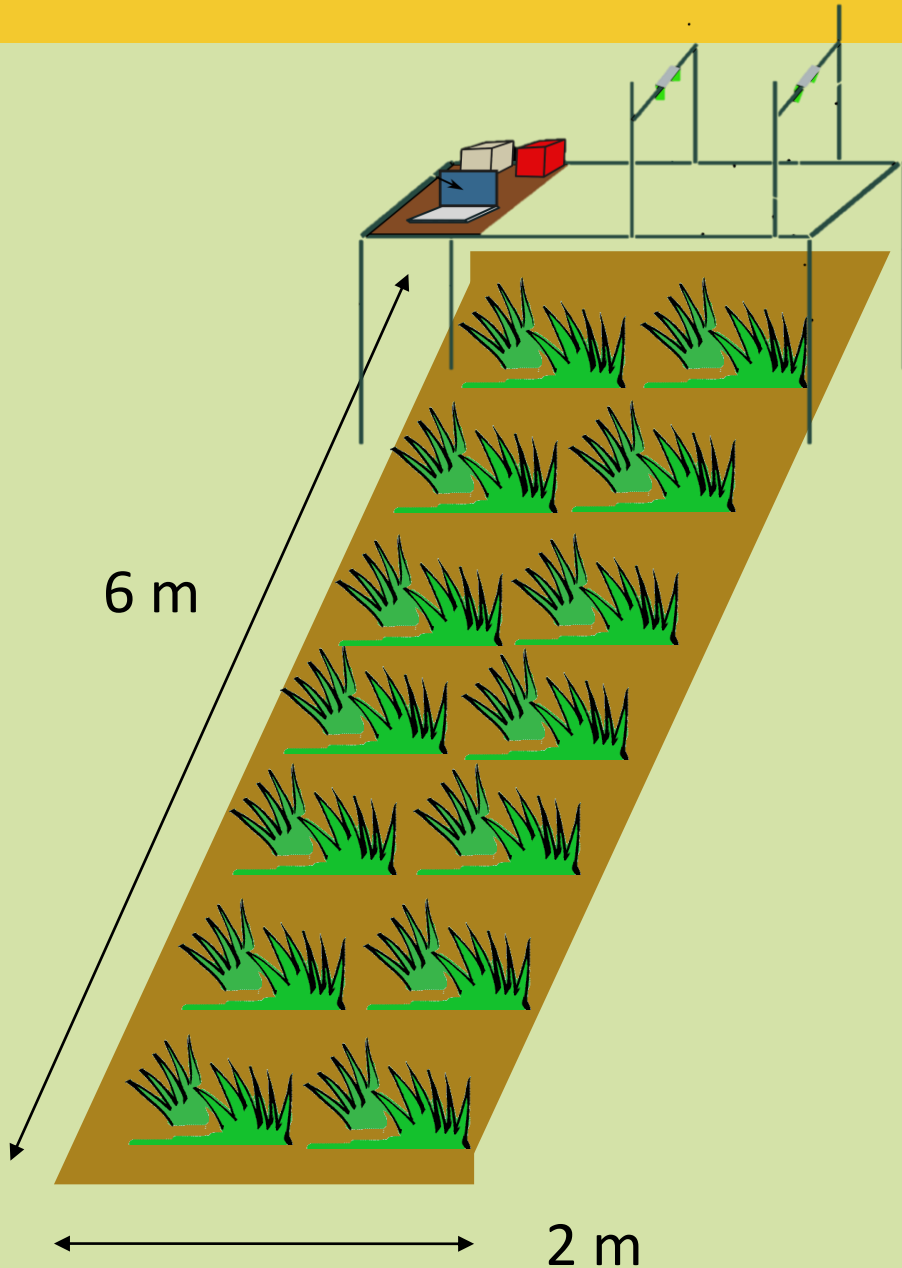
# What about the experiment ?



2 RGB cameras



# What about the experiment ?



Shoot image 1 !

Shoot image 2 !

Shoot image 3 !

Shoot image 4 !

- **Winter wheat** *Edgar*
- **Spring barley** *Planet*
- 4 fertilization practices
- 4 plot replication

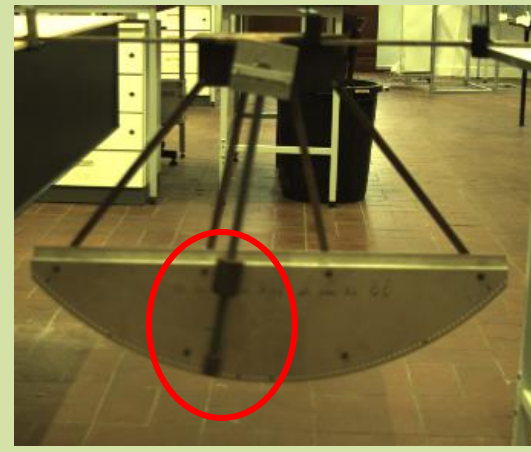
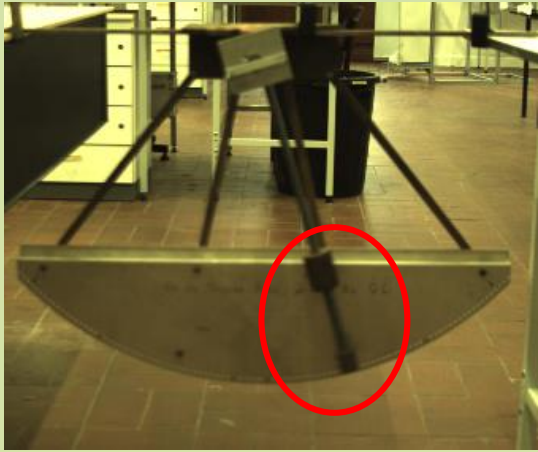


Is the wind a problem ?

