MANGANESE

FACT SHEET
April 2017

MANGANESE IN SOILS

Manganese (Mn) is present in the soil 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 that are not available for plant uptake. The total amount of manganese 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.

Plants take up manganese from the soil as the divalent manganese ion Mn^{2+}. Factors which affect manganese availability include:

Soil pH – Manganese availability decreases as the pH increases. Above a pH_w of 7.5, manganese availability may not be adequate to meet plant demand. At pH_w levels below 5.5, manganese becomes very soluble and 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 – Complexes form between manganese ions and organic matter in alkaline soils that are high in organic matter, reducing the amount of plant-available Mn^{2+}.

Soil Disturbance - Cultivation will increase the availability of manganese in the soil, by accelerating the decomposition of soil organic matter.

The Weather - Exchangeable manganese levels in the soil can fluctuate depending on seasonal conditions. Cold wet conditions sometimes induce deficiency, possibly attributable to the combined effects off reduced mineralization of soil organic matter, and reduced root growth and reduced metabolic activity in roots affecting manganese uptake.

Soil Moisture - Under water-logged conditions, insoluble manganese oxide can be reduced by soil bacteria to Mn^{2+}. This may result in temporary toxicity.

Under very dry conditions, insoluble dehydrated manganese salts can form in the soil, reducing the availability of manganese.

MANGANESE IN PLANTS

Once taken up and incorporated into plant tissue, manganese is relatively immobile in the plant. 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.

Manganese deficiency occurs in plants grown in alkaline soils but is not common elsewhere.

Toxicity occurs on very acid, poorly drained and water-logged soils.

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.

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.

APPLICATION

Soil applied manganese can be rapidly fixed or converted to forms plant that are unavailable for plant uptake. For this reason, foliar sprays are generally recommended.

One of the few situations where soil applications are used is at planting in grain crops on calcareous soils in South Australia. Banding the manganese with the seed is more effective than pre-plant broadcast applications. It exposes the manganese to less soil, reduces fixation and allows lower rates to be used.

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

Manganese will not need to be applied in fertiliser programs where manganese based fungicides such as Maneb and Mancozeb, e.g. Dithane M45, are applied on a routine basis in horticultural crops.

MANGANESE FERTILISERS

Incitec Pivot Fertilisers markets a Granular grade of Manganese Sulfate for dry application to the soil. It is primarily intended for use in planting fertilisers for grain crops in in soils derived from limestone in South Australia. Its effectiveness elsewhere is likely to be limited, e.g. soil application in tree crops.

Soluble grades of manganese sulfate and manganese chelate may be applied in solution, e.g. foliar sprays. The chelates are less subject to fixation in the soil, but are more costly.