Soil Fertility in Focus: Moving Beyond N, P, K

MEETING THE NUTRITIONAL NEED OF CROPS WITH MINERALS, MICROBES, & MANAGEMENT

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NOFA RHODE ISLAND
ADVANCED GROWERS SEMINAR

SUNDAY OCTOBER 20, 2013

Seminar Resources

Each Other, Farm & Garden Community

New England Vegetable & Fruit Conference – Dec 17-19 in NH (http://www.newenglandvfc.org/)

- Bionutrient Food Association **Bibliography - http://bionutrient.org/library/recommended-reading**
- Brix Bounty Farm Website – www.brixbounty.com
- NOFA Rhode Island - http://nofari.org/

- County Soil Maps – http://www.nesoil.com/
- NRCS - http://www.nrcs.usda.gov/wps/portal/nrcs/site/ri/home/
- URI - http://web.uri.edu/riaes/extension/
- Web Soil Survey - http://websoilsurvey.nrcs.usda.gov/

- Acres USA, Extension, & many other print/online publications – "Veg Notes"
- Logan Labs (Mehlich-3 analysis w/ traces) – www.loganlabs.com
- Online OrganiCalc™ Worksheet - http://growabundant.com/organicalc/
  - $9.50 per year "for auto-computing Logan Lab test recommendations" for Gardeners

Biography – Derek Christianson

- Commercial Vegetable Grower for the past 12 years, actively consulting, teaching courses & workshops the past 6 years

- Started farming in 2002&2003 at Waltham Fields Community Farm
- 2 Seasons on the Vineyard, managing Bayes-Norton Farm
- 2 Years as a vegetable manager at Hawthorne Valley Farm, Biodynamic Dairy & Vegetable Farm in New York (12 acres veg.)

- Started Brix Bounty Farm in Dartmouth, MA in 2008 – leased land
  - Small, Diversified Vegetable Farm – cropping ~4 acres, plus some in cover
  - 6-mile marketing radius: 90-member summertime CSA, 40-member wintertime CSA, self-serve roadside stand, & 1 Farmers Market (Downtown New Bedford)
  - Started offering "Deep Nutrition Shares" in Winter 2011-12

Brix Bounty Farm

Started in 2008 on leased land in Dartmouth, MA
Moving winter 2013-2014 … to better drained fields

- ~$100K in gross vegetable sales + ~$2K Deep Nutrition
- ~$38-42K "net" depending on expenses/additional income
  - 90 member Summertime CSA - $49K
  - 40 member Wintertime CSA - $10K
  - Honor System - Roadside Stand - $35K > $38K+ in 2013
  - New Bedford Farmers "Outreach" Market –$6K/year - 17 markets

  - Myself plus 1 full-time farmer (year-round) & 1 full-time (May-Aug)

Marketing Season – 90% marketed on the farm

- Self-Serve Roadside Stand
  - Opens weekends in early May, daily by early June
  - Daily through mid-November
  - Open daily/weekends into mid-December depending on season
- Summertime CSA
  - 21 Weeks starting 2nd week of June through end of October
- "Wintertime" CSA
  - 2 distributions in Nov, 2 distributions in Dec, 2 in Jan/Feb
    - Planned expansion 2015 - to add 2 distributions in Mar/Apr & 2 in May
- New Bedford Farmers Market (heavy coupon traffic)
  - Starts 1st Thursday in July > end of October (~17/18 markets)

Harvest & Marketing Rhythms

- **Monday - CSA Distribution** (& Farmstand – Light Pick)
  - Harvest for 20 full share & 25 partial shares = 45 shares
- Tuesday - Farmstand (CSA "Remains" + Fresh Harvest)
- Wednesday - "Fish & Foliar" Morning (Light Stand Pick)
- Thursday – NB Market (6 miles from farm) & Farmstand
- **Friday – CSA Distribution** (& Farmstand – Light Pick)
  - Harvest for 40 full shares & 15 partial shares = 55 shares
- Saturday – Farmstand (CSA "Remains" + Fresh Harvest)
- Sunday – Farmstand (Full or Light Stand Pick – season?)

Presentation Overview

Introduction

Broader Picture – Case for Fertility Investments on Vegetable Operations

Minerals in Soils

Crops in Focus:

Beets, Onions, Spring Cabbage

Tomatoes, & Winter Squash

Guiding Principals

Honoring & dignifying our natural systems w/ complete fertility allows us to reap the greatest return for energy invested, while improving our soils as a natural resource for future generations.

