Northern NY Agricultural Development Program
2015 Project Report

Advancing Season Extension and Protected Culture Efficiency with NNY Growers

Project Leader(s):

- Amy Ivy, Vegetable Specialist, Eastern NY Commercial Horticulture Program (ENYCHP), Cornell Cooperative Extension (CCE) Clinton County: overall project coordination
- Judson Reid, State Vegetable Specialist, Cornell University: project advisor, collaborator
- Crystal Stewart, Vegetable Specialist, ENYCHP: collaborator and project advisor on cost/benefit analysis and financial management

Collaborator(s):

Melissa Spence, CCE Lewis County; Sue Gwise, CCE Jefferson County; Paul Hetzler, CCE St. Lawrence County; Richard Gast, CCE Franklin County.

Cooperating Producers:

- Clinton County: Jesse Mulbury, Northern Orchard
- Essex County: Michael McCauliffe, Carriage House Garden
- Franklin County: Louis Lesniak, Summit Farm
- Jefferson County: Maria Mix, Garden Hill Farm
- Lewis County: Mike Colwell, Colwell's Farm Market
- St. Lawrence County: John Dewar, Village Veggies

Background:

The project team wanted to build on past years' NNYADP projects and identified areas of improvement for NNY growers using season extension/protected culture technology to maximize profitability in three key areas:

1. Fine tuning of fertility management for both organic and conventional growers
2. Recordkeeping related to annual production costs, inputs and yields on a crop-by-crop basis to maximize net profitability.

3. Use of crop rotations for soil improvement with three high-value high tunnel crops: ginger, lettuce and basil as rotations away from tomatoes, the most commonly grown high tunnel crop.

Methods:

1. Foliar Nutrient Study in Tomatoes

To address fine tuning fertility management for both organic and conventional growers, we worked with six growers, one from each county, to monitor fertility levels in their high tunnel tomato crops with a pre-plant soil test followed by 6 foliar nutrient tests at 2-week intervals during the peak growing season. See summary charts showing the rise and fall of nutrients by county in Appendix B.

2. Enterprise Budgets

To help growers understand annual production costs, inputs and yields on a crop-by-crop basis to maximize net profitability, we taught them to use customized enterprise budgets to track each crop separately. A sample is included for high tunnel-grown tomatoes in Appendix C.

3. High Value Crop Rotations

We assessed potential yields and timings for three high-value alternative high tunnel crops: ginger, lettuce and basil. See data graphs are in Appendix A.

Ginger and Turmeric

Ginger and turmeric are grown from rhizomes, called "seed" in the trade, ordered from Hawaiian suppliers in October 2014, and shipped to the Willsboro Agricultural Research Farm in Willsboro, NY, March 2015. The seed was placed on trays filled with Vermont Compost Fort Vee potting mix in March for pre-sprouting. Trays were kept on heat mats set to 85 degrees F for several weeks until sprouted and then seedlings were transplanted into the high tunnel.

Due to erratic sprouting we had three transplanting dates: June 4, June 24, and August 11. Sprouted seeds were placed 12" apart in the bottom of a 6" deep trench that was gradually filled in as the shoots elongated. Most of the 30" wide growing beds had a single row planted in the middle of the bed, but we experimented with double rows (two rows spaced 18" apart in a 30' wide bed) with the later transplanting dates.

Fertility: 40 ton/acre composted cow manure and 0.5 tons/acre North Country Organics Pro-Gro 5-3-4 granular fertilizer were applied to all the high tunnel growing beds prior to transplanting. After transplanting, the beds were fertigated weekly at a rate of 5 lbs/acre N, P, and K.

Summer Lettuce

Salanova Varieties: Eight Salanova varieties were seeded into 72-cell trays filled with Vermont Compost *Fort Vee* potting mix for three weeks prior to planting. Seedlings were spaced 8" within the row and 8" between rows (four rows per 2.5'x13' bed). A randomized complete block experimental design was employed with four plants of each

Salanova variety per replication. All Salanova plants were harvested 28 days after transplanting, and both head weight and lettuce mix weights were recorded.

