Foliar application of Micronutrients on High Yield Soybeans

Vatren Jurin

"High-Yield Soybeans Suck Up More Nutrients"
Feb 1, 1998 Mick Lane

THE CORN & SOYBEAN DIGEST

"As soybean yields edge upward, there's a growing risk that nutrient deficiencies will put a lid on further yield gains.

The problem that may have snuck up on you, especially if you're pushing hard for high yields, is shortages in the secondary and micronutrient complex. Those elements are seldom considered, unless an obvious deficiency raises a red flag. "

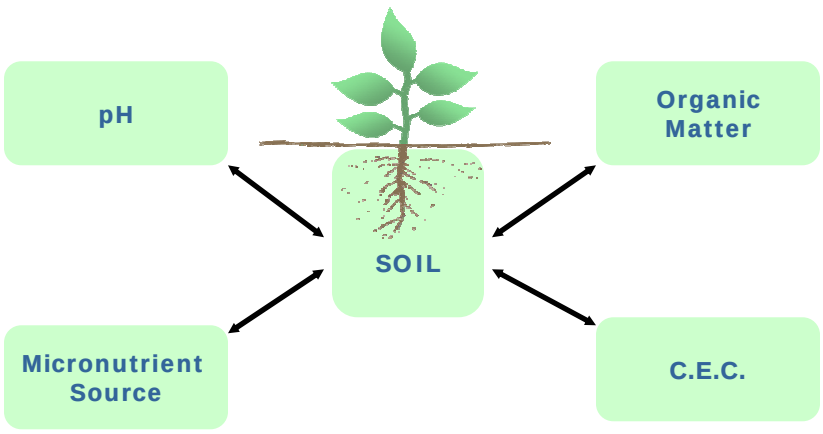
Micronutrients on High Yielding Soybean systems

- Where do Micronutrients come from ?
- Transient Nutrient Deficiency
- Foliar application of Mn and B

Where do Micronutrients come from ?

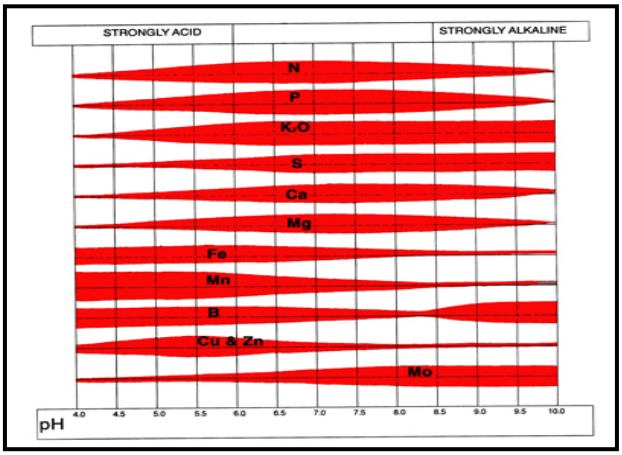
- Soil
- Fertilizers

Factors Influencing Micronutrient Availability



Soil pH Affects Availability of Plant Nutrients

pH is the quantitative measure of the acidity or basicity of aqueous or other liquid solutions. The term, widely used in chemistry, biology, and agronomy, translates the values of the concentration of the hydrogen ion in solution.

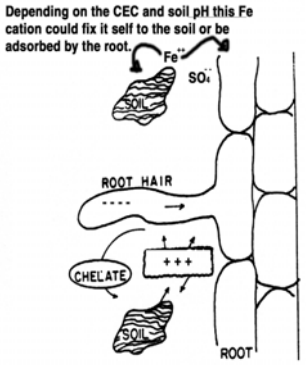


Cation Exchange Capacity

The ability of a soil to hold exchangeable cations.

