

State/Province Report: Ontario, Canada

Interest in cover crops and soil health is high in Ontario and consequently, the request for cover crop talks at various meetings, events and conferences around the province has been high. Some of the places where cover crops were profiled in 2015-2016 are listed below. These presentations and demonstrations were made by Ministry of Agriculture, Food, and Rural Affairs staff, associated researchers and farmers.

Location	Event	Topics covered	Number of attendees
Ridgetown	Southwest Crop Diagnostic Days	Cover crop garden with monocultures and mixes served as a tool to discuss the potential for using cover crop mixtures in Ontario.	400
Winchester	Eastern Crop Diagnostic Days	Similar to above	300
Innisfil	Innovative Farmers Association of Ontario (IFAO) Soil Health Day	Numerous mixtures were planted on a farm in Central Ontario to discuss benefits of cover crops and using different species in mixes	200
Woodstock	Outdoor Farm Show	Strips of cover crop mixes planted to demonstrate the potential for cover crops. Plots with cover crop interseeded into corn and soybeans to compare species and planting dates	Show attendance 40,000
Ridgetown	Southwest Agriculture Conference	5 different sessions on cover crops offered	1000
London	IFAO Conference	Several speakers discussed the benefits of cover crops and how they can be used on farm	250

Current Cover Crop Researchers and Projects in Ontario

Dr. Laura Van Eerd, University of Guelph, Ridgetown Campus

lvaneerd@uoguelph.ca

for more information and to read all reports visit Dr. Van Eerd's research page at:

http://www.ridgetownc.uoguelph.ca/research/profile_lvaneerd.cfm

Legume cover crops – minimizing nitrogen loss in the fall and supplying N in the next season

Cover crops are a significant component of OMAFRA's nutrient management plans and best management practices. Cover crops hold onto nutrients in the fall. Ideally cover crops hold onto nutrients over winter and release nutrients to the following crop, thereby minimizing losses and fertilizer needs. The project aimed to build on previous research to better understand the role of three legume cover crops (crimson clover, red clover, and alfalfa) in terms of nitrogen (N) use efficiency and providing cover crop management recommendations.

The results of this research were that planting red clover or alfalfa at a 6 lb ac⁻¹ seeding rate and terminating in the spring prior to corn planting is recommended to lower the risk

of nitrogen loss over the winter, increase nitrogen availability in the spring and provide a yield increase to the following corn crop.

Funding source: Growing Forward 2, Farm and Food Care Ontario

Dr. Darren Robinson, University of Guelph, Ridgetown Campus

drobenson@uoguelph.ca

for more information and to read all reports visit Dr. Robinson's research page at:

http://www.ridgetownc.uoguelph.ca/research/profile_drobinsocfm

Effect of Residual Herbicides on Establishment and Performance of Spring- and Fall-seeded Cover Crops

Twelve field experiments were completed over a two-year period (2014, 2015) to determine the effect of herbicides in soybean and wheat on cover crop establishment. In four of the studies, twelve different preemergence herbicides were applied at soybean planting in May of 2014 or 2015. Oilseed radish was broadcast into standing soybeans at leaf drop of the soybeans, and monitored for injury, stand count and yield. Though Sencor, Pursuit and Command caused visible injury symptoms to oilseed radish, there was no reduction in oilseed radish stand counts or biomass production. In another four studies, seven different postemergence herbicides were applied to soybean in June of 2014 or 2015 and oilseed radish was broadcast into standing soybeans at leaf drop. Pursuit reduced oilseed radish above ground biomass. In the remaining four studies, ten different postemergence herbicides were applied to winter wheat in the spring, and oilseed radish was planted after wheat harvest. None of the herbicide treatments injured oilseed radish.

Interseeding Annual ryegrass in corn

Two field studies were initiated in 2014 and again in 2015 to determine the establishment of annual ryegrass in corn. Annual ryegrass can be successfully established in grain corn at the 3-, and 5--leaf stage of the corn, but later planting timings (ie. 7-leaf and later) did not allow for successful establishment of annual ryegrass in corn.

