Glenwood Seed Potato Farm & Nuclear Seed Potato Propagation Facility

2013 - 2014 Final Report

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EXECUTIVE SUMMARY

Glenwood Seed Potato Farm

Having a seed potato certification system is crucial for the control of quarantine and non-quarantine pests and essential for the control of all potato diseases, resulting in the production of high yield, high quality potatoes. The operation of the Glenwood Seed Potato Farm is essential and plays a key role in the NL Seed Potato Certification system. The farm was initiated in 1973 to supply local growers with clean, disease-free seed as a first step to expand the potato industry in Newfoundland and Labrador. The Province currently grows nine varieties of potatoes at this farm to supply seed producers throughout the province. Production is market responsive and the evaluation of new seed varieties not previously used in this province is crucial to the development and growth of both the seed potato sector and the continued commercialization of table potato production. The research initiative at the Glenwood Seed Potato Farm for the 2013 growing season was to evaluate the horticultural performance of the potato variety “Innovator” and also to assess the effectiveness of tillage radish for providing weed control and improving potato yields at the Glenwood Seed Potato Farm.

Newfoundland and Labrador Nuclear Seed Potato Propagation Facility (NSPPF)

A major component of the provincial seed potato certification system is the ability to obtain Canadian Food Inspection Agency (CFIA) certified nuclear tubers for planting at the Glenwood Seed Potato Farm. On April 17, 2012 the Canadian Government announced the closure of the CFIA Plant Health Facility in St. John’s. This decision resulted in the loss of an in-province source for nuclear seed stock which impacts the entire seed potato industry in Newfoundland and Labrador. In an effort to fill the void left in the certification system by the withdrawal of the federal government, the Forest Ecology Centre (FEC) in Mount Pearl was transferred to the Agrifoods Development Branch of the Forestry and Agrifoods Agency. Agrifoods Development Branch then formally established the Newfoundland and Labrador Nuclear Seed Potato Propagation Facility (NSPPF) as the site for the production of nuclear seed potato stock for the Provincial Seed Potato Program. The research initiative at the Newfoundland and Labrador Nuclear Seed Potato Propagation Facility for the 2013 growing season was to produce nuclear class tubers of all established Newfoundland potato varieties to be utilized at the Glenwood Seed Potato Farm and to assess the accelerated release variety AR-2010-12 for future implementation in the provincial seed potato program.
BACKGROUND AND INTRODUCTION

Glenwood Seed Potato Farm

Having a seed potato certification system is crucial for the control of quarantine and non-quarantine pests and essential for the control of all potato diseases, resulting in the production of high yield, high quality potatoes. Potato wart and potato cyst nematode are two serious pests found in Newfoundland and Labrador and both are subject to control by the Canadian Food Inspection Agency (CFIA) through Quarantine Enforcement and Integrated Pest Management. Both the CFIA and Agriculture and Agri-Food Canada (AAFC) have placed high priority on the continuation the Seed Potato Program in NL and in turn, have helped reduce the incidence of potato wart disease in this province; increase potato yields; and improve product quality.

The operation of the Glenwood Seed Potato Farm is essential and plays a key role in the NL Seed Potato Certification system. Certified seed production is a technical, demanding and complex system, especially for the productions of initial disease-free crops from which all other seed crops derive. Strict plant health requirements, including the absence of quarantine pests in the area of production, must be met to produce the initial seed classes.

The Farm was initiated in 1973 in response to limited table stock supply from local farmers. The operation was to serve a dual purpose: supply growers with clean, disease-free seed stock while expanding the potato industry. After 30 years of seed potato production, a review was needed as there were problems with production. The crop was described as poor, with excessive levels of phoma rot and scab. After the review in 2004, it was determined that due to the high clay content of the soil, drainage was poor throughout the farm; the soil was very rocky, resulting in bruised tubers and damaged equipment; and the soil pH was very low. To alleviate these issues, perimeter ditching and tile drainage were completed on existing fields; rock picking was done periodically; and 100 tons of limestone was purchased and spread in 2006.

It was also acknowledged that in order to maintain a sustainable level of production, the clearing of additional land was required for a proper crop rotation. Crop rotation systems which include cereals and forages will maintain higher levels of soil organic matter than continuous potatoes. Potatoes produce little plant residue and therefore do not contribute a significant amount of organic matter to the soil. Furthermore, the little residue that is produced provides very little hummus, which is considered the stable portion of organic matter. Continuous potato production further reduces soil productivity as the use of heavy equipment compacts the soil; inhibiting root penetration and negatively impacting soil aeration, soil moisture levels and temperature regimes.

To aid both soil fertility and structure at the Glenwood Seed Potato Farm, green manure cover crops were added to the crop rotation in 2006. Currently, the Farm has approximately 85 acres of cultivated land; approximately 44 acres of this total acreage was planted in certified oats for the 2011 growing season. Oats are considered to be a spring cereal and are commonly used as inexpensive catch crop after potato harvest. Barley and wheat can also be used; however barley may not be the best choice, as past research has shown that it may increase scab levels in the potato crop that follows it. Oats are typically planted in the spring and incorporated into the soil the following spring. The use of cover crops following potato harvest has not been evaluated at
Tillage radish (Raphanus sativus var. niger), also known as forage radish, is an annual fall/winter cover crop that is relatively new to Atlantic Canada (Weil et al. no date). It can alleviate soil compaction (Williams and Weil 2004), decrease weed numbers in corn, and as a result lead to increased yields (Weil et al. no date). The roots of forage radish can penetrate the plow pan layer of compacted soil; the taproot can grow 12 to 20 inches long (Weil et al. no date) creating vertical holes in the soil thereby reducing soil compaction and improving tillage (Williams and Weil 2004). Chen and Weil (2006) discovered that when forage radish was planted as a winter cover crop after corn harvest, four times as many corn roots penetrated compacted soil compared to soil left as winter fallow (Weil et al. no date).