Head Lettuce Varieties: Heat-tolerant lettuce varieties were seeded into 72-cell trays and planted in the tunnel on the same schedule as the Salanova varieties. Head lettuce plants were spaced 10" apart within the row with a 12" spacing between the rows (3 rows per bed). All heads were harvested 28 days after transplanting, the same time as the Salanova heads. While three to nine plants of each variety were evaluated by weight, the head lettuce plants were not replicated across multiple growing beds.

Lettuce Mix: Allstar Gourmet Lettuce Mix (Johnny's Selected Seeds) was direct seeded into the 2.5 x 13' growing beds on the same day that the Salanova and Head lettuce varieties were transplanted into the high tunnel. A randomized complete block experimental design with three replications was used. The lettuce mix was direct seeded into rows spaced 2.25" apart with a pinpoint seeder. The lettuce mix was harvested 28 days after seeding to align with the Salanova and Head Lettuce harvests, but it should be noted that this was earlier than a grower would likely harvest.

Basil
Three blocks of basil seedlings (variety Genovese) were planted at 3 different times: June 15, July 13 and August 6. Twelve plants per block, 10 inches on center, in 3 rows, 4 plants per row. Harvest dates were July 13, August 6 and August 28. To harvest, entire stems were cut to within a few inches of the ground with several nodes remaining for re-growth. The first planting was harvested 3 times, the second planting harvested twice and the third planting harvested once.

Results:

1. Foliar Nutrient Study

Most high tunnel tomato growers everywhere struggle with nitrogen (N) and potassium (K) levels, especially as fruit set and ripening begins in early-mid July. In the summary charts (Appendix B) one can see those struggles. Some of the growers are conventional, using water soluble fertilizers supplied through drip irrigation, which is called fertigation. Other growers in this group follow organic practices. Most organic fertilizers, with the exception of Chilean nitrate, do not dissolve well in water or move through drip lines easily. These growers need to supply most of the nutrients for the season before planting their crop and are challenged if they need to their boost nutrients mid-season.

2. Enterprise Budgets

Growers were introduced to the concept and mechanics of using enterprise budgets to evaluate the profitability of individual enterprises and to compare different enterprises to each other at winter meetings in Westport and Carthage and five site visits.

3. High Value Crop Rotations – Results

Ginger: The benefits of an earlier transplanting date were evident as the ginger transplanted on June 4 into single rows were taller and produced higher yields than ginger transplanted into single rows on June 24. The earlier transplanting date allowed for a

longer growing season, which translated into larger plants and greater yields. Ginger transplanted on August 11, failed to produce a marketable yield (see Appendix A).

We didn't transplant any double row beds on June 4, but the double row beds that were transplanted on June 24 produced higher yields on a per square foot basis than the single row beds transplanted on either June 4 or June 24. This indicates that late transplanted ginger will yield more if grown at a higher planting density (double rows) on the bed. It further suggests that the higher planting densities associated with double row beds could be preferable for earlier transplanted ginger as well.

Turmeric: The turmeric seed did not sprout, so no data was collected. This could be due to poor seed or the more exacting, high humidity conditions turmeric needs in the pre-sprouting environment.

Summer Lettuce

First run transplanted into the high tunnel on July 12, and harvested on August 9. Second run transplanted on August 1, and harvested on August 29.

- All yields were higher in the first run of the experiment compared to the second run (Appendix A). Reduced yields in the second run likely resulted from the decreased daylengths and higher heat levels in August.
- Salanova varieties differed significantly in yield. *Green Sweet* consistently produced more lettuce than any of the other Salanova varieties (Appendix A).
- On a per square foot basis, the transplanted Salanova varieties produced more leaf mix than the direct seeded lettuce mix during the 28-day growing periods in the high tunnel (Appendix A).
- The direct seeded lettuce mix needed approximately 2 more weeks in the ground to achieve a similar harvest to the transplanted Salanova.
- Head lettuce yields on a per-square-foot basis were similar to the Salanova head yields (Appendix A). *Skyphos* was a butterhead type that had the lowest yields of the head lettuce varieties; the other head lettuce varieties performed well in the summer high tunnel.

