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## Zinc deficiency in corn

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Corn has a high demand for zinc (Zn) relative to other crops and is the most likely crop commonly grown in Indiana to show Zn deficiency.

Symptoms of Zn deficiency are first evident in the youngest leaves because Zn is not readily translocated in the plant tissue. Typically a broad band of white to yellowish-white tissue occurs on both sides of the leaf midrib beginning at the base of the leaf but not extending to the leaf tip (see right). The affected tissue may eventually brown or bronze. The midrib and outer edges of the leaf remain green. Zinc deficient corn also tends to be stunted due to shortening of the internodes. Plant sampling can be used to confirm Zn deficiency. Tissue Zn concentrations of 20-70 parts per million (ppm or mg/kg) indicate sufficient levels for seedling corn, early growth, and tasseled or silking corn.



## Tissue Sampling

The best way to identify a Zn deficiency is by tissue sampling. In plants less than 4 inches tall sample the whole plant beginning about 1 inch above the soil surface. For larger plants sample the youngest collared leaf. At tasseling or silking sample the leaf adjacent to the uppermost ear no later than several days past silking. About 15-20 individual plant or leaf samples constitute a good sample.

If samples are contaminated by soil they can be rinsed quickly in cold distilled water, but do not overdo it because some nutrients, especially potassium, may be leached out of the tissue. Wet samples should be air-dried before shipping to the laboratory in paper bags.

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## **Factors Affecting Zinc Deficiency**

In addition to low soil levels of available Zn conditions favoring Zn deficiency are cool, wet, and cloudy weather during the early growing season, high soil pH in all types of soils, sandy low organic matter soils, organic soils, and high soil phosphorus (P) levels.

Early season Zn deficiency due to cool, wet, and cloudy conditions are often transient in nature. When temperatures warm and the soil dries, the plant is able to acquire enough Zn from the soil. This type of deficiency is not likely to cause yield loss.

Significant yield loss can occur in soils where Zn availability is low due to high pH which may cause deficiencies that persist through the growing season and. Zinc availability decreases 100-fold for each unit increase in pH. Typically soil pH levels greater than 7 are associated with Zn deficiency. Eroded areas in soils derived from calcareous parent materials are also associated with Zn deficiency because erosion exposes the high calcium carbonate subsoil which has low Zn availability. Total Zn supply can be low in sandy soils and organic soils and in conjunction with high pH can exacerbate the low levels of Zn and cause more severe deficiencies.

High soil P levels and P fertilization rates can induce Zn deficiency in soils with marginal levels of Zn. Tissue P to Zn ratios in excess of 100:1 have been associated with Zn deficiency. Phosphorus interferes with the plant's metabolism of Zn causing the deficiency. High soil P levels arising from manure applications are not thought to cause Zn deficiency because high amounts of Zn are typically added with manure as well as large amounts of P.

## **Soil Testing for Zinc**

The possibility of Zn deficiency can be identified by soil testing. When sampling soil suspected of low Zn avoid using galvanized metal or rubber which both can contain Zn. Soil extractants that use chelating agents (DTPA or EDTA) are considered best for detecting inadequate soil Zn levels. However, the critical level for sufficiency is highly dependent on the method utilized. Some laboratories also consider soil pH and P level when estimating Zn availability. Consult your soil testing laboratory guidelines for interpretation of soil Zn levels considered deficient.

## **Correcting Zinc Deficiency in Corn**

There are several materials sold as Zn fertilizers (see Table below). Granular Zn sources must be at least 40-50% water soluble to be reasonably effective nutrient sources. When soil applied Zn EDTA is 2-5 times more effective than Zn sulfate or Zn lignosulfonate. Zinc sulfate and lignosulfonate are nearly 100% water soluble and are excellent sources of Zn. Zinc oxysulfate is a good Zn fertilizer if it contains a high percentage of Zn sulfate but if Zn oxide is the predominant component it will not be a good source of Zn. Zinc oxide and Zn sucrate are poor sources of Zn when granular because of their low solubility. Water insoluble materials, such as Zn oxide, can provide plant available Zn when powdered but are difficult to spread in that form.

**Table 1.** Zinc-containing fertilizers and their approximate composition (see ref. 4).

<b>Fertilizer</b>	<b>%Zn</b>	<b>Water solubility</b>
Zinc EDTA	~10%	100%
Zinc lignosulfonate	~10%	>90%
Zinc oxide	~70-80%	~0%
Zinc oxysulfate	variable	variable
Zinc succinate	~35%	~0%
Zinc sulfate	~25-36%	~100%

#### Soil-applied zinc

Zinc can be applied broadcast at a rate of 5-10 lb Zn/acre as chelate or at 15-30 lb Zn/acre as zinc sulfate. Broadcast applications provide enough Zn to remain effective for several years if soil conditions allow.

Zinc can also be banded or added to starter fertilizers at the rate of 0.5-1.0 lb Zn/acre as chelate or at 2-4 lb Zn/acre as sulfate. Co-application with acid forming fertilizers promotes Zn availability. Because of the lower application rate banded applications usually have less residual effect than broadcast rates and must be repeated annually. Zinc movement into the soil is quite limited so subsurface placement is highly recommended for no-till production systems.

#### Foliar zinc application

It is generally accepted that foliar Zn applications are not as effective at overcoming Zn deficiency as soil-applied Zn in most situations. Leaf tissue greens in response to foliar Zn but it is less effective at increasing yield, perhaps because the translocation of Zn from the leaf tissue, where it is absorbed, to the root tissue is limited. Greening of the leaf symptoms often occurs in 5 to 10 days after application.

If zinc deficiency symptoms appear, a foliar spray of 0.5-1.0 lb Zn/acre (1.5 to 3.0 lb Zn sulfate) in 20-30 gallons of water per acre should give marked improvement. Broadcast or row applications of zinc should be considered as a preventative measure when corn is grown in subsequent years.

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