Exploring “win-win” regenerative agriculture practices in potato production in Prince Edward Island, Canada



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REGENERATIVE AGRICULTURE





Agriculture & Agri-Food Canada:

“Regenerative agriculture considers every aspect of the land’s ecological system, from the soil, to the water, to the diversity of plant life, ensuring every part of the ecosystem is healthy and working well together. It also improves biodiversity and increases the land’s resilience to climate change.”

https://agriculture.canada.ca/en/sector/canadian-food-system/taste-commitment/regenerating-hope

McCain Foods:

“Regenerative agriculture as an ecosystem-based approach to farming that aims to improve farm resilience, crop yield and quality by improving soil health and water quality, optimizing water use, enhancing biodiversity, and reducing the impact of synthetic inputs.”

https://www.mccain.com/sustainability/smart-sustainable-farming/

REGENERATIVE AGRICU



Core Principles Include:

- Keep Soil Covered
- Year Round Living Roots
- Minimum Soil Disturbance
- Livestock Integration
- Crop Diversity

REGENERATIVE AGRICULTURE



Room for Flexibility

- Cropping System
- Climate/Length of Growing Season
- Access to Technology
- Presence of Animal Agriculture

Reality versus Hype

- We still require fertilizer/crop protectants
- Continuous improvement, not overnight change
- **Growers still have to be profitable**





“WIN-WIN” OUTCOMES

Focusing on BMPs that marry environmental benefit with grower benefit in the short term.

Adoption will be faster and more widespread if BMP provides **net value** and is relatively **easy to implement**.

For the growers I work for, the most limiting resource is **TIME**!

KEEPING SOIL COVERED



Fall - Seeded Cover Crops

- #1 reason to have a cover crop:
  PREVENT SOIL EROSION!

- Heavily dictated by crop rotation, climate, etc.
- Where possible, have something with living roots, minimize the number of weeks per year with nothing growing!
- Hard after corn, beans, potatoes...but there are options that can be explored.

