



Northern NY Agricultural Development Program 2014 Project Report

Advancing Season Extension with Non-Traditional High Tunnel Crops

Project Leader(s):

- Amy Ivy, Vegetable Specialist, ENY Commercial Horticulture Program and Executive Director, CCE Clinton County: overall project coordination, 518-561-7450, adi2@cornell.edu
- Mike Davis, Willsboro Farm Manager: conduct and coordinate research at Willsboro Farm, mhd11@cornell.edu
- Judson Reid, Cornell University NYS State Vegetable Specialist: project advisor/collaborator, jer11@cornell.edu
- Stephen Reiners, Cornell University Professor of Horticulture: faculty advisor, sr43@cornell.edu

Background:

Tomatoes and winter greens are the traditional crops grown in high tunnels with financial success in northern NY. As these crops have proven to provide excellent returns, growers are compelled to grow them year-after-year. But replanting the same crop year after year is detrimental for soil health and encourages diseases, e.g., Brown Leaf Mold of tomatoes has become one of the greatest production constraints of several NNY tomato growers.

To help growers vary their crop rotations and diversify farm production we studied crops less commonly grown in tunnels that may have good to excellent market potential. These included seedless cucumbers, fresh ginger, basil, zucchini, and green beans. Except for ginger, these crops are commonly grown in fields in NNY, but they are not traditionally grown in tunnels to the extent of tomatoes and winter greens.

These less traditional crops for high tunnels have the potential to appeal to a broader market base while providing a rotation in the cropping system. These rotations will breakup disease and pest cycles in the tunnels. We could have included peppers and eggplants as well since they do perform well in tunnels but since they are related to tomatoes they share the same soil-borne disease problems so would not work well as a rotation crop for disease management.

Methods:

Cucumbers

We compared two training methods of one variety of cucumber, *Cucapa*, that is well suited to high tunnel production. This variety is parthenocarpic, meaning it is self-fertile and does not need bees for pollination. This is an important characteristic to address for production in tunnels where bees do not visit as often as field-grown crops. It is important to train cucumbers vertically in tunnels to minimize the ground space they occupy while maximizing yield. Vertical training also increases air circulation, which helps reduce disease pressure such as powdery mildew. We tracked yield and hours of labor to train and harvest each method. Seedlings were transplanted on May 28, and final harvest was on October 16.

Ginger

Ginger is a tropical plant that prefers to grow in steady, warm temperatures in the 80s. It sells for an average of \$16/lb so it is of increasing interest to growers. We started pieces of rhizomes indoors in trays of potting mix set on heat mats to induce sprouting. On June 16, 12 plants were planted in a single row, 12” apart, and two plants were set into individual 3-gallon pots. All were harvested on November 21.

Basil – Double cropped

Basil is grown for its leaves and it takes about a month from transplanting to produce the bushy habit and vigorous shoots for repeated harvest. To harvest, the young shoot tips are removed from all over the plant. The remaining stems quickly produce new shoots for the next harvest. After a few harvests the stems become tougher and vigor and leaf quality decline. In this study we set out the first transplants on May 31 and harvested them 6 times through August 25. We replaced that planting on August 25 with new seedlings. These plants were harvested twice, with the final harvest on October 16.

Green Beans and Zucchini – Double cropped and alternated

Both of these crops are easily grown in the field and have a relatively short number of days to harvest, about 50 days on average. On May 31 we planted 2 beds of beans from seed and 2 beds of zucchini transplants. We made 2 harvests of the beans and 10 harvests of the zucchini. On July 30 all plants were pulled and the beds that had beans were planted with zucchini transplants and the beds that had zucchini were planted with beans from seed. Final harvest was on October 16.

Results:

For this study we surveyed growers across northern NY to find an average fresh market price for each of the crops we studied, then calculated the gross dollar generated per square foot by each crop. This comparison is complicated by the fact that two short season crops (green beans, zucchini, basil) can be grown in the same space that one long season crop (ginger, cucumbers, tomato) is grown. The chart in the appendix summarizes the gross per square foot for comparison purposes. Tomatoes were not part of this study but based on past research we used a conservative average of \$7.50 per square foot gross

for a crop of tomatoes, based on a yield of 15 lbs per plant at \$2.50 per pound for comparison with these non-traditional crops.

