



**Evaluation of Integrated Planting  
Systems for Growing Sweet Potato  
(*Ipomoea batatas*) in Newfoundland**

**2013 Project Report**



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## **ACKNOWLEDGEMENTS**

**Special thanks are extended to the following:**

**Chris Lester, Lester's Farm**

**Dr. Viliam Zvalo, AgraPoint International Inc.**

**Dr. Loretta Mikitzel, NB Department of Agriculture, Aquaculture & Fisheries**

**Charles Keddy, C.O. Keddy Nursery Inc.**

**Peter Murphy, Agriculture and Agri-Food Canada**

Producers Participating in the Project:

**G. and E. Wells**

**P. and S. Lomond**

**M. Rideout**

**K. Fudge**

**D. and C. Oram**

**N. Abbott**

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## **EXECUTIVE SUMMARY**

Vegetable producers in this province are beginning to expand their operations and are looking to grow a variety of non-traditional crops. The use of plastic mulch; floating row covers; tunnel houses; and irrigation systems have allowed producers to diversify and tap into new markets by allowing them to capture the health-conscious consumer looking for a variety of fresh vegetables in their daily diet.

Statistics Canada data show that consumption of sweet potato has increased by three times in recent years. They are being grown commercially in Ontario and Quebec, while smaller acreages have been grown in the Maritime Provinces in recent years. Innovative, integrated planting systems including the components of raised beds, mulch, drip irrigation and fertigation systems can be efficient for modification of microclimate for growing high-value, warm-weather sweet potato in temperate Atlantic Canada.

During the 2013 season, an evaluation of an integrated planting system and its effects in modifying a microclimate for growing sweet potato was carried out on three farms throughout western and central Newfoundland. Monitoring of growth rates; time to maturity; and total yield was completed in this final year of a three year project, which will ultimately assist individual producers in making informed decisions as to whether this is a viable new product for their operations.

## INTRODUCTION

An ample supply of vegetables was necessary for survival in the early days of settlement, making vegetable production the oldest form of agricultural activity carried out in this province. Today, traditional root crops, including potatoes; cabbage; carrot; rutabagas; and beets still represent the majority of vegetables grown in Newfoundland and Labrador, as these are well suited to our soil and climate conditions.

Vegetable producers in this province are beginning to expand their operations and are looking to grow a variety of non-traditional crops. The use of plastic mulch; floating row covers; tunnel houses; and irrigation systems have allowed producers to diversify and tap into new markets by allowing them to capture the health-conscious consumer looking for a variety of fresh vegetables in their daily diet. In addition to the traditional five crops mentioned above, producers have started growing smaller acreages of green and waxed beans; broccoli; cauliflower; lettuce; parsnips; green peas; pumpkins; squash and zucchinis; and sweet corn. Many of these crops are considered “high-value crops”, providing a good return on investment.

Statistics Canada data show that consumption of sweet potato has increased by three times in recent years. Sweet potatoes are an excellent source of vitamin A (in the form of beta-carotene) and a very good source of vitamin C, giving them healing properties as an antioxidant food. They are also very high in dietary fiber and complex carbohydrates, making them beneficial to diabetics who require stabilized blood sugar levels.

In Canada, sweet potato is grown commercially in Ontario and Quebec, while smaller acreages have been grown in the Maritime Provinces in recent years. They belong to the Morning Glory plant family (Convolvulaceae) and therefore have no relation to the potato at all. Almost all aspects of sweet potato production, harvest, handling and storage are different from those of potatoes, and so the two crops must not be confused or treated similarly.

Sweet potato is a sub-tropical, long season crop requiring 90-110 days to reach full maturity. The most popular orange flesh variety is Beauregard, which matures in 90-95 days under Maritime conditions. The quick maturity time combined with the extreme high yielding potential and minimal cracking make Beauregard a good choice for Northern gardeners.

