

# MOLYBDENUM FACTSHEET

December 2003

## 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 to plants. Sandy soils, and those which are inherently infertile in their natural state, e.g. soils low in phosphorus, are typically low in molybdenum. Peats tend to be high in molybdenum. Availability in the soil is influenced by the pH. Acid soils, i.e.  $\text{pH}_w$  less than 6.0, and the presence of iron and aluminium oxides greatly reduce the availability of molybdenum.

Molybdate is quite strongly sorbed, or attached to clay particles or organic matter in soils, and is therefore 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.

## MOLYBDENUM IN PLANTS

Of all the essential micronutrients or trace elements, molybdenum (Mo) is required in the smallest amount by plants. Plant uptake of molybdenum is as the molybdate ( $\text{MoO}_4^{2-}$ ) ion.

Molybdenum is moderately mobile in plants and can be moved quite freely from older to younger tissue. Many large seeded annual plants (especially legumes) contain sufficient molybdenum to last the crop, as long as 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 ( $\text{NO}_3^-$ ) to nitrite ( $\text{NO}_2^-$ ), 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 ( $\text{N}_2$ ).

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 most commonly occurs in legume-based pastures and in various vegetable crops on sands and podsollic soils derived from sedimentary rocks in the south-west 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 ( $\text{N}_2$ ), by symbiotic *Rhizobium* bacteria. Symptoms of nitrogen deficiency are displayed by the plant, e.g. sub-clover. These symptoms can be relieved by applying nitrogen fertilizer (although this would not normally be the



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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 ( $\text{NO}_3^-$ ) 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 fertilizer, but only by adding molybdenum. In fact, the addition of extra nitrogen may make the symptoms worse.

## **MOLYBDENUM FERTILIZERS**

Because molybdenum is required in such minute amounts, it is necessary to apply it with a carrier, e.g. fertilizer, seed, or water, to achieve uniform coverage. Molybdenum can be applied to the soil or the foliage. Foliar sprays are popular in vegetable crops. As molybdenum is mobile in plants, one or two early season sprays, e.g. to transplants while still in the seedbed, and/or after planting in the field, is normally all that is required.

Commonly used molybdenum fertilizers are:-

**Molybdenum Fortified Superphosphate** is commonly used in legume-based pastures to supply of phosphorus, sulfur and molybdenum simultaneously. Molybdenum only needs to be applied to pasture once every 3 to 4 years, typically at a rate of 50 to 100 g/ha Mo.

**Molybdenum Trioxide** is used as a seed dressing for grass and/or legume seeds when establishing or over-sowing pasture.

**Sodium molybdate** or **ammonium molybdate** are water-soluble and can be applied in solution, either as foliar sprays or through a boom-spray to the soil.

Incitec Pivot Limited does not market molybdenum trioxide, sodium molybdate or ammonium molybdate.

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

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