

Choosing the Right Rotation Crops to Meet the Needs of Your Fields

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What are some of the factors in soil that are limiting yield?

- Potato Early Dying (Verticillium and root lesion nematodes)
- Common Scab
- Wireworm
- Low soil organic matter
- Soil compaction / soil structure
- pH / Fertility
- Excess moisture / Insufficient moisture



It's hard to make the right management choices if you don't know what the problem is!

- Soil Testing ahead of potatoes
 - Soil chemical analysis (PEI Soil Lab, A&L)
 - Soil health analysis (PEI Soil Lab)
 - Verticillium & nematodes (PQI)
 - Soil Compaction with penetrometer
 - Soil Electroconductivity (management zones)
- Wireworm
 - Bait traps, click beetle traps



Optimizing Your Crop Rotation is not “One Size Fits All”

- We're learning a lot in recent years that crop rotation can have a big impact on yield limiting soil conditions.
- However, it's not realistic to expect one crop to be a “silver bullet” to fit everything!
- Important to assess what the limitations of your field are and then adapt crop rotation to address them.



Optimizing Your Crop Rotation is not “One Size Fits All”

- Rotation crops/mixtures to build organic matter may not be the right choice for battling Verticillium/nematodes
- Biofumigant green manures may have big impact on wireworm or nematodes but may be hard on soil OM or soil structure, less effective in dry conditions



Disclaimer!

- Results from split field trials are somewhat limited because background variability can't always be accounted for. We do our best to limit in-field variability where possible.
- **Don't base decisions on one year of results!** Can be quite variable, especially in a year with extreme weather (like 2018 and 2019!)
- We are still building expertise with soil testing for Verticillium and nematodes. Take these results as an indicator, not an exact number.



Potato Early Dying (PED)

- Since the start of AIM, investigating options to reduce the impact of PED has been a very high priority.
- With absence of fumigation, adapting crop rotation has become an important tool in reducing Verticillium and root lesion nematode numbers.
- Can't base decisions on one year, one field!



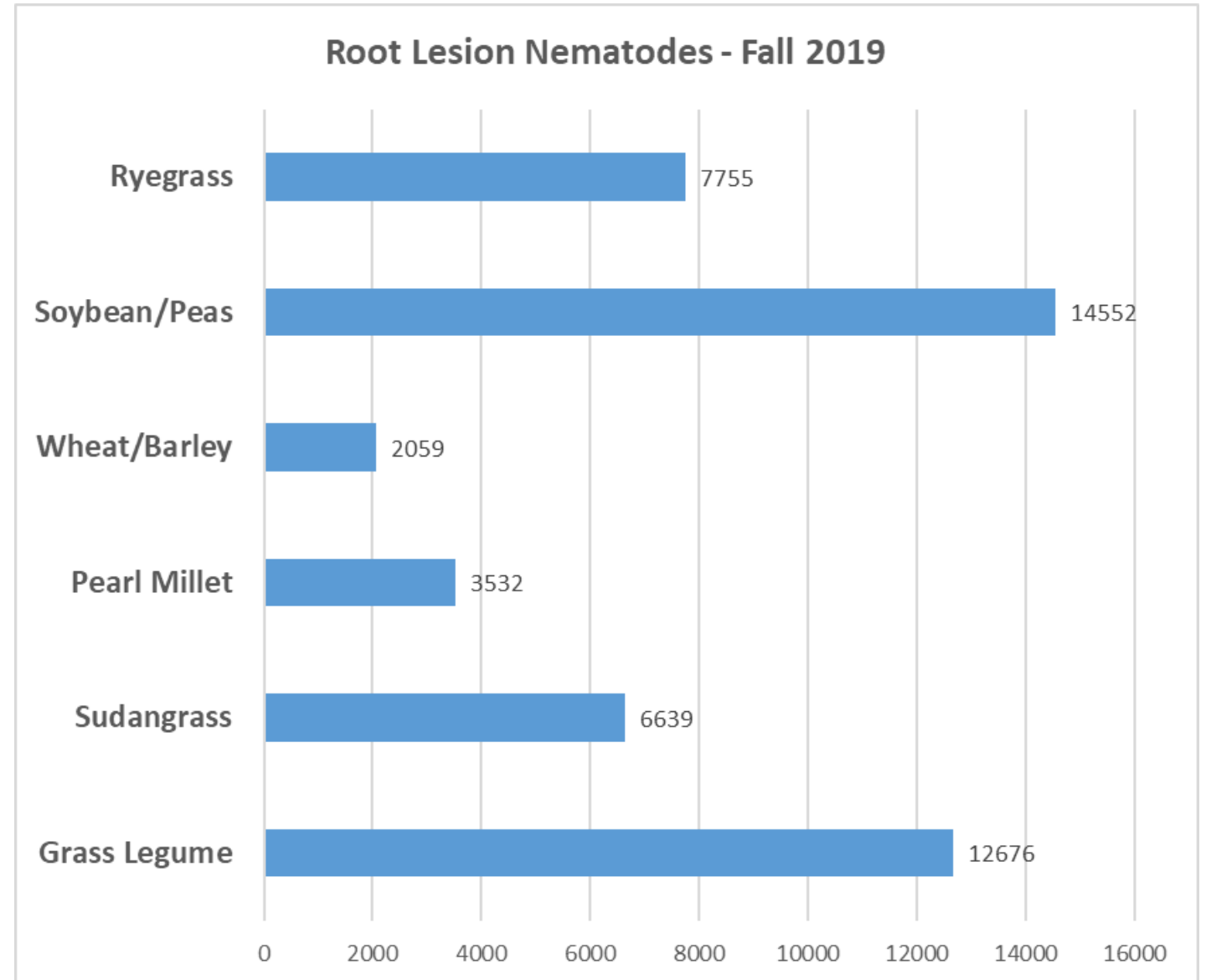
Potato Early Dying (PED)