Nutrient Extraction in Commercial Vegetable Production

Social Contract > “the best quality” (flavor & nutrition)

Growing Vegetables with Respect for the Earth & Future Generations

Every Day… Farms as Solar Arrays

Plant Metabolism & Health

Carbon, Hydrogen, & Oxygen

Minerals as the Foundation for Plant Health

Structure, Energy, Processes, & Patterns

Complexity – Full Expression

Microbial Metabolites (J. Kempf)

Judging Our Production

Considering the Whole

Inputs

Yields - Quantity
Yields - Quality

Additional Benefits & Costs (“Externalities”)

Impact on Future Resource Base

Minerals, Microbes, & Management

3 Keys to Vigorous Production

Akin to Chemical, Biological, & Physical

All 3 Are Connected

Management?

Building Fires…

Beyond N, P, K

Nitrogen, Phosphorous, Potassium or Nitrogen, Phosphate, Potash

Considered to be nutrients needed in greatest amounts for plant growth… but also consider for plant/human health

- Carbon, Hydrogen, Oxygen
- Sulfur
- Calcium, Magnesium, Silicon
- Boron, Chlorine, Molybdenum, Selenium
- Cobalt, Copper, Iron, Manganese, Nickel, Sodium, Zinc

Nitrogen – The "Green" Rules

- Nitrogen is part of our atmosphere
- 78% of air is Nitrogen in N_2 form – unavailable for plants
- Nitrogen –Plant Growth – structure, metabolic, genetic
- Nitrate vs. Ammonium
- Molybdenum – Nitrate Reductase Enzyme
- Cover Crops – Legumes, Grasses, & Catch Crops
  - Rhizobia but also… Azotobacter
- Residue Digestion & Nutrient Circulation
- Protozoa – Consuming Bacteria & Releasing Ammonium
  - Need food (bacteria) & water (mobility)

Nitrogen – NOFA/Mass Winter 2014 Workshop

Chlorophyll Molecule

- Crop Needs
- Springtime Considerations
- Flooding & Drought – Impact on N availability
- PSNT – Pre Sidedress Nitrate Test and/or Solvita Test

? Does the Managed Cycle Match up with Crop Needs?

Too Little? Too Much?

Phosphorous

Cellular Energy

ADP & ATP

Phosphate – P_2O_5

Is it present in the soil? Is it available?

Is there “biology” to increase its availability?

Different Soil Tests Yield Different Information

Potassium

TEC impacts K capacity of soil K adsorption – especially K from mineral salt applications…

Low TEC = usually low Potassium

- K during the crop cycle (fertilizers, residues, & recharge)

- K "missing" on soil tests – organic matter or fixed
- Fixed K in some type of "clay" soils – clay mineralogy
- K-Clay "lock" in dry conditions (J. Kempf)

Cation and Total Cation Exchange Capacity

CEC and TCEC & Soil Colloids

- Cation (definition) – nutrients with a positive charge
- Soil: Air, Water, Mineral (Sand, Silt, **Clay**) & OM
- Soil Colloids – Cations Adsorb onto negative sites
  - Clay
  - Humus & Organic Matter (OM)

- “Light” or Low TEC Soils <10 CEC
- “Heavy” or High TEC Soils >10 CEC

Soil Testing

- Often seen as a critical tool for making fertility decisions.
- Test – when you need additional info., 1x year typically
  - Avoid "Shooting Blind"… (the expenses of)
  - Provide Another Tool for **Learning the Land**
- Total Nutrient Testing, Strong Acid Testing, Weak Acid Testing, Saturated Paste Testing… different tests will provide different information at different times.
- UMass Soil Testing Lab – Modified Morgan
  - Dilute glacial acetic acid & ammonium hydroxide (Dr. M.F. Morgan UConn 1940's)
- Logan Labs – Mehlich III (M3) test w/ trace minerals - AEA Base+
  - ICP – Inductively Coupled Plasma – acid is "strength of vinegar"
  - Caution when testing recently limed, heavily limed, or calcareous soils & don't rely for available P…
- Other Labs

“Common” Observations

What is/are the farm’s limiting factors?

