Molybdenum Fertility in Crop Production

Function in Plants

- Molybdenum is a micronutrient required in very small amounts for plant growth.
- Molybdenum is a component of the enzyme nitrogen reductase which regulates the nitrogen reduction process in plants. This process involves the conversion of nitrate (NO₃⁻) to the amino form (-NH₂) to build proteins.
- In legumes, such as alfalfa and soybean, molybdenum is also a component of nitrogenase, an enzyme needed for nitrogen fixation.

Deficiency Symptoms

- Since molybdenum is essential for nitrogen metabolism, a deficiency of molybdenum will manifest in plants as nitrogen deficiency, with leaves that are light green or yellow.
- Leaves may yellow, cup or roll, have scorching in leaf margins, and older leaves can become chlorotic.
- Molybdenum is mobile in plants so deficiency symptoms can appear over the entire plant, often appearing first on the oldest leaves.

Crop Requirements

- Most crops require less than 1.0 ppm of molybdenum. Of the 17 essential nutrients, molybdenum and nickel are needed in the smallest quantities.
- Leguminous crops such as alfalfa and soybean require more molybdenum than grasses and other non-legumes.
- Molybdenum deficiency is very rare in corn.
- Molybdenum deficiency can occur in soybean in acidic and highly-weathered soils, and can result in significant yield reductions.

Availability in Soil

- Molybdenum is taken up by plants in the anion form molybdate (MoO₄²⁻).
- Molybdate is released from the weathering of soil minerals.
- Soils typically contain between 0.25 and 5.0 ppm total molybdenum.
- Molybdenum is the only plant micronutrient that becomes more available as pH increases (Figure 1). Solubility increases 100x for every point increase in pH.

Molybdenum Fertilization

- In most soils, liming to increase the soil pH can increase the concentration of available molybdate and eliminate deficiencies, making liming the best molybdenum fertility strategy in most cases.
- In soils where liming is not practical and molybdenum concentrations are low, molybdenum fertilizers can be applied.
  - Sodium molybdate is the most common form of molybdenum fertilizer. It can be banded or broadcast on the soil, applied with a foliar treatment, or incorporated in a seed treatment (Table 1).
  - Soluble molybdenum sources, ammonium molybdate and sodium molybdate, are suitable for foliar application and are typically applied at a rate of 2-3 oz/acre.
  - Seed treatments that include molybdenum fertilizer are frequently used in areas with molybdenum deficiencies. A rate of 0.5 oz/acre is usually adequate.

<table>
<thead>
<tr>
<th>Source</th>
<th>Formula</th>
<th>Mo (%)</th>
<th>Solubility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium molybdate</td>
<td>(NH₄)₆Mo₇O₂₄•2H₂O</td>
<td>54</td>
<td>400 g/L</td>
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<tr>
<td>Molybdenum trioxide</td>
<td>MoO₃</td>
<td>66</td>
<td>3 g/L</td>
</tr>
<tr>
<td>Sodium molybdate</td>
<td>Na₂MoO₄•2H₂O</td>
<td>39</td>
<td>653 g/L</td>
</tr>
</tbody>
</table>

Table 1. Fertilizer sources of molybdenum.

- Soybean yield responses to molybdenum fertilizer have been documented in soils with pH between 5.6 and 6.0 (Rasnake, 1982).
- At soil pH levels below 5.5, molybdenum fertilizers may not be effective.

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