isUP-AgrO

WORK PACKAGE: 2

DELIVERABLE: D2.2 – Training School Report vs. 1

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1. Executive Summary

This Deliverable outlines the different ways used within Dissemination about the training schools aimed at the technical and academic communities, organized within the framework of WP2 of the isUP-AgrO project.

Two training schools were held: the first training school for "Agrosystems and Crops Monitoring" (Task 2.2) was from **18 to 22 November 2024**, with **23 participants**, and the second training school on "Smart Irrigation Technologies" (Task 2.3) was from **27 to 31 January 2025**, with **24 participants**.

Dissemination efforts were carried out through multiple channels:

- Online forms
- Media dissemination
- Personal communication

The proactive dissemination strategy enabled us to exceed initial expectations regarding participant numbers. It also extended the reach beyond the ISOPlexis Centre, engaging individuals from universities, government entities, and stakeholders from the viticulture industry.

These successful training schools significantly enhanced the scientific and technical expertise of the participants, strengthened collaborative networks among stakeholders, and laid a solid foundation for the effective implementation of the research project in the near future.

2. Introduction

The isUP-AgrO project is dedicated to enhancing the capabilities of ISOPlexis by establishing it as a center of excellence in the agricultural sector. To achieve this ambitious objective, the project implements extensive networking activities through Twinning with two leading agricultural research institutes from Italy and Spain. These collaborations are further supported by the involvement of an expert entity specializing in innovation, aimed at strengthening research management practices and fostering sustainable advancements in the field.

Within this context, Work Package 2 - Training School & International Workshops (WP2) focuses on delivering theoretical and practical training through a series of structured school sessions.

3. Training School

As part of this initiative, both Training Schools of Tasks 2.2 and 2.3 were successfully organized and widely disseminated at the local level, setting a strong foundation for future capacity-building efforts and fostering meaningful knowledge exchange among key stakeholders. These events not only provided valuable technical and academic content but also served as a catalyst for ongoing collaboration across sectors.

To recognize their engagement, all participants received a certificate of participation. Additionally, a post-event survey was distributed to gather feedback on the overall experience and to collect suggestions for improving future editions. This input is instrumental in shaping upcoming training initiatives to better address the needs and expectations of our growing network.

3.1. Training school: Agrosystems and Crops Monitoring

The 1st training school, organized in the framework of Task 2.2, was initially foreseen to have 20 trainees, but in the end, 23 trainees attended it. It was held on **Month 5**, (instead of month 6 as included in the grant agreement) and lasted 1 week.

Our Advanced partner **IRNAS - CSIC** oversaw the lecture with 2 trainers: José Enrique Luque and Antonio Díaz from the Grupo de Riego y Ecofisiología de Cultivos (www.irnas.csic.es/rec) of the Instituto de Recursos Naturales y Agrobiología de Sevilla (Spain).

Scope/Description: The training school seeked to perform an accelerated program on recent trends and research advances in agrosystems and crop monitoring, especially related to interactions between crop-soil and crop-other species present in the agrosystems that strengthen its resiliency, and adaptation to new climate constraints, using vineyards as model.
The training has provided activities that include classroom lectures and field theoretical and practical training for the participants. This training program applies to those who seek to improve their knowledge in the area, including researchers and students of the ISOPlexis Centre and the University of Madeira. The training was also open to interested outside stakeholders' technicians as well.

Training School module structure:

- ✓ Topic 1. Functional agrobiodiversity and agrosystem resilience
- ✓ Topic 2. Experiment with design and implementation layout

- ✓ Topic 3. Advanced tools in agrosystems and crop monitoring
- ✓ Topic 4. Plant-soil interactions
- ✓ Topic 5. Crop ecophysiology and stress coping
- ✓ Topic 6: Sensing connected to agriculture
- ✓ Topic 7: Plant imaging and machine learning

Other activities included: a guided visit to a vineyard, a traditional Madeiran agrosystems, and team building actions.

