HIGH TUNNEL CUCUMBER PRODUCTION

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carolina farm stewardship association

Who We Are

CFSA is a non-profit, member-based organization

- **Vision:** A sustainable regional food system that is good for all consumers, farmers, farmworkers, and ecosystems.

- **Mission:** To advocate, educate, and build connections to create sustainable food systems in the Carolinas centered on local and organic agriculture.

Programs

- **FARM SERVICES**:
- **Technical assistance** on **organic production & certification**, **conservation planning**, and **seasonal high tunnel production.**
- **Elma C. Lomax Research and Education Farm:** Certified organic farm in Concord, NC. That provides beginning farmers with access to land and equipment to start their own farm business. Onsite organic research program.
- **LOCAL FOOD SYSTEMS TEAM**: Technical assistance on food safety, market access, and business planning.
- **EDUCATION:** Host annual Sustainable Agriculture and Organic Commodities and Livestock conferences, and the Piedmont Farm Tour
- **ADVOCACY:** We work to change agriculture laws to benefit smaller-scale, local and organic farms.

Technical Service & Related Support

- **Organic Production and Transition**: production questions/challenges, guidance choosing a certifying agent and record keeping system, Q&A on NOP regulations, and records and application review.
- **Conservation Planning**: ID of soil and water quality issues and options to address them, in addition to recommendations to improve soil health or improve organic management; CPA138 provides paperwork for organic certification.
- **SC Department of Agriculture Cost Share:** Provides reimbursements up to 50% of the certification costs, up to a maximum of $500 with an additional 25% available from SC Farm Credit Associations.
- **High Tunnel Production:** Help farmers identify best management practices including planting dates, varieties selection, and irrigation, soil fertility and pest management.
- **Good Agricultural Practices (GAP):** Conduct risk assessments, identify ways to mitigate pathogen risks, review Food Safety Plans, and provide assistance preparing for an audit.
- **SC Department of Agriculture GAP Cost Share:** Growers can get reimbursed 90% for their annual audit.
- **SCDA & SC Specialty Crop Growers Association Water Quality Analysis Cost Share:**
    - Farmers can receive up to $1000 per year or $750 for nonmembers for water testing.
- **SCDA & SC Specialty Crop Growers Association Cold Storage Cost Share:** Farmers can receive reimbursements for purchasing and installing up to two (2) Cool-Bot cooler systems.Up to $750.
- **Market Access:** Connecting growers with those who want to buy their products. Providing technical assistance for farmers interested in exploring new markets, including: financial recordkeeping, succession planting, postharvest handling, product specifications (grading, packaging, labeling) developing specific crop budgets, conducting feasibility studies, and developing and implementing business plans.

How To Become A Member

- Join our network of more than 2,500 members across the Carolinas
- $40 annual Membership
  - Limited Income Rate - $20
  - Covers ALL employees/household members
- Benefits:
  - Free access to CFSA's technical services programs
  - Discounts to conferences and trainings
  - Post to job board, calendar, listservs, and crowdfunding board (coming soon)
  - Network of more than 2,500 members across the Carolinas

CFSA Resources

- Seasonal High Tunnel Production: Organic Tomato Guide
- High Tunnel Micro-irrigation Guide
- Infrastructure Toolkit
- GAPs Manual and Videos
- Results from CFSA's research program
- Sample CAP Plan
- Organic Transition Handbook for Produce Farmers
- Organic Enterprise Budgets
- Organic Inputs and Pest Control Finders
- Downloadable Record Keeping Templates

Overview

- 3 Farms – Lomax, New Ground, Wild Hope
- 6 Cucumber Varieties
- 2 Trellises Types
- Randomized, replicated, split plot design
- 6 x 90’ beds, 30” tops, 2 rows per bed, 24” in-row spacing, 540 plants on black plastic
- 36 plots, 3 of each variety on each trellis system
- Which gives best yield & disease suppression and any differences between varieties and trellis types

Poniente

- Long, Slicer
- European
- Disease Resistant,
- Parthenocarpic – Self Pollinating
- Gynoecious – Female Flowers
- Thin-skinned
- Resistance to cucumber mosaic virus (CMV) and cucumber vein yellowing virus (CVYV).

- Bitter-free, 12–13" fruits grow straight with trellising and fill out well. Excellent vigor and yield potential. High resistance to scab; and intermediate resistance to cucumber mosaic virus, cucumber vein yellowing virus, and powdery mildew.

- Johnny’s

Socrates

- Beit Alpha (Heirloom, OP)
- Thin-skinned,
- Gynoecious
- Parthenocarpic
- Stress tolerant
- Disease Resistant

- 7–8" fruits. Socrates is regarded as one of the best tasting cucumbers on the market today. Suitable for growing indoors with temperatures ranging from 50–82ºF (10–28ºC). Very stress tolerant for strong performance in high tunnels. Seedless fruits can be produced if pollinators are excluded. High resistance to scab and target spot; and intermediate resistance to powdery mildew.

- Johnny’s

Excelsior

- American Pickler
- Parthenocarpic
- Gynoecious
- Disease Resistant
- Spines

- 4–5" cucumbers with American-style spines. Vigorous, balanced plant with consistent fruit setting. Excellent flavor. Also does well in screen houses, in the field under row cover, or wherever else pollinators are absent. High resistance to scab and target spot; and intermediate resistance to cucumber mosaic virus, cucumber vein yellowing virus, and powdery mildew.

- Johnny’s

Picolino

- Cocktail,
- Thin-skinned,
- Few suckers
- Gynoecious
- Parthenocarpic
- Disease Resistant

- Best harvested at 4–5". Picolino's vines produce fewer suckers than typical cucumber varieties, so you will spend less time pruning them. Excellent yields. High resistance to scab and target spot; and intermediate resistance to cucumber mosaic virus, cucumber vein yellowing virus, and powdery mildew.