Tillage radish has also been shown to provide weed control up until early April in Maryland (Weil et al. no date). Where herbicides were not applied prior to planting and forage radish was used as a cover crop, corn yields were not negatively affected (Weil et al. no date). Williams and Weil (2004) found that using tillage radish as a cover crop has a significant effect on soybean yields in comparison to the traditional rye cover crop. Another benefit of using forage radish as a cover crop, is that it leaves the soil surface punctured by holes with minute amounts of plant residue (Weil et al. no date). This allows the soil to warm up and dry faster during the spring, enabling an earlier planting date. Tillage radish can also reduce nitrate leaching due to its deep root system (Weil and Kreman 2007; Weil et al. no date); after spring-seeded crops are finished with nitrogen uptake, excess nitrogen is free to leach into groundwater and surrounding waterways. The deep root system and rapid growth of forage radish has shown to adsorb nitrogen in the soil (Dean and Weil 2009), which prevents leaching.

2012 marked the first tillage radish trial conducted in NL within potato production systems. Tillage radish field trials have been used in PEI within potato production as a cover crop and success has been observed (Roper, Personal Communication 2011). It was unknown if tillage radish would establish in NL, provide weed control, or affect yields, but was thought very likely as it has been successful in PEI. The first component of this project was to assess the effectiveness of tillage radish for providing weed control and improving potato yields at the Glenwood Seed Potato Farm.

The Farm typically grows nine traditional varieties of potatoes and supplies seed producers throughout the province. The reduced incidence of potato pests has significantly contributed to the development of Newfoundland and Labrador’s potato industry, as producers have experienced higher yields and quality, making locally grown potatoes more marketable. Production is market responsive and the evaluation of new seed varieties not previously used in this province is crucial to the development and growth of both the seed potato sector and the continued commercialization of table potato production. The Department of Natural Resources, along with the growers, have a responsibility to seriously evaluate the production merit of these new varieties prior to inclusion into the program and ensure as much as possible that they do not negatively impact agricultural production now and for the future.

“Innovator” is an early to mid-season potato variety that is characterized as being high yielding and uniform in grading. It was developed mainly for the fresh market, but is also suitable for

Agricultural Research Initiative - Department of Natural Resources
Potato growers in the province have requested that we evaluate and produce new early potato varieties. The Farm currently supplies Mirton Pearl as its earliest variety. While it is uniform in growth and yields well, the deep eye set seems to be a deterrent in the market. In response to this request from industry, the second component of this project was to evaluate the horticultural performance of “Innovator” at the Glenwood Seed Potato Farm.

**Newfoundland and Labrador Nuclear Seed Potato Propagation Facility (NSPPF)**

The production of nuclear seed potato stock is critical to the ongoing support and growth of the potato industry in this province. The seed potato producers and their clients rely heavily on the seed potato program provided by the Government of Newfoundland and Labrador. Now that the responsibility has fallen upon the province to ensure that the potato industry maintains the ability to produce nuclear seed stock, the province has established a nuclear seed potato propagation facility in St. John’s. The ongoing production of traditional Newfoundland specific varieties as well as the evaluation of new varieties is crucial to the overall success of the potato industry in this province.

After the closure of the CFIA plant health lab in St. John’s the Agrifoods Development branch stepped in and established the NSPPF at the former Forest Ecology Center on Brookfield Road in St. John’s. The facility itself was originally constructed in 1963 as an experimental facility with the permanent structures built in 1977 with an upgrade and expansion taking place in 1988. At the time occupation was transferred to the Agrifoods branch the facility consisted of two greenhouses with approximately 3000 square feet each, a header house/garage, three offices, a full kitchen area and boardroom.

The purpose in establishing a provincial source of nuclear seed potato was two-fold. The single and most important reason was that the Newfoundland potato industry deals with a number of problematic growing conditions, pests and viruses which all negatively impact harvest yields. In response, a number of cultivars have been developed through breeding programs at Agri-foods and Agriculture Canada and elsewhere which are unique to our province. These cultivars have been used with great success by producers and their customers in Newfoundland for a number of years. Unfortunately, there is no central repository in Newfoundland where this genetic material is maintained. Currently it is only available at the Agriculture Canada laboratory in Fredericton, New Brunswick and this lab was scheduled to be closed due to a lack of funding as of January 2014. If this were to occur, the nuclear source of this genetic material for the Newfoundland specific varieties would be lost. With the construction of a new tissue culture lab at the NSPPF the government of Newfoundland and Labrador has guaranteed that the potato industry of Newfoundland will be able to continue to use well suited, well known Newfoundland potato varieties for years to come.
The second major purpose in establishing the NSPPF is food security. A major concern after the exposure of the Glenwood Seed Potato Farm to pink rot bacteria from a load of imported seed is the issue of possible importation of viruses and pests that have not previously existed in Newfoundland. Historically, there was not enough nuclear stock produced by the CFIA at the St. John’s facility to satisfy the demand at Glenwood and there will only be a need for more seed potato as new land is cleared and new fields established in Glenwood. By establishing a production facility where nuclear stock can be produced in large quantities, the need to source nuclear stock or lower from outside Newfoundland is eliminated for both Glenwood and the individual producers. This benefits the province in multiple ways. It ensures biosecurity by minimizing the possibility of harmful pests or viruses on imported material. It creates a closed loop in commercial seed potato production allowing for a higher level of traceability should an issue of biosecurity violation occur and also develops a stronger relationship between government and seed producers as it gives them a source where they can request new varieties that we can bring in and produce in large quantities that will be CFIA certified disease and pest free and provided at a cheaper cost to them than purchasing it themselves from alternate sources.

