SHARING RESEARCH

that

GROWS ORGANIC

2nd CANADIAN ORGANIC SCIENCE CONFERENCE

September 19-21, 2016 • MONTRÉAL-LONGUEUIL (QUÉBEC) CANADA

PROCEEDINGS

THIS EVENT IS ORGANIZED BY:

irda

RESEARCH AND DEVELOPMENT
INSTITUTE FOR THE
AGRI-ENVIRONMENT

WITH THE COLLABORATION OF:

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valacta

OACC Organic Agriculture Centre of Canada

DALHOUSIE UNIVERSITY

Cultivons l'avenir 2
Une initiative fédérale-provinciale-territoriale

Canada

Québec

This conference was made possible through the financial assistance of the Innov'action agroalimentaire Program from the Growing Forward 2 Framework settled between the Ministère de l'Agriculture, des Pêcheries et de l'Alimentation and Agriculture and Agri-Food Canada.

THANKS TO OUR SPONSORS FOR SUPPORTING RESEARCH IN ORGANIC AGRICULTURE. CLICK HERE TO CONSULT THE LIST.

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The only French agricultural weekly in North America since 1929, owned by the agricultural producers. Reaching more than 100 000 weekly readers it's the best source for agricultural information!

GOLD Sponsors

GRAIN MILLERS

We aim to be your partner!

We buy directly from growers and offer strong markets for your crops of oats, barley, rye and wheat, along with agronomy & sustainability resources.

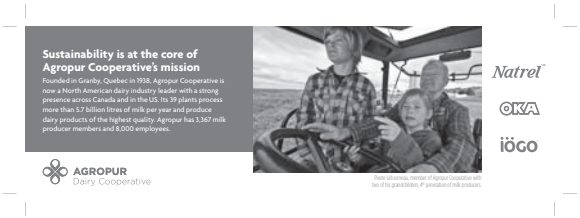
NATURE'S PATH
3 GENERATIONS
ORGANIC

Take a step on Nature's Path.

Delicious pumpkin seeds, nutritious flax and wholesome oats – a healthy organic breakfast to get you on your path.

SILVER
Sponsors

Agrisys offers agronomic consultancy services, including an organic production specialist, as well as crop monitoring, feasability studies, and research & development.



Sustainability is at the core of Agropur Dairy Cooperative's mission.

Conscious of the need to protect our natural resources, Agropur offers quality dairy products in Canada and the US.

ST-LAWRENCE BEANS

Saint-Lawrence Beans, a division of Agrocentre Belcan, focuses on trading, marketing and processing of organic and non GMO grain end by-products. We offer high quality products for human and animal consumption with the support of our local and international partners.

chfa MD

The Canadian Health Food Association is Canada's largest trade association dedicated to natural health and organic products.

SILVER Sponsors

Representing organic certifying agencies in British Columbia, COABC promotes organic agriculture and provides education on organic agriculture and foods.

We provide all of the goods and services necessary for agricultural operations under three divisions: Agribusiness (under the Elite and La Coop brands), Retail and Innovation (under the Sonic, Unimat, BMR, and Agrizone brands), and Meats (under the Olymel, Flamingo and Lafleur brands).

Earth Alive provides organic inputs that have the greatest environmental impact with the smallest footprint.

We provide fast and efficient organic and sustainable development certification services.

SILVER Sponsors

FILIÈRE BIOLOGIQUE DU QUÉBEC

Together, let's support the supply and sale of organic products grown in Quebec!

prairie organic grain initiative

Proud to support organic agronomy research across the Prairies!

Pro-Cert ORGANIC

We believe in organic!

Cost effective certification services provided by a Canadian, family-owned enterprise.

Sagami

SAVOURA Biologico

A brand name that equals pleasure and quality.

Organic tomatoes available year-around.

SILVER
Sponsors

Processor of local agricultural products, Soya Excel supports the development of the feed soybean value chain.

TRITURO soya meal offers a high level of energy and digestible proteins rich in amino acids to fulfill the nutritional needs of livestock.

The Union des producteurs agricoles represents 42,000 Quebec farmers as well as all forestry producers in the province.

USC Canada's work promotes vibrant family farms, strong rural communities and healthy ecosystems around the world.

Commanditaires

BRONZE

Agri-Fusion
Ferme biologique

A leader in organic cash crop production, the farm produces organic grains for human consumption. We contribute to sustainable development by innovating new agricultural production techniques for the next generations.

Bleuets Mistassini Ltée

The world's 4th largest processor of frozen wild blueberries. The environment is at the heart of everything we do.

CITADELLE
COOPÉRATIVE DE PRODUCTEURS DE SIROP D'ÉRABLE

We process and commercialize maple, honey and cranberry products of only the highest quality.

fertilec
biodiversité | biodiversity

Fertilec is recognized for the quality and efficiency of its organic fertilizer and input products, such as phosphorus-free fertilizers.

Fruit d'Or

An international company that specializes in cranberry and blueberry processing.

Homestead Organics

Organic grain processor and farm supply business, with a mission "to serve and develop organic agriculture.

Horizon Nature

Horizon Nature distributes fresh, dry and frozen natural and organic food products.

KOPPERT
BIOLOGICAL SYSTEMS

We use natural enemies to combat pest infestations, bumblebees for natural pollination, and natural products that support and strengthen crops both above and below ground.

Dairy Farmers of Canada

We promote the production of safe and high quality dairy products for consumers.

Western Grains Research Foundation

WGRF is a farmer funded and directed non-profit organization investing in agricultural research that benefits western Canadian producers.

We

WELCOME YOU

Message from the CO-CHAIRS

Greetings!

As co-chairs of this conference, we would like to welcome you to this 2nd edition of the Canadian Organic Science Conference.

We have prepared sessions targeted towards agronomic, soil, crop, animal sciences as well as the evolution of the broader organic sector that represent the depth of the diverse disciplines of attendees. This conference is uniquely interdisciplinary! More than 20 invited speakers will address you on their areas of expertise. Our plenary keynote speakers will encourage you to reflect on the science behind organic research, the future of organic agriculture (Organic 3.0), and organic livestock production.

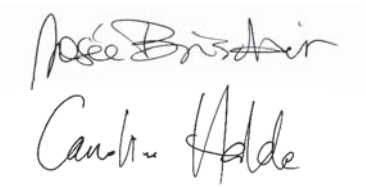
The program will begin on Sunday evening with an opening reception in the hotel lobby. Monday will feature an open discussion on genetic engineering and organic agriculture, and a panel discussion on participatory plant breeding. Three concurrent sessions are also planned for Monday: Horticultural Crops, Field Crops, and Putting Organic Research into Context. Our field day on Tuesday is purposely placed in between the two days of conference meetings, to force scientists to go out, visit organic farms, and get their shoes dirty! Nothing like a bus ride to network and foster new research collaborations. Three concurrent sessions are planned for Wednesday: Weed Management and Crop Pests, Soils and the Environment, and Livestock. Wednesday will also feature a lunch workshop on the prioritization of organic research needs and a panel discussion on organic dairy research.

The local organizing committee is proud to welcome you in Québec! Organic farming has a long tradition in Québec, with its first farm organically certified in 1983 by OCIA. Québec now has more than a thousand certified organic farms, representing 29% of organic farms in Canada. Currently, 3.6% of farms are certified organic in Québec, with larger farms undergoing their organic transition at the moment. We hope that by hosting the Canadian Organic Science Conference here, we will be able to establish new long-lasting research collaborations and relationships.

We would like to thank the Organic Agriculture Centre of Canada (OACC) staff for initiating the organization of the conference. Our organizing committee is also proud to highlight the 15th anniversary of the OACC this year, an organization that has proved to be a pillar for organic research in Canada.

Finally, thanks to members of our organizing committee for your commitment, time, and efforts. We are very grateful that we had the opportunity to work with you to make this event a successful one.

We hope that this conference will be an opportunity for meeting and exchanges which will be "organically fruitful" and that your stay in the Montreal area will be memorable.



Josée Boisclair, agr., M. P. M.
Researcher

Research and Development
Institute for the
Agri-Environment (IRDA)

Saint-Bruno-de-Montarville (Québec)

Caroline Halde, Ph. D.
Assistant Professor

Université Laval

Québec (Québec)

Message from the PRESIDENT AND CEO OF IRDA

It has been over 18 years that the IRDA has carried out research projects aimed at fostering more in-depth scientific knowledge in agri-environment and organic agriculture – all of which have played crucial roles in the work we accomplish. Since 2013, thanks to the creation of the ***Organic Agriculture Innovation Platform (OAIP)*** at Saint-Bruno-de-Montarville, our researchers benefit from a sprawling outdoor 90-hectare laboratory, which is certified as organic, and a multitude of cutting-edge equipment that enables the team to further push its studies in organic crop production.

The IRDA has always been committed to establishing close ties with the industry's farmers and stakeholders; that is why we are immensely proud to have organized such a large-scale event, which I am certain will encourage compelling discussions and advance our collective know-how.

The event's organizing committee took on a stimulating and bold challenge to bring together high-calibre international speakers, researchers from across Canada and farmers to share their visions and realities. It was challenge they successfully completed with quite a lot of enthusiasm.

I would like to highlight the amazing work that was carried out by our colleagues and partners for this project: Université Laval, the Organic Agriculture Centre of Canada at Dalhousie University, Centre d'expertise et de transfert en agriculture biologique de proximité, Centre de référence en agriculture et agroalimentaire du Québec (CRAAQ), Organic Federation of Canada, Valacta, Agriculture Canada and MAPAQ. Each organization spent a tremendous amount of time and energy to make this event happen. Thank you again!

I would also like to deeply thank our partners and sponsors that, with their support, demonstrated the importance of sharing scientific information in this fast-growing market sector.

And I would like to thank you, our event attendees, for taking part in this great event.

Have a wonderful conference!

Georges Archambault
President and CEO of IRDA

Research and Development Institute for the Agri-Environment (IRDA)

Organizing COMMITTEE

Sylvie Bellerose,
Director of Operations

Research and Development Institute for the Agri-Environment (IRDA)

Josée Boisclair,
Co-chair of the conference
Researcher

Research and Development Institute for the Agri-Environment (IRDA)

Nicole Boudreau,
Coordinator

Organic Federation of Canada (OFC)

Lyne Desnoyers,
Project Officer

Quebec Reference Center for Agriculture and Agri-food (CRAAQ)

Martine Dorais,
Research Scientist

Agriculture and Agri-Food Canada (AAFC)

Jean Duval,
Director

Centre d'expertise et de transfert en agriculture biologique et de proximité (CETAB+)

François Labelle,
Organic Dairy Production Expert

Valacta, Centre d'expertise en production laitière Québec-Atlantique

Marie-Claude Fradette,
Communications Officer

Research and Development Institute for the Agri-Environment (IRDA)

Caroline Halde,
Co-chair of the conference
Assistant Professor

Université Laval

Andrew Hammermeister,
Director

Organic Agriculture Centre of Canada (OACC) – Dalhousie University

Jonathan Roy,
Organic Farming Advisor

Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ)

Nicolas Turgeon,
Expert Advisor – Organic Section

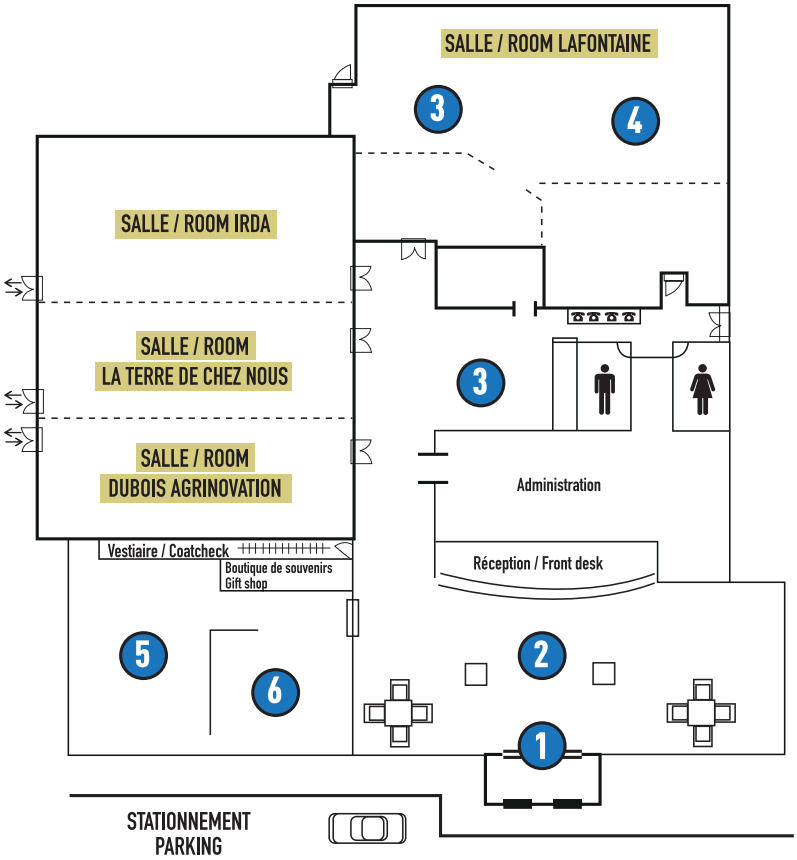
Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ)

Joanna White (MacKenzie),
Communications Officer

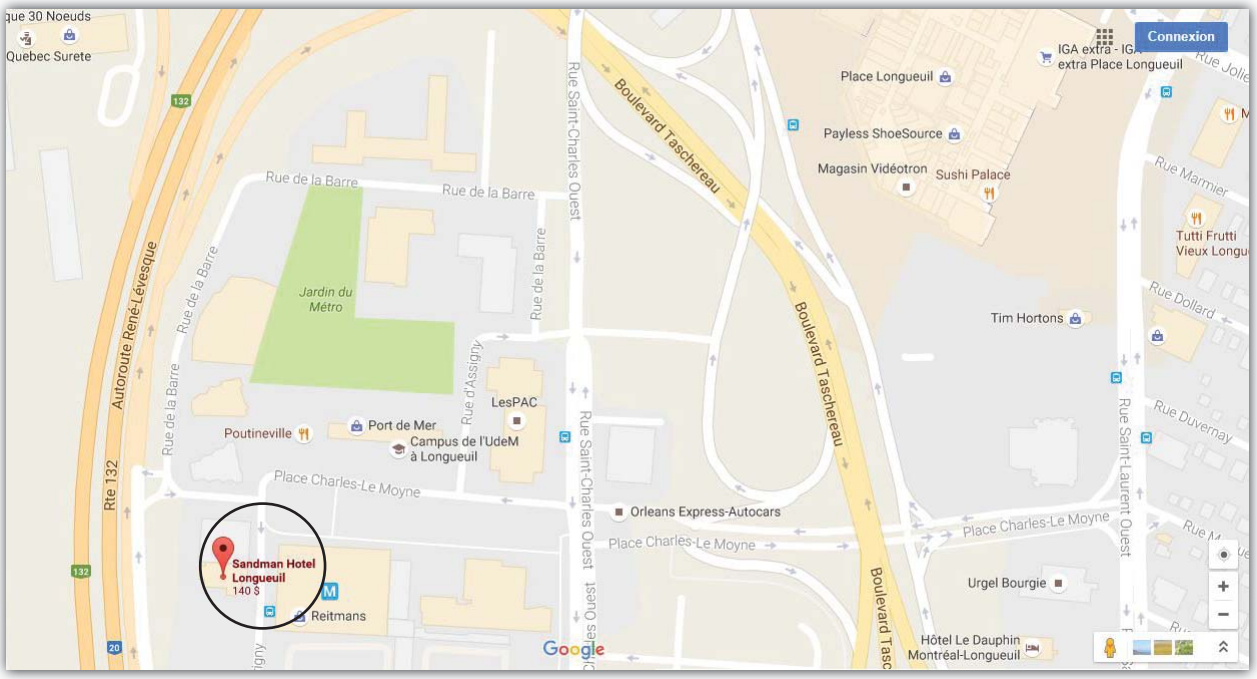
Organic Agriculture Centre of Canada (OACC) – Dalhousie University

Site Plan

HOTEL AND CITY



1. Entrée / Entrance
2. Hall d'entrée / Lobby
3. Kiosques / Stands
4. Affiches / Posters
5. Bistro de Sérigny
6. Bar de Sérigny



Plenary and Session Guest SPEAKERS

Abonnez-vous!

VERSION **NUMÉRIQUE**

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il est **le parfait outil pour tous les travailleurs du secteur agricole**. Actualités, offres d'emplois, petites annonces, encans, boutique en ligne, météo agricole, cours des marchés et bien plus!

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ou téléphoner au **1 877 679 7809**

Presentation of

PLENARY AND SESSION GUEST SPEAKERS

MARKUS ARBENZ

Markus Arbenz is Executive Director of IFOAM – Organics International since 2009.

IFOAM – Organics International is the global organic umbrella with 800 members in 120 countries with the purpose to cultivate change for true sustainability in agriculture. Markus and his team set global landmarks, organize the *Organic World Congress*, advocate to international bodies such as the UN, maintain the global organic guarantee system, implement development programs and train future organic leaders. Before joining IFOAM – Organics International, Markus worked as Director of Bio Suisse, the federation of the Swiss organic farmers. He has six years of experience in Bhutan, Kyrgyzstan and Afghanistan, with Helvetas in agriculture development programs, in collaboration with the Swiss and local governments, the World Bank and IFAD. Prior to that, Markus was director of the foundation Pro Specie Rara in Switzerland for the safeguard of domestic animal and plant genetic resources.

MONIQUE BESTMAN

Monique Bestman studied biology with specializations in animal ecology and animal behaviour. She has worked for the Animal Husbandry section of the Louis Bolk Institute (The Netherlands) since 1999. She is responsible for projects in animal welfare and animal health, especially in (organic) egg production.

Her research themes are feather pecking, health problems caused by production, rearing conditions, environmental enrichment, design of the free range area, poultry production in an agroforestry context, targeting challenges with avian influenza risk birds and predators. These topics have been addressed in national and European research projects, demonstration projects and several publications and lectures for farmers, students and scientists.

Cont'd

MARTINE DORAIS

A scientific researcher at AAFC and adjunct professor at Laval University since 1996, Dr. Dorais has vast research experience in the field of sustainable protected crops with more than 15 years dedicated to the development of organic growing systems for horticultural crops such as ginseng, medicinal plants, small fruits under high tunnels and greenhouse vegetable and ornamental crops.

She is the president of the Organic commission of the International Society for Horticultural Science and the chair of the working group on Organic Greenhouse Horticulture since 2014. She was the recipient of an honorary doctorate awarded in 2013 (doctorat honoris causa) by the Swedish University of Agricultural Sciences highlighting her achievements in the field of sustainable production of fruits and vegetables, with a particular emphasis on organic production, product quality and the environmental assessment of different production systems. Her holistic vision of horticultural agroecosystems and integration of industrial, governmental and academic research have established a continuum between all stakeholders and promoted the transfer of new knowledge and innovations in the industry to increase its competitiveness and profitability.

NADIA EL-HAGE SCIALABBA

Nadia El-Hage Scialabba is a Senior Natural Resources Officer of the Food and Agriculture Organization of the United Nations in Rome, Italy, since 1985.

Over the years, she held different positions in the Fisheries, Agriculture and Environment Departments of the Organization, always aiming to mainstream environment and sustainable development considerations in food and agriculture systems. Since 1999, Ms. Scialabba is responsible for the cross-sectoral programme on organic agriculture, in addition to other "green" tasks, where the challenge is to address the dual need to conserve natural resources while providing for an ever more demanding global population. Work includes technical backstopping of field projects in Africa, Asia, Caribbean and Pacific countries, as well as normative and policy advice to FAO member countries. Nadia El-Hage Scialabba has a Masters Degree in Environmental Studies and is a mother of two children and one grandchild.

Cont'd

DAVID GRANATSTEIN

David Granatstein is a Professor with the Washington State University (WSU) Center for Sustaining Agriculture and Natural Resources based in Wenatchee, Washington, USA.

He has worked on sustainable agriculture and organic farming for over 35 years on different crops and in several states and countries. He currently focuses on tree fruit production, organic systems, and soil quality.

TODD KABALUK

With research comprising biological control of insect pests using pathogens, and the development of novel pest control product technology, Todd envisions how biopesticides will play an increasingly important role to manage pests in the production of organic crops.

He is currently developing a biologically-based comprehensive strategy for wireworm control by targeting both larvae and adult beetles. To promote the adoption of biopesticides, he created the Directory of Biopesticides for Agricultural Crops in OECD Countries as a searchable database for finding products for both domestic use and new registrations for Canada. Todd has been active in professional associations including President of the Professional Pest Management Association of BC, Associate Editor of the journal Organic Agriculture, the Society for Invertebrate Pathology, and is adjunct faculty in the biology department at the University of the Fraser Valley. Todd is Research Biologist in Integrated Pest Management at Agriculture and Agri-Food Canada.He lives in south coastal BC, working with colleagues to harmoniously integrate intensive agriculture with urban populations, wildlife, and natural resources.

Cont'd

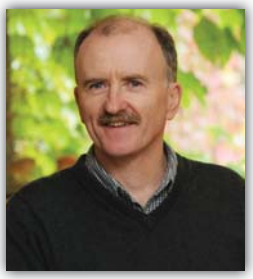
TIA LOFTSGARD

With extensive experience working in the organic food industry, Tia co-founded Camino (La Siembra Co-operative) in 1999, going on to become the organic and Fairtrade cocoa company's Director of Sales until 2009, when she joined Fairtrade Canada.

As its Business Development and Licensing Director, she led strategy, building the not-for-profit's membership base and encouraging sustainable and ethical sourcing standards in North America. In 2013, she moved over to Fairtrade America, where as its Chief Operating Officer, she successfully developed advocacy initiatives and grew U.S. market opportunities for small farmers via the Fairtrade model.

Tia's academic work included research on conflict analysis, human rights and trade, with a BA in Human Justice from the University of Regina and Masters studies with the Norman Patterson School of International Affairs at Carleton University. As part of an initiative with the Sri Lanka Canada Development Fund, she has also investigated the maternal health of Indian Tamil tea plantation workers in the highlands of Sri Lanka.

Passionate about sustainable agriculture, government policy, trade and ethical business models, Tia is dedicated to promoting the growth of organic and fair trade practices that benefit consumers, growers and the environment. For Tia Loftsgard, organic is more than a way of life – it's about creating a just and sustainable world.



DEREK H. LYNCH

Derek Lynch is an Associate Professor at the Dalhousie University Faculty of Agriculture (Dal-AC). From 2005-2015, he held the position of Canada Research Chair in Organic Agriculture. His academic training includes agronomy (B.Sc., M.Sc., McGill University) and soil science (Ph.D, University of Guelph).