- Two main approaches:
 - Biofumigation with green manuring (mustards, brassicas)
 - Trap crops not requiring incorporation (sudangrass, pearl millet)
- We've been trying to build a bigger database of the effects of these crops in grower fields as well as research plots



Potato Early Dying (PED)

2019 Fall Survey for Root
Lesion Nematodes



Potato Early Dying (PED)

Split Field Trial in Kensington area – 2017/2018

Preliminary comparison of double cut red clover with sorghum sudangrass. FL variety.

Treatment	Total Yield Cwt/acre	Total Defects %	Smalls %	Specific Gravity	Market. Yield cwt/ac
Red Clover	240.3	2.0	25.0	1.109	176.2
Sudangrass	288.2	3.0	24.0	1.111	208.7

33 cwt difference in marketable yield, 48 cwt diff in total yield.
Enough to look at doing additional trials.

Potato Early Dying (PED)

Strip Trial – Freetown Road – 2018/2019

5 Treatments Established in 2018:

- Red Clover (Check)
 - Sorghum Sudangrass/Pearl Millet
 - Sudangrass/Pearl Millet/Buckwheat
 - Forage Pearl Millet
 - Multi-Species Mixture (10+ species)
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- Each strip only 36 feet wide, close together at top of field.

Potato Early Dying (PED)

Strip Trial – Freetown Road – 2018/2019

Spring 2018 (before planting):

Treatment	Soil OM	pH	Verticillium (ng DNA/g)	RL Nematodes (#/kg soil)
Red Clover	2.8	5.5	0.40	3863
Sudangrass/Millet	2.6	6.5	0.30	0
SS/PM/BW	2.9	5.8	0.31	3281
Pearl Millet	3.0	6.0	0.62	2718
Multi-species Mix	2.6	6.4	0.45	2664

Potato Early Dying (PED)

Strip Trial – Freetown Road – 2018/2019

Spring 2019 (before potatoes):

Treatment	Soil OM	pH	Verticillium (ng DNA/g)	RL Nematodes (#/kg soil)
Red Clover	2.7 (-0.1)	6.0 (+0.5)	0.33 (-0.07)	3652 (-211)
Sudangrass/Millet	2.6 (even)	6.8 (+0.3)	0.54 (+0.24)	2415 (+2415)
SS/PM/BW	2.8 (-0.1)	6.4 (+0.6)	0.65 (+0.34)	7095 (+3814)
Pearl Millet	3.1 (+0.1)	6.2 (+0.2)	0.57 (-0.05)	7464 (+4746)
Multi-species Mix	2.5 (-0.1)	6.6 (+0.2)	0.32 (-0.13)	4782 (+2120)

Potato Early Dying (PED)

Strip Trial – Freetown Road – 2018/2019

2019 Potato Yield Data: FL variety

Treatment	Gross Yield Cwt/acre	% solids	Undersize (1"7/8) Cwt/acre	Marketable Yield Cwt/acre
Red Clover	206.9	20.48	23.8	183.1
Sudangrass/Millet	218.1	20.97	24.4	193.7
SS/PM/BW	200.6	20.97	30.0	170.6
Pearl Millet	253.1	21.86	29.4	223.7
Multi-species Mix	215.0	20.21	26.3	188.7

Potato Early Dying (PED)

Strip Trial – Freetown Road – 2018/2019

- **Pearl Millet performed 40 cwt/ac better than Red Clover**, also with higher solids/gravity
- SS/PM and Multi-Species mix may have been **compromised by wet conditions** closest to the road (poor drainage)
- Pearl Millet also had highest Vert & nematode numbers in Spring 2019!
- No appreciable increase in soil OM in one year

Potato Early Dying (PED)

Strip Trial in Orwell – 2017-2019

Four different rotations

2017

Green Peas

Soybean

Soybean

Brown Mustard

2018

Sudangrass/Pearl Millet (edge of field)

Buckwheat

Brown Mustard

Brown Mustard

Russet Burbanks in 2019

Potato Early Dying (PED)

Strip Trial in Orwell

Spring 2018 (after 1st rotation crop, before 2nd rotation crop)

