
eia
Quality Irrigation Water Savings
EUROPEAN IRRIGATION ASSOCIATION
EIA Winter Irrigation Forum
26 January 2024
TOGETHER FOR SUSTAINABLE IRRIGATION

THE HOUSEKEEPING RULES FOR A SMOOTH FORUM

- The event is recorded and will be shared
- Please present your full name and your organisation properly
- Please mute your microphones while you not participating
- Please use the chat box for questions and comments
- If you can, turn on your camera on so we can see each other

THE HOUSEKEEPING RULES
EIA CODE OF CONDUCT

- EIA believes it is important that its activities are at all times carried out in accordance with the applicable law, especially competition law.
- EIA believes that business shall be conducted in an atmosphere of free competition, i.e. based on price and quality.
- The Code of Conduct aims at providing clear rules to EIA's members, thus reducing the risk of improper conduct and consequently of fines being imposed.
- This Code of Conduct shall be binding on all members as well as all other participants when taking part in EIA activities.

Code of Conduct

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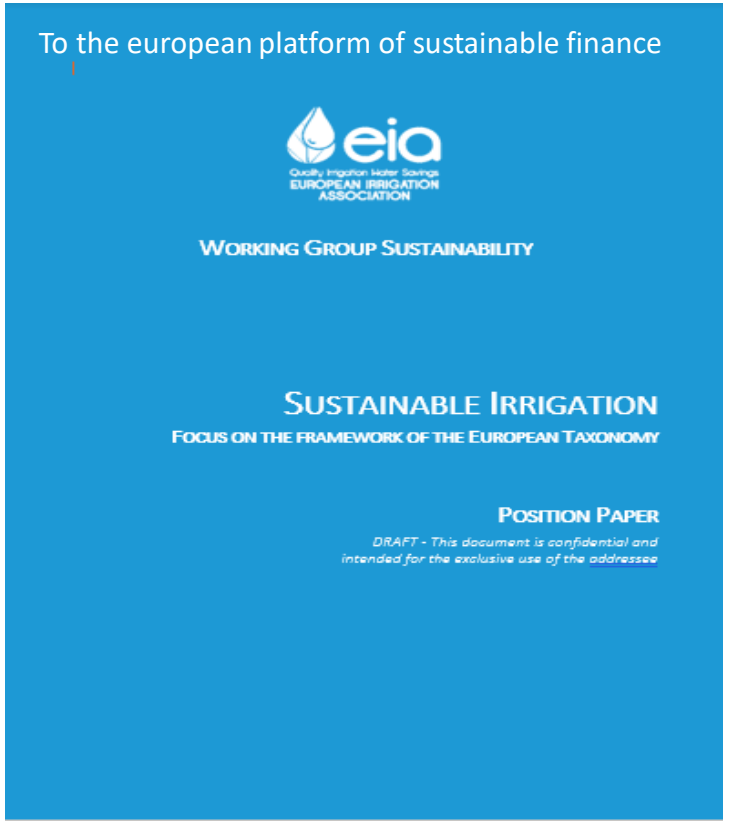
Agenda for this forum

14:00 -14:20	**Opening** **Introduction** **The EU taxonomy for sustainable activities**	Moshi Berenstein/ EIA President
14:20 -14:30	**Welcome & introduction of New Members**	Fleur Martin/ EIA Communication Officer
14:30 -15:00	**Guest speaker** **“Plant, soil and water ...a look at the rhizosphere"**	Annette Bérard and Claude Doussan, Research Director, INRAE
15:00 -15:30	**Innovation and Technology session** **« Smarter than just ET - Digital-Twin for designing and operating irrigation systems »**	Andreas Maurer, CEO DVS Beregnung GmbH, Tübingen, Germany
15:30 - 15:40	**Open session for Q&A**	

EIA Position Paper: Sustainable Irrigation from water crisis to sustainable irrigation

1) After several months of work, supported by many EIA's internal and external experts, we have finalized the Position Paper "Sustainable Irrigation – Focus on the framework of the EU Taxonomy".
2) On December 15th, 2023, we officially submitted to the European Commission the identified economic activities and technical criteria drafted to measure the potential contribution of the irrigation sector to the environmental objectives defined by the EU Taxonomy.
3) Our aim is not only to integrate Sustainable Irrigation within the European framework, but to also provide a univocal basis for measuring and improving the performance of our value chain and foster the sector's sustainable transition.



Special thanks to the companies that took part in the Fund-raising campaign for this project in 2023 :

A reminder : Irrigation and Taxonomy

1) The **EU taxonomy** as a classification system that establishes the rules for sustainable economic activities, a common language and a clear definition of what is ‘sustainable’
2) It’s part of the European Agenda for Sustainable Development (Paris agreement 1.5°C , SDG sustainable development goals, the European commission policies and the new European growth strategy).
3) To support the financial sector in meeting the sustainable investments targets that will lead Europe to carbon neutrality by 2050, the European Commission introduced a new common classification system at the international level for sustainable companies, the EU Taxonomy. The Regulation is the main instrument with which investors will integrate their investment process with decisions based on sustainability. So, an effective inclusion of a given industry within the Taxonomy can already represent an important lever for its competitiveness and its contribution to the sustainable transition.
4) Today the EU Taxonomy doesn’t apply to the irrigation sector.
5) The objective of the EIA Position Paper is to increase transparency and the quality of the information on irrigation technologies & benefits available for investors so to allow them to make effective sustainable investment decisions.
6) We're excited about the positive impact that this Sustainable irrigation work-stream can have on the sector!

Recommendations to irrigation stakeholders

5 recommendations for the future of Sustainable Irrigation

STK	1	2	3	4	5
	IRRIGATION COMPANIES	END USERS & VALUE CHAIN	INTERNATIONAL INSTITUTIONS	RESEARCHERS & STANDARDS	FINACIAL SECTOR
RECCOMANDATION	**Sustainable Irrigation criteria to orientate sustainability goals and reporting**	**Application of sustainable practices unlocking irrigations' enabling potential**	**Consider irrigation within current and future regulatory classification systems**	**Development of a universally recognized Sustainable Irrigation label**	**Become familiar with irrigation systems to reward the sector's sustainability**
LINE OF ACTIONS	Spread knowledge among companies about sustainability best practices and criteria at the base of Sustainable Irrigation	Global Alliance among different actors, inside and around irrigation, to share actions to safeguard water	International collaboration to promote and advocate for a common definition of Sustainable Irrigation	Start from activities and criteria defined to develop thresholds at the base of a new sustainability label	Collaboration among different actors to make investors aware about the enabling potential of irrigation

Open Webinar on Irrigation & Taxonomy

9 February 2024, 12h00 CET

We are happy to invite you to attend our 1-hour open webinar on February 9 at 12:00, where we will present the project and the results achieved.

Microsoft Teams meeting

Join on your computer, mobile app or room device

Click here to join the meeting

Meeting ID: 399 625 539 034

Passcode: brnhha

Download Teams | Join on the web

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We look forward to your participation!

Quality Irrigation Water Savings
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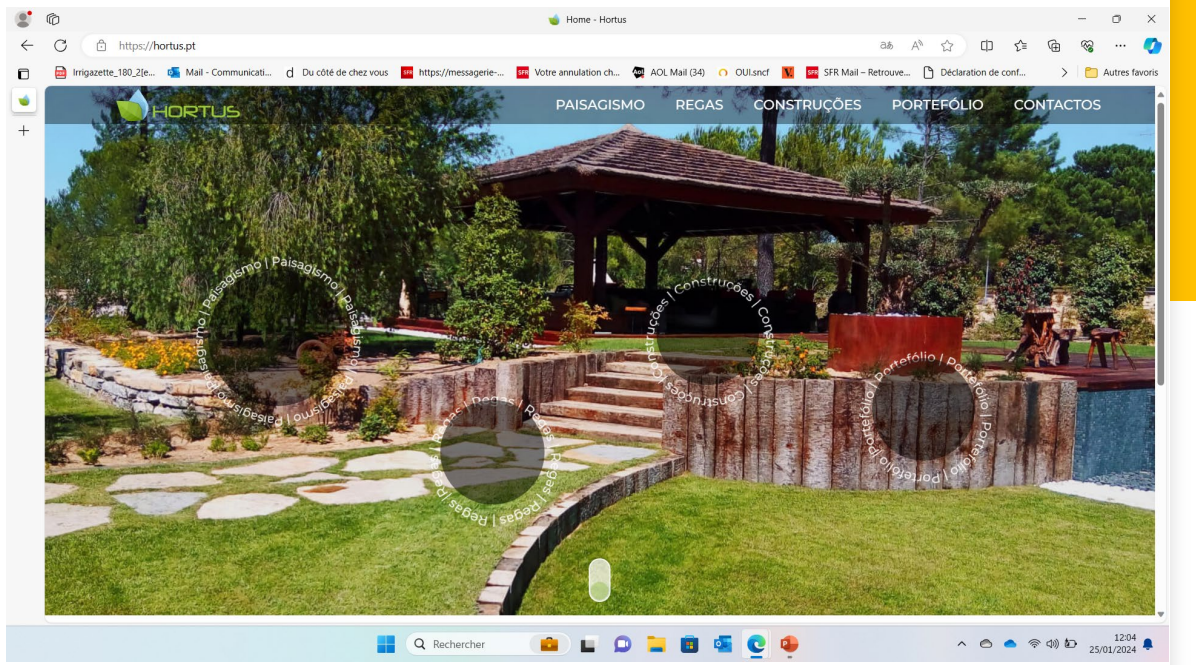
Welcome new members

- We are very pleased to welcome 3 new members in the association since our latest forum, in November
- We now have members 81

Cropin

Seeding the future of food with the world's first intelligent agriculture cloud

HORTUS



Hortus

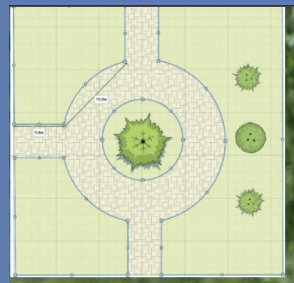
Contact for EIA : Miguel Agostinho

Email : geral@hortus.pt

IRRISketch

IRRISketch.com

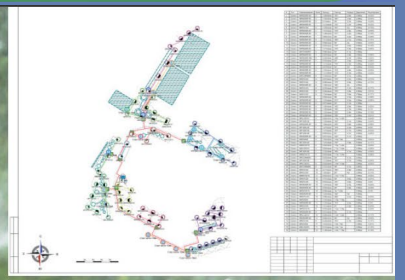
The innovative web-based PLANER FOR IRRIGATION SYSTEMS



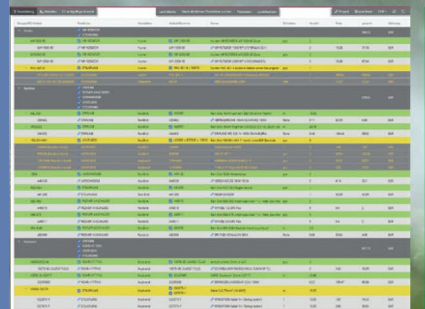
Design Studio
Receive client projects directly online. Clarity from the start. Design without detours.

Import images
Easily scale images to internal units, to get proper dimensions.

Design irrigation system
Build optimal systems, with intuitive sprinkler placement and hydraulic calculations.



Print layouts
Highly-configurable views with scalable graphics.



IRRISeller
Precise irrigation cost calculations at your fingertips.
Parts and labor, seamlessly integrated.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Soisy Arrosage
sun Agri
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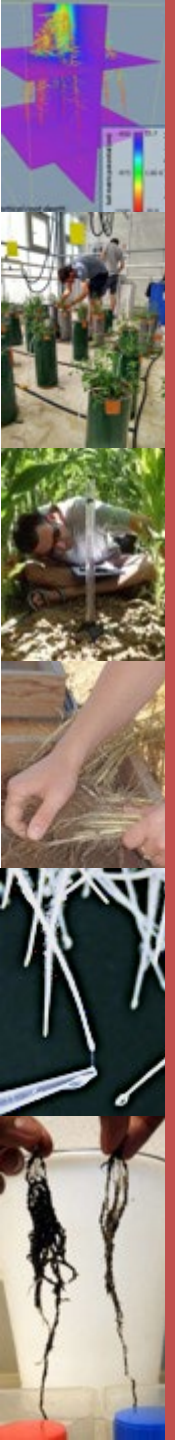
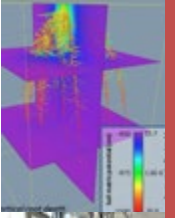
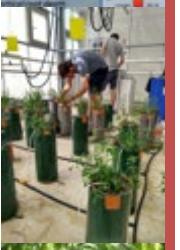
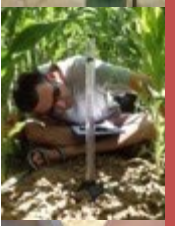
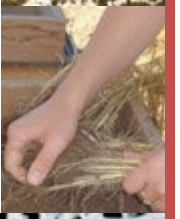
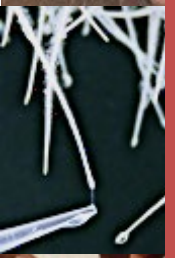
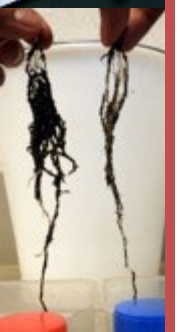


Plant, soil and water ... a look at the rhizosphere

Claude Doussan and Annette Bérard

UMR 1114 EMMAH
team SWIFT

Backgound and issues

Driver

Climate Change

Events

Drought events

Intense rainfall events

Crop water deficit

Runoff / infiltration

impacts

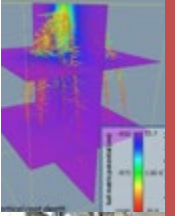
⇒ Yield/quality
(e.g. effect already visible for wheat)

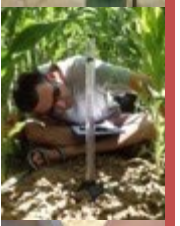
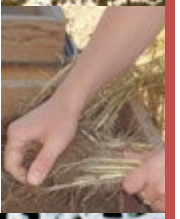
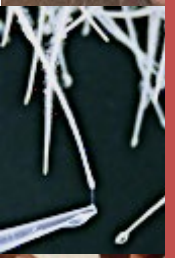
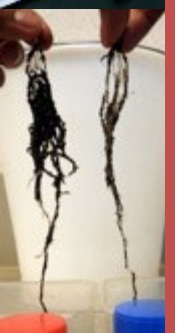
⇒ Waterlogging of soil / crops
⇒ Runoff/ erosion/ flooding
⇒ Groundwater recharge

+/-"Conventional" solutions

- Technical: irrigation, ReUse
- Genetics: improvement by breeding
- Agronomic: (species / varieties, plant density, amendments, etc.)

- Tillage / soil amendments
- Equipment (basins, drains, etc.)
- Agronomy (cover crops, grass strips, etc.)
- …



Enjeux et Contexte

Driver

Climatic Change

Events

Drought events

Episodes of +/- intense rainfall

Conditions / impacts

Crop water deficit

Runoff / infiltration

⇒ Yield/quality
(e.g. effect already visible for wheat)

⇒ Waterlogging of soil / crops
⇒ Runoff/ erosion/ flooding
⇒ Groundwater recharge

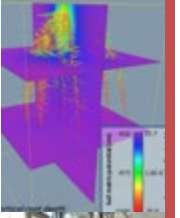
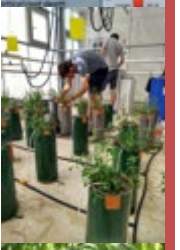
Nature-based solutions?

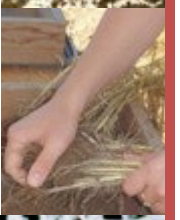
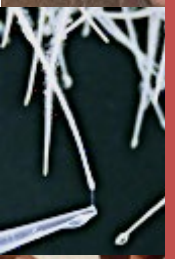
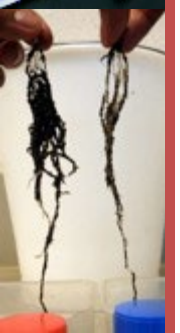
Use of plants and their root systems?

Increase the Soil Available Water Capacity?