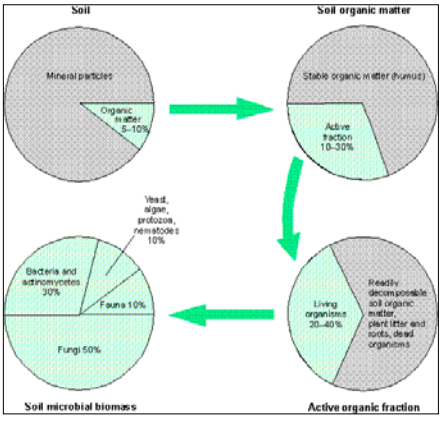
- Soil clay and organic matter have negatively charged sites.
- Readily exchangeable with solution ions & then available for plant uptake.

Cations (+)	Anions (-)
Ca, Mn, S	Phosphates
Fe, Cu, Mg	Sulfates
B, Mo, Ni	Nitrates
Zn	Chlorides
	Carbonates

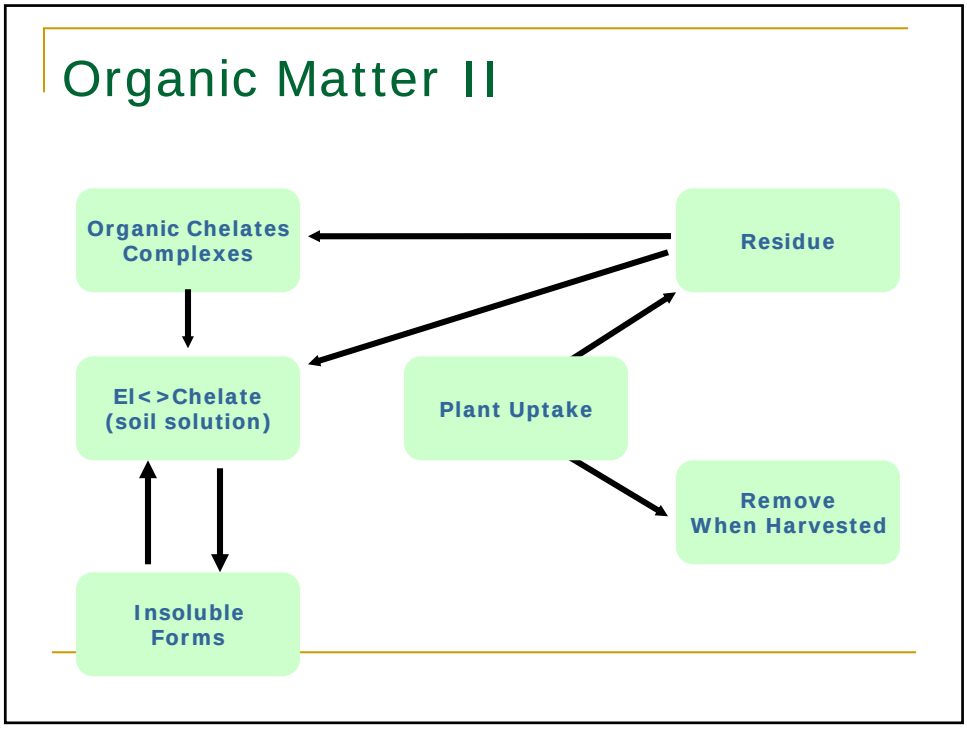


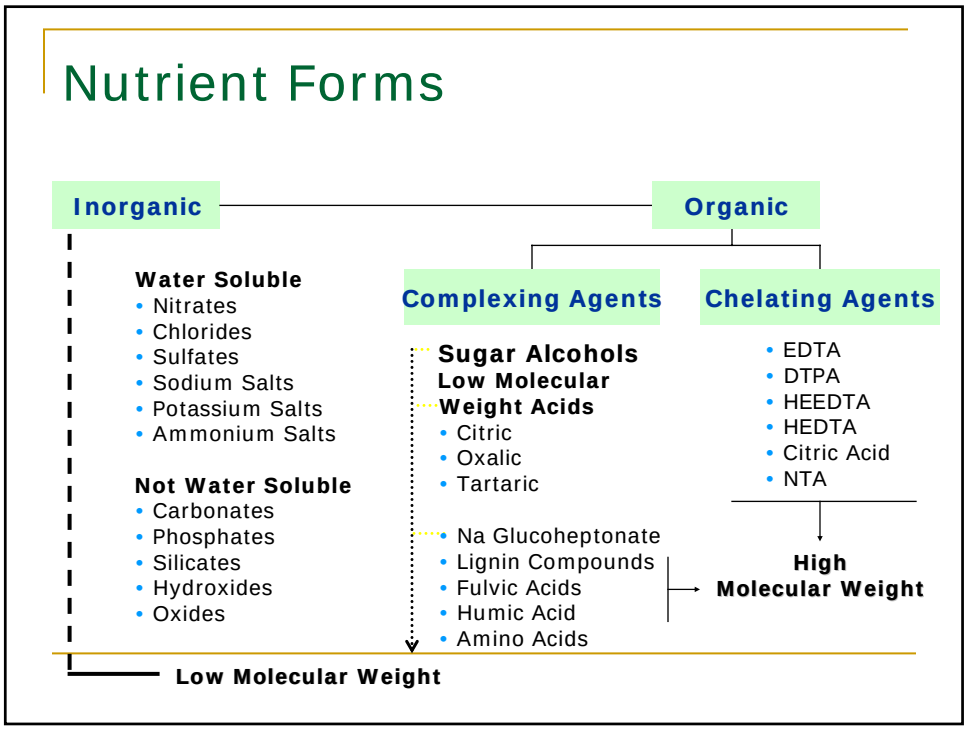
Organic Matter

- Reservoir of plant nutrients.
- Chelation and complexing of micronutrients.
  - Organic compounds form complex with metals.
  - Keeping them soluble and available for uptake.



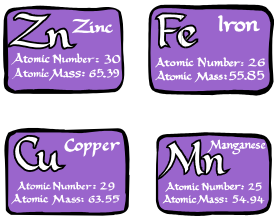
Courtesy
Agri Food, Canada