Basil

The most productive period of growth was from June through early July. The blocks planted on June 5 and harvested 3 times had the highest yield but took up space in the tunnel for 12 weeks. The second block planted on July 13 and harvested twice had about half the yield as the first block but only took up space for 6 weeks; half the yield in half the time. The last block planted August 6 was a complete loss due to basil downy mildew.

The first symptoms of basil downy mildew, an aggressive water mold pathogen specific to basil, were seen August 17 and by August 28, 90% of the crop was infested with a 100% loss for sales.

For all 3 blocks, the third cut had the lowest yield of all, mostly likely due to the disease for which there is no effective treatment or resistant varieties.

Conclusions/Outcomes/Impacts:

1. **Foliar Nutrient Study in Tomatoes**

Some of the growers in this project were ready and able to adjust their fertility in response to the test results. Some could have done so but hadn't seen the need to until they saw these results. One grower in this group will install a fertigation system in 2016 as a result of seeing his levels drop in spite of what he thought was adequate fertility.

Having a series of tests like this, every 2-3 weeks throughout the growing season, gives growers an objective picture of what is going on inside their crops, and it can reveal a deficiency before any symptoms are apparent, which gives the grower a chance to make corrections before the crop/yield is too adversely affected. With these tests, growers are learning to not wait until symptoms of deficiency appear before taking action.

2. Enterprise Budgets

All participants were given access to a customizable high tunnel enterprise budget that can be used in Excel or Google Spreadsheets, and growers who received a farm visit received a complete enterprise budget for their presumed most profitable crops along with blank spreadsheets to fill out for other crops in order to perform comparisons (Appendix C.

3. **High Value Crop Rotations**

Ginger

- Ginger yields benefit from earlier (late May – early June) transplanting dates that allow for a longer growing season.
- Pre-sprouting ginger seed can be difficult, and it is essential that growers have a system for maintaining warm temperatures (75-80 degrees F) during the pre-sprouting period. Slow sprouting seed can delay transplanting dates, and thereby reduce yield potential.
- Ginger grown in high tunnels in northern New York may yield more on a per-square-foot basis when grown in double rows than is single rows on a 30" wide bed.
- Turmeric is more demanding to sprout than ginger.

Market Opportunities for Ginger

Bob Weybright, a regional marketing specialist, looked at market opportunities in the NNY region. A short and informal survey of various growers and markets found that there currently are a number of farms growing ginger on a small scale for CSA or farmer's market table diversification and getting a price anywhere from 4 to 6 times that of conventional ginger sold in stores ($4 for conventional ginger in stores vs. $16-18 for fresh baby ginger at markets).

In small quantities ginger has the opportunity to raise the sales and profits on a small scale for growers adding this to their mix. This does not however support the expansion of ginger on a large scale for the NNY region unless expensive and involved value-added processing is added in the region such as dehydration, freeze drying, or products such as candied, crystalized, or pickled ginger.

Fresh ginger grown in NNY has a very short shelf life and molds quite rapidly in cold storage. Harvest needs to occur over time, in quantities that would be sold within 2-3 days of harvest and consumed within 5-6 days. One way to expand the sales window would be to portion and freeze pieces of the ginger. With a number of markets having sales of frozen meats this could be considered an option.

So there is potential for small volumes of high margin ginger sales. NNY-grown ginger has a pleasant, light, and surprising fresh ginger taste.

Some ginger production in limited quantities by farmers with the high tunnel or greenhouse infrastructure and space appears feasible.

Summer Lettuce

The Salanova varieties produced good quantities of high quality lettuce when grown in a high tunnel during the summer. Mature lettuce heads were ready to harvest 28 days after transplanting. This short residence time in the tunnel could allow for multiple waves of lettuce to be produced in a bed during a summer field season, or allow lettuce to be rotated with other market crops. Green Sweet was exceptionally productive.

The Salanova lettuce mix yield 28 days after transplanting was higher than the direct-seeded Allstar lettuce mix. It would have taken approximately 2 more weeks of time in the tunnel for the Allstar crop to reach the Salanova yield. Transplanting the Salanova seedlings reduces the residence time required to produce a crop, and thereby increases the return per square foot of bed space per day.