KEEPING SOIL COVERED

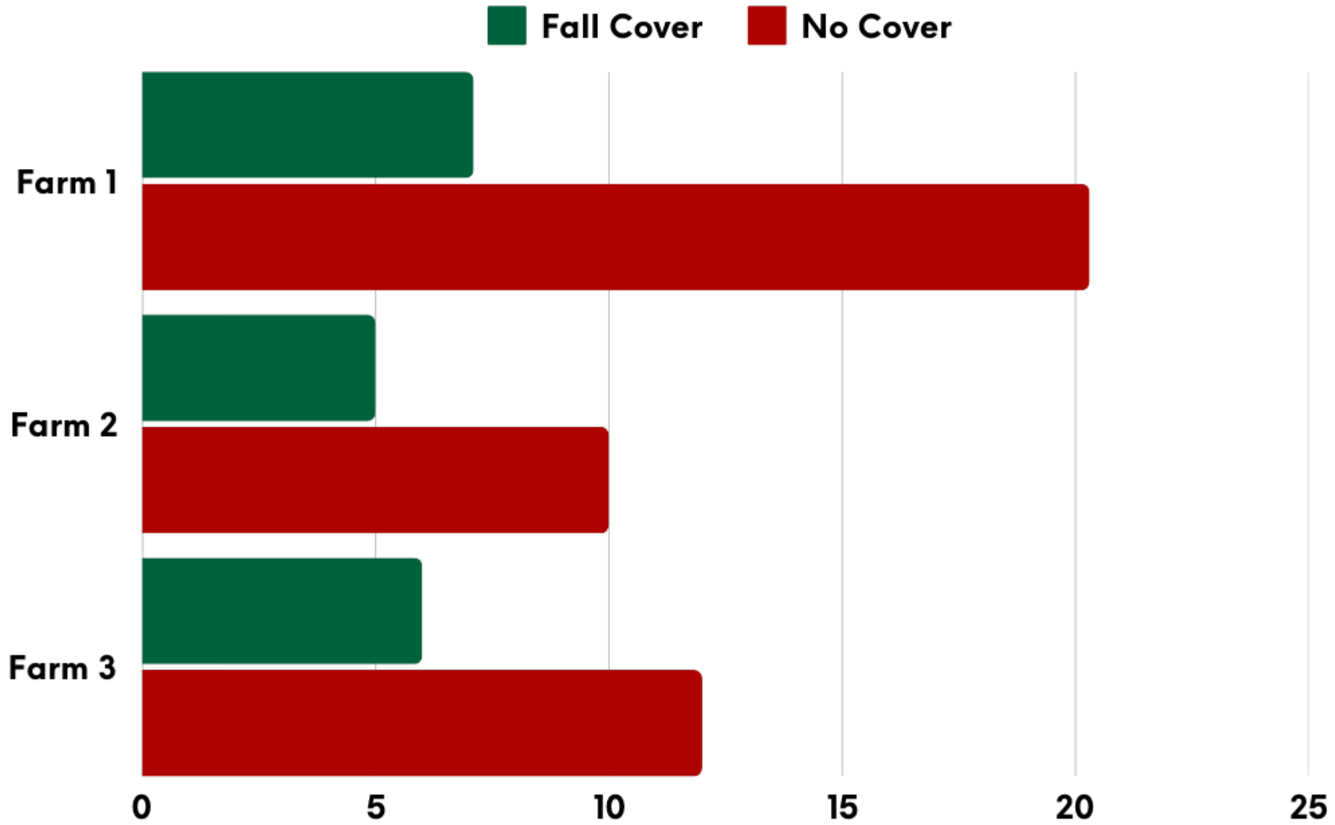


Living Labs (2019 - 2022)

- Moving tillage up to late summer/early fall
- Spring cereals/brassicas ahead of potatoes (winter termination)
- **Winter cereals** after potatoes where possible
- **50 - 75% reduction in soil nitrates**
- Significant reduction in soil displacement by water/wind
- **10% yield increase in potatoes** following winter - terminated cover crop
- **Implementation grew from 25% to 60%** of PEI acres before potatoes following Living Lab project

FALL COVER CROP NITRATE MITIGATION

Soil Nitrate (NO3) measured in November 2023 (ppm)



In multiple on-farm trials, we have observed a significant reduction in soil nitrate in late fall with use of a fall cover crop.

This is nitrogen that in PEI would normally be lost as nitrous oxide or nitrate leaching to groundwater (sandy soil, high rainfall)

FALL COVER CROP IMPROVEMENT

Living Labs Trial comparing Fall Cover vs No Cover (2019 -2022)

	Total Yield cwt/ac	Market Yield cwt/ac	Crop Value CAD/ac
Cover Crop	352	316	$4,546
No Cover Crop	318	284	$4,016
Difference	**34**	**32**	**$530**
p-value	0.002	0.006	0.005

Across 19 site-years of grower trials, we observed an **11% increase in marketable yield** following a winter-terminated fall cover crop compared with no cover crop (bare soil) ahead of potatoes.

Covers include spring cereals and brassicas following termination of forage crops or after combine of other crops.

YEAR ROUND LIVI

Optimizing Crop Rotation for PEI

- 3-4 months of winter in PEI, but increasingly variable (less snow, earlier thaws)
- Disease suppressive crops
  - C4 grasses (sudangrass, pearl millet)
  - Brassicas (radish, mustard)
  - Buckwheat
- Nitrogen-fixing legumes
  - Alfalfa
  - Clovers (annual/ perennial)
- 2-3 species mixes (grass/ legume / brassica)



YEAR ROUND LIVING ROOTS



Building Soil Health

- Fighting **compaction** with alfalfa, daikon radish, sudangrass
- Fighting **wireworm** with brown mustard, buckwheat
- Fighting **Verticillium wilt** with sudangrass, forage pearl millet, brown mustard
- Building soil organic matter with **whatever will provide the greatest root biomass and the least soil disturbance**
- Species/mixture selection suited to climate, rotation system, pest/disease hosts, etc.

YEAR ROUND LIVI

Let Common Sense Reign!