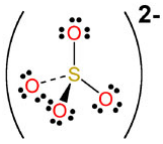




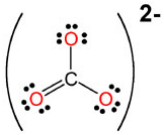
INORGANIC SALTS

- Metal exposed
- Water Solubility
- Not Complexed

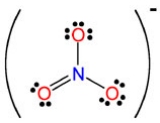




Sulfates



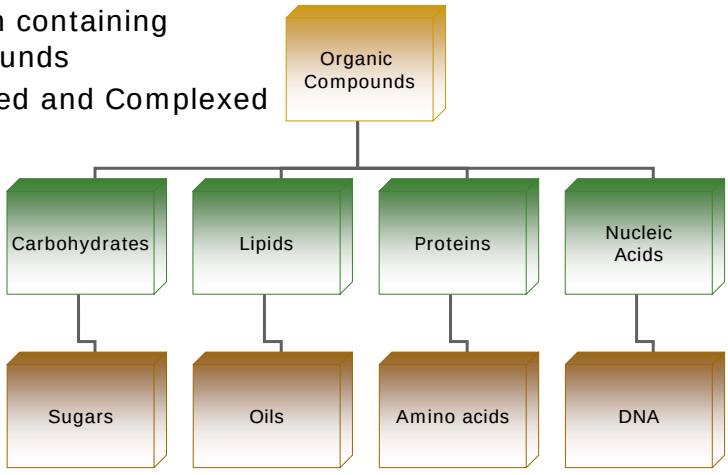
Carbonates



Nitrates

ORGANIC

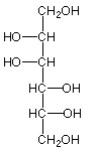
- Carbon containing compounds
- Chelated and Complexed



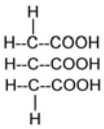
Complexes

- Sugar Alcohols
- Organic Acids
- Glucoheptonates
- Lignin Compounds
- Amino acids

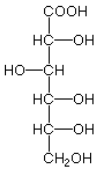
- Water Soluble
- Are present in all biological organisms.



