PRO-GRACE
PROMOTING A PLANT GENETIC RESOURCE COMMUNITY FOR EUROPE

Funded by the European Union

Cost-effective plant phenotyping tools: combining emerging technologies and open source solutions

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Joint PRO-GRACE-EMPHASIS policy symposium

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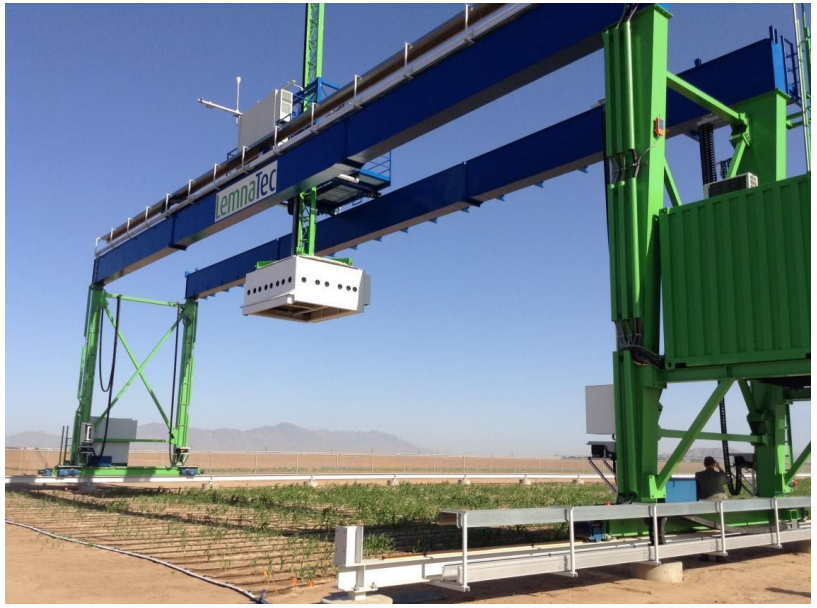
What is cost-effective in phenotyping?

- **Low-cost vs cheap vs cost-effective**
- Cost per data point
  - Instrumentation
  - Labor (time per measurement)
  - Sample processing / analysis
- A matter of scale
  - Spatial: number of plants / plots / trials
  - Temporal: number of time points / dynamic traits

