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THIRD AFRICA CONGRESS ON CONSERVATION AGRICULTURE
5-8 June 2023 | Rabat, Morocco

Could the Introduction of Cover Crop provide Ecosystem Services? Case of a Mediterranean Citrus Orchard

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Theme:
Building a Resilient Future in Africa
through Conservation Agriculture and Sustainable Mechanization

Organizers

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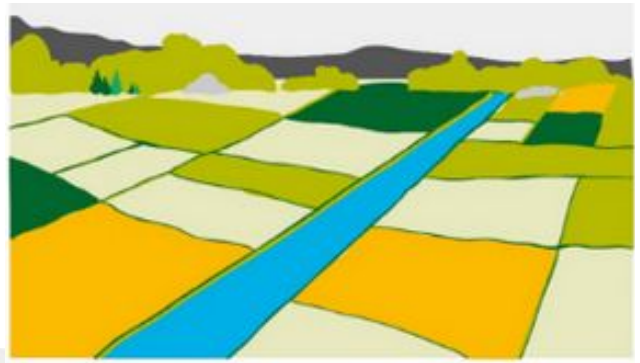
Land degradation: High intensive inputs of chemical fertilizers and heavy mechanizations



Natural ecosystem

Agriculture Intensification

=> Converting forests to woodlands and crop monocultures

Conventional farming

- Reduction of biodiversity *(Raj, A. et al. 2021)*
- Decline of soil fertility *(Raj, A. et al. 2021)*
- Yield losses *(Li et al., 2010)*

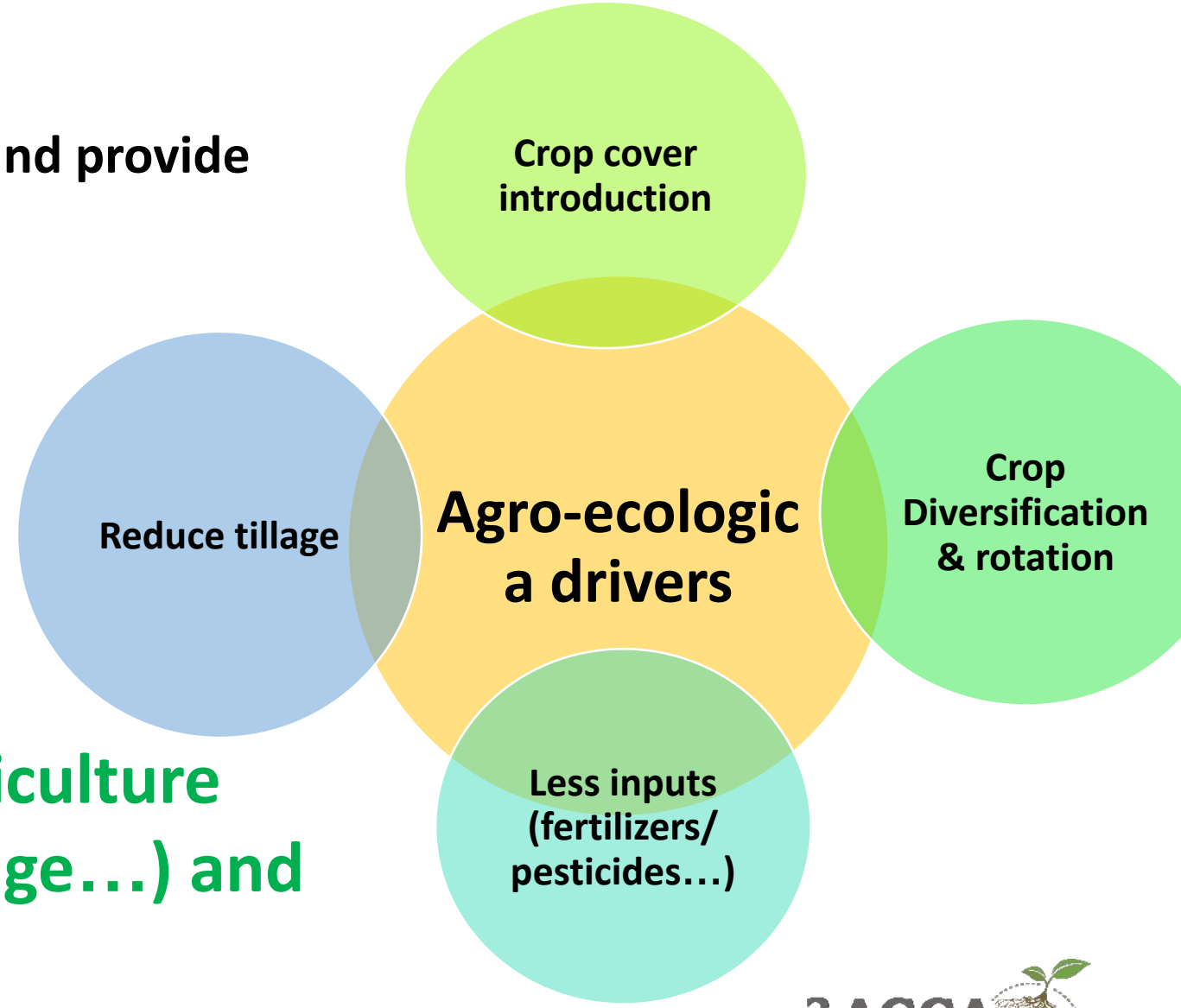
https://www.ofb.gouv.fr/lofb-et-lagriculture

