AIM Science & Tech WG

Trial Results

AIM Local Workshops

Feb 28 & Mar 1, 2022

Workshop Agenda:

- Fall Hilling
- Foliar Fertility
- Compaction Mitigation (Subsoiling)
- Quash Fungicide
- Nitrogen Rate
- Cover Cropping (from Soil WG)

Fall Hilling

- Since 2017, we've harvested 10 trial fields over 4 crop years
- Comparing making hills in the fall (with GPS) with conventional field preparation.
- Treatment and control both had a cover crop or both had no cover crop (treated the same).
- In the spring, most growers were able to plant directly into those hills without additional tillage

Fall Hilling

Variety/Year	Total Yield cwt/ac	% Smalls	% > 10 oz	% Defects	Spec. Gravity	M. Yield cwt/ac	Crop Value $/acre
R. Burbank 2018	-4	-3	0	-2	0.001	15	222
Prospect 2018	-2	-1	-5	-6	0.003	20	203
Ranger Russet 2018	-30	-8	8	-3	0.001	11	77
R. Burbank 2019	26	-1	5	-2	-0.001	32	438
R. Burbank 2019	-1	4	-2	1	0.000	-16	-256
Prospect 2019	29	2	0	-9	0.002	45*	603*
R. Burbank 2020	21	-1	10	1	0.004	18	334
Dakota Russet 2021	-36	-5	5	-4	0.000	-3	-110
Dakota Russet 2021	8	-1	-12	-2	0.001	15	189
Dakota Russet 2021	28	0	3	0	0.002	28	463
Average (10 site-years)	+4	-1.5	+1.2	-2.6	+0.0013	+16.5	+216

* indicates statistically significant differences at $p < 0.05$.
Positive values indicate that the mean values were higher in the fall hilled treatment than the conventionally-managed control.

Fall Hilling

- Over 10 site-years, trend is +17 cwt/ac, +$216/ac
- This may still be “non-significant” but marketable yield and crop value has only been negative in 8 out of 10 site-years.
- Even if the increase in yield/crop value was zero, there are potential financial advantages
  - Reduced tillage
  - Ability to plant earlier in the spring due to faster soil warmup
  - Ability to establish hills and cover crop early in the fall, ahead of potato harvest

Fall Hilling

- Factsheet available on PEI Potato Agronomy site now.

Fall Hilling: An Option for PEI Growers?

Results from local research trials

By Ryan Barrett, P. Ag., CCA

In the autumn of 2017, the Agronomy Initiative for Marketable yield (AIM) Science & Technology Working Group began work on a series of on-farm field trials to investigate the practice of creating hills in potato fields in the early fall in advance of those fields being planted to potatoes the following year.

The inspiration for this research came after coming across some research reports from Maine a couple of years earlier, where fields were hilled as part of the process to apply a chemical fumigant in the fall. In one of these fields, the hilling took place but the fumigant was not applied; however, there was still an increase in yield for the non-fumigated hilled acres compared with the conventionally managed part of the field.

Other parts of North America have experience with hilling (or "ridging") in the fall ahead of potato planting. Sometimes this is accompanied by fumigation, but not always. The theory from some producers is that by increasing soil surface area, that soil with dry out and warm up a bit faster in the spring, enabling earlier planting, particularly on heavy soils.

In addition, getting fields prepared in late summer/early fall by completion of primary tillage followed by hilling and establishment of a cover crop has the benefit of getting that work done ahead of the busy potato harvest season, while also maximizing the time for cover crop establishment. This cover crop then either dies over winter or is terminated early in the spring, followed by potato planting. Depending on field conditions and the equipment available, growers can then plant directly into those hills made the fall before (with GPS) or following a pass with a "freshener" tool.

Example of a row freshener tool.
Photo by Ryan Barrett

As noted, work began through AIM starting with set up of three fields in the fall of 2017 to compare fall hilling with establishment of a cover crop versus conventional land preparation on each farm, with establishment of a cover crop. These fields then had potato harvest samples evaluated for yield and quality in the fall of 2018. A further three fields were set up in 2018, followed by one field in 2019 and three fields in 2020.

In 2018, two fields had data loggers installed to track soil moisture and soil temperature in both the hilled treatment and the conventionally-planted control. At both sites, soil temperature in the fall hilled part of the field appeared to be 0.5 - 1.0 C higher than in the control section until early July. In addition, there was a trend for hilled treatment to retain more moisture after planting for approximately the first month than the conventionally planted area. This may be due to a reduction in tillage or moving the tillage further away from planting in order to improve soil structure and improve soil aggregate stability. Follow up testing by both AIM staff and individual growers have shown similar observations in the following years.