- Johnny’s

Shintokiwa

- Long
- Japanese
- Thin-Skinned
- Small Seed Cavity
- Spines
- Tasty at Large Size
- Monoecious – Male & Female Flowers
- Open Pollinated
- Japanese Burpless Type
- 9-12” Fruits
- High Resistance to Bacterial Wilt

- High Mowing

Itachi

- Asian
- White
- Small Seeded
- Spines
- Good to cook
- Trellis for Straighter Fruit
- Greens in Light
- Few Suckers
- Avg. 9–11" long. Itachi holds up well to cooking and makes an excellent addition to any stir-fry. Performs well in the greenhouse and field.
- Johnny’s

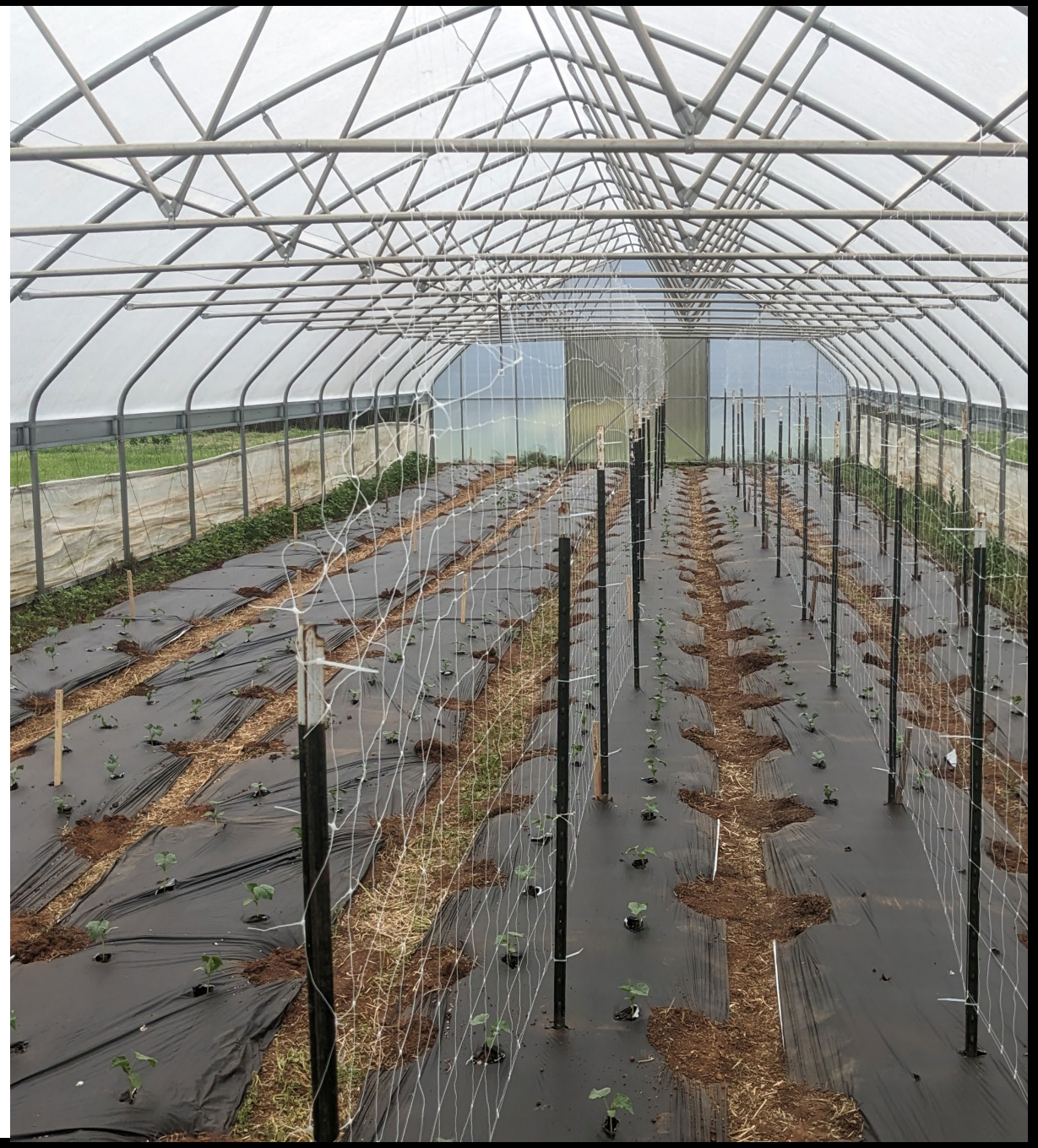
A little background…

- Mixed species cover crop grown prior to cucumbers
- Rotation has included cucurbits in the last few years
- Poor germination on a few varieties led us to plant half the tunnel 1 week later
- Pest damage from mice/rats over first few weeks of production

- Planted approx. 4/7 – That's kind of late!
- Started harvesting approx. 5/8

Trellising

- Setting top wire
  - Eye bolts and 6” turnbuckles with hooks,
  - 12 gauge, high tensile
  - 1/4 is preferred for 100’ house or
  - 7x19 304 galvanized wire or aircraft cable
  - Wire anchored across top of trusses or to bows themselves along outer beds if needed.
  - Ratchets can be used to add tension where needed
- Top wires can be very simple, rope, cord, cable, etc
- T-Posts may be needed for additional support of netting



Drop Line Trellis

- Drop Line
  - Tomahook - Cost: 12 meters, $.27ea, $72.90 per 3 beds
  - Roller Hook - Cost: 25 meters, $.70ea, 2 separate pieces, $.25 wire & $.45 spool, $189 per 3 beds
- Labor: 2.5 hour setup
- Examples

