AIM Soil Health & Fertility Projects 2024

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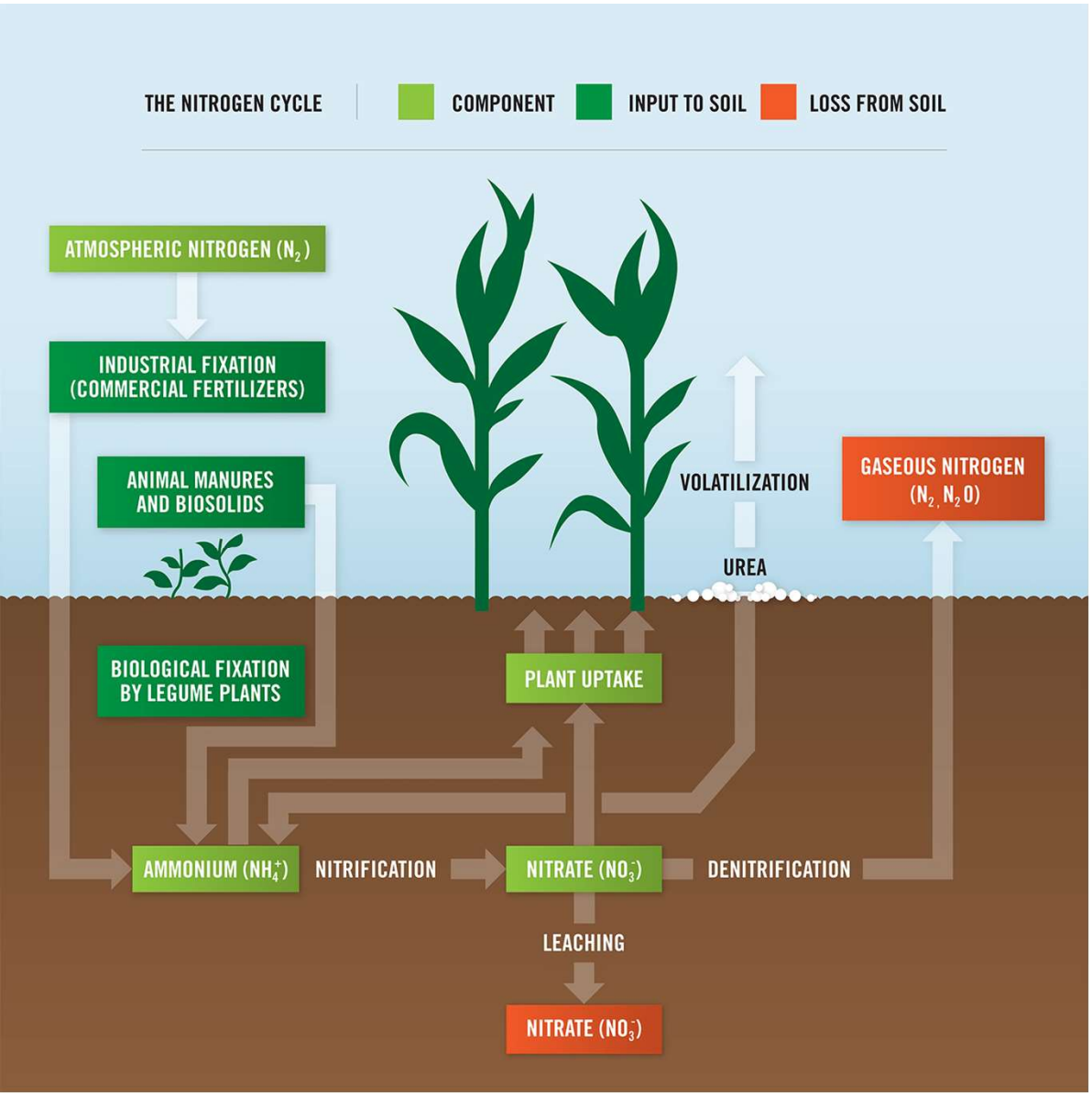
Prince Edward Island Potato Board

AIM Soil Health & Fertility Projects:

- ACS-LL: Legume Nitrogen
- Reduced Phosphorus
- ACS-LL: Rotational Grazing
- ACS-LL: Long-Term Cover Cropping
- FVGC Cluster - Regen Agriculture
- Additional Crop Rotation Projects



Nitrogen

- Nitrogen is possibly the most complex nutrient to understand in plant nutrition, as it comes in many forms, and is the easiest nutrient to be lost from the system
- Accounting for all inputs and outputs is import to arrive at the right N rate!

Image: https://kochagronomicservices.com/

Nitrogen in Potatoes…the tricky part…

- In crops like corn and wheat, too much N application doesn't really hurt yield, but is just economically inefficient
- In potatoes, **too much N can delay tuberization, delay maturity, reduce tubers/plant, and lower specific gravity**
- Not enough N = reduced yield, plants with reduced vigour/health
- Managing N in-season is difficult without fertigation, but there are some foliar N products to deliver small amounts at a time.

Building a Nitrogen Rate/Fertilizer Blend:

- How much does the **crop need**, according to your yield goal?
- How much N will be available from your **soil organic matter**?
- How much N will be available from **previous legume crop**?
- How much N will be available from **manure/compost**?
- What is the **timing of N availability**?

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How much N from previous legume crop?

