

Calcium, Silica, & Boron



MINERAL SYNERGIES FOR PLANT HEALTH

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Approaching Agriculture - Philosophy



- Brix Bounty Farm – Growing Food with Respect for the Earth & Future Generations
- Keys to Healthy Crops
- Addressing mineral deficiencies in our soils, increasing biological activities to ensure these minerals are available and biologically complexed, and ensuring adequate moisture and air in our soils we can achieve healthy crops.
- Yields and Farm Viability are Connected with Soil Health

Plant Functions and Benefits of Calcium



- **Growth**
 - Proper cell division & elongation
- **Structure**
 - Proper cell wall development
 - Quality and Storage Life
 - Disease Mitigation – Calcium Pectate in Cell Walls re: Fungi
- **Assist Nutrient Uptake**
 - Secondary Messenger – “Guard” Stimulating Protein Channels

Plant Functions of Silica



- Protection from Stress
- Silica in Cell Walls
 - Abiotic – Rigidity
 - ✦ Protects against nutrient toxicity
 - Biotic – Resist Fungal Stress with Stronger Cell Walls
- Promotes Biosynthesis of Defense Compounds:
Secondary Plant Metabolites – (equisetum, etc.)

Plant Functions of Boron



- Cell Wall Structure
 - Bonding of Polysaccharides (molecular staple)
- Cell Division (all new growth)
 - Root Tips, New Leaves, & Bud Development, etc.
- Sugar Transport
 - Increased rate of transport from mature leaves > new growth
- Transporter of Potassium to Guard Cells (Stomata)
 - Water balance, transpiration > mass flow (nutrient uptake)

General Recommended Amounts (in Soil)



- Calcium
 - Base Saturation Approach – Levels Determined by CEC
 - Sufficiency Levels of Available Nutrients (SLAN) – McKibben
 - ✦ Low CEC soils
 - Reams – Available Calcium 3000 pounds per acre
- Silica
 - Silicic Acid – key to availability (weathering and/or bioactivation)
 - New Testing Methods In Development
- Boron (anion) readily leaches with nitrogen
 - 1-3 ppm Based on Crop, Timing, and Calcium Levels

Calcium (Availability)



- Misconception: If you have a high pH you always have plenty of Calcium available. (False)
- CEC – Quantity
- Competition with other Cations

- Moisture Levels – Need Water /Transpiration for Mass Flow
- Importance of Availability at Root Tip
- Needed Consistently Throughout the Season

Silica (Availability)



- Plant uptake – Silicic Acid (H_4SiO_4) – Mass Flow
- Weathering in Soils > Increase Availability
- Weather Soils (but Not Too Much)
- Bioactivation
- Needs Partially Dictated by Plant Form
- Needed Throughout the Season (to counteract stress)

Boron



- Highly Leachable as Borate (H_4BO_4)
- Lower pH = Higher Availability
- Dependent on Organic Matter (ability to hold ions)

- Low Moisture Limits B Availability (mass flow)
- High Calcium Levels Need Higher Boron Levels
- Depending on Crop – “Differing Needs”
 - Variations in B Mobility
 - Fruiting Crops

Necessity of All 3 - Synergy



- We Need to Honor the Complexity of Biological Systems.
- NPK and Traditional Bottom Line Accounting Shortchange our Capacities as Farmers and Providers.
- Calcium, Silica, & Boron is Just One Example of Mineral Synergies in our Healthy Crop Production
 - Molybdenum & Nitrogen – Nitrate Reductase Enzyme

Testing (and Availability)



- Gather Information to Assess Needs
- Different Tests Yield Different Results
- Avoid “Shooting Blind”
- Provide Another Tool for Learning the Land

Calcium Applications



- **Mineral Sources**

- High Calcium Limestone
- Dolomitic Limestone
- Gypsum
- Rock Phosphates
- Bone Char or Bone Meal

- Micronized Sources
- Chelated Sources

- Humic Substances with Dry Applications

Silica Applications



- “Biological Activity”
- Equisetum
- Potassium Silicates (from sand/OMRI approved)
- Clays, Diatoms, Etc.
- BD 501

Boron Applications



- Need to Show “Nutrient Deficiency” for Applications
- Split Applications is Recommended
- Careful, Careful, Careful
- Dry – Borax (9%B) or Solubor DF (18% B)
- Liquid – Solubor (21% B) – Important to “stabilize” w/carbon
- Foliar - Solubor (21% B)

Timing of Mineral Applications



- Calcium , Silica, & Boron
- All Needed Throughout the Growing Season
- Avoiding Nutrient Tie Ups with Calcium Applications
- Best to Allow Soil Biology to Complex Nutrients
- Natural Cycles to the Seasons

Financial Considerations



- Investing in our Soils and Plant Vitality
- “Savings” – Improved Yield and Quality
- Calcium “Costs” – possible to build up
 - \$60-\$200/acre for 1 ton/acre lime – for multiple seasons
 - \$20-\$100/acre for 100-500#/acre gypsum (23% Ca, 17% S)
 - Bone Char (33% Ca), Rock Phosphate (~20% Ca)
 - Micronized Sources - \$8-10/acre
- Silica “Costs” – possible to build up
- Boron “Costs” – often “needed” annually
 - \$8 -\$20/acre for 5-15#/acre Solubor (21%B)

Tying it Together with Ca, Si, & B



- **Healthy Plants Creating Disease Resistance with Strong Cell Walls and Proper Nutrient Cycling...**
- Hugh Lovel's Article:
 "The Biochemical Sequence of Plant Nutrition"
- Trial, Observe, & Learn,
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Thank You



Bibliography for This Presentation
Available at www.brixbounty.com

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