Modify the soil's surface and deep infiltrability?

Plant and soil interact in the rhizosphere

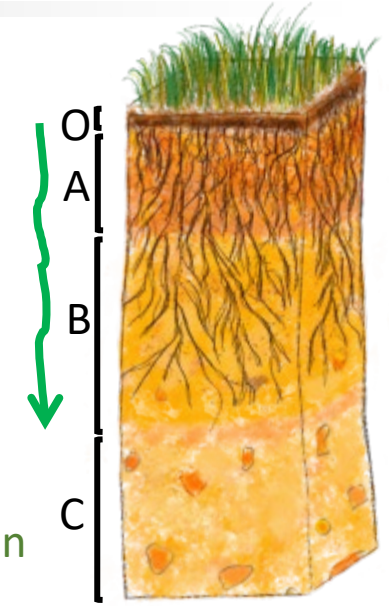



Uptake
Growth
Yield
Adaptation
to water deficit

Plant acts on the soil

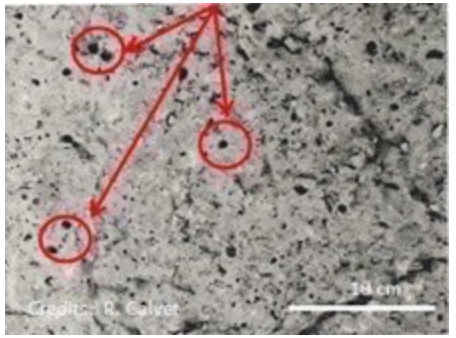
Hydric properties of the soil are modified in the rhizosphere



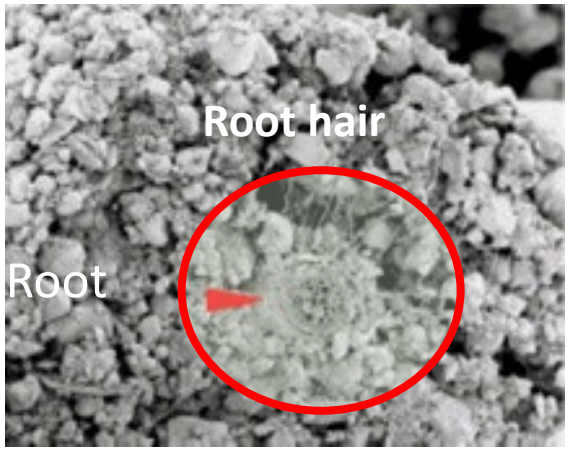
Indirect actions
→ "Rhizosphere effect"
rhizodeposition: C

Direct actions

Creation/clogging pores

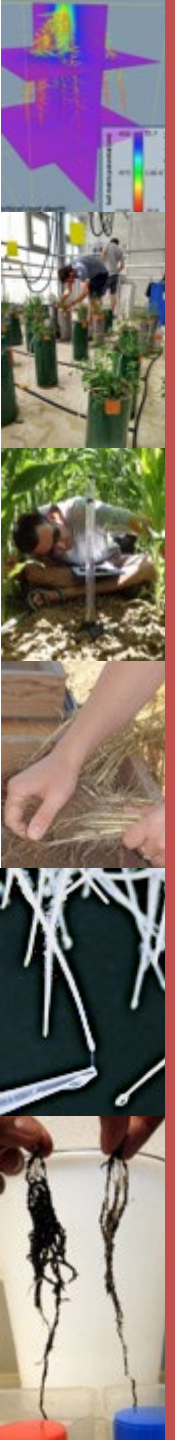


Root architecture



interactions with microorganisms

Indirect actions, the "Rhizosphere effect"



The plant

The microorganisms

Root exudations

Plant nutrient uptake

Microorganisms interactions

The soil…

Soil aggregation

EPS

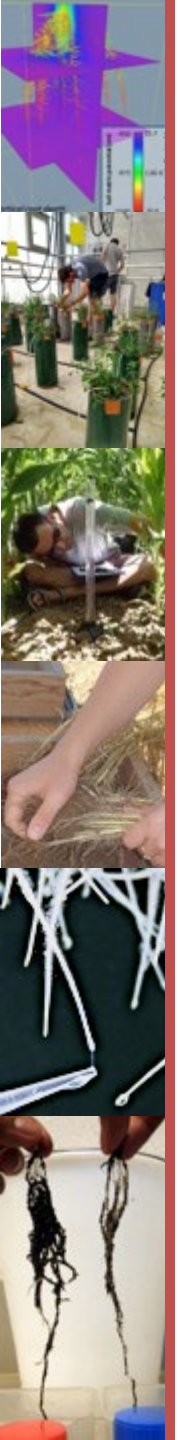
Water retention

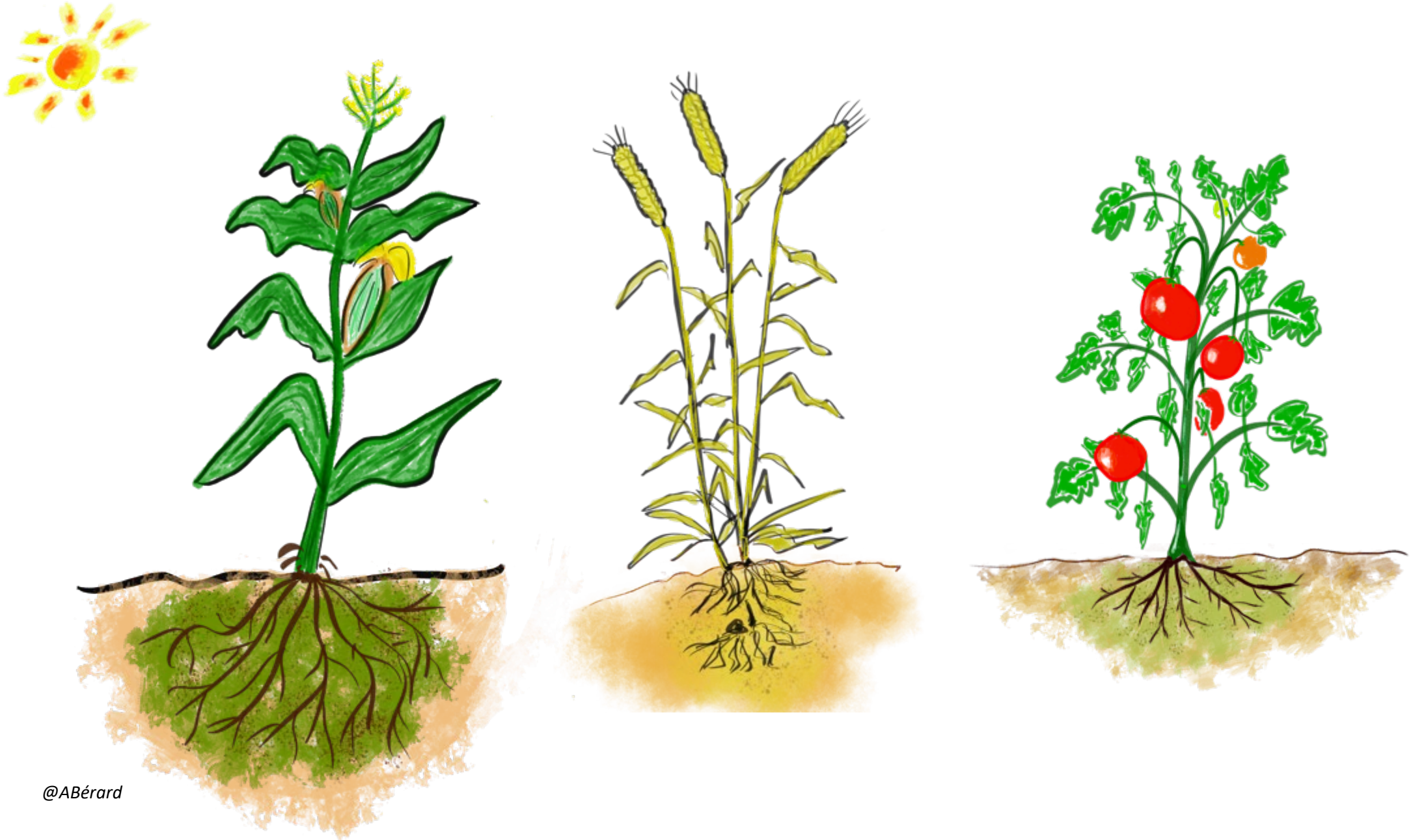
Mucilage Rhizodeposition

and The water …

@ABérard

Observations of the "rhizosphere effect" ...

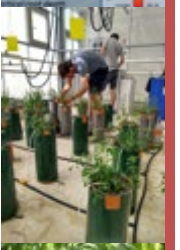


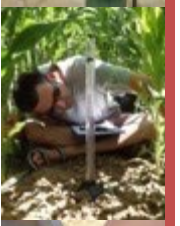


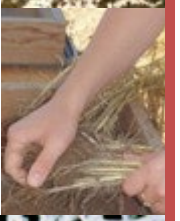
@ABérard

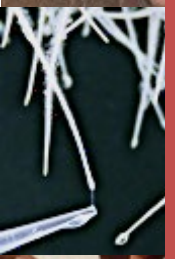
Local effects: observations in the field (maize rhizosphere)

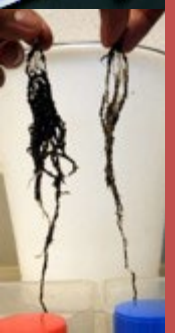
Local effects (maize rhizosphere)

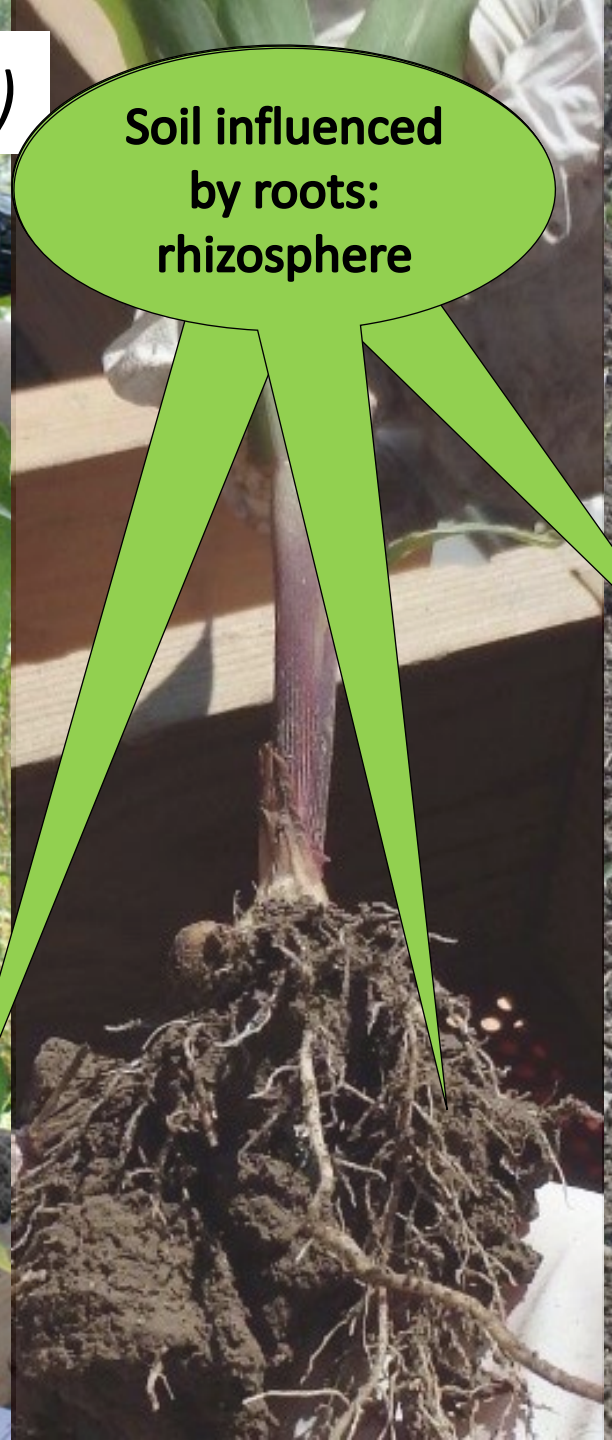












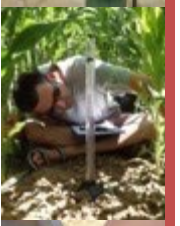
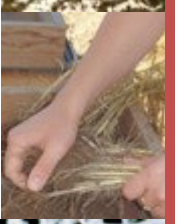
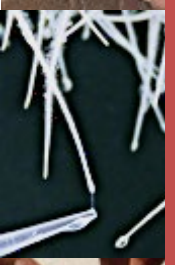
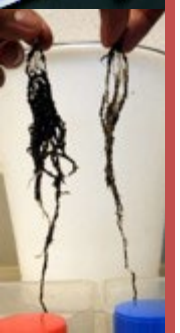
Soil influenced by roots: rhizosphere

Bare soil taken between 2 rows: "bulk"

Maize

Local effects *(maize rhizosphere)*

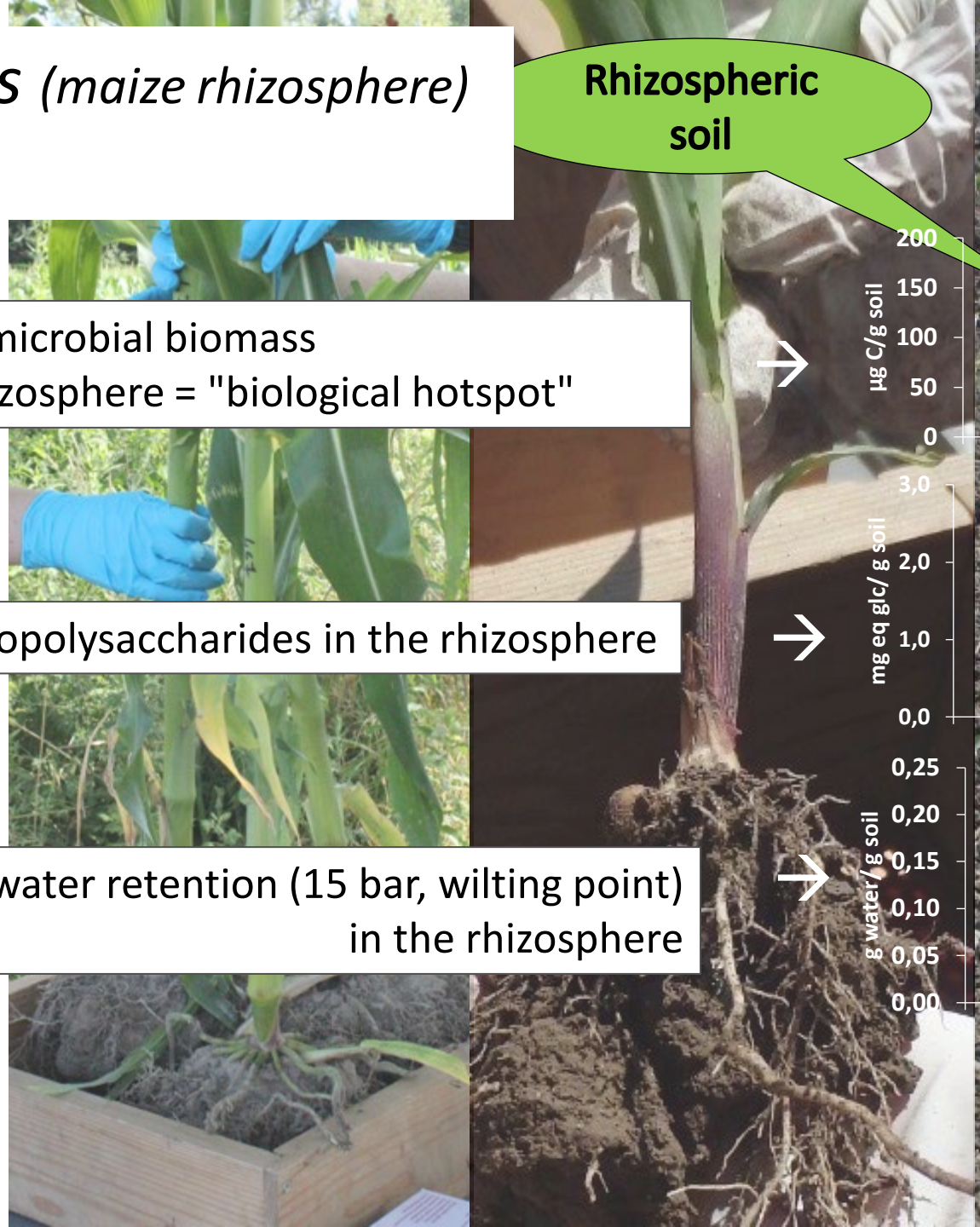


Higher microbial biomass
→ la rhizosphere = "biological hotspot"

