



# Great Lakes Fruit, Vegetable & Farm Market EXPO Michigan Greenhouse Growers EXPO

December 5-7, 2017

DeVos Place Convention Center, Grand Rapids, MI



## Hoop House

**Where:** Ballroom D

**MI Recertification credits:** 2 (COMM CORE, PRIV CORE)

**OH Recertification credits:** 4 (presentations as marked)

**CCA Credits:** CM(2.0)

**Moderator:** Collin Thompson, MSU Upper Peninsula Exp Station, Chatham, MI

- 9:00 am            Beyond the Tomatoes - Specialty Crops in Hoophouses (OH: 2B, 2 hr)
- Rachel Cross, Spirit of Walloon Market Garden, Boyne City, MI -- Presentation will focus both on hoophouse strawberry production (both as an annual and biennial crop), as well hoophouse cut flower production, including snapdragons, lisianthus, and sweet peas. We will also cover growing hoophouse ginger, turmeric, and new potatoes.
- 9:40 am            Salad/Lettuce Mix Production Systems in Hoophouses (OH: 2B, 2 hr)
- Dion Stepanski, Presque Isle Farm, Posen, MI -- Salad/Lettuce mix is a fundamental part of many small market farm systems. We will discuss a nearly year-round lettuce mix production system. This will include a focus on building efficiencies including the implementation of a paper pot transplanting system, other planning, planting, harvesting, and washing methods, as well as how this farm has marketed and branded a consistent product.
- 10:20 am           Seed Production in Hoophouses
- Mark Uchanski, Specialty Crops Program, Colorado State Univ. -- Hoophouses, or high tunnels, are an integral part of many farms' production systems. The structures are useful for season extension, training vining crops, and creating a microenvironment. We will discuss some important considerations if you are considering using your hoophouse to produce a seed crop.
- 11:00 am           Session Ends

# Beyond the Tomatoes - Specialty Crops in Hoophouses

Rachel Cross, Manager and Owner of Spirit of Walloon Market Garden, Boyne City, MI.

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[www.spiritofwalloon.com](http://www.spiritofwalloon.com)

- **Strawberries**
  - **Sourcing Plants**
    - Nourse or Indiana Berry Company, or propagate your own (see below). We use Chandler exclusively in hoophouses.
  - **Growing Information**
    - Can be treated as an annual or biennial.
    - Prep beds with compost and amendments as needed, lay drip irrigation.
    - We plant double rows at 12” spacing on black woven ground cover.
    - Plant out last week of August/first week of September for May harvest.
    - When we first spot buds in spring, (Usually early April), we order a hive of bumblebees from Koppert Biologicals in Howell, MI.
    - If expecting extreme lows during flowering, we use a backup kerosene heater on a thermostat to protect blossoms.
    - We move the hoophouse off the berries the first week of May, but continue to use low hoops over the plants.
  - **Harvest**
    - We begin harvesting in mid-May. Harvest continues for about 2 weeks.
    - We pick every other day for top quality.
    - Retail at \$5/pint.
  - **Propagation**
    - After fruiting, collect runners aka daughter plants to propagate (end of July).
    - Take plants with at least 3 leaves and emerged rootlets.
    - Pot into 50s and place on mist table with a controller. Run mist only during daylight hours. For the first 4 days, run every 5 minutes for 10 seconds. Then run every 12 minutes for 30 seconds. Gradually decrease the run time over 7-10 days.
    - Mist table components can be purchased from Rainflo (mist nozzles and tubing) and Nolt’s Midwest Produce Supply (DIG battery-operated controller)
  - **Treatment as a Biennial**
    - After fruiting and runner collection, mow foliage. We use a weed whacker with a hedge trimmer attachment or a DR push mower for this.
    - Plants will have produced multiple crowns; thin to 3 crowns per plant.
    - After renovation, we fertigate with fish emulsion and Humikelp.
    - On our farm, we move a hoophouse back over the strawberry beds the last week of October.
- **Cut flowers**
  - **Lisianthus**
    - **Sourcing Plants**
      - We have bought plugs from Raker’s and Kube-Pak (in NJ). We buy 288s and bump up into 72s for 4 weeks before transplanting.
      - Can start from seed, but they are *very* slow-growing. I recommend plugs.