Heat-tolerant head lettuce varieties also performed well in the summer high tunnel, similar to Salanova head yields on a per-square-foot basis. The heat-tolerant varieties produced larger heads than the Salanova varieties, but the head lettuce varieties were grown at a wider plant spacing, so overall lettuce production per square foot of bed space was similar. But Salanova heads can be converted (cut) into higher value salad mix while head lettuce cannot. So the dollar return per square foot of bed space of head lettuce is lower than Salanova.

Basil, Successive Crops

- Basil is a rapid crop with valuable return per square foot in a high tunnel.
- It can either be kept for the full 12 weeks for continued harvest yielding an average of $7.14/sq foot or it can be planted in July after a spring crop of lettuce, for example, for a return of $3.88/sq foot in just 6 weeks. It could then be followed by an early August planting of lettuce or spinach for fall harvest.
- Basil downy mildew is widespread across the northeastern US and is a major constraint to growing basil, with no effective treatments, organic or conventional, at this time. All sweet basil varieties are very susceptible at this time although some exotic varieties such as Thai, lemon, spice and red leafed types are showing some resistance.

Outreach:

- The project team visited each of the farms conducting foliar tests on tomatoes and discussed enterprise budgets with them.
- Two summer field meetings were held to discuss soil health and fertility in high tunnels:
    - July 29: St. Lawrence CCE Learning Farm, Canton, for 22 growers
    - August 24: Shady Grove Farm, Peru, for 21 growers
- Two winter high tunnel schools were held to discuss crop alternatives to tomatoes, tomato fertility and using enterprise budgets to understand and plan crop rotations:
    - December 9, 2015: Carthage, 24 growers
    - December 10, 2015: Westport, 12 growers
- High tunnel tomato fertility and ginger were discussed at the Northern Vegetable School on March 15, 2015, for 44 growers

Acknowledgments:

This project fit well with other on-going efforts elsewhere in New York state related to high tunnel soil and fertility management funded through the NY Farm Viability Institute and Hatch funding through Cornell University.

For More Information:

- Project leader Amy Ivy, Cornell Cooperative Extension Clinton County, 518.561.7450
- Michael McCauliffe, Carriage House Garden Center, Willsboro, NY 12996, akamich71@yahoo.com
- John Dewar, Village Veggies, Potsdam, NY 13676, jdewar78@verizon.net

Appendix A.
Ginger, Lettuce, Basil Trial Data and Photos, NNY, 2015.

Ginger Trial Data

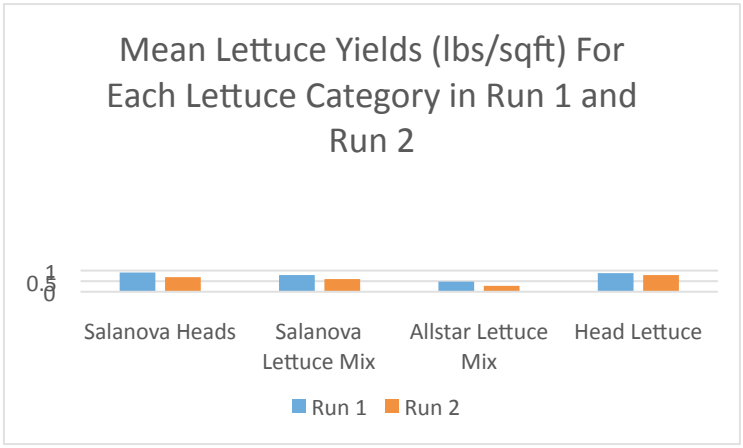
Table 1: 2015 Mean Plant Height and Yield for Ginger Plots, NNY trials.