Is fertility adequate for anticipated yields?

Are deficiencies impacting plant health?

Diseases and/or Pests

ERoEI – Energy Returned on Energy Invested

Maximize Returns - Profitability

Fertility in Practice – 2014 at Brix Bounty

- Field Sprays (low concentration traces) late winter/spring
- Bio-Builder Sprays – 1-3x spring depending… & in fall
- BD Preps – bd#500 and barrel compost 1-2x spring & fall
- Fall mineral applications (as budget/time allows)
- Pre-plant Mineral Mix & Energy Mix
- Nutrient Drench/Inoculation at Planting & as needed
- Sidedressing – 1-3x as needed for high requirement crops
- Foliar sprays – 1x per week to 1x per month until busy season slams us…

*~5%-**10%**-15 % of Gross Sales for Fertility Budget*

Dry Minerals 2014

Pre-Plant Mineral Mix

Address Calcium Needs & long-term Nutrient Deficiencies

- Carbonatite (SRC) – 1000# per acre (perhaps) and/or Gypsum
- Greensand – 500# - 1000# per acre (heavy for nightshades, roots) – clay source
- Hi-Calcium Limestone (as needed in the fall)
- Soft Rock Phosphate – 500# per acre (heavier for high value crops)
- & specific traces as needed

Pre-Plant Energy Fertilizer

- Krehers 4-3-3 Composted Chicken Manure at ~700# per acre +/-
- Sul-Po-Mag at 200# per acre +/-
- Bone Char at 100-600# per acre +/- (typically at 200# per acre)
- plus traces as needed

Address Macro/Minor Nutrients then… Trace Minerals

Sidedressing

As needed – crop by crop basis

The best fertility is the farmers footsteps

conductivity meters, refractometers, sap meters, etc.

At Brix Bounty we sidedress by hand
(low-tech but also maximum flexibility)

Blended Org Fertilizer or Nitrogen + other "nutrients"
Krehers at 400-1000#/acre
plus sul-po-mag – 100-200#/acre
carbonatite – 100-400#/acre
Cost for 1000# Krehers, 200# sul-po-mag, 400# carbonatite
= less than $10/bed (1000 sq. ft.) plus labor

Economics of Sidedressing (continued) - Spinach

- Case Study Spinach – at BB we tp 3 rows/bed at 6'' in row with 2-3 seeds/cell from 128's > 20 bed feet per flat, usually 120'/planting
- Target Yield 12 oz – 1# - 1.5# per bed foot on first cut depending on size (salad spinach vs cooking spinach) 1.5#/ft = 13,000 lbs/acre

- Market - 8 oz – 12 oz. bags at $3-4 per bag - ~$6 lb.
- $600-$1,200 per bed or $26-52K per acre **for just 1 cut**

Hypothetical wholesale (not us) – 7,000# at $2 = $14,000/acre

avg. wholesale yields for fresh market spinach 5-7 t/acre (NE Veg)

- Sidedress before canopy fills in (2nd or 3rd/final cultivation) + labor

$20 per bed or $800 per acre – need to increase yield by .4 oz (10 grams) per bed foot for fresh market or .7 oz (20g) wholesale…

Beets (late July 2012) beet phoma/cercospora

Takeaways Beets

- Flexible harvest windows make Beets valuable additions to the planting calendar
- Focus on Fertility: Potassium & Boron. (Ca & P)
- Trial different genetics:
  - Boro & Merlin – productive & delicious
- Transplanting (isn't as insane as it sounds) – scale ??

Key Management Points Beets

- TP Production or DS Establishment (weed management)
- Clean Cultivation – Early on…
- Meeting Fertility Requirements – esp. Potassium & B
- Enough Energy/Sidedressing

Fertility & Nutrient Requirements Beets

Fertility	Nitrogen	Phosphate	Potash
Very Low		150	300
Low	75-100, 30sd	100	150
Optimum		50	75-100

http://nevegetable.org/crops/varieties-1

- Calcium & Boron (2# B as indicated by soil test)
- Nitrogen (early season growth) …. Ideally "lower" at end
- Phosphorous – Roots & Sugar Production
- POTASSIUM
- Sodium – likely only "necessary" w/low K

Addressing Mineral Needs Beets

- Soil Test, Field History, OM Credits, Cover Crop Credits, Time of Planting, Speed of Growth & Expected Yield…

