FACT SHEET

L-721

# Zinc Deficiency and Fertilization

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Zinc deficiency has been recognized for many years as "rosette" on pecan trees, but only recently has the problem been associated with field crops grown in Texas.

## Present Situation

Available zinc levels in Texas soils are not identified well at present, but those areas where deficiencies have been confirmed on one or more field crops are shown in Figure 1. Rosette on pecans occurs over a wide area but is more pronounced on alkaline soils.

The following conditions have been associated with deficiencies as well as responses from zinc fertilization:

1. *Alkaline soils.* The availability of zinc decreases with increased alkalinity.

2. *Susceptible crops.* Corn, pecans, snap beans, and flax are affected most frequently, although deficiencies have been reported for a number of crops including cotton, grain sorghum, peanuts and some vegetables. Other crops may be affected to varying degrees, but distinct symptoms have not been observed in Texas.

3. *High phosphorus.* A number of studies have shown a relationship between high levels of soil phosphorus and zinc deficiency. If alkaline soils are relatively high in native or applied phosphorus, the possibility of zinc deficiency is greater than at low phosphorus levels. Adequate phosphorus to meet the nutritional requirement of the crop is essential; however, there is good evidence that high levels of soil phosphorus can contribute to zinc deficiency. This does not suggest that crops should be limited in phosphorus fertilization, but that the level of this nutrient should be considered in determining the need for zinc fertilizers.

Zinc soil tests are in the developmental stages. It is possible to extract zinc from soils, but the range between deficient and adequate amounts is narrow. Therefore, extractable zinc must be related to previous items 1, 2 and 3 in determining if the soil is at a deficient level and represents a high probability of profitable returns from zinc fertilization.

## Deficiency Symptoms

Leaf symptoms differ between crops. Fields generally are not affected uniformly. Therefore, it is difficult to identify zinc deficiencies through soil tests of composite samples or to measure yield differences between treated and untreated plots. Information in Table 1 provides a guide to the identification of zinc deficient crops.

**Table 1. Description of zinc deficiency on crops**

| Crop | Description of symptom |
|---|---|
| Pecans | Shortening of the internodes on new growth giving an appearance of "rosette." Yellowing or chlorosis between the veins gives leaflets a striped effect. They are also small. In severe cases, some leaflets may die imparting an appearance of "terminal die back." |
| Corn | A broad band of yellow or white tissue develops on both sides of the midrib when plants are 2 or 3 weeks old. These pale bands start near the base of the leaf but generally do not extend to the tips. The margins and midrib generally remain green. Part of the chlorotic tissue may die or turn reddish-brown. The stalk may be barren or produce a partially filled ear. The root system may be poorly developed. |
| **Grain sorghum** | The symptoms on grain sorghum are similar to those on corn but less pronounced. Although grain sorghum is not as susceptible as corn, zinc deficiency appears to retard development and maturation of heads and seems to inhibit head exertion. |

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| Crop | Description of symptom |
|---|---|
| Cotton | The bottom leaves are often normal because they have obtained ample zinc from the seed. The first true leaves may show a pronounced yellowing between the veins and develop a "mottled bronze" appearance. The leaves become thick and brittle with their margins cupped upward. The early stem growth may have short internodes. Squares and flowers formed on deficient plants are usually shed. Zinc-deficient plants are slow to mature. |
| Snap beans | Symptoms are similar to those on cotton. Plants are stunted and may fail to form seed pods under severe deficiencies. |
| Flax | Chlorosis and white spots on the new leaves develop to a bronze or grayish-brown on the leaves followed by a loss of color and dead spots. Short internodes cause rosetting of leaves on the top of the main stem. The growing point of the main stem may die back. |
| Citrus | Leaves become chlorotic with a condition known as "mottleleaf" or "frenching." Irregular green bands develop along midrib and lateral veins. Leaves become small and narrow. Twigs tend to "die back." |
| Peaches | Leaves look "frenched" and chlorotic, similar to citrus, and has been called "narrow leaf." |
| Peanuts | Usually reduced pegging and little or no pod set with no distinct leaf symptoms. Very severe deficiency results in stunted plants, dwarfed upper leaves that curl downward. Older leaves develop a slight bronzing followed by defoliation. |
| Tomatoes | Transplants show extreme relaxing of leaflets followed by downward curling of petioles. Older plants develop thick leaves with a brownish-orange chlorosis on older leaves, some may show necrotic spots. Stems are normal size but leaves are smaller commonly called "little leaf." |
| Small grains and grass crops | Not been observed in Texas. It appears these crops can produce high yields with relatively low levels of available zinc. |

