WP4. GHG SAMPLING

Protocol:

- Install collars into the ground (4-5 cm deep) 2/3 weeks before each measurement period.
  * *This is to limit any disturbance to the soil before sampling.*
  * *If already installed, check that PVC collars are hammered into the soil around 4-5 cm to seal the system and the remaining 3-4 cm are aboveground to place the chambers on top.*
- GHG measures will be performed only in the following compositions, which results in 27 selected plots (Table 1).

			PLOT				
Composition	**Mixture**	**Diversity**	**Spain**	**France**	**Slovenia**	**Lebanon**	**Jordan**
1	Monoculture	Monoculture	11	4	8	29	22
2	Monoculture	Monoculture	2	21	20	35	9
4	Monoculture	Monoculture	26	23	3	37	24
5	Monoculture	Monoculture	39	26	11	26	25
7	Monoculture	Monoculture	22	14	4	6	16
8	Monoculture	Monoculture	9	31	30	3	17
18	4-sp mixture	Dominance	35	18	2	27	15
19	4-sp mixture	Dominance	4	29	13	14	29
20	4-sp mixture	Dominance	28	2	27	38	34
21	4-sp mixture	Dominance	8	5	21	28	14
22	4-sp mixture	Dominance	1	30	23	39	35
23	4-sp mixture	Dominance	25	36	25	1	27
24	4-sp mixture	Dominance	27	22	32	20	28
25	4-sp mixture	Dominance	40	8	1	33	23
26	4-sp mixture	Co-dominance	5	37	29	36	20
27	4-sp mixture	Co-dominance	19	9	24	7	32
28	4-sp mixture	Co-dominance	10	3	26	19	3
29	4-sp mixture	Co-dominance	31	7	9	34	5
30	4-sp mixture	Co-dominance	17	17	22	9	11
31	4-sp mixture	Co-dominance	3	24	10	22	12
32	4-sp mixture	Co-dominance	15	25	14	16	40
33	4-sp mixture	Co-dominance	14	27	40	8	19
34	4-sp mixture	Centroid	16	20	12	12	18
35	4-sp mixture	Centroid	29	28	36	13	30
36	6-sp mixture	Centroid	34	38	38	32	31
37	6-sp mixture	Centroid	13	13	19	40	37
38	6-sp mixture	Centroid	37	19	15	18	4

Table 1. Composition of the plots where the measurements with the PAS will be carried out.

GAS CHROMATOGRAPHY

Material needed for the GHG measurements

- Digital thermometer (EL-USB 2+ or a similar thermohydrometer)
- PVC collars
- GHG dark chambers → provided by the coordinator.
- Exetainers/vials → provided by the coordinator.
- Syringes → provided by the coordinator.
- Needles → provided by the coordinator.

GHG recording steps

1. Check the PVC collars

After some time, the PVC collars can move from the original position and be into the soil too deep or too shallow. Check that PVC collars are hammered into the soil around 4-5 cm to seal the system and the remaining 3-4 cm are aboveground to place the chambers on top.

2. GHG measurements

We need to record the air temperature inside the chamber during the sampling time to afterwards convert the resulting GHG concentration values in ppm to umol.m^3, according to the ideal gas law. GHG concentration values in umol.m^3 are used to calculate the GHG fluxes. Thus, in order to record the air temperature inside the chamber, place a thermometer sensor inside the chambers. At least in 1 of the chambers. The thermometer must record the temperature inside the chamber and the time.

To perform the GHG recording, place the chamber on top of the PVC collar. If it is very hot, it is recommended to also cover the chamber with a carboard box during the sampling time to avoid overheating the system.

Close the chamber and take the corresponding samples:

- T_0: just immediately after closing the chamber.
- T_{10}: 10 minutes after closing the chamber.
- T_{20}: 20 minutes after closing the chamber.
- T_{30}: 30 minutes after closing the chamber.