A practical use case: phenotyping plant height for growth rate

Instrumentation cost for plant height

Fixed phenotyping gantries

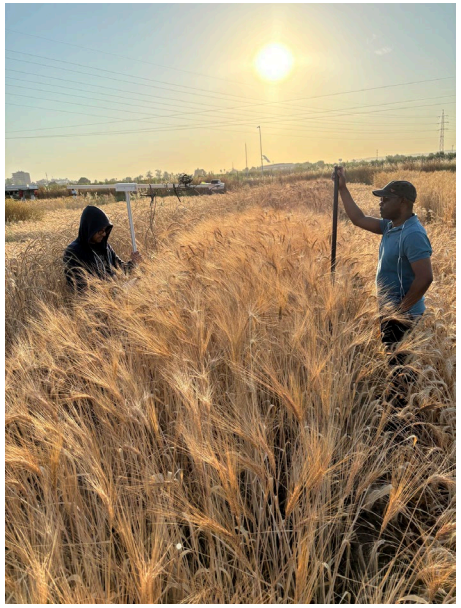


X 10^6 €

Phenomobiles

X 10^5 €

PhenoSticks

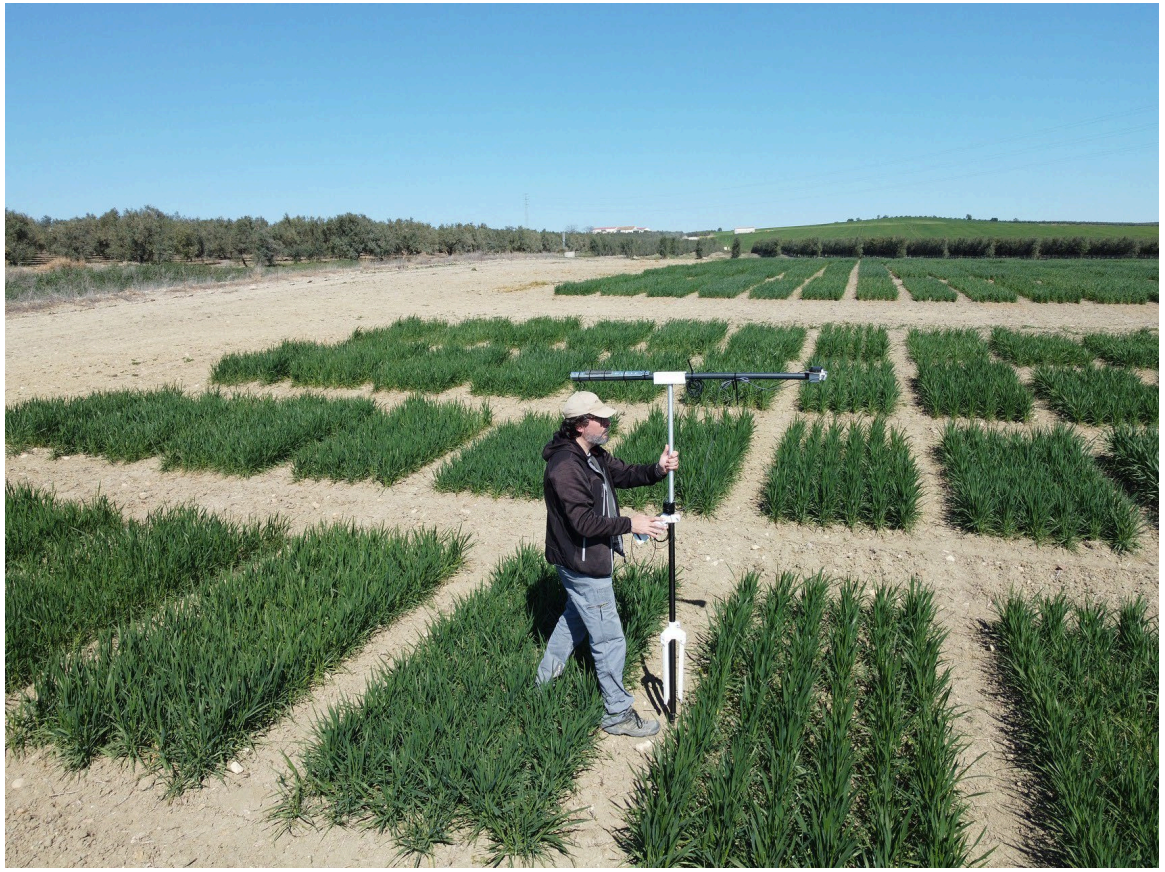


X 10^3 €

Ruler

X 10^0€

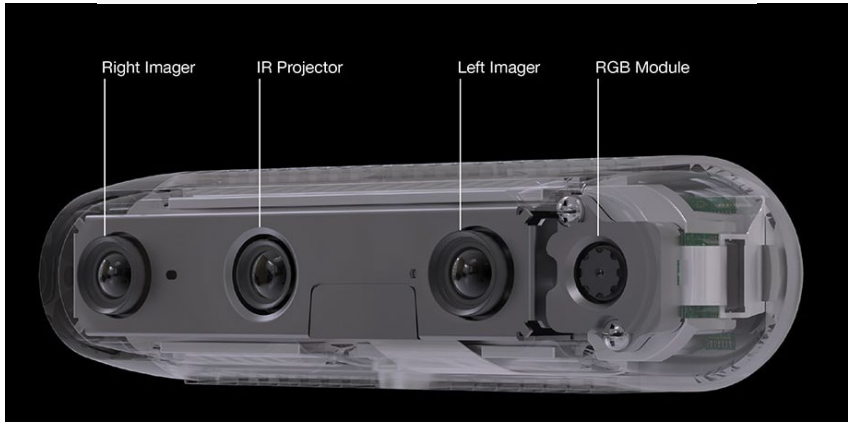
QPheno: a phenostick based on 3D-RGB cameras



