The Road to Reduced Seed Cutting:

Growing a Smaller-Sized Seed Lot without Sacrificing Yield

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based on work done under the Agronomy Initiative for Marketable yield (AIM)
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Opportunities to increase tuber numbers per cwt and reduce oversize seed tubers while not sacrificing the yield of seed include:

- Controlling **physiological age** through storage temperatures, sprout inhibition
- Use of **ethylene gas** in storage
- Tightening **in-row seed spacing**
- **Reduced nitrogen** fertilizer rates
- **Gibberellic Acid** (GA)

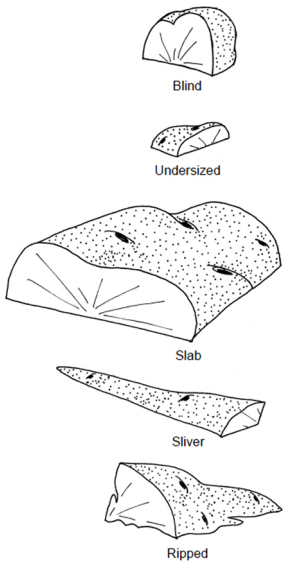
Continue reading as we explore how to create a more optimally sized seed lot, and what that means for the commercial potato producer.

Since the beginning of AIM, one of the priorities for our Seed Management Working Group has been to identify how producers can reduce seed cutting and plant larger seed pieces. A number of studies and grower testimonials across multiple regions and years have largely shown that:

- Larger seed pieces have greater yield potential than smaller seed pieces
- Cut seed pieces under 1.5 ounces have significantly lower yield potential and are much more likely to have emergence issues.
- Cutting large tubers (greater than 10 ounces) is more likely to result in an increase in “slivers” and compromised seed pieces (sliced off apical ends, etc)
- Fewer cut surfaces requires less energy from the seed piece for suberization and reduces avenues for infection from soft rot bacteria or Fusarium
- There is largely no difference in yield between cut seed and whole seed pieces under ideal circumstances, but whole seed pieces come with less risk of set rot or blind sets (for varieties with fewer eyes).

Many PEI potato growers have been increasing their target weight for average seed piece size during cutting in recent years, particularly by eliminating those "slivers" during cutting and making sure they don't get planted. This is resulting in more even emergence and improved seed vigour, particularly if there are any early-season stress events (ie. frost, lack of soil moisture, etc). In a couple of AIM field trials in 2018, we saw up to a 30% yield reduction from slivers compared a regular run of cut and whole seed.

However, it is only possible to reduce seed cutting (majority whole seed pieces or single cut seed) if our seed lots have a tighter size distribution, with fewer oversized tubers (greater than 8 oz.). At the same time, seed producers get paid for seed by the hundredweight. We can't expect seed producers to produce a more uniformly sized seed lot if it means that they sell less seed, particularly if seed prices are not adjusted. Therefore, the AIM Seed Working Group has put a great deal of work in recent years to look at different options available to seed producers to increase tuber numbers and decrease average tuber size in seed lots without compromising total yield. In this article, we will review some of these local research results and explore how they can be implemented on PEI seed farms.



Examples of non- or less-viable seed pieces to avoid creating. Copyright: University of Maine Cooperative Extension.

Controlling physiological age:

The accumulated physiological age of seed has repeatedly proven to be one of the key factors influencing tuber number, tuber size and total yields. A great deal of the physiological age of seed can't be readily controlled, as the accumulated growing conditions and stresses of the last growing season contribute to seed age. However, the conditions under which producers store seed can have a significant impact on the physiological age of a seed lot.

