Cornell Cooperative Extension
Eastern NY Commercial Horticulture Program

Producing Sweet Potato Slips On-Farm from Certified Rootstocks and Effects of Slip Quality on Overall Marketable Yield and Quality

2021 Annual Report

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I. Background:

Sweet potatoes continue to gain popularity with growers not only in eastern NY, but also across the whole state. According to the 2007 US Census of Agriculture, there were 19 farms in NYS with only 7 acres in production. In 2012, the number of farms more than doubled to 46 farms (no acreage values were reported) and most recently the 2017 Ag Census, reported 129 farms producing sweet potatoes in NY. I can say conservatively from personal experience with sweet potato growers just in eastern NY, there are over 30 growers with at least 200 acres of sweet potatoes in production. Sweet potatoes offer growers that provide winter CSA shares or that participate in winter farmers' markets with an additional offering due to their ability to store for long periods of time without losing quality.

Sweet potatoes are not planted from seeds or transplants but by a "slip", which is nothing more than a cutting that is taken from a "mother plant". Nearly all the slips that are purchased by growers in NY are produced in North Carolina, with a few from an organic producer in Pennsylvania. Once slips are cut, the clock starts ticking to get them packaged, shipped and planted by NY growers. Once they are packed they immediately start to produce heat which then degrades the overall plant quality. In addition, slips also start to become "slimy" as leaves and stems start to breakdown. On average, it takes 3-5 days to have them shipped from North Carolina - add to that probably another day or two depending on weather, for growers to actually get them planted. If the weather does not cooperate (too cold or wet etc.), slips may be held for 10 days or more and the higher the breakdown rates. There is no data tracking the percentage of slips that are so deteriorated that they are either thrown out before planting or die right after planting; however, from my observations, I would estimate that level to be 25 – 30%.

Even though the cost of the slips is relatively inexpensive ($55 - $65 per 1000 plants), shipping is the major cost. One major slip supplier to the Northeast no longer ships slips anywhere in the United States and only offers local pickup. There is also one more reason why producing slips locally would be advantageous. In years when southern states or other major sweet potato production areas suffer from extreme weather events such as flooding during planting, these southern slip produces will cancel all orders that are not local growers. This leaves growers in NY and other minor states with no slips or drastically reduced overall slip orders. This has happened at least 2 times out of the last 5 years.

Furthermore, not just the overall quality of the slips when they arrive is important, but we feel that the overall size of the slips is as important. Yield potential of each slip is impacted by how many nodes the slip has when it is planted. The more nodes that a slip has, the more potential yield it has. In a bundle of purchased slips there

is a mix of many different stem lengths and diameters. As many as 20% of the slips can have less than 2 nodes per stem and be as short as 4" which is not only hard to plant, but we feel the survival of these slips is also questionable.

With financial support from the Hudson Valley Farm Hub (HVFH) in 2021, Cornell Cooperative Extension Eastern New York Commercial Horticulture (ENYCHP) regional vegetable specialists Charles Bornt, Ethan Grundberg and Teresa Rusinek set out on two different research projects to determine the following:

1.) Determine how long it takes to produce high quality sweet potato slips in local NY greenhouses from certified roots purchased from producers in North Carolina (Jones Family Farms, Bailey, NC)
2.) Evaluate the yield and quality of slips produced in local greenhouses based on square footage of greenhouse space used.
3.) Evaluate any differences in plant survival/health, overall marketable yield and quality of roots planted and taken to harvest in the field from slips grown locally to those slips purchased from Jones Family Farms, Bailey, NC.
4.) Determine the length of time for slip regrowth and quantity of slips harvested after first cutting.
5.) Determine if above second cutting results in acceptable overall root yield and quality compared to those first cut and southern purchased slips.
6.) Grade bundles of purchased slips into three categories (small, medium and large) and plant these graded slips to determine the impact of slip quality on overall plant survival, yield and root quality.