Agroecology implementation to enhance biodiverstiy and yields

Agroecology aims to enhance biodiversity and provide ecological services

=> Re-employment of traditional practices

=> Enhances agrosystem resilience

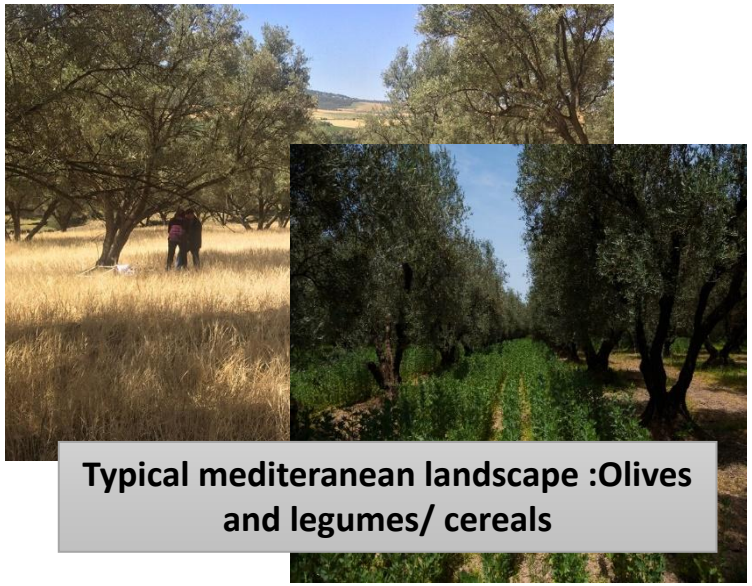


=> Integrating conservation agriculture principles (soil covering, no tillage…) and agroforestry practices

Walnut- Cereals/mulch

Apple trees - vegetables

Oasis system



Typical mediteranean landscape :Olives and legumes/ cereals

Orange/Legumes or vegetables (Greece)

Orange / grass cover in Sicily (Italy)

Mandarin/Legumes (Spain)

An evolving system in the Mediterranean where citrus are very important

Mediterranean : leader of citrus-producing regions

The main citrus-growing regions in the Mediterranean (orange) *(Liu et al., 2012)*

- Second biggest citrus producer with 20% of the world's citrus fruit production *(Imbert, 2014;Urbaneja et al., 2020)*
- 60% of the world fresh citrus market. *(Lacirignola & D'onghia, 2009)*