Hortonova Netting

- Cost: $77 for 78” x 328”, enough for 3 beds
- Clips cost $17 for 1000
- Labor: 2 hour setup

Pros/Cons Trellis Types

- Hortonova Netting
  - Pros:
    - Easy to clip to
    - Nice having the horizontal pieces for easy attachment
    - Don’t have to clip as much or at all
    - Less pruning, only up to the 6th node, umbrella style
  - Cons:
    - Plant and trellis spacing more important
    - Height of netting important and needs to reach the ground
    - May need additional T posts for support
    - Blocks access across beds
    - Hard to re-use

Pros/Cons Trellis Types

- Drop Line
  - Need to clip under leaf to stop slipping
  - Takes 2 hands
  - Must be single leader
  - Requires lots of clips, pruning, twirling
  - Must be clipped properly to line

  - Roller Hook –
    - Pro:
      - No extra string dangling at bottom
      - Less tangling
      - Doesn’t fall off top line
    - Cons:
      - More expensive
      - Takes two hands to unroll
      - Harder to wind up and re-use

  - Tomahook –
    - Pro:
      - Easy to unfurl
      - Easy to wind up and re-use
      - Use the rubber bands to secure
    - Con:
      - Leaves extra string at bottom
      - More labor to unroll properly
      - Falls off the line if pulled too hard
      - Some tangling

Why Are We Pruning/Trellising?

- Straighter, cleaner fruit, increased yield
- Use the vertical space and increase plant density
- Disease resistance/suppression

- Powdery Mildew - Wind blown fungal pathogen, leads to decreased yields and early plant death

- Control with fungicide, sanitation, resistant cultivars, spacing/air flow/dry leaves, rotation

- Downy Mildew - Fungal like oomycete, wind blown, air borne, yellow/brown patches restricted by leaf veins, dark spores on bottom of leaves, mistaken for alternaria, angular leaf spot, anthracnose, leads to decreased yields and early plant death

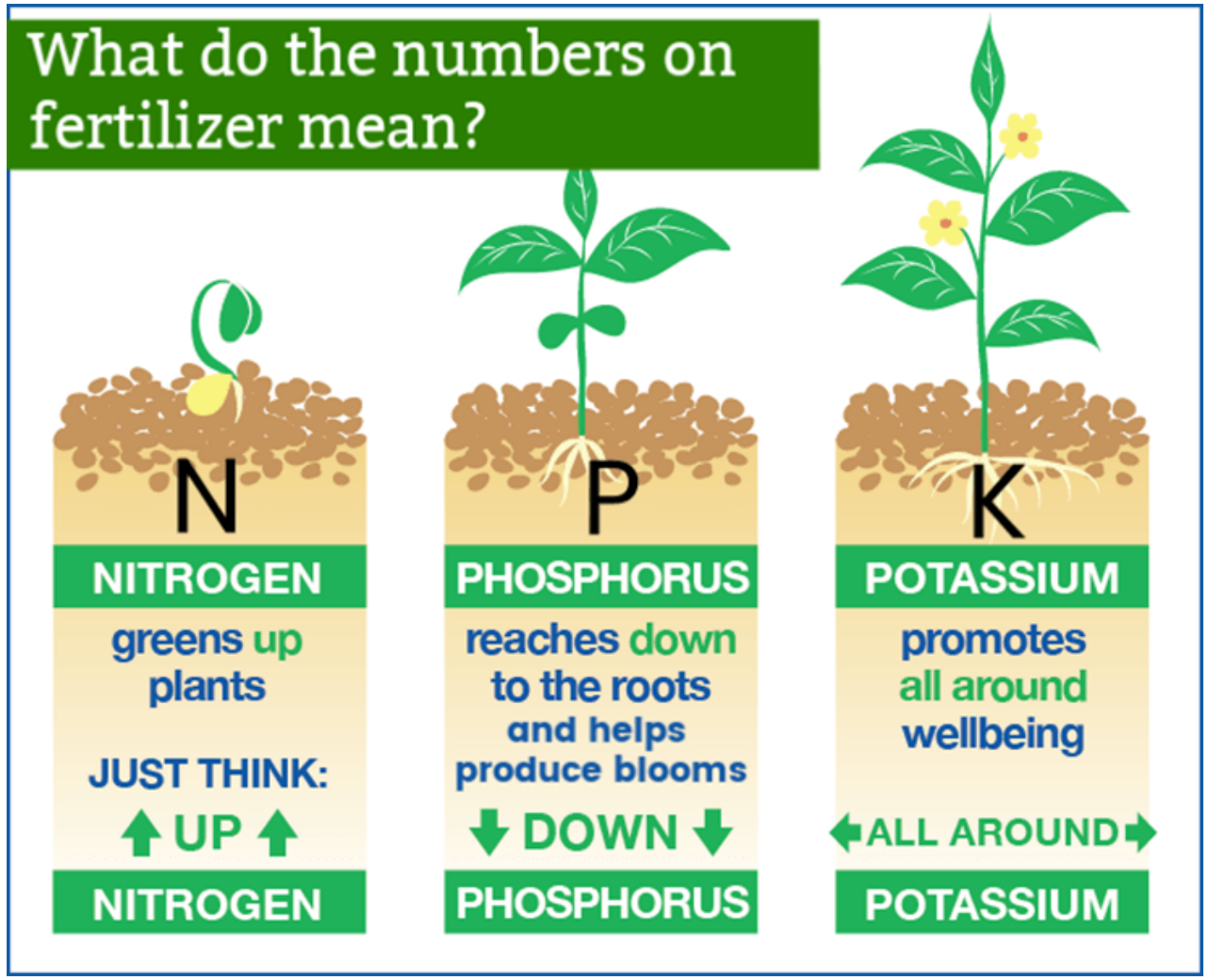
- Control with fungicide, sanitation, resistant cultivars, spacing/air flow/dry leaves, rotation

Pruning

- Improves airflow, leaves dry faster, reduces ground contact, more sunlight, reduces disease, larger, higher quality fruit
- Reduces amount of fruit set and sends energy to remaining fruit. Similar to suckering tomatoes or pinching basil
- Using clean, sharp shears, sanitized between prunings/plantings as needed
- Remove the lateral sprouts, NOT leaves, produced in the axil (where leaf and stem meet)
- Choose 1 strong “single leader” to allow upward growth
- DO NOT REMOVE IMMATURE FRUIT THAT ALSO DEVELOPS IN THE AXIL!