II. Methods

Trial Design 1: Sweet Potato Slip Production

On March 11, 2021, G1 certified sweet potato roots of the varieties Covington and Murasaki were purchased from Jones Family Farm in Baily, North Carolina and shipped via motor freight to the Hudson Valley Farm Hub(HVFH) in Hurley, NY. On April 8, 2021, these Covington and Murasaki roots were "bedded" in the greenhouse located at the HVFH (Figure 1). The bins were made of untreated lumber with the dimensions of 15" wide x 10' long and 5" tall. Wire mesh was attached to the bottom and a piece of landscape fabric placed on top of the wire. Before filling bins with 1" to 1.5" of Vermont Lite potting mix, 12" wide x 10' long RediHeat heat mats were then placed in the bottom of 4 bins (2 Covington and 2 Murasaki). The thermostat for the mats was set to 90^{O}F. Roots of the two varieties were then placed on top of the potting mix and covered with the

Figure 1: Sweet potato roots bedded and ready to cover (Covington on the left, Murasaki on the right).

same potting mix as used on the bottom. At the same time, one bin of each variety without heat mats was also planted. The number and weight of roots for each bin were counted and weighed.

On May 20, 2021, all plants that had emerged from the sweet potato roots were removed to encourage more shoot development and to even off the growth. On June 4, 2021, slips of Covington and Murasaki were cut from the respective bins (Figure 2), transported to the field and planted in raised ridges that were prepared by HVFH personnel. Due to a delay in the shipping of slips from Jones Farm, purchased slips were planted several days later on June 7, 2021. For this trial, there were six treatments in total (see Table 1). Plots consisted of 3 ridges, 20' long and all slips were planted 12" apart on the ridge in a randomized complete block design with three replicates. Plots were separated in row by a 3' buffer. On June 21, 2021, a second cutting (referred to in this trial as Covington – Late and Murasaki –Late) were cut from the production bins in the greenhouse at the HVFH and planted in the field the same as earlier treatments in the same configuration. All watering, cultivating, hand weeding and plant care was completed by HVFH staff.

Figure 2: View of sweet potato slip cutting, before and after (left) and slips ready to head to the field (right).

Table 1: Slip Production Treatments.

Variety	Slip Source	Field Planting Date
Covington	NY-Hudson Valley Farm Hub	June 4, 2021
Murasaki	NY-Hudson Valley Farm Hub	June 4, 2021
Covington	Jones Family Farm, Baily, NC	June 7, 2021
Murasaki	Jones Family Farm, Baily, NC	June 7, 2021
Covington - Late	NY-Hudson Valley Farm Hub	June 21, 2021
Murasaki-Late	NY-Hudson Valley Farm Hub	June 21, 2021

Data Collection: On June 4 (first planting) and 21 (second planting), 2021 the number of slips cut for each variety (Covington and Murasaki) before planting was recorded. On June 21, plant stands in the field were taken for the first planting. On July 30, 2021, plant stands were taken and recorded for the second planting. Plots were harvested on September 20, 2021 and placed in the packinghouse to be cured. After a week of curing,

roots were placed in the cooler with the rest of the HVFH sweet potatoes. Roots were graded on January 28, 2022.

Trial Design 2: Sweet Potato Slip Quality Trial

For this trial, there were 3 treatments for both Covington and Murasaki for a total of 6 treatments. On June 7, 2021, bundles of Covington and Murasaki slips purchased from Jones Family Farms, Bailey, NC, were graded into 3 categories as found in Table 2 and seen in Figure 3. Plots consisted of 3 ridges, 20' long and all slips were planted 12" apart on the ridge in a randomized complete block design with three replicates. Plots were separated by a 3' buffer. All watering, cultivating, hand weeding and plant care was completed by HVFH staff.

Figure 3: Comparison of the three slip size treatments: Large slips located the left, medium in the center and small on the far right.

Table 2: Slip Quality Treatments (Covington and Murasaki Varieties)

Size Category	Number of Nodes	Length of Stem
Small	2 - 3	3-5"
Medium	Between 3 – 4	6 -9"
Large	More than 5	Minimum of 10"

Data Collection: Plant stands were taken on June 21 and plots were harvested on September 20, 2021 and placed in the packinghouse to be cured. After a week of curing, roots were placed in the cooler with the rest of the HVFH sweet potatoes. Roots were graded on January 28, 2022.

