

# Principles of Biological Systems 2017

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Day 1

# Addressing Limiting Factors

- General principle and objective
- Life will do the best with what she has
- Identify limiting factors and endeavor to address them.
- Minerals, biology, carbon, water, air.

# Life is the Objective

- Supporting and empowering soil life is the key to healthy plants.
- Things that you do or let be done that harm soil life harm your plants.

# Quality Objective

- Nutrient Level
- Flavor/Aroma
- Shelf Life

# Correlations of Health

- Soil Health
- Plant Health
- Human Health
- Cultural / Environmental Health

# Topics for Today

- Soil Testing / Mineral Balancing
- Cover Cropping / Mulch
- Biological Inoculation
- Potting Soil
- Tillage
- Fertigation / Irrigation
- Foliar Spraying

# Target levels of macro minerals

- Base Plus or “Agri-Dyn II” Test
- A Strong Acid test
- Sulfer - 75 ppm
- Phosphorus - 75 ppm
- Calcium - 60-75%
- Magnesium - 12-18%
- Potassium - 3-5%

# Target levels of trace elements

- Boron - 3 ppm
- Manganese 80-90 ppm
- Copper - 4 ppm
- Zinc - 8 ppm
- Cobalt - 2 ppm
- Molybdenum - 1 ppm
- Selenium - .5 ppm



# Conversions

- 500lbs per acre = 11.5 lbs per 1000sq ft
- 100lbs per acre = 2.3 lbs per 1000sq ft
- 20lbs per acre = .46 lbs per 1000sq ft
- 5lbs per acre = 2 ounces per 1000sq ft

# Math for Minerals

- PPM - Parts per Million
- PPA - Pounds per Acre
- 2,000,000 pounds of soil in the top six inches of an acre
- $PPA = PPM \times 2$
- Necessary level of Phosphorus and Sulfur  $75 \text{ PPM} = 150 \text{ PPA}$

# Sulfur for Example

- Need 75 PPM or 150 PPA
- Report level 25ppm = 50 ppa
- Needed level = 100 ppa
- Gypsum is  $\text{CaSO}_4 + 2\text{H}_2\text{O}$
- Atomic weight Ca =40, S =32, O = 16, H = 1
- $40+32+((6\times 16) = 96)+4 = 172$
- $100/172=.59$ ,  $40\times .59=23.5$ ,  $32\times .59=19$
- 100lbs gypsum = 23.5lbs Ca, 19lbs S

# Max yearly application Sulfur

- Sulfur - with Calcium needed, 500 pounds per acre (ppa) gypsum
- Sulfur - with Magnesium and Potassium needed 300-500 ppa Sul-Po-Mag or K-mag
- Sulfur - with Potassium needed 200-300 ppa potassium sulfate.
- Sulfur - with Magnesium needed 200 ppa magnesium sulfate (epsom salt)
- Sulfate forms of the trace elements

# Max yearly application Phosphorus

- Phosphorus - with calcium needed, 500-2000 ppa colloidal soft rock phosphate, Tennessee brown rock phosphate, Black hard rock phosphate
- Phosphorus - with potassium needed, animal manure, or animal manure based compost.

# Max yearly application

## Calcium

- Calcium - 500-2000 lbs Calcium Carbonate (Calcite or Hi-cal Lime) Also Aragonite, Coral Calcium, Egg Shells,
- Calcium - with Magnesium needed 500-2000 ppa Calcium Magnesium Carbonate, (Dolomite, or Dolomitic Lime)
- Calcium - with Sulfur needed, 500 ppa gypsum
- Calcium - with Phosphorus needed, 500-2000 ppa Soft Rock Phosphate.
- Calcium - Phosphorus and Traces and Paramagnetic needed 500-2000 ppa Carbonatite

# Max yearly application Magnesium

- Magnesium - with Calcium needed 500-2000 ppa Dolomite
- Magnesium with Sulfur and Potassium needed 300-500 ppa Sul-Po-Mag or K-mag
- Magnesium - with Sulfur needed, 200 ppa magnesium sulfate (epsom salts)

# Max yearly application Potassium

- Potassium - Spread well, clean wood ash
- Potassium - with Magnesium and Sulfur needed, 300-500 ppa Sul-Po-Mag or K-mag
- Potassium - with Sulfur needed, 200-300 ppa potassium sulfate
- Potassium - with Phosphorus needed, animal manure or animal manure based compost



# Max yearly applications - Traces

Boron - 30ppa borax.

