

Monday February 25th

1:15pm – 2:30pm

Structures for Winter Growing: Michael Kilpatrick

Note on abbreviations:

GH= greenhouse

HT= high tunnel

TPs= transplants

IR= infra-red

Italics indicate Product or Company Name

SLIDE 1

Structures for Winter Growing: Michael Kilpatrick, Kilpatrick Family Farms, New York

SLIDE 2

www.michael-kilpatrick.com

SLIDE 3

Introduction

- Michael grew up in Massachusetts
- He now farms in NY near VT border

SLIDE 4

- 4 season farm- harvest year round with season extension
- diverse produce
- 14000 square feet under cover

SLIDE 5

- Motivation: shorten food miles (ie 100 mile diet)
- Farm started 2004, initially with brother
- 12 acres crops, 25 cover crops, pasture
- 8 full time employees (growing season), 2 full time (winter season)
- 285 CSA members, 140 winter CSA members
- 3 markets weekly, some restaurant sales

SLIDE 6

- 450,000+ annual gross income
- 47% CSA
- 95% of operation is vegetables, 10% eggs/poultry

SLIDE 7-9

- Great team of workers

SLIDE 10-11

- First GH in North America, then a modern operation

SLIDE 12

- GH soil tested twice annually, including at least one Saturated Medium test
- GH soil target 6-8% organic matter

SLIDE 13

- Tune soil for winter production (aim to have the best possible growing conditions)
- Quality seed=quality produce (don't skimp on seed!)

SLIDE 14

- Michael makes leaf compost on a contract with the local government

SLIDE 15

Orientation of GH:

- Michael's are on a southern slope with 10 degree angle toward the West.
- Michael's have tile drainage buried around the edge, crushed gravel.
- Would like to use a cistern to capture rainwater .

SLIDE 16

- Above 40 degrees latitude generally orient east/west
- Maximum southern exposure (morning sun, spring warming) - north conscious.

SLIDE 17

- Prevent shade, power poles, height hazards.

SLIDE 18

- Orientation depends on prevailing winds, other site specific factors like drainage (ie floodplain conditions, watercourses)

SLIDE 19

- Michael's farm uses different types of structures for different purposes

SLIDE 20

- Haygrove tunnel

SLIDE 21

MINI TUNNELS

SLIDE 22-34

- Row cover can lay over hoops, weigh edges with sandbags
- Example: cover a November (late) planting for a late winter harvest (ie kale, swiss chard, asian greens, onions, beets and greens, spinach
- *DuBois* has innovative technology, recommended
- Simple covering technique: bungee cords to hold row cover to hoops

SLIDE 35

HOOP HOUSES

SLIDE 36-59

- Less expensive option for season extension, about \$2000 each or \$.65 per square foot

- Plastic cover is installed by mid-November
- Ropes hold plastic down and are staked for additional wind protection
- Grid spacing between them because snow needs somewhere to go when it slides off (or is removed from) the structure
- Small option: 2 beds under PVC hoops but these arches are flexible and can't bear a snow load
- Problem: management intensive because of manual assembly/removal
- Michael recommends 18-24 inch anchor for thawing conditions (mud)
- Irrigation: For greens he uses sprinklers, for tomatoes and peppers uses drip tape

SLIDE 60

Haygrove TUNNEL

SLIDE 61-77

- Single huge piece of plastic, problem because must be manually managed
- Roll-up door helpful (crank-style system on endwall)
- Problem: not really wind (up to 60 MPH) or snow tolerant
- Winter heating: Michael uses a bed-width flame-weeder just to melt snow off so structure doesn't collapse
- Multi-bay also available, a series of archway roofs all connected (field-scale)

SLIDE 78

PROPAGATION GH

SLIDE 79-85

- Has heated benches to hold TPs, covered at night with row cover
- Has heated germination chamber, built with 2 inch blue board (insulation)
- Soil mix is prepared and brought into GH, thaws out under heated benches
- structure doubles as a barn in the winter
- animals go out to pasture in spring/summer- GH holds TPs in spring/summer
- has half wood walls under plastic sidewall (extra stability/structure), also 4x4 posts into ground to secure it.

SLIDE 86-87

- rolling rack in germination chamber for easy access
- rolling racks underneath benches that can take the space of the aisles when not being used to maximise space and light (100% of surface area)
- *Four Season Tools*

SLIDE 88-97

- Example of a GH on a rooftop
- *Rainflow.com* - automated watering of 75% of GH, remainder is spot-watering
- bedding plants (TPs) are more profitable than vegetables those run April-May, tomatoes, eggplant, peppers June-October, then greens in the fall.

SLIDE 98

HIGH TUNNELS

SLIDE 99-104

- easiest to manage and grow in, yet most expensive structure for season extension
- easy to automate, permanent
- more tolerant to 4 season conditions, snow load, winds
- 2 feet closest to sidewalls are the coldest areas (“edge effect”) so Michael creates paths there instead of beds. Plants in those edge areas grow slower than the inside.
- Michael builds the plastic sidewalls up about a foot before the ventilation roll-up sides attach. This mitigates the cold and wind from damaging greens inside GH.

SLIDE 105

VENTILATION

SLIDE 106-122

- Three approaches:
- 1) Always vent - prevent disease/fungi, reduce humidity
- 2) Vent at 50-60 degrees F - prevent fluctuating temperatures, less moisture
- 3) Don't vent - let GH heat up, plants will respond to average temperatures, not to extremes (moisture is major concern)
- when GH heats up water condenses on walls/produce and rolls down to soil - problem!
- Types of ventilation:
- Peak vent - highly recommended to use always, unless it is a heated structure
- Roll-up sides (4 feet length) - not used in winter in cases of deep snow on sidewalls. Note aluminum piece holds roll-up sides down (photo)
- Drop-down sides - controlled with crank and ropes, useful in winter conditions
- for wider structures: peak vent - expensive to install but very useful
- endwalls - vent (ie butterfly peak vent, photo)
- screen on all sides - higher production from pest protection (additional investment)

SLIDE 123-132

CONSTRUCTION MATERIALS

- Types of covers for season extension structures
- Thermal film (Infra Red, IR) keeps heat in GH by absorbing IR wavelength of light, also prevents water from beading and rolling down.
- when water beads on the inside of plastic structures it blocks the transmission of light
- *Agrotech.com* woven poly
- *Pete's Greens* - photo examples
- polycarbonate - lasts longer, tougher material, more expensive

- woven poly - durable, more expensive but useful for roll-up curtains (areas that experience friction/hard wear)
- Remember: Wood rots - can drastically shorten life of structure, especially due to dampness. Treated wood is not permitted in organic production, some “eco-treatments” are even problematic for certification due to trade secrets of ingredients. Michael recommends aluminum, metal wherever possible.

SLIDE 133-135

IRRIGATION

- Michael has a frost-free hydrant in each GH
- water in the fall (November) but often not again until March
- automated GH have overhead sprinklers, recommended for larger operations
- collect waste water - any covered area makes run-off, so catch it to use later

SLIDE 136-144

ROW COVER

- to maximise growth take off cover at 32 degrees F
- row cover closer to plant holds more heat (think about bedsheets: you want to be tucked in and so do the plants!)
- spinach doesn't need hoops, row cover can settle right on top of the plants (easiest crop, highly recommended for beginners)
- roll-up row cover innovation - (photo) Michael shows an example of beds oriented side to side (width of GH, not length) with a structure of hoops to hold up automated rolling row-cover, again with side to side rolling action. It is still problematic because it clumps up unevenly. Walkways on sides to mitigate edge effect. Problematic automation due to row cover bunching.

SLIDE 145-155

TO HEAT OR NOT TO HEAT?

- *GreenGro* - direct vent heaters for greenhouses- very efficient
- heat the soil with hot water pipes going through soil - soil holds heat better than air because of its thermal mass. HOWEVER, soil that is heated tends toward more growth as well as more disease due to soil “sweating” conditions.
- case study available on soil heat through www.uvm.edu

SLIDE 156-159

- *Green Mountain College* - solar panel GH heat, research results available (only useful on sunny days, of which there are very few in the winter when you want heat)
- Michael shows an example: heat 2 GHs with hot air moving via ducts between the two
- possible area for research/improvement: Biochar (produce it in a GH and make both a heat source and multi-purpose soil amendment)

SLIDE 160-161

- Biochar is produced and used on Polyface Farms, Virginia

SLIDE 162

- Biomeiler - compost can produce heat. Youtube video demonstrates pipes laid through large compost heap to capture and redistribute heat

SLIDE 163-172

- GH can collapse! Wind or snow load can compromise structure
- Caution: snow drifts on one side of tunnel, so tunnel must be able to shed snow off sides, and heat must be about 60 degrees F to melt snow on top.
- Michael recommends strong end walls to maintain integrity by radiating strength toward centre of structure.
- snow removal: start at the centre on the GH, and do both sides evenly to prevent uneven weight or stress on structure
- remember if metal pipes are part of the structure, such as anchors, the metal will warm up and radiate heat down into the soil and can cause heave/slump of soil. Michael recommends pounding in deeper anchors and tying down plastic with tension.
- Michael recommends a larger house because it would have more air mass, and therefore the temperature will be more stable. Also, edge effect doubles in a small structure. Wider structures will have less edge effect for more soil surface.
- Michael also recommends higher sidewalls with roll ups so you can walk along the edges, and so ventilation can be automated. Other highlighted recommendations are the soil heat and peak vent.

SLIDE 173-183

MOVING TUNNELS

- tunnels must be well- anchored
- house doesn't need to shelter a crop all the way through its growth, so moving tunnels over a previously planted area is very useful.
- if using multiple tunnels, make sure they never shade each other (grid pattern spacing)

SLIDE 184-195

- moving tunnels can roll on purlin pipes to a location down the field
- ground anchors are important to provide good tension across the house (plastic/rope)
- end walls must roll up to prevent running over the plants
- possible to pull tunnel with a tractor
- *Harnois.com* or *Four Season Tools.com* - recommended brands

SLIDE 196-200

PACKING & STORAGE

- *winterpanel.com* - insulated paneling, seconds are more affordable
- Michael's farm uses a skatewheel to move produce across farm

SLIDE 201-212

- root cellars - possible to use a decommissioned shipping container previously used in China. Purchase cooling system. Total costs were about \$15,000 including cooling cost. For this option, higher ceilings are better (9 ft size vs 8 ft size) even though you pay more for it.

SLIDE 213

- Recommended to line up windows to let light into packing area - workers must be able to see daylight especially in the winter.

SLIDE 215-220

- cooler doors can have an automated switch so the light is never left on and also doesn't need to be turned on when going in
- humidity controls are extremely important
- Michael creates a warm room in his basement to cure all squash and sweet potatoes

SLIDE 221

- Previously his farm has used root pits (slides) to store veg in the ground in a 3x3 hole covered with straw. Soil temperature can keep produce at 40-50 degrees F, but this is not a long term solution for the whole winter

SLIDE 222

- Michael's farm freezes a lot of produce like strawberries and tomatoes

AUDIENCE Q&A

ADDITIONAL STRUCTURAL NOTES

- caution with vertical trellis crops because of the limitation of weight bearing ability - use snow specs but be aware that end walls must be strong. Michael recommends using purlins across the width of the GH
- hot water soil heating radiates upwards at a 45 degree angle. Michael uses water at 100 degrees F and using that as the only heating in the structure.
- Plastic used on the farm is either 6 mm layers of anti drip or IR
- Michigan State/Pennsylvania State University have research information available on season extension
- Spray the outside of the GH with "surround", kaolin clay, for example, as shade in the summer to control temperatures - this is a midsummer operation

Monday February 25th, 2013

3:00pm – 3:50pm

Farm Case Studies: Broadfork Farm, Nature's Route Farm, and Windy Hill Farm

Note on abbreviations:

GH= greenhouse

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Farm Case Studies

Broadfork Farm (NS) - Shannon Jones and Bryan Dyck

Nature's Route Farm (NB) - Kent and Ruth Coates

Windy Hill Farm (NB) - Will Pedersen and Alyson Chisholm

Broadfork Farm

SLIDE 1-3

- Structures chosen based on low cost and move-ability (caterpillar tunnels)
- Caterpillar tunnels designed for winter use
- Size of current structure: 12 by 136 with 4 foot bow spacing, which is closer than usual because of concerns about wind and snow load.
- Inspired by Windflower farm, easton, NY

SLIDE 4-6

- Construction: rototilling, tamarack stakes (18-24 inch stakes)
- PVC - recommended for fast construction and no need to bend to fit
- End walls - T bar, wrapped plastic

SLIDE 7

- Used duckbill earth anchors that have a wire leader, they get driven into soil with a driving rod, when the driving rod is pulled out, the toggle flips and secures the anchor, found from Forestry Supplies company in the US for \$2.60 each to most expensive at \$6 each, and Broadfork advises using the larger, more expensive option for better security.

SLIDE 8

- Rope system to hold plastic on is criss-crossed, which added to structural integrity. When venting, this tension across the PVC pipes held up the plastic without any aid.

SLIDE 9

- The two tunnels together cost: \$2,780, or \$.85 per square foot - remember they bought more bows for more strength
- All information (materials, sources and costs) available on their website: www.broadforkfarm.com

SLIDE 10-14

- 1st year, without a greenhouse, started seeds indoors and moved to caterpillar tunnels after germination, and then the tunnels were used for tomatoes, melons, eggplants, peppers.
- Trellising done with Rebar and twine. The “Florida Weave” system.

SLIDE 15-16

- Both tunnels were filled with spinach for the winter. Seeded end of September in plugs and transplanted mid-October.
- After a heavy snow, they would shovel out the windward side of the tunnel, but usually they had only to walk inside and press along the roof of the tunnel with a car snow brush or broom
- Snow accumulates on one side due to SW exposure and prevailing winter winds
- Spinach in tunnel for winter has never been covered (ie row cover) and is very sweet-tasting

SLIDE 17

- Contact info for Bryan and Shannon at Broadfork Farm.
broadforkfarm@gmail.com www.broadforkfarm.com,
www.facebook.com/broadforkfarm

Nature's Route Farm

- Past and present season extension structures: tunnel, 2009, 13x42 for tomatoes, peppers, eggplant
- Farm highest grossing crops are potatoes and carrots (majority of field crop)
- New storage facility allows better quality winter sales of root crops
- At current stage Nature's Route are seeding with a tractor, unlike at the beginning
- 2012 tunnel: 17x300, pre-bent rectangular hoop structure houses 3 beds using a single large piece of plastic. Secured with 15mm rebar for anchors, with 18 inches above soil. This structure is from *Multi-Shelter Solutions*.***
- This farm is in a windy area

- In spring seeded 3 beds, then it snowed a foot, then installed hoops.
- Ends are anchored with a wooden fence post with a twine brace
- With this structure, the plastic was lost so new plastic was bought and installed in June
- The structure still allowed a 6 week jump on carrot production
- The plan is to replace the ponytail that secures the ends with wiggle wire to make venting easier because water collects in the folds.
- Next year the plan will include a crank for roll-up sides (presents a challenge at 300 feet length) because in the summer the heat requires rolling up sides underneath the structure so that water runs off, which chafes the plastic against the hoops, so hopefully only will be necessary twice yearly.
- Purpose of this structure is to heat soil for early crop production - plastic was stored for the winter this year
- *Harnois* ovaltec GH is a 28 ft permanent structure with a headerhouse to collect the waste heat from the cooler installed there for winter storage room. This GH will be used to start plants and then grow tomatoes and peppers

Windy Hill Farm

(Written presentation available from ACORN)

- 40 minutes North of Moncton
- 3 ½ acres in total under cultivation, 1 ¼ acre in crops each year.
- 75% of crops produced are from TP
- Has three different structures:
 - 1) Lean-to - 18x9, wood frame, home made, for starting seeds (TPs), has heated tables
 - 2) Cold-frame, 24x72, unheated, from *Multi-Shelter Solutions*, used for tomatoes, greens
 - 3) High Tunnel (HT), 12x100, Quick Hoops, from *Johnny's Selected Seeds*

LEAN-TO

- The lean-to has heated tables made with ½ inch plywood, 2 inch styrofoam, heating cable ("roof de-icing cable" usually used for prevention of ice build-up in eavestroughing). 80 feet of cable is about \$60 which covers 8 feet of table with strands 3 inches apart. Then covered with playground sand to hold/distribute heat.
- These tables can hold about 11 trays (128-cell flat)
- Table uses a Hydrofarm heat mat thermostat from *Amazon.com*. It uses a soil probe to keep temperature at 20 degrees C or warmer if desired.
- Installed "Sensaphone" monitoring system for about \$100 which is an alarm system that calls the house if the temperature is too low or if the power fails.