III. Results

Local Slip Production vs. Purchased Slips:

Growth of the slips in general was slow. It took nearly 3 weeks for sprouts to emerge from the bins. The average number of slips that were cut from each treatment, the average number of slips per root bedded and the average number of slips that were cut per square foot of bin area can be found in Table 1. Due to the lack of heat mats, we decided to bed 2 bins each of Covington and Murasaki with heat mats. We also bedded 1 bin of each variety without heat as an observation to see what kind of impact supplemental bottom heat has on the production of slips. It was clear that including bottom heat improves the number of slips that are produced, but from visual observations, bins with supplemental heat also produced healthier and higher quality slips. However, issues with the heat mats working properly and maintaining the set temperature of 90^{O} F was very inconsistent. Upon removal of the heat mats from the bins at the conclusion of the trial, several of the mats had melted, exposing the internal components of the mats and potentially tripping the circuit breakers. This could explain why there was so much fluctuation in the heating of the bins consistently. Variety also played a role in the number of slips that were produced. Murasaki produced nearly twice as many slips as Covington.

Table 3 - The number of sweet potato slips produced by two different varieties with and without supplemental heat (Data is combined for two cuttings: June 4 and June 21, 2021).

Variety	Treatment	# of roots used at bedding	Weight of roots used at bedding (lbs)	Average number of slips cut per bin	Average number of slips cut per Root planted	Average number of slips per pound of root planted	Average # slips per square foot of bin space
Murasaki	**Unheated**	177	36.8	234	2.6	12.7	23.4
Murasaki	**Heated**	180	38.8	308	3.4	15.9	30.8
Covington	**Heated**	180	36.0	144	2.0	8.0	14.4
Covington	**Unheated**	170	35.1	122	1.4	6.9	12.2

In general, we had very good plant survival rates in all the different treatments as can be seen in Table 4. Part of this can be attributed to watering immediately after transplanting. There are no statistical differences in the number of plants that survived in each treatment.

Figure 4: Plants in the red box are from the first planting on June 4th while the plants in the blue box are from the late planting of June 21st. You will notice the 2nd planting has considerably less foliage compared to the 1st planting.

Table 4: Effect of variety, slip source and planting date on plant survival.

Variety	Slip Source	Planting Date	Average # of plants per plot
Murasaki	NY - HVFH	June 4, 2021	20
Covington	NY – HVFH	June 4, 2021	20
Covington	Jones Family Farm	June 4, 2021	19
Murasaki	Jones Family Farm	June 4, 2021	18
Late Murasaki	NY - HVFH	June 21, 2021	20
Late- Covington	NY - HVFH	June 21, 2021	19

We were disappointed in the overall yields and average root size (Table 5 and 6) from this trial, however, as can be seen in Table 5, there were differences albeit, not statistically different except for the late planting of slips. June 21st, at least in this particular trial was clearly too late to plant slips. There were no statistical total yield differences between purchased slips (Jones Farm) and slips produced locally (NY) except for Murasaki in which local slips produced statistically more roots compared to purchased slips.

Table 5 - Total marketable yield of sweet potato roots using NY grown or Southern sourced (Jones Farm, Bailey, NC) slips.

Treatment	# Fingerling Roots	Weight Fingerling (lbs)	# Small Roots	Weight small (lbs)	# Large Roots	Weight Large (lbs)
NY Murasaki	85	12.7	83	27.3	23	15.4
NY Covington	92	12.9	87	30.6	36	22.6
Jones Mursaki	47	5.9	24	6.9	11	5.9
Jones Covington	64	8.1	102	42.7	9	10.7
NY Late Murasaki	52	5.5	5	1.4	0	0
NY LATE- Covington	57	6.4	10	2.2	0	0

Fingerling: 1-4 ounces
Small: 4-10 ounces
Large: > 10 ounces

Table 6: Effect of sweet potato slip source and planting date on average root size.

