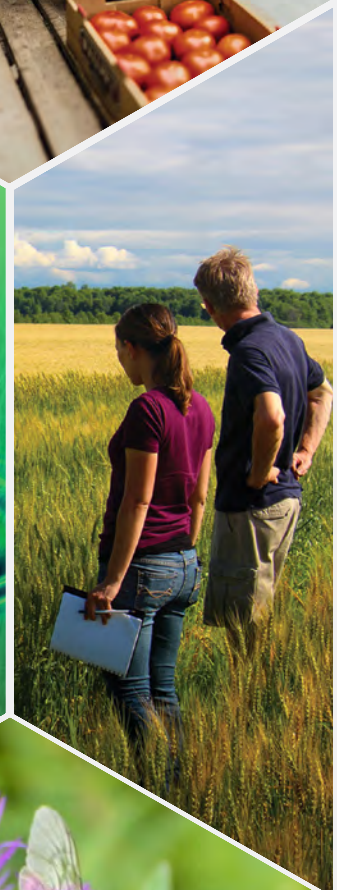
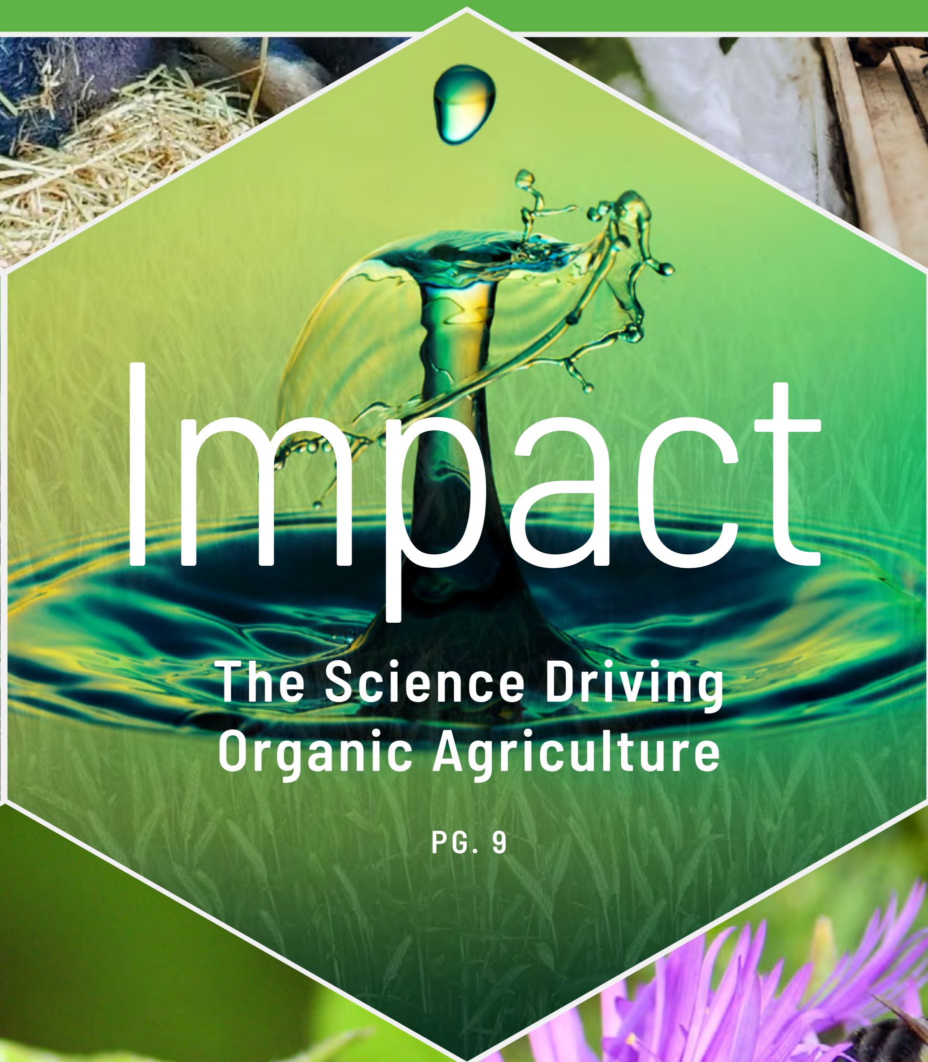
ORGANIC SCIENCE CANADA

SCIENCE FOR PRODUCERS | ISSUE 5 | SPRING 2023



Impact

The Science Driving Organic Agriculture

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About Organic Science Canada Magazine

Organic Science Canada magazine is packed with the latest advancements in organic research and innovation from the national Organic Science Cluster (OSC) program. The magazine brings you trends, news and results from across Canada. The scientists who appear in these pages are working hard to improve the sustainability and profitability of organic and low-input agricultural systems.

Organic Science Canada magazine is published by the Organic Federation of Canada (OFC), in cooperation with the Organic Agriculture Centre of Canada (OACC).

Created in 2007, the OFC is composed of ten organic associations representing nine provinces and one territory. Collectively, they promote the development of the Canadian organic industry across the country. The Federation is responsible for the maintenance and interpretation of the Canadian Organic Standards and the management of Organic Science Clusters 1, 2, and 3. OFC is based in Montreal.

The OACC was formed in 2001 with a mission to lead and facilitate organic research and education. The Centre plays a key role in national efforts to advance the science of organic agriculture. OACC also supports the training of the next generation of organic professionals. OACC's home base is in Truro, Nova Scotia, at Dalhousie University's Agricultural Campus.

OSC3 (2018-2023) is supported by the AgriScience Program under Agriculture and Agri-Food Canada's Canadian Agricultural Partnership, and by over 70 partners from the agricultural community. OSC3 has 27 research activities under five general themes: field crops, horticulture, pest management, livestock, and environment.

FOR MORE INFORMATION:

- www.organicfederation.ca
- www.dal.ca/oacc
- @OrganicAgCanada
- @OFC_organic

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Above: Photo by Janet Wallace
Cover photos, top left to bottom right: Emma Bryce, exposeimage.com, Pixabay.com, Jedidiah Gordan-Moran, Yann Vergriete, Janet Wallace, Paul Manning

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Organic Agriculture: A Source of Innovation for the Sustainability of the Canadian Agri-food Sector

Since its inception, organic agriculture has sought to improve on-farm management practices, focusing on soil health, ecological soil-plant synergy, and the well-being of living organisms and their environments. Over time, the development of organic production has been combined with scientific research to better understand the whys and hows of this collective and ecological approach. Like the Canadian organic sector itself, research in organic agriculture is diverse. The theme of this year's *Organic Science Canada* magazine is the "Impact of research on organic production."

Research is no longer done in a vacuum; it must be done in close collaboration with farmers. As farmers across the country continue to implement practices recommended by researchers, impact can be measured on an individual, regional, provincial, and national level. In this *Organic Science Canada* issue, learn why understanding impact is important, how it can be measured, the current efforts being made by the OSC team, and some of the barriers that exist to this work. Whether the impact is economic, such as increased productivity, or ecological, such as increased biodiversity on farm, measuring impact is essential in ensuring the research is effective and meets the needs of producers.

As you read through this magazine, enjoy a collection of snippets, articles, organic updates, and even an informative Q&A. The Q&A provides insight from researchers themselves with their views on the evolution of research. The priorities and needs have certainly evolved since the first Organic Science Cluster (OSC). Find out what the featured researchers have to say after having participated in the last three Organic Science Clusters and hear their vision of the future of research.

Through success stories from producers, learn how research activities have improved farm practices: this is the concrete goal of research. Success stories like these help us further understand the impact that research has on the sustainability and productivity of organic farming operations.

Other articles describe OSC3 research activities that could have a significant impact on Canadian organic production. These research projects help tackle a series of challenges and explore opportunities in organic production systems across the country. Find out more about Dr. Jason Gibbs' activity to increase pollination, biological control, and diversity on field crop farms using flowering habitats, and Todd Kabaluk's activity developing practices to control wireworms in vegetable production. Dr. Myriam Fernandez's work on cropping strategies, biological control, and management of significant crop diseases is a reminder of how interconnected our farming systems really are. Finally, in addition to the snippets that summarize other research activities, one article describes how research is influencing the Canadian Organic Standards by scientifically validating practices prescribed in the standards.

By focusing on the impact of research, this 5th edition of the *Organic Science Canada* magazine concludes OSC3, which will end in March 2023. The Research Impact Study guides researchers who have submitted research proposals in preparation for Organic Science Cluster 4, which will hopefully be launched in April 2023.

Organic agriculture research will continue to play a critical role in the development of promising innovations for the future of agriculture. It is now up to us to make it happen!

Enjoy your reading,

JÉRÔME-ANTOINE BRUNELLE, agr.
Organic Agriculture, Horticulture and Advisory Services Coordinator
Union des producteurs agricoles

Organic Science Cluster 3 Farm Participation

THE ORGANIC SCIENCE CLUSTER SCIENTISTS RECOGNIZE THE IMPORTANCE OF PRODUCER INVOLVEMENT IN RESEARCH.

Their activities are designed around addressing the needs of farmers and enhancing the sustainability and productivity of the organic industry as a whole. This collaboration will continue to be prioritized, and drive on-farm impact.