~ 10s per plot: RGB + Plant Height

RTK GNSS
2cm accuracy

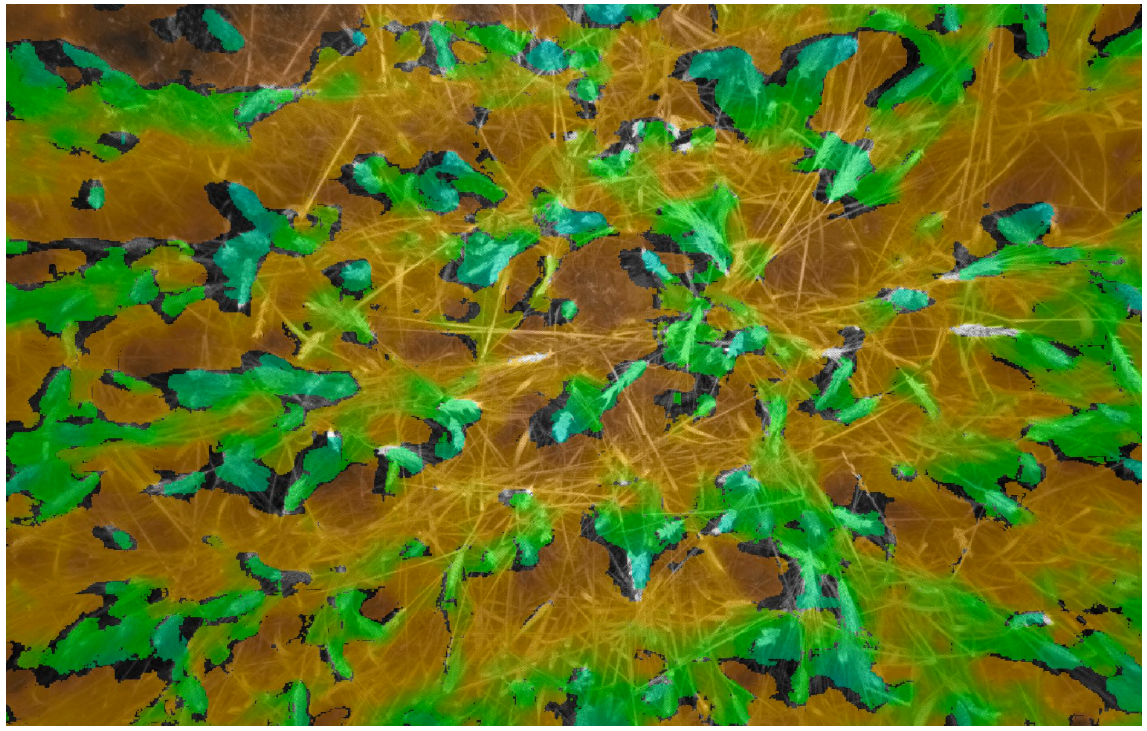
Intel Realsense
3D-RGB



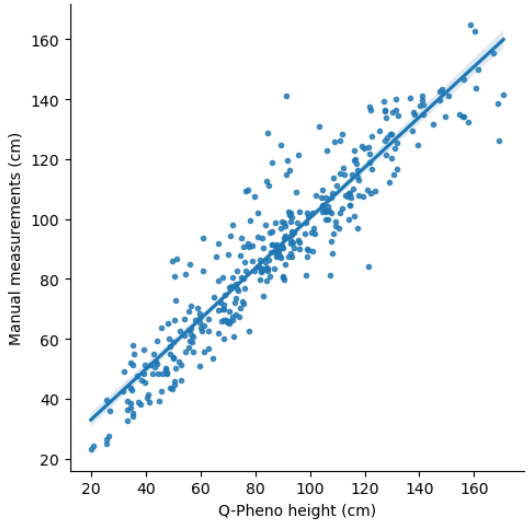
Raspberry Pi
Computer

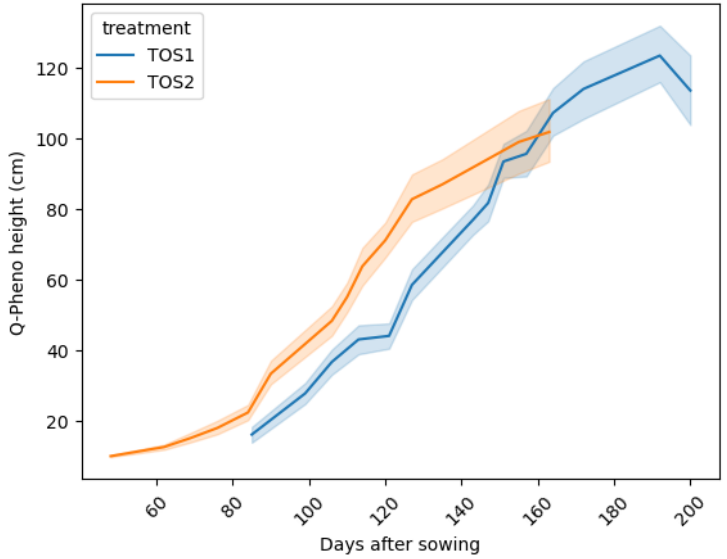
Raspberry Pi

