

MANGANESE FACTSHEET

December 2003

MANGANESE IN SOILS

The total amount of manganese (Mn) in soils is typically around 0.25%, and is normally in the range of 0.02 - 1%. It can be as high as 13% in some volcanic soils. Manganese is present in greater quantities than other trace elements, with the exception of iron. Its concentration typically exceeds that of macronutrients such as phosphorus and sulfur, and often that of nitrogen. Consequently, where plant deficiencies occur, it is not because the soil is low in total manganese, but because most of it is present in forms which are not available for plant uptake.

Plants take up manganese as Mn^{2+} from the soil solution. It is fairly mobile in the soil and can be leached, particularly on acid podsollic soils.

Manganese deficiency occurs in plants grown in alkaline soils, but is not common elsewhere. Toxicity occurs on very acid and poorly drained soils. Exchangeable manganese levels in the soil can fluctuate, depending on seasonal conditions. Temporary excessive levels may occur if the soil becomes water-logged. Factors which affect manganese availability include :-

Soil pH - Soil Mn^{2+} concentrations decrease as the pH increases. At high soil pH_w (over 7.5), manganese availability may not be adequate to meet plant demand. At low pH_w levels (less than 5.5), manganese becomes very soluble, and manganese toxicity may occur. Toxicity is usually associated with other acid soil infertility problems such as aluminium toxicity and deficiencies of calcium, magnesium and molybdenum.

Soil Organic Matter - Soils with high pH and high organic matter are prone to manganese deficiency. As soil pH increases, complexes between divalent manganese ions and organic matter form, reducing the amount of plant-available Mn^{2+} . Cultivation will increase the availability of manganese in the soil, by accelerating the decomposition of soil organic matter.

Soil Moisture - Under water-logged conditions, manganese oxide can be reduced by soil bacteria to Mn^{2+} . This may cause soil manganese levels to become potentially toxic. Under very dry conditions, insoluble dehydrated manganese salts can form in the soil, reducing the availability of manganese.

Cold wet weather sometimes induces deficiency, possibly attributable to the combined effects of reduced mineralization of soil organic matter, and reduced root growth and reduced metabolic activity in roots affecting manganese uptake.

MANGANESE IN PLANTS

Once taken up and incorporated into plant tissue, manganese is relatively immobile in the plant, i.e. it is not readily relocated from old to young tissue. High concentrations of other cations in the soil solution, e.g. calcium, zinc, magnesium and ammonium, may reduce manganese uptake by plants. On the other hand, manganese may depress the uptake of other cations such as iron, e.g. in pineapples and ginger, resulting in iron deficiency.

DEFICIENCY SYMPTOMS

Manganese deficiency symptoms, which first appear in young leaves, closely resemble those of magnesium. In both cases, interveinal chlorosis (yellowing) occurs in the leaves, although with magnesium deficiency, the older leaves are first affected.

In cereals and grasses, greyish or brownish spots and streaks occur in the middle or basal parts of younger leaves. These necrotic spots may merge into a band across the leaf isolating the still green end portion of the leaf.



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Manganese deficiency symptoms in broad-leaf plants (dicotyledons) occur as small yellow spots on the younger leaves, which turn brown or black. The abscission of developing leaves commonly occurs and flower formation is reduced.

In tree crops, deficiency symptoms usually appear in early summer growth on recently matured leaves, as opposed to very young leaves in the case of iron deficiency, or old leaves in the case of magnesium and potassium deficiency. Leaf shape and size, and shoot length are usually normal, symptoms being worse on the southern or shady side of trees (in the southern hemisphere).

TOXICITY SYMPTOMS

Manganese toxicity is characterised by raised interveinal areas giving a puckered appearance, red, brown or black spotting of the older leaves and an uneven distribution of chlorophyll. If the toxicity continues, the plants will wilt and die prematurely. Plants particularly susceptible to manganese toxicity are lucerne, cabbage, cauliflower, cereals, clover, pineapple, potato and tomato.

MANGANESE FERTILIZERS

The only solid manganese fertilizer marketed by Incitec Pivot Limited is **Granular Manganese Sulfate**. It is applied dry to the soil, either on its own or in blends. It is not fully soluble and is therefore unsuitable for use in sprays.

Manganese can be applied in solution (dissolved in water) to the soil or foliage as manganese sulfate or manganese chelate. The chelated forms are less subject to fixation in the soil, but are more costly. The use of manganese based fungicides such as maneb and mancozeb, e.g. Dithane M45, will often supply sufficient manganese to correct deficiency.

APPLICATION

In most crops, foliar sprays are recommended, as soil-applied manganese can be rapidly fixed or converted to plant-unavailable forms. Compared to broadcast applications, band applications with or near the seed at planting are likely to be more effective, and allow lower rates to be used.

Foliar sprays are normally recommended in horticultural crops. In tree crops, an annual spray in spring, as soon as there is a good cover of new leaves, is usually sufficient for maintenance. If the deficiency is severe more than one spray may be required.

FURTHER READING - An Agritopic is available on Manganese if more detailed information is required.

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