- Young plants can be finicky. Avoid temperatures above 85\* during the day and 70\* at night. Don't over or underwater.
- **Growing Information**
  - At SOW, 5 rows per 30' bed, 6" between row and in row.
  - Have planted out the second week of May (wk 19) in past. Will be planting last week of April (wk 17) in '18.
  - Use Hortnova trellis netting staked horizontally above plants for support.
  - Plant varieties from Groups I-IV for a staggered harvest.
  - Lisis are prone to root diseases; use rootshield for prevention.
- **Harvest**
  - Stems have multiple blossoms; we cut off the first "queen" blossom, then cut the entire stem once the other blooms start to open. Leave at least 2 sets of leaves at base of plant.
  - Great vase life and beloved by florists. We sell for \$1.5-\$2.5 per stem wholesale. Each plant produces 3-5 stems.
  - After initial harvests in July and August, we fertigate with fish emulsion and humikelp. Plants produce a second flush for September-November harvest.
- **Snapdragons**
  - **Transplant Tips**
    - Seed is inexpensive and easy to germinate. We purchase from Johnny's and Geoseed. Cotyledons do require high humidity to push free of seed coat- we cover mini blocks with plastic wrap until the leaves are fully expanded.
  - **Growing Information**
    - At SOW, 3 rows per 30' bed, 9" between row and in row.
    - We succession plant starting the last week of April (week 17) every three weeks for three total successions.
    - We like 'Madame Butterfly,' 'Chantilly,' 'Opus,' and 'Overture.'
    - Use Hortnova trellis netting staked horizontally above plants for support.
    - Plant varieties from Groups I-IV for a successful crop throughout the summer.
  - **Harvest**
    - Harvest when 1/3 to 1/2 of the flowers on a spike are open.
    - Each plant produces at least 5-7 stems during the main season. We wholesale for \$1/stem.
    - A second flush generally occurs in October.
- **Ranunculus**
  - **Sourcing Plants**
    - We purchase corms through Van Englen Bulb Company or a broker like Glockner. Order early (July)- varieties sell out quickly.
  - **Growing Information**
    - We plan on planting out in hoophouse the last week of March. Plants are hardy!
    - Four weeks before planting out, soak and sprout corms. Corms are soaked at room temperature for 10 hours with aeration (we use an aquarium bubble stone).

- Place soaked corms in open flats or 50s, cover lightly, and grow on at 50\*-55\* until ready to plant out.
  - In '17, we planted 3 rows per 30' bed, 9" between row and in row. For '18, we are switching to 5 rows per bed, 6" between row and in row.
  - Plant fizzle out quickly in temperatures above 75\*-80\*, so vent aggressively.
  - **Harvest**
    - Harvest begins in Mid-May. Cut stems when buds are fully colored and just opening.
    - Florists love these! We wholesale for \$1-\$1.5 per stem.
    - Each plant produces 10-15 stems for about 4-6 weeks. Bigger corms make more stems.
  - **Saving Corms**
    - Let plants yellow completely, then lift and cut tops. Wash corms, let dry, and store at room temperature until ready to plant again.
    - Our corm count multiplied by 5 after just one season of growing!
- **Sweet Pea**
    - **Transplant Tips**
      - We grow sweet peas as a 6-week transplant. Soak seed for 24 hours, then plant 2 seeds per cell in deep cell trays or deep pots. Grow on at 60\*-65\*.
      - Pinch at 6" to encourage branching.
    - **Growing Information**
      - We grow two successions of hoophouse sweet pea- one is planted out the third week of March, the other the first week of April .
      - At SOW, 2 rows per 30" bed, 12" BR, 9" IR.
      - Heavy feeders, so we provide extra compost at planting and fertigate throughout season.
      - Hoophouse plants will be tall! Provide enough trellis. We needed two layers of hortnova trellis (9-'10') in '17.
      - Vines need help climbing, so we tie to trellis once every week or so.
    - **Harvest**
      - Harvest begins in Mid-May, and continues for at least 8 weeks. We stop picking when stems begin to shorten.
      - Prolific and fragrant, a market favorite. We retail poseys for \$4, and wholesale stems for \$0.25 apiece.
    - **Saving Seed**
      - Stop picking and leave plants to die back. Pick pods when they are dry to the touch.
      - We grow both saved and bought seed each year, and the difference in vigor is astounding. If you have the space, save your seed!