- Plastic is rolled over at night to hold heat, with an extra layer of bubble foil on cold nights
- Whole structure and components built by farmers for about \$7-800, no exact figures

COLD-FRAME

- 24x72 - has 1x2 rectangular steel hoops like structure described by Nature's Route Farm
- Manual roll up sides at 3 feet off the ground
- Some wood parts were treated with "Eco Wood Treatment" to prevent rot but this is proving problematic for organic certification because the ingredients are not disclosed
- Cost \$3,362 + end wall lumber \$233.23 + cement, bolts, wood treatment \$328.21 = \$3,923.44
- Structure faces NW, strong in the wind (added wooden poles inside for additional support for snow load), still requires shoveling out the sides several times each winter
- Structure has two purlins running lengthwise. Corner ground anchors and every third ground anchor are set in concrete, others are pounded in. Used for growing early greens and green onions then mid season tomatoes. Have good crops of cherry tomatoes but other varieties have had disease and nutrient deficiency problems.
- Built internal trellis for tomatoes.
- Inside shows 3 beds each 5 feet wide, with 2 half size beds on the sides which produced excellent basil.

HIGH TUNNEL

- 12x100, 7 ft high, Quick Hoops High Tunnel from Johnny's
- 5 feet spacing of hoops, structure can be built to any length in multiples of 5 ft.
- Spreadsheet downloaded from Johnny's website can factor costs if you enter length of tunnel and number of purlins desired
- Best to install cover on warm day so plastic is flexible and it will shrink in cooler conditions for a tighter fit
- Johnny's bender used to bend 10 ft. galvanized rails, two bolted together to make each hoop. 1 5/8 anchors pounded down, fit hoops inside them
- cost \$1.13 per square foot, \$1.41 with two purlins added (purlins used to hang trellis lines)
- (simplicity) plastic comes in one piece 20 ft. x 125 ft.
- Farm uses woven poly mulch with holes burned in, lasts 10 years or more.
- Melons were grown successfully
- Used parachute cord to tie down plastic which has been secure so far. Parachute cord comes in 1000 ft rolls.

- Spring clamps were used to hold up sidewalls when ventilating over the summer
- Conclusions - easy to build, fairly cheap
- Had some problems with rain pooling between the ridge pole and the purlins, have since removed the purlins as they are optional.

Additional notes from Windy Hill Farm, re: heat table construction in the lean-to:

The heating cable I used was from Home Hardware:

EASYHEAT Item #5513-223 Model #ADKS-0400 (the 400 is the wattage though I found it uses around 350w).

And yes, that is the heat mat thermostat I used. I found it was available on the US amazon.com site but not at amazon.ca for some reason.

These are some notes on the construction:

I ran the loops 3" apart and 1.5" from the edges so that no part of the cell tray is more than 1.5" from a cable. One 80' cable covers 7-8 ft of the 32" deep bench. I think at one point I calculated the inches of cable in one loop and increased the 3" spacing a bit to fill up the 8' or so of the second bench. I have 3 roughly 8 ft. sections of bench with 3 80 ft heating cables, this is about the wattage limit for one thermostat though I don't usually have all three hooked up at once.

I first built a frame using 2x4 lumber (1.5" side up) to support the benches, this frame is attached to the framing of the greenhouse (and side of the barn) and the 1/2 inch plywood goes on top of this (just covering the 2x4 frame). I made the bench 32" deep so you can get 3 32"x48" pieces out of one sheet of plywood. The cell trays we use are around 10" x 22" and this size bench will fit two rows of the trays, one turned sideways (photo attached). This picture shows 2 of the three 8 ft benches. The plastic covered divider there keeps the heat in if only one section is turned on.

The styrofoam insulation goes under the plywood and is kind of wedged between the 2x4 framing and is held in by some 1x1" blocks attached to the 2x4s. I put plastic sheeting on top of the plywood and sloped the bench forward a bit so any excess water would run off (and not rot the plywood) but I don't think we ever water so much that this happens. Anyway, the aluminum sheeting was also from home hardware, comes 24" wide. I fastened the cable down with small fencing staples (carefully so as not to damage the rubber coating). You could also get electrical cable staples that are

insulated on the part that contacts the cable. Next time I might wrap the staples with a bit of electrical tape where they contact the heat cable.

The instructions with the heating cable say not to install it contacting flammable materials so the I thought the flashing might prevent a fire in case of a short in the cable as well as sort of spreading and reflecting the heat up where you want it. I have it on a GFCI receptacle too so I think this would cut out if there was a major short in the cables. I worry a bit about fires so put a smoke alarm in the lean-to greenhouse as well. The Sensaphone 1104 monitoring system I bought (used around \$100 on eBay) can detect the sound level of the smoke alarm and phones me with an alert (hopefully before the barn burns down!). I don't think most smoke alarms work well at low temps but the system worked when I was weed wacking in there and the exhaust set off the smoke alarm.

The rim of 1x3 (red wood in picture) is used to attach the wire hoops (just a hole drilled in the wood with 10 ga heavy wire for the hoops) and also keeps the sand in. I put enough sand so it is maybe 1/8" to 1/4" over the top of the cables.

Q & A WITH PANEL:

- Broadfork - used 20 foot lengths of PVC from *Corkum's* in the Annapolis valley, which is an uncommon length since usually they come in 10ft length
- Broadfork - next season will also be growing under a high-tunnel that is 24x100', purchased as a kit from *Multi-Shelter Solutions*. The size was chosen a flat site on the farm.
- Broadfork - their caterpillar tunnel is on a slight slope, which can be done but remember soil always moves downhill.
- A regular GH can be put on a slope permanently but installation will be difficult because the plastic may not fit well
- Windy Hill - Hoops of HT are easy enough to move for rotation because they can fit over rebar
- Nature's Route - 40x200 structure will be their next large permanent structure, but in the short term they will be adding quick hoops inside other structure to act as heat instead of inputting energy to heat

February 25th, 2013

4:00- 4:50pm

Succession Planting and Crop Profitability by Michael Kilpatrick

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SLIDE 1

Succession Planting and Crop Profitability

Kilpatrick Family Farms, NY

SLIDE 2

(for a detailed introduction to Michael, see his talk from 2013 GH conference titled "Structures for Winter Growing")

SLIDE 3-6

- 30 crops available at (American) Thanksgiving
- 52 weeks of growing and selling
- In spring most crops are coming from the GH

SLIDE 7-10

- This farm has a few different soil types, but generally a shaley silt loam with good drainage or a gravelly sandy loam, and some clay loam which still has good drainage
- plastic is often laid out over crops in tunnels, some by hand

SLIDE 11-14

- Marketing - 95% sales from produce, most through market or CSA
- CSA pickup is from the Market (strategy), includes 2 given items and 6 chosen items from what is available
- Planning to get larger as an operation: currently 55 different crops in smaller quantities, generally, although 1 ½ acres are in carrots

SLIDE 15-25

- Good recordkeeping is key - temperatures, seeding amounts, dates, % germination, TP dates, harvest dates, events, field & bed location, # row feet, # seeds/ft, row cover or special notes, mulch, spray needed (photo example of manager's journals)
- GH chart: beds in 2 wk rotation, visual representation for planning/directing staff

- Include interplanting (photo) for crops that mature at different rates to take advantage of covered space: for example, Asian greens grow best in the fall/winter but bolt in the spring, while swiss chard is slow growing and can take over the space in February (2 crops in less space)

SLIDE 26-31

- Interplanting examples: tomatoes with greens/lettuce - this is risky due to need for irrigation and potential for disease due to dampness

SLIDE 32

- Onions (slow growing) and micromix

SLIDE 33

- Chart of growth rates - April spike and June spike (unheated)

SLIDE 34

- Gross sales goals: \$40,000 per acre, \$4.50 per bed foot (field), \$8-9 per bed foot (GH), with \$40/hr made from picking the crop

SLIDE 35-42

- Acclimation is important! Crop that is gradually brought down to colder and colder temperatures does much better than crop that is protected and allowed to freeze hard one night. We will keep tunnels open at 32 degrees to allow plants to harden off.

SLIDE 43-45

SPINACH

- spinach is picked into 5 gallon buckets (photo)

SLIDE 46-48

- Farm uses many *Rubbermaid* bins because they have a lifetime warranty which has been used about 4 times for some bins - highly recommended

SLIDE 49-57

- some crops can be covered in the fall and, untouched, will come back in the spring (ie spinach, even though it may have been cut in the fall)
- spinach succession plantings are shared (slides)
- wall to wall spinach (3 pickings), covered for best results, can produce \$300,000 per acre using succession harvests
- varieties/cultivars are recommended, many seeds are sourced from *Johnny's*

SLIDE 58-61

- This farm also uses spinach TPs into tunnel from germination in heated GH
- latest seeding for baby spinach is October 10

SLIDE 62-65

- varieties: Pigeon (high yields), Giant winter, Palco, Space, red cardinal (colour),

SLIDE 66-71

- use different varieties with different maturity dates to diversify ripening

SLIDE 72-73

- “bubble washer” gently washes spinach (photo) - drains in 50 gallon tank, no spinning to dry

SLIDE 74-82

MESCLUN

- mesclun - less demand in this farm’s markets, usually sells more lettuce mix)
- grows outdoors until December - stack row covers
- harvesting tip: cut from an open edge, working backwards into the bed, hand without cutting tool will grab and move produce so the bin should be nearest to non-dominant hand
- in midwinter mesclun is replaced with TPs

SLIDE 83

- Recommended varieties for mesclun

SLIDE 84-89

MUSTARDS/ASIAN GREENS

- mustards are sweet in the winter
- varieties are grown separately because it is easier to pick a cleaner, better quality product when the bad leaves can be seen better (ie one colour at a time)
- recommended varieties - ie Tokyo Bekana, Yukina Sovoy

SLIDE 90-91

- Late winter mustards and Asian greens are bunched as “braising greens”

SLIDE 92-95

MACHE, ARUGLA

- mache is cold tolerant but arugula is less hardy

SLIDE 96-101

- prevent stems: cut, shake handful with shorter leaves into bin, then cut again to remove stems from longer leaves
- mini tunnel is used to extend this crop

SLIDE 102-120

KALE

- sweet in the winter
- remember, markets want it when you can’t grow it easily, but when it grows easily markets don’t seem to want it
- fall planting of kale uses plastic mulch
- kale is picked in the fall to sell later (December, January), stored, better quality this way and frees up space
- kale is sometimes sprayed with “surround” to prevent burning plants - spray plastic to minimize heating up, bugs
- don’t cover your kale too soon because it will get wimpy and less tolerant
- kale can be interplanted with Bok Choi (photos)
- collards are hardier than kale but there is less market for them

SLIDE 121-123

- Micro greens are worth the expense (great looking product)

SLIDE 124-133

- *rootshield* prevents disease

SLIDE 134-136

- recommended cordless grass shears (short video) for micro greens/micro basil (a summer only crop)

SLIDE 137-147

- Swiss Chard in succession crops both for field/protected crop

SLIDE 148-149

LETTUCE

SLIDE 150-156

- recommended varieties!
- important that lettuce seed is DMT tolerant
- look for varieties that have more density and weight to your lettuce mix
- bring down temperature slowly
- Michael plants lettuce indoors in *haygrove* tunnel

SLIDE 157-179

- Lettuce mix:
- Always in demand
- recommended varieties!
- plant colours separately, as with other mixes, so colour shows bad leaves more easily
- *High Mowing Seed Company* - study: lettuce that is direct seeded stands up to cold better than TP
- most of this farm (90%) is via TP but more is being done by direct seeding
- lettuce like kale, is cut and stored to sell later, up until New Year's

SLIDE 180

- Asian Greens:
- bok choi - photo January 17th, 3 row covers

SLIDE 194-205

- Asian greens recommended varieties like Joi Choi, Mei Qing
- GH strawberries are interplanted with Asian greens
- broccolini was overwintered and they are hoping to harvest side shoots

SLIDE 206-220

peppers

- recommended varieties!
- focus was on colours, early to beat market (indoor with mulch)
- \$15/bed foot, around \$2 each pepper

- drip tape and landscape fabric/plastic mulch used
- to extend season into fall, acclimate to change average temperatures and then place tunnel over
- GH peppers - trellis and stake
- favorite variety - Carmen(good red), Flavourburst (for its vivid yellow)

SLIDE 221-228

- French beans - beat market, good profit margins

SLIDE 229-138

- cherry tomatoes - 2 plantings, use root grafts (stock from *Monsanto*-owned "Maxifort"), 1 month ahead, high demand
- tomatoes - pick into waist bucket, mix in barrel washer, rinse off copper spray, rainbow
- colours all together, sold at \$4 ½ pint in June = \$12-15 per bed foot

SLIDE 239

CUCUMBERS

SLIDE 240

- recommended varieties!

SLIDE 241-245

- prune - 1 stem, like tomatoes
- self-pollinating varieties
- new ideas: keep flowers pruned off until leaves are 1 ft across to increase plant vigor

SLIDE 246-249

- Sunflowers - great to have on the market table

SLIDE 250-259

- ginger - hilled, no watering in the early months, needs lots of fertility

SLIDE 260-267

- winter onions - 4-5 inches, beautiful, good sellers, favorite variety is Bridger

SLIDE 268

(contact info Michael Kilpatrick)

Q & A

- pests/diseases: uses *Slug-o* (organic approved), and *Pyganic* for strawberries and potatoes
- www.flameweeder.com - 2 wheels on front, one person operates
- direct seeding greens - *johnny's* greens cutter (not for TPs)
- Tokyo Bekana - needs 3 row covers, dies at -20 degrees F even with cover
- GH - weekly sales targets per bed foot
- all salad mix is spun to dry, but not spinach

February 25th, 2013

7:00pm – 8:00pm

Season Extension on our Farm

Michael Kilpatrick, Kilpatrick Family Farm, Middle Granville, NY

- 2 full-time winter employees actually means 1 full-time employee and 4-5 part-time people.
- How do we produce food year-round?
- How do we get good soil? The best soil is the soil you already have. If it's too wet, you can create a raised bed.
- He has been blessed with 7 different soil types to grow on. On his home farm, where his tunnels are located, he mostly has Bernardston soils.
- They use a lot of compost.
- They do a lot of soil tests. In the tunnels, they do 2 soil tests per year. In the fields, they do one test per year.
- They plant lots of cover crops. Buckwheat in the summer is something they plant a lot of for the soil but also for the bees. Make sure to plough under 2 weeks after flowering.
- Also use hairy vetch.
- Plant acres of rye and let it grow tall (6-7').
- Compost-making: contracted with the County a few years back to dump all the collected leaves off at their farm. They get about 150 truckloads per year. We compost the leaves by turning them 2-3 times a year.
- In the greenhouse, they don't apply any animal-based composts because of the salt content. Since greenhouse soils don't get flushed with rainfall or snow, the salt will just build-up until finally it can reduce yields and kill plants.
- They don't add supplemental Nitrogen fertilizer in the greenhouses or else they end up with aphids.
- They're always growing more and more varieties with disease resistances.
- Earlier and later plantings are spaced farther apart to increase air flow.
- They spray down their equipment between fields to reduce the movement of weeds and diseases.
- Uses Oxidate which is like hydrogen peroxide and Milstop which is a baking soda product.
- They add ladybugs every year for control of aphids. Sprinkles them in the greenhouse then puts a layer of row cover over top for a day so they think of it as their home and don't fly away right away.
- The \$40,000 per acre is gross, not net.

