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Incorporation and measurement of synthetic nanosized iron oxides into soil profile for innovative agricultural applications

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Iron oxides are natural constituents of soils providing them different characteristics. That differentiation has been used as in fingerprinting studies to determine sources of sediment, especially at large scales. However, there is a lack of studies that use this approach at smaller scales using iron oxides differences because these differences, among zones, are difficult to establish. The incorporation to soil profile of synthetic nanosized iron oxides could increase and improve the detection of differences in iron oxide properties among zones at plot or hillslope scales, solving problems that arise when that objective have been pursued with magnetic tracers of millimeter scale (Ventura *et al*. 2002).

Magnetite (Fe_3O_4), hematite (α-Fe_2O_3) and goethite (FeOOH) can be commercially available as Bayferrox® 318M, 110 and 920 respectively, and traditionally used as pigments. Because of their properties, these iron oxides could fulfill all the requirements, defined by Zhang *et al*. 2001, for being sediment tracers.

This communication describes the whole process of incorporation into the soil profile and the determination of the concentration of these iron oxides into the soil and in the transported sediment in water erosion experiments, and their use to estimate soil losses, identifying erosion and deposition areas, and quantifying the contribution to exported sediment of different zones. Their characteristics allowed a relatively easy detection by measuring the magnetic susceptibility, in the case of magnetite, and spectral properties by diffuse reflectance spectroscopy for hematite and goethite. Laboratory and field magnetic measurement techniques were set up considering bulk density variations at the soil samplings. Hematite and goethite measurements were also calibrated for the study-site soil and for different magnetite, hematite and goethite concentrations. A comparison of the measured iron oxide concentrations and a multivariate mixing model (Rhoton *et al*. 2008), normally used in fingerprinting studies, was carried out obtaining promising results.

The results indicates that synthetic nanosized iron oxides affords quick, nondestructive and relatively inexpensive analysis and are useful tools as monitors of sediment dynamics.

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