



# Modern Micronutrient Use Considerations

**Fertilizer Industry Round  
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# Essential Micronutrients

## Formulae

- Those that solve the problem
- Shotgun vs. rifle
- Raw material vs. formulated vs. actual sale

## Elements

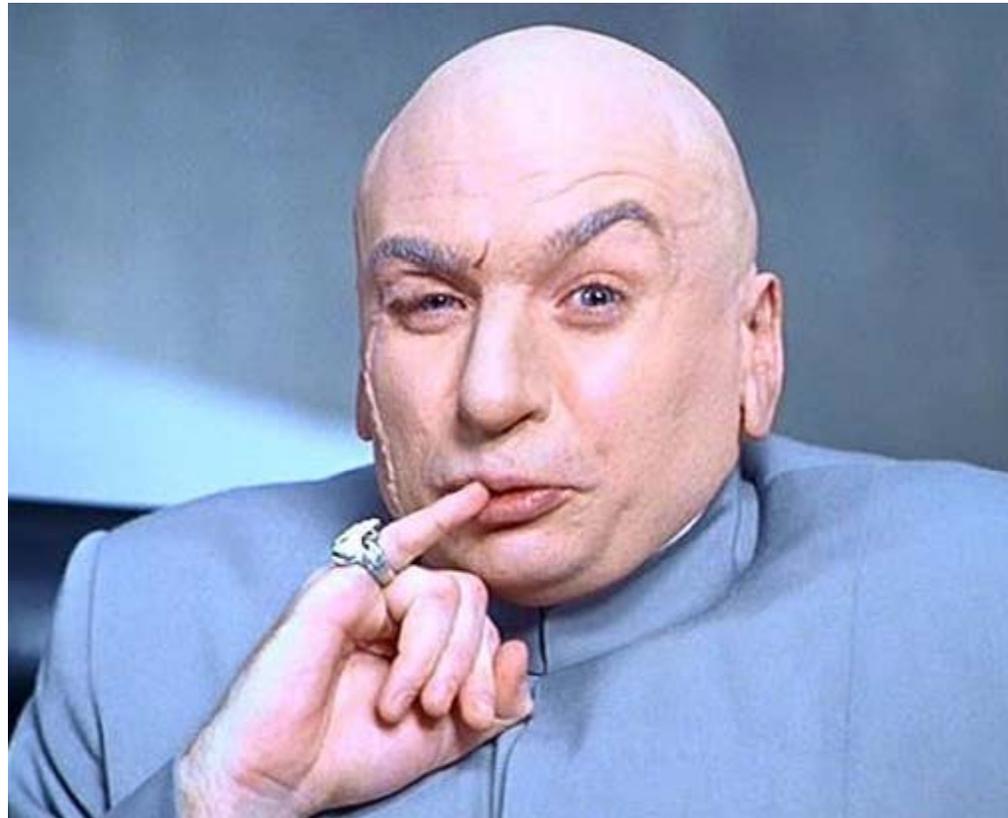
- Zinc
- Boron
- Iron
- Manganese
- Copper
- Molybdenum
- Ni, Se, Si, Co, Cl?

# “Major Players” vs. Finesse



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# Industry Overview



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# U.S. Market Ranking – reality?

- Zinc – 45%
- Iron – 25%
- Boron – 20%
- Manganese – 8%
- Copper – 2%

# Market Realities?

- Fertilizer distribution channels comfort zone is commodity trading and logistics
- Ag chem distribution used to jugs and “specialty” markets
- Neither model perhaps understands the nuances of “non-agricultural” commodities, raw materials, real life agronomics, metal markets etc.....
- As a result, any guesstimate of the market is meaningless
  - Raw materials
  - Sales to distribution – double / triple count
  - Adjuvants / biologicals / others

