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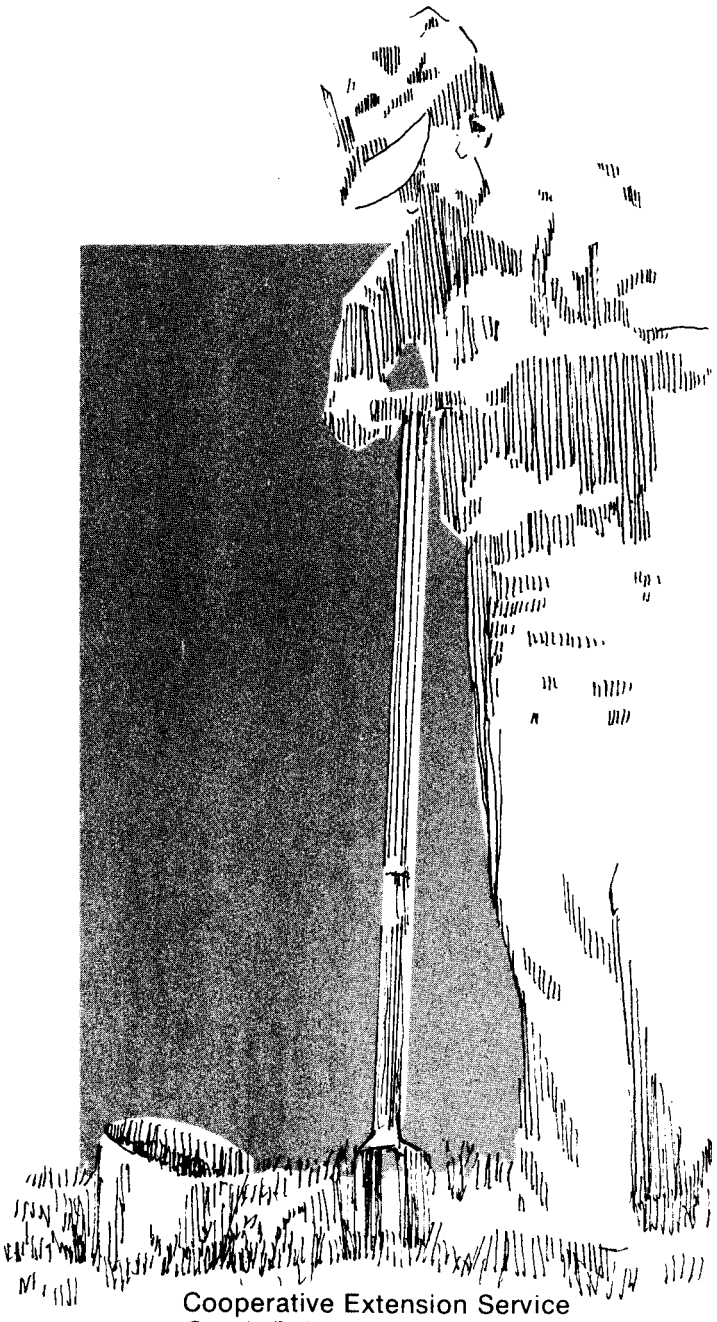

Cooperative Extension Service
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ZINC DEFICIENCIES

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The amount of zinc per acre you need to grow high yielding crops is only a few ounces compared to the many pounds of nitrogen you may need. However, that very small amount is mighty—without it you'll have hidden yield losses, or in severe cases, the plants will not develop or will die.

Even though zinc is an essential nutrient, just 1/10th to 1/4th pound of actual zinc is taken up by an acre of a good crop.

Seldom will zinc deficiencies occur uniformly across a field and frequently there are no visible symptoms; thus, you may miss a zinc problem. We know, however, that zinc deficiencies occur on corn, sorghum, and beans in South Dakota.

The purpose of this fact sheet is to help producers detect zinc deficiencies by plant observations, soil tests, and plant analysis so recommendations can be made to correct these shortages.

Identification of Zinc Problems

Zinc deficiencies are frequently associated with:

1. Corn, sorghum, potatoes, and beans, with corn being the most sensitive.
2. High yield conditions.
3. Disturbed topsoil, where it has been removed by leveling for irrigation, erosion, or by terrace channel construction.
4. Soils low in organic matter, sandy, or having a high pH.
5. Unusually cool, wet soil conditions.
6. High available soil phosphorus levels because of native fertility or because of high phosphate fertilization. Phosphate applied as a starter may interfere with zinc utilization by the plant more than broadcast phosphate fertilizer.

Visual signs differ, but several general symptoms apply to most crops.

Deficiencies show up early in the plant's growth. In general, the stems and leaves of zinc deficient plants fail to develop to normal size. Young corn and sorghum plants exhibit broad yellow bands or striping on both sides of the leaf midrib, starting near the base of the leaf but generally not extending to the tip, with the midrib and outer margin remaining green. Dead areas of the lower leaves and a shortening of the plant internodes are other symptoms.

