

Are Your Irrigated Fields Looking for Zinc?

Irrigation Agronomy Workshop

April 9, 2013

Outlook, SK

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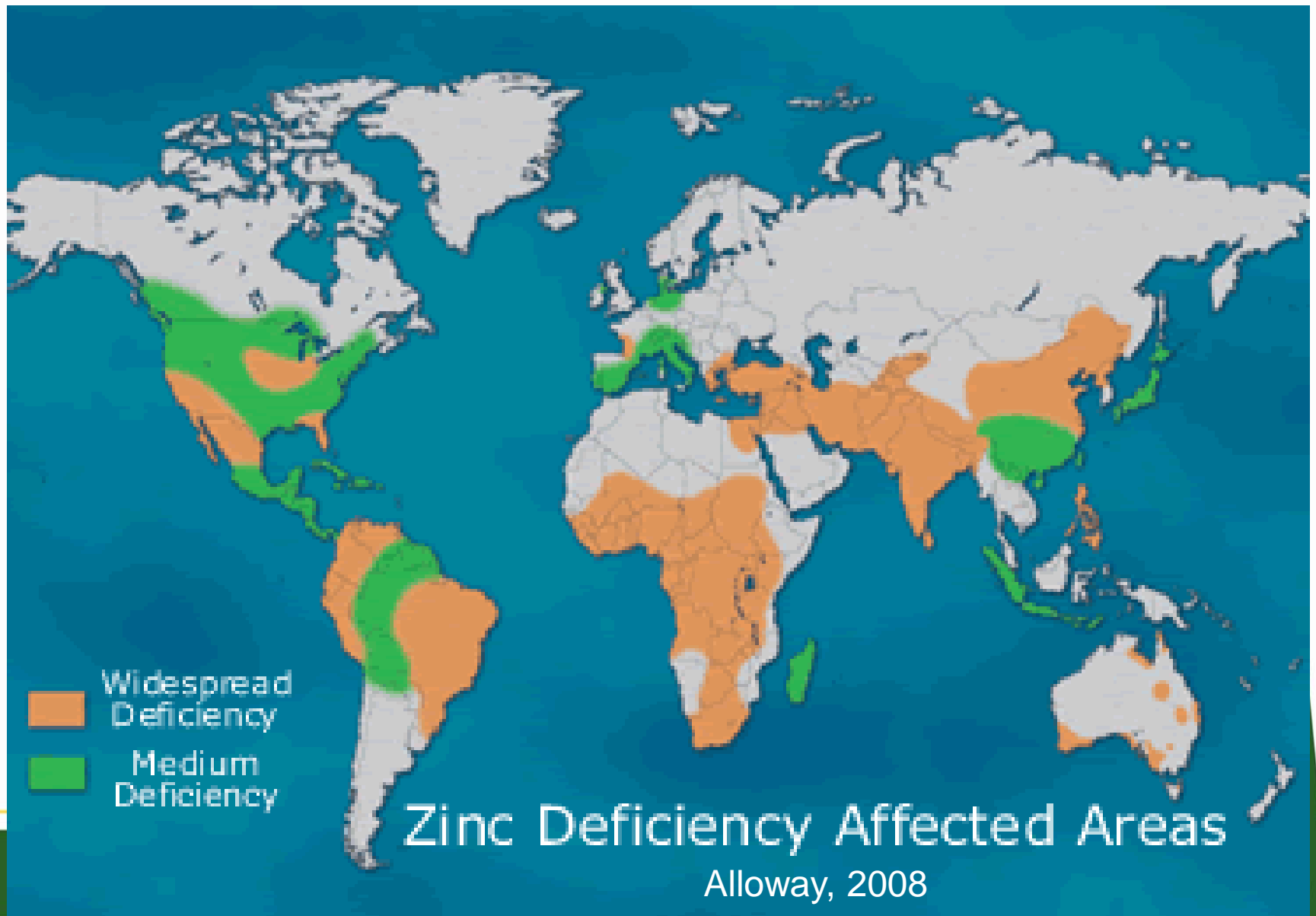


