FACT SHEET

L-721

ZINC DEFICIENCY AND FERTILIZATION

Charles D. Welch, Carl Gray and H. Dale Pennington*

Zinc deficiency has only recently been associated with field crops grown in Texas. The following conditions are associated with deficiencies and responses from zinc fertilization:

Alkaline soils. The availability of zinc decreases with increased alkalinity. Few zinc deficiencies are observed below pH 6.5.

Susceptible crops. Corn, pecans and flax are affected most frequently, although deficiencies have been reported for a number of crops including cotton, grain sorghum, peanuts, rice and some vegetables and fruit crops.

High phosphorus. A number of studies show 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. 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.

Alkalinity. Soils underlaid by calcium carbonate may become deficient when deep plowed, leveled or when levees or terraces are built.

Deficiency Symptoms

Visual symptoms differ between crops, and fields generally are not affected uniformly. Therefore, it is difficult to identify zinc deficiencies through soil tests of composite samples. Information in table 1 provides a guide for identifying zinc deficiency.

Zinc deficiency is confirmed by spraying deficient plants with a dilute solution of zinc sulfate or other zinc compounds containing 1 level teaspoon of material per gallon of water. Laboratory analyses for pecan leaves and greenhouse tomatoes 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. For more information about these tests, see your county Extension agent.

*Extension soil chemists and area Extension soil chemist, Lubbock, The Texas A&M University System.

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. 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 root system may be poorly developed and plants may be stunted.
Grain sorghum	Symptoms 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. Delayed maturity can result.
Cotton	The first true leaves may show a pronounced yellowing between the veins and develop a "mottled bronze" appearance. Leaves become thick and brittle with margins cupped upward. Leaves usually are deeply indented between lobes, and yellowing or chlorosis develops between veins. Symptoms may develop late in the season.
Flax	Chlorosis and white spots on the new leaves develop to a bronze or grayish-brown followed by a loss of color and dead spots. Short internodes cause rosetting 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 "die back."
Peaches	Leaves look "frenched" and chlorotic, similar to citrus. Has been called "narrow leaf."
Peanuts	Very severe deficiency results in stunted plants and dwarfed upper leaves that curl downward. Older leaves develop a slight bronzing.
Tomatoes	Older plants develop thick leaves with a brownish-orange chlorosis; some may show necrotic spots. Stems are normal size but leaves are smaller, commonly called "little leaf."
Rice	Seedlings appear chlorotic or yellowed and may exhibit mottled or uneven bronzing. Severe deficiency causes seedling death, resulting in thin stands and general stunting of the surviving plants. Surviving plants may outgrow these deficiencies, but fail to recover adequately to regain normal yield potential.

Texas Agricultural Extension Service • The Texas A&M University System • Daniel C. Pfannstiel, Director • College Station, Texas

Correcting or Preventing Deficiencies

Consider foliar applications of zinc as salvage measures since this only prevents the development of symptoms on new growth. Use soil application for future susceptible crops. Determine definite need for zinc before including it in the fertilizer. When the decision is made to use zinc, apply it in amounts adequate to correct or prevent the deficiency. Information in table 2 serves as a guide in selecting suitable materials, application methods and rates.

Table 2. Rates of zinc materials

	Spray (include wetting agent)	Soil applications as elemental zinc[3]	
Crop	**Zinc sulfate[1]**	**Zinc sulfate[2]**	**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/acre	3 to 6 lb/acre	.5 to .8 lb/acre
Vegetables	¼% solution (1 lb in 50 gal water)	4 to 8 lb/acre	.8 to 1.0 lb/acre
Greenhouse tomatoes	¼% solution (1 lb in 50 gal water or spray). Repeat as needed.	⅓ to 1 lb/1,000[4] sq ft	⅛ to ¼ lb/1,000 sq ft
Pecans, citrus and tree crops	¼% solution (1 lb in 50 gal or regular spray). Thoroughly dampen foliage.	Generally limited to noncommercial trees	

[1]Do not exceed the concentration of zinc sulfate as there is danger from burning the leaves. Including ¼ pound of hydrated lime per 50 gallons of spray minimizes chances of burning. Addition of 1¼ quarts NZN per 100 gallons increases the zinc concentration in pecan leaves.

[2]Rates for polyflavonoid compounds are similar to those suggested for zinc sulfate.

[3]Lower rates for band application, higher rates for broadcast. Use half these rates for very sandy soils.

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

Single broadcast applications of zinc materials that supply 8 to 10 pounds of elemental zinc per acre such as zinc sulfate should correct a zinc deficiency problem for at least 3 to 5 years. A soil test at this time indicates whether additional zinc is needed. Use annual applications of 2 to 3 pounds per acre of elemental zinc for 3 or 4 years. Then discontinue until a zinc soil test shows a need. Use annual applications of chelated zinc materials that supply 0.4 pounds of elemental zinc per acre long enough to accomplish an adequate build up in soil zinc to eliminate the need for further application.

Precautions

Apply only where it is known to be sufficiently deficient to affect the yield of a crop. Limited data indicate that applications to acid soils can be toxic under some conditions. Use primarily for field crops on alkaline soils, soils high in phosphorus and those with low soil test values. Reduce the suggested rate 50 to 60 percent for very sandy soils.

When applying liquid zinc fertilizers with a herbicide, check the herbicide label to be sure the materials are compatible.

Application Methods

Since small amounts of zinc fertilizers are involved, distribution in the root zone is more important than with major plant nutrients. Either banding or broadcasting before planting is effective. Side dressing does not give consistent results. The objective in zinc fertilization is to prevent plants from becoming deficient; therefore, applying before planting is preferable. Use foliar applications during the early stage of growth.

Conclusions

If zinc deficiency is suspected:

Confirm deficiency. Observe deficiency symptoms and use foliar sprays, soil tests and plant analysis to confirm observations. Spray as a temporary emergency treatment.

Spray zinc. If the deficiency is extensive, spray with a ¼ percent solution of zinc sulfate, zinc chelate or equivalent amount of zinc from another source.

Zinc fertilization. Apply a mixed fertilizer or material to supply 3 to 5 pounds of elemental zinc per acre if zinc sulfate is used or at least .3 to .4 pound of zinc when using a chelate. The rate of other sources depends on zinc content and availability.

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 polyflavonoids sometimes are used. Although some are less water soluble than zinc sulfate, they have been used with satisfactory results under special formulation processes.

Suggested rates are for elemental zinc (zn); therefore, consider the analysis of a material. Zinc sulfate is generally 30 to 36 percent zinc; thus, the amount of material is about three times the elemental rate.

The chelates and other sources vary in composition. Liquids contain zinc fertilizer materials in solution or suspension. Calculate the concentration or amount of zinc based on the weight of the liquid. For example, a liquid zinc product containing a chelate is 6 to 9 percent zinc. A quart weighs about 3 pounds; therefore, 1 quart contains .18 to .27 pounds of zinc. This means that 2 quarts per acre is needed to meet the minimum rate of .3 to .5 pounds of zinc. Rates of 1 quart per acre are not adequate to meet crop requirements under zinc deficient conditions.

Cooperative Extension Work in Agriculture and Home Economics, The Texas A&M University System and the United States Department of Agriculture cooperating. Distributed in furtherance of the Acts of Congress of May 8, 1914, as amended, and June 30, 1914.
5M—7-80, Revision AGR 13-1