Treatment	Average Fingerling Root Size (ounces)	Average Small Root Size (ounces)	Average Large Root Size (ounces)
NY Murasaki	**2.4**	**5.3**	**10.7**
NY Covington	**2.2**	**5.6**	**10.0**
Jones Murasaki	**2.0**	**4.6**	**10.0**
Jones Covington	**2.0**	**6.7**	**19.0**
NY Late Murasaki	**1.7**	**4.5**	**0**
NY LATE- Covington	**1.8**	**3.5**	**0**

Fingerling: 1-4 ounces
Small: 4-10 ounces
Large: > 10 ounces

Slip Size and Quality Trial:

Again, we were disappointed with the overall yield from this trial. Similarly to the slip source trial, these plants, with the exception of the 'Small' treatments, flourished throughout the season with full, lush canopy growth (Figure 5). Plant stands were excellent except for the small slips which resulted in about half of the plants that were planted surviving (Table 7).

Figure 5: The result of planting small slips. Note the lack of plant canopy due to poor plant stands.

Table 7 - Effects of variety and slip size on the average number of plants per plot.

Variety	Slip Size Treatment	Average # of plants per plot
Covington	**Large**	20
Covington	**Medium**	18
Covington	**Small**	11
Murasaki	**Large**	19
Murasaki	**Medium**	18
Murasaki	**Small**	7

The effects of slip size between large and medium slips had no impact on yield between these two treatments, but the lack of plants in the small treatments resulted in significant reduction in overall total yields.

Table 8 - The effects of slip size on total marketable yield and root size.

Variety	Slip Size Treatment	# Fingerling Roots	Weight Fingerling (lbs)	# Small Roots	Weight small (lbs)	# Large Roots	Weight Large (lbs)
Covington	**Large**	24	2.6	11	2.8	2.7	1.6
Covington	**Medium**	16	1.8	14	4.3	1.0	0.7
Covington	**Small**	11	1.2	6	1.9	0.3	0.1
Murasaki	**Large**	14	1.8	13	4.6	2.3	1.4
Murasaki	**Medium**	16	1.8	9	2.8	0	0
Murasaki	**Small**	2	0.1	1	0.5	0	0

Fingerling: 1-4 ounces
Small: 4-10 ounces
Large: >10 ounces

Table 9: The effects of slip size on average sweet potato root size.

Variety	Slip Size Treatment	Average Fingerling Root Size (ounces)	Average Small Root Size (ounces)	Average Large Root Size (ounces)
Covington	Large	1.8	4.2	10.0
Covington	Medium	1.8	4.8	10.1
Covington	Small	1.7	5.1	10.0
Murasaki	Large	2.1	5.8	10.0
Murasaki	Medium	1.9	4.8	0
Murasaki	Small	1.0	6.0	0

Fingerling: 1-4 ounces
Small: 4-10 ounces
Large: >10 ounces

IV. Discussion

Local Slip Production vs. Purchased Slips:

I feel that the best way to discuss this project is to go back to the questions that we were asking and try to answer them in regards to this project. First is the question of how long does it take to produce high quality sweet potato slips? All these sweet potato roots were bedded on March 11, 2021 in the greenhouse at the Hudson Valley Farm Hub. The first cutting of plants for the field occurred on June 4, 2021. It took 86 days from bedding to cutting slips for field planting. However, I feel that the issues we had with the heat mats and inconsistent bottom heat hampered the ability of these roots to produce roots in a quicker timeframe. It is critical, especially right after bedding, for root zone temperatures to be in the 80^{O}F range. It is difficult to determine, but I feel that if the heat mats were working properly, we might have been able to cut these slips a week or so earlier which would have gained us an additional week on the second cutting and planting date. For 2022, I will research out other heat mat alternatives and purchase a different brand to see if we can improve our ability to use bottom heat for slip production.

Second cutting: Since the temperatures in late May/early June usually warm up significantly in the greenhouse, I think the regrowth of the slips was very good and we were able to take the second cutting June 21, approximately 17 days after the first cutting. However, as the data shows, the yield of those plants planted on June 21 was significantly reduced compared to the earlier planting. Due to a shipping issue of the roots in March, we received them two weeks later than what I had initially planned. An earlier planting date in the greenhouse and better bottom heating may help push the first cutting and planting date by 10 days to two weeks. This would allow us to plant possibly the 3 week of May followed by a second cutting and planting two weeks earlier than the June 21 date in 2021. Again, this is dependent I think on the shipping availability of the roots, better bottom heating and of course appropriate field planting conditions in the spring.

