Evaluation of the change of tillage effected humus quality with remote sensing

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The adequate tillage improves the soil's air content, thus the microbial activity and the decomposition of the organic mater in the soil will be more rapid. As a result of degradation processes, the amount of humus can be reduced and the quality of humus can be change. The proportion of mature humic acids and humic substances may increase within the humus content. Microorganisms oxidize the fragments of more easily degradable molecules to CO_2 and water, as a result significantly more difficult to decompose these small molecules. If they are polymerized the new larger molecules will contain more nitrogen, aromatic and double bonds. The produced fulvic acids of lower molecular weight are light yellow, while humic acids and humic substances are dark in colour. The colour of the humus extracts has a strong correlation with the quality of the humus. The ratio of absorbance values between 465 nm and 665 nm (E4 / E6) is related to the amount of condensation of humus molecules, the presence of aromatic systems and carbon content (GHOSH and SCHNITZER, 1979). If the hummus is younger with a higher proportion of fulvic acids, the E4 / E6 value will be higher (6-8.5), while the more mature humus has higher quality humic acids which are predominate, thus the E4 / E6 ratio is less than 5 (STEVENSON, 1994).

Our investigations were made in the soil tillage long term experiment on Calcic Chernozem soil (WRB, 2006). The experiment were established in 2002 in the Experimental farm of the Szent István Unviersity in Hatvan, Józsefmajor (BIRKÁS, 2010). We took our samples in the middle line of the plots. The long-term experiment was designed with 6 randomized striped treatments in four repetition. The treatments are: disking (10-15 cm), shallow tine tillage (15-20 cm), tine tillage (20-30 cm), ploughing (25-35 cm), loosening (30-45 cm) and direct drilling.

E4 / E6 values for humus quality were determined by three optical methods:

- based on the absorption of the soil extracts,
- analysis of reflectance spectra of soil samples under laboratory conditions by hyperspectral ASD FieldSpec ® 3 Max portable spectroradiometer
- based on analysis of georeferenced, atmospherically corrected raster image of the area provided by the Sentinel 2 satellite multispectral reflectance spectra of pixels.

The differences can also be seen in aerial views in RGB published by Google-Earth (Figure 1, left). On the picture which was taken on 01.16.2016, the for darkest strips showing the ploughed plots. The lighter colour of the other plots may be caused by the mulch on the surface. The different humus quality of the ploughed plots is shown in the figure depicting E4 / E6 reflection data calculated from the spectral data recorded with the Sentinel 2 satellite. The ploughed plots are characterized by lighter bars indicating that the lowest E4 / E6 values can be calculated there (Figure 1, right).

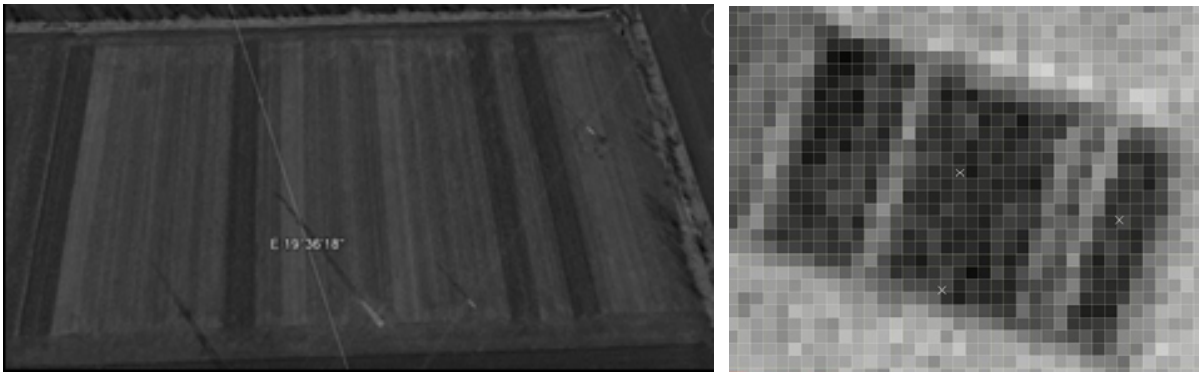

Figure 1..: Long-term soil tillage experiment in Józsefmajor, Hatvan.. Left: Google Earth imagery. Right: E4 / E6 values calculated from spectral data recorded by Sentinel 2 satellites.

As a result, we found a correlation between the reflectance spectra determined by two types of remote sensing methods and the calculated humus quality (E4 / E6) values determined with the help of absorbance analysis of the soil extracts.

References

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