PROJECT PROCEDURE

Glenwood Seed Potato Farm

The Glenwood Seed Potato Farm followed Provincial Best Management Practices in their land preparation for the 2013 growing season and all fields were fertilized in accordance with Provincial Soil and Feed Lab recommendations. New seed was sourced and purchased for 2013 due to an outbreak of pink rot in storage during the fall of 2012. Unfortunately, seed for many of the traditional varieties could not be sourced, as these varieties are not being grown anywhere else in Canada. As a result, three new varieties were added to the program. A total of 30,750 lbs of seed potatoes comprised of six varieties of varying classes were planted into prepared fields as part of Newfoundland and Labrador’s Seed Potato program. These varieties and classes along with the amounts planted are summarized in Table 1.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Class at Planting</th>
<th>Amount Planted (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goldrush</td>
<td>EliteII</td>
<td>22,500</td>
</tr>
<tr>
<td>AC Chaleur</td>
<td>Elite II</td>
<td>1,500</td>
</tr>
<tr>
<td>Eva</td>
<td>Elite II</td>
<td>1,500</td>
</tr>
<tr>
<td>Exploits</td>
<td>Elite II</td>
<td>3,000</td>
</tr>
<tr>
<td>Chieftan</td>
<td>Elite I</td>
<td>1,125</td>
</tr>
<tr>
<td>Yukon Gold</td>
<td>Elite I</td>
<td>1,125</td>
</tr>
</tbody>
</table>

In addition to these classes found in Table 1, nuclear seed potato of the varieties AC Blue Pride, AC Red Island, Atlantic, Frontier Russet, Glenwood Red, Goldrush, Exploits, and Mirton Pearl were obtained from the Canadian Food Inspection Agency’s Plant Health Laboratory and planted as smaller plots. As part of Glenwood’s 2013 research initiative, 4,800 lbs of Elite IV Innovator seed potato was also planted. The Foundation-class seed produced was intended to be distributed to interested seed potato growers to evaluate Innovator on their own farms during the
2014 growing season. Standard production practices were followed throughout the season and included a blight control program.

Newfoundland and Labrador Nuclear Seed Potato Propagation Facility (NSPPF)

The transfer of the FEC to the Agrifoods Development Branch occurred in March of 2013. Due to the timing it was decided that only one greenhouse would be brought online for production this year. To meet the standards for a protected environment production facility as defined by the CFIA in directive D-97-08 the NSPPF required several upgrades including a new double door entrance, disinfectant foot bath, sealing of all cracks and spaces in the greenhouse structure and aphid proof screening on all intake and exhaust fans. There was also a requirement to provide raised planting beds in which to grow the plants. In total there were 64 raised aluminum benches purchased from and manufactured by Harty Industries of Goulds, NL. In addition the decision was made to repair, update or replace any parts of the existing automated air circulation system. This work was completed in early June 2013 and the first crop of certified nuclear plantlets was received from Agriculture Canada and planted on June 10th, 2013 although this is a planting date approximately 30 days later than a typical greenhouse planting date. The varieties and numbers planted are listed below in Table 2.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Number of plantlets</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Blue Pride</td>
<td>255</td>
</tr>
<tr>
<td>Exploits</td>
<td>255</td>
</tr>
<tr>
<td>Frontier Russet</td>
<td>225</td>
</tr>
<tr>
<td>Mirton Pearl</td>
<td>225</td>
</tr>
<tr>
<td>Atlantic</td>
<td>225</td>
</tr>
<tr>
<td>Yukon Gold</td>
<td>225</td>
</tr>
<tr>
<td>Goldrush</td>
<td>225</td>
</tr>
<tr>
<td>AR-2010-12</td>
<td>225</td>
</tr>
<tr>
<td>AC Red Island</td>
<td>290</td>
</tr>
<tr>
<td>Glenwood Red</td>
<td>290</td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSION

Glenwood Seed Potato Farm

All varieties planted in the spring of 2013 as part of NL’s Certified Seed Potato Program passed CFIA inspection and were certified at the Elite I, Elite II, and Elite III levels. Upon inspection by CFIA staff, the nuclear stock planted had lost a generation due to planting location. The federal Seed Regulations state that nuclear seed stock cannot be planted in a field that had previously had potatoes within the past two years. Staff at the Glenwood Seed Potato Farm harvested 215,900lbs of seed potatoes in September and October 2013. Varying yields were harvested from the 12 varieties; the breakdown of yield by variety and class is shown in Table 3.
Table 3: 2013 Glenwood Seed Potato Farm yields.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Class</th>
<th>Yield (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goldrush</td>
<td>Elite I</td>
<td>1,700</td>
</tr>
<tr>
<td>Goldrush</td>
<td>Elite III</td>
<td>160,000</td>
</tr>
<tr>
<td><strong>Goldrush Total</strong></td>
<td></td>
<td><strong>161,700</strong></td>
</tr>
<tr>
<td>Mirton Pearl</td>
<td>Elite I</td>
<td>450</td>
</tr>
<tr>
<td><strong>Mirton Pearl Total</strong></td>
<td></td>
<td><strong>450</strong></td>
</tr>
<tr>
<td>Exploits</td>
<td>Elite I</td>
<td>1,600</td>
</tr>
<tr>
<td>Exploits</td>
<td>Elite III</td>
<td>20,000</td>
</tr>
<tr>
<td><strong>Exploits Total</strong></td>
<td></td>
<td><strong>21,600</strong></td>
</tr>
<tr>
<td>Atlantic</td>
<td>Elite I</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td><strong>Atlantic Total</strong></td>
<td></td>
</tr>
<tr>
<td>AC Red Island</td>
<td>Elite I</td>
<td>700</td>
</tr>
<tr>
<td><strong>AC Red Island Total</strong></td>
<td></td>
<td><strong>700</strong></td>
</tr>
<tr>
<td>AC Blue Pride</td>
<td>Elite I</td>
<td>350</td>
</tr>
<tr>
<td><strong>AC Blue Pride Total</strong></td>
<td></td>
<td><strong>350</strong></td>
</tr>
<tr>
<td>Glenwood Red</td>
<td>Elite I</td>
<td>600</td>
</tr>
<tr>
<td><strong>Glenwood Red Total</strong></td>
<td></td>
<td><strong>600</strong></td>
</tr>
<tr>
<td>Frontier Russet</td>
<td>Elite I</td>
<td>400</td>
</tr>
<tr>
<td><strong>Frontier Russet Total</strong></td>
<td></td>
<td><strong>400</strong></td>
</tr>
<tr>
<td>Yukon Gold</td>
<td>Elite II</td>
<td>4,000</td>
</tr>
<tr>
<td><strong>Yukon Gold Total</strong></td>
<td></td>
<td><strong>4,000</strong></td>
</tr>
<tr>
<td>Eva</td>
<td>Elite III</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Eva Total</strong></td>
<td></td>
<td><strong>5,000</strong></td>
</tr>
<tr>
<td>AC Chaleur</td>
<td>Elite III</td>
<td>10,000</td>
</tr>
<tr>
<td><strong>AC Chaleur Total</strong></td>
<td></td>
<td><strong>10,000</strong></td>
</tr>
<tr>
<td>Chieftain</td>
<td>Elite II</td>
<td>10,500</td>
</tr>
<tr>
<td><strong>Chieftain Total</strong></td>
<td></td>
<td><strong>10,500</strong></td>
</tr>
</tbody>
</table>

In addition to this, 30,000 lbs of Foundation-class Innovator was produced from the 4,800 lbs of Elite IV seed planted.