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THE NUMBER OF FARMS THAT PARTICIPATED IN OSC3 RESEARCH BY HOSTING EXPERIMENTS

12 FIELD CROPS

3 LIVESTOCK

185 HORTICULTURE

28 ENVIRONMENT

142

THE NUMBER OF FARMERS THAT PARTICIPATED IN OSC3 RESEARCH IN AN ADVISORY OR SUPPORTING CAPACITY

20 FIELD CROPS

3 LIVESTOCK

55 HORTICULTURE

64 ENVIRONMENT

Snippets

Harvested soybean field, October 2020. (Photo by Stephanie Lavergne)

SOIL HEALTH AND BIODIVERSITY DRIVEN BY INTENSITY OF ORGANIC FARMING IN CANADA

Macy Penney Cameron
Organic Agriculture Centre of Canada, Dalhousie University

The number of organic farms across the country continues to increase, yet data suggests that the size of an average organic farm is not increasing. One possible explanation is that organic producers might not prioritize acquiring more land, but instead focus on better managing the land they have.

In a recent publication by Dr. Derek Lynch, his paper states that health and environmental concerns are amongst the greatest motivators shared by organic producers. As a result, organic farms are becoming better designed and managed at a level of intensity that supports productivity, while ensuring the health of ecosystem services. Ecosystem services contribute to soil carbon storage and flux, soil health, and soil biodiversity.

Organic farmers consider many factors when managing production intensity. To reach a level of highly productive and sustainable management requires a long-term commitment, dedication, and ongoing learning about the climate and farm-specific growing conditions.

Soil organic carbon can be impacted by several factors such as region, length of crop rotations, cropping systems, tillage frequency, and use of organic amendments. The implementation of crop diversification and cover crops is a significant driver in soil health. However, their overall impact on soil organic carbon is dependent on the intensity of farm level management. A lack of attention in management can lead to resource- and nutrient-poor systems.

A link has been found between soil microbial carbon use efficiency and long-term negative phosphorus (P) balances in organic systems. Maintaining an adequate level of P and preventing deficiency is immensely important. P deficiencies can negatively impact soil microbial communities, and impede the success of cover crops and green manures.

Successful production is dependent on a healthy agroecosystem; the success of an agroecosystem is sensitive to the decisions made at the management level. You can drive soil health and biodiversity on your farm by optimizing the intensity of managerial practices and by knowing the ins and outs of your individual production system.

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MORE OATS, FEWER WEEDS!

Macy Penney Cameron
Organic Agriculture Centre of Canada, Dalhousie University

High-quality organic oats are a staple ingredient in many cereals and energy bars. As the demand for these products continues to increase, so must production, but how? Dr. Steve Shirtliffe studies techniques that improve weed control in oat production by increasing the competitive ability of the crop and by using mechanical weed control. As his Organic Science Cluster 3 activity comes to a close, he discovers weeds are, in fact, manageable, but there is a bit of a "formula" per se: investment in equipment is needed, and timing is everything.

To best control weeds in an organic oat production system, he recommends a combination of practices. Start with high density seeding. Following this, early in the season, use a tine weeder or rotary hoe for in-crop weed control. The rotary hoe is a "hero implement" for annual weeds on rock-free land. Lastly, clean up the "misses," the surviving weeds, with inter-row cultivation.

Over years of study, it has been determined that one implement is not enough. Timing is crucial: for best results, weeds should be killed when they are small. Biomass samples and aerial imagery has shown these methods to be effective.

FOR MORE INFORMATION

To learn more about Activity 7, please visit www.dal.ca/OACC/OSCIII

CULTIVATING BIODIVERSITY: MIXING WHEAT VARIETIES TO MAKE TASTY ORGANIC BREAD

Julie Anne Wilkinson
CETAB+, Victoriaville

Researcher Julie Anne Wilkinson of the Centre d'expertise et de transfert en agriculture biologique et de proximité (CETAB+) at the Cégep de Victoriaville is concerned about the quality of organic bread. As part of a research project she is leading, she is evaluating the agronomic and baking qualities of wheat varieties grown in mixtures to assess their performance under organic management. The objective of the project is to develop competitive mixtures for farmers, millers, and bakers. The mixtures are evaluated throughout the field season, based on various agronomic criteria such as disease incidence, yields, and other important criteria, such as the resilience of the selected varieties to stress from climate change and disease.

The baking quality of the mixtures was evaluated on an annual basis by Moulins de Soulanges, a miller that markets specialty flours, in order to eliminate unpromising mixtures and to ensure the relevance of the mixtures during the project.

The highly contrasting climatic conditions of the five years of the project had a marked impact on the growth of spring wheat; this impact will be described in the final performance report that will be published at the end of the project.

The results of the project will be presented at the Colloque Bio pour tous! to be held on February 16, 2023, in Victoriaville, QC.

The ultimate goal of the project is to offer wheat variety mixtures that are adapted to organic agriculture and to the climatic conditions of farmers in Eastern Canada.

FOR MORE INFORMATION

To learn more about Activity 10, please visit www.dal.ca/OACC/OSCIII

ORGANIC RESEARCH LEADS TO INCREASED GREENHOUSE PRODUCTION

Amanda Oberski
Organic Agriculture Centre of Canada, Dalhousie University

Organic greenhouse production has grown in the last 15 years to become a $43-million/yr industry thanks to support of research and innovation.

A series of organic greenhouse research projects conducted by a team of researchers led by Dr. Martine Dorais at l'Université Laval have made tremendous advances supporting the growth of intensive, commercial production in organic greenhouses.

Backed by Agriculture and Agri-Food Canada's Organic Science Clusters (OSC), the research focus was initially on finding the optimum blend of ingredients to produce a healthy and fertile soil medium to support crops in a container production system. This included introducing soil biology to meet the requirements of organic standards without introducing soil diseases. Other research projects explored advanced LED lighting systems, efficient heating and cooling systems, and wastewater recycling and management.

With the help of research, greenhouse sales have reached $43 million per year, in sales of tomatoes ($31 mil/yr) and cucumbers and peppers ($12 mil/yr). In addition, the innovation within the research program has produced new technologies to support the advanced production systems. Canadian partners in the research have sold nearly $40 million in greenhouse technologies to export markets.

The future is bright for the organic greenhouse market thanks to the research and innovation that has occurred within the Organic Science Cluster program.

FRIENDLY ALTERNATIVE TO SURGICAL CASTRATION FOR ORGANIC PIGS

Emma Bryce
Organic Federation of Canada

The castration of male animals in livestock operations has long been a challenge for producers. Male hormones are linked to increased aggression and hazardous behaviour such as mounting, which can result in injuries for both farmers and animals. Intact male swine pose an additional problem, as their male hormones produce a pungent, unpleasant smell during cooking, known as 'boar taint'. Castration of male swine is done surgically, yet even with the use of analgesia, the procedure is painful and comes with a risk of infection, herniation, and haemorrhage, as well as lowered growth rates and increased fat content of the carcass.

Research Activity 25 has been looking at non-surgical methods to control boar taint through the analysis of genetic markers. The research uses the genetic diversity already present in nature to produce breeding lines of swine with lower levels of the hormones that result in boar taint and sexual aggression. By selecting for individuals that have genetic markers for lower levels of the compounds associated with boar-taint, Drs. Jim Squires, Renee Bergeron, and Ira Mandell from the University of Guelph hope to determine how this selective breeding may potentially affect not only meat quality, but also behaviour and physiology by avoiding the need for castration. This research has the potential to represent an exceptional improvement for the welfare of these animals, and improved worker safety, as well as helping to decrease the environmental impact of swine production through increased performance efficiency.

FOR MORE INFORMATION

To learn more about Activity 25, please visit www.dal.ca/OACC/OSCIII

COVER CROP STRATEGIES TO MAXIMIZE NITROGEN FIXATION AND ENHANCE SOIL HEALTH

Emma Bryce
Organic Federation of Canada

Organic producers rely heavily on the addition of manure, compost, and/or leguminous crops to meet nitrogen needs in organic field crop production systems. The use of large amounts of manure and compost as the primary nitrogen source for grain crops can often lead to negative impacts on the environment, such as the accumulation of phosphorus and other nutrients. Frost-seeding red clover into winter wheat could provide nitrogen for the succeeding crops and improve soil quality in general, however, the use of this practice typically has declined over time because of the difficulty maintaining adequate red clover stands in southern Ontario. Summer seeding legume cover crops could be a promising alternative to frost-seeding in corn-soybean-winter wheat rotation in view of poor plant stands of frost-seeded red clover, especially in organically managed soybean-wheat-corn production systems.

