New analytical technologies to tackle the biological and environmental implications of iron fertilization

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Fertilization with synthetic ferric chelates (xenobiotic compounds) is a common and very expensive method to correct iron deficiency in plants. Several key processes relevant to Fe-fertilization efficiency under field conditions are still poorly known, including i) the real plant mechanisms for Fe uptake from fertilizers, ii) the fraction of Fe applied that enters the plant, iii) the chemical forms entering the plant and being transported at short and long distance, iv) the fraction of Fe taken up which plants are able to use in their metabolism. For instance, if the synthetic chelate-Fe form enters the plant as some authors have indicated, their distribution and half-life within the plant should be known. Also, the mobility, distribution and persistence of these xenobiotics in the environment are under scrutiny because of their potential influence on metal availability. Studies have been limited until now by the selectivity and sensitivity of the analytical techniques used to determine Fe fertilizers in environmental matrices (e.g. plant tissues and fluids), as well as to the difficulties to distinguish the Fe applied from that present in the system. This presentation reviews modern analytical techniques that can be used with that purpose, and proposes a new highly selective and sensitive method, using high performance liquid chromatography – electrospray/time of flight mass spectrometry (HPLC-MS(ESI/TOF), capable to determine simultaneously many synthetic Fe chelates, including Fe-EDTA, Fe-HEDTA, Fe-DTPA, Fe-CDTA, Fe-*o*,*o*EDDHA, Fe-*o*,*p*EDDHA, Fe-EDDHMA, Fe-EDDCHA and Fe-EDDHSA. Limits of detection (LOD) were between 0.14 and 3.30 μM for the different Fe-chelates. Recovery of exogenously added Fe-chelates was higher than 70% for all compounds in the environmental matrices tested (irrigation water, soil solution, nutrient solution and peach xylem). Finally, the application of the method to analyze commercial formulations of fertilizers and tissues of plants treated with Fe-*o*,*o*EDDHA are presented.

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