QPheno: a phenostick based on 3D-RGB cameras



Overlay of RGB + Plant height

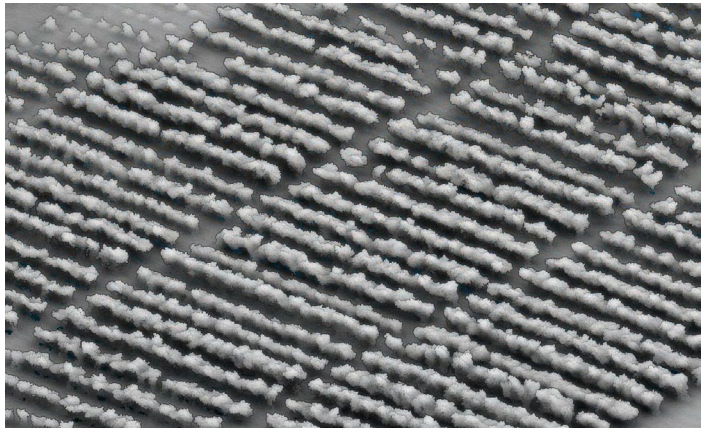


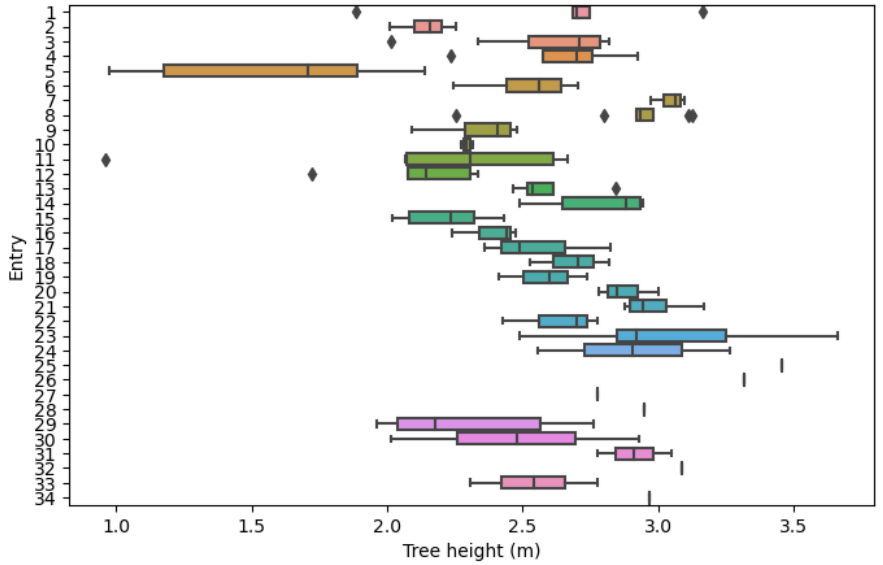


(Quintana, Bellido et al., in preparation)

What about phenotyping tree species?