- **Not all areas can justify full -season cover crop** ahead of potatoes. Maximize fall covers?
- Pick species that will grow well, **don't cause other issues** .
- **Know what your challenge is** (Vert, scab, compaction, soil OM, etc) to inform choice!
- **Manage full season covers like cash crops** , with adequate fertility, timely termination/ incorporation



YEAR ROUND LIVING ROOTS

AGRICULTURAL CLIMATE SOLUTIONS



N Credits from Legumes

- Multi-year project under ACS Living Labs
- Fine-tune N credit rec's for PEI with alfalfa, clover
- 2024 was very dry, but preliminary results:
  - 75% of GSP N: 97% of MYield
  - 50% of GSP N: 95% of MYield
  - 0% of GSP N: 74% of MYield
- Using mid-maturity russet varieties (Mountain Gem, Dakota, Payette, Ranger)
- Purpose of the Zero N is to determine how much is coming from legume and soil OM
- **New varieties** - more N efficient than Burbank!

MINIMIZING SOIL DISTURBANCE

- Widespread adoption of **vertical/residue tillage**, with ability to seed cover crops on the same pass
- Hilling/ridging in the fall along with cover crop, **hilling at planting**
- Research into **site-specific compaction mitigation**
- **No-till planting** in rotation crops



LIVESTOCK INTE

Rotational Grazing

- Most potato fields in PEI are preceded by forages, but many of these fields are just mulched.
- **Living Labs project** looking at the soil health, GHG, potato yield and economic aspects of rotational grazing ahead of potatoes with beef cattle.
- **Foster further partnerships** between cattle producers and potato farms for **mutual benefit.**
- Establish the value of **manure** , the value of hay/ silage/ straw for equitable exchange.