- In the picture of the home farm, you can see their 8-15 degree slope. This slope always warms up the faster and stays warmer than other fields.
- Frost-sensitive crops are grown either in a tunnel or under multiple layers of row cover.
- Does 3 or 4 succession plantings of summer squash and cucumbers, 30 succession plantings of lettuce and greens, 8 or 9 succession plantings of beets and carrots, and weekly succession plantings of annual herbs.
- Figured out recommended last planting dates, and then just keeps planting for 2 more weeks and takes notes. Has learned that a lot of plants can hold longer in the field than commonly thought.
- Also, he finds that seasons are shifting a bit. The falls seem warmer and the springs cooler. More reason to keep experimenting with planting dates.
- Equipment – they have 4 tractors. A large John Deere which is used for field prep, potato harvesting and some bed preparation. Farmers without a tractor this size can custom hire out the work. They have 2 cultivating Super C tractors which they use for weeding with belly-mounted cultivators. These tractors are also used for hauling trailers. The 4th tractor is a smaller John Deere which they use for rototilling, over-seeding, and loading compost.
- Plastic mulch layer from Nolt's. It has been invaluable. It's nice because it's small and can be used in the tunnels.
- Flame weeders – for early weed control. Have both a small and large-scale one.
- On the flaming basics page, there is a typo. It should say "Ideal" situation, not idea.
- Irrigation. They are irrigating from wells, ponds, and a river. They irrigate overhead in the fields and with drip tape in the greenhouses. With an irrigation reel, you need to be careful with the tip size (of the nozzle) because you want to make sure the water droplets aren't damaging your crops.
- Uses the germination chamber for Solanacea crops.
- Uses one of the tunnels as a hardening-off house for transplants before they go out into the field.
- They transplant using their waterwheel transplanter as well as a lot of hand-transplanting. All of their lettuce seedlings are transplanted by hand (with a crew of 4, they can do 3000 plants/hour).
- Raised beds are important for season extension as it makes the beds warmer and drier. Their raised bed maker is from Buckeye.
- Seeders: 70-80% of their seeding is done with an Earthway seeder. They have a Jang seeder also which is nice to have but not necessary. Have used a six-row seeder (from Johnnys) but has found it difficult to get all the hoppers calibrated the same.
- Uses a landscape rake often to form beds.

- They use a lot of straw mulch. It keeps the worms happy which is the most important part.
- Biotelo plastic mulch, which is approved for use in organic agriculture in Canada, is now semi-OMRI approved in the U.S. (it is in the process of being approved right now).
- They have a bale chopper that throws mulch onto their fields and then they sweep it off the plastic mulch.
- After the Biotelo is laid, the seed some pathways to rye.
- They always put row cover down after they seed carrots to keep the bed moist and increase germination.
- They don't use any row cover that is more fine than PRO 30 (.9 oz) in their greenhouses.
- Use sandbags to hold row cover down.
- Use row cover in their mini tunnels as well.
- Put hoops along brassica beds before putting down row cover to prevent abrasion on the growing tips.

Post-Harvest

- They're bringing greens to market in the winter, but mostly selling root crops. Greens are the loss leader.
- Use a root lifter/undercutter bar to harvest roots.
- Root cellar is an insulated shipping container.
- Harvest knives: their standard is the Stainless Steel Produce Knife from Johnnys. Use the Serrated greens knife from Johnnys for greens. Some of his employees prefer the smaller Victorinox/Johnnys Pocketknife.
- A must-have are insulated gloves for washing crops during the winter. You can find them at Gempler's or any marine supply stores.
- Use an insulated garage to store garlic, sweet potatoes, and winter squash.
- They've also stored crops in root pits which they found could be used until December but not through the entire winter.
- Mini tunnels. You need to shovel the snow off them in the winter in order to harvest. They help you get crops 3-4 weeks earlier in the spring.
- The Haygrove is a 3-season, larger-scale tunnel.
- Spinach is great in the winter because you can pick it again and again which increases its gross value/acre.
- Bordeaux spinach – they call it Christmas spinach.
- Sells arugula separately from other greens.
- Even now (end of February), they are still selling storage onions and garlic.

- Kilpatrick hasn't had much success leaving leeks in the field over winter. They haven't survived. So, they harvest their leeks in the fall and store in the root cellar.
- To grow green garlic, they plant an entire bulb of garlic into Biotelo and in the spring harvest bunches of green garlic.
- Strawberries: With the annual bed system that they use, they can harvest a week earlier than with a matted bed system. Kilpatrick feels that Chandler is the best variety. They keep them under bird netting (Oesco) to keep the birds out. The 1st day they had them at the farmers market, they sold out in 15 minutes.
- Winter Squash: they grow Pink Banana types and other big ones in order to cut them and sell them pre-cut at market.
- Brussels Sprouts. They harvest them in the fall, store them, and sell them until mid January or early February. They are grown on Biotelo. if you keep light on them in storage they will stay green.
- Broccoli: they plant them super late.
- Kohlrabi: plants on plastic mulch, it's a small crop for them but helps bring the values per acre up.
- Sweet Potatoes: if you leave row cover on them for too long, they will end up with a lot of vegetative growth and small roots. Their yields are 1.5-2 lbs/plant.
- Parsnips: they plant them in May and harvest both in fall and spring (the spring-harvested ones are sweeter). The problem with parsnips is that they take up a lot of ground for the whole season.
- Specialty potatoes: they attract farmers market customers and restaurants. Mid- winter, they bust out new varieties so customers get excited.
- Hakurei turnips: they sell a lot at market
- Carrots: take up the most acreage (1.25 acres). Their storage carrots last until May or June of the following season.
- Beets: they focus on different colours.
- Questions from audience:
- How do they make holes in the plastic mulch? Their waterwheel transplanter makes holes or, if they are transplanting by hand, use dibblers. If they didn't have a waterwheel transplanter, they would likely get a Jab transplanter.
- Fertility? They apply 10 tons/acre of compost. If they're not using chicken compost, they use soybean meal. In the high tunnels, they don't use animal fertility, they use soybean or alfalfa meal or Sul-Po-Mag.
- How long do they use the greenhouse plastic before replacing it? They replace it every 4 years. With the plastic they've removed, they either use

it for a Slip n' Slide on the farm or to put over mini tunnels. When it's no longer useful for those purposes, they'll make it into a bale which can be used for random things (building blocks).

- Do they have wireworm problems? Yes. Wireworm is the reason they prefer harvesting parsnips in the fall. After taking a field out of sod, they prefer waiting a few years before using it for vegetables that wireworms like (potatoes, parsnips).
- Do they use row cover to protect against root maggot or rust fly? For root maggot, need to cover Hakurei turnips with either row cover or spray with Pyganic, though they usually go with the row cover. Haven't had a lot of issues with rust fly, haven't used row cover for it. One year they had a big problem but not really since then. Somebody recommended mixing sage or onion seeds with carrot seed when seeding because the rust fly doesn't like them.
- Where did he source his sandbags for holding down row cover? He got them from Uline (where he also gets bags for packaging greens). The bags are UV resistant. He buys a different colour every year so he knows how long he's had each bag. He has also just used rocks to hold down row cover.
- How does he store his row cover? He shakes it off and lets it dry off (never store wet row cover). Then he straightens it out and rolls it into a large ball (like rolling a snowball). When he gets to the end, he twirls the edge and tucks it into a ball. He makes sure to label each piece with useful information like the grade, size, and the person who packed it.
- What kind of row cover does he use? He prefers Covertan because it's heavier duty and the edges are reinforced. He also likes Typar T5-18 because it's super thick and he uses it to cover strawberries in the winter because the deer can't paw through it.
- Does he re-use his plastic mulch? He doesn't because he finds that it breaks down pretty fast in their soils but he thinks it could work for an early crop like peas, followed by something like Brussels sprouts.
- Does he always put drip tape under his plastic mulch? He does with everything except spring-planted potatoes and Brussels sprouts. Onions get 2 lines of drip tape.
- What brand of potting soil does he use? He uses McEnroe and in the past has used the mix from Vermont Compost Company. He thinks both are excellent quality but McEnroe is cheaper.
- How does he cure his winter squash? In his greenhouse. He cures all of them, regardless of whether the variety requires curing because they have so much it would be difficult to treat them all differently.

- Where does he source his strip trays/channel trays? From Nolt's. They cost \$120 for a 100 tray case.
- Kilpatrick mentions that they have a listserv in their area where people can post bulk orders they're doing, or equipment they have for sale, etc. He says it is very helpful and suggests we do the same.

February 26th, 2013

8:30am – 9:50am

Nature Does the Trick! Intro to Greenhouse Biocontrol

Sebastien Jacob, Biobest

- First asked the audience about their level of knowledge. Most people either had very little knowledge or were using it on a small-scale (in particular for aphids). There were also some Extension Agents in the audience.
- Learning the scientific names and using them is an important part of using biocontrols
- Biocontrols have been used for a long time, the Chinese were using them 8000 years ago.
- Each person consumes 1.8 kg of pesticide residue from their food per year.
- Only in the last 20 years has a biocontrol industry started to be developed more extensively in North America.
- WF stands for White Fly
- In the last 5 or 6 years, the ornamentals industry has had problems with thrips and white flies becoming resistant to pesticides which has made them look back to biocontrols.
- Why implement BCAs?
- Myths – some chemicals can be sprayed while using biocontrols.
- With just the basics in my talk today, you'll be able to use biocontrols. There's a lot of help out there – Extension, online, books...
- Facts – Biocontrols are often used as a last resort but, logically, they should be considered the first choice.
- People sometimes wait too long to start using biocontrols. It should be used preventatively.
- Curcumis eats the eggs of thrips. You can't wait to use it after they've hatched out.
- Recommended book: Nature Wars. Gives a lot of examples of biocontrol from around the world, even in airports.
- Biobest started in 1986. This is the Biobest facility in Belgium. They produce 7 species of Bumblebees – these are the top 4. They also produce nematodes for fields, golf courses, greenhouses, etc. Their lab does side effect trials as well, they are the only company in the world that does this to try to figure out what good bugs the biocontrols might be going after as well as the bad.
- Honeybees are nectar collectors. They collect pollen by accident. And they store honey for themselves.

- Bumblebees are different. They have a one-year cycle. After a year, they have a new Queen. It takes 3-4 months to make a hive at Biobest and 5-10 days between cycles. Bumblebees fly at cooler temperatures than honeybees. They can also fly in a greenhouse which honeybees cannot do because they can't see, they need the sun's rays to see. Honeybees stay in their hives in windy, cool weather. Bumblebees don't store so much honey.
- Bumblebees are also more efficient. They only need to visit a flower 1-2 times to pollinate it. Honeybees need to visit the flower 10 times.
- Jacob suggests growers use both honeybees and bumblebees. Bumblebees slow down when the temperature gets above 31-32 degree C. Honeybees thrive at 30 degree C.
- Honeybees are long-distance pollinators, which can be good and bad. Bumblebees usually fly 500 m around their hive, at most 1 mile away from hive.
- This is what the hive looks like when you receive it from Biobest. You can just put it in your field and it's ready to go. They need to be fed sugar for energy to fly.
- When bumblebees collect pollen, they vibrate the flower and the pollen falls out and is collected on their legs.
- With tomatoes, after the flower has been hit by a bumblebee, the flower turns slightly bronze. If it's too dark, the flower has been over-pollinated.
- Bumblebees see light in the UV range which is how they can fly. They see light differently from us. They wouldn't be able to fly in a camera room. Removing the UV light is how Biobest catches the bumblebees and puts them into the hives.
- If you had a plastic without protectant, the sun would ruin it. All greenhouse plastics have a UV blocker that still allows the plastic to filter as much light as possible into the greenhouse. Bumblebees can still fly under this plastic. You should ask your plastic supplier how much UV light gets through. It might be none in which case bumblebees wouldn't be able to fly under it.
- Aphids: Do you know how to ID aphids? It's very important to know which species you have before you order your biocontrol products (this is also true with White Flies).
- Figure 9 is a picture of a Potato Aphid. You can recognize them by the brown line on their back.
- Figure 5 is a Foxglove Aphid. They have 2 orange patches around their tailpipes.
- Figure 3 is a Cotton or Melon Aphid. They can be different colours, either pink or black, however their tailpipe is always black.
- Figure 10 is a Green Peach Aphid. Their antennae are just shorter than their bodies.
- With aphids, you also have 4 different agents to use for biocontrol. You can use a predator (ladybugs or lacewings) which provide a curative control. Or you can use a parasitoid agent for preventative use. *Aphidius colemani* will go after the

smaller aphid species (Cotton and Green Peach). *A.ervi* will go after the larger aphid species (Potato and Foxglove). *A.abdominalis* will go after all the aphid species however is not a specialist of any. It will lay only 15-20 eggs per day and offers a smaller amount of control but over a longer term (slow and steady).

- Thrips: can also be problematic with tomatoes. *Orius insidiosus* is big. *Amblyseius cucumeris* feeds on the larvae and lives under leaves. The nematode *Steinernema feltiae* is a microscopic worm, it will go inside the thrips and release a bacteria.
- It's important to know who kills what and at what stage of development.
- Fungus gnats: are very common, it's the larval stage that does all the damage. If you have *Pythium* in your greenhouse, the larvae will distribute it from root to root. The Sciarid fly adult doesn't do damage but they do excrete on plants (which is not nice). The larvae don't do a lot of damage unless there are lots in which case they can kill plants. *Hypoaspis miles* will go after the larvae. They live in the ground and can go up to 6 weeks without food. *Steinernema feltiae* also goes after thrips, you can apply them by using a drench.
- Nematodes are easy to apply by using a sprayer. You want to make sure you don't filter them out and don't spray when there's lots of light out.
- Shore Fly larvae have a black head. They are similar to fungus gnat larvae. Their predator *Atheta coriaria* are generalists. Their larvae are orange and they eat the shore fly larvae.
- Spider mites: Not everyone knows how to ID their eggs. They are totally round and small. The nymphs eat more leaves than the adults. By the time you see spider mite webs, you should have applied something long before. Control is with *Feltiella acarisuga*, *Phytoseiulus persimilis* (a killing machine, they can kill more within a smaller amount of time, they also need more humidity and work best within 20-28 degrees C, they work well in the middle and lower-story of a crop where the humidity is naturally higher), or *Amblyseius californicus* (slower but are also pollinators, they can do better in drier conditions than *P.persimilis* but won't thrive, they might be well utilized on the tops of plants).
- Whitefly: a huge problem in Poinsettias. There are 2 species which require different controls. A lot of people mistake the larvae for eggs. Larvae are pointy on one end. Whiteflies can transmit viruses. The greenhouse whitefly is *T.vaporariorum* and the field whitefly is *B.tabaci*. The main way to tell the difference between the 2 is their wing shapes. *T.vaporariorum*'s larvae is shaped like a hockey puck. They lay their eggs in a perfect circle and are slightly different-coloured than *B.tabaci*'s eggs but it's not easy to tell. *B.tabaci*'s larvae have irregular sides and they will lay their eggs anywhere.
- Be careful when you're buying cuttings. *B.tabaci* can't overwinter unless it's warm enough so they are usually coming in on southern crops like Poinsettias.