……..But these systems are subject to several threats

1) Limitation of irrigation water

Overuse of irrigation water *(Chebil et al., 2019; Wright, 2020)*

Ineffective irrigation systems *(Fader et al., 2016)*

2) Climate change threats

Rainfall decrease

Temperature Increase

Increase water scarcity

effective and sustainable water management is needed

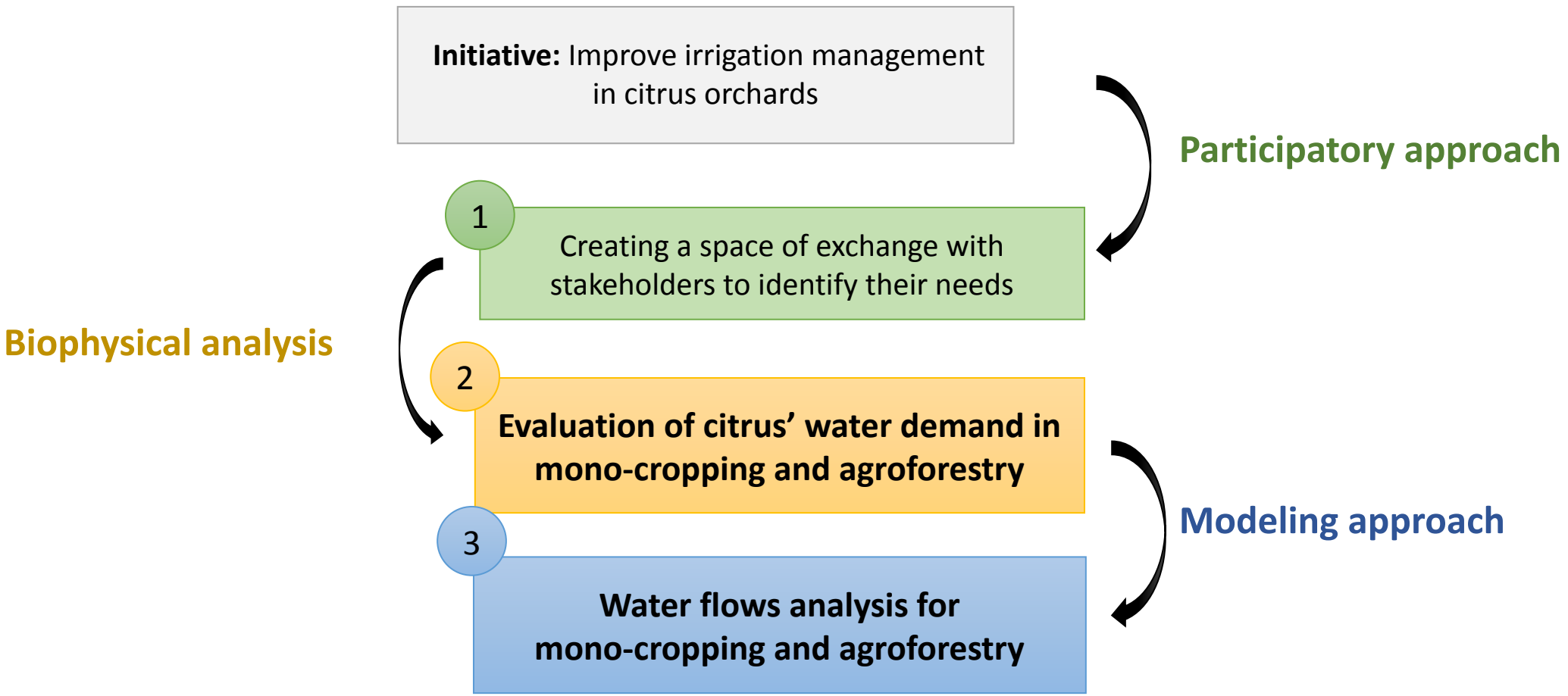
Work Objectives

✔ Develop a simple decision tool, which can help stakeholders to plan irrigation scheduled

Sub-objective 1: Develop a free, user-friendly tool for conventional fruit orchards exp: citrus, based on Fao 56 paper

Sub-objective 2: Introducing grass cover into citrus orchards as an agroecological transition => Need to take into account the technical and physical informations on grass cover

