



# **Fall Seeded Cover Crops:** **Keep Your Soils Covered!**

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Prince Edward Island Potato Board

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# Agenda:

- Benefits of Fall Cover Crops
- Fall Cover Crops ahead of Potatoes
- Fall Cover Crops after Potatoes
- Fall Hilling Research



# Benefits of Fall Cover Crops:

## Erosion Control

- It has been estimated that 80% of soil erosion happens during heavy rainfall events in the spring and fall.
- “Quick-growing cover crops hold soil in place, reduce crusting, and protect against erosion due to wind and rain” (SARE.org)
- Topsoil is a finite resource!
- Keep the neighbours happy by avoiding “snirt” or gully erosion.





# Gully Erosion





# Benefits of Fall Cover Crops:

## Erosion Control

- Eroded parts of fields will generally be less productive, less resilient to extreme weather, less able to hold nutrients
- Movement of soil to watercourses – siltation, fish kills
- Can take 500 years to build an inch of topsoil...so we need to keep what we have!





# Benefits of Fall Cover Crops:

## Prevent Nitrate Leaching

- Nitrates are at their greatest risk of leaching in the fall.
- PEI soils are highly leachable: sandy, high rainfall amounts
- Nitrate comes in many forms:
  - Leftover chemical fertilizer
  - Natural release from soil organic matter
  - Breakdown of crop residues
  - Fall-applied manure

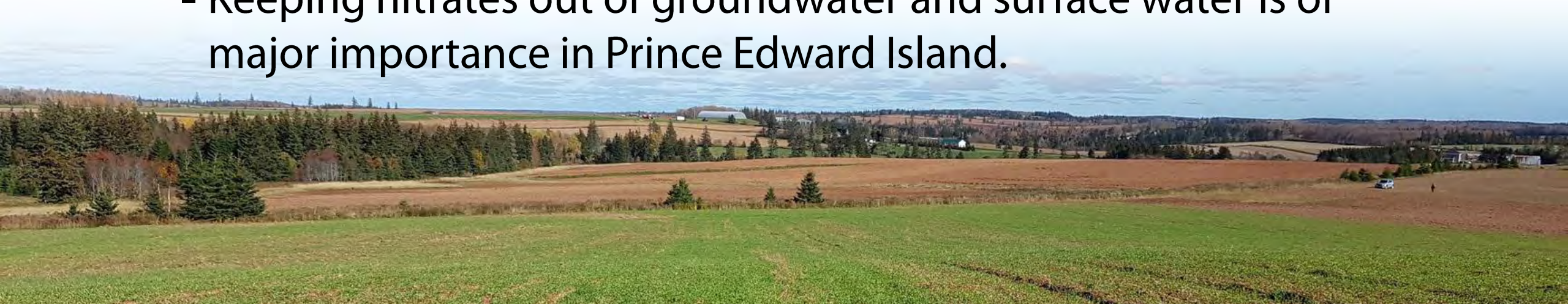




# Benefits of Fall Cover Crops:

## Prevent Nitrate Leaching

- A growing crop will take up soil nitrate to feed the crop and hold it over the winter in roots/above ground biomass
- This nitrate will then be more available in the spring for the next crop
- Nitrates help establish winter cereals (rye, wheat, etc)
- Keeping nitrates out of groundwater and surface water is of major importance in Prince Edward Island.





# Benefits of Fall Cover Crops:

## Keep Something Growing!

- A growing crop not only holds soil together and takes up nutrients, but it also:
- Builds soil organic matter
- Improve aggregate stability (soil structure/compaction)
- Increases microbial activity/nutrient cycling
- Improves overall soil health!





# Benefits of Fall Cover Crops:

## Weed Control

- Dense cover crop outcompetes perennial or winter annual weeds
- Some species are alleleopathic (directly inhibit weeds)
  - Fall rye
  - Buckwheat (as little as 20% of mixture)
  - Oats





# Benefits of Fall Cover Crops:

## Managing Soil Moisture

- Having a growing cover crop helps with water infiltration
- Creates more stable soil aggregates > more room for water
- Having a cover crop surviving to the spring can help dry out naturally wet/heavy soils to get them ready to plant earlier
- Cover crop residue will catch more snow over winter, allowing for more recharge of soil moisture





# Benefits of Fall Cover Crops:



Photo courtesy Peter Webb,  
PEIDAL



# Benefits of Fall Cover Crops:

## Fighting Pests & Diseases

- Mustard and Buckwheat to fight Wireworm
- Still sorting out effect on Vert/nematodes but early indications are that grass and brassica mixes don't increase numbers much
- Brassicas are not a host for most fungal diseases
- Opportunity to break pest/disease cycles with a break crop





# Benefits of Fall Cover Crops:

## Opportunity to Apply Manure/Compost/Lime

- Apply manure before tillage, then plant cover crop to help capture nutrients
- Apply compost/solid manure on a living cover crop for same reason, help protect manure from erosion
- Foster microbial community to “buffer” the addition of manure or lime to prevent any issues with scab





# Benefits of Fall Cover Crops:

## Social/Environmental Benefits

- Keep the neighbours happy – no blowing dirt, “snirt”
- Public likes seeing lots of green fields in the fall/winter
- Avoid risk of visible gully erosion
- Keep nitrates, phosphates, and sediment out of the streams





# Benefits of Fall Cover Crops:

## Benefit to Yields in the following crop

- More on this to come!

## Establishing a Cash Crop

- Established market for winter wheat, fall rye (new hybrids)
- Potential market for new crops (winter barley, winter triticale)





# Benefits of Fall Cover Crops:

## Research in Ontario (Dr. Laura van Eerd)

- 13 years of cover crops in multiple rotations
- Largest benefit in vegetable rotation (tomatoes), with **8 to 12% increase in tomato yield following cover crop.**
- In a six year rotation with four years of cover crops, both marketable yield and soil health indices improved with cover crops
- **Fall rye was the best cover crop at increasing soil organic C.** Quite noticeable increases in six year rotation.
- Follow Soils @ Guelph on Twitter or on their website (source)





# Things to Consider...

- Species choice/mix
- Terminate in the spring, or die over winter?
- Seeding rate
  - The later you seed, the higher the rate
  - Up the rate by 15-25% if broadcasting instead of drilling
- Method of establishment (drill, broadcast, air seeder)





# Winter cover crops: making them work

## SELECTING COVER CROPS FOR POST-HARVEST CONDITIONS

Growers usually know what they want a post-harvest cover crop to do. At the very least, winter cover crops need to become established during late summer–early fall conditions, grow in the fall and provide enough cover over winter.

Consider the following questions when selecting cover crop types based on characteristics, functions and limitations.