- PEI Soil Lab:
  - Alfalfa: Good Stand = 71 lbs/ac Fair Stand = 36 lbs/ac
  - Red Clover (1st yr): Good Stand = 36 lbs/ac Fair Stand = 18 lbs/ac
  - Red Clover (2nd yr): Good Stand = 18 lbs/ac Fair Stand = 9 lbs/ac
- OMAFRA:
  - Half or more legume in stand: 100 lb/ac
  - One-third to half legume in stand: 49 lb/ac
- Perennia (NS):
  - Depending on amount of biomass: 20-100 lbs/ac

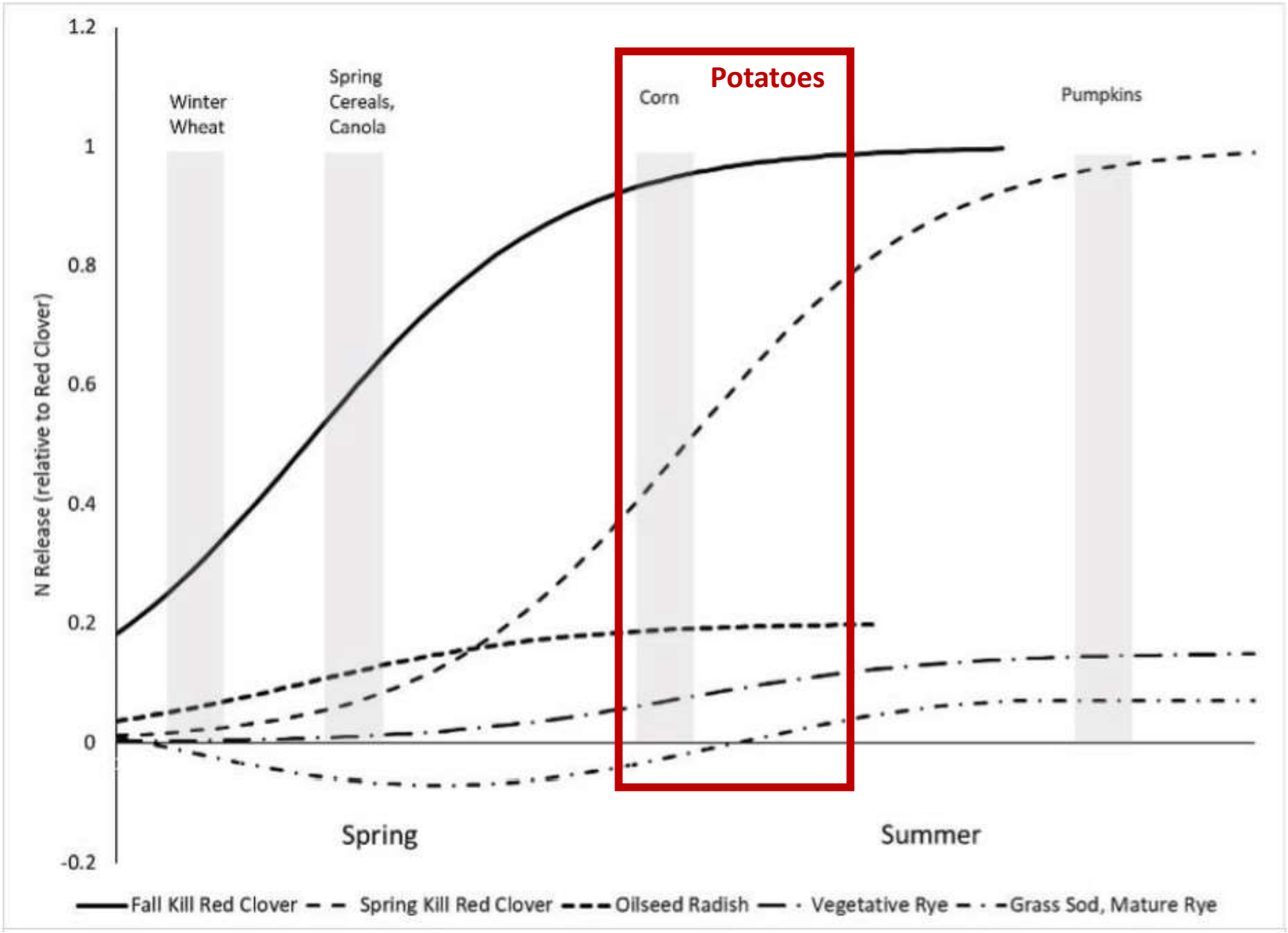

Image: Perennia factsheet

How much N from previous legume crop?

- In new ACS-Living Labs project, looking at dialing-in N credits from legumes based on:
  - Legume species
  - Timing of termination
  - Presence of cover crop
  - Different N fertilizer rates

- 4 fields in potatoes in 2024. 1 in West Prince, 3 in East Prince
  - Mountain Gem, Ranger, Dakota, Payette

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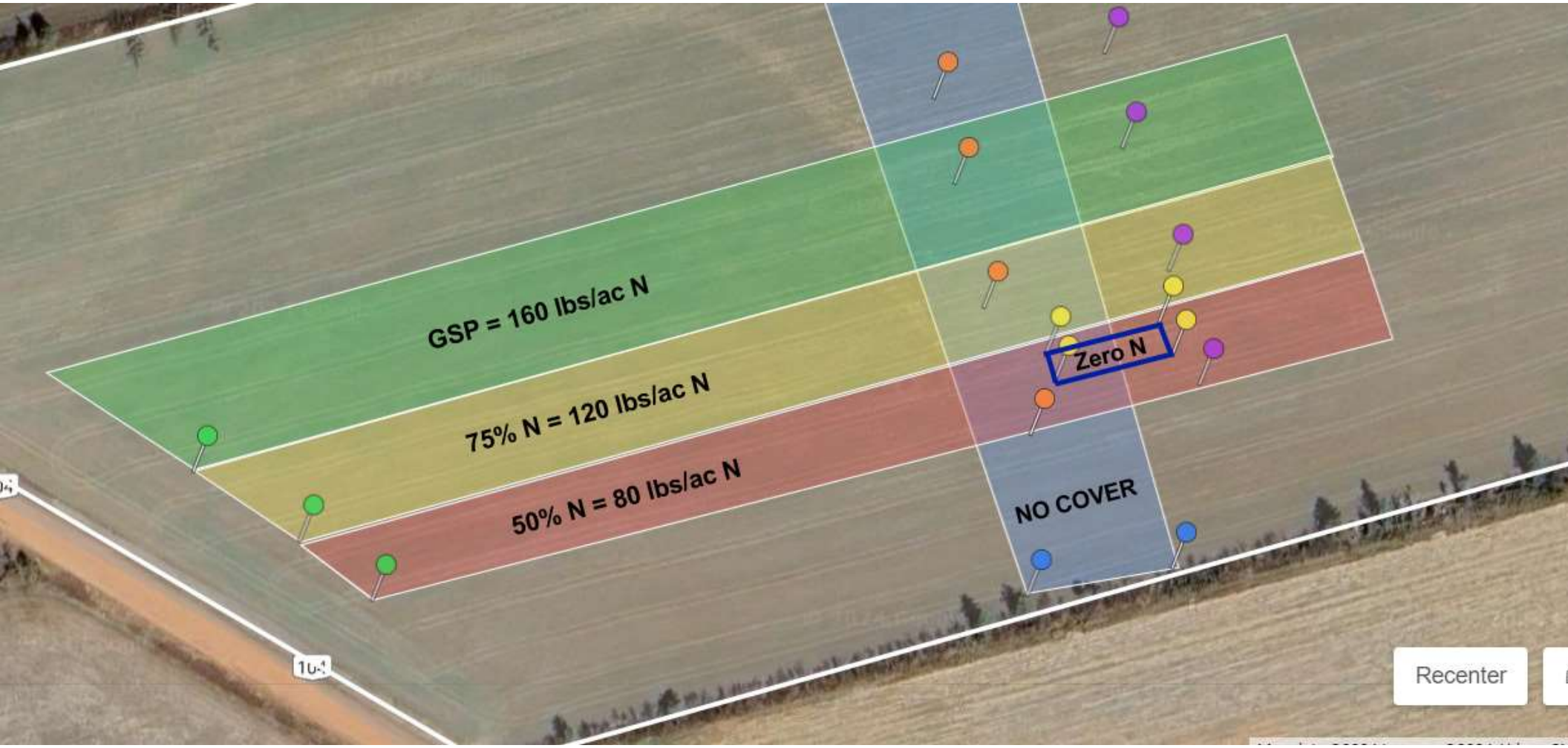
ACS-LL: Legume N Project