T.vaporariorum are more likely to come from cuttings grown here in the Maritimes, they can overwinter here.

- Whitefly's enemies are 3 parasitoids. You need to know which whitefly species you have before selecting a parasitoid. *E.formosa* is for the greenhouse whitefly, they will turn the whitefly pupae black. *E.eremicus* works on either species and will turn the pupae orange. *E.mundus* works on *B.tabaci*.
- Leafminer: Can be a problem in lettuce and many other crops. The most common type has a yellow spot on its back. They feed on leaves by piercing one cell wall at a time and emptying the content. They also lay their eggs between 2 layers of the leaf. The pupae's damage on the leaf looks like a tunnel.
Biocontrols: there used to be 2 insects but one has been discontinued (*Danucsa* – it was good in cool weather). *Diglyphus isaea* works better in warm weather. It can definitely win the battle against the leafminer as it reproduces faster.
Nematodes also work. People have also been using the Sterile technique where males are caught, sterilized, and then released. They then mate, but the eggs aren't fertilized. If you have leafminers at the larval or pupal stage, use parasitoids. *Diglyphus* doesn't kill the leafminer right away, it feeds off it for a while. It is also an ecto-parasite, laying its eggs on the outside of its host.
- Nematodes are generalists.
- *S.carpocapsae* is a nematode that works on caterpillars.
- *Phasmarbdis* doesn't live naturally in this country so it's not allowed for use.
- How to use nematodes/How they work: The whole cycle happens in 7 days.
- You need to use the nematodes quickly. They can't breathe in water, they're not fish. And if they don't find a host within a few hours after you've sprayed them, they'll die. You have about a 4 hour window in which to use them. Once you've added them to water, you need to spray them within 30-45 minutes (ideally as soon as possible, that is just the maximum amount of time).
- You need to agitate the solution. Nematodes can't swim so they are constantly sinking.
- You'll need to spray them when the sun is not out. UV light will kill them.
- At 300 psi, 20% of them will be killed (so you'll be wasting money).
- Remove the filters on your sprayers first. Nematodes are 1 mm in size. 30-50 mesh or smaller won't let them through.
- Ideally, you'd spray them on a cloudy day, at the end of the day. Early morning is an option but it's better to do it in the evening.
- Since usually you don't want your crop to stay wet all night after being sprayed, but you do want the nematodes to have moist conditions, spraying at about 4-5 pm works well and you can make it home for 6 pm to eat supper.

- If you are unable to spray the nematodes in solution within 30-45 minutes, you should put ice packs in the water and keep the water oxygenated. In this situation, you can keep it up to 6 hours.
- To oxygenate, you can use an air compressor, fish bubbler.
- Question from audience: If a person wants to use biocontrols for onion thrips in the field, will it work or will they just move away? In the field, for flying biocontrols, you'll need to do multiple releases or use hedgerows or attractant crops to keep them in the area. Nematodes will still work. It would be better to use small releases every week rather than one large release.
- Whiteflies won't travel very far without reason which is a good reason to have multiple hedgerows or trap crops.
- How to make it work:
- We can make it fail by spraying too late, using the wrong biocontrol, spraying the wrong pesticide at the wrong time and killing beneficials and allowing pests to thrive.
- Four steps:
- 1) Clean: this includes cleaning cuttings or other plants once you've received them, disinfect, and practicing disease management.
- 2) Scout: don't follow a scouting calendar schedule; find out if you have a problem first. Told a story about a grower in BC who wanted to try a newly-released pesticide for spider mite but didn't have any spider mites. And then he wondered if it worked.
- 3) Pro-active: start before you have a problem. It's not like using pesticides.
- Be consistent and keep doing it.
- Don't put a biocontrol down if there's no food for it.
- Ideally, make one person responsible for biocontrols that is not the grower. The grower sees the greenhouse differently, they're looking at other issues with crops and crop work to be done. The pest manager focuses just on pests.
- You don't require a pesticide applicator's license. Anyone can do it. Children love doing it.
- Keep good notes and you'll do a better job every year and reduce the amount of money you'll spend.
- You can do weekly orders through Halifax Seed.
- Scout on Monday or Tuesday. Place your order on Wednesday. You'll receive your order the following Tuesday.
- It's important to get your biocontrols quickly. 2 weeks later is too late.
- It's wise to order before you see a problem. You can do this if you keep good records.

- You can also save a lot of money by pre-ordering and using the biocontrols before you need them. If they can take care of a pest before they get out of hand, you won't need to use so much.
- Nematodes are the only ones you can store (for 4 weeks) in the fridge. All the rest, use ASAP (within a week max.).
- Thrips control is more preventative. You need more bugs to control once your thrips problem has become bad which equals more money.
- Often pesticides can interfere with your biocontrol program. It depends on the pesticide. Find out: How long does it last? Will it also kill the good bugs?
- If you bring cuttings into your greenhouse, you're also going to bring pests in as well as pesticides. Think of the pesticide residue lasting about 3 weeks. During this time, it can kill your good bugs. Ask your supplier what they have sprayed on the cuttings/plants. They may be hesitant to tell you but let them know that you're working with biocontrols and need to know. Don't be afraid to ask questions. It's your money and your investment.
- Plan now for next year. A good plan made ahead of time will ensure you can take steps that will lead to success and save you money.
- Too many people try using biocontrols without doing it properly. They can't tell if it made any difference and so they don't try it again.
- When planning your rotation, think about biocontrols just like you would think about planning pesticide application.
- If you Google "Biobest side effects", you will find the research Biobest has done on how different pesticides affect the different biocontrols.
- Question: How do you catch the pests in order to ID them? You can catch them in a jar or Ziploc bag and then put them into the fridge. They will stop moving long enough that you can take a picture or look through a microlens. If you're unsure, send the picture to your Extension Agent or contact Biobest or Halifax Seed. If you are a Biobest customer, they will provide this service for free.
- The best resource for you is another grower in your area working with biocontrols. You can help each other out and collaborate.
- People who use biocontrols will often choose to buy cuttings from growers who are also using biocontrols.
- Don't give up! Just because it didn't work doesn't mean it will never work. Be patient just as people are patient when using pesticides.
- Biobest has crop info sheets that basically give you a recipe. They're not foolproof but a good baseline to start.
- You can submerge your cuttings in water with nematodes to clean and get better coverage.
- In Ontario and the US, growers are finding that Spinosad is no longer working.

- During plant propagation, you are already providing for the plants the best conditions for nematodes (moist).
- While scouting, keep track of your data. Biobest has a monitoring sheet you can use for this.
- You can also trap such as potted flowers in the greenhouse. Keep a garbage bag under the pot so that when you see a pest problem, you can just roll up the garbage bag over the flower plant and tie it up before taking the pot out of the greenhouse. Too many people will remove a problem plant by walking it through the greenhouse. The pests will just fly away to other plants as you are doing this.
- You can also raise your own biocontrols to reduce your costs.
- You can also try cool ways of knowing when to apply biocontrols. Say you are growing gerberas. If you plant some bean plants among them, which have thinner leaves, you will see damage to the bean leaves before you would see it on the gerberas. So, you'll know when to apply the biocontrols to the gerberas from seeing damage on the bean leaves.
- You can use a trap of eggplants for greenhouse whiteflies and also use the eggplant to reproduce your biocontrol (*Encarsia*). This will reduce the time spent scouting tons of plants, you just check out the eggplant. You need to put the *Encarsia* directly on the eggplant and it reproduce and then be able to control the rest of the greenhouse. If you stop taking care of your trap crop (like stop watering the eggplant), the whiteflies will fly off to other plants. So make sure you take care of your trap crops.
- Question: What about Colorado Potato Beetle? It's very hard to control. The larvae can be controlled with nematodes but this is very difficult in a field situation. You can use eggplant as a trap crop. There has also been a lot of success with making ditches around your field and covering them with black plastic.
- Normally, it will take 2-3 years to learn to use biocontrols well.

February 26th, 2013
8:30am – 9:50am

Best Practices for Low Tech GH Vegetable Production by Andre Carrier

Note on abbreviations:

GH= greenhouse

HT= high tunnel

TPs= transplants

IR= infra-red

Italics indicate Product or Company Name

SLIDE 1-2

Best Practices for Low Tech GH Vegetable Production

Andre Carrier (MAPAQ, QC)

- organic is more complex than hydroponic because soil is alive! It is your capital

SLIDE 3-4

- structures:
- factors: sturdiness (load bearing), height/width (climate stability in larger sizes due to more air volume), minimum recommended side height 2m so you can walk down edges, and for trellising, gothic peak (pointed) better for shedding snow, as many side openings as possible (ventilation key), size-appropriate to your equipment, gutter/drainage

SLIDE 5

- space between 2 GH is a microclimate - use it!

SLIDE 6-8

- High Tunnel (HT) less expensive, about \$1-2 per square foot, more fragile (ie wind, snow), ventilation (can open anywhere), manual management (can be troublesome)
- HT doors open upwards, less resistance
- crank operation of vents/doors very useful
- GH: \$3-4 per square foot - 2 layers of plastic, less condensation, permanent
- HT: \$1-2 per square foot - removable plastic, adjustable size/length

SLIDE 9-10

- Plastics:
- able to diffuse light (cooler than clear plastic), uniform performance
- most are bee friendly (check)
- anti-drip coating (prevent disease)
- IR holds heat in cold conditions
- should be stretched tightly

SLIDE 11

- Irrigation:
- mist system - permanent, find correct nozzle for crop (ie minimize damage), can lower temperature 6-8 degrees C, bio control sometimes requires controlling humidity, easier with mist

SLIDE 12

- screens used for bio control - simple for GH, prevent large insect pests

SLIDE 13-15

- SOIL is the most important factor for success and so it takes the most effort
- soil must be suitable to the crop
- different for container growers - they tune the soil mix, and recommended dimensions are 1 ft high and 2 ½ ft wide (for the Québec certification agencies)
- DRAINAGE is also the most important factor for success - recommendations for one drain pipe per bed and peripheral drains outside (or catchment)

SLIDE 18-19

- two soil tests per year is recommended: standard soil analysis, and “SSE” (or saturated soil extract test) to see what is immediately available in the soil.
- difficult soil (ie because of drainage/compaction problems) is a constant battle
- start with ‘good’ soil, preferably light, and amend it to improve it with organic matter
- when planning and building, include drain pipes! Installation is much easier before than after.
- vapor disinfection is a high tech way to treat/prevent disease in soil, requires a hot water pipe in each bed. Water vapor from a boiler is aspirated into the soil. This requires a fan to move vapours.
- Andre recommends never adding lime to compost because often the pH is too high (6.7-7.2). He also indicates not adding lime to soil UNLESS you have a soil test that indicates a need. pH readings can block nutrients which may become insoluble at a high pH.
- FERTILIZATION - there is an art of making compost
- you can create a working, living soil that has the ability to regenerate
- microbial action comes from compost
- FIRST feed soil, then the soil feeds the plants (we must work with soil to achieve plant success)
- renew the organic matter in the GH soil with every growing cycle - stimulate bioactivity

SLIDE 20

- drainage and aeration are key factors - permanent beds and walkways are recommended to prevent compaction

- Rotation is also key factor, especially to maintain effectiveness of disease/pest management strategies
- it is important to manage fertility - Nitrogen (N) and Potassium (K) content especially, but don't overdo it on the Phosphorus (P)
- educate yourself about compost - richer is better because then you use less
- young compost is easier to mineralize - speed is key
- increase K - you may need to blanket your compost pile to retain it

SLIDE 21-22

- green materials - you may use the pruned leaves on the beds as fertilizers (but it must be covered with a plastic or something to keep humidity) because the N, P, K are recycleable (ie tomatoes, slides)
- a study quoted indicated that 25% of N need in tomatoes can come from its prunings being recycled - note: do not recycle diseased green matter (use wisdom)

SLIDE 23

- earthworms needed!
- biostimulants - induce self defense mechanism in plants (trials in a study quoted) but more research is needed
- try adding (ie bentonite) clay for sandy soil - in moderation
- avoid tilling (ie rototiller) because this is aggressive action against the soil layers
- don't disrupt the soil layers!

SLIDE 24

- raised beds - lots of support for these such as better drainage for clay, less compaction, warming up faster, permanent solution

SLIDE 25

- Crops: CULTIVARS - you need the best so invest!
- seed is not a major expense (unlike labour) and also it pays to spend on good seed
- tolerant cultivars with resistance bred in are available and useful
- Andre recommends doing your own trials, experimenting to find what works for your conditions. Also a network of growers is a useful model to share information from a deeper pool of experimentation.
- recommended varieties for low-tech GH - tomatoes: Macarena (big), Big Dina, Masada (smaller), Caiman, New Girl (not leaf mold tolerant), Trust
- cultivars can pay for themselves and are worth the investment

SLIDE 26

- TRANSPLANTS: (TPs)
- it is wise to grow them yourself - we don't have a local propagator
- to have a plant that performs well you need a vigorous TP because poor TPs always yield poor results

SLIDE 27

- Soil mix - needs compost
- EC - electric conductivity - a way to measure soil fertility by measuring the richness
- Compost with EC that is too high may burn the plant roots

SLIDE 28

- GRAFTING: highly recommended for tomatoes; also possible for peppers, cucumbers and eggplant
- problems would include corky root disease so you need resistant root stock for it!
- it makes a big improvement, not that expensive, and a more efficient method
- strong roots are a must - this can be the difference of disease resistance
- grafting isn't hard - clamp together pieces - it's fast (photo **SLIDE 29**)

SLIDE 30

- "Maxifort" rootstock (by *Monsanto*/ de Ruiter) - vegetative root stock which can take 2 or even 3 stems on each plant (2 is recommended)
- some root stock are resistant to a specific disease, depending on your needs (ie nematode)
- the first week is the most critical time for grafted plants - you graft when plant stems are 1.5mm in diameter (young). Generally when first true leaves show it is time to graft.
- grafted plants resist heat, increase yield, and remember that sometimes disease can affect taste so quality may be improved with grafting
- when grafting, if you want 2 stems on a plant at the cotyledon level, you must pinch the head of the newly grafted TP: it's a very delicate operation...don't begin with this...
- you can graft your cukes to combat Pythium disease - use the same method as in tomato grafting
- grafted cukes yield better in the first half of summer but non-grafted yield better in the second half of summer - still doing trials to determine efficacy in cucumbers

SLIDE 31-32

- when grafting use water vapour to mist the plant, then cover with a plastic dome and keep in GH. These plants have no tolerance for direct sun. Keep at 100% humidity for the first 3-4 days, at least, until they need water. This is what we call "intensive care"
- generally grafted plants are more resilient after 7 days of intensive care

SLIDE 33-34

- PLANT DENSITY - generally new growers make the mistake of not planting enough because they think it's too expensive (remember - seed is not a major expense)
- tomatoes space at 2.5 to 3 plants per square meter

- more density = more \$
- tomatoes are less stressed when crowded at the right level. They like a canopy to keep a bit of shade, which in turn can create the humidity they desire.

SLIDE 35-36

- V-training tomatoes is a strategy for trellising that allows for diagonal light transmission. Tomatoes want uniform light and get it through uniform spacing. You may need to lower the trellised plant in a long season, but you can plan for this.
- GH may need to be shaded because it may be too hot in summer; but generally speaking, it is not necessary.