In Practice

- Pre-Plant >
- Row Cover at TP - worth the labor?? depends
- Sidedress once or twice – 2-6 WAP (weeks after planting)
  - Including K in sidedressing
- Foliar Sprays
- Fertigation…

Microbes

Beets

Non-mycorrhizal

Nitrogen… but not too much

beets in > “salty” soils

likely decreased biological activity

Minerals > Microbes (Brix Bounty Approach)

Leaf Miner – Boron deficiency? (Phil Jones)

Brix Bounty Production Beets

- Primarily transplant beets > ~1/5th acre in production
  - Operations who are big enough to have mechanical transplanters/water wheels likely better off ds (except for early crop).
- ~6 successions: spread labor & broaden harvest windows
- Boro, Kestrel, Merlin, & Zeppo are favorite varieties
- Father's Day Beet Bunches through the fall
- Bunched, Bunched but Topped, Loose (bagged)
- 2,800 – 3,500 bunch equivalents per season – 8 x 1000 ft^2

Yield Analysis Beets

- Best Yields at BB – 3 bunches / bed foot at $3.50 ea.
  - $10.50 per bed foot or $90K per acre!
- Avg. Yields – 2 bunches /bed foot at $3.50 ea.
  - $7.00 per bed foot or $60K per acre
- Low Yields – no tops (Aug 2013) – 1.75# /bed foot loose
  - $3 per bag for 1.25# bags or 1.5# bags = $2.40 or $2.00 per lb.
  - $3.50 per bed foot or $30K per acre
- Wholesale (not us)
- 2# per bed foot = 400 # per bed = 17,000# per acre
- 3# per bed foot = 600# per bed = 26,000# per acre

Economics of Beets

Beets can be highly profitable!

Building & Sustaining Demand

Flavor!

Small Acreage Allows for Attention to Detail

Bunching may be labor intensive depending on Leaf Quality

Building Fires vs. Fighting Fires

Growers Tips & Marketing Considerations

- Once nice beets w/ greens are available swiss chard sales slow down…
- Aim to have Beets available at the farmstand for Father's Day (mid-June) … from mid-April transplants.
- We'll usually start distributing beets for our CSA around the Summer Solstice – ideally week #2.

Beets … in the Garden

- Adequate Space (thinning) & Fertility are key to good yields.
  - Phosphorous is key to sugar production
  - Potassium & Boron are essential to moving the sugars into the roots.
- Transplanting offers an opportunity for earlier harvests
- Germination Tips > Beets
- Experiment with high quality hybrid seeds

Onions – Ailsa Craig – June 2011

Takeaways Onions

- Early season growth is essential for top yields
  - Fertility in Focus: Available N & P, Sulfur… Calcium & Copper
- Additional N in GH Cells…
- Plenty of water (& nutrients) early in their growth cycle
- If selling by weight – consider "cost" of drying down & curing/handling for cured onions
- Watch out for Weeds!

Key Management Points Onions

- Transplant Production > Vigor
- Establishment Period
  - Root Maggots
- May & June
  - Cultivation & Sidedressing
- July
  - Thrips & Moisture

Fertility & Nutrient Requirements Onions

Fertility	Nitrogen	Phosphate	Potash
Very Low		150	175
Low	80-100 + 50sd	100	150
Optimum		25-50	50

http://nevegetable.org/crops/varieties-10

- Calcium
- Nitrogen (early season growth)
- Phosphorous – Roots
- Sulfur (NE Veg Guide – 35-55 lb/A) impacts pungency

Addressing Mineral Needs Onions

- Soil Test, Field History, OM Credits, Cover Crop Credits, Time of Planting, Speed of Growth & Expected Yield…

In Practice

- Pre-Plant >
- Row Cover at TP - worth the labor?? depends
- Sidedress #1 - 2-3 WAP (weeks after planting)
- Sidedress #2 – 4-6 WAP
- No more N applications after mid-June
- Foliar Sprays
- Fertigation…

Microbes

Onions

Mycorrhizal

Big Growth Period Timed with “Spring” Flush

Minerals 1st (our approach at Brix Bounty)

Brix Bounty Production Onions

Alliums every week of the CSA

& always try to have an allium at the stand

- Scapes/Scallions > Mini Onions (purplette/pearl drop) > Fresh Garlic > Fresh Onions (tropea/ailsa craig) > Summer Leeks > Fall Rotation: Onions, Leeks, Scallions, & Garlic
- 1/3 acre of alliums including small garlic crop

- Cluster planted from 98's – 3-4 plants/cell (4-5 seeds) 6''

Yield Analysis Onions

Tremendous Potential for Heavy Yields!