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Zinc deficient regions



Soil Conditions for Zn Deficiency

- 1) Acid sandy soil low in total Zn
- 2) **Neutral or basic calcareous soils**
- 3) High fine clay and silt soils
- 4) **High available P soils**
- 5) Certain organic soils
- 6) **Sub soils exposed by land leveling or wind and water erosion**

Tisdale, Nelson and Beaton Soil Fertility and Fertilizers, 1985



Induced Zinc Deficiency

- Interaction with other nutrients
 - P – zinc deficiency impairs root regulation of P uptake
 - building up soil P levels in soils with marginal Zn levels -> corrected by zinc application
 - High P suppresses michorrhizal uptake of Zn and Cu.
 - High N can increase requirement for Zn



Effect of Soil Temperature

- Increase in soil temperature raises Zn supply
 - Increased diffusion rate from soil colloids to plant roots
 - Increased mineralization from organic matter



Crop Sensitivity to Zn Deficiency

Very Sensitive	Mildly Sensitive	Insensitive
Bean	Alfalfa	Asparagus
Corn	Barley	Carrot
Flax	Potato	Mustard
Soybean	Wheat	Oat
Onion	Clover	Pea
	Tomato	Rye



Function of Zinc in Plants

- Component in enzyme systems of plant
 - Energy capture in glucose, protein synthesis, growth regulation,
 - Immobile in plants – symptoms appear on new growth
 - N metabolism of plant – role in synthesis of amino acids
 - Delayed maturity with deficiency



Zn Deficiency Symptoms

- Yellowing in a broad band on one or both sides of the leaf
- Stunting and shortening of the internodes
- Smaller leaves
- Symptoms are similar to Group 2 herbicide injury in pulses



Deficiency Symptoms Occur With

- Cold wet spring
 - Reduced root growth, slowed diffusion, slowed release of zinc from organic matter by microbes
- Fine textured soils
- Topsoil removed (loss of organic matter)
 - Calcium carbonate on soil surface
 - Elevated soil pH



Likely Zn Response

- Previous crop – high Zn demand – depleted available soil pool
 - Corn, barley
- High rates of fertilizer phosphorus application
- Absence of manure application



Zinc Deficiency in Alfalfa

- Zinc deficiency in alfalfa extremely rare
 - Mycorrhizal associations increase uptake of diffusion supplied nutrients
 - P, K, Zn, Mn, Fe,



Zinc Deficiency in Barley



Photo credit: IPNI



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Zn Deficiency in Bean

- Yellowing of lower leaves
- Yellowing turns to bronze or brown as season progresses
- Potential confusion with sunburned leaves



Photo credit: Bean leaves showing chlorosis and browning due to a deficiency of zinc.

Howard F. Schwartz, Colorado State University



Zinc Deficiency in Corn



Photo credit: IPNI



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Zinc Deficiency in Flax



Photo credit: IPNI



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Zn Deficiency in Potato

- 1) Stunting
- 2) Brown spots on stems and petioles
- 3) Leaf malformation
- 4) Young leaves roll up – “fern leaf” – upward and cupping
- 5) Thick , brittle, and puckered leaves
- 6) Older leaves have grey-brown area and bronzing along margins



Photo credit: <http://www.yara.us/agriculture/crops/potato/crop-nutrition/deficiencies/zn/zinc-deficiency-potatoes-8772/>