His research program has spanned sectors as diverse as organic field crop, organic dairying, and organic blueberry production. Much of this research is conducted directly in partnership with commercial organic farms and producer groups and typically combines an assessment of the productivity and environmental or ecological impact of the production system. Derek teaches on soil management, organic field crop management, and agroecology at the undergraduate and graduate level at DAL-AC. He has served for many years on national sector committees such as the Organic Value Chain Round Table and the CGSB committee on organic production standards. In 2014-15 he was president of the Canadian Society of Agronomy.

Cont'd

RALPH C. MARTIN

Ralph C. Martin grew up on a beef and hog farm in Wallenstein, ON. After 4-H, his formal education includes, a B.A. and an M.Sc. in Biology from Carleton University and a Ph.D. in Plant Science from McGill University.

His love of teaching grew unexpectedly when he began teaching at the Nova Scotia Agricultural College, in 1990, and realized how students teach him too. In 2001, he founded the Organic Agriculture Centre of Canada (www.oacc.info) to coordinate university research and education pertaining to organic systems, across Canada . In 2011, he was appointed as Professor and the Loblaw Chair in Sustainable Food Production at the Ontario Agricultural College, University of Guelph.

URS NIGGLI

Urs Niggli is Director of the Research Institute of Organic Agriculture (FiBL) in Switzerland since 1990. He is responsible for the overall scientific, financial and administrative co-ordination of the institute with 170 staff and 80 students. He is also president of FiBL Germany and FiBL Austria (50 scientific staff).

Urs Niggli is an Honorary Professor at the University of Kassel in Germany where he teaches organic farming policy and research strategy in the EU. He was appointed an Honorary PhD by the University of Life Sciences in Estonia.

He holds both an M.Sc. and a Ph.D. in plant production. He started his career as a weed scientist in grassland, arable and horticultural crops at two Agroscope Federal Research Stations.

He serves on boards of national, European and international committees for research, agro-ecology, sustainability and organic farming. Among others, he is president of the Technology and Innovation Platform of IFOAM (TIPI) and of the Sustainable Organic Agriculture Action Network of IFOAM (SOAAN). He has published 240 papers.

Cont'd

STEVEN J. SHIRTLIFFE

Steven J. Shirtliffe was raised on a grain and oilseed farm in Manitoba. After completing a B.Sc. in Agronomy, he returned home and farmed with his family for five years.

In 1992, Steve returned to the University of Manitoba, where he received his PhD in 1999. Currently, he is a professor in the Department of Plant Sciences at the University of Saskatchewan. His position involves teaching, research and extension in the areas of weed control and agronomy. Past and current research projects have focused on the control of volunteer canola, oat agronomy, pulse agronomy, non-herbicidal weed control and agronomic applications of UAVs.

GUNTA VITINS

Gunta Vitins of Resilient Solutions Consulting has been spearheading innovative agri-food initiatives in the organic sector for over two decades. Her work experience spans government, academia, business and industry development, agricultural production, processing, sales and marketing.

Gunta's involvement in the organic sector includes national and international speaking engagements and past roles on Agriculture and Agri-Food Canada's Organic Value Chain Roundtable as Industry Co-Chair, as well as past presidents of the Canada Organic Trade Association and the Pacific Agricultural Certification Society.

Gunta received the Canadian Health Food Association's Organic Achievement Award in 2007 and the Certified Organic Associations of British Columbia's Founders Award in 2005 in recognition of her dedication to the Canadian organic sector.

Useful

INFORMATION

Need help during the conference? Here are the people you should contact

(by subject)

Scientific Program

Caroline Halde – Université Laval
Cellular: 418 262-7094

Josée Boisclair – IRDA
Cellular: 514 966-8418

Farm Tours

François Labelle – Valacta
Cellular: 819 681-8920

Posters

Sylvie Bellerose – IRDA
Cellular: 438 824-0550

Logistics

(audio-visual, registration, schedule)

Marie-Claude Fradette – IRDA
Cellular: 418 561-6710

Sponsors and stands

Nicole Boudreau – OFC
Marie-Claude Fradette – IRDA
Cellular: 418 561-6710

Media

Martin Belzile – IRDA
Cellular: 418 580-8270

Getting around...

The Sandman Hotel Montreal-Longueuil is located on the South Shore of Montreal, across the Saint-Lawrence River.

To get to Montréal

Take the metro (subway) at the Longueuil Station, towards Berri-UQÀM station. This will put you in downtown Montréal.

To get there, you can either buy a single ticket or an OPUS card. For additional information on public transportation in Montreal, go to:

http ://www.stm.info/fr

** A bit of advice... **

The subway tickets bought in Longueuil do not work for the return trip from Montreal and vice-versa, so it's best to buy just one at a time!

Finding what you need around the hotel

There is a pharmacy and a grocery store at the Place Longueuil, located 1 km from the hotel.

https ://www.placelongueuil.com/location

825, rue Saint-Laurent Ouest, Longueuil (Québec) J4K 2V1

To get there

http ://bit.ly/2bVWrLj

Internet access to a tourist guide and an official map of Montreal.

http ://octgm.com/guide/

that

GROWS ORGANIC

2nd CANADIAN ORGANIC SCIENCE CONFERENCE

September 19-21, 2016 • MONTRÉAL-LONGUEUIL (QUÉBEC) CANADA

PROGRAM

www.craaq.qc.ca/cosc2016

Sunday 18

Recherchez ce symbole pour connaître les conférences traduites en français !

6:00 to 9:00 pm Hotel lobby	**Welcome reception and registration** A great opportunity to mingle with colleagues and meet new collaborators! (Registration desk, poster setup, and presentation upload station available)

Monday 19

7:30 am Hotel lobby	**Registration** (registration desk, poster setup, and presentation upload station available)

Room	DUBOIS AGRINOVATION	LA TERRE DE CHEZ NOUS	IRDA
8:15 to 10:30 am **Session**	*Session chair:* Josée Boisclair		
8:15 to 8:30 am	**Welcome and opening remarks**		
8:30 to 9:30 am	**Organic 3.0 (#1)** *Plenary keynote speaker:* **Markus Arbenz** Executive Director, International Federation of Organics Agriculture Movements (IFOAM – Organics International)		
9:30 to 10:30 am	**An Overview of the Canadian Organic Sector** *Panel discussion:* **Andrew Hammermeister,** Organic Agriculture Centre of Canada, Dalhousie University **Tia Loftsgard,** Canada Organic Trade Association **Nicole Boudreau,** Organic Federation of Canada **Alain Rioux,** Filière Biologique du Québec **Ashley St Hilaire,** Canadian Organic Growers		

10:30 to 11:00 am - COFFEE BREAK, POSTER SESSION AND STAND VISITS - Room Lafontaine

Room	DUBOIS AGRINOVATION	LA TERRE DE CHEZ NOUS	IRDA
Session	**Horticultural Crops** *Session chair:* Lyne Desnoyers	**Putting Organic Research into Context** *Session chair:* Joanne Thiessen Martens	**Field Crops** *Session chair:* Margaret Graves
11:00 to 11:30 am	Current Trends for Temperate Organic Tree Fruits in North America **(#5)** *Invited session speaker:* **David Granatstein,** Washington State University	Keeping Up to Date with Consumer Perceptions and How Is the Market Able to Meet These Demands? **(#14)** *Invited session speaker:* **Tia Loftsgard,** Canada Organic Trade Association	*Open discussion:* Genetic Engineering and Organic Agriculture

11:30 to 11:45 am	Growing High-Density, High-Value Apple Plantings under Row-by-Row Exclusion Nets: Effects on Pests and Fruit Quality **Gérald Chouinard (#6)**	Organic Research that is Innovative and Fundamental **(#15)** *Invited session speaker:* **Ralph C. Martin,** University of Guelph	Evaluation of a New Method for the Sowing of Clovers in Cereals **Jean Duval (#20)**
11:45 to 12:00 pm	Impact of Silicon Amendments on Strawberry Powdery Mildew Control in Poly-Tunnel and Field Productions **Marie-Hélène Goyette (#7)**		Effect of AM Fungal Inoculation and Soil P Fertilizers on Bacterial Assemblages Colonizingm the Roots of Pulse Crops under Organic Farm Management **Rim Klabi (#21)**
12:00 to 1:30 pm - LUNCH - Bistro de Sérigny			
Room	**DUBOIS AGRINOVATION**	**LA TERRE DE CHEZ NOUS**	**IRDA**
Session	**Horticultural Crops** *Session chair:* Maryse L. Leblanc	**Putting Organic Research into Context** *Session chair:* Margaret Graves	**Field Crops** *Session chair:* Derek Lynch
1:30 to 2:00 pm	Production, Consumer Trends, Research Development and Market Opportunities of Organic Protected Vegetables in the 21st Century **(#8)** *Invited session speaker:* **Martine Dorais,** Agriculture and Agri-Food Canada	Value Added Opportunities for Organic Agriculture - Building the Future **(#16)** *Invited session speaker:* **Gunta Vitins,** Resilient Solutions Consulting	Panel Discussion on Participatory Plant Breeding, *with:* - **Daniel Brisebois,** Tourne-Sol Co-operative Farm - **Loïc Dewavrin,** Le Moulin des Cèdres - **Martin Entz,** University of Manitoba - **Helen Jensen,** USC Canada
2:00 to 2:15 pm	High Tunnels Can Be Used for Organic Vegetable and Nutraceutical Crop Production in Southern Ontario **Youbin Zheng (#9)**	Role of an Advisory Committee on Organic Research in the Design and Execution of Research Projects **Myriam R. Fernandez (#17)**	
2:15 to 2:30 pm	Nitrogen Mineralization Rate of Five Organic Fertilizers Commonly Used for Greenhouse Fruit and Vegetable Crops **Pierre-Paul Dion (#10)**	Translating Scientific Knowledge for Farmer Adoption: A Green Manure Model **Joanna L. MacKenzie (#18)**	
2:30 to 2:45 pm	Fertilization Management of Organic Greenhouse Soil-Less Cucumber **Martine Dorais (#11)**	Farm System Co-Design for Sustainable and Successful Organic Farming **Joanne Thiessen Martens (#19)**	Farmer Participatory Plant Breeding for Organic Production in Canada: Summary of the Last 4 Years **Martin H. Entz (#22)**
2:45 to 3:00 pm	Intracanopy LED Lighting Effects on Yield and Fruit Quality of Greenhouse Vegetable Crops **Steeve Pepin (#12)**	—	Nutrient Availability from Soil Test and Resin Methods following Compost Manure Application to Commercial Organic Field Crops **Terence P. McGonigle (#23)**

3:00 to 3:15 pm	Permanent Raised Beds for Vegetable Crops **Denis La France (#13)**	—	—

3:15 to 4:30 pm - **COFFEE BREAK, POSTER SESSION AND STAND VISITS** - Authors are present - Room Lafontaine

4:30 to 6:00 pm - **BREAK** - Free time

6:00 to 6:45 pm - **COCKTAILS** - Hotel lobby

6:45 to 8:45 pm — **Banquet**

8:45 to 11:30 pm - **LIVE MUSIC AND DANCING** - Jacynthe Guimond and her musicians

Tuesday 20

Hotel parking	**Departing from and returning to Sandman Hotel Montreal-Longueuil**
8:00 am to 5:30 pm	Three options for full-day field tours are offered to participants: **Option A:** **Field crops** – Visits to 3 organic farms **Option B:** **Livestock** – Visits to 3 organic farms **Option C:** **Horticulture** – Visits to 2 organic farms and the Organic Agriculture Innovation Platform at the IRDA Research Center, Saint-Bruno-de-Montarville

Evening - **DINNER ON YOUR OWN**

Wednesday 21

7:30 am Hotel lobby	**Registration** (registration desk, poster setup, and presentation upload station available)		
Room	**DUBOIS AGRINOVATION**	**LA TERRE DE CHEZ NOUS**	**IRDA**
8:00 to 10:00 am **Session**	*Session chair:* Andrew Hammermeister		
8:00 to 9:00 am	**The Science behind the Organic Movement (#2)** *Plenary keynote speaker:* **Urs Niggli,** Research Institute of Organic Agriculture (FiBL) - **by videoconference**		

9:00 to 10:00 am	**Organic-Plus for a Sustainable Future (#3)** *Plenary keynote speaker:* **Nadia El-Hage Scialabba,** FAO

10:00 to 10:30 am - COFFEE BREAK, POSTER SESSION AND STAND VISITS - Room Lafontaine

Room	DUBOIS AGRINOVATION	LA TERRE DE CHEZ NOUS	IRDA
Session	**Weed management** *Session chair:* Jean Duval	**Soils and the environment** *Session chair:* Anaïs Charles	**Livestock** *Session chair:* François Labelle
10:30 to 10:45 am	Optimizing Weed Control in Grain Crops **(#25)** *Invited session speaker:* **Steve Shirtliffe,** University of Saskatchewan	Wheat Productivity and Nitrogen Uptake following Green Manure Precrops and Biofertilizer Supplementation **Simon Lachance (#34)**	State of Science Concerning Organic Poultry Production in Europe **(#45)** *Invited session speaker:* **Monique Bestman,** Louis Bolk Institute
10:45 to 11:00 am		Legume Crops Effects on Nitrogen Availability to Subsequent Crop in Organic Farming **Paul Deschênes (#35)**	
11:00 to 11:15 am	Assessment of Biofumigation for Weed Control in Organic Agriculture **Maxime Lefebvre (#26)**	Effects of Green Manure Termination Method on Agronomic and Soil Properties in an Organic Grain Rotation **Carolyn B. Marshall (#36)**	How Much Can Different Aspects of Dairy Cow Welfare be Improved by Providing Yearlong Regular Exercise to Dairy Cows Kept in Tie-Stalls? **Santiago Palacio (#46)**
11:15 to 11:30 am	Perennial Sow-Thistle and Canada Thistle Vegetative Propagation and Regenerative Capacity in Organic Field Crops **Maryse L. Leblanc (#27)**	Impact of Cover Crops and Fertilization Methods on Yields and Quality of Organic Carrot in a Muck Soil **Caroline Côté (#37)**	Would Organic Dairy Cows with Year-Long Outdoor Experience Choose to Spend Time at Pasture over their Free-Stall Barn? **Elise Shepley (#47)**
11:30 to 11:45 am	The Use of Spring Fallow and Mechanical Weed Destruction to Combat Sow Thistle, Canada Thistle and Coltsfoot in Organic Field Crop Production in Southern Québec **Anne Weill (#28)**	Impact of Cover Crops and Combinations of Organic Fertilizers in Organic Carrot Cropping System Assessed by Metagenomic Analysis of Soil Bacterial Diversity **Thomas Jeanne (#38)**	Switchgrass as an Alternative Bedding for Dairy Cows Housed in Tie-Stalls **Renée Bergeron (#48)**
11:45 to 12:00 pm	Organic Weed Management in Perennial Fruits **Andrew M. Hammermeister (#29)**	Life Cycle Analysis for Wheat Production in Organic, Pesticide Free, Conventional and Intensive Systems **Élisabeth Vachon (#39)**	Plant Bioactive Products and Internal and External Parasite Control in Dairy Production **Simon Lachance (#49)**

12:00 to 1:00 pm - LUNCH - Bistro de Sérigny	HAVE LOOK AT THE ACTIVITIES HELD AS OF 12:30 !		
Room	**DUBOIS AGRINOVATION**	**LA TERRE DE CHEZ NOUS**	**IRDA**
12:30 to 1:50 pm	—	—	**Workshop: Prioritization of Organic Research Needs** **Andrew M. Hammermeister (#4)** Prioritizing Research for the Evolution of Organic Agriculture
Session	—	—	*Session chair:* Nicole Boudreau, Organic Federation of Canada
1:00 to 2:00 pm - POSTER SESSION AND STAND VISITS - Authors are present - Room Lafontaine			
Session	**Crop pests** *Session chair:* Gérald Chouinard	**Soils and the environment** *Session chair:* Caroline Halde	**Livestock** *Session chair:* Simon Dufour
2:00 to 2:15 pm	Toward a Comprehensive Solution for the Biological Control of Wireworms in Organic Crops **(#30)** *Invited session speaker:* **Todd Kabaluk,** Agriculture and Agri-Food Canada	Intensifying Organic Production while Maintaining Soil Health and Farm Agroecological Attributes **(#40)** *Invited session speaker:* **Derek Lynch,** Dalhousie University	A Systematic Review of Non-Antimicrobial Treatments of Clinical Mastitis in Dairy Cows **David Francoz (#50)**
2:15 to 2:30 pm			
2:30 to 2:45 pm	Development and Validation of an Organic Sanitation Treatment for Alfalfa Sprouting Seed: Effect of Mild Heat and Non-Chlorine Sanitizers **Siyun Wang (#31)**	Meta-Analysis of Cover Cropping Systems under Organic and Conventional Management: The Effects of Cover Crops on Subsequent Cash Crop Yields and Nitrogen Contribution **Anaïs Charles (#41)**	Panel Discussion on Organic Dairy Research, *with:* - **Valérie Bélanger,** Novalait - **Monique Bestman,** Louis Bolk Institute - **Bryan Denis,** Ferme Denijos - **Simon Dufour,** Université de Montréal - **François Labelle,** Valacta - **Linda Labrecque,** Ferme Desgemo - **Elsa Vasseur,** McGill University
2:45 to 3:00 pm	The Efficacy of Quassia Extract MD in the Control of European Apple Sawfly in Apples **Julia Reekie (#32)**	Green Manures for Organic Production: A Prairie-Centric Literature Review with Broad Outcomes **Joanna L. MacKenzie (#42)**	
3:00 to 3:15 pm	Hydrophobic Polymer Exclusion Nets **Ariane B. Bérard (#33)**	Soil Biological Activity in Biochar-Amended-Organic Greenhouse Tomato Crops – Study Case for Six Types of Soil **François Gagnon (#43)**	
3:15 to 3:30 pm	—	Restoring Yield Productivity and Soil C in Organic Farming Systems on the Prairies **Martin H. Entz (#44)**	
3:30 pm - END OF THE CONFERENCE			

POSTERS (39)

Room		LAFONTAINE
Session Horticultural Crops 8 posters	#51	**Béatrice Perron** Optimising Fruit Load and Stem Density in a Semi-Closed Organic Tomato Greenhouse.
	#52	**Paul Deschênes** Irrigation Strategies for Organic June-Bearing Strawberry "Clery" Improving Nutrient Management.
	#53	**Ekene M. Iheshiulo** Haskap Response to Soil Nutrient Status, Compost and Compost Placement.
	#54	**Camille O'Byrne** Penetration of Fungicides Through Insect Nets and their Effect on the Durability of the Nets.
	#55	**Gérald Chouinard** Producing High-Quality Honeycrisp Apples under Exclusion Nets : How to Allow Pollination while Excluding Pests?
	#56	**Noémie Gagnon Lupien** Evaluation of Single-Plot Nets for the Protection of Apple Trees against Insect Pests without Pesticides.
	#57	**John O'Sullivan** New Innovative Weed Management Products for Organic Crop Production.
	#58	**Amanda L. Stefanson** Novel Carrot-Derived Oxylipin (CX) Confers Acute And Systemic Anti-Inflammatory Effect In The Liver And Small Intestine.
Session Field Crops 6 posters	#59	**Myriam R. Fernandez** Impacts of Reduced Tillage and Diversified Cropping under Organic Management on Common Wheat Productivity in the Brown Soil Zone of Western Canada.
	#60	**Myriam R. Fernandez** Examining Intercropping in Saskatchewan under Organic and Conventional Cropping Systems.
	#61	**Christine Landry** *Impact des cultures de couverture et des engrais de ferme sur la dynamique saisonnière de l'azote disponible dans la culture de la carotte biologique en terres noires.*
	#62	**Christine Landry** *Impacts de divers types de fumures animales et d'engrais verts en production biologique de grandes cultures sur la dynamique saisonnière de l'azote disponible dans la culture du maïs-grain.*
	#63	**Josée Boisclair** Chia: A New Crop for Organic Production in Québec, Results from 2015 Preliminary Trial.
	#64	**Yunliang Li** Phosphorus Sources and Arbuscular Mycorrhizal Inoculation to Improve Organic Crop Yield.

Session Weed management 4 posters	#65	**Oleksandr S. Alba** The Effect of Mechanical Weed Control (Rotary Hoeing, Post-Emergence Harrowing and Inter-Row Cultivation) and Crop Seeding Rate on Yield and Weed Suppression in Organically Grown Pea and Lentil.
	#66	**Noémie Gagnon Lupien** Effect of Irrigation Regimes on Weed Control in Organic Cranberry Production.
	#67	**Maryse L. Leblanc** Herbicidal Potential of Essential Oils.
	#68	**Myriam R. Fernandez** Weeds under Reduced Tillage and Diversified Organic Cropping Systems in the Brown Soil Zone of Western Canada.
Session Crop pests 4 posters	#69	**Arthur Desplat** The Control of Tarnished Plant Bug in Organic Strawberry Field.
	#70	**Gérald Chouinard** Large-Scale Implementation of Mating Disruption in Organic and Conventional Apple Orchards to Reduce Insecticide Applications in Quebec.
	#71	**Josée Boisclair** Study of a Flowering Strip and its Impact on Natural Enemies of Lepidopteran Pests of Organic Cole Crops in Québec – First Results.
	#72	**Josée Boisclair** Evaluation of Seed Treatments in Hulless Pumpkin Seed Production.
Session Soils and the Environment 10 posters	#73	**Yantai Gan** Effect of Green Manures on Residual Soil Water, Available N and Subsequent Durum Wheat Yield in Dryland Agroecosystems.
	#74	**Steve Lamothe** Evaluation of Cover Crop Planting Date on Lettuce in Two Soil Types.
	#75	**Olanike O. Aladenola** Influence of Allelopathic Cover Crops and Their Residues on the Growth of Perennial Thistles in the Brown Soil Zone.
	#76	**Caroline Halde** Root and Shoot Characterization of Four Cover Crop Species.
	#77	**Mohammed Z. Alam** The Effect of Green Manure and Organic Amendments on Wheat Yield, Nitrogen Uptake and Soil Mineral Nitrogen.
	#78	**Joanne R. Thiessen Martens** Assessing Nutrient Status of Organic Grain Farms on the Canadian Prairie.
	#79	**C.-Y. Lay** Impact of AMF Inoculations on the Fungal Assemblages Inhabiting Pulse Roots under Organic Farming with AMF Inoculation.