Work' approach

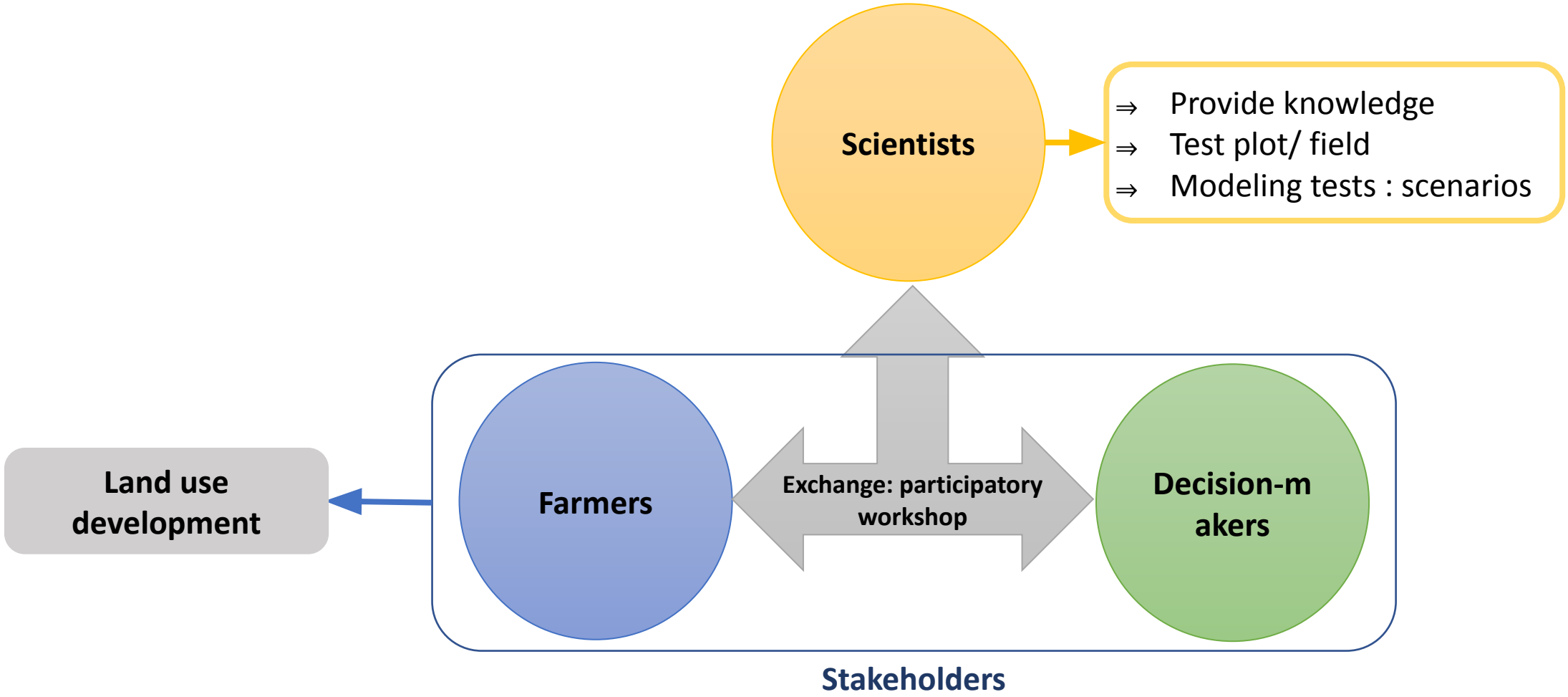


Participatory approach

1

Creating a space of exchange with stakeholders to identify their needs

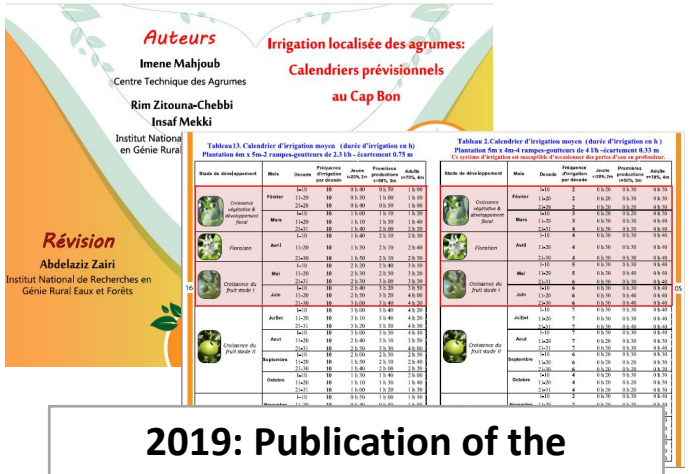
3 pillar for sustainable development



2015 First particapatory Workshop with stakeholders : need to know irrigation times

Field surveys 2016

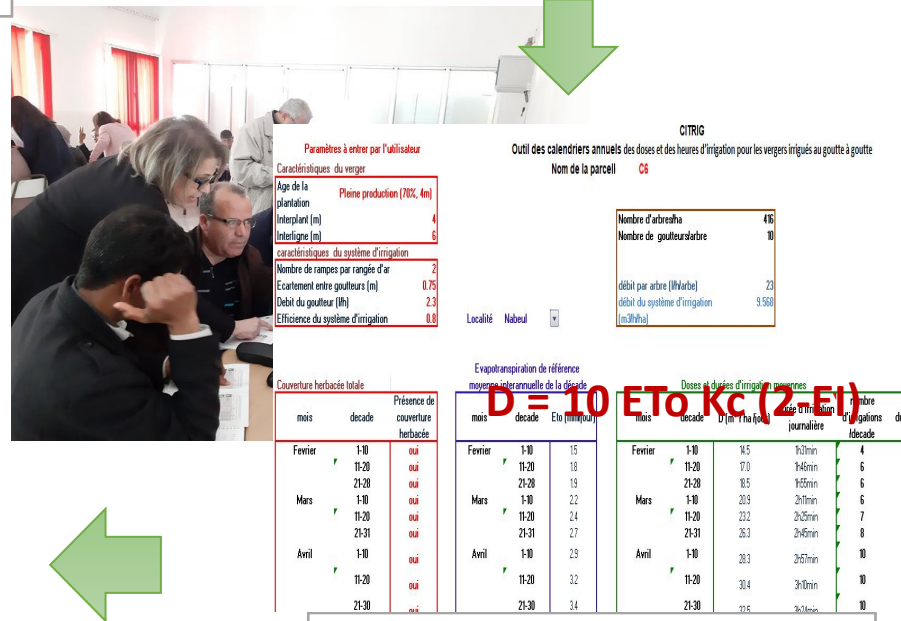
Workshop 2018: Workshop with stakeholders: need for a simple tool to be developed



2019: Publication of the technical leaflet

October 2022: Test of Citrig smartphone application and web site

Mars 2022: Presentation of the improved tool and discussion of possible diffusion forms



Mars 2019: Presentation/ test of the Citrig tool : an Excel file

December 2022: CITRIG application launched for citrus growers (monocropping of citrus)

2022/23: Work objective: Adjust Citrig for agroforestry systems (citrus + cover crop / mulch)

1) Rethinking citrus orchard

Participatory approach

Septembre 2023: a planned workshop with stakeholders about how we can biodiversify citrus orchards? Which species should be sown? What is the purpose of the introduced species? livestock feed, mulch ...

