

Carbon Action MULTA field observations July 2023 - Methods

Soil hydraulic conductivity

A mini disk tension infiltrometer (Meter Group, USA) was used to measure the infiltration rate and hydraulic conductivity on the test sites. Each site had 5 sampling points which were located within the 10-meter radius from the three GPS referenced points used for soil quality assessment. A thin 1-3 mm layer of quartz sand was used under the infiltrometer to ensure a good contact with the soil. The infiltrometer was used with the **-1,5 cm water head suction**. **The infiltration was recorded for 5-10 minutes so that the minimum of 10-15 ml water had infiltrated into the soil. In some cases, the measurement time was expanded to 15 min.** The hydraulic conductivity was calculated from the rate of infiltration vs. time data using the method of Zhang et al. 1997 (Dohnal, Dusek, and Vogel 2010; Zhang 1997), and the Van Genuchten parameters provided in the Meter group user manual. For the soils with the low van Genuchten n-parameter values ($n < 1,35$, fine textured soils) the correction suggested by Dohnal ym. 2010 was implemented: the first timestep of each measurement was excluded from the calculations in order to eliminate the possible effects of the sand layer. The five readings were averaged for each site.

Biomass measurement

Biomass was measured by cutting **six 0,33 x 0,33 m random squares** of crop per field. Sampling points were located within the 10-meter radius from three GPS referenced points. In the case of pastures or mown grass, also the current year layer of thatch was included in the biomass. The samples were pooled together, weighed and subsampled (100-150 g subsample) for dry matter content analysis. Dry matter was measured by drying the sample at 105 C for 16-20 hours.

Soil bulk density and moisture content

Three **80 mm diameter**, 50 mm depth soil cores were collected from each field. The samples were pooled and dried at 105 C for 16-20 hours and weighed. The soil moisture was measured gravimetrically and calculated from the weight difference before and after drying and further divided by the volume of the three soil cores. The total soil porosity was calculated with the following formula:

$$\Phi = 1 - \frac{\rho_{\text{bulk}}}{\rho_{\text{particle}}} \quad (1),$$

where Φ = total porosity of the soil (%), ρ_{bulk} = soil bulk density (kg/l) and ρ_{particle} = soil particle density (kg/l). 2,65 kg/l was used as value for particle density (Hartge and Horn 2009).

Visual evaluation of soil structure (VESS)

VESS was conducted following to Guimarães et al. (2017) using a VESS chart (SRUC, UK). **Depending on soil conditions 3-5 soil pits were dug per plot.** The 35 cm deep pits were within 10 m of three GPS marked locations. At each pit the soil was divided into distinct layers and the layers were scored from 1-5 depending on structural characteristics. An overall VESS score was calculated for each measurement by a layer thickness weighted average of the layer scores. The VESS scores were averaged for each site.

Green cover & chlorophyll

Green cover (%) was estimated by Canopeo app. Two photos were taken within 10 m radius from the GPS referenced sampling points for each field. The Canopeo results of all photos were averaged for each site.

Chlorophyll was measured from 5 plants per field using a handheld chlorophyll meter (Atleaf+, FT GREEN LLC, USA). Each measurement was from the recently emerged top leaf of the plant, from the center of the leaf, avoiding the midrib. Several measurements were taken on each leaf to determine the position with least variation between samplings (Dunn et al. 2018), then 10 readings were averaged using the best position. The readings were converted to chlorophyll and SPAD scale using converters from the atLeaf website (included in the field observations excel file).

Earthworms

Earthworms were analyzed by taking 10 cm x 20 cm x 35 cm spade of soil, crumbling and hand sorting earthworms out (Stroud 2019). The analysis was conducted from the same spade of soil as was used for the VESS inspection. The weather in July was dry, so earthworm numbers were low.

Root biomass

In addition to routine sampling 2019-2022, in 2023 root biomass was collected from a depth of 0-60 cm for three repeated samples for each field. An Eijkelkamp soil auger was used to dig the soil in 10 cm increments and each increment layer was pooled separately for each field. (I.e. 6 samples per field, collected from 3 GPS locations.) The soil was stored refrigerated, weighed, subsampled for moisture content analysis to report results per dry mass of soil. The soil samples were then soaked in 1 % sodium pyrophosphate/carbonate solution (baking powder) overnight to disperse clay. The roots were washed over 1 mm sieve and residue was separated from roots by flotation and by tweezers. The washed and cleaned roots were frozen, dried at 65 C for 16 hours and weighed. (The whole process took 40 minutes per sample due to high amounts of non-root plant residue.) The root data will be added to the dataset when the analysis is complete.

References

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