3.1.1. Attendees

A total of 23 individuals registered for the training sessions (Figure 1). Among the 23 participants, 17 were affiliated with the ISOPlexis Centre, reflecting strong institutional engagement. The remaining attendees included one graduate student, one professor from the University of Madeira (UMa), three government technicians, and one stakeholder representing the viticulture industry.

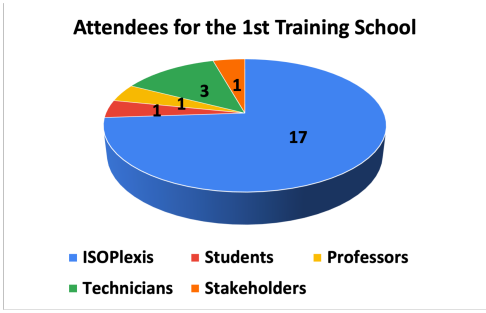

***Figure 1**. Number of attendees for the 1st Training School.*

This diverse group of participants contributed to a multidisciplinary environment, fostering a rich exchange of knowledge and perspectives that will enhance the practical applications and outreach of the methodologies discussed during the training.

3.1.2. Schedule

The overview of the 1st Training School schedule is represented in Table 1.

***Table 1**. First Training School Schedule*

1st TRAINING SCHOOL (November 2024)					
Time	**Monday 18/11 - Sala 0.57**	**Tusday 19/11- Sala 0.57**	**Wednesday 20/11**	**Thursday 21/11 - Sala nº20 e nº12**	**Friday 22/11 - Anfiteatro 7**
09:15h	Enrique and António arrival	**E.F.)** Fundamentals of irrigation, 2 h - Soil physics, Meteorology, Agronomy and Physiology (Task 2.2, Topics, 4, 5 and 6)	Field trip - Quinta das vinhas	**E.F.)** New perspectives of the use of water in agriculture, 1.5 h (Task 2.2, Topic 1; Task 2.3, Topics 1, 2, 3 and 4)	**A.D.)** Remote sensing and its application in agriculture, Use of plant sensors in precision agriculture, Application of plant physiology in precision agriculture (Task 2.2. Topic 3. Advanced tools in agrosystems and crop monitoring)
10:30h	Coffe break	Coffe break		Coffe break	Coffe break
10:50-13h	Introduction and visit to ISOPlexis facilities	**E.F.)** Strategies of irrigation, 1 h (Task 2.2, Topic 7; Task 2.3, Topic 2)		**A.D.)** How do plants respond to the environment? Overview, Water relations and transport in plants (Task 2.2. Topic 5)	Continuation of the previous lecture
13-14h	Lunch	Lunch	Lunch - 14h	Lunch	Lunch
14-17h	**E.F.)** Terms, symbols and units related to the use of water in agriculture, 1.5h	**E.F.)** Irrigation scheduling, 3 h (Task 2.2., Topic 3; Task 2.3, Topics 1 and 2)	Return to Funchal	**A.D.)** Leaf gas exchange in plants, Plant energy balance, Feeling like a plant: practical exercises, (Task	Virtual presentation - Rafael Romero (Zoom)
18:15h	----	----			Enrique and António leaves
E.F. = JOSÉ ENRIQUE FERNÁNDEZ LUQUE					
A.D. = ANTONIO DÍAZ ESPEJO					

3.1.3. Photos

At Figure 2, there are some photos of the 1st training school and the field visit.

***Figure 2**. First Training School Photos*

3.1.4. Lessons learned

The 1st Training School allowed participants to learn about the following topics:

- Terms, symbols and units related to the use of water in agriculture
- Fundamentals of Irrigation, Irrigation Strategies and Irrigation Scheduling
    - Soil physics
    - Meteorology
    - Agronomy and Physiology
- The use of water in agriculture
    - Strategies of irrigation
    - Irrigation scheduling
    - New perspectives on the use of water in agriculture
- How do plants respond to the environment? Overview
    - Water relations and transport in plants
    - Leaf gas exchange in plants
    - Plant energy balance
    - Feeling like a plant: practical exercises.
- Advanced tools in agrosystems and crop monitoring
    - Remote sensing and its application in agriculture

- Use of plant sensors in precision agriculture
- Plant physiology applications in precision agriculture.
- How to establish connection between physical sensors and the computer, integrating information of dataloggers which store information.