Biophysical analysis

2) Testing the water requirements of citrus in agroforestry considering how to introduce the herbaceous component in Citrig

1

Initiative: Improvement irrigation management in citrus orchards

Participatory approach

2

Creating a space of exchange with stakeholders to identify their needs

Biophysical analysis

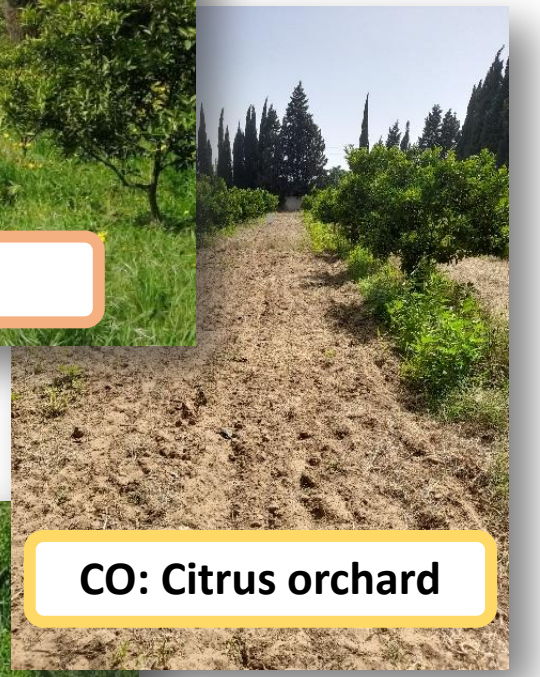
2

Evaluation of citrus' water demand in mono-cropping and agroforestry

How we can improve citrus orchards durability in a context of a climate change ?

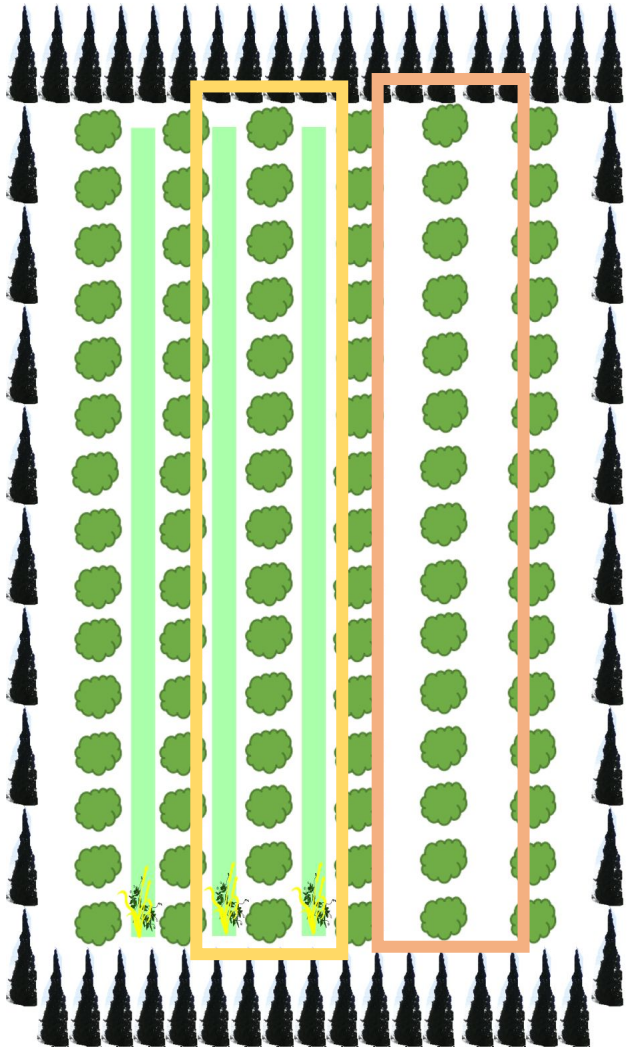
…. Diversifying is it a solution?!

