Zinc

Zinc (Zn) is a micronutrient that can affect the profitability of crop production in New York. A crop sensitive to zinc deficiency planted or grown in soils with low zinc levels may result in significant economic loss. Crop sensitivity to zinc deficiency is shown in Table 1. There are not only differences among crops but also among varieties and cultivars in their sensitivity to zinc deficiency; some corn hybrids and inbreds utilize zinc more efficiently than others.

Table 1: Relative sensitivity to zinc deficiency.

High	Medium	Low
Bean Corn Flax Fruit trees (deciduous) Grapes Hops Onions Sorghum Sweet corn	Barley Lettuce Potato Soybean Sudangrass Sugar beet Table beet Tomato	Alfalfa Asparagus Carrot Clover Grasses Oat Pea Rye Wheat

Deficiency Symptoms

Zinc plays an important role in a number of plant processes that also relate to zinc deficiency symptoms. Zinc is a constituent in enzymes involved with photosynthesis which may be why zinc deficient plants have decreased chlorophyll content. Plants that are zinc deficient typically have an interveinal chlorosis of leaves. This chlorosis may be pale green or yellow or in some instances pure white in comparison to the more normal green chlorophyll color.

Also, zinc is necessary for the synthesis of auxin (indole acetic acid, IAA), a plant hormone. It is thought that low levels of zinc contribute to a reduction in IAA production or allow IAA to be more quickly broken down. The rosetting of leaves is a distinct characteristic of zinc deficiency related to low IAA levels. Plants have very short internodes giving leaves the appearance of being stacked on top of one another with no stem like flower petals. Plants then take on a flower or “rosette” appearance.

Corn is the field crop where zinc deficiency is most often observed in New York. Zinc deficiency in corn begins as an interveinal chlorosis usually during the 4 to 6 leaf stage although it might occur earlier. The plants will have a “rosette” appearance with shortened inter-nodes. As the plants get older and the root system removes zinc from a larger volume of soil, the newer leaves may be normal. When the zinc deficiency is mild (only 1 or 2 leaves per plant are affected and new leaves are normal), little or no yield reduction occurs. Under severe conditions (plants stunted and 4 or more leaves show symptoms), silking and tasseling may be delayed 2 to 6 days and barren ears may result. Yield may be reduced by 10 to 30% as a result of zinc deficiency.

In deciduous fruit trees the ends of branches may have very short nodes between leaves giving the branches a “bottle brush” appearance. Leaves may also be smaller than normal and misshaped, again the result of the lower IAA levels.

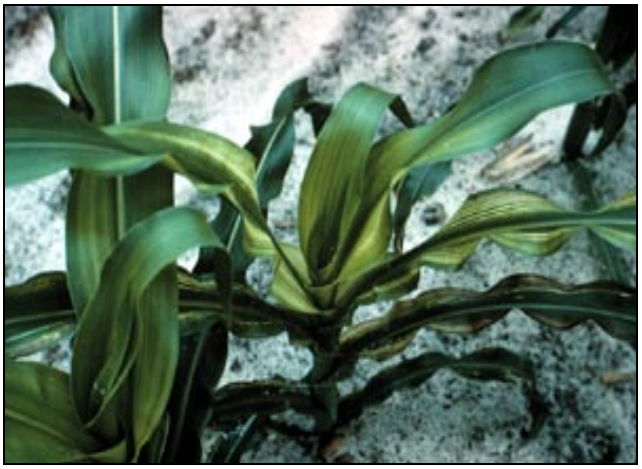

Figure 1: Zinc deficiency in corn. Photo by Owen Plank, University of Georgia.

Factors Contributing to Zinc Deficiency

Soils with low zinc content

Soil test reports from the Cornell Nutrient Analysis Laboratory (CNAL) mark soils with

less than 1 pound zinc per acre (Morgan extracting solution) as low (deficient) in zinc.

High pH soils
Zinc becomes much less available as the soil pH increases. This usually occurs at pH> 7.4 (calcareous soils) but may happen at a pH as low as 6.5. The total amount of zinc in high pH soils may be equal to that of other soils but the plant availability of zinc will be lower. It is also possible that zinc may be adsorbed to liming materials such as $CaCO_3$, again making zinc less available.

High soil phosphorus levels
Why high levels of soil phosphorus (P) tend to coincide with zinc deficiency is not entirely understood. High phosphorus levels may interfere with metabolic processes that involve zinc uptake but it has also been suggested that what is classified as a zinc deficiency in these soils is actually a phosphorus toxicity.

Low organic matter and coarse textured soils
Low organic matter soils are not able to retain much zinc. Sandy and gravelly soils are typically low in organic matter and these are the soils most likely to have lower zinc levels. Also if crops are grown in subsoil because of top soil removal, the lack of organic matter also leads to reduced zinc levels. Manure addition may increase zinc levels because manure contains zinc and organic matter.

Restricted root growth
Zinc is not mobile in the soil so anything that restricts root growth (compacted or saturated soils, etc.) may contribute to zinc deficiency.

Cool soil temperatures
Zinc deficiencies appear more often under cool soil temperatures when any of the above listed mitigating factors are present. Zinc deficiencies that appear under cool wet spring conditions might disappear by late June and early July when root growth and microbial action that releases zinc from organic matter are greater.

Peat or muck soils
Naturally high organic matter soils may contain very low levels of plant available zinc.

Correcting Zinc Deficiencies in Corn

How zinc deficiency is corrected depends on the situation (soils, crop rotation, etc.). If the zinc soil test is low and zinc deficiency occurred in previous crops, broadcast 8 to 10 pounds per acre of zinc and mix it with the soil before planting. Use a soluble form such as zinc sulfate. This should provide adequate zinc for the next 5 to 10 years. After about 5 years some zinc will be needed occasionally (1 to 2 pound of zinc per acre every 2 to 3 years) to maintain soil zinc levels. If soil test levels of phosphorus are high reduce the starter phosphorus rate to 10 to 20 pounds per acre. If the phosphorus soil test is very high, phosphorus should be eliminated from the starter.

If the zinc soil test is low but zinc deficiency has not been observed, apply 2 pounds of zinc per acre as starter fertilizer until the soil test is increased above 1 pound per acre. Recent research results indicate banded zinc is of limited value in correcting a serious zinc deficiency in the year of application, but it does result in an increase in soil zinc with time, thus preventing or correcting the problem in future years. Zinc can be broadcasted with other fertilizers.

Additional Resources:

- "Diagnostic techniques for corn and small grains" by C. Owen Plank and Dewey Lee, University of Georgia. http://www.cropsoil.uga.edu/~oplank/diagnostics70/.
- International Zinc Association website on "Zinc and Crop Nutrition". http://www.zinc-crops.org/index.htm.
- "Zinc in Soils and Crop Nutrition" by Brian J. Alloway. This is a comprehensive online book on zinc and crop nutrition downloadable from http://www.zinc-crops.org/Crops/Alloway-all.php.

Disclaimer:

This fact sheet reflects the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

For more information

Cornell University
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Nutrient Management Spear Program
http://nmsp.css.cornell.edu

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2007