“Covington” is a newer orange-fleshed variety developed out of North Carolina State University and is believed to be the improved Beauregard. It produces yields comparable to Beauregard, but 5-10 days later in maturity. The difference with this cultivar is that Covington typically sizes its roots more evenly as compared to Beauregard, resulting in fewer jumbo class roots and a higher percentage of number one roots. It has shown resistance to fusarium wilt and southern root-knot nematode, and moderate resistances to streptomyces soil rot.

Sweet potatoes are sown by vine cuttings once all threats of frost have past. They grow better in well-drained, slightly acidic soils (recommended pH of 5.0-6.5) and require high heat units; with optimal temperatures ranging between 20-30°C, abundant sunshine and warm nights. Long days promote vine growth while shortening days influence root development. They are not heavy feeders and care must be taken not to over-fertilize, especially with nitrogen, as it will promote vine growth at the expense of the roots.

While they are generally drought-tolerant, irrigation is essential during prolonged periods without rainfall. Soil type will dictate the frequency of watering; with lighter soils requiring more frequent light irrigations. Without adequate moisture, root development may be compromised and cracking may occur in some varieties. Water should be applied uniformly and care must be taken not to overwater during the last three to four weeks before harvest, as it may affect storage quality of the roots.

The harvest must be done before the first killing frost to avoid chilling injury. While it is believed that roots can double their weight every two weeks, they will not grow much in soil temperatures below 18°C and soil temperatures below 10°C can harm the tubers. Depending on the length of exposure to lower soil temperatures, symptoms may include surface pitting, loss of dry matter, internal breakdown, discoloration or changes to the texture and taste of the root.

US #1 marketable roots are greater than 3 inches but shorter than 9 inches long with a minimum diameter of 1 ¾ inches to a maximum diameter of 3 ½ inches. These roots can be up to a maximum of 20 ounces in weight. There is also a market for the smaller roots or “petites”. US #1 Petit can measure as low as 1 ½ inches in diameter up to 2 ¼ inches with a length of 3 to 7 inches.

Smaller acreages for fresh market can be hand-harvested and cured for 5-10 days by maintaining the temperature of 25-28°C with a relative humidity of 85-95%. Curing is required to allow the starches which accumulate in the developing roots during the growing season convert to sugars. Once cured, roots can be stored at 12-14°C for several months.

Work in Nova Scotia has shown that integrated planting systems including raised beds, mulch, drip irrigation and fertigation systems can be efficient in the modification of microclimates for growing high-value, warm-weather sweet potato in temperate Atlantic Canada. In terms of sweet potato production, their trials have shown that raised beds offer improved drainage and earlier soil warming. Mulch absorbs heat and this absorption warms the soil earlier in the spring and later into the fall. It also helps to conserve moisture and reduce weed growth. Drip irrigation helps the slips to root after transplanting and can also increase the plant water use and therefore reduce leaching. Fertigation can improve plant nutrient use to further enhance sweet potato production.

## PROJECT PROCEDURE

Sweet potato is a new crop to this province. When designing the trial, it was decided that it would be beneficial to begin with small plots with producer partners having their own farm markets. Sweet potato would be a great high-value addition to their market and assist in bringing public awareness back to the farm. By offering their customers a variety of locally grown fresh produce, farmers can certainly increase their overall farm market sales.

An Expression of Interest was posted province-wide in February 2011 and five sites were originally selected to participate in the trial: Riverbrook Farm located in St. Fintan's; Wells' Farm in Robinsons; Lomond Farms in Pasadena; Mountain View Farm in Wooddale; and LA Farms located in Gambo. Neither Riverbrook Farm nor Mountain View Farm participated in the 2012 trial and the Wooddale site was moved to Mark's Market for a total of four sites for 2012.

Only three farms participated in 2013; Rideout's Farm in Cormack, Mark's Market in Wooddale, and LA Farms in Gambo. Also, as clear plastic is believed to be more effective in raising soil temperature, both clear and black plastic was used on two of the three sites for the 2013 season. Total required materials including drip irrigation kits; plastic mulch; and low tunnels were determined, sourced, and purchased during the winter months.

