

It will be noted that the germination of the untreated Bermuda grass seed was particularly low, indicating that the seed used was a low grade or that the conditions provided in the test were unfavorable for germination. The tests were made in flats in the greenhouse in October at a mean temperature of 70°, which is too low for good germination of Bermuda grass seed. Tests made on good commercial seed in the Department of Agriculture at the alternating temperatures, 68° and 95°, have given germination percentages varying from 85 to 95 percent, depending on the sample. Perhaps had the germination tests with seed of Bermuda grass and centipede grass been made under more favorable temperature conditions, the results might have been higher both for scarified and unscarified seed.

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#### ACTIVATED SLUDGE AS A SOURCE OF MINOR NUTRIENT ELEMENTS

In recent years, it has been shown conclusively that certain elements such as boron, copper, zinc, and manganese, in very small quantities are essential for the growth of plants. These and certain other elements are known collectively as the minor elements. Because of the very small quantities of these elements which

are necessary for the proper growth of plants, they are usually present in soils in sufficient quantities or are added as impurities accompanying the crude salts in the fertilizers which are used.

There have been cases, particularly in the very sandy soils of the southeastern states, however, where striking benefits have been reported as a result of the use of boron, copper, manganese and zinc. In these same areas, the use of Milorganite which is the dried activated sludge from the Milwaukee Sewage Disposal Plant, has apparently resulted in benefits from constituents of the sludge other than the nitrogen, phosphoric acid and potash. It was felt that perhaps the presence of the minor elements might have been responsible for at least part of these benefits.

For this reason, C. J. Rehling and Emil Truog in the University of Wisconsin conducted experiments with Milorganite which have been described in a recent issue of the *Journal of the American Society of Agronomy* and in an earlier paper in the *Analytical Edition of the Journal of Industrial and Engineering Chemistry*. In the earlier paper they demonstrated by analysis of Milorganite that it contains 23 elements. Among these were boron, copper, manganese, and zinc, significant

amounts of which were present in a form available to plants.

The experiments discussed in the more recent article demonstrated that Milorganite could supply the minor nutrient elements to corn, tomato, and sunflower plants growing in nutrient solutions in Mason jars. In some jars the plants were grown in the nutrient solutions free from one or more of the minor elements until symptoms of the deficiency appeared after which time a carbonic acid extract of Milorganite was added along with the nutrient solution. The authors state that "In every instance where a minor element deficiency existed and the Milorganite extract was later added, increased yield resulted which was attributed to correction of the deficiency by the minor element contained in the extract."

In control jars in which the plants were grown in nutrient solutions containing the minor elements in addition to nitrogen, phosphorus, potassium, calcium and magnesium, the plants showed normal growth and were not stimulated to additional growth by the addition of the Milorganite extract.

Analyses of the dried tops and roots were made and in general the amounts of these elements present in the plant tissues were closely corre-

lated with the amount of growth expressed in terms of dry weight. Increases both in plant yields and the minor element contents were associated with the addition of Milorganite extract to the cultures deficient in any of the minor elements but not with its addition to the control cultures which were already receiving the minor elements.

From these experiments the authors concluded that "Since Milorganite extract did not stimulate additional growth in control cultures which already contained all of the minor nutrient elements, it is evident that the highly stimulating effects of the extract which were observed in the other cultures, can be attributed to the presence of available minor nutrient elements in Milorganite" and that "These observations and results undoubtedly explain, at least in part, the additional unusual stimulating effects which have been noted following the use of Milorganite on certain soils."

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#### THE USE OF POTASSIUM PERMANGANATE

Potassium permanganate is known to be an active oxidizing agent. As such it hastens the decay of organic matter. C. B. Greening, of the Wisley Experiment Station in England, has conducted a number of experi-