- Drop line – Single leader
  - Lower and lean if you get that far!
- Netting – Prune to 6th node and then umbrella style
  - I’d like to see this trial done with the same pruning techniques

- Suckering - Nice to be able to sucker early, when new growth is small
- Socrates - Long stems on cukes, easy to see suckers
- Shintokiwa - Shorter stems on fruits, harder to sucker without damaging/losing fruit
- Itachi - Few suckers, visible fruit before suckering



Irrigation/Fertility

- Drip Tape
- 30min every 2 days, increasing to 1hr every 2 days as harvests began and finally 1 hr daily. (may exacerbate disease?)

- Fertility added from soil test 2/21/23 - 100# N, 60# P, 30# K, pH 6.9

- Tissue Sampled 5/9/23, slightly low Boron, all others good
    - I normally would have fertilized at this point, but already seeing disease!?

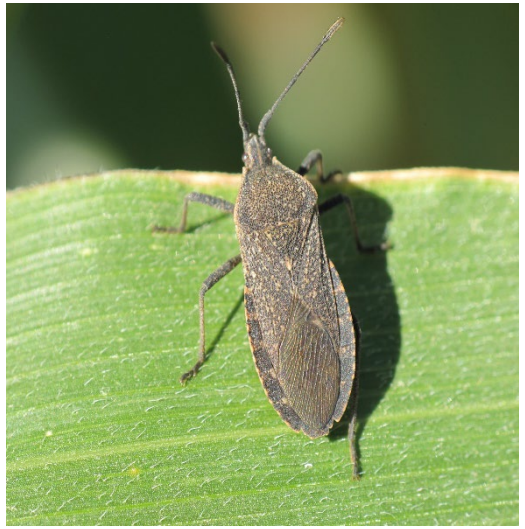
Disease

- 5/3/23 Powdery Mildew, fungus spread in air with white, bloomy mold on leaves
- 6/20/23 Gummy stem blight/black rot, seed/wind borne fungus, favors warm and wet
- 6/20/23 Alternaria, fungus, spread by spores in water, wind, believed to be secondary
- Treated bi-weekly, then weekly with Serenade Fungicide
- There were a number of other pathogens present in the tunnel that NCSU believed to be secondary to initial infections and opportunistically feeding on decaying plant tissue.
- Sanitation is key in this scenario. Diseased plants, pests, constant pruning and harvesting makes it hard to control!

