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Soil exchangeable cations estimation using Vis-NIR spectroscopy in different depths: Effects of multiple calibration models and spiking

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Due to high rate of nutrient removal by cotton plants, the productive cotton-growing soils of Australia is becoming depleted of exchangeable (exch.) cations. For long-term development, data on exch. calcium (Ca), magnesium (Mg), potassium (K) and sodium (Na) throughout the soil profile is required. However, traditional laboratory analysis is tedious. The visible-near-infrared (Vis-NIR) spectroscopy is an alternative; whereby, spectral libraries are built which couple soil data and Vis-NIR spectra using models. While various models have been used to predict exch. cations, their performance was seldom systematically compared. Moreover, most previous studies have focused on prediction of topsoil (0–0.3 m) exch. cations while the effects of depth on applicability of topsoil spectral libraries are rarely investigated. Our first aim was to determine which model (i.e. partial least squares regression (PLSR), Cubist, random forest (RF), or support vector machine regression (SVMR)) produces the best prediction of topsoil exch. Ca, Mg, K and Na. The second aim was to evaluate if the best topsoil model can be used to predict subsurface (0.3–0.6 m) and subsoil (0.9–1.2 m) cations. The third aim was to explore the effect of spiking on the prediction in subsurface and subsoil. The fourth aim was to see if combining all depths to build a profile spectral library improved prediction. Based on independent validation, PLSR was superior for topsoil exch. cations prediction, while Cubist outperformed PLSR in some cases when spiking was applied, and the profile spectral library was considered. Topsoil PLSR could be applied to predict exch. Ca and Mg in the subsurface and subsoil, while spiking improved prediction. Moreover, a profile spectral library achieved equivalent results with when topsoil samples coupled with spiking were considered. We, therefore, recommended to predict exch. Ca and Mg throughout the profile using topsoil spectral library coupled with spiking approach.