Treatment	Soil OM	pH	Verticillium (ng DNA/g)	RL Nematodes (#/kg soil)
Peas/SSPM	2.0	6.1	0.36	4249
Soy/BW	1.8	6.1	0.17	2516
Soy/Mustard	1.7	5.9	0.08	1407
Mustard/Mustard	1.8	6.1	0.30	2243

Potato Early Dying (PED)

Strip Trial in Orwell

Spring 2019 (after 2nd rotation crop, before potatoes planted)

Treatment	Soil OM	pH	Verticillium (ng DNA/g)	RL Nematodes (#/kg soil)
Peas/SSPM	2.0 (even)	6.3 (+0.2)	0.24 (-0.12)	3567 (-682)
Soy/BW	1.7 (-0.1)	6.1 (even)	0.33 (+0.16)	8074 (+5558)
Soy/Mustard	1.8 (+0.1)	6.3 (+0.4)	0.15 (+0.07)	0 (-1407)
Mustard/Mustard	1.8 (even)	6.4 (+0.3)	0.15 (-0.15)	3478 (+1895)

pH increased. Verticillium and nematodes up and down. Vert/Nematode numbers on the low side

Potato Early Dying (PED)

Strip Trial in Orwell

2019 Yield Data: Russet Burbank

Treatment	Total Yield Cwt/acre	Total Defects %	Smalls %	10 oz %	Specific Gravity	Market. Yield cwt/ac	Payout \$/acre
Peas/SSPM	301.2	1.5	28.4	5.3	1.076	227.0	\$2142
Soy/BW	337.8	2.8	13.6	17.8	1.076	295.9	\$2933
Soy/Mustard	337.5	3.5	17.3	13.8	1.080	283.0	\$2959
Mustard/Mustard	332.2	1.1	19.1	6.0	1.077	270.0	\$2844

Peas/SSPM in a narrow strip next to hedgerow/edge of field. Lower elevation than rest

Potato Early Dying (PED)

Strip Trial in Orwell

- **Levels of Vert/nematodes were not overly high.** May not be robbing yield as much in this field.
- **One year of mustard was as good for marketable yield as two years** of mustard in this trial. However, this area consistently had the lowest Vert/nematode numbers.
- Sudangrass/Pearl Millet strip had lower yield, more smalls but also lower Vert/nematode numbers. May have suffered due to another reason.

Potato Early Dying (PED)

Split Field Trial in Indian River – 2017 to 2019

	2017	2018
Left	Sudangrass	Alfalfa/Timothy
Right	Wheat	Brown Mustard (incorporated)

2019: Prospects (not as PED sensitive)

Front part of left side has poorer soil type (shaley)

Potato Early Dying (PED)

Split Field Trial in Indian River – 2017 to 2019

- Soil OM, pH, P, K consistent within the field.
- Root Lesion Nematodes tracked since spring 2017. Always on the low side (between 1000 and 3500)
- Verticillium numbers inconsistent. Spiked high in fall 2017 on the sudangrass side, but returned to normal in 2018.

Potato Early Dying (PED)

Split Field Trial in Indian River – 2017 to 2019

2019 Yield Data: Prospect

Treatment	Total Yield Cwt/acre	Total Defects %	Smalls %	10 oz %	Specific Gravity	Market. Yield cwt/ac	Payout \$/acre
SS/Alfalfa	316.1	0.7%	2.9%	31.1%	1.089	313.2	\$3901
Wheat/Mustard	277.2	1.8%	12.8%	9.5%	1.085	248.2	\$2970

Significant difference in yield, size distribution

\$1000 difference in payout

More scab in mustard side, but some inconsistencies in field layout

Nitrogen level was not adjusted, so residual N from alfalfa may have boosted yield on that side.

Potato Early Dying (PED)

Split Field Trial in Knutsford – 2018/2019

In 2018, field was split between Sorghum sudangrass, barley underseeded with clover, and ryegrass.

2019: Russet Burbank

Potato Early Dying (PED)

Knutsford: Spring 2018 (before seeded out)

Treatment	Soil OM	pH	Verticillium (ng DNA/g)	RL Nematodes (#/kg soil)
Sudangrass	2.8	5.9	0.11	2345
Barley/Ryegrass	2.8	5.7	0.05	2073

Spring 2019 before potatoes

Treatment	Soil OM	pH	Verticillium (ng DNA/g)	RL Nematodes (#/kg soil)
Sudangrass	2.8	6.3	0.28	6787
Barley	2.6	6.3	0.19	3101
Ryegrass	2.6	6.3	0.33	10919

Potato Early Dying (PED)

Knutsford: Yield Data 2019 (Russet Burbank)

Treatment	Total Yield Cwt/acre	Total Defects %	Smalls %	10 oz %	Specific Gravity	Market. Yield cwt/ac	Payout \$/acre
Sudangrass	372.2	1.5%	10.1%	16.2%	1.077	344.3	\$3795
Barley	380.3	1.4%	6.7%	16.9%	1.078	364.4	\$4038
Ryegrass	397.9	9.0%	6.2%	29.4%	1.075	358.8	\$3705

Sudangrass on edge of field. May or may not have had an impact on yield

Ryegrass had biggest total yield but had higher rot and defects

Differences in yield/payout unlikely to be significantly different

Potato Early Dying (PED)

Split Field Trial on Baltic Road – 2017-2019

South Side: Sorghum Sudangrass in 2017, Mustard in 2018

North Side: Alfalfa/Timothy mix for both years

Soil OM, pH, soil nutrient levels reasonably consistent

Root lesion nematode numbers consistently higher on north side compared to south side. Numbers halved from spring 2018 to 2019. Verticillium numbers were inconsistent.