Manual measurements of tree volume



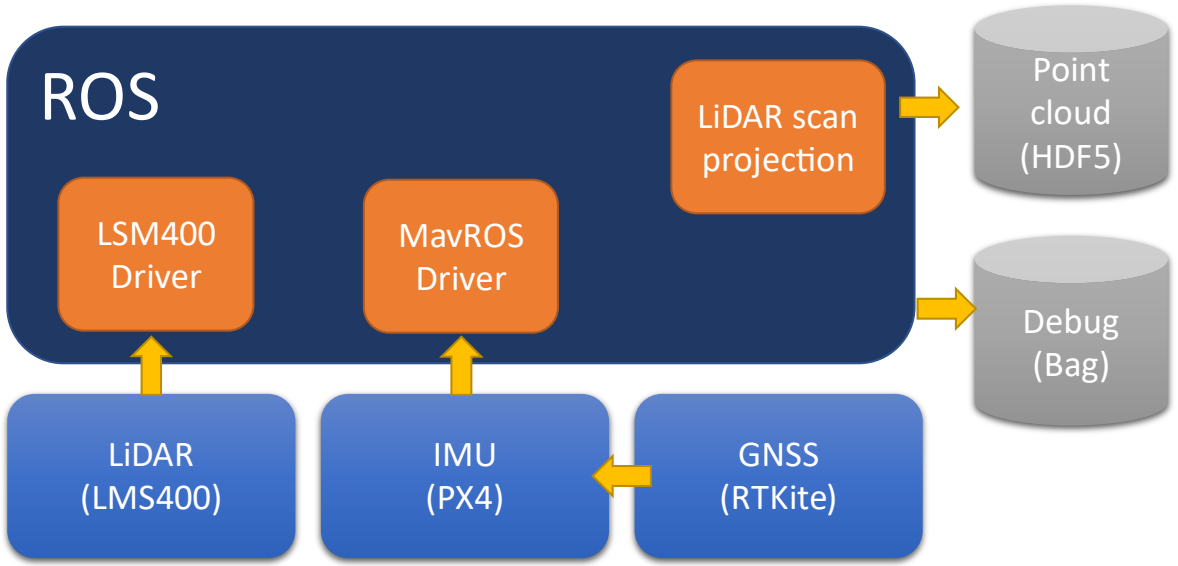


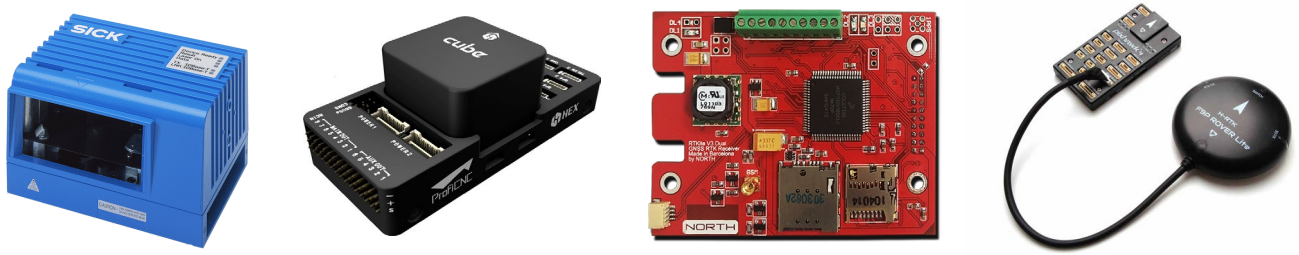
Characterization of olive genotypes using airborne LiDAR