Session Soils and the environment (cont'd) 10 posters	#80	**Morgan O. McNeil** Organic Soybean Production with Influences of Crop Rotation, Weed Populations and Management on Mycorrhizal Growth and Soil Health.
	#81	**Carolyn Mann** Soil Health: Comparing Farmers' Perceptions and Methods of Assessments.
	#82	**Julia Reekie** Effect of Ground Cover Management on Yield and Leaf Nutrient Concentrations in an Organic Honeycrisp Apple Orchard in Nova Scotia Canada.
Session Livestock 1 poster	#83	**Renée Bergeron** Lack of Social Influence on the Development of Grazing Behaviour in Dairy Heifers.
Session Value Adding 6 posters	#84	**Maëlle Derrien** *Optimisation de l'extraction et de la séparation de la lutéine et de la chlorophylle de l'épinard par la méthode des surfaces de réponses.*
	#85	**Rafik Missaoui** *Optimisation de l'extraction des polyphénols, des flavonoïdes et des saponines à partir de l'asperge (Asparagus officinalis).*
	#86	**Minty Thomas** Identification and Quantification of Plant Bioactives from *Brassica oleracea* By-Products using UPLC – MS/MS.
	#87	**Minty Thomas** Identification and Quantification of Plant Bioactives from *Allium porrum* By-Products using UPLC – MS/MS.
	#88	**Anmol Grewal** Vermitechnology: A Sustainable Approach Towards Agro-Based Waste Management.
	#89	**Anmol Grewal** Reutilization of Spent Mushroom Paddy Straw from *Volvariella volvacea* for Value Added Compost: Quantitative Analysis.

Farms

ITINERARIES – FIELD TOURS

Field Crops Tour	
8:00 am	**Departure from the hotel** (Longueuil)
9:00 am	**Arrival at Fermes Longprés**
11:00 am	**Lunch on the road**
11:30 am	**Arrival at Agri-Fusion**
1:30 pm	**On the road**
2:15 pm	**Arrival at Ferme Steven Lalonde**
4:00 pm	**On the road**
5:00 pm	**Arrival at the hotel** (Longueuil)

FERMES LONGPRÉS

Fermes Longprés, owned by the Dewavrin brothers, has over 600 hectares of organic crops. The farm is an industry leader in innovation and end-to-end integration of all of its operations, from initial planting all the way to the transformation of grains into flour and other products.

FERME STEVEN LALONDE

Ferme Steven Lalonde is located in Ormstown. Its very first fields were certified organic in 2000. The company has 89 hectares and cultivates corn, popcorn, wheat, alfalfa.

AGRI-FUSION

The company is located in the western part of Montérégie and started its transition towards organic farming in 2004. It has 2500 hectares of cereal crops and vegetables for processing. The farm was created based on a partnership between four producers: Gilles Audette, Daniel Gauthier, Mario Gauthier et Claude Carrière.

Farms

ITINERARIES – FIELD TOURS *Cont'd*

LIVESTOCK Tour	
8:00 am	**Departure from the hotel** (Longueuil)
8:30 am	**Arrival at Ferme des Belles prairies**
10:00 am	**Lunch on the road**
11:30 am	**Arrival at Ferme Rheintal**
1:00 pm	**On the road**
2:30 pm	**Arrival at Ferme Bio-œufs**
4:00 pm	**On the road**
5:00 pm	**Arrival at the hotel** (Longueuil)

FERME DES BELLES PRAIRIES

This certified organic farm has 60 hectares of land and 30 Swiss brown cows. Their milk is widely used to make several different types of cheeses.

FERME RHEINTAL

This 84-hectare organic farm mainly raises pigs and cattle for meat. It also specializes in the transformation of fresh meat and organic cured meats.

FERME BIO-ŒUFS

This farm produces organic eggs from 15 000 laying hens spread over three poultry houses. It has 140 hectares of organic crops used for feedings its hens.

ITINERARIES – FIELD TOURS *Cont'd*

HORTICULTURE Tour – 2 possible schedules

PRESENTATIONS IN ENGLISH		PRESENTATIONS IN FRENCH	
8:00 am	**Departure from the hotel** (Longueuil)	8:30 am	**Departure from the hotel** (Longueuil)
8:45 am	**Arrival at Les Serres Lefort**	9:00 am	**Arrival at the Organic Platform – IRDA**
10:15 am	**On the road**	11:30 am	**Lunch on the road**
11:00 am	**Arrival at Tourne-Sol Cooperative Farm**	12:30 pm	**Arrival at Tourne-Sol Cooperative Farm**
12:30 pm	**Lunch on the road**	2:30 pm	**On the road**
1:30 pm	**Arrival at the Organic Platform – IRDA**	3:15 pm	**Arrival at Les Serres Lefort**
4:00 pm	**On the road**	4:45 pm	**On the road**
4:30 pm	**Arrival at the hotel** (Longueuil)	5:30 pm	**Arrival at the hotel** (Longueuil)

TOURNE-SOL COOPERATIVE FARM

Five young farmers started this vegetable farm in 2004. They strive to produce agricultural products of the highest quality according to organic standards and agro-ecological principles.

LES SERRES LEFORT (LEFORT GREENHOUSES)

This enterprise started in 1984 and now owns over 300 greenhouses. It is a leader for the production of sweet peppers, vegetable transplants and organic production.

ORGANIC AGRICULTURE INNOVATION PLATFORM – IRDA

Discover the wide variety of different research projects on horticultural, fruit and vegetable crops. Learn more about natural methods used in organic farming to protect crops against insects, diseases and disorders, and weeds. Visit different portions of land and meet the researchers at the Organic Agriculture Innovation Platform (OAIP), located on the site of the Centre de recherche de l'IRDA – the biggest center for research in organic farming in Canada.

ABSTRACTS

#1 - Invited plenary speaker: MARKUS ARBENZ

ORGANIC 3.0

M. Arbenz

Dipl. Ing.-Agr. ETHZ, Executive Director of IFOAM – Organics International

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The planet is challenged. Poverty and hunger, climate change, loss of biodiversity and depletion of water, soil and genetic resources are just a few major issues for which the present agriculture and food system is at least partly responsible. Agriculture is a main problem, but also a main solution.

Since its early days (referred to as Organic 1.0), the organic movement advocates for an alternative agriculture paradigm. The movement enables agro-ecological methods to unfold their potentials, which are showcased today (Organic 2.0) on more than 80 million ha of certified land, with 2,3 million certified farmers and consumer purchases of 80 billion US$.

However, while the markets are dynamically growing, certified organic agriculture represents still less than 1% of agriculture land and food markets. The present organic system has excluded many producers: smallholder and peasant farmers - frequently women, and often in the least economically developed countries in the global south - who play a critical role in feeding much of the world's population. It has also limited the own opportunities to build bridges with other sustainability initiatives that share the objectives but do not aim at full compliance with the organic standards, including agro-ecology, fair trade, food movements, smallholder and family farmer movements, community supported agriculture, urban agriculture and many others.

Organic 3.0 is the title of the future visions and strategy of the organic movement, which is presently widely discussed. It seeks to positioning organic as a modern, innovative system, which puts the results and impacts of farming in the foreground. The overall goal of Organic 3.0 is to enable a widespread uptake of truly sustainable farming systems and markets based on organic principles. At its heart, Organic 3.0 is not prescriptive but descriptive: instead of enforcing a set of minimum rules to achieve a final static result, this model is outcome-based and continuously adaptive to the local context. Organic 3.0 is still grounded upon clearly defined minimum requirements maintained by many government regulations and private schemes (and in the objectives of the IFOAM Standards Requirements). But it also expands outward from these base requirements: it calls for a culture of continuous improvement towards best practices based on local priorities as described in the Best Practices Guidelines of IFOAM – Organics International.

Keywords: Organic 3.0, future vision

#2 – Invited plenary speaker:
URS NIGGLI

THE SCIENCE BEHIND THE ORGANIC MOVEMENT

U. Niggli

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Organic farming is said to be a bottom-up farmer-driven innovation or in fact a social innovation. Zapf (1989) defined social innovation as "new ways of reaching specific goals, including in particular new forms of organization, new regulations and new lifestyles which alter the trajectory of social change and which are therefore worth being imitated and institutionalized". In consequence of the steady growth of the organic markets, the number of research programs and projects and consequently the scientific community has increased. Europe is by far the leading place for organic food and farming research; the estimated annual funding is at 180 million US dollars representing more than 60 % of global funds. Due to new programs in the EU, in Germany and Switzerland, further expansion is expected. Despite this growth, the funding for specific organic approaches has not yet topped 1 percent of all public and private food and agriculture research. Especially subpar is the research funding in low-income countries (Africa, Latin America and parts of Asia). The Technology and Innovation Platform of IFOAM (TIPI) thus was started in 2014 to address this gap. The future challenge for agriculture is to reduce the trade-offs between productivity and long-term sustainability. Organic farming is a practical example of this approach. It is less driven by off-farm inputs and better embedded in ecosystem functions. The literature on public goods and non-commodity outputs of organic farms is overwhelming. Publications address the positive effects of organic farming on soil fertility, biodiversity and the protection of the natural resources soil, water and air. A fast growing number of scientific meta-analyses were published on the evidence of these claims leading to a reconsideration of organic agriculture by national policies. Best use of human, social and natural capital characterizes organic farmers, especially in developing countries. Hence, the question whether organic agriculture may be a strategy in the context of the Sustainable Development Goals (SDG) of the United Nations has strengthened the focus of organic research on productivity, profitability and agronomic and technical solutions recently. The yield gap of intensive organic farming systems is still considerable.

Keywords: TIPI, research trends, funding

#3 – *Invited plenary speaker:*
NADIA EL-HAGE SCIALABBA

ORGANIC-PLUS FOR A SUSTAINABLE FUTURE

N. El-Hage Scialabba

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A mass-flow model investigated the sustainability of agriculture in 2050. In our era of climate and dietary chaos, most food systems strives towards sustainability but none has so far demonstrated its capacity to provide for both nature and people's security. Organic agriculture is regarded by some as a possible model for sustainable consumption and production. However, increasing food demand and increasingly scarce resources pose technical feasibility questions to the organic alternative. The project analyzed organic agriculture scenarios for 2050 in terms of global food availability and environmental impacts. While most environmental indicators - such as climate change, energy and water use, soil erosion, N and P-surplus and pesticide toxicity – would become positive in a 100% conversion to organic management, land requirements remain critical. Increased land use is avoided if organic agriculture is combined with reductions of food wastage and/or animal feed from arable land, along with reduced consumption of animal products, and monogastrics in particular. The study indicates that, while conversion to organic practices is the best available option, organic standards need to evolve towards grass-fed ruminants and residue-fed ruminants. Also, any sustainable food supply strategy must be complemented with reduced food wastage and decreased global consumption of livestock-based products. Combined scenarios of: (i) organic conversion; (ii) reduced food wastage; and (iii) reduced feed rations can deliver sustainable food systems at 350 degrees.

Keywords: organic agriculture, food security, food wastage, livestock feed, sustainability

#4 - Workshop:
PRIORITIZATION OF ORGANIC RESEARCH NEEDS

PRIORITIZING RESEARCH FOR THE EVOLUTION OF ORGANIC AGRICULTURE

A. M. Hammermeister

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Organic agriculture was built from the premise that healthy soils, diversity and recycling of nutrients would lead to healthy and resilient plants, animals and people. Organic is now one of the most well-recognized production system label around the world and has become part of regulated trade within nations and between nations. Despite its rapid growth, however, organic agriculture is not growing fast enough to impact major global issues such as climate change, biodiversity loss, environmental contamination, animal welfare, hunger, poverty, fair trade etc. Organic 3.0 represents the next stage of the evolution of organic agriculture with the intention that it grows beyond a niche market to become recognized by farmers and policy makers as a viable and sustainable system of production. What research must we prioritize in order to support this evolution? The individual farmer is facing daily challenges in managing pests, crop and livestock nutrition, and fair pricing. Businesses are interested in profiting from the organic sector through development and marketing of innovative products. Regional and national governments are concerned with economic development, trade, social issues and employment, while setting policy for environmental protection climate change adaptation and biodiversity loss, etc. At the same time we have tremendous disparity between organic farmers in developed and developing countries in terms of wealth, access to technology and access to information. How do we prioritize research to achieve these many goals from a local to a global context? Ultimately we must demonstrate to producers and policy makers that the organic production system is multifunctional and beneficial in terms of socio-economic wellbeing as well as environmental sustainability. From a global perspective, we must target, adapt, and support organic development in regions where it may have the greatest impact

Keywords: research prioritization, Organic 3.0, organic agriculture, evolution, strategy

#5 – Invited session speaker: DAVID GRANATSTEIN

CURRENT TRENDS FOR TEMPERATE ORGANIC TREE FRUITS IN NORTH AMERICA

David Granatstein* and Elizabeth Kirby

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Fresh fruits and vegetables are a core component of the market for organic foods and an important gateway for consumers to enter the organic market. In the U.S., fruits and vegetables have accounted for 35-40% of retail organic food sales, and were estimated to represent about 7% of all fruit and vegetable sales (organic and non-organic) in 2014. Currently North America and Europe account for over 90% of global organic food sales, and organic temperate fruits grown in those two regions are primarily consumed there. In the U.S., the top four selling fresh fruits, organic and conventional, in 2015 were berries, apples, bananas, and grapes. In 2013, there were approximately 213,000 ha of organic temperate tree fruits under organic management globally, up 109% from 2008. Apples accounted for 43% of all organic temperate tree fruit area but only 1.8% of global area for all apples (organic and non-organic). Countries with the largest areas included Poland, China, and the USA. However, Poland had many hectares under minimal management that were organic to capture and EU subsidy, while the status of Chinese organic apples is unclear due to various levels of certification (Chinese standard vs standards suitable for international trade). Virtually all organic tree fruits produced in the EU are consumed there, and additional imports come from Turkey, New Zealand, Argentina, and Chile. Organic fruit production is concentrated in the semi-arid western state of the U.S., where lack of summer rainfall and availability of irrigation water minimize many disease challenges. Washington State supplied approximately 93, 79, and 94% of the fresh organic apples, pears, and cherries grown in the U.S., respectively. California is the other leading organic fruit producing state, dominating in grapes, soft fruit, berries, and oranges. Canada is the leading export market for organic apples from Washington State, receiving 510,000 boxes (18 kg) from the 2014 crop. Progress in expanding organic apple production in northern Europe provides an example of how production may also be expanded in the eastern states and provinces of North America.

Keywords: organic fruit, apple

#6

GROWING HIGH-DENSITY, HIGH-VALUE APPLE PLANTINGS UNDER ROW-BY-ROW EXCLUSION NETS: EFFECTS ON PESTS AND FRUIT QUALITY

G. Chouinard*, J. Veilleux, V. Philion, D. Cormier and F. Pelletier

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Organic apple production in most parts of Canada and the United States is difficult because of the important number of insect and disease pests affecting the production and quality of fruit. A modified version of a row-by-row exclusion system developed in Europe has been tested for 3 years in eastern Canada to measure its effectiveness as a pest management tool and its possible adverse effects on fruit load and quality. Our findings show that most direct fruit pests were efficiently controlled by the system and that it did not have a negative impact on fruit load, size, color, firmness, sugar content and pollination. Leafrollers were however unaffected by exclusion, and fruit maturity was delayed by ca. 1 week.

Keywords: exclusion, apple, pest management, pesticides, physical control

#7

IMPACT OF SILICON AMENDMENTS ON STRAWBERRY POWDERY MILDEW CONTROL IN POLY-TUNNEL AND FIELD PRODUCTIONS

M-H. Goyette * [1], S. Ouellette[1], L. Gaudreau[1], M. Dorais[1-2], A. Van Sterthem[3], A. Gosselin[1] and R.R. Bélanger[1]

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Powdery mildew caused by *Podosphaera aphanis* is an important disease of day-neutral strawberry. In spite of a recurrent use of fungicides, the disease remains difficult to control. Several studies have shown that silicon (Si), in the form of soluble amendments, reduces powdery mildew in multiple crops. In a recent study, we showed that strawberry cultivated in a high tunnel and fertilized with liquid Si (1.7 mM) added to the nutrient solution can accumulate over 2% Si. Furthermore, Si treatment significantly reduced powdery mildew severity and increased the number of saleable fruits by up to 250%. In a parallel study, we want to evaluate the possibility to adapt this technology for growing techniques in the field on plastic mulch with solid Si amendments. Two day neutral cultivars and one short day cultivar will be tested for their susceptibility to powdery mildew and their absorption of Si in a field plasticulture system. Several forms of Si amendments will be tested and evaluated for their economic benefits. This project aims to offer strawberry growers with biological alternatives for disease control that could translate into a new approach supporting organic farming.

Keywords: silicon absorption, biological control, organic production, disease resistance, biotic stress

#8 – *Invited session speaker:* MARTINE DORAIS

PRODUCTION, CONSUMER TRENDS, RESEARCH DEVELOPMENT AND MARKET OPPORTUNITIES OF ORGANIC PROTECTED VEGETABLES IN THE TWENTY-FIRST CENTURY

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Organic horticulture farming has doubled during the last decade, representing 1.33 million ha of cultivated organic land. The growing popularity of organic food products is driven by health values and safety issues (e.g. pesticides, hormones, antibiotics, GMOs), environmental benefits and equity concerns. Although the demand for fruits and vegetables is around 30 to 40% of the global demand, the total area under organic vegetable production is only 0.5% of the total area of vegetables grown in the world. Forty-five percent of the total vegetable organic farmland is in Europe, followed by North America (22%), Latin America (18%) and Asia (12%). The five countries with the largest organic vegetable areas are the United States (59,669 ha), Mexico (46,573 ha), Poland (26,664 ha), Italy (25,930 ha) and China (22,331 ha). Main crops are fresh beans and peas, leafy and stalked vegetables and fruit vegetables. The world greenhouse industry represents around 473,466 ha, with a 14% increase over 2015 (Hickman, 2016). The total area for organic greenhouse crops in Europe is >5,236 ha (1.8% of total vegetable greenhouse area; 2000 ha Spain; 2,000 ha Italy, 500-600 ha France, 263 ha Germany, 125 ha The Netherlands, 80 ha UK, 57 ha Switzerland, 32 ha Belgium, 30 ha Austria, 49 ha Nordic), which is almost entirely used for fruit vegetables and lettuce. In non-EU countries, organic greenhouses cover 500 ha in Israel, 230 ha Morocco, 31 ha in Turkey, 30 ha in Egypt and more than 2,275 ha in North America, mainly located in Mexico. In the USA, organic protected vegetables cover 186 ha (farm sale value of 76.2 million US$), while in Canada 241 ha of heated greenhouse are organically certified, representing 15% of the total greenhouse vegetable area. In northern countries, organic protected production is often year-round conducted under high technology and heated greenhouses, while in the Mediterranean area greenhouse production is mainly done in unheated plastic greenhouses or high tunnels. Specific rules for organic protected production were established by several countries such as the organic soilless growing systems in the United States and Canada, which is not allowed under EU organic regulation. Recent international reports and scientific literature highlight a number of economic and environmental benefits resulting from organic vegetable production systems. According to market analysis of 2015 in Canada, market conditions are favourable for organic greenhouse products as a result of significant price premiums over conventional products resulting in higher returns. However, to minimize producing risks for growers and achieve acceptable productivity and profitability, research should be intensively conducted to provide new technologies, tools and know-how to organic vegetable producers.

Keywords: organic farming, organic horticulture, profitability, sustainability, quality

#9

HIGH TUNNELS CAN BE USED FOR ORGANIC VEGETABLE AND NUTRACEUTICAL CROP PRODUCTION IN SOUTHERN ONTARIO

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High tunnels have been used for organic fruit and vegetable production in many different regions, with success in Asia, the Mediterranean and the USA; however, there was a lack of research data and recommendations for cold climates such as Canada. To provide the scientific information and guidance necessary for organic growers to take advantage of this technology in cold regions, a multi-year research project has been taking place at the University of Guelph. Specifically, this project was designed to test the feasibility of using high tunnels for organic production of value-added vegetables (e.g., cherry tomato, pea shoot and pea pod) and nutraceutical crops (e.g., bitter melon and edible chrysanthemum) in southern Ontario's climate. The aforementioned crops were planted in either open field (OF), high tunnel (HT), or high tunnel with insect-proof netting (HTN) plots. There were three replications of each type of plot, configured in a 3x3 arrangement on the same site. Crop performance (e.g. growth, development and yield), microclimate (e.g. temperature, light), and insect and disease incidence were recorded within OF, HT, and HTN. HT and HTN substantially improved these crops' growing environments; especially in terms of higher accumulated growing degree days, and reduced incidence of insects and diseases. Further, crop growth and yields were significantly increased in HT and HTN, compared to those in the OF. For example, the highest marketable bitter melon fruit yield was achieved in HTN (38 $t \cdot ha^{-1}$), followed by HT (34 $t \cdot ha^{-1}$), and the lowest was in OF (3 $t \cdot ha^{-1}$). This talk will report the lessons learned from constructing and maintaining high tunnels, provide an overview of our research results, and provide recommendations for organic crop production in high tunnels in cold climates.

Keywords: bitter melon, cherry tomato, edible chrysanthemum, insect-proof netting, microclimate, pea shoot, pea pod, insect and disease incidence, protected agriculture

#10

NITROGEN MINERALIZATION RATE OF FIVE ORGANIC FERTILIZERS COMMONLY USED FOR GREENHOUSE FRUIT AND VEGETABLE CROPS

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Because of the complexity of the nitrogen (N) cycle and multiple forms of N in the soil, N fertilization management is based on complex models. Organic fertilization provides a nutritional context seldom seen in conventional agriculture and natural ecosystems, as N is provided in abundance, but mostly in organic forms. N availability thus depends on an efficient mineralization of organic fertilizers, leading some organic producers to fertilize more than necessary, resulting in buildup of salinity and N leaching. Our objective was to determine the mineralization rate of five organic N fertilizers commonly used in organic greenhouses in Quebec: (i) shrimp (SM; N-P_2O_5-K_2O: 6.5-4.7-0.7), (ii) blood (BM; 12-0-0), (iii) feather (FM; 11-0-0) and (iv) alfalfa (AM; 3-0-3) meals, and (v) pelleted poultry manure (PM; 5-3-2). Two different soils (organic and mineral) with an amount of fertilizer equivalent to that used in organic greenhouse productions were incubated under controlled conditions (21°C and 90% relative humidity). The mineralization and distribution of N in its different pools (dissolved organic and inorganic N, microbial N, and total N) were assessed after 1, 2, 4, 9, 18 and 27 weeks. After nine weeks of incubation, mineralization started to plateau for both soils in all fertilizer treatments: at ca. 40% of applied N for AM, 60-70% of applied N for SM and PM, and 70-80% for FM and BM. AM yielded the highest microbial biomass and CO_2 efflux, but because there was a net N immobilization in the first week, it had the slowest mineralization rate of all fertilizers. PM had the highest extractable mineral N immediately after the application (week 0), but yielded mineralization curves similar to that of SM, BM and FM thereafter. Our results will provide a better understanding of long-term mineralization of organic N fertilizers. Data from this experiment will be used to build a model which will be integrated in the N fertilizer management tool NLOS (www.nlos.ca; see Bittman *et al*., 2001 *In* Shaffer & Hansen [eds.], Modeling carbon and nitrogen dynamics for soil management). Validation will be performed in commercial crops of tomato, sweet pepper and cucumber.