Cover crops did not establish uniformly well in each field. In some years, the cover established very well; in others, the cover crop was sparse due to either late establishment or poor growing conditions. Nonetheless, the cover crop establishment was similar for both the treatment and control in each field.

Foliar Fertility Trial

- Conducted a trial in partnership with a farmer in East Prince. Compared a conventional fertility program with a program supplemented with foliar fertilizer application at multiple times during the growing season.

- Starting fertility levels for the field:
  - High P
  - High K
  - Moderate Mg
  - Low Ca
  - Moderate Zn
  - Low-moderate B

Foliar Fertility Trial

- Two long strips of potatoes. Each strip split in half between foliar fertility and control.

- Mountain Gems planted May 27
- Total applied nutrients:
  178N 177P 203K 22Mg 1B 3Zn
- 7 foliar applications, totalling $145.60 per acre in cost
  (Ca, Zn, Mn, Mg, B & K products)

Foliar Fertility Trial

	Total Yield cwt/ac	% Smalls	% 10 oz	% Total Defects	M. Yield cwt/ac	$/acre*
Control	336.4	5.6	21.9	14.1	279.6	$3611
Foliar	325.2	5.2	27.6	11.6	281.0	$3689
Diff	**-11.2**	**-0.4**	**+5.7**	**-2.5**	**+1.4**	**+$78**

- No difference between treatment and control
- When truck weights were also done, only a 46lb difference per truck (0.1%), so no difference observed.
- Total cost of foliar program: $161/acre

Compaction Mitigation

- Part of a larger project with UPEI looking at whether we can use soil electroconductivity sensors to detect soil compaction
- If we can map compaction and tell how deep it is, can we do site-specific subsoiling…or avoid it if not necessary?
- How much benefit is there from subsoiling fields the year before potatoes are planted?

Compaction Mitigation

- Two fields in East Prince. Both had a subsoiled section and a check (not subsoiled).
- Field 1 – Alverstone Russets, had irrigation but not needed
- Field 2 – Mountain Gem Russets, no irrigation

Compaction Mitigation – Field 1 (Alverstone)

	Total Yield cwt/ac	% Smalls	% 10 oz	% Total Defects	M. Yield cwt/ac	$/acre*
Check	341.9	7.0	13.5	5.5	305.3	$3976
Subsoil	370.2	7.4	16.3	2.4	338.4	$4410
Diff	**+28.3**	**+0.4**	**+2.8**	**-3.1**	**+33.1**	**+434**

- No real difference in quality attributes, but possibly an increase in yield and crop value.

- Key point: **Ripping was done in the summer, dry conditions!**

Compaction Mitigation – Field 2 (M Gem)

	Total Yield cwt/ac	% Smalls	% 10 oz	% Total Defects	M. Yield cwt/ac	$/acre*
Check	297.3	7.4	13.8	14.3	240.8	$3165
Subsoil	320.2	7.7	22.0	15.2	251.9	$3268
Diff	**+22.9**	**+0.3**	**+8.2**	**+0.9**	**+11.1**	**+103**

- This field was affected a bit by wireworm and/or grub damage, but about the same between treatment and control.
- Possibly an increase in 10 oz %?
- Increase in yield and crop value less than in other field, but still positive.
- Two more fields set up in 2021 to be potatoes in 2022.

Quash Fungicide

- Early blight fungicide (metconazole)
- In some studies in certain varieties, it has provided an increase in yield independent of its effect on early blight suppression. Possibly due to an effect on vine maturity.
- Two fields in 2021. Neither statistically significant. One with small yield increase, one with small yield decrease
- Four fields in 2022. Two Russet Burbank in Souris. Two Clearwater in East Prince. Both had Quash applied at 1st or 2nd spray (before row closure) instead of Luna Tranquility.

