Additional 2019 AIM Seed Projects

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AIM Seed Management Trials

- Ethylene for Seed Accumulation
- Seed Refrigeration Trial
- Seed Generation Trial
- Individual Seed Management Demos with Individual Growers

Introducing Ethylene…

- Ethylene is a natural gas produced by many vegetables/fruit during ripening/storage

- Produced in substantial quantities by apples in storage

- In potatoes, exposure to ethylene has two effects:
  - Can break apical dominance and cause more eyes to sprout
  - Acts as a sprout inhibitor as long as ethylene gas is present

Restrain

- Company based in United Kingdom
- Electric generator that creates ethylene gas from liquid ethanol, sensors keep ethylene gas at constant ppm in storage
- Can be used for sprout inhibition in table or seed potatoes
- A higher concentration of ethylene has been shown to produce more stems/tubers per plant in certain varieties

Year 1 of Trial - 2018

- AIM Seed Working Group wished to see how ethylene gas would effect seed from 5 processing varieties
  - Russet Burbank, Shepody, Prospect, Ranger Russet, Dakota Russet
- Also assessed 3 privately controlled fresh market varieties, two of which were creamer varieties
- Seed from each variety was split between treated and not treated, with the same storage conditions
  - 4 C through majority of storage period, 95% RH
  - Warmed up to 10 C a week before planting

2018 Trial

2018 Trial

2018 Trial

- Planted to a seed standard, with tighter spacings and lower nitrogen fertility than commercial standard
  - RB and Ranger: 12 inches
  - Dakota and Shepody: 10 inches
  - Prospect: 9 inches

- Planted May 22nd at both sites
- Topkilled Sept 5th at Harrington, Sept 12th at AAT
- Harvested Sept 27th at Harrington, Sept 25th at AAT

Restrain

Agriculture and Agri-Food Canada

Accelerated Emergence

- Most varieties emerged faster from the ethylene treated seed than the control.
- Difference in emergence most noticeable for Dakota Russet and Russet Burbank. 2-3 days difference in full emergence
- All varieties had full emergence by late June/early July

Processing Varieties

Variety	Stems/ Plant	# tubers/ 6 m	Yield (cwt/ac)	Ave Tuber Wt (g)
R. Burbank (Ctrl)	4.5	175.7	289.7	113.0
R. Burbank (Eth)	4.6	230.5	315.7	88.3
Difference	0.1	**54.8**	26.0	**-24.7**
Dakota R (Ctrl)	1.9	130.9	250.9	120.1
Dakota R (Eth)	2.0	148.1	253.0	124.3
Difference	0.1	17.2	2.1	4.2
Ranger R (Ctrl)	2.9	160.9	229.1	91.8
Ranger R (Eth)	3.4	181.2	215.5	77.6
Difference	0.5	20.3	-13.6	-14.2

Bold were significantly different at p=0.05

Processing Varieties

Variety	Stems/ Plant	# tubers/ 6 m	Yield (cwt/ac)	Ave Tuber Wt (g)
Prospect (Ctrl)	2.7	148.4	310.8	140.1
Prospect (Eth)	2.6	136.1	304.9	146.0
Difference	-0.1	-12.3	-5.9	5.9
Shepody (Ctrl)	3.6	195.0	290.3	97.2
Shepody (Eth)	3.2	195.7	282.3	96.8
Difference	-0.4	0.7	-8.0	-0.4

General Observations

- Only Russet Burbank had significant difference (p=0.05) in tuber number among the processing varieties. Dakota and Ranger small numerical increase…will require a further year of study to see if repeated. Shepody and Prospect showed no effect.
- Where tuber number was increased, average tuber size generally decreased.

Year 2 of Trial - 2019

- 6 processing varieties evaluated
  - Russet Burbank, Ranger Russet, Dakota Russet (2nd year)
    Clearwater Russet, Mountain Gem Russet, Payette Russet (new)

- Also assessed 4 privately controlled fresh market varieties, two of which were creamer varieties

- Seed from each variety was split between treated and not treated, with the same storage conditions
  - 4 C through majority of storage period, 95% RH
  - Warmed up to 10 C a week before planting

2019 Trial

- Ethylene generator started on Feb 22.
- Temperature for treated seed kept at 7.5 C until April 8, then lowered to 4.0 C.
- Non-treated seed stored at 4 C, but with some daily temp fluctuation. Some varieties were sprouted a bit by planting.
- Ethylene generator turned off on May 23rd
- Temp increased to 10 C on May 24
- Both sites planted on May 29th
- Average seed piece size was the same between treatment and control, very little variation in size within rep.