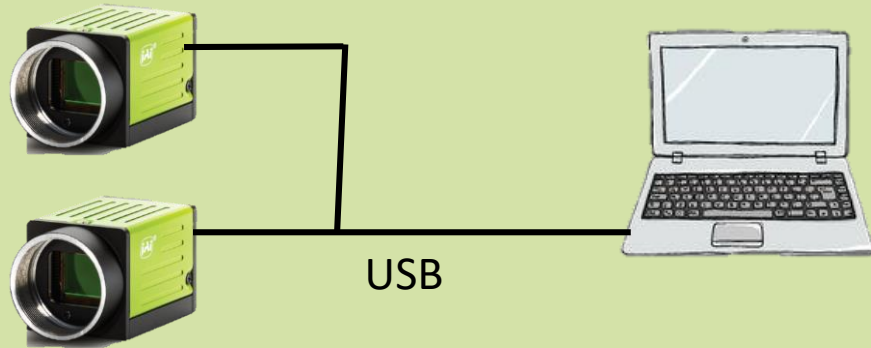




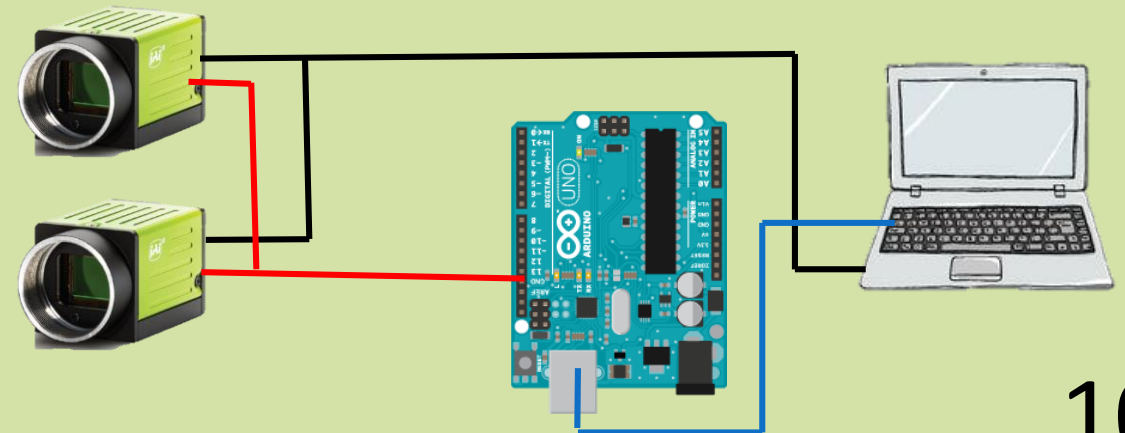
# Is the wind a problem ?