- Alfalfa/grass mix in 2023, terminated late summer/early fall 2023 (glyphosate)
- Tilled early September, cover crop established. Radish x 2 ; Barley x 2
- In each field, strip perpendicular to the direction of potato rows was left with no cover crop
- Baseline soil samples in both cover and no-cover strip in fall 2023
- Follow-up samples in spring 2024 before potato planting
- Each field had 4 fertilizer treatments:
  - Grower Standard Practice (~160 lbs/ac N)
  - 75% N (~120 lbs/ac N)
  - 50% N (~ 80 lbs/ac N)
  - 0 N (plot – P, K, micros were hand-applied to be even with planter blend)

ACS Legume N: Trial Layout



ACS-LL: Legume N Project

- Late August/Early September: **Plant and tuber samples** collected in each treatment at peak biomass – for calculation of N uptake. (Don't have results yet)

- Late September/Early October: **Harvest samples and soil nitrate samples** taken in each treatment. (Don't have nitrate results yet)

- All sites impacted by dry growing season. Yield are below budget for all four farms. Yields did not accumulate much in last 3-4 weeks of season. One site (Dakota) was particularly impacted, no appreciable rainfall after early August.

ACS-LL: Legume N – Dakota Russet

	GSP N	75% N	50% N	Zero N
Total Yield (cwt/ac)	273	261	247	174
Smalls (%)	15.7	13.0	13.8	15.3
> 10 oz (%)	2.3	3.2	2.0	1.9
Total Defects (%)	0.7	0.8	0.8	0.2
Specific Gravity	1.094 a	1.095 a	1.094 a	1.087 b
Market. Yield (cwt/ac)	205 a	203 a	190 a	132 b
Crop Value ($/ac)	3623 a	3586 a	3349 a	2300 b

- Only in Zero N plot did we see a big difference in yield between no cover and cover (+36 cwt). Not sig. diff. across all treatments for yield.
- No difference between 50%, 75% and 100% N.
- Planter blend = 80 lbs/ac N
  GSP had 80 lbs/ac N from Super U
  75% had 40 lb/ac N from Super U

ACS-LL: Legume N – Ranger Russet

	GSP N	75% N	50% N	Zero N
Total Yield (cwt/ac)	345	311	304	277
Smalls (%)	17.3	18.0	20.5	19.7
> 10 oz (%)	3.0	4.0	3.0	0.4
Total Defects (%)	2.6	5.7	12.3	17.5
Specific Gravity	1.096	1.092	1.093	1.092
Market. Yield (cwt/ac)	250 a	214 ab	190 b	157 b
Crop Value ($/ac)	4456 a	3812 ab	3397 b	2794 b

- Inconsistent difference between cover and no cover for yield
- 50% and Zero N plots had higher scab than rest of field
- GSP N was best performing
- 277 cwt total yield with no applied N was surprising!
- Planter blend = 80 lbs/ac N
  GSP had 80 lbs/ac N from Super U
  75% had 40 lb/ac N from Super U

ACS-LL: Legume N – Mountain Gem

	GSP N	75% N	50% N	Zero N
Total Yield (cwt/ac)	292	306	316	267
Smalls (%)	12.5	10.4	14.2	11.4
> 10 oz (%)	7.8	8.3	4.9	3.2
Total Defects (%)	0.8	1.8	0.2	0.5
Specific Gravity	1.106 b	1.106 b	1.109 a	1.107 b
Market. Yield (cwt/ac)	227 ab	242 a	246 a	211 b
Crop Value ($/ac)	4066 a	4307 a	4378 a	3721 b

- Only in the Zero N plot did we see much different between cost and no-cover (+67 cwt/ac total yield, +50 cwt/ac market yield)
- Essentially the same yield between 50%, 75% and 100%
- "GSP" is actually higher than what grower would use, was included for comparison. True GSP closer to 75% N.
- Planter blend = 90 lbs/ac N
  GSP had 90 lbs/ac N from Super U
  75% had 45 lb/ac N from Super U

ACS-LL: Legume N – Payette Russet

	GSP N	75% N	50% N	Zero N
Total Yield (cwt/ac)	338	337	351	269
Smalls (%)	9.4	9.5	10.3	15.1
> 10 oz (%)	11.3	9.5	6.8	6.1
Total Defects (%)	0.3	0.5	0.9	0.8
Specific Gravity	1.096	1.096	1.098	1.098
Market. Yield (cwt/ac)	274 a	274 a	281 a	203 b
Crop Value ($/ac)	4899 a	4881 a	4982 a	3631 b

