

Seed Management

Research & BMPs

AIM Local Workshops
March 10th, 2021



Workshop Agenda:

- BMPs for producing a quality seed crop
- BMPs for handling/cutting seed
- BRR – Latest Update from CFIA
- Cleaning and Disinfection / Biosecurity

Key attributes of a quality seed lot:

- Free of disease
 - Virus: PVY, Leafroll, PMTV
 - Bacterial: Blackleg, soft-rot, BRR, common scab
 - Fungal: Rhizoctonia, Fusarium, Pythium, silver scurf, late blight
- Physiological age/maturity of seed
- Bruising/mechanical injury/suberization
- Managing Seed Size profile

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All of these are more or less determined by the time you receive your seed! They all need to be managed before they arrive at your farm or when you are growing your own seed.

Disease-Free Seed: PVY

- In 2015/2016, work in New Brunswick showed that **rate of PVY spread in a wheel track row could be 2x to 7x higher** than in a non-travelled row. (MacKenzie et. al, 2018, *Amer. Journal of Potato Research*)
- Last year, we did a small trial on 3 fields to see whether we could observe a difference in PVY from post-harvest tests in wheel tracks versus non-travelled rows.
- Chose 3 commercial fields with susceptible varieties (1 Shepody, 2 Mountain Gem Russet) and with higher starting levels of PVY (between 1.5 and 2.5%)

Disease-Free Seed: PVY

Field	% PVY Control Rows	%PVY Wheel Tracks	Difference
Shepody (Central)	0.0%	2.0%	+2.0%
M Gem (Central)	3.0%	2.0%	-1.0%
M Gem (West)	37.8%	39.2%	+1.4%

No obvious trend of increased PVY % in sprayer tracks

Western field had similar starting value of PVY but much higher rate of spread

All 3 fields used self-propelled sprayers with skinny tires and vine lifters

Disease-Free Seed: PVY

Field	Total Yield Control Rows cwt/acre	Total Yield Wheel Tracks cwt/acre	% diff	Market. Yield Control cwt/acre	Market Yield Wheel Tracks cwt/acre	% diff
Shepody (Central)	180.7	169.4	-6.2%	167.1	145.3	-13.0%
M Gem (Central)	236.7	213.9	-9.6%	217.8	197.1	-9.5%
M Gem (West)	470.2	418.5	-11.0%	460.2	405.5	-11.9%

Average Marketable Yield Reduction in Sprayer Tracks: 11.5%

Average Reduction in Crop Value: \$380

Disease-Free Seed: PVY

Best Management Practices to Minimize the Spread of PVY

compiled by Ryan Barrett, Research & Agronomy Coordinator, PEI Potato Board
based on research by Dr. Mathuresh Singh and research team, Potatoes New Brunswick

Over the past five years, the PEI Potato Board has supported research into improved management practices for Potato Virus Y (PVY) as part of the Canadian Horticultural Council's National Potato Research Cluster. This research has been led by Dr. Mathuresh Singh and his team at ACS Lab, operated by Potatoes New Brunswick. Dr. Singh's team has published several scientific papers resulting from their PVY research, and Mathuresh has also presented results to Island growers on multiple occasions. In this factsheet, we seek to emphasize some of the best management practices for management of PVY tested in this research project.

Minimizing the impact of PVY in potatoes requires a two-pronged approach: minimizing PVY inoculum in seed, and reducing the spread of PVY in the field. By examin-

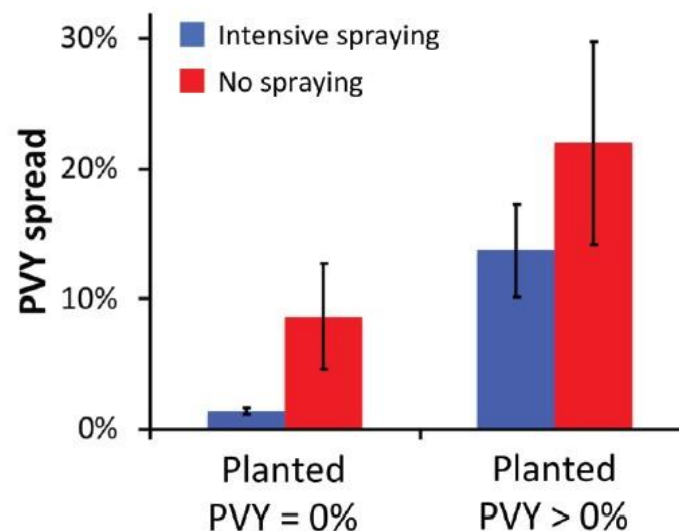
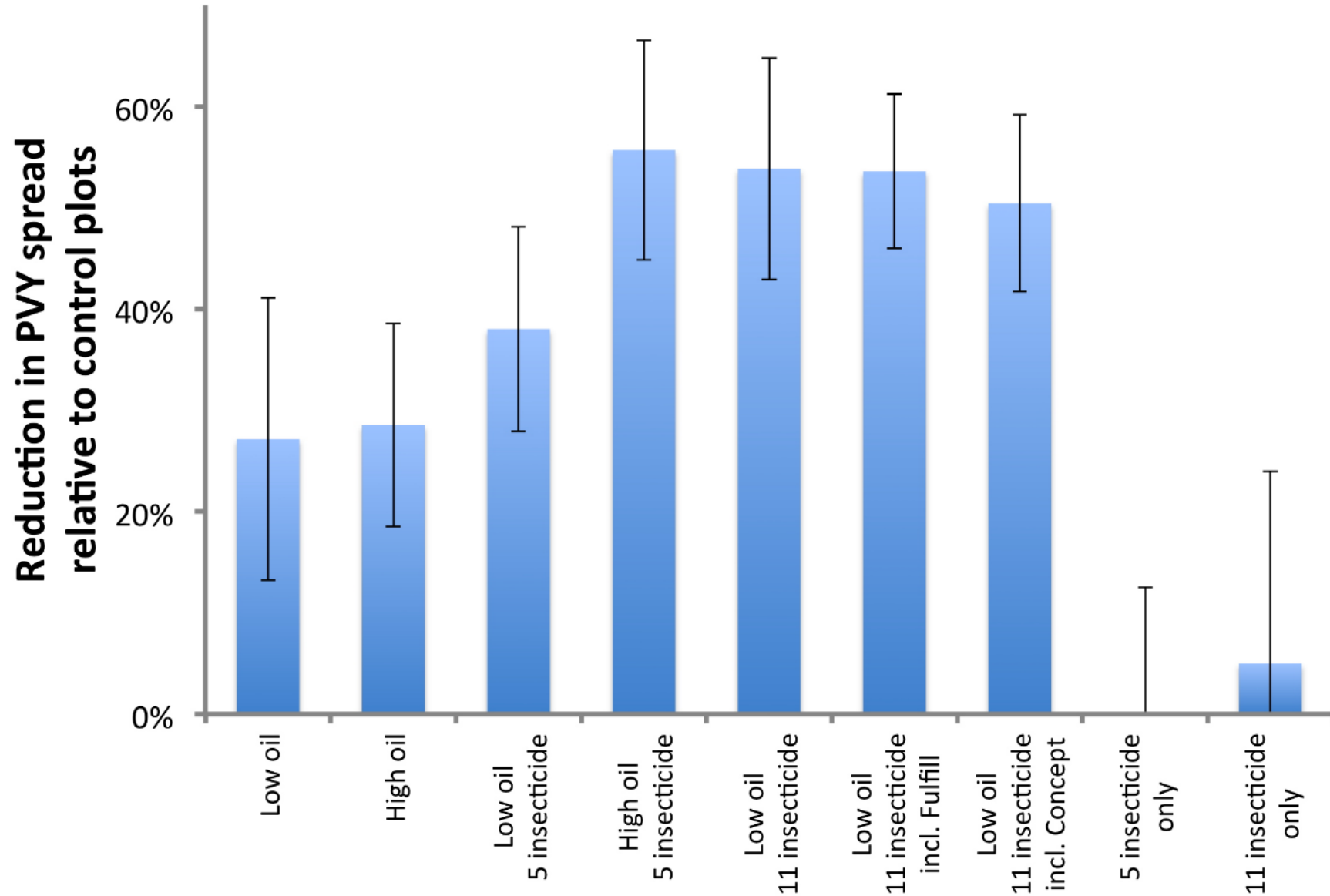
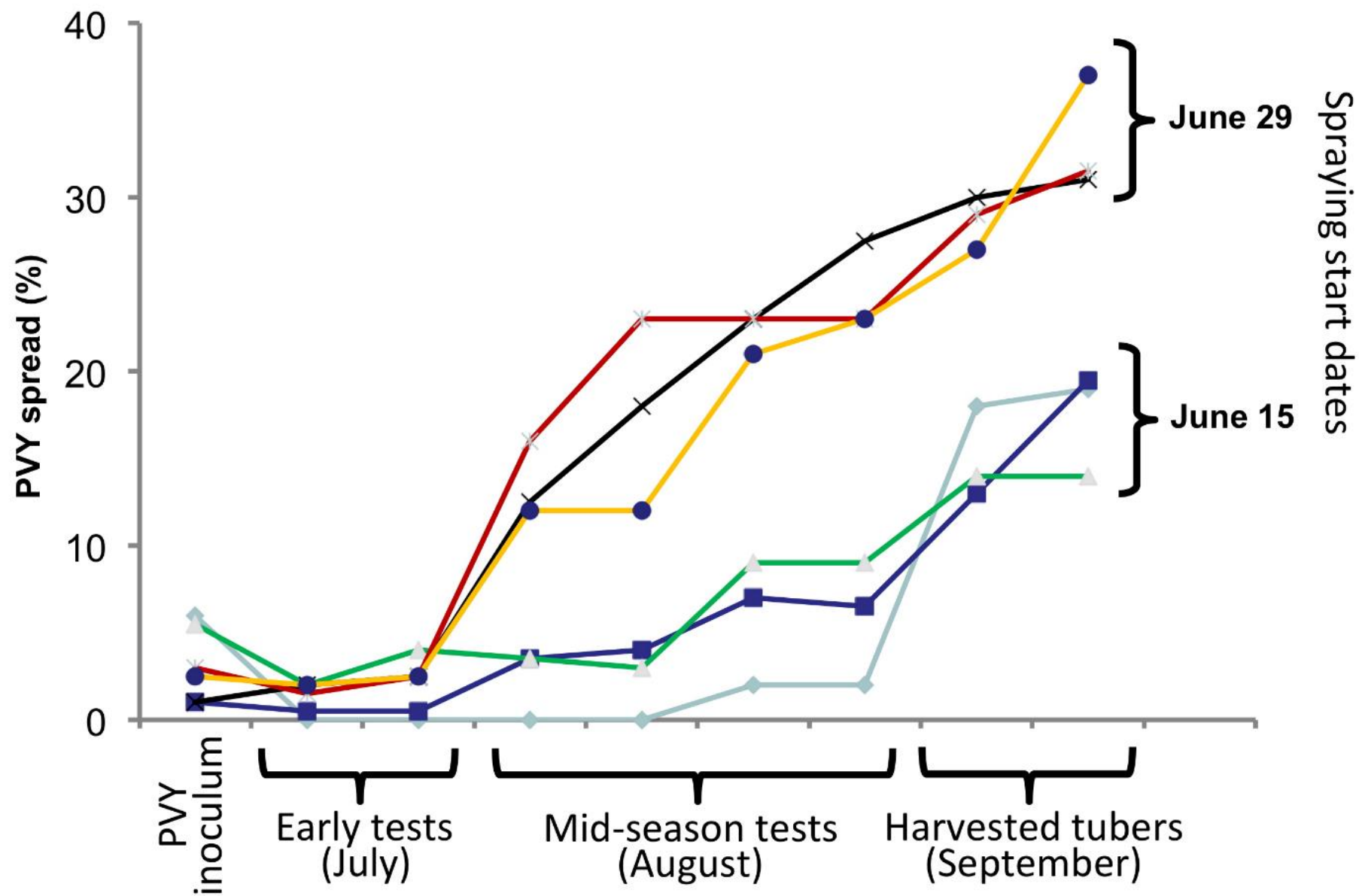


