

ZINC DEFICIENCY DIAGNOSIS THROUGH SOIL ANALYSIS

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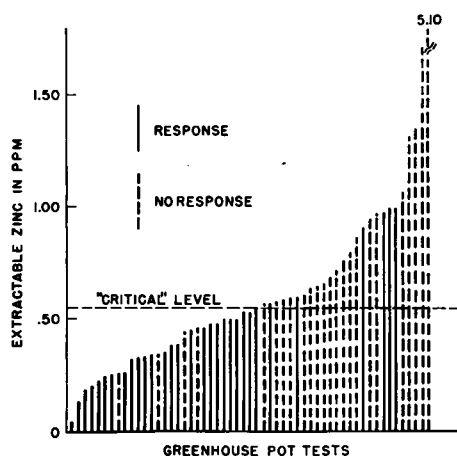
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Both greenhouse and field results indicate that the ammonium acetate-dithizone test may be useful in identifying soil areas likely to be zinc deficient. Tentatively, 0.5 ppm (parts per million) is believed to be a critical level below which a zinc response might be expected on sensitive field and vegetable crops.

Zinc deficiency in certain field and vegetable crops is a widespread problem in California. Since some plant species do not show zinc deficiency by clear-cut symptoms, diagnosis by other means such as soil analysis would be highly desirable. Since preliminary studies with the dithizone method of zinc analysis looked promising, additional information was needed to establish the value of this procedure. Thus, soil samples were collected from 55 locations in 19 counties in cooperation with farm advisors.

Chemical analyses and greenhouse tests were conducted on all 55 soils and field trials were established in certain locations.

The extractable zinc content of soils



Response of sweet corn to soil applied zinc sulfate in relation to dithizone extractable zinc in 55 California soils. Each solid line represents a soil which responded to applications of zinc sulfate, while each broken line represents no response.

was closely related to the zinc response of corn plants as is shown in the graph included here. Twenty-nine soils contained less than 0.55 ppm extractable zinc, and of these, 25 (or 86%) responded to soil applications of zinc sulfate. Of the remaining 26 soils which contained more than 0.55 ppm extractable zinc, 20 (or 77%) did not respond to soil applications of zinc sulfate. Growth responses to zinc applications have been observed in 22 field trials where the soil contained less than 0.5 ppm of extractable zinc. The crops used in these field trials included sweet corn, field corn, small white beans, kidney beans, pink beans, tomatoes, cotton, sorghum, and barley.

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LEACHING SOIL SALTS

Recent work has shown for the first time—both theoretically and experimentally—how mineral salts are leached through soils of various textures under different conditions. The leaching process in unsaturated soils is vastly different from that in moisture-saturated soils, and studies on unsaturated soils are particularly important because of the prevalence of this condition.

Results of the investigation indicate that some soils are leached more efficiently than others because of the differences in pore geometry. They also show why leaching by rainfall may be more efficient than ponding water on the soil surface. New methods are being developed for reclaiming salted lands and maintaining satisfactory salt balance in the root zone of irrigated crop lands. In addition, theoretical predictions of the quality of percolating ground waters can be made with some assurance.—James W. Biggar, Dept. of Irrigation, Davis.

PROCEDURE FOR DITHIZONE EXTRACTABLE SOIL ZINC

The distilled water should be purified by redistillation from an all glass still or passed through a cation exchange resin column or passed through a demineralizer. All reagents used should be made zinc free by purification with dithizone. All glassware must be acid washed and rinsed with zinc free water.

Reagents required

1. Dithizone in carbon tetrachloride 0.01%.
2. Dithizone in carbon tetrachloride 0.001%.
3. Ammonium acetate: 1N, pH 7.0.
4. Sodium acetate: 136 g. sodium acetate plus 57.2 ml. glacial acetic acid made up to 1 liter (pH 4.5 to 4.7).
5. Sodium thiosulfate: 16 g. in 100 ml. water.

Procedure

2.5 g. of air dry soil, which has been screened through a 1 mm. stainless steel or plastic sieve, is placed in a 125 ml. glass stoppered reagent bottle. The soil is shaken for 2 hours with a mixture of 25 ml. 1N ammonium acetate solution and 25 ml. 0.01% dithizone in carbon tetrachloride.

After shaking, the contents of the reagent bottle are transferred to a 40 ml. conical centrifuge tube. A portion of the aqueous phase may be discarded at this point so that the whole of the organic solvent phase may be transferred to the centrifuge tube. These tubes with their contents are centrifuged at 1800 rpm for 15 minutes. A 5, 10, or 15 ml. aliquot of the CCl_4 phase is removed using a "propipet" type filling device or an ordinary pipet attached to a mild vacuum to prevent inhalation of CCl_4 fumes. The end of the pipet must be rinsed with distilled water and wiped dry with tissue.

The aliquot (commonly 10 ml.) is transferred to a 125 ml. separatory funnel in which has been placed about 25 ml. of 0.02 N HCl. Shake for 2 minutes. The extracted zinc is now in the aqueous phase separated from copper and most other metals which remain in the CCl_4 phase. Draw off the CCl_4 phase and discard. Add 2 or 3 ml. pure CCl_4 to the aqueous phase and again shake for about 1 minute, draw off and discard the CCl_4 phase. Repeat this CCl_4 treatment once more.

To the aqueous phase in the separatory funnel, add 10 ml. sodium acetate solution, 1 ml. sodium thiosulfate solution, and exactly 10 ml. 0.001% dithizone in CCl_4 . Shake for 2 minutes and allow phases to separate completely. The zinc is now in the CCl_4 phase.

Draw off the CCl_4 phase into a clean dry cuvette and determine the percent transmittance in a colorimeter or spectrophotometer using a wavelength of 535m μ . The zinc concentration is then estimated from a calibration curve prepared by carrying standard zinc solution samples containing up to 5 micrograms of zinc through the above procedure.