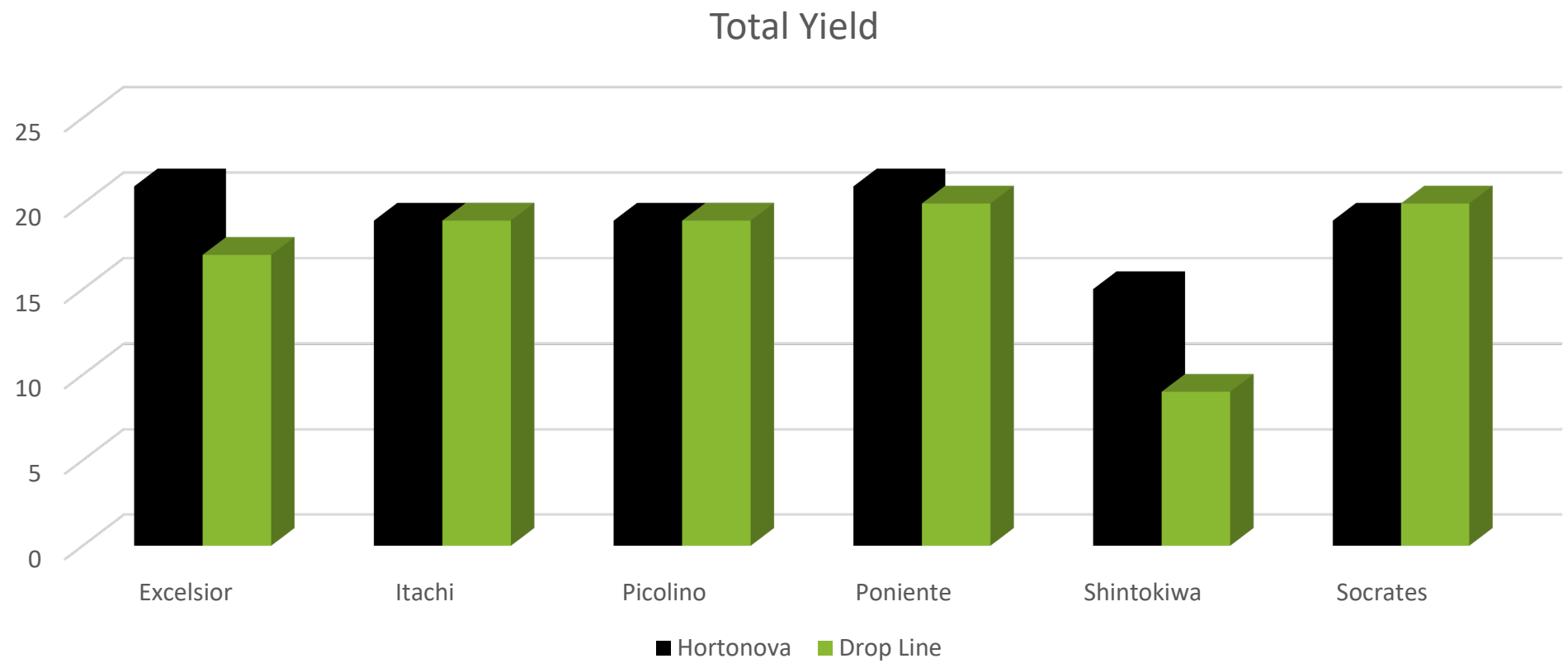
Pests

- Cucumber Beetles – Spread disease and weaken plants, damage fruits
- Aphids – Spread disease, weaken plants, believed to be secondary
- Thrips – Damage flowers which damages developing fruit, Devastating!
- Squash Bugs – Spread disease, weaken plants, damage fruit, believed to be secondary

- Controlled with bi-weekly and then weekly alternating applications of Spinosad and Pyrethrum