Keywords: fertilization, greenhouse, mineralization, nitrogen, vegetables

#11

FERTILIZATION MANAGEMENT OF ORGANIC GREENHOUSE SOIL-LESS CUCUMBER

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For organic greenhouse vegetables, one of the main challenges for growers is to synchronize soil nutrient release with plant nutrient uptake, without any leaching or emissions into the environment. As organic greenhouse fruit vegetable growing system constitutes an intensive production system, high mineralization rates of organic amendments are needed to fulfil nutrient plant demand, while minimizing soil salinization, nutrient leaching and greenhouse gas emissions. Because under organic farming practices the soil should provide the main portion of nutrients to the plant, solid fertilizers are regularly supplied. However, little is known about the fertilization management of organic greenhouse vegetables grown in soil-less growing system where root development is confined to about 70 to 180 L per m^2. The goal of this study was to determine the effect of fertilization frequency on plant nutrient availability, cucumber plant productivity and fruit quality. Three experiments were conducted at Les Serres Lefort located at Ste-Clotilde-de-Napierville, QC, Canada (45°14'N; 73°66'W). In the first two experiments (summer and winter experiments), amendments were applied every (i) week, (ii) two weeks, (iii) three weeks, and (iv) four weeks. The same total amount of nutrients was given for each treatment based on plant nutrient uptake. In the third experiment, two fertilization rates (low vs high) at two application time intervals (2-week vs 4-week) were compared. The experimental design was a 4 x 4 Latin square with 43 to 53 plants per experimental unit. No significant effect was observed among treatments during the first experiment, whereas fruit yield of the 2-week fertilization interval treatment was higher than that of other treatments during the second experiment. A low fertilization rate applied at 2-week interval resulted in slightly lower yield compared to high fertilization treatments. No significant effect was observed for fruit quality expressed by their percentage of dry matter, soluble sugars, electrical conductivity and titratable acid content. Soil microbial activity, root colonized by mycorrhizae (AMF) and soil CO_2 efflux were not significantly affected by the fertilization time interval treatments during the first experiment, while differences were observed during the second and third experiments. Results will also be discussed in terms of nutrient soil availability and labour required for amendment application.

Keywords: organic farming, organic greenhouse horticulture, raised bed cultivation, protected crops, plant nutrient management, fruit quality

#12

INTRACANOPY LED LIGHTING EFFECTS ON YIELD AND FRUIT QUALITY OF GREENHOUSE VEGETABLE CROPS

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The demand for healthy and tasty foods produced locally has increased significantly over the last decade. However under northern latitudes, supplemental lighting is required during the October-March period to produce vegetables on a year-round basis. The recent advent of light emitting diode (LED) technology offers great opportunities for increasing yield and fruit quality as it has been shown that supplementary lighting of specific wavelengths may enhance the concentration of health components in fruits and vegetables. A completely randomized experiment was performed in a 150 m^2 greenhouse to determine the effects of using supplemental LED interlighting on plant growth, yield and fruit quality. Cucumber seedlings (*cv* Proloog and Verdon) were transplanted in ~0.65 m^3 containers (n=5 per treatment with 6 plants/container) filled with organic substrate (OM1, Les Tourbières Berger, Saint-Modeste, QC) and grown from October to December 2015 under natural light supplemented with 16-h above canopy HPS lighting per day (*control*). Solid organic fertilizers were applied once per month (compost Fertilo, Acti-sol, blood and feather meal, potassium sulfate and Sulpo-Mag). Two intracanopy LED lighting treatments were examined: 3-D LED modules, which provided a photosynthetic photon flux density (PPFD) of ~80 µmol m^{-2} s^{-1} at a 30-cm distance (72% red, 7% blue, 14% white, 6% infrared and 1% UV; Lidlum, Laval, QC), were installed at (*i*) 70 cm (*LED_bottom*) and (*ii*) 140 cm (*LED_top*) above ground. Cucumber plants exposed to *LED_bottom* had shorter internodes and greater stem diameter than control plants. After 6 weeks of production, total fruit yield of both cultivars was ~20% higher in *LED_bottom* plots (*i.e.* 7.7 and 4.8 kg FW per m^2 for Verdon and Proloog, respectively) than in *LED_top* and control plots. Furthermore, there were significantly higher plant dry mass (stem, leaves, fruits) and earlier fruit harvest in Prolong plants exposed to *LED_bottom*. Fruit colour (skin and mesocarp) and firmness did not differ significantly among lighting treatments. Analysis of health compounds are in process and will be discussed in relation to microclimate conditions and growth parameters.

Keywords: supplemental LED lighting, phytonutrients, fruit firmness

#13

PERMANENT RAISED BEDS FOR VEGETABLE CROPS

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Based on the principles of Controlled Traffic Farming, applied to vegetable crops, a system was developed in France whereas tractor wheel tracks are permanent and not tilled deeply. The growing space under the tractor is tilled using adapted tools and bed-making implements. This system was adapted to Canada. Six pieces of equipment were developped: a disk hiller, a deep working cultivator, a flex-tine bedmaker, an adapted green manure seeder, an adapted manure spreader, an adapted harvest platform. The CETAB+ developed the equipment. A five year trial was set-up on a St-Urbain heavy clay and a Du Jour clay loam, at the Plateforme d'Innovation en Agriculture Biologique, using plowing and a rotary bedmaker as check plot. The main results are an improvement in soil structure and root development and after a time improved crop yields and quality. Earthworm populations were also improved with the permanent bed system. Differences in the effect on weeds were negligible. The system has been adopted by a sizeable portion of Quebec organic market farmers.

Keywords: soil tillage, soil structure, vegetables, cropping systems

#14 - Invited session speaker: TIA LOFTSGARD

KEEPING UP TO DATE WITH CONSUMER PERCEPTIONS AND HOW IS THE MARKET ABLE TO MEET THESE DEMANDS?

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The organic sector is ever evolving but without adequate data, how can we make assessments of areas of high growth or loss of organic operators to help our sector be robust and tackle the obstacles concretely? COTA will present the most up to date data outlining key trends emerging. Provincial assessments will be outlined to provide key insights to all sector actors and empower the Canadian organic industry with data to meet the needs of the sector better. Imported products are on the rise to meet local demand in many product categories. As demand is constantly outstripping local supply, COTA will present the most up to date consumer insights to highlight what consumers want, perceive and an overview of sales trends to encourage the sector to continue to innovate to meet this demand.

Keywords: consumer perceptions, Canadian organic industry, data, market

#15 – *Invited session speaker:* RALPH C. MARTIN

ORGANIC RESEARCH THAT IS INNOVATIVE AND FUNDAMENTAL

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Organic agriculture represents traditions and values, reaching back to how we co-evolved with other organisms in systems of health, balance, resilience and adaptability. It also provides opportunities to probe previously unappreciated holistic interactions and options. In the context of modern economic imperatives, organic agriculture, with less focus on maximizing production, is often tolerated as a luxury, while it can be afforded. However, with growing awareness of the need for social license and trust in the agri-food system, the regenerative potential of organic agriculture is providing a template, once again, for restoration. Food production increases are not necessarily axiomatic. Sustaining sufficient production can match adequate, healthy consumption. Reducing food waste, meat consumption and unhealthy foods will provide options to produce within ecological boundaries to maintain human and ecological health. Research can assess ways to understand and achieve what we need rather than narrowly pursuing more of what may be harmful. What if a research project could demonstrate that organic principles, applied over an entire water shed, were able to improve synergistic ecological interactions, human health and community development, while also providing sales of branded, local organic products? What if soil health indicators, such as soil organic matter, could be measured cost effectively, rapidly and representatively on each field and with the accuracy of current measurements from very specific soil cores? With appropriate incentives based on these measurements, how might organic farmers improve their practices and other farmers gravitate toward organic management? In addition, adapting to climate change with research on how to make numerous nutritious species more productive could be more resilient than pursuing a focus on improving the nutrition and yield of a few productive species. Integrating livestock and forages with these nutritious species, in the context of ecological dynamic stability can further advance resilience, in conjunction with marketing research to explore consumers' attitudes about impacts of eating a broader range of species, seasonally and within eco-zone possibilities.

Keywords: resilience, soil organic matter, sufficient production, water shed

#16 - *Invited session speaker:* GUNTA VITINS

VALUE ADDED OPPORTUNITIES FOR ORGANIC AGRICULTURE - BUILDING THE FUTURE

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Consumers' insatiable appetite for all things organic continues to drive double digit sales growth year after year. According to the Organic Trade Association, 2015 heralded over $43 billion of organic product sales in the US and the largest annual dollar gain ever. In Canada, organic food sales have quadrupled over the past decade, now estimated at over $4 billion, positioning Canada globally as the 4th largest market for organic foods. Greater access to organic products in mainstream retail, big box stores, foodservice and direct-to-consumer options is helping to fuel consumer demand.

While fresh fruits and vegetables lead the organic category, representing 40% of organic food sales at the retail level, value added products are celebrating unprecedented growth rates. Value added opportunities abound from beverages to dairy and meat products to snack foods and condiments. In fact, organic is now present in over 75% of all food categories on supermarket shelves.

What is driving growth in 2016? A recent study by the Canadian Centre for Food Integrity indicates that close to half of Canadian consumers are concerned about the use of hormones in farm animals, use of pesticides in crop production, and eating food that comes from genetic engineered crops. Overall, general concerns for health, safety, transparency and environmental sustainability continue to resonate with consumers, especially millennials.

Organic continues to offer the best food choices for discerning consumers. However, growth in the organic market is challenged with supply issues. In Canada, where less than 50% of organic products sold at retail are from domestic sources, the need to increase organic acreage and encourage more producers to farm organically is critical for continued growth and economic success. Organizations and farmers are developing strategic partnerships to build secure supply chains but more investment in the sector is needed.

In her presentation, Gunta Vitins will provide up-to-date information on value added opportunities and challenges for organic producers and manufacturers, and discuss innovative approaches for a sustainable future.

Keywords: organic, value-added, Canada

#17

ROLE OF AN ADVISORY COMMITTEE ON ORGANIC RESEARCH IN THE DESIGN AND EXECUTION OF RESEARCH PROJECTS

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The organic research program at the Swift Current Research and Development Centre (SCRDC) of Agriculture and Agri-Food Canada (AAFC) was initiated in 2009-10. The first projects included evaluations of wheat cultivars for disease reaction, funded by the Canadian Wheat Board, and wheat breeding trials. In 2009, at the first organic field day, attending producers were invited to participate in a new advisory committee on organic research (ACOR) for the Brown soil zone. This committee was important to researchers for identification of the most pressing needs for organic production in this region, and to provide timely management advice during project execution. Full members and advisors have provided recommendations, input, and feedback during planning and execution of all research projects, and range from organic producers to provincial government and university staff, in addition to AAFC researchers. They also provide letters of support for funders and in-kind contributions. Recent major organic projects include an agronomic trial evaluating reduced tillage and diversified crop rotations (2010-15); a follow-up trial focused on tillage timing and intensity (2015-18) funded by the Western Grains Research Foundation (WGRF) and AAFC through the Organic Cluster II; an intercropping trial with different crop mixtures and seeding ratios (2015-19) funded by WGRF, SaskWheat, SaskPulse and Prairie Organic Grain Initiative; and a cover crop trial examining impacts of crops with allelopathic potential on perennial weeds (2016-19) which received core funding by AAFC. ACOR meets regularly throughout the year to review progress and any problems encountered in ongoing trials, discuss issues faced by organic producers, as well as hear presentations by organic and low-input researchers from western Canada. To the best of our knowledge, this type of advisory committee and its contribution to, and involvement with, the organic research program at SCRDC is unique at AAFC. In summary, ACOR has proven an invaluable platform to discuss research priorities for organic production and, more importantly, to tap into the deep and extensive experience of regional organic producers to improve the field management and practical relevance of our research activities. We recommend that research and development organizations undertaking organic research consider establishing a similar advisory body.

Keywords: organic research, organic producer advisory committee, Saskatchewan

#18

TRANSLATING SCIENTIFIC KNOWLEDGE FOR FARMER ADOPTION: A GREEN MANURE MODEL

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As the science supporting organic agriculture thrives and moves forward, there is a need to ensure that the knowledge generated through research is translated and transferred to organic practitioners, who can use this information to adapt their production practices. Here, we will explore the knowledge translation process through the lens of green manuring on the Prairies. Legume green manures are an important component of organic crop rotations, especially in the large-scale organic grain operations of the Prairies, where other fertility sources are unavailable or expensive. Yet, farmer uptake of green manures is less than complete, in spite of a wealth of research into green manure benefits and management. Farmers hesitate due to the perceived cost of green manures and concern about green manure fit in their production systems. In an effort to increase the production and quality of organic grains, the Organic Agriculture Centre of Canada in partnership with the Prairie Organic Grain Initiative embarked on a learning and education exercise to promote the use of green manures within the Prairie transitioning and organic grain community. This talk will walk through the process undertaken to first understand the needs and wants of the organic community, and to then assess the cost and impact of various translation and transfer activities, and on to the development of science-based, but accessible resources that addressed the main barriers to green manure uptake. While the process described here explores this in a green manure context, the process can be applied or adapted to many situations. A sound knowledge of the needs of your target audience, and the depth and breadth of the material on which resources can be based are important considerations when translating scientific knowledge into resources that can have impact on the organic farming community.

Keywords: knowledge translation, knowledge transfer, green manure

#19

FARM SYSTEM CO-DESIGN FOR SUSTAINABLE AND SUCCESSFUL ORGANIC FARMING

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Sustainable and successful organic production relies heavily on farmer knowledge of ecological processes and farming practices, as well as social and economic factors that influence farm viability. New and existing organic farmers alike face challenges in designing farm systems that are ecologically sound, productive, and well-suited to their local conditions and personal goals. A "farm system co-design" process brings together farmer knowledge and the scientific expertise of researchers to foster farm-specific application of relevant research findings. The Natural Systems Agriculture Lab at the University of Manitoba is using this co-design process to extend research results to farmers in "learning communities". We are currently working with volunteer farmers on two separate co-design projects: Project 1 (11 farms) aims to optimize nutrient management on organic grain farms; Project 2 (13 farms) aims to support current and transitioning organic farmers in a whole-farm approach to adopting a new crop (soybeans / dry edible beans), including suitable rotations and production techniques. The farm system co-design process involves an initial farm scan (data gathering), a collaborative scenario development process, and an iterative implementation, evaluation and adaptation process. Preliminary results indicate that farmers place high value not only on the information gained, but also on the one-on-one relationships with researchers and the connections established with other farmers in the group. Through this process, farmers are able to integrate new knowledge more effectively into their existing knowledge base, resulting in better-informed application of research results on farms. Researchers benefit from the process through better understanding of challenges faced by farmers and how research results are being applied on farms. This project provides valuable information on a new extension model for organic and ecologically-based farming.

Keywords: farm system design; innovation; extension; ecological agriculture

EVALUATION OF A NEW METHOD FOR THE SOWING OF CLOVERS IN CEREALS

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The production of uniform stands of green manures with good biomass consistently through the years is a guarantee of success for organic producers. In the case of clover undersown in cereal crops, it appears difficult to obtain this consistency using current sowing method, i.e. seeds sown close to soil surface between cereal rows. In a dry year, the risk of a poor establishment is high, and, conversely, in a wet year, the interseeded clover may harm the cereal growth and interfere at harvest. CETAB + began in 2014 a 3-year project with MAPAQ's Innov'Action program funding to evaluate a new method of establishing clover in cereals. It consists of sowing the clover directly into the groove made by the seeder for the cereal. The aim is to ensure that the green manure will always establish successfully and be sufficiently delayed in its growth not to harm the main crop while obtaining optimal biomass of green manure. The tests are conducted on two organic farms in the Mauricie region of Quebec, on two soil types on each farm. Three clovers (Alsike, Huia and Red) are tested with the two sowing methods (broadcasted and sown in the groove) in a randomized complete block design with four replicates. In 2014, a normal year for rainfalls, the average biomass of the clovers was greater with the groove method on the heavy soils, but not on the light soils. In 2015, a wet year, clover biomasses were 16% greater with the broadcast method than with the groove method on all sites and for all clovers. Huia clover behaved differently with the groove method whether the soil was light or heavy. Cereal yields were not negatively affected by the undersown clovers in both years with either sowing methods. However, barley yields were greater with clover sown in the groove on one of the light soils in 2014. The new method is well adapted to red and alsike clovers in heavy soils. The advantages of the new method in various situations might appear more clearly in a dry year, which we did not have yet.

Keywords: green manure, cover crops, clover, sowing methods

#21

EFFECT OF AM FUNGAL INOCULATION AND SOIL P FERTILIZERS ON BACTERIAL ASSEMBLAGES COLONIZING THE ROOTS OF PULSE CROPS UNDER ORGANIC FARM MANAGEMENT

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The management of soil P fertility combined with AM fungal inoculation may promote more efficient use of P and increase production of organic pulse-flax on the Canadian prairies, where crops yields are often limited by phosphorus. However, P fertilization and AM inoculation may modify the diversity and function of the root-associated microbial community, which may in turn have a substantial impact on crop production and nutrition. The objective of this study was to test the influence of AM fungal inoculation used in combination with rates and sources of organic P on the structure and diversity of the bacterial assemblages inhabiting the roots of rotation crops, with pulses in the first year (2015) and flax in the second year. Here, we present the results of the first year. Composted manure or rock phosphate were applied at three rates (0%, 75% and 150% of P recommendation). The total DNA was extracted from the roots of lentil growing in Swift Current SK, and of pea growing in Beaverlodge AB, and 16S rRNA gene amplicons were submitted to Illumina MiSeq sequencing. Results show that AM inoculation modified the root associated bacterial community in lentil, while the composition of the bacterial community in pea was influenced by soil P fertilisation. Bacterial diversity was not affected by treatments, but a higher bacterial diversity was found in lentil than pea roots. The bacterial core microbiome of pulses roots was more strongly influenced by crop species/farm location than by AM inoculation or P fertilization. *Streptomyces avermitilis*, that can increase plant resistance to soil-borne pathogenic nematodes, was more abundant in lentil than in pea, as were other rare bacterial taxa belonging to the genera *Lentzea*, *Glycomyces* and *Kribbella*. Overall, this study demonstrates that organic management may differently affect crop root bacterial assemblages. The bacteria in the crop root microbiome appears to be selected more strongly by the identity of the plant and other environmental conditions than by AM inoculation or P fertilisation.

Keywords: bacteria, pulse, lentil, pea, AM fungal inoculation, P fertilizers, Illumina MiSeq sequencing

#22

FARMER PARTICIPATORY PLANT BREEDING FOR ORGANIC PRODUCTION IN CANADA: SUMMARY OF THE LAST 4 YEARS

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A plant breeding system was developed that involves farmers directly in plant breeding for organic production. Interested organic farmers were involved in identifying parental material as well as on-farm selection. Wheat parents identified by farmers included historical varieties 'Acadia', 'Champlain' and 'Red Fife'; in several cases these were crossed with modern cultivars. Five to seven thousand seeds per population were provided to farmers for the purposes of on-farm selection. After 3 years of selection, farmer-selected wheat varieties were compared with conventional cultivars in "common garden" experiments over three site-years. Results showed that farmer-selected lines are unique relative to commercially available check cultivars in terms of yield (12% higher) growth habit, ability to withstand weed pressure and plant height. Having more than one farmer make selections within the same population provided the opportunity to determine how individual farmers influence the makeup of a particular population. Results showed that these populations were similar in terms of yield and amount of leaf disease. There were, however, differences in early season vigour, height, days to maturity (up to 5 days), and lodging. This observation confirms the value of on-farm selection to shape populations to local circumstances. There are currently 78 farmers working on either wheat, oats, potato and corn across Canada.

Keywords: cultivar adaptation, weeds, crop quality

#23

NUTRIENT AVAILABILITY FROM SOIL TEST AND RESIN METHODS FOLLOWING COMPOST MANURE APPLICATION TO COMMERCIAL ORGANIC FIELD CROPS

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Nutrient availability in soil and crop was evaluated following compost manure application to a commercially successful organic farming system in southern Manitoba. The seven-year crop rotation was three years of alfalfa, followed by flax, oats, yellow sweet clover, and rye. Manure compost was applied in fall of each year after alfalfa plow down. Manure compost rates were varied to evaluate the impact of manure on the nutrient levels within the rotation. The experimental design was a randomized complete block with six replicates and one treatment factor, manure compost rate, applied at four levels: 0, 0.5, 1, and 2, where 1 = the rate historically used. Cattle manure compost was sourced from the organic herd of the same commercial farm. Measurements each year were soil nitrate and soil ammonium from 1.0 KCl extracts, soil phosphate from 0.5 M sodium bicarbonate extracts at pH 8.5, early season shoot N and P concentrations, harvest shoot and grain N and P concentrations, and yield. Alfalfa plow down was in fall 2013, with rye to be planted in spring 2017. At the time of writing, results are available for flax in 2014 and oats in 2015. As a simultaneous investigation, resin-captured anions were investigated to determine if the resin system gives insights to nutrient availability in organic systems. Resin anions were evaluated within-and-between crop rows in 2014, and resin anions were compared to traditional approaches of soil sampling and soil extraction in 2015. Soil and plant nutrients have all fallen within well-established ranges from previous studies. Thus far, no response of any measured property has been noted following variable rates of manure compost addition. This outcome indicates that nutrient release is delayed from compost manure application by at least two years. Resin phosphate was close to detection limits and of limited utility. Resin nitrate was variable across the site, was locally consistent, but was not related to local soil nitrate test. The resin nitrate evaluation offers promise to detect local nitrate delivery to crops within field sections, likely relating to local topology and hydrology. The study continues for evaluation of responses to compost manure addition.

Keywords: alfalfa, flax, oats, sweet clover, rye, cattle manure

#25 – Invited session speaker: STEVEN J. SHIRTLIFFE

OPTIMIZING WEED CONTROL IN GRAIN CROPS

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Weed control is one of the major production obstacles for organic grain farmers. The objective of this presentation is to present and evaluate the efficacy of applied organic weed control research that has been conducted at the University of Saskatchewan. Increasing a crops competition with weeds can result in higher yields and reduced weediness. For a given crop, increasing its seeding rate is the most effective way of increasing its competition with weeds. Competitive crop varieties can help but the lack of information and the high cost of developing crop varieties and unpredictable environmental interactions limits this method. Mechanical weed control can effectively reduce weed populations under proper conditions. Harrowing, rotary hoeing and inter row cultivation all can control weeds however the relative efficiency of these methods is not known. Combining multiple control methods has the greatest potential to reduce weediness. Using a high seeding rate of a competitive cultivar along with harrowing reduced weed biomass by 70% compared to standard agronomy. Crop rotation also has the ability to reduce weeds in the long term, however results can not be generalized across ecosystems. In Scott, Saskatchewan including forage legumes resulted in increased weediness in a long term rotation. Organic weed control is possible with diverse tactics.