# Issues

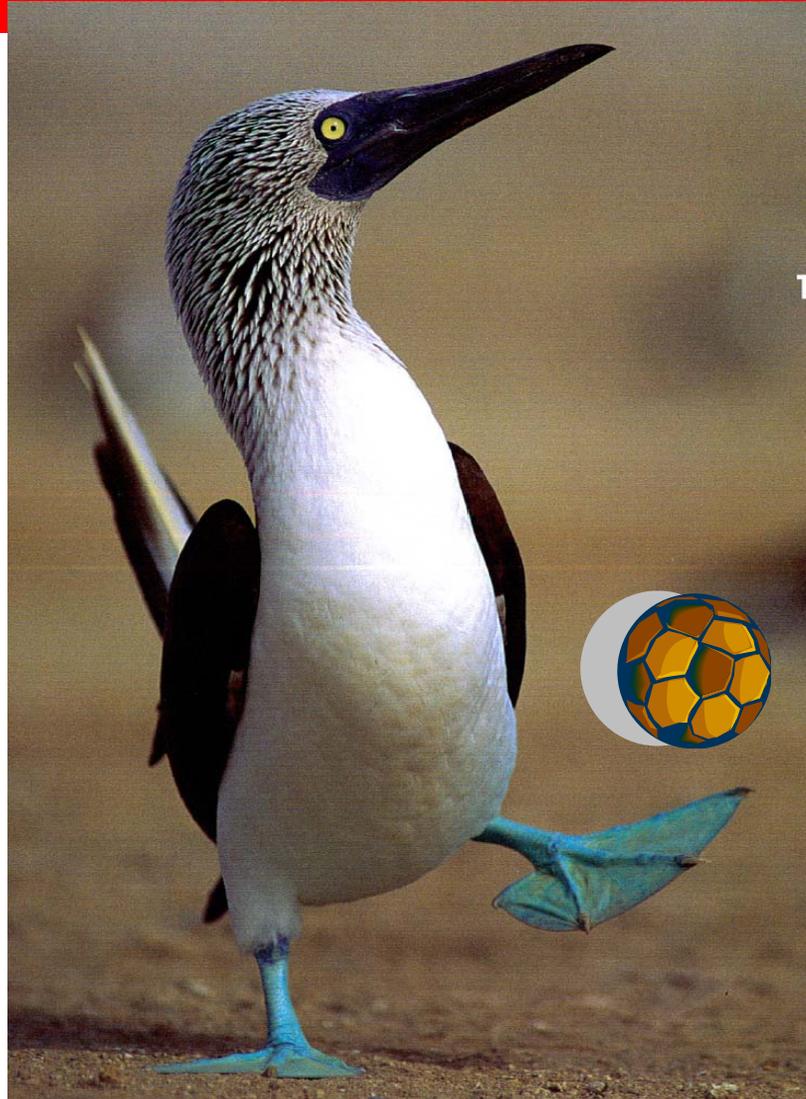
- Secondary nutrients (e.g. Ca, Mg) often dumped to “micros” – i.e. afterthought
- Agronomic “research”
  - Solution culture vs. soil
  - Curative (loser) vs. Preventative (there’s a novelty)
  - Yield as the Holy Grail?
  - Nutritional / Quality – poor NPK practices?
    - Constitutive
    - Chemical
    - B, Mn, Ni classics
  - Genetics – you generally need a seed to grow a crop – *ignore at your peril*

Not an attractive market?



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# How to be a happy booby....



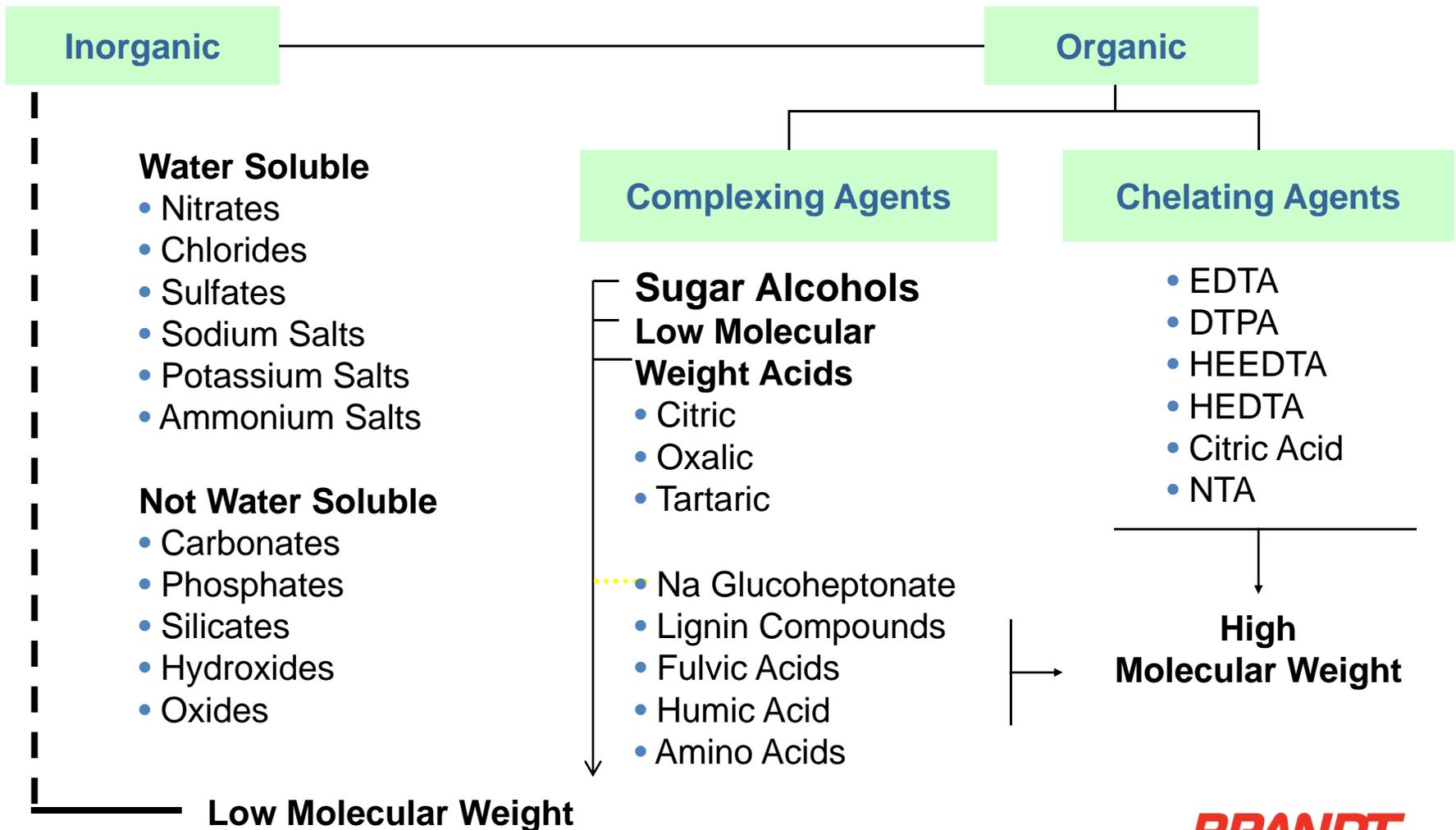
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It is somewhat of a play-pen but there are rules.....