2019 Trial

- Spacing: 9 inch for Ranger, Mountain Gem, Payette, Dakota
  11 inch for Russet Burbank, Clearwater Russet

- Total N: 105 lbs/acre for Dakota, 120 lbs/acre for rest
  Total P: 105 lbs/acre
  Total K: 180 lbs/acre

- Planting Dates: May 29 (Harrington), June 4 (AAT)
- Top-killing Dates: Sept 6 (Harrington), Sept 10 (AAT)
- Harvest Dates: Sept 30 (Harrington), Oct 7 (AAT

Accelerated Emergence

- Most varieties emerged faster from the ethylene treated seed than the control. Very variety dependant, but improved full emergence by up to 4-5 days for some varieties

- All varieties had full emergence by early July except for Payette Russet. The Payette control only reached 90% emergence, while the Payette ethylene treatment reached 99% emergence.

Processing Varieties

Bold were significantly different at p=0.05

Variety	Stems/ Plant	# tubers/ m2	Yield (cwt/ac)	Ave Tuber Wt (g)
R. Burbank (Ctrl)	2.55	37.0	301.3	92.3
R. Burbank (Eth)	3.53	45.6	326.4	81.8
Difference	**0.98**	**8.6**	**25.1**	**-10.5**
Dakota R (Ctrl)	2.17	28.7	300.0	117.1
Dakota R (Eth)	2.24	32.7	306.2	106.0
Difference	0.07	4.0	6.2	**-11.1**
Ranger R (Ctrl)	2.97	37.4	247.1	73.7
Ranger R (Eth)	3.05	39.8	254.0	72.2
Difference	0.08	2.4	6.9	-1.5
LSD (p = 0.05)	0.33	4.8	21.8	8.66

Processing Varieties

Bold were significantly different at p=0.05

Variety	Stems/ Plant	# tubers/ m2	Yield (cwt/ac)	Ave Tuber Wt (g)
Clearwater (Ctrl)	4.77	45.8	265.3	65.4
Clearwater (Eth)	4.61	46.3	277.4	67.2
Difference	-0.16	0.5	12.1	1.8
Mountain Gem (Ctrl)	4.03	41.3	361.3	99.2
Mountain Gem (Eth)	4.07	43.9	364.1	93.7
Difference	0.04	2.8	2.8	-5.5
Payette (Ctrl)	3.88	39.0	245.8	75.2
Payette (Eth)	4.32	44.7	270.9	70.6
Difference	**0.44**	**5.7**	**25.1**	-4.6
LSD (p = 0.05)	0.33	4.8	21.8	8.66

Fresh Market Varieties

Variety	Stems/ Plant	# tubers/ 6 m row	# of tubers 30-45 mm	Total Yield (cwt/ac)
Creamer 1 (Ctrl)	5.13	684.5	526.8	258.3
Creamer 1 (Eth)	5.53	539.3	371.5	231.9
Difference	0.4	-		
Creamer 2 (Ctrl)	5.13	440.3	292.5	217.8
Creamer 2 (Eth)	5.75	421.0	267.3	227.6
Difference	0.62			
Round White 1 (Ctrl)	2.40	138.0	25.0	190.3
Round White 2 (Eth)	2.18	138.5	21.5	203.7
Difference	-0.22			
Long White 1 (Ctrl)	2.85	200.5	41.5	228.0
Long White 1 (Ctrl)	3.20	240.0	53.8	266.0
Difference	0.35			

General Observations

- **Russet Burbank and Payette Russet showed significant effect of ethylene use** on both total yield and number of tubers.
- For the 2nd year, **Dakota Russet showed a trend toward a moderate effect on tuber number** but not significant at p=0.05. Effect on tuber size was significant.
- Other varieties showed no significant effect on tuber number, stems or tuber size.
- Creamer varieties did not respond as anticipated (fewer small tubers). Number of stems was higher, however.