1000 "Covington" sweet potato slips were harvested in North Carolina and arrived in Newfoundland on June 11<sup>th</sup>. Plants were divided and planted into four inch pots and kept in the greenhouse at the Cormack site. Supplies and potted plants were delivered to each site with producers being responsible for plant storage, field preparations, and planting.

The first planting was done in Wooddale on June 26<sup>th</sup>. As with all sites, the area to be planted was fertilized, drip irrigation was installed and black plastic mulch was laid. Plants were set in a double row, with the rows 30 inches apart and the plants set 16 inches apart in the row. Plants were set in single rows at all other sites, with a plant spacing of 16 inches. Two-thirds of the plant was placed underground with one-third left out. All planted sites (excluding Gambo) also placed low tunnels over the beds immediately following planting. Frost protection of 2 to 4°F is afforded by the covers, but the biggest benefit is growth enhancement provided by the daily increments of solar heating.

Site visits were conducted throughout the season to monitor growth rates and record observations. Hand harvesting began on October 7<sup>th</sup> and finished on October 11<sup>th</sup>. Total yields were recorded and any pest/physiological problems were noted.

## RESULTS AND DISCUSSION

Sweet potatoes are planted as vine cuttings or slips; generally the slips would be about 20-25 cm long with 5-7 nodes and without a root system. The slips received out of North Carolina were of excellent quality, as shown in Figure 1.

**Figure 1: Sweet potato plants upon arrival to NL.**



During the first two years of the trial, plants were divided and spread into trays with moist cloths and then stored at 10-12°C upon arrival to the province. This would keep the slips from drying out and help rooting structures to form. What was observed during the 2011 and 2012 seasons was once transplanted into the field; the plants actually lost their leaves and dropped back to the soil level. However they did later rebound from lower nodes. Once the plants did root, it was noted that as the newer leaves were coming out, they had reddish color to them that resembled a nutrient-related problem. However, once the newer leaves fully expanded, the healthy green color replaced the red.

In 2013, the slips were planted into four inch pots with ProMix being used as potting soil. This was done, as the producer in Gambo had done this with success in previous years to help preserve the plants until the conditions were suitable for field planting. It was noted that as with field planting, the slips would lose their leaves once potted and would restart again.

Once the plants are established, there is no maintenance. Providing good weed control is obtained before planting, the black plastic mulch is effective in providing weed control throughout the growing season. As Newfoundland is outside the natural range for the insect pests that normally plague this crop, no insecticides are required.

Sweet potatoes are very sensitive to environment and do not produce well in cold climate conditions. To grow well, the crop requires abundant sunshine and warm nights; they will not grow much in soil temperatures below 18°C. 2011 marked the first season and it started with wet and cold conditions that continued throughout the growing season. The summer of 2012 was a complete opposite of 2011, as hot and dry weather conditions



persisted throughout the season for most of the province. The spring of 2013 was a little cold and wet however, the summer months did not experience the extremes of 2011 or 2012.

Planting was completed in Wooddale on June 26<sup>th</sup>; by July 3<sup>rd</sup> the slips were still looking badly, however some plants were forming new leaves. The producer had stated that two or three days had passed between planting and the low tunnel being placed over the plants. During those days, the weather had been very cold and wet. During the July 3<sup>rd</sup> visit, it was noted that the weeds present under the clear plastic were turning white, as if they were burning off. Misses were noted throughout the plot as some plants died off after transplanting. No major issues were noted in the plot, other than the presence of weeds, namely lamb's quarters and shepherd's purse.