Zn Deficiency in Soybean



Photo credit: IPNI



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Zn Deficiency in Tomato

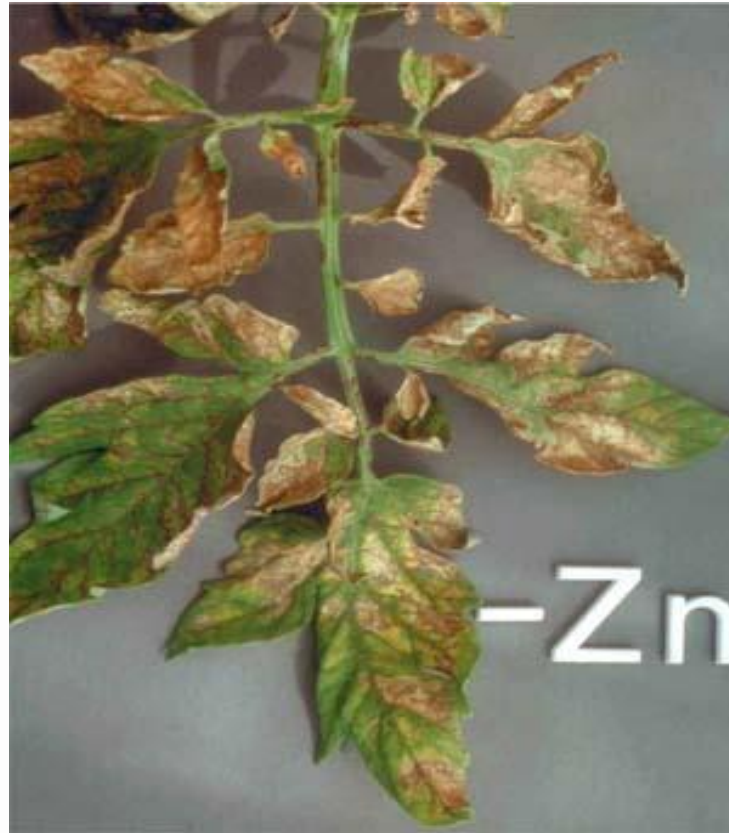


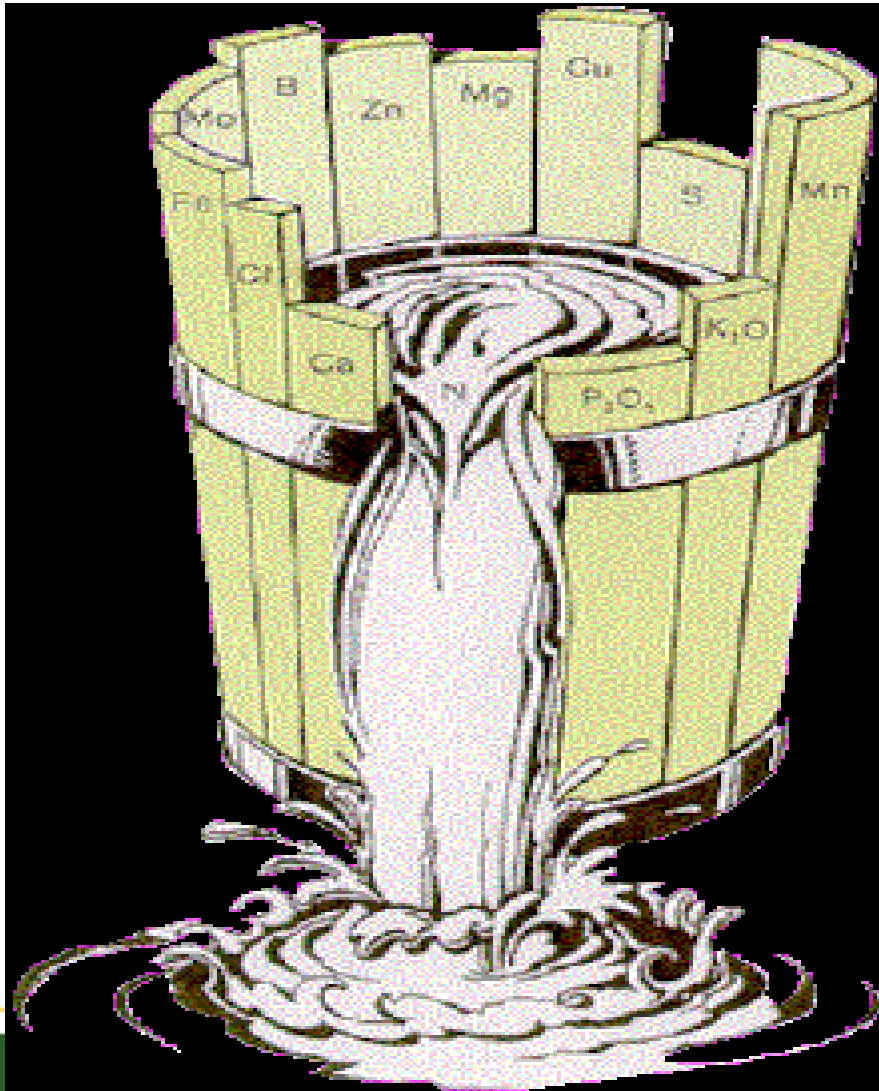
Photo credit: <http://5e.plantphys.net/article.php?ch=3&id=289>



