Foliar Micro Nutrients in High Management Crop Production

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The Next Yield and Quality Level – How Will We Get There?

- 1. Wait and wish upon a pink moon rising over the left branch of an Aspen tree at 9500 feet, while a blue fairy sprinkles pixy dust, and we repeat three time "I hope for 300 bu, I hope for 300 bu, I hope for 300 bu"
- 2. NO It Will take!
 - 1. Knowledge
 - 2. Time
 - 3. Hard Work
 - 4. Leadership
 - 5. Innovation
 - 6. Courage

3. There Are No Silver Bullets:



Genetic Yield Potential & Fertility Management

- Plant genetics and fertility management are the major factors that influence the plants ability to optimize yield and <u>quality</u> in cropping systems.
- Maximizing plant fertility is a key factor in optimizing the plants genetic potential in any cropping system.

New Terminology

Sink to Source Relationship

Leaves x Roots

Roots x Leaves X Fruit

<u> Pounds per acre per day vs. ppm in the soil</u>

It is all about what gets in the plant over time!

✤ We Have to Manage The Above!

 \geq ? = How

- Soil Sampling Enough? =
 - Tissue Sampling
 - Resin Balls/Cylinders

Need to Think <u>Physiology not Fertility</u>

Need to Create Thinking Agronomists and Work with Thinking Farmers

Photosynthesis



Diagram of nutrient role in plant cell

What we are selling the grower is plant physiology. Every essential nutrient is found in every leaf cell of every plant. Genetic Families are driven by plant nutrition.

Boron= Rate of Growth. **Stalk Strength** Mn Mn = RateMo Cu ENZYME of Growth, NUCLEU **Grain Fill** Period, Test NUCLEOLUS Weight DNA LINKER CYTOPLASM Cu MITOCHONDRION Mg Mn VACUOLE Zn = Cell division MITOCHONDRION CELLWALL and Cell Differentiation. Leaf Area, Bloom (numbers and set) Winfield Solutions, EL company

Things That Must Be Considered

- Are you truly in need of the element?
 - Indiscriminate applications cause issues!
- At what growth stage is the element affecting yield and/or quality?
- What provides the best ROI to the producer? Soil, Foliar, Fertigation, Seed Applied?
- What form is the element in that will be applied?
- What will it be tank mixed with?

Factors Affecting Nutrient Uptake

•<u>Negative</u>

- •-High RH of the air and reduced transpiration.
- Certain Herbicides.
- •-Soil compaction.
- •-Puddling of soils.
- •-Plow pan.
- •-Too low or too high of soil pH.
- •-Water logged soils.
- •-Dry soil.
- •-Cold soil.
- •-CO₂ enrichment.
- •-O₂ def.
- Restricted root growth.
- •-Insect and disease of roots and vascular system.

• Positive

- •-High transpiration of plants
- Good soil structure and O₂ supply to roots
- •-Optimal soil humus content and adq. supply of organic matter
- •-Intensive activity of the soil organisms
- •-Presence of Soil Micorrhizae
- •-Optimum pH
- •-Moist soils
- •-Warm soils
- Good root system

Soil Applied Micro Nutrients

- Form
- Placement
- Do we really need to be building soil levels in high yield environments?

Resin Ball Data From Nine Commercial Locations in KS and IA

% as Di-Valent Cations of ppm of DTPA Extracted



Winfield Solutions, LLC 11

Soil Applied: Forms

- Nothing Has Really Changed Much
 - Broadcast
 - Sulfates and Oxy Sulfates
 - Oxides still???
 - Liquids
 - Ammoniated Zinc
 - Chelated
 - EDTA, Citric Acid, EDDHA, Amino Acids, Fulvic Acids, Sugars or Carbohydrates.
 - 2, What are the base materials that we are reacting?
 - Sulfates
 - Oxides
 - Nitrates
 - Carbonates

Soil Applied: Placement

- In Furrow or Starter
- Strip Till
 - How deep and how many placements
- Drip tape
 - Timing?
 - Form?
- Injection on Center Pivot
 - Timing?
 - Form?

Foliar Applied Micro Nutrients

- Form
 - Nitrates
 - Sulfates
 - Oxides
 - Carbonates
 - Hydroxides
 - Acetates
 - Amino Acids
- Uptake
- Duration
- Timing

Uptake Obstacles For Foliar Applied Nutrients



Britannica



Overhead Comparison







1.0 microliter

Cuticle and Stomata

Figure 24. Relative comparison of adjuvants for performance, weed control, and crop injury potential.



Uptake:

Stacey and Oosterhuis, 2005

The leaf cuticle is a hydrophobic layer, comprised of high-molecular-weight biopolymers, such as cutins and suberins, and hydrophobic C_{14} - C_{7} epicuticular waxes (Holloway, 1993). Recent physiological studies have identified polar aqueous pores, which may facilitate the absorption of charged ions into leaf epidermal cells (Schonherr, 2000). Nutrient sorption via aqueous pores is a relatively slow process, however, as the cuticle still represents the primary barrier for foliar nutrient absorption. We hypothesised that the negative charge of metal-EDTA complexes and their high molecular weight would reduce the rate of trace element absorption through leaf cuticles. The narrow size (0.3 nm) and negative charge of aqueous pores (Popp et al., 2005; Schonherr and Schreiber, 2004) may hinder the diffusion of anionic, high molecular-weight species such as EDTA. The aim of this investigation was to determine whether EDTA would affect trace element sorption by leaf cuticles and slow nutrient absorption into leaves.

Effect of Form of Micro on Cuitcle and Leaf Uptake. Stacey and Oosterhuis, 2005

Table 1. Sorption of Zn and Fe fertilizers by enzymatically excised *Citrus sinensis* leaf cuticles.

Sorption by leaf cuticle (µg metal/mg cuticle)



Uptake

Treatments	Fe Content in Soybeans
1 qt/ac Fe w/o Adj	175
1 qt/ac Fe with Adj	215 23% Increase
2 qts/ac Fe w/o Adj	220
2 qts/ac Fe with Adj	252 15% Increase
4 qts/ac Fe w/o Adj	255
4 qts/ac Fe with Adj	334 31% Increase

Fe EDTA

Uptake

Treatment	Fe Content in Soybeans (ppm)
Check	90
Fe with Component A and Component B	169
Fe with Component A only	107
Fe with Component B only	126

Fe sulfate

Adjuvant Affects and Element Source on Nutrient Duration



Timing: Calcium Movement Into Fruit

- There is an early *movement* (not to be confused with absorption) of calcium towards the fruit which corresponds to the period of cell division within the fruit
- After this time calcium migrates to the growing points (new sites of cell division)
- It is cell division which acts as a 'calcium pump' drawing calcium towards the fruit. This phenomenon can be used to improve the early migration of calcium to developing fruits







Calcium Builds in fruit from Petal Fall until apple is approx. golf ball size (cell division stops)





Thank You

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