Data adquisition: Open PhenoLiDAR

ROS

PEN
PHENO-LIDAR





https://github.com/OpenAgriTech/Open-PhenoLiDAR

A special case: phenotyping highly dynamic traits

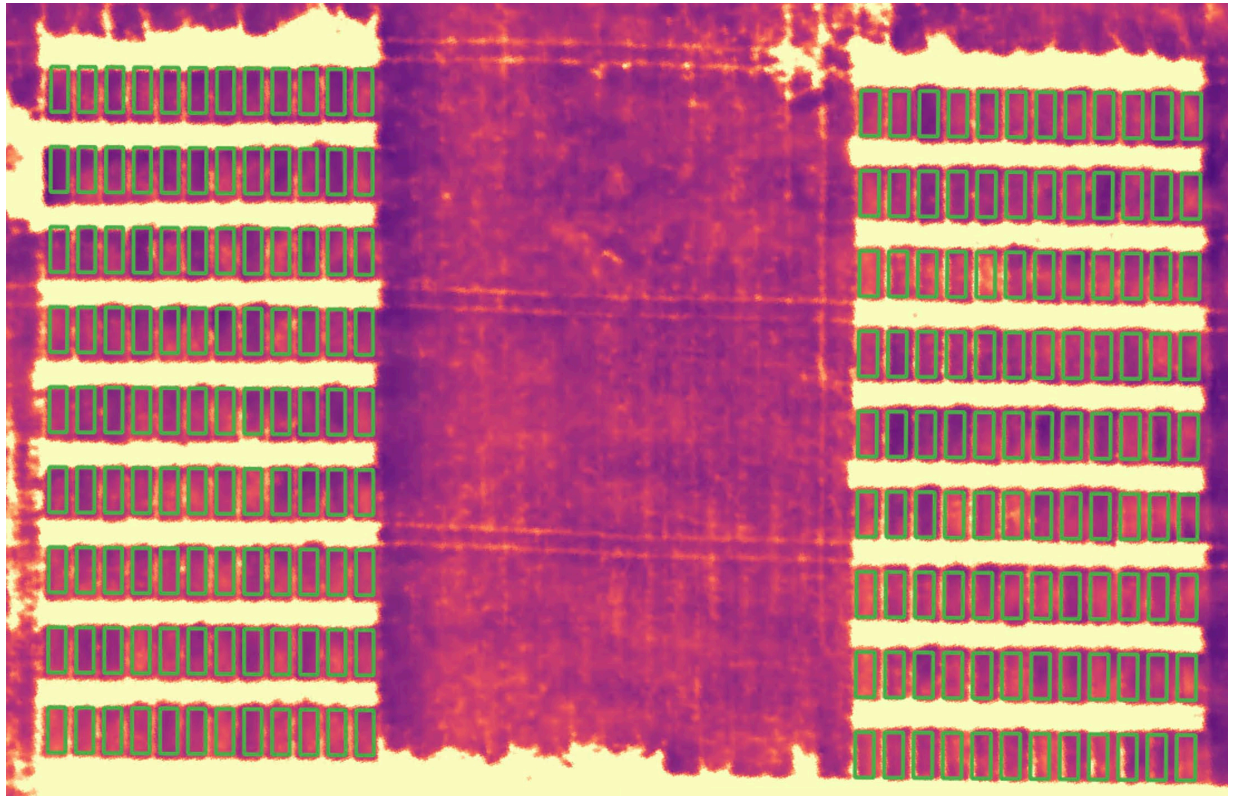
Using temperature proxy for stomatal conductance