- **Minor Crops**
  - **New Potatoes**
    - **Sourcing Plants**
      - We order seed potatoes in the fall from Wood Prairie Farm in Maine.
      - “Rose Gold” and “Red Gold” have performed well in the spring hoophouse.
    - **Presprouting**
      - We “greensprout” potatoes about two weeks before we plan to plant in hoophouse. Seed potatoes are brought into the heated greenhouse and stored under the benches until they begin to sprout.
      - Once they are sprouted, we move into the light until ready to plant.
    - **Growing Information**
      - We plant anywhere between early March and early April, depending on soil warmth- waiting for at least 50\*.
      - At SOW, 2 rows per 30” bed, 12” BR, 9” IR.
      - We hill once.
      - The hoops are moved off the plants the first week of May.
    - **Harvest**
      - Harvest begins once plants begin to produce flower buds, generally 60 days after planting.
      - We get a premium for first new potatoes- retail at \$5/pint.
  - **Baby Ginger and Turmeric**
    - **Sourcing Plants**
      - We buy from Biker Dude Ginger/Puna Organics in Hawaii. Seed stock sells out early, so order ASAP (end of October/Early November).
    - **Presprouting**
      - At least 6 weeks before planting out, spread your seed pieces out in trays, cover with an inch of slightly moist media, and hold at 72\*-75\* until sprouted.
      - We use our germ chamber for this.
      - Sprouting can be slow and erratic. Be patient and get your seed pieces early!
    - **Growing Information**
      - We plant out in hoophouses early to mid-May.
      - At SOW, 2 rows per 30” bed, 16” BR, 6” IR.
      - Heavy feeders- we provide supplemental feathermeal and fish emulsion every 4 weeks.
      - Hill once or twice in growing season.
    - **Harvest**
      - Harvest begins in late August and can continue into early November.
      - We dig entire plants, trim tops, rinse, and retail for \$15/pound (ginger) and \$20/# (turmeric) .
      - Baby ginger and turmeric has a life of about 10 days in fridge. Excess freezes beautifully.

# Salad/Lettuce Mix Production Systems in Hoophouses

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[www.instagram.com/presqueislefarm](https://www.instagram.com/presqueislefarm)

## *Introduction*

Salad/Lettuce mix is a fundamental part of many small market farm systems. In this session, we will discuss a nearly year-round multileaf head lettuce production system. This will include a focus on building efficiencies including the implementation of a paper pot transplanting system, other planning, planting, harvesting, and washing methods, as well as how our farm has marketed and branded a consistent product.

## *Protected Culture*

High tunnels/hoophouses provide an optimal setting for growing multi-leaf head lettuce mix nearly year round in northern Michigan. Our production starts with seeding at the beginning of February for a late April or early May harvest and ends with our last harvest around the end of December. We work to have product available 9 months of the year. Our houses are 30'x 96'.

We section off a heated propagation space in one of our houses. The 12'x 80' sectioned off space on the north side of the hoophouse can be heated very efficiently because of the insulation provided by the hoophouse itself. Covering and heating benches inside the sectioned off space is another way to decrease the cost of heating in the winter.

## *Planning*

We use the crop planning software Aqsquared to keep detailed records of our seeding, planting, and harvest schedule. Easy-to-use records allow us to hone in our planting dates and quickly make changes to consistently produce enough and avoid overproduction.

## *Propagation, Bed Preparation, and Planting*

Consistent weekly seeding and planting is necessary to maintain a constant supply of lettuce mix. To make this happen, we have implemented the paper pot transplanting system. This transplanting system has become integral to our entire lettuce production system. The seeding system saves us hours of time seeding, and the transplanter itself saves us time planting. To simplify our seeding, planting, harvest, and wash process, we mix all of our chosen varieties of seed together before seeding. Our mix currently includes Salanova varieties from Johnny's Selected Seeds and One-Cut varieties from High Mowing Organic Seeds. Osborne Seed Company also provides a line of multi-leaf head lettuce varieties.

Clean bed preparation free of rocks and debris is necessary for quickly planting with the paper pot system. We compost and amend between every planting based on annual soil samples. If we are tilling with a tractor driven rototiller, we till in all of the leftover plant matter, leave the bed for a few days and then rake it out before amending and composting. If we are not tilling, we pull out all the old plant material from the previous planting, amend and fork the bed, apply compost, and then rake it out for planting.

### *Irrigation*

Overhead irrigation is used almost exclusively in our lettuce production. It makes it easy to keep soil uniformly moist. Young seedlings in paper pots can dry out very easily if they are sitting high in the soil. Keeping them from getting dry is key as they establish their roots. Overhead irrigation also offers a way to cool plants down in the heat of the summer.

### *Weed Control*

Our main tool for weed control is a wheel hoe with a single cultivator tooth. We weed between rows approximately 1-3 weeks after transplanting. The canopy of the densely planted bed usually prevents a second flush of weeds. A collinear hoe also works well to do the same thing.