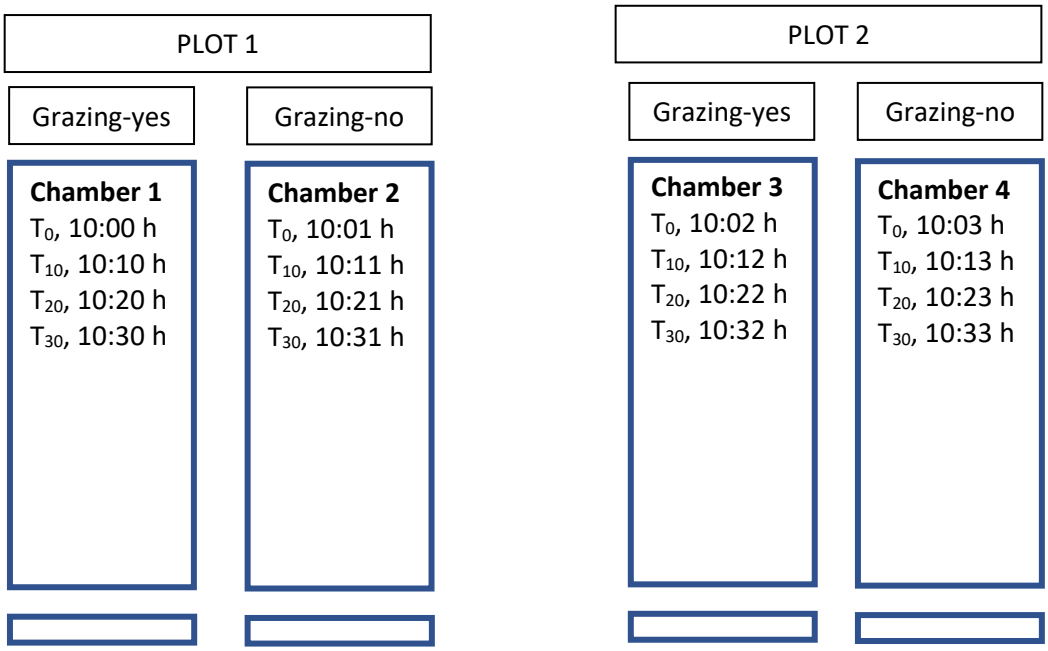
For every GHG measurement nail one needle (green) in the septum and the needle that is connected to the syringe (blue). The green needle is needed to compensate the change in the air pressure inside the chamber caused by the air extraction.

- Fill the syringe with the air from inside the chamber.
- Transfer the air from the syringe to the exetainer tubes/vials.
- Bring the vials to field already organized and labelled as follows:
    - PLOT NUMBER, SAMPLING TIME (0, 10, 20, 30), GRAZING (yes: G, no: NG). For instance, the vials of the plot 3 grazed will be labelled as follows:
      3-0-G, 3-10-G, 3-20-G, 3-30-G.

To calculate the flux we need to know the temperature inside the chamber. Write down the plot number and the sampling time in the field sheet every time that an air sample is collected. The time of the thermometer must be set with the current time.

GHG measurements can be done simultaneously or in chain using the several chambers available.

Example:



Once the GHG measurements are done store the vials. Add a label to the parcel with the site and the sampling date.

ONLY FOR A LIMITED NUMBER OF SITES

765 PHOTOACOUSTIC SPECTROSCOPY (PAS) ANALYZER SYSTEM PROTOCOL

System setup:

- PAS analyzer
- Cylindrical chamber (XX L nominal volume) → transparent and darkened when needed.
- Rubber joint at the base of the cylindrical chamber
- Teflon sampling tube (xx m length & xx cm diameter)
- Batteries (12 V)
- 12 V–220 V converter
- Metal collar to install in the soil.
- Thermometer (EL-USB 2+)
- Small fan powered by its own battery.
- External air-filter before entering the PAS.
- Laptop for data storage.