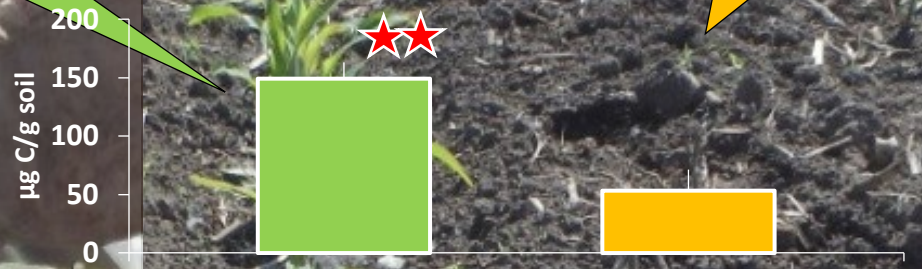
More exopolysaccharides in the rhizosphere

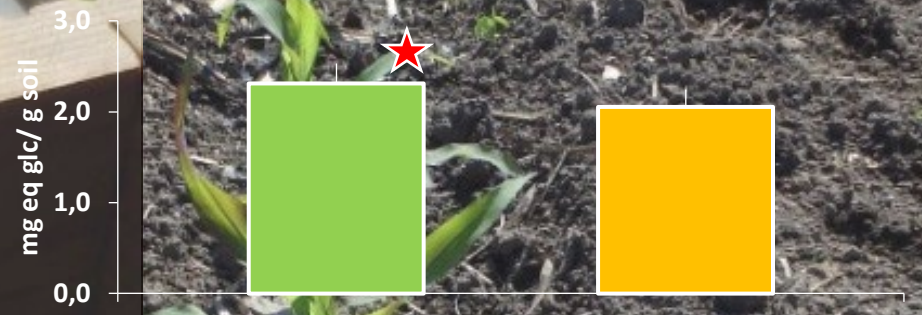
Higher water retention (15 bar, wilting point) in the rhizosphere

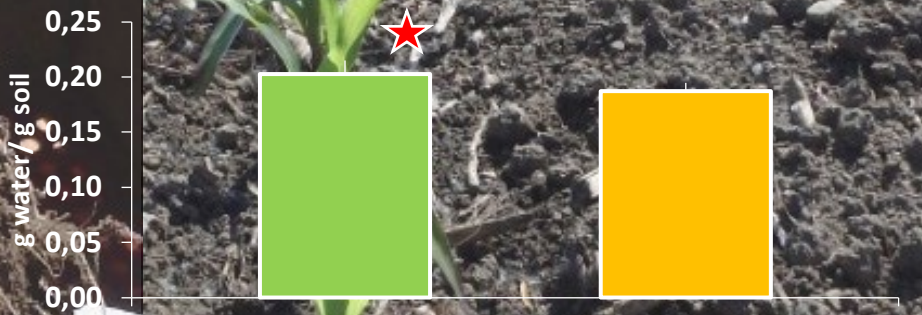


Rhizospheric soil

Bulk soil

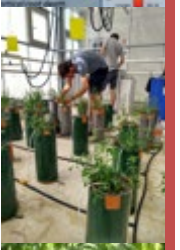


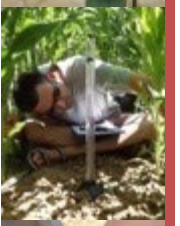


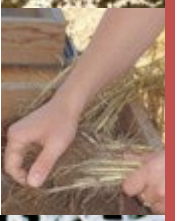


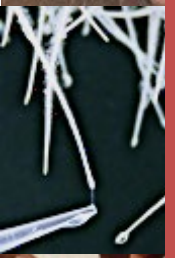
Maize

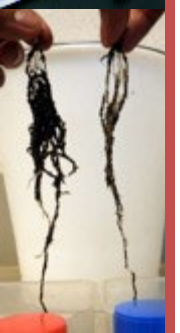
Local effects (maize rhizosphere)

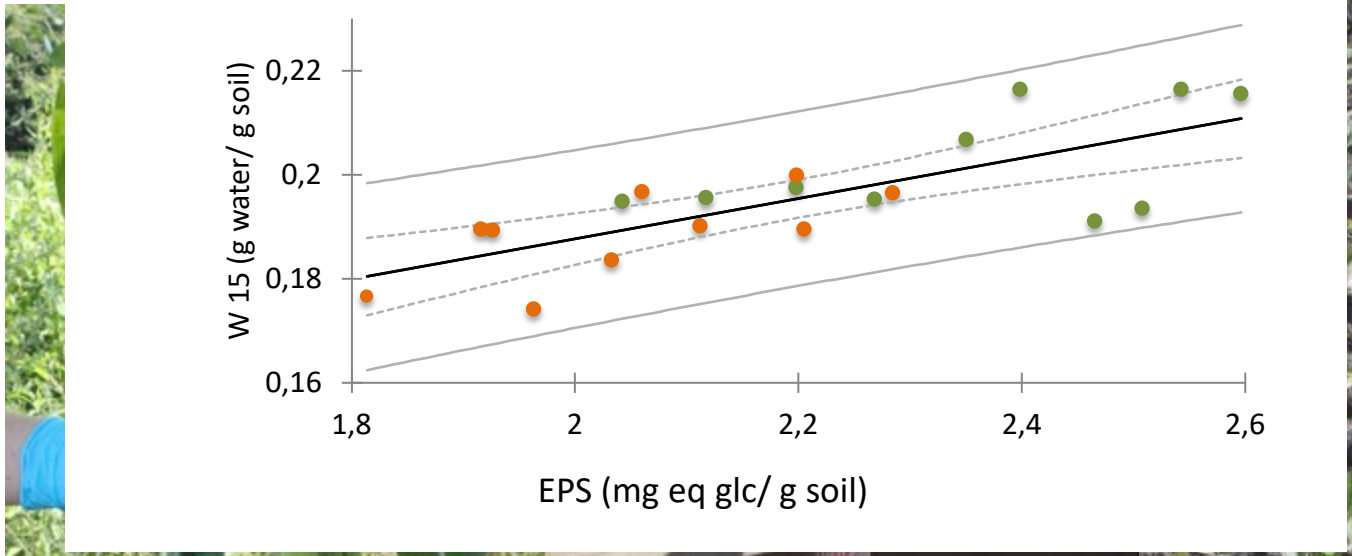






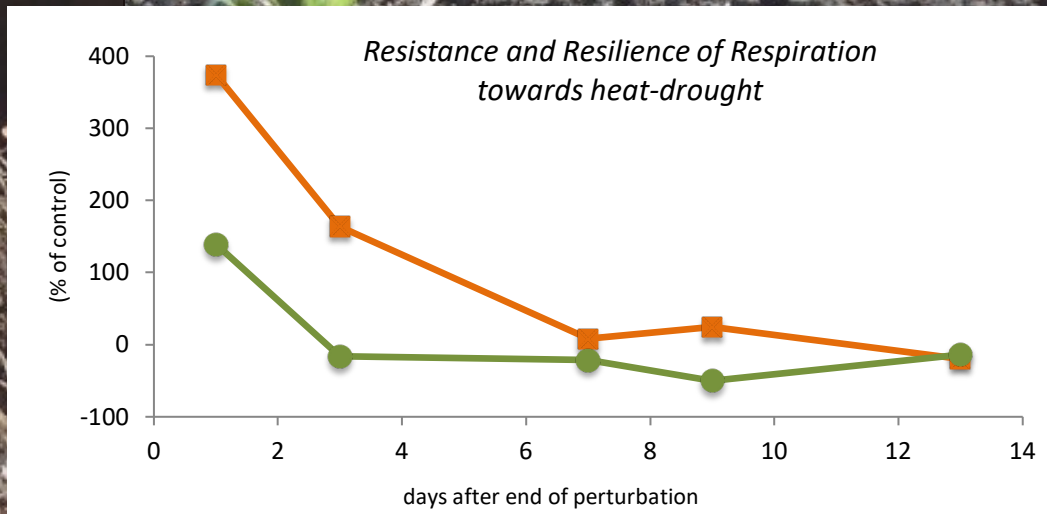




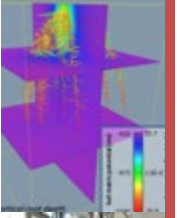
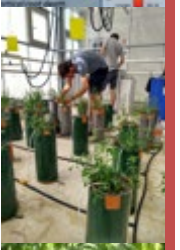
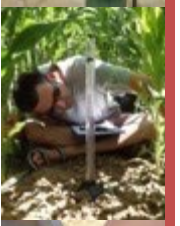
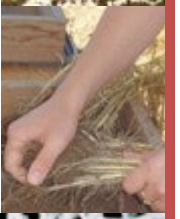
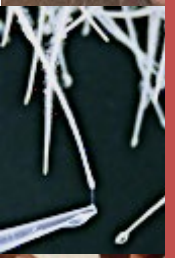
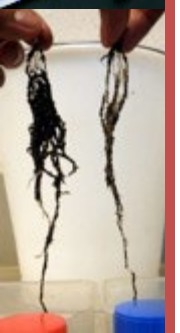


water retention is partly explained by soil exopolysaccharides and microbial activity

in the rhizosphere, soil microbial communities have greater resistance to climatic stress (artificially applied)



Maize

Local effects: field observations of the maize rhizosphere

→ an effect on the hydraulic properties of the soil

→ and on the response of micro-organisms to heatwave stress

(Doussan, Bérard et al., 2016)

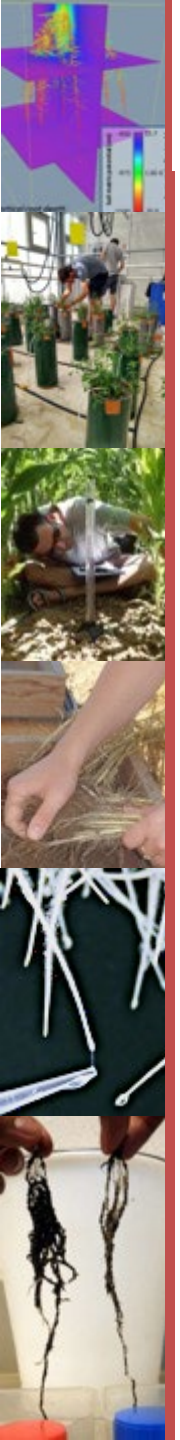
Maize

Local effects and water deficit: a wheat experiment

Stomatal conductance Measurement

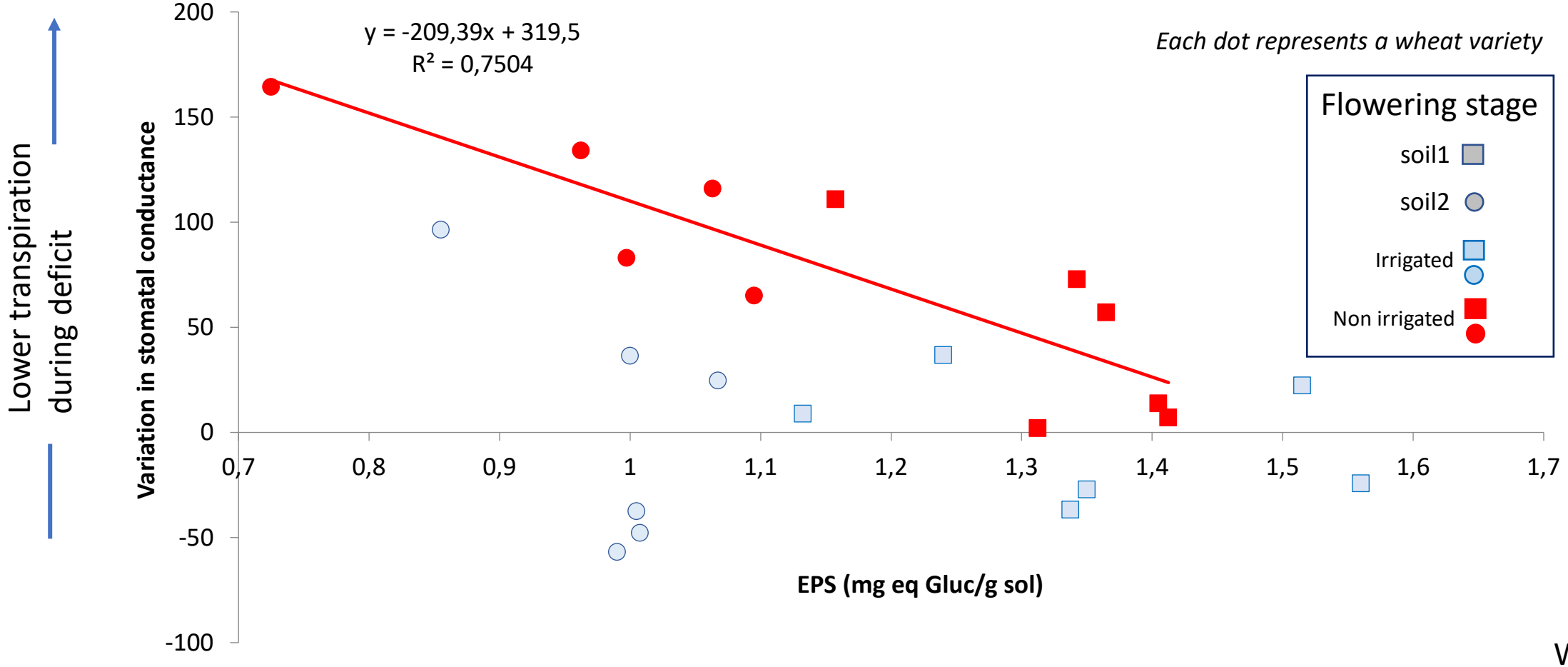
6 wheat cultivars
2 irrigation conditions (water stress and control)
2 soils studied

Wheat



Soil exopolysaccharides in the rhizosphere reduce the sensitivity of wheat varieties to water deficit

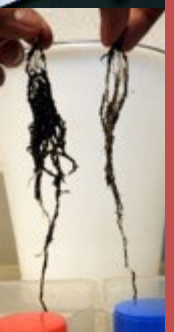
Inverse relationship between the decrease in transpiration during drought and exopolysaccharides in the rhizosphere