### *Summer Considerations*

Hoophouses provide a small amount of shade from direct sunlight and lettuce can grow very well inside during the summer. The summer hoophouse lettuce has a lighter, fluffier texture than field lettuce. We usually mix the hoophouse lettuce with the field lettuce. The hoophouse lettuce is more reliable and predictable than the summer field lettuce. In the summer, we are always trying to balance texture and taste/bitterness. Having both hoophouse and field summer lettuce production gives us more control over the balance of our final product.

Germination can be difficult in the heat of the summer. Place flats in a walk-in cooler for 48 hours after seeding to increase germination rates.

### *Intercropping*

To get the most out of our tomato and cucumber houses, we plant two rows of lettuce on either side of our tomatoes and cucumbers when they are transplanted. The lettuce on the south side of the tunnel grows much faster and more evenly than the northernmost rows due to shade. The lettuce from these plantings can get leggy and be more delicate. To be sure we are always providing a uniform mix to our customers, we usually mix the intercropped lettuce with other plantings at harvest.

### *Winter Considerations*

We always vent and keep the tunnels as cool as possible. Once the first lettuce is planted in February, there will still be many below freezing nights. Preventing the house from heating up on sunny days is important. We also utilize good record keeping to hone in planting dates. In 2017, our Feb 1st seeding was harvested earlier than our Jan 15th seeding. The earlier plants struggled with too little light and low temperatures. It is a waste of time and money to heat a propagation space earlier than needed. In northern Michigan we drop below 10 hours of sunlight starting November 4th and go back up to 10 hours starting February 6th. Beyond simply heat, these numbers are critical to healthy plants.

### *Harvesting*

Waiting until heads have reached their full size before harvesting can increase yield two or three fold. Fulfilling orders before your first succession has reached its full size can result in many weeks of chasing full yield potential.

We do all our harvesting with a sharp, serrated knife. Lettuce heads are cut just above the base so the leaves fall apart. Nothing but perfect, ready to eat lettuce is put in the harvest bin. Harvest bins are immediately taken to the walk-in cooler to await washing.

### *Post Harvest*

After the entire harvest is complete, we begin washing. We use two 150 gallon water tanks. The lettuce is washed in batches of roughly 30-40#. Lettuce is dunked in the first tank to remove sand. It is then dunked

in a second tank that includes a bubble washing system. The bubble washing tank removes all other debris and includes Sanidate sanitizer. The bubble washer makes a significant difference in producing a super clean, ready to eat mix. We get a total of around 60-80# washed in the 300 gallons of water in the two tanks before changing the water. Between batches we clean debris from the water with a pool skimmer. After the bubble wash, the greens are spun dry, bagged, and stored in the walk-in cooler at 34-38 degrees for delivery.

Our spinner is a converted washing machine. A new washer with a stainless steel bin and without an agitator works far better than an old washer.

Our cooler is a 10"x15" commercial walk-in cooler running with a coolbot and air conditioner.

### *Marketing and Branding*

Marketing and branding our farm and our lettuce mix has been the most crucial step in the success of our production system. Chefs and direct sales customers all want a stable product that is as convenient and consistent as the greens they can buy through large wholesalers or at the grocery store. Consistent availability of a virtually identical product every week is crucial in developing a reliable market.

### *Conclusion*

Developing and adopting systems and practices that can be consistently replicated week in and week out is the key to successful lettuce mix production.

### *Useful Resources*

Hartman, Ben. *The Lean Farm: Guide to Growing Vegetables*. Chelsea Green Publishing, 2017.

Mefferd, Andrew. *The Greenhouse and Hoophouse Grower's Handbook: Organic Vegetable Production Using Protected Culture*. Chelsea Green Publishing, 2017.

Stone, Curtis. *The Urban Farmer: Growing Food for Profit on Leased and Borrowed Land*. New Society Publishers, 2016.

Coleman, Eliot. *The Winter Harvest Handbook: Year-Round Vegetable Production Using Deep-Organic Techniques and Unheated Greenhouses*. Chelsea Green Publishing, 2009.