Lomax Disease 6/26

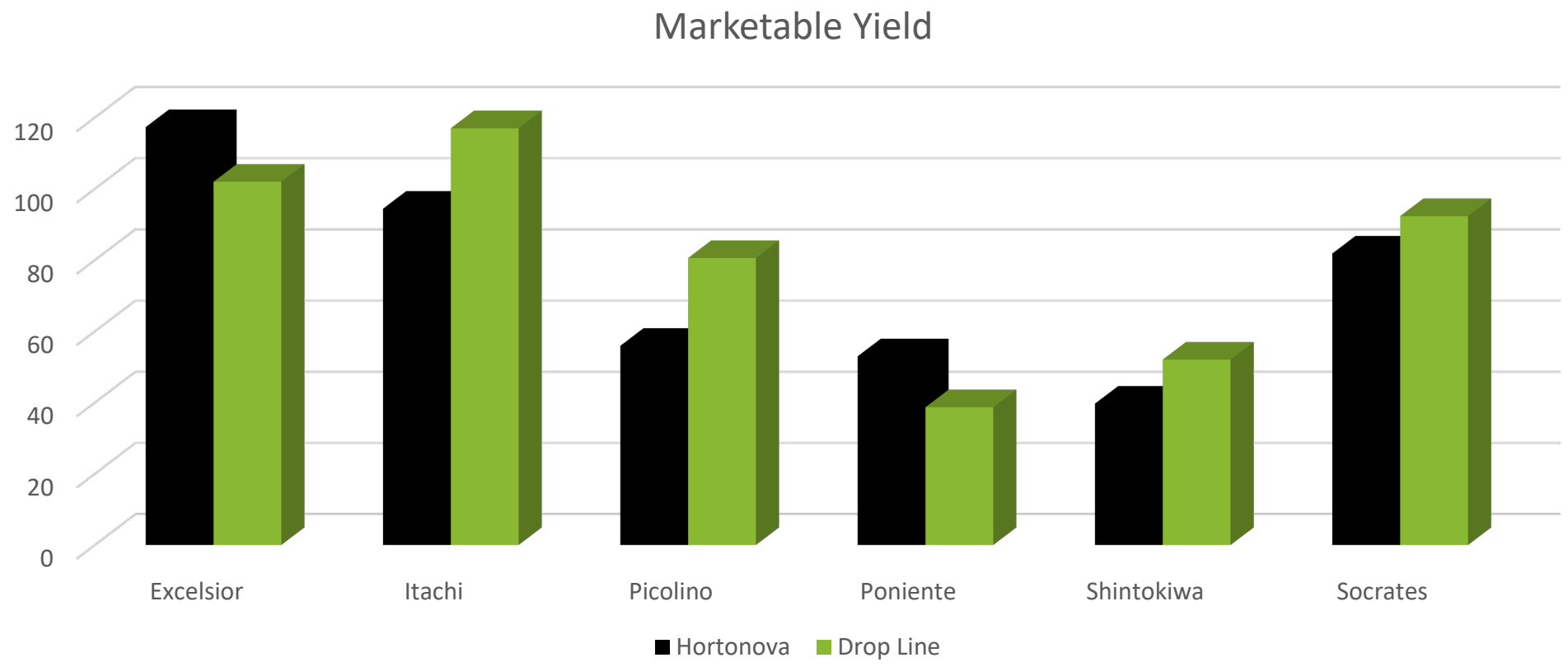


Lomax Disease Per Trellis

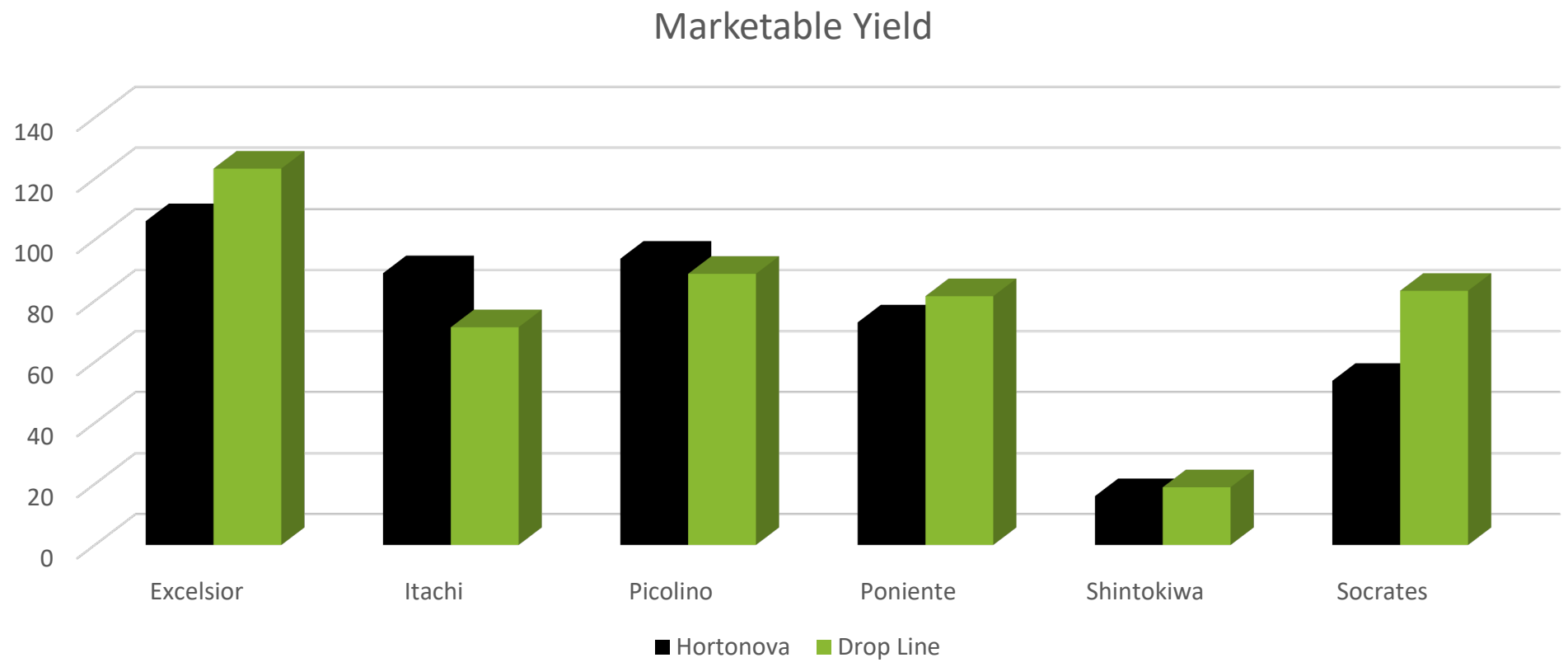
Disease Rankings

- Poniente had the most disease
- Shintokiwa had the least disease
  - Plants were younger and very late to mature and almost a month later to produce fruit.
  - Itachi, Excelsior, Picolino, Socrates almost identical
  - Drop line trellis had slightly more disease than the hortonova netting based on an average of all plots