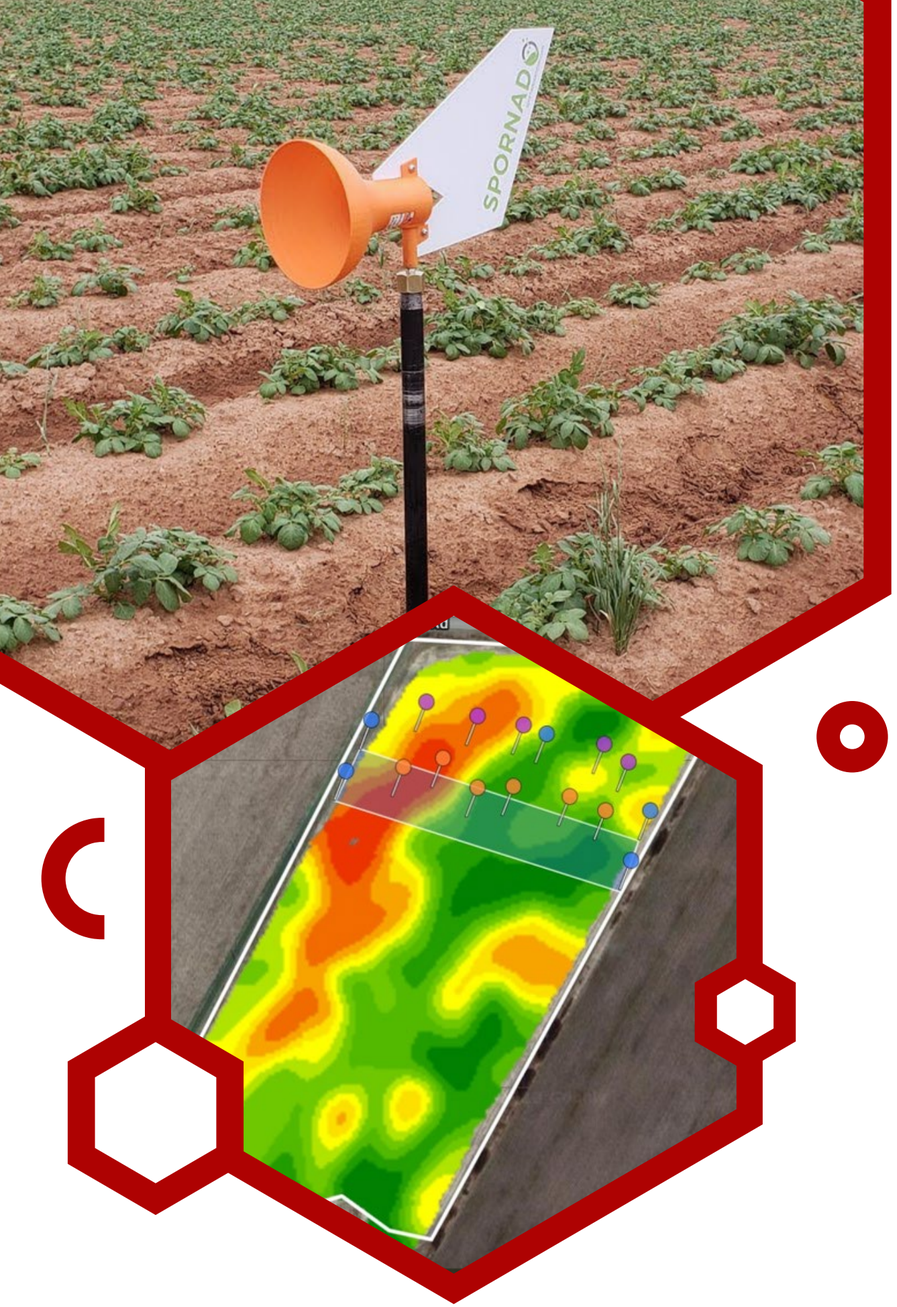


CROP DIVERSITY



Function, not Fad!

- **Diverse cover crop mixes** as well as **diversity over time** .
- Board has supported implementation of temporary and permanent **pollinator habitats** .
- Plot-scale and farm-scale trials have not shown a definitive benefit for very diverse crop mixes, but some potential benefit of **2 or 3 species mixes of complementary species** .
- New research on **intercropping** of peas/mustard or camelina ahead of potatoes (DalAC/ECODA)



PRECISION AGRICUL

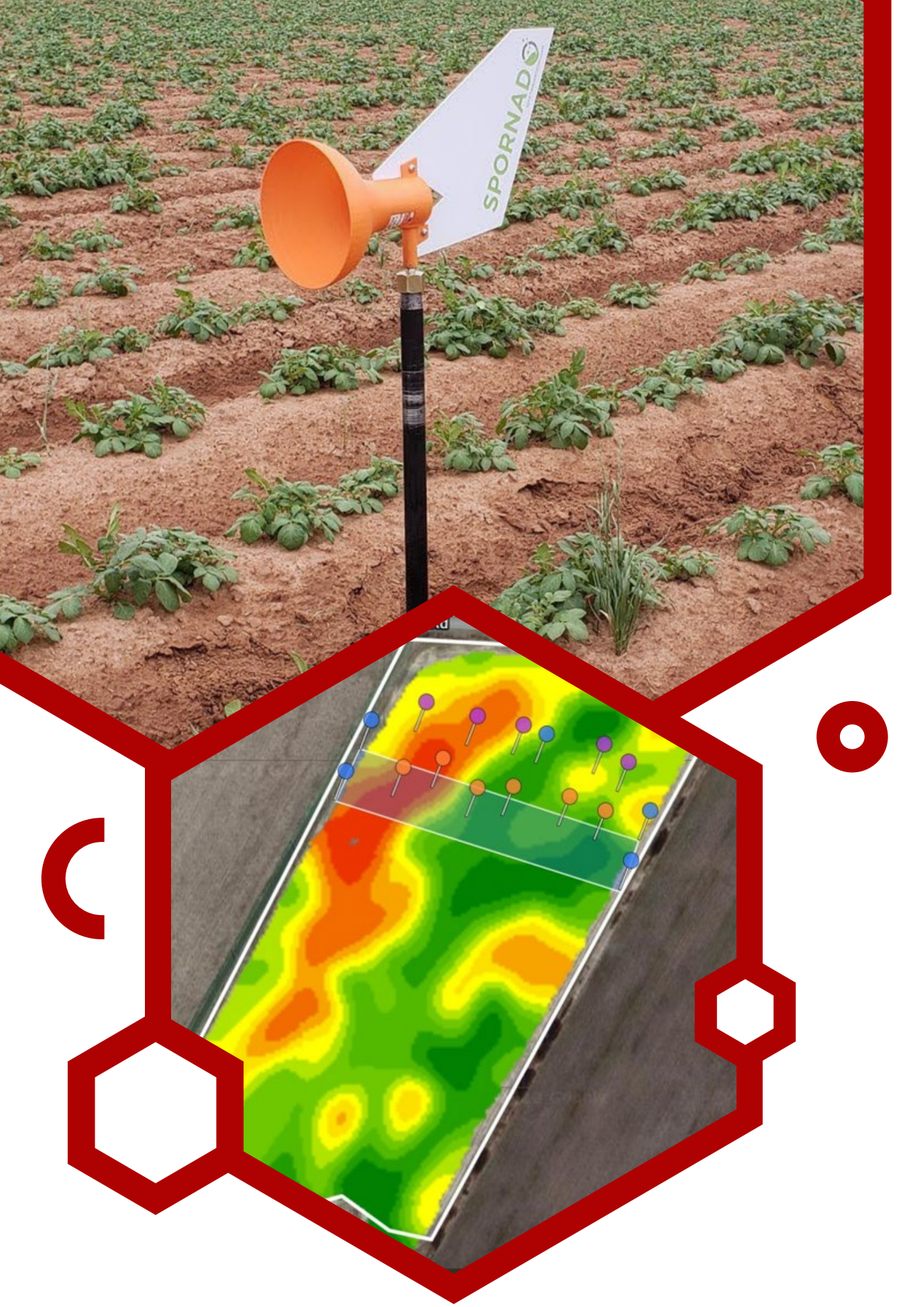
Site-Specific Management and Integrated Pest Management