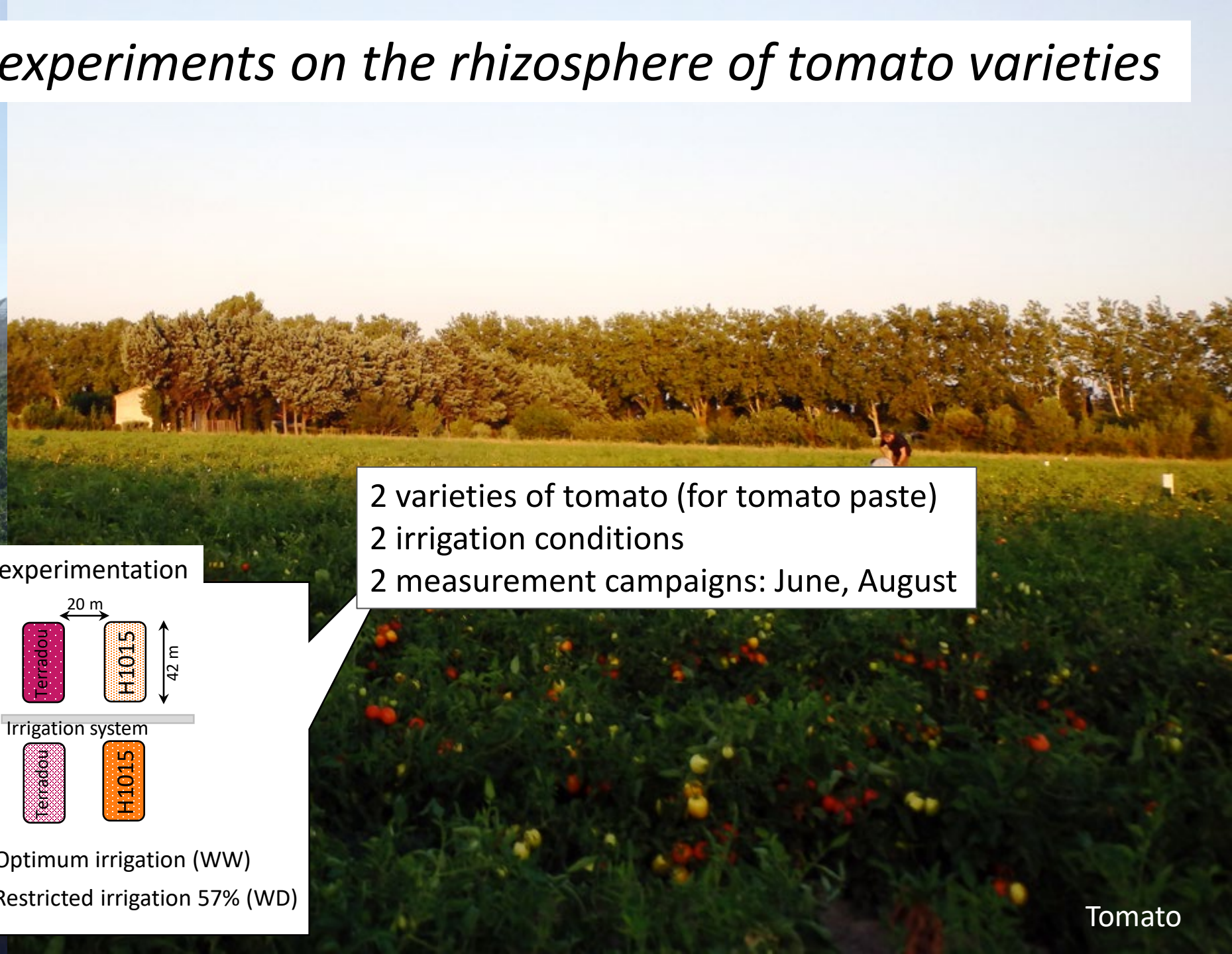


Wheat

(Doussan, Bérard et al., 2016)

Local effects: field experiments on the rhizosphere of tomato varieties





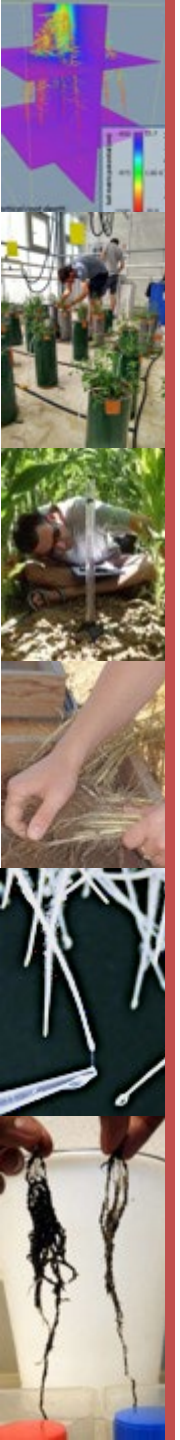
experimentation

Optimum irrigation (WW)

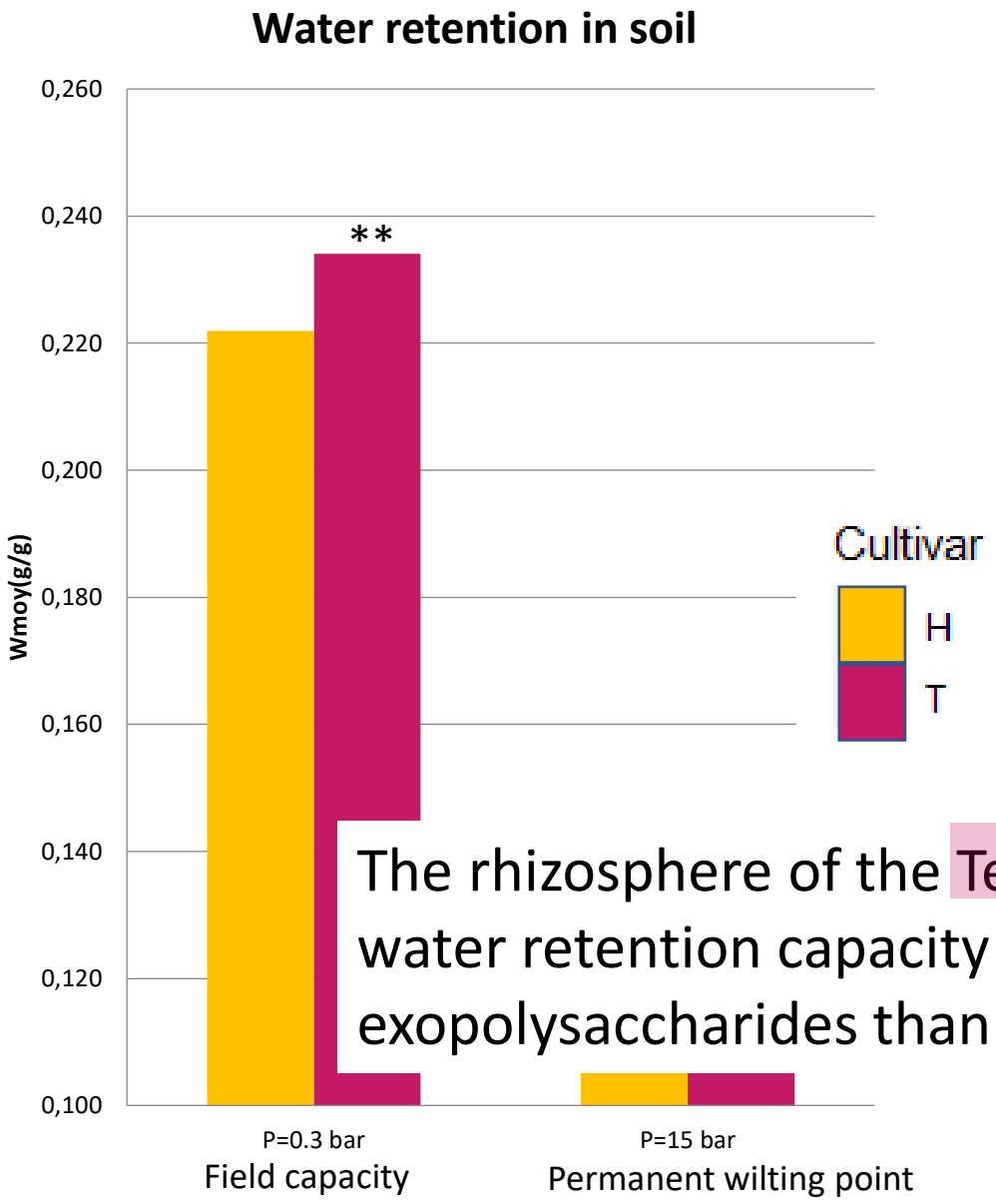
Restricted irrigation 57% (WD)

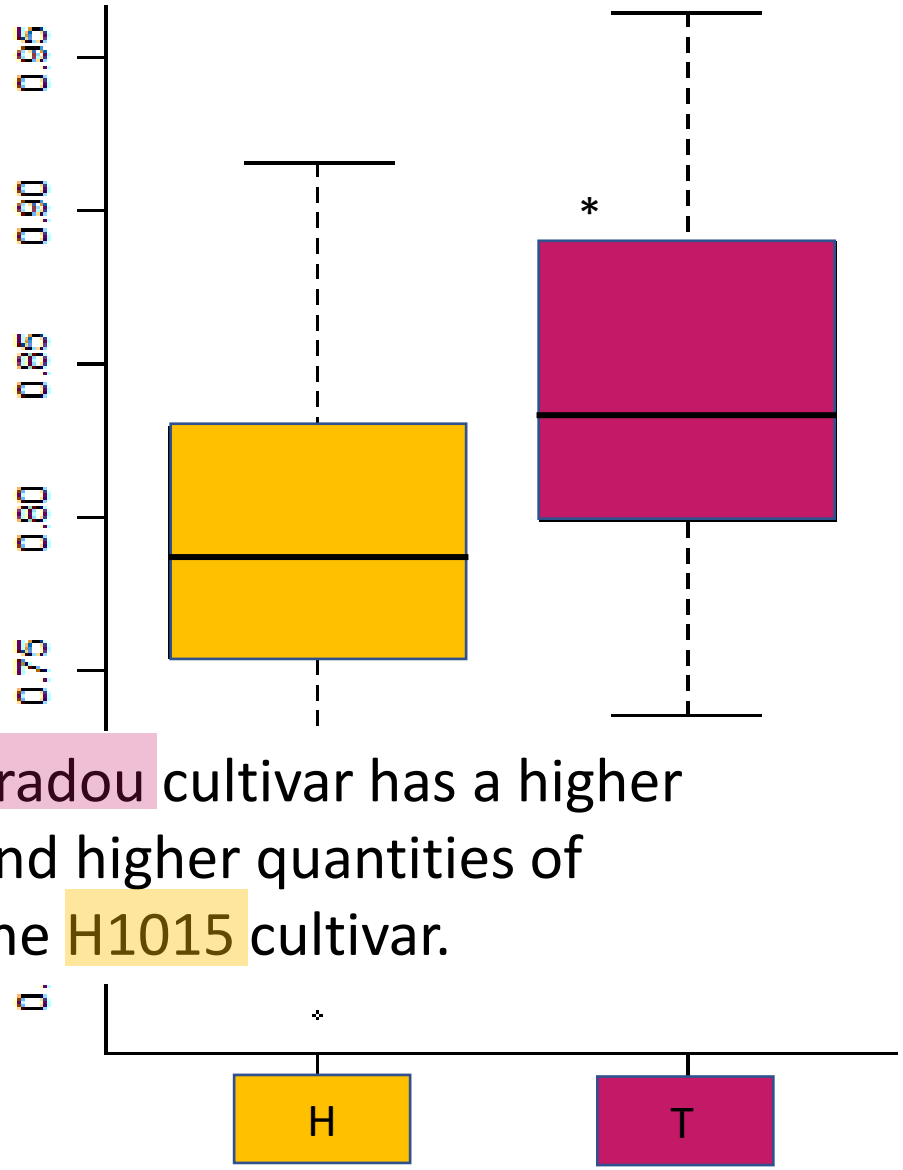
2 varieties of tomato (for tomato paste)
2 irrigation conditions
2 measurement campaigns: June, August

Tomato



Soil properties of the rhizosphere

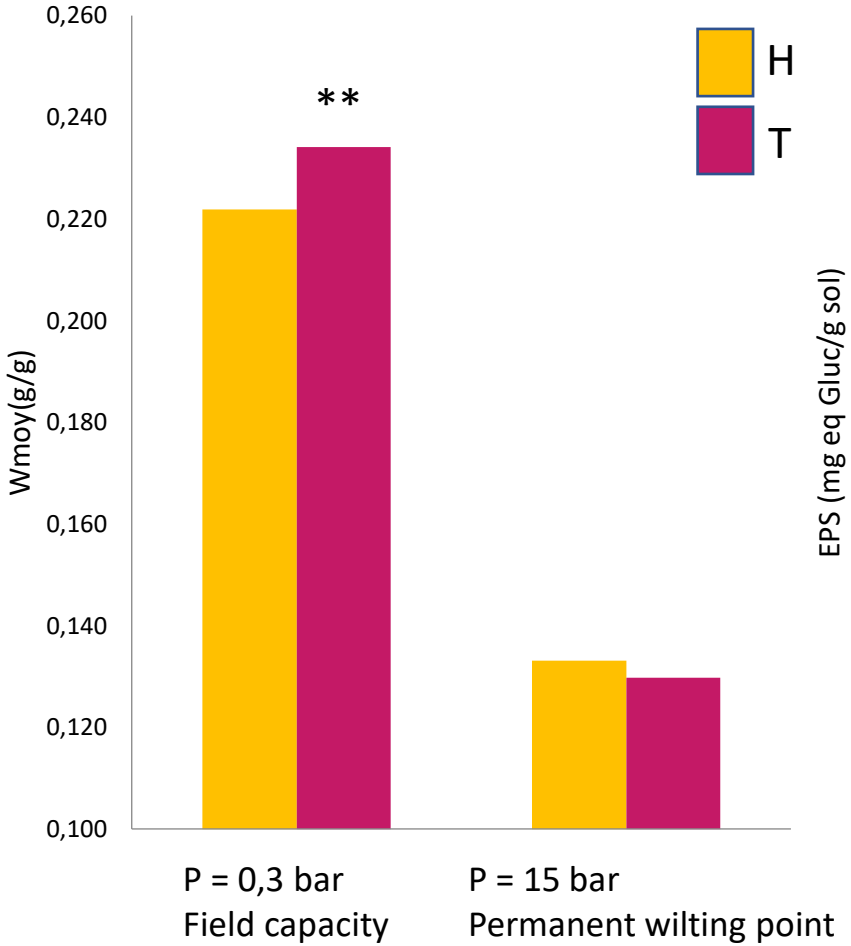




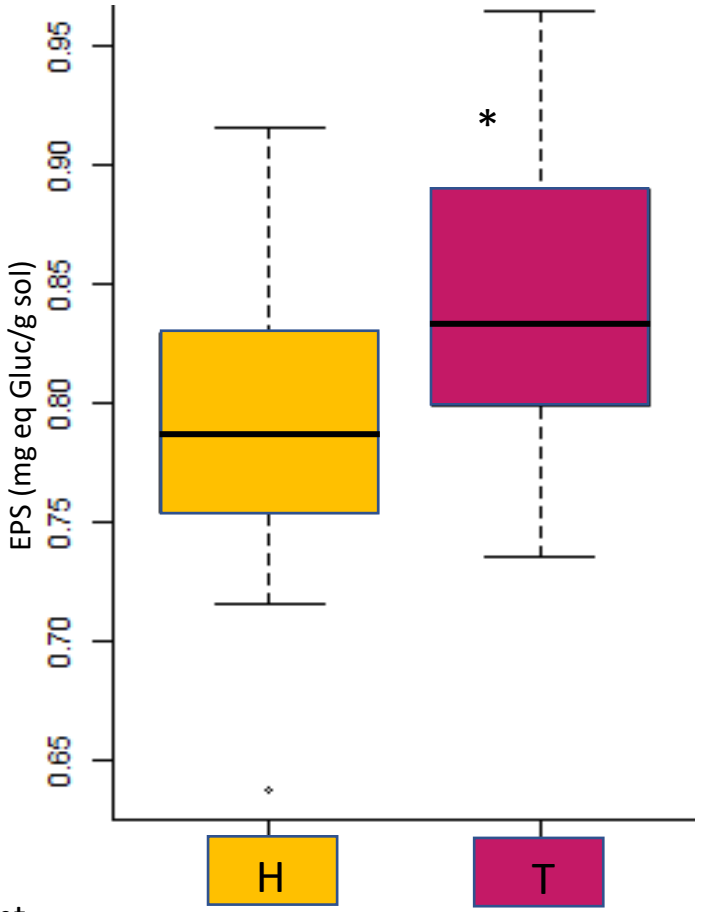
The rhizosphere of the Terradou cultivar has a higher water retention capacity and higher quantities of exopolysaccharides than the H1015 cultivar.