Top Yields – 8# per bed foot – Ailsa Craig in 2010

Average Fresh Yield ~4# per bed foot

Mini Onions - ~2 to 2 ½ # per bed foot

17,500# - 35,000# - 70,000# per acre

Yield per bed foot depends on variety & season

Economics of Onions

At Brix Bounty we don't compete on price for alliums

They are too labor intensive!

Scallions at $2 or $2.50 per bunch depending on season

3 bunches/bed foot for scallions

Fresh Mini Onions at $3 or $3.50 per bunch

2-3 bunches/bed foot for mini-onions

Onions at $2 $2.50 or $3 per pint, at $4 or $5 per quart

3-5# per bed foot

Building Fires vs. Fighting Fires

Row Cover

Plastic Mulch – we don't use, but many do…

All about the Roots! … Calcium

Growers Tips & Marketing Considerations

Labor Intensive, especially if cured & stored

Alliums are a “staple”

Onions need adequate water (relatively limited root system)

Onions… in the Garden

- Root and Top growth before the Summer Solstice will impact yield potential.
- Early Plantings? Ensure adequate P, Ca, N, & Sulfur
  - Bone char or Bone meal
  - Gypsum
  - Blood Meal or other N source
  - Sul-Po-Mag
- Water
- Planting Depth is important
- Avoid late season N application/release to improve storage.

Takeaways Spring Cabbage

Farao is Delicious!

- Early season growth is essential for top yields
- Cell Size & GH Nutrient Management Matters
- Row Cover / Flea Beetle Control
- The “Right” Spacing
- Fertility in Focus: Zinc – Early & Calcium - Throughout

Key Management Points — Spring Cabbage

- Transplant Production > Vigor
- Establishment Period
- May & June
  - Cultivation & **Sidedressing**
- July
  - Boron & Calcium … preventing tip burn in heat/humidity

Fertility & Nutrient Requirements Spring Cabbage

Fertility	Nitrogen	Phosphate	Potash
Very Low		150	175
Low	100 + 60sd	100	125
Optimum		50	50

http://nevegetable.org/crops/varieties-2

- Calcium
- Nitrogen (early season growth not early stage growth)
  - Crop removal 20t removes est. 185# N (U Cal Ag Nat Resources)
  - Up to almost 6 lbs. N per acre per day at folding stage (UCANR)
- Boron: 2-3 # elemental B per acre (depending on soil test)
- Sulfur

Addressing Mineral Needs Spring Cabbage

- Soil Test, Field History, OM Credits, Cover Crop Credits, Time of Planting, Speed of Growth & Expected Yield…

In Practice

- Pre-Plant >
- Row Cover at TP
- Sidedress #1 - 2-3 WAP (weeks after planting)
- Sidedress #2 – 4-6 WAP
- Foliar Sprays
- Fertigation…

Microbes

Spring Cabbage

Soil Temperature

Row Cover

N cycling with biology > “assist” with optimum yields

Brix Bounty Production Spring Cabbage

- Early (Preview) Planting = 60 bed feet > 60 plants > stand
  - All Farao
  - GH 1st wk Mar. (Feb), TP 1st or 2nd wk Apr., harvest mid/late June
- Main Spring Planting = 240 bed feet > 240 plants > csa
  - Split 50/50 Farao & Super Red 80
  - GH 2nd wk Mar., TP late April, harvest late June/early July
- Late Spring Planting – 240 bed feet > 240 plants > csa/market/stand
  - Split 60/40 Farao & Super Red 80
  - GH 1st wk of Apr., TP 1st wk of May, harvest early – mid – late July