SLIDE 37

- pruning and training must be timely and disciplined - do it regularly or else you may have wasted your energy. It is recommended to train and prune 1 - 2 times weekly
- remove old leaves and suckers because they take away from the plant instead of adding to it. Do this in dry conditions, ie sunny day. Avoid disease by cutting flush to the stem (with an Exacto or a knife). About 3 leaves /week can be pruned, especially in late summer when canopy offers shade and can feed fruit. But be sure to have the right quantities of leaves on a plant; during summer, a tomato plant need 18-20 leaves of 40-45 cm length.
- grape and cherry tomatoes are easier to grow and are taller

SLIDE 38-40

- cluster pruning (beefsteak tomatoes) - avoid having too much fruit at the beginning of the season, at the bottom of the plant. It negatively affects vigour of plant and the length of life. About 4-5 fruit per cluster is most efficient

SLIDE 41-44

- LABOUR - train people correctly, give them the tools to work efficiency (no step ladder, how about a rolling one? photos), work at hand height, not shoulder height. Also remember to ventilate for the benefit of the workers as well as the plants
- sprayer is a necessary piece of equipment, either for dust or liquid application. Low volume sprayers will do by creating tiny droplets that penetrate the foliage canopy.

SLIDE 45

- IRRIGATION - with tomatoes, for example, each plant will consume 3-4 litres per day if they have a good root system. If the plant consumes water correctly it is likely a healthy plant (good indicator).
- know the capacity of your soil to hold water

SLIDE 46

- tensiometer - tells soil moisture availability by using the pressure of water (0 is saturated)
- do not irrigate for more than 1 ½ hours at a time (not useful)
- water uptake is directly related to light (ex: 2000 joules of light per cm squared = 2L water needed for the plant)

SLIDE 47

- water only when plants are active
- 2-3 hours after sunrise, 2-4 hours before sunset
- you don't want any excess water in the GH at night because this will give root pressure and can cause cracking of fruit (ie tomatoes) because of the temperature changes and water storage there. You may also drown the plant roots (asphyxiation)

SLIDE 48

- drip tape is useful - it covers 12 inch width, so measure the width of your bed.

SLIDE 49

- FERTILIZATION - remember it's a BIG and complicated question, needs research

SLIDE 50

- test your soil before each spring planting, and mid season.
- Andre advises people to also have a pH meter, an EC meter, and test and record your results.
- Easy EC test: 1 part soil + 2 part water = soak 30 min, test, multiply by 2
- remember that EC that is too high will burn the plants so you must match the crop needs with compost
- produce a rich compost and use less (emphasized here!)

SLIDE 51

- Potassium is needed in ratio 1N: 2K in peak season (tomatoes)
- you can add K with potassium sulfate, for example. Remember that sulfate accumulates so you need to manage and monitor leaching nutrients
- best growers fractionate their fertilizers applications (ex: compost/feather meals every 2-3 weeks)
- remember there is a nutrient ceiling, all plants have limits

*Andre had a very extensive presentation which is available in its entirety but at this time he didn't talk beyond **SLIDE 51**. His 2013 GH Conference talk on GH Tomatoes continues the slides where this talk ends.*

February 26th, 2013

10:30am – 11:20am

How We Use Biocontrols to Manage Aphid Blanchard, Pleasant Hill Farm, Pleasant River, NS

- Wanted to focus on one specific pest since Sebastian Jacob did such a good job giving an overview.
- Chose to focus on aphids for 2 reasons: 1) It is arguably the most common greenhouse pest. 2) It is arguably the easiest pest to control using biocontrols. It's a really good starting point before starting with a challenging pest like thrips.
- Biocontrols can completely eliminate aphids from a greenhouse with minimal labour on your part. It takes maybe a minute, you just walk through your greenhouse with the open bottle of your biocontrol agent and they'll fly out.
- Safer's Soap (also used for aphid control), by contrast, is difficult to apply, as well as tedious.
- The use of biocontrols, while not labour intensive, is knowledge intensive. You need to understand ecology and biology.
- Aphids are sap suckers.
- Plants have 2 types of fluid. Phloem (which aphids mostly feed on) and Xylem (which comes from roots and has higher water content. Aphids will also feed on this.).
- Aphid babies are born live as opposed to hatching from an egg. Within a week, they are ready to reproduce.
- David once saw an amazing photo where you could see (through the aphids translucent skin) a female with unborn babies inside and the unborn babies within the unborn babies. They are ready to repopulate!
- With biocontrols, it's very important to get started early.
- Aphids suck nutrients from plants which stresses the plant and weakens it. They are good at vectoring viruses from one plant to another. If you look at them with a magnifying lens, you'll see that they move around more than you thought.
- Aphids take in way more sugar than they need. They excrete honeydew which mould will grow on (unappetizing and unattractive).
- Nitrogen is the limiting factor in their diets (they get a lot of sugar). If there is too much nitrogen, it is no longer a limiting factor for them and their population will grow.
- Natural enemies: aphids have a lot of natural enemies. There are predators which will eat them. You can encourage predators by planting appropriate flowers which will provide both food and habitat. Hoverflies are their predator, they look a lot like honeybees except that they are flies and have 1 set of wings

(not 2 like honeybees). Lacewings are also a predator that is commonly seen on farms. Parasitoids are a lot less familiar to people however they are incredibly common.

- A.colemani lays its eggs inside the aphid, the eggs hatch and the larvae feed off, and eventually kill, the aphid.
- **Predators**
- Ladybugs: Don't work that well for aphids. They have a dispersal nature (they want to leave the greenhouse). They have an instinctual urge to go somewhere else. David is a big fan of ladybugs and works hard to encourage native ones which do move into their greenhouses. Having many different tools (or species) is more ecological. Ladybugs, though, are not their main aphid control agent and they don't purchase any.
- A.aphidimyza: David does purchase this. They're roughly the same size as mosquitoes. They are shipped in pupal form. David keeps the container on his kitchen table where it's warm and he can see them often. As soon as adults are seen, they should be released. Release in the evening at dusk. The adults are not predators, the larvae are. The larvae are bright orange so easy to spot. They kill more aphids than they can eat. They pupate in the soil. If plastic mulch or landscape fabric is down, it will limit their access to soil in order to pupate which limits their activity. Porous mulch like straw is fine. They will also go into potting soil in pots in order to pupate. David has not successfully overwintered them but Sebastien from Biobest said it can be done.
- Lacewings: Pyganic will kill them (as well as other predators). Create a farm that is friendly to them by planting flowers and not spraying broad spectrum pesticides.
- Winter and early spring, in a greenhouse planted with salad greens, is prime time for aphids. Those will likely be the Green Peach Aphid. Use A. colemani as a control.
- In cucumbers, it is likely be the Cotton Aphid that is causing problems. Use A.colemani.
- In tomatoes, you are likely to have problems with the Potato Aphid (aka Foxglove Aphid or Glasshouse Potato Aphid). The Potato Aphid is big so you would need A.ervi as a control (it is 2x the size of A.colemani).
- A.colemani and A.ervi lay most of their eggs within the first 3-4 days and they die after 1 week.
- There is also A.abdominalis which is interesting because the adults do the host feeding (suck juices out of aphid). They also lay eggs (double whammy). Their downside is that they lay fewer eggs per day than the others. However, they live longer. They are also more expensive (30-40% more). They will eat all aphids so it is not as critical for you to identify which aphid species you have. If you're

bringing in a lot of cuttings over a period of time and you know a few aphids always come with them, a longer-lived species could be better.

- David thinks it's better to go with the cheaper options (*A. colemani* and *A. ervi*).
- Biobest does offer a mix if you don't identify your aphids.
- Scouting is absolutely critical. You need to know that pests are there.
- Regarding the comment made by Sebastien Jacob from Biobest during his Biocontrols presentation about having one person at an operation devoted to biocontrol. This would be difficult on a small-scale, diversified farm operation such as the majority of conference attendees are coming from. At Pleasant Hill Farm, every person is trained to scout and they do it all the time.
- If you see a pepper leaf that is wrinkled and crinkled, this may be a sign of aphids on the underside.
- Baby aphids (1-2 days before they are considered adults) are called Nibs. They shed their skin before becoming adults. The skin is often visible and sometimes mistaken for white flies. Look at it up close with a hand lens to identify properly.
- **Identification**
- You need to learn how to do it.
- The basic tool is a decent optical quality 10x hand lens. With \$20, you can buy a nice one.
- A 30 power microscope that is made of plastic can be purchased for \$20-25. The battery is built-in and has a light. It works amazingly well, David has been impressed. You can buy them through biocontrol suppliers.
- There is lots of info online. Some is good and some not so good (showing mis-identified photos for example).
- Aphidnet.org is run by scientists and is interactive when you have an aphid you're trying to identify. It's not totally user-friendly at this point but be patient with it and it can work well. There are lots of links on it that have good photos. For example, Aphid Man knows what he's doing. You can count on his IDs.
- Koppert has a great book which you can buy from their website. It's called "Knowing and Recognizing". It's not cheap (\$135) but it's worth it. Sebastian Jacob also uses it. David uses it constantly. It has an emphasis on greenhouse production with some information that is also relevant to field production.
- Most biocontrol companies are European.
- Most pests found in greenhouses now have a worldwide habitat since plant materials move around.
- Companies or specialists for outdoor/field biocontrols are a different set of people than those doing greenhouse biocontrols.
- The outdoor focus is on attracting rather than purchasing.
- Usually biocontrols are shipped as pupae. They have sometimes already emerged by the time you receive them but often not.

- It's important to follow the directions for releasing the biocontrols from the company you bought them from.
- **Raising Your Own**
- David has been raising *A. colemani* all winter.
- Why? It's cheaper. A previous invoice of theirs shows they bought a bottle of 500 wasps which came to 5 cents per wasp. They need to be shipped overnight. The shipping was more than twice the cost of the bugs. With shipping costs, the cost became 16 cents per wasp. Even though this is more expensive than raising your own, it is still cost effective to use biocontrols when you are buying them in.
- Why? You don't need to wait at all when you want to start using the controls. As soon as you see aphids, you can apply the control rather than waiting for 8 days after you order them.
- David thinks it's great that Biobest will also sell Banker plants (to raise your own biocontrols) since many companies won't because they don't want to lose sales.
- Raising your own is dead easy! If you can raise chickens or pigs, you can raise bugs. They are a type of livestock.
- You can't raise banker plants in unheated tunnels over the winter so this winter, they raised theirs under grow lights in their house.
- Insect life cycles are totally dependent on temperature.
- Between May and October, you can raise them in your unheated tunnels.
- The 1st thing to do is order the aphids. You must raise a non-pest type of aphid (ones that feed on grasses). Use barley plants as your banker plants.
- You need a place to rear them. David has seen lots of different homemade types. He likes to buy the ones that are specific for working with bugs.
- Start your barley plants. Put the aphids on them. Order your wasps when you have lots of aphids. You'll need 2 enclosures – one for the aphids and one for the parasitoids. When you're feeding the parasitoids, keep some aphids back to feed to them later.
- There is not yet a lot of popular literature out to use as resources about banker plants.
- UVM uses hairnets to contain their banker plants.

February 26th, 2013

10:30am – 11:20am

On-Farm Transplant Production & Potting Mixes: Tim Livingstone

Note on abbreviations:

GH= greenhouse

HT= high tunnel

TPs= transplants

IR= infra-red

Italics indicate Product or Company Name

SLIDE 1

On-Farm Transplant Production & Potting Mixes

Tim Livingstone, Strawberry Hill Farm, NB

- Tim's farm is in the Woodstock area of NB
- You can source soil mix or make your own
- Your production of soil mix depends on your capital investment (high or low) and your level of technical sophistication (high or low)

SLIDE 2

- There are three basic types of soil mix:
 - 1) Peat-based - light-weight, coir (coconut husk), ie Pro Mix
 - 2) heavy mix - high proportion of compost (60-80%), of which the quality is key
 - 3) traditional mix - heavier mix

SLIDE 3

- different types of soil mix area are suited to types of production

SLIDE 4

- Tim outlines the pros and cons of types of soil mix (slides have more details of these topics, these are notes from his verbal presentation)
- COMPOST-RICH -

- Pros: uses less peat, which is a controversial additive because it takes thousands of years to be created. It has ballast for the roots so it can hold up the plant (ie tomatoes).
- Cons: germination rate may be reduced. There is less air space, which could lead to weak roots and makes it harder to wet because it shrinks. It may be harder to tell when to water unless you touch the soil because it will be darker, while a peat-based medium will be lighter coloured when dry. To tell when to water you may need to pick up tray to sense how much water (weight) is still in soil.

SLIDE 5

- PEAT-BASED -
- Pros: root stability, suited to a commercial system, holds water (high water tension), gives back 50% of held moisture, low pH
- Cons: costly to add nutrients

SLIDE 6

- Components:
- Black peat from Woodstock (local) or Sphagnum (lighter, finer texture, from northern NB)
- Coir: pH neutral, imported, but doesn't take 1000 years to grow

SLIDE 7

- Perlite: inert, used for drainage, if you use more compost you should also use more perlite in the same proportion in a lighter mix.
- Vermiculite: creates airspace. It has a high pH but that doesn't affect the mix. It also is reported to act as a lubricant for gentle removal of TPs from trays. A medium grade holds water and humidity in soil mix.

SLIDE 8

- Electric Conductivity (EC): basic fertility measure, looks at all salts in soil. EC is an indicator of the uptake of available nutrients. EC that is too high can restrict nutrient uptake (which can be a detriment or a benefit depending on your strategy and crop). Measurement can vary, and advice on appropriate EC numbers also varies... (see Rachael Cheverie's presentation on Nutrient Deficiencies in GH Soils)

SLIDE 9

- COMPOST FOR SOIL MIX: - this is your long-term nutrient component. There is a pathogen risk if you are using animal manure and therefore care must be

exercised in producing compost. It is difficult to make a good compost without manure, but you can find some that is pre-processed.

- Avoid wood-based compost because it creates an unstable nitrogen supply. The wood breaks down slowly and consumes N as this process happens. Before wood is broken down the N supply may be high but after a while when wood is more incorporated there may be far less N.
- Compost has two cycles before it is finished: 1) break down organic matter and 2) build up organisms and structure

SLIDE 10 & 11

- signs of compost (slides have more info):
- black = overheated (caramelized), poor quality, brown is better.
- crumbly = great (not gluey, feel the texture)
- primary materials should not be visible. Compost will be heavy if it isn't finished.
- check EC and pH
- should smell good, earthy
- Notes: compost from leafy matter has higher potassium, and Calcium comes from animal source

SLIDE 12 & 13

- NUTRIENT SOURCES:
- Tim recommends to stay away from animal products (ie bone meal, blood meal).
- caution: soybean meal may be GMO and is not advisable if source isn't identified because it may jeopardize organic certification.
- there are different available nutrients in lobster meal, crab meal, and fish meal, so keep in mind what you need
- "MEALS" - these still have to break down which creates ammonia which can burn your plants. It needs to be turned into Nitrate and then Nitrogen to be available to plants
- you may want to pre-compost meals to heat and stabilize them - this is a lot of work, aka "intensive process"
- limit meals in your mix because too much break down activity is problematic

SLIDE 14

- PH AND LIME - your mix is more biology, less chemistry
- 5.8 is optimal generally
- pH neutralized by peat unlike coir which is neutral
- lime of the finest grind must be selected for instant release.
- NB: Potting mix has a quick turn around

- test the pH of mix: saturate for 72 hours and then the lime has a chance to stabilize.

SLIDE 15

- “wetting agents”: most aren’t approved for organics, but Yuccah is (desert plant)

SLIDE 16

- RECIPES (see slides):
- Pro mix - needs supplemental fertility in a few weeks.

