Bionutrient Ferments

Nutrient deficiencies as revealed through plant sap analysis can be addressed by including specific foliar formulations in holistic spray applications. Ferments of mineral nutrients can easily be made by the grower at the farm with the same resources as used by commercial formulators. Recommended timing ties to nutrient pulsing, determined by metabolic points of influence in the context of what all nutrients might be called for at a particular orchard site. Rates are determined by degree of deficiency as well as percentage of targeted mineral in any given formulation.

A few tenets concerning bioavailabilty

- Specific organisms *ferment* mineral amendments into available form.
- Getting the biology up to speed from a dormant state for the reducing phase is step one, followed by the chelating phase leading to stabilization.
- Organic acids produced by the biology are the means by which this gets done.
- Humic/fulvic acids help stabilize formulations as well as increase cell permeability
- Spray tank pH should ideally be in the 5.5 to 6.5 range when applying.

A work-in-progress!

The recipes and notes that follow are what I did last season in discovering how to craft bionutrient ferments (BNFs) on the farm. These methods can undoubtedly be improved upon so take heed that nothing is set in stone at this point. Soil amendments that readily dissolve and stay in solution are more agreeable to work with and so a good place to start. Sulfate forms of the minerals are generally the preferred choice, as indicated on the labels of many commercial formulations. I purchased the following bulk amendments in 50# bags from North Country Organics in Vermont, all of which should be available from farm suppliers in other regions as well:

- Magnesium sulfate (aka Epsom salts)
- Manganese sulfate
- Iron sulfate (aka ferrous sulfate)

It's absolutely critical the Mn and Fe be delivered in a reduced form (lowered valence state) to arboreal surfaces and thus choice of organisms to get the job done matters. The lactobacilli in effective microbes (EM) are a given. *Bacillus subtilis* and *Pseudomonas putida*ð obtained via JH Biotech's BioActÊ SDð seem right for an assortment of reasons. That's open to further discussion, mind, as everything that I'm doing is based on "proprietary clues" obtained from different manufacturers. What's cool about this intuitive journey is that plant sap results were nudged in the right direction in the 2021 season. The crop itself was stellar, and while that may be too subjective for some, I believe legitimate progress has been made. You'll find certain tweaks that I'm considering for this coming season at the end. One thing for sure, this season I will hit the ground running as I now have everything on hand to start BNFs earlier.

Please keep me posted if you give any of this a try: michael@groworganicapples.com

Growers learn best by keeping each other informed!

MACRONUTRIENTS: Each six gallon batch creates "six tank applications" total

Magnesium Sulfate

5/22 added 10# Epsom salts to ~5 gallons of water
added quart em plus two cups sweet soil molasses
added one quart SeaCrop (2.6% magnesium chloride content)
added 5 gm of BioAct organisms
added one quart of Terra Vita FA-O (fulvic acid)
starting pH ~4.5

Have been stirring daily to initially keep Epsom salts in solution

Calculations: Epsom Salt contains 9.8 percent magnesium and 13 percent sulfur.
Thus 10# contains 16 ounces elemental Mg (and 21 ounces sulfur)
16 / 920 = 1.7% magnesium content ➔➔➔ since revised

5/28 application rate of four quarts per acre (thus ~2# Epsom salts per tank mix)
Intend this to be Phyto-Mag equivalent applied at two quarts per acre
pH dropped slightly to ~4.2 at time of first application

Total batch ~6 gallons (thus six tank applications)

Epsom salts readily dissolveé therefore I added 6# more to remaining four gallons of Mag BNF. This essentially would have set overall rate at 18# (288 oz.) of which 28 oz. would be elemental magnesium.

Revised Calculations: 288 + 664 + 96 = 1048 net ounces fluid
28 / 1048 = **2.7% magnesium content + SeaCrop factor**

Application rate of four quarts per acre now 3# Epsom salts (bare salt applied @5# per)

Batch pH has further dropped to 3.8 (Note: pH of magnesium sulfate solution averages 6.0 thus this would be indicative of the biology going back towards dormancy)

MICRONUTRIENTS: Starting with 6# per batch for "six to twelve tank applications"

Manganese Sulfate

5/26 added 6# Manganese sulfate to ~5 gallons of water
added quart em plus two cups sweet soil molasses
added one quart SeaCrop (ionic sea minerals)
added 5 gm of BioAct organisms
added one quart of Terra Vita FA-O (fulvic acid)
starting pH ~4.5 brewing atop EM drum (random cellar heat)

This amendment stirs readily into water so could add more.

Calculations: Manganese sulfate contains 32 percent manganese and 18 percent sulfur.
Thus 6# contains 30 ounces elemental Mn (and 17 ounces sulfur)
96 + 664 + 96 = 856 net ounces fluid
30 / 856 = **3.5% manganese content**

Ferment pH has dropped to 4.0 five days later

6/2 Spring4 at rate of 2 quarts per acre, applied w/Ca-BNF

Iron Sulfate

5/26 added 6# Iron sulfate to ~5 gallons of water
added quart em plus two cups sweet soil molasses
added one quart SeaCrop (ionic sea minerals)
added 5 gm of BioAct organisms
added one quart of Terra Vita FA-O (fulvic acid)
starting pH ~2.5 brewing aside boiler (random cellar heat)
added 6 ounce humate powder to hopefully assist biology w/acid bath

Sludge factor to be determined after daily stirring; solid bottom precipitate in evidence

Calculations: Iron sulfate contains 30 percent iron and 17 percent sulfur.
Thus 6# contains 28 ounces elemental Fe (and 16 ounces sulfur)
96 + 664 + 96 = 856 net ounces fluid
28 / 856 = **3.3% iron content**

Question in mind concerning starting up biology at least one day before reducing phase (with mineral element added) to accentuate metabolite release, including gluconic acid from *Pseudomonas putida* (helped by aeration from stirring)

Ferment pH has not changed five days later but precipitate chunks have dissolved.

6/9 Comp1 at rate of 2 quart per acre, applied w/Mg-BNF

Potential Tweaks

- Add quart citric acid to Mg-BNF
- Add pint citric acid to Mn-BNF
- Add pint citric acid to Fe-BNF
- Research as to using citric acid with boron
- Use no more than quart rate of citric acid for Ca-BNF (eruption factor!)
- Double up SeaCrop to 2 quarts in Mg-BNF to increase Mg percentage
- Use yucca extract as surfactant (saponins also found in amole lily and soapwort)
- Nancy wonders if mucilage would help (marshmallow root decoction)
- Need more time between reducing phase and chelating phase, as much as three to even five days (versus current 24 hours)
- Need to determine if humic acid should be part of reducing phase (this would provide carbon for conversion to nutrient in reduced form and CO2 off gassing)
- Experiment with corn starch as additional thickening agent?