Quash: Average of 2 fields - Clearwater

	Total Yield cwt/ac	% Smalls	% 10 oz	% Total Defects	M. Yield cwt/ac	$/acre*
Check	363.9	9.9	12.6	6.5	311.7	4172
Quash	372.2	10.2	19.4	5.2	322.8	4355
Diff	**+8.3**	**+11.1**	**+6.8**	**-1.3**	**+11.1**	**+182**

- Statistically no difference. Quite similar yields and quality between two fields.
- No difference in gravity

Quash: Average of 2 fields – R. Burbank

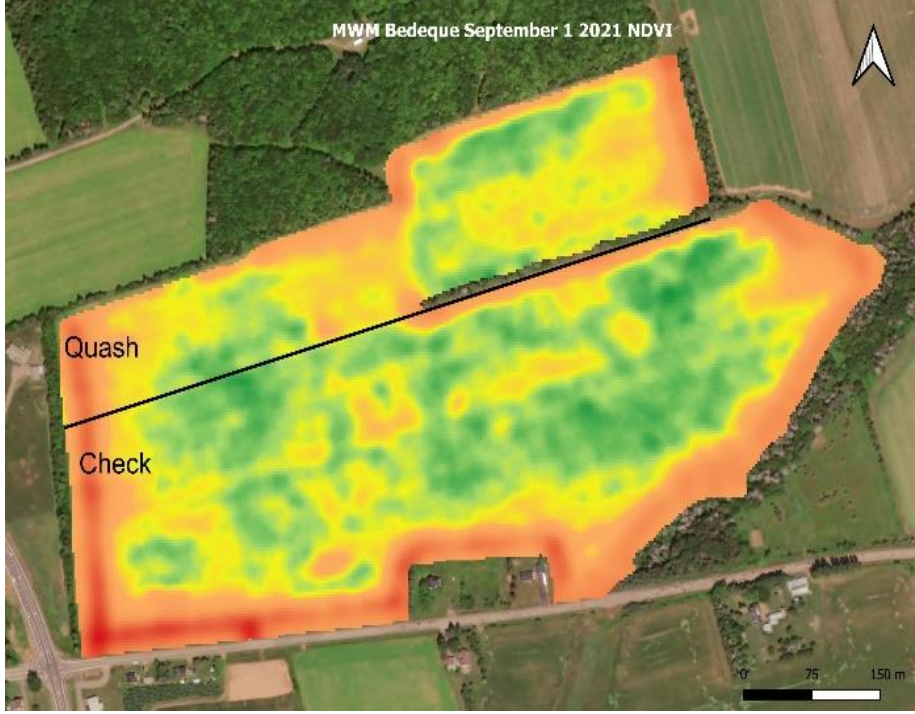
	Total Yield cwt/ac	% Smalls	% 10 oz	% Total Defects	Spec. Gravity	M. Yield cwt/ac	$/acre*
Check	443.3	6.0	39.6 b	7.1	1.085 b	397.5	$5215
Quash	412.3	6.8	29.1 a	5.7	1.082 a	370.6	$4704
Diff	**-31.0**	**+0.8**	**-10.5**	**-1.4**	**-0.003**	**-26.9**	**-511**

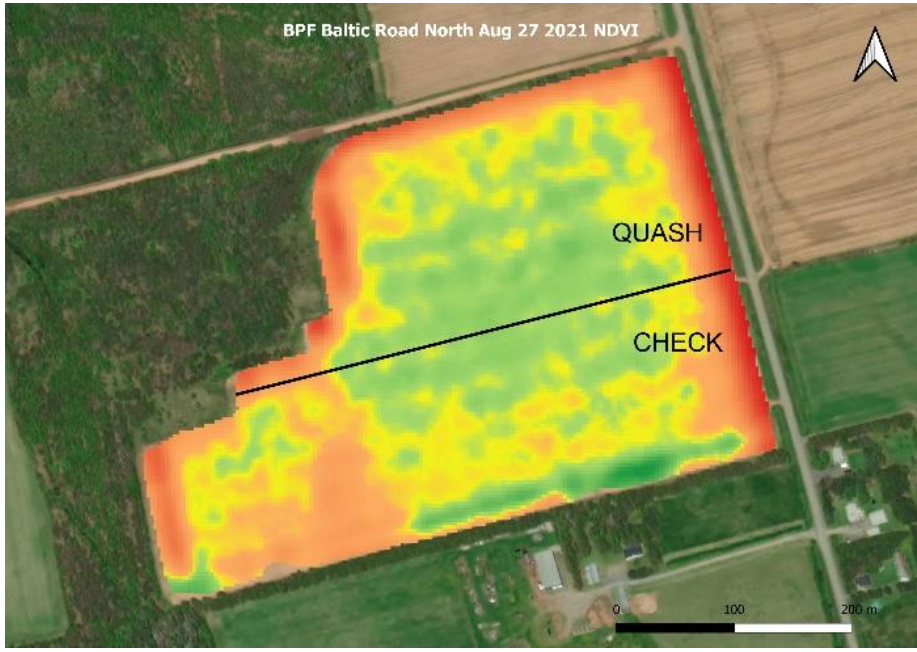
- Statistically difference at 90% confidence for gravity and % 10 oz (both lower for Quash)
- Other variables not statistically different from each other.