GROWTH HABITS	<ul style="list-style-type: none"> <li>• What kind of growth habit is needed? Fast or slow?</li> <li>• Moderate growth in the early fall or lots of vigorous growth in late fall?</li> <li>• What is the rooting type? Is deep rooting required to break up compaction or fibrous rooting needed to hold soil in place?</li> </ul>
OVERWINTERING	<ul style="list-style-type: none"> <li>• Does the cover crop need to survive over winter?</li> <li>• Would it suit the cropping schedule and soil type to have the cover crop winter-killed and dried out by spring?</li> </ul>
CONTROL OPTIONS	<ul style="list-style-type: none"> <li>• Will the cover crop become a weed concern in the spring if not properly terminated?</li> <li>• How is it to be controlled in the late fall or early spring?</li> <li>• What options are there for control (tillage or chemical)?</li> </ul>
SENSITIVITY TO HERBICIDES	<ul style="list-style-type: none"> <li>• How sensitive is the cover crop to herbicide residues from other crops in the rotation, e.g. radish after peas or beans?</li> </ul>
SEED COST AND AVAILABILITY	<ul style="list-style-type: none"> <li>• What is the seed cost and is the seed readily available in your area?</li> </ul>



ESTABLISHMENT	<ul style="list-style-type: none"> <li>• Considering the seed size and soil type and condition, what is the best way to plant the seed – broadcast or drilled?</li> <li>• Is different equipment required?</li> <li>• How easy is it to establish in the early fall, mid fall or late fall?</li> <li>• Will it create a solid cover in cool and/or wet conditions?</li> <li>• Is good establishment critical to the success of the cover crop?</li> </ul>
NUTRIENT MANAGEMENT	<ul style="list-style-type: none"> <li>• Is it a nitrogen producer or does the cover crop require nitrogen to grow well?</li> <li>• Does the cover crop require other nutrients for successful establishment and growth?</li> <li>• What is the nitrogen cycle and timing of nitrogen release?</li> <li>• Does it scavenge well for nitrogen?</li> <li>• Does it scavenge and release other nutrients?</li> </ul>
PEST MANAGEMENT	<ul style="list-style-type: none"> <li>• What crop family is the cover crop in?</li> <li>• Is it related to other crops in the rotation?</li> <li>• Will this crop host pests?</li> <li>• Can this crop break pest cycles?</li> </ul>

**Cover crops following winter wheat in Ontario have reduced the levels of nitrate left in the soil in October and November by 50% compared to no cover.**



# Fall Cover Crops Ahead of Potatoes

- Termination/Tillage in Aug/Sept, followed by seeding cover crop
- Plant early to get maximum biomass before cold weather
- Planting in Aug/Sept allows for greater choice of species or mixes
- Gets primary tillage out of the way at a less busy time of year. Then in the spring, minimum tillage required.





# Fall Cover Crops Ahead of Potatoes

- **Living Labs Initiative:** Board is leading 3 projects on cover crops and soil building crops, in partnership with EPAA, AAFC, multiple other research partners.
- **BMP1:** 6 fields set up in fall of 2019, tracked through to potato harvest in 2020





# Fall Cover Crops Ahead of Potatoes

- Field 1: Oats broadcast compared with check (Sept 27)
- Field 2: Oats/Mustard mix drilled compared with check (Aug 28)
- Field 3: Brown Mustard compared with check (Sept 20)
- Field 4: Barley, Oilseed Radish compared with check (Sept 30)
- Field 5: Barley broadcast compared with check (Sept 19)
- Field 6: Oilseed Radish, Mustard compared with check (Sept 23)





# Trends We Saw in 2019-2020 Trials

- No visible effect on soil OM in one year (as expected).
- No trend toward difference in soil nutrients
- No noticeable difference in soil health metrics. 5 out of 6 fields rated mostly L for these metrics.
- No difference observed in soil nitrates at 3 depths
- Verticillium/nematodes were very field specific





# Considerations from 2019-2020 Trials

- Most of the fields were established later than advised
  - Too dry in August for tillage/seeding
  - Too wet after Hurricane Dorian until late September
- Just one year of data. More data to come in 2021 & 2022.
- No statistics applied to this data yet, just showing trends.