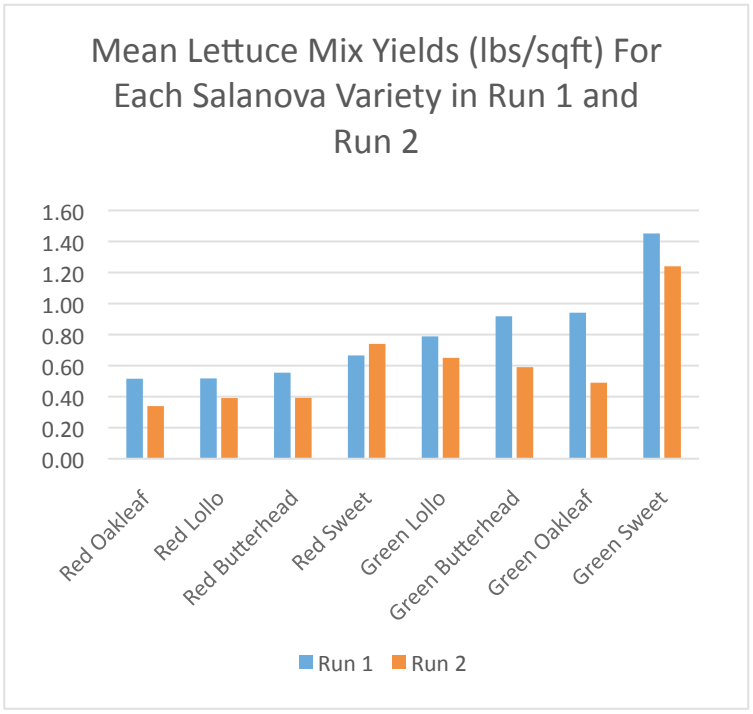
Transplant Date	Rows/Bed	Plant Height (cm)	Yield (lbs/sq.ft.)	Yield ($/sq ft) @$16/lb
June 4, 2015	Single	76	0.48	7.68
June 24, 2015	Single	64	0.33	5.28
June 24, 2015	Double	72	0.55	8.8
August 11, 2015	Double	48	0.11	1.76

Lettuce Trial Data

Table 2. 2015 Mean Head Lettuce Yields (lbs/sq ft) for each Salanova Variety and Head Lettuce Variety in Run 1 and Run 2, NNY trials.

Salanova Variety	Run 1	Run 2
Red Oakleaf	0.60	0.38
Red Lollo	0.56	0.43
Red Butterhead	0.66	0.46
Red Sweet	0.74	0.83
Green Lollo	0.86	0.73
Green Butterhead	1.10	0.67
Green Oakleaf	1.17	0.66
Green Sweet	1.57	1.4
Head Lettuce Variety		
Skyphos	0.60	0.45
Adrianna	0.91	0.54
Green Star	0.72	0.72
Concept	1.07	0.96
Nevada	0.92	0.97
Tropicana	1.04	1.08





Lettuce prices vary widely between markets and growers. Some average summer prices:
Salanova heads: $1-2 ea.
Large heads: $2-3 ea.
Salad mix (sold in ½ lb bags): $8-12/lb.

Appendix B. Summary Charts by County for Foliar Nutrient Tests in Participating High Tunnels, NNY, 2015.

The summaries below show the rise and fall of 6 main nutrients in high tunnel tomatoes. Most high tunnel tomato growers everywhere struggle with nitrogen (N) and potassium (K) levels, especially as fruit set and ripening begins in early-mid July and continues through the summer. Note in particular the fluctuations in Nitrogen and Potassium (the first and third columns); they are often the most challenging for growers to manage.