Figure 1: Effect of PVY inoculum planted in the field. Fields planted with no detectable PVY (Planted PVY = 0%) show much less PVY spread even than intensively managed

Disease-Free Seed: PVY



Disease-Free Seed: PVY



Disease-Free Seed: PVY

Key BMPs for keeping PVY levels low:

- Plant the lowest PVY seed available
- Weekly application of at least 2 L per acre of mineral oil from soon after emergence until shortly before top kill, combined with use of effective insecticides
- For particularly susceptible varieties, delaying planting to avoid early season aphids
- Early rogueing
- Isolation!
- Border Crops

Disease-Free Seed: Blackleg

- Growers are reporting increased incidence of blackleg recently
- Certain varieties are particularly challenging (Dakota Russet, Lamoka)
- In many cases, does not appear until late in the season after setting tubers, bringing blackleg rot into the storage



Disease-Free Seed: Blackleg

- Changing profile of bacterial species which cause blackleg, as well as impact of changing weather patterns.
- New, aggressive blackleg species: ***Pectobacterium parmentieri***
- **More easily spread through cutting/handling of seed**



Disease-Free Seed: Blackleg

- Preliminary research in the UK links blackleg spread to high nematode #s
- #1 management tool: CLEAN SEED
- #2 management tool: PROPER SEED HANDLING/CUTTING



Disease-Free Seed: Other Pathogens

- Seed should be free of common scab, silver scurf, Fusarium, Rhizoctonia, etc.
- Pay close attention to the quality of your seed before cutting.
- Clean and disinfect between seed lots (more on that later!)
- If you have emergence issues or evidence of seed piece decay...send in a sample to the Plant Pathology Lab.

Seed Cutter Disinfection

Photos courtesy Bluefield Acres



3 small booms with flat fan nozzles
Spray for 10 seconds every 4 minutes when cutter was running

Seed Cutter Disinfection

Photos courtesy Bluefield Acres



Parts purchased from Ken Lingley.
\$2500 per unit (not including installation cost)

Physiological Age of Seed



Influenced by:

- Variety
 - End Use
 - Growing Conditions in previous year
 - Storage Temperature
-
- We can't turn the clock backwards!
 - Some varieties we may want to keep young (Burbank, Clearwater), others we may want to age (Prospect, Dakota, Payette)

Physiological Age of Seed

- Can we manipulate physiological age during seed storage to influence the resulting crop?
 - Number stems per tuber or tubers per plant
 - Faster emergence
- Can we add degree-days to seed without having it go out of condition (prior to breaking dormancy)?
- Can we keep seed cool for some varieties to reduce tuber number per plant and increase tuber size?

AIM Phys Age Trial | Genesis Crop Systems

Why is this important?

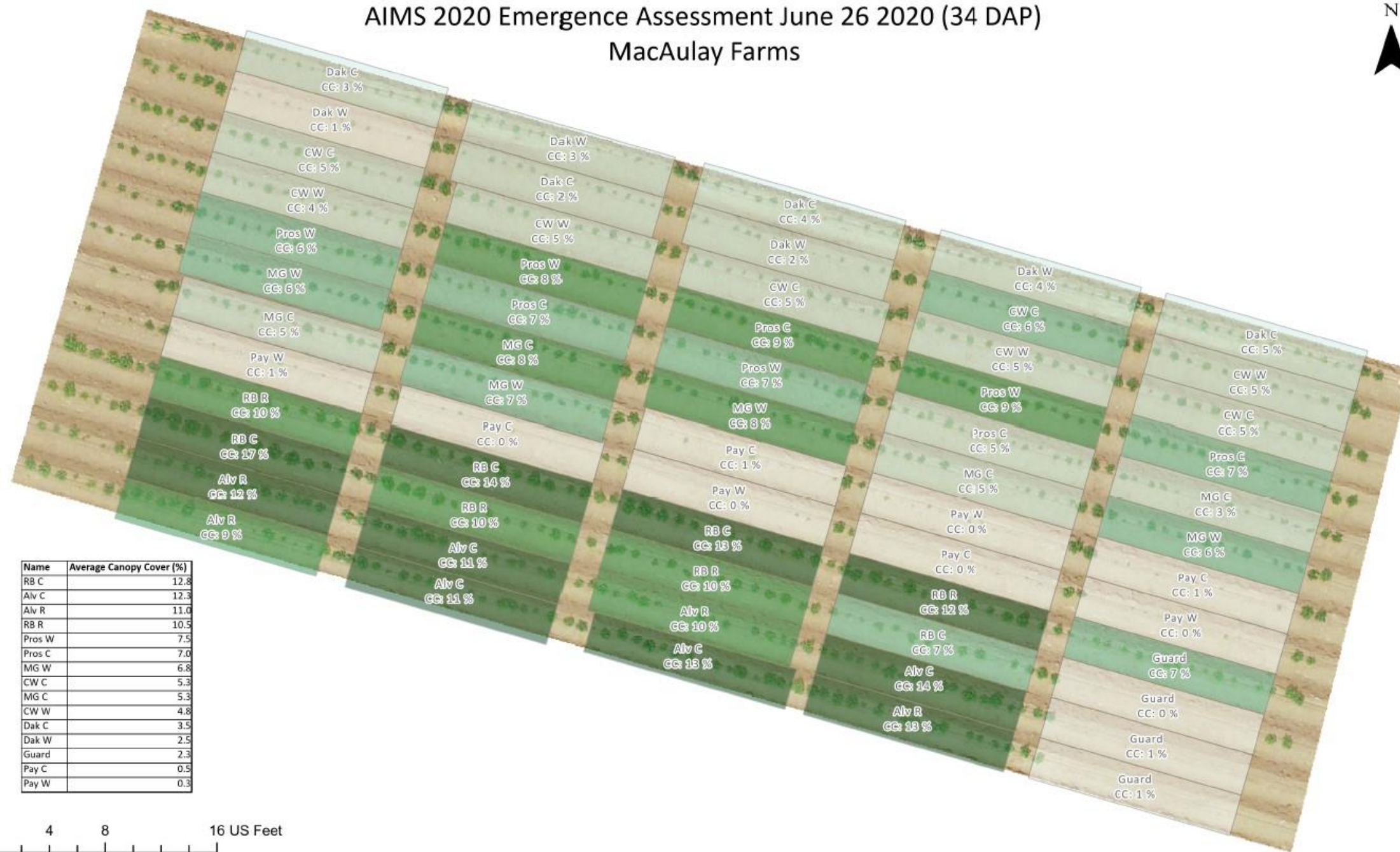
- We have a short growing season, and most varieties are bred for longer seasons.
- Certain varieties have very slow emergence (ie. Payette Russet) but great yield potential.
- Trying to balance yield with size and quality, particularly for certain varieties (ie. Alverstone Russet)
- **Can we add a week on to the front of the growing season, at a time of maximum sunlight?**