Zinc deficiency can be confirmed by spraying, painting or dipping leaves from deficient plants in dilute solution of zinc sulfate, or other zinc compounds, containing 1 teaspoonful of material per gallon of water. New growth should have a more normal green color compared with the older chlorotic leaves. Soil tests are being refined to assist in identifying zinc deficient soils. Plant tests are being used to evaluate and calibrate soil tests. Laboratory analyses for pecan leaves along with suggested zinc treatments if needed, are available on a service basis from the Texas Agricultural Extension Service Soil and Plant Testing Laboratory at College Station. Analysis of greenhouse tomato leaf samples can also be obtained. For more information about these tests, see your county agricultural agent.

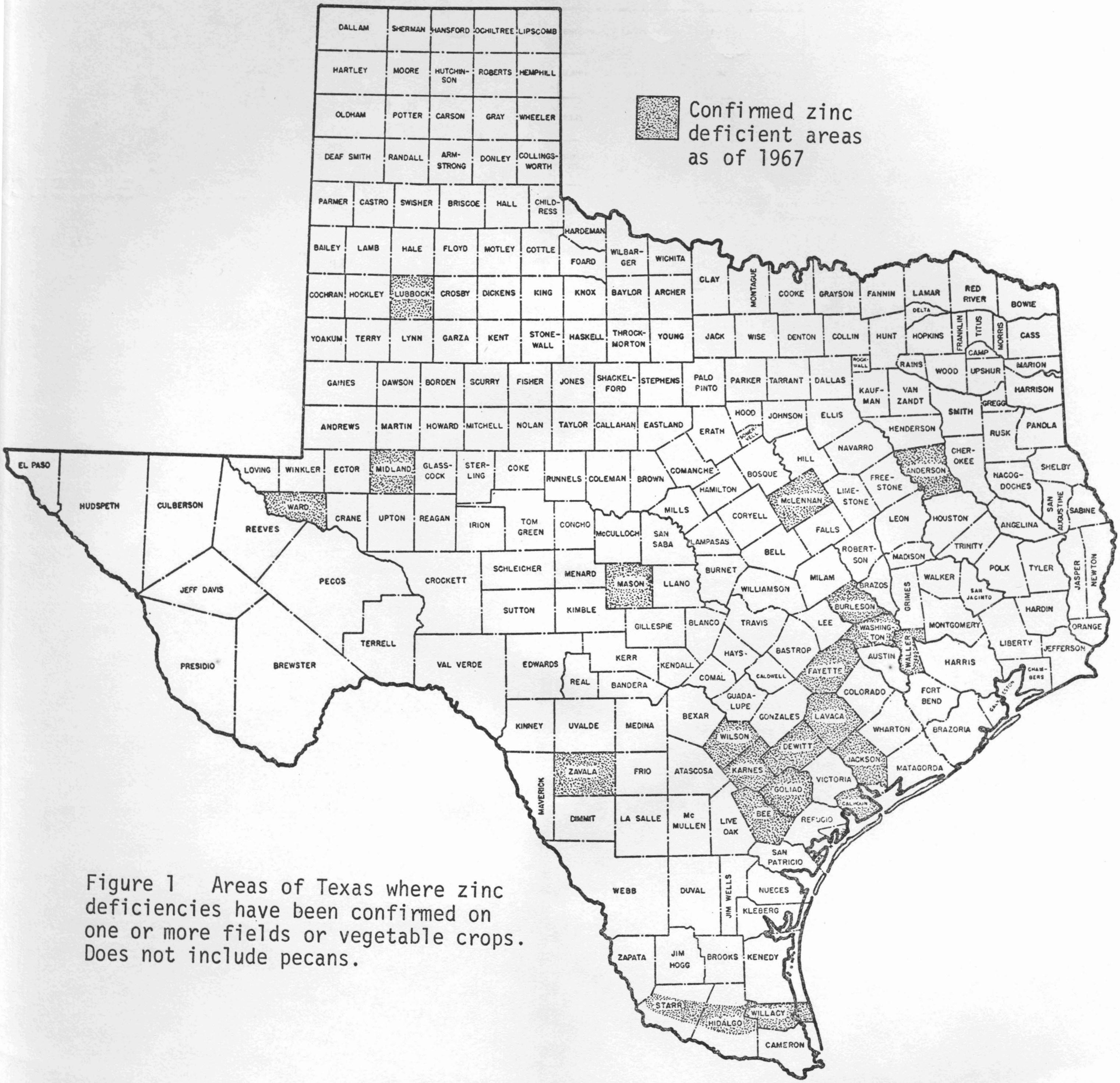


Figure 1 Areas of Texas where zinc deficiencies have been confirmed on one or more fields or vegetable crops. Does not include pecans.

## Correcting or Preventing Deficiencies

Applications of zinc after deficiency symptoms are observed should be considered as emergency measures since foliar applications will only prevent the development of symptoms on new growth. The symptoms will remain on those leaves affected prior to the treatment. Soil application should be used for future susceptible crops. A definite need for zinc should be established before including zinc in the fertilizer. When the decision has been made to use zinc, apply it in amounts that are adequate to correct the deficiency. Information in Table 2 will serve as a guide in selecting suitable materials, methods of application and rates.

**Table 2. Rates of zinc materials**

| Crop | Spray (include wetting agent) Zinc sulfate[1] or chelates | Soil applications Zinc sulfate[2] | Soil applications Chelates |
|---|---|---|---|
| Field crops (Corn, grain sorghum, flax and peanuts) | ¼ to ½ % solution, (1 to 2 lb. in 50 gal. water) 15 to 30 gal./A. | 10 to 30 lb/A. | 2 to 6 lb/A. |
| Vegetables | ¼ % solution. (1 lb. in 50 gal. water). Dampen foliage thoroughly. | 20 to 40 lb/A. | 3 to 6 lb/A. |
| Greenhouse tomatoes | ¼ % solution. (1 lb. in 50 gal. water or spray). Repeat as needed. | 1 to 3 lb/1,000[3] sq. ft. | ½ to 1 lb/1,000 sq. ft. |
| Pecans, citrus and tree crops | ¼ % solution. (1 lb. in 50 gal. of regular spray). Thoroughly dampen foliage. | Generally limited to noncommercial trees. | |