Each variety and class was placed in storage, where they would typically be graded in the spring. Each March, a planting schedule for the upcoming season at Glenwood is determined and seed growers in the province are advised as to what classes of each variety are available; they then submit their requests for seed potato. These growers will then multiply this disease-free material obtained from Glenwood to supply producers, nurseries, and home gardeners.

During a visit on September 23rd, it was noted that there was an issue with both Innovator and the Elite III Goldrush, as it had started to breakdown in the crates. It was believed that the problem was pink rot and tuber samples were collected and sent to an accredited lab in Guelph, ON for confirmation of the disease pathogen(s).
Pink rot is a soil-borne fungal disease found in most agricultural soils. It develops rapidly at soil temperatures from 10°C to 30°C, with optimal temperature for infection at 25°C. While tuber infection initially occurs during the growing season, the disease becomes most apparent during harvest and storage when tubers can become bruised or wounded. These wounds and/or bruises become entry points for the pathogen into the tuber. Weather conditions during the 2012 growing season did favor the development of this disease, as the temperatures were quite hot for most of the summer and into the fall, allowing soil temperatures to remain considerably warm and optimal for the development of many soil-borne potato diseases. Many producers throughout the province were experiencing issues with their potatoes following harvest, especially in earlier maturing varieties or those potatoes harvested before skins were fully set. Pythium leak and secondary soft rotting bacteria had also been confirmed in other areas of the province. Like pink rot, leak is most prevalent following harvesting, as it enters through wounds and bruises resulting from harvesting activities. It also thrives in warm soil temperatures.

Lab reports were received on October 17th and high levels of pink rot were confirmed. Low levels of Fusarium species, Pythium species, and Verticillium species were also detected. Based on what was experienced during the fall of 2012, a decision was quickly made to destroy the entire crop of Innovator and Elite III Goldrush produced. Fortunately, no breakdown was observed in any other varieties or classes of seed produced.

**Figures 1 & 2: Pink rot in cut tubers - October 1, 2012.**

2012 marked the first tillage radish trial conducted in NL within potato production systems, with planting completed at the Glenwood Seed Potato Farm on October 10th, 2012. During a site visit on November 5th, 2012, it was noted that the radish had germinated; however, it was only in the cotyledon stage and was just starting to develop their first true leaves. It was determined that the radish would have to be planted earlier to obtain full maturation and therefore provide the full benefit of a green manure crop. Plans were made for earlier planting for 2013; however, due to human resource issues, planting was not completed in Glenwood this past season. The trial is expected to resume during the 2014 season.
Figures 3 & 4: Germinated tillage radish - November 5, 2012.

Newfoundland and Labrador Nuclear Seed Potato Propagation Facility (NSPPF)

All varieties were disease tested and passed during the growing season as required by the CFIA and were subsequently classified nuclear class seed potato. There was one major issue that arose during the season and was related to the power supply to the greenhouses. On June 11th, the day after all plantlets were planted, a power outage occurred at approximately 12:00 in the afternoon and lasted roughly three hours. The day was one of the hottest in the last decade for St. John’s and due to the loss of power the shade cloth could not be closed. As well, the facility gets its water supply from a well and the pump is driven by an electric motor which did not function due to the power loss. This prevented any misting of the greenhouse to try and cool the air. Additionally the default setting on the new vent louvers is to shut upon power loss. These three issues combined to raise the temperature in the greenhouse substantially. As a result, there was a loss of anywhere between 10-20 plantlets per variety. Despite this setback, the majority of plantlets survived and grew to maturity. The yields are listed below in Table 4.

Table 4: 2013 tuber yield per variety at the NSPPF.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Number of tubers</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Blue Pride</td>
<td>512</td>
</tr>
<tr>
<td>Exploits</td>
<td>608</td>
</tr>
<tr>
<td>Frontier Russet</td>
<td>375</td>
</tr>
<tr>
<td>Mirton Pearl</td>
<td>363</td>
</tr>
<tr>
<td>Atlantic</td>
<td>497</td>
</tr>
<tr>
<td>Yukon Gold</td>
<td>354</td>
</tr>
<tr>
<td>Goldrash</td>
<td>356</td>
</tr>
<tr>
<td>AR-2010-12</td>
<td>486</td>
</tr>
<tr>
<td>AC Red Island</td>
<td>458</td>
</tr>
<tr>
<td>Glenwood Red</td>
<td>607</td>
</tr>
</tbody>
</table>

While the number of tubers harvested was less than was hoped for, the growing season was still considered a success. Given the large amount of upgrading and prep work completed in a very short period of time, the use of a new facility and equipment and late planting date we were able...
to obtain at least one and a half times the number of tubers than plantlets we had planted for all varieties.

**Figure 5: Seed Potato plants in the NSPPF greenhouse.**

During post-harvest discussions with management, crop development officers and contacts within the CFIA and Agriculture Canada it was noted that several changes for the 2014 growing season and the future may help to increase tuber yield. These include but are not limited to:

- Only filling planting benches half-way with growing medium at the start of the season and filling in periodically throughout the growing season as a form of artificial hilling. It was noted that a number of aerial stolons were visible on the surface with no tuber formation. It was suggested that by filling over this stolons as the plants grew the tuber formation may be increased.

- Larger spacing. In an effort to increase tuber yield it was decided prior to planting that 6 inch spacing would be utilized between plants due to a small number of planting beds. The logic was that a larger number of undersized tubers were better than a smaller number of large tubers. This did not work out however as tuber yield and size were both down. In the 2014 growing season with the addition of a second greenhouse we are anticipating a spacing of at least 10 inches between plants to encourage more tuber formation with the additional benches making up for the lower number of plantlets per bench.