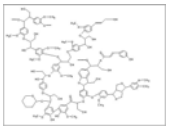
Mannitol

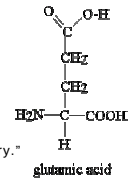


Citric Acid



Gluconic Acid


Lignin
(Courtesy of "Real-World in green chemistry."

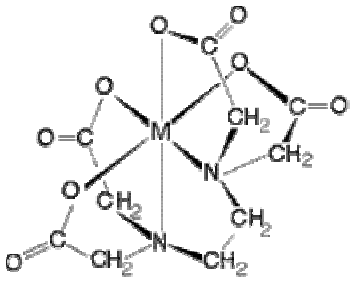


glutamic acid

Synthetic Chelates

- EDTA
- EDDHA
- DTPA
- HEDTA
- NTA

- pH range
- Synthetic
- Metal scavenger
- Carcinogenic



Metal-EDTA complex

TRANSIENT NUTRIENT DEFICIENCY

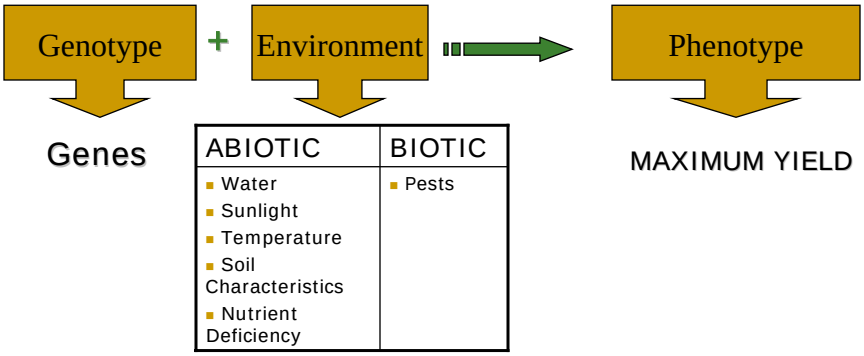
- The specific demand of a nutrient during reproductive growth or periods of peak demand.
- Occurrence
  - Environmental
  - Artificial

Transient Nutrient Deficiency In Soybeans

- Environmental
  - Temperature
  - Moisture
  - Transition between vegetative growth and reproductive growth
- Artificial
  - Liming (Soil Amendment)
  - Genetics ??
    - Adaptation
    - Glyphosate

Genetics

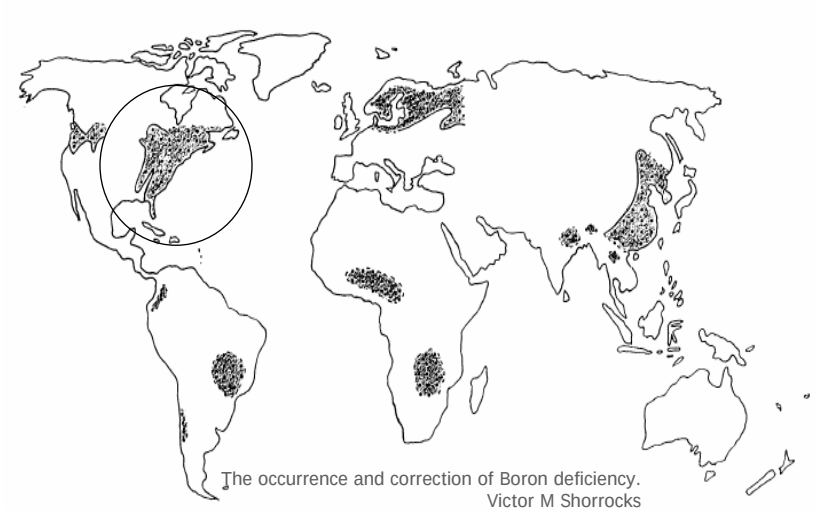
- Non native plant
- Glyphosate resistance gene
  - Do we know how to grow it ??