Keywords: organic weed

#26

ASSESSMENT OF BIOFUMIGATION FOR WEED CONTROL IN ORGANIC AGRICULTURE

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Biofumigation is an agronomic practice in which toxic molecules (mainly isothiocyanates, ITCs) are released during Brassicaceae decomposition and negatively affect pests. The global objective of this project was to assess the impact of biofumigation on weed ecology, which included two experiments with specific objectives: 1) Evaluate how biofumigation acts on fitness (survival, reproduction, growth) of weeds and 2) Assess the seasonal variation and long-term impact of biofumigation on weed communities. This study was conducted at the Organic Agriculture Innovation Platform, Research and Development Institute for the Agri-environment (IRDA), St-Bruno-de-Montarville, QC. In experiment 1, weed seeds were exposed to dried mustard powder *in vitro*, and seeds that survived the process and germinated were transplanted in a greenhouse for further assessment. For experiment 2, *Brassica juncea* L. 'Caliente 199' and *Avena sativa* L. were seeded in the spring, in the fall or twice a year for different timing of biofumigation at two experimental sites (Verchère muck soil). Impact on weed populations was assessed over the year. According to experiment 1, biofumigation significantly affected fitness components of surviving plants. Biofumigation reduced survival of germinated seeds and seedlings up to 17% and 88% for *Ambrosia artemisiifolia* L. and *Abutilon theophrasti Medik*. respectively. The number of male flower heads of *A. artemisiifolia* was reduced but the number of seed produced per biomass of plants increased for biofumigated plants. Biofumigation increased the number of buds, flowers, fruits, seeds and the reproductive effort of *A. theophrasti*, but seed mass was reduced. Spring weed emergence in 2015 was reduced by the 2014 biofumigation treatments (by 34% when biofumigation occurred twice; 23% when spring biofumigated and 16% when fall biofumigated) in one of our sites. As mustard plants produced low amount of ITCs in 2014, sulfur was had in 2015, increasing by 10 times the amount of ITCs produced during biofumigation. Weed biomass was lower during mustard growth in the spring and the fall compared to oats, but less significantly in the second site. Results underline the potential for biofumigation to be part of weed management programs and highlight preventive measures that should be consider for effective weed control.

Keywords: biofumigation, weeds, survival, reproduction, weed control

#27

PERENNIAL SOW-THISTLE AND CANADA THISTLE VEGETATIVE PROPAGATION AND REGENERATIVE CAPACITY IN ORGANIC FIELD CROPS

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Perennial sow-thistle (*Sonchus arvensis* L.) and Canada thistle (*Cirsium arvense* (L.) Scop) are perennial weeds that have become more abundant in Canada. As many European studies have reported, this increase is mainly due to the expansion of organic farming and to the lower frequency of soil tillage like ploughing, in combination with a fast-growing vegetative reproducing root system and abundant seed production. Both species show similarities such as sprouting from adventitious root buds, but some distinctive traits have to be taken into account in establishing specific weed control strategies. The purpose of this project was to study perennial sow-thistle and Canada thistle vegetative propagation and regenerative capacity in order to develop efficient weed control strategies and improve Canadian organic field crop production. This project was established at the Organic Agriculture Innovation Platform, at St-Bruno-de-Montarville, Québec and consisted of four experiments. The specific objectives were to 1) assess the minimum regenerative capacity where these weeds are most vulnerable to soil cultivation, 2) determine the effect of weed-free periods on shoot and root growth, 3) study the vegetative propagation of both weeds over the years, and finally 4) evaluate the physical damages caused by different tillage tools on both weeds. In greenhouse, root fragments of 5 and 10 cm length were buried at 10 cm soil depth. At the minimum dry weight of underground organ of C. arvense and S. arvensis, the number of leaves was 4-9 and 3-6, respectively. In the field, the minimum weed free period to kill C. arvense and S. arvensis was 6 and 10 weeks, respectively. Within one growing season, root biomass of C. arvense and S. arvensis increased by 50- and 200-fold, respectively.

Keywords: perennial sow-thistle, Canada thistle, organic field crop

#28

THE USE OF SPRING FALLOW AND MECHANICAL WEED DESTRUCTION TO COMBAT SOW THISTLE, CANADA THISTLE AND COLTSFOOT IN ORGANIC FIELD CROP PRODUCTION IN SOUTHERN QUEBEC

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Sow thistle, Canada thistle and coltsfoot have become major problems in organic cash crop production systems (in our area/Southern Quebec). In order to address these problems a spring fallow method was tested on 6 farms in Southern Quebec over 4 years. The effectiveness of 2 and 3 mechanical weed destructions prior to seeding either a green manure or soybeans was evaluated. Excellent results were obtained when the timing of weed destruction was well chosen and if a very aggressive green manure or (cultivated?) soybean were sown just after the last destruction of weeds.

Keywords: sow thistle, Canada thistle, coltsfoot, spring fallow

#29

ORGANIC WEED MANAGEMENT IN PERENNIAL FRUITS

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Weed management is key component of establishing and sustaining a profitable organic orchard. Good site preparation is a critical part of an orchard establishment plan. Pre-plant weed control coupled with addressing soil fertility issues before planting can dramatically increase the options available to producer for weed management, while reducing the time to commercially viable levels of fruiting and harvest. Tillage may be the best option on sites with perennial rhizomatous weeds and low soil fertility, or where there is high risk of rodent damage to the crop. Dead organic mulches are best suited to sites with low presence of perennial rhizomatous weeds and sites where at least moderate levels of soil fertility are present. While living mulches tend to provide a desirable habitat in the orchard understory, they are competitive with the crop for water and nutrients, regardless of whether they are mowed or not. They should only be used on sites with good background soil fertility, with frequent mowing, and where climate or irrigation minimize risk of moisture stress. Most manufactured mulches can provide effective weed control for a longer period of time but reduce soil fertility management options. The use of biodegradable mulches under dead organic mulches poses interesting possibilities and should be studied further. Organic herbicides are presently not effective enough or too costly to be used as the primary means of weed control but would be a useful tool for spot and edge control of weeds in mulches.

Keywords: organic, fruit, weed management, manufactured mulch, dead organic mulch, living mulch, herbicide, plastic, fabric, tillage

#30 – Invited session speaker: TODD KABALUK

TOWARD A COMPREHENSIVE SOLUTION FOR THE BIOLOGICAL CONTROL OF WIREWORMS IN ORGANIC CROPS

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Organic crops are particularly vulnerable to damage and loss caused by wireworm feeding. While practical and reliable organic solutions to wireworm management have remained elusive, the progress of research is bringing us closer to biologically-based wireworm management methods using entomopathogens. Two methods applied to wireworm larvae have been shown to reduce feeding damage to potato: broadcast application of *Metarhizium brunneum* and a new biologically-based attract and kill product whose registration is currently being pursued in Europe. In addition to targeting wireworm larvae, success has been achieved in targeting wireworm adults (click beetles) whose mating and oviposition are responsible for the input of new larvae into agricultural land. Field trials testing an attract and kill tactic utilizing a new granulated pheromone and *M. brunneum* killed up to 100% of the test population. Excellent results were also achieved with the application of *M. brunneum* spore suspensions. Applying biocontrols to field margins would reduce or eliminate a click beetle supply source and their invasion of adjacent crop land; applying them to rotational forage and grasses would reduce or eliminate the direct introduction of new larvae from resident beetles. The combination of controlling both adults and larvae represents a comprehensive strategy that may be the organic control solution for which we've been hoping. Additional findings by Canadian and European researchers offer opportunities to further diversify wireworm control tactics, including mating disruption.

Keywords: wireworm, biocontrol, attract and kill, *Metarhizium*, mating disruption

#31

DEVELOPMENT AND VALIDATION OF AN ORGANIC SANITATION TREATMENT FOR ALFALFA SPROUTING SEED: EFFECT OF MILD HEAT AND NON-CHLORINE SANITIZERS

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Many outbreaks of foodborne illness caused by *Salmonella enterica*, toxigenic *Escherichia coli* and *Listeria monocytogenes* have been linked to sprouted vegetables. Seed disinfection is a critical factor for the reduction of risks associated with such pathogens. The current Canadian Code of Practice for the Hygienic Production of Sprouted Seeds recommends treatment of alfalfa seed with a 2,000 ppm calcium hypochlorite solution for 20 minutes or 6-10 % hydrogen peroxide (H^2O^2) solution for 10 minutes. Such treatments entail the use of concentrated chemicals in the production environment, with attendant risks to worker health and safety. Moreover, previous research has indicated that neither treatment can eliminate pathogens on alfalfa seed. The purpose of our research is to develop an effective disinfection strategy for alfalfa seed using treatments compatible with organic production principles. A two-step treatment consisting of a soak in water at 50˚C followed by exposure to a mixture of H^2O^2 and acetic acid was first evaluated for effects on the germination rate and weight (yield) of sprouted alfalfa seed after treatment. Alfalfa seeds soaked in water at 50˚C for 10 minutes followed 2% H^2O^2 + 0.1% acetic acid (diluted vinegar) or 4% H^2O^2 + 0.2% acetic acid for up to 10 minutes germinated at the same rate and provided the same yield as seed soaked in water at room temperature. Alfalfa seeds were then inoculated with 5 log cfu/g of *S. enterica, E. coli* O157:H7 and *L. monocytogenes* to examine the antimicrobial efficacy of the treatment. Enrichment was required to detect each species after treatment of the seed with water at 50˚C for 10 minutes, followed by exposure to a 4% H^2O^2 + 0.2% acetic acid solution at room temperature for 10 minutes. This exceeded reductions achieved with a 2,000 ppm calcium hypochlorite for 20 minutes (4 log cfu/g) and was equivalent to that achieved by treatment with 8% H^2O^2 for 10 minutes. Current work is aimed at improving the efficacy of the combined mild heat to achieve complete destruction of pathogens on alfalfa seed, and analogous treatments are under investigation for the disinfection of mung bean and radish seed.

Keywords: alfalfa seeds, foodborne pathogens, organic sanitation

#32

THE EFFICACY OF QUASSIA EXTRACT MD IN THE CONTROL OF EUROPEAN APPLE SAWFLY IN APPLES

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The European apple sawfly (*Hoplocampa testudinae* Klug) (EAS) is an introduced pest of apples in North America. In 2010, it destroyed approximately 90% of the apple crop in an organic orchard in Nova Scotia. Currently in Canada there is no registered organic control product for this pest. EAS is an early season pest and its emergence coincides with the opening of the king apple flowers. Adult females lay eggs in the flower receptacles when pollinators are actively foraging; thus control measures for EAS are complicated by the need to protect these pollinators. Quassia extract MD (active ingredients: quassin), manufactured by Trifolio-M GmbH in Germany, has been used in Europe to control EAS in organic apple orchards and this product poses no harm to bees. The efficacy of Quassia extract MD against EAS was evaluated in an organic apple orchard at the Kentville Research and Development Centre in Nova Scotia, Canada. A randomized complete block design experiment with nine replications was set up to test Quassia extract at 0, 3, 6 and 9 g quassin/ha concentrations. In 2011 when pest pressure was high (47.4 %), level of EAS control increased progressively with higher quassin concentrations; fruit damage was 27.3%, 17.7 % and 6.3 % respectively for trees treated with 3, 6 and 9 g/ha of quassin. In 2013 when pest pressure (18.5 %) was lower, all quassin concentrations tested proved to be equally effective and fruit damage was low, ranging from 0.9 to 1.1 %.

Keywords: Quassia extract, European apple sawfly, organic apples

#33

HYDROPHOBIC POLYMER EXCLUSION NETS

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Demand for organic produce has increased over the past 15 years and is expected to keep growing due to consumer demand. This important market faces a multitude of problems due to the special needs of growing organic produce, particularly apples, including the limited number of tools to control or prevent the development of diseases and pests and poor economic competitiveness. Polymer exclusion nets that cover apple orchards nets restrict insect infestations (e.g. weevils, flies, moths, etc.), but increase the time of water exposure on apple and force producers to deploy fungicides to prevent the apparition of scab lesions on fruit, caused by the fungus Venturia inaequalis). To control the scab-inducing fungi and maintain competitiveness, we propose to treat the nets with chemical vapor deposition, thereby creating a highly hydrophobic film on the surface and limiting water ingress during rainy conditions. Our process of photo-initiated chemical vapor deposition (PICVD) employs syngas initiated by hydrogen peroxide under 254nm ultraviolet light. The resulting film deposited on the exposed surface is highly hydrophobic, increasing the water contact angle from 99° to 124°. Atomic force microscopy shows that the polymer surface is physically altered, while FTIR analysis demonstrates a chemical change (addition of C=O and C-O moieties), suggesting the presence of carbonyl, ether, and possibly ester groups in the films. A preliminary economic analysis of this process confirms the viability of this method, with an approximate price of $1,10/m2 of treated net. With this development, we hope to reduce scab along with several other problems affecting organic crops, allowing for an increase in Canada's organic apple producers' competitiveness.

Keywords: organic apple, exclusion nets, hydrophobic, PICVD

WHEAT PRODUCTIVITY AND NITROGEN UPTAKE FOLLOWING GREEN MANURE PRECROPS AND BIOFERTILIZER SUPPLEMENTATION

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Managing nitrogen in organic systems to sustain adequate productivity is a challenge. Green manures and amendments provide supplemental nutrients for organic field crop but can vary substantially with cropping region. The productivity of green manure (hairy vetch cv. Bounty and Common; common red clover) was evaluated in Eastern Ontario. Wheat productivity following the green manure, and as affected by nitrogen supplementation (dried poultry manure, 0, 40, 80, 120 kg/ha), was also evaluated. The green manure plant stands looked thicker with the hairy vetch cv. Bounty, but the dry matter was not significantly different between green manure types at the end of the season, nor was any differences found in weed pressure. Soil samples analyzed in spring following fall green manure plow down did not show any statistical differences between the nutrient contents (N, P, K, Ca) or organic matter. Wheat dry matter at flag leaf was generally higher as doses of dried poultry manure applied increased, but did not result in higher wheat yield at harvest. The third year of the rotation (2016) will involve soybeans. Hairy vetch has been generally shown to offer weed suppression, N2 fixation and other ecosystem services, and the benefits may appear later in the rotational scheme.

Keywords: red clover, hairy vetch, green manure, wheat, poultry manure

#35

LEGUME CROPS EFFECTS ON NITROGEN AVAILABILITY TO SUBSEQUENT CROP IN ORGANIC FARMING

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Legume crops may increase soil nitrogen (N) availability to subsequent crops in organic farming. However, the most efficient legumes under southern Québec cold-temperate conditions are not yet identified. A five years study (2012-2016) was conducted at the Research and Development Institute for the Agri-Environment (IRDA) organic experimental farm, at Saint-Bruno-de-Montarville (Québec, Canada). The study evaluated the effects of legume crops, dairy cattle manure or compost application and tillage regime on subsequent corn yield and N nutrition. Treatments in 2012 and 2014 were seven legume crops (crimson clover, ladino clover, red clover, red and white clover mix, hairy vetch, alfalfa and dry peas) and barley as control. Clovers were underseeded into barley. Corn was cultivated in 2013 and 2015. Organic fertilizers (dairy cattle manure or commercial compost) were applied at 30 Mg /ha prior to soil tillage (plowing or harrowing with offset discs) in fall. Compared with barley as control, legume crops significantly increased corn yield and N uptake by 22 to 138 % and 21 to 147 % respectively. Corn yield and N uptake were highest in the following order: hairy vetch, red and white clover mix, red clover and ladino clover. Those legume crops also presented highest corn N use efficiency (13 to 54 %), which represented 20 to 41 kg N/ha used by that crop. Corn yield and N uptake were also significantly increased by manure and compost application. Soil plowing significantly increased corn yields and N availability from legume crops, manure and compost, compared with harrowing with offset discs. Results of this study showed that legume crops must be completed by manure or compost to achieve highest corn yields.

Keywords: legume, nitrogen, green manure, fertilization, tillage

#36

EFFECTS OF GREEN MANURE TERMINATION METHOD ON AGRONOMIC AND SOIL PROPERTIES IN AN ORGANIC GRAIN ROTATION

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Interest in no-till practices in organic agriculture is growing, partly in response to criticism on over-reliance on tillage techniques for chemical-free weed control and the potential damage tillage can cause to the soil. One way to incorporate no-till into organic farming is to use no-till termination of green manures, leaving them on the soil surface for the following crop as a mulch rather than incorporating them with tillage. The mulch biomass could also then infer weed control benefits. However, research on termination of green manures in organic agriculture has focused almost solely on how it affects weed control and yield of the following cash crop. Experimental evidence as to whether this practice actually benefits soil health is absent. A full season hairy vetch/oat green manure was established in Truro, NS and in Carman, MB in 2013 and followed by wheat in 2014 and repeated again with green manure in 2014 and wheat in 2015. Three levels of green manure termination intensity were employed; fall tillage (tilled in the fall and spring), spring tillage (rolled in fall and tilled in spring), and no-till using a crop-roller to terminate the green manure. Soil was sampled from two depths (0-5cm and 5-15cm) four times throughout each phase of the rotation. Agronomic data from the green manure and wheat phase was collected (biomass, nitrogen content, and yield, weed biomass). In the Truro site termination method significantly affected weed biomass in the wheat phase with the highest biomass in the no-till treatment in 2014 (1707 kg/ha) and the lowest in the fall tilled (204 kg/ha) but wheat yield was not affected. Weed biomass was not significantly different in 2015. Soil nitrogen and microbial biomass dynamics throughout the rotation at two depths will be presented to discuss impacts of tillage on these properties and their recovery after disturbance.

Keywords: organic, no-till, green manure, soil health

#37

IMPACT OF COVER CROPS AND FERTILIZATION METHODS ON YIELDS AND QUALITY OF ORGANIC CARROT IN A MUCK SOIL

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Canada imported over 1000% more metric tons of organic carrots than it produced in 2010, which was estimated at 1,634 metric tons. However, very little research has been conducted to evaluate organic carrot production practices leading to optimum yields and quality. Cover crops and fertilization methods may have an impact on soil's bacterial communities, which could lead to changes in crop productivity and quality. The objective of this multidisciplinary project is to evaluate different organic carrot production systems on soil's microbial communities, yields and quality and nutrients availability in a muck soil. The experimental design is a split-plot factorial design including cover crops as the main plot factor (forage pea, oat, and control) and organic fertilizers (poultry manure pellets, composted bovine manure, and control) as the subplot factor. Each treatment is repeated 3 times for a total of 27 experimental plots. All plots are irrigated approximately two weeks after seedlings with fecally-contaminated water to evaluate the persistence of *Escherichia coli* (used as a fecal contamination indicator) under the different production systems. Many variables are measured in soil and on crop including yields, soil microbial populations, and nutrients availability in a multidisciplinary approach. This presentation will focus on yields and safety. Total yields didn't differ statistically between treatments. However, preliminary results showed that organic fertilizers may have an impact on marketable yields. No differences were observed among treatments regarding the fate of *E. coli i*n soil and carrot nitrates content. The experiment will be repeated for a second year in 2016 on the same field plots. It is anticipated that the effect of treatments could be emphasized for this second year, considering amplification of changes in soil physico-chemical and microbiological properties.

Keywords: organic carrot, cover crops, fertilization, microbial communities, yields

#38

IMPACT OF COVER CROPS AND COMBINATIONS OF ORGANIC FERTILIZERS IN ORGANIC CARROT CROPPING SYSTEM ASSESSED BY METAGENOMIC ANALYSIS OF SOIL BACTERIAL DIVERSITY.

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The use of organic fertilizers and the incorporation of cover crops in organic carrot cropping system may induce major changes in the structure and function of soil microbial communities. These changes may alter the persistence of potentially pathogenic microorganisms for humans introduced by organic fertilizers. They can also alter the availability of soil nitrogen and the organic carbon cycle. The experiment plots were set in a split-plot factorial design including cover crop as the main plot factor (forage pea or oat, with fallow as a control), and organic fertilizers as the sub-plot factor (poultry manure pellets or composted bovine manure, without any organic fertilizer as a control). Each treatment was repeated 3 times for a total of 27 plots. Soil cores (2-20 cm) were taken from each plot before the application of organic fertilizers, then 1 d, 29 d and 82 d after the fertilization. The sampling at 29 d took place 7 d after the irrigation with *Escherichia coli* contaminated water. The sampling at 82 d took place 1 d before the carrots harvest. The soil DNAs were extracted and the V6-V8 variable regions of the 16S rDNA were amplified and the amplified products were sequenced on a MiSeq platform (Illumina) with a strategy 2x300 bp. Bacterial richness was assessed with the Faith's PD index. The compositions of the soil bacterial populations extracted from each plot were compared using comparison matrices obtained with Bray & Curtis distance and represented by PCoA figures. The cover crops and the secondary treatments with organic fertilizers have not significantly altered the soil bacterial richness index and the global bacterial composition. The oat cover crop and composted bovine manure induced a greater variability of the soil bacterial richness index. Correlations between treatments and soil bacterial taxonomic classes were established. Some bacterial classes increase with cover crop (peas: *Flavobacteria*; *β-proteobacteria; Actinobacteria,* Oat: *β-proteobacteria; Opitutae; Mollicutes*) or with fertilization (Compost: *α-proteobacteria; Acidobacteria; Cytophagia; Methylacidiphilae,* Acti-sol: *Opitutae; Methylacidiphilae*).

Keywords: bacterial diversity, bacterial richness, green manure

#39

LIFE CYCLE ANALYSIS FOR WHEAT PRODUCTION IN ORGANIC, PESTICIDE FREE, CONVENTIONAL AND INTENSIVE SYSTEMS

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In 2012, La Meunerie Milanaise commissioned a firm to carry out the LCA (life cycle analysis) of the company. According to Robert Beauchemin, CEO and owner of the company since 1982, European references used for the study did not represent the Quebec reality. However, this study has identified supply chain as having the largest environmental weight on the activities surrounding the mill. Where the idea of measuring the environmental impact of wheat production. The project aims to answer many questions; is intensive wheat production more environmental because it produces more tonnage per hectare? Is the pesticide free wheat produced in Agriculture RaisonnéeMC profitable to farmers? Does organic production generate more GHG (greenhouse gas) than conventional production? Plots established in all regions of Quebec allowed to compare the production of wheat in intensive, conventional, pesticide free and organic systems; same varieties and soil types per regions. The pesticide free wheat is produced under a program registered by the mill called Agriculture Raisonnée. This program, recorded in 2011 by the Moulins de Soulanges, allows farmers to produce wheat pesticide free with an added value. Financial assistance from MAPAQ (programme PSSSD) in 2013 permitted to do the life cycle analysis of wheat with the research team in agricultural economics of Luc Belzile at the IRDA (institut de recherche et de développement en agroenvironnement). They measured the production of GHGs and the environmental impact of 4 production systems. In 2014 and 2015, the Mills continued the project and self-financing plots. Health and environment risk factors were integrated in the life cycle analysis which is measured by SAgE pesticide with a web tool IRPEQ (Quebec pesticide risk indicator). The project helped validate cost-effectiveness and environmental impact over 3 years of wheat production. In conclusion, the project helped to convince a group of farmers that organic production and pesticide free, is overall more profitable economically and environmentally.