A field trip was taken to the west part of the island of Madeira, *Estreito da Calheta*, to a local grape producer called "Quinta das Vinhas", that allowed the theoretical and practical training for the participants, and the opportunity to interact and establish a networking. The participants had the opportunity to interact with different grape crops and have a presentation on the diverse array of sensors that can be installed to assess the anatomical and physiological variations that occur with time, weather and conditions imposed. It was also provided a workshop of a flying drone capability to take images that could be used to highlight the crop condition.

The 1st Training School received, overall, excellent feedback from the participants. In Figure 3, there is the satisfaction questionnaire that was sent to all participants, with 12 responses collected.

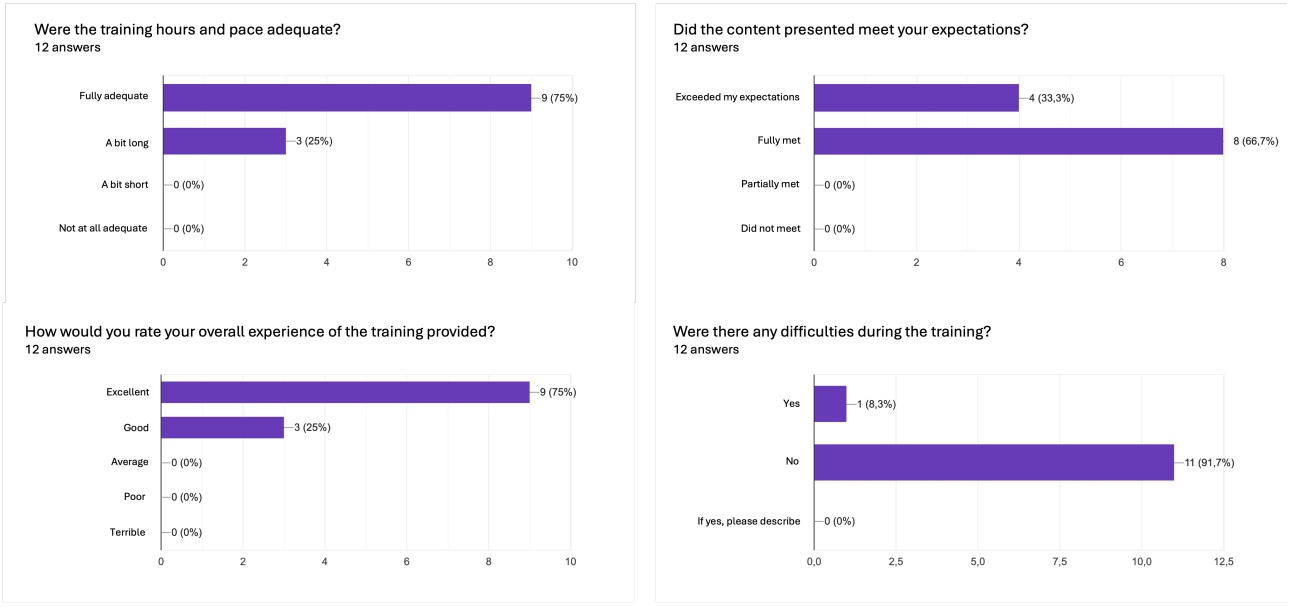

Figure 3. *Participant feedback for the 1st Training School.*

The training program seemed to be very effective. With high ratings in overall satisfaction, well-aligned content, an appropriate pace, and few reported difficulties, the feedback supports the continuation of the current training model with only minor adjustments if necessary.

3.2. Training school: Smart Irrigation Technologies

The Training School, organized under Task 2.3, was originally planned to host 20 trainees; however, it exceeded expectations with a total of 24 participants. It took place on **Month 7** of the project—one month ahead of the schedule outlined in the Grant Agreement (Month 8)—and ran for the duration of one week.

