



Micronutrient Formulations and How They Fit Into Nutrient Programs

COMPATIBILITY PROPERTIES WITH LIQUID FERTILIZERS

Essential Elements for Growing Plants

Primary and Secondary

- ▶ N
- ▶ P
- ▶ K
- ▶ Ca
- ▶ Mg
- ▶ S

Micronutrients

- ▶ Zn
- ▶ Fe
- ▶ Mn
- ▶ Cu
- ▶ Mo
- ▶ B
- ▶ Co

Compatibility of Micronutrient Formulations with Liquid Soil and Foliar Fertilizers

- ▶ The metallic micronutrients (Co, Cu, Fe, Mn & Zn) have many incompatibilities
- ▶ The small amounts we apply requires good uptake and compatibility with other nutrients when tank mixed
- ▶ We will focus on Zinc to simplify the information and because it is normally of the highest interest

Available Sources of Micronutrient Formulations are Many

- ▶ Oxides
- ▶ Sulfates
- ▶ Citrates
- ▶ Gluconates
- ▶ Glucoheptonates
- ▶ EDTA Chelates
- ▶ Amino Acids
- ▶ Lignosulfonates
- ▶ Nitrates

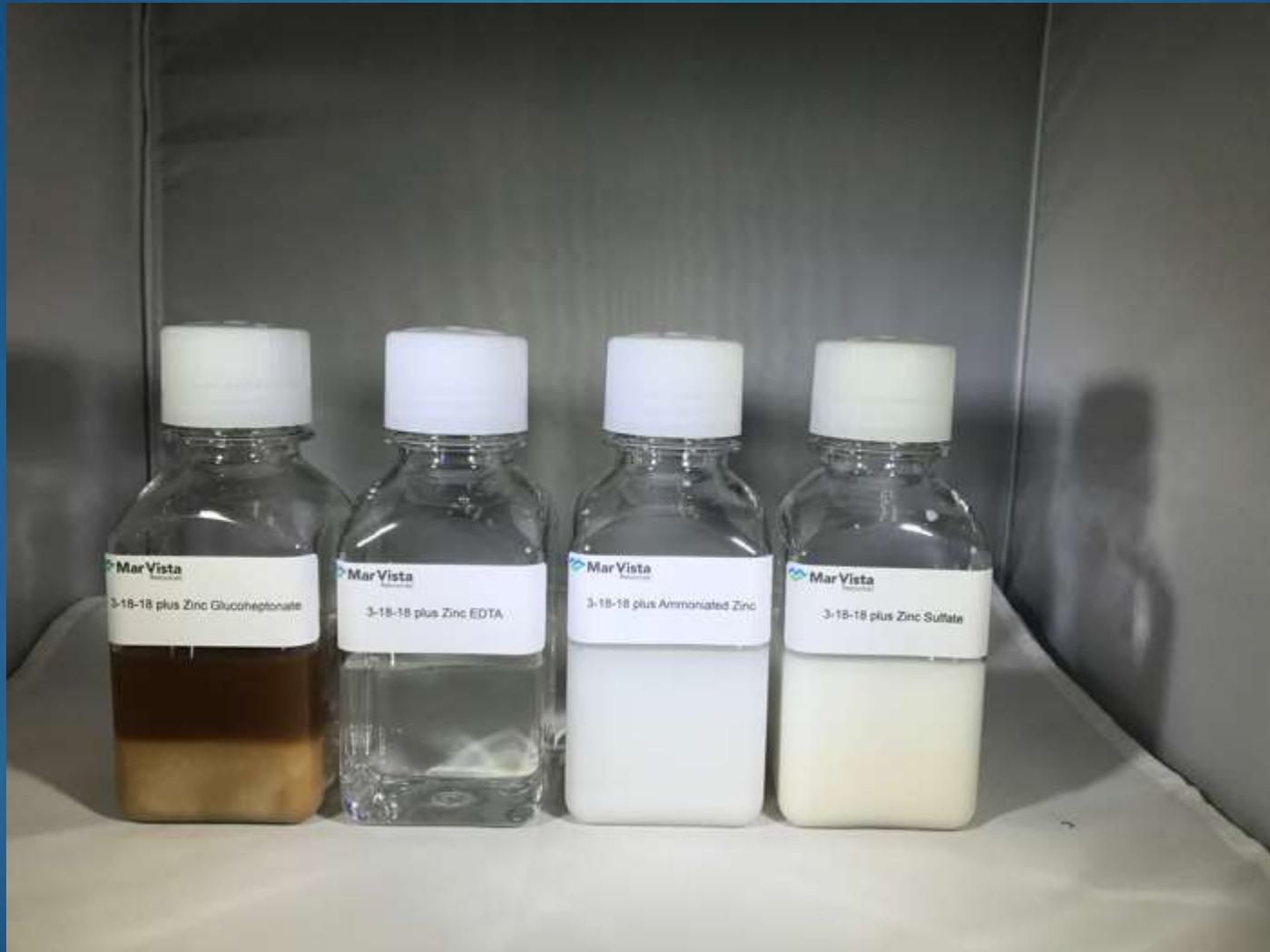
What's Important

- ▶ Micronutrient Formulations in Fertilizer Blends for Fertigation or Soil application
- ▶ Determining the correct formulation depends on the blend properties

Micronutrient Compatibility with Ortho Phosphates

- ▶ Ortho-Phosphate at neutral pH requires fully chelated micronutrients in concentrated blends except for Boron and Molybdenum
- ▶ EDTA or better chelates at a full one to one molar ratio of metal to chelating agent is required