Without trigger



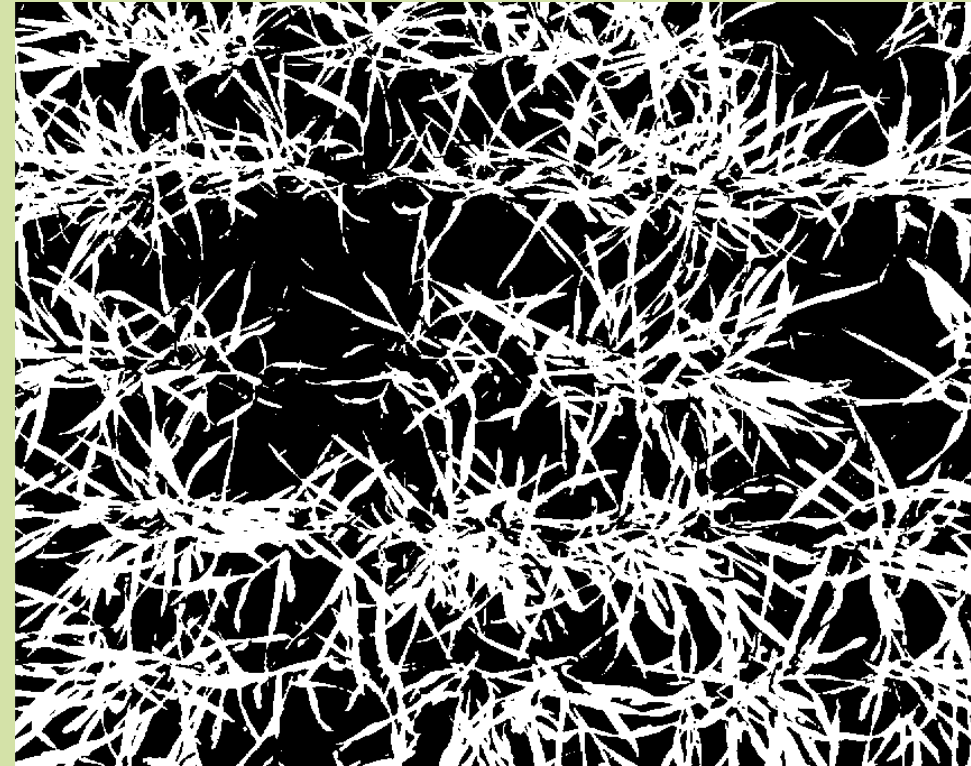
With trigger





# What does it measure ?

**Plant ratio**



Neural networks  
SVM



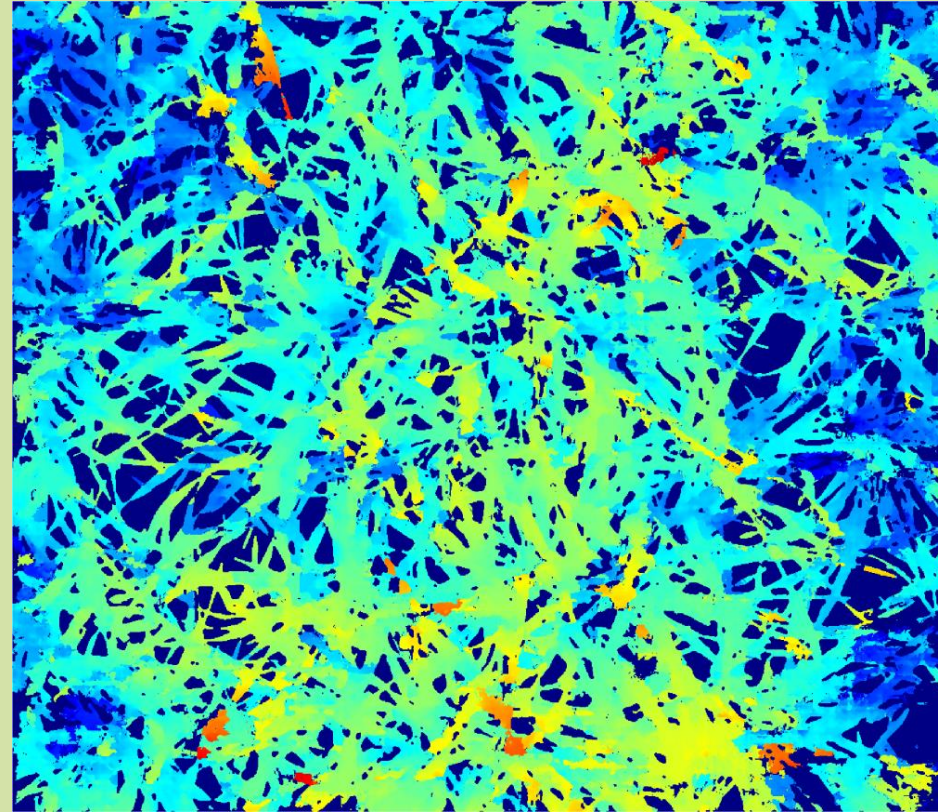
Segmentation accuracy : 98.5 %



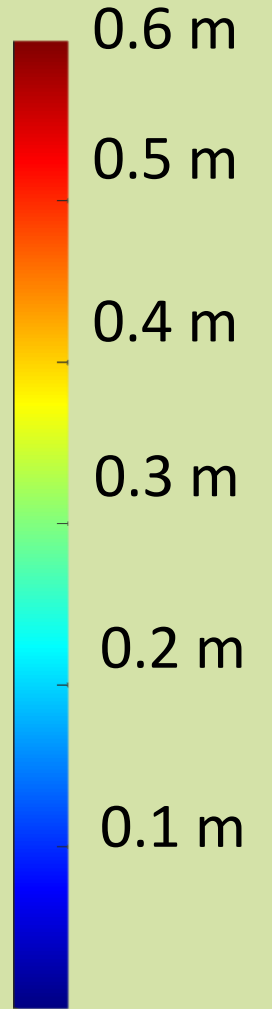
# What about the 3D information ?



Some barley



**Height map**

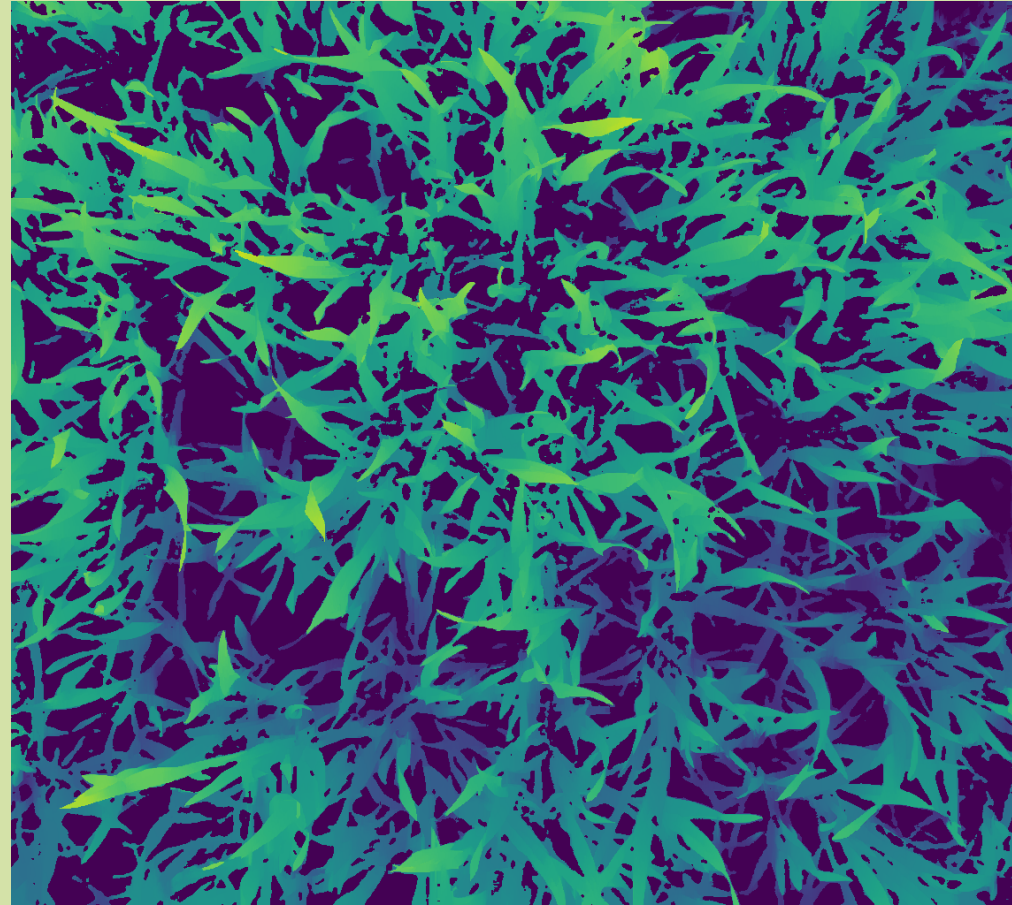




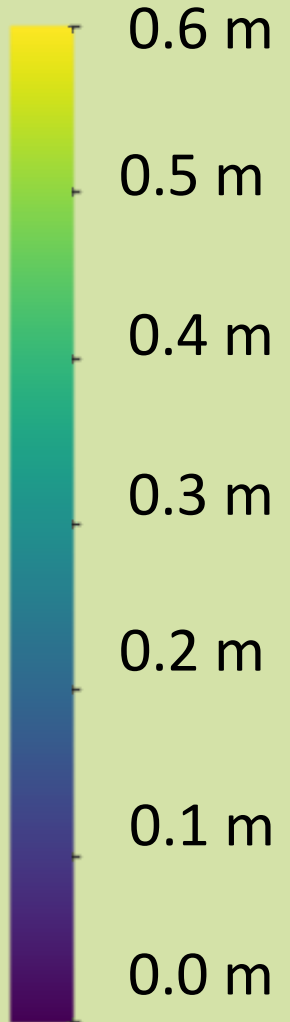
# What about the 3D information ?