Zinc Deficiency in Wheat



Liebig's Law of the Minimum



- The yield potential of a crop is like a barrel with staves (nutrients) of unequal length.
- The capacity of the barrel is limited by the length of the shortest stave and can only be increased by lengthening that stave.
- When that stave is lengthened, another stave becomes the limiting factor.

Source: http://www.microsoil.com/liebigs_law_of_the_minimum.htm



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Soil Testing for Zinc

DTPA extraction (lb Zn/ac)

Crop	Deficient	Marginal	Adequate
Bean	0 - 2.0	2.0 - 3.0	3.0 - 15.0
Potatoes	0 - 1.0	1.0 - 1.5	1.5 - 15.0
Corn	0 - 1.0	1.0 - 1.5	1.5 - 15.0
Cereals	0 - 0.5	0.5 - 1.0	1.0 - 15.0
Grass	0 - 0.5	0.5 - 1.0	1.0 - 15.0
Other crops	0 - 0.75	0.75 – 1.25	1.25 – 15.0

Source: ALS Laboratories



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Plant Tissue Analysis for Zinc¹

Crop	Plant Part	Adequate Above
Alfalfa	Top 15 cm of shoot prior to flowering	20 ppm
Barley	Whole plant at boot	15 ppm
Canola	Whole plant prior to flowering	15 ppm
Faba bean	Recent fully developed leaves at early flower	15 ppm
Field pea	Recent fully developed trifoliate leaves at early flower	25 ppm
Potato	3 rd to 5 th leaf blade and petiole at bud stage	15 ppm
Wheat	Whole plant at boot	15 ppm

¹Nitric Acid and Hydrogen Peroxide Digest with ICP Scan



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Management of Zn Deficiency

- Use soil testing and plant tissue analysis to evaluate unusual observations
- Keep on the lookout for signs of hidden hunger in your fields
- Test strategies with Zn strips in your fields to evaluate your ideas and conclusions



Correction of Zn Deficiency

- 2 ¼ actual lb Zn as granular blended in seed-placed or broadcast phosphate blend
- 2-3 granules per linear foot with 12" row spacing for 8 lb/ac of 36% ZnSO₄ fertilizer
- Fertilizer absorbed into plant shoots and roots and spread in plant residues
- Fertilizer impregnation with liquid Zn fertilizer
 - better distribution in soil



Correction of Zn Deficiency

- Zinc is adsorbed to soil colloids and is not prone to leaching or loss other than erosion and crop removal
- Common fungicides may provide adequate zinc to soils to correct a deficiency.
- One time application of 4 lb/ac Zn may be adequate for 10-20 years.



Conclusion

- Zinc deficiency is most common on calcareous, high pH, eroded or land leveled soils
- Although zinc is fairly costly to apply, with the appropriate application method, it will provide returns on a responsive field for many years.