Quash Fungicide

- No difference in NDVI by late Aug/early Sept
- No statistical difference in yield in any field.
- Lower gravity and 10 oz in Burbanks
- Across 6 site-years, no real difference in yield of quality.

- It might be that there was an effect in irrigated fields where N is "spoon-fed." **High rates of N applied at planting likely has more impact on vine maturity than Quash would have.**





“Accidental” Fertility Trial

- Mountain Gem Russets
- At planting, one of the fertilizer tubes was blocked on the planter, meaning that every 6th row received no fertilizer at planting.
- This created a bit of an “accidental trial” to assess the effect of dramatically reduced fertility
- Starting soil test for the field:
  3.2 OM 6.2 pH 361 P2O5 178 K2O 79 Mg 800 Ca 9.9 CEC

	N	P	K	Mg
Control (GSP)	201	180	234	46
Reduced Fertility	51	0	134	21

“Accidental” Fertility Trial

“Accidental” Fertility Trial

	Total Yield cwt/ac	% Smalls	% 10 oz	% Total Defects	Spec. Gravity	M. Yield cwt/ac	$/acre*
Check	347.6	3.5	46.2	14.2 a	1.083 a	297.6	$3835
Low Fert	322.2	5.1	28.2	2.5 b	1.094 b	288.2	$3858
Diff	**-25.4**	**+1.6**	**-18.0**	**-11.7**	**+0.011**	**-9.4**	**+23**

- No difference in yield or crop value, despite 150 lbs less N and 180 lbs less P
- Low N rows were definitely lighter green, more upright
- Low Fert had significantly higher specific gravity
- Check (normal fertility) had 14% hollow heart. Low Fert had 2%
- Field was not lacking in P or K and had good pH, so field did not suffer.

“Accidental” Fertility Trial

- Obviously, I would never recommend reducing this much fertilizer. However, it shows that there is room to explore reducing fertility rates, especially on newer varieties that are more efficient/disease resistant.

- Most soil tests I get back are 300-400 ppm for P or higher. **More P than a crop would use for 10 crops of potatoes**

- In this year of high fertilizer prices, take a look at your soil tests and your varieties, and consider how much fertilizer you really need. Do a few reduced N and P strips in your fields.

Cover Cropping before Potatoes

- Tillage in late August/early September, followed by cover crop seeding.
- Gets land prepared early (before harvest), lots of time for healthy, green cover crop to protect from soil erosion, feed the soil.
- Winter kills, so doesn't need to be sprayed or extra tillage in the spring.

- In some other areas, we've also seen evidence of an improvement in marketable yield following cover crops for potato/vegetable crops.

Cover Cropping before Potatoes

Cover Cropping before Potatoes – 2020 data

Trial/Treatment	Total Yield (cwt/ac)	% Smalls	% Over 10 oz	Specific Gravity	Marketable Yields (cwt/ac)	Crop Value ($/Acre)
Field 1:Mustard/Oats	**+27.2**	-0.7	-8.2	-0.001	+17.7	+231
Field 2: Barley	+2.6	-1.9	**+5.0**	+0.001	+8.9	+118
Field 3: Barley	**+59.5**	**-9.6**	-4.1	NA*	**+69.0**	**+1196**
Field 3: Radish	**+47.2**	**-12.7**	**-5.0**	NA*	**+62.6**	**+1084**
Field 4: Radish	-12.4	-0.3	**+6.8**	+0.004	-21.3	-221
Field 4: Mustard	+9.2	+0.5	+1.5	-0.001	-8.5	-197
Field 5: Mustard	+13.7	+1.1	-1.6	+0.003	+12.3	+274
Field 6: Oats	**+55.9**	-6.5	+1.6	NA*	**+53.0**	**+914**
Average	+25.4	-3.8	-0.5	0.001	+24.2	425

Note: NA= Not Applicable. In this case not measured. Statistically significant differences are bolded.