Some wheat



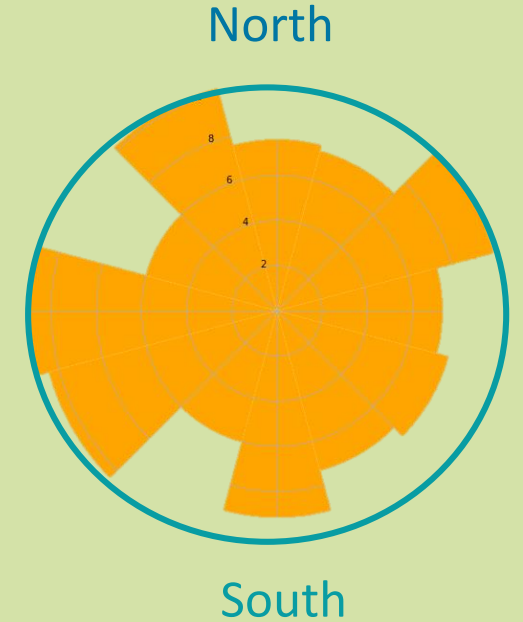
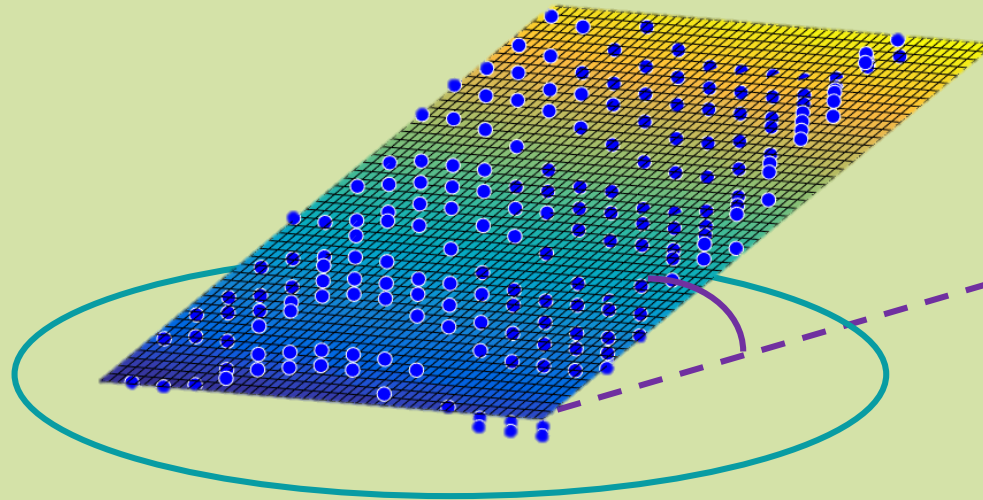
**Height map (2019 result)**



# What about the 3D information ?



1. Detect leaf edges
2. Sample zone of good matching



3. Fit a plane on the point cloud
4. Compute zenith angle
5. Compute azimuth angle



# What are the results ? The perspectives ?

- Plant ratio
- Canopy height
- Leaf angles
- Spike counting
- Leaf Area Index
- Height of spikes
- Biomass estimation

## Estimation of ear density in winter wheat crop by stereoscopic imaging for crop yield

Bouvry, A.<sup>1</sup>, Dandrifosse, S.<sup>1</sup>, Dumont, B.<sup>2</sup>, Leemans, V.<sup>1</sup>

<sup>1</sup>Biosystem Dynamics and Exchanges, TERRA Teaching and Research Center

<sup>2</sup>Plant Sciences, TERRA Teaching and Research Center



...rate

...evaluating the performance of regular image analysis  
...plemented with 3D information from a stereoscopic device, demanding  
...development time and potentially addressing specific issues in 2D ear counting.

- JAI-5000C-USB RGB cameras
- 5 MP sensor
- Exposure time based on saturation ratio
- Microcontroller triggering simultaneous acquisition