Ortho Phosphate Compatibility



Micronutrient Poly Phosphate Compatibility

- ▶ Polyphosphate such as 10-34-0 can provide some chelation for small amounts of Fe, Mn, Zn or Cu
- ▶ Small means <1% total metals in pure 10-34-0
- ▶ In blends such as 4-10-10 this must be reduced to about 0.25% unless chelated formulations are used
- ▶ Liquified metal solutions such as lignosulfonates, amino acids, citrates, glucoheptonates, gluconates and ammoniated zinc products are examples of complexes that work with Polyphosphates

10-34-0 Polyphosphate Chelation



10-34-0 Polyphosphate Chelation Capacity



The Good News

- ▶ Most nitrogen and potassium sources will work with complexed micronutrients
- ▶ Exceptions are high pH materials like potassium carbonate which will form insoluble carbonates or hydroxides.
- ▶ UAN solutions, KTS, MOP, Urea, AN-20, ATS all work with most complexed materials

The Bad News

- ▶ Calcium solutions like CATS, Calcium Nitrate and CAN-17 are mostly incompatible with many micronutrients
- ▶ Even fully chelated EDTA products will not store for very long in strong calcium blends
- ▶ The Calcium will bind to the EDTA preferentially to the metal causing the zinc, for example, to precipitate
- ▶ Many micronutrient formulations start out as sulfates which can form insoluble gypsum in the blends