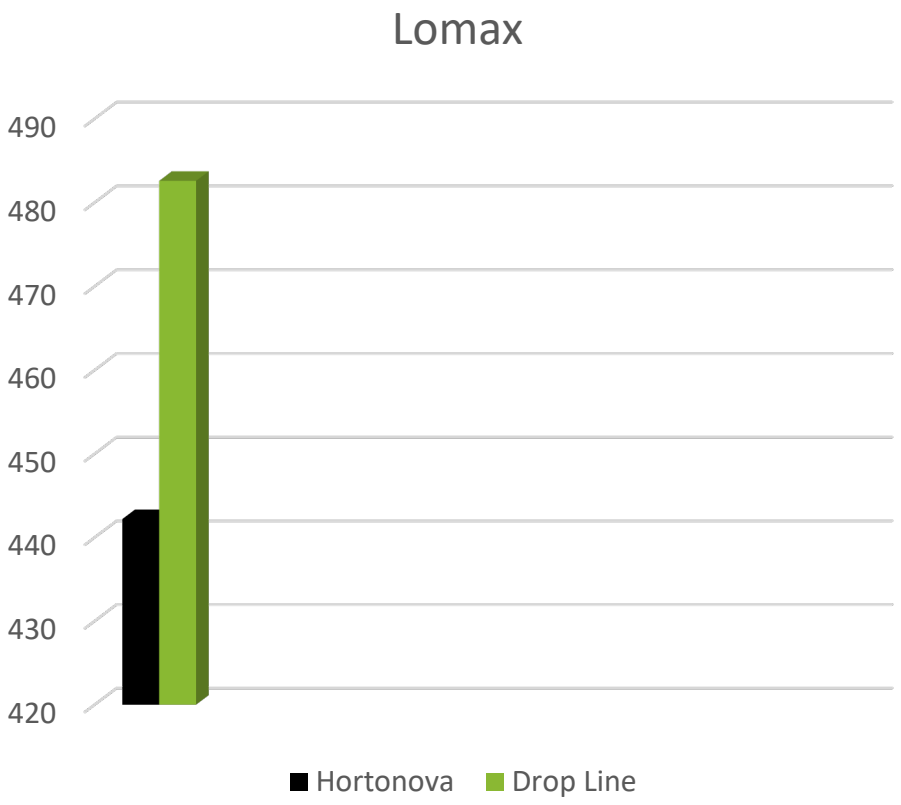
Lomax Farm

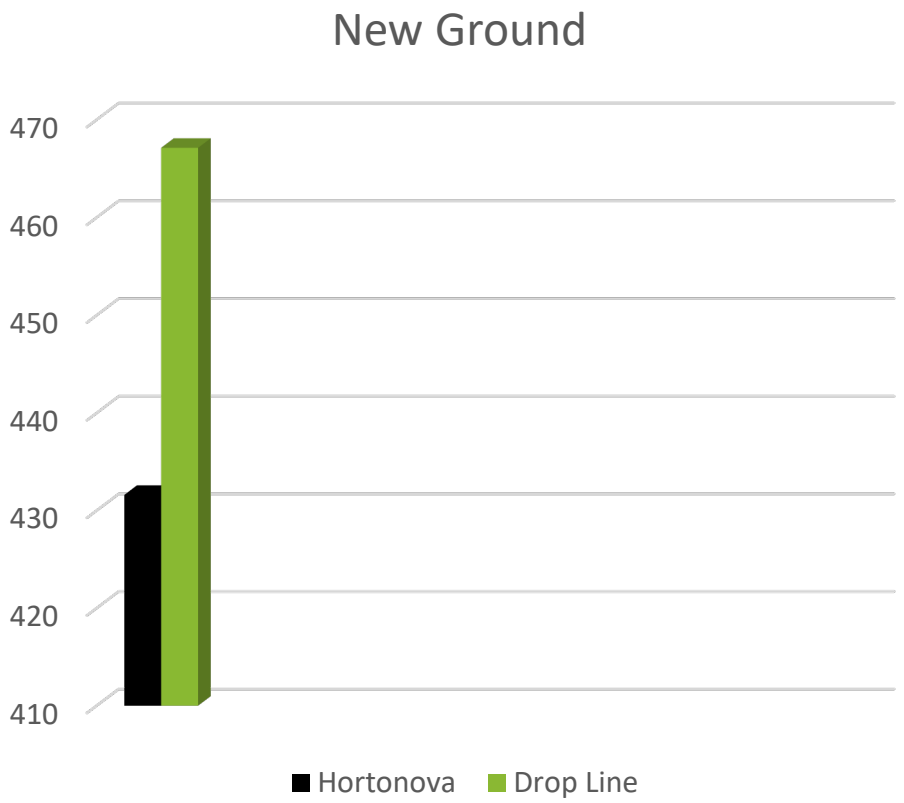

Marketable Yield
120
100
80
60
40
20
0
Excelsior
Itachi
Picolino
Poniente
Shintokiwa
Socrates
Hortonova
Drop Line

New Ground Family Farm



Marketable Yield Per Trellis Type





Rankings by Marketable & Total Yield

- **Marketable Yield**
- Lomax – Excelsior, Itachi, Socrates, Picolino, Shintokiwa, Poniente
  - 924.79#, avg. 115.59#/Week – 8 Week Harvest
- New Ground – Excelsior, Picolino, Itachi, Socrates, Poniente, Shintokiwa
  - 898.74#, avg. 199.72#/Week – 4.5 Week Harvest
- **Total Yield**
- Lomax – Socrates, Picolino, Excelsior, Itachi, Poniente, Shintokiwa
  - 1,444.25#
- New Ground – Excelsior, Picolino, Socrates, Poniente, Itachi, Shintokiwa
  - 1,033.23#

Variety Rankings, Yield by Trellis Type

Lomax	New Ground
Net:	**Net:**
Excelsior	Itachi
Poniente	Picolino
String:	**String:**
Itachi	Excelsior
Picolino	Poniente
Shintokiwa	***Shintokiwa***
Socrates	***Socrates***

