Soil biological quality determination in agricultural soils using near infrared spectroscopy

Francisco Comino (1), Víctor Aranda (2), Roberto García-Ruiz (3), María José Ayora-Cañada (1), and Ana Domínguez-Vidal (1)

(1) Department of Physical and Analytical Chemistry, Universidad de Jaén, Spain (fcomino@ujaen.es), (2) Department of Geology, Soil Science Section, Universidad de Jaén, Spain, (3) Department of Animal and Plant Biology and Ecology, Ecology Section, Universidad de Jaén, Spain.

Quantification of soil quality is a very good mean to determine soil status and detect variations and alterations due, e.g., to management. But there is no unanimity about what parameters should be included in soil quality assessment because no single or combined biological or physicochemical variable is able to reflect the many interacting processes responsible for soil quality. However, soil properties based on biological and biochemical activities, such as soil enzymes, have shown to respond to small changes in soil conditions, thus providing information sensitive to subtle alterations in soil quality. However, measurement of theses variables is expensive and time consuming. In this study we explored the potential of reflectance near infrared (NIR) spectroscopy, a non-destructive technique, that needs a simple sample pretreatment (sieving and milling), which analysis is rapid, inexpensive and accurate, as an alternative to determine soil biological status. Four different agricultural soils (2xhaplic cambisol, haplic regosol and cutanic luvisol), each one under two different managements (conventional and organic) were used. Biological status was established by measuring soil enzyme activities related to nutrient cycling (acid phosphatase, alkaline phosphatase, β-glucosidase, arylsulfatase and dehydrogenase), and potential nitrification rate, and calculating the GMea index (geometric mean of six variables). Results shown that infrared spectroscopy is sensitive to soil biological status, able to discriminate between the different types of soil, which differ in biological quality (sensitivity and specificity >97%), and also between soil managements (sensitivity and specificity >75%). In addition, NIR spectroscopy predicted the biological GMea index (RPD $\approx$ 2) by means of partial least squares (PLS) regression. These results demonstrate the applicability of NIR as a fast and efficient technique for estimating biological soil quality, as well as for discriminating between soils with different biological status.