FACT SHEET

April 2022

MOLYBDENUM

MOLYBDENUM IN SOILS

Molybdenum (Mo) is the least abundant of the trace elements in soils, and very little is present in forms that are available for plant root uptake. Sandy soils are typically low in molybdenum, as too are infertile soils that are inherently low in other nutrients such as phosphorus in their natural state. Peats tend to be high in molybdenum.

Plants take up molybdenum from the soil as the molybdate (MoO_4^{2-}) ion. It's availability in the soil is influenced by the pH, being most available in neutral to alkaline soils, and least available in acid soils with a pH_w below 6.0. The presence of iron and aluminium oxides greatly reduces the availability of molybdenum. Molybdate is moderately strongly sorbed or attached to clay and organic colloids in the soil. Therefore, it not readily leached. Of the anions (negatively charged ions) which are of importance as plant nutrients, molybdate is second behind phosphate in this respect, and much more strongly sorbed (resistant to leaching) than nitrate or chloride. The first report of the importance of molybdenum as an essential plant nutrient came from Australia in 1942 when A J Anderson reported responses in sub clover.

MOLYBDENUM IN PLANTS

Of all the essential micronutrients or trace elements, molybdenum (Mo) is required in the smallest amount by plants. Molybdenum is mobile in plants and moves freely from older to younger tissue. Many large seeded annual plants (especially legumes) contain sufficient molybdenum to last the crop, if the seed came from plants which were adequately supplied with molybdenum.

Molybdenum is important in nitrogen metabolism, and the synthesis of protein. Two important processes in which it is involved are:

- The reduction of nitrate (NO_3^-) to nitrite (NO_2^-), the first step in the synthesis of amino acids and protein.
- In root nodules in legumes, *Rhizobium* bacteria require molybdenum to fix atmospheric or molecular nitrogen (N_2).

Symbiotic bacteria require about ten times more molybdenum for nitrogen fixation than does the host plant (for protein synthesis). Hence, molybdenum deficiency commonly occurs in legumes before it does in other plants when grown in the same soil. In non-legume plants, cruciferous crops (particularly cabbage and cauliflower) and cucurbits have a high molybdenum demand. Grasses are relatively tolerant of low molybdenum, and deficiency in cereals only occurs in extreme conditions. Molybdenum toxicity in plants is rare. Compared to other micronutrients, molybdenum can be taken up in concentrations many times that regarded as necessary for optimal plant growth without toxic effects. Livestock may be affected when the pasture is not. High molybdenum can induce copper deficiency in grazing animals.

DEFICIENCY SYMPTOMS

Molybdenum deficiency occurs most commonly in legume-based pastures and in various vegetable crops on sands and podzolic soils derived from sedimentary rocks in the southwest of Western Australia, parts of South Australia, Victoria and Tasmania, the coast and tablelands of New South Wales and coastal areas in Queensland.

Deficiency symptoms vary between legume and non-legume plants:

In legumes, a lack of molybdenum prevents proper nodulation and fixation of molecular nitrogen (N_2) by symbiotic *Rhizobium* bacteria. Symptoms of nitrogen deficiency (stunted growth and yellowing of the leaves, starting with the older leaves) are displayed by the plant, e.g., clover. These symptoms can be relieved by applying nitrogen fertiliser (although this would not normally be the recommended treatment). Growth is stunted and nodulation is poor. The root nodules are green or colourless, not the typical healthy pink colour.

In non-legume plants, symptoms specific to molybdenum deficiency occur, e.g., “Whip tail” of cauliflower; although plants suffer essentially from a shortage of protein, due to the failure to convert nitrate (NO_3^-) to amino acids. Nitrates can accumulate in the plant. In contrast to legumes, the symptoms of molybdenum deficiency in non-legume crops cannot be corrected by applying nitrogen fertiliser, but only by adding molybdenum. In fact, the addition of extra nitrogen may make the symptoms worse.

MOLYBDENUM FERTILISERS

Because molybdenum is required in such minute amounts, it is necessary to apply it with a carrier, e.g., fertiliser, seed, or water, to help provide as uniform coverage as possible. Molybdenum can be applied to the soil or the foliage. As molybdenum is sorbed in the soil and not readily leached, soil applications can remain effective for several years.

In legume-based pastures, molybdenum is typically applied once every 3 to 4 years at a rate of 50 to 100 g/ha Mo. Molybdenum fortified grades of Single Superphosphate, e.g., SuPerfect Mo 0.025%, are available for this purpose. Molybdenum can also be incorporated into seed coatings, as Molybdenum Trioxide, when establishing or over-sowing pasture.

Water soluble molybdenum fertilisers that can be sprayed onto the soil or foliage are sodium molybdate or ammonium molybdate. Foliar sprays ensure uniform coverage and are popular in vegetable crops. As molybdenum is mobile in plants, one or two early season sprays, either to the transplants while still in the seedbed and/or after planting in the field, is normally all that is required.

DISCLAIMER

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

28 Freshwater Place

Southbank Vic 3006

Free call 1800 009 832

www.incitecpivotfertilisers.com.au