Yield Analysis **Spring** Cabbage

- 2 rows at 2’ spacing = 200 heads/bed > 180 marketable
  - ~7,850 heads per acre
    - At 3 lbs. = 23,550 lbs.
    - At 4 lbs. = 31,400 lbs.
    - At 5 lbs. = 39,250 lbs.
    - At 6 lbs. = 47,100 lbs.
- 2 rows at 18’’ spacing = 266 heads/bed > 240 marketable
  - ~10,450 heads per acre
    - At 3 lbs. = 31, 350 lbs.
    - At 4 lbs. = 41,800 lbs.
    - At 5 lbs. = 52,250 lbs.
- 2 Rows at 12’’ spacing = 400 heads/bed > 360 marketable
  - ~15,680 heads per acre

Economics of Spring Cabbage

- At Brix Bounty we aim for a nice size (~4 pound heads)
- Price at $5 per head = $1.25 per lb., smaller @ $4 each

We believe this is a very fair price

Grow only enough cabbage to meet demand at our price.

Cabbage should be special!

- Compare to a bunch of Kale @ $2.00, $2.50 or $3.00
- 180 heads per bed @ $4.00 = $720 per bed or $31K/acre
- 180 heads per bed @ $5.00 = $900 per bed or $39K/acre

Building Fires vs. Fighting Fires

Fertility Investments

- N,P,K
- Calcium and Sulfur
- Boron
- Molybdenum
- Zinc

Growers Tips & Marketing Consideration

- Summer Solstice Cabbage – Hearty Crunch for the CSA
- Size Impacts Marketability – Especially in Summer
  - Cabbage popular with older folks (small family size?)
- Summertime Cabbage – key for "slaw" & lettuce alternative

CSA – like to pair with beets, carrots, & dill in summer

(2 or 4 heads for shareholders in June-July) + 20 h/week stand

Week 3 (6/23) - for full share – 60 h

Week 4 (6/30) - for everyone – 100 h

Week 5 (7/07) – > chinese cabbage

Week 6 (7/14) – for everyone (usually w/ 1st carrot dist.) - 100 h

Week 7 (7/21) – for full share – 60 h

Spring Cabbage … in the Garden

- Plant Spacing – Cabbage Like their space…
- Pest “Prevention” including flea beetles, ICW & four legged … bunnies/woodchucks/etc.
- Provide plenty of fertility
- Plant only if you have the room…

Tomatoes – August 2011

Takeaways Tomatoes

- Genetic Potential
- Fertility in Focus: Potassium Needs & Traces for Fruit
- Trellis & “Moisture” Management
- Successions
- Foliars

Key Management Points Tomatoes

- Transplant Production > Vigor
- Establishment Period
  - “Building Plant Frame” (John Kempf, AEA)
- Fruit Establishment
- Harvest Season

Fertility & Nutrient Requirements Tomatoes

Fertility	Nitrogen	Phosphate	Potash
Very Low		180	250
Low	80-100 30sd, 30sd	120	150
Optimum		0-60	50-100

(based on 22t/A yield) http://nevegetable.org/crops/varieties-19

- Calcium & Phosphorous
- Potassium
- Boron, Copper & Traces
- Sulfur

Addressing Mineral Needs — Tomatoes

- Soil Test, Field History, OM Credits, Cover Crop Credits, Time of Planting, Speed of Growth & Expected Yield…

Calcium & Phosphorous

Nitrogen & Potassium

In Practice

- Pre-Plant >
- Sidedress #1 (1st or 2nd week of June)
- Sidedress #2 (early July) – final cultivation / sow clover
- Fertigation >

Microbes Tomatoes

Alternaria (Early Blight) as friend or foe?

Healthy Root Colonization

Phylloplane Biology

Brix Bounty Production Tomatoes

- 3 successions plus a few in the high tunnel (40 plants)
  - Early succession (in case of warm spring) – 200-300 plants in 2014
  - Main succession – 600 plants in 2014
  - Late succession (LB resistant varieties) – 200 plants in 2014

  - 1,000+ plants =12,000 lbs. > @ 12 lbs per plant…
  - Full Share CSA (3,3,5,5,5,5,5,3,3,2) = 34 # = 2,040# aim for 2,400
  - Partial Share CSA (1,2,3,3,3,3,3,2,2,1) = 23# = 920# aim for 1,000
  - Market 12-14 weeks @ ~60 pounds = 840# aim for 1,000
  - Roadside Stand – 14 weeks @ ~500 pounds = 7,000# aim for 7,600

Yield Analysis Tomatoes

- Plant Population = 100 plants/1000 square feet (2’ in row)
  - ~4,000 plants per acre (4,356 to be exact) or 3,600 plants on 6’ centers
- Low Yield = 8 pounds of marketable fruit = 34,848 lbs.
- Avg. Yield = 12 pounds of marketable fruit = 52,272 lbs.
- Good Yield = 15 pounds of marketable fruit = 65,340 lbs.
- Great Yield = 20 pounds of marketable fruit = 87,120 lbs.