Calcium Compatibility



Calcium Compatibility with Nitrates vs. Salts



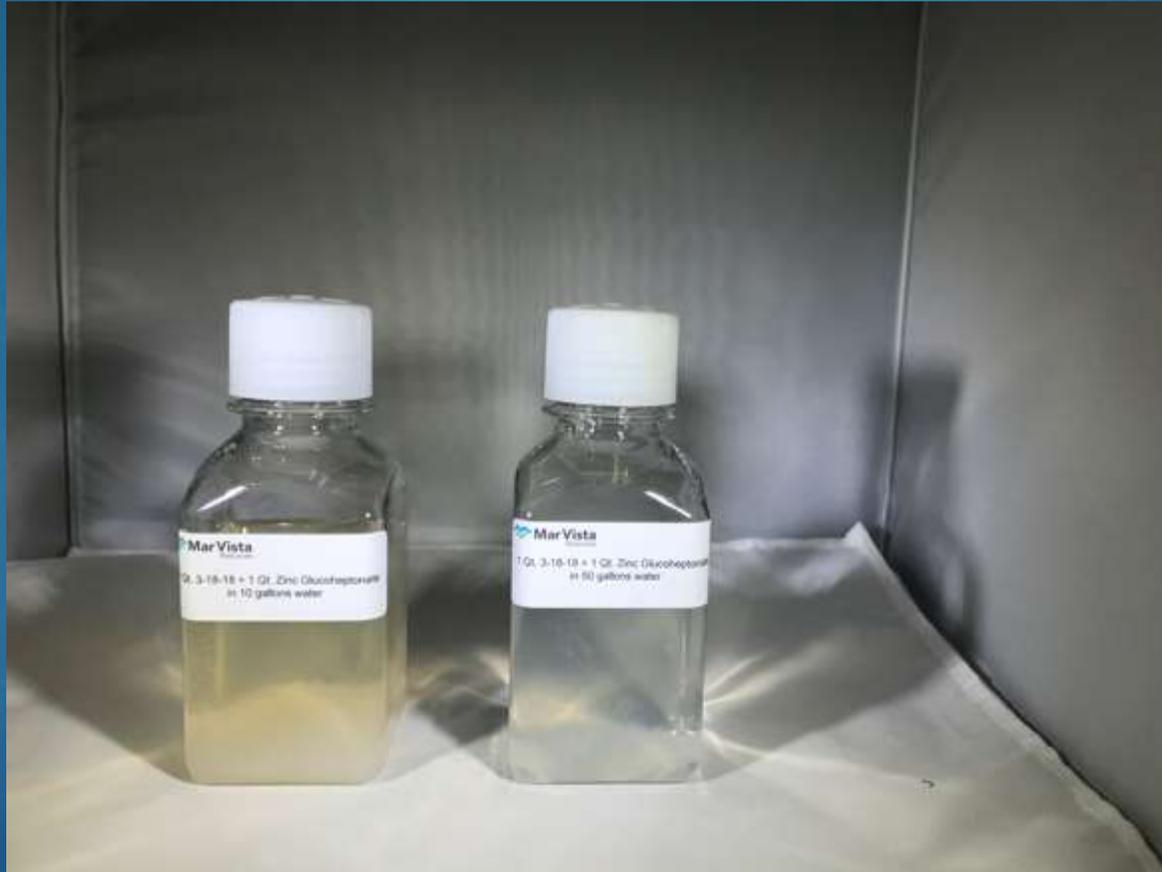
Soil Application

- ▶ In the soil, most non-chelated micronutrient formulations are prone to tie up by phosphates and silicates in the soil structure
- ▶ Common complexes have poor mobility in the soil solution and are very inefficient sources
- ▶ Some specialized materials can cause plants to scavenge these elements from the soil by causing exudates from roots which will bind the nutrients for root uptake.
- ▶ Organic matter in the soil helps as well.

Micronutrients For Foliar Applications

- ▶ Since foliar sprays are fairly dilute some differences from soil applications occur
- ▶ Spray tank concentrations can often alleviate the incompatibilities
- ▶ However, what works in 50 gallons per acre may not work in 10 gpa

Micronutrient Concentration in Spray Tank



Foliar Applications can be Very Good Depending on Formulations

- ▶ Solutions of straight salts like zinc sulfate are not well absorbed and are prone to produce phytotoxicity on foliage
- ▶ Complexing agents such as citric acid, lignosulfonic acids, glucoheptonates, gluconates, amino acids and others form weak bonds which improve absorption and reduce salt effects on foliage

Foliar Micronutrient Formulations

Compatibility Characteristics

- ▶ Most of these formulations start out as a soluble salt such as sulfate or nitrate and the complexing agent is added to allow more flexibility in pH and compatibility.
- ▶ Often the key to quality is the amount and identity of the complexing agent in the formulation

When in Doubt of Micronutrient
Formulation Compatibility with
Fertilizers Always do a Jar Test
First Before Mixing



Thank You