- Not packing the soil prior to planting. Following the lead of a CFIA representative working cooperatively with provincial staff at the NSPPF, the growing medium was packed down after the initial watering using a small 1x3 piece of timber. It is unclear the purpose of this process and it will be excluded next growing season. It is well established that potatoes grow best in a loose, well-draining soil. It was noted that the medium at the bottom of the planting boxes very compact during harvest, to the point of being unbreakable with bare hands.
A back-up generator would have prevented the loss of plantlets early in the season. While there is a diesel generator on-site, it is unusable. It was arranged with management that a new generator system would be put in place as soon as possible to provide back-up power generation so that the facility will not be forced into prolonged periods of power loss in the future.

Following the growing season a large scale upgrade of the facility was undertaken with the following major changes taking place:

- A new pellet stove heating system was purchased and installed capable of heating both greenhouses to 20 degrees Celsius while the external air temperature is -7 degrees or higher. This allows for future growing seasons to begin earlier in the spring and run longer into the fall as well as being expandable to give the possibility of year round potato production.

  **Figure 6: Biomass Furnaces at the NSPPF.**

- The construction of a tissue culture lab in the header house which included the installation of a laboratory grade autoclave, laminar flow hood and three diurnal plant growth chambers which allow for the maintaining of a nuclear plant stock of Newfoundland specific and non-specific varieties which can be multiplied via cuttings to provide an endless supply of nuclear plantlets for use in the greenhouses.

  **Figure 7: Growth Chambers at the NSPPF.**
• Purchase and installation of a new walk-in cooler for the storage and over-wintering of harvested tubers from the greenhouse.

**Figure 8: Cool storage unit at the NSPPF.**

**CONCLUSIONS**

Seed potato production has contributed significantly to the Newfoundland and Labrador potato industry during the past 30 years. The supply of seed has reduced the incidence of potato wart disease, increased potato yields, improved product quality and added greatly to the marketability of locally grown potato crops. This contributes to greater financial return to producers and created a new industry which previously did not exist. The production and sale of locally grown seed potatoes provides a new market for potato producers in the Province, which was previously supplied by farms in the Maritime Provinces. The Glenwood Seed Potato Farm and Newfoundland and Labrador Nuclear Seed Potato Propagation Facility play a major role in supporting the potato industry and compliment the work of CFIA and the other stakeholders to suppress potato diseases.

New varieties, knowledge and technologies are important in maintaining economically and environmentally sustainable potato production systems. As markets change and new improved varieties become registered, the Farm will continue to evaluate new seed varieties not previously used in this province to further enhance the potato industry in Newfoundland and Labrador.
APPENDIX A

Seed Potato Varieties Grown at Glenwood Seed Potato Farm

Innovator

GENERAL

Origin & Breeding: bred by BV de ZPC from the cross (Shepody x RZ-84-2580) in The Netherlands.
Year registered in Canada: 2004
Registration number: 5850
Maturity: early to mid-season

BOTANICAL FEATURES

Plants: medium large, semi-erect; stems not or very weakly pigmented, wings moderately prominent.
Leaves: yellowish green, moderately close, moderately pubescent. Terminal leaflets: narrowly to medium ovate; often fused to the first primary leaflet; acute to acuminate tip; obtuse to cordate base; strongly wavy margins. Primary leaflets: five to six pairs, narrowly ovate, acute tip, cordate base.
Flowers: numerous, white corolla; few to moderately numerous berries.
Tubers: long oblong, large to very large; russetted tan coloured skin; shallow eyes, evenly distributed; slightly to moderately prominent eyebrows; pale yellow to yellowish-white flesh.
Sprouts: large, broad cylindrical; weak red-violet pigmentation; medium to strong pubescence.
AGRICULTURAL FEATURES

High yielding variety, uniform in grading. Rather good resistance to internal bruising. Medium to high dry matter content.

**Utilization:** fairly firm to floury after cooking texture; suitable for fresh market and chipping.

**Chief Markets:** fresh market, processing for chips.

REACTION TO DISEASES

**Immune:** potato wart.

**Resistant:** pale cyst nematode (*Globodera pallida* pathotypes Pa 2,3).

**Good resistance:** leaf late blight.

**Moderately resistant:** leaf roll, PVX, PVY, tuber late blight, common scab.
AC Blue Pride

GENERAL

**Origin & Breeding:** bred by Agriculture and Agri-Food Canada Research Center in St. John’s, Newfoundland, from the cross (N713-16 x N889-78-3). Released in 1994.

**Year registered in Canada:** 1997

**Registration No.:** 4576

**Maturity:** mid-season

BOTANICAL FEATURES

**Plants:** medium size, erect, spreading at maturity; stems slightly pigmented, especially at base and in leaf axils; inconspicuous wings; nodes slightly swollen and slightly pigmented.

**Leaves:** medium green, dull, smooth, closed; midribs and petioles slightly pigmented. Terminal leaflets: ovate; tip cuspidate; base slightly asymmetrical.

Primary leaflets: three pairs; ovate.

Secondary and tertiary leaflets: numerous.

**Flowers:** frequent; white corolla, medium sized; yellow anthers; green buds; long calyx lobes, slightly hairy; medium berry production.

**Tubers:** oval to long; smooth blue purple skin; shallow eyes; white flesh, occasional coloration in vascular ring.

**Sprouts:** purple; scattered long basal hairs.

AGRICULTURAL FEATURES

Medium high yielding variety; excellent storability, long dormancy period; medium specific gravity.