Dr. Bill Deen, University of Guelph

bdeen@uoguelph.ca

Mapping Red Clover Ground Cover Using Unmanned Aerial Vehicles

The environmental and economic benefits of using red clover in Northern Corn Belt cropping systems are well established. However, producer use of red clover and realization of these benefits are restricted due to nonuniformity of the stands during years of low precipitation. Spatial applications of nitrogen with respect to the non-uniform regions could mitigate the above concerns, however this requires that a map of red clover ground cover (RCGC) be generated. In this paper, we present an integrated system for collecting, processing, and analyzing aerial data for the mapping of RCGC at a patch-level. Our method is based on machine learning classification algorithms which attempt to produce a complete map from an extremely sparse set of samples which require human effort to collect. We show through our experiments that the method generalizes well, despite limited labeled data.

Collaborators: Ammar M. Abuleil, Graham W. Taylor, Medhat Moussa, Ralph C. Martin, Bill Deen

Role of rotation diversity in increasing system resilience

As part of an ongoing project, the role of rotation diversity in increasing system resilience, particularly resilience to water stress is being examined. Treatments, including wheat with and without red clover, at the Elora research station will be imposed with moisture treatments.

Collaborators: Dave Hooker, Amelie Gaudin (UC Davis)

Dr. Xueming Yang, Harrow Research and Development Centre, Agriculture and Agri-Food Canada

xueming.yang@agr.gc.ca

Cover crops and organic amendments to reduce agricultural pollution of the Great Lakes and improve field-crop productivity

It is now clearly established that plant nutrient pollution of surface and ground waters in the lower Great Lakes and Midwest derives largely from leaching of nitrogen out of the root zone and into tile drains under corn and winter wheat crops. The primary origins of the nitrate are agricultural fertilizers, decomposing crop residues, and mineralized soil organic matter. The leaching occurs primarily during the non-growing season (i.e. after harvest, over winter, early spring) and involves mainly “residual” or “non-assimilated” mineral nitrogen that were left over in the root zone after crop harvest. Extensive research shows that one of the most effective ways for mitigating leaching losses of residual nitrate is to plant over-winter cover crops. The cover crops scavenge and temporarily store the nutrients in their tissues for later use during the next cropping cycle (as “green manure”); and they improve the nutrient retention and recycling capacity of the soil by reducing erosion, increasing soil organic carbon content, and enhancing soil physical quality. Cover crops are a significant component of nutrient management plans and one of the best recommended management practices in the Mid-west of US and in Southern Ontario. The expected objectives were test the role of some traditional cover crops (crimson clover, red clover, and hairy vetch) and some new cover crops (Nitro radish, Sasbenia and Phacelia) in terms of suitability in the region.

Some of the key findings from this research were:

- Planting sasbenia and phacelia after winter wheat harvest as a fall cover crop should be avoided in the region.
- Planting Nitro radish after winter wheat harvest showed the Nitro radish is a very good land cover and excellent nitrogen scavenger in S Ontario which can reduce the risk of nitrogen loss over the no-growing season. However, this scavenged nitrogen (dominant NH_4^+) does not provide a nitrogen credit to the following crop corn. It is speculated that the significant amount of nitrogen being scavenged by Nitro radish in fall was released from the soil as ammonia (NH_3 , strong ammonia odour in spring around the plots) in following spring, and this is worthy of future study.
- Planting red clover, hairy vetch and Crimson clover after winter wheat harvest is endorsed to reduce the risk of nitrogen loss over the non-growing season; terminating red clover, hairy vetch, and Crimson clover in May prior to corn planting can supply substantial amounts of nitrogen nutrient to the consequent crop corn.

Co leads: Xueming Yang and Dan Reynolds

Dr. Mehdi Sharifi, Trent University, Canada Research Chair in Sustainable Agriculture

mehdisharifi@trentu.ca

Screening cover crops for sustainable grape production in Ontario

The objective of this project was to screen a suite of CCs common in the region and to evaluate their impact on soil properties, nitrogen cycling and fruit production in three grape growing regions of Ontario. The main benefit of this project is that new knowledge from this study can be used to help growers identify the suitable CC varieties for their vineyard to maintain efficient soil moisture levels, optimize nutrient uptake, while improving or maintaining vine vigor and yield.

Lead Researcher: Mehdi Sharifi Collaborators: Kathryn Carter, Scott Beaker, Deanna Nemeth, Anne Verhallen, Margaret Appleby

Evaluating cover crops interseeded into corn

This project was initiated in 2015 at three locations, Trent, Elora and Ridgetown. The objective of the project is to evaluate red clover and annual ryegrass as cover crop options either broadcast or interseeded into V6-V8 corn. This is a three year project.

