Boron and Molybdenum— Critical Plant Levels in Forage Legumes

By Umesh C. Gupta

Boron (B) and molybdenum (Mo) are important micronutrients for forage legumes in the northeastern region of Canada and the U.S. Soils of the region are subject to intensive leaching, leading to frequent crop deficiencies of these nutrients.

BORON AND Mo are probably more important than any other micronutrient for the production of forage legumes in the northeastern region of Canada and areas of the northeastern U.S. Available forms of these nutrients exist in the soil as anions. Because precipitation in the region is normally high, both nutrients are subject to intensive leaching. Crops are frequently deficient, particularly on sandy soils.

Boron Deficiency and Toxicity Symptoms and Levels

Boron deficiency symptoms generally appear on younger plant parts since B is relatively immobile in the plant. In alfalfa and clover, B deficiency symptoms appear in a variety of colors. **Figure 1** shows symptoms of yellowish-red colored young leaves in alfalfa. In Persian clover, the symptoms appear as bright pinkish-red colored leaves.

Boron toxicity symptoms are confined to the older leaves and appear as burning and/or browning of the edges of the leaves, as shown for alfalfa in **Figure 2**. When normal application rates of 1 to 2 lb B/A are used, there is no danger of B toxicity.

Boron deficiency and toxicity levels in forage legumes are generally associated with less than 20 and more than 60 parts per million (ppm) B, respectively, in the vegetative tops at 10 percent bloom (**Table 1**). Plant B concentrations of 20 to 50 ppm are considered to be optimum for the growth of forage legumes.

Molybdenum Deficiency Symptoms and Levels in Plants

Molybdenum deficiency in forage legumes appears as a general yellowing of the whole plant and is associated with

Figure 1. Yellowish-red colored young leaves indicate B deficiency in alfalfa.

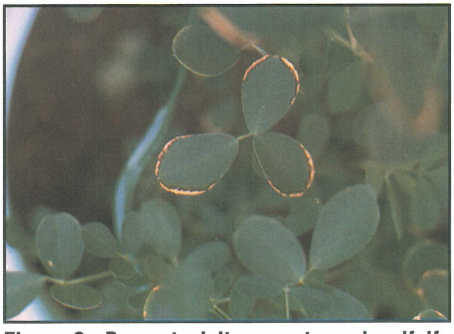

Figure 2. Boron toxicity symptoms in alfalfa appear on older leaves.

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Table 1. Deficient, sufficient and toxic plant B concentrations in forage legumes.

	B concentration, ppm		
Crop	Deficient	Sufficient	Toxic
Alfalfa	20	20-50	100
Red Clover	20	20-50	60
Birdsfoot Trefoil	15	30-40	70

Table 2. Deficient, sufficient and toxic plant Mo concentrations in forage legumes.

	Mo concentration, ppm		
Crop	Deficient	Sufficient	Toxic
Alfalfa	0.2	0.2-2	5-10[1]
Red Clover	0.2	0.2-2	5-10[1]

[1]Toxic to livestock but not to the plant itself.

reduced yields. Deficiency of Mo prevents utilization of nitrogen (N) by plants . . . the conversion of nitrates to ammonium, amides and proteins. For this reason, Mo deficiency symptoms resemble those of N deficiency. Molybdenum deficiency also interferes with the activity of the N-fixing Rhizobium bacteria by reducing the number of nodules formed and the amount of N fixed in them. **Figure 3** compares forage growth in a Mo deficient clover field (left side) to a healthy clover crop (right side) which received Mo fertilization.

Plant requirements for Mo are lower than those of the other essential micronutrients. Plant Mo deficiency generally occurs when forage legume plants contain less than 0.2 ppm, while sufficiency levels often range from 0.2 to 2.0 ppm Mo (**Table 2**).

Forage concentrations of Mo can increase to levels which are toxic to livestock without the plants exhibiting toxicity symptoms. Forage producers should be aware of this, particularly when fertilizing forage legumes with Mo.

The relationship of liming to plant available Mo is critical. Soil pH greatly influences the availability of Mo to crops. Unlike the other micronutrients which become less available as soil pH rises, Mo becomes more available when soil pH increases. Liming the soil to pH 6.5 can alleviate the Mo deficiency on most soils. However, sandy soils with low total soil Mo may require some Mo fertilization of crops such as clovers and Brassicas (such as kale, fodder rape, and canola) in addition to liming. **Figure 4** shows Mo deficiency in Brussels sprouts.

Summary

To overcome B deficiency in established stands of forage legumes, soil application of 2 lb B/A in alternate years is recommended. For foliar sprays, the recommended rate is 0.5 to 1 lb B/A. Annual application rates of 2 to 4 ounces Mo per acre are recommended as a foliar spray to provide sufficient Mo for forage legume production, particularly for soils below pH 6.0. ■

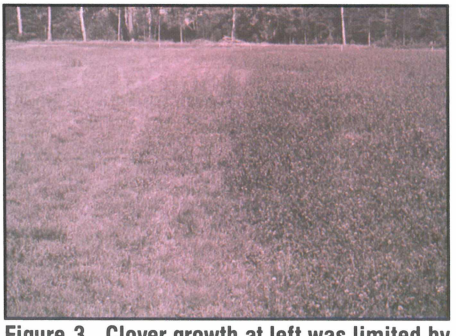

Figure 3. Clover growth at left was limited by Mo deficiency; healthy clover at right received Mo fertilization.

Figure 4. Molybdenum deficiency symptoms are shown in Brussels sprouts.