Foliar application of Mn and B

- Boron
  - .. Least understood plant nutrient ….
  - Involved in more than one key area (*)
  - Reproductive Stages
    - Pollination
    - Flower set
    - Pod set
    - Bean fill
- Manganese
  - Aids in chlorophyll production.
  - Synthesis of phenols (Plants natural defense)
  - Biosynthesis of Lignin (Hardy roots)

Boron



Boron deficient areas. Areas identified on the basis of crop responses to boron and by soil B analysis.

Boron

- " ..the total demand for Boron in a crop is a function of the yield realized.
- ..therefore a crop which yields 40 bushels per acre will have a lower Boron requirement than one which yields 60 bushels..

Why foliar Boron works …

- Indiana Soils are deficient (For Soybeans)
- Water dependent
- Early Glyphosate applications are the correct timing for Boron use on Soybeans.

How Boron Increases yield

- Evaluated the content of B and other elements in main stems and branch leaves and seed of Soybean.
- Foliar Boron increased the content of B and other elements on branch leaves, pods and seed.
- Increased yield due to more branches holding pods.

- Maximizes use of nutrients by helping their movement through the plant.
- Increases amount of branches and pods on the branches.
- Increased amount of seeds on pods on branches and main stem.

Content of Boron and Other Elements In Main Stem and Branch Leaves And Seed of Soybean

T.M. Reinbott, D.G. Blevins and M.K. Schon
Journal of Plant Nutrition, 20(7&8) 1997

How Boron Increases yield

Manganese

- .. Soil diseases have a more difficult time infecting plants with adequate amounts of Manganese …
- Reduced chlorophyll production during growing season:
  - Glyphosate application
  - Cool and wet late spring to early summer

Areas of Manganese Deficiency
(Purdue University Extension Bulletin AY-276-W)

Manganese

- ".thus, nutrition, although frequently not recognized, always has been an important factor in disease control"
- " the severity of most disease can be greatly reduced by complete nutrition"..
  - Don Huber (Purdue)

Why foliar Manganese works

- Certain soils in Indiana are naturally deficient.
- Indiana soils have a high available Fe content inhibiting the application of Mn fertilizers.
- Acid based starter fertilizers will allow temporary assimilation of Mn until the soil starts buffering it self.
  - pH above 6.2 Mn becomes unavailable.
- Foliar
  - Glyphosate its self is a chelate with strong affinity to Manganese ties it up in the plant.
    - Work at Purdue suggest to apply foliar Mn a 9 days after Glyphosate application. (Dr. Huber and collaborators)

How Manganese increases yield

Conclusions

- Micronutrients are essential components for maximizing yields.
- Proper agronomic practices will enhance the ability for the soil to provide the crops need.
- Foliar nutrition is an excellent tool to deliver micronutrients when the Soybean plant needs it the most.

Conclusions

- New soybean practices have increased the opportunity to feed your crop with the proper nutrient at the proper time..
  - Glyphosate
  - Fungicides (Soybean rust !!!)

REFERENCES

- Manganese Deficiencies in Indiana Soils (Purdue University Coop Extension bulletin AY-276-W)
- Management of Nutrition To Control Plant Pathogens (Don M. Huber, Botany & Plant Pathology Purdue University)
- *Content of Boron and Other Elements In Main Stem and Branch Leaves And Seed of Soybean (*T.M. Reinbott, D.G. Blevins and M.K. Schon Journal of Plant Nutrition, 20(7&8) 1997)
- Transient Nutrient Deficiency lecture. (Dr. Patrick Brown, UC Davis)
- Boron in Plant and Animal Nutrition (Kluwer Academic /Goldbach, Rerkasem, Wimmer, Brown and Bell)
- The occurrence and correction of Boron deficiency. (Victor M. Shorrocks / Plant and Soil 193:12-148, 1997)