Recently, AIM has done some trials examining the use of both winter warming (adding 150-200 degree days to seed prior to breaking dormancy) or extended season refrigeration to control the physiological age of seed to be planted to produce a commercial crop. Use of these methods are highly dependant on the variety and end use (processing, table, creamer). Nonetheless, seed growers can also manipulate physiological age in an effort to maximize tuber numbers. Aged seed is generally associated with increased tuber number. By keeping storage temperatures slightly warmer, particularly before cutting/planting, growers can influence the resulting number of stems and tubers per plant. There are also storage treatments such as 1,4 DMN or ethylene (see below) that can be used to allow producers to store seed longer without having seed excessively sprouted prior to planting. Local research has shown these storage treatments to have no negative impact on yield and quality.

Clearwater Russet seed pieces from the AIM physiological age trial in 2021.

From L to R: seed kept refrigerated until cutting, seed stored conventionally (gradual warm-up), seed with additional 190 degree-days added through winter warming.

Photo: R. Barrett.

Use of ethylene in storage:

In 2018 and 2019, AIM partnered with AAFC to investigate the use of ethylene during storage to increase tuber numbers in seed from multiple processing varieties. The Restrain ethylene generator was present in storage from mid-February to mid-May, generating a constant ppm of ethylene gas to temporarily suppress sprouting while also helping to break apical dominance. The Restrain generator is now approved by PMRA for use in Canada, with the approval process based in part on data generated from our project.

Restrain ethylene generator

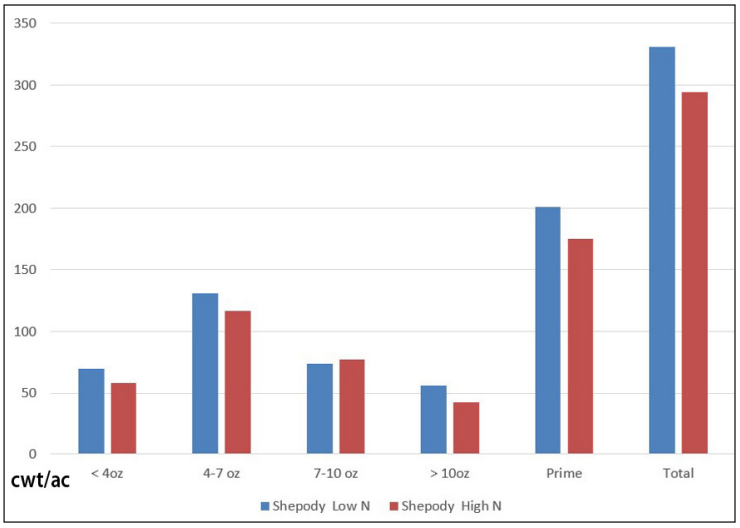
In our trials, the ethylene-treated seed had statistically higher tuber numbers and higher total yields than the non-treated control. The increased yield was largely in the 30-45 mm and 45-55 mm size categories, with a corresponding yield reduction in the 55-85 mm size category. Generally, the ethylene-treated seed produced a more consistently sized seed profile with fewer oversize tubers and increased number of tubers per plant. At the same time, the effect was not consistent over all varieties, with some varieties responding much more than others. Across both years, the variety with the most consistent response was Russet Burbank. Ethylene-treated Russet Burbank seed produced 27% more tubers with 8.7% greater total yield averaged across two years. Payette Russet also showed a statistically favourable response, with a 14.6% increase in tuber numbers and a 10% yield increase for the ethylene-treated seed. Other varieties did not show big differences in total yield, but some varieties (ie. Dakota Russet and Ranger Russet) experienced a shift in size distribution following ethylene treatment, with larger yield of tubers in the smaller size categories. The end result for these varieties: no reduction in seed yields for any variety while generally producing seed lots requiring less cutting.

Tightening In-Row Seed Spacing:

When less concerned about getting tubers over 8 ounces in size, tightening in-row seed spacing has long proven to be an effective way to increases tuber numbers while not sacrificing total yields in most varieties. Three years of recent research by Cavendish Farms has confirmed that reducing between-plant spacing can increase tuber numbers while also increasing total yield. Choosing the appropriate spacing will be dependent on variety, irrigation/water availability, and on the size of seed being planted.