Keywords: wheat, agriculture raisonnée, mills

#40 - Invited session speaker: DEREK LYNCH

INTENSIFYING ORGANIC PRODUCTION WHILE MAINTAINING SOIL HEALTH AND FARM AGROECOLOGICAL ATTRIBUTES

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Globally all of agriculture is being asked to 'sustainable intensify', i.e. to increase production while at the same time limiting the agroecological impacts of agriculture. All organic agricultural systems vary significantly in their intensity of production. Well-established measures of agricultural intensity and sustainability, which have been also applied to organic farming, include assessments of water, energy and nutrient use and efficiency. More recently, there has been widespread interest in identifying farming systems that may support pollinators and enhance soil health. For example, in Europe wild bee abundance and diversity has been shown to decline as production intensity (measured as nitrogen use, livestock density and pesticide use) increases across agroecosystems. But while there is growing appreciation of the fundamental importance to sustainability of soil organic matter (SOM) storage and soil health much less effort has been devoted to improving our understanding of how intensification of a farming system influences both SOM storage and soil health, and what might be the potential tradeoffs with intensification due to changes in other farm agroecological attributes. Soil health and SOM levels are influenced by both soil type and texture, and agricultural management (including tillage and crop rotation practices, cover crops and organic matter additions etc.). For example, the frequency in rotation (i.e. intensity level) of crops such as soybean, corn and potatoes, which return little crop residue to soil, may be expected to deplete SOM and soil health. In organic production, new developments in reduced tillage of green manures may allow for intensification (i.e. shorter rotations) of production once the net effect on SOM and soil health is better understood. Drawing on results from ongoing replicated and on-farm cropping system trials the potential for development of an index of sustainable intensification linked to dynamics in SOM storage and soil health will be presented. The potential for use of decision-support whole-farm models, which help examine the tradeoffs between organic farm intensification, profitability and changes in SOM will also be discussed.

Keywords: organic, soil health, agroecology, whole-farm models

#41

META-ANALYSIS OF COVER CROPPING SYSTEMS UNDER ORGANIC AND CONVENTIONAL MANAGEMENT: THE EFFECTS OF COVER CROPS ON SUBSEQUENT CASH CROP YIELDS AND NITROGEN CONTRIBUTION

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The integration of cover crops (CC) in cropping systems is a best management practice recommended to enhance biodiversity and minimize erosion. Cover crops also have considerable potential to maintain or enhance crop yields. The potential benefits of CC to crop productivity are largely determined by CC biomass production, the timing and methods of CC termination, and the CC type (legumes, non-legumes, mixtures). Further, synchrony between crop nitrogen (N) demand and CC mineralization is critical in this process for which climatic conditions, soil properties and management practices act as important modulators. Consequently, the performance of CC often depends on site-specific factors and yields variable results, making it difficult to identify best management practices. In this study, we performed a meta-analysis of data from 110 field experiments published in peer-reviewed (83) or grey (27) literature to provide a comprehensive approach of assessing CC influence to cash crop systems. More specifically, we quantified (1) the effect of CC on cash crop yield, (2) the N contribution of CC to cash crop growth (compared to bare fallow), and (3) the variation of these impacts across a wide range of systems. Data were included if they met the following criteria: (1) CC were grown (intercropping, successive or full season systems) with a subsequent annual cash crop (corn, soybean, canola, cereals); (2) a control treatment without CC was present; (3) the treatments were replicated; (4) the study has been conducted under humid temperate climate; and (5) cash crop yield, CC biomass and N concentrations in plant tissues were reported, which allowed us to estimate the relative contribution of CC to subsequent cash crop yields in terms of yield ratio (Yield with CC \Control Yield without CC). Nitrogen contribution of CC under both organic and non-organic management will be discussed comparing the aboveground N yield of the CC, the apparent recovery of CC N, and the fertilizer replacement value. The influence of CC types, soil properties, management practices and environmental conditions will be described.

Keywords: green manure, catch crop, intercropping, relay cropping, successive cropping, double cropping, full season, biomass, corn, soybean, canola, cereals

#42

GREEN MANURES FOR ORGANIC PRODUCTION: A PRAIRIE-CENTRIC LITERATURE REVIEW WITH BROAD OUTCOMES

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Green manures, crops that are grown without intent for harvest or profit, but to build soil fertility, are an important component of organic production systems. Green manures consist largely of legume species that provide nitrogen to the organic system through a symbiosis with nitrogen-fixing Rhizobia. In partnership with the Prairie Organic Grain Initiative, the Organic Agriculture Centre of Canada embarked on a literature review of green manure research relevant to organic grain production, with a goal to then translate and transfer this knowledge to the Prairie organic community to increase the production and quality of organic grains. A number of research studies conducted over the last thirty-five years on the Canadian Prairies and adjacent US Northern Great Plains were reviewed. Research studies largely fall into one of two focus areas: studies that aim to demonstrate the myriad benefits of green manures, and those that aim to find optimal crop choices and management strategies for various production systems, soils and climates. Both align well with the needs of organic growers, for justifying the economic cost of green manures, and for finding crops and systems that work well in their operations. Green manure benefits include nitrogen fixation and supply, the cycling of other soil nutrients, promotion of the many aspects of soil health, erosion protection, weed and pest management, and biodiversity. Green manure management can be adapted to fit most any production system, with crop choice an important aspect, along with rotational strategies that range from short-duration crops to long-lasting perennial stands, and planting and termination strategies that can allow producers to finely tune their system. While studied in the Prairie context, the generalized outcomes apply much more broadly.

Keywords: green manure, nitrogen, Prairie, management, costs vs. benefits

#43

SOIL BIOLOGICAL ACTIVITY IN BIOCHAR-AMENDED ORGANIC GREENHOUSE TOMATO CROPS – STUDY CASE FOR SIX TYPES OF SOIL

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Several studies have shown that using biochar as soil amendment can increase the sustainability and productivity of cropping systems by improving soil properties and soil fertility via its effects on porosity, particle aggregation, soil structure, water and nutrients retention, and by improving microbial activity and plant health. Thus, we tested the hypothesis that biochar amendment to different types of soil enhances soil microbial activity, mycorrhizal colonization, plant nutrient availability, plant growth, productivity when fertilizers are applied monthly or bi-monthly. The experiment consisted of 36 experimental units (~0.65 m^3 containers) randomized in a complete block design with three replicates. The following organic soils were investigated: 1) a loam, 2) a sandy loam, 3) a sandy soil, 4) a muck soil, 5) a reconstituted organic soil with 40% air porosity and 6) a peat soil amended with sawdust. Half of the experimental units were amended with 20% (v/v) biochar (balsam fir + white and black spruces). Tomato plants (*Solanum lycopersicum* 'Trust') were cultivated from May to October 2014. The crop was fertilized at 4-week (May to August) and 2-week (August to October) intervals using certified organic amendments. Irrigation was controlled for each soil based on the matric potential measured at 15-cm depth. Effluents from each container were collected and their nutrient content analyzed. Regardless the type of soil, our results showed that biochar amendment increased soil microbial activity expressed by the hydrolysis of fluorescein (FDA) by 26-41%, and led to greater soil CO_2 efflux (~10% and 20% when fertilizers were provided at 4- and 2-week intervals, respectively). No significant effect of biochar on root colonisation by mycorrhizae was observed. However, adding biochar to organic soils reduced by 53% the earthworm population. Macronutrients were higher in the biochar-amended soils, while NO_3 was reduced in the leachate. Plant growth and crop yield were not influenced by biochar amendment. In conclusion, biochar amendment to different organic soils improved the microbial activity, which might in the long term have beneficial effects on crop performance. In the short term, we were not able to validate our hypothesis that a 20% (v/v) biochar amendment increases crop productivity.

Keywords: biochar, greenhouse, tomato crop, organic farming

#44

RESTORING YIELD PRODUCTIVITY AND SOIL C IN ORGANIC FARMING SYSTEMS ON THE PRAIRIES

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The overarching objective of this study is to find ways to effectively restore the productivity of soils that have been managed organically for many years but have lost yield productivity. Organically managed soils that lose crop yield productivity can also lose subsoil carbon (Bell et al., 2012, Agric, Ecosys & Enviro 158: 156-163). Therefore, we were also interested in determining how restoring the yield productivity of organically-managed soils might also restore and increase soil C levels. Research work to address these objectives is being conducted at the long-term Glenlea plots where sustainable and unsustainable organic systems are present in the same experiment; and on farm fields across various ecoregions of the Canadian prairies. Work at Glenlea in 2014/15 showed that adding composted manure immediately after recognizing a soil P deficiency (Welsh et al., 2009; Agron J. 101:1027-1035), increased yield productivity and soil C levels in the 0 to 60 cm profile after 7 years. The soil C increase was attributed to greater plant growth (presumably roots) in manure-amended plots. Current work at Glenlea involves examination of C at deeper depths (0 to 90 cm) in collaboration with the Carbon Management & Sequestration Center at Ohio State University. One reason for low P status on organic farms is reliance on alfalfa hay crops during and after the transition phase without return of manure nutrients back to the land. On-farm trials to investigate use of manure to restore yield productivity and soil C in such situations was initiated in 2015. Also, we will report on a new set of experiments, established on a P depleted organic farm in 2015/16 to examine: 1) manure rates to restore P depleted organic alfalfa-grain systems; 2) fertilizer and manure P additions before and during organic transition for ensuring P sufficiency for grain production; and 3) effects of grazing vs haying during and after the transition phase.

Keywords: manure, C sequestration, alfalfa rotations

#45 – Invited session speaker: MONIQUE BESTMAN

STATE OF SCIENCE CONCERNING ORGANIC POULTRY PRODUCTION IN EUROPE

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According to organic principles, monogastrics like poultry should eat those ingredients that cannot be eaten by man or by ruminants. Poultry should be kept on a small scale on mixed farms. However, in Europe this had developed differently. Most organic poultry farms in Europe have developed to highly specialized farms with thousands of chickens being kept in a professional way. Because of its scale and novelties compared to the conventional way of poultry keeping (free range area, organic feed, no beak trimming), organic poultry production draw the attention of animal scientists. Research often is problem-driven. And if not, it will be the problems that strike the most. Therefore, it is unavoidable that my overview contains small and big 'challenges'. But my conclusion is that within its differing appearances, organic poultry keeping should continue to go forth in its ambition to do right on many aspects. At the end of the 20th century, much attention was related to feather pecking in organic laying hens. Feather pecking means: not being able to cope with the conditions we offer. Several weaknesses and solutions have been found and applied. Higher mortality compared to indoor housing has drawn attention. Management is more professional now and broad preventive animal health care led to mortality being comparable to the indoor systems. The free range area used to be an area only in qualitative terms, but realizing a chicken being a forest animal has led to very nice examples of free range areas. A next step is to shape double purpose free range areas, where fruit trees or biomass willows offer revenues as well. At the moment risk of avian influenza and mortality caused by predators have our attention. The accumulation of phosphor and nitrogen in the free range soil will be one of the next things to be addressed. Because of some of the challenges mentioned, future organic poultry keeping may look different as how it looks now. But we should always keep in mind what we have learned about animal welfare and try not to do concessions to this. Examples of farms will be shown.

Keywords: animal welfare, animal health, housing, environment, organic

#46

HOW MUCH CAN DIFFERENT ASPECTS OF DAIRY COW WELFARE BE IMPROVED BY PROVIDING YEARLONG REGULAR EXERCISE TO DAIRY COWS KEPT IN TIE-STALLS?

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Certified organic dairy producers are required to provide regular exercise to their cows both in summer and in winter seasons. The impacts of providing yearlong regular exercise on the welfare of tie-stall cows are not well documented. The objectives of this study were to evaluate how regular exercise and stall improvements affected outcome measures of welfare of lactating dairy cows housed in tie-stalls. Over 12 months, 20 cows/farm from 12 farms were visited and their welfare was assessed on 4 visits; of these farms 8 provided regular exercise, 4 did not. Visit 1 was conducted towards the end of the pasture season, visit 2, 9-30 days after stall improvements were applied, visit 3, towards the end of winter, and visit 4, 1 year after visit 1. Assessments of cow welfare consisted of animal and housing based measures and a management questionnaire. Farms were classified on whether they provided exercise (Exc) or not, as well as cows that were kept on improved (Mod) stalls or in unmodified stalls. Differences in the outcome measures were analyzed with a mixed model. Farm was nested in Exc and was included as a random effect, Exc and Mod and their interaction were treated as fixed effects. On visit 1, farms that provided exercise had fewer cows with neck and knee injuries (31 and 13% less, respectively, $P < 0.01$). During visit 2 (in winter), we found 19% ($P < 0.05$) fewer cows with neck injuries when provided with exercise. Towards the end of winter (visit 3) providing exercise resulted in 16% and 20% fewer ($P < 0.05$) cows with hock injuries and lameness, respectively. In addition, on visit 3 providing exercise and an improved stall decreased ($P < 0.05$) the number of cows with neck and knee injuries by 39% and 28% respectively. During visit 4, access to exercise reduced the number of cows with hock injuries by 39% ($P < 0.05$). Our results showed that providing dairy cows housed in tie-stalls access to regular exercise, particularly in winter when they spend more time confined can improve the overall welfare of the animals by reducing body injuries and lameness prevalence.

Keywords: dairy cow, exercise, injuries, tie-stall, welfare

#47

WOULD ORGANIC DAIRY COWS WITH YEAR-LONG OUTDOOR EXPERIENCE CHOOSE TO SPEND TIME AT PASTURE OVER THEIR FREE-STALL BARN?

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Pasturing of dairy cows during grazing season is a requirement of the organic standards. Pasture access provides health and behavioural benefits and evidence suggests that dairy cows may have an inherent preference for the outdoors even during winter. The study objective was to investigate cow preference for day-pasture access or a free-stall barn under Eastern Canadian summer conditions. Thirty-two lactating organic Holstein cows with year-long outdoor experience were enrolled in a 6-d preference cycle comprised of three 2-d phases: forced-indoor (restricted to a free-stall barn), forced-outdoor (restricted to pasture) and the free-choice (choice between barn and pasture). The same feed options (silage, fresh forage) were provided inside and on pasture. Live observations of activities (eating silage, grazing, lying down, and other) were conducted every 2 min for 6 h by scan sampling during the forced-outdoor and free-choice phases. A group level t-test was used to test whether preference of cows to be outdoors differed from 0 % (choice to stay in free-stall), 50 % (indifference), and 100 % (choice to go to pasture). An independent 2-sample t-test was used to compare time spent conducting the observed activities inside vs. outside. Cows chose to spend more time on pasture (range h1 to h6 across weeks: 68.4 to 87.4 % of time), displaying either partial (difference from 0 %; $P < 0.01$) or complete preference for outdoor (difference from 0 and 50 %; $P < 0.01$). The same levels of activities were observed on pasture as indoors ($P > 0.05$). Interestingly, cows chose to graze fresh forage over eating silage on pasture (33.1 vs. 10.2 %, respectively) and chose to eat fresh forage over silage when indoors (33.6 vs 4.2 %, respectively). A combination of previous experience and the provision of similar feed options in both locations may have enabled the cows to choose more often to go to pasture, an environment that meets her behavioural and welfare needs, warranting further study on the importance of outdoor access for dairy cows and its application in both organic and conventional dairies.

Keywords: dairy cow, preference test, organic, outdoor access

#48

SWITCHGRASS AS AN ALTERNATIVE BEDDING FOR DAIRY COWS HOUSED IN TIE-STALLS

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Cows spend more time lying down when stalls are soft and dry, and bedding plays a key role in the stall comfort. Even though farmers are aware of the importance of bedding, the cost associated with good-quality bedding forces them to either use less bedding, or to look for alternatives. Switchgrass (*Panicum virgatum* L.), a high-yielding, long-term perennial grass growing on marginal land, could constitute a promising bedding alternative to straw, especially in organic systems where straw may be difficult to source. The objective of this experiment was to evaluate the quality of switchgrass as a bedding option, by comparing it to straw in a tie-stall housing system. The effects of the 2 bedding treatments (2-3 cm chopped bedding on mattress-based stalls) on lying behaviour, injuries, cow cleanliness, somatic cell count, and teat end bacterial contamination were evaluated in a cross over design using 16 Holstein cows (parity from 1 to 4; DIM from 34 to 237 d; BW: 663.6 ± 54.26 kg), with beddings being switched after 4 wk. Lying behaviour was measured with data loggers. Total lying time, number of lying bouts, and bout duration were on average 13.4±0.41 h/d, 10.6±0.56 bouts/d, and 1.3±0.07 h/bout, respectively, and did not differ between treatments. No treatment effects were found for hock and knee injury scores, which were on average less than 1 (0-3 scale), or for leg, flank and udder cleanliness scores, which were all at 0 (0-3 scale). No differences were found for bedding dry matter, stall cleanliness (1-5 scale) and bedding quality scores (1-3 scale), which were on average 73.2±2.83%, 2.0±0.12, and 1.4±0.11, respectively. Somatic cell counts were the same across treatments (31.8±4.86 x1000 cells/ml). Teat end counts of coliforms (0.54±0.225 $\log_{10}$ cfu/g) and *Streptococcus* spp. (0.58±0.332 $\log_{10}$ cfu/g) did not differ between treatments, but *Klebsiella* spp. count was lower on switchgrass than on straw (0.02 vs. 0.18 $\log_{10}$ cfu/g; SEM=0.054; P=0.048). Teat end bacterial counts were, however, overall low. In conclusion, both bedding sources were equivalent in terms of comfort and cleanliness, and thus switchgrass appears to be a suitable bedding alternative for dairy cows.

Keywords: dairy cow, bedding, switchgrass, comfort

#49

PLANT BIOACTIVE PRODUCTS AND INTERNAL AND EXTERNAL PARASITE CONTROL IN DAIRY PRODUCTION

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Pastured ruminants are not only facing external parasites, such as pest flies, but are also under pressure from gastrointestinal nematodes. The lack of efficient methods to control external and internal parasites is of concern to organic producers. Phytochemicals have been recognized as having important biological activity against pest insects as well as having anthelminthic activity. To identify and develop efficient products suppressing parasites and promoting health within the dairy management system, experiments were performed to: 1) evaluate natural repellents based on plant essential oils; 2) test the impact of essential oils on gastrointestinal nematodes; and 3) determine the prophylactic and therapeutic potential of phytochemicals (primarily focussing on tannins in birdsfoot trefoil) against gastrointestinal nematodes. The formulation, the dose, the mixture and the environmental factors all had an effect on the effectiveness of the products tested against external parasites. Species of pest flies (horn, face, biting stable and house flies) had differential responses to the repellent applications to cows. The essential oils tested were most efficient against the horn fly, the most important pest. The essential oils tested in-vitro had a significant impact on mobility and mortality of gastrointestinal nematodes. Two *Cymbopogon* spp. essential oils were the most effective against nematode larvae. When grazing heifers were supplemented with tannin-containing birdsfoot trefoil, a preventative effect against the rise of their parasitic load was observed. The potential usefulness of plant botanicals in dairy production will be discussed, as well as implementation methods.

Keywords: dairy cattle, parasites, phytochemicals, gastrointestinal nematodes.

#50

A SYSTEMATIC REVIEW OF NON-ANTIMICROBIAL TREATMENTS OF CLINICAL MASTITIS IN DAIRY COWS

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The objective of this review was to identify non-antimicrobial therapies (i.e. treatments other than antibiotics) for the treatment of clinical mastitis in lactating dairy cows. A systematic review was performed with eligible studies selected from CAB Abstract, Pubmed and Web of Science from January 1970 to June 2014. Assessment of risk of bias in included studies was evaluated using the Cochrane Collaboration's tool for assessing risk of bias. Outcomes evaluated were resolution and recurrence of clinical signs, bacteriological cure and milk production. A total of 2,451 manuscripts were first identified to finally reach 39 manuscripts corresponding to 41 studies. Among these studies, 23 were clinical trials, 18 were experimental studies, and one was an observational study. The non-antibiotic treatments evaluated were: conventional anti-inflammatory drugs (n=14), oxytocin with or without frequent milk out (n=5), homeopathy (n=5), phytotherapeutic products (n=4), immunoglobulins based products (n=4), products used to enhance the immune system (n=3), products with bactericidal or bacteriostatic properties (n=2) and probiotic (n=2). Most of the alternative treatments were directly tested in clinical trials without any prior efficacy investigation in an experimental model. On the other hand, efficacy of conventional anti-inflammatory drugs was only evaluated in experimental models of clinical mastitis. High risk of biases was noted with most frequent biases being blinding of participants and personnel (41%), blinding of outcome assessment (38%), and selective reporting (33%). Various other uncategorizable biases were also noted in 92% of the papers. Based on the studies available, homeopathic treatments of clinical mastitis should be considered ineffective. Some phytotherapeutic products or immunoglobulins based products need further investigation before conclusion on their efficacy. Efficacy of oxytocin with or without frequent milking out is inconsistent and some detrimental effects were reported. Anti-inflammatory drugs have demonstrated potential beneficial effects mainly on control of clinical signs. To date, no alternative therapies had consistently demonstrated efficacy for the treatment of clinical mastitis in clinical trials. Positive effects of anti-inflammatory drugs have to be confirmed in randomized clinical trials. Primary evaluation of new alternative therapies in experimental trials is recommended before initiation of clinical trials.

Keywords: dairy cows, clinical mastitis, non antimicrobial treatment, systematic review

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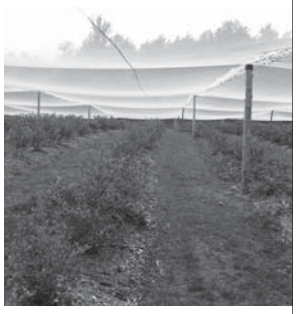





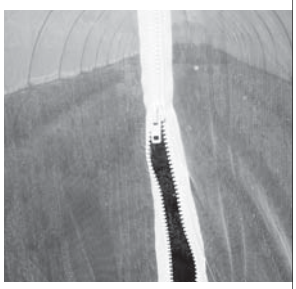

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OPTIMISING FRUIT LOAD AND STEM DENSITY IN A SEMI-CLOSED ORGANIC TOMATO GREENHOUSE.