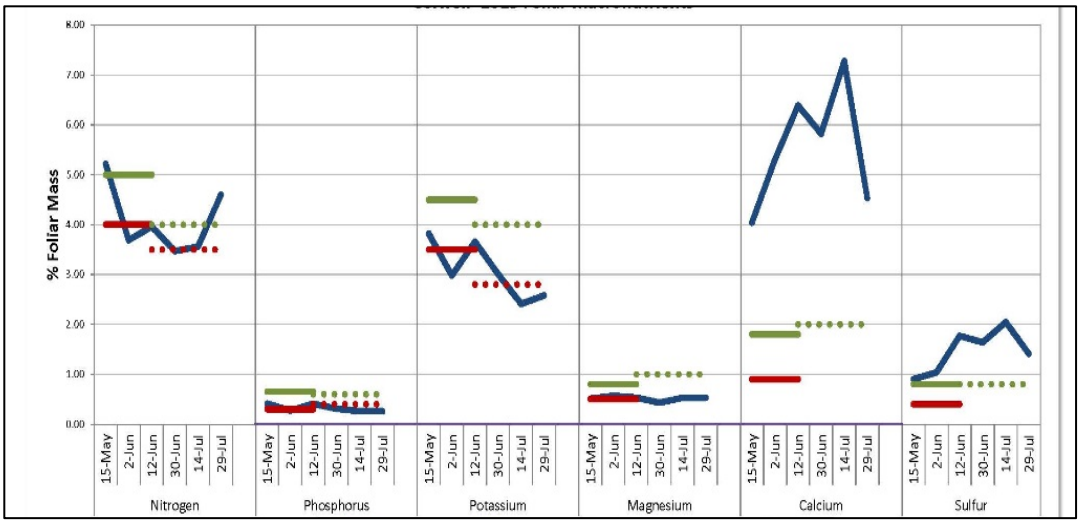


Figure 1: Foliar Nutrient Tests in Participating High Tunnels, Lewis County, NNY, 2015.

Min. recommended level (vegetative)
Max. recommended level (vegetative)
Nutrient level
Min. recommended level (fruiting)
Max recommended level (fruiting)

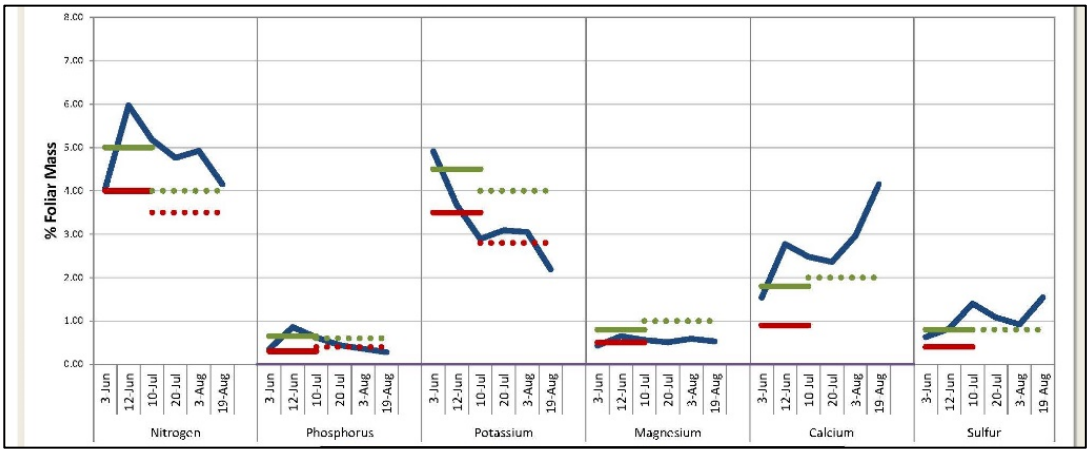


Figure 2: Foliar Nutrient Tests in Participating High Tunnels, St. Lawrence County, NNY, 2015.

Min. recommended level (vegetative)
Max. recommended level (vegetative)
Nutrient level
Min. recommended level (fruiting)
Max recommended level (fruiting)

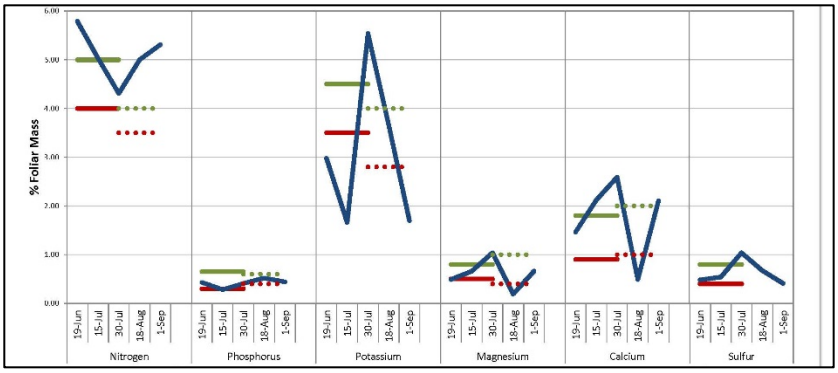


Figure 3: Foliar Nutrient Tests in Participating High Tunnels, Franklin County, NNY, 2015.