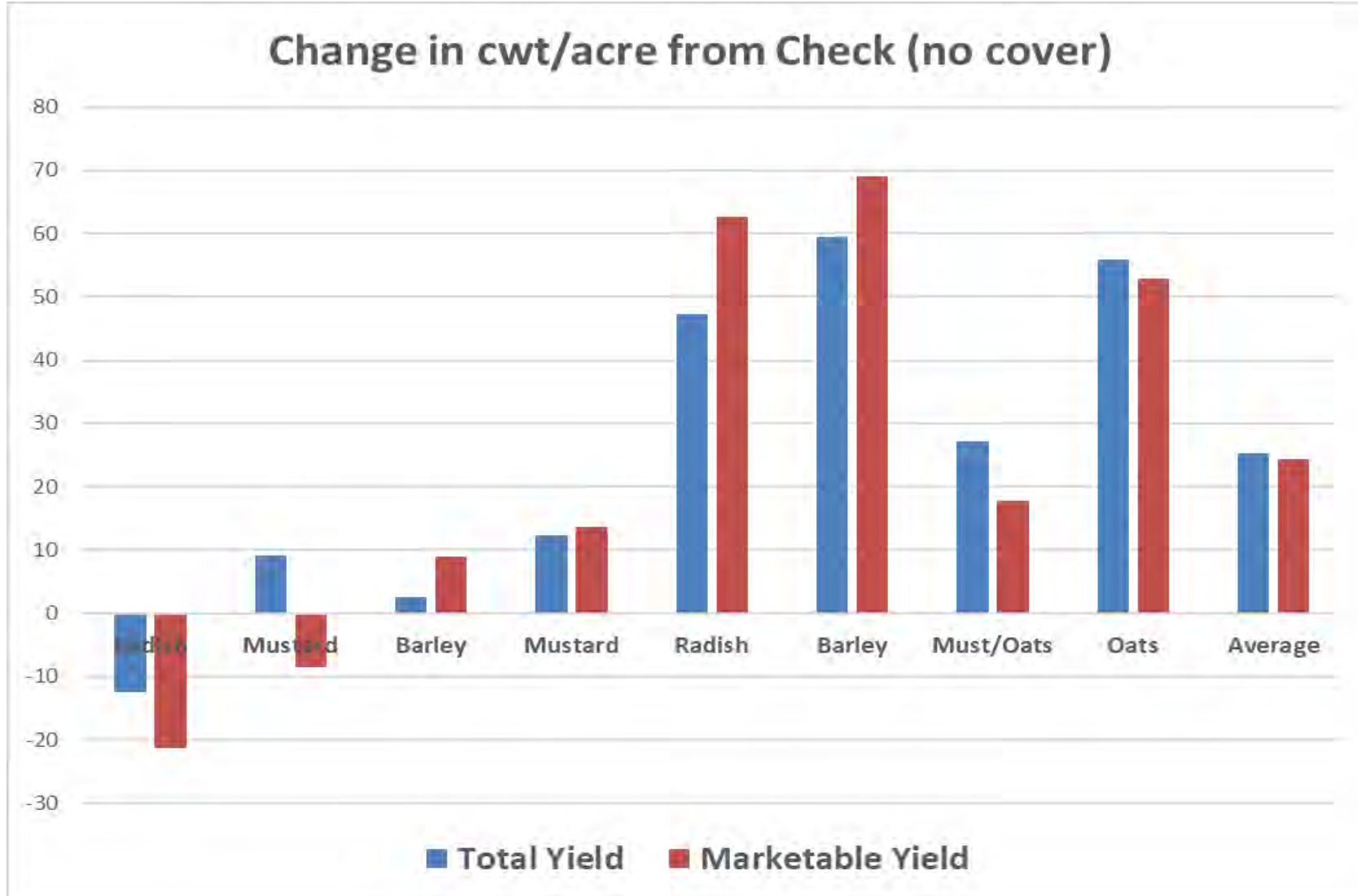
# Trends We Saw in 2019-2020 Trials

- Across all 6 trials, we saw a positive trend on yield:
  - Total Yield: +25 cwt/acre
  - Marketable Yield: +24 cwt/acre
- If we remove 2 fields that did not establish properly due to late establishment:
  - Total Yield: +39 cwt/acre
  - Marketable Yield: +42 cwt/acre





# Trends We Saw in 2019-2020 Trials





# Field 2: Oat/Mustard Mix versus check

- Established August 28/2019. Planted with Mountain Gem in 2020
- % green cover:
  - Nov 6: Mustard/Oats = 75.6%    Check: 0.2%
  - Nov 18: Mustard/Oats = 58.5%    Check: 2.0%
- Erosion Potential from Splash Pans: 5 g/pan over 6 weeks versus 39.5 g/pan
- *Verticillium dahliae*: No difference in check, increase in Mustard/Oats
- Root Lesion Nematodes: No difference in Mustard/Oats  
Check went from 4815 to 12,144 (Fall to Spring)





## Field 2: Oat/Mustard Mix versus check





# Field 2: Oat/Mustard Mix versus check

	Total Yield cwt/ac	% Smalls	% 10 oz	Specific Gravity	M. Yield cwt/ac	\$/acre
Check	291.1	3.7	25.8	1.086	275.5	\$3511
Must/Oats	318.3	2.9	34.0	1.085	293.2	\$3742





# Field 1: Oats versus check

- Established September 27/2019. Planted with Nadine in 2020
- % green cover:
  - Nov 8: Oats = 13.8%    Check: 0%
  - Nov 18: Oats = 6.7%    Check: 0%
- Penetrometer reading at 12 in: Oats = 121    Check = 279
- *Verticillium dahliae*: Decreased in both sides, slightly lower on oats side
- Root Lesion Nematodes:    Oats: 2306 (Fall) increased to 5745 (Spring)  
Check: 5855 (Fall) increased to 17,068 (Fall)





# Field 1: Oats versus check Nov 5/19





# Field 1: Oats versus check

	Total Yield cwt/ac	% Smalls	% 10 oz	% Total Defects	M. Yield cwt/ac	\$/acre*
Check	327.9	19.0	2.0	3.0	255.8	\$4425
Oats	383.8	12.6	3.7	7.2	308.6	\$5339

\* To calculate \$/acre, used Feb 28/2019 GRI of \$17.30 x Marketable Yield





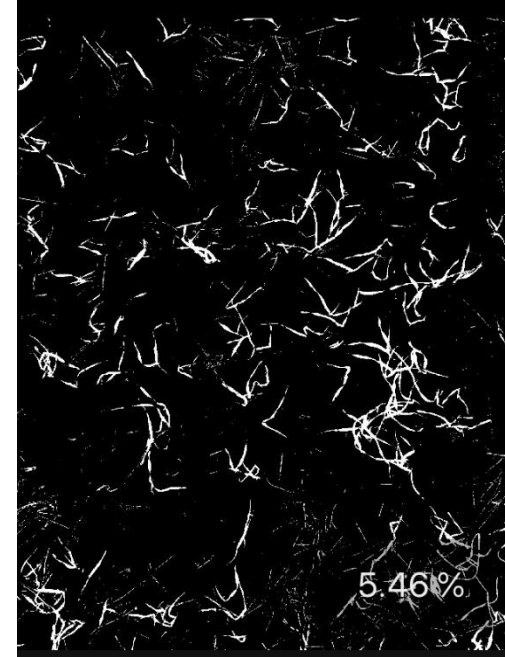
# Field 4: Barley, Oilseed Radish versus check

- Established September 30/2019. Planted with Goldrush in 2020
- Low soil OM (between 2.1-2.4%), planted quite late, low soil health ratings
- % green cover:
  - Nov 18: Check = 1.1%   Radish: 5.5%   Barley: 4.2%
- *Verticillium dahliae*: about 12,000 cells/g for barley side, 2000-3600 for others
- Root Lesion Nematodes:   Barley:   8296 (Fall) to 24,899 (Spring)  
   Radish:   9677 (Fall) to 11,817 (Spring)  
   Check:   6013 (Fall) to 16,092 (Spring)

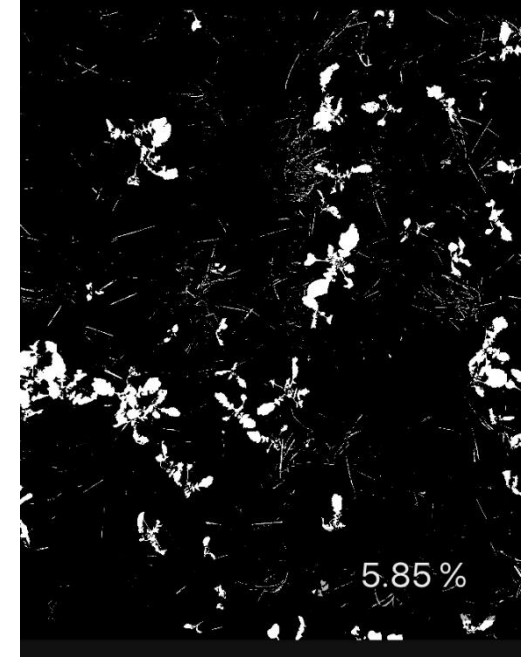




# Field 4: Barley, Oilseed Radish versus check



**Barley**  
November 18



**Radish**  
November 18



# Field 4: Barley, Oilseed Radish versus check

	Total Yield cwt/ac	% Smalls	% 10 oz	% Total Defects	M. Yield cwt/ac	\$/acre*
Check	174.6	24.5	5.0	2.2	128.6	\$2224
Radish	221.8	11.8	0	1.7	191.2	\$3308
Barley	234.1	14.9	1.0	1.8	197.7	\$3420

