

**Summary Winter School "Grassland Soil Health Assessment", H2020 project  
Developing sustainable permanent grassland systems and policies, 14<sup>th</sup>-15<sup>th</sup> December  
2023, University of Córdoba, Spain.**

The Winter School organized by the University of Córdoba in Spain as part of the H2020 project Super-G took place on Thursday 14<sup>th</sup> December and Friday 15<sup>th</sup> December 2023. The overall objective of the event was to impart and strengthen knowledge on soil health and how to assess the soil status in order to contribute to the sustainable management of permanent grassland in Mediterranean environment. Two researchers from Córdoba and four international master students from Costa Rica, Colombia, and Panama participated. For the second day a seventh participant (master student) from Uruguay was able to join. The first day was dedicated to an excursion to the Finca "La Jarosa" in Sierra Morena to collect soil data and samples. The second day was planned to present different ways to interpret and process the collected data and samples in the laboratory and using RStudio and QGIS.

**14th December: Field Day**

The first day was intended to collect data and samples in two differing plots of the finca "La Jarosa" (approximately half an hour drive from Rabanales). The first plot is grazed and irrigated in the summer months and the second plot has not been grazed for several years. Corresponding differences were to be expected and could be identified by the participants.



*Figure 1: Location Finca "La Jarosa"*

The SUPER-G team that day was represented by course directors Tom Vanwalleghem and Pilar Fernandez Rebollo and the project workers Jesús Fernández Habas, José Ramón Leal Murillo, Javier San Martín Loren, María Peña Marín, and Verena Arndt. After registering at 8:30 a.m. on Rabanales-Campus all the participants were transported to the finca "La Jarosa".

On arrival, the day's tasks were explained and an introduction about the finca's specifics and the two different plots the day's focus was on were given. All the selected methods to measure soil health were demonstrated, and first observations were made together as a group. Later on, the participants had the opportunity to try out the applications and carry out the measurements themselves. They divided into two groups to assess the data on soil and the data on pasture to later swap.



*Figure 2: Arrival on the first plot (irrigation)*

The selected set of methods to measure soil quality consisted in:

- Water infiltration: single ring (Beerkan method)
- Bulk density: sampling with Kopecky rings
- Sampling of soil carbon by colour
- Biological activity of coprophages (visual assessment)
- Bare soil cover: visual estimation
- Grass production: visual estimation with category assignment
- Grass production: rising plate meter
- Functional groups: dry-weight-rank
- Field radiometry
- Root density and length
- Legume nodules assessment

After returning to Rabanales the gathered samples were prepared in the laboratory for the next day. The pasture's fresh weight was recorded, and the soil samples were introduced to the oven to dry for the next day's data processing activities. The group of participants was very dedicated and demonstrated a high amount of motivation and interest in the topic.



*Figure 3: Bulk density; sampling with Kopecky rings*



*Figure 4: Sampling grass production*



Figure 3: Grass production; rising plate meter and field radiometry



Figure 6: Biological activity of coprophages (visual assessment)



Figure 7: Field radiometry



*Figure 8: Root density and length*



*Figure 9: Legume nodules*



*Figure 4: Group of the day and used instruments*



Figure 5: SUPER-G winter school Córdoba 2023

### **15<sup>th</sup> December: Data Processing**

On the second day the obtained data was processed. The day started in the laboratory. The now dried soil samples were weighed to calculate the bulk densities of the two plots' soils and therefore their ability to function as a structural support for plants and to provide oxygen, water, and nutrients. Also, the pasture samples were weighed to later that day interpret the results, establishing a linear regression relationship between dry matter production per hectare and the accordingly to the comparative-yield-method created categories. Furthermore, the pH values of the soil samples were measured with phymeters and indicator papers.

After the laboratory activities, Tom Vanwalleghem presented soil health indicators in pastoral ecosystems, how to evaluate soil quality, and its relevance in the current context of the legislative framework related to soil degradation in the EU.

The work with the results from the dry matter production weights then continued in excel guided by Jose Ramón Leal Murillo. Thereafter, the participants had the chance to follow the explanations of Jesús Fernández Habas on field radiometry for the calculation of vegetation indices using the statistic software RStudio and the transfer of the indices to QGIS. Eventually, Javier San Martin Loren shared his knowledge on what remote sensing information is available online and how to access and use it (Copernicus Data Space Ecosystem).



Figure 6: Presentation Jesús Fernández Habas



Figure 7: Presentation Javier San Martin Loren