Considerations

- For the processing varieties, **exposure to ethylene was not a negative**, so treating a storage with multiple varieties not likely to have a negative effect.
- BMPs for ethylene usage in Europe **allows for storage at higher storage temperature.** This would increase physiological age without sprouting, which is associated with more stems and higher tuber numbers. May be important for varieties that didn't respond to ethylene alone.
- For creamer varieties, may require more precise management or different concentrations of ethylene. More study would be recommended.

Seed Refrigeration Trial

- 2018 trial results on Russet Burbank were promising, so wanted to continue the trial in 2019 with additional varieties.

- Purpose: to assess how keeping seed cool for longer ahead of planting may impact yield and quality in the commercial crop

Summary Table for Refrigerated Seed Trial 2018

Treatment	Total Yield cwt/ac	% small	% 10 oz	Good Tubers cwt/ac	Crop Value
Lot A refrigerated	511	21	7	380	4903
Lot A conventional	511	30	4	342	4296
difference	**0**	**-9**	**3**	**38**	**607**
Lot B refrigerated	498	19	15	380	4809
Lot B conventional	452	26	17	314	4143
difference	**46**	**-7**	**-2**	**66**	**666**
Lot C refrigerated	486	18	14	380	4892
Lot C conventional	494	24	10	352	4535
difference	**-8**	**-6**	**4**	**28**	**357**
Lot D refrigerated	433	20	16	304	3988
Lot D conventional	460	19	19	342	4437
difference	**-27**	**1**	**-3**	**-38**	**-449**
Average difference	**3**	**-5**	**1**	**24**	**295**

Seed Refrigeration Trial

- Worked with Genesis Crop Systems again.
  Two field locations (west and east)
  Four varieties (R. Burbank, Dakota R., Ranger R., and Clearwater R.)
  Measured storage temperatures at both locations (conventional and refrigerated)

- Due to cool May temperatures, **there was next to no accumulated degree-day difference between two storages.** As a result…we saw no differences in the field. In the future, we should ensure that the "conventional" storage will warm up for good research results!

Seed Refrigeration Trial

West Prince Site

Variety	Total Yield cwt/ac	Defect %	Smalls %	10 oz %	Specific Gravity	$/acre
Russet Burbank	409	10	8	30	1.094	$4737
Ranger Russet	440	5	9	32	1.100	$5147
Dakota Russet	502	24	8	23	1.092	$4734
Clearwater Russet	337	9	17	11	1.093	$3369

Seed Refrigeration Trial

East Kings Site

Variety	Total Yield cwt/ac	Defect %	Smalls %	10 oz %	Specific Gravity	$/acre
Russet Burbank	473	5	10	29	1.083	$4994
Ranger Russet	502	6	8	36	1.080	$5470
Dakota Russet	453	16	12	15	1.072	$4463
Clearwater Russet	443	4	12	18	1.078	$3786

Seed Refrigeration Trial

- Dakota Russet had high defect levels at both sites due to rot. Issue with blackleg in the seed, possibly.

- Clearwater Russet performed the worst at both sites, particularly lower at Western trial site

- Yields calculated using 14.5 multiplier, hand-planted, hand-cut

Future Physiological Age Research

- This year, we will be comparing a “winter warm up” of approximately 165 degree-days on Prospect, Mountain Gem, Clearwater, Payette and Dakota versus normal storage temperatures

- We will also compare refrigeration in May for Russet Burbank and Alverstone Russet versus conventional seed storage temps.