\* To calculate \$/acre, used Feb 28/2019 GRI of \$17.30 x Marketable Yield





# More fields set up this year...

- Oats, Radish, Oat/Radish Mix, versus check (Sept 9)
- Mustard/Radish Mix versus Check x 2 (Sept 9, Sept 24)
- Tillage Radish, Spring Tilled Killed Sod versus Check (Oct 5)
- Barley (130 lbs) versus Check (Sept 11) following moldboard plough
- Oats, Buckwheat Stubble versus Check (Oct 13)
- Tillage Radish, Mustard versus Check x 2 (Sept 2, Sept 8)





# Fall Cover Crops After Potatoes:

## Types of Research Trials:

- Different species of the same crop
- Different seeding dates of the same crop
- Different seeding rates of the same crop
- Importance of fall weather conditions for trial success





# Fall Cover Crops After Potatoes:

## **Trials Established in 2019 (Seven):**

- Oats, Fall Rye, Barley
- 1 Rate Comparison, rest just Cover Crop(s) vs Check
- Measured Fall Soil Chemistry, Nitrates (3 Depths), Erosion (Splash Pans), % Ground Cover (Canopeo)





# Fall Cover Crops After Potatoes:

## Soil Nitrates Trends in 2019:

- Generally more nitrates from Check than Cover Crops
- Of 3 depths (0-6", 6-12" and 12-18") nitrates were greater in lower two depths, particularly at earlier time points (mid-Oct/early Nov. vs mid-Nov.) regardless of Check or Cover Crop
- Range from <5.00 to 21 ppm





# Fall Cover Crops After Potatoes:

## Nitrate Case Study #1 in 2019:

- Fall Rye vs Check (Planted Oct.14, 2019)
- Mid-Oct: More nitrates in Rye at top 2 depths, more in 3<sup>rd</sup> depth in Check
- Early Nov: More nitrates in Check at all 3 depths



# Fall Cover Crops After Potatoes:

## Nitrate Case Study #2 in 2019:

- 85lb/ac Barley vs 120lb/ac Barley vs Check (Planted Sept. 30, 2019)
- Early Nov: Nitrates higher in Check than in the Barley treatments





# Fall Cover Crops After Potatoes:

## Trials Established in 2020 (Eight):

- Fall Rye, **Winter Barley (x4)**, Spring Barley, Oats
- 3 Species, 2 Rate, 1 Method Establishment
- Better variety in different types of trials than in 2019
- Measured Fall Soil Chemistry, **Nitrates (3 Depths)**, Erosion (Splash Pans), % Ground Cover (Canopeo)
- Waiting on most of 2020 trial Nitrate results





# Fall Cover Crops After Potatoes:

## Winter Barley Trial #1 in 2020: (Souris & Area Watershed)

- Winter Barley (right) vs Winter Wheat (left) vs Check
- Planted: September 28, 2020
- Seeding Rate: 190 lb/ac (Winter Wheat), 120 lb/ac (Barley)

Pictures taken:  
November 20, 2020





# Fall Cover Crops After Potatoes:

## Winter Barley Trial #2 in 2020: (Kensington North Watershed)

- Winter Barley (left) vs Spring Barley vs Check
- Planted: October 8, 2020
- Seeding Rate: 100lb/ac (For Both Species of Barley)

Pictures taken:  
November 17, 2020





# Fall Cover Crops After Potatoes:

## Winter Barley Trial #3 in 2020: (East Prince)

- Winter Barley (right) vs Spring Barley (left) vs Check
- Planted: October 1, 2020
- Seeding Rate: 100lb/ac (Both Species)

Pictures taken:  
November 17, 2020





# Fall Cover Crops After Potatoes:

## Soil Erosion Trials (Splash Pans) in 2020:





# Fall Cover Crops After Potatoes:

## Soil Erosion Trial Case Study #1 in 2020:

- Winter Barley vs Check (Planted October 8<sup>th</sup>)
- Pans Installed October 22<sup>nd</sup>
- Barley Pans Soil Accumulation (Over 4 weeks): **125g**
- Check Strip Pans Soil Accumulation (Over 4 weeks): 149g





# Fall Cover Crops After Potatoes:

## Soil Erosion Trials Case Study #2 in 2020:

- Fall Rye vs Check (Planted October 1, 2020)
- Pans Installed October 22<sup>nd</sup>
- Rye Pans Soil Accumulation (Over 4 weeks): 85 g
- Check Strip Pans Soil Accumulation (Over 4 weeks): 84 g

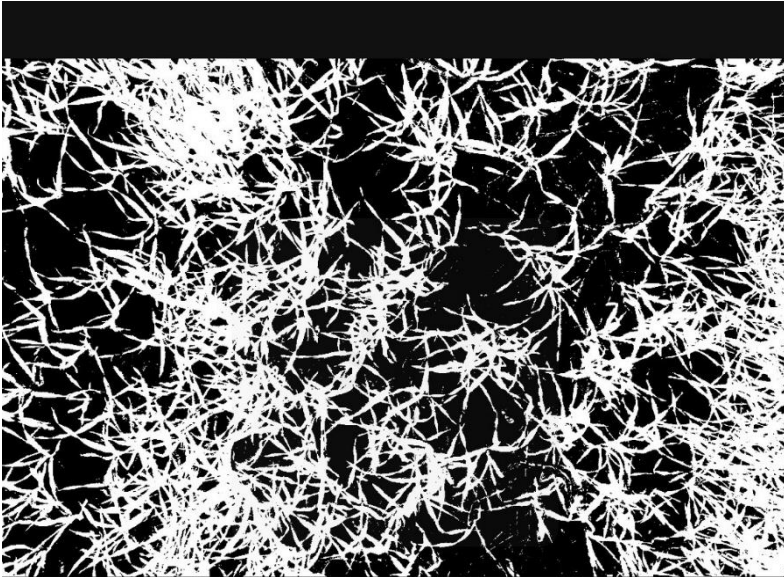
Almost no difference at second site, planted a week earlier, but in rye as opposed to winter barley.