15 ppa solubor

- Manganese – 20 ppa manganese sulfate
- Copper - 10 ppa Copper Sulfate.
- Zinc - 10 ppa Zinc Sulfate.
- Sodium Molybdate .5 lb actual molybdenum per acre/per year
- Sodium Selenate .25 lb actual selenium per acre/per year
- Cobalt Sulfate - 4 ppa

# Percents in Macro Minerals

- Greensand 7-9% K - 52% Silica
- K-Mag (Sul-po-mag) 22%K - 22%S - 11%Mg
- Rock Phosphate 22% P - 20% Ca
- Hi-cal Lime 38-40% Ca
- Dolomitic Lime 30% Ca - 10% Mg

# Percents in Trace products

- Solubor = 20% BORON
- Borax = 11% boron
- Cobalt Sulfate = 27% Cobalt
- Copper Sulfate = 37% Copper
- Manganese Sulfate = 32% Manganese
- Zinc Sulfate = 35% Zinc
- Molybdenum need up to 1/2lb per year, check percentages
- Selenium need up to 1/4lb per year, check percentages.

# Bionutrient Food Association

- Evolute of Real Food Campaign, RTE
- Membership based, multiple constituencies
- “Increasing Quality in the Food Supply”
- Education - Courses
- Outreach - Handbook, Website, Articles
- Research - Bionutrient Meter, 3 yr plan

# Inoculants

- Collostrum
- Critical symbiotes for plants.  
Foundational life in the food chain
- Bacterial and Fungal species
- Ideally present at germination

# Seed

- Seed size
- Seed history
- Seedling vigor - culling
- Yield potential – spacing
- SRI/SCI

# Potting soil

- Besides Compost, peat, vermiculite and perlite, Consider, Kelp, Alfalfa, Zeolite, Humate, Montmorillonite, Lime, Rock Phosphate, Gypsum, Trace Elements, and critical role of biological inoculants and enzyme stimulants.

# Tillage

- Effect of tillage on soil life
- Strategy for minimal tillage
- Permanent raised beds - green or brown mulch



# Complexing Compounds

- Simple sugars
- Complete carbohydrates
- Complete proteins
- Lipids / essential oils
- Phytonutrients, phytoalexins, antioxidants, plant secondary metabolites

# Evolution of pest and disease resistance

- Complete carbs - soil borne pathogens  
Fusarium, verticilium, alternaria
- Complete proteins - larval forms of insects  
cabbage looper, tomato hornworm, corn earworm, colorado potato beetle larvae
- Complete lipids - air borne pathogens  
mildews and blights
- Complete Phytoalexins - Cucumber beetle, potato beetle, flea beetle, japanese beetle

# Fertigation / Irrigation

- Drip tape, sprinkler, hose
- Maintain water at good level in soil at all times. Critical.
- “Good Level” able to pick up soil, clench it into ball and have it stay as a ball.
- Plan to have this system in place
- Fertigation capacity to feed in season

# Foliar Spray

- Plant feeding through the leaf surface.
- Backpack sprayer, squirt bottle, etc.
- Best response when an immediate turn around is desired.
- Very powerful if all other pieces are working.
- Plan to be able to do this now.

# Homework

- Build permanent beds
- Mulch, apply minerals and cover crops
- Procure inoculants
- Good seed
- Potting soil
- Fertigation and Foliar infrastructure
- Read, read, read