AIM Phys Age Trial | Genesis Crop Systems

- Two plot locations (Springfield West and St. Peters)
- 5 varieties undergoing “Winter Warm-Up” versus conventional storage:
 - Dakota, Clearwater, Prospect, Mountain Gem, Payette
- 2 varieties comparing Refrigerated versus conventional storage:
 - Russet Burbank, Alverstone Russet
- Temperature loggers accompanied seed in all storage conditions
- Winter warm-up: $15^{\circ}\text{C} \times 11 \text{ days} = \mathbf{145 \text{ degree-days}}$ more
- Refrigerated Seed: **223 fewer degree-days** than conventional storage
- All other variables were the same (seed source, fertility, spacing, etc)

MacAulay Farms



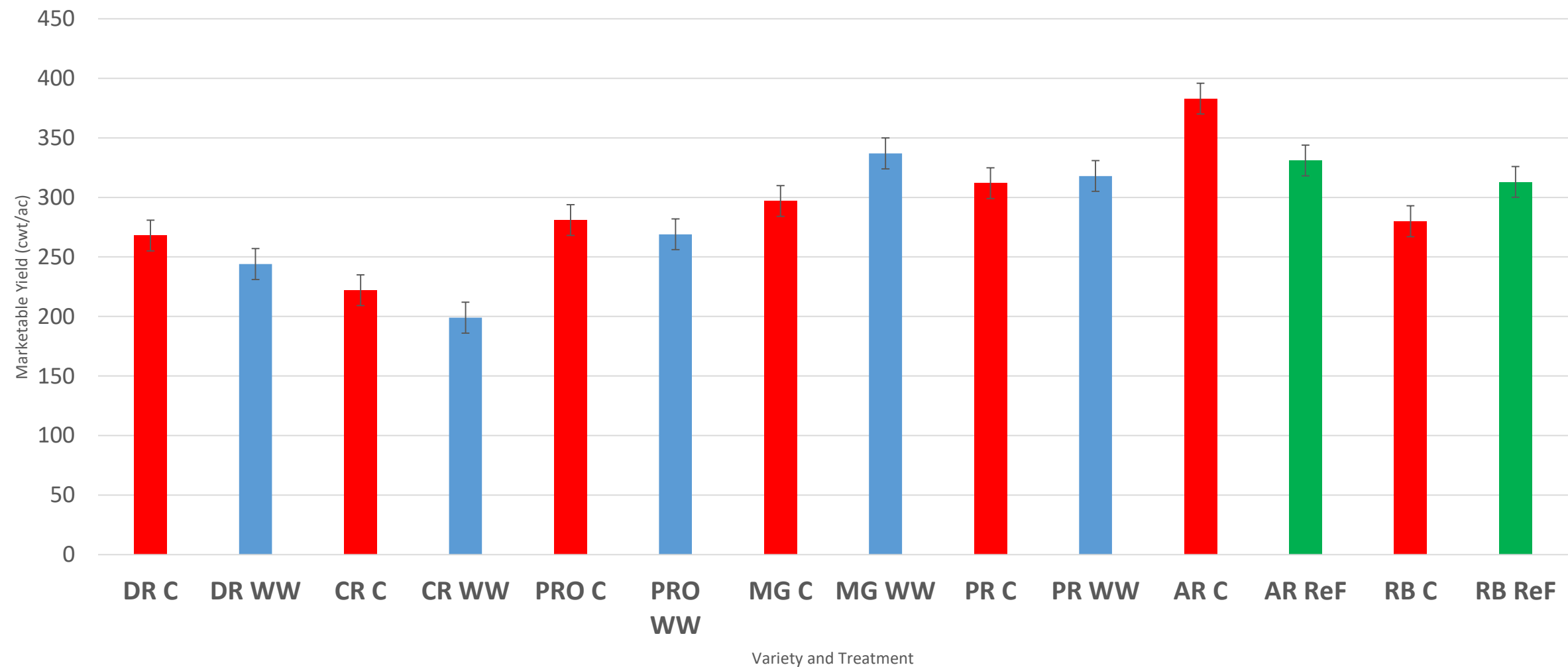
Name	Average Canopy Cover (%)
RB C	12.8
Alv C	12.3
Alv R	11.0
RB R	10.5
Pros W	7.5
Pros C	7.0
MG W	6.8
CW C	5.3
MG C	5.3
CW W	4.8
Dak C	3.5
Dak W	2.5
Guard	2.3
Pay C	0.5
Pay W	0.3