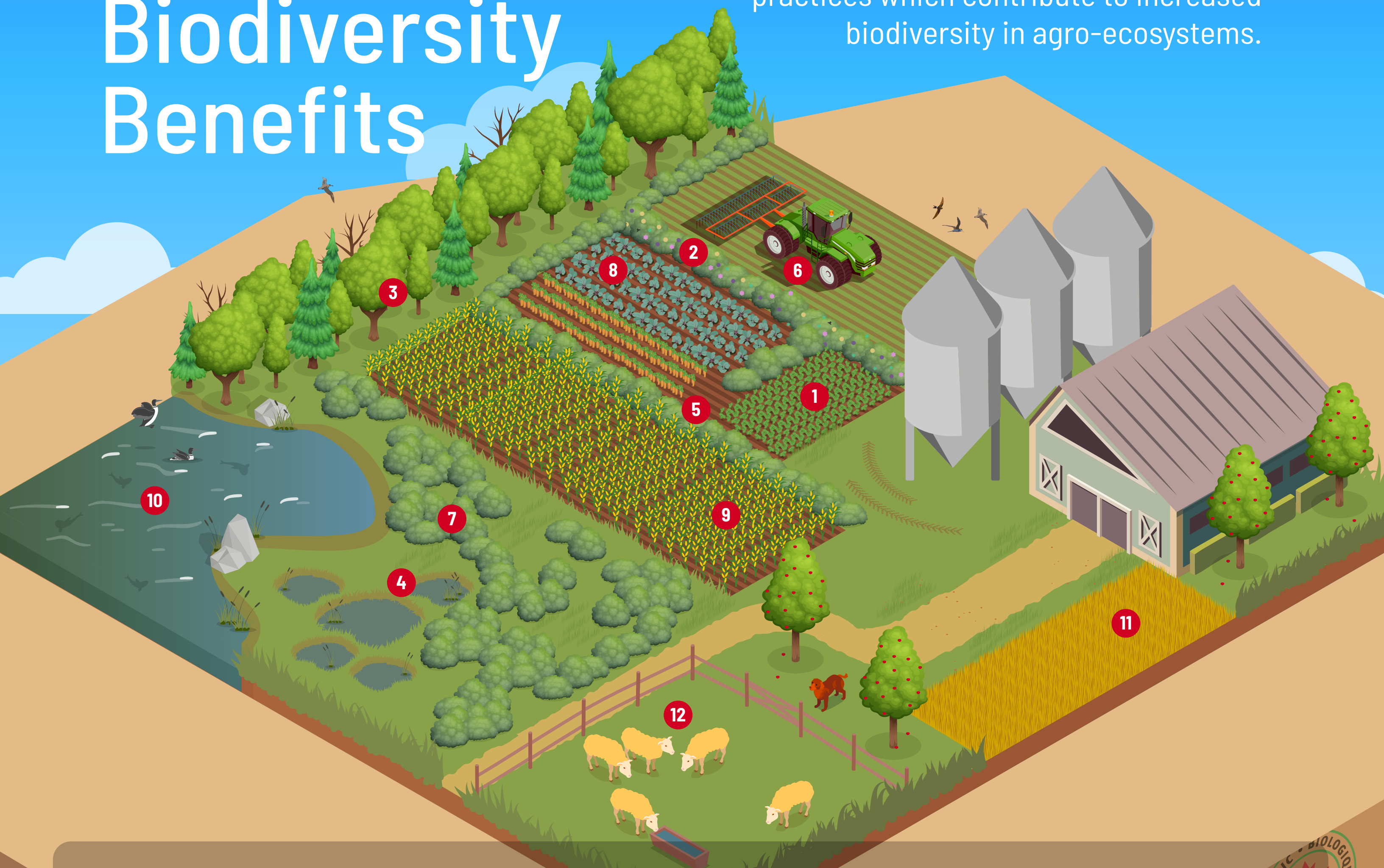
Activity 4 aims to identify the best cover crop management strategies to maximize biological nitrogen fixation and enhance soil health. Focused on a rotation of organic soybean, winter wheat, and corn, Agriculture Agri-Food Canada researcher Dr. Xueming Yang and his associates have been developing a cropping system that uses solely the nitrogen fixated by leguminous cover crops in an effort to replace the need for synthetic nitrogen fertilizers and maximize the potential for year-round cropping. Results from five years of research demonstrate that using summer-seeded legumes to provide N in grain production systems is productive, economically viable, and resource-conserving, and can contribute to sustainable agriculture production in southwestern Ontario.

FOR MORE INFORMATION

To learn more about Activity 4, please visit www.dal.ca/OACC/OSCIII

A Bundle of **Biodiversity Benefits**

Supporting organic farms supports biodiversity. Here are some agricultural practices which contribute to increased biodiversity in agro-ecosystems.



1. Cover Crops
Support a diversity of healthy soil organisms.

2. Flowering Habitats
Attract and increase the abundance of pollinators as well as attracting natural enemies of pests to provide pest control.

3. Shelterbelts
Trees and shrubs protect farms from wind, while also creating natural habitat and resources for many animals and insects.

4. Wetlands
Wetlands provide natural habitat, while storing large amounts of carbon. Preserving wetlands helps to mitigate climate change while supporting many different insects and animals.

SEE REFERENCES ON PAGE 10

5. Hedgerows/Biodiversity Strips
Diversified woody vegetation provides habitat for a variety of wildlife species.

6. Ecological Weed Control
Organic farmers manage weeds without synthetic pesticides which create a risk of environmental contamination.

7. Riparian Buffers
Vegetation separating bodies of water from agricultural activity provides habitat while also reducing nutrient runoff and erosion.

8. Biocontrol
Organic farmers use biocontrols, natural enemies of pests, to help control pests.

9. Crop Rotation
Diversity of plant species over time, supports soil diversity and fertility, while naturally breaking pest cycles.

10. Clean Water
No synthetic pesticides or fertilizers leaching into local bodies of water, protecting aquatic life and water quality.

11. Natural Seed
Genetically engineered seed is not used in organic farming. Treatment of seed with synthetic pesticides is not permitted, thereby reducing risk of impacts on other organisms.

12. Crop-Livestock integration
Many organic farmers integrate livestock to diversify their farms and support recycling of nutrients.

Impact:
Science Driving Organic Agriculture

DR. EMMANUELLA ELLIS AND DR. ANDREW HAMMERMEISTER
ORGANIC AGRICULTURE CENTRE OF CANADA, DALHOUSIE UNIVERSITY

In the last 14 years, the Organic Federation of Canada (OFC), in collaboration with the Organic Agriculture Centre of Canada (OACC), at Dalhousie University, has overseen more than 80 research activities conducted under Organic Science Clusters. These projects have been undertaken by more than 100 researchers, in collaboration with industry and government institutions. Once adopted, the research findings and their recommended practices and tools can result in increased yields and profits; healthier soils; a reduction in crop pests, diseases, and weeds; reduced carbon emissions; and other benefits. We know that these research activities have produced valuable results and recommendations, but how much impact has the research had?

Why do we want to know about the impact? Evaluating the impact of research enables us to communicate the value of scientific research by demonstrating how it is being translated into economic, social, and environmental benefits for society, as well as informing policy and training of human capital. It allows us to demonstrate the benefits of supporting research, especially to funders, while accounting for investment in the research activities.

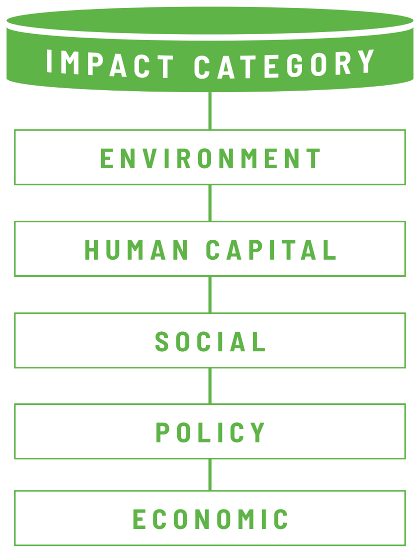


Figure 1: Impact categories

Measuring impact from research can be challenging. One such challenge is that a single research activity can lead to multiple impacts, some of which may be difficult to measure and quantify (Figure 1). Also, since most research happens as part of a body of other projects, attributing impact to a single, specific research project can be difficult. This challenge is compounded when a project falls within an on-going, long-term research program.

A scan of the literature reveals that several evaluation frameworks have been developed to assess research impact. Using these as a guide, we have developed a six-stage framework to evaluate the impact of Organic Science Cluster research activities (Figure 2). The framework takes into consideration knowledge transfer, researcher and producer interactions, uptake of recommendations, and research impact. The framework considers both the types of impact experienced by end users

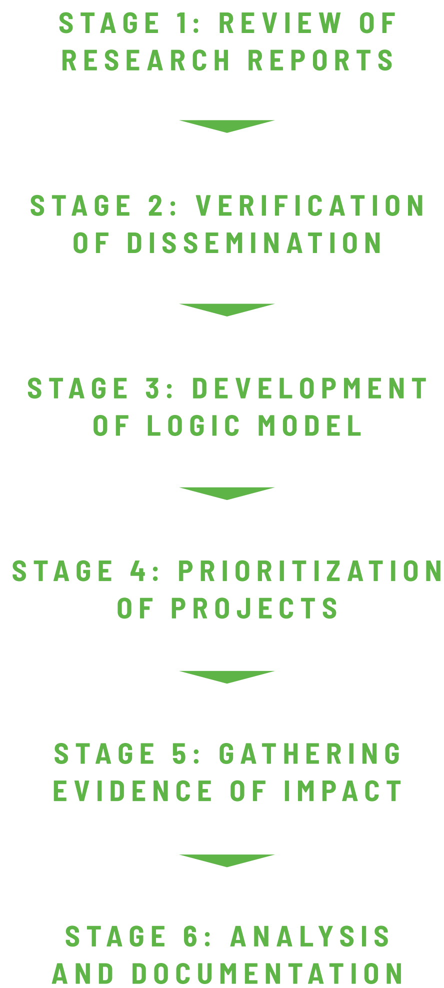


Figure 2: Framework to evaluate the impact of Organic Science Cluster research activities

and the pathways to achieving impact. The goal is to show not only whether research contributed to change, but how that happened.

At the end of the impact analysis study, we hope to determine: i) if research results were valued by producers, ii) if research results were adopted, iii) how research benefited producers, and iv) what were the barriers to adoption. Our focus is to learn from organic producers whether there have been any gains, measurable or otherwise, from adopting new or improved practices from research.

We have started engaging with producers and industry partners (as well as researchers); some have told us how they have benefitted from the research activities. For instance, the adoption of an improved orchard management system has resulted in increased apple yield and improved fruit quality. A new table-top approach to growing strawberries organically has led to increased yields and improved fruit quality that are now comparable to conventional production. Organic treatments for seed disinfection in the sprout industry have been tested and validated; this has resulted in an increase in productivity while maintaining food safety.

