FACT SHEET

January 2022

MANGANESE

MANGANESE IN SOILS

Manganese (Mn) is the second most abundant trace element after iron in the earth's crust. Its concentration typically exceeds that of macronutrients such as phosphorus and sulphur and often that of nitrogen. Consequently, where plant deficiencies occur on soils with adequate/ high total manganese, it is because most of the Mn 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+}. Several factors affect manganese availability.

Soil pH

Manganese availability decreases as the pH increases. Above a pH_{water} of 7.5, manganese availability may not be adequate to meet plant demand. At pH_{water} 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 $Mn2^{+}$.

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 $Mn2^{+}$. 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. Conversely, 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 appear first in young leaves. Symptoms closely resemble those of magnesium. In both cases, interveinal chlorosis (yellowing) occurs in the leaves. However, magnesium deficiency appears first on older leaves. 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, leading to reduced flower formation. In tree crops, deficiency symptoms usually appear on recently matured leaves during early summer growth. This is different to the development on 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 but symptoms are generally greater 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, annual foliar applications in spring or 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 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. Chelate formulations are subject to less soil fixation but are more costly.

Incitec Pivot Fertilisers (a business of Incitec Pivot Ltd ABN 42 004 080 264)

28 Freshwater Place

Southbank Vic 3006

Freecall 1800 009 832

www.incitecpivotfertilisers.com.au