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Diffuse Reflectance Fourier Transform Mid-Infrared Spectroscopy Associated with Peak Area Integration to Predict Soil Carbonate

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Abstract

Soil carbonate is a key component in agricultural soil influencing fertility and productivity. But its determination has need of using labour intensive and expensive traditional approaches. Diffuse reflectance infrared Fourier transform spectroscopy in mid-range (midDRIFTS) has with various degrees of success been used to determine different soil properties. This study evaluated the feasibility of using two different spectroscopic-based approaches, integrated peak area (IPA) & independent calibration (IC), to predict soil carbonate. The specific peak area (PA) as an indicator of soil carbonate and composition [e.g. 2515 cm^{-1} (calcite and dolomite), 730 cm^{-1} (dolomite) & 713 cm^{-1} (calcite)] obtained from midDRIFTS spectra were related to carbonate contents separately. Calibration model was also developed via independent calibration (IC) approach taking the whole midDRIFTS spectra. A total number of 126 soil samples (0–30 cm) across two contrasting agroecological regions [Kraichgau (K) and Swabian Alb (SA)], Germany were analysed for their carbonate using Scheibler's method and also scanned by midDRIFTS. The study resulted in a calibration model for carbonate prediction with high accuracy representing R^2=0.99. In terms of IPA approach, regression analysis between PA713 cm^{-1} and carbonate contents showed significant correlation with R^2 value of 0.98 while there was no significant correlation for PA2515 cm^{-1} and PA730 cm^{-1}. It was attributed to the error made by presence of dolomite in a few samples which is usually ignored during carbonate measurement by Scheibler's method. To conclude, midDRIFTS provide a rapid-throughput approach to predict soil carbonate without need of laboratory measurement. Specifically, the IPA approach for carbonate prediction resulted in a predictive equation as accurate as calibration model developed via IC approach. IPA approach is free of calibration and specifically recommended when the limited number of samples obstacle model calibration via IC approach. However for transfer of index, the approach should be tested beyond carbonate data range used in the current study and further investigations are required to differentiate carbonate composition (e.g. calcite and dolomite) to overcome Scheibler's method weakness in measuring dolomite.

Keywords: Soil analysis, soil propereties

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