# Any take home message ?



## Hello the (outside) world

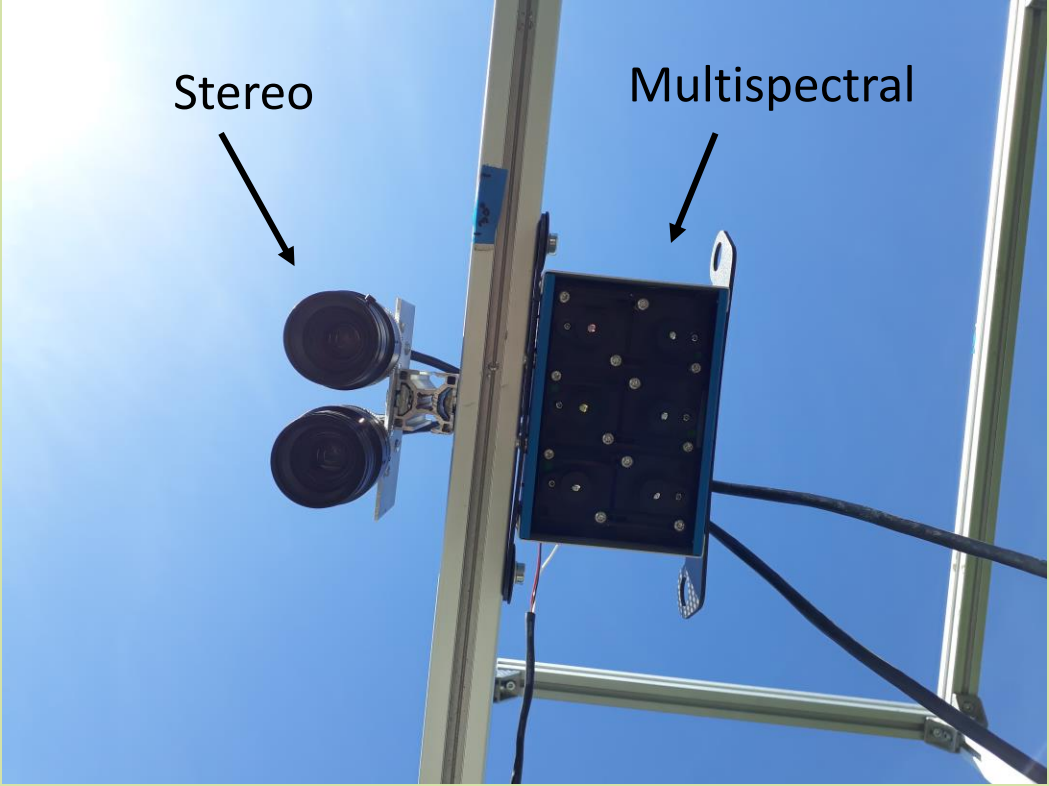


# Thank you for your attention !



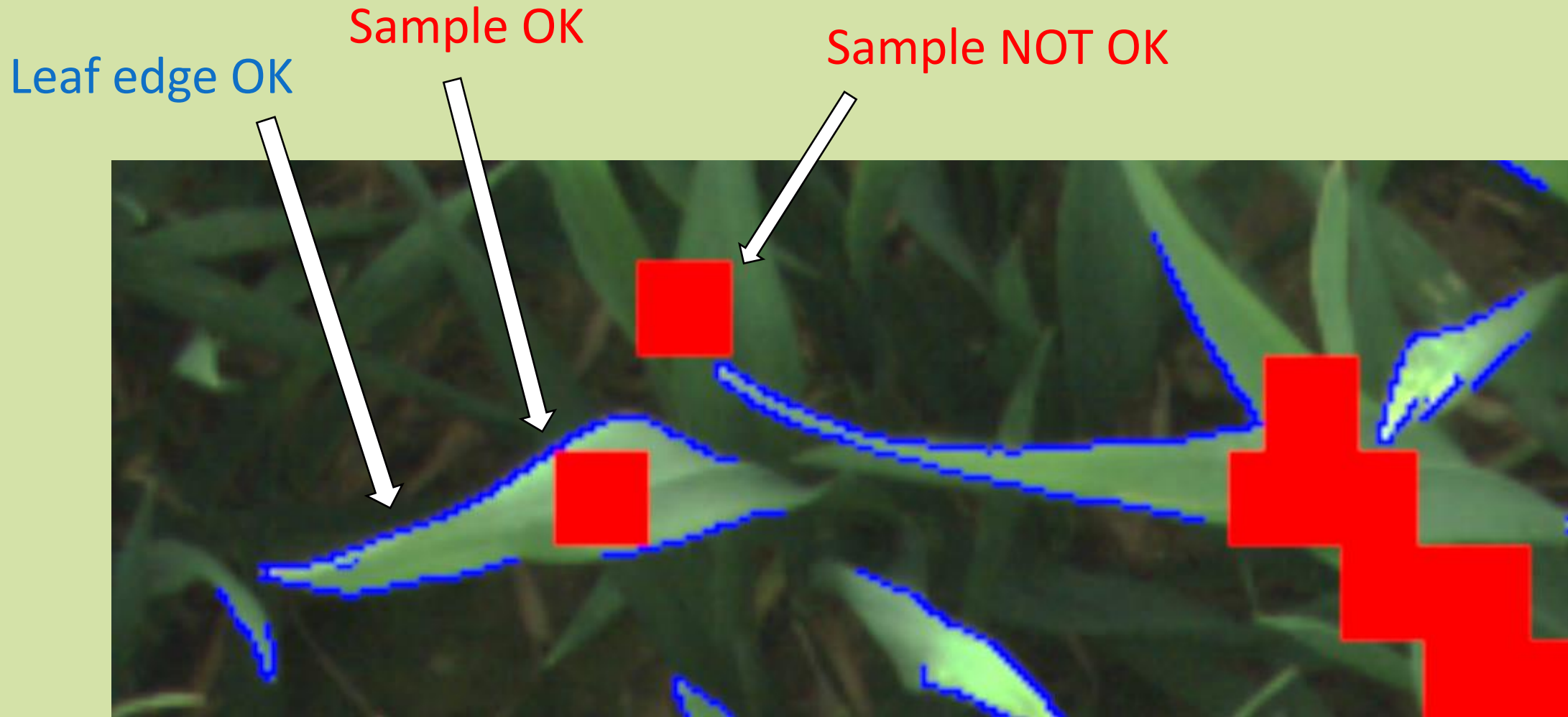
How to contact me ? : [sebastien.dandrifosse@uliege.be](mailto:sebastien.dandrifosse@uliege.be)