- Cover crop treatment was better in 50% N and Zero N than no-cover
  - +110 cwt total yield (50%)
  - Fewer smalls
  - 8-10% more 10 oz
- No diff in yield between 100%, 75% and 50% N
- Planter blend = 80 lbs/ac N
  GSP had 80 lbs/ac N urea top-dress
  75% had 40 lb/ac N urea top-dress

ACS-LL: Legume N – Four Fields Combined

	GSP N	75% N	50% N	Zero N
Total Yield (cwt/ac)	312	304	305	247
Smalls (%)	13.7	12.7	14.7	15.3
> 10 oz (%)	6.1	6.3	4.1	2.9
Total Defects (%)	1.1	2.2	3.5	4.8
Specific Gravity	1.098	1.097	1.099	1.096
Market. Yield (cwt/ac)	239 a	233 a	226 a	176 b
Crop Value ($/ac)	4261 a	4147 a	4015 a	3111 b

- No statistical difference in yield or payout between 100%, 75% and 50% N
- % smalls and % 10 oz remarkably similar
- No difference in gravity, but all gravities were high this year

ACS LL – Legume N : Year 1 trends

Will have more to dig into on nitrogen budget when we get rest of data, but in 2024 growing season, we saw the following trends:

- Only one site (Rangers) where there was a difference in yield/quality between 100%, 75% and 50% N rates
- Marketable yield from Zero applied N ranged from 120 to 238 cwt/ac. N for these plants came from soil OM, legume, and cover crop carryover
- In a dry year, cover crop treatment mostly increased yield/size in Zero N plot
- Gravities were all high across all treatments/fields

ACS LL – Legume N : Year 1 Trends

- If fields would have had more moisture or access to irrigation, would higher N treatments have performed better?

- Having higher N applied didn't make any difference under drought stress to yield or quality. N needs water to get into the plant!

- For 2025 fields, 4 more fields set up (1 West, 2 Central, 1 East). Issues with getting fall covers established due to dry summer weather, so only 1 field will have cover / no-cover comparison. 2 red clover, 2 alfalfa

- Also interested in doing a couple of corn fields – contact me if interested!

Phosphorus: What does it do?

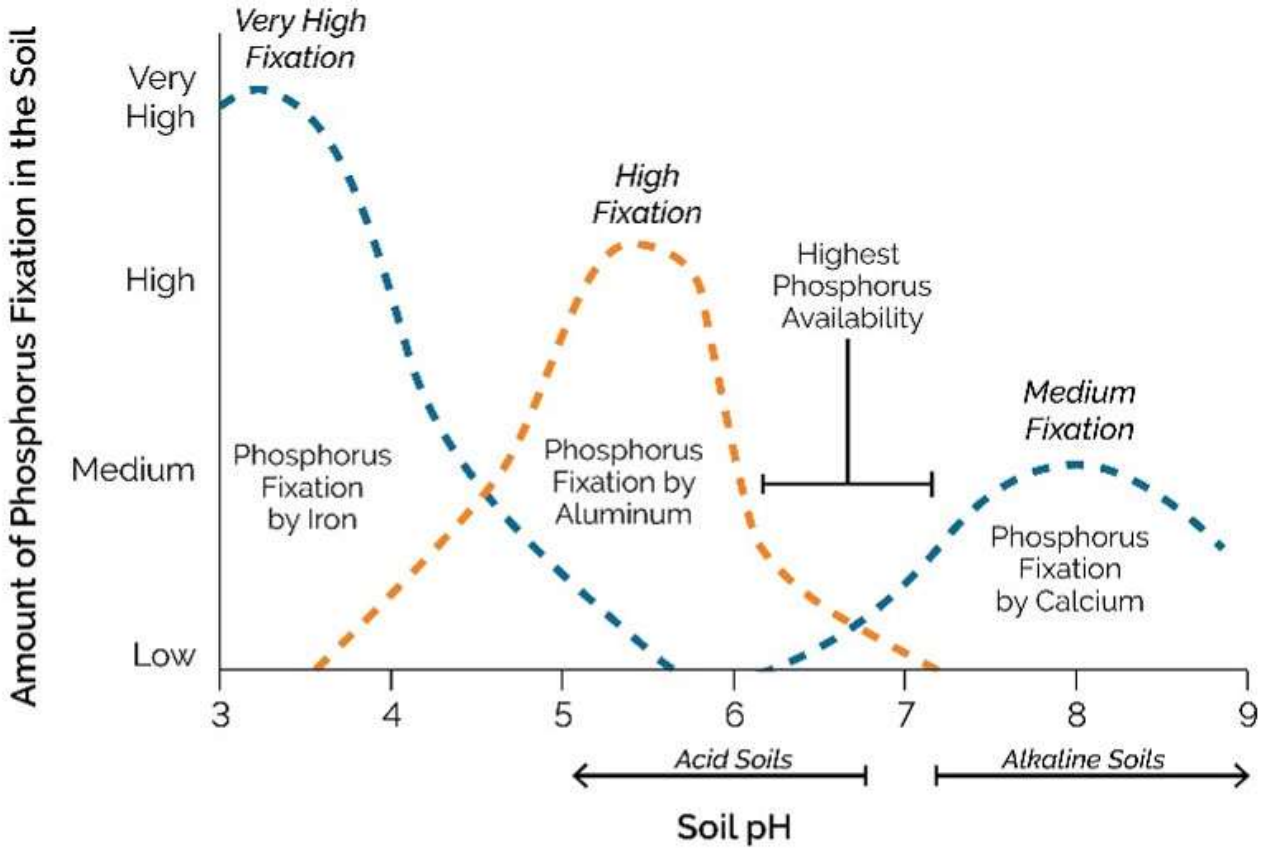
- Key component in DNA and RNA, building blocks of life
- Key component of ATP and ADP (energy transfer system)
- Stimulates root development
- Increased stalk/stem strength
- P deficient plants will have “purpling,” reduced root growth

Phosphorus: Finding the right rate

P_2O_5	300 cwt/ac	350 cwt/ac	400 cwt/ac	450 cwt/ac
Tubers	45	52.5	60	67.5
Above Ground	15	17.5	20	22.5
Total	**60**	**70**	**80**	**90**

