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Nanosiderite is effective to alleviate iron chlorosis in sensitive plants growing on calcareous soils

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Nanosized siderite ($FeCO_3$) prepared by mixing $FeSO_4$ and K_2CO_3 solutions [either alone or in presence of phosphate (siderites SID and SIDP, respectively)] was used in our experiments. The products of oxidation of siderite in a calcite suspension were goethite or a mixture of goethite and lepidocrocite when phosphate was present. These iron oxides were nanosized and acid NH_4oxalate-soluble, which suggested they could be a good source of iron (Fe) for plants sensitive to Fe deficiency yellowing (chlorosis).

To evaluate the effectiveness and long-term effects of suspensions of siderite mixed with calcareous soil to prevent Fe chlorosis, a pot growth experiment was carried out with five consecutive crops: chickpea (twice), peanut (twice) and strawberry. Suspensions of siderites (SID and SIDP) were mixed with 220 g of soil at the beginning of the experiment at rates of 0.24, 0.46, 0.93 and 1.40 g siderite (0.12, 0.22, 0.45, and 0.67 g Fe) kg^{-1} soil. A control (no Fe added) and a positive control (Fe-chelate as FeEDDHA before each cropping) were included. The concentration of chlorophyll in the youngest leaves was estimated three times for chickpea and peanut, and five times for strawberry via the SPAD value (SPAD 502 portable chlorophyll meter).

The SPAD for the control plants was lower than that for Fe-fertilized plants. For all crops, times and siderite types, SPAD tended to systematically increase with increasing siderite dose, and SID and SIDP had similar effectiveness. At harvest, the SPAD for the plants fertilized with the highest siderite dose (1.40 g kg^{-1}) did not differ significantly from that for FeEDDHA-fertilized plants.

Our results suggest in summary that siderite is effective in preventing iron chlorosis and has a long-lasting effect, as the likely result of the high specific surface and high solubility of the crystalline Fe oxides resulting from its oxidation. Futhermore, siderite is readily prepared in the field, not easily leached from the soil and environmentally safe, thus constituting a good Fe fertilizer.

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