Our analysis has revealed a number of distinct drivers and barriers to the impact of research on producers (Figure 3). In short, effective communication between researchers and producers from start to finish is essential for impact to occur. However, the impact of research may extend beyond the producers; for example, research findings may affect the training of sector professionals and influence organic standards and policies.

This impact analysis project will feature success stories from the Organic Science Clusters. However, we are hoping to get a lot more out of this study. It will also serve as a platform to learn how to effectively communicate research, prioritize, and guide further research, optimize impacts, and assess the impact of research.

Figure 3: Drivers and barriers to the impact of research on producers

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Looking to the Future: How is Organic Research Evolving?

INTERVIEWED BY AMANDA OBERSKI, APRIL STAINSBY, AND MACY PENNEY CAMERON
ORGANIC AGRICULTURE CENTRE OF CANADA, DALHOUSIE UNIVERSITY

Field day with Dr. Martin Entz

How has organic science research changed over time, and how might it evolve in the future to meet our growing needs? Organic Science Canada Magazine interviewed organic agriculture researchers **Drs. Myriam Fernandez**, **Derek Lynch**, **Martin Entz**, and **Steve Shirtliffe** to hear their predictions for the future of organic.

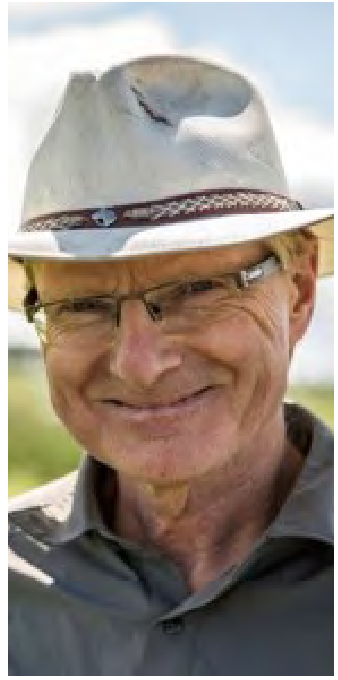
HOW LONG HAVE YOU BEEN INVOLVED IN ORGANIC AGRICULTURAL RESEARCH?

ENTZ: I was interested in organic agriculture as soon as I started at the University of Manitoba back in the early 1990s, and I dedicated some of my time to organic agricultural crop production research for the first 10 or so years of my career. I later went into organic agriculture research full-time because I found it quite fascinating and really challenging.

FERNANDEZ: I have been a scientist at AAFC for over 30 years with most of my research being initially on plant pathology and breeding. I started getting involved with organic research in the late '90s.

LYNCH: I was part of the foundation of the Nova Scotia Organic Growers Association when it launched close to 30 years ago. I'm very proud that over the past 20 years, half or more of my research was done on farms. In fact, the farms were the whole focus of [these studies]. That meant sitting down at the kitchen table with lots of different organic farmers and talking.

SHIRTLIFFE: It's been probably 20 years. I haven't ever fully devoted my career to it. But for a while, I was doing predominantly organic research.



DR. MYRIAM FERNANDEZ
Swift Current Research and Development Centre, AAFC
OSC III, Activity 9 and 22

DR. STEVE SHIRTLIFFE
University of Saskatchewan
OSCIII, Activity 7 and 17

DR. MARTIN ENTZ
University of Manitoba
OSC III, Activity 3

DR. DEREK LYNCH
Dalhousie University
OSC III, Activity 27

HOW HAS YOUR EXPERIENCE WITH ORGANIC RESEARCH DEVELOPED OVER TIME?

FERNANDEZ: It has grown over time. In 2007, I started transitioning to organic research, originally with about seven acres. Since then, it has increased substantially. Over time, we ended up getting more land from management for organic research and currently have 23 acres. This has allowed us to have a variety of different projects on cover cropping, intercropping, diversified rotations, and biocontrol of important crop diseases, among others. When we started converting conventional land to organic, we also began interacting with experienced organic producers in the region, as we did not know what their priorities would be. That is still important today: meeting with producers, having field days, and communicating.

LYNCH: I work in a blend of soil and agronomy, so my research focus has been a sort of agroecology. In most of my research, I try to look at practical questions and answers while also tracking some of the ecosystem services. Over the years, this has included questions of fertility, rotations, and cover crops to nutrient management for very diverse farms including whole organic dairy farms.

> One of my hopes for the future… is developing a strong understanding of what works in distinct regions around the country to mitigate any climate challenges moving forward.
>
> —Dr. Myriam Fernandez, Swift Current Research and Development Centre

ENTZ: Some of the main research considerations in the past were how to get nutrients into an organic system and how to control weeds. Those were major challenges to begin with, and I say we've made some progress due to advancements in knowledge, research, and the machines we have today.

SHIRTLIFFE: Most of my work in organic crop production has been around controlling annual weeds. Over the years, I've maintained part of my program being organic. Primarily in the past, I've mostly been what I call a 'weedy agronomist'.

WHAT TOPICS IN ORGANIC RESEARCH DO YOU THINK ARE IMPORTANT NOW AND INTO THE FUTURE?

LYNCH: Soil carbon, biodiversity, and soil health. I'm keen on the topic of intensity of management, because that in turn influences whether a farm can actually be regenerative. That's important to think about when you think about soil. Let's not forget [about] maintaining a minimum level of phosphorus and other soil nutrients.

> There is an opportunity for organics to be in the lead in championing some fundamental sustainability issues.
>
> —Dr. Derek Lynch, Dalhousie University

You can't have regenerative agriculture if you're running deficiencies.

FERNANDEZ: Considering the suitability of each organic crop to the specific soil and environmental conditions. Particularly in the case of cover crops or intercrops, it is important to select the species most adapted to regional conditions in order to understand and identify the most adaptive systems (for making regional recommendations). This is not only for organic production in general, but specifically [to see] how those practices may help with carbon sequestration and mitigation of climate change.

[Secondly] biocontrol work: It's very important to continue to study the microbial interactions underground and take advantage of them, not only in biocontrol of diseases, but also in making the crops more resilient.

SHIRTLIFFE: To me, it seems the number one issues are always weed control and soil nutrients. These will continue to be issues: weed control in terms of crop production, and soil nutrients, like phosphorus.

ENTZ: There's always been an interest in crop-livestock integration in organic because it just makes sense. Early on, we knew from research that farms with crop-livestock integration had greater diversity overall and better nutrient flows.

Thinking ahead, especially for large-acre production, the phosphorus issue is critical. We'll need attention in every aspect of crop soil management, whether it's seed vigour, seedborne diseases, or soil management.

Recent research demonstrated that crops produced organically can result in some significant human health benefits. I think as we look for lower-cost ways of improving the health of our population, organic may be something people will look toward because eliminating pesticides and allowing the plants to get their nutrients through biological processes does seem to have some beneficial effect on the nutrition of these crops. I think that's an exciting new area of research.

Where to deploy organic in the landscape might be a future question.

WHAT HOPES DO YOU HAVE FOR ORGANIC RESEARCH IN THE FUTURE?

LYNCH: There is an opportunity for organics to be in the lead of championing some fundamental sustainability issues. There is a crisis. Putting carbon back in the soil and reducing the amount of nitrogen as a greenhouse gas are two major climate issues where organics could position itself as a leader. Are we going to lead [by] demonstrating closing the urban-rural nutrient loop, or are we nervous about the perception if we do that? It is a very interesting issue… Organic farmers should be the lead in exploring these issues because we need to be. Again, you can't have regenerative agriculture if you're running deficiencies.

SHIRTLIFFE: One of the challenges I've seen is this continual political polarization of these issues which has gotten much worse over the last couple of years. I like that idea that things are changing for the better, and I hope the research can move forward.

ENTZ: One thing we need in the future is a community of innovation, which involves not only researchers working together, but also farmers, and perhaps other people in healthcare and the food industry. We definitely need researchers working together! We have enjoyed the researcher community in the Science Cluster because we've been able to leverage all kinds of people to work together. I am really looking forward to how this community of innovation will develop, and the next time we can get together at a conference and share results.

FERNANDEZ: One of my hopes for the future of research and for producers is developing a strong understanding of what works in distinct regions around the country to mitigate any climate challenges moving forward, to tailoring our research and understanding based on each region. Most importantly, sharing that information with each other, so we can use what has already been learned and have it available as regions experience climate shifts. From a microbial standpoint, really studying the microbial relationships as those can be used to strengthen the crops and to help balance out things.

ANY ADVICE FOR NEW ORGANIC RESEARCHERS?

SHIRTLIFFE: The number of researchers that are out there and wanting to work in organic systems today is truly astounding. This grew from a very researcher-poor area, where there was essentially almost no research happening in Western Canada, and very little across Canada. I've always had the most positive farmer feedback from the organic part of my research. They are very thankful for the research.

FERNANDEZ: Interact with producers in the region, learn as much as possible from them, and learn what their needs and concerns are. This is most valuable.

ENTZ: I would advise new researchers to go and visit a variety of organic farming operations to learn what it actually means, to get to know the processes better, and the strengths and weaknesses, so [the researchers] can conceptualize their own contribution, their own research proposals, and ideas that they would like to pursue.

LYNCH: Collaborate, collaborate, collaborate. It's a very exciting time: very challenging, but a very exciting time for agriculture and for organic farming.

Organic Science Cluster Supporters

With great appreciation, we would like to acknowledge the following industry partners for their contributions in support of Organic Science Cluster 3.

