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Optimising calibration of on-line visible (vis) and near infrared (NIR) sensor for measurement of key soil properties in vegetable crop fields

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Research in precision agriculture (PA) has provided technical improvements in the agriculture sector over the last decades, which led to increase in outputs in agriculture while maintaining crop quality and minimizing the environmental impacts. Proximal soil sensors are important part of this technology, which provide fast, high resolution and affordable data on multi-soil properties. The visible and infrared (vis-NIR) spectroscopy has been used as a promising technique for the on-line measurement of soil properties. The aim of this work is to implement the vis-NIR spectroscopy for the on-line measurement of key soil properties in fields with vegetable crops. Experience showed that the physico-chemical complexes of soils in vegetable crop production systems are different than those of arable crops. Therefore, the calibration process of the on-line vis-NIR sensor in these soil conditions will be evaluated in this study.

A mobile, fibre-type, vis-NIR spectrophotometer (AgroSpec, Tec5 Technology for Spectroscopy, Germany) with a measurement range of 305-2200 nm was used to measure soil organic carbon (OC), total nitrogen (TN), pH, phosphorus (P), sodium (Na), potassium (P), calcium (Ca) and magnesium (Mg) in 28.5 ha two Brassica spp. fields in UK, during 2013 season. A general calibration set of 111 soil samples were used to establish calibration models for the studied soil properties using partial least squares (PLS) regression analysis along with full cross validation. The model performances were evaluated by the root mean square error of perdition (RMSEP) and the ratio of prediction deviation (RPD), which is the ratio of the standard deviation to RMSEP. The accuracy of the models was classified as poor for K and Mg (RPD = 1.0–1.4); fair for TN, OC, Na and Ca (RPD = 1.4–1.8); and good for pH, MC and P (RPD = 1.8–2.0). Future improvements of the calibration models are being undertaken to consider the geographic scale of samples, with the aim to develop reliable vis-NIR calibration models for the on-line measurement of the listed key soil properties in vegetable crop fields.