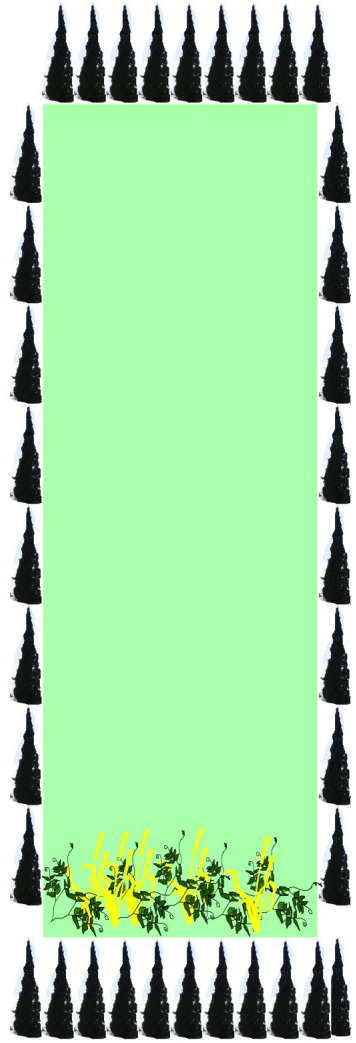
ACS: Citrus+SGC



CO: Citrus orchard

SGC: vetch+ triticale

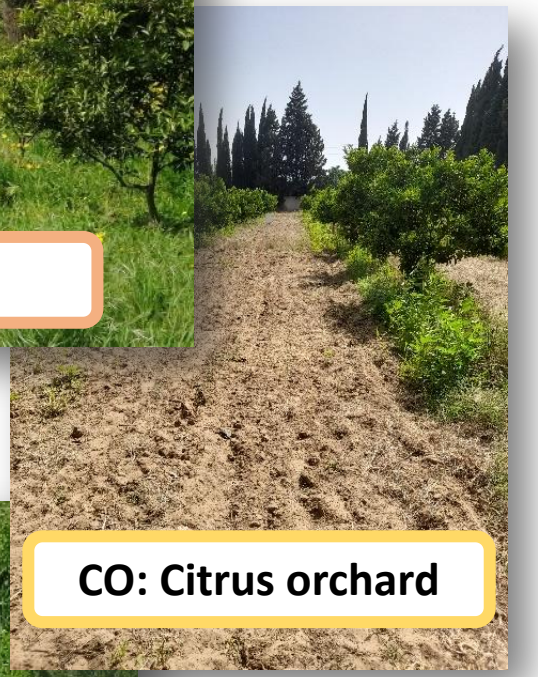




SGC: sown grass cover a mixture of vetch and triticale

Experimental analysis of citrus based agroforestry system

ACS: Citrus+SGC

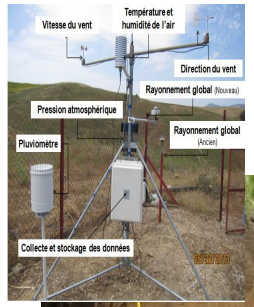


CO: Citrus orchard

SGC: vetch+ triticale

Experimental measurement

- Weather data
- Soil moisture
- Stem water potential
- Shoot growth
- Root growth
- Cover crop biomass



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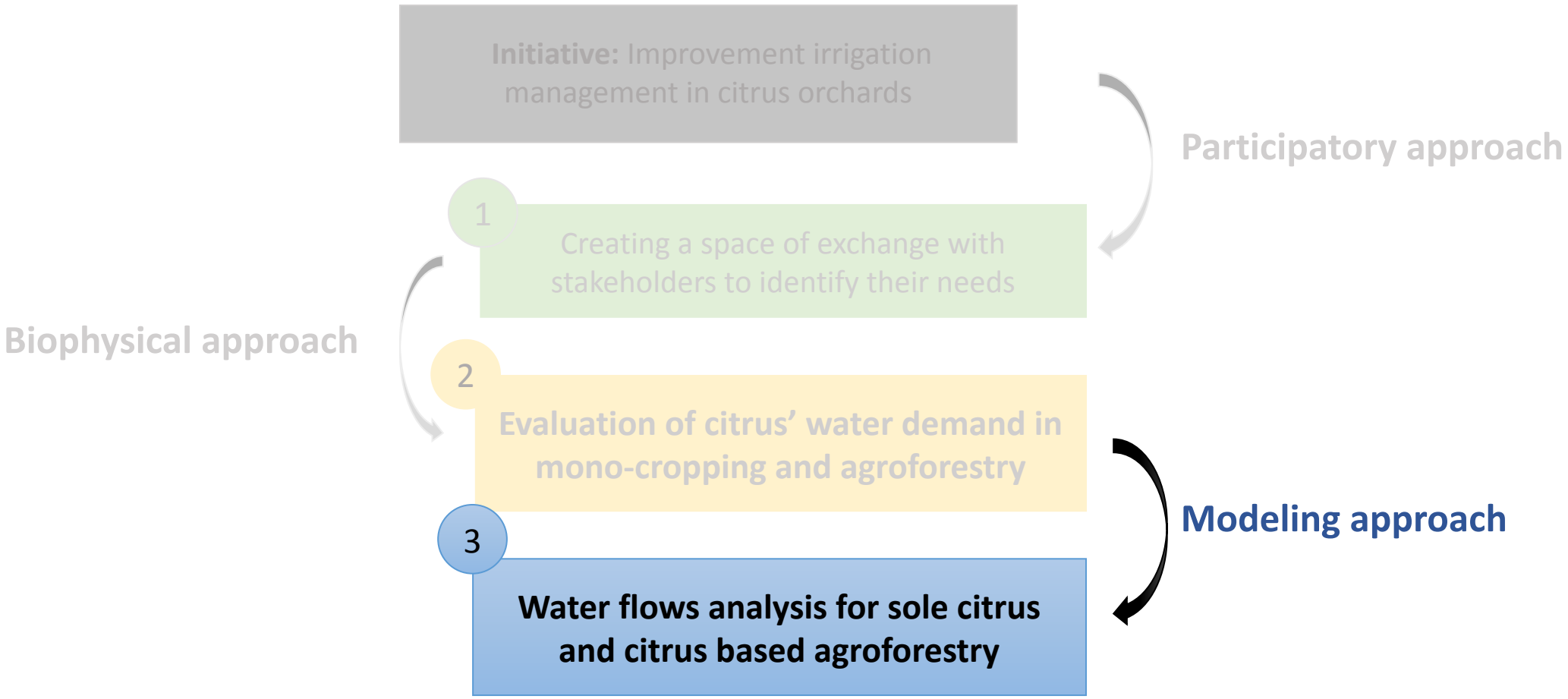
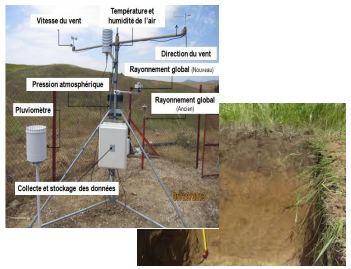
Further step