Economics of Tomatoes

Inputs – Labor Intensive

Disease can significantly impact yields

Mortgage Lifter if market demand is present

Fertility is “Cheap” Investment for Potential Return

Building Fires vs. Fighting Fires

- High N & K needs for High Yields

- Fertigation needs of 1# N, 2# K (potash) per acre per day in high tunnels (UMN Rosen et. al. http://www.extension.umn.edu/distribution/horticulture/components/M1218-8.pdf)

Case for Intensive rather than Extensive plantings…

Growers Tips & Marketing Considerations

CSA, Direct Market On-Farm, Off-Farm, & Wholesale

Small Farm's Version of "Corn" for the casual customer

What is Market Demand?
How to match peak demand & "lower demand" periods

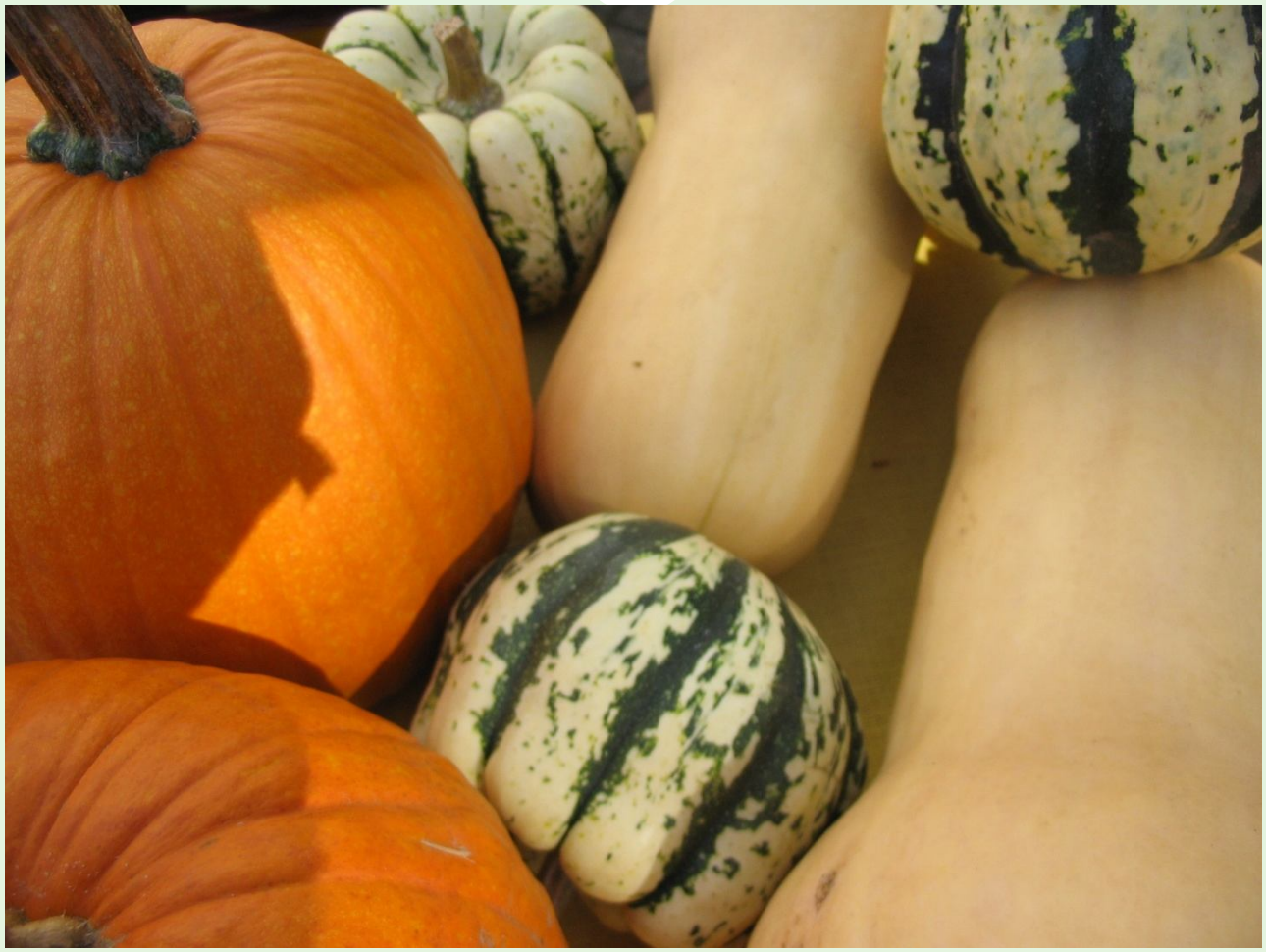
Type ? Cherry Tomatoes, Slicers, Heirlooms, Paste ?

