 AVAILABLE BORON AS AFFECTED BY SOIL TREATMENTS

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In the last decade the roles played in the development of plants by a number of elements occurring in them in small quantities have been undergoing thorough investigation. The importance of several of these elements in plant growth has been universally admitted. Prominent among them is boron. The commercial form in which boron is most readily procurable and, at present, least costly is granulated borax \((\text{Na}_2\text{B}_4\text{O}_7\cdot10\text{H}_2\text{O})\). This compound contains 11.34% boron.

The exact role played by boron in plant nutrition is not yet definitely established. Many investigators, however, have shown that its absence results in an internal breakdown of the plant cells and finally death of the plant.

The general method for the study of the effects of a single element in plant growth involves the use of nutrient solutions. These solutions contain the salts of the essential nutrient elements—nitrogen, phosphorus, sulfur, potassium, magnesium, calcium, iron, and small quantities of the minor elements.

Through the use of these solutions it soon became obvious that the quantity of boron necessary for normal growth varied with different plants. Moreover, the quantity of boron available to plants growing on soil, a factor of great importance, has been shown to have no significant correlation with the total amount of boron in the soil \(^3\).\(^2\)

While the need of boron for plant growth has been receiving considerable attention, fewer investigators have been concerned with the specific factors affecting the availability of boron. It is the purpose of this investigation to continue the study of the nature of boron fixation by the soil through its effects upon soybean and sugar beet plants.

LABORATORY PROCEDURES

Standard laboratory methods were used in the chemical analyses of plant tissue. All analyses were made on tissue dried in the oven at 65°C.

Boron was determined by the Berger-Truog method.

Calcium and magnesium were determined on the same ash samples, calcium by titrating the oxalate with standardized potassium permanganate, and the magnesium by the gravimetric pyro-phosphate method.

Iron was determined by titrating the ferric ion with absolute standardized titanium trichloride.

A modified Gunning procedure was used to determine nitrogen.

TYPE OF FIXATION

It has been reported that boron deficiency occurs more frequently in alkaline than in acid soils \(^3\), \(^1\), \(^7\) and that overliming may produce boron starvation \(^9\), \(^10\).

Ferguson and Wright \(^5\) have pointed out that the fixation of boron in the soil by lime may happen in one of three ways, viz., (a) “lime may fix boron into some insoluble or slightly soluble form, (b) lime increases the pH of the soil and thereby may reduce the ability of the root to absorb boron, (c) lime may stimulate the growth of soil microorganisms and there is competition between them and the plant for the supply of boron.”

In a report by Cook and Millar \(^3\) some factors affecting boron availability have been pointed out. The growth and appearance of soybean plants were used as measures of the availability of boron. Some plants exhibit very plain and dependable symptoms of toxicity when a small excess of boron is present. It was assumed when borax is applied to soils in heavy quantities and the soybean plant is not injured, that some constituents of the soil render the boron unavailable to the plant.

The boron toxicity symptoms of soybeans are noticed about ten days after the plants emerge from the soil. Yellowish brown spots form near the edges of the leaves. The cotyledons turn yellow well before the leaves. The symptoms are more pronounced on the plants injured by borax. An excessive quantity of borax also causes a rapid development of new leaves at the top end of the stem and premature death of the base leaves. The injured plants thus appear more spindling and less sturdy than do the normal plants.

From the yield data (Table 1) taken from the above mentioned report \(^3\), the following conclusions were drawn: (a) “Calcium and magnesium carbonates were very effective in fixing borax in this soil. Sodium carbonate had no effect on the availability of borax,” (b) Calcium and magnesium carbonates were very effective in fixing borax in this soil. Sodium carbonate had no effect on the availability of borax. (c) Calcium and magnesium carbonates were very effective in fixing borax in this soil. Sodium carbonate had no effect on the availability of borax.