Tomato

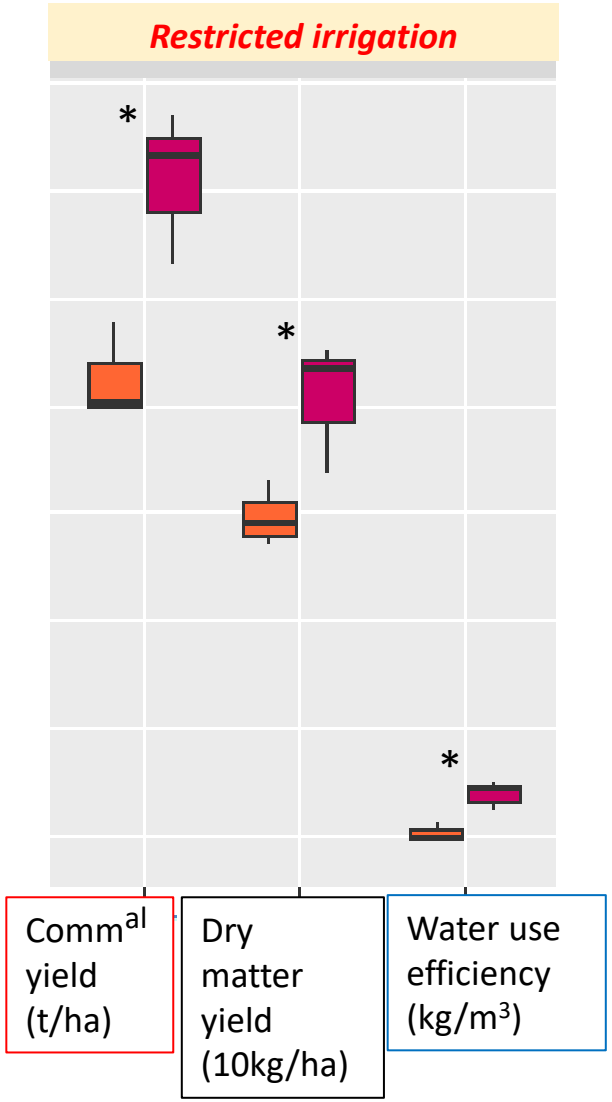
Water retention in soil



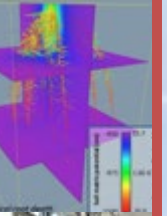
Rhizospheric soil exopolysaccharides

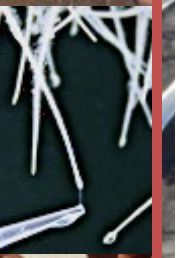


Plant performance



Tomato





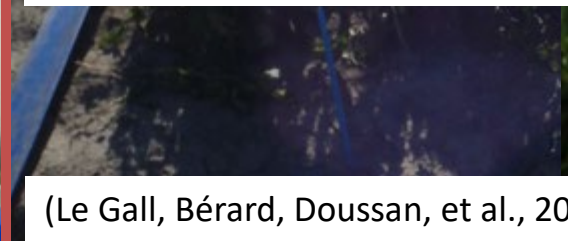
Local effects: in the field, the rhizosphere of tomato varieties

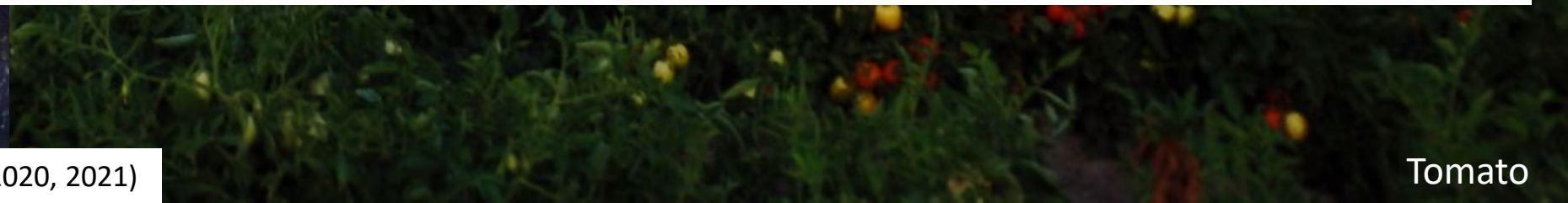
→ *"rhizosphere effect" on soil water properties*

→ *Partly explained by microbial activity and soil EPS*

→ *These hydrophysical, chemical and microbial properties differ between the rhizospheres of the 2 tomato varieties*

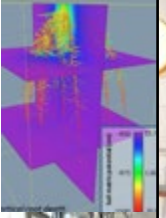
→ *And are in line with the difference in water use efficiency of these varieties*



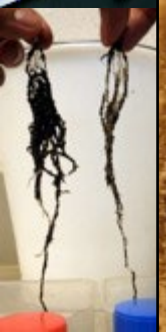


(Le Gall, Bérard, Doussan, et al., 2020, 2021)

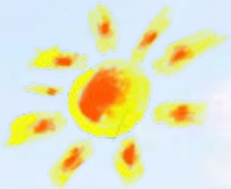
Tomato

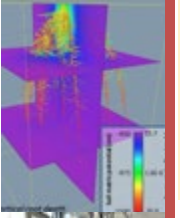


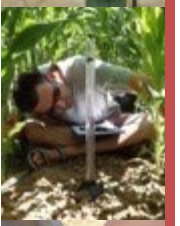
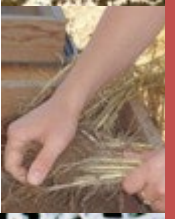
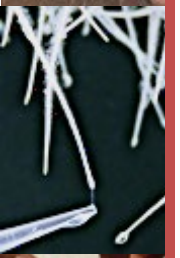
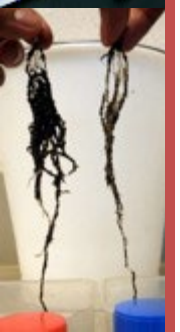



SUMMARY ….



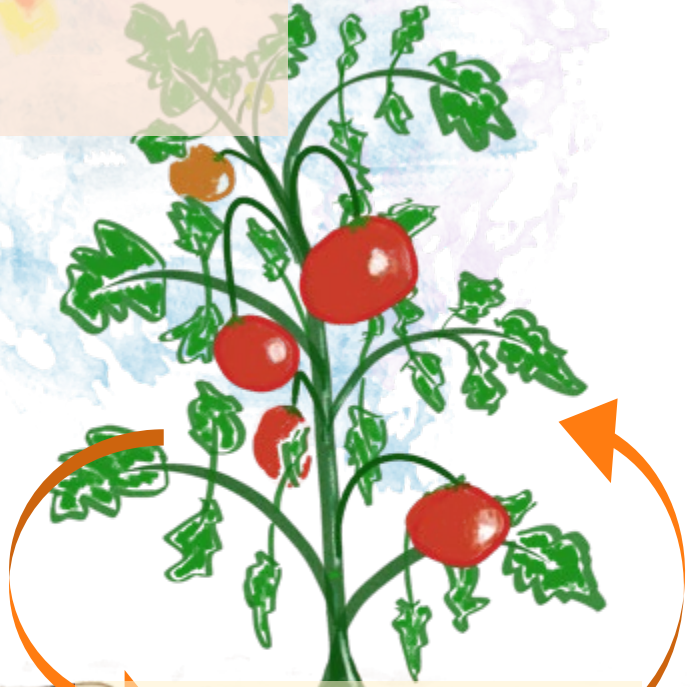





The plant
→ a " rhizospheric effect " ...

→ Plant-related variations in soil properties

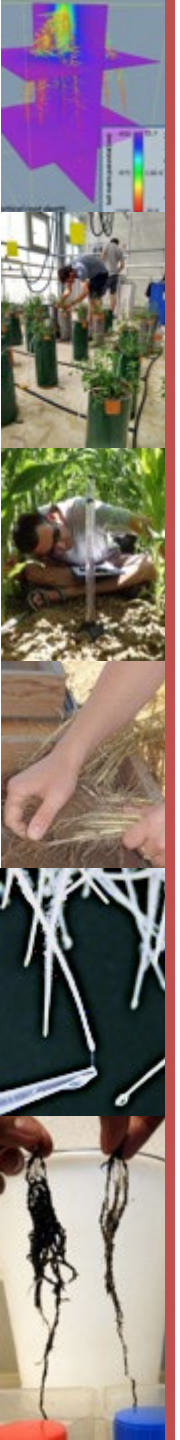
→ EPS, microbial activity → water retention

++ Microbes
(drought resistant)
++ EPS ++ water retention

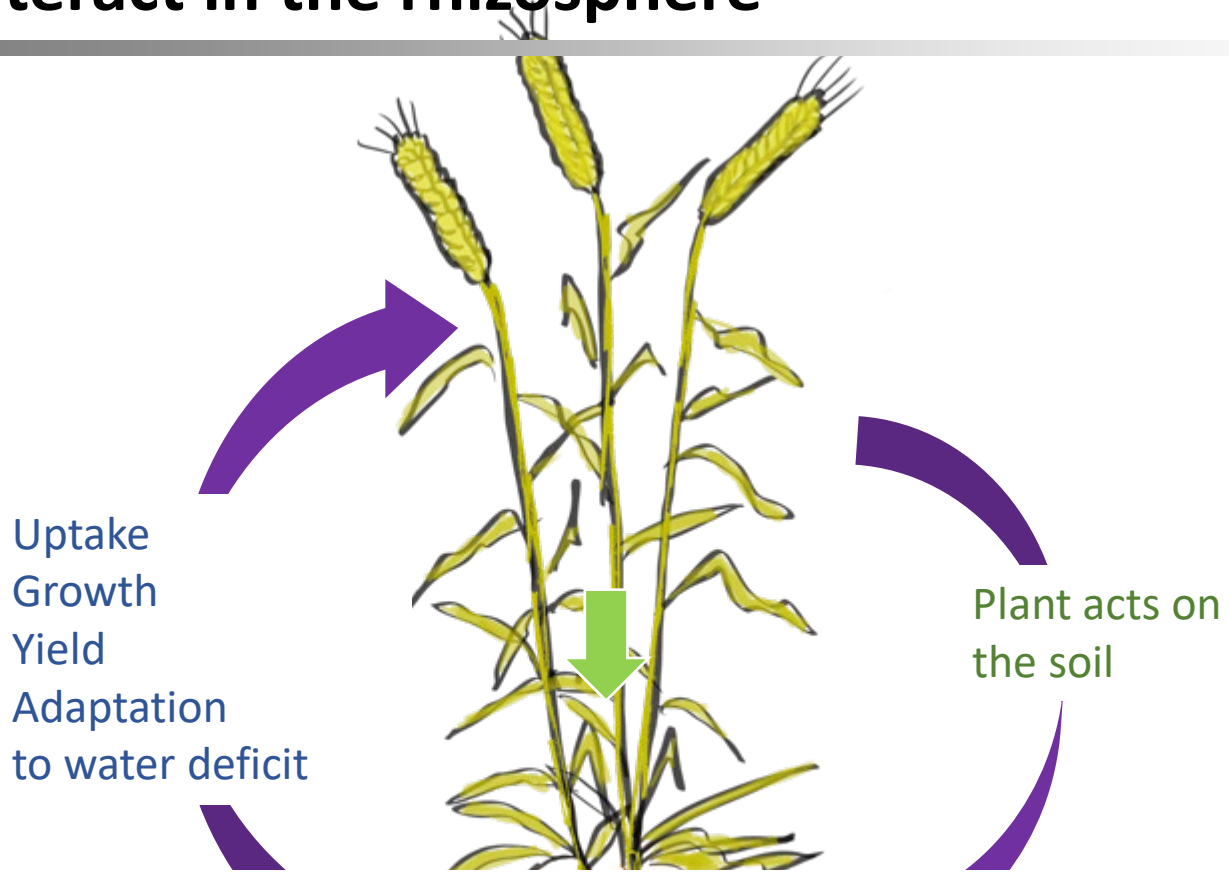


++ Microbes
(drought resistant)
++ EPS ++ water retention

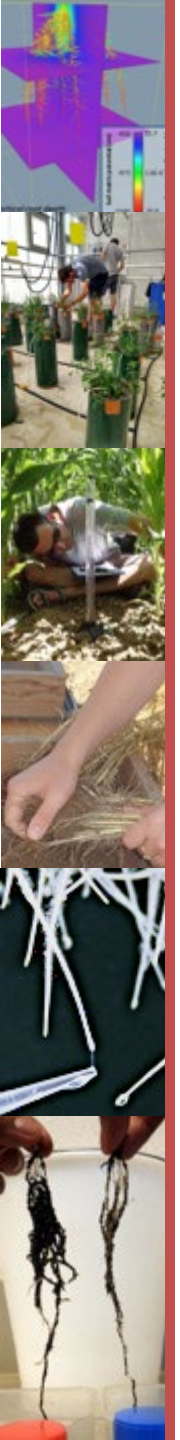
Possible consequences on water use efficiency ….
which vary according to species and varieties



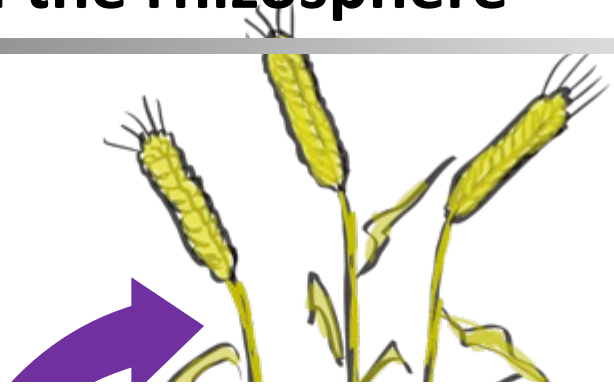
Plant and soil interact in the rhizosphere



A Nature-based Solution: Using roots and the rhizosphere to improve water management In agrosystems ?



Plant and soil interact in the rhizosphere



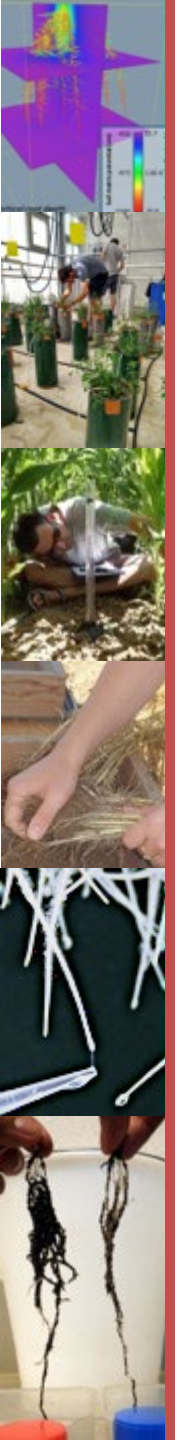
Research, Engineering questions to be explored further :

i) Plant scale

→ Which results can be obtained with different soils?

→ Characterizing the "rhizospheric traits" of various agricultural species (genotypes)

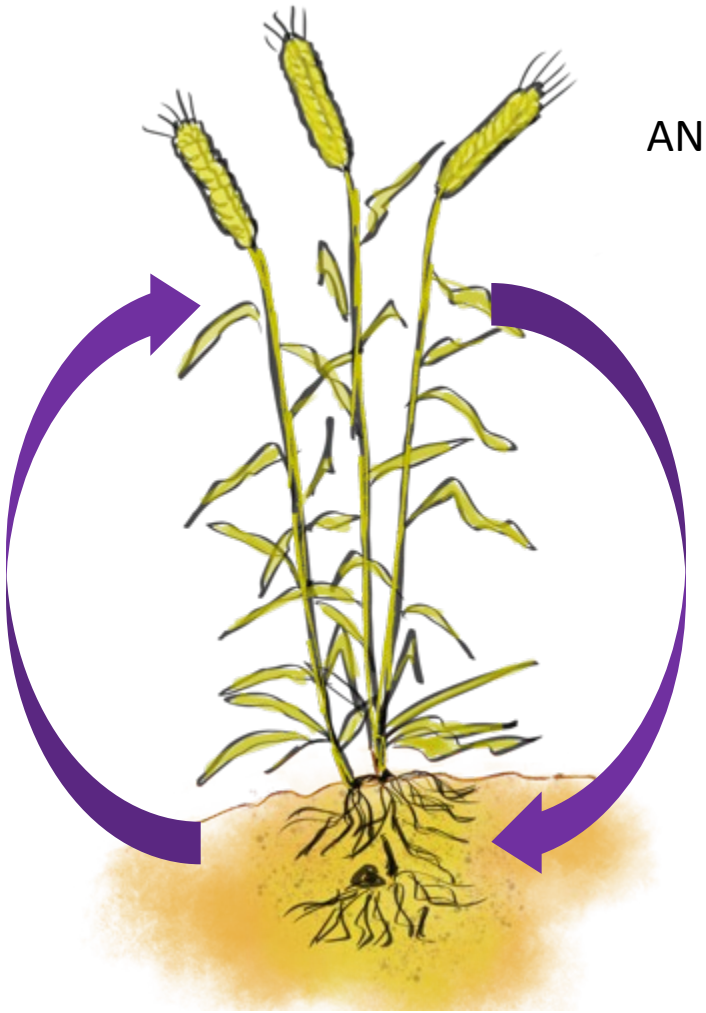
→ "Extended below-ground phenotyping"?