Min. recommended level (vegetative)
Max. recommended level (vegetative)
Nutrient level
Min. recommended level (fruiting)
Max recommended level (fruiting)

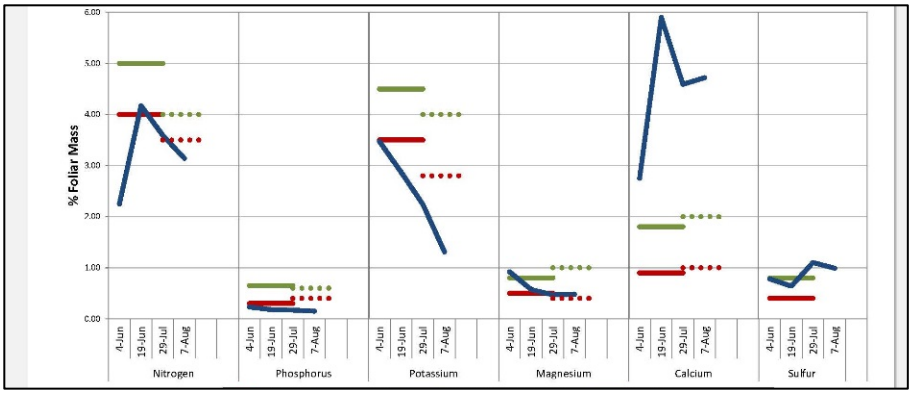


Figure 4: Foliar Nutrient Tests in Participating High Tunnels, Jefferson County, NNY, 2015.

Min. recommended level (vegetative)
Max. recommended level (vegetative)
Nutrient level
Min. recommended level (fruiting)
Max recommended level (fruiting)

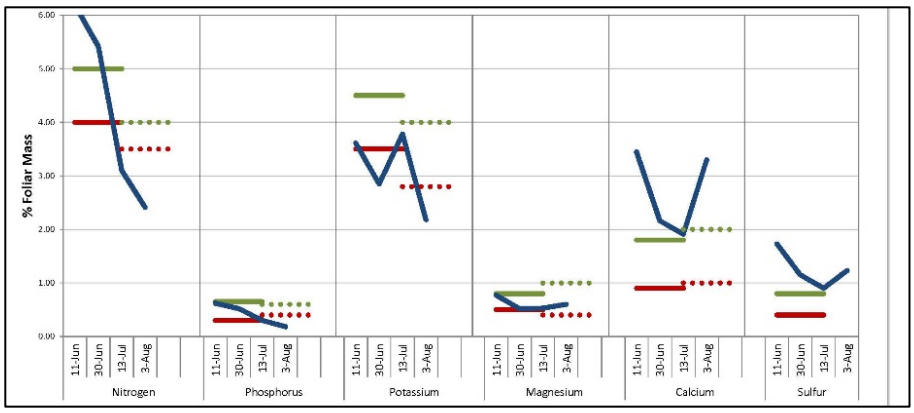


Figure 5: Foliar Nutrient Tests in Participating High Tunnels, Clinton County, NNY, 2015.

Min. recommended level (vegetative)
Max. recommended level (vegetative)
Nutrient level
Min. recommended level (fruiting)
Max recommended level (fruiting)

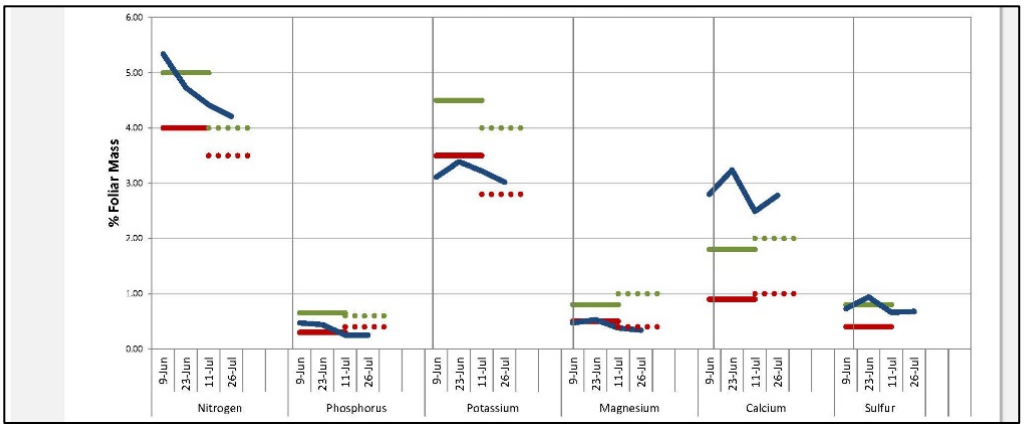


Figure 6: Foliar Nutrient Tests in Participating High Tunnels, Essex County, NNY, 2015.