Cover Cropping before Potatoes – 2021 data

Trial: Treatment	Total Yields (cwt/ac)	Specific Gravity	% > 10 oz	%Total Defects	%Smalls	Marketable Yields (cwt/ac)	Payables ($)
1: Rad-Mus	40.1	-0.001	**+15.7****	2.1	-2.4	35.9	446
2: Rad-Mus	5.1	0.001	1.3	**+7.2****	1	-18.5	-163
3: Mustard	0.3	-0.003	0.5	1.3	1.1	-7.5	-116
3: Radish	-18.4	-0.002	-5.8	2.4	1.3	-28.5	-366
5: Spring Barley	**+70.3****	0.003	1.0	**+2.9****	-2.9	**+68****	**+894****
7: Tillage Radish	-4.9	0.003	-0.8	-20.5	-4.7	**+86.7****	**+1107****
8: Oats	**+82.7***	**+0.007****	-4	-0.9	**+3.1****	**+65.3***	**+901***
Averages:	**+25.0**	**+0.001**	**+1.1**	**-0.8**	**-0.5**	**+28.8**	**+386**

Note: Rad-Mus= Radish-Mustard mix. Differences were determined by subtracted Check values from Cover Crop values. The bolded differences represent treatments where significant differences were detected at α=0.1 if including an * or at α=0.05 with two asterisks **.

Cover Cropping before Potatoes – 2021 data

Table 7: ANOVA output across 6 trials comparing all cover crops against check strips

	# Trt.	Total Yields (cwt/ac)	Specific Gravity	% > 10 oz	% Total Defects	%Smalls	Marketable Yields (cwt/ac)	Crop Value ($)
Check	6	**305.9 b****	1.082	18.1	11.4	8.9	**247.6 b****	**3140 b****
Cover	7	**335.2 a****	1.085	18.7	9.3	8.0	**284.9 a****	**3658 a****
Difference	0	+29.3	+0.003	+0.6	-2.1	-0.9	+37.3	+518

Note: The values within the same column not sharing a letter grouping are significantly different from each other, as bolded in the table. Differences were detected at α=0.1 if including an * or at α=0.05 with two asterisks **.

Cover Cropping before Potatoes – 2021 data

- So far, there appears to be a **25 to 30 cwt/acre improvement in marketable yield** the following year, just by growing a cover crop.

- Too early to tell which cover crops perform better…but working on that. Planting date, seeding rate, method of planting all important.

- This is in addition to all of the other long term benefits of cover-cropping: reduced soil erosion, increased soil OM, improved soil health

- **Cost of cover crops: $40-50/acre**
  Improvement in crop value: ~$400/acre so far in this study

Thank You!

www.peipotatoagronomy.com

Ryan Barrett, P. Ag., CCA-AP

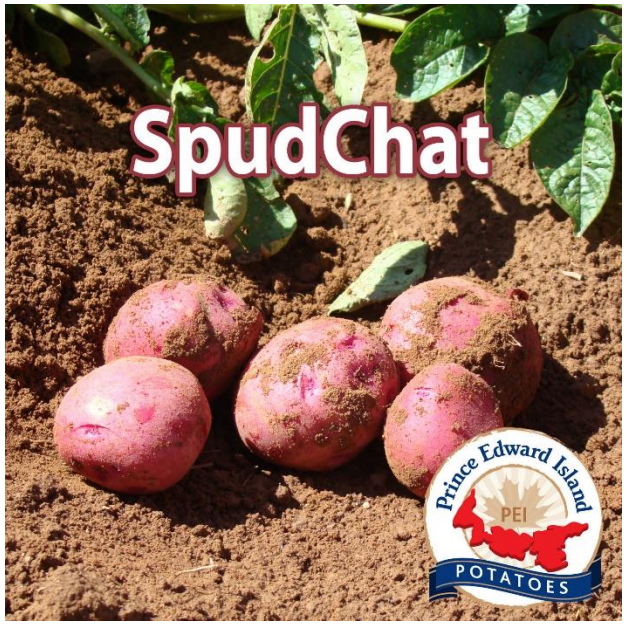
Research & Agronomy Specialist

PEI Potato Board

Tel: (902) 439-9386

Email: ryan@peipotato.org

@rbarrettPEI



AIM Funding Partners

Prince Edward Island PEI POTATOES

Prince Edward Island CANADA

Les Fermes Cavendish Farms