Boron Deficiency in Indiana Soils

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Boron is one of the minor elements necessary for plant growth. It is required in small amounts, and most soils have an adequate supply. However, some Indiana soils do not always have enough available boron for optimum growth of alfalfa, a crop that requires a larger amount than other field crops. These potentially-deficient soils have been determined from surveys, and the deficiencies can be successfully corrected with applications of borax.

Alfalfa Limited by Boron Supply

The need for soil boron depends upon the plant requirement. Corn and grain crops have a boron content of less than 0.0005% (5 ppm) and are able to obtain enough of the element even on soils having a low available boron supply. Alfalfa, on the other hand, has a boron content of about 0.004% (40 ppm) and is unable to obtain its needs from soils low in boron.

Boron Deficiency Symptoms on Alfalfa

Deficiency of boron in alfalfa causes the upper leaves to turn yellow and often stunts the plant. Because of this, the condition is frequently called "yellow-top." Recognizing the symptoms correctly as boron deficiency, however, is difficult since a number of other factors can also cause yellowing of alfalfa. The specific symptoms associated with boron deficiency as they occur in the field are as follows:

1. Yellowing occurs most prominently on the top leaves and progresses down the plant as severity of the deficiency increases. Leaves may turn red or brown instead of yellow.
2. Yellowing occurs first on the tip half of the leaflet. As the damage becomes more severe, the tip dies and turns brown.
3. The flowers die, turn brown and fail to produce seed.
4. The plant is stunted so that the internodes are shortened.
5. These symptoms will most likely show up during periods of drought and will occur first in spots over the field.

Distinguishing Boron Deficiency From Other Problems Affecting Alfalfa

Follow is a brief discussion of other troubles that cause yellowing or stunting and how their symptoms can be distinguished from boron deficiency:

Potassium deficiency: Leaflets turn yellow in a crescent shape about the tip. As intensity of the deficiency increases, the tip dies and turns gray. Unlike boron deficiency, the symptoms occur on both upper and lower leaves.

Figure 1. Boron-deficient alfalfa, left; normal alfalfa, right.

Figure 2. The green strips are where boron has been applied.
Calcium starvation: The entire plant turns pale green and is stunted. This deficiency may be corrected by liming.

Leafhopper damage: The leafhopper attacks the midrib of the leaflet about halfway to the tip. The tip turns yellow in a distinctive V shape, with the base of the V at the point of attack. All the area inside the V extending to the tip turns yellow. Affected leaves may be on any part of the plant, but are generally concentrated at the top. In severe cases, entire leaflets will turn yellow and the plant will be stunted, much like boron deficiency. However, buds on leafhopper-damaged alfalfa do remain green and flowers are produced.

Spittlebug damage: These insects attack the main stem of the plant, causing stunting but not yellowing. Also, the insect can be detected by the presence of the spittle or white slimy mass on the plant.

Leaf spot: This disease is more easily distinguished from boron deficiency. Symptoms are small, round, brown spots on the leaves — both upper and lower. Generally, the lower leaves die and fall off.

Potentially Boron-Deficient Areas in Indiana

Surveys and experiments have been conducted on alfalfa fields over much of Indiana. Such tests have consisted of (1) application of borax on replicated plots for field studies, (2) application of borax strips across the field and observation of growth on treated and untreated areas, and (3) sampling alfalfa fields and analyzing the plants for boron content to determine its availability in the soil.

Boron content of alfalfa grown on soil to which borax has not been applied is a good index of boron availability in the soil. Where the boron content of alfalfa is less than 0.002% (20 ppm), there usually are boron deficiency symptoms. In a survey of 67 fields in northern and southern Indiana, it was found that growing alfalfa contained less than 20 ppm boron in 5% of the fields in the north and 83% of the fields in the south. Such fields are considered potentially boron-deficient.

Figure 3 shows the boron-deficient areas in Indiana. The old residual and oldest glacial soils occurring in southern Indiana are all potentially deficient. In other parts of the state, boron deficiency is found on only very sandy soils, mainly in the north.

Chemical Tests for Available Boron

Chemical analysis of plant tissue has been more satisfactory than soil tests for indicating need for boron fertilization in Indiana. Information on sampling instructions and the cost of plant analysis can be obtained from your County Extension Office or fertilizer dealer. For information on soil test for boron, contact fertilizer dealers or the Purdue Soil Testing Laboratory, Life Science Building, Lafayette, Indiana 47907.

Crop Response to Boron Applications

Boron applications are recommended on alfalfa and red clover fields where deficiencies occur. They are suggested as insurance against deficiency on alfalfa grown for hay and red clover grown for seed production.

Response of alfalfa to boron applications on potentially deficient soils is seen mainly in terms of improved hay quality. However, in dry years when severe deficiencies occur, yield responses may also be noted. The prevention of yellowing increases the nutritive value of the hay.

Recommended Boron Applications

Boron may be applied by broadcasting a mixed fertilizer containing boron. A mixture of this type is especially made for use on alfalfa fields and is often called “alfalfa fertilizer.” It may have a “B” after the analysis such as 0-10-30 B. Do not drill this fertilizer with the seed for any crop, since boron will injure germinating seed. Boron may also be applied by broadcasting either borax containing 12% boron or higher-analysis fertilizer borates containing 15-20% boron.

Application rates: Apply boron at rates of 2.5 to 4 pounds of boron per acre. Rates higher than 10 pounds per acre may injure the crop and should not be used.

The 2.5 to 4 pound-per-acre levels are obtained by applying either 20 to 30 pounds per acre of borax or 250 to 400 pounds per acre of mixed fertilizer containing 1% boron.

(Fig. 1 & 2 courtesy U.S. Borax & Chemical Corp.)