SLIDE 17

- The recipe depends on what you are growing, and your personal preferences, and your opinion of liquid nutrients
- *rootshield*: aggressive fungi fight fungi that create decay, but you may need a pesticide license (research)
- Other factors when making soil mix: light, temperature, humidity
- HEAVY MIX:
- generally it is 80% compost and 20% peat
- there is a 50% threshold for compost content. Once you cross it there are fewer problems.
- results are crop-specific, can be touchy to use or resilient
- generally holds nutrients better

SLIDE 18

- TRADITIONAL MIX: (slides) includes topsoil
- see Eliot Coleman for more on this style of mix

SLIDE 19

- adding fertility depends on soil mix tests - there is much debate, some difficulty
- NB: Add fertility a week before you need it. Anticipate the needs of your crop. If the leaves are pale it is too late (ie N deficient) even for liquid fish fertilizer.
- be ahead of the game when it comes to fertility
- do not use fish hydrolysates in drip irrigation (clog), but hose-on solution
- *gardener’s dream* not permitted in organic certification
- remember if you are flushing drip tape water will flow through quickly at first but it will take a long time to flush the far end, which tends to clog first
- organic liquid fertilizer is difficult to work with
- dry fertilizer such as protein meals may yield poor results and is risky

SLIDE 20

- PHYSICAL PROPERTIES:
- remember that if you fill a bucket with 2 inch rock, then you can still add ½ inch rock, and after you can still add sand. You can fit in more material if it is a finer texture - this demonstrates that size of particles is important. Consider drainage.
- DRAINAGE: depends on physical properties, particle size.
- also, more upright containers drain faster than low flat containers.
- If you are using a traditional mix with topsoil, a sandy or granular topsoil will be needed for success to create airspace and drainage.

- Q: algae on surface of soil - probably water is staying on surface of soil, aeration/ventilation
- Q: sand - fine grade, doesn't replace perlite

SLIDE 21

- TRANSPLANTS (TPs)

SLIDE 22 & 23

- E-Z seeder (vacuum) - foot valve for vacuum (photos)

SLIDE 24

- wand seeder (*Grow More Inc*)

SLIDE 25

- How high tech is your operation?

SLIDE 26-31

- Tim covers seeds in twice their thickness in vermiculite, with good results
- Tim has a 30x90 GH with a lean-to inside which is heated and on the south side

SLIDE 32-33

- Water as needed - don't let plants dry out, especially after germination

SLIDE 34-35

- Important to note the relationship of light and temperature: more light is more power, which can lead to higher temperature tolerance, which is the "gas pedal"

SLIDE 36-37

- Requirements for success: keep in mind your method must match your needs

- In the field (photos: **SLIDE 38**) Tim has a “water wheel” transplanter, which is used for brassicas except for kohlrabi. It works best with long and tall plants, and gets a jump on weeds.

(PHOTO SLIDES)

SLIDE 52

- Recommendations for TP production (see slide)

Q & A

- clear plastic transmits more heat (sweet potatoes)
- mesh tunnel - melons
- tomatoes are planted in mid-May into an unheated GH, although a section of it is heated during the TP stage of production. It gets cooler over time.

February 26th, 2013

11:30am – 12:20am

Disease and Pest Control

Vincent Dieras, Halifax Seed and Claude Bertheleme

Vincent Dieras

- **Prevention**
- Should be the first approach
- Use crop rotation. Ideally a 5-year rotation.
- Consider your land exposure and air flow.
- The type of soil and water you have are important to think about. The source of water will affect the consistency of the pH of your water. If you use a deep well, the pH of the water is unlikely to change much. With pond water, it will change often.
- In a greenhouse, at different times of year, you may need to raise or lower your pH based on the pH of the water you're using to irrigate.
- The prevailing wind can bring botrytis.
- With your greenhouse structure, it's best to start with a clean structure. No weeds or pests and diseases. This will give you a head start.
- Consider the qualities of your soil. Do you have a cold, wet soil? Is it heavy or light? It should have a good air-to-water balance.
- **Log Books and Journals**
- Everyone should have at least one log book that they write in daily.
- The worst thing is to make the same mistakes year after year.
- We are always guessing if we're basing decisions on our memory.
- Write something down the first time you see a problem.
- Always write down when you are using a pesticide.
- Create maps of your fields to get to know them better.
- **IPM**
- Using biocontrols, should be the first line of defense.
- **Physical Protection**
- Be careful that you may trap some pest under covers and they will have a ball.
- You may require drip irrigation under plastic mulch.
- Insect screens are great for greenhouse use. You need to understand how they work and do calculations. Screens reduce your air flow by 30-40% which is very important to remember.

- Tree pollen can get caught in insect screens which you'll need to clean out.
- Insect screens will last for many years and can help keep beneficial inside the greenhouse.
- A trench made around your field and lined with plastic will trap potato beetles. This is a great way to control them.
- **Greenhouse Disease Control**
- Passive ventilation works well. Roll up sides can be used that are manual (with a hand-crank) or automatic with a small motor on each side of the greenhouse. It depends on your budget. When considering roll-up sides, consider the length of your greenhouse. If it's too long, the plastic will get very heavy as you roll it up. With the basic hand crank, if you let go of it by accident while rolling up the sides, it can hurt you by hitting you. With a 200' long greenhouse, you really need to be careful.
- A shade system reduces temperature extremes. You can use shade cloth or white wash the outside of your greenhouse plastic.
- An energy curtain is the same idea as row cover but it's more expensive. It also offers more heat and frost protection.
- Bottom heat (soil heat) reduces root diseases such as damping off.
- Bench heat can be achieved using a hot water tank or small boiler if you need a larger system. 50% of the total heat requirements of greenhouse crops can be achieved by using double poly insulation.
- **Pest ID**
- You can use rolls of sticky tape to trap the pests and ID them. You'll need to replace them every 2-3 weeks so you know if the pest population is increasing. The sticky traps won't eliminate pests; they just show you what you have.
- **Insect Control**
- You don't need a pesticide applicator's license to apply beneficial insects.
- When your shipment of controls has been delivered to Halifax Seed, you need to make sure you pick up your live product on time or they will die.
- The latest you can order from Biobest through Halifax Seed is noon on Thursday. Halifax Seed will receive the orders the following week.
- Ask Halifax Seed for advice about your specific problem. It's best to ask your questions before things are out of control.
- **Greenhouse Production**
- Try to make your soil fluffy and able to retain water well.
- You can use Coir for this. It's made from coconut fiber.
- Or you can use Peat. Don't get the peat that is very fine. You want something with some fiber. If it's too fine, it will be dusty.
- A good potting mix will save you lots of problems later.

- You need to know the EC (electrical conductivity) – the salt content- before adding things to your mix.
- Some people add sand to their potting mix. It's fine and cheap. Make sure that salt wasn't added (this is sometimes done so that the salt won't freeze over the winter). You don't want salt that is too fine, you want a good air-to-water ratio.
- Coir is a newer product available for small organic growers. Large greenhouse operations use it. It is a very coarse fiber, it won't compact, it lasts for 7 years, no wetting agent is required and very little lime is required to buffer. Check its salt content before buying it. Coconut trees grow very close to the ocean in many cases. Usually the coir has been washed to reduce the salt content but not always.
- **Understanding Growth Factors**
- All growth factors are very important but light is the limiting factor.
- The cost of using grow lights during the winter in the Maritimes is cost prohibitive. Only the Power Corporation would benefit.
- **Organic Potting Mix**
- Trying to wet peat moss is a pain so usually wetting agents are added. For organic certification, you need to make sure the wetting agent used is approved by your Certifying Body. Usually a wetting agent made from yucca plants is the organic approved choice.
- Mycorrhizae: Really helps to develop the root systems, in which case the top of the plant will take care of itself. Especially useful for poor soils.
- A trial was done with growing seedlings in various potting mixes. The results showed that none of the mixes grew a poor seedling however the mix with mycorrhizae gave the best results.
- If you're not starting with a good seedling, you'll have more problems later on in the season.
- Coir: can be reused. It's easy to re-wet if it dries out.
- Perlite and Vermiculite are by-products from copper mining that are heated up in a big popper.
- **Insecticides**
- Organic growers will often get a bit "excited" when they aren't allowed to buy an organic approved pesticide without a pesticide applicator's license. However, all pesticides need to be used properly or they can make your life very complicated.
- Remember: Beneficial bugs should be your 1st approach but if you have a hot spot, pesticides will work.
- Don't stockpile pesticides. All products have a shelf life. High temperatures can reduce the shelf life so try to keep them somewhere cool. If you want larger amounts, let the company know ahead of time because they don't stockpile either.

- Myke: It works well in vegetable production. It also works when planting trees in less than perfect conditions (cities, etc.). It's OMRI listed. It's best to add to your potting mix but can also put it directly on a bed to incorporate before direct-seeding.

Greenhouse Inputs for Pest Management

Claude Bertheleme

- Claude says he is assuming that most of the audience is familiar with the ACORN website but he wants to direct people to 2 resources on it: 1) the General Farm Supplies information and 2) the Organic Inputs directory. Both of these are very helpful and he uses them often. The Organic Inputs directory has recently been updated and so is current. It lists inputs, commercial brand names, and pest control numbers. It also has descriptions of insects and weeds and is useful for identification.
- OrganicInputs.ca – is a new tool that was just launched. More info will be added in the future and Claude thinks it will be a very useful tool.
- Organic growers have a lot of responsibilities. They must follow both the label on inputs they use as well as the organic standards.
- All pesticides that can be used in Canada are decided upon by the Pest Management Regulatory Agency. We have a smaller amount of products approved than in the U.S. but growers in Canada can know that all the approved products are useful. In the U.S., the grower needs the products out to see if they will work.
- Everyone must follow the label on a product. The labels are legal documents.
- The Health Canada website has a Search Product Label tool to help you learn about products. You type in a brand name or active ingredient, and you will be taken to the label and other information. This is a better way to research a product than Google-ing it because you can be sure you're seeing the Canadian label and not the American one.
- If you're thinking of doing vegetable production in a greenhouse, these are 2 references for you. 1) Crop Production Guide for Greenhouse Vegetables. Available to purchase online for \$15. It lists all products. 2) There is a similar guide in French. It comes from Quebec and you can order it from the website agrireseau.qc.ca. It has a shorter list of products you can use.
- But which products can be used in an organic system? Based on these 2 documents, Claude has made a short organic list. Each producer still needs to

check with their certifying body though before using any new product. The list is dynamic, there are always changes.

- Be careful before you use a product in your greenhouse, that the label specifies it may be used in a greenhouse. A product label may say it can be used on field tomatoes but that doesn't mean it's allowed for greenhouse tomatoes. You also need to make sure the product is approved for crops that are eaten and not just greenhouse ornamentals.
- For NB producers who want to get their Pesticide Applicator's Certificate, you can find information about it on the NB government website.

February 26th, 2013
11:30am – 12:20am

Nutrient Deficiencies in GH soils – Rachel Cheverie (Perennia)

SLIDE 3

- How to diagnose deficiencies? If leaves are breaking down or slimy, generally a disease. Look at the book Vegetable Diseases or Ontario Soils Handbook for nutrient deficiencies (OMAFRA) as resources
- Sometimes the problems could be toxicity
- or Environmental damage – chlorinated water, high heat, too much UV,
- Explore all reasons crop might be suffering
- Know where to look!

SLIDE 4

- Use the deficiency diagnostics key – following step by step through depending on how questions are answered

SLIDE 5

- Nitrogen deficiency – pale green or pale yellow lower leaves, or whole plant stunted and paler green
- Corn a good indicator plant, or cannabis,

SLIDE 6

- Nitrogen excess – lush green growth
- more attractive for disease or insects,
- lodging in cereals, more susceptible for blights or Powdery Mildew

SLIDE 7

- Phosphorus deficiency – purple on leaves, red/dark purple at bottom part of the plant

SLIDE 8

- Phosphorus excess – chlorosis on leaves, can cause iron deficiency, if not enough zinc plant can take up too much P

SLIDE 9

- Potassium deficiency – lower parts of leaves, margins of leaves drying, yellowing and curling, white spots along leaf margins of legumes

SLIDE 10

- Magnesium deficiency – interveinal chlorosis on bottom leaves of plant (yellow leaves with green veins)

SLIDE 11

- Molybdenum deficiency – cupping of leaves on cole crops, elongated stems and deformed leaves

SLIDE 12

- For immobile nutrients look at top of the plant

SLIDE 13

- Calcium deficiency- tip burn in cole crops, black heart in celery and potatoes, blossom end rot in tomatoes, brown spot in apples

SLIDE 14

- Manganese deficiency – interveinal chlorosis, curling of leaves, russetting of leaves, best applied as a foliar application

SLIDE 15

- Boron Deficiency – Heart rot, or hollow stems, cat scratches on celery, misshapen fruit in strawberries,

SLIDE 16

- Iron deficiency – bleaching out of leaves

SLIDE 17

- Copper deficiency – too much is toxic!, cereals causes pigtailling, curling of leaves,
- scaling in onions (paler in colour)

SLIDE 18

- Sulfur deficiency – more common now that industrial practices are cleaning up, similar symptom as N, stunt in growth

SLIDE 19

- Zinc deficiency – yellowing of leaves in spotting pattern,

SLIDE 23

- If growing in acids soils, or acid loving plants, some micronutrients may need to be applied as a foliar since they are not as available at low pH – such as calcium, and Molybdenum

SLIDE 24-29

- In container growing you should test almost weekly for pH and EC
- Some smaller pH meters can work just as well as more expensive equipment
- Tissue analysis can be a good to get a snapshot of what's going on.
- Temperature can play into nutrient uptake
- Make sure you are charting test results over time to know what is working for you on your farm.

February 26th, 2013

1:30pm – 2:45pm

Farmer-to-Farmer: Salad Mix and Asian Greens

With farmers from Strawberry Hill Farm, Diddly-Squash Farm, and Heart Beet Organics

Susan Linkletter – Diddly-Squash Farm (markets with the Earth Friendly Farms label)

- Bought her greenhouse 3 years ago. It's a Harnois greenhouse that was bought from Octa Greenhouse in Amherst, NS. The company could have been hired to put it all together for \$15,000 but she decided to save the money and do it themselves. She later wished they had hired the company to do it. They probably lost \$15,000 in time spent without a crop under it.
- Her greenhouse has polycarbonate panels which look like 2 large pieces of corrugated cardboard with an air space in between. They chose the polycarbonate because it never needs to be replaced. Their investment on it should be returned within 30 years.
- The greenhouse is cooled using 2 large fans.
- The greenhouse is very strong. It's built to withstand snow. You can walk on it.
- She uses grow lights inside. They are high pressure sodium lamps.
- An insulating curtain is used which saves 30% of heating costs.
- It has in-floor heating. She wanted to use geothermal but it would have cost \$40,000 so instead she uses 4 heat pumps as well as wood heat. It costs \$150 to run each heat pump. The thing she likes about using the heat pumps is that she does not have to stoke the woodstove. Her costs in January to heat using the heat pumps was \$600. She does get ice problems with the heat pumps.
- She uses a precision planter - the 6-row one from Johnnys seeds. She likes it for spinach in particular in her raised beds (which are in wood-frames boxes).
- She has an Atmosphere system that runs the greenhouse. It opens and closes the curtain, adjusts the amount of light, controls the humidity and the irrigation system.
- **The crops she grows**
- She did a lot of experimenting. She started off wanting to grow head lettuce with greens like spinach interplanted between. She found the return, however, was too low. Turning that head lettuce into salad mix brought her more value.
- There are 6 beds in her greenhouse. Each week she harvests one bed so every crop she grows needs to have a 6 week turnover.