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# Here's the playpen



# Solutions

- Inorganic vs. Organic
- Complexes vs. Chelates vs. Salts
- Stability constant
- Role of pH and soil type
- Organic matter
- Solubility and plant availability

# Considerations

- Molecular weight, size, dimension
- Soil or foliar? Both?
- In plant mobility?
- Biodegradable / environmental compatibility
- Chemical compatibility
- Phytotoxicity
- Stability constant

## Agronomic considerations – try not to forget the plant...

- Micronutrients usually applied in amounts of less than 10 lb metal /ac
- Problems?
  - Uniformity of soil application – surface activity
  - Liquid vs. dry
  - Are the combinations plant available?
    - Biological / chemical - glyphosate
  - Can you get it out of the spray tank?
  - Crop safety issues – timing (pollenation)
  - Predicting the problem

# Soil applications

- Strong chelate
- Compatible with fertilizer
- Plant mobility not an issue, chemical stability is....
- Local market / custom usually dictates
  - Liquid / dry
  - Chelate vs. salt (starter vs. fall blend)
  - Cost per lb / vs. cost per acre

## % Zn remaining after 4 minutes mixing with a 1-2-0 ortho P

■ ZnEDTA	100
■ ZnPhenolic	11
■ ZnCitrate	8
■ ZnSO <sub>4</sub> -NH <sub>3</sub> complex	8
■ ZnSO <sub>4</sub>	4