SOCRATES

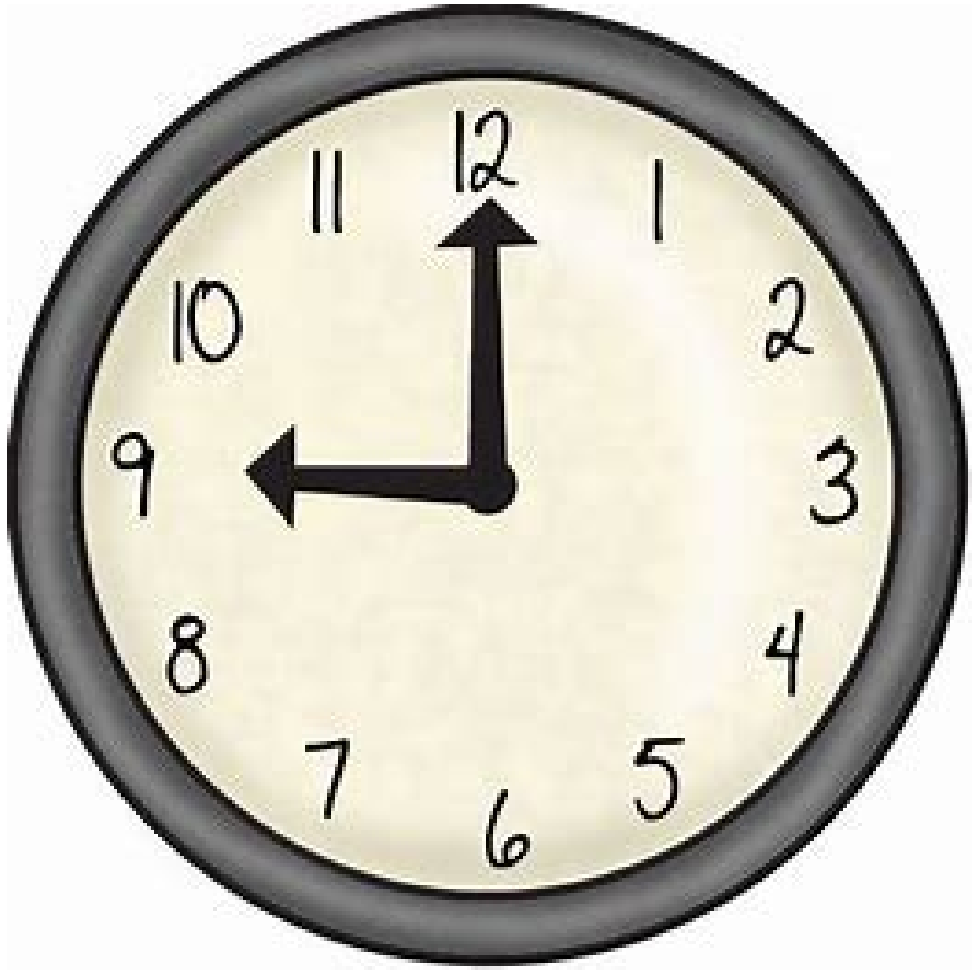
PICOLINO

EXCELSIOR

PONIENTE

SHINTOKIWA

MARKETABLE



Pre/Post Plant Labor – Approx 30 hrs

Bed Prep 11 hr - Pulling plastic, tillage, mowing, bed shaping

Amending 1 hr - Adding fertility

Trellis Set Up 4.5 hr

Transplanting 5.5 hr

Shade Cloth 2 hr

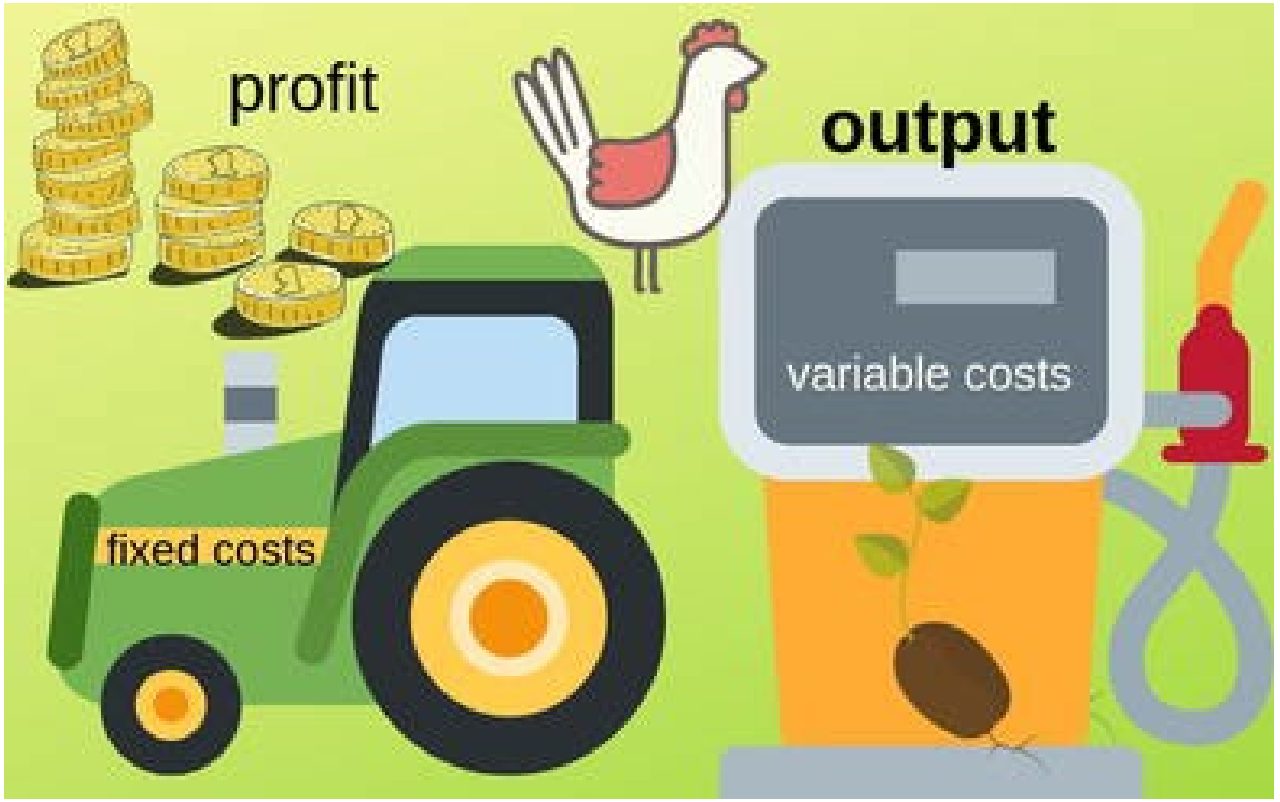
Weeding 1.75 hr

Clean Up 4.5 hr

Greenhouse Production 2 hrs

In-Season Labor

- 18.25 hr Prune/Trellis
- 4 hr Scout/Spray/Sample
- 34 hr Harvest
- Approx. 60 Hours Labor
- **7.5 hrs per week during 8 week harvest season**
  - **1 full day per week spent on this crop!**



Costs

- Trellis $149.90
- Clips $17
- Seeds $315.60
- Soil $18
- Fertility $5
- Trays $20
- Irrigation $178, (some are permanent, header pipe, valves, Dosatron)
- Amendments $153 (includes sampling fees)
- **Supply Costs = $856.5**
- **Labor Costs = 90 Hours x $10/hr = $900, x $15/hr = $1,350**
- **Marketable Yield = 924.79# Cucumbers x $2lb = $1849.58, Net Income = $93.08**
- **Total Yield = 1,444.25# x $2 = $2,888.50, Net Income = $682**
- **Wild Hope had a total yield of 4000#**
  - **DO THE MATH!**

Takeaways

- Clips are annoying and tedious
- Easy to break stems in both systems, especially trying to fit into netting
- Netting felt easier/faster to manage, but drop line felt cleaner and more efficient
- Thin-skinned varieties fair worse with pests and blemishing
- American style with spines and thicker skin are more versatile in tough conditions
  - Definitely grow – Excelsior, Itachi
  - With more management/trials – Picolino, Poniente, Socrates
  - Depends on further trials - Shintokiwa
- **Drop line system had slightly more disease at Lomax**
- **Drop line system produced more cucumbers at all 3 participating farms**

Contact

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