Lead Researcher: Mehdi Sharifi. Collaborators: Laura Van Eerd, Dave Hooker and Bill Deen.

Screening cover crops for sustainable grape production in Ontario

The objective of this project was to screen a suite of CCs common in the region and to evaluate their impact on soil properties, nitrogen cycling and fruit production in three grape growing regions of Ontario. The main benefit of this project is that new knowledge from this study can be used to help growers identify the suitable CC varieties for their vineyard to maintain efficient soil moisture levels, optimize nutrient uptake, while improving or maintaining vine vigor and yield.

Key findings of the research and the final report can be found through the Grape Growers of Ontario website: <http://www.grapegrowersofontario.com/>

Lead Researcher: Mehdi Sharifi. Collaborators: Kathryn Carter, Scott Baker, Deanna Nemeth, Anne Verhallen, Margaret Appleby

Dr. Merrin Macrae, Associate Professor & Associate Chair, Undergraduate Studies, Geography Programs, University of Waterloo

mmacrae@uwaterloo.ca

Advancing Cover Crop Systems in Ontario - Focus on Soil Nutrients (N+P)

Recent studies have suggested cover crops may increase the export of dissolved reactive phosphorus (DRP) resulting from damage caused by freeze-thaw cycles (FTC). The objectives of this project include: determining the impact of variable freeze-thaw magnitude on DRP export, finding candidate cover crop species which best resist the impacts of FTC, and determining the effect early termination of cover crops (via glyphosate application) has on DRP export compared to leaving plants green. This project is comprised of separate laboratory and field studies.

To date, a laboratory experiment has been conducted to examine the effects of cover crop species, type of freeze-thaw cycle, and the effects of termination prior to freezing. These variables were tested for both phosphorus and nitrogen release. Much of the lab work has been completed and two conference presentations (IAGLR, CGU) are in preparation.

The field component of the study will begin in the fall of 2016. At present, a series of field trials have been initiated on the University of Waterloo campus to determine an appropriate set of instrumentation for the leaching studies. We are currently seeking a co-operator and field for the trials to begin in late 2016.

Other Projects	Lead
Advancing Cover Crop Systems in Ontario - Focus on Soil Nutrients (N+P), Soil Health, Insects and Nematodes OSCIA Tier 2 Grant – St. Clair Region http://www.ontariosoilcrop.org/wp-content/uploads/2016/02/V12-2015CrpAdv_Gen1_St.-Clair-OSCIA_Tier-2_Advancing-Cover-Crop-Systems-in-Ontario-Focus-on-Soil-Nutrients-Soil-Health-Insects-and-Nematodes.pdf	Adam Hayes, OMAF adam.hayes@ontario.ca
A Systems Approach To Cover Crops In A Rotation Norfolk SCIA - Tier One Grant Project Final Report http://www.ontariosoilcrop.org/wp-content/uploads/2016/02/V12-2015CrpAdv_Gen5_Norfolk-OSCIA-Tier-1_A-Systems-Approach-to-Cover-Crops-In-A-Rotation.pdf	
Roots Not Iron: Evaluating Cover Crop Options and Planting Strategies Thamesvalley SCIA OSCIA Tier 2 Grant Interim Report http://www.ontariosoilcrop.org/wp-content/uploads/2016/02/V12-2015CrpAdv_Gen8_Thamesvalley-OSCIA-Tier-2_Roots-Not-Iron-Evaluating-Cover-Crop-Options-and-Planting-Strategies.pdf	Peter Johnson, Agronomist, Real Agriculture, peter.johnson@bell.net

MCCC Executive Committee member – Ontario

Anne Verhallen
 Soil Management Specialist, Horticulture
 Ontario Ministry of Agriculture, Food and Rural Affairs
 120 Main Street
 Ridgetown, Ontario, Canada
 N0P 2C0
 519 674 1614
anne.verhallen@ontario.ca

Other OMAFRA staff with cover crop involvement:

Christine Brown, Nutrient Management - OMAFRA Christine.brown1@ontario.ca
 Adam Hayes, Soil Management, Field Crop – OMAFRA adam.hayes@ontario.ca