Cucumbers

Growers are reluctant to try training cucumbers to a single leader, assuming that more labor will be involved for a similar yield. At the grower field meeting in late July the mesh trellised plants were bushier and looked as though they would yield more than the more spindly, single leader plants. But our data showed otherwise.

Training cucumbers to a single leader resulted in a 20% greater yield and used 1.2 hours less labor over the season than cucumbers trained up a mesh trellis, which is an insignificant difference. Cucumbers are sold by the piece and the trellised plants yielded a total of 1014 fruits while those trained to a single leader yielded a total of 1275 fruits. Labor included both training and harvesting the crop.

Cucumber Trial	Trellised	Single Leader
Yield	1014 fruits	1275 fruits
Labor	15.23 hrs	14.48 hrs

Ginger

Our one pound of seed yielded 10.86 lbs of rhizomes (the edible part of the plant). Ginger leaves can also be sold for use as tea but for this study we considered the market value of only the more commonly used rhizome. One of the plants grown in a pot yielded considerably higher than the average yields from the plants grown in the ground. The pot-grown plant yielded 1.12 lbs compared to an average of 0.78 lbs for the ground-grown plants.

Basil – Double cropped

Basil is a warm season plant that is very sensitive to frost and cold temperatures. Under ideal conditions it yields well and is comparable to cucumbers and ginger for gross per square foot. The first planting yielded well, the second planting, set out on August 25, had a very low yield. Our combined plantings generated a total average of \$4.52 per square foot.

Green Beans – Zucchini, double cropped and alternated

Green beans out-performed zucchini in both treatments. Whether beans were followed by zucchini, or zucchini was followed by beans, the beans yielded the most and had the better gross per square foot value. The two plantings of zucchini combined generated a total of \$2.24 per square foot and the two plantings of green beans combined generated a total of \$4.32 per square foot.

Conclusions/Outcomes/Impacts:

It is clear that tomatoes are the best choice for a summer crop in high tunnels in northern NY due to the gross dollar amount they generate per square foot. But growers looking to diversify and incorporate crop rotations into their plans are looking for options. All of the alternative crops we studied: cucumber, ginger, basil, zucchini and green beans were

chosen because they are *not* members of the Solanceous family (tomatoes, peppers, eggplant, potato) and would therefore have an advantage in a crop rotation with tomatoes.

Of these alternative crops, zucchini was the clear loser with the lowest gross price per square foot (\$1.45/sq ft).

Cucumbers, ginger and basil averaged relatively close in their \$gross/sq ft, and green beans were less. Beans do have the advantage of being legumes and may help replenish some nitrogen to the soil, but they are also a host of a soil-borne disease called white mold or timber rot that is becoming a problem for some high tunnel tomato growers. If white mold is building up in a tomato planting, rotating to green beans would not be advisable in that tunnel.

There are many approaches and factors growers can take into account in scheduling their crops and rotations over the years. Based on the data from this study, a high tunnel grower might consider starting with a few years of tomato production for the greatest return, and then begin working in some rotations with cucumbers, ginger and/or basil depending on their market demand.

Peppers are another option but, because they are in the same family as tomatoes, they do not provide a break in the disease cycle as do the non-related crops we studied. Since none of these crops provides the same gross income as tomatoes, the grower needs to balance the loss of gross income with the benefits of interrupting disease cycles in the tunnel. There is no single answer for the best course to follow.

Other Conclusions Crop by Crop:

Cucumbers thrive when allowed to grow up a trellis and yield per square foot is optimized. Parthenocarpic and disease resistant varieties are ideal for tunnel production. Although our plantings continued to yield well into October, most growers find their first plantings cease production by mid August. Growers might consider two plantings, one in late May and a second in late June for an extending cropping season.

Training plants to a single leader did not take more time than the mesh trellis and with the increased yield and air circulation growers are advised to consider this option.