- Planted at two sites, replicated plot trial in grower fields

Seed Generation Trial

- Question from growers: ***Is there a yield advantage to planting earlier generation seed for the commercial crop?***
- We did a trial in 2017, but we lost some of our trials before harvest. As well, the seed was from the same grower but not the same field, so hard to say that any difference was truly due to the generation alone
- So, we worked with a grower in 2018 to produce Russet Burbank seed of multiple generations side by side in the same field so that they would have exactly the same growing conditions/management

Seed Generation Trial 2019

- Three Sites (2 in Kensington area, 1 in Souris area)
- E2 compared with E3 Russet Burbank, planted side by side
- Four 10 foot strips at harvest in each variety. One site was also able to get bulk truck weights
- No visual differences observed in the field between varieties at any locations

Seed Generation Trial 2019

Site	Seed Class	Total Yield cwt/ac	M. Yield cwt/ac	Defects %	Smalls %	10 oz %	Specific Gravity	$/acre
K'ton A	E2	277	194	2.4	32.5	4.8	1.083	$2123
	E3	248	171	0.9	34.1	6.1	1.083	$1837
K'ton B	E2	274	199	10.7	24.3	20.4	1.078	$2209
	E3	262	206	4.2	22.9	21.0	1.077	$2171
Souris	E2	367	**323 a**	1.7	14.3	10.4	1.080	**$3251 a**
	E3	333	**271 b**	0.0	22.4	6.0	1.080	**$2754 b**

Bold are significantly different at 90% confidence level but not at 95% confidence level

Seed Generation Trial 2019

Seed Class	Total Yield cwt/ac	M. Yield cwt/ac	Defects %	Smalls %	10 oz %	Specific Gravity	$/acre
E2	306	239	4.9	23.7	11.9	1.080	$2528
E3	281	216	1.7	26.5	11.0	1.080	$2254

No significant difference between performance of E2 and E3 seed.

Truck weights at one site were almost identical in total weight.

At one site that showed significant difference at 90% level, the E2 rows were next to a terrace, which may have had an impact on soil conditions/moisture

Two sites were extremely dry with late planting, lack of rainfall

Seed Generation Trial

- From data in 2017 and 2019, haven't seen significant difference in yields or quality due to different generations of seed.

- All of our trials have been on earlier generation (Elite) seed, as that is what we could get that met the requirements of the trial. May seed different results if comparing E3 vs E4 or Foundation

- Factors which may have more importance:
  Virus Level, Physiological Age, Seed Health, Tuber Size Profile

Seed Management Demos with Growers

- Worked with individual seed growers to evaluate how changes in management would impact yield/size profile.

- Key Question: ***Can we produce a smaller size profile of seed that will require less cutting/waste without sacrificing yield?***

Seed Management Demos with Growers

Farm A: Kings County Comparing 3 spacings and N reduction

	CWT/AC					Tubers per 10 ft			
	< 4 oz	4 – 8 oz	> 8 oz	Total		< 4 oz	4 – 8 oz	> 8 oz	Total
High N – 11 inch	96	180	11	287		45.3	39.7	1.7	86.7
Low N – 10 inch	104	152	20	275		50.3	38.7	3.0	92.0
Low N – 11 inch	154	134	6	294		72.7	32.3	1.0	106.0
Low N – 12 inch	123	150	15	289		62.0	36.7	2.3	101.0

Decreasing N rate by 40 lbs/acre there was no difference in total yield but an increase in total tuber numbers and a decrease in average tuber size.

Seed Management Demos with Growers

Farm B: Kings County Comparing N reduction

Treatment	0-5 oz cwt/ac	5-7 oz cwt/ac	7-10 oz cwt/ac	> 10 oz cwt/ac	Total cwt/ac	Tubers/ 10 ft
Shep | Low N	131	76	53	3	262	70
Shep | High N	95	94	82	12	283	66
RB | Low N	210	76	15	8	308	98
RB | High N	198	57	15	3	271	99

Decreased N rate by 40 lbs/acre for RB, 22 lbs/acre for Shepody.
Spacing: 7.5’’ for Shepody, 10’’ for RB
Noticeable difference in vine growth and senescence between high and low N rates