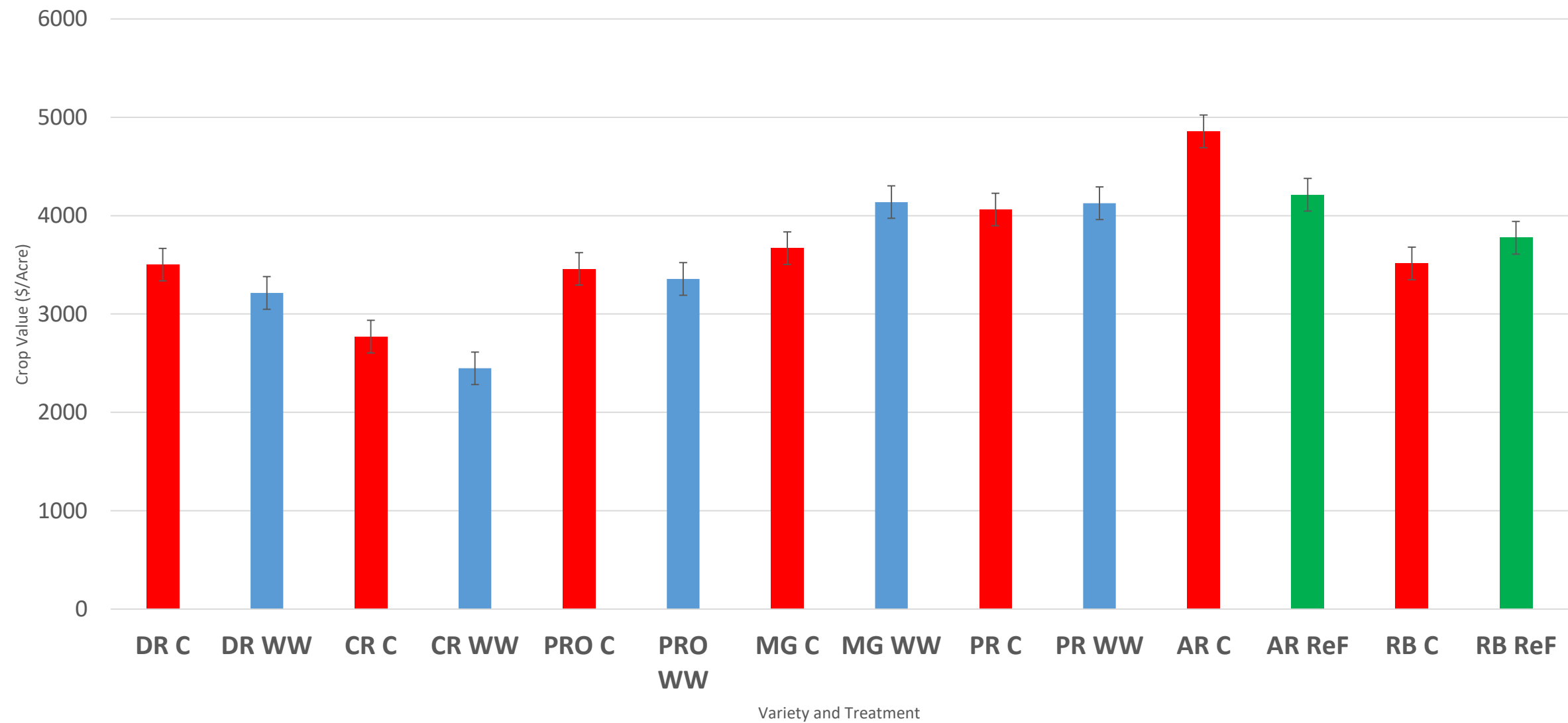


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Dak C	3.5
Dak W	2.5
Guard	2.3
Pay C	0.5

AIM Phys Age Trial | Genesis Crop Systems



AIM Phys Age Trial | Genesis Crop Systems



AIM Phys Age Trial | Genesis Crop Systems

Winter Warm-Up

- Only variety that showed significant difference: **Mountain Gem (+40 cwt/acre)**
- Other varieties not significantly different than zero on yield/quality
- Appeared to be slight increase in emergence for Winter Warmed, but not huge

Refrigerated Seed

- Alverstone Russet performed significantly **better under conventional** than refrigerated (-52 cwt/acre, -\$645/acre)
- Russet Burbank not stat. significant but similar trend to previous years of research (**+33 cwt/acre**, +261/acre in favour of refrigeration)

AIM Phys Age Trial | Genesis Crop Systems

Looking Ahead to 2021

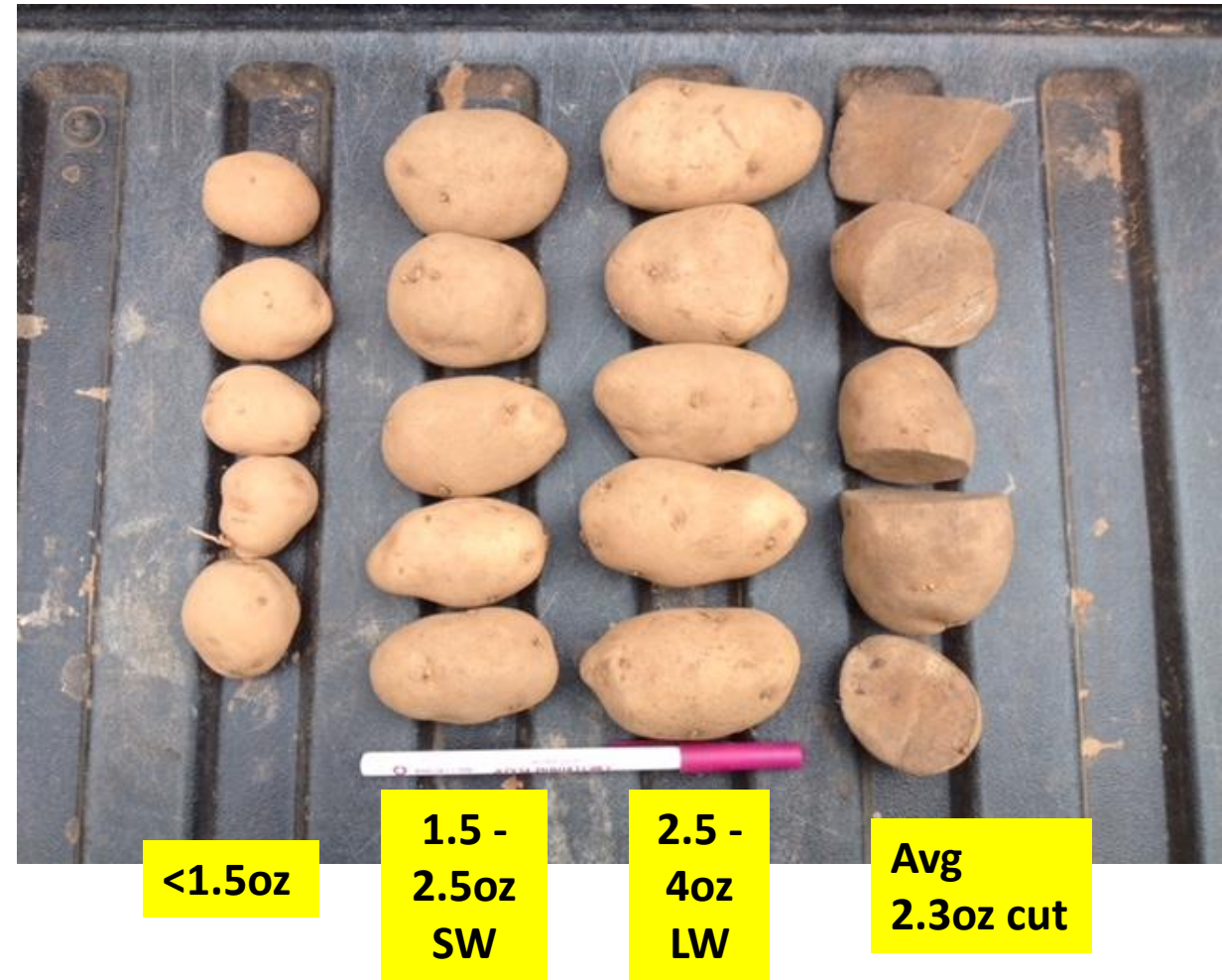
- Replicating this trial again at two plot locations (east and west)
- Increased number of degree-days for Winter Warm-up (up to ~175 DD)

Seed Size Profile

- AIM has been working on multiple trials in recent years with the goal of cutting less seed, while ensuring that the seed producer is still able to produce a profitable crop.
- Started with work looking at whole vs. cut seed comparisons
- In last couple of years, have focused on some other management practices that can influence the yield and size profile of seed
 - Nitrogen rate
 - Pre-cut vs Fresh Cut
 - In-row spacing

2016-2017 Whole Seed Project with GCS

- 3 sites each year for two years, multiple seed sources compared
- Russet Burbank and Prospect
- Treatments for each seed source:
 - Cut seed (15 in)
 - Small whole (12 in)
 - Small whole (15 in)
 - Large whole (15 in)
 - Large whole (18 in)
- Small whole seed was sized 1.5 – 2.5 oz
- Large whole seed was sized 2.5 – 4.0 oz
- Average cut seed size 2.3 oz



Ave. Difference from Cut Seed Across 2 Years

	Total Yield cwt/ac	% Defects	% Smalls	% > 10 oz	\$/acre
Cut Seed	0	0	0	0	0
SW12	19	-2	7	-9	41
SW15	7	-2	2	-5	-28
LW15	35	-3	7	-11	213
LW18	14	-2	3	-5	189

Results over Two Years of Whole Seed Trial

In comparing average difference from hand cut seed over two years (4 total sites), whole seed treatments produced:

- **The same or better total yield**
- Slightly fewer total defects
- 2-7% more small potatoes (under 2 inches)
- 5-11% fewer potatoes > 10 oz
- The same or better total crop value
- The larger sized whole seed (2.5 to 4.0 oz) consistently performed better for yield and crop value than the smaller whole seed or the cut seed.

