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# Application of VNIR diffuse reflectance spectroscopy to estimate soil organic carbon content, and content of different forms of iron and manganese

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Visible and near-infrared (VNIR) diffuse reflectance spectroscopy is a progressive method used for prediction of soil properties. Study was performed on the soils from the agricultural land from the south Moravia municipality of Brumovice. Studied area is characterized by a relatively flat upper part, a tributary valley in the middle and a colluvial fan at the bottom. Haplic Chernozem reminded at the flat upper part of the area. Regosols were formed at steep parts of the valley. Colluvial Chernozem and Colluvial soils were formed at the bottom parts of the valley and at the bottom part of the studied field. The goal of the study was to evaluate relationship between soil spectra curves and organic matter content, and different forms iron and manganese content (Mehlich III extract, ammonium oxalate extract and dithionite–citrate extract). Samples (87) were taken from the topsoil within regular grid covering studied area. The soil spectra curves (of air dry soil and sieved using 2 mm sieve) were measured in the laboratory using spectometer FieldSpec®3 (350 – 2 500 nm). The Fe and Mn contents in different extract were measured using ICP-OES (with an iCAP 6500 Radial ICP Emission spectrometer; Thermo Scientific, UK) under standard analytical conditions. Partial least squares regression (PLSR) was used for modeling of the relationship between spectra and measured soil properties. Prediction ability was evaluated using the R2, root mean square error (RMSE) and normalized root mean square deviation (NRMSD).
The results showed the best prediction for Mn (R2 = 0.86, RMSE = 29, NRMSD = 0.11), Fe in ammonium oxalate extract (R2 = 0.82, RMSE = 171, NRMSD = 0.12) and organic matter content (R2 = 0.84, RMSE = 0.13, NRMSD = 0.09). The slightly worse prediction was obtained for Mn and Fe in citrate extract (R2 = 0.82, RMSE = 21, NRMSD = 0.10; R2 = 0.77, RMSE = 522, NRMSD = 0.23). Poor prediction was evaluated for Mn and Fe in Mehlich III extract (R2 = 0.43, RMSE = 13, NRMSD = 0.17; R2 = 0.39, RMSE = 13, NRMSD = 0.26). In general, the results confirmed that the measurement of soil spectral characteristics is a promising technology for a digital soil mapping and predicting studied soil properties.

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