MONETARY CONTRIBUTIONS

Organic Science Cluster Supporters

LEFFERS BROTHERS ORGANICS

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THE MARTENS FAMILY ORGANIC RESEARCH ENDOWMENT

ORVAL G. CALDWELL AND H. RUTH GARDNER CALDWELL FELLOWSHIP IN SUSTAINABLE AGRICULTURE/AGROECOLOGY

IN KIND CONTRIBUTIONS

DUBAN FARMS

OVER 150 MORE INDIVIDUAL FARMS

Above and Below Ground: An Interconnected Approach

MACY PENNEY CAMERON

ORGANIC AGRICULTURE CENTRE OF CANADA, DALHOUSIE UNIVERSITY

(Photo by Andrew Hammermeister)

Consumer demand for organic products is growing in Canada. In order to stay competitive, meet the growing demand, and drive growth in both national and international markets, the organic industry must continue to grow, learn, and adapt.

Although there is no one clear-cut approach on how to improve the sustainability and resilience of organic production, implementation of certain practices can help organic producers work towards those objectives. Dr. Myriam Fernandez, a scientist for Agriculture and Agri-Food Canada, is determined to help Canadian organic production practices become more sustainable and resilient through science. She has dedicated more than 20 years to organic research and works very closely with farmers and industry.

With every finding, it is continuously becoming more apparent to Dr. Fernandez how interconnected an agroecosystem really is and, in particular, how sensitive an agroecosystem can be to farm management decisions. This is reflected in some of her most recent projects, which investigate cropping strategies to improve the sustainability of organic crop production in the Brown soil zone in the Prairies, as well as biological control and management of significant crop diseases.

Traditionally, legumes, such as forage peas, have been grown as a monocrop green manure in Western Canada to provide nitrogen, build soil quality, and control weeds. However, Fernandez believes that over time, organic-based production systems using intensive legume cropping for nitrogen supply are unsustainable. This is due to a number of reasons. The first is that, compared to many other species, such as grasses, legumes decompose more rapidly, and they do not contribute as much organic matter. Additionally, legume diseases have been increasing, including root diseases. A common disease, Fusarium root rot, which may be found in legumes in the semi-arid region can reduce biomass, yield, and nodulation rates, thereby also reducing nitrogen fixation.

Fernandez and her team decided to explore other practices, such as using other cover crops and intercropping. At the time, there was very little information and literature available specific to the semi-arid regions of western Canada, or even to other semi-arid parts of the world. In fact, there was great disbelief that cover cropping and intercropping practices could be successful in these regions. However, the opposite is proving to be true.

The main objective of Fernandez's recent cover cropping project was to investigate the viability of cropping systems under organic management, including cover crop mixtures grown as green manure in rotation with grain crops. The team explored ways to maintain or improve grain quality and yield, as well as soil quality. Crop growth and quality were evaluated by taking samples of biomass, recording grain yield, and sampling the harvested grain, while soil was tested both before and after growing the cover crops.

The study examined four different cover crop blends that incorporate multiple species from different functional groups (e.g., grasses, brassicas, legumes, forbs). Each blend focused on a different functional group (Table 1). The species that were selected over the years were highly compatible with the local semi-arid growing region. Choosing species adapted to the region from different functional groups was found to be a successful method when creating blends.

Cover crops can help increase organic matter, suppress weeds and pests, improve yield, mitigate disease, and reduce the need for tillage. As a result, the use of cover crops can improve the productivity and sustainability of organic systems, as well as increase overall resilience to the impacts of extreme climate events.

Table 1: Cover crop blends grown at the Swift Current Research and Development Centre in 2022.

Blend 1	Seeds/ sq.ft.	% plant stand	Blend 2	Seeds/ sq.ft.	% plant stand	Blend 3	Seeds/ sq.ft.	% plant stand	Blend 6	Seeds/ sq.ft.	% plant stand
Forage Rape	1.7	5.1	Badger Radish	4.3	28.5	Japanese Millet	1.7	11.7	Forage Rape	4.0	15.0
Turnip Rape	2.1	6.4	Turnip Rape	5.6	37.1	Oat	1.5	10.3	Turnip Rape	4.0	15.0
Japanese Millet	13.8	42.2	Japanese Millet	2.0	13.2	Chickling Vetch	3.2	22.1	Japanese Millet	4.0	15.0
Oat	7.5	23.0	Oat	1.6	10.6	Crimson Clover	1.8	12.4	Oat	4.0	15.0
Chickling Vetch	1.6	4.9	Forage Pea	1.6	10.6	Sub Clover	3.2	22.1	Forage Pea	8.0	30.0
Crimson Clover	2.5	7.8				Forage Pea	1.2	8.3	Balo Phalecia	2.7	10.0
Balo Phalecia	3.5	10.7				Indianhead Lentil	1.9	13.1			

Although the selected blends are well suited to this semi-arid environment, farmers from other areas within Canada can also benefit from the project findings as drought and the effects of climate change are becoming more common across the country.

When selecting cover crops or intercrops, one must consider the competitive nature of the species being used, and their competitive ability when grown in different mixtures. A farmer should choose species that are well-adapted to their growing conditions. Finding the right variety and species can take time, especially under variable environmental conditions. Stay up to date, not only with organic production practices in general, but also with information shared on practices that may help with carbon sequestration and the mitigation of climate change.

DIGGING DEEPER

It is important to look beyond the cover crops themselves and see what is happening underground. This provides insight into the microbial communities, as well as diseases that may affect the cash crop that follows.

As mentioned, legumes are quite susceptible to root rot, even when grown in a dry environment. The most common grain legumes that are grown in the semi-arid region are field peas, forage peas, and lentils, all of which are very susceptible.

One of the main objectives in the crop disease project was to identify other legume species that could be more resistant to root rot. Notably, the clovers in the experimental mixtures as listed in Table. 1, did not do very well under very dry conditions, however they did prove to be more resistant to Fusarium root rot.

Badger radish. (Photo by Myriam Fernandez)

Chickling vetch. (Photo by Myriam Fernandez)

To study this, root samples were taken from every legume, grown as a monocrop or in a blend. The microbial community on the roots was analyzed, including the pathogens responsible for root rot. The interactions of these organisms were examined, both with themselves and with the pathogens.

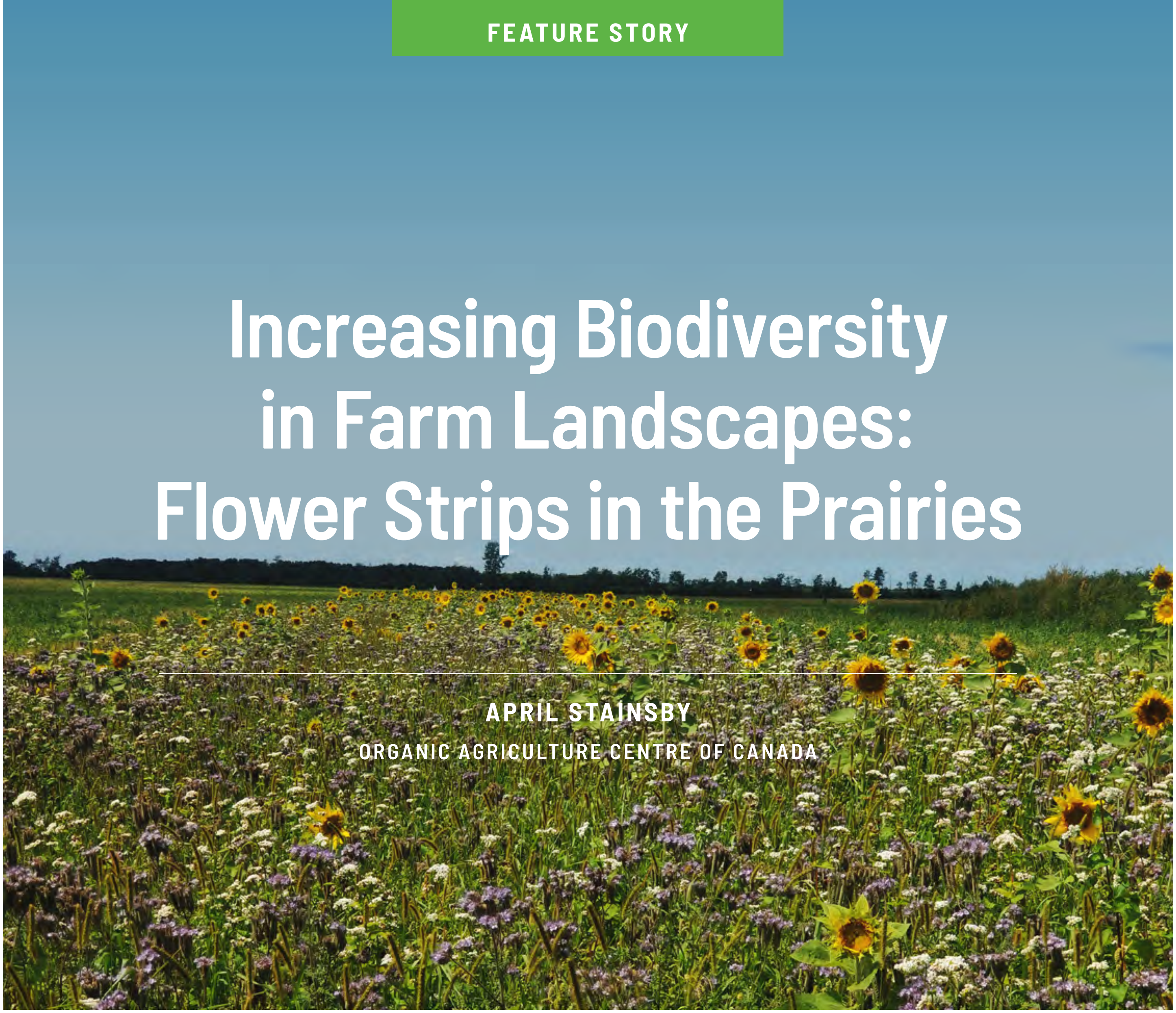
Some of the Fusarium species that were found in crop roots can cause Fusarium head blight, which is a devastating disease of cereals, particularly for durum wheat. This highlights the importance of looking underground and considering the cash crop that might follow the cover crop.