Cut vs. Whole Seed Four Year Average

MJ Pavek, Washington State Univ., Russet Burbank 2015-2016, 2018-19

	Adjusted Gross	Total Yield	Market Yield > 6 oz	Ave Tuber Weight/Plant	Ave Tuber No./Plant	Ave Weight Per plant
	\$/A	CWT/A	%	Oz		Lbs
Whole	4990	773	75	8.4	8.8	4.6
Cut	4960	781	72	8.2	9.1	4.6
Sig. difference	No	No	Yes	Yes	Yes	No

Russet Burbank, gross return adjusted for seed price differences

NOTE: HAND CUT SEED USED
MACHINE CUT SEED WOULD LIKELY BE MORE VARIABLE

Whole Seed / Reduced Cutting Considerations:

- These trials all compared whole seed with hand cut seed. No commercial cutter can replicate the precision of hand cutting.
- A normal run of seed (1.5 to 10+ oz tubers) will have **highly variable seed piece size** at the end, lots of opportunity for trimmed eyes, slivers, etc.
- The size of the seed piece and the consistency of size appears to have more of an impact on marketable yield.
- Maximizing the amount of “**prime size**” seed (**less than 7 ounces**) significantly reduces the amount of cutting necessary.

Whole Seed / Reduced Cutting Considerations:

- Whole seed can be sized out and planted separately to improve consistency of emergence and in-row spacing.
- **Whole seed can be planted earlier (cooler ground)**, increasing the size of your planting window.
- Effect of apical dominance in some varieties, blind sets, few eyes/set, multiple cut sides requiring energy to suberize



Managing Seed Size | Reduced N

2019 Trial – Kings County

Treatment	0-5 oz cwt/ac	5-7 oz cwt/ac	Prime Seed	7-10 oz cwt/ac	> 10 oz cwt/ac	Total cwt/ac	Tubers/ 10 ft
Shep Low N	131	76	207	53	3	262	70
Shep High N	95	94	189	82	12	283	66
RB Low N	210	76	286	15	8	308	98
RB High N	198	57	255	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

Managing Seed Size | Reduced N

- 2020 trial – Eastern Kings
- Compared grower standard fertility program with modified fertility program
 - Nitrogen reduced by 33-57 lbs per acre
 - Potassium reduced by 13-48 lbs per acre
 - Cost savings of \$52-57/acre in fertilizer

Managing Seed Size | Reduced N

2020 Field Trials	< 7 oz tubers cwt/acre	> 7 oz tubers cwt/acre	Total Yield cwt/acre	Tubers/Plot
Shepody Low N	201	130	331	69
Shepody High N	175	119	294	64
R Burbank Low N	371	41	413	130
R Burbank High N	364	43	407	127

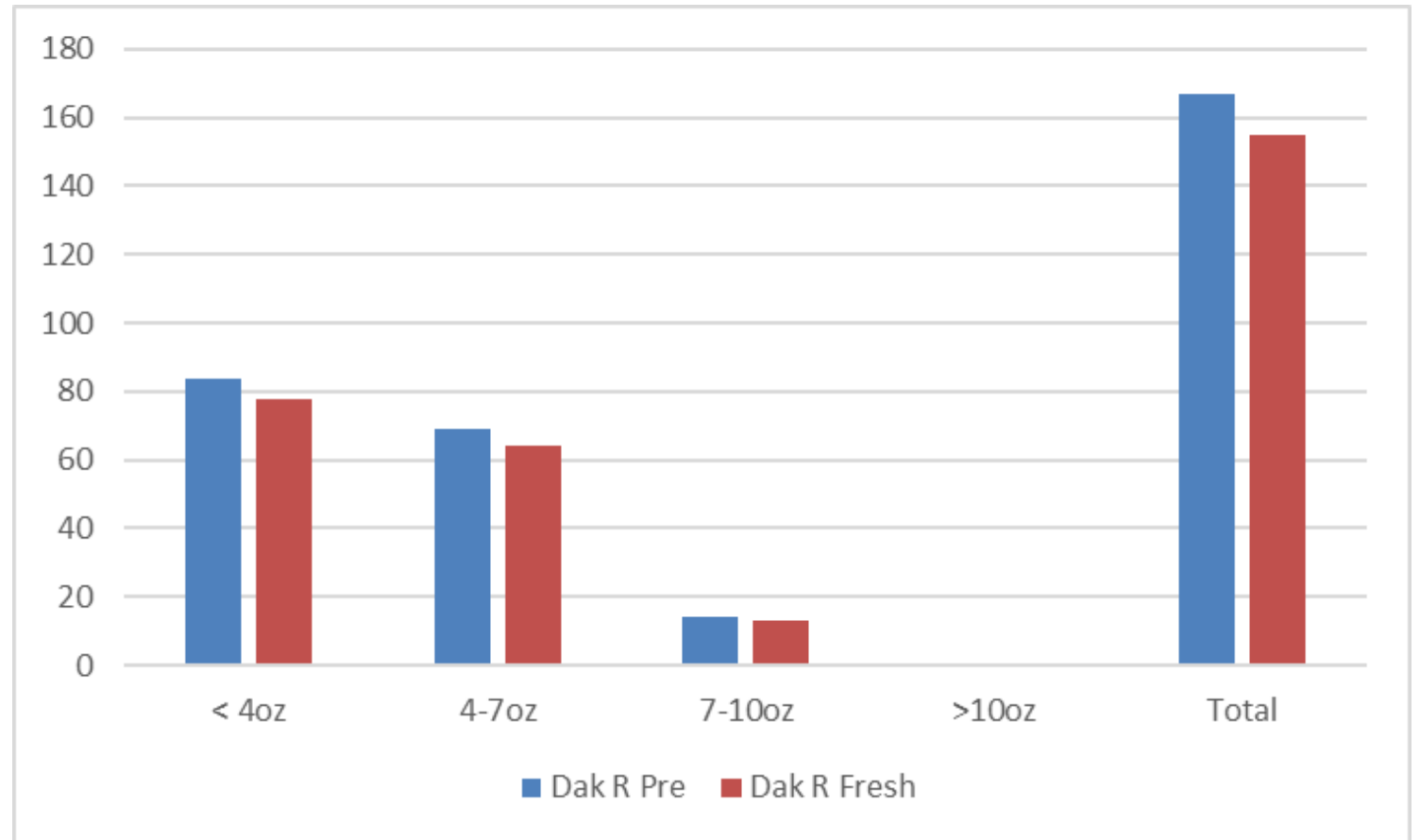
Managing Seed Size | Reduced N

2020 Field Trials	< 7 oz tubers cwt/acre	> 7 oz tubers cwt/acre	Total Yield cwt/acre	Tubers/Plot
Payette Low N	214	79	294	76
Payette High N	212	83	295	78
Mountain Gem Low N	258	53	311	75
Mountain Gem High N	277	33	310	86