**REMARK:** susceptible to post emergence application of the herbicide metribuzin.

**Utilization:** none to some after cooking discolouration; good for boiling.

**Chief Market:** fresh market.
REACTION TO DISEASES

Resistant: potato wart (race 2, 8).
Moderately susceptible: rhizoctonia, leaf roll, common scab.
Susceptible: potato cyst nematode.
AC Red Island

GENERAL

**Origin & Breeding:** bred by K.G. Proudfoot from the cross (Brigus x Redsen) at the Agriculture and Agri-Food Canada Atlantic Cool Climate Crop Research Center in St. John's, Newfoundland. Selected in 1987.  
**Year registered in Canada:** 2000  
**Registration number:** 5098  
**Maturity:** mid-season

BOTANICAL FEATURES

**Plants:** medium size; upright; stems have purple pigmentation, more intense in younger foliage, especially in side shoots in leaf axils; nodes not swollen; wings prominent.  
**Leaves:** dark green, smooth, open; midribs purple, very slightly pubescent; petioles very slightly pigmented and very slightly to not pubescent.  
Terminal leaflets: ovate; tip cuspidate, base asymmetrical.  
Primary leaflets: three to four pairs widely separated; oval.  
Secondary leaflets: few, variable in size, usually large.  
Tertiary leaflets: variable in number, small.  
**Flowers:** numerous; lavender corolla, medium size; buds purple, pubescent; yellow anthers; infrequent berries.  
**Tubers:** round to oval; bright red skin; shallow eyes, predominantly apical; creamy white flesh.  
**Sprouts:** slightly pubescent; red-pink pigmented base; apex green.

AGRICULTURAL FEATURES

High yielding variety of medium size tubers. Tubers have very good red colour which is retained during storage. High specific gravity.

**Utilization:** good for boiling, baking and french frying.  
**Chief Market:** fresh market for red skinned variety.
REACTION TO DISEASES

Resistant: potato wart (pathotype 2, 8).
Good resistance: late blight.
Moderately resistant: common scab.
Atlantic

**GENERAL**

*Origin & Breeding:* bred and selected by the USDA from the cross (B5141-6 (Lenape) x Wauseon) in 1969. Released in 1976.

*Year registered in Canada:* 1983

*Registration number:* 2300

*Maturity:* mid-season

**BOTANICAL FEATURES**

*Plants:* medium large, upright; stems thick, purple at the base with an irregular pigmentation pattern upward; nodes slightly swollen; wings prominent.

*Leaves:* close, smooth, bright green, moderately pubescent.

  Terminal leaflets: large, ovate; tip cuspidate; base obtuse, asymmetrical.
  Primary leaflets: large, ovate; tip cuspidate; base obtuse, mostly asymmetrical; three pairs.
  Secondary and tertiary leaflets: numerous.

*Flowers:* numerous, pale lavender; heavily pubescent buds having diffuse lavender pigmentation on a green background.

*Tubers:* oval to round, smooth; lightly netted to heavily scaled white skin; shallow white eyes; white flesh.

*Sprouts:* purple.

**AGRICULTURAL FEATURES**

High yielding variety, attractive appearance; good tuber set and uniform tuber size and shape. Widely adapted but not recommended for dry sandy soils. Moderate fertilization, close spacing between plants and proper timing of overhead irrigation will prevent the production of oversized tubers that might have hollow heart. Low total glycoalkaloids and high total solids. Medium dormancy period.

Atlantic is the standard for potato chip quality in Canada and United States.
Utilization: good for boiling and baking, excellent for chipping and french frying.
Chief Markets: fresh market, chipping.

REACTION TO DISEASES

Immune: tuber net necrosis, PVX.
Resistant: golden nematode (Globodera rostochiensis Ro1).
Moderately resistant: common scab, late blight, bacterial pink eye disease, verticillium wilt.
Exploits

General

Origin & Breeding: bred by Kenneth G. Proudfoot from the cross (N1614-5 x N69-478) made in 1993, at the Agriculture and Agri-Food Canada St. John's Research Center, Newfoundland.

Year registered in Canada: 2008
Registration number: 6460
Maturity: medium late

Botanical Features

Plants: medium height, erect; stems very weakly pigmented; straight single wings; nodes not swollen, very weakly pigmented.
Leaves: medium green, semi-open; midribs and petioles not pigmented.
Terminal leaflets: medium ovate; tip acuminate; base cordate and strongly asymmetrical; weakly wavy margins.
Primary leaflets: four pairs; medium ovate; tip acuminate; base cordate, strongly asymmetrical.
Flowers: few inflorescences per plant, numerous flowers; medium size white corolla with prominent star; orange anthers; flower buds and peduncles not pigmented.
Tubers: round; smooth light yellow skin; few moderately deep eyes, predominantly apical; slightly prominent eyebrows; cream coloured flesh.
Sprouts: spherical; red-violet; base weakly pubescent, strongly pigmented; tip medium to strongly pubescent, weakly pigmented, semi-open habit.

Agricultural Features

Moderate to high yields of uniform and attractive round tubers; medium dormancy period; moderately high specific gravity.

Utilization: good for boiling, acceptable to good for baking.
Chief Market: fresh market.
Reaction to Diseases

**Resistant:** potato wart (*Synchytrium endobioticum, race 2 and 8*), golden nematode (*Globodera rostochiensis, Ro1*)

**Highly resistant:** PVY

**Moderately resistant:** common scab, fusarium dry rot.
Frontier Russet

GENERAL

**Origin & Breeding:** bred by J.J. Pavek at the USDA Research Station in Aberdeen, Idaho (USA) from (A66102-16 x WN330-L). Tested as A74114-4; released in 1990.

**Year registered in Canada:** 1996

**Registration number:** 4389

**Maturity:** medium early

BOTANICAL FEATURES

**Plants:** medium small, upright and moderately compact; medium thick stems with varying light brownish-purple pigment; narrow, straight, inconspicuous wings; nodes slightly swollen.

**Leaves:** medium green, open, narrow to medium width; mid-rib and petioles are light green.

Terminal leaflets: broadly ovate; acuminate tip; obtuse to truncate base.

Primary leaflets: four pairs, ovate, acuminate tip, obtuse base.

Secondary leaflets: few, small.

**Flowers:** few, medium size white corolla, bright yellow anther; buds are green with purple pigmentation at the base and on tip and edge of calix lobes.

**Tubers:** oblong to long, cylindrical with blocky ends; tannish-brown skin with diffuse brown spotting; medium to light russet; shallow eyes, well distributed; white flesh.

**Sprouts:** ovoid to cylindrical; moderately pubescent with a dark red-purple pigmentation.

AGRICULTURAL FEATURES

Moderately high yielding variety that produce high quality tuber. Adapted to both irrigated and dryland conditions in northern United States. Good resistance to hollow heart and blackspot; susceptible to growth cracks and internal brown spot. Medium specific gravity. Long dormancy period.
Avoid overwatering late in season. Since tubers may have a high reducing sugar content out of storage, storage temperature for potatoes intended for frying must be above 8°C. Store seed potatoes at 4°C.