Potato Early Dying (PED)

Baltic Road: Yield Data 2019 (Russet Burbank)

Treatment	Total Yield Cwt/acre	Total Defects %	Smalls %	10 oz %	Specific Gravity	Market. Yield cwt/ac	Payout \$/acre
SS/Mustard	380.7	1.0	17.1	2.2	1.081	326.9	\$3,437
Alfalfa/Timothy	384.0	0.6	11.1	10.5%	1.077	355.1	\$3,548

No difference in total yield, but higher smalls resulted in 28 cwt diff in marketable yield.

Higher gravity on sudangrass/mustard side, reducing difference in payout

Residual N on Alfalfa side may have boosted size but limited gravity

Two years of Alfalfa/Timothy would have deep root system, reduced compaction

Potato Early Dying (PED)

Split Field Trial – West Cape – 2017 – 2019

East side: Sudangrass underseeded alfalfa in 2017

West side: Barley underseeded alfalfa in 2017

Alfalfa left to establish on whole field in 2018

Prospects in 2019

Soil tests consistent across the field. Vert levels consistently a bit higher on the East side. Nematode numbers consistently low.

Potato Early Dying (PED)

Split Field Trial – West Cape – 2017 – 2019

Treatment	Total Yield Cwt/acre	Total Defects %	Smalls %	10 oz %	Specific Gravity	Market. Yield cwt/ac	Payout \$/acre
SS/Alfalfa	369.3	28.9	1.5	48.3	1.077	269.8	\$3,064
Barley/Alfalfa	317.5	9.9	5.4	37.9	1.082	287.2	\$3,451

Yields and size were higher on SS/Alfalfa side, but had higher level of pit rot. Grower didn't see this in whole field...may have been unfortunate sampling.

SS/Alfalfa side had lower gravity.

\$400 difference in payout, but largely skewed by defects percentage.

Potato Early Dying (PED)

Do different legume species multiply Verticillium and nematodes differently?

- Many growers have a need for forages for hay/silage, either for their own cattle or for farmers they rent/trade land with
- Legumes fix nitrogen (up to 80 lbs/ac credit)
- Alfalfa has deep taproot, can help with soil compaction/structure
- Red clover has been shown to be host for Verticillium, nematodes, and common scab
- Not a lot of good data comparing different legume species

Potato Early Dying (PED)

Legume Strip Trial – 2 fields established in 2019

- Worked with two growers in West Prince to establish strips of different forages (primarily legumes) to assess how they multiple Verticillium and root lesion nematodes
- Both fields were chosen as fields with history of early dying.
- Established on the same day, same seeder, same seed
- Will be in forage for two years, potatoes in 2021

Potato Early Dying (PED)

Legume Strip Trial – Field A

Spring 2019: pH = 6.1 soil OM = 2.4 K20 = 147 (H)

	RL Nematodes (#/kg soil)	% change	<i>V. dahliae</i> (cells/g soil)	% change
Spring 2019	5,855		9,395	
Fall 2019				
Red Clover	10,494	+79%	9,748	+ 4%
Alfalfa/Timothy	5,816	- 1%	8,593	- 9%
White Clover/Festolium	5,812	- 1%	9,311	- 1%
Ryegrass/Festolium	9,614	+ 64%	7,244	- 23%

Potato Early Dying (PED)

Legume Strip Trial – Field B

Spring 2019: pH = 6.3 soil OM = 2.1 K20 = 306 (VH)

	RL Nematodes (#/kg soil)	% change	<i>V. dahliae</i> (cells/g soil)	% change
Spring 2019	1,742		7,489	
Fall 2019				
Red Clover	19,931	+ 1044%	9,405	+ 26%
Alfalfa/Timothy	2,319	+ 33%	9,444	+ 26%
White Clover/Festolium	5,653	+ 225%	6,185	- 17%
Ryegrass/Festolium	14,568	+ 736%	6,582	-12%

Building Soil Organic Matter

- Takes longer to build soil organic matter than to lower it!
- Practices most associated with building organic matter:
 - **Use of compost/manure when possible/available**
 - Reducing tillage
 - Maximizing use of cover crops
 - Keeping something growing in your fields as much as possible
 - Use of grass/legume crops with large root mass
 - Mulching of hay crops/straw (lowest impact of this list)

Building Soil Organic Matter

AAFC Plot Trial at Harrington (started 2017)