Managing Seed Size | Pre-Cut/Fresh Cut

2020 results

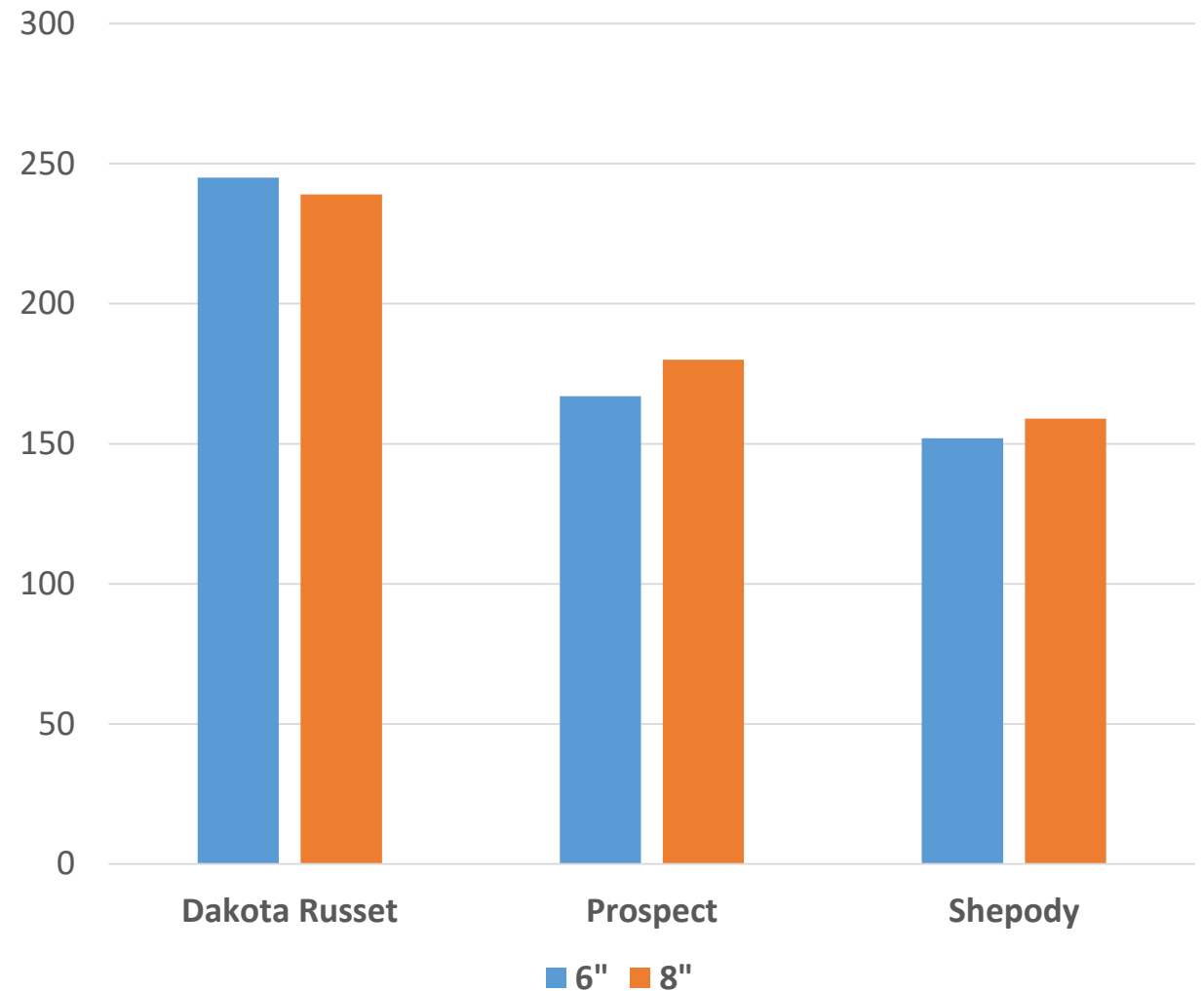
- Impacted by severe lack of moisture, corresponding low yields.
- No significant difference between pre-cut and fresh cut on four varieties (Dakota, Prospect, Shepody, Targhee)
- Difference in yield between 1 and 19 cwt/acre.
- No disadvantage to pre-cut



Managing Seed Size | Seed Spacing

2020 results

- Impacted by severe lack of moisture, corresponding low yields.
- No significant difference between 6 and 8 inch spacing for these 3 varieties.
- 6 inch spacing would have higher seed cost for appreciable gain in yield.



Managing Seed Size | Gibberellic Acid

GA has been proven to be useful for:

- Breaking dormancy
- Stimulating more eyes to sprout
- Increasing stem # and tuber # per plant
- Faster emergence?
- 1 g (1 tablet) does 1345 cwt of seed, so precise application is necessary



Managing Seed Size | Summary

Toolbox for producing a smaller profile run of seed without sacrificing overall yield:

- Warming up seed before planting
- Dial back the N
- Optimize in-row spacing
- Consider planting whole seed separately
- Gibberellic acid (GA)
- Narrower row width (34" vs 36")
- Pre-cut seed for varieties with strong apical dominance



Bruising/Mechanical Damage

Factsheet on PEI
Potato Agronomy
Site

Maximizing Crop Potential with Proper Seed Handling

based on presentation by Steve Holland, Holland Agricultural Services, WA
printed March 2017. Compiled by Ryan Barrett (ryan@peipotato.org)

Being Open to Improvement

The biggest opportunities for improved yields in potato production are often improvements to production practices which don't require spending significantly more. However, improvement requires changes from current practices to practices that produce consistently better results. Change is generally an evolution of refinement over time, examining steps in our production practices where practical and cost-effective improvements can be made.

Managing Seed for Optimum Yield Potential

There are few decisions as vital to producing a profitable crop of potatoes than purchasing high quality seed. Likewise, if you grow your own seed, ensuring that seed will provide you with the greatest potential for a large

seed), it is important to pay attention to the shape and size distribution of seed pieces coming out of your set cutter.

Generally, sets with larger weight (2.5 to 3.0 oz) are associated with improved emergence and performance. Conversely, small slivers and small tubers under 1.5 oz should generally be discarded, as their performance potential is often limited.

Additionally, having fewer cut surfaces per seed piece is also associated with higher yield potential. A seed piece with fewer cut surfaces is less susceptible to bruising or seed piece decay, and can better partition energy for wound healing.

Set Cutter Maintenance and Calibration:

Set Cutter Maintenance & Calibration:

- Sizing Roller Spacing: get the right sizes!
- Adjust flow volumes to ensure even cutting, minimal bruising
- Keep cutting knives sharp
- Check the horizontal knife for equal sized halves
- Open chip eliminator to discard pieces less than 1.5 oz
- ***Frequently take samples of your seed profile in order to make adjustments as necessary!***

BMPs for Seed Cutting:

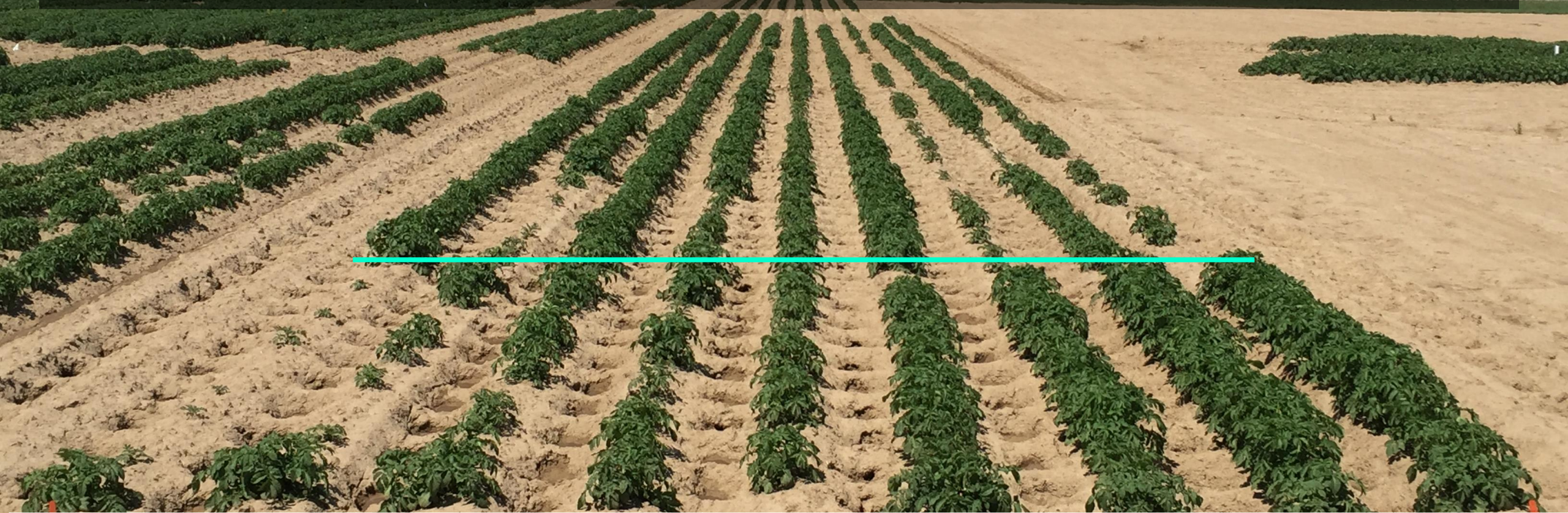
- Warm your seed up before cutting. Warmer seed temperatures encourages suberization, clean cutting
- Avoid drops, particularly for cut seed pieces. A drop of 6 inches onto an edge or corner will cause bruising almost 100% of the time at 50F
- Do not store or cut seed in a storage previously treated with CIPC
- Remove visibly diseased tubers before cutting
- Use a registered fungicide seed treatment on cut seed.
- Get your cut seed dried back down to avoid soft-rot decay. Don't pile cut seed very high, ensure proper ventilation.