**Utilization:** excellent for french frying directly from the field and for the first few month in storage; very good for baking.

**Chief Market:** fresh market, processing.

### REACTION TO DISEASES

**Good resistance:** common scab, Fusarium dry rot.

**Moderately resistant:** leafroll, Verticillium wilt.

**Susceptible:** all common potato viruses, foliar and tuber early blight.
Glenwood Seed Potato Farm & Nuclear Seed Potato Propagation Facility
2013-2014

Glenwood Red

GENERAL

**Origin & Breeding:** bred by Kenneth G. Proudfoot from the cross (N637-6 x N1653-7) made in 1991 at the Agriculture and Agri Food Canada Research Centre in St. John's, Newfoundland.
**Year registered in Canada:** 2004
**Registration number:** 5794
**Maturity:** late

BOTANICAL FEATURES

**Plants:** medium size, spreading; stems moderately pigmented; straight single wings; nodes slightly swollen and slightly pigmented.
**Leaves:** grey green, closed; midribs and petioles moderately pigmented.
Terminal leaflets: broadly ovate; tip acuminate; base lobed and slightly asymmetrical; wavy margins.
Primary leaflets: four pairs; broadly ovate; tip acuminate; base lobed and slightly asymmetrical.
Secondary and tertiary leaflets: numerous (13-15)
**Flowers:** medium flowering; strongly pigmented red-violet corolla; orange anthers; flower buds moderately pigmented; peduncles weakly pigmented.
**Tubers:** round; smooth light red to red skin; shallow eyes, few to intermediate in number, predominantly apical; slightly prominent eyebrows; white to cream coloured flesh.
**Sprouts:** broad cylindrical; red-violet; base weakly pubescent, strongly pigmented; tip weakly pubescent, green with red-violet undertone, closed habit.

AGRICULTURAL FEATURES

High yields of small, uniform tubers; many tubers per plant; short dormancy period; medium specific gravity.
Glenwood Red is well adapted to the growing conditions in Newfoundland for which it was selected.

**Utilization:** good for boiling and baking.
**Chief Market:** fresh market.

**REACTION TO DISEASES**

**Highly resistant:** potato wart (*Synchytrium endobioticum*) pathotypes 2 and 8.
**Moderately resistant:** late blight, common scab, fusarium dry rot.
**Susceptible:** golden nematode (*Globodera rostochiensis*)
Goldr Rush

General

**Origin & Breeding:** bred by North Dakota State University from (ND450-3Russ x Lemhi Russet) in Fargo, North Dakota (USA). Released in 1992.

**Year registered in Canada:** 1999

**Registration number:** 4905

**Maturity:** mid-season

Botanical Features

**Plants:** medium to large, upright growth; stems have purple pigmentation at the base, medium size waved wings and no prominent nodes.

**Leaves:** medium green to dark green, open, moderately pubescent; midribs and petioles are light green, sparsely pigmented and slightly pubescent.

- Terminal leaflets: elliptical; tip acuminate; base lobed and asymmetrical.
- Primary leaflets: three to four pairs, ovate, tip acuminate; asymmetrical base.

**Flowers:** few, large, off-white to light lavender, orange anthers; long, straight and pubescent calix.

**Tubers:** oblong to long; dark brown russetted skin; eyes are numerous, shallow and well distributed; they may show a reddish blush after storage; very white flesh.

**Sprouts:** white with purple tips.

Agricultural Features

High yielding variety; tubers are usually smooth and quite uniform with very few external or internal defects. Very good resistance to hollow heart. Medium specific gravity. Good storability; medium dormancy period.

**Utilization:** excellent for baking and boiling; very good for French frying if processed from harvest or short term storage. Its very white flesh, texture and excellent flavour make it particularly suitable for home and restaurant.

**Chief Markets:** fresh market, count carton trade, processing.
Reaction to Diseases

**Good resistance**: common scab.
**Moderately resistant**: verticillium wilt, silver scurf.
**Susceptible**: most potato virus, early blight, late blight, soft rot, fusarium dry rot.

Leaf roll expression: light rolling of bottom leaves only; infected plants have normal size and colour.
**Mirton Pearl**

**GENERAL**

**Origin & Breeding:** bred by Agriculture Canada (MIRA x F5318) and selected at the St. John’s West Research Station, Newfoundland, in 1966.

**Year registered in Canada:** 1975.

**Registration number:** 1606.

**Maturity:** early to mid-season.

**BOTANICAL FEATURES**

**Plants:** medium-sized, upright to spreading; nodes slightly swollen; wings not prominent.

**Leaves:** close, smooth.

Terminal leaflets: symmetrical.

Primary leaflets: slightly asymmetrical, three pairs.

Secondary leaflets: large, two to three pairs.

Tertiary leaflets: numerous.

**Flowers:** numerous, white, on slightly bronzed green buds.

**Tubers:** round, uniform, smooth white skin; evenly distributed medium-deep eyes, occasionally very deep at the bud end; white flesh.

**Sprouts:** reddish purple, non-pubescent.

**AGRICULTURAL FEATURES**

High yielding, some resistance to damage from mechanical harvesting. Low total glycoalkaloids and high total solids. Good storability.

Remarks: space 18 to 20 cm in the row to avoid oversize tubers. This variety has very high yield performance in Atlantic Canada.

**Utilization:** good for boiling and baking.

**Chief Market:** fresh market
REACTION TO DISEASES

**Resistant**: potato wart (pathotypes 2 and 8)
**Moderately resistant**: common scab, fusarium dry rot, late blight.
**Susceptible**: black leg, powdery scab, potato cyst nematode.
Yukon Gold

General

**Origin & Breeding:** bred from the cross (Norgleam x W5279-4) at the University of Guelph and selected jointly by Agriculture Canada, the University of Guelph and the Ontario Ministry of Agriculture and Food, Guelph, Ontario (Canada) in 1966.

**Year registered in Canada:** 1980

**Registration number:** 2047

**Maturity:** mid-season

Botanical Features

**Plants:** medium large, upright with little tendency to spread; lower three-quarters of stems purplish with the upper quarter faintly purple.