- Pea Shoots: she gets \$8/sq.ft (wholesale). She picks a small bundle and packs it directly into plastic bags. They are ready to harvest in 2-3 weeks.
- Sunflower Shoots: they are time-consuming because you need to pick off the hulls and cut off the roots. She gets \$8/sq.ft. from these wholesale so if you were selling them retail it should be higher. She's looking for other ways to grow them. Maybe hulless sunflowers?
- Chard: She plants them once and the plants grow all winter. She gets 10 bunches of chard per row.
- Cilantro: The return is close to \$8/sq.ft. It's a bit tricky to water. If you over-water or damage the stems while watering, they will get a mildew that spreads, especially in the winter when there is less air flow. They need to be watered by hand.
- Edible flowers: she grows these for chefs in Moncton. She sells Pea flowers (in a pack of 25) from the pea shoots. She also grows pansies, nasturtiums, and sweet peas.
- Collards/Kale: this is an experimental one for her. She has come close to getting the return she wants but this year was not so great. She chops it up and puts it in her salad mix to get a better return.
- Lettuce/greens: she harvests these more than once. They are on a 12 week turnover schedule because they are re-picked.
- Parsley: The Italian type is bolting right now (Feb./Mar.). She has transplants ready to replace those plants.
- Spinach: Varieties she likes - Winter Density (she may mean Giant Winter?), and Tyee.
- Basil: in the greenhouse, it gives a really good return. She sells 5 stems in a package for \$2. She picks the tops to encourage branching.
- Mizuna and Arugula: She mixes them together. If the Mizuna is leggy, she will bunch it. Mizuna sometimes crowds the row next to it (because it grows so quickly) and so it reduces the return on the crop next to it.
- Sprouts: she bought a commercial sprouter. She keeps it in her greenhouse which is not the best set-up. The sprouts would taste sweeter if they were grown in the dark. She isn't currently growing sprouts at the full capacity of the sprouter. If she were, she would be making a lot more money on them. Her biggest challenge with sprouts is the marketing aspect. Growing sprouts also makes her a bit nervous because of the incidents of food poisoning. She runs a microbiology lab as well so she takes samples there to test them. She started growing sprouts originally because the market she sells to requested them.
- **Production management**
- Nutrients: she was using a commercial brand but found the salts levels too high so now she does soil test and adds greensand (for potassium) and crab man

(for nitrogen and magnesium) as needed. She used to buy earthworm castings but ran into a problem with her certifying body requiring it be sterilized. So now she “raises” earthworms in her raised beds because they love the alfalfa pellets she adds.

- Pests: Aphids (her slides show a picture of a kale leaf with aphids). She bought *A. colemani* once but it seems like they have moved in for good. She originally spent \$200 and hasn't bought them again since. She doesn't change the soil in her greenhouse. Kale and Collards are the crops she grows that are most attractive to the aphids in her greenhouse. Thrips are a bigger problem for her, they damage the leaf. They primarily affect her basil. She's found that the fact that she cleans the crop residue out of each raised bed every 6 weeks helps reduce the thrips (but also reduces the beneficial predators). Spiders are a huge problem around the ceiling where she couldn't reach them. One year a cedar waxwing came into the greenhouse daily to eat them.

Tim Livingstone, Strawberry Hill Farm – Growing Greens

- Wants to give a caveat: he still has a lot to learn. He'll share some mistakes (what not to do) as well as successes.
- He and his wife bought their farm and moved there in July 2011. He took 1 week off from Jolly Farmer in November to put up a second-hand greenhouse. He started greenhouse production in it in March 2012, at which point he was not yet heating it.
- They put up 2 caterpillar tunnels for season extension. He seeded the ground on the 3rd week of September and then put up the tunnels over them. The greens he grew in those were sold at the end of November to ACORN for the conference meals. The value on those wasn't good; he should have seeded them earlier. He didn't make any money on those because the weight wasn't there. Biggest lesson this past year was to start the greens earlier than you think.
- His caterpillar tunnel hoops are made with two 10' PVC pipes attached in the middle to make 20' long pipes. He had a problem with his ground anchors, the plastic blew off at the end of November and he lost the plants to tipburn.
- He used the Premium Greens Mix from Johnnys seeds. He used a mix because he had leftover seed. From now on, he will only plant separate varieties.
- The lettuce mix (Encore mix) in his tunnels had one variety with mildew problems. It was too much work to pick out the mildewed leaves.
- There was a problem with his Caterpillar tunnels in November during a snowstorm. The weight of the snow bent the PVC pipes which looked really bad. Luckily, they didn't break and just sprang back up.

- He planted romaine lettuce (into plastic mulch) in the field, put hoops and row cover over top and harvested it until November.
- Spectrum greens is his favourite mix. He likes the feathery ones (Ruby Streaks) and Tokyo Bekana.
- Tim has not had good success with crops outside after November 25th (below -10 degrees C). He has tried with 2-3 layers of row cover as well as a layer of row cover and a layer of plastic but it hasn't worked.
- He's been told that greens that are coming back from a second cut are hardier.
- In his heated greenhouse, which he kept to 10C, he planted greens mix in open trays (with potting soil about 1.5" deep) on January 19th. You have to plant them 2x as close as you think you would. Planted Premier Mix and Tokyo Bekana. Used an electric bread knife to cut the greens into bins. Sometimes a perlite pebble fell into the mix. The greens weren't being washed and once a customer thought they got a bit of bone in their salad.
- Grew pea shoots in his kitchen on 5-shelf racks on trays. He covered trays with seeds then added more potting mix on top. They were grown to add variety for his Winter Box Program. They were delicious and succulent, good thrown in stir-fries. Don't give them too much light, but enough. He grew them next to a North-East window without grow lights. The variety was either Sugar Ann or Sugar Snap, he just bought more pea seeds than he needed for the field since it was cheaper to buy in bulk. He also tried growing them on a paper plate with potting mix on it, then the seeds, and more mix and gave the customers the shoots on the plate that they could cut themselves which was neat. It takes 2 weeks to get pea shoots.
- He tried sunflower shoots but found getting the seed hulls off was problematic.
- He's also tried sprouts but doesn't like it when they're tangled so he sets them in a wire basket. It gives a nice visual appeal. It takes 7-8 days to get sprouts.
- When he harvests his winter greens, they are maximum 6" tall.
- In the audience, Kent Coates from Nature's Route Farm said that he was able to source 20' long PVC pipes from Emco in Amherst.

Amy from Heart Beet Organics in PEI – Growing Asian Greens in an Unheated Greenhouse

- When they bought their farm, it came with 2 greenhouses.
- In their 1st year, they trialled lots of different greens in their greenhouse. They sowed the greens in October without a marketing plan for selling them. By New Years, they were harvesting those greens so they applied to the Charlottetown Farmers' Market (which had a 3 year waiting list) and were able to get in because no one else had greens to sell at that time of year.
- Likes Red Choi for the interesting colour it adds to the mix.

- Mizuna has a great spiky edge. They cut it a few times to add to salad mix. When it's larger, they cut it for braising mix. They find it to be unbelievably cold-hardy.
- Bok choi and Giant Red Mustard grew right through December and January (slowly, but it still grew).
- Purple mizuna gets intensely purple in cold temperatures.
- Photos of some greens shown: Tat soi, Red choi, Bok choi, Purple Mizuna, Spicy Micro Mix (from Johnnys Seeds).
- Grow Asian greens year round but in summer they are spicier and less intense-coloured (purples). They also only get one cutting per planting in the summer and so are seeding every week. They mix the Asian greens with baby lettuce to mellow out the spiciness of the Asian greens.
- Overwintering. If there is a lot of snow, keeping the snow off the tunnels can be a full-time job.
- It's amazing to see a frozen plant thaw out and be in great condition!
- They find bok choi to be tricky to overwinter because it bolts quickly in early spring.
- Figuring out ideal dates takes time. They found that their earlier-seeded crops (September sown) had a lot of rodent pressure. They planted greens every 2 weeks in the fall to trial different dates.
- The timing of your planting will be determined by your ideal harvest dates. September is a good time to plant if you want to harvest in the late fall.
- This year, they seeded the greens in November and they aren't at the stage they would like them to be.
- The fan that inflates between their 2 layers of greenhouse plastic broke down and they didn't fix it right away. They learned how important that layer of air is.
- **Great cold-hardy Asian greens**
- Arugula – in the winter, the flavour isn't as offensive to the people who hate it in the summer. It becomes more sweet.
- Mizuna – gets so big.
- Cress – they love it, it comes in quickly. They use Wrinkled Crinkled Curly Cress. It's not as finicky for water requirements as water cress.
- Komatsuna and Vitamin Green – they were amazed with the field-grown ones in the fall even with the cold weather. If the outer leaves become damaged, the inner leaves can still be perfect.
- Kitazawa is a good seed source in California for unusual greens.

Questions and Discussion

- How are greens washed?

- Amy found a big tub (7'x2') that was used in the fishing industry and was cheap. She harvests into buckets that are lined with laundry sacks for delicates. When it's full, she throws the bag into the tub to rinse and then into an old washing machine on the spin cycle. She spends a lot of time cleaning/sorting as she cuts.
- David Hastings from Waxwing Farm said you can also use clean onion sacks instead of laundry sacks. This may be a cheaper option.
- Susan lets her greens drain dry. She doesn't spin them. Her greens are harvested into the green bins that can be purchased from grocery stores, she dunks the whole bin in water and then attaches cheesecloth to the top of the bin using clothes pins and turns the bin over to drain.
- Tim uses a big Rubbermaid tub from Walmart. He picks his greens into plastic bags and spins dry with the manual Dynamic Spinner.
- Amy said that there are a few drawbacks to using a washing machine to spin dry. One is that the central metal part will get hot if used for a long time. Also, you need to be careful with the newer models that may contain nano technology which would be a concern for a Certified Organic producer.
- What prices do you sell the winter greens for?
- Amy sells direct to consumer through the farmers' market and her prices tend to be the most expensive at the market. She sells lettuce mix and spinach for \$16/lb and arugula for \$12/lb. Her prices stay the same throughout the year for the most part. They have a signature blend which keeps many of their customers from leaving to buy less expensive options at the market.
- Susan primarily is selling wholesale. She sells her spinach and salad mix for \$7/lb and the retail store she sells it to prices it up to \$10/lb.
- Tim sells most of his through his CSA box and values the greens at \$8/lb. For the ACORN conference, he sold greens wholesale for \$6/lb but that wasn't a profitable price for him.
- Susan's goal had been to sell \$500 worth/week. This just covered her costs. Her new goal is to sell \$1000 worth/week which will allow her to make an income. When she started, she gave herself 10 years to make an income.
- Susan does grow head lettuce to full size (especially romaines) but she cuts them up for her salad mix.
- Amy grows a lot of Amaranth microgreens in trays which she adds to the salad mix. The microgreens help create a high-quality product to justify the high price of her mix.
- Susan uses grow lights because she heats her greenhouse. Each light costs \$1.25/hr in electricity and she has 6 lights. She runs each light for 10 minutes at a time in sequence. This fools the plants into thinking they are getting full day length. The lights run between 5 pm and 10 pm. With this schedule, she is trying

to mimic the day lengths in March which is the time of year the greens grow best. If she added too much light, the spinach would bolt.

February 26th, 2013

1:30pm – 2:45pm

Tomatoes – Andre Carrier, Marc Schurman, & Pleasant Hill Farm

Pleasant Hill – presentation will be up at www.pleasanthillfarm.ca

SLIDE 2

- 2013 crop already started. Showing true leaves right now: February 26.
- Use heated bench in basement taking hot water from wood boiler. Start in 72 cell trays. Use plastic dome lid to retain heat and moisture

SLIDE 5

- Pot up into 3.5" pots early to mid-march. 18 pots per 10X20 flat. Then out to heated greenhouse kept above 15 C

SLIDE 6

- Some varieties are more vigorous than others, so plant spacing varies due to that
- Most greenhouses they use are 20X60 structures, heated with wood furnaces

SLIDE 7

- Use seaweed as source of K.

SLIDE 8-9

- Use tomato twine from Halifax Seed. Natural fibre twines have failed in past for them

SLIDE 10-11

- Use a turnbuckle on each length of high tensile fence wire the trellises are on.
- Have cross ties on every other bow, wire rests on these to prevent sag, at about 8' of the ground
- If you have it lower than 8' that the bottom fruit will be on the ground when you start lowering the plant.

SLIDE 12

- Prune suckers at 2 to 4", going through once a week, 10 days max.
- Don't put clips right below the fruit stem. Can kink against the clip. Only put under leaf stems

SLIDE 13

- If you are using in-ground heat to warm the soil you will run into more disease issues.

SLIDE 14

- Use liquid calcium if they run into deficiency situations to prevent blossom end rot

SLIDE 15-16

- Hand pollinate early in season when bumblebee pollination isn't ideal

SLIDE 17

- Harvest day before they are going to market.

SLIDE 18-19

- As the plants are lowered once they reach the end of the wire they are moved to the other side. Plants move in opposite directions down the wires when lowered.

SLIDE 20

- Stop spraying when fruit set to avoid having to wash spray-speckled fruit

SLIDE 21

- can also use Sluggo to deal with slugs

Andre Carrier – continued presentation on from slide 52/53

SLIDE 52-53

- Need to cover the compost on the soil so that it gets decomposed by biology.
- Good to have stem supports to keep them off the ground to prevent diseases.

SLIDE 54-55

- For pollination can shake the wire or use electric toothbrush.

SLIDE 56-58

- The weekly growth of a healthy tomato plant should be 18-24cm. if the stem diameter from where last week's growing tip was is less than 11.5-12.5mm than it is losing vigor. Too much more than that isn't good either. Check mature leaf length (43-48cm) to check for vigor as well. If the leaves are shorter then you need to leave more on the plant 22+. If leaves are longer, then it can be 19 or less.
- Need to make sure the fruit is shaded well to prevent sun scald. High N and low K can also be an issue contributing to this.

SLIDE 59-60

- Need to have gauging equipment. Min/max thermometer, tensiometer, electronic humidity/temp logger

SLIDE 80

- Make sure the tunnels are well cleaned at the end of the season

SLIDE 82

- Crop residues can make great compost material if not diseased

SLIDE 111-115

- Encountered big problem with sow bugs (see photos), came up with a solution of a plastic collar, bugs cannot crawl up to get access to stem

SLIDE 125

- Need good information (data) to make good decisions, keep good records
- Always use preventative measures instead of reactive!

ADDITIONAL SIDE NOTE

- Biological system can buffer excesses, some growers he has encountered has had 2000kg/ha of P
-

Marc Schurman

SLIDE 2-3

- Grow in pots using peat and compost based mix, add crab meal and sul-po-mag plus other side dressings during growing season

- White pipes along the ground carry hot water for heating
- Has over head night-time heat covering to reduce heat loss overnight

SLIDE 4

- Use multi-bay structures

SLIDE 5

- Control CO₂ levels, adding more when necessary (white tanks in picture)

SLIDE 6

- Use wood chips to heat the structure, need adequate facilities to receive trucks

SLIDE 7

- Use bio-controls, best to use preventatively as once a problem starts it is hard to catch up and get it under control.

SLIDE 13-18

- by changing temperature, fertility, and watering regimes you can direct how the plant grows
- adds heat early in the morning before the sunlight hits the fruit to prevent condensation
- lets it cool off pre-night to direct the sugars into the fruit

February 26th, 2013

3:15pm – 4:15pm

Gourmet Greenhouse Vegetables (Renamed Growing Ginger and Mushrooms in a Greenhouse)

With Cindy Rubinfine from Pleasant Hill Farm in NS and Amy from Heart Beet Organics in PEI

Ginger at Pleasant Hill Farm

- 2012 was their first year growing ginger and it was very profitable.
- Pleasant Hill Farm grows a lot of greenhouse tomatoes and they are constantly on the lookout for crops that they can add to their rotation that are not Solanacea or Brassicas (or in the same Family as their other winter crops).
- They sell at 2 farmers' markets.
- Inspired to try ginger after reading an article about it in Growing for Market.
- Ginger leaves are also usable for tea.
- This is not the same tough, dried ginger that you can find in a grocery store. It is tender and juicy and pink.
- In 2012, they planted a 90' bed of ginger. In 2013, they will plant double that. Expenses (cost and shipping of the rhizome, Rootshield, Actinovate, labour, kelp, fish fertilizers, gypsum, compost) came to \$667. Their gross income from the ginger was \$3400.
- They kept the ginger seed pieces on trays in a warm place out of sunlight for a week before planting them in flats. Seed was cut into 4" pieces with 2-4 "eyes"
- They dusted the ginger with Rootshield and planted in Jolly Farmer potting mix in open flats (1020s) on a heat table in their basement (since they don't heat their greenhouse until March – too \$\$\$).
- Important to not overwinter ginger early on and err on dry side because ginger is susceptible to a lot of bacterial diseases (can reduce yields or kill plants). The grower they buy the ginger seed from strongly recommends using Rootshield or Actinovate as a pre-emptive strike.