Roots were harvested on October 7, 2013 with the use of a vegetable lifter. The digger proved to be effective, as it allowed the producer to harvest the plot in much less time without compromising the quality of the sweet potato roots. Under the clear plastic, a total of 68 roots were harvested; with 13 roots being of market size, 7 petites and 48 small, unmarketable roots. The weights were 5 lbs, 1 lbs, and 4.5 lbs, respectively. The yield under the black plastic was better, with 31 market sized roots, 48 petites and 174 small, unmarketable roots. The weights were 13 lbs, 11 lbs and 17 lbs, respectively.

**Figure 2: Sweet potato roots produced in Wooddale, October 7<sup>th</sup>, 2013.**



Planting was completed in Cormack on July 3<sup>rd</sup>. During a plot visit on July 10<sup>th</sup>, it was noted that some plants were starting to produce new leaves. It appeared that the plants under the clear plastic were doing better than those under the black mulch, as the clear plastic appeared to have moisture underneath. Weeds were not an issue at that time. However, by August 20<sup>th</sup> the plot was not looking healthy, as the low tunnel had suffered wind damage and many of the plants had died off. The tunnel was not repaired and by September 4<sup>th</sup>, it was noted that the vines were not growing in and the plants were still small. Upon talking with farm staff, it was also noted that while the drip irrigation tape

was installed in the plot prior to planting, the producer had not provided a water source to the plot. Water is essential, as root development can be compromised without adequate moisture.

**Figure 3: Sweet potato plot located in Cormack NL, July 10<sup>th</sup>.**



Unfortunately, the plants did not fully mature by the end of the season and therefore, no yields were obtained out of Cormack in 2013.

The final plot was planted in Gambo in late July. The producer had decided to leave the plants in the greenhouse in an attempt to help them establish. Upon a visit to the greenhouse on July 18<sup>th</sup>, it was noted that the surviving plants were establishing quite well.

**Figure 4: Sweet potato plants located in greenhouse, July 18<sup>th</sup>.**



By mid-August, the vines were starting to spread in the field and the plot was looking very healthy, with minimal small weeds present. The low tunnel had not yet been placed over the rows, as the producer felt that ambient temperatures were adequate for plant growth.

**Figure 4: Plot located in Gambo, August 13<sup>th</sup>.**



Row covers were placed over the plot by September 12<sup>th</sup> and had remained in the field until harvest on October 7<sup>th</sup>. No marketable roots were harvested out Gambo in 2013; while the plants did set roots and achieved adequate length; they did not bulk to marketable size.

2013 marked the third year of sweet potato trials in Newfoundland. The 2011 growing season was less than ideal in terms of growing conditions for this subtropical crop. A lot of vegetable crops were delayed and some areas experienced reduced yields, especially in those crops that require higher heat units to grow well. The 2012 growing season turned out to be the complete opposite of 2011. Heat-loving crops such as corn and pumpkins thrived and producers had some of the best yields ever experienced on their farms. Environment Canada had reported ambient temperatures in the low – to mid-twenties all through the second half of June and also considerably dry conditions near all four sites. The temperatures remained consistently hot and dry near the sites throughout July and August. Nighttime temperatures remained warmer as well, providing favorable conditions for root development and growth. While the daytime temperatures remained warm throughout September, the nighttime temperatures started to decline. But overall, ambient temperatures were favorable throughout the season.

While the weather extremes of 2011 or 2012 were not experienced this past season, it was believed that the conditions would have been adequate to produce marketable roots. Wooddale was the only site that had produced any roots of adequate size, however the yield was low. This is consistent with 2012, which was the first year for the trial at that particular location. There have been issues at this site with plant establishment and it is believed that may be the main contributing factor to the low yields. The Gambo site has

had success in producing market-sized roots in previous years. While the producer did have good plant establishment, it is believed that planting was completed too late to obtain maturity this past season. Furthermore, it is questionable whether or not ambient temperatures were adequate for optimal growth.

This was the first year for Cormack's participation in this trial. The producer partner was not successful in establishing the plants in the field. The fact that the plants did not receive water following transplanting would be the main factor in the failure of this plot.