# Foliar applications

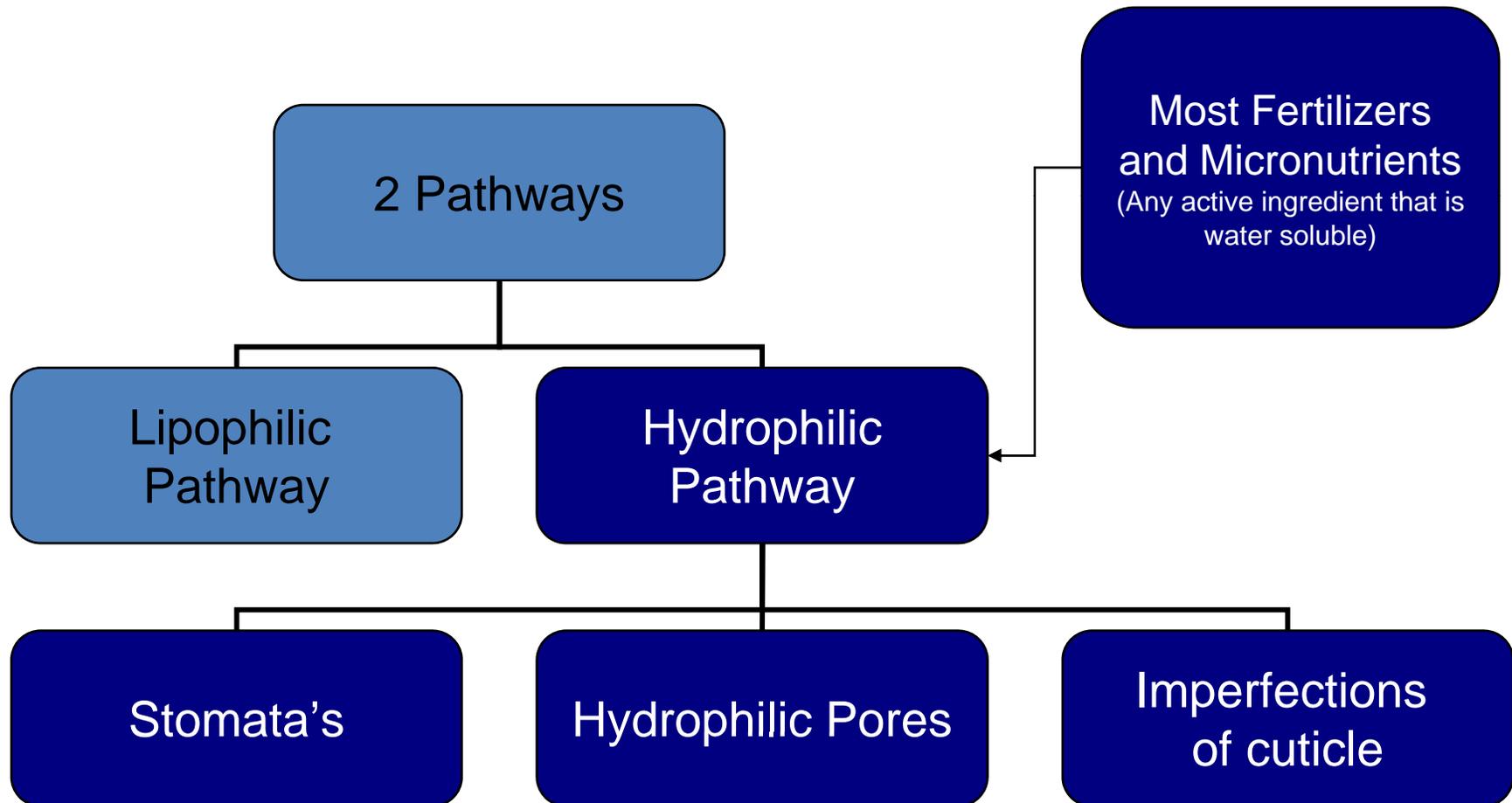
- Much maligned in “conventional” circles
  - Cure all vs. agronomic proven supplement
  - Muck and mystery vs. proven solutions
  - Ignorance at “research” level is a hurdle (disparate disciplines)
- Multiple ride opportunities?
  - Glyphosate / herbicide
  - Fungicide
  - Corrective / compensatory / additive aspects

# Foliar needs

- Weak complex
- Low molecular weight
- High water solubility
- Low phytotoxicity
- Plant analog
- In-plant mobility

# Foliar Applied Ingredients

2 Pathways



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# Leaf Penetration (Cuticle)

- Lipophylic
  - Non-electrolytes – organic molecules
    - Agrochemicals
- Hydrophylic
  - Polar / Aqueous pathways
  - Hydrated ionic compounds (sugars, inorganic ions)
  - Pores – 0.45 – 1.18 nm

## Factors influencing permeability of inorganic ions and charged molecules across plant cuticles

- E.g. –  $\text{Ca}^{2+}$ , glyphosate, precipitation at pore (Fe)
  - Humidity
    - 2-3 x greater as RH approaches 100%
    - Sorption of water to polar domains
    - = swelling of cutin polymer
    - = increased penetration of ionic compounds
  - Temperature
    - No effect (except humidity)
  - Light
    - Rates of salt penetration 2-fold lower in dark
  - Molecular weight
    - Reduced 3-10x as Ca salt increases from 100 – 500 gmol

## In summary – the crop or end-user that counts?

- Operational vs. agronomic service
  - Just another SKU or a business necessity?
- Prescription vs. insurance
  - Re-birth of real agronomists
- Chemistry vs. price
  - Sophisticated products in a singularly unsophisticated market
- Soil vs. foliar
- Yield vs. quality
- Nutritional value of the crop

Sometimes it helps to stay quiet and look inconspicuous.....



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# Regulatory health warning and thank you.....



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