[1]Do not exceed the concentrations of zinc sulfate suggested as there is danger from burning the leaves. Including ¼ pound of hydrated lime per 50 gallons of water will minimize chances of burning.

[2]Rates for polyfalvonoid compounds would be similar to those suggested for zinc sulfate.

[3]Based on incorporating with 10 to 12 inches of soil.

Where zinc and iron are mixed in solutions, use 1½ percent iron sulfate (6 pounds per 50 gallons water) and ¼ percent zinc sulfate (1 pound per 50 gallons water). Concentrations of chelates can remain about the same in combination as for single application, since they are less likely to cause leaf burn. Suggested concentrations of chelates in sprays are the same as for zinc sulfate due to the lower zinc content of the chelates and experimental evidence shows that their effectiveness in sprays is not much different from zinc sulfate.

## Methods of Application and Distribution

Since small amounts of zinc fertilizers are involved, the distribution in the root zone appears to be more important than with major plant nutrients. The differences between banding and broadcast treatments have been small and not generally affected by rates.

## Conclusions

If conditions are such that zinc deficiency is suspected:

1. *Confirm deficiency.* Observe deficiency symptoms and use foliar sprays, soil tests and plant analysis to confirm observations.

2. *Spray zinc.* If the deficiency is extensive, spray deficient plants with a 1/4 to 1/2 percent solution of zinc sulfate or zinc chelate.

3. *Zinc fertilization.* Apply a mixed fertilizer or material to supply at least 3.5 pounds of elemental zinc per acre if zinc sulfate (36 percent) is used or at least .4 pounds of zinc when using a chelate (assuming about 10 percent zinc). The rate of other sources would depend on zinc content and availability.

4. *Sources.* Several zinc-containing materials are available for soil applications. Zinc sulfate and chelates are the most common, but zinc oxide, zinc ammonium sulfate, zinc ammonium phosphate, zinc carbonate and zinc polylavinoids sometimes are used. Although some are less water soluble than zinc sulfate, they have been used with satisfactory results under special formulation processes. Rates would generally be similar to those suggested for zinc sulfate.

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