- They bought their ginger seed stock from the Clean Seed Project in Hawaii (it's grown by Puna Organics).
- They left their ginger in the flats too long last year and it started to go downhill. This year, they will use deeper flats and feed the plants regularly once they take off, and hopefully, get them in the ground sooner.
- To plant, they composted the bed and added Gypsum (to add Calcium without raising pH), dug a trench down the middle, sprinkled Rootshield in it, and planted the ginger. They hilled and re-composted the ginger and applied gypsum once more (although ideally they would have done this twice more). Twice, they gave it a foliar spray because they thought it was getting thick.
- One month after planting, the crop was growing but showed signs of a potassium deficiency (Viliam Zvalo from Perennia helped them identify the problem). They did a foliar spray of kelp and put kelp and fish fertilizer through the drip irrigation every week. The crop pulled through and new leaves didn't have tip burn. The grower in Hawaii referred to ginger as half pig (you need to feed it a lot).
- They harvested the ginger 2x/week for 4 weeks and sold ginger with stalks on for \$12/lb.
- They found the ginger very easy to wash, especially with their light soils.
- Market customers lined up to buy the ginger. Two local chefs bought it and featured it in a new recipe.
- In 2013, they will also be trialing Galangal (aka Thai Ginger) to follow the ginger.

Amy from Heart Beet Organics – Growing Ginger in Canada

- They did it very differently than Cindy.
- They did everything wrong and still got a crop.
- Were inspired to try ginger from a friend Missy Bahret who runs Old Friends Farm in Amherst, Mass. who grew ginger in 2006. They actually found that they sold more in hot ginger tea sales than the roots. Missy received a SARE grant to grow the ginger and the results were published from there, many other North American growers started growing ginger.
- Jen and David Greenberg from Abundant Acres in NS have been growing ginger for the last two years also. They start their ginger in bread trays, while others

start them in bulb crates. Last March, Amy bought 2.5 lbs organic ginger from Pete's Frootique and started it in pots.

- They started 91 plants from those 2.5 lbs. They cut them into very small pieces.
- They grew them in empty feed/grain sacks that they were able to get for free. This was how Missy had grown her ginger originally. The sacks drain well. They put 4 pieces (sometimes 2 but they found 4 was better) in each sack.
- They didn't know a lot about disease management in ginger. They didn't supplemental feed them either. As the ginger tops grew, they rolled the sack up and added more compost (to hill).
- To harvest them, they waited one day too late and they had frost inside the greenhouse. This lowered the quality of the greens but didn't seem to affect the roots.
- The 1st foot of the stalk is just as tender as the root but it only lasts for 2-3 weeks. They told their customers to stick it in the freezer to keep it longer if they weren't going to use it right away..
- They saved their own seed to see how it does, however they can sell it for \$16/lb and it only costs them \$5/lb to buy from East Branch Ginger.
- This year, they ordered a bulk amount with Jen and David Greenberg from Abundant Acres in NS because the ginger seed company has more demand than they can fill and they give priority to previous customers (which Jen and David were). You can be put on a waiting list and may be able to order some in the future.
- Rodale just published a useful article on ginger.
- Ginger growing has totally taken off in the US but so far is less popular in Canada.

Mushrooms – Amy from Heart Beet Organics, PEI

- Grew the Pink Oyster mushroom (Pleurot D'Jamour)

- Inspired from a farm in QC that grows them as well as fig trees in the greenhouse.
- Look like little pig's ears. A show-stopper at farmers' markets.
- Commercial growers spend a lot on infrastructure to control humidity, heat, CO2 and oxygen exchange. But they can also be grown on a small scale as some people are doing inside their houses, in which case the infrastructure needs are basically none.
- The 1st year, they put the mushrooms directly in the greenhouse, but it got too hot. They moved them to their header house which is attached to their greenhouse.
- Wheat straw is the most common substrate to use.
- At Heart Beet, they used sterilized millet. The guy who produced the spawn uses organic millet so they were able to certify the mushrooms.
- The 1st year, they used 10 gallon plastic bags. These created a management issue. How to stack the bags? Where to store them? They ended up stacking them on pallets which was not the best system.
- In 2012, they used buckets which they liked because they were reusable (they hated throwing out the plastic bags). One farmer they know puts a bucket inside a bucket to prevent the straw from drying out. Both buckets have holes. Once the mycelium has begun to grow on the straw the inner bucket can be removed, exposing the holes to oxygen, and the mushrooms grow like crazy from the holes.
- They also tried blue/gray oyster mushrooms but only got one fruit cluster from it unfortunately.
- The biggest labour input was in day one. After that management was relatively easy.
- You need to re-saturate the buckets after a mushroom flush is over. Submerge the container (bag or bucket) into temperate water (10 degrees C) for 1 hour to stimulate the next flush.
- At the farmers' market, they sell out of mushrooms before they even have time to put a sign up.

- They display them at the market in pre-weighed pint containers of ¼ lb., then put them in brown paper bags for better storage.
- They have a short shelf life which means they won't be able to import them easily. Good for local producers.
- When you research mushroom spawn, you'll find that many companies make the bags up and sell them just before they'll fruit for \$20/bag.
- Currently, Heart Beet's system is very inefficient in the way they set up their grow buckets and realize their yields aren't what they should be. They want to focus on becoming more efficient. They aren't doing it the way it is done commercially. They're just doing it as a sideline, primarily because they wanted to have them for themselves, but are happy with sales and plan to increase production each year.
- The pink oyster mushrooms are very temperature sensitive; consequently most spawn producers will only ship them during the warm month; so the mushrooms are only available in the summer which increases the "special-ness" of them for customers.
- Paul Stamets is the guru of mushrooms and has written great books. The company Fungi Perfecti is affiliated with him.
- Most companies seem to want to sell kits, not just the spawn. Heart Beet worked with Wylie who were willing to sell just the spawn.

Cindy Rubinfine, Pleasant Hill Farm, NS – Mushrooms

- They originally were interested in growing mushrooms in the greenhouse as a way to make money from a crop in the greenhouse while giving the soil a rest from all vegetable crops.
- Started experimenting with mushrooms in 2010.
- Started with the Almond Portobello (*Agaricus subrufescens*) because of its ability to grow in hot, sunny conditions in non-sterile substrate. This mushroom is commonly grown outdoors on compost heaps in Brazil. They found it difficult though to maintain the humidity it required without waterlogging it since they weren't growing any plants in the greenhouse. They also changed their minds about wanting their greenhouse soil to take a rest from plant matter. They

realized that healthy soils should have a plant cover over it and plant roots growing in it.

- Their organic certifier told them they needed to try to find an organic spawn provider. They found Field and Forest Products in Wisconsin who were intercropping mushrooms with tomatoes in tunnels as well as intercropping with asparagus in the field.
- In 2012, they grew the Winecap or Garden Giant mushroom (*Stropharia Rugoso Annulata*) produced on sawdust substrate (important because voles and insects like to eat the grain substrate normally used).
- Field and Forest were using unpasteurized soaked straw as a substrate under tomatoes. Cindy and David couldn't find a source of organic straw so they mowed some of their winter rye cover crop, dried it, and used that. Cereal straw works better than hay because it doesn't rot as quickly, mat as easily, and it provides more surface area for colonization by mycelium.
- They soaked the straw in a clean stock tank full of water for 3 days, laid on screens to dry most of the way, then placed on layers in a tomato bed in late June. The tomato crop was already well established and producing.
- Layers were 3" straw, a sprinkle of spawn, 3" straw, spawn, 3" straw on top.
- Irrigation drip tape was placed on top of straw next to tomato plants (they prefer to not bury the lines because they find that voles chew on them and they spring leaks). Put the mushrooms in the north bed thinking there would be more shade and humidity. At least 2x week, lightly watered the straw, as well as watering the tomatoes 2-3x/wk with the drip tape.
- July and August in 2012 were so hot and dry they thought the experiment would be a failure. But after the first good rain in September, mushrooms started to appear.
- From 10' row of mushrooms, they harvested nearly 17.5 lbs of mushrooms without any detriment to the tomato crop.
- They will expand the trial this year and try some other mushrooms.
- Last summer, Field and Forest produced some beautiful Almond Portobellos on compost under their hoophouse tomatoes so they will try a few feet of these, possibly also some pink oyster mushrooms which thrive in hot weather and are eye-catching.

- Their hope is that they are improving their greenhouse soil while making nutrients more available to their tomatoes and keeping their customers happy.
- They ate most of the mushrooms themselves and could only part with 3 lbs. However those 3 lbs sold out within 15 minutes at \$8/lb.
- Questions/Discussion:
- Need to harvest them when they're ready, if you wait, they'll "bloom."
- Separation distance between mushroom types? Cindy did a buffer of 10' between varieties. Some are more aggressive than others so you may not want to mix them.
- How to use ginger greens (besides tea)? A chef Chris Velden used the ginger greens by cutting them up finely and made a sauce with them (he didn't even use the roots).
- Cindy feels that the profitability of ginger is up there with their tomatoes (harvested 8 lbs/foot and sold for \$12/lb).
- Puna Organics is sold out already so if you want to try growing ginger this year, you'll have to try to buy some from your grocery store. Grocery store garlic many not be the right variety. Some are grown in Peru and need a longer season. Rudy is a variety they like.
- David Hastings from Waxwing Farm grew a yellow variety but his yields were lower and the roots weren't as smooth.

February 26th, 2013

3:15pm – 4:15pm

Transplant Production: Jen & Derek's Farm and Strawberry Hill Farm

(Please note: we do not currently have the slides to match this presentation)

Note on abbreviations:

GH= greenhouse

HT= high tunnel

TPs= transplants

IR= infra-red

Italics indicate Product or Company Name

Transplant Production

Jen & Derek's Farm, PEI

- Jen apprenticed and still generally uses those same TP practices
- Started with straw bale cold frames with windows on top, which was cheap to make and very low-tech
- Next they built a lean-to structure, while still germinating under grow-lights in the house
- Now they have moved to a new property on which they built a 30x96 GH
- This year they trialled Farfard soil mix, successfully
- Open trays: leeks, onions, peppers, eggplant, tomatoes
- From open flats Jen would "pot up" plants into pots or cells
- This is a practice she has been doing since apprenticing because it's how she learned to produce TPs but is re-thinking some practices
- Tomatoes go into 3 inch pots one month after seeding
- They sell TPs at the Summerside market in the spring
- This year they had trouble with damping off, and next year they plan to seed into 128 cell trays instead of "potting up", and also are going to have a heated table
- Currently using a homemade germination chamber (photo) which can stack trays and therefore do a lot at once.
- Have been using homemade transplant tables of wood frames with fine mesh fencing attached, then whole mounted on cinderblocks in the GH. These are used as a place to sit transplants. Once plants have their true leaves they go outside

- Jen says she struggled with being mean to the TPs by putting them out but although they looked weak at first they get better over time and this past year she had the best TPs yet, even after the damping off problem.
- Watering - has tried tempering water to temperature above freezing, but unsuccessfully, and yet no negative results have happened that she knows of because of using unheated water
- The tables are covered with row cover or plastic to keep heat

Tim Livingstone, Strawberry Hill Farm, NB

- 1 heated GH, about 30 x 90 which had to be taken down and put back up but was bought at a reduced rate
- Old wood furnace that was in the house they bought but was uninsurable, so he put it in the GH which is also uninsurable
- The lean-to inside the GH is on the southern side and has 5 x 10 tables with electric heat and ventilation via a fan and a vent on opposite sides of the structure which create air movement into the larger GH space
- GH door widened for tractor use, but still seldom uses tractor in there
- Under germination table they start sweet potatoes or else they have trays that are still germinating and don't need light yet.
- Green plants on top of heated table
- In larger GH benches are simple and low tech: hay bales on ends for legs and 16 ft boards that can be easily disassembled
- Vacuum seeder - note, not useful for onions which have irregular shape. Also that skips or doubles are fixed by hand after mechanized seeding
- Uses vermiculite to cover seeds which prevents damping off by holding water and yet promoting air flow
- Gentle watering via *wonderwater*
- By using chard TPs you can prevent rot - use 8 inch spacing. seeded in early March in 288 cell trays
- Tim uses a curtain to partition the GH so the heat doesn't enter the whole space when it isn't in use.
- Also sprouts potatoes in GH
- NB: do not crowd your tomatoes - they go in 4 inch pots until they go in the ground
- NB: Tim tries to handle the plants a little as possible, meaning he doesn't "pot up" plants as Jen has done in the past
- Tomatoes bud around April 30

- Melons germinate at high temperatures
- Transplanting machine is good also for cultivation because it makes straight rows. Also the machine is easier on the employees
- Melons were transplanted using the water wheel which was good for the plants because they were wet. This machine is problematic in wet conditions because it gets gummed up with mud. *Rainflow* - brand
- Equipment like this was available used and cheap, otherwise Tim would have thought twice about buying it
- *Hatfield* transplanter from *Johnny's* - Tim thinks it would be a decent first step
- GH gets TP tomatoes in May, which means other TPs have to be finished in the aisles, which is a big pain
- Tim will TP corn or direct seed - direct seeding takes less time and space so utility of TP corn is debatable
- Most TPs are from 144 cells
- Few things get potted up: tomatoes, peppers, eggplant, ground cherries
- Time cautions not to let plants get root bound
- Brassicas are in TP trays for 5 weeks, then TPed outside
- Peppers - 3 inch tray to mesh hoop tunnel. they flower before or at TP time
- Mesh tunnel: *DuBois* called "protectnet 60 GR". Mesh was all in one sheet (24 feet). Easy to take down and put up. Used PVC pipe and twist-in anchors. Also used *biotello* and staking peppers.
- Favourite pepper variety: purple star because it is good looking, not for taste
- Tomatoes are planted in GH by May 18 which may sound late but is because they have to share the GH with TPs
- Tim cautions against burying the stem because it creates more vegetative growth
- Potting mix trials are going on this season, along with Rob English, Sweet Valley Herbs

Q & A

Tim:

- TPs generally try not to push out of cell, but sometimes have to

J & D:

- Grow lights were 50% regular fluorescent and 50% full spectrum bulbs for aquariums. They rotated the trays in case it actually mattered. The motivation is because the full spectrum were very expensive
- Nighttime low temperature approximately 9-10 degrees C

Tim:

- Tomatoes can freeze even at 2-3 degrees C inside, so use row cover as they are very sensitive
- Organic doesn't mean blemished - maybe produce used to pass as imperfect=organic but no more because there is bigger market, more demand, and also more competition for quality control. Bar has been raised.
- Leeks: trench, transplant, hill
- Seed melons late April, May, planted out 24 May on *biotello*, hooped with plastic or hoops with row cover - use sandbags so the wind can't affect cover.
- Melon harvest 5-7 August. They cover the whole bed to heat a bigger air mass
- Melons covered with 50 ft row cover, just take off and cultivate and then replace
- Melons may not need cover, according to *Johnny's*. Remember to take off cover to pollinate about a week after blossoms start opening.