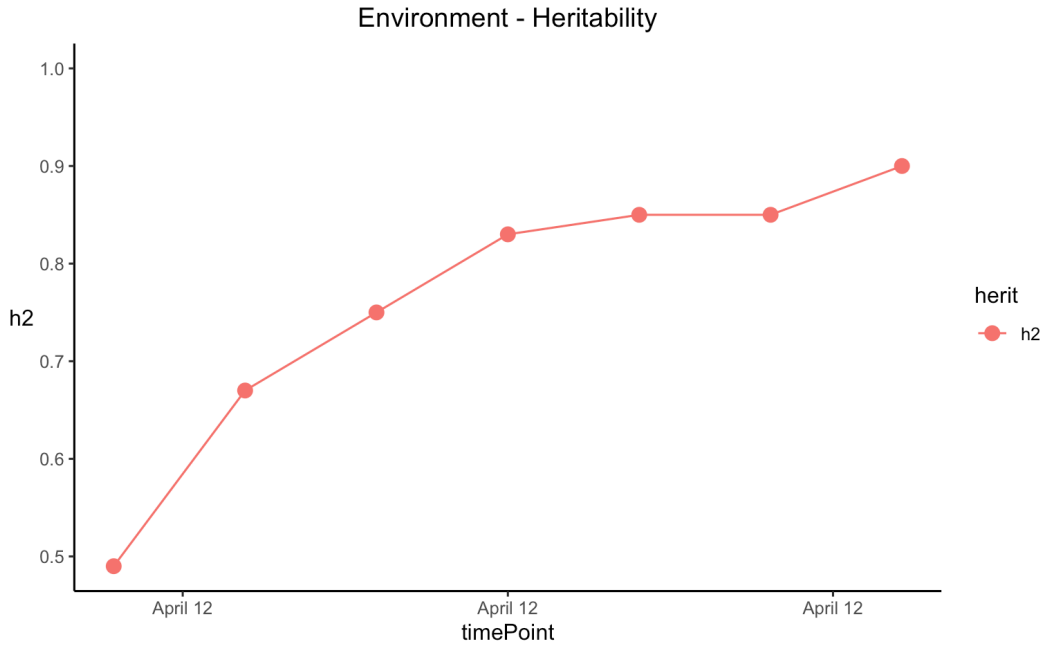
Stomatal conductance is time consuming

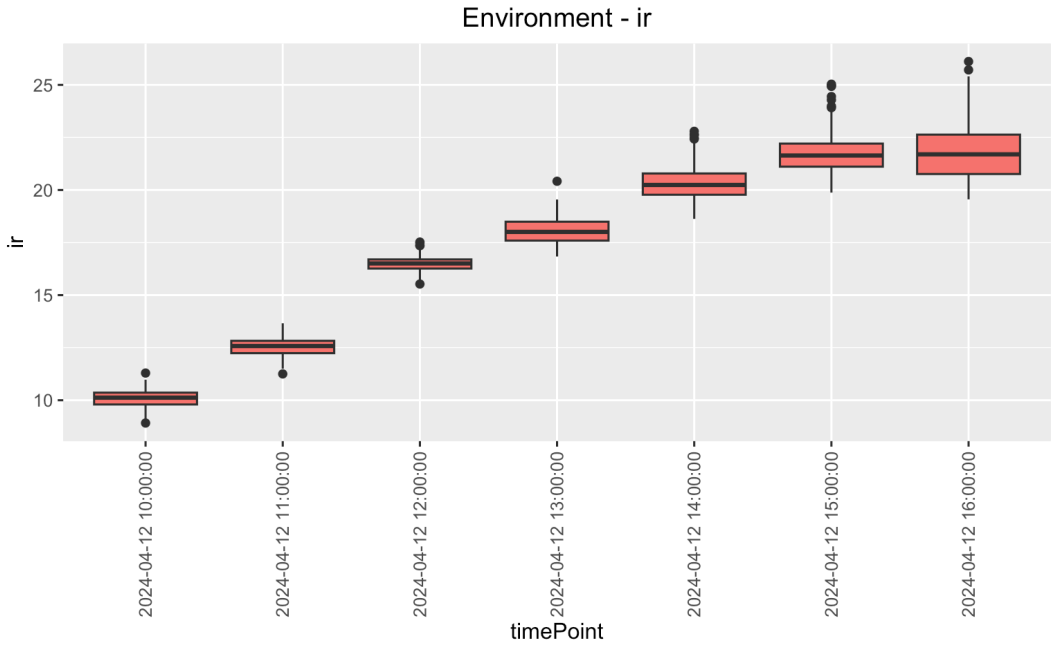
Continous measurements of canopy temperature

(Jimenez-Berni et al, Front. Agron., 2023)

Airborne themography







Plot extraction with BreederMap Plug-in for QGIS (**open-source**)
Data analysis with statgenHTP (**open-source**)

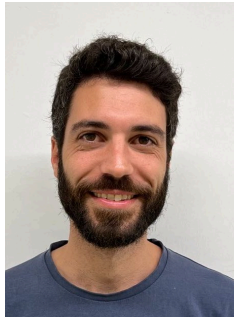
Take home messages

- Think about the cost of each data point and its value
- There may be low-cost tools but limited when scaling up
- LiDAR and 3D-RGB cameras for plant height and canopy architecture
- Canopy temperature traits have to be fast or continuous
- Open-source for data acquisition and analysis is critical
  - Cost
  - Transparency and reproducibility
  - Data soberanity
- A call for collaboration and build up communities

Thanks to a great team!

Rafa Orozco
Smart irrigation

Daniel Lozano
Técnico superior



Gabriel Soriano
Ground-based LiDAR

Fernando Madrid
Ingeniería electrónica

Kika Ruz
Heat and drought tolerance in wheat

Teresa García
Postdoc on phenomics and plant pathology

AgroPhenoLab

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THANK YOU

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