Min. recommended level (vegetative)
Max. recommended level (vegetative)
Nutrient level
Min. recommended level (fruiting)
Max recommended level (fruiting)

Appendix C. Crop Specific Enterprise Budget Sample for High Tunnel Tomatoes (30x96-foot tunnel, 5 rows), 2015. See next page.

Crop Specific Enterprise Budget							
Crop: High Tunnel Tomatoes (30 X 96 foot tunnel, 5 rows tomatoes)							
Cropping year: 2015							
Expenses:	**Labor Cost Planned**	**Labor Cost Actual**	**Machinery Cost Planned**	**Machinery Cost Actual**	**Product/ materials cost planned**	**Product/ materials cost actual**	**Notes:**
							Labor: $12.5/hour
Soil Preparation							
Chisel plow	$ -		0		0		
Rototill/form beds	$ 25.00		2.5		0		
Fertilizer	$ 12.50		0		$150		
Compost	$ 25.00		0		225		
Irrigation	$ 300.00						
Plastic mulch	$ 25.00		0		30		
Ghouse plastic	$ 25.00		0		200		Costs divided over 4 years
Other (detail)	$ 25.00				75		Pound wooden stakes every other plant
Soil Testing	$ 6.25		0			16	
Seed/Transplant			0				
Grow/buy transplant	$ -		0		281.25	1	$1.25 each plant, purchased
Plant transplants	$ 37.50		0				
			0				
Cultivation			0				
Sucker plants	$ 100.00		0				8 hours
Trellising (first pass)	$ 12.50		0		4.5		Using baling twin (.01/foot)
Trellising	$ 12.50		0		4.5		
Trellising	$ 12.50		0		4.5		Also list each day of irrigation work
Insect control	$ 25.00		0		40		1 release of predatory mites, 1
Disease control	$ 37.50		0				3 applications of copper for late blight
Scouting	$ 25.00		0				prevention
			0				
Harvesting							
harvest and bring to	$ 210.94		0				180 plants with a yield of 15 lbs/plant.
Clean, pack in boxes	$ 125.00		0		507		270, 10 lb boxes @ $1.50/box
Delivery to wholesale markets			0				No wholesale markets assumed here
Harvest culls	12.5						
Retail Sales Costs							
Farmers' market staf	$ 787.50		54				3 farmers' markets, divided over 5 crops.
sales calls							
Farmers market fees	$ 60.00						3 farmers' markets, average fee $100 each, divided over 5 crops
Unsold product					225		5 lbs per week for 15 weeks, @ $3 per
Overhead Costs							
Total Costs	1320.94		54		785.5		
Grand total Costs					2160.44		
Sales	# of Units		Price per unit		Total $		
Retail	3000		3		9000		
Wholesale					0		
Other	300		1.25		375		
Total Sales					9375		
Net Profit (Total Sales -Total Costs)					7214.56		

APPENDIX D. PHOTOS

Advancing Season Extension Summer Field Meetings, NNY, 2015.

Above: Cornell NYS State Vegetable Specialist Judson Reid, far left front, demonstrates pruning determinate tomatoes in the high tunnel at a grower twilight meeting at the St. Lawrence County Extension Learning Farm in Canton on July 29, 2015. Photo: Amy Ivy

Left: 2015 NNYADP Advancing Season Extension project leader Amy Ivy, Eastern NY Commercial Horticulture Program Vegetable Specialist Crystal Stewart, and Cornell NYS State Vegetable Specialist Judson Reid lead a grower discussion about soil health in high tunnels at Shady Grove Farm in Clinton County on August 24, 2015. Photo: Jolene Wallace.