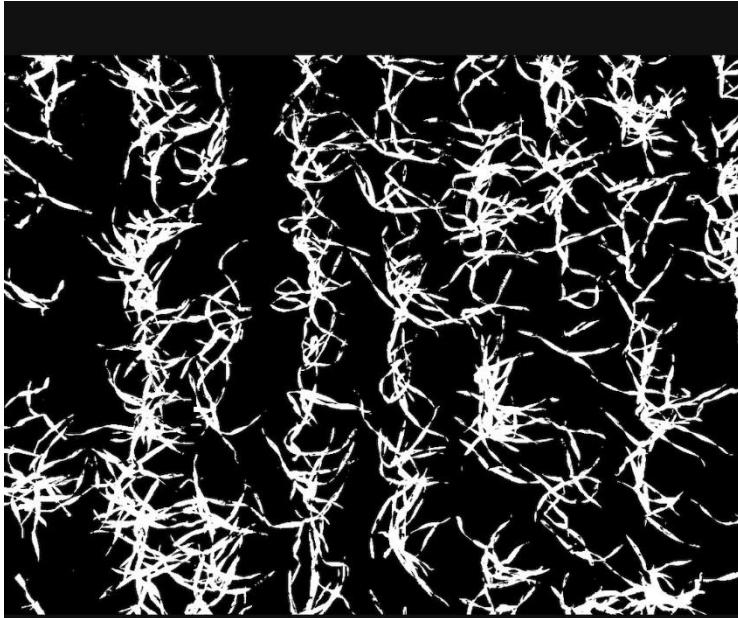
# Fall Cover Crops After Potatoes:

## Canopeo Ground Coverage (%) in 2020:



S. Barley  
Planted Oct.1<sup>st</sup>  
100lb/ac

43.65 %



S. Barley  
Planted Oct.8<sup>th</sup>  
100lb/ac

19.47 %



S. Barley  
Planted Oct.12<sup>th</sup>  
150lb/ac

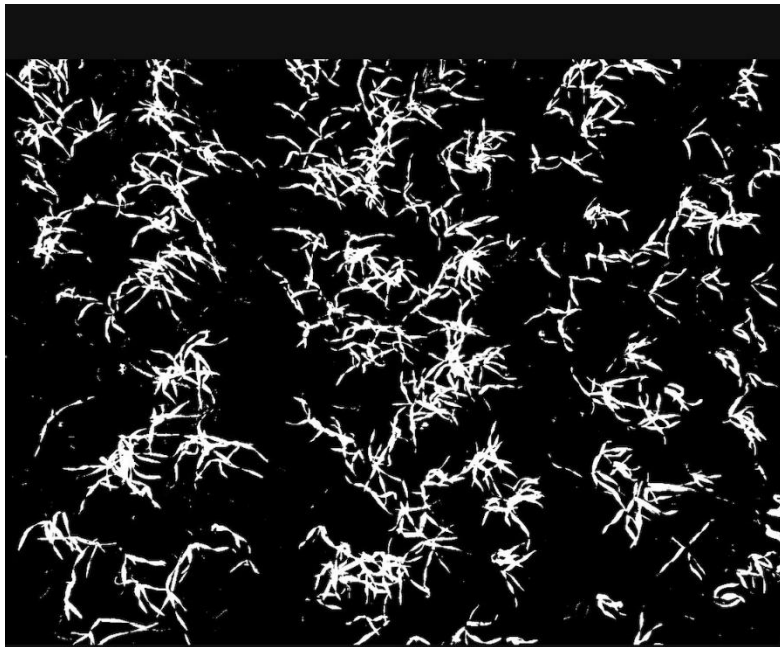
4.04 %

- 3 Different Trials- Pictures all taken November 17th



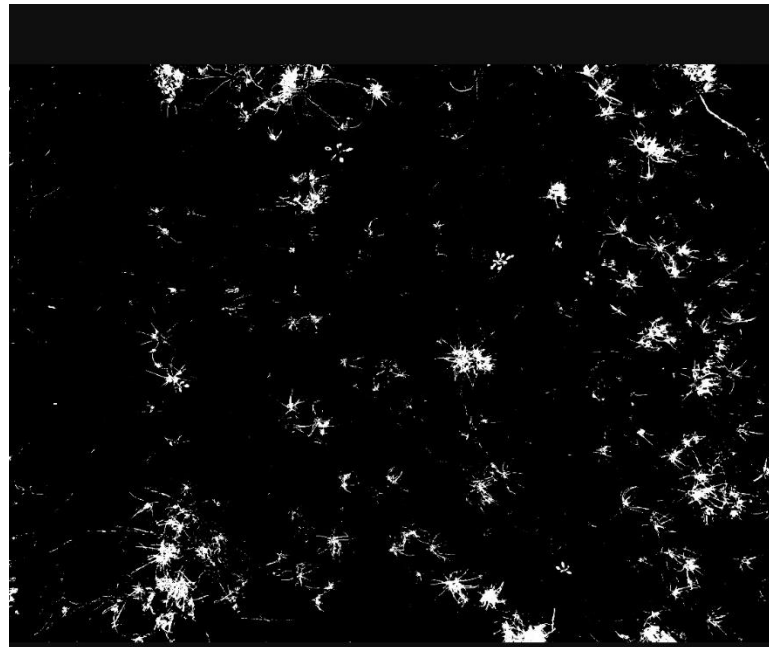
# Fall Cover Crops After Potatoes:

## Canopeo Ground Coverage (%) in 2020:



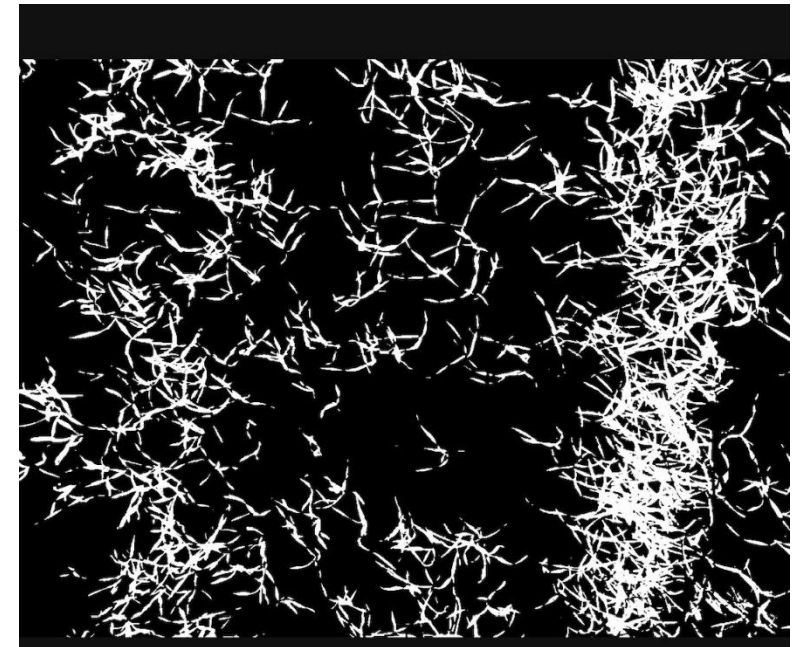
Fall Rye  
Broadcast After  
Planted Oct.6<sup>th</sup>