Next, the yield of slips produced in the greenhouse again was I think a bit low. Some of this can be explained by the variety with Murasaki, a very aggressive and vegetative production anyway, producing nearly double the slips of Covington. For the same reasons stated above, I think with better, more stable and even bed heating, we can increase the number of slips being generated. We may also need to increase the number of overall roots that are placed in the bins. However, this is not something that we evaluated in this trial, only hypothesize that the more roots in the bin, the greater the potential for more slip production. The overall quality of the slips was excellent and even though the plant stands were not statistically different, visual differences in the first couple of weeks after field planting between slips that were grown locally, cut and planed the same day, were very noticeable compared to slips that were purchased from southern sources. The ability of those locally grown slips to take right off will be critical in the future of this projects success and is one of the advantages to using local slips.

We were hoping to see more of a difference in overall yields between locally grown and purchased slips, but there was no statistical difference in yields except between the early and late plantings. That said, a 20% increase in Covington yields and nearly a 50% increase in Murasaki yields cannot be ignored. Murasaki has been reported by several growers to be low yielding. If we can increase Murasaki yields by half again, it may make it more attractive for growers to grow or for those that are currently growing, more profitable by increasing yields and size of individual roots. There is a demand for Murasaki in certain ethic markets in NYC, but few growers are willing to grow it because of its low yielding potential. A 50% increase should be enough to make it

worthwhile for growers to produce their own slips, especially if they could use those roots that are harvested but too small to sell, for seed stock the following spring. Although not normally recommended, I think because of the lack of pests here in eastern NY, growers could save a certain percentage of their own roots for replanting the next spring. However, I would suggest that not more than half of the planting be from saved roots and that the remaining half be purchased from seed stock sources.

Slip Size and Quality Trial:

From this trial it was clear to see that planting any slips that fall into our 'Small' category(2-3 nodes or less than 5" in height) are just not worth planting in the field due to the fact that most of them will not survive. In our trial, less than half of these slips survived and those that did survive, did not yield or produce quality roots. The decreased survival rate also increases the weed pressure that may occur because there is no or limited vine cover there to compete and shade these weeds. This can increase labor costs for weeding and harvesting. There is no way of knowing how many of these types of slips may be put into a bundle. Prior data shows that upwards of 20-30 percent of a bundle may contain slips that fall in the small category. Even if half of these survive, overall yield can still be impacted. However, one solution a grower could use is to take these 'Small' slips and plant them in a transplant flat (something like a 72 or 50 count tray) and allow them to grow in the greenhouse for a week to 10 days (Figure 6). Once bigger, they could be taken to the field and used as replants for field plants that might not have survived post plant. However, I would not plant these as you would a transplant but rather cut them just like we did with the locally grown slips in our beds. These plants can become quickly root bound in the small cells and when this happens, they will not grow properly and you can end up with a large gnarly root mass that is unmarketable (Figure 7). It's still a way to maximize what is purchased from southern sources and a useful way to fill in any gaps that may occur in the planting.

Along the same thought, you could also do this for those plants that are cut early in the bedding process to even up and encourage more sprouts to emerge. I can vision these cutting being placed into trays and could then be cut probably around the same time as the first field cutting is happening, adding to the overall number of plants that could be planted and reducing waste.

Figure 6: Slips freshly cut on May 20, 2021 from evening up the beds, that were planted into the 72 cell count tray on the left. On the right are what those slips looked like on June 4, 2021 at the time of the first cutting for field planting.

Figure 7: This is what happens when you try to grow a sweet potato from a "transplant". The result can be a mass of unmarketable roots and loss of overall yield and quality. (Photo courtesy of Chuck Bornt from 2011 Sweet Potato Trials conducted at Samascott Orchards in Kinderhook, NY.