Ginger is a challenging crop to grow. It is a heavy feeder and needs warmth and a steady supply of water without being overwatered. Included in the appendix are tips from an experienced ginger grower. Ginger does not return as much per square foot as tomatoes but its uniqueness draws in customers at farmers markets and it can easily be frozen for winter sales, so it is worthy of consideration as part of a diversified cropping plan for high tunnels.

Basil can bring in a fair price per square foot, comparable to ginger and cucumbers. Basil is sensitive to cold and our results showed a very low yield from the late summer planting. Based on these results, it would be better to make multiple plantings a couple of

weeks apart, from late May through late June in order to have plants at peak production all summer long, rather than successive plantings.

Zucchini does not return enough to be worth the space it takes up in a tunnel. Growers would be better off to grow zucchini outdoors and use the tunnel space for more profitable crops. Growers who want early zucchini for fresh market sales would do better to cover a field planting with row cover for the first few weeks to give the plants a head start rather than take up valuable space in a high tunnel.

Green beans do not provide an impressive gross price return per square foot. Although they may not be feasible as a primary tunnel crop, because they have such a short season, green beans could be useful to fill a gap between other crops in a tunnel. And because it is possible to get two crops of beans in the same time it takes to grow one crop of cucumbers or basil, they can provide nearly the same gross return per square foot.

Outreach:

We held a field meeting on July 28 at the Willsboro Research Farm for 24 growers. Although we did not have yield results at that time growers were able to see the various crops in production and the rationale behind the plantings was discussed with the group. Cornell University NYS Vegetable Specialist Judson Reid led the discussion with the growers about the pros and cons of alternative crops to tomatoes for high tunnel production. We repeated this meeting with Judson Reid on July 29 at the CCE St. Lawrence County Extension Learning Farm in Canton for 25 growers.

Next steps:

Cucumbers planted in late May often decline by mid-August. It would be useful to see if multiple plantings would result in a greater gross price generated per square foot. For example, a May planted bed of cucumbers could be replaced in mid-August with a fall crop of lettuce or spinach, or a spring crop of greens could be followed by a late June planting of cucumbers for harvest through September.

Ginger is challenging to grow. We plan to grow it again in 2015 to see if we can increase the yields and fine-tune management of water and fertility.

Multiple plantings of basil, every 2 weeks through June, might yield more than a single planting. By planting greens before and after basil, it might be possible to increase the gross price generated per square foot over the course of the season.

The difference in planting times, days to harvest, and price per pound make it challenging to accurately compare the different crops. Future work could include collaborating with an economist to summarize yield and evaluate return potentials for the various crops.

Acknowledgments: NNYADP funding.

For More Information:

See project leaders section on page 1.

Appendix

Summary of Crops and Yields					
	# units	unit price	\$ Gross	\$ Gross/sq ft	comments
zucchini first planting	174 fruits	\$0.50	\$87.00	\$1.45	early crop
zucchini second planting	95 fruits	\$0.50	\$47.50	\$0.79	late crop
			\$134.50	\$2.24	2 crops/summer
beans first planting	25.74 lbs	\$3.50	\$90.09	\$1.50	early crop
beans second planting	48.27 lbs	\$3.50	\$168.96	\$2.82	late crop
			\$259.05	\$4.32	2 crops/summer
basil first planting	32.47 lbs	\$8.00	\$259.76	\$4.33	early crop
basil second planting	1.42 lbs	\$8.00	\$11.36	\$0.19	very late crop
cucumbers					May-mid Oct
trellised	1014 fruits	\$0.50	\$507.00	\$5.63	
single leader	1275 fruits	\$0.50	\$637.50	\$7.08	
ginger	10.86 lbs	\$16.00	\$173.76	\$5.79	May-Nov
Average tomato gross for comparison <i>(based on 15 lbs/plant, 3 lbs/sq ft, \$2.50/lb)</i>				\$7.50	May-early Oct

Total square footage of each treatment combined was 90 sq ft for each cucumber method, 60 sq ft for beans, zucchini and basil, and 30 sq ft for ginger. More detailed results are available upon request.