The sessions were ministred by **IRNAS - CSIC**, which provided two expert trainers to deliver the lectures: Celia Rodríguez Domínguez and Virginia Hernández Santana from the Grupo de Riego y Ecofisiología de Cultivos (www.irnas.csic.es/rec) of the Instituto de Recursos Naturales y Agrobiología de Sevilla (Spain).

Scope/Description: The training school aimed to conduct an accelerated program focused on recent trends and research advancements in agrosystems and crop monitoring. This school particularly emphasized strategies for regulating plant water and carbon use based on plant physiology, using vineyards as a model. The activities included classroom lectures and demonstrations of plant physiological sensors, and both theoretical and practical field training for participants. This training program was designed for those looking to enhance their knowledge in this area, including researchers and students from the ISOPlexis Centre and the University of Madeira. It was also open to technicians from external organizations who were interested in the subject.

Training School module structure:

- ✓ Topic 1: Process innovations connected to agriculture.
- ✓ Topic 2: The new irrigated agriculture.
- ✓ Topic 3. Effect of climate on crop productivity and quality.
- ✓ Topic 4. Adaptation actions and strategies.

Other activities included: a guided visit to a vineyard and tropical fruit agrosystem, and team building actions.

3.2.1. Attendees

A total of 24 individuals registered for the training sessions (Figure 4). Among these participants, 16 were affiliated with the ISOPlexis Centre, indicating strong institutional engagement. The remaining attendees included one graduate student, three master's students, two government technicians, one stakeholder from the organic composting sector, and one stakeholder from the viticulture industry.

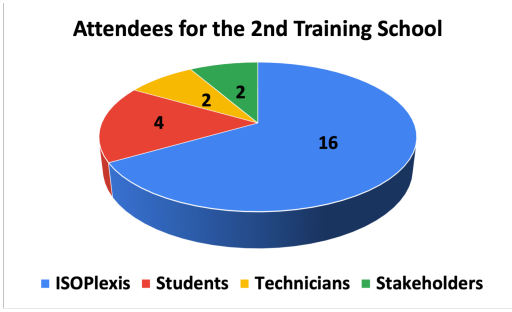

Figure 4*. Number of attendees registered for the 2nd Training School.*

This diverse group contributed to a multidisciplinary environment, facilitating a rich exchange of knowledge and perspectives. This exchange will enhance the practical applications and outreach of the methodologies discussed during the training.

3.2.2. Schedule

Below, at Table 2, is an overview of the 2nd Training School schedule.

Table 2. Second Training School Schedule

2nd TRAINING SCHOOL (end of January 2025)					
Time	**Monday 27/01 - Sala 16**	**Tuesday 28/01- Sala 16**	**Wednesday 29/01**	**Thursday 30/01 - Sala 16**	**Friday 31/01 - Anfiteatro 5**
09:30-11h	Introduction and visit to ISOPlexis facilities	**C.R.)** Plant Hydraulics (Task 2.3 - Topic 1,2)	Field trip - Fajã dos Padres	**V.H.)** Sensing connected to agriculture: sap flow sensors (Task 2.3 - Topic 4) **C.R.)** Sensing connected to agriculture: Leaf turgor pressure-related sensor (Task 2.3 - Topic 4)	**V.H. & C.R.)** Practical overview and questions
11h-12h	**V.H.)** introduction to vascular plant anatomy for understanding water relations and hydraulic function *				
12-13h	**C.R.)** Introduction to vascular plant physiology for understanding water relations and hydraulic function *				
13-14h	Lunch	Lunch	Lunch	Lunch	Closing session - Lunch
14h-16h	**C.R.)** Water potential: a fundamental plant water status indicator (Task 2.3 - Topic 2)	**V.H.)** Sensing connected to agriculture: sap flow sensors (Task 2.3 - Topic 4)	Field trip - Fajã dos Padres	**V.H.)** Experiment with design and implementation layout (Task 2.3 - Topic 3)	----------
16h-17h	**V.H.)** Functional agrobiodiversity and agrosystem resilience (Task 2.3 - Topic 4)				
* Workshops					
C.R. = CELIA M. RODRÍGUEZ DOMÍNGUEZ					
V.H. = VIRGINIA HERNÁNDEZ SANTANA					

3.2.3. Photos

At Figure 5, there are some photos of the 2nd training school and the field visit.