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To increase crop yield and fruit quality, alternative growing systems called closed and semi-closed greenhouses were developed in the Netherlands in the early 2000s using geothermal systems to ensure greenhouse cooling and/or heating. This allows an independent control of humidity, temperature and CO_2 concentration in the greenhouse where the rate of CO_2 supply is reduced. Then, we suggest that fruit load or stem density could by increased following the better climate management (temperature and humidity) due to the elevation of CO_2 concentration which affects positively rates of leaf photosynthesis. To test this hypothesis, two semi-closed experimental double polyethylene 225 m^2 compartments (G1 and G2) were used during 2015 growing season (January-October). Three stem density treatments: 3.0, 3.3 and 3.6 plants/m^2 in G1 and three fruit load treatments: 70, 85 and 90 fruits/m2 in G2 were compared using a Latin square design at Les Serres Jardins-Nature (QC, Canada). Climate parameters of CO_2, vapor pressure deficit (VPD), temperature and solar radiation were monitored. Data also included crop growth parameters, yield, fruit size, fruit quality parameters (color, firmness, fresh and dry mass, carotenoids, phenolic compounds, ascorbic acid, soluble sugars, titrable acidity and electrical conductivity). The semi-closed compartments showed a 40% higher seasonal mean CO_2 concentration than the conventional production compartments. The two semi-closed compartments showed different system efficiencies explaining the differences in CO_2 level and climate parameters in those two systems. Lowest fruit density treatment in G12 and lowest fruit load treatment in G2 both seemed to show the best agronomic performance in those two semi-closed systems. Dry mass and carotenoid content were reduced when fruit load was increasing. The project leads to an improvement of the whole semi-closed system, adding a heat pump providing better climate control (temperature and VPD) and better use of geothermal energy (water from water table). The semi-closed system was efficient and additional observations may allow continuing the optimization of growth management techniques.

Keywords: greenhouse, organic, tomato, fruit density

#52 - Poster

IRRIGATION STRATEGIES FOR ORGANIC JUNE-BEARING STRAWBERRY "CLERY" IMPROVING NUTRIENT MANAGEMENT

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Optimal nutrient uptake by plants can only be achieved with adequate soil moisture. This condition can be difficult to obtain in drip irrigated crops, especially those cultivated on plastic mulch raised bed like strawberry. Québec strawberry growers widely use raised bed plasticulture planting system. However, soil areas underneath the plastic mulch tend to slowly dry out as a result of the inability of drip irrigation to apply water effectively in those areas. Nutrient from fertilizer cannot be solubilized and won't be available for uptake by strawberry roots if kept in dry soil. As a result, supplemental fertilizing is necessary to fulfill strawberry nutrient needs. Growers can use soluble organic fertilizer, but issues regarding drip emitters plugging and water application uniformity within the strawberry field must be considered. Furthermore, nitrogen leaching is likely to occur while fertilizing with soluble fertilizer. Water from drip emitters underneath the plastic mulch have to reach all of the soil surrounding strawberry roots, increasing the latter's capabilities of nutrient uptake. Thereby, plant growth, strawberry yield and irrigation water use efficiency (IWUE) will tend to increase. A two years study (2015-2016) was conducted in Saint-Bruno-de-Montarville (Québec, Canada) at the Research and Development Institute for the Agri-Environment (IRDA) experimental farm on a June-bearing strawberry field "Clery" established in August 2014. The main objectives of this study were evaluating irrigation strategies providing adequate soil moisture, enhancing strawberry nutrients uptake related to enhanced water availability, measuring the impacts of those irrigation strategies on strawberry yield and measuring the economic outcomes of those strategies. Irrigation was carried out with buried drip tape (one tape laid down on the center of the bed or two tapes laid down aside each row of plants toward the edge of the bed) and with dripper stakes (one stake per plant, inserted in the punched hole). The upcoming results will guide organic strawberry growers in their irrigation and fertilization management. Gaining knowledge on the number and positioning of drip tape required for irrigation in raised bed plasticulture planting system and reducing/removing supplemental fertilization with soluble fertilizer could be the outcome of this study.

Keywords: drip irrigation, fertilization, strawberry, soil drying, plasticulture

#53 - Poster

HASKAP RESPONSE TO SOIL NUTRIENT STATUS, COMPOST AND COMPOST PLACEMENT

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Haskap - *Lonicera caerulea* L. is a relatively new fruit crop for Canada; recognized as a healthy fruit and a promising new berry crop. The productivity and harvest quality of haskap are affected by genotypic, environment and management factors. Plant vigor varies widely among farms in Nova Scotia which could be attributed to variable soil conditions. Soil condition at planting may be an important factor in haskap growth during the establishment years; newly cleared forest is likely to be at a higher risk of failure if adequate measures are not taken to enhance the soil environment. However, there is no established recommendation for soil fertility or tissue nutrient level ranges for haskap. To bring haskap bushes to a harvestable yield in the shortest time possible, the fertility management strategy for establishing bushes must focus on maximizing vegetative growth in the first three years. First-year growth also plays a crucial role in determining future bush yields. Management practices that increase shoot number and length at the first harvest can increase future productivity. Therefore, there is a dire need for research to assess the optimum fertility and management practices for the production of haskap berry. This research ultimately aims to develop recommendations for soil fertility management by i) determining the relationship between plant health and nutrient status of soil and leaf tissue, ii) evaluating response to soil fertility amendments , and iii) evaluating the effects of compost and compost placement in the establishment of haskap. It is expected that the results and recommendations will be adopted by haskap growers for sustainable management and production of organic haskap in Nova Scotia.

Keywords: compost, haskap berries, sustainable management, vegetative growth.

#54 - Poster

PENETRATION OF FUNGICIDES THROUGH INSECT NETS AND THEIR EFFECT ON THE DURABILITY OF THE NETS

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Albeit current in Europe, the use of insect nets for plant protection in apple orchards is relatively new in Northeastern North America. Our study, conducted in 2015 and 2016 at the CETAB+ experimental orchard in Victoriaville, Quebec, had three objectives. The first was to estimate the penetration of fungicide applications through nets. The second was to evaluate the durability and resistance of the nets as affected by fungicides and weather. The third was to compare the incidence and severity of apple scab (Venturia inaequalis) on leaves and fruits with and without netting. Three types of anti-insect netting were tested: Protek Net (Dubois Agrinovation, Quebec), Alt'Carpo, and Alt'tordeuse (Filpack, France). In 2015, the evaluation of fungicide penetration was carried out using water-sensitive papers placed underneath the nets at various depths into the plant canopy. These papers were analyzed to determine the surface covered by the sprays. Spots were counted and classified by size. Papers located inside the nets showed an even distribution of fungicide spray droplets, though reduced compared with papers located on trees without nets which showed full coverage. In 2016, an artificial tree receiving normal spray applications of the orchard was created to measure with more precision the amount of spray intercepted by the nets and passing through them. For the testing of the nets resistance and durability, pieces (0,15 m^2) of the different types of nets of various ages were immersed in solutions of each of the most commonly used fungicides against apple scab in organic orcharding : copper-based products, sulfur, lime-sulfur, and potassium bicarbonate. They were then exposed outdoors to wind, rain, and solar radiation. ASTM D Series tests for breaking strength, cut resistance and durability were conducted on subsamples. Over the 2015 growing season, the occurrence of apple scab on both leaves and fruits was not different with or without the presence of a net over the rows of Cortland semi-dwarf trees. However, the severity of the disease was greater in July without nets, indicating a direct or indirect effect of the nets presence on the development of apple scab.

Keywords: apple scab, insect net, fungicides

#55 - Poster

PRODUCING HIGH-QUALITY HONEYCRISP APPLES UNDER EXCLUSION NETS: HOW TO ALLOW POLLINATION WHILE EXCLUDING PESTS?

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While organic apple production can be difficult in the northeast because of the numerous pests affecting the crop, a row-by-row exclusion system currently under study by our team has proven its effectiveness for many key pests while not demonstrating adverse effects on Honeycrisp fruit load and quality. A major concern with row-by-row exclusion – the necessity of opening the nets to allow access to pollinators – has been studied for two years in our experimental orchard to evaluate the minimal period required for effective pollination with this production system. Results with this cultivar have shown that opening the nets on two occasions (full or half-days) was enough to provide a yield that did not differ from that in un-netted plots, provided that meteorological conditions for effective pollination were encountered on those selected days. Further reducing the pollination time reduced crop load but also reduced the time needed for manual fruit thinning, which could compensate – at least partially - for the time involved in opening and closing the nets during bloom.

Keywords: exclusion, apple, pollination, pesticides, physical control

#56 - Poster

EVALUATION OF SINGLE-PLOT NETS FOR THE PROTECTION OF APPLE TREES AGAINST INSECT PESTS WITHOUT PESTICIDES

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Conventional pest management in apple orchards involves using pesticides that are harmful to the environment and human health. In organic productions, pesticides treatments are expensive, sometimes less efficient and the complexity of pest management often leads to marketable fruits proportions around 50%. Organic and conventional apple growers need innovative and sustainable pest control methods and tools to reduce the risks of damages on their crops, and the arrival of new exotic pests makes this even more urgent. Since 2012, the CETAB+ and its partners have been working on a physical control method called "single-row" exclusion nets. This approach has been used in Europe for commercial apple production for more than ten years, and has made it possible for several orchards to stop using insecticides. The results we have had in Québec with these nets are very promising. The CETAB+ also tested a variant approach to allow easier orchard maintenance operations: "single-plot" exclusion nets. In this approach, the nets cover a whole plot – roof and sides –, the ground being enclosed in the isolated block of trees. We compared the efficacy of these single-plot nets to that of a usual organic pest management. Throughout the season, the monitored parameters were: insect populations, insect damages on fruits, diseases on fruits and leaves, and non-biotic damages on the fruits. Damages from codling moths (*Cydia pomonella*) and sawflies (*Hoplocampa testudinea*) were not abundant enough for us to draw any conclusion on the efficacy of the nets in excluding these insects, but the net prevented leafrollers (*Argyrotaenia velutiana* and *Christoneura rosaceana*) and apple maggots (*Rhagoletis pomonella*) from reaching and damaging the apples. However, several secondary pests thrived under the net. Moreover, the single-plot net seems to offer favourable conditions for apple scab (*Venturia inaequalis*) infections. Overall, single-plot netting has shown to be an interesting alternative to insecticides. Further research should focus on the behaviour of secondary pests and auxiliary fauna under the nets, so it can be adapted for a better pest management. The structure should be improved to allow a better control of apple scab infections and to minimize handling time.

Keywords: physical control, orchard, insect pests, apple

#57 - Poster

NEW INNOVATIVE WEED MANAGEMENT PRODUCTS FOR ORGANIC CROP PRODUCTION

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While demand for organic food has grown tremendously throughout the developed world, weed management remains the most significant agronomic problem associated with organic crop production. There is a need and a market for new, natural, non-synthetic weed management tools. The objective of this study was to evaluate improved biological and lower-risk, natural product, that are appropriate for use by organic growers to provide enhanced weed management. This study focused on crop safety and enhanced weed control efficacy of Manuka oil, an extract from the Manuka plant. When Manuka oil is applied in mixtures with other organic weed control products it controls or effectively suppresses weeds in organic crop production. Manuka oil was applied directed-postemergence alone or tank mixed with other products three weeks after planting tomato, sweet corn and pepper and again four weeks later. The best overall weed control was from a combination of Manuka oil plus Weed Zap and Manuka oil plus Horticultural Vinegar. This control was significantly improved compared to each product used alone. These results were comparable to control with a combination of the synthetic herbicide Callisto and Horticultural Vinegar. Yields from combinations of Manuka oil plus Weed Zap and Manuka oil plus Horticultural Vinegar were comparable to yields obtained with Callisto plus Horticultural Vinegar and the hand weeded control. The enhanced weed control efficacy associated with tank-mix applications of Manuka oil with essential oils or vinegar has the potential to significantly improve weed management in organic crop production. Unlike currently-approved products, Manuka oil displays systemic and soil activity and has pre-emergence activity on weeds. This research will satisfy weed control needs for organic crop production with effective and environmentally responsible natural weed control solutions that will improve productivity, increase yield potential and profitability. Innovative weed management solutions with natural source-products will provide alternatives to synthetic herbicides that will reduce risk to human health and the environment. New natural weed control products with superior weed management properties to control or effectively suppress weeds will help the organic crop production remain competitive and will enhance the sustainability of organic crop production into the future.

Keywords: Manuka oil, alternative weed control, soil activity, essential oils, Horticultural Vinegar

#58 - Poster

NOVEL CARROT-DERIVED OXYLIPIN (CX) CONFERS ACUTE AND SYSTEMIC ANTI-INFLAMMATORY EFFECT IN THE LIVER AND SMALL INTESTINE

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Phytoalexins are plant-protective compounds that often also have biological effects when consumed. We evaluated the effect of a carrot-derived phyto-oxylipin on acute and systemic inflammation in mice. Nuclear factor (erythroid-derived 2)-like 2 [Nrf2] is a transcription factor responsible for the regulation of a set of anti-oxidant, anti-inflammatory and DNA protective genes by binding the anti-oxidant response element [ARE]. Heme oxygenase 1 [Hmox1] is an ARE-responsive, stress-inducible enzyme that plays an important role in resolving inflammation. Twelve three-month old male C57BL/6 mice were divided into 4 groups: treated twice daily with 5 mg/kg phyto-oxylipin (CX) or sulforaphane (SF); positive (PC) and negative (NC) control groups were vehicle-treated. After seven days, mice received an intra-peritoneal injection of lipopolysaccharide (LPS; 5 mg/kg) (CX, SF, PC) or saline (NC) and were sacrificed after 4 hours. Plasma was recovered by cardiac puncture for analysis of inflammatory cytokines by multiplex ELISA; duodena were formalin-fixed, slide-mounted and H&E stained for microscopy imaging. Small intestinal mucosa was isolated and tissues were flash frozen for gene and protein expression analysis. Hmox1 was upregulated in all treatment groups with the greatest effect in the liver and small intestine of CX-treated mice. Proinflammatory cytokine Tnfα and it's receptor were downregulated in the small intestine. H&E stained duodena tissues were was evaluated for tissue architecture and inflammatory cell infiltration. Remarkably, qualitative score analysis established that CX demonstrated less inflammatory cell infiltration than the negative control despite LPS treatments. Additionally, there was a higher crypt epithelial mitotic rate in the PC and SF groups relative to NC and CX groups, suggesting an increased rate of intestinal epithelial turnover that was suppressed by CX treatments. Our study demonstrated that novel carrot-derived phytochemical CX effectively upregulates Hmox1 expression in the liver and small intestine. Additionally, CX showed a remarkable suppression of inflammatory cell infiltration in the duodenum despite LPS treatment, to levels below that of the saline treated control. In parallel, we are evaluating the effect of agronomic practice on CX accumulation in 2 carrot varieties; this research is ongoing with results expected in early 2017.

Keywords: carrot, heme oxygenase, inflammation, phytochemical

IMPACTS OF REDUCED TILLAGE AND DIVERSIFIED CROPPING UNDER ORGANIC MANAGEMENT ON COMMON WHEAT PRODUCTIVITY IN THE BROWN SOIL ZONE OF WESTERN CANADA

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An agronomic study was conducted at the Swift Current Research and Development Centre, near Swift Current, SK with the objective of determining if diversified crop rotations and reduced tillage under organic management in the semi-arid Brown soil zone can keep weed populations at low levels, soil fertility at adequate levels, and plants healthy for sustainable and profitable production. There were two crop rotations (Simplified: green manure (forage pea) – wheat; and Diversified: green manure (forage pea) – oilseed (mustard or flax) – pulse (lentil or field pea) – wheat), and two tillage systems (Low: reduced cultivation and mowing of forage pea; and High: more intensive cultivation, incorporation of forage pea by tandem double disk). The growing season in the years since this trial was initiated (2010) until 2014 had above-average precipitation, especially in June, and similar or lower temperatures than average. For 2011-15, wheat grain yields were significantly higher after green manure than a pulse crop, regardless of tillage intensity. In most years, the highest wheat yields were under High Tillage. Overall, N levels were significantly higher after green manure than any crop regardless of rotation, and under High than Low Tillage after green manure. The greater availability of N under High Tillage would explain the differences in grain yields between the two tillage systems. The highest weed biomass was generally in the Low Tillage Diversified Rotation, while their lowest levels occurred in the High Tillage Simplified Rotation. High weed biomass can be partially attributed to the establishment of perennial sow-thistle and Canada thistle, particularly in the Low Tillage systems. Starting in 2013, a decision was made to cut the perennial thistles at flowering to prevent their further spread to adjacent areas and the loss of this trial. Based on the results obtained in years with above-average precipitation, we can conclude that reduced tillage in this area might only be viable for a few years after which intensive tillage would be needed to achieve an adequate control of perennial thistle infestations. More intensive tillage with cultivator resulted in the greatest wheat yields and N levels, and lowest weed biomass, especially following green manure.

Keywords: reduced tillage, diversified rotations, wheat, green manure, pulses, oilseeds, perennial weeds

#60 - Poster

EXAMINING INTERCROPPING IN SASKATCHEWAN UNDER ORGANIC AND CONVENTIONAL CROPPING SYSTEMS

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Organic grain producers on the Prairies have been meeting their fertility needs, and much of their weed control needs, with green manure plow downs, although plow downs generally require the producer to forego a year of cash cropping. This is especially of concern now, as producers are encouraged by high organic commodity prices to crop continuously. Intercropping of pulses with competitive crops may provide an alternative to the poor weed suppression of the former and the lack of economic returns of green manures. The use of legumes in intercrops provides soil N, while more competitive crops provide weed suppression. Disease suppression may also be obtained in these mixtures. This type of intercropping is expected to improve the yield and quality of the following cereal crop. However, little information is available to organic producers in the Brown soil zone on the agronomic and economic merits of planting mixtures of legumes and cereals. For intercropping to be successful, the appropriate crop species combination and sowing densities need to be selected. A project initiated at Swift Current, SK in 2016 includes crop mixtures of chickpea/flax, lentil/oat, pea/yellow mustard, and lentil/fall rye, in addition to each of the sole crops and a green manure legume. Seeding ratios include an equal mix, and different ratios of each species. In the following year, all plots will be sown to wheat except the intercrop plots with fall rye. Information from this study will allow the identification of the best intercrop combination and ratio for achieving the greatest agronomic and economic benefit. Research on intercropping with legumes would also be useful to crop production under non-organic methods, by potentially reducing fertilizer and pesticide requirements, and allowing producers not to forego a year of cash cropping through summerfallow or green manure. Intercropping studies under conventional management include chickpea/flax trials at Redvers and Indian Head, in southeast SK, and a forage trial in southwest SK. It is expected that all these trials will generate new knowledge and understanding of various intercropping combinations in the Brown soil zone and beyond. An overview of results from these various trials will be presented.

Keywords: intercropping, organic production, conventional production, pulses, Saskatchewan

#61 - Poster

IMPACT DES CULTURES DE COUVERTURE ET DES ENGRAIS DE FERME SUR LA DYNAMIQUE SAISONNIÈRE DU NITRATE ET DE L'AMMONIUM DANS LA CULTURE DE LA CAROTTE BIOLOGIQUE EN TERRES NOIRES

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En agriculture biologique, les sources d'azote (N) efficace sont majoritairement des fumures animales (FA) riches en phosphore (P). Il est ainsi difficile de subvenir aux besoins des cultures exigeantes en N sans apporter un excès de P ou parce que les apports sont déjà limités par la richesse en P du sol déjà présente. Un essai de deux ans a donc été entrepris en 2015 à la plateforme d'agriculture biologique de l'IRDA à Saint-Bruno-de-Montarville (Qc) afin de valider une régie de fertilisation basée sur les cultures de couvertures (CC). L'essai comparait l'avoine et le pois, en parcelles principales, aux fientes de poules pondeuses granulées et au compost de fumier de bovin (CFB), en sous-parcelles, dans un dispositif en tiroirs subdivisés. Les flux de NO_3 et de NH_4 (AR204-SZRA et CR67-HMR, Ionics Inc.) ont été mesurés in situ par l'insertion de membranes d'échange ionique (MEI) du semis à deux semaines post-récolte. Des analyses chimiques ont aussi été réalisées et les rendements déterminés. Il en ressort que les flux de NO_3 sont déterminants, comparativement aux flux de NH_4, et que ce sont les CC qui ont généré les flux les plus élevés (1,3 à 1,5 fois) en début de saison malgré un apport jusqu'à 7 fois moindre de N total. Le CFB a généré les flux les plus faibles, souvent inférieurs au sol non fertilisé, en plus de donner les rendements vendables les plus bas et de hausser fortement le P Mehlich-3 du sol. L'intégration des CC comme source de N en culture maraichère biologique appert donc comme une alternative profitable à l'emploi des FA. Même utilisées seules, celles-ci ont soutenu des rendements vendables aussi élevés que ceux atteints avec les FA. Cela indique que la nature du N apporté et la composition en éléments autres du produit jouent un rôle déterminant dans la disponibilité du NO_3 à la culture et que la quantité totale de N apporté n'est pas le facteur principal sur lequel doit se baser la fertilisation. Dans le cas des CC, un impact sur les microorganismes impliqués dans la minéralisation du N organique pourrait être en cause.