- We don't export as much P with the crop as we do with other nutrients.
- Too much P – no impact on yield
- Above ground returns to the soil for all crops except N

Phosphorus: Finding the right rate



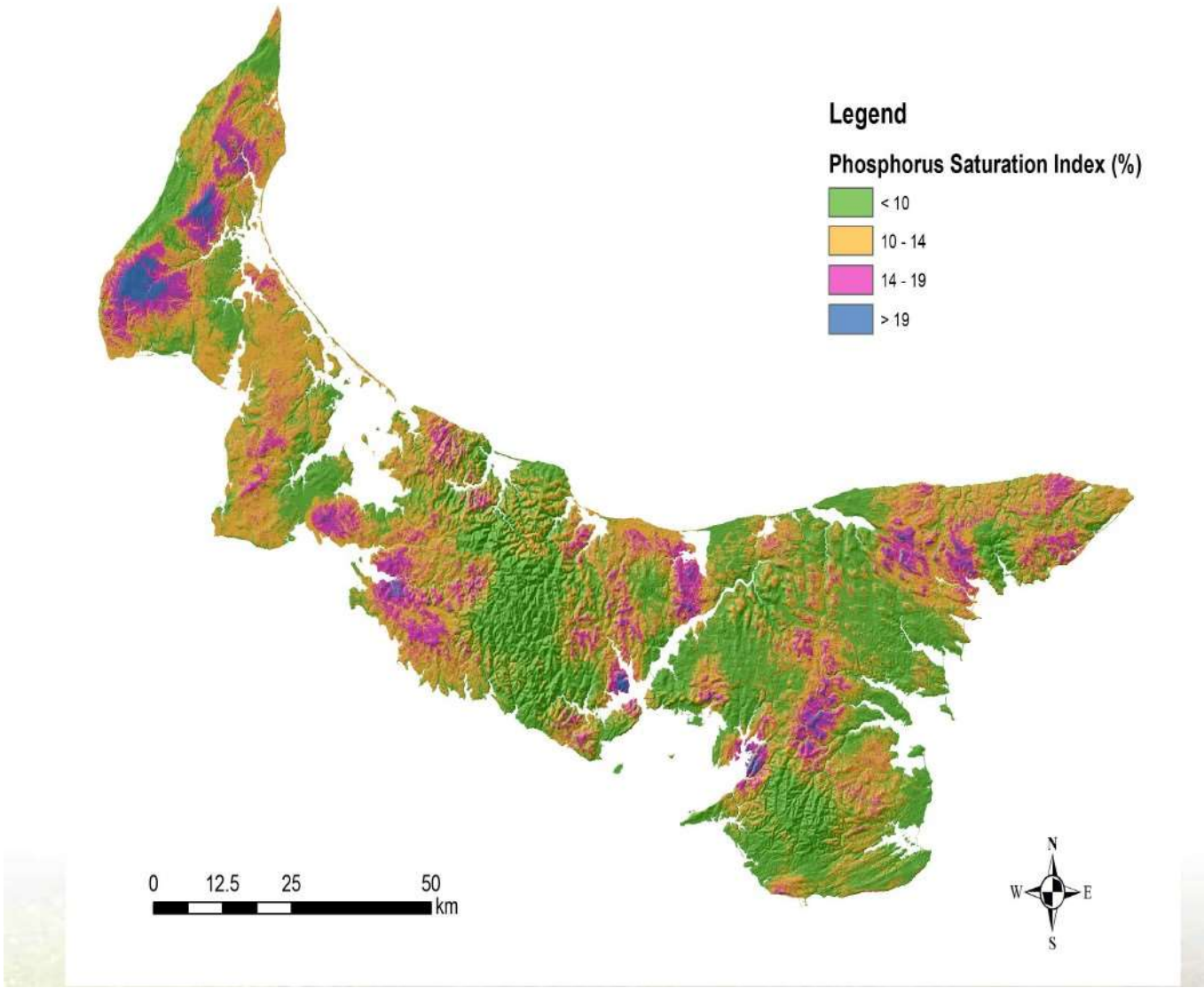
- Historically, we went higher with applied P rates because most fields were at pH < 6.0
- P is much more available at pH > 6.0
- Seeing soil tests now with >500 ppm P_2O_5. Building up in soil due to over-application.

Phosphorus: Prior Research

- When deciding on need to apply P, key soil test factor is P saturation index (P/Al %)
- Dr. Judith Nyiraneza and team did research at 23 sites in PEI over multiple years, both plot scale and grower fields.
- When P/Al was 10 or higher, the optimum P rate was ZERO
- When P/Al was between 5 and 10, the optimum P rate was 160 lbs/ac
- Recommendations have now been updated at PEI Analytical Lab

Phosphorus: Local Research

- P Saturation Index from the PEI Dept of Ag's Soil Quality Monitoring Program (SQMP)



Phosphorus: Local Research

Total P_2O_5 Applied lbs/ac	Total Yield cwt/ac	Market. Yield cwt/ac
40	318	312
80	371	369
160	346	342
GSP (200+)	343	337

- 2017 demo trial by Kyra Stiles, PEI Dept of Ag
- No difference in yield between 80, 160, and 200+ lbs/ac
- Significantly more residual P_2O_5 in the soil after harvest in GSP

Phosphorus: Local Research

	99 lbs P_2O_5	198 lbs P_2O_5
Total Yield (cwt/ac)	324	325
Market. Yield (cwt/ac)	290	291
Spec. Gravity	1.085	1.086
% smalls	10%	10%
% 10 oz	18%	16%

- 2020 grower trial in Prince County. Russet Burbank
- Field had 484 ppm P_2O_5
- P/Al % = 14.4

- No difference in yield with 50% reduction in P

Phosphorus: 2024 AIM Trial

- Initiated 3 grower trials, all three in Mountain Gem Russets
- Farm A: GSP = 160 lbs/ac P_2O_5 Low P = 100 lbs/ac Planted May 27
- Farm B: GSP = 150 lbs/ac P_2O_5 Low P = 100 lbs/ac Planted May 22
- Rest of the nutrients were equal, fields managed the same, planted the same day.
- 10-foot harvest samples taken side-by-side in Low P and GSP strips. Same regions of each field to control background variability
- No differences were observed in foliage through the growing season
- Graded at CF Central Grading