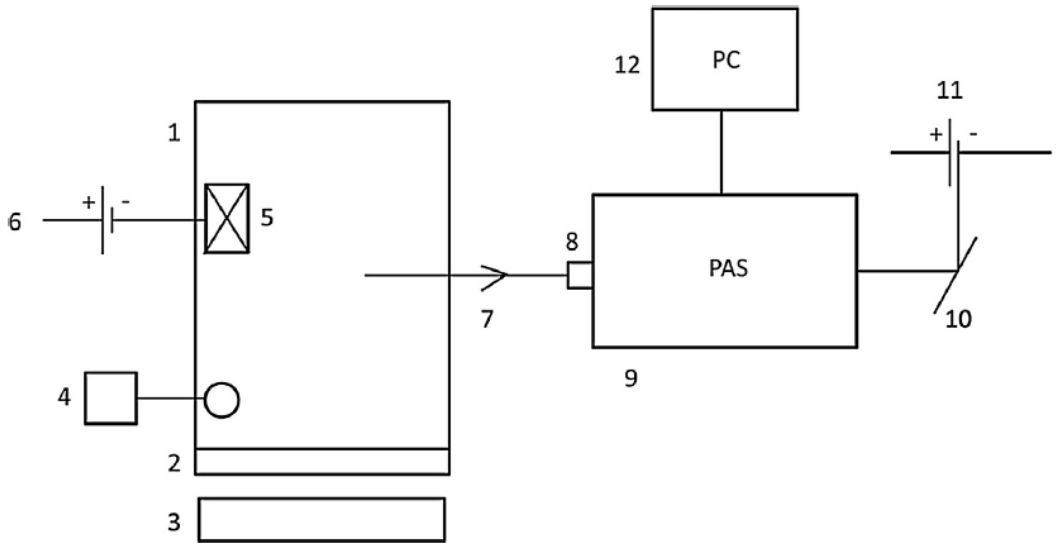


Fig. 1. Scheme of the chamber-scale gas-exchange measurement system set-up. The enclosure consisted of (1) a methacrylate chamber (h = 38.5 cm; Ø = 25 cm), (2) a rubber joint at its base to provide sealing at the chamber/collar junction, and (3) a metal collar (h = 8 cm; Ø = 25 cm) installed 3 cm deep in the soil. The chamber was equipped with (4) monitoring of the internal air temperature with thermocouple connected to an AMPROBE multi-logger thermometer TMD-56, (5 and 6) air mixing to homogenize the air in the headspace with a small fan powered by its own battery, and (7) a 20-m long Teflon sampling tube. Air was intermittently drawn at a rate of 1 L per minute (LPM) and passed through an external air-filter before entering the (8) PAS analyzer (9) and being eventually exhausted. The flow rate was produced and determined by the analyzer, therefore there was no additional pump or flow controller. The system was powered by 12 V batteries +12 V–220 V converter (10 and 11). Communication to PAS and data storing was done with a laptop (12). To allow portability, the equipment was housed on a carriage and it was shaded from direct sun-light to avoid overheating.

(INNOVA 1412, LumaSense Technologies, Denmark → https://innova.lumasenseinc.com/manuals/1412i/)

Extended PAS protocol

- Activate cross-interference and water-interference modes.

  ** To take into account the interference between gases and the interference of the water vapor in the measure of the gas.*

- Select gases and write tube length.
- Measure for 45 min to warm up the machine with the chamber open.
- Measure temperature and humidity inside and outside the chamber (EL-USB 2+ or a similar thermohydrometer), with 1 or 2 measures per minute.
- Place the chamber on top of the PVC collar.
- Flux measurements placing the chamber around the collar to enclose the vegetation and soil for about **4 PAS measurements** (approx. 4 min)
- Leave the chamber open for 4 measurements before each flux measurement to ensure ventilation of the chamber headspace, and to obtain the values of ambient gas concentrations.
- **Measurements per plot:**
  1. Light conditions:
     - Measure fluxes of intact vegetation under light conditions (4 measures).
     - Measure the PAR in each 4 light condition measurement.
     - Leave the chamber open for 4 measures.
  2. Dark conditions:
     - Measure fluxes of intact vegetation under dark conditions (4 measures).
     - Leave the chamber open for 4 measures.
  3. Dark conditions (without vegetation)
     - Cut the aboveground vegetation when you are measuring with the chamber open in the previous step.
     - Measure soil fluxes without vegetation and under dark conditions (4 measures).
     - Leave the chamber open for 4 measures.
  4. Start the next plot.
- **Annotations per plot:**
  1. Starting time (local and solar time) → only at the beginning of the day.
  2. Opening and closure time of the chamber for each measurement
  3. PAR measurement value in each four light condition PAS measurement
  4. Thermohydrometer: inside and outside the chamber → temperature and humidity (export at the end of the day).
  5. Brief description of the weather during measurement time (cloudy, sunny, if it has rained previously…).
- When finished:
  - Export all-day data (temperature, humidity, and PAS data)
  - Charge batteries once return from field!!!!!