***Figure 5**. Second Training School Photos*

3.2.4. Lessons learned

The 2nd Training School allowed participants to learn about the following topics:

- Water potential: a fundamental plant water status indicator
  - Basic principles
  - Methodologies
  - Optimizing practical use
- Leaf turgor pressure-related sensor
  - Basic principles

    - Methodological considerations
    - Practical use in precision irrigation
- Plant hydraulics
    - Basic principles
    - Considering plant hydraulics in agriculture
    - Methodologies for measuring leaf, stem and root hydraulic conductance
    - Importance of considering soil-root hydraulic interactions in precision agriculture
    - Practical application of imaging techniques in agriculture
- Experience with design and implementation layout
    - Introduction to research design: independence assumption, replication and randomization
    - Factorial design or ANOVA
    - Other experimental designs: randomized block, split-plot, repeated measures ANOVA, nested ANOVA, pseudoreplication
    - Mixed models
    - Exercises
- Functional agrobiodiversity and agrosystem resilience: species and varieties of water and carbon-related traits
    - Theory and methods
    - Practical calculations with real data of some traits
- Sensing connected to agriculture: sap flow sensors
    - Theory
    - Methods
    - Sap flow applications to agriculture
    - Hands-on sap flow methods installation
    - Data management: Scaling from single-point sap velocity measurements to tree/plot transpiration

A field trip was taken to the south part of the island of Madeira, Quinta Grande, to a local grape and tropical fruit producer called *Fajã dos Padres*. The visit allowed theoretical and practical training for the participants, and the opportunity to interact and establish a network. The participants had the opportunity to interact and learn about malmsey vineyards grown in a microclimate agrosystem of supratidal talus at the foot of coastal cliffs caused by landslides. The Madeiran vineyards are at risk of disappearing, because this variety is unique and only exists in that location. It was approached the cultural management in maintaining the variety, the production cycle with anatomical and physiological variations of the variety, and finally the winemaking process, including bottling and shipping. It was also provided a workshop of a weather station was provided to monitor the microclimate conditions of the vineyard, namely atmospheric and soil monitoring to moisture, temperature, solar radiation, wind, precipitation, and evapotranspiration.

The 2nd Training School received, overall, excellent feedback from the participants. In Figure 6, there is the satisfaction questionnaire that was sent to all participants, with 16 responses collected.