Reducing nitrogen in seed production:

In recent years, a number of seed growers have been exploring reducing rates of nitrogen in an effort to control tuber size and accelerate maturity (which can improve skin set). Largely, this reduction in nitrogen rates has not decreased total yields, but we wanted to do some on-farm evaluations to confirm these findings.



Results from an AIM seed trial in 2020, where N was reduced by 33 lbs/ac in a Shepody seed field, resulting in a smaller size profile and increased yield.

In 2019, we partnered with two farms to look at the effect of reducing nitrogen rate by 20-25% versus their conventional nitrogen rate. At one farm, we compared Russet Burbank at the grower standard N rate of 180 lbs/ac N versus a reduced rate of 140

lbs/ac. At the reduced N rate, the grower had no reduction in total yield and a slight shift in size profile toward smaller sized tubers. In fact, yield in the under 4 ounce size category increased by more than 50 cwt/acre, resulting is a larger proportion of seed that did not need to be cut at all.

Also in 2019, we partnered with another farm to assess the effect of reducing N by approximately 20% in both Shepody and Russet Burbank. For both varieties, the yield of "prime seed" (defined as being less than 7 ounces per tuber) was the same or greater for the low nitrogen treatment compared with the standard nitrogen rate. Following up on these initial observations, we repeated the trial again in 2020, this time adding both Mountain Gem and Payette Russet to the trial. Once again, we found that the reduced nitrogen treatments (reduction of 33 to 57 lbs/ac of N, depending on variety) produced the same or greater yield of "prime seed" compared with the control treatment. Generally, the average tuber size was also decreased, which would result in less tuber cutting per cwt. Our thanks to Genesis Crop Systems for their assistance with these trials.

Gibberellic Acid (GA):

Research on the use of gibberellic acid to increase tuber numbers has been ongoing in multiple places over many years. However, there is interest in assessing how the effects of gibberellic acid (GA) may vary by variety, particularly with some of the new varieties being grown for French fry processing in Prince Edward Island. Cavendish Farms has conducted a number of trials in recent years on the use of GA, and found that it increased tuber numbers without sacrificing total yield, with the most consistent results in the Dakota Russet and Payette Russet varieties. While adding GA to your seed treatment requires attention to detail (one tablet is sufficient for 1345 cwt of seed), there are several Island producers that now use it routinely, as the cost is only cents per acre.

In a 2021 AIM trial in partnership with AAFC, use of different rates of GA was compared with a no GA control for Dakota Russet and Payette Russet, two varieties that tend to struggle with slow emergence. For both varieties, we observed between a 12 and 14% increase in tuber numbers without a significant difference in yield. As expected, most of the additional tubers were in "small" size category on a processing grade (less than 1.875 inch diameter) but would still be suitable for planting as seed.

Summary:

In other regions, particularly in European countries, potato seed is largely not cut, but instead sized into consistent size categories and planted as whole seed with in-row spacing varied according to seed size. This tends to work well in Europe, where seed producers have the infrastructure and market demand needed to justify sizing during grading. As well, the lack of a true Canadian-style winter for breaking disease cycles also favours planting whole seed.

Here in Prince Edward Island, there would need to be massive investments across the industry to facilitate moving to a European-style seed system. At the same time, there would need to be wholesale changes to how seed is contracted and marketed. In our view, it is unlikely that we will see these types of changes in our domestic seed production system in the near future. Nonetheless, there are tangible and significant advantages to be gained from reduced cutting of seed.

Optimizing seed lot production to produce seed that can be planted whole or with a single cut while avoiding slivers and trimmed ends can hold real value for potato producers across all sectors. From the work that we've done through AIM and outlined in this document, we've been able to demonstrate that seed producers can reduce the amount of oversize in their seed lots and increase tuber numbers without sacrificing total yield. Many of the producers that we worked with on these trials have already made adjustments to their growing practices with this in mind.

Agronomy Initiative for Marketable Yield

AIM Funding Partners:

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Les Fermes Cavendish Farms

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