Looking at what is underground, and at what promotes the growth and persistence of those organisms over time can lead to better management of disease development in the following crop. Remember that each growing combination can result in very different outcomes. For example, when intercropping, oats and field peas interact differently than mustard and lentils. Oats and field peas, despite being different species, tend to share some of the same pathogens. In regard to yellow mustard and lentils, the opposite was found to be true; mustard, a brassica, is known for being a biofumigant, resulting in an increased presence of biocontrol agents. As a result, when yellow mustard and lentils are grown together, the level of root rot in lentils was reduced. Also, in the following crop (durum wheat), there was a higher control of root rot due to the previous lentil-mustard intercrop. That being said, there are still other factors to consider when using brassicas, as they can take up considerable amounts of soil nitrogen, which can result in less available N for the following crop.

Future work will continue to investigate disease, the knowledge of intercropping, and cover crop blends, and will improve upon best management practices through research.

Increasing Biodiversity in Farm Landscapes: Flower Strips in the Prairies

APRIL STAINSBY
ORGANIC AGRICULTURE CENTRE OF CANADA



Flower strip beside grain field in southern Manitoba, August 2019. (Photo by Michael Killewald)

IMPORTANCE OF BIODIVERSITY IN FARM LANDSCAPES

Biodiversity is a key component of organic farming systems. Organic farms rely on healthy functioning landscapes that can provide the ecosystem services required to grow healthy crops. Supporting diverse functioning ecosystems on farms can be challenging, especially in the large-scale grain cropping systems of the prairies. This is where Organic Science Cluster (OSC) researchers from the University of Manitoba have been experimenting with adding flowering habitat to the margins of grain fields, with the goal of increasing both sustainability and farm productivity.

Many of the practices commonly used on organic farms (e.g., higher crop diversity, cover crops, reduced pesticide use) are likely to support higher biodiversity compared to conventional practices. However, with overall farm landscapes becoming increasingly simplified, increasing pesticide use, and insect and bird populations declining, it is clear that we need to do more to provide habitat and increase biodiversity across these landscapes. Features that protect and promote biodiversity are, in fact, mandated in the Canadian organic standards (section 5.2.4). The standards state that:

"Management practices shall include measures to promote and protect ecosystem health on the operation and incorporate one or more of the following features:

a) pollinator habitat;

b) insectary areas;

c) wildlife habitat;

d) maintenance or restoration of riparian areas or wetlands; or

e) other measures which promote biodiversity

NOTE: Existing native prairie, parkland, or wetland habitats should be maintained and enhanced whenever possible"

How can organic farmers increase biodiversity and the related benefits, including pollination and biocontrol, on their farms?

Hoverfly (Toxomerus marginatus). *(Photo by Paul Manning)*

Habitat can be increased both in crop fields, and in surrounding non-crop areas. One intervention that has gained attention is seeding patches of non-crop plants along field margins or within the field itself. Within the field, this could be in the form of strips of native prairie plants through a field at regular intervals (for example the Iowa STRIPs project), or it could be patches of perennials in marginal low-producing areas of the field. Often the types of non-crop plants are chosen to match the local ecology. For example, in a forested ecoregion you might incorporate shrubs and trees, while in the prairies you might include wildflowers, grasses, and forbs.

These strips of non-crop plants provide habitat, particularly for insects—which can provide food for insectivorous birds, and benefit nearby crops through the provision of ecosystem services, such as pollination and pest control. Patches of perennial plants also serve to cover the soil, potentially reducing soil erosion and nutrient runoff, while impacting the soil microbial community and carbon storage.

SPECIES SEEDED IN FLORAL STRIPS

Annuals: Phacelia, buckwheat, sunflower, sainfoin, crimson clover, Persian clover

Tame perennials: Intermediate wheatgrass, chicory, alfalfa, alsike clover, red clover

Native perennials: Blue grama, purple prairie clover, white prairie clover, little bluestem, green needlegrass, showy sunflower, stiff sunflower, heartleaf golden alexanders, old field goldenrod and gray goldenrod

FLORAL STRIPS PROJECT IN MANITOBA

OSC3 researcher Dr. Jason Gibbs and his team at the University of Manitoba have been studying the impacts of floral strips on organic and conventional farms in southern Manitoba. The project is titled 'Increasing pollination, biological control, and beneficial insect diversity on farms using flowering habitats.'

The researchers worked with producers to establish floral strips of approximately one acre in size along the edges of grain fields. The floral strips contained nineteen species of flowering plants and grasses including native and introduced plants, both annuals and perennials. They wanted to determine the effect of the strips on insects, particularly insects that can be beneficial to crops such as pollinators, weed seed herbivores, and biocontrol or "natural enemy" insects that prey on plant pests. To compare the invertebrate communities, insects were collected from the floral strips and adjacent crop fields, as well as from control fields with no floral strips and nearby semi-natural areas.

The study is ongoing and final results will be forthcoming, but first-year results showed that the wildflower plantings next to the fields attracted a greater abundance of beneficial insects compared to the control field edges. Wild bees were much more abundant in the wildflower plantings, which was expected because the flowers attract bees from the surrounding landscape. Interestingly, there also tended to be more bees in the flower strips compared to nearby undisturbed semi-natural areas. This is likely because the natural areas were not as diverse and had less abundant floral resources than the

Northern Amber bumblebee (Bombus borealis). *(Photo by Paul Manning)*

floral strips themselves. Pitfall traps were used to collect another group of beneficial insects: ground-dwelling beetles in the family Carabidae. In the first year, there was a dramatic increase in the abundance of these beetles, which act as predators (of insects), as well as weed seed herbivores.

The researchers attribute these preliminary increases in insect numbers to the floral strips providing an attractive resource and a refuge for beneficial insects. The strips could not have led to an increase in the local populations in such a short time frame, instead, they must have attracted insects from different parts of the landscape. In subsequent years, the researchers continued to find high levels of insects maintained in the plantings, which supports the idea that the floral strips are sustaining insect populations in the area. The researchers are still in the process of analyzing the thousands of samples that have been collected; it remains to be seen whether the floral strips will result in a build-up of the populations over time.

Another group of beneficial insects, hover flies, showed slightly different patterns. Hover fly larvae tend to be predators of plant pests and the adults are pollinators. Some of these flies, also known as syrphid flies, were more abundant in the unmodified grassy areas compared to the floral strips, and it remains to be seen how the diversity of hover flies varies between the grassy strips and floral areas.

In addition to the impact on insect diversity and abundance, producers want to know how the floral strips will impact their crops. Will the floral strips increase crop pollination, and will this affect yield? Or will they harbour weeds and invertebrate pests? The researchers in Manitoba are determining the impact of the strips on pollination and the yield of the crops in adjacent fields; these results are not yet available. They also assessed the weed community in the crops beside the strips to see if they were causing weed problems, although it is possible that the floral strips could help reduce weed pressure by acting as a buffer to stop weeds from invading the field margins. So far, the researchers have not found any evidence that floral strips had a negative effect on pollination, nor increased weed pressure.

An important objective of this research was to develop a set of best management practices to help producers establish habitat enhancement strips on their own farms. Dr. Gibbs advised that preparation is key to successfully establishing perennial floral plantings. He recommends that producers carefully consider the context of their fields (for example, assess weed pressure and moisture availability) and start slowly with a small area using a high seeding density. Gibbs also suggests using an annual cover crop or nurse crop to help control weeds while the perennials establish, and to not be afraid to mow the floral strips to remove the seed heads of fast-growing weeds. The hope is that once perennials are established, they should be quite low maintenance. Future research aims to determine which plant species are most reliable in terms of germination and establishment.

Dr. Gibbs' team will be producing summaries of the best management practices developed during their study to help producers establish floral strips. As the third Organic Science Cluster wraps up this winter, we are looking forward to the final results from this study. Stay tuned!

Thank You!

The Organic Science Cluster would like to thank those who contributed their time and effort to support our ongoing work in organic agriculture and science:

- Members of the Science Advisory Body
- Individuals in the Letter of Intent Working Group
- Peer Reviewers
- Cluster Participants, Researchers, and Producers

Your contributions will continue to impact the future of organic agriculture.

CANADIAN AGRICULTURAL PARTNERSHIP | OFC FBC ORGANIC FEDERATION OF CANADA FÉDÉRATION BIOLOGIQUE DU CANADA | OACC Organic Agriculture Centre of Canada | DALHOUSIE UNIVERSITY | Canada

Wireworm Management in Vegetable Crops

EMMA BRYCE
ORGANIC FEDERATION OF CANADA

One of the biggest challenges facing organic producers is the control and management of pests. The wireworm is a pest which poses significant economic losses to both conventional and organic farmers. Wireworms are the subterranean larvae of click beetles. They are a substantial problem worldwide and can cause severe damage to a variety of vegetable crops. Organic farms are particularly vulnerable as there are limited options for managing this pest organically, other than crop rotation. Few control products are available for organic growers.

Todd Kabaluk, the lead Agriculture and Agri-Food Canada (AAFC) researcher on Activity 21, estimates the wireworm's economic damage to crops in Canada exceeds $20 million dollars. "Considering that wireworm loss in PEI potatoes alone likely exceeds $5M/year, you can extrapolate from that to each crop in every province and it does not take long to arrive at a remarkably high figure," Kabaluk explains.