## CONCLUSIONS

Vegetable producers in this province are beginning to expand their operations and are looking to grow a variety of non-traditional crops. The use of plastic mulch; floating row covers; tunnel houses; and irrigation systems have allowed producers to diversify into what are considered "high-value crops", that provide a good return on investment.

The sweet potato trial in Newfoundland was initiated in 2011 with four producer partners across Newfoundland participating: Elaine and Glenn Wells in Robinsons; Paul and Shirley Lomond in Pasadena; Kent Fudge in Wooddale; and Ken and Nita Abbott in Gambo. Despite the cool, wet conditions of the 2011 growing season, the Robinsons site had success in establishing and growing sweet potatoes with the use of an integrated planting system consisting of drip irrigation, black plastic mulch and low tunnels. Given the poor growing conditions in 2011, the farmers at the Pasadena and Gambo sites decided to do things a little differently in the 2012 season to try and achieve better success in getting the slips to establish. During the first year of the trial, slips were placed directly into the field without any roots. While this can be done with success in areas of the Annapolis Valley (Keddy, C., Personal Communication), the wet, cold soil conditions experienced in Newfoundland in 2011 were not ideal when trying to get the slips to root.

Going into the second season, the producer partners in Pasadena and Gambo decided to start their plants in the greenhouse to enhance root development. Slips were placed in four-inch pots or in large plastic trays in the greenhouse and watered routinely and this allowed the plants to begin to root before being planted into the field. It was noted early in the season that both sites had achieved good success in getting the plants established and very few slips were lost. Also the low tunnel was not placed over the plots directly following planting at these two sites, as the producers felt ambient day and nighttime temperatures were sufficient for crop development. The Robinsons site had experienced lower yields in 2012, as there was higher weed pressure and it is believed that the sweet potato plants were outcompeted. Overall 2012 had better yields as compared to the first season, however Newfoundland and Labrador did experience another anomaly summer; one that was the complete opposite of 2011

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**Figure 5: Sweet potato roots produced in Gambo, NL, 2012.**

With year two of a three- to five-year project completed, the emphasis was to try and focus on fine tuning this system for 2013 to try and achieve higher yields in what is considered a “normal” Newfoundland growing season. In terms of variety, Covington appears to be an attractive cultivar that has potential to perform well in Newfoundland. The biggest challenge is creating the required microclimate to achieve greater yield. 2012 has shown that if plant survival is achieved, overall yield potential will be higher. 2013’s research proposal included a greenhouse component, as protocols for starting plants in the greenhouse to allow rooting before transplanting them to the field were determined. Once established, sweet potatoes grow well with soil temperatures of 18°C and above, and so increasing soil temperature was thought to be another avenue to explore. Black plastic had been used the first two years of this trial. For black plastic mulch to properly increase soil temperature, it is a must that the soil surface is smooth and that the plastic actually adhere to the soil surface. With many Newfoundland soils being rocky, smooth soil surfaces may be difficult to achieve. Getting the mulch laid properly is generally accomplished with a mulch laying attachment designed for this purpose; such equipment has not been used at all sites and should be considered. Clear plastics have been shown to be more effective in increasing soil temperatures as compared to the black; however, it does not offer the benefit of weed control. The first two seasons have shown that weeds can still be an issue with the use of black plastic. 2013’s research proposal attempted to look at the use of clear plastic mulch as opposed to the black plastic previously used. Given the fact that no substantial yields were obtained, it was undetermined which plastic is best for sweet potato production in Newfoundland.

2013 marked the third and final year for the sweet potato trial. While there is potential for the crop, it does require a lot of work to establish the plants and achieve any substantial yield. Past producer partners have questioned whether it was economical for their operations considering the inputs that are necessary. While it may never reach commercial production in Newfoundland and Labrador, some producers may still be interested in trying to grow them on a smaller scale. This trial has at least provided some

general information to help get producers started and possibly build on their knowledge, and maybe even their bottom line.

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