Estimate water demand for citrus based agroforestry system

Experimental data



- Weather data
- Crop calendar
- Root growth
- Soil properties

Model Input'

Modeling test

Soil water balance

Sensitivity analysis of parameters affecting the water balance

Adjust crop water demand

- Soil moisture
- Stem water potential

Evaluation

Citrig Ag nof

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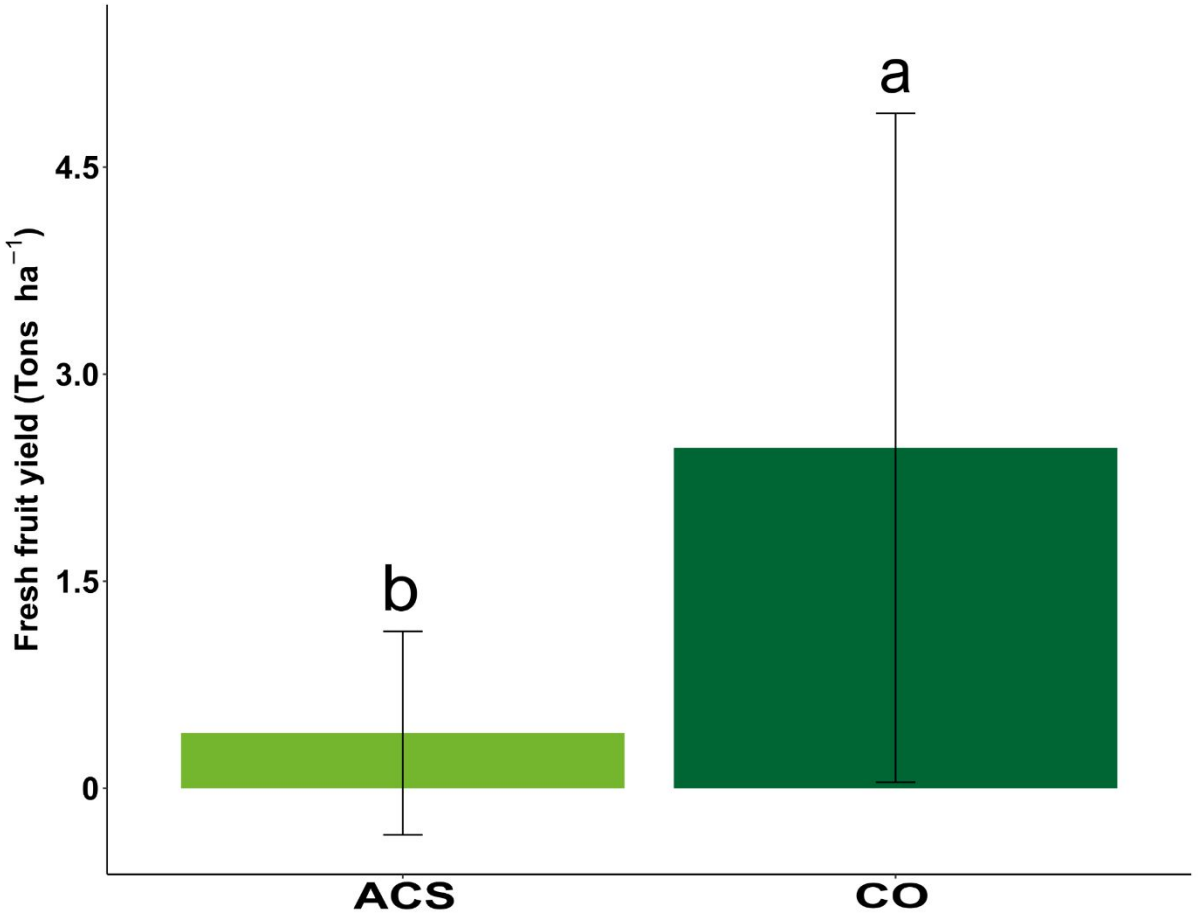
Preliminary results

Citrus yields

Cover crop biomass

Stem water potential

Fruit yield was higher in Citrus orchard



High fruit yield variability due to fruit drop:

