Regenerative and Sustainable Agriculture for Climate Change Adaptation and Carbon Sequestration: Rebuilding Soil Health and Increasing Crop Productivity of Canadian Potato Production Systems

LEAD RESEARCHER

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Regenerative and sustainable agricultural practices (RSAPs) are being studied in several locations across Canada to mitigate soil degradation and loss of bio-diversity caused by intensive farming practices and ensure long-term viability of potato farms. Research has been done at 15 farms with researchers finding improved forage yields and reduced pathogen and nematode pressure in some systems. There have been strong regional variations in soil carbon stocks discovered.

Extreme drought in 2025 significantly reduced yields across regions. Despite the stress conditions, the diversified systems (multi-species mixes) maintained higher yields than conventional (potato-barley). The research team found improved soil moisture retention in multi-species mix systems. This led them to the conclusion that RSAPs buffer yield losses under climatic stress making for stronger system resilience. In addition, forage systems of alfalfa and grass significantly improved biomass production. These findings point to RSAPs being able to maintain productivity while improving sustainability.

The research team has found that diversified crop rotations have lower nitrous oxide (N_2O) and carbon dioxide (CO_2) emissions and more efficient nutrient cycling compared to conventional crop production systems and shorter rotations. Three-year rotations and multi-species systems reduced Verticillium dahliae, researchers discovered. Disease severity was found generally to be lower in longer, diversified rotations but similar between some two-year treatments.

(L-R) Tyler Nugent and Thomas Foster harvesting potatoes at the McCain Farm of the Future in Florenceville-Bristol, N.B.

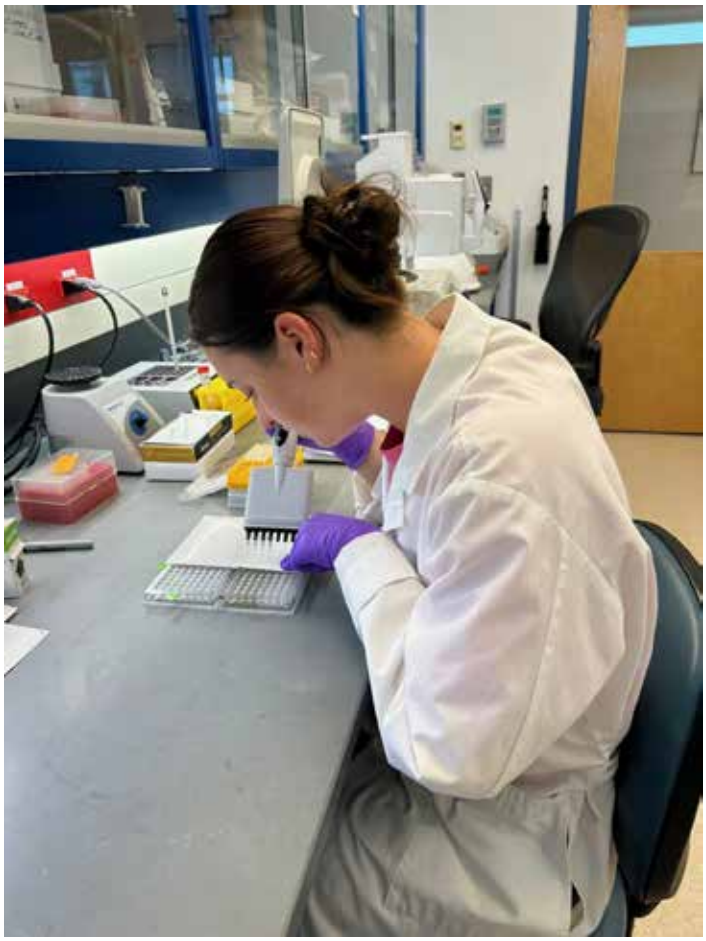
Sean Whitney bagging potatoes at the McCain Farm of the Future in Florenceville-Bristol, N.B. Photos: Claudia Goyer

This points to diversification contributing to natural disease suppression, especially over longer rotations.

In previous years, the research team found the yield differences among management zones, based on electrical conductivity and elevation, were tied to soil properties in non-drought conditions. However, no strong differences in yield and greenhouse gas emissions were observed in 2025, but this was likely masked due to the extreme drought. This shows that climate conditions can override treatment effects in a single year. Another approach to delineate management zones is to map the spatial variability of soil moisture to support future targeted management. Using precision ag tools requires multi-year datasets to show the full impact of how RSAPs work.

KEY TAKEAWAYS:

- Due to severe drought across regions, last years improved soil moisture retention was found in multi-mix systems. RSAPs buffer yield losses under climatic stress making for stronger system resilience.
- Diversified crop rotations have lower nitrous oxide (N_2O) and carbon dioxide (CO_2) emissions and have more efficient nutrient cycling compared to conventional crop production systems and shorter rotations.
- Three-year rotations and multi-species systems reduced Verticillium dahliae. Disease severity was found generally to be lower in longer, diversified rotations but similar between some two-year treatments.
- Yields were highest in diversified three-year rotations and cover crop systems than compared to two-year rotations. Forage systems of alfalfa and grass significantly improved biomass production.



Master of Science student Taylar Austin working in the lab at the Agriculture and Agri-Food Canada Fredericton Research and Development Centre. Photo: Claudia Goyer