Small Farm Works - Paper Pot Transplanter System - [www.smallfarmworks.com](http://www.smallfarmworks.com)

Coolbot - Walkin cooler controller - [www.storeitcold.com](http://www.storeitcold.com)

Nifty Hoops - high tunnels/hoophouses - [www.niftyhoops.com](http://www.niftyhoops.com)

Webstaurantstore - bags, clamshells, etc. - [www.webstaurantstore.com](http://www.webstaurantstore.com)

Frontier Label - product labels - [www.frontierlabel.com](http://www.frontierlabel.com)

AgSquared - record keeping software - [www.agsquared.com](http://www.agsquared.com)

RainFlo - irrigation supplies - [www.rainfloirrigation.com](http://www.rainfloirrigation.com)

Hoss - wheel hoes, weeding tools - [www.hosstools.com](http://www.hosstools.com)

Johnny's Selected Seeds - Salanova seeds - [www.johnnyseeds.com](http://www.johnnyseeds.com)

High Mowing Organic Seeds - one-cut lettuce seed varieties - [www.highmowingseeds.com](http://www.highmowingseeds.com)

# The Potential of Vegetable Seed Production in Hoop Houses

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Figure 1: Hoop houses, also known as high tunnels, covered with shade cloth can exclude insect pollinators, or containment them if desired, for seed production (photo credit: Emma Locke).

## Outline:

- Brief introduction and background
  - Illinois
  - New Mexico State University
  - Colorado State University
- The many uses of hoop houses
  - Why seed production?
  - Why in a hoop house?
- Conclusions, questions, and discussion



Figure 2: Chile pepper seed production in a homemade hoop house made from cattle fencing and insect netting in Hatch, New Mexico.

Selected tables with examples:

Table 1\*. Vegetable Breeding and Reproduction Characteristics

<b>Crop</b>	<b>Compatibility</b>	<b>Life Cycle</b>	<b>Pollen Vector</b>	<b>Proportion of Outcrossing</b>
Asparagus	Dioecious	Perennial	Insects	Complete
Beans	Self-fertile	Annual	Insects	Self
Beets	Self-incompatible	Biennial	Wind	Complete
Carrots	Self-fertile	Biennial	Insects	High
Eggplants	Self-fertile	Annual	Insects	Moderate
Lettuce	Self-fertile	Annual	Insects	Self

\*Modified from Swiader and Ware (2002)

Table 2\*\*. Self-pollinated Vegetables (i.e. isolation not required)

Bean	Chicory
Lettuce	Tomato
Bean, lima	Endive
Pea	

Table 3\*\*. Isolation Distances for Cross-pollinated Vegetables

<b>Wind-pollinated crop</b>	<b>Distance (miles)</b>
Beet	0.5-2 (5 from sugar beet or Swiss chard)
Sweet corn	1
Spinach	0.25-3
Swiss chard	0.75-5 (5 for sugar beet or beet)

Table 4\*\*. Isolation Distances for Cross-pollinated Vegetables

<b>Insect-pollinated crop</b>	<b>Distance (miles)</b>
Asparagus	0.25
Carrots	0.5-3
Eggplant	0.25

Table 5\*\*. Vegetable Seed Yields (lb/ac)

<b>Crop</b>	<b>Yield</b>	<b>Note</b>
Asparagus	925	open pollinated
Beans, snap	1,800	
Bean, lima	2,220	
Beets	1,950	open pollinated
Carrot	840	open pollinated
Eggplant	640	open pollinated
Lettuce	600	
Pea	2,085	
Pepper	170	open pollinated

\*\*Tables 2-5 modified from Maynard and Hochmuth (2007)

Resources:

- CSU Specialty Crops Program website: <http://specialtycrops.agsci.colostate.edu/>
  - Economics of low cost hoop houses: <http://aces.nmsu.edu/seasonextension/research.html>
  - Low cost hoop house construction, example: [http://aces.nmsu.edu/pubs/\\_circulars/CR606/](http://aces.nmsu.edu/pubs/_circulars/CR606/)
  - Hoop house vegetable production: [http://aces.nmsu.edu/pubs/\\_h/H252/welcome.html](http://aces.nmsu.edu/pubs/_h/H252/welcome.html)
- 
- Maynard, D.N. and G.J. Hochmuth. 2007 Knott's Handbook for Vegetable Growers: Fifth Edition. John Wiley and Sons, Inc. Hoboken, NJ.
  - Mefferd, A. 2017. The Greenhouse and Hoophouse Grower's Handbook: Organic Vegetable Production Using Protected Culture. Chelsea Green Publishing. White River Junction, VT.
  - Swiader, J.M. and G.W. Ware. 2002. Producing Vegetable Crops: Fifth Edition. Interstate Publishers, Inc. Danville, IL.



Figure 3: Open-field radish seed production (white flowers) at the certified organic research farm in Fort Collins, Colorado.