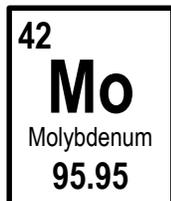


## Molybdenum Fertility in Crop Production

### 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 ( $\text{NO}_3$ ) to the amino form ( $-\text{NH}_2$ ) to build proteins.
- In legumes, such as alfalfa and soybean, molybdenum is also a component of nitrogenase, an enzyme needed for nitrogen fixation.

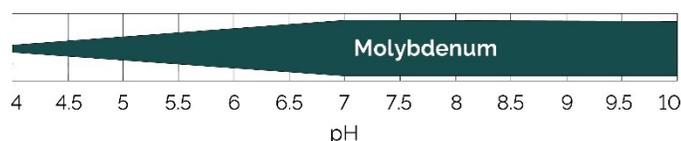
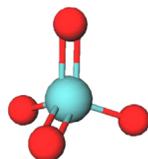
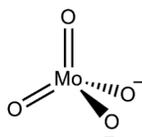


### Crop Requirements

- 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 ( $\text{MoO}_4^{2-}$ ).
- 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.



**Figure 1.** Relative availability of molybdenum by soil pH.

- Deficiencies rarely occur in soils with a pH greater than 6.2.
- High concentrations of sulfate in the soil can limit molybdenum availability, as sulfate ( $\text{SO}_4$ ) and molybdate ( $\text{MoO}_4^{2-}$ ) compete for root uptake sites.
- Addition of phosphate can promote plant uptake of molybdenum by causing molybdate adsorbed to soil solids to be released.

### 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.

### 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 1.** Fertilizer sources of molybdenum.

Source	Formula	Mo (%)	Solubility
Ammonium molybdate	$(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 2\text{H}_2\text{O}$	54	400 g/L
Molybdenum trioxide	$\text{MoO}_3$	66	3 g/L
Sodium molybdate	$\text{Na}_2\text{MoO}_4\cdot 2\text{H}_2\text{O}$	39	653 g/L

- 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.

Authors: Samantha Reicks and Mark Jeschke  
August 2017

IPNI. 2014. Molybdenum. Nutrifacts No. 13. International Plant Nutrition Institute.  
Rasnake, M. 1982. Use of molybdenum for soybean production. Soil Science News and Views. Vol. 3 No. 4. Univ. of Kentucky Extension.  
Sawyer, J. 2012. Nutrient deficiencies and application injuries in field crops. IPM42. Iowa State Univ. Extension.  
Schulte, E.E. 1992. Understanding plant nutrients: Soil and applied molybdenum. A3555. Univ. of Wisconsin Extension.

The foregoing is provided for informational use only. Please contact your Pioneer sales professional for information and suggestions specific to your operation. Product performance is variable and depends on many factors such as moisture and heat stress, soil type, management practices and environmental stress as well as disease and pest pressures. Individual results may vary.