12.12 %



Check Strip  
No Cover

3.86 %



Fall Rye  
Broadcast Before  
Planted Oct.3<sup>rd</sup>

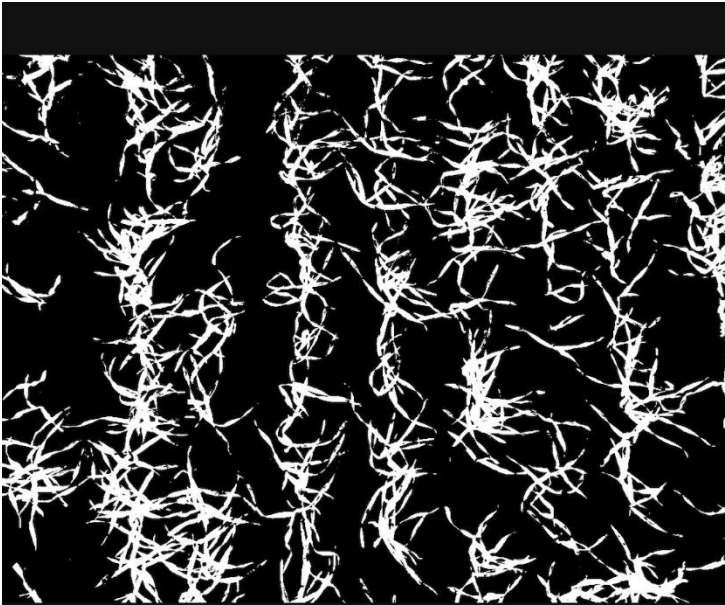
18.14 %

■ Same Trial: Pictures all taken November 17th



# Fall Cover Crops After Potatoes:

## Canopeo Ground Coverage (%) in 2020:



S. Barley

Planted Oct.8<sup>th</sup>

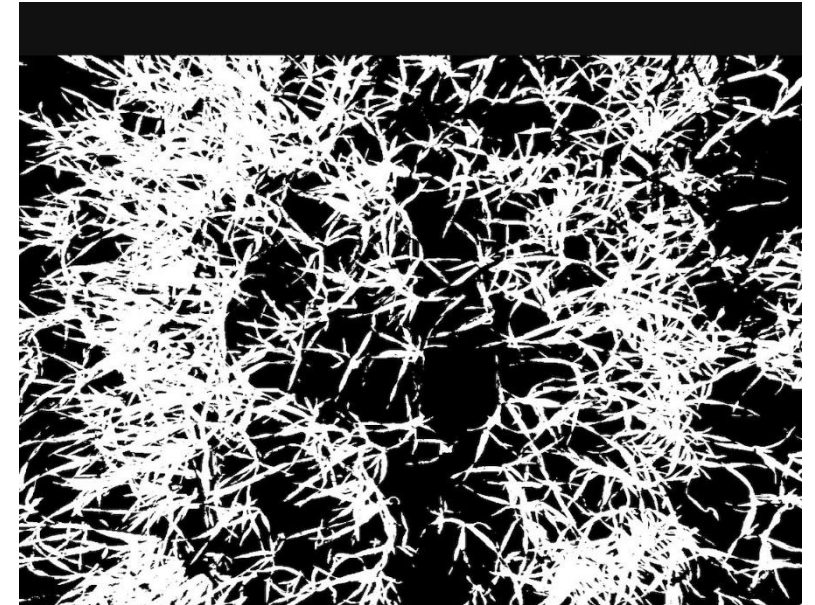
19.47 %



Check Strip

No Cover

0.93 %