Project initiated after request from the AIM Soil WG in spring 2017, looking at different crops/mixtures for effect on soil OM and PED

2017: Rotation crops planted, manure applied on half of field

2018: Potatoes

2019: Barley underseeded or rotation crops

2020: Rotation crops

2021: Potatoes

Building Soil Organic Matter

AAFC Plot Trial at Harrington (started 2017)



Building Soil Organic Matter

AAFC Plot Trial at Harrington (started 2017)

Alfalfa/Orchardgrass	15 lbs/ac
Sorghum sudangrass	30 lbs/ac
Red Clover	20 lbs/ac
Ryegrass/Common Vetch/Crimson Clover	45 lbs/ac
Forage Pearl Millet	30 lbs/ac
Sorghum sudangrass underseeded VR alfalfa	15 lbs/ac
Winter Rye/Hairy Vetch	112 : 35 lbs/ac
Forage Sorghum followed by Brown Mustard	30 lbs/ac
No crop (bare soil)	

Building Soil Organic Matter

AAFC Plot Trial at Harrington (started 2017)

Manure applied to half of the field (20 T/ha wet weight) before planting of rotation crops in 2017. No fertilizer in manure plots

Two cuts of most crops, three cuts of red clover. Ploughed in fall.

Building Soil Organic Matter

AAFC Plot Trial at Harrington: Potato Yield in 2018

- Marketable Yield for Forage Pearl Millet and Forage Sorghum about **20% higher than** Red Clover (sig. diff)
- Sorghum sudangrass about **15% higher** than Red Clover (sig diff)
- Between **20-30% yield improvement in plots with manure** applied the year before!
- Differences in soil organic matter not significant but appear to be slightly higher following sudangrass/sorghum/pearl millet

AAFC Crop Rotation Trial (2015-2018)

- Compared 3 Rotations:
 - Grain corn / Sorghum sudangrass / Potatoes
 - Barley / Red Clover / Potatoes (control)
 - Soybean / Brown Mustard / Potatoes
- In first year of trials, **11 to 15% yield increases** in two treatment rotations (following mustard and sudangrass)
- In second year of trials, **10 to 19% yield increases** in two treatment rotations.

Building Soil Organic Matter

Living Labs Projects – Started in 2019

- 9 fields in different rotation crops in 2019, potatoes in 2020
- 6 fields comparing cover crops after tillage/before potatoes
- 7 field comparing cover crops following potatoes
- Looking at soil OM, erosion, nitrate leaching, and yield following cover crops for first two projects
- Continuation of the plot project at Harrington

Mustard & Buckwheat for Wireworm Control

Rotation	Total Yield (cwt/ac)	Market. Yield (cwt/ac)	WW Damage (holes/tuber)
P – W Wheat – Soy	353.7	273.8	2.0
P – BW – BW	420.1	337.1	0.3
P – Mus – Mus	470.0	404.5	0.3
P – Mus – BW	450.7	409.1	0.2
P – Fallow – Fallow	371.4	271.8	0.1
P – Fallow – Mus	387.9	324.8	0.6

Russet Burbank

Yields adjusted to 7 plants/10 ft row. Graded to Canada #1

Mustard & Buckwheat for Wireworm Control

Rotation	Spring RLN (#/kg soil)	Fall RLN (#/kg soil)	Spring V. dahliae (cells/g)	Fall V. dahliae (cells/g)
Wheat – Soy	200	420	1680	10384
Mus – Mus	180	940	1469	2065
BW – BW	360	280	697	1833

Testing before potato planting and at potato harvest

Not much difference in nematode numbers but big difference in Verticillium

So...what crop should I use?

- **What is the biggest issue with your field?** Always tackle the biggest issue first!
- **What is your crop rotation?** Has a big impact on choice of crops
- **Do you have fields that are relatively healthy?** Consider planting all cash crops, but incorporating crop residues or maximizing use of cover crops after harvest



Mustards

Wireworm

- Brown Mustard has been shown to reduce wireworm damage in multiple studies
- Has shown effect just by growing as a cover but also as an incorporated biofumigant

Early Dying

- Research in NB has shown Caliente mustard to have similar level of effect as chloropicrin fumigation at lower cost
- Research in PEI has been variable. More work needed, but have seen yield increases following mustard incorporation. Effect on Verticillium and nematodes work in progress but has shown effect elsewhere.
- Biofumigant effect on Rhizoctonia, Black dot, Pythium, etc



Mustards

Cash Crop

- If conditions aren't right to incorporate, brown mustard (Centennial) can be grown out as cash crop. There is a market for it!
Note: only for early seeded mustard
- Can be interseeded with peas, separated at harvest. Sell both crops or blow mustard out the back of the combine as fall cover crop

Fall Cover Crop

- Should be established in August/early September (before potatoes?)
- Can be established with air-seeder on tillage equipment, 10-15 lbs/acre



Mustards

Considerations

- Possibly not the ideal choice for building soil OM
- **Doesn't overwinter well** in PEI. By spring, biomass is pretty much down to nothing.
- Conflicting reports of brown mustard (not incorporated) as host for Vert/nematodes
- Need **adequate fertility** to get maximum benefit. Especially N and S (5:1)
- **Brown vs Caliente/White:** what are you trying to do?
- Requires **more tillage** if doing biofumigation. Ideally have cover crop afterward
- Need **adequate soil moisture** for biofumigation to have max. effect. Incorporating in July/August gets tricky for large acreages



Buckwheat

Wireworm:

- Has also been shown to be effective at fighting wireworm without need for green manure incorporation.
- Similar levels of control as wireworm without need for incorporation.