TETRHIZ-b INRAE Project

Water deficit tolerance and RHIZospheric traits:

A possible link for wheat varieties?



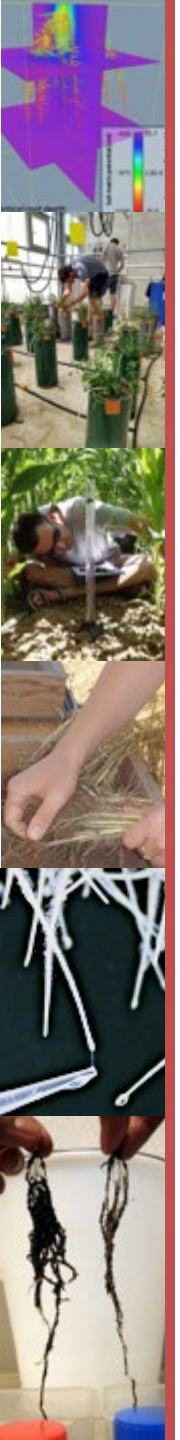
ANR FFAST context: phenotyping wheat/hydric stress

3 types of experiments

germinated seeds
3 days

Phytotrons
1 week

field platforms
With water stress
Crop cycle



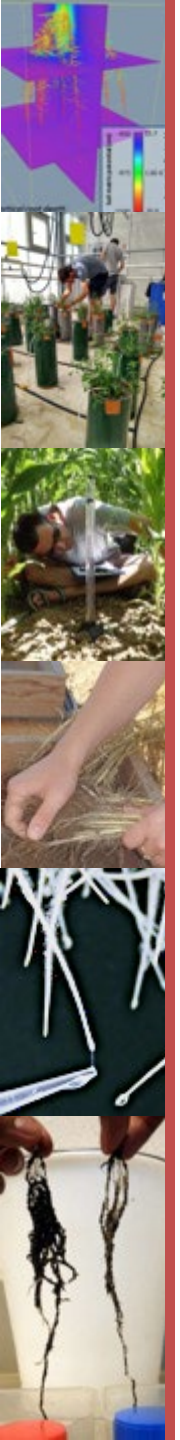
Research, Engineering questions to be explored further :

ii) Crop system scale

Can we prepare the soil (through the root system and its rhizosphere) by diversifying crops (agroforestry, conservation agriculture - mixtures, cover crops, living mulch, etc.)?

Rhizosphere

SOERE ACBB - Lusignan



Grassland/crop rotation: an overall effect on the soil

Variation in field capacity depending on rotation

T1 Continuous cereal crops

T2 Rotation: grassland 3 years / cereals 3 years

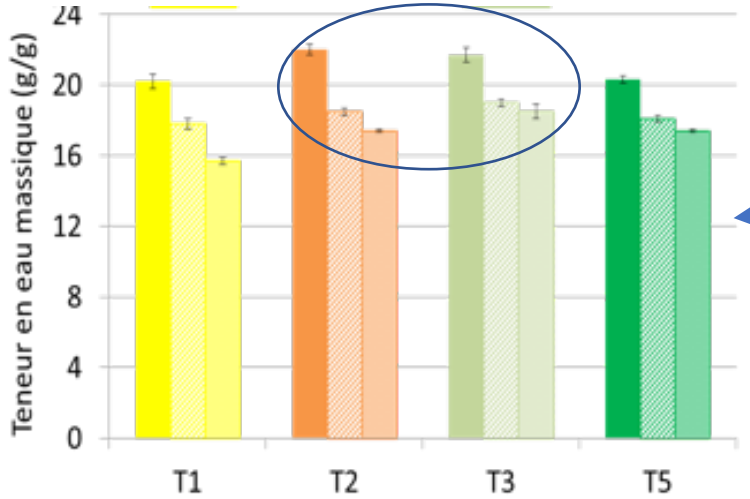
T3 Rotation: grassland 6 years / cereals 3 years

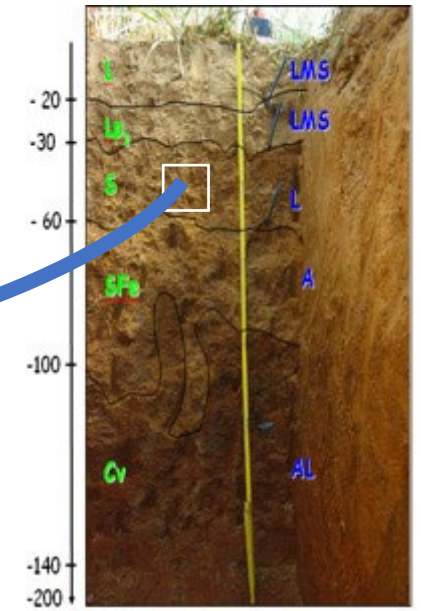
T5 Permanent grassland

0.1 0.3 0.5

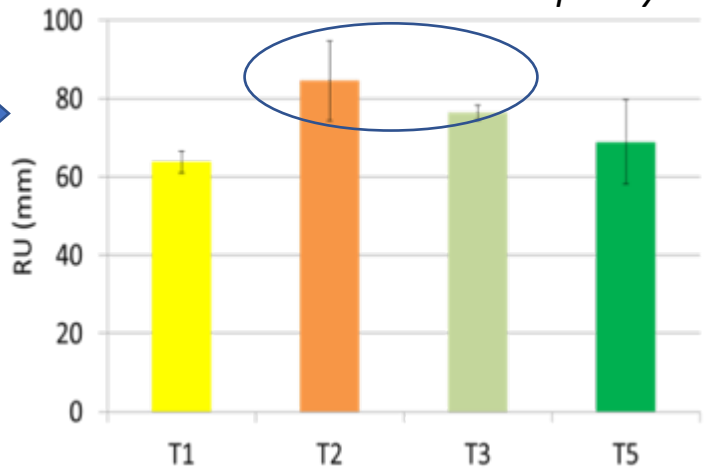
Matrix potential for estimating field capacity(bar)

Water retention at 0.1, 0.3 and 0.5 bar (field capacity)



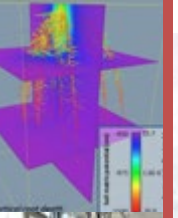


Soil Available Water Capacity

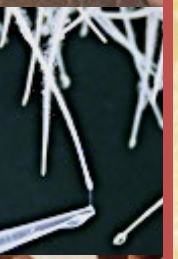


An increase of Soil Available Water Capacity: a significant increase with soil in rotation compared to a permanent crop (grassland or cereals)

Cousin, Doussan et al., 2015








@Annette Bérard

Thank You !

Annette Bérard et Claude Doussan

EmmaH

INRAE

AVIGNON UNIVERSITÉ

Equipe SWIFT

DVS Beregnung

Smarter than just ET - Digital-Twin for designing and operating irrigation systems

Tübingen, 26.01.2024

Content

Digital Approach to Irrigation Management

WATER EFFICIENCY

How can we get a better understanding of **system efficiency** and **watering needs**?

Living Environment

How can we **map sensor data** and information about the **living environment**, to understand **water demand of plants**?

ALGORITHMS

How to make **calculations** with the generated data and make **good decissions**?

AUDITING

How can we **transfer knowledge** from designer and gardener to system operator. Would it be possible to **audit and certifiy irrigation systems digitally**?

Definition: Digital Twin

/ dig•i•tal twin /

A digital twin is a **virtual representation** of real-world entities and processes, **synchronized at a specified frequency** and fidelity.

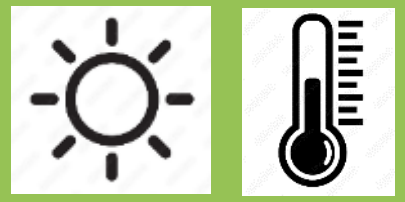
•Digital twin systems transform business by accelerating holistic understanding, optimal decision-making, and effective action.

•Digital twins use real-time and historical data to represent the past and present and simulate predicted futures.

•Digital twins are motivated by outcomes, tailored to use cases, powered by integration, built on data, guided by domain knowledge, and implemented in IT/OT systems.

https://www.digitaltwinconsortium.org/initiatives/the-definition-of-a-digital-twin/

What is „Smart“ Irrigation at the moment?



Transpiration +
Evaopration =
Evapotranspiration (ET)

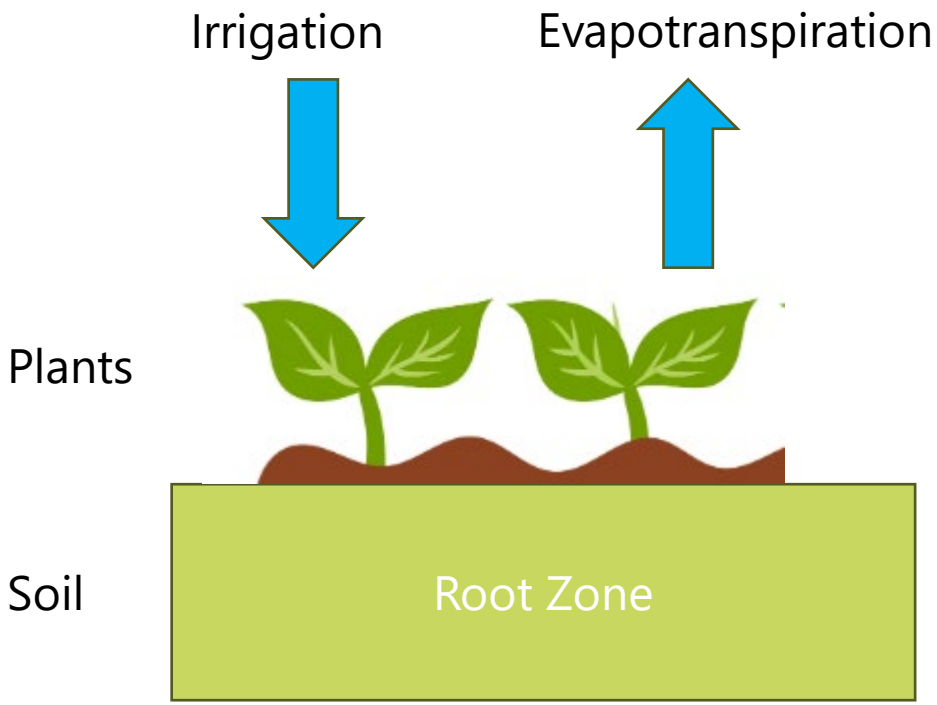
ET based runtime adjustment for residential irrigation systems

What we do not know:

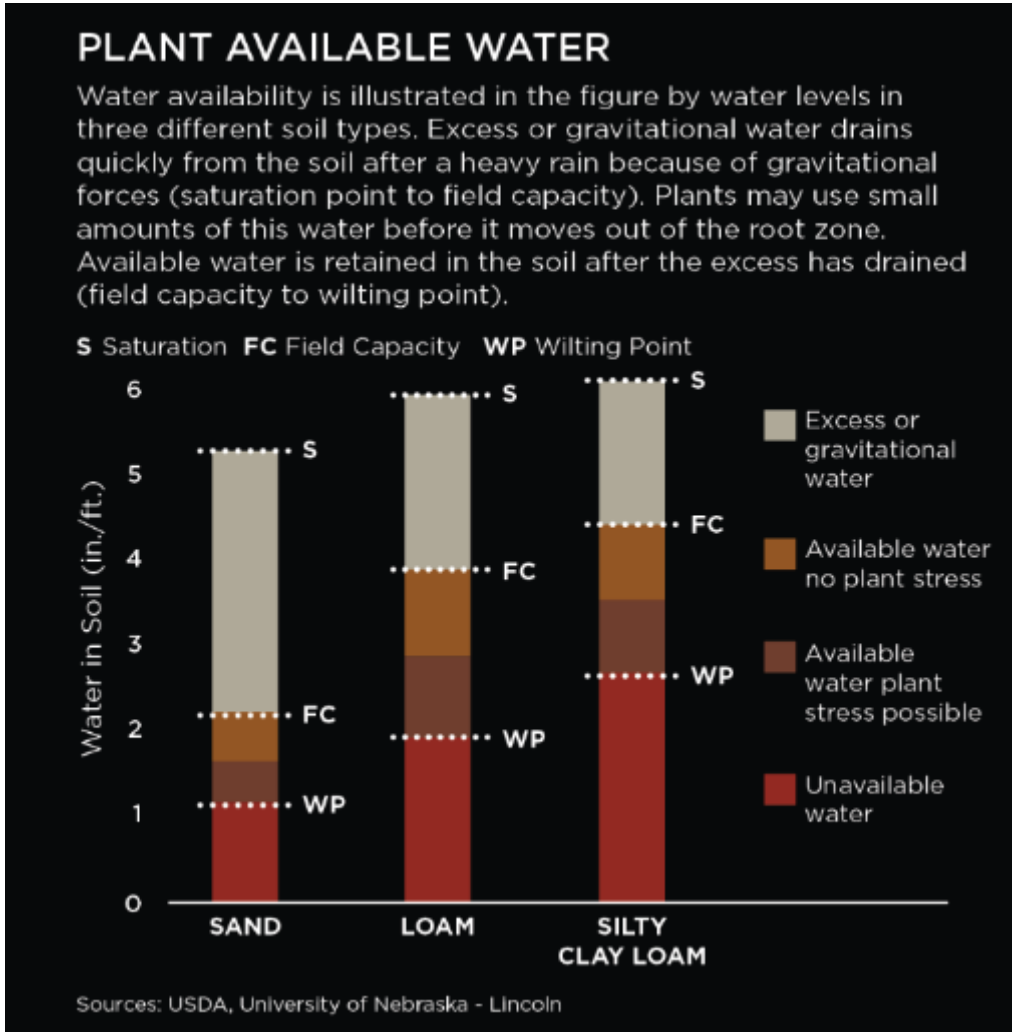
- What irrigation type?
- How to interprete soil moisture?
- Irrigation times & cycles why?
- Sun / shade?
- What soil type?
- Which plants?

ET-Adjustment of Smart Controllers based on (questionable) user settings and lack relevant information

PLANT-ET: Soil, Climate & Plants determine irrigation



Precice management of plant available water between Field Capacity and Wilting Point is possible when all data is available for calculation.



https://www.noble.org/regenerative-agriculture/soil/soil-and-water-relationships/

Which data for digital twin in irrigation?