# What are the perspectives ?





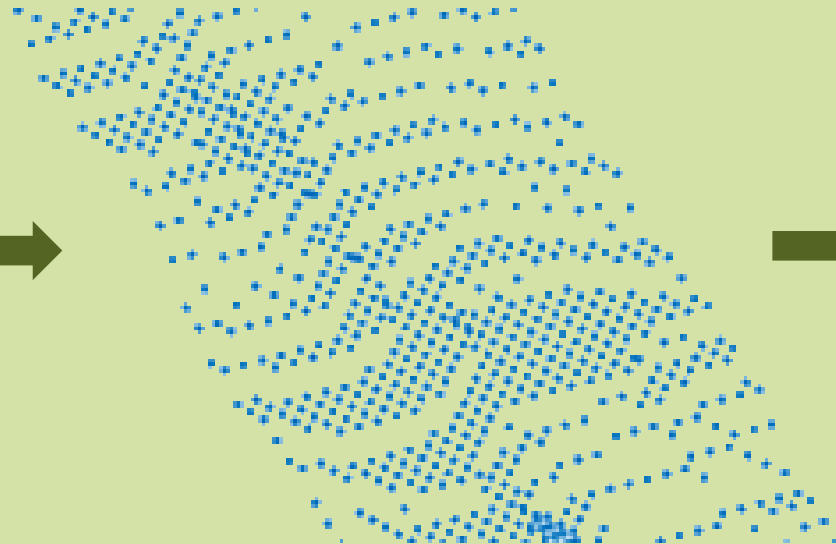
# Sampling of leaf zones



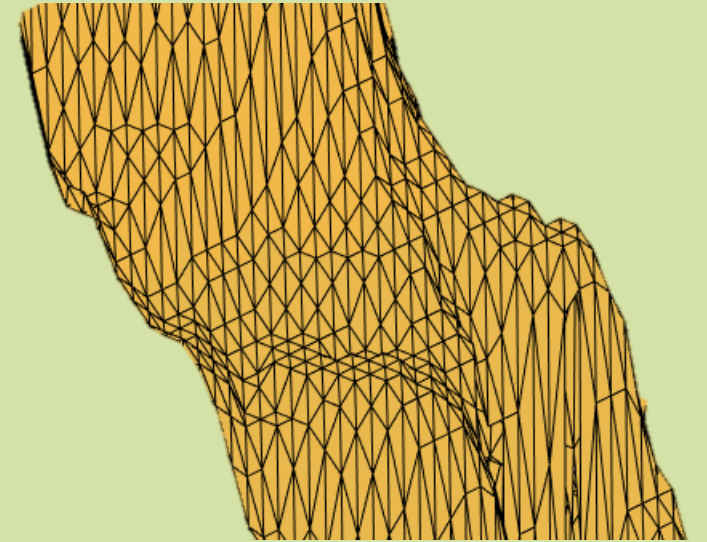
# How to reconstruct a 3D surface ?



