

Effect of Manganese Sources on Plant Manganese in Calcareous Soils

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ABSTRACT

ABADÍA J., L. MONTAÑÉS and L. HERAS, 1981. — Effect of Manganese Sources on Plant Manganese in Calcareous Soils, *An. Aula Dei*: **15** (3/4): 412-416.

The effects of two sources of Mn (MnSO_4 and Mn-DTPA) at several rates on the Mn content of plants growing on calcareous soils were studied.

Up to 200 ppm of added Mn, the Mn content depends only on the Mn rate, and not on the Mn source. Thus, a close relationship between the «easily reducible form» and the plant uptake is suggested.

The effectiveness of Mn chelates in calcareous soils remains as yet unclear. Their low stability, specially at high pH, was shown in experiments with soil suspensions (NORVELL and LINDSAY, 1972). However, several researchers have pointed out that Mn chelates are superior to other compounds in increasing the plant Mn concentration (BOXMA and DE GROOT, 1971; OSMAN, EL-SHERIF and BASSIOUNY, 1978). ABADÍA (1981) reported that in calcareous soils Mn-DTPA is more effective than manganese sulphate for maintaining Mn in exchangeable and DTPA-soluble forms, but both compounds maintain in an «easily reducible» form ($\text{HCl} \cdot \text{NH}_2\text{OH}$ -soluble) similar quantities of Mn. The objective of this research is to study the plant response to different Mn sources. Two plant species were grown on five calcareous soils with different rates of Mn, as MnSO_4 or Mn-DTPA.

Some characteristics of the soils used are presented in Table 1. All the soils were calcareous, and they were chosen among those presenting the lowest Mn available levels in the Ebro Valley (Spain).

Soils were crushed to pass a 2 mm sieve and were potted in 1 kg plastic containers. Subsequently Mn (as MnSO_4 or Mn-DTPA) was applied in solution. A Mn-DTPA solution was prepared by dissolving equimolar quantities of MnSO_4 and DTPA. The applied rates of Mn varied from 50 to 400 ppm (oven-dry soil basis) for Mn-DTPA, and from 75 to 900 ppm for Mn as sulphate. All treatments were replica-

TABLE 1.— *Soil properties.*

Soil n. °	CaCO_3 %	Organic Matter %	Clay %	Gypsum %	pH (H_2O)
1	37,1	2,0	34	9	8,2
2	36,0	2,0	20	—	8,1
3	31,0	1,5	n.d.	45	7,8
4	35,4	1,7	26	—	8,3
5	44,4	2,8	40	—	8,1

n.d.: not determined.

ted three times. Distilled water was added to pots in order to reach the water holding capacity. Ryegrass (*Lolium perenne* L. cv. Westerswald) and alfalfa (*Medicago sativa* L. cv. Aragón) seeds were planted in the pots 24 hours after fertilizer application. A nutritive solution was applied weekly. Among other elements this solution included Cu and Zn, due to the fact that the influence of the Mn-DTPA addition on the available levels of these nutrients has been previously stated (ABADÍA, 1981). The pots were maintained close to water holding capacity during the experiment.

Ryegrass and alfalfa were harvested after 5 and 7 weeks respectively. They were oven-dried and dry-ashed (A.O.A.C., 1980). Mn determination was carried out in the HCl extracts by atomic absorption spectrometry.

The effect of Mn application on plant Mn content is shown in figure 1. The Mn contents without Mn addition in ryegrass (31-54 ppm in dry-weight basis) and alfalfa (50-92 ppm) were in the normal range (COTTENIE *et al.*, 1979; BENTON-JONES, 1967). The highest rates of both products increased the plant Mn concentration to excessive values (SULLIVAN, 1972), giving toxicity symptoms and killing the young plants. However, the toxicity is also related to the addition of DTPA, and the growth of alfalfa is restricted for applications of more than 200 ppm of Mn as Mn-DTPA.

The relationship between plant Mn and the amount of the compound applied may be described in linear terms up to an addition of 200 ppm of Mn. Within this range plant Mn depends only on the Mn rate, and not on the Mn source. The highest dose of both compounds, and specially of Mn-DTPA in ryegrass, cause great increases in plant Mn, higher than should be expected when using a linear plot based on the first pairs of values.

Assuming that only Mn in easily reducible form does not depend on Mn compound (ABADÍA, 1981), it seems that this Mn form is in relation with the plant uptake of Mn, in good agreement with the results of SALCEDO *et al.* (1979), and GODO and REISENAUER (1980).

The rates of utilization were very low in all cases (1% of Mn applied). Therefore, if any deficiency is detected, high Mn doses may be necessary, irrespective of Mn source. This fact may explain the lack of response shown by some researchers (SHUMAN *et al.*, 1979), who utilize low quantities of Mn chelate.

R E S U M E N

Se ha estudiado el efecto de diferentes dosis de dos fuentes de Mn (MnSO_4 y Mn-DTPA) sobre el contenido de dicho elemento en plantas cultivadas sobre suelos calizos.

En un rango de 50 a 200 ppm de Mn añadido, el contenido de Mn en planta no depende del tipo de producto, sino de la dosis aplicada. Esto hace suponer que existe una estrecha relación entre la fracción fácilmente reducible y la tomada por la planta.

R E F E R E N C E S

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