Wireworms are an exceptional barrier to organic expansion. Their presence in land not currently in production (organic or conventional) means that certain fields planned for future crops are already a battlefield. "There are wireworms out there in land that has not been broken... as soon as they turn it over and want to plant it, farmers find that it is infested with wireworms. It prevents them from further expanding. Organic growers are really in a bind, and infestations ruin [the] opportunity for the sector to expand in Canada," Kabaluk says.

Biocontrol field trials. (Photo by Aaron Thien)

With a three-to-five-year life cycle, wireworm larvae can evade control efforts by staying underground and only coming to the topsoil to feed, though a greater understanding of their subterranean movements is needed. The research of Activity 21 targets wireworm larvae as well as the adult click beetles through a mixture of physical, cultural, and biological controls.

Researchers are looking to exploit a particular trait of wireworm feeding. Wireworms are attracted to carbon dioxide as their means of locating their food source. As plant roots respire, they emit carbon dioxide, drawing wireworms to them to feed on the roots and germinating seeds. Kabaluk and the AAFC research team have been experimenting with a strain of pathogenic fungus, Metarhizium LRC112, which is highly virulent to wireworms specifically. To attract the wireworms, they use carbon dioxide attractants, such as granules of rice or rolled oats which release CO_2 as they decompose. These are inoculated with Metarhizium spores. By attracting wireworms with CO_2 and fatally infecting them with Metarhizium in field trials, Kabaluk's graduate student Aaron Thien has protected vegetables from wireworm damage, thereby significantly increasing marketable yields.

Kabaluk's previous research has shown that adult click beetles also succumb to Metarhizium. Each female click beetle can lay hundreds of eggs at a time. Controlling the beetles before they have a chance to lay eggs represents an opportunity to limit the introduction of new wireworms into farmland.

Alongside the use of Metarhizium, researchers have been experimenting with combination applications of an organically approved fertilizer blend called Enterra-

Wireworms in potato. (Photo by Andrew Hammermeister)

Wireworms infected with a strain of the insect fungal pathogen Metarhizium brunneum *discovered and developed by Todd Kabaluk at Agriculture and Agri-Food Canada. (Photo by Todd Kabaluk)*

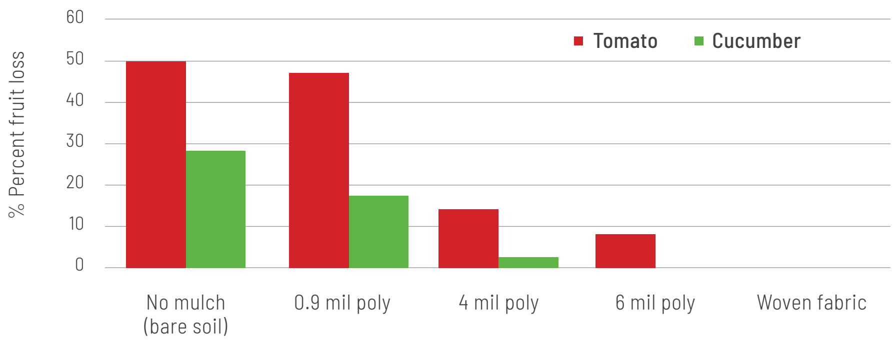


Figure 1: Wireworm damage to tomato and cucumber (percent fruit loss) is reduced with the use of increasing thicknesses of polyethylene mulch and woven fabric.

Todd Kabaluk looking at a culture. (Photo by Anita Poon)

FrassTM (EF), which acts as a desiccant on the wireworms, killing them by dehydration. Field trials using both the EF and Metarhizium LRC112 showed significant yield increases in a variety of crops grown where wireworms were present. "In field carrots, we were able to increase the number of marketable carrots by around 50%, and the marketable weight by 30% per hectare", Kabaluk explains. These are impressive numbers, especially for organic growers.

In addition to the Metarhizium, Activity 21 has been looking at other biocontrol agents aimed at controlling wireworms at distinct stages of their lifecycle. Researchers have been able to identify a variety of sex pheromones that female beetles use to attract males. In collaboration with a private company, Kabaluk has developed a granular formulation for these pheromones. Distributing the substance on the soil surface when beetles are mating can prevent the click beetles from successfully mating, laying eggs, and producing more wireworms. Initial trials with this method, led by Activity 21 researcher Dr. Wim van Herk, have identified four pheromone formulations that successfully disorient and disrupt mating patterns of six wireworm species.

Some of the wireworm control methods being studied are less technical, while still yielding impressive results. Wireworms are an issue not only for root crops, but also for cucurbits and other ground-resting fruit. The wireworms come to the surface to feed and can damage fruit where it meets the soil. Researchers have been studying the use of plastic mulch with different thicknesses as a physical control method to act as a barrier between the fruit and the soil surface to prevent feeding damage (Figure 1).

Kabaluk's research has been running concurrently with that of Dr. Michael Bomford from Kwantlen Polytechnic University, whose students have been leading field trials with Metarhizium LRC112 and other products. This data collection helps students learn about both research methods and alternative pest management techniques. Both Metarhizium LRC112 and the pheromone formulations have yet to be registered by the Pest Management Regulatory Agency, so the challenge of getting these products into the hands of farmers remains. However, results from this activity suggest that organic producers will have many new tools in their wireworm control toolkit in the years to come.

Success Stories: How do Producers use Organic Research?

AMANDA OBERSKI
ORGANIC AGRICULTURE CENTRE OF CANADA

(Photo by Ashly Griffin)

How do producers use organic research to enhance their practices and crop yields? The Organic Science Cluster is meeting with producers and industry partners to examine how innovative organic research makes a difference in the field. These stories are being produced as Organic Science Cluster Success Stories.

Research results can be unpredictable, however as Karnail Singh Sidhu from Kalala Organic Estate Winery points out, "If we say it's not going to work and we didn't try it, then I think we failed. If we do it and it didn't work, we have not failed, we learned. It's two different things."

GROWING ORGANIC WINE

Kalala Organic Winery in British Columbia participated in Organic Science Cluster research from 2013-2018. Researchers inoculated the grapevine roots with arbuscular mycorrhizal fungi (AMF). AMF inoculation can potentially protect plants from fungal diseases, such as powdery mildew, thereby increasing yield. However, AMF inoculation to crops in the field might be ineffective and a waste of money, whereas inoculating crops in containers or in greenhouses might be a better investment.

In 2020, Kalala Organic Winery was B.C.'s viticulturist of the year.

FOR MORE INFORMATION

To learn more about how producers and industry partners are using organic science research, or share your own success story with organic research, visit https://www.dal.ca/faculty/agriculture/oacc/en-home/organic-science-cluster/OSCIII/latest-news-/Success.html

DISINFECTING ORGANIC SEEDS

In Organic Science Cluster II (2013-2018), Eatmore Sprouts and Greens partnered with researchers to test a variety of organic seed disinfection substances—and discovered that a mix of hydrogen peroxide, acetic acid and hot water is more effective than chlorine!

The organic treatment has led to an increase in alfalfa sprout yields by 25-43%. Eatmore is now able to use more Canadian seeds, such as alfalfa, garbanzo, lentil, peas, radish, and clover, thereby supporting more Canadian organic growers.

(Photo by Karen McKinnon)

ORGANIC FRUIT IN RAISED GUTTERS

Les Fraises de l'Île d'Orleans Inc. participated in Organic Science Cluster research from 2009-2013. Researchers developed a raised gutter approach within tunnels to grow organic strawberries.

Since then, Les Fraises de l'Île d'Orleans Inc. has adopted raised gutters as their standard practice. The result: higher yields and larger fruit.

Also, workers can harvest almost twice as many strawberries per hour compared to the traditional system in the field.

(Photo by Jean-Christophe Yelle)

Organic Standards Update

NICOLE BOUDREAU
ORGANIC FEDERATION OF CANADA

Organic Science Cluster research is conducted in accordance with the Canadian Organic Standards (COS), which aims to develop sustainable and environmentally friendly farming operations.

The many Organic Science Cluster research activities on crop rotations, cover crops, reduced tillage, soil health, and ecological pest management help determine what practices are permitted by the Canadian Organic Standards. The scientific findings provide essential information to help update and improve the standards. As mandated by the Canadian General Standards Board, the COS must be reviewed every five years.

Consider the OSC3 research activity led by Dr. Jason Gibbs (Page 19) which investigated how flowering habitats along field crops in Manitoba affected pollinators and other beneficial organisms. This fits perfectly with clause 5.2.4, introduced in the 2020 COS, which requires farms to promote biodiversity by using measures such as pollinator habitats or flowering strips. Dr. Gibb's findings identify ways how large-scale field crop growers can meet the requirement of the standard and best enhance biodiversity on their operations.

Cutting edge research sometimes ventures beyond the parameters set by the COS. The many research activities conducted on organic greenhouse production are prompting greenhouse growers to question certain limits imposed by the COS. For example, there has been a lot of debate about the clauses that govern greenhouse production under artificial lighting. Why can't you grow greens under artificial light for more than 30 days and call them organic? Is sunlight a necessary 'input' for organic production in a cold country like Canada? What measures can be taken to extend the growing season and promote local production?

Vertical farming intensifies production by using high-performance substrates developed through research along with new artificial lighting technology that is reported to provide a light spectrum comparable to that of the sun. During the last COS revision, to encourage Canadian production of organic salad greens in the winter, the Greenhouse Production Task Force proposed to allow organic plants to be grown for up to 60 days under artificial light. This proposal was rejected by the voting members of the Canadian General Standards Board's Organic Technical Committee: according to the current COS, there is no way to produce organic greens without exposure to natural sunlight beyond 30 days.