Optimal Seed Piece Size

- Large seed piece size is associated with better yield.
- Cut seed pieces under 1.5 ounces generally struggle to produce a viable plant.
- Cut seed pieces between 1.5 and 2.0 ounces may establish but have reduction in yield.
- Consistently larger seed size may require adjustment to in-row spacing (variety dependent)

Clearwater Russet Seed Size Demo and Research

MJ Pavek, Washington State University, 2020



0.5 oz

0.75 oz

1.0 oz

1.25 oz

1.5 oz

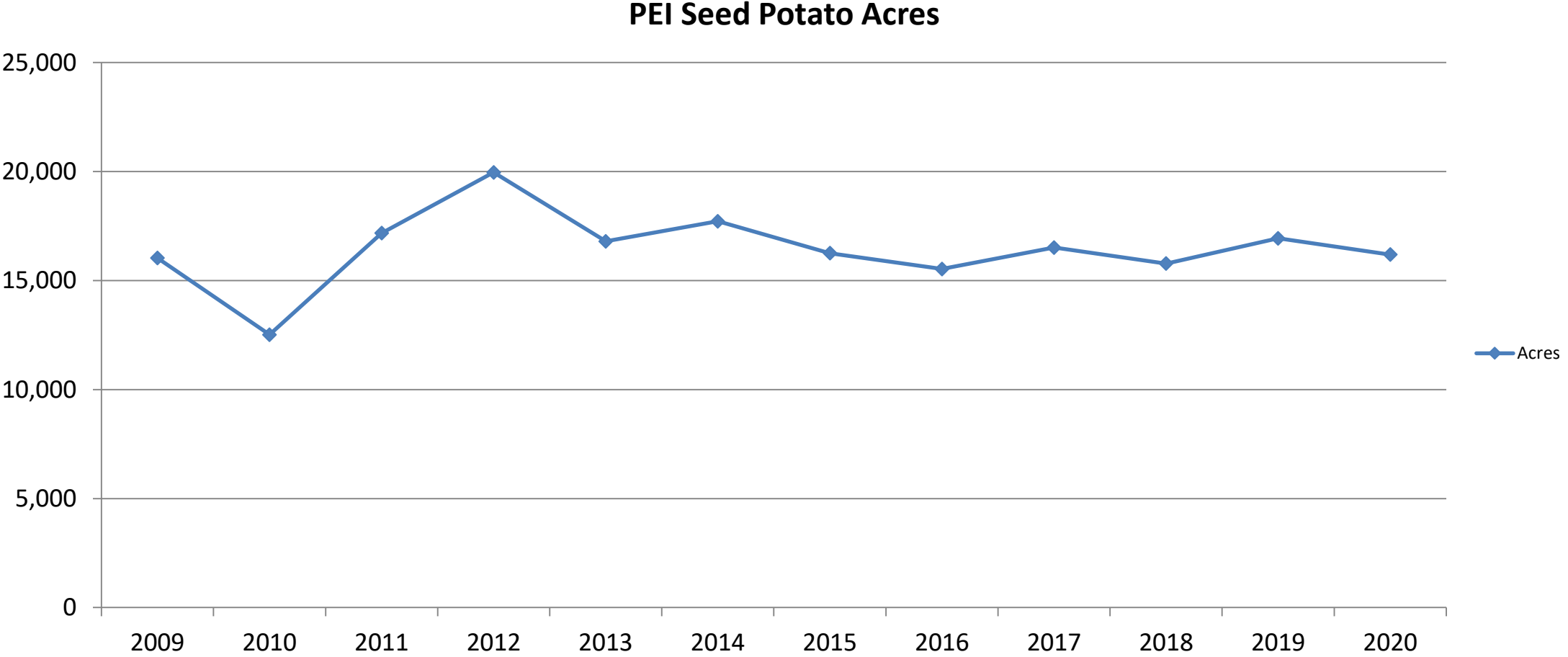
2.0 oz

2.5 oz

3.0 oz

3.5 oz

Seed Acreage on PEI



Post Harvest Test Results & Seed Availability

Pass rate by lots tested the past
number of years.

Year	% Visual Pass Rate	% PHT Pass Rate
2020	92.2	82
2019	97.7	84
2018	95.3	86
2017	99.2	88
2016	97.1	92
2015	96.2	77
2014	97.5	89
2013	96.8	78
2012	95.7	57
2011	92.2	80

2020 Pass Rates by Acre

- 81% by lot and by acre
- Russet Burbank – 76% by lot, 84% by acre
- Dakota Russet – 81% by lot, 90% by acre
- Goldrush – 55% by lot, 41% by acre

In most cases for major varieties, the percent passed was higher by acre than by lot.

Look Ahead to the 2021 crop...

- The largest impact on seed availability in NB and PEI is yield reduction due to the 2020 drought conditions.
- Specific varieties are experiencing a shortage as a result of decertification due to BRR cases.
- Seed availability page on the Board website:
<https://www.peipotato.org/pei-potato-industry/seed/seed-availability-listing>

Slides from CFIA

Cleaning & Disinfection

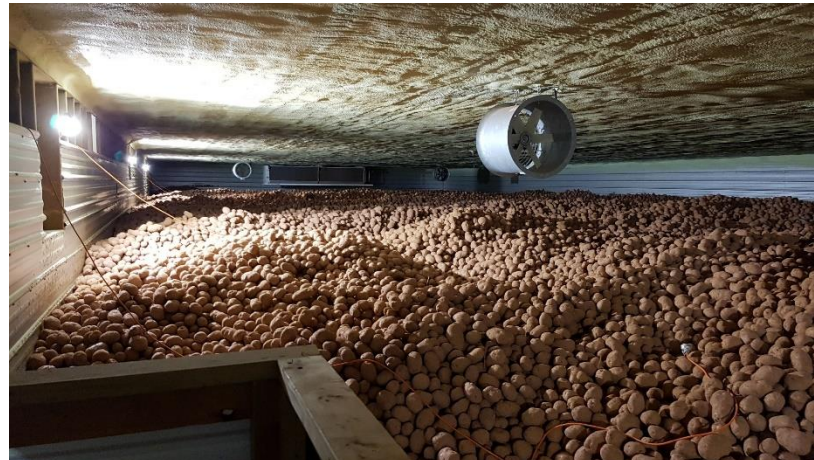
- What to clean?
- When?
- How?
- What products?
- Biosecurity policy and practices
- Resources



Photo: University of Idaho Extension

C&D: What to clean?

- Storage facilities
- Boxes
- Machinery
- Trucks



Courtesy:
Ron Howard

Materials	Sources	Ease of Sanitization*
Mild steel	Seed cutter, conveyor	Easy
Stainless steel	Potato washer	Easy
Galvanized steel	Plenums, wall sheeting	Easy to Moderately Difficult
Aluminum	Ventilation fan	Easy
Polyethylene/plastics	Vapor barrier, guards, covers	Easy
Foam padding	Conveyor sides, plenum joints	Difficult
Foam insulation	Walls, ceilings, truck beds	Moderately Easy to Difficult
Rubber	Belting, bumpers	Easy to Moderately Easy
High density paper	Humidicell material	Moderately Difficult to Difficult
Plywood	Wall sheeting	Moderately Easy to Difficult
Concrete	Floors, foundations	Moderately Easy to Difficult

* Easy → Moderately Easy → Moderately Difficult → Difficult

C&D: When to clean?

- Facility clean up – summer, between crops
- When moving seed
- Between lots when seed cutting
- When moving between farms



C&D: How to clean?

Cleaning & Disinfecting are a package deal!

1. Removal of visible soil and plant debris
2. Hose off with a power washer, using detergent if necessary to clean off any stuck on dirt or bacterial slime and to get into cracks and hard to reach places.
3. Thorough application of disinfectant and **keep surfaces wet for 20 minutes** (necessary to break down biofilms)

C&D: What products to use?

- General Storage Disinfectant
- Sanidate
- StorOx
- Industrial Bleach



Biosecurity | Visitors and Farm to Farm

How useful are footbaths?

