# Investigation of SOC in the lab and soil scanner to refine input of the InVest model for ecosystem analysis

*Lyndré Nel, Csaba Centeri, Eszter Kovács, Viktória Vona, Márton Vona*

*Institute of Natural Resources Protection, Szent István University, Hungary, e-mail: lyndre.agri@gmail.com*

*Csernozjom Ltd., 5065-Nagykörű, Arany J. u. 10., Hungary, e-mail: vonaviki@gmail.com, vona.marton@gmail.com*

SZENT ISTVÁN UNIVERSITY
GÖDÖLLŐ
FACULTY OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

## Introduction

Soil survey data are increasingly being collected to develop spatio-temporal carbon estimations for regional modelling of soil carbon sequestration (SOC stock). Methods to measure the quantitative determination of soil carbon sequestration is, historically, based on the lab-based evaluation of the amount of organic carbon (OC). New technologies, like soil scanners, are new to the soil measurement scene and present a new method of analysing soil parameters. The objective was to compare the results of two soil carbon estimations by the lab method versus from near infrared soil scanner and consider their application for soil carbon stock estimation.

## Methods

Thirty soil samples were taken across the Szentendre Island, Hungary, between October and December 2019. Samples were taken from 5 sites for arable land, forest and natural vegetation each (15 sites). A soil sample consisted of a 1.5 kg mixed sample of 3 soil cores from one site, taken for 2 depths, 0–30 cm and 30–60 cm (i.e. 2 samples taken from each site). 1 kg of each sample was sent to a Hungarian laboratory where the Turin method was used to measure soil organic matter. The rest of the samples were used to measure humus % (based on total carbon) by conducting soil scanning with the AgroCares Near InfraRed (NIR) Soil Scanner. The results are plotted and presented as box-and-whisker graphs.

## Lab Analysis (Turin Method)

Wet oxidation is a very popular method for the determination of **organic matter content** (humus %) in soil. Carbon in soil samples are converted to carbon dioxide which is measured through dichromate procedures, widely used for routine soil organic carbon determinations in laboratories.

The Turin method (Turin, 1951; Ponomareva and Plotnikova, 1980) is used to measure the SOM through a wet chemical oxidation method followed by titration of the remaining dichromate with ferrous ammonium sulfate or photometric determination of $Cr^{3+}$.

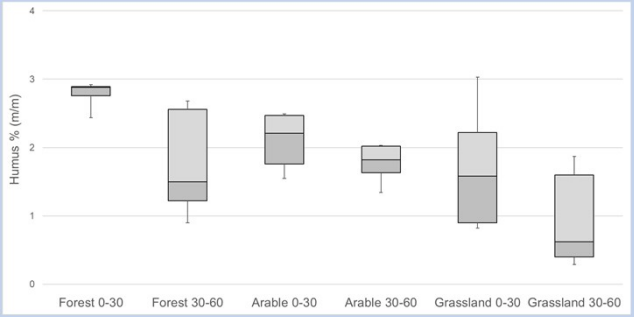


Fig. 1. Humus % (m/m) for 0–30 and 30–60 cm soil samples, results from lab analysis.

## Soil Scanner

Near InfraRed (NIR) soil scanner is based on the spectroscopy, i.e. the specific way in which light is reflected by soil as a function of the wavelength in the electromagnetic spectrum, and measures **humus %** (m/m) based on total organic carbon (g/kg).

Mid Infrared Reflectance (MIR) and Near Infrared Reflectance (NIR) Spectroscopy can provide detailed information about organic components and texture in soils. While Rontgen (or X-Ray) Fluorescence (XRF) Spectroscopy collects information about concentrations of minerals and trace elements. The Scanner contains a light source and a NIR spectrometer on a chip. Statistical algorithms, through machine learning, are used with in-country soil data to identify patterns in the data that correspond with the soil's chemical properties and update results.

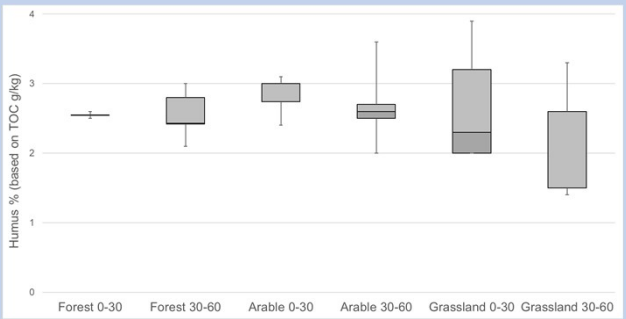


Fig. 2. Humus % (m/m) based on total carbon (g/kg) measured at 0–30 and 30–60 cm soil samples, results from NIR soil scanner.

## References

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## Conclusion

Both the lab analysis and soil scanner methods of determining soil carbon stock have merits and limitations depending on the context of why the soil carbon estimation is required. The use of NIR soil scanners for carbon mapping potentially has great value in the future as it provides a cost- and time-effective alternative to labs.

To get to this point, more research on the scanners' application in soil sampling must be done to establish a best-practice methodology for soil stock measurement, and data should be shared on open source repositories for widespread use.