**Leaves:** open, moderately shiny, olive green, stiffly pubescent; nodes not swollen.

Terminal leaflets: obovate, gradually tapered to the base; tip slightly acuminated.

Primary leaflets: ovate; tip acute to slightly acuminated; four pairs.

Secondary leaflets: broadly ovate, varying from two on the lower leaves to six or eight on the upper leaves.

Tertiary leaflets: small, varying from none on the lower leaves to twenty on the mid and upper leaves.

**Flowers:** light violet; star yellow-green at the base becoming light violet towards the edges; buds light green to purplish green.

**Tubers:** oval, slightly flattened; finely flaked yellowish white skin; shallow pink eyes; light yellow flesh.

**Sprouts:** reddish purple.

Agricultural Features

Medium to high yielding variety of attractive appearance. Large tubers are slightly susceptible to hollow heart. Excellent storability; long dormancy period. High specific gravity.

Remark: often sold under its variety name.
Utilization: very good for boiling, baking, and French frying; unsuitable for chipping; retains its yellow flesh color when cooked.

Chief Markets: fresh market and seed export potential.

Reaction to diseases

Highly resistant: PVA
Moderately resistant: leaf roll.
Susceptible: common scab, PVY, air pollution.
AC Chaleur

GENERAL

**Origin & Breeding:** bred at the Agriculture Canada Research Station in Fredericton, New Brunswick, from the cross (Belleisle x N457). Released in 1988.

**Year registered in Canada:** 1993

**Registration No.:** 3785

**Maturity:** early

BOTANICAL FEATURES

**Plants:** medium, spreading growth; medium thick stems; inconspicuous wings, nodes not prominent.

**Leaves:** medium green, open, sparse pubescence on upper surface. Terminal leaflets: ovate, tip acuminate, obtuse to truncate base, usually symmetrical. Primary leaflets: four pairs, narrowly ovate, tip acute, base somewhat asymmetrical.

**Flowers:** medium size white corolla, petals are separated at the base (hole); orange anthers.

**Tubers:** round to oval, slightly blocky; smooth buff coloured skin; moderately shallow eyes; white flesh.

**Sprouts:** spherical, small, no colouration or pubescence.

AGRICULTURAL FEATURES

Medium to high yielding variety; not susceptible to hollow hart. Medium specific gravity. Medium dormancy.

**Utilization:** good to excellent quality for boiling and baking.

**Chief Market:** early fresh market
REACTION TO DISEASES

**Resistant:** PVY, tuber symptoms of early blight.
**Moderately resistant:** common scab, PVS, *Verticillium albo-astrum* wilt, phoma tuber rot.
**Susceptible:** leaf roll, *Verticillium dahliae* wilt, blackleg, rhizoctonia, late blight, foliar symptoms of early blight, fusarium dry rots.
Chieftain

**GENERAL**

- **Origin & Breeding:** bred by A.E. Kehr from (la1027-18 x La1354) and selected by the Department of Horticulture, Iowa State University, Ames, Iowa, in 1957.
- **Year registered in Canada:** 1973
- **Registration number:** 1487
- **Maturity:** mid-season

**BOTANICAL FEATURES**

- **Plants:** medium sized, upright, spreading at maturity; wings prominent.
- **Leaves:** dark green, semi-open, long, slightly pubescent; midribs reddish purple.
- Terminal leaflets: broadly ovate.
- Primary leaflets: narrowly ovate, generally four pairs.
- **Flowers:** large, light violet.
- **Tubers:** oval to oblong, smooth bright red skin; shallow to medium-deep eyes, darker than the skin; white flesh.
- **Sprouts:** reddish purple.

**AGRICULTURAL FEATURES**

High yielding variety, attractive appearance, widely adapted. Undersizing can be a problem if soil moisture becomes limiting. Well suited for washing at maturity. Good storability. Medium specific gravity.

Remark: space at 15 cm with low nitrogen for seed export.

- **Utilization:** good to excellent for boiling, good for chipping at harvest, excellent for french frying; not suitable for processing.
- **Chief Market:** seed export, fresh market, pre-peeled product in the institutional trade.
REACTION TO DISEASES

**Moderately resistant:** late blight, common scab, rhizoctonia, silver scurf, stem-end browning, tuber net necrosis, verticillium wilt.

**Susceptible:** black leg, fusarium dry rot, leaf roll, phoma rot, PVX and PVY.
Genus & Breeding: bred by Robert L. Plaisted, Cornell University, Ithaca, New York, from a cross made in 1986 between Steuben and bulk pollen from clones that were neotuberosum x tuberosum hybrids. Most of the clones were considered resistant to PVY and golden nematode Ro1.

Year registered in Canada: 2010
Registration number: 6783
Maturity: mid-season

Botanical Features

Plants: medium height, semi-erect; stems weakly pigmented; prominent waived single wings; nodes swollen.
Leaves: medium green, closed; midribs and petioles not pigmented.
Terminal leaflets: ovate; tip cuspidate; base obtuse.
Primary leaflets: three pairs; ovate; tip cuspidate; base cordate.
Flowers: medium frequency, corolla white on both surfaces, medium size; orange anthers; flower buds weakly pigmented; calyces and peduncles light green.
Tubers: round to slightly oval; smooth white skin; shallow eyes, predominantly apical; white flesh.
Sprouts: spherical; red-violet; base moderately pubescent, strongly pigmented; tip weakly pubescent, weakly pigmented, closed habit.

Agricultural Features

Medium yielding variety of very attractive appearance; well shaped and uniform sized tubers; good resistance to internal defects such as hollow heart and internal necrosis. Long dormancy period; good storage capability. High specific gravity.

Remark: pre-cutting or warming seed is recommended.

Utilization: good for boiling and baking, acceptable chip color; slight darkening after boiling (similar to Superior).
Chief Markets: fresh market and chips.
Reaction to Diseases

**Resistant:** golden nematode (*Globodera rostochiensis* Ro1).
**Highly resistant:** PVX, PVY.
**Moderately resistant:** early blight, corky ringspot (Tobacco rattle virus symptoms), powdery scab.
**Moderately susceptible:** common scab.
**Susceptible:** late blight.
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