Phosphorus: 2024 AIM Trial

Farm A-1 – Mountain Gem Russets

Treatment	Total Yield	Smalls	>10 oz.	Total Defect	M. Yield	Payout
	cwt/ac		%		cwt/ac	$/acre
Low P	306	9.2	2.8	1.5	274.9	$4817
GSP	292	5	14.5	0	277.3	$4938
Difference	14	4.2	-11.7	1.5	-2.4	-$121
p value	0.42	0.11	<0.001	0.13	0.91	0.74

Farm A-2 – Mountain Gem Russets

Treatment	Total Yield	Smalls	>10 oz.	Total Defect	M. Yield	Payout
	cwt/ac		%		cwt/ac	$/acre
Low P	294	8.3	12.2	1.5	266.0	$4751
GSP	281	9.2	3.3	0.3	254.8	$4478
Difference	13	-0.9	8.9	1.2	11.2	$273
p value	0.18	0.35	0.11	0.12	0.28	0.17

Phosphorus: 2024 AIM Trial

Farm B – Mountain Gem Russets

Treatment	Total Yield	Smalls	>10 oz.	Total Defect	M. Yield	Payout
	cwt/ac		%		cwt/ac	$/acre
Low P	319.2	10.5	11.0	0	287.0	$5144
GSP	308.7	9.4	10.6	0.8	277.8	$4970
Difference	10.5	1.1	0.4	-0.8	9.2	$174
p value	0.69	0.67	0.95	0.30	0.77	0.77

3 Field Combined – Mountain Gem Russets

Treatment	Total Yield	Smalls	>10 oz.	Total Defect	M. Yield	Payout
	cwt/ac		%		cwt/ac	$/acre
Low P	308	9.5	9.0	0.9	278	$4938
GSP	295	8.0	9.5	0.4	271	$4809
Difference	13	1.5	-0.5	0.5	7	$129
p value	0.27	0.27	0.89	0.35	0.61	0.62

AIM P Trials - Summary

- There was **no difference in yield or quality** when reducing P2O5 rate by 50-60 lbs/acre on fields that were strong candidates for reduced P
- **A reduction of 50 lbs/ac P2O5 is worth about $37/acre**, based on the 2024 price of DAP plus the cost of adding back in the N from DAP
- On 500 acres of potatoes, this would be worth $18,650 per year with no reduction in yield/quality.

Phosphorus Recommendations:

- There is a lot of local evidence that **growers can significantly reduce P rates** from what has previously been applied without harming the crop.
- **Pay attention to pH and P/Al %** when making decisions on P rate
- If particularly interested in early-season P and making it available, **liquid in-furrow starter P** products are widely used in both PEI and elsewhere. Many other provinces only use starter P
- **Broadcast P is a waste of money**…needs to be concentrated near the seed piece for maximum uptake.
- Try your own trial with reduced P blend on good candidate fields. I can assist with data collection if interested.

ACS-LL: Rotational Grazing

- What impact does grazing livestock on forages that would otherwise just be mowed/baled have on soil health, fertility and potato yield/quality?

- Three fields in potatoes in 2024
  - Bluefield Acres/Kingston View Farms (Alverstone)
  - Oyster Cove Farms/Beech Point Farms (Alverstone)
  - Rayner Farms (Yellow Star creamer)

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Grazing: Bluefield Acres/Kingston View

Year	Grazing 1 (SS/Alf)	Grazing 2 (Corn/Forage)	Control
2022	Sorghum sudangrass, underseeded with alfalfa/timothy	Corn (Forage variety)	Barley, underseeded red clover
2023	Alfalfa/timothy	Oats/ryegrass/pearl millet/ forage peas/berseem clover	Double cut red clover
2024	Potatoes	Potatoes	Potatoes

- Potatoes in 2021
- Soil sampled prior to planting/grazing in 2022. Resampled spring 2023 and spring 2024
- In control treatment, barley/straw was harvested, clover was mulched.
- In rest of the field, cattle were grazed, though not necessarily at the same time ie. Corn was grazed in November 2022, sudangrass grazed in the summer.

Grazing: Bluefield Acres/Kingston View

Soil Characteristics:

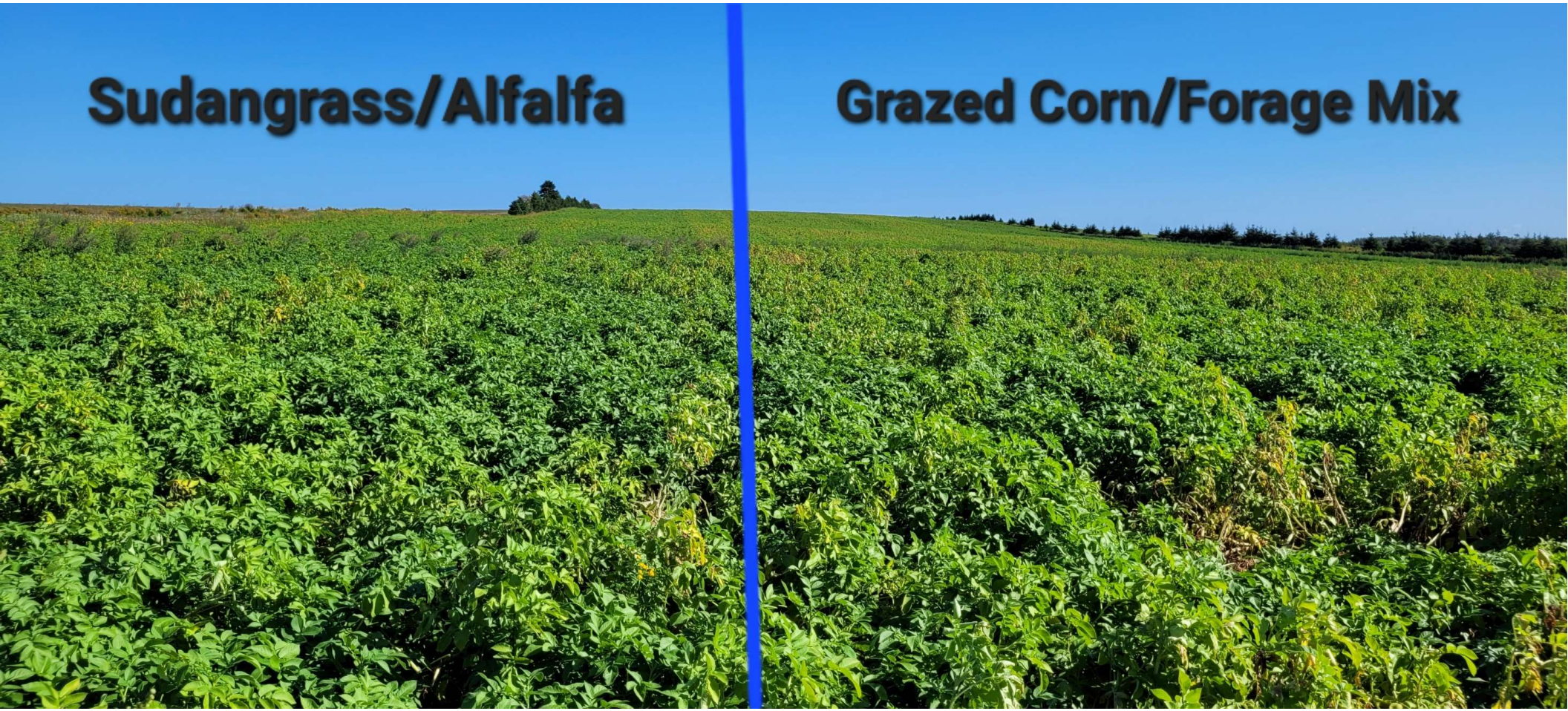
- Organic matter climbed in all three treatments, but grew fastest in control treatment (started lower)
- Aggregate stability increased in control and corn/forage mix treatments, largely the same in sudangrass/alfalfa treatment
- Not much difference in BNA or Active Carbon
- pH was variable at the start of the trial, similar in all 3 treatments by spring 2024 (6.1)
- Residual nitrates were highest following the control treatment at both 0-6 in and 6-12 in depths following potato harvest

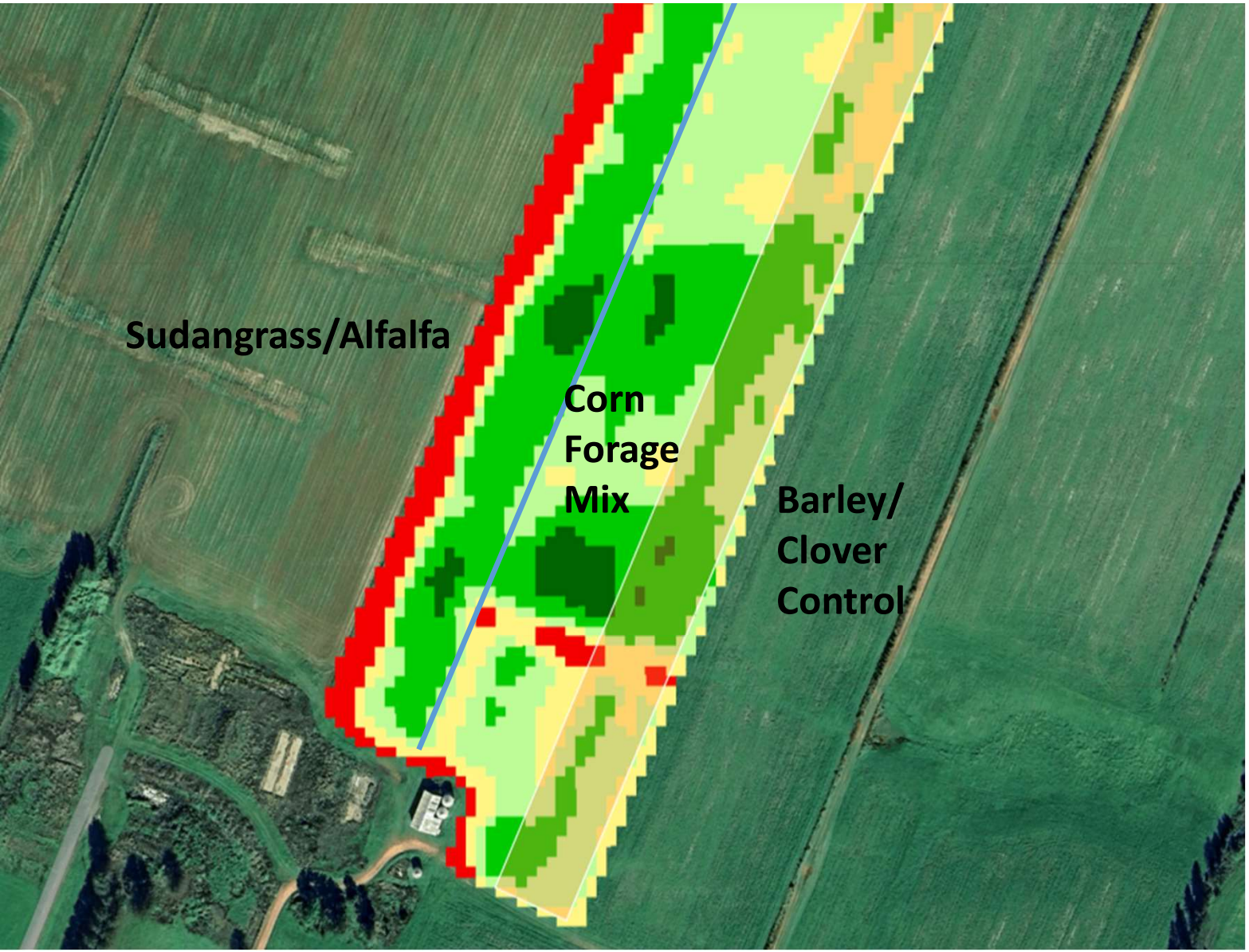
Grazing: Bluefield Acres/Kingston View

Potato Yield and Quality:

