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Near infrared spectra are more sensitive to land use changes than physical, chemical and biological soil properties

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We studied the sensibility of the near infrared spectra (NIR) of soils to the changes caused by land use, and we compared with the sensibility of different sets of physical, chemical and biological soil properties. For this purpose, we selected three land uses, constituted by forest, almond trees orchards, and orchards abandoned between 10 and 15 years previously to sampling. Sampling was carried out in four different locations from the province of Alicante (SE Spain). We used discriminant analysis (DA) using different sets of soil properties. The different sets tested in this study using DA were: (1) physical and chemical properties (organic carbon, total nitrogen, available phosphorus, pH, electrical conductivity, cation exchange capacity, aggregate stability, water holding capacity, and available Ca, Mg, K and Na), (2) biochemical properties (microbial biomass carbon, basal respiration and urease, phosphatase and β-glucosidase activities), (3) phospholipids fatty acids (PLFAs), (4) physical, chemical and biochemical properties (all properties of the previous sets), and (5) the NIR spectra of soils (scores of the principal components).

In general, all sets of properties were sensible to land use. This was observed in the DAs by the separation (more or less clear) of samples in groups defined by land use (irrespective of site). The worst results were obtained using soil physical and chemical properties. The combination of physical, chemical and biological properties enhanced the separation of samples in groups, indicating higher sensibility. It is accepted than combination of properties of different nature is more effective to evaluate the soil quality. The microbial community structure (PLFAs) was highly sensible to the land use, grouping correctly the 100% of the samples according with the land use. The NIR spectra were also sensitive to land use. The scores of the first 5 components, which explained 99.97% of the variance, grouped correctly the 85% of the soil samples by land use, but were unable to group correctly the 100% of the samples. Surprisingly, when the scarce variance presents in components 5 to 40 was also used, the 100% of the samples were grouped by land use, as it was observed with PLFAs. But PLFAs analysis is expensive and time-consuming (some weeks). In contrast, only some minutes are needed for the obtainment of the NIR spectra. Additionally, no chemicals are need, decreasing the costs.

The NIR spectrum of a soil contains relevant information about physical, chemical and biochemical properties. NIR spectrum could be considered as an integrated vision of soil quality, and as consequence offers an integrated vision of perturbations. Thus, NIR spectroscopy could be used as tool to monitoring soil quality in large areas.

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