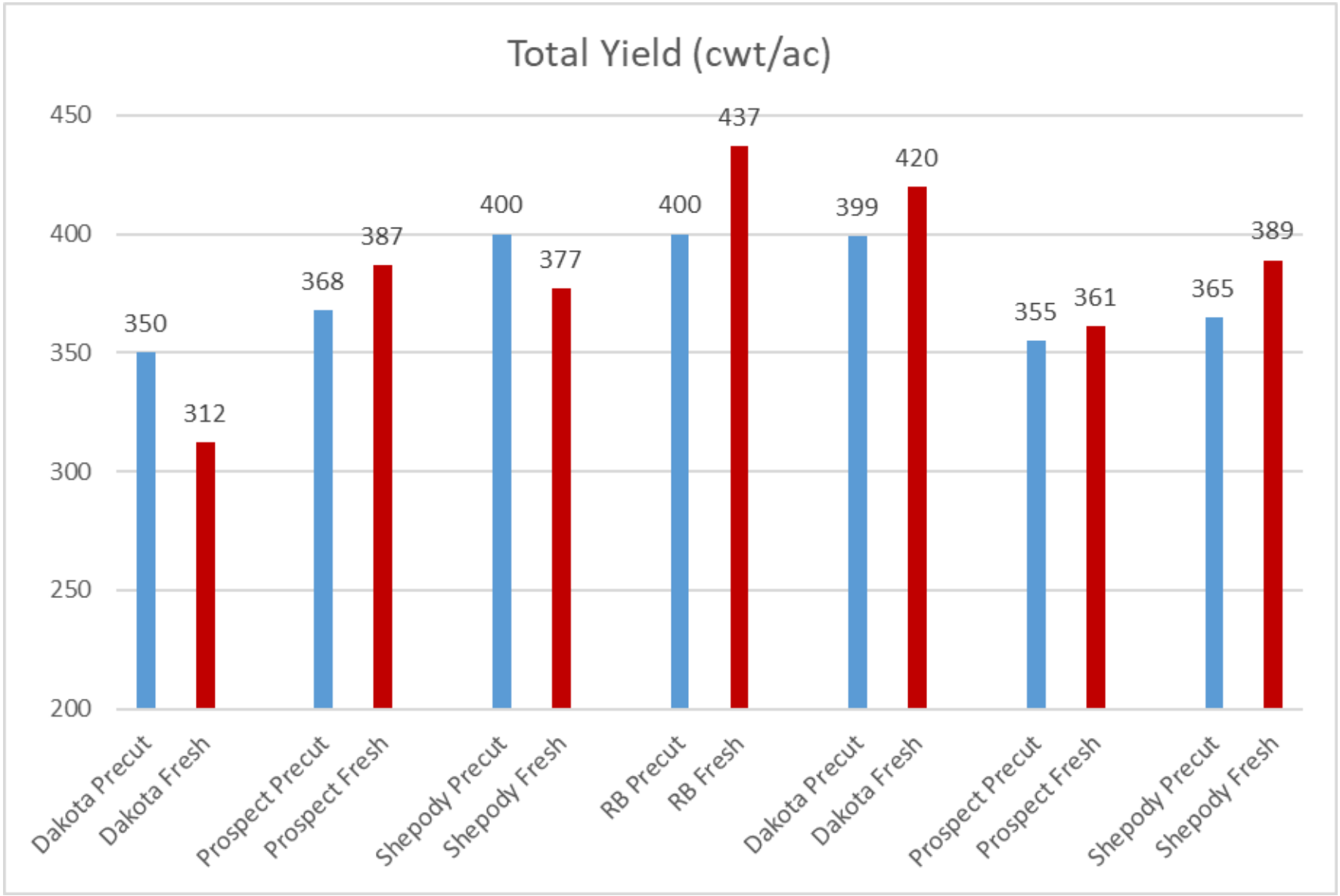
Seed Management Demos: Pre-Cut Seed

- Looking at whether pre-cutting seed would increase tuber numbers and decrease average tuber size while not sacrificing overall yield.

- In theory, **pre-cutting seed would increase physiological age** when compared with fresh cutting seed, which would normally increase stems/plant and tubers/plant.

- At two farms, **cut seed and stored for 3 weeks** compared with fresh cut at planting.

Comparing Pre-Cut with Fresh Cut



Demo Trial (2 plots/trt)
15 foot plots
Across two farms

No consistent trend in overall yields

At first farm, all pre-cut plots had higher tuber # per plot

At 2nd farm, only Shepody had higher tuber #s, other were the same.

High level of plot variability at first farm, less variable at second farm.

Any Questions?

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