Part of a leaf



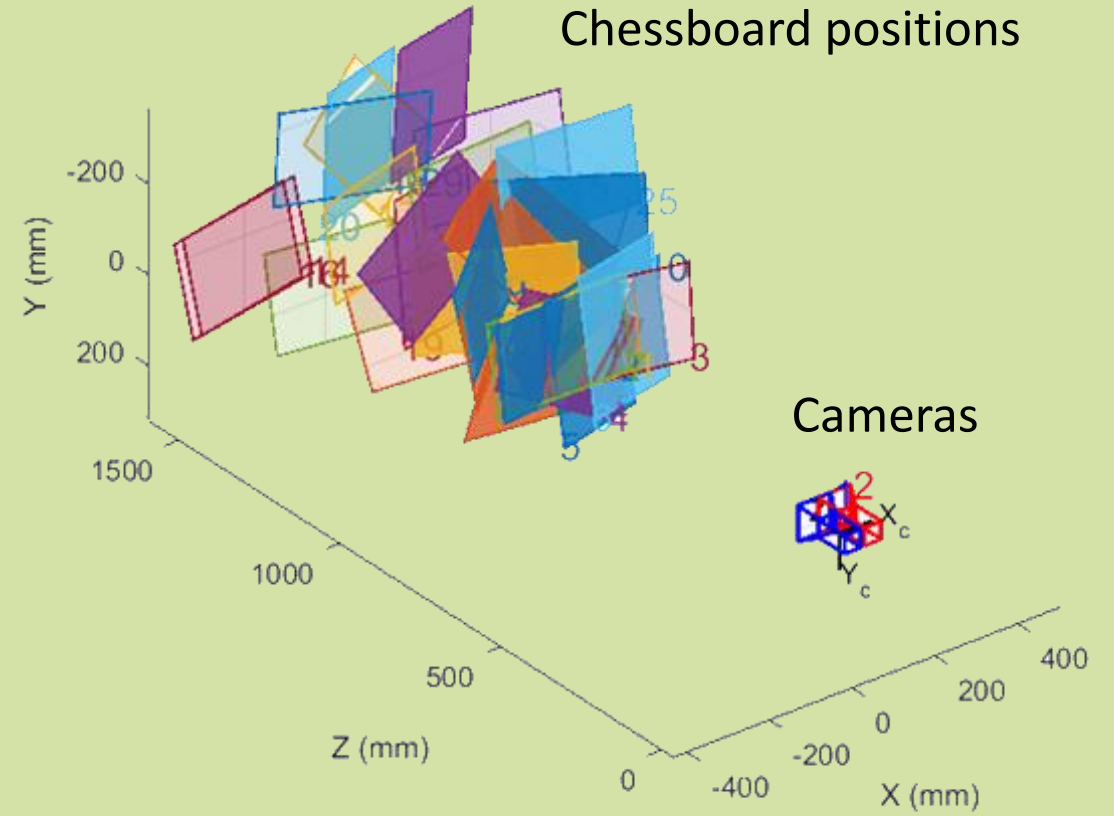
3D point cloud



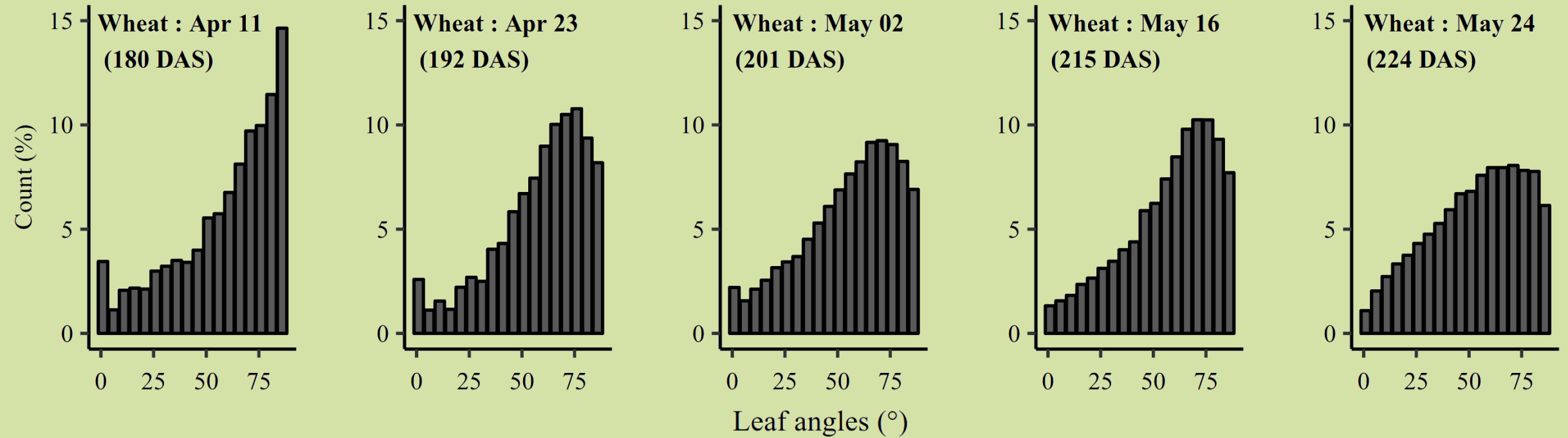
Triangle mesh



# How to calibrate the device ?

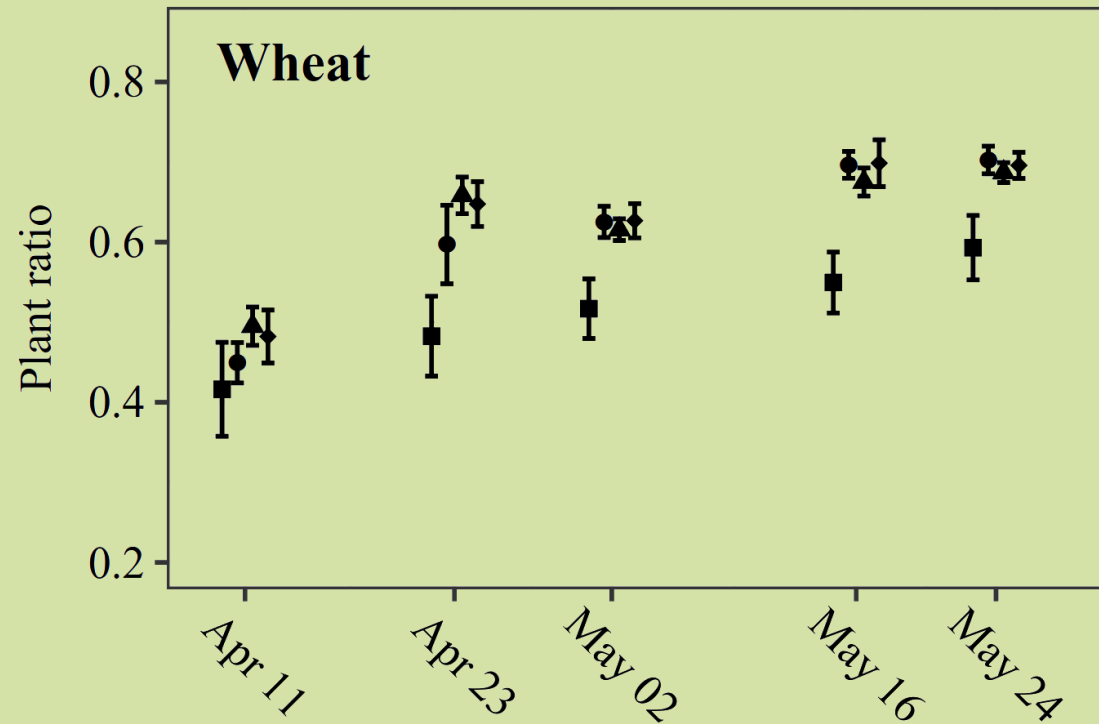


# Leaf angle distribution



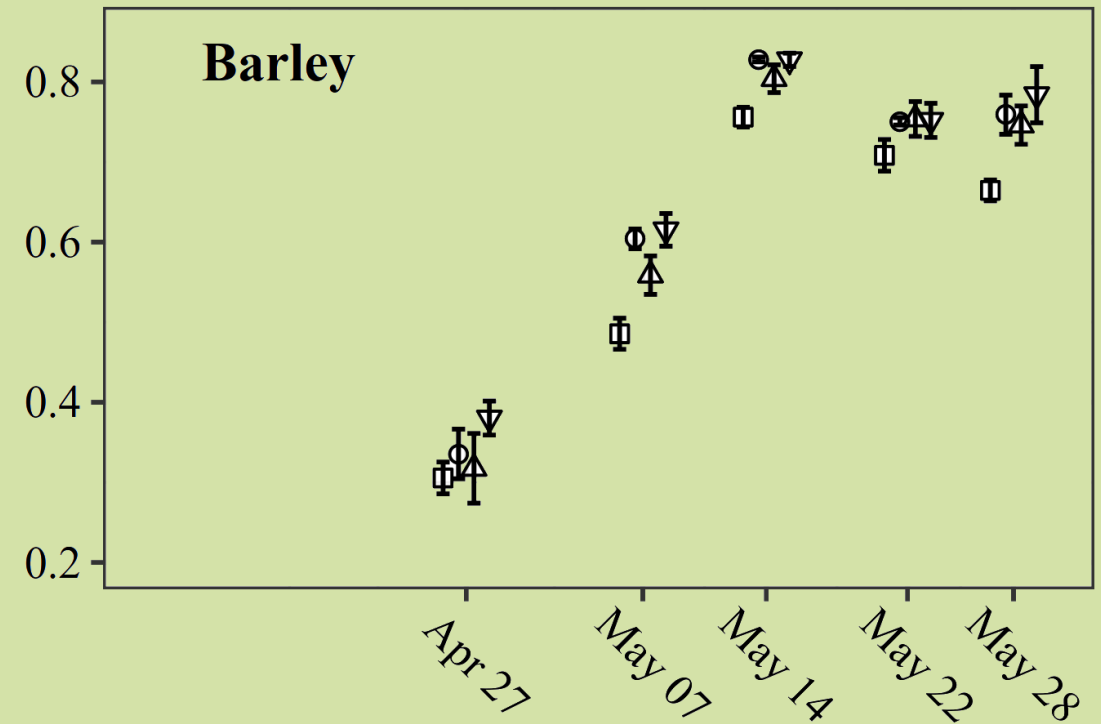


# Plant ratio



Fertiliser at stages: Tillering (2 Apr)  
and Stem elongation (21 Apr) (kgN/ha)