Late Blight Resistant Varieties are "promising"

Tomatoes … in the Garden

- Adequate Space & Support
- “Early Establishment”
- Nutrient Needs Through the Plant Life Cycle
- Shifting from Leaf Growth > Fruiting Energy

Winter Squash – Fall 2010



Takeaways

Winter Squash

- June Sunshine & Day Length
- Fertility in Focus: Silica
- Sulfur & Striped Cucumber Beetles
- Genetics – Big Impact on Yield & Fruit Size (market ?)
- Leaf Production & Fruit Production

Key Management Points — Winter Squash

- DS or Transplant Production > Vigorous start
- Final Cultivation (& undersow clover?)
- Flowering & Pollination
- Canopy Health – Fruit Maturation

Fertility & Nutrient Requirements Winter Squash

Fertility	Nitrogen	Phosphate	Potash
Very Low		110	160
Low	50, 50sd	60	110
Optimum		0	40

for tp's (ds diff rates) http://nevegetable.org/crops/varieties-14

- Calcium & Phosphorous
- Silicon – calcium silicate – wollastonite (Heckman, J.)
- Boron (careful), Copper, Zinc & Traces
- Sulfur

Addressing Mineral Needs Winter Squash

- Soil Test, Field History, OM Credits, Cover Crop Credits, Time of Planting, Speed of Growth & Expected Yield…

Calcium & Phosphorous

Nitrogen & Potassium

In Practice

- Pre-Plant >
- Sidedress >
- Fertigation >
- Foliar Sprays >

Microbes

Winter Squash

Brix Bounty Production Winter Squash

- 2 successions – slightly staggered planting for flexibility
  - 1st succession started in 50-cell trays 3rd week of May
  - 2nd succession started in 50-cell trays end of May
  - Total ~1/3 to ½ acre at 12'' 18'' or 24'' spacing in row
  - Both are transplanted out ~14 days after seeding (depending on speed of germination)… small seeded types i.e. sweet dumpling and delicata might be transplanted closer to ~21days.
  - By staggering planting dates we can alter/change plant density on 2nd planting as necessary and/or add additional beds. We usually start an extra 2-3 beds worth of transplants (15% extra on top of usual 110%)

Yield Analysis

Winter Squash

Highly Dependent on Variety

5-7t/acre or 10-30t/acre (NE Veg Guide)

Butternut (e.g) on 6’ row spacing 2’ in row – 2 fruit/plant
=7,200 fruit at 4# average = 28,800 lbs. ~14t/acre

Economics of Winter Squash

At what price are they profitable on the small scale?

Acreage Intensive

Relatively “low” value per acre

Popularly Grown by less diversified operations…

Storage Period impacts quality & weight

Building Fires vs. Fighting Fires

Cell Size for TP's

Transplanted at young age if vigorous seedlings…

Timing the crop to the season…
early plantings before disease pressure builds

Great Use of Compost… Cucurbits

Growers Tips & Marketing Considerations

"Staple" of the fall & early winter – for CSA & Markets

Honor System Stand > we don't go crazy selling b-nut
(it's too easy for it to potentially disappear)

Difficult to "compete" on price w/larger conventional growers

Selling by unit instead of by pound – price elasticity

Small at $2-3, Med. Size squash ~$4, Large at $5-6

Winter Squash … in the Garden

Get friendly with a farmer

Compost Pile Plantings

Capture June Daylight

Powdery Mildew > Foliars…