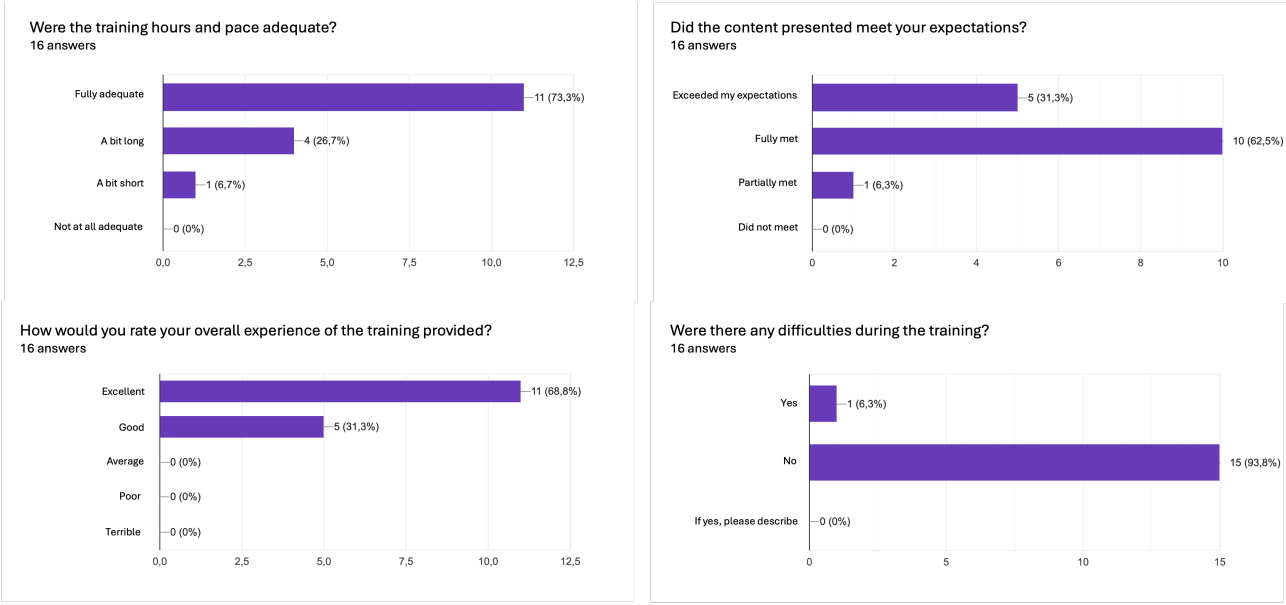

***Figure 6**. Participant feedback for the 2nd Training School.*

The training was positively received, with participants pleased with the content, delivery, and structure. Making minor adjustments to the pace or workload could enhance the experience further.

4. Conclusions

This Deliverable marks a significant milestone in the ongoing capacity-building efforts in the fields of Agrosystems and Crop Monitoring, as well as Smart Irrigation Technologies. Through comprehensive training sessions, participants acquired valuable knowledge of advanced methodologies for monitoring agrosystems, with a strong emphasis on precision irrigation and plant physiology—particularly focusing on plant hydraulics.

The training covered the integration and practical application of tools such as sensors, probes, and other monitoring technologies. These tools were highlighted for their critical role in optimizing irrigation practices and deepening the understanding of plant water relations. Participants examined plant physiological responses to varying irrigation regimes and scheduling, enriching their comprehension of crop behavior under diverse water management strategies, particularly in relation to plant water potential, leaf turgor, and hydraulic conductance in leaves, stems, and roots.

Two practical field trips complemented the theoretical sessions. The first visit, to a vineyard, enhanced the learning experience by offering hands-on demonstrations of advanced equipment, including a drone, an Infrared Gas Analyzer (IRGA) from ISOPlexis, and sensors presented by trainers from CSIC. This immersive experience not only reinforced the theoretical content but also showcased real-world applications of the discussed methodologies. Importantly, this vineyard is one of the future sites for the implementation of the research project under Work Package 6 (WP6). The visit also facilitated preliminary discussions on the project's rollout, scheduled for March 2025, thereby laying the foundation for future collaboration and experimental work.

The second field trip took participants to a vineyard located in a microclimatic zone near sea level. This visit focused on the vineyard's climate monitoring systems, with demonstrations and explanations of

the weather stations installed on-site—systems similar to those planned for implementation in the WP6 research project.

By integrating in-depth theoretical instruction with practical field experience, this training school successfully enhanced participants' expertise, reinforced collaboration among stakeholders and project partners, and laid critical groundwork for the successful implementation of the upcoming research project.

4.1. Next steps

The upcoming steps will center on the preparation and organization of the next Training School, aligned with **Task 2.4: Training School on Soil Microbial Interactions – Challenges and Advanced Techniques**. Scheduled to take place during the 20-24 of October 2025, this one-week event will accommodate up to 20 trainees, fostering a focused and engaging learning environment.

Our advanced partners IRNAS-CSIC and **UNIPR** will play key roles in delivering the training, each providing one expert trainer to lead sessions and share their knowledge in soil microbial technologies. This Training School is designed to build on the foundational knowledge established in previous activities, equipping participants with advanced skills and practical insights into cutting-edge practices and technologies related to irrigation and soil microbiology.

We are currently in communication with the trainers and actively working to optimize the training program. Feedback on the preliminary schedule is awaited from the ISOPlexis Center team to finalize the agenda.

Preparatory efforts are now focused on logistical coordination, curriculum development, and participant selection. These efforts aim to ensure that the Training School achieves its intended learning outcomes and continues to contribute meaningfully to the overall objectives of the project.