Soil Tests for Available Boron

- Boron deficiencies may be suspected on coarse-textured soils where organic matter content is low, on soils with a pH above 6.0, and on recently limed soils.
- Soil testing and plant analyses are both helpful in assessing the potential boron-supplying capacity of the soil and the current boron status of the plant.
- Recent research has shown that three commonly used soil tests, the Mehlich-1 and -3 tests and the DTPA test modified to include sorbitol, also may be used to determine available boron in soils.
- The critical value of available boron in a soil test may be affected by soil and the environment, which must be considered in interpreting soil test results.

Most of the available B in soils is found in the soil organic matter fraction. Sandy soils that are well drained are most likely to be B deficient in high rainfall situations because of their greater leaching potential. Boron availability to plants decreases with increasing soil pH, especially above pH 6.5. However, strongly acid soils (pH less than 5.0) also tend to be low in available B. Some crops with a high demand for B – such as alfalfa – also require a soil pH above 6.5 for optimum growth so liming may be necessary. Overliming acid soils often has resulted in temporary B deficiencies, especially when liming to pH levels above 7.0.

Soil Testing

Soil tests are used to determine the amount of available B in soils, so that proper B recommendations can be made for the crop in a specific field. Soil tests are laboratory analyses of samples to estimate the levels of available nutrients in soils. Measurements of other parameters relevant to plant growth, such as soil pH, organic matter content, and texture are generally made at the same time.

Sound interpretation of the results will improve fertilizer recommendations. Soil test methods must be correlated with plant response to a given nutrient on a number of soils which vary in level of availability of that nutrient. Those methods with high correlation values provide a better estimation of plant nutrient availability in the given field.

Careful sampling is essential to ensure that the sample being tested is representative of the field being sampled. Generally, the field or area of the field being sampled for a composite sample should be no larger than 50-100 acres. About 15 core samples should be taken with a stainless soil test probe to the tillage depth (about 6-8 inches) for most crops. These samples should be air dried, mixed well and about one pint subsampled for analysis at a certified laboratory.

It is important to complete the information form to accompany the soil sample for proper interpretation of the results. Without this information, the fertilizer recommendation can not be tailored to the specific situation.

Soil Tests for Available Boron

The hot-water-soluble (hws) test

This method was developed in 1939 and it continues to be used to determine available B in soils. While numerous modifications have been developed over the past 60 years, extraction of soil with boiling water for 5 minutes is still the basis of this method (see Reference 1).

Some of the problems associated with this method are: it is not well adapted for routine analyses; it is time consuming; and, it requires special precautions to prevent contamination. In addition, this soil test is specific for B, so a separate test must be conducted for each soil samples when available B is requested.

The critical level of hws B for crops which require the most available B ranges from 0.5 to 1.0 ppm in most soils. The critical B level also is related to the soil pH, organic matter content and texture. Crops which are grown on soils that are less than the critical level generally will respond to B.

The Mehlich-1 (M-1) and Mehlich-3 (M-3) tests

These methods are commonly used to determine available P, K, Ca, Mg, Mn and Zn, mainly in acid soils of the Eastern United States. Recent research has been done to compare the amounts of B in these soil-test extracts with those of hws B in 100 soil samples in six states of this region.

Results showed that the M-3 method extracted similar amounts of B as the hws method, but more B than the M-1 method. Both methods were significantly correlated with hws B ($r = 0.82$ and 0.74, respectively) (see Reference 3), so either the M-1 or M-3 method could be used to determine available B in routine soil testing.

The B in these extracts was determined by inductively-coupled plasma spectrometry (ICP), so this analysis can be made simultaneously with those of the other nutrient elements.

The DTPA test

This method was developed mainly for the determination of available Zn and Fe in alkaline soils of the western states. Recently it has been determined that inclusion of sorbitol (a sugar compound) in the DTPA extractant will complex soil B.

Results showed that the amounts of B extracted by this method were 96% of those of hws B in these soils, and were significantly correlated with hws B ($r = 0.97$) in 42 soils (see Reference 2).

Determination of B along with Cu, Fe, Mn, and Zn by ICP in DTPA extracts results in no extra costs to determine available B using routine soil test procedures.

Summary

Recent research has shown that available B in soils can be determined simultaneously with other nutrients by three routine soil test methods . This will significantly reduce the cost of determining the amount available B in soils, so more soils will be tested for available B in the future.

There is still a need for more research to obtain critical levels of B in soils using these methods, as well as correlation studies of the values obtained by these methods with crop response to applied B.

References

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2) Miller, R. O., B. Vaughan and J. Kotuby-Amacher. 1999. Extraction of Soil Boron with DTPA-Sorbitol. Agronomy Annual Meeting Abstracts, Madison, WI.

3) Shuman, L. M., et al. 1992. Comparison of Mehlich-1 and Mehlich-3 Extractable Boron with Hot-water Extractable Boron. Communications in Soil Science and Plant Analyses 23:1-14.

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