Living Environment Soil type Sun Exposure	**System Settings** Sprinklers, Dripline Operation times	**Irrigation characteristics** Irrigation uniformity Precipitation rate
Data Wheather data Soil Moisture Water loss	**System Integrity** System Pressure Filter pressure drop	**Process Optimisation** Fertigation (Rain-) Water Management

Approach Data Entry, Visualisation & IOT

Data Entry

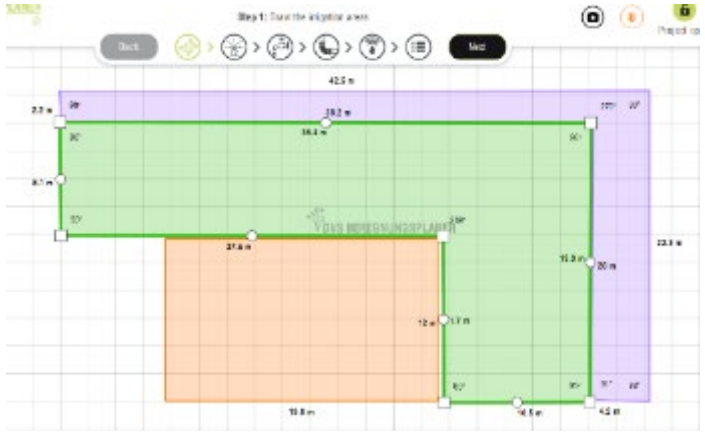
CAD Planning Software

Visualisation

Live & historic data
Input of living environment

IOT

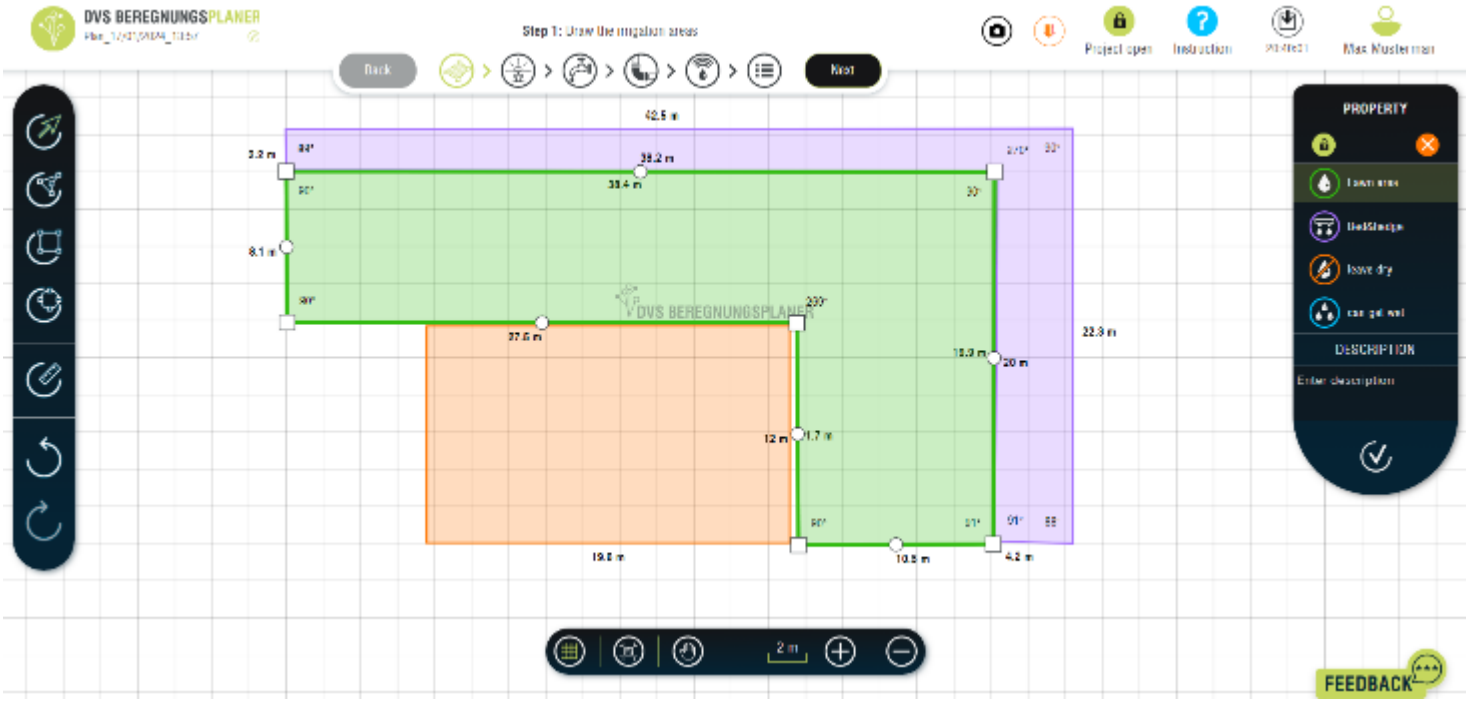
LORA Sensor Nodes
Online Database
Online Weather Data
API to Controller



Auditing of irrigation design and operation

Content

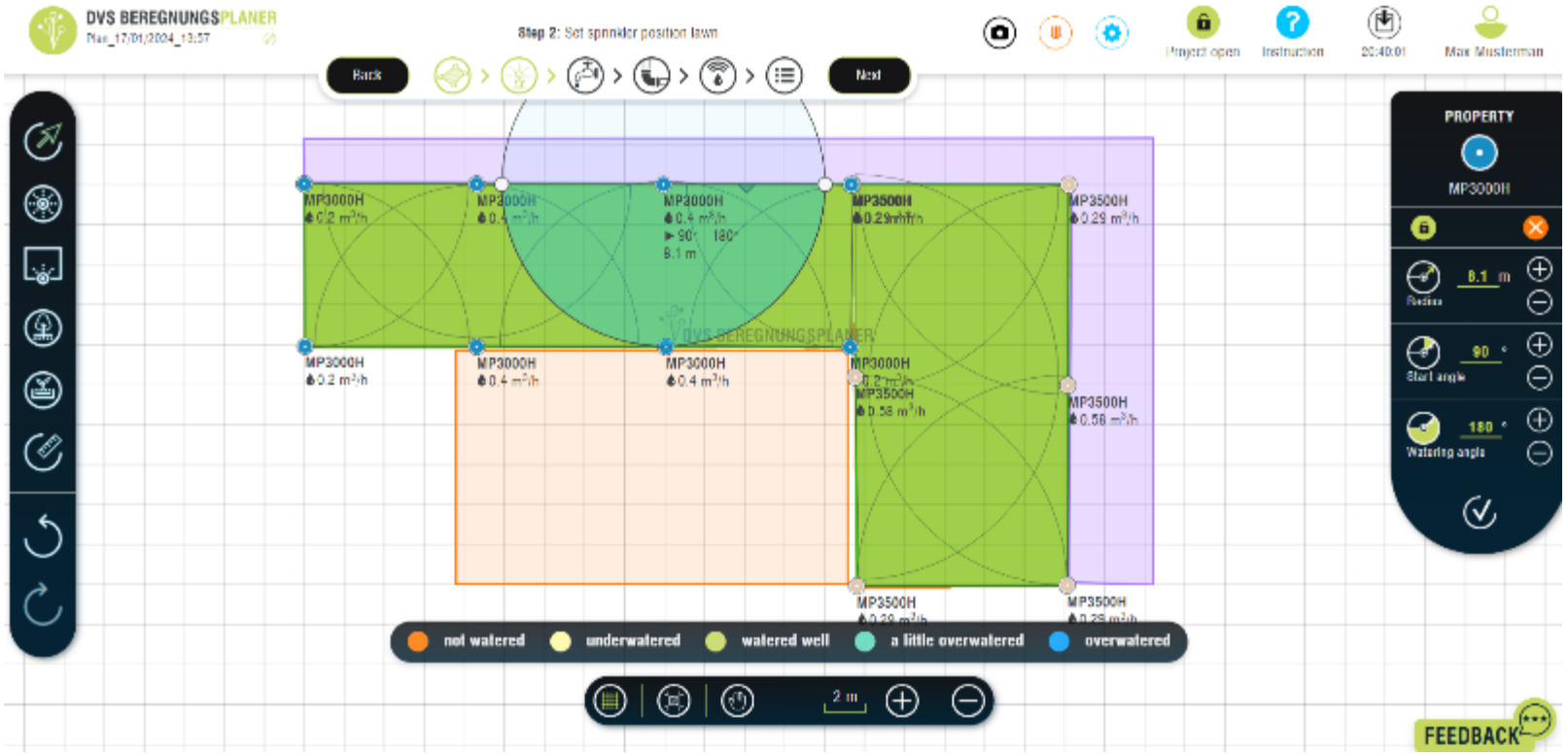
Irrigated Areas



Design: Data Entry

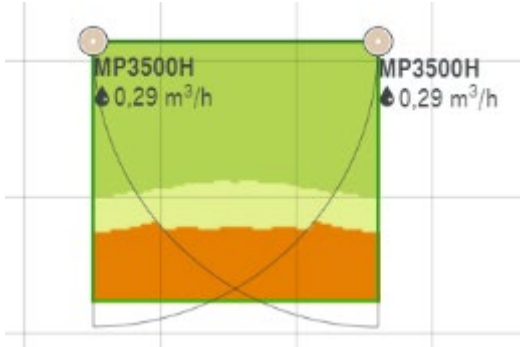
- Areas drawn to scale
- Define irrigation type
- Basis of the layout of irrigation system

Sprinker & Precipiation

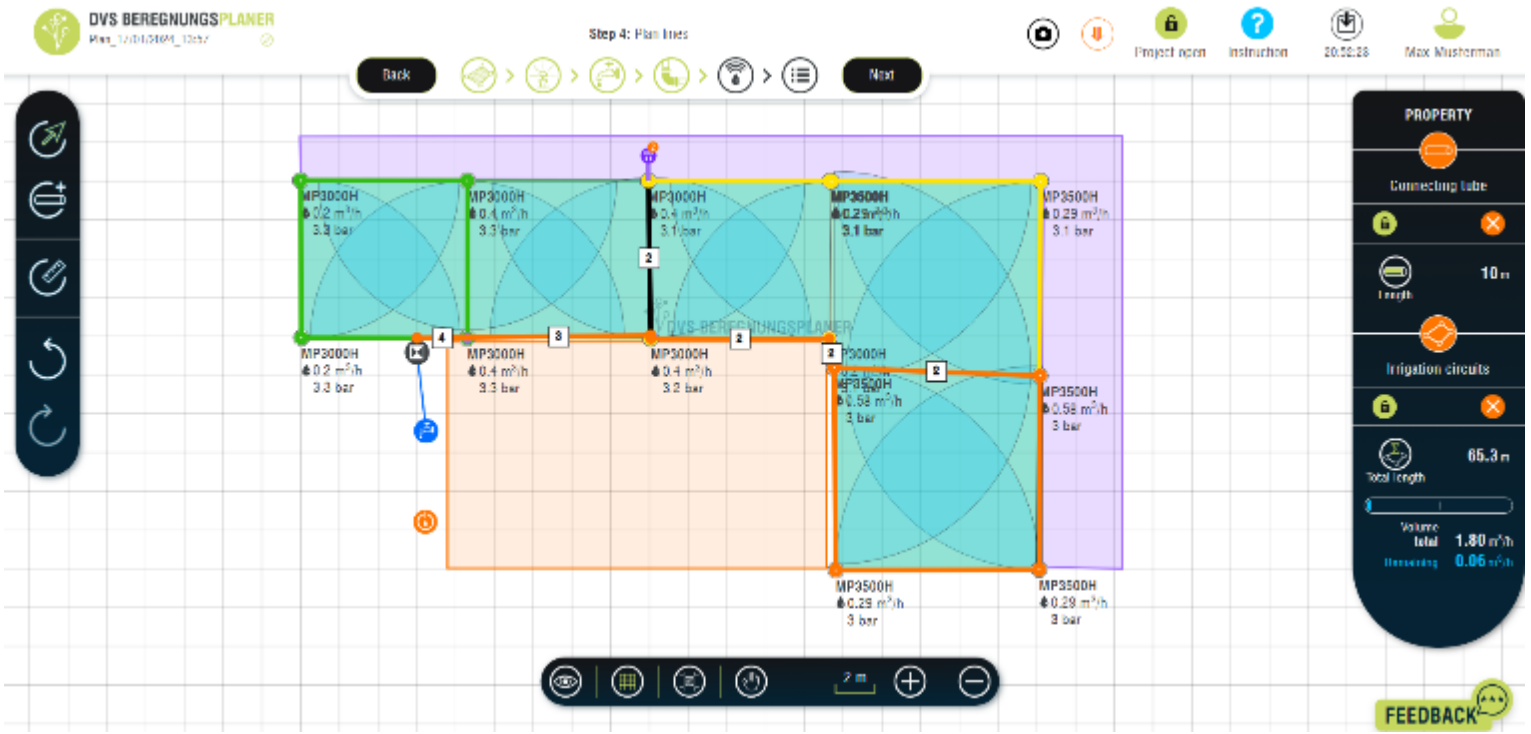


Design: Sprinkler Position

- Sprinkler position & radius
- Precipitation
- Distribution Uniformity
- Basis for precipitation calculation based on runtimes



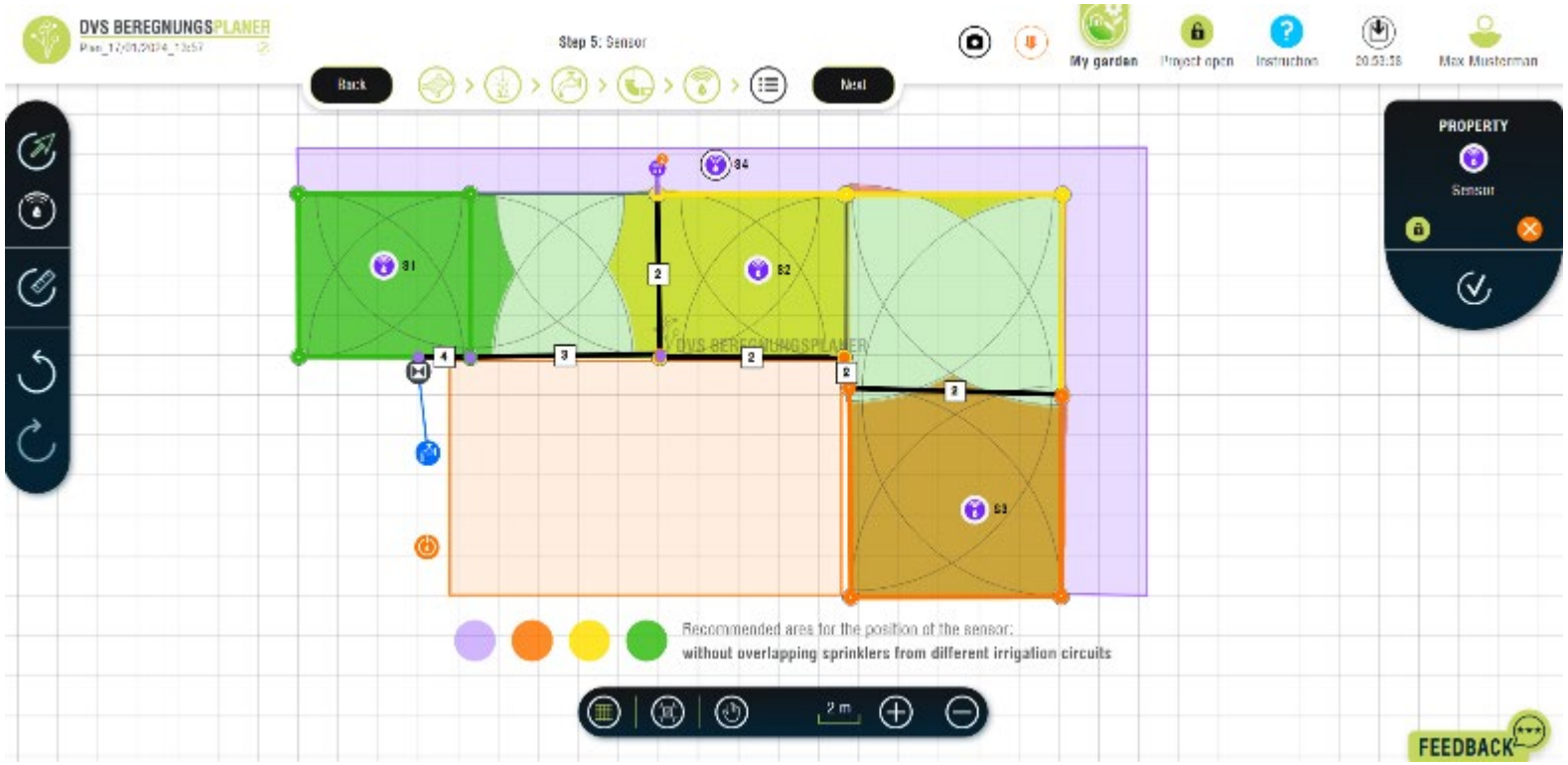
Hydraulics & Pressure Drop



Design: Pipeline

- Define circuits – connect sprinklers that are controlled together
- Basis for clustering soil types, plant types and sun exposure