Beans exhibit a general stunting of the young plants. Lower leaves show a yellow and crinkled appearance, while the topmost leaves remain green. A general downward curl of the leaves will also occur, and pod set will be poor.

Soil deficiencies may limit yield yet visual symptoms may not be noticed. Visual observations should be confirmed by soil tests, plant analysis, or field trials.

Soil Testing for Zinc

A surface (0-6 inches) composite soil sample (mixture of 15-20 subsamples) should be collected from only the areas of the field suspected of being low in zinc. Avoid using any tool made of rubber or that is galvanized; these materials will contaminate the sample. Plastic containers are satisfactory for collecting and shipping soil for zinc analysis.

Mail approximately a pint of soil to: Soil Testing Laboratory, South Dakota State University, Brookings, South Dakota, 57007. For additional sampling information, refer to the "Soil Sampling Information Sheet" or Fact Sheet FS 633, "Taking Soil Samples."

Several zinc soil test methods can be used. These tests are all based on use of a solution of acid, a chelate, or a combination of reagents to extract from the soil a portion of the total zinc. This extracted portion is then correlated to the amount of zinc that plants can extract from the soil. The method used by the Soil and Plant Analysis Lab at SDSU is termed DTPA-extractable zinc. The interpretation for this test can be found in Table 1.

Table 1. Interpretation of DTPA Zinc Soil Test

Zinc (Zn) Soil Test (ppm)	Interpretation	Comments
0-0.50	Low	Likelihood of a response to added zinc is good on corn, sorghum, beans, and potatoes.
0.51-1.00	Marginal	Questionable range where response to zinc may be obtained under adverse conditions.
Greater than 1.00	Adequate	Response to zinc is not likely to occur.

Plant Analysis for Zinc

Plant analysis can help to diagnose a zinc deficiency, especially if accompanied by a soil sample from the cropped area. A representative plant sample should be taken according to directions in Table 2.

Table 2. Sampling Procedures for Zinc Plant Analysis

Crop	Time of Sampling	Plant Part	Number of Plants to Sample
Corn or grain sorghum	Less than 12 inches tall	Whole above-ground portion	20-30
Corn or grain sorghum	Prior to tasseling or heading stage	The entire fully developed leaf below the whorl	12-25
Corn	From tasseling to silk	The entire leaf opposite and immediately above or below the ear	12-25
Grain sorghum	At heading	Second leaf from top of plant	15-25
Beans	Prior to podding	Top fully emerged trifoliate leaves	15-25
Potatoes	10% bloom	Uppermost mature leaves	25-35

Take care to avoid contaminating the plant samples by exposing them to galvanized metal containers, fertilizer residue, etc. The interpretation of plant analysis zinc is shown in Table 3.

Table 3. Interpretation of Zinc Plant Analysis

Crop	Low	Sufficient
	(ppm)	
Corn	<20	20-70
Grain sorghum	<20	20-70
Beans	<20	20-50
Potatoes	<30	30-50

Zinc Fertilizer Application Guidelines

Zinc materials can be mixed with fertilizers and applied as a starter or broadcast and plowed down. If you apply broadcast rates of zinc, the carryover will usually last 2-5 years. If you apply the zinc fertilizer in a starter band at planting time, the distribution may not be as good as when broadcast. To obtain more efficient use of band applied zinc, reduce the recommended rate (Table 4) by half, but apply each year for 3 years. This should be sufficient zinc to supply crop needs for 2-4 years.

Foliar applications may improve or correct plant color; however, such applications seldom provide enough zinc to correct the deficiency and assure optimum yields. Consequently, consider foliar application of zinc only as a last resort. Manure applications are effective in eliminating zinc deficiency problems when applied at the rate of 15-20 tons per acre.

Zinc deficiency is expressed in young corn by broad yellow stripes between the midrib and the margin of the leaf. Or there may be no symptoms at all. If you suspect zinc deficiencies, have a soil test and plant analyses made.

Table 4. Recommendations for Zinc Application - Corn, Sorghum, Beans and Potatoes*.

Crop and Management (Corn, Sorghum, Beans, and Potatoes)	Zinc soil test (ppm Zn) Low (0-0.50)	Medium (0.51-1.00)	High (≥1.00)
	lbs/A Zn (broadcast basis)		
Dryland	5	5	0
Irrigated	10	5	0

* Based on the use of inorganic products as source of zinc.

Zinc Carriers or Fertilizer Materials

There are several inorganic sources of zinc available. Zinc sulfate (36% zinc) is commonly used. Other inorganic sources are zinc ammonium sulfate, zinc oxide, zinc chloride, and zinc ammonium phosphate. Application of granular zinc oxide on calcareous soils should be avoided because the material has low solubility.

Organic sources of zinc that can be used are chelates, zinc polyflavonoid, and zinc lignin-sulfonate. If using organic sources, divide the rate of zinc per acre by 3 (If 5 pounds of zinc were recommended then 1 ⅔ pounds of zinc in the organic form could be applied). Although less zinc needs to be applied when using the organic materials, the cost per acre is likely to be about the same or higher.

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