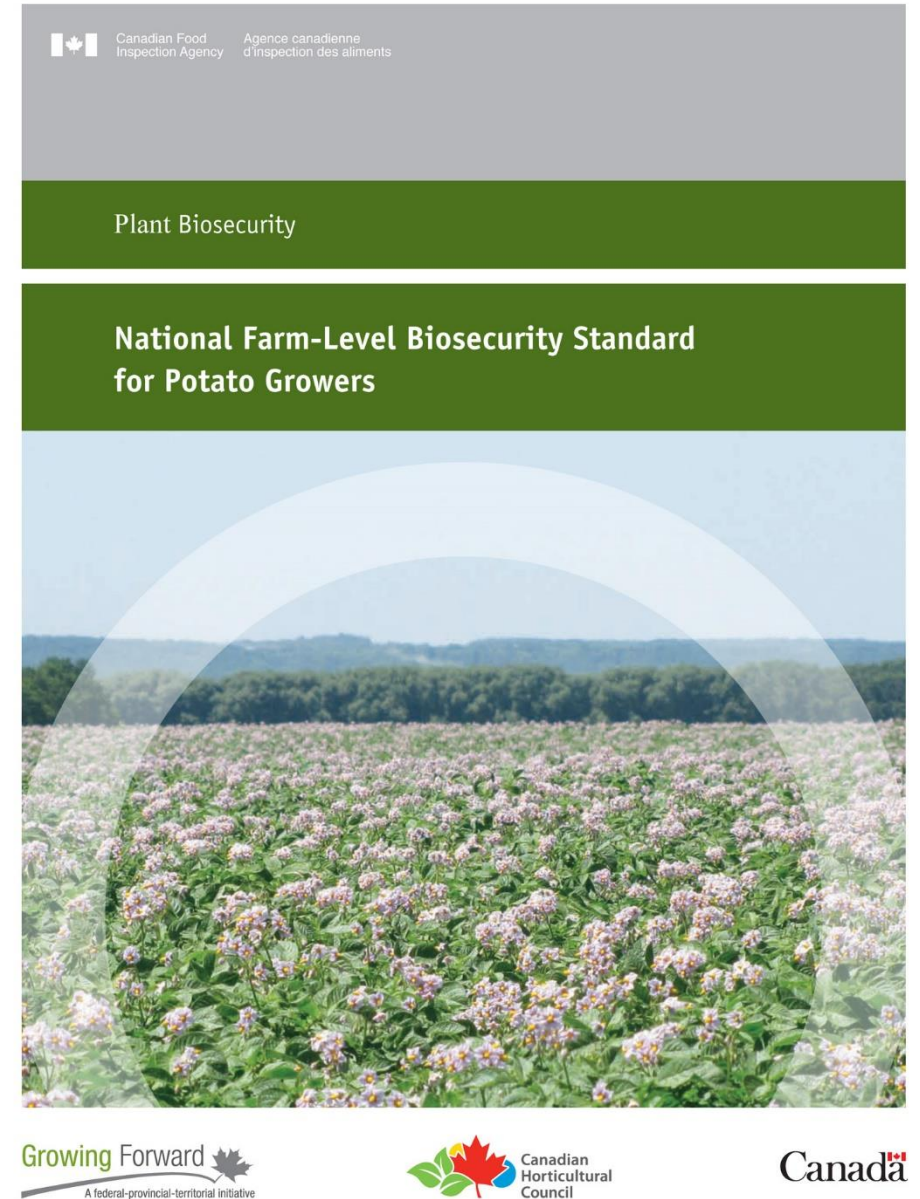
- Disinfectant will not sterilize soils and organic debris.
- Cleaning is important!
 - Bootbrush
 - Alternate on-farm footwear

Disinfecting is a reminder to clean first!

- Vehicles:
 - Hose off or pressure wash loose soil from wheels and wheel wells when moving from farm to farm and spray wheels with disinfectant.
 - Park on road - not in field.
 - Transport visitors around the farm in a regular farm vehicle if possible.

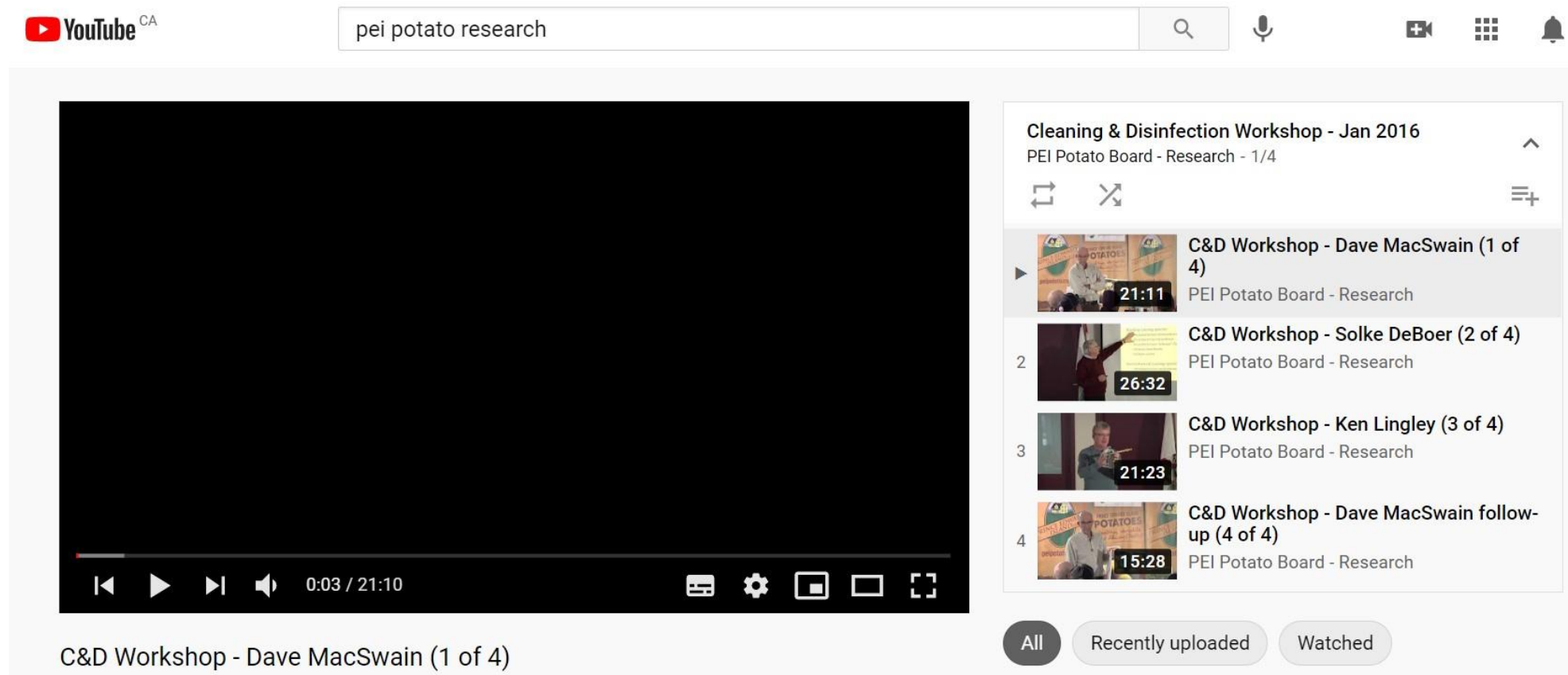
Resources

- National Farm-Level Biosecurity Standard for Potato Growers (CFIA)
- Google “Potato Biosecurity” – #1 result



Resources

- Cleaning and Disinfection Videos on YouTube
- Search for “PEI Potato Research” and click on “Playlists”



The screenshot shows a YouTube interface. At the top, the YouTube logo is on the left, and a search bar contains the text "pei potato research". To the right of the search bar are icons for a microphone, a video camera, a grid of apps, and a notification bell. Below the search bar, a large video player is shown, currently displaying a black screen. At the bottom of the video player, there is a progress bar and playback controls (play, pause, next, previous, volume, and full screen). Below the video player, the title "C&D Workshop - Dave MacSwain (1 of 4)" is displayed. To the right of the video player, a playlist is shown with the title "Cleaning & Disinfection Workshop - Jan 2016" and the subtitle "PEI Potato Board - Research - 1/4". The playlist contains four items, each with a thumbnail, a duration, and a title. The first item is "C&D Workshop - Dave MacSwain (1 of 4)" with a duration of 21:11. The second item is "C&D Workshop - Solke DeBoer (2 of 4)" with a duration of 26:32. The third item is "C&D Workshop - Ken Lingley (3 of 4)" with a duration of 21:23. The fourth item is "C&D Workshop - Dave MacSwain follow-up (4 of 4)" with a duration of 15:28. At the bottom right of the playlist, there are three tabs: "All", "Recently uploaded", and "Watched".

YouTube^{CA}

pei potato research

Cleaning & Disinfection Workshop - Jan 2016
PEI Potato Board - Research - 1/4

C&D Workshop - Dave MacSwain (1 of 4)
PEI Potato Board - Research
21:11

2 C&D Workshop - Solke DeBoer (2 of 4)
PEI Potato Board - Research
26:32

3 C&D Workshop - Ken Lingley (3 of 4)
PEI Potato Board - Research
21:23

4 C&D Workshop - Dave MacSwain follow-up (4 of 4)
PEI Potato Board - Research
15:28

C&D Workshop - Dave MacSwain (1 of 4)

All Recently uploaded Watched

Resources

- CPC Webinar on Bacterial Ring Rot – March 2nd
- Video available online (link on PEI Potato Agronomy Site)



Thank You!

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AIM Funding Partners