The use of struvite to supply phosphorus to soils in organic production has also been a hotly debated issue: can struvite derived from municipal wastewater (sewage sludge) be used or should only struvite from livestock be used? Companies are precipitating phosphorus from wastewater and making it available as crystals called 'struvite.' As phosphorus deficiencies tend to be more pronounced on organic farms that do not have sources of animal manure in their immediate area, a research activity of Organic Cluster 3 is studying the impact of using struvite derived from municipal wastewater on organically managed plots. Will the Organic Technical Committee be more receptive to the use of this source of struvite if this research produces encouraging results and offers a solution to soil phosphorus depletion? The organic community likes to recycle; however, the main source of phosphorus currently accepted is rock phosphate, a non-recyclable resource which doesn't perform well in certain types of soils. The European Commission has ruled that struvite derived from municipal wastewater is acceptable under certain conditions in organic production. The research conducted under the OSC3 will certainly be considered when the COS are revised again, as phosphorus is an essential input for plant growth.

In fact, organic agriculture research is in its infancy; organic production has only been regulated since 2009. The sector needs several more science clusters to build sustainable and resilient agriculture to meet the threat of climate change; the COS will benefit from research-driven innovation.

DID YOU KNOW THAT:

When operators apply annually for organic certification, the process involves a rigorous inspection and review of application forms to ensure the operation meets the specifications of the COS. But agricultural research facilities are exempt from certain requirements of the COS. For example, contrary to what is required under clause 5.1.4 of the COS, parallel production is allowed on research facilities which can grow simultaneously organic and non-organic crops that are visually indistinguishable when grown side by side. This exemption is critical for research: it allows researchers to simultaneously grow identical crops under organic and conventional management in order to compare the results of the two types of management for those crops.

Clause 5.1.4 allows research facilities to opt out of a full conversion of their production site to organic production, as required in clause 5.1.3. This allows researchers to engage in organic research while continuing to conduct research under conventional management.

RESOLUTE ORGANIC RESEARCHERS

Six Canadian researchers participated in all three of the organic science clusters launched since 2009: Dr. Martin Entz (University of Manitoba), Dr. Martine Dorais (Université Laval), Dr. Steve Shirtliffe (University of Saskatchewan), Dr. Derek Lynch (Dalhousie University), Dr. Myriam Fernandez (Agriculture and Agri-Food Canada, Swift Current Station) and Dr. Jennifer Mitchell-Fetch (Agriculture and Agri-Food Canada, Brandon Station).

MOVING FROM THEORY TO PRACTICE

Reading the COS clauses and applying them correctly in the field can be tricky: each farmer applies the COS based on his or her own experience and agronomic knowledge. Other farmers with an innovative spirit like to adopt environmentally sustainable practices that are not explicitly described in the COS.

The Standards Interpretation Committee was created in 2009 by the Canadian Food Inspection Agency to answer questions from operators and certification bodies in order to harmonize the application of the COS across the country and to protect the organic designation of products imported into Canada.

The Questions and Answers issued by the SIC are prescriptive and are published on the Organic Federation of Canada website.

FOR MORE INFORMATION

organicfederation.ca/resource/final-questions-answers-canadian-organic-standards/

Organic Science Cluster Progress and Integrity

DR. ANDREW M. HAMMERMEISTER, OACC DIRECTOR
ORGANIC AGRICULTURE CENTRE OF CANADA,
DALHOUSIE UNIVERSITY

GOALS OF THE OSC PROGRAM:

- Find ecological solutions to production challenges including maintaining soil fertility and managing pests
- Increase productivity and profitability
- Enhance environmental performance
- Improve animal welfare practices
- Support training of young professionals in ecological agriculture

The Organic Science Cluster (OSC) program strives to bring progress and integrity to organic agriculture. The OSC would not be possible, however, without the financial and in-kind support of industry partners and Agriculture and Agri-Food Canada's AgriScience Clusters program. To justify the investment in science supporting organic agriculture, the research must be relevant to stakeholders and make progress toward addressing agricultural challenges. In doing so, the science must have integrity and impact.

Science is more than a random collection of observations. Science is a structured and intentional process of studying a subject and explaining it in a way that predictions can be made about the subject. The scientific method follows a process of i) providing a clear question (or testable statement), ii) formulating a strong experimental design, iii) collecting data that not only observes a result but helps to explain it, iv) rigorous analysis of the data, v) peer review of the research for scientific merit before publication, and finally vi) communicating the results through scientific publications.

The OSC program strives to bring the highest level of integrity to science that supports organic agriculture. The OSC proposals undergo a rigorous review process by other scientists, as well as sector leaders, to ensure that the research is novel, has scientific merit, and has relevance to organic production systems.

In order to be relevant to organic stakeholders, the OSC takes into account the four Principles of Organic Agriculture (Health, Ecology, Care, and Fairness) when setting research priorities. Research within the OSC also must be consistent with, or able to inform, the Canadian Organic Management Standards and Permitted Substances Lists. However, the goal is to find sustainable solutions to agricultural challenges that could be relevant to the wider agricultural community, even beyond organic.

Progress comes through innovation, and innovation, in turn, comes through research that is relevant to stakeholders, produces useful results, and effectively communicates results to relevant stakeholders. The OSC has strived to foster relationships between researchers and producers to identify research priorities and identify practical solutions that can be adopted by many producers.

Our evaluation of the impact of Organic Cluster research has demonstrated that the research is much more likely to have impact when producers and other industry partners actively participate in the research. For example, producers who see the research on their own farms will be more likely to adopt new practices. In addition, researchers and producers learn from each other in the process of planning and carrying out the research. They take this knowledge and share it with their peers.

With OSC3 wrapping up by March 2023, planning is underway for OSC4 slated to run from 2023-2028. The next federal policy framework for agriculture, proposed to be titled "Sustainable Canadian Agricultural Partnership", identifies environmental performance as a key priority area, with special focus on reducing greenhouse gas emissions and enhancing carbon sequestration. Other environmental priorities included supporting biodiversity, ensuring clean water, reducing plastic waste, and recycling of food and agricultural wastes.

OSC3 RESEARCH NETWORK:

- 27 projects working in 9 provinces
- 79 scientists from 14 AAFC research stations and 22 university or other research centres.
- 74 industry partners
- >100 farms collaborating in the research
- > 40 graduate students trained

One priority area is enhancing resilience in agriculture through climate adaptation, improved soil and plant health, and improved animal welfare.

Through its guiding principles, the organic sector has always focussed on developing a production system that is environmentally sound by maintaining good soil health, supporting biodiversity, recycling nutrients, and finding alternatives to synthetic pesticides.

KEYS TO CLUSTER PROGRESS:

- Priorities are identified by producers
- Focus on continuous improvement
- Producer or partner participation in the research
- Scientific integrity
- Active and ongoing communication of results to stakeholders

As organic agriculture has grown and evolved, so have producers' yield goals, the nature of pest pressure (given a changing climate), and consumer expectations related to environmental performance, food supply, and food quality. Innovation and continuous improvement in organic agriculture are key features of Organic 3.0, the vision for the next stage in the evolution of organic agriculture. OSC4 will target innovative solutions to environmental and production challenges by encouraging a strong link between researchers, producers, and industry partners.

The OSC program would not be possible without the financial and in-kind support of partners shown on pages 15 & 16 in this issue, the interest of researchers and students across the country, and the close collaboration between the Organic Federation of Canada and Organic Agriculture Centre of Canada at Dalhousie University.

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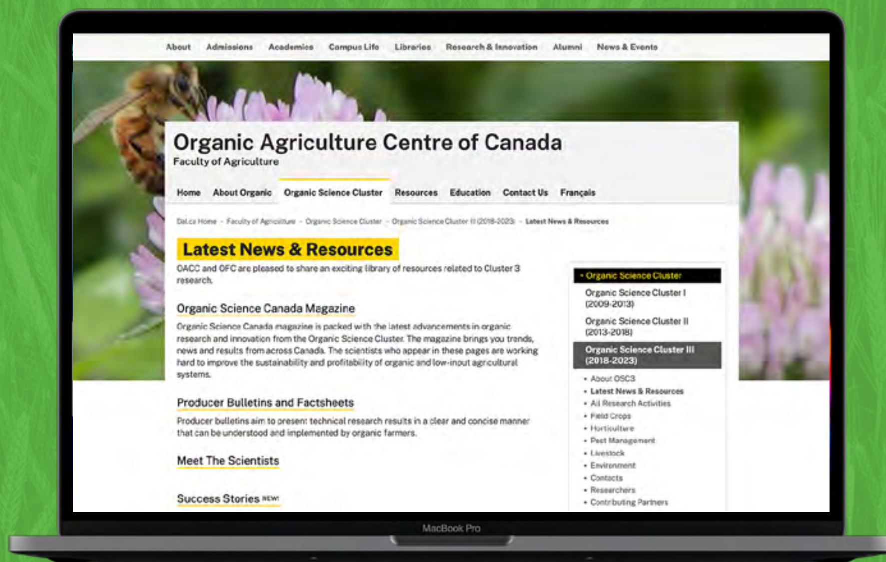

dal.ca/oacc/osciii

PODCASTS

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The OACC and OFC webpages may have just what you are looking for. Discover a wealth of producer resources; These are available in various forms, such as podcasts, producer bulletins, factsheets, infographics, success stories, magazines, and more! Check these websites often: new resources are continuously getting added.

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