Other Benefits:

- Fast establishment, weed fighter, soil conditioner, phosphorus scavenger, low fertility requirements.



Buckwheat

Considerations:

- Not frost tolerant (poor fall cover crop choice)
- Needs to be planted into warm soil (don't plant too early)
- Considerations for white mold in tight rotations with other host crops
- Doesn't regrow as well from mowing as mustard
- Unsure about effect on root lesion nematodes in PEI
- Not the best choice for building soil organic matter



Sorghum Sudangrass

Early Dying:

- Trap crop for Verticillium. Research from elsewhere has shown reduction in Vert spores. Local research not entirely consistent, but we are just developing testing capacity/testing procedures.
- Effect on root lesion nematodes is unclear. More work needed.
- Can be mixed with multiple crops like pearl millet.



Sorghum Sudangrass

Building Soil OM:

- **Builder of soil organic matter** with extensive root system
- Root system doubles after first mowing, **compaction fighter**
- Can be **underseeded** with forage (ie. alfalfa) for rotations requiring hay/silage for cattle or longer rotations.
- **Soil conditioner**, easy tillage following sudangrass (improves soil structure)



Sorghum Sudangrass

Considerations:

- Warm season crop, **can't be planted until mid to late June**. Ideally **soil temps 15C or higher**. Managing weeds before and after planting might be a consideration. A thick stand of sudangrass can help suppress weeds.
- **Don't let it get too mature/tall** (woody) or it can tie up N next year
- Most of the time, can be mowed in Sept and then **left over winter without ploughing**, work in the spring.
- **Should be fertilized** (particularly N) to ensure rapid emergence

Forage Pearl Millet

Early Dying:

- Literature from Quebec showing effect on reducing RL nematode populations (Belair et al. 2005)
- Preliminary results in PEI plot and field trials have also shown **reduced nematodes**
- Preliminary results in PEI trials show slightly higher yields after pearl millet than SS
- Not a host for Verticillium....not making it worse
- Can be mixed with sudangrass to attack both Verticillium & nematodes



Forage Pearl Millet

Building Soil OM:

- Similarly to sudangrass, **builder of soil organic matter** with extensive root system
- Root system doubles after first mowing, **compaction fighter**
- Can be underseeded with forage (ie. alfalfa) for rotations requiring hay/silage for cattle or longer rotations.
- **Soil conditioner**, easy tillage following pearl millet (improves soil structure)



Forage Pearl Millet

Considerations:

- Still trying to build data on how it impacts nematode numbers in PEI conditions
- Like sudangrass....**don't plant in cold soil** and use some N for rapid emergence
- Experience has shown that 20-25 lbs/acre is probably not enough. 30 lbs/acre more appropriate for both PM and SS. Can back off slightly if underseeded.



Alfalfa

Building Soil OM/Soil Health:

- Alfalfa has deep taproot, fibrous root system helping with compaction/soil structure
- 2 or 3 year stand of alfalfa can build a lot of OM
- After 2nd year, can provide N credit of 80-100 lbs/ac
- Easily mixed with grasses like timothy, brome grass, orchardgrass
- High value hay/silage crop, allowing for cash flow in soil building year



Alfalfa

Considerations:

- Preliminary studies shows alfalfa doesn't multiply nematodes as much as red clover, but *Verticillium* still under investigation
- Seed is more expensive than other forages. Having a stand for more than one year with multiple cuts for greater return.
- **Susceptible to winter-kill**, particularly in fields close to water
- **Don't cut too late** in summer/fall if wanting to re-grow next year
- **Requires pH > 6.0 and good K levels.** Don't skimp on K fertility, especially if selling hay/silage
- **Need to reduce N rate in potato crop** following alfalfa to ensure proper crop maturity (especially in Burbanks)
- May be preferred laying habitat for click beetle (like grasses/other legumes)



Forage Grasses:



Building Soil OM:

- Diverse grass/legume mixes are gold standard for building soil organic matter.
- Lots of species to pick from to suit your rotation, whether you want to make hay/silage, longevity, etc.
- Establish is cooler soils than warm-season grasses or brassicas
- Can be underseeded with grains/warm-season annual grasses

Wireworm:

- Can be preferred laying habitat for click beetles and food source for wireworm, so not recommended for wireworm “hot spots”
- Need to do bait trapping/beetle trapping if you want to use forages

Forage Grasses:



Early Dying:

- Grasses don't host Verticillium
- Some grasses can host root lesion nematodes. Have seen high nematode numbers after ryegrass in PEI fields. But generally lower than corn/soybean

Considerations:

- If underseeding barley/wheat, pick species that will re-grow (not annual ryegrass)
- Perennial ryegrass sometimes doesn't overwinter well.
- Easy management (simple mowing).
- If pure grass (no legume), can tie up N if left to get too mature.
- Wet spots/grass waterways? Consider **reed canarygrass**

Other Brassicas (Tillage Radish/Oilseed Radish)

Building Soil OM/Soil Health:

- Brassica species are not a host for many pests/diseases and have been shown to combat some nematode species.
- Fast-establishing biomass crops that are more frost-tolerant than warm-season grasses or legumes
- Tillage radish can help with decompaction/water infiltration
- Oilseed radish makes great fall/winter cover crop, higher biomass



Other Brassicas (Tillage Radish/Oilseed Radish)

Early Dying:

- Inconclusive so far. More research needed
- Reports of radishes multiplying some nematodes
- Oilseed radish/mustard used to fight PCN in Europe

Wireworm:

- More research needed. Does contain some level of glucosinalates (like mustard) but not in as high of levels.



Other Brassicas (Tillage Radish/Oilseed Radish)

Considerations

- **Establish in August/early Sept** following wheat, barley, peas, or biofumigant crop or forage burn-down
- **Somewhat frost tolerant**, breaks down easily in spring. Oilseed radish/winter rapeseed more frost tolerant than mustard/tillage radish
- Tillage radish best used **in combination with a grass/cereal** species for maximum biomass
- Tillage radish can decompose/smell if thaw periods during winter months
- Tillage radish **won't break through hard plough-pans** that well...will just stick out of the ground



Multi-Species Mixtures

- Much to be learned on how different mixtures may help with some soil health attributes but may not help with others.
- Very **difficult to “fix everything”** with one mixture. Choose species that are complementary and addressing similar things.
- Be choosy about what is being sold to you. **Make sure it meets your needs!**

- **Early Dying:** Sudangrass / Pearl Millet / brassica species
- **Wireworm:** Brown mustard / Buckwheat / other brassicas / sudangrass
- **Soil OM:** Legume species (clovers/alfalfa/vetch/peas), ryegrass, oats, grasses, phacelia, rye
- **Soil Compaction/Structure:** Sudangrass, pearl millet, buckwheat, ryegrass, alfalfa, sunflower

Looking at Cash Crops

- On your best fields, it might be more advantageous to have a cash crop every year, as long as you are not making that field worse for early dying, compaction, soil organic matter, etc.
- **Particularly if you have access to manure/compost**, this might be great option.
- I tend to **gravitate toward crops that you can harvest early** (grains, peas) as it allows you to **spread the work load** through the growing season and opportunity to **establish a cover crop**.
- I'm not a big fan of soybeans in potato rotation, as they are late harvested, low residue, erosion prone, no opportunity for cover crops, big K users, multiply Vert and nematodes.
- Soybeans can fit in longer rotations or field less prone to erosion.



Grain Crops

- Winter Rye gold standard cover crop following potatoes, will normally **establish up to October 15** in PEI
- Some market for rye, newer varieties available
- So far in PEI testing, **nematode numbers are usually low following straight barley**. Not a host for Verticillium
- Winter wheat also a great option following earlier harvested potatoes
- Because they are harvested in late summer/early fall, **lots of opportunity for cover crop establishment**
- Opportunity to underseed if looking for a no-work cover crop plus hay crop next year
- Can be laying habitat for click beetle
- Grains a great break crop following potatoes, and also are fast establishing cover crops
- Oats/peas can be used as green manure crop or as forage crop



Peas

- Opportunity to seed early, harvest early, establish a cover crop early
- Potatoes / winter wheat / green peas / brassica cover in 3 year rotation would mean your ground is covered most of the time with 4 different families of crops to break disease cycles
- Some growers are interseeding peas with brown mustard
- Peas/potatoes/mustard all have risk of white mold (monitor for presence)
- Need to have the right combine set-up or custom harvester available, listen to agronomic advice, harvest early for superior quality.
- Unclear what effect peas have on Vert/nematode levels – more research needed



Corn

- Allows for **use of neonic seed treatments** to suppress wireworm (ie. Force)
- Cash crop option if you have a combine, customer
- Does produce a lot of **above ground biomass** if not removing for silage
- Fibrous root system
- Does not multiply Verticillium but does has a **reputation for multiplying nematodes**
- Higher erosion potential than grasses and brassicas
- Late harvest, no option for cover crop. Can use a “nurse crop” or grass/legume established under the corn after emergence
- **High risk crop in PEI** due to shorter growing season, fewer heat units. Make sure you use a short-season hybrid, avoid sloped fields.