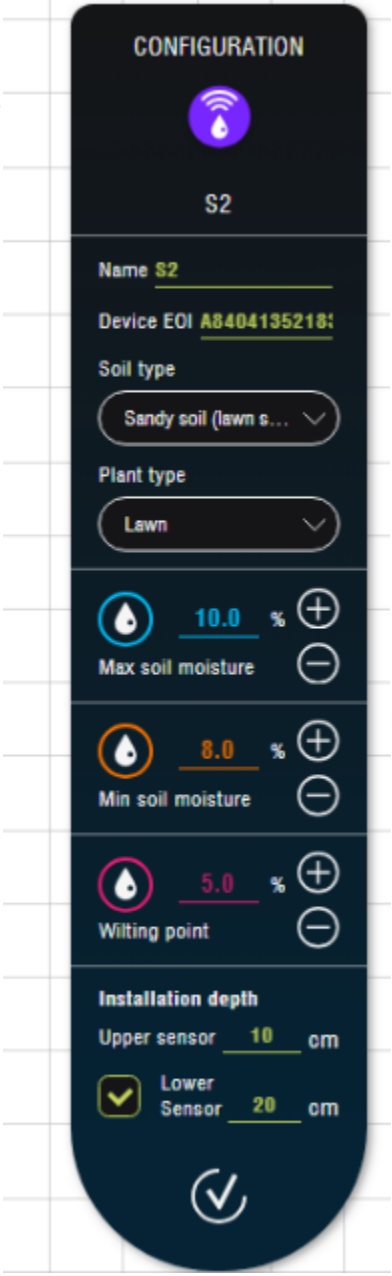
Define Position for Soil Moisture Sensors



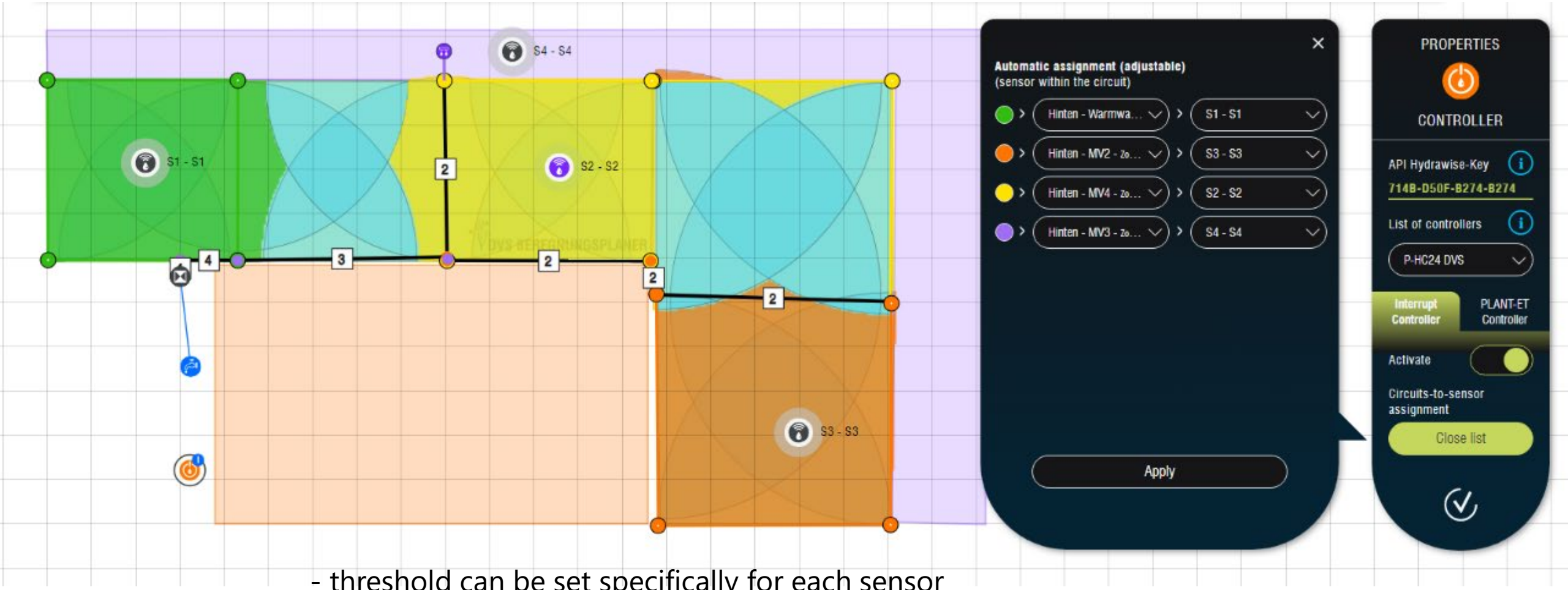
Design: Sensor placement

- Define representative locations
- Asign sensors to circuits
- Basis for monitoring and spacial understanding
- Basis to asign circuits with no sensors for same settings

Database-Visualisation: IOT Sensors



Control / Interrupt Irrigation by Soil Moisture



- threshold can be set specifically for each sensor
- asignment of sensor to more than one circuit
- data anomaly detection / correlation possible

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From Design to Control

WATER EFFICIENCY

By knowing **distribution uniformity** and by defining **living environment per irrigation circuit** we get a better understanding of **watering needs**.

Living Environment

By **mapping sensor data** to the irrigated area and by adding relevant information about the environment we can **calculate precisely the water demand** of plants.

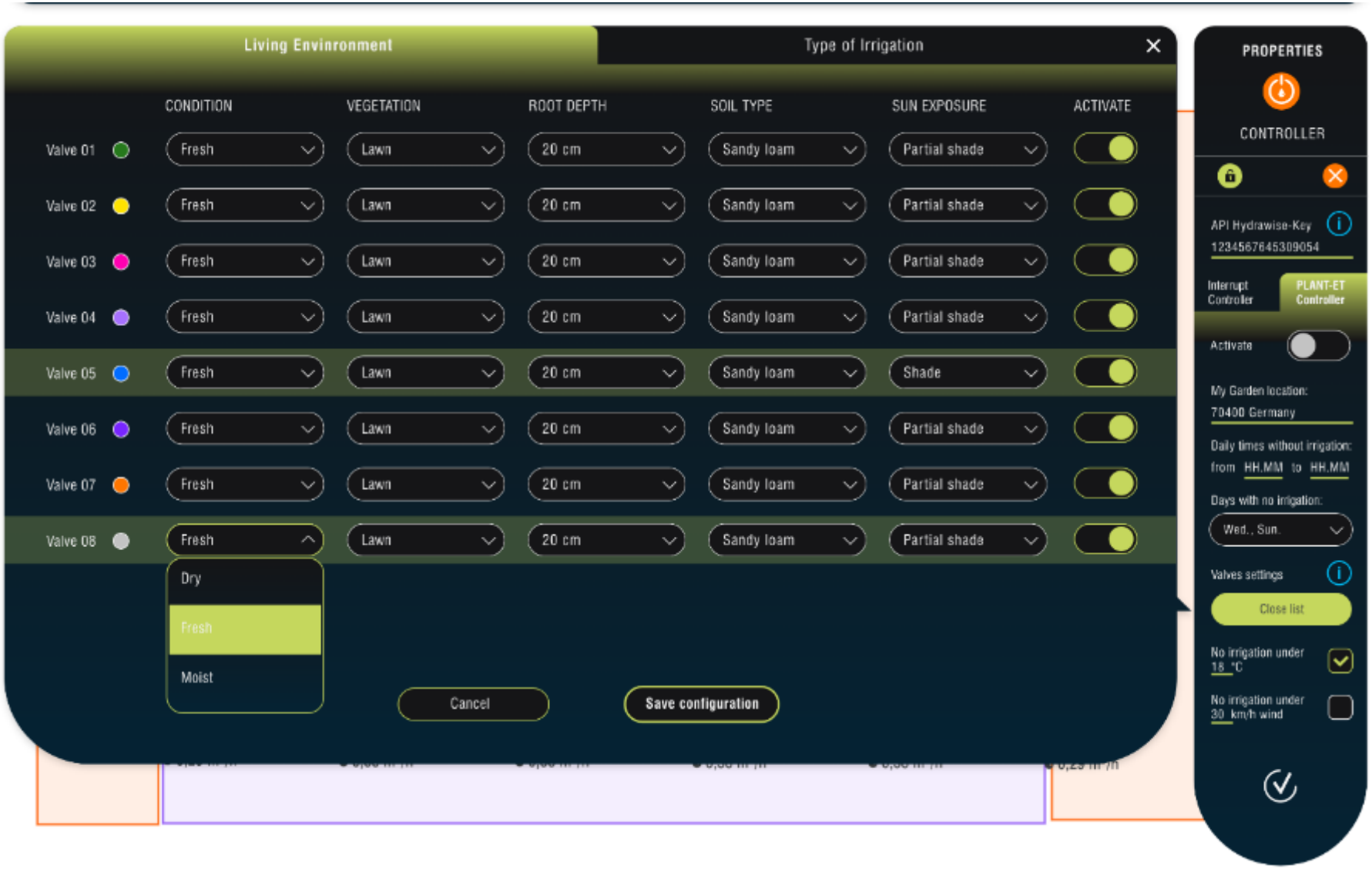
ALGORITHMS

How to make **calculations** with the generated data, **make decissions** and **detect anomalies**?

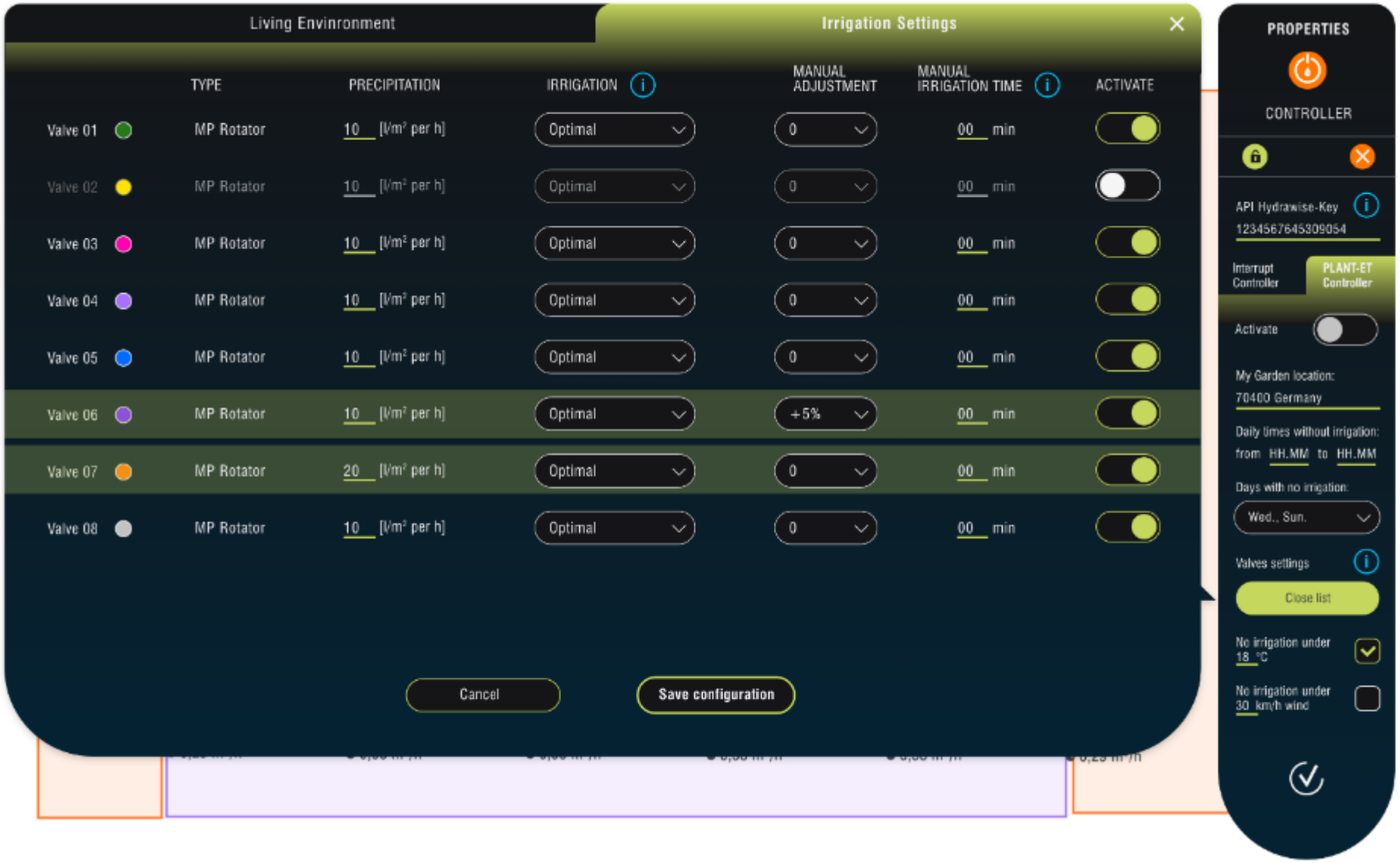
AUDITING

Design and Enable an **auditing process** to transfer irrigation **design to operation**.

PLANT-ET Controller (1/2)



PLANT-ET Controller (2/2)



Connected Sensors to monitor system integrity

Pressure Sensor

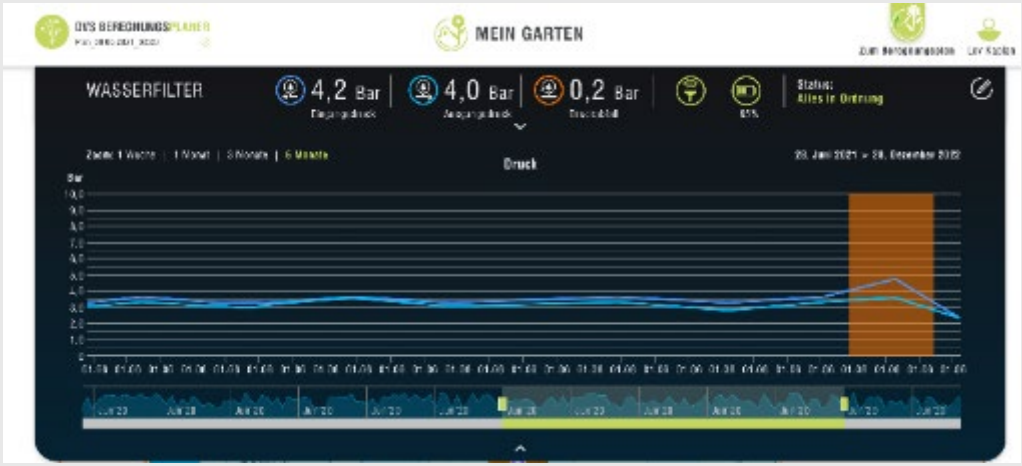
Filter Pressure Drop

The sensor node was developed to transmit data from pressure sensors via LoRa wireless technology to DVS Beregnung's database.

Pressure Drop Visualisation

Software

The software visualizes the pressure values to the user. The user can use this information to prevent clotting of filters.



Content

05 Conclusion & next steps

WATER EFFICIENCY

Efficient use of water will be a dominating toppic **for gardening and landscaping** as well as in **agriculture** in the next years.

PRODUCTS

By creating a digital twin, we can use **sensor data** and information about the **living environment**, to understand much more about the **humidity status in the soil** and water demand of plants as well as **system integrity**.

ALGORITHMS

Creating **robust Algorithms** to monitor and control the systems will lead to efficient irrigation management. Predictions based on historic data allows **anomaly detection.**

EVALUATION

Understanding the parameters that influence the system, such as soil type, plant growth and system integrity will be focus on **field tests in 2024**.

AUDITING

Transferring this technology to increase the impact of saving ressources.

Allowing **auditing and cooperation** between designer, gardener and system operator.

Urban Landscape Working Group

See you soon!

Thank you for the attention

DVS Beregnung GmbH | Tübingen | info@dvs-beregnung.de

Fertigation

Fertilizer feed + weight control

Smart Garden

The fertilizer feed doses the fertilizer output into the overall system by means of digital flow values. A digital weighing function and an interface via Lora-Wan radio module will enable control in the digital twin of your own garden in the future.

Fertilizer stock monitoring

Software

The software visualizes the remaining fertilizer weight to the user. The user can use this information to prevent running low on fertilizer.