W. Barley

Planted Oct.8<sup>th</sup>

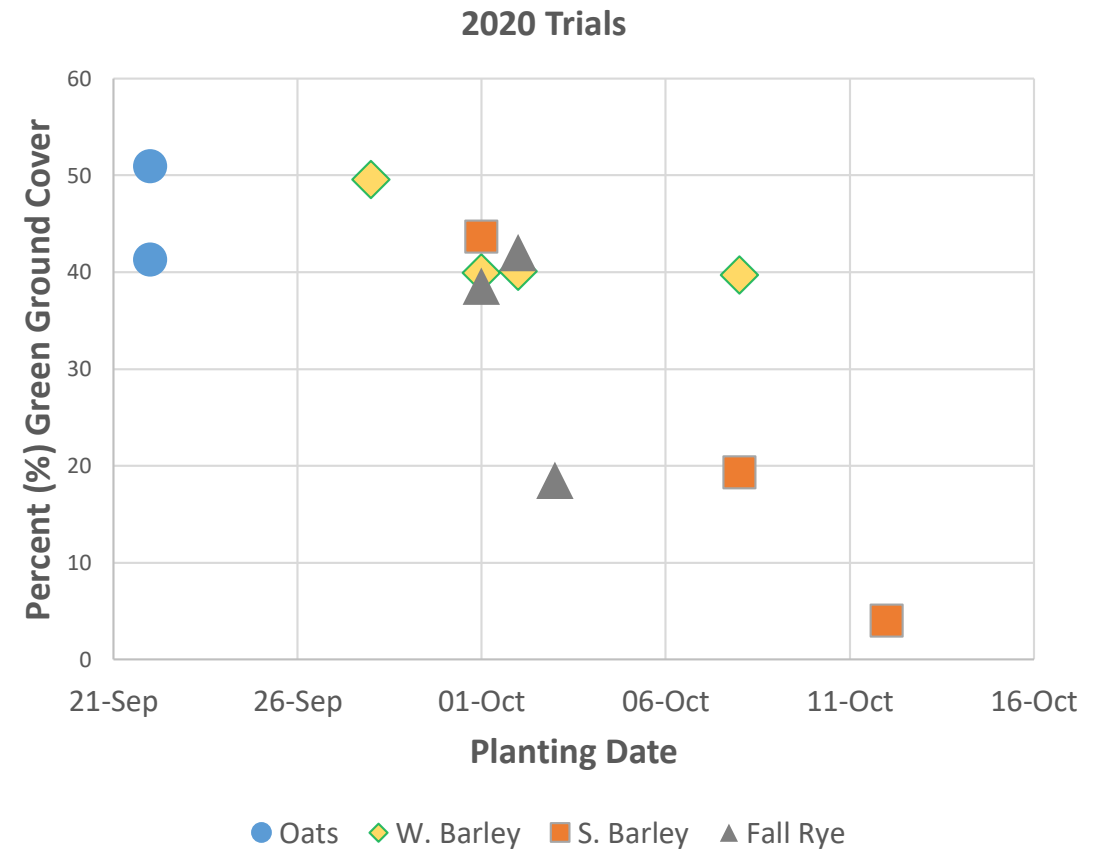
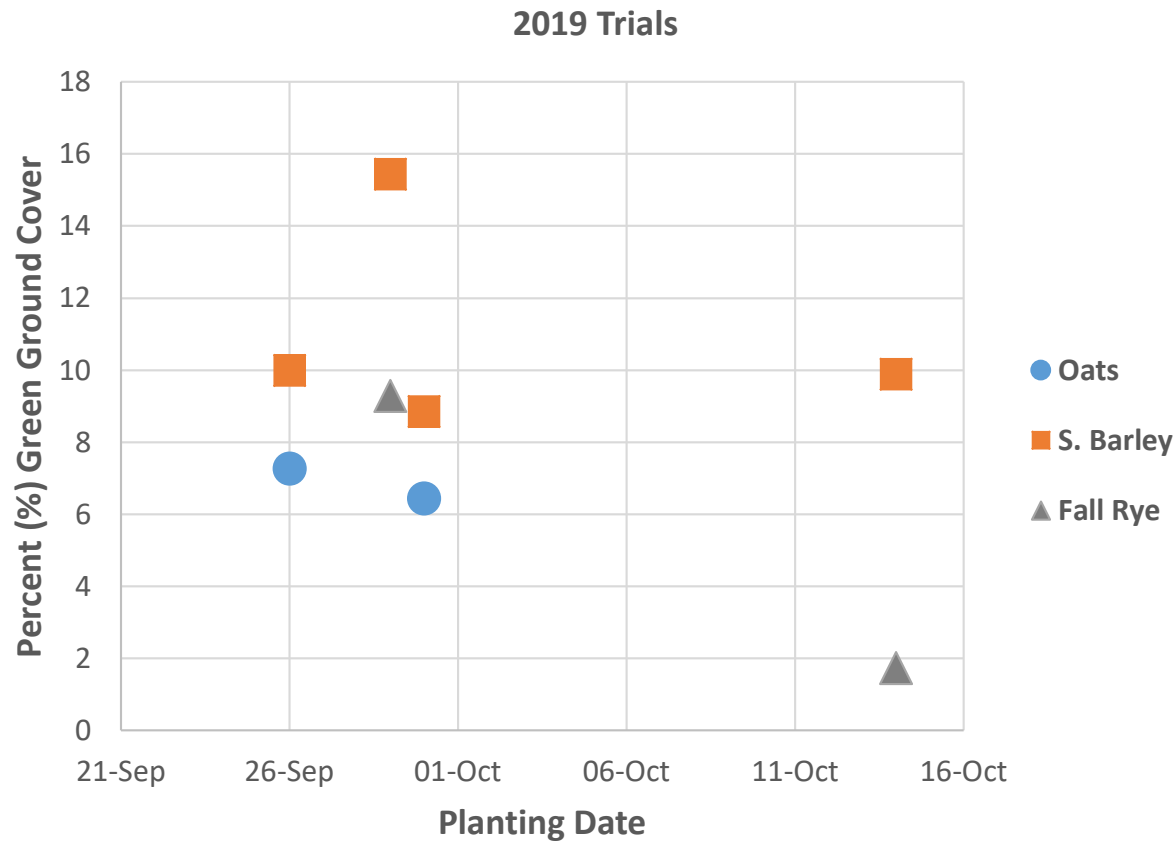
44.12 %

- Same Trial: Pictures all taken November 17<sup>th</sup>
- Winter cereals establish better than spring cereals seeded after Oct.5<sup>th</sup>



# Fall Cover Crops After Potatoes:

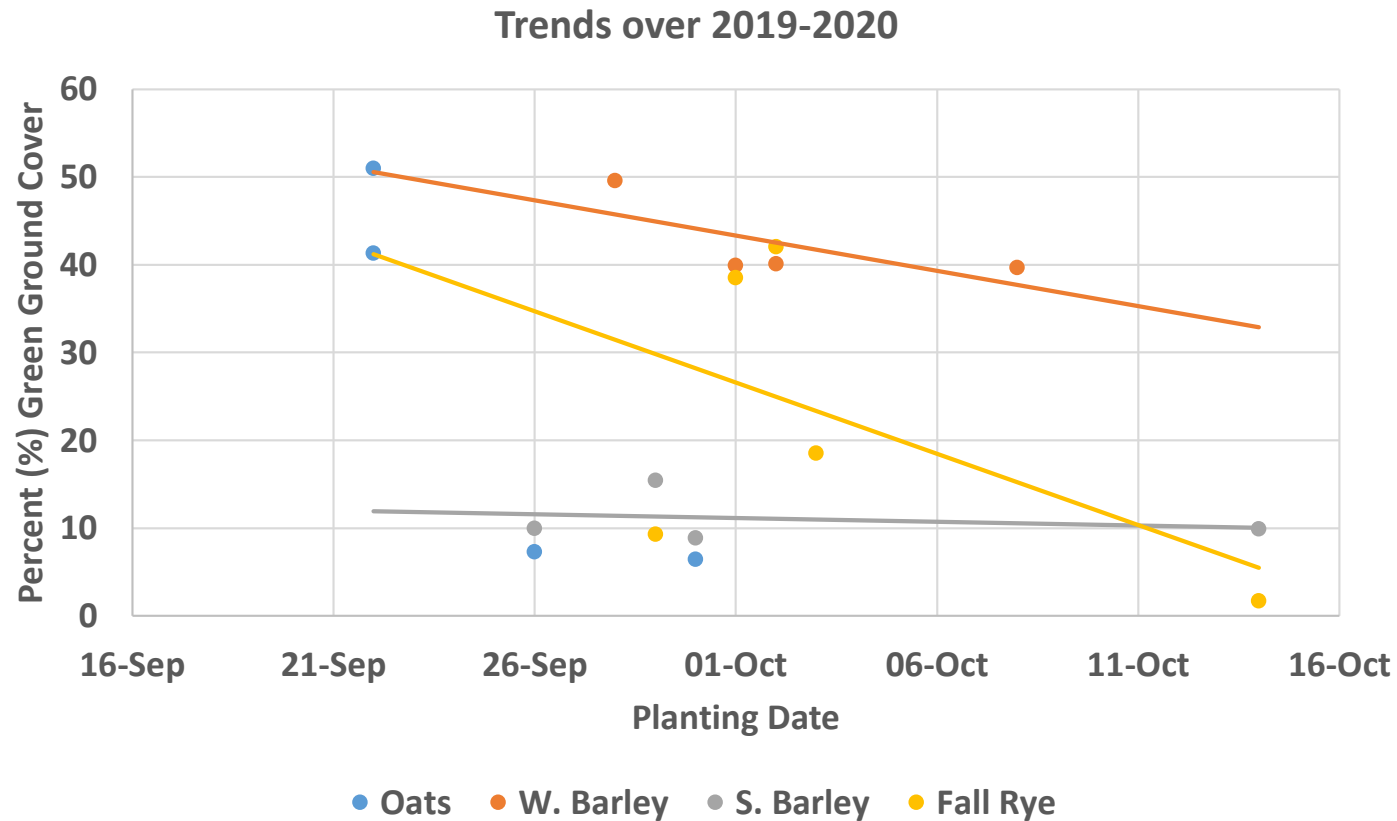
## Canopeo Ground Coverage (%) In 2019, and 2020:





# Fall Cover Crops After Potatoes:

## Canopeo Ground Coverage (%) Across 2 Years:



- Importance planting date
- Winter barley performed best
- Oats had mixed results by year



# Fall Hilling

- Opportunity to get more of your land worked the year before at a less busy time of year.
- Opportunity to get an early-established cover crop on.
- Opportunity to reduce tillage passes
- Opportunity to lightly incorporate fall-applied potash or lime





# Fall Hilling: First Two Years Data

Trial	Total Yield Cwt/acre	% Total Defects	% Smalls	% 10 oz	Specific Gravity	Market Yield Cwt/ac	\$/acre
2018 Burbank	-4	-2	-3	0	+0.001	+15	+222
2018 Prospect	-2	-6	-1	-5	+0.003	+20	+203
2018 Ranger	-30	-3	-8	+8	+0.001	+11	+77
2019 Burbank	+26	+1	-1	+5	-0.001	+32	+438
2019 Burbank	-1	-2	+4	-2	0	-16	-256
2019 Prospect	+29	-9	+2	0	+0.002	+45	+603
Average:	+3	-3.5%	-1%	+1%	+0.001	+18	+215



# Fall Hilling Field 2020

- Russet Burbank
- Planted late May
- Hilled in mid October, no cover crop on hills. Compared with worked land with no cover crop.
- There was a section not hilled with a cover crop, but cover crop barely emerged (late planting) so didn't give different numbers than unhilled check.
- Central PEI, moisture deficit but decent yields





# Fall Hilling: Three Years Data

Trial	Total Yield Cwt/acre	% Total Defects	% Smalls	% 10 oz	Specific Gravity	Market Yield Cwt/ac	\$/acre
2018 Burbank	-4	-2	-3	0	+0.001	+15	+222
2018 Prospect	-2	-6	-1	-5	+0.003	+20	+203
2018 Ranger	-30	-3	-8	+8	+0.001	+11	+77
2019 Burbank	+26	+1	-1	+5	-0.001	+32	+438
2019 Burbank	-1	-2	+4	-2	0	-16	-256
2019 Prospect	+29	-9	+2	0	+0.002	+45	+603
2020 Burbank	+21	+1	0	+10	+0.005	+18	+334
Average:	+6	-3%	-1%	+2%	+0.002	+18	+232

# Fall Hilling: Results

- Numerically positive at 6 out of 7 fields.
- Average over 7 fields is **+18 Cwt** marketable yield and **+\$232/acre**
- Does not appear to have negative impact on yield and would allow getting significant tillage, cover crop work done early, shortening amount of work in the spring
- With use of “freshening tool” and hill subsoiling, might have even greater impact.



*Photo: John Robertson, CBC PEI*



# Hill Freshener

- Freshen up the top of the hill without destroying the hill.
- S tyne the goes down the middle of the hill to decompact soil where the seed piece will go.
- Use of freshener increase tuber size profile in Alberta study
- One grower I talked to in NB said he would use hiller and freshener system even if he didn't fumigate.
- Can then go in with planter.



# Take Home Messages – Covers Before Potatoes

- **Early tillage and establishment** has the most benefit
- If seeding in Aug/Sept, crop choices are greater
- If seeding after Sept 15, stick with cereals (barley, oats)
- Mixes of cereal and brassicas can maximize coverage, diversity of root systems
- First year of data appears to show a **yield benefit of using cover crops ahead of potatoes.**





# Take Home Messages – Covers After Potatoes

- Cover crops after potatoes have great ability to hold soil, catch snow, improve soil health, even if establishing late.
- Winter cereals (fall rye, winter wheat) are recommended.
- Spring cereals (barley, oats) are not recommended after about October 5<sup>th</sup> (don't grow fast enough in cool soil temps)
- Even a little bit of green growth means that there is **double that much root growth**...which will help hold soil!



# Take Home Messages – Fall Hilling

- Three years of field research appears to show a **positive trend for yield and quality.**
- System allows for earlier land prep, maximizing cover crops, and reduced tillage (financial and soil health value)
- If planning to do on a larger scale, consider use of freshener tool to avoid lumps and reduce surface crusting





# Additional Resources:

- OMAFRA: Use of Cover Crops  
[http://omafra.gov.on.ca/english/crops/facts/cover\\_crops01/cover.htm](http://omafra.gov.on.ca/english/crops/facts/cover_crops01/cover.htm)
- OMAFRA: BMPs for Winter Cover Crops  
<http://www.omafra.gov.on.ca/english/environment/bmp/AF189.pdf>
- SARE: Benefits of Cover Crops  
<https://www.sare.org/publications/managing-cover-crops-profitably/benefits-of-cover-crops/>
- Cover Crops Decision Tool <http://decision-tool.incovercrops.ca/>
- AIM Factsheet – Keeping Your Soils Covered  
<https://peipotatoagronomy.com/wp-content/uploads/2018/04/Cover-Crop-Factsheet-Apr18.pdf>

# Biosecurity

- With recent cases of potato wart and BRR, it's important for all growers to pay extra attention to biosecurity.
- This includes:
  - All movement of potatoes onto your farm
  - Movement of equipment onto the farm
  - Access to fields by people from outside your farm
  - Cleaning and disinfection of all storages and equipment





# Biosecurity

- CFIA Biosecurity Standards Document:
- <http://www.inspection.gc.ca/plants/potatoes/guidance-documents/national-farm-level-biosecurity-standard/eng/1351685363578/1351685528151>



# Biosecurity

- **PEI Potato Board Videos on Biosecurity** (YouTube)
  - [Complete 4 video playlist](#) (YouTube)
  - [Plant Biosecurity](#)
  - [Disinfection for BRR and other bacterial diseases](#)
  - [C&D of Equipment](#)
  - [C&D Records and Funding Available](#)





# Any Questions?

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