Cover Crop Decision Tool

■ <http://decision-tool.incovercrops.ca/>

Cover Crop	Soil	Goals / Benefits
<i>For more info, click on cover crop name.</i>	+	+
Broadleaf, non-legume		
Buckwheat		
Grass		
Millet, Pearl		
Sorghum-sudangrass		
Oats		
Barley, Spring		
Wheat, Spring		
Ryegrass, Annual		
Rye, Winter Cereal		
Timothy		
Triticale, Winter		
Wheat, Winter		
Brassica		



Factsheet on Rotation Crops (PDF)

Topics > Soil & Fertility >
Crop Rotation and Organic
Matter

	Sorghum Sudangrass	Forage Pearl Millet	Brown Mustard	Buckwheat	Oilseed Radish	Annual Ryegrass
Seeding Rate	25-30 lbs/ac	25-30 lb/ac	10-12 lb/ac	30-55 lbs/ac	10-15 lbs/ac	20-30 lbs/ac
Earliest Planting Date	mid-June	mid-June	late May	mid-June	early May	late April
Latest Planting Date	mid-August	mid-August	early September	early September	early September	early September
Annual/Perennial	Annual	Annual	Annual	Short-Season Annual	Annual	Annual
Winter Survival	Never	Never	Never	Never	Never	Seldom
Can it be mowed?	Yes (> 6 inches) Increases root mass	Yes (>6 inches) Increases root mass	Yes	No	Yes	Yes (>3 inches)
Termination	Freeze, Tillage, Herbicide, Mowing close to ground	Freeze, Tillage, Herbicide, Mowing close to ground	Freeze, Tillage, Herbicide, Mowing close to ground	Freeze, Tillage, Herbicide, Mowing	Freeze, Tillage, Herbicide	Tillage, Herbicide
Soil OM Builder	Very Good	Very Good	Good	Good	Good	Excellent
Compaction Fighter	Very Good	Good	Good	Fair	Very Good	Fair
Weed Suppression	Very Good	Very Good	Excellent	Excellent	Excellent	Fair
Quick Growth	Very Good	Very Good	Excellent	Excellent	Excellent	Fair
Effect on RL Nematodes	Inconclusive	Reduces Numbers	Very Good if incorpo- rated. Host if not	Moderate Host	Moderate Host	Moderate Host
Effect on Verticillium	Trap Crop	Non-Host	Very Good (biofumigant)	Beneficial (Green Manure)	Inconclusive	Non-Host
Wireworm Fighter	No	No	Yes (biofumigant)	Yes	Inconclusive	No
Effect on Common Scab	Unknown	Possible Suppression	Possible Suppression (Green Manure)	Possible Suppression (Green Manure)	Possible Suppression (Green Manure)	Unknown
Forage Harvest	Good (before frost)	Good	Poor	Poor	Poor	Very Good
Preferred Soil pH	5.5 - 7.0	5.5 - 7.5	5.5 - 8.5	5.0 - 7.0	6.0 - 7.5	5.5 - 7.0
Drought Tolerance	Excellent	Excellent	Good	Good	Good	Good
Additional Effects:	- Non-host for cyst nematodes - Best to mow before plants be- come woody (3-4 ft) to avoid N tie-up	- Best to mow before plants become woody (3-4 ft) to avoid N tie-up	- risk for white mold - incorporate in pres- ence of adequate soil moisture - do not go to seed	- P scavenger - Pollinator crop - Wireworm control when actively growing - do not go to seed - risk for white mold	- risk for white mold - N scavenger - establishes in colder soil than mustard	- can be used as underseed with grain crops - perennial ryegrass more winter hardy

Source: <http://decision-tool.incovercrops.ca/> and additional academic sources for disease/pest control effects

Compiled by Ryan Barrett, AIM, PEI Potato Board

- <https://peipotatoagronomy.com/wp-content/uploads/2020/01/Rotation-Crop-Table-Jan20.pdf>

Next Local Workshops

- Wednesday, Feb 12th 9:00 am Emerald
- Wednesday, Feb 12th 1:30 pm Mill River
- Thursday, Feb 13th 9:00 am Montague



Agronomy
Initiative for
Marketable Yield

- Topic: **Seed Management Topics**
 - Speaker: Russell Jonk, Seed Grower from Manitoba
 - Presentation of AIM Seed Trials from 2019



March Local Workshops

- Thursday, Mar 12th 9:00 am Emerald
- Thursday, Mar 12th 1:30 pm Mill River
- Friday, Mar 13th 9:00 am Montague



Agronomy
Initiative for
Marketable Yield

- Topic: **Soil Compaction and Reduced Tillage**
 - Speaker: “Wheat Pete” Johnson, Agronomist/RealAgriculture
 - Presentation of AIM Compaction/Tillage Trials from 2019



Additional Meetings

- **United Potato Partners Seminar**
 - January 29th at Red Shores, Charlottetown
- **International Potato Technology Expo Conference**
 - February 21/22 at Red Shores, Charlottetown
- **Cereal & Oilseed / Soil & Crop Conference**
 - March 4/5 at Credit Union Place, Summerside
- **Wireworm Research & Extension Seminar**
 - March 24 at Red Shores, Charlottetown



Any Questions?

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