- Heat waves
- Fruit bursting

ACS: Alley cropping system; CO: citrus orchard

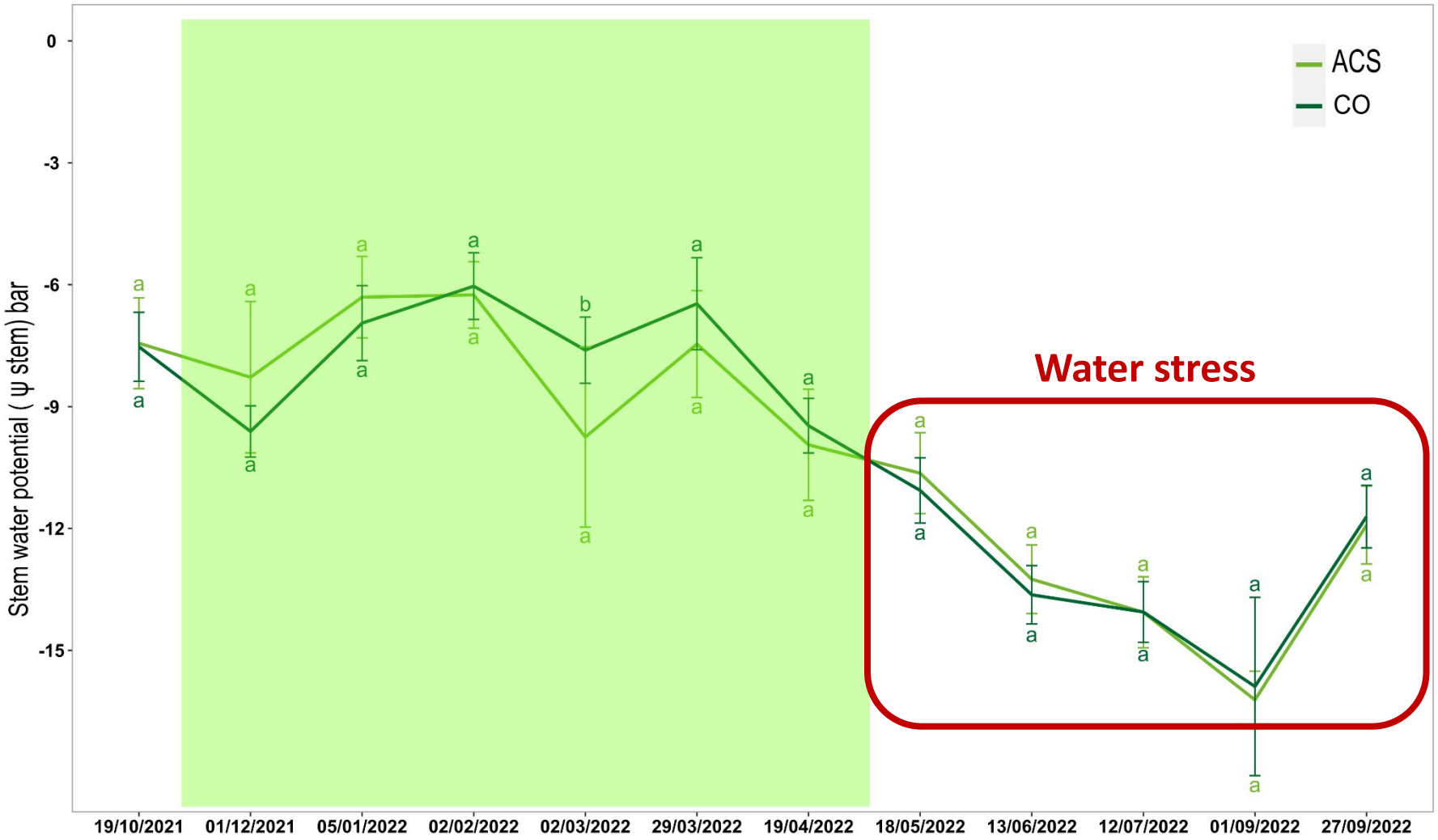
No effect of cropping systems on cover biomass

Dry biomass g m^{-2}

Date	ACS		SGC	
29/03/2022		810±134a		1222±308a
05/04/2023		315,9±85a		243,2±149a

ACS ≈SGC in both 2022$_{(p = 0.072)}$ & 2023$_{(p=0,372)}$

Presence of water stress in summer for both ACS and CO



ACS ≠ CO at cover crop flowering => a slight water stress (ψs = -9.7 bar) in ACS

Perspectives

- **Sub-objective 1:** Develop a free, user-friendly tool for conventional fruit orchards exp: citrus, based on Fao 56 paper

Smartphone application: scheduling irrigation

This step highlighted the Importance of irrigation system maintenance

Perspectives

Sub-objective 2: Next participatory approach: Co-constructing of intercropped citrus orchard => discussion with stakeholders

- Adapt CITRIG for other regions and other fruit species and for other mediterranean agroforestry systems : e.g. olive trees (79 %, and 60% of Arbo areas in Tunisia and Morocco respectively). In Morocco, 75% of olive orchards are combined with annual crops).*(Gharbi et al., 2014,El Mouhtadi et al., 2014, Razouk et al., 2016)*

Thank you for your attention

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3ACCA Secretariat

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