■	0-0	●	30-90
▲	60-0	◆	90-30

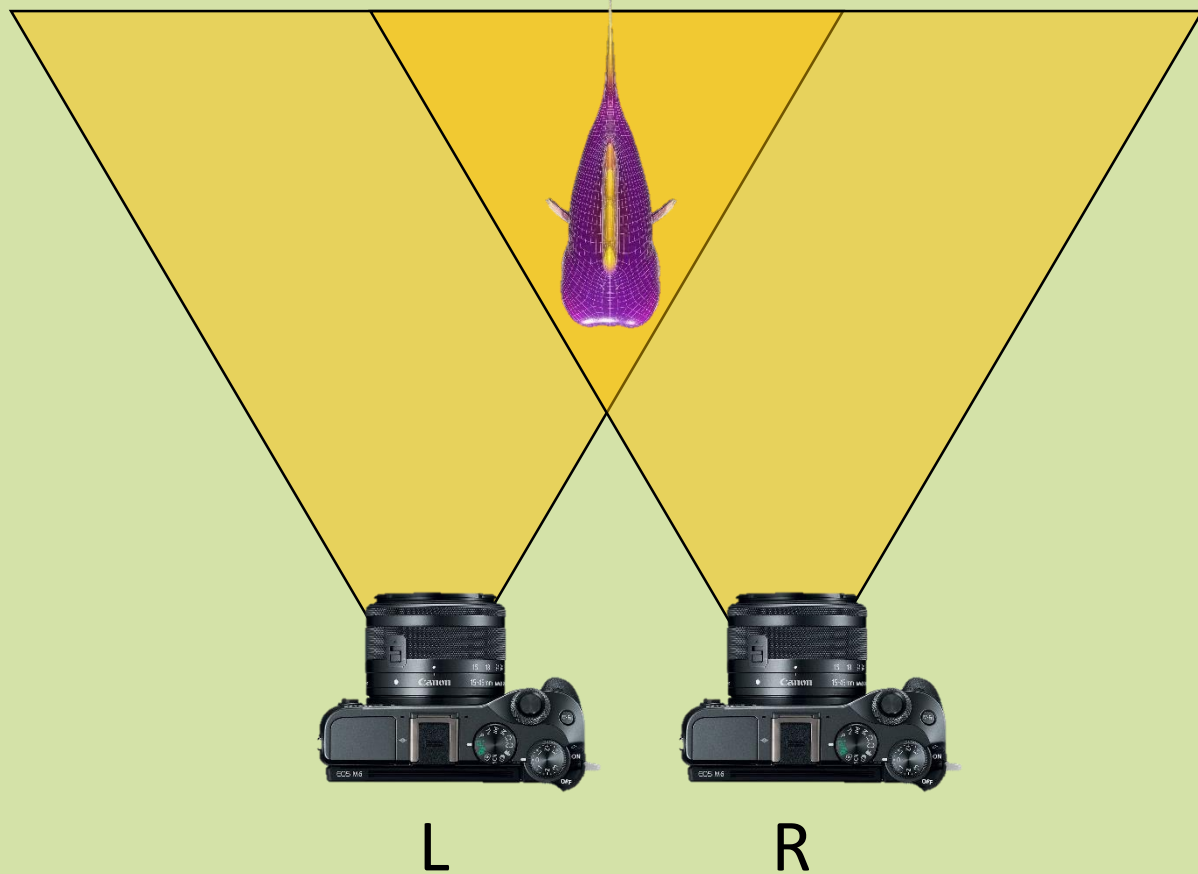


Fertiliser at stages : Seedling (14 Apr)  
and Stem elongation (13 May) (kgN/ha)

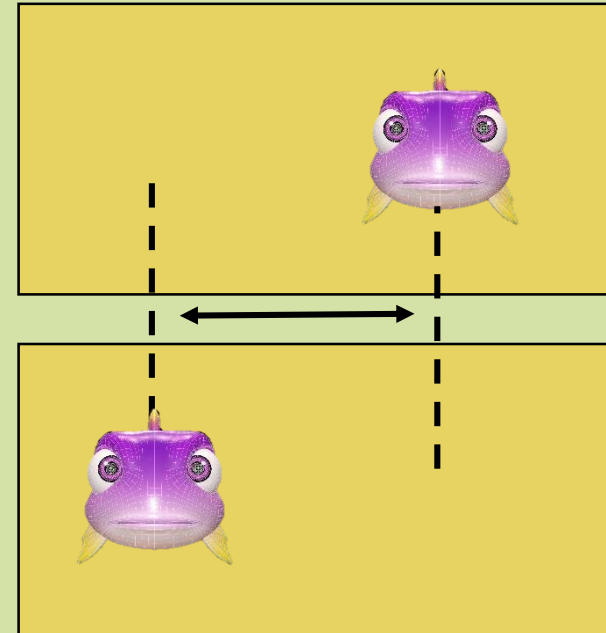
▽	90-30	○	135-45
□	0-30	△	45-15

# What is stereovision ?

Stereo vision : from 2D images to 3D information



What camera L sees



What camera R sees