- Using soil electroconductivity (EC) to make management zones for **VR fertilizer, seed spacing** (Evan MacDonald, UPEI)
  - +$357/ac with tighter spacing in best zones
  - +$90/ac with wider spacing in worst zones
- Using soil EC and other sensing tools to **mitigate compaction** (Andrew Fraser, UPEI)
  - EC not the best measurement of compaction, but developing other approaches for compaction mapping

Tight spacing in lower zones (more moisture but well drained) outperformed GSP 7/10 times with an average profitability increase of $357/ac

Zone 3	Value per ac ($)			
Farm/Year	Tight (VR)	GSP		Difference
Clearwater2021	$ 4,878	$ 4,412		$ 466
RussetBurbank2021	$ 5,019	$ 4,842		$ 177
Waneta2021	$ 6,695	$ 6,713		-$ 18
Clearwater2022	$ 3,943	$ 3,991		-$ 48
OCF2022	$ 4,678	$ 4,396		$ 282
MountainGem2022	$ 7,131	$ 6,183		$ 948
MountainGem2023	$ 6,268	$ 5,384		$ 884
RussetBurbank12023	$ 5,124	$ 5,628		-$ 504
RussetBurbank22023	$ 5,773	$ 5,362		$ 411
Satina2023	$ 4,355	$ 3,387		$ 968
			Average	**$ 357**

- Evan MacDonald Ph.D. project, AIM supported



PRECISION AGRICUL

Site-Specific Management and Integrated Pest Management

- Using **AI and robotics to ID PVY** in-field (Aitazaz Farooque, UPEI)
- Using **spore trap/climate data** to inform fungicide application.



PVY Agri-Scout robot in the field in 2024 - AIM Supported Project with UPEI

KNOWLEDGE TRANSFER





Fundamental to our Agronomy Initiative is Effective Communication!









LOOKING AHEAD

- Increased use of winter cereals
- Quantifying N credits from legumes
- Long-term effects of fall cover crops
- Increasing cash crop frequency with maximized fall covers
- Nitrogen use efficiency
- Tillage reduction strategies
- Greater livestock integration
- Alternative carbon amendments
- Improved varieties!
- New fertility products

VALUED PARTNERS

Agriculture and Agri-Food Canada

AGRICULTURAL CLIMATE SOLUTIONS

Agriculture & Agri-Food Canada:

Agricultural Climate Solutions: **Living Labs**

On-Farm Climate Action Fund :

administered by PEI Federation of Agriculture



SOIL FIRST FARMING

PEI Department of Agriculture:

Soil First Farming Program , free soil health testing

ALUS/RALP program : acreage payments for taking land out of production

Ag Stewardship/Regenerative Ag sections: programs and resource staff

EAST PRINCE AGRI-ENVIRONMENT ASSOCIATION

Les Fermes Cavendish Farms

DALHOUSIE UNIVERSITY
Inspiring Minds
Faculty of Agriculture

UNIVERSITY of Prince Edward ISLAND

FRUIT & VEGETABLE GROWERS OF CANADA | PRODUCTEURS DE FRUITS ET LÉGUMES DU CANADA

and Prince Edward Island potato growers!



Thank You!

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