- Comparable between control and corn/forage grazed. Sudangrass/alfalfa treatment had lower yield.
- Field was killed early for seed. SS/Alf side was greener at top-killing

Treatment	Total Yield	Smalls	>10 oz.	Total Defects	M. Yield	Payout
	cwt/ac	%			cwt/ac	$/ac
Control	355	18	0	0.7	290.7	5121.20
Corn/Forage	350	21	1.8	0.3	276.3	4899.24
SS/Alf	304	18.5	1	0.3	247.7	4376.06
p value	0.09	0.73	0.41	0.76	0.25	0.25


Sudangrass/Alfalfa
Grazed Corn/Forage Mix


Sudangrass/Alfalfa
Corn
Forage
Mix
Barley/
Clover
Control

Grazing: Rayner Farms

- Ryegrass field in 2023. Whole field had first cut removed. Portion of field was then grazed from August to November. Non-grazed check on west side of field with no forage removal.
- Yellow Star creamer variety in 2024
- AAFC collected soil test and GHG emission data in 2024. Results to follow in near future.
- Field was split between manure and no manure.

Grazing: Rayner Farms

Grazing: Rayner Farms

Potato Yield/Quality

- Samples from manure treatment had 34 cwt/ac more total yield (p=0.05) and more tubers per sample
- There was numerically more yield (12 cwt/ac) on the grazed treatment than the control, but this was not sig. different.
- Yields were compromised by extreme drought in this field. Field is also quite sandy to begin with.
- Noticed fewer weeds in the grazed section than the non-grazed control, but not directly measured.

Grazing: Oyster Cove / Beech Point Farms

- Soil sampling done prior to grazing in spring 2023
- Large field was sampled, but only a small portion of field was potatoes in 2024
- Control treatment (non-grazed) was small in size
- 2023 mix was largely grass where potatoes were planted in 2024.
- Grazed 4 times in 2023. Control was mowed twice
- Spring plowed (April 2024) ahead of potatoes
- Soil tests and GHG emission data to follow soon.

Grazing: Oyster Cove / Beech Point Farms

- No significant difference in yield between treatments.
- There was more common scab found in the check than the grazed treatment, but not statistically significant.
- Field suffered from drought, so marketable yields were quite low (~200 cwt/ac) because Alverstone Russets had high percentage of smalls.

- More sections of this field will be grazed over next 2-3 years.

Grazing: Summary

- No significant difference in yield between treatments in most fields.
- More story to tell on soil test / GHG emission data
- 2 more fields set up for potatoes next year
  - 1 field that has been grazed for 2 years
  - 1 field that was grazed for 1 year
- 1 field set up for potatoes in 2026 (after 2 years of grazing)

ACS-LL: Long Term Cover Cropping

- Previous Living Labs research showed encouraging results for yield improvement, reducing orphaned soil nitrates and reducing soil erosion susceptibility with fall cover crops.
- Showing differences in soil organic matter and soil health are more difficult in the short term.
- We initiated two fields in fall 2023 that will compare cover and no cover crop for five years
- Initiated a third field in 2024 that will compare cover and no cover crop for four years

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ACS-LL: Long Term Cover Cropping

- To early to report much on soil characteristics. No significant trends to report thus far.
- UPEI M.Sc. Student Soyeon Shim collected GHG emissions in two fields in 2023 & 2024 as well as soil nitrate and other cover crop data
- One field had very poor cover crop establishment in 2023.
- No significant differences in potato yield or quality in 2024.
- Better cover crop establishment in 2024

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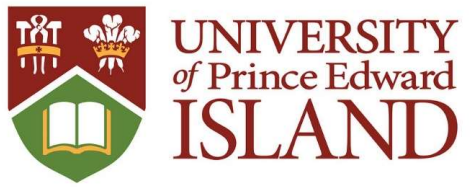
ACS-LL: Long Term Cover Cropping

- New field in 2024: spread cover crop pre-harvest using drone at 150 lbs/ac. Variable level of establishment. First time using drone for cover crop seeding, work in progress.

- Hopefully we will see largely differences toward the end of this trial. Stay tuned for more!



FVGC Cluster: Regen Agriculture

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- **Fox Island:** Comparing no cover crop with cover crop and improved rotation over 5 years.
  - 2024 was potato crop, no sig. diff. in yield/quality
  - Some trends toward higher soil health metrics in cover crop treatment, more years of data needed.
  - Winter cereals MUCH better established than spring cereals!
- **Shore Lane Farms:** Comparing 3 different rotations
  - GSP – Spring wheat/underseeded alfalfa/Potatoes
  - Cash Crop – Spring wheat (pea cover)/Barley (pea cover) / Potatoes
  - Alfalfa – Direct seeded alfalfa/grass for 2 years, potatoes

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Additional Crop Rotation Trials:

- Barley/underseeded clover compared with 2 year alfalfa/timothy and 2 year sudangrass followed by oilseed radish (2 fields – Kings Co.)
- Wheat underseeded forage mix compared with direct-seeded forage mix (1 field, Kings Co.)
- Barley/underseeded alfalfa compared with 2 year alfalfa/timothy and corn followed by barley (1 field, West Prince, started 2024)
- Barley/underseeded alfalfa compared with corn followed by barley (1 field, East Prince, started 2024)

Acknowledgements:

AIM Funding Partners:

Prince Edward Island POTATOES

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Les Fermes Cavendish Farms

Agriculture and Agri-Food Canada

Agriculture et Agroalimentaire Canada

Living Labs Partners:

East Prince Agri-Environment Association Inc.

Dalhousie University Faculty of Agriculture

University of Prince Edward Island

Thank You!

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www.peipotatoagronomy.com

	NM	SW	PM	CM	PD
CEU Tracking Number: AP 51653 **Approved CEUs:**	0.0	2.5	0.0	0.0	0.0

Meeting Title: AIM Winter Workshops: Soil Health
Location: Emerald, PE
Meeting Date: 01/21/2025, 09:00 AM to 12:00 PM

SIGN-IN SHEET FOR CCA, CPAg, CPSS and CPSC ONLY.

Please scan code through the CCA App on your mobile device to receive CEUs immediately.

No need to sign if scanned!