Keywords: cultures de couvertures, engrais verts, biologique, terres noires, carottes

#62 - Poster

IMPACTS DE DIVERS TYPES DE FUMURES ANIMALES ET D'ENGRAIS VERTS EN PRODUCTION BIOLOGIQUE DE GRANDES CULTURES SUR LA DYNAMIQUE SAISONNIÈRE DE L'AZOTE DISPONIBLE DANS LA CULTURE DU MAÏS-GRAIN

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En grandes cultures biologique, il est difficile de soutenir les besoins élevés en azote (N) du maïs-grain. Pour certains agriculteurs situés en dehors des zones d'élevages animales, il peut être ardu de trouver des fumures animales (FA). Pour ceux étant dans ces zones, l'enrichissement des sols en phosphore limite souvent les apports de FA. Les engrais vert (EV) pourraient combler une partie des besoins en N. Un essai a donc été débuté en 2014 à la plateforme d'agriculture biologique de l'IRDA à Saint-Bruno-de-Montarville (Québec, Canada) afin de valider une régie de fertilisation de 3 ans (maïs-soya-blé) basée sur l'emploi d'EV, complémentés de démarreur de FA l'année maïs. L'essai en tiroirs subdivisés comparait en parcelles principales les engrais d'automne (vesce velue et trèfle incarnat semés mi-août, fumiers de bovin (FB) et FB composté en octobre), avec en sous-parcelles des démarreurs (100 kg $N_{disponible}$*/ha) (lisier de porc (LPS) et de bovin (LBS) en pré-semis, LP en post-levé (LPP)). Les flux de* NO_3 *et de* NH_4 *ont été mesurés* in situ *avec des membranes d'échange ionique (25 mai - 9 septembre) (Ionics Inc. Watertown, MA). Le maïs a été récolté le 4 novembre. Il en ressort que les flux de* NH_4 *ont été marginaux par rapport à ceux de* NO_3*. Ensuite, malgré des apports en* N_{total} *très inférieurs (3,5 à 5 fois), les EV ont généré du 25 mai à la mi-juillet des flux de* NO_3 *plus élevés (1,3 à 3 fois) que les FA. En absence d'apport d'automne, le LBS a généré les flux de* NO_3 *les plus hauts (1,2 à 1,4 fois) jusqu'en fin juin, en comparaison du LPS. Le LPP appliqué au 3 juillet a par contre présenté les flux de* NO_3 *les plus élevés durant la période où le maïs comble 60 % de ses besoins en N. C'est d'ailleurs le seul fertilisant qui a eu un impact sur les rendements, avec 0,9 Mg/ha de grains récoltés en plus, les autres fertilisants n'ayant eu aucun effet significatif. Le moment de disponibilité en N apparaît donc plus important que la fourniture totale. Enfouir les EV au printemps permettrait peut-être de mieux synchroniser leur libération de N et de profiter de leur capacité intéressante à générer du* NO_3*.*

Keywords: engrais verts, régie biologique, maïs-grain, membranes d'échange ionique, azote

#63 - Poster

CHIA: A NEW CROP FOR ORGANIC PRODUCTION IN QUÉBEC, RESULTS FROM 2015 PRELIMINARY TRIAL

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For the last few years, functional foods have arisen a lot of attention around the world due to increased interest in healthy lifestyle. Chia seeds are very high in omega-3 fatty acids which have many health benefits. Chia seeds are now used in many processed foods such as cereals and granola bars. Chia, *Salvia hispanica* L. (Lamiaceae), could become a crop contributing to the diversification and profitability of organic farms in Québec. Originating from South America, chia is a short-day flowering plant. Researchers from Kentucky have been able to develop lines which are able to flower under long days, may be sown as late as the end of June and still reach maturity. This two-year project will be conducted at the Organic Agriculture Innovation Platform (Saint-Bruno-de-Montarville, Québec) and will aim at comparing the seed yields from chia crops sown at three different dates and three seeding rates. Insect pests and diseases will be monitored weekly. In order to determine the feasibility of chia production in Québec, an economic analysis will be performed based on the production costs. Results of a preliminary trial completed in 2015 will be presented.

Keywords: chia, Salvia hispanica, organic oilseed production, functional food

#64 - Poster

PHOSPHORUS SOURCES AND ARBUSCULAR MYCORRHIZAL INOCULATION TO IMPROVE ORGANIC CROP YIELD

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Phosphorus (P) is highly reactive in soil and largely unavailable to plants. Phosphorus is an essential plant macronutrient and its availability can limit plant productivity even in soils with high P content. Certified P sources are typically slow-release and may not optimize crop yield. Arbuscular mycorrhizal fungi (AMF) help plants acquire P from soil through a symbiotic association that may raise the efficiency of slow-release fertilizing materials. We tested the hypothesis that the combined use of the commercial AM inoculant AGTIV™ and composted manure or rock phosphate, two slow release P sources, can optimize organic crop production. Composted manure increased pea yield in Beaverlodge experimental farm, but decreased lentil yield in Swift Current experimental farm; rock phosphate had no effect on plant productivity. AGTIV™ did not improve the fertilizing value of composted manure and rock phosphate in Beaverlodge, but reduced the level of mycorrhizal root colonization at high level of rock phosphate, indicating the ability of AGTIV™ to compete with resident AMF. Composted manure and rock phosphate had not influence on the productivity of lentil grown on low P soils on two commercial organic farms of southwest Saskatchewan. However, AGTIV™ increased mycorrhizal root colonization slightly and lentil yield by 28% on one of two organic farms. No effects of inoculation were detected on the other organic farm, perhaps due to the severe drought experienced at this site. The results highlight the importance of soil biological fertility for efficient use of nutrients by plants. Flax should be planted in the experimental plots in 2016 to reveal the legacy effect of AGTIV™ and fertilization.

Keywords: organic, AMF, fertilizer

#65 - Poster

THE EFFECT OF MECHANICAL WEED CONTROL (ROTARY HOEING, POST-EMERGENCE HARROWING AND INTER-ROW CULTIVATION) AND CROP SEEDING RATE ON YIELD AND WEED SUPPRESSION IN ORGANICALLY GROWN PEA AND LENTIL.

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Weed control is a major challenge for organic producers, as synthetic herbicides, fertilizers and pests are prohibited in organic production. Nevertheless, organic farmers mainly rely on crop rotation and cultural practices, tillage still remains important component of their weed management system. This study will determine effect of mechanical weed control (rotary hoeing, post-emergence harrowing and inter-row cultivation) and crop seeding rate on yield and weed suppression in organically grown pea and lentil. Experiments will be conducted on certified organic land in Kernen Research Farm and Goodeve in Saskatoon, SK. Seeding rates for both crops will be 1x and 2x according to organic recommendations. Initially, two passes of Rotary-mini will be done as a pre-emergence weed control. Next, harrow will be applied as a post-emergence weed control. Finally, as the Rotary mini-till and harrowing could not suppress large weeds the inter-row cultivator will be used. Achieved results will be presented at the conference.

Keywords: mechanical weed control, rotary mini-till, harrowing, inter-row cultivation, organic, pea, lentil, weed biomass

#66 - Poster

EFFECT OF IRRIGATION REGIMES ON WEED CONTROL IN ORGANIC CRANBERRY PRODUCTION.

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The American Cranberry (*Vaccinium macrocarpon*) is one of three berries native to North America. Quebec is the leading producer of organic cranberries in the world. One of the major issues that compromise organic cranberry production is weed management. When weeds establish themselves in a cranberry field, they compete with the crop for physical space, create shade that adversely affects pollination and delay fruiting in fields under establishment, causing yield losses estimated at more than 25% of production. Studies on cranberry irrigation have demonstrated its strong response to irrigation, mainly associated with the hydraulic properties and capillary rise in sandy soil (Bonin, 2008). Cranberries require a significant amount of water availability when the crop is being established. This water availability fosters the establishment of weeds. Optimized irrigation management should allow the cranberry to establish itself and occupy the space while avoiding the invasive establishment of tough perennial weeds. The purpose of this study is to test the effect of optimized irrigation regimes on weed suppression in a cranberry field under establishment and in a field in production. The proposed optimized irrigation regimes in this activity consider soil-moisture tension, canopy temperature and the amount of water needed by the cranberry crop to form roots during establishment. The recovery rate of the cranberry and the recovery rate and identification of the weeds is compared in the different study plots. In 2013, we compared three water regime in a field in production. The dryer irrigation treatment (-4,5 to -10 kPa) lead to an increased yield as high as 14%, while reducing the amount of water used by 14 to 82%. Despite the use of differential irrigation treatments during two years of experiment, this had little effect on the biomass of the established cranberry plants and on weeds. In fact, the field was really clean (weeds were present at a rate of 1% and less). We expect a more important impact of the differential irrigation at the establishment of cranberry vines in a newly planted field, an experiment to be conducted in summer 2016.

Keywords: weed, cranberry, irrigation

#67 - Poster

HERBICIDAL POTENTIAL OF ESSENTIAL OILS

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Growth chamber experiments were conducted at the Organic Agriculture Innovation Platform, at St-Bruno-de-Montarville, Québec to determine the herbicidal effect of plant-derived oils. The first objective of this research was to screen commercially available essential oils for herbicidal activity. Height different oils at concentration of 15% were applied to seedlings at 2-leaf stage of lambsquarters (Chenopodium album) and barnyard grass (Echinochloa crus-galli). Essential oils from cinnamon, clove and wild bergamot were the most phytotoxic. In a second experiment, different concentrations of these three oils ranging between 0 to 30 % were applied on both weeds at the same growth stage. Dose-response curves were used to determine the LD50 and select the optimum dose. Lambsquarters was more susceptible than barnyard grass. Adding soap base to essential oils increased herbicidal activity.

Keywords: essential oils, herbicidal activity

#68 - Poster

WEEDS UNDER REDUCED TILLAGE AND DIVERSIFIED ORGANIC CROPPING SYSTEMS IN THE BROWN SOIL ZONE OF WESTERN CANADA

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An agronomic study was established in 2010 near Swift Current, SK to determine if diversified crop rotations and reduced tillage under organic management in the semi-arid Brown soil zone can keep weed populations at low levels, soil fertility at adequate levels, and plants healthy for sustainable and profitable production. There were two crop rotations (Simplified: green manure (forage pea) – wheat; and Diversified: green manure (forage pea) – oilseed (mustard or flax) – pulse (lentil or field pea) – wheat), and two tillage systems (Low: reduced cultivation and mowing of forage pea; and High: more intensive cultivation, incorporation of forage pea by tandem double disk). Weed populations were assessed in mid-July by identifying and counting all weeds in twenty quarter metre square quadrats per plot in 2014 and 2015. Precipitation was higher than average from 2010 to 2014, and lower than average in 2015. In 2014 and 2015, the lowest weed densities were in the High Tillage Simplified Rotation. Under drier conditions, the Low Tillage Simplified Rotation had lower total weed densities than the Diversified Rotations regardless of tillage. Species richness was higher under Low Tillage and wet conditions. The dominant weed species were similar in all systems; stinkweed (*Thlaspi arvense* L), lamb's-quarters (*Chenopodium album* L.) and redroot pigweed (*Amaranthus retroflexus* L.) were the most abundant species in all systems in both years. Redundancy analysis identified perennials and winter annuals that were significantly associated with Low Tillage Systems and some annuals that were associated with each of the Diversified Rotations. Wet conditions contributed to the establishment of perennials. Perennial thistles (Canada thistle, *Cirsium arvense* (L.) Scop. and perennial sow-thistles, *Sonchus arvensis* L.) were first identified as a problem on the site in 2013, and the flowering heads were removed as necessary to slow their spread from 2013 to 2015. However, Canada thistle continued to spread within the plots even under the dry conditions of 2015. While the High Tillage system was able to delay the establishment of the perennial thistles neither tillage system was able to prevent their vegetative spread, necessitating a change in tillage management.

Keywords: weeds, Canada thistle, reduced tillage, diversified cropping systems

THE CONTROL OF TARNISHED PLANT BUG IN ORGANIC STRAWBERRY FIELD

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The tarnished plant bug (TPB), *Lygus lineolaris* (P. de B.) (Hemiptera: Miridea) is a major pest of strawberry causing fruit deformities when adult and nymphs make nutritional puncture on developing fruits. No organic insecticides are registered for organic growers to control the TPB in Canada whereas this pest causes major economic loss in untreated strawberry crops. Our objective was to evaluate the effect of four organic insecticides on TPB mortality, fruit damage and yield in a two years study. The experiment was realized in a CLERY CIV® strawberry field planted on black plastic mulch. The experimental unit was composed of netted cage displayed in a complete randomized block design and TPB were introduced in netted cage the day of the first insecticide application. The four insecticides were applied repetitively at 3 or 7 days of intervals during 15 days. Populations of TPB were evaluated 72h and 7 days after applications. Percentage of damaged fruits and yield were recorded over the season. Results observed during both years will be relevant for insecticide registration in Canada and finding valuable solution for organic growers.

Keywords: strawberry, tarnished plant bug, control, organic insecticides

LARGE-SCALE IMPLEMENTATION OF MATING DISRUPTION IN ORGANIC AND CONVENTIONAL APPLE ORCHARDS TO REDUCE INSECTICIDE APPLICATIONS IN QUEBEC.

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A large-scale implementation program of mating disruption against a major insect pest in apple orchards, the codling moth, *Cydia pomonella* (L.) was initiated in 2016 in Quebec, Canada. The two-year program is financially supported by the "ministère de l'Agriculture, des Pêcheries et de l'Alimentation" of the Quebec government and run by the Research and Development Institute for the Agri-Environment. The program involves the participation of public and private consultants who will support the apple growers in using this pest-specific technology, much different from insecticide applications. Mating disruption has already been scientifically demonstrated as effective in both reducing insecticide applications and preventing fruit damage on apples. This technology relies on the installation of a series of dispensers that saturate the air of synthetic sexual pheromone, reducing mating, female fertility and thus the number of larvae that cause damage to apples. To effectively maximize mating disruption, this method should be carried out on large surfaces. Therefore, the program aims at implementing mating disruption of codling moth in 25% of orchards in all apple growing regions of Quebec. We envisage that mating disruption becomes the main method for codling moth control in apple orchards in Quebec. We also expect a significant reduction in the number of insecticide applications made against this insect and in the risks associated with their use, for a better protection of the environment and human health.

Keywords: areawide, pest management, Lepidoptera, Tortricidae, *Malus*

#71 - Poster

STUDY OF A FLOWERING STRIP AND ITS IMPACT ON NATURAL ENEMIES OF LEPIDOPTERAN PESTS OF ORGANIC COLE CROPS IN QUÉBEC – FIRST RESULTS

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Organic cole crop production has many challenges among which the control of a few species of Lepidopteran pests: diamondback moth (*Plutella xylostella* L.), imported cabbageworm (*Pieris rapae* L.) and cabbage looper (*Trichoplusia ni* Hübner). Very few tools are available to control these caterpillars in organic cabbage production. The use of flowering strips adjacent to crops contribute to the functional biodiversity of an agroecosystem. This management strategy offers more plant resources such as pollen and nectar, as well as shelter to natural enemies. Laboratory and field experimentation conducted in Switzerland at the Research Institute of Organic Agriculture (FiBL) has led to the development of the following flowering mix "FiBL Flowering strips 2012/1" to be used in cole crops against some Lepidopteran pests. The main objective of this 3-year project is to determine the potential of this flowering plant mix to encourage the presence and activity of natural enemies of Lepidopteran pests of cabbage in Québec. More specifically, this study will look at the optimal establishment of the flowering plant mix comprised of *Fagopyrum esculentum* Moench, *Centaurea cyanus* L., *Vicia sativa* L. and *Ammi majus* L.. It will also evaluate the impact of the flowering mix on the abundance of Lepidopteran pests and their natural enemies on cabbage crop, particularly their parasitoids. Results from 2015 experimentation looking at the establishment (growth and flowering periods) of the flowering plant mix will be presented. Insect sampling showed that many parasitoids of Lepidopteran pests of cabbage, such as *Diadegma insulare* Cresson, *Microplitis plutellae* Mues. and *Cotesia* sp. are foraging in the flowering strips. Many species of predators were also collected from the flowering strips.

Keywords: Plutella xylostella, Pieris rapae, parasitoids, flowering strips, cole crop

#72 - Poster

EVALUATION OF SEED TREATMENTS IN HULLESS PUMPKIN SEED PRODUCTION

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Hulless pumpkin seed production has a good potential for the diversification of organic field crop farms in Québec. However, seedlings are very sensitive to soilborne pathogens that cause damping-off and there is actually no efficient and organic seed treatment available. Sowing seeds coated with copper oxychloride (Copper Spray®), priming seeds with or without biological fungicides coating and pre-germinating seeds without or in solutions of biological fungicides (Mycostop® WP *Streptomyces griseoviridis*, Serenade® Max WP *Bacillus subtilis*, Actinovate® SP *Streptomyces lydicus* and Rootshield® HC *Trichoderma harzianum*), were evaluated in growth chambers and field experiments, conducted at the Organic Agriculture Innovation Platform (Saint-Bruno-de-Montarville, Québec), in 2014 and 2015. Phytotoxicity, germination percentage and dry biomass of these treatments were compared with controls (untreated), two weeks after seeding, in sterilised and unsterilized soil naturally contaminated with *Pythium aphanidermatum* (Edson) Fitzp. No phytotoxicity symptoms were observed for all treatments. In growth chambers and field experiments, percentage of germination varied between doses of copper oxychloride, from 3 to 16 % and 31 to 53% respectively, while no germination occurred in the non-treated control. Primed seeds and/or biological fungicides did not result in the control of *P. aphanidermatum*. Pre-germination of seeds was the best strategy evaluated in growth chamber to increase seed germination, with an average percentage of germination of 72%. Field experiment comparing the highest doses of copper oxychloride, pre-germination and the use of transplants was also conducted in 2015. Germination percentage, bacterial wilt, *Erwinia tracheiphila* (EF Smith) Holland, incidence and seed yield were evaluated. In both seeded treatments, germination was low and heterogeneous. Seedlings were also very attractive to the striped cucumber beetle, *Acalymma vittatum* (Fabricius), which aggregated and fed actively on newly emerged plants. Mechanical weeding was not effective in these treatments, because of the heterogeneousness of plants. The incidence of bacterial wilt and seed yield were 38, 24 and 23% and 234, 574 and 1062 kg/ha in copper oxychloride, pre-germinated seed and transplants treatments respectively. Lack of maturity of the seeded plants could also be a concern in case of early autumnal frost.

Keywords: hulless pumpkin seeds, damping-off, *Pythium*, seed treatments, biological fungicides, copper

EFFECT OF GREEN MANURES ON RESIDUAL SOIL WATER, AVAILABLE N AND SUBSEQUENT DURUM WHEAT YIELD IN DRYLAND AGROECOSYSTEMS.

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In organic production systems, green manures play a key role in supplying nutrients to the soil for the benefit of following crops. However, little is known about how the agronomic management practices of green manures would provide best benefits to a cereal crop grown in the subsequent year. In this study, we determined the effect of green manure on residual soil water, residual soil N and the subsequent durum wheat (*Triticum turgidum* L.) performance in comparison with the effect of preceding dry pea (*Pisum sativum* L.) that was harvest for silage or for grain and spring wheat (*Triticum aestivum* L.) that was harvested for grain. Three green manures [black lentil (*Lens culinaris* Medik.), chickling vetch (*Lathyrus sativus* L.), and forage pea (*Pisum sativum* L.)] were grown in 2006, 2007, and 2008, along with pea, wheat, and a summerfallow (check) in Saskatchewan (50.28° N, 107.79° W). Each green manure was planted in May (as Early treatment), June (Mid-treatment), and July (Late-treatment) and were terminated after 7 to 9 weeks. Durum wheat was grown the year following these treatments. At durum wheat planting, the green manure treatments had the same amount of water in the 0-1.2 m soil profile as the summerfallow in both 2007 and 2009 but less water compared with the summerfallow in 2008. Summerfallow provided highest soil N among all treatments in 2007 and 2008, but lower soil N than green manure treatments in 2009. Green manure treatments increased subsequent durum wheat grain yield by 19% compared with preceding silage pea or dry pea and by 54% compared with preceding spring wheat, but decreased yield by 12% compared with summerfallow treatments. The green manure with late planting and termination enhanced soil-water conservation and offered input-saving advantages compared with the early- and mid-planting and termination treatments. Overall, green manure treatments enhanced soil water storage, provided N benefits, and increased subsequent durum wheat yield compared with crops harvested for grain.

Keywords: residual soil water, residual soil N, green manure, durum wheat

#74 - Poster

EVALUATION OF COVER CROP PLANTING DATE ON LETTUCE IN TWO SOIL TYPES

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Use of cover crops is a cultural practice that greatly modified soil properties that consequently affects the main crop. Cover crops help promote soil fertility, improve its structure, reduce erosion, increase biological activity, which generally increase yield. Many vegetable growers have integrated cover crops in their production schedule however most of them bury the crop in the fall, leaving the ground bare all winter. The main reasons mention for this practice is the complexity of soil work in the following spring and the risk that ground work is slowed by too abundant residues. As soil erosion is a real problem in vegetable production, the use of cover crop during winter should be considered. Thus, this project aims to determine the impact of the cover crop planting date on a lettuce main crop in two soil types. Five planting dates for the cover crop (oat) were compared to control plots (no cover crop and cover crop buried in autumn) in a sandy and loam-clay soil. Lettuce were planted the following summer and several parameters were noted, such as soil properties and lettuce development and yield. The results obtained demonstrate that cover crop treatments had an impact on soil compaction the following spring. Soil compaction was lower in treatment with cover crop buried in autumn compare to cover crops left over the winter. Lettuce showed a different growth and weight according to planting date and soil types. Results of this project showed the important role of cover crop on soil structure and main crop (lettuce). Thus, producers will have additional information to establish farming practices that conserve and improve soil health.

Keywords: cover crops, soil erosion, soil type, planting date

#75 - Poster

INFLUENCE OF ALLELOPATHIC COVER CROPS AND THEIR RESIDUES ON THE GROWTH OF PERENNIAL THISTLES IN THE BROWN SOIL ZONE

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Perennial weeds have been identified to be a major threat to organic crop production. Maintaining a healthy, living soil rich in organic matter with good physical structure however poses challenges to organic producers attempting to control highly invasive perennial plants like Canada thistle (*Cirsium arvense*). Although organic producers often use intensive tillage and cultivation for thistle control, this is neither a sustainable practice nor economically feasible, driving producers to search for effective control alternatives. A greenhouse study was conducted at the Swift Current Research and Development Centre to explore the possible suppressive effect of some cover crops with allelopathic potential on the growth and development of Canada thistles. Three cover crops (hairy vetch [*Vicia villosa*], spring rye [*Secale cereal*] and tillage radish [*Raphanus sativus*]) that have been documented to exert weed suppressive effects, and forage pea [*Pisum sativum*] (a non-allelopathic cover crop but with potential to increase soil fertility) were first potted and terminated close to flowering for their residues by uprooting and shredding the shoots and roots. Canada thistle roots, collected from an organically managed field in Swift Current were cut into 2.5 cm long pieces with a minimum of one bud per piece and planted alongside another set of the same cover crop seeds. The plants were simultaneously transplanted (7 plants of each cover crop: 3 thistle plants) at the 3-4 leaf stage. The experiment was then laid out in a 3 X 4 completely randomized factorial design consisting of three cover crops' applications (live plants - with no crop residue, and two crop residue applications - as surface mulch or incorporated) and four levels of cover crop species. Treatments were replicated three times with the pots being watered three times a week. Results from this experiment will be presented. This greenhouse experiment will complement a field trial with the same cover crop species and similar treatments starting in 2016.

Keywords: allelopathy, Canada thistle, cover crop, crop residue, organic

#76 - Poster

ROOT AND SHOOT CHARACTERIZATION OF FOUR COVER CROP SPECIES

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Nitrogen budgeting is a complex task in organic cropping systems, and assessing the contribution of cover crops to soil fertility is a research priority for Canadian organic growers. Generally, only shoot biomass of cover crops is considered when estimating the contribution of cover crops to nitrogen budget and fertilization plan. On rare occasions, root N contribution is calculated based on estimates of the root:shoot ratio. However, C:N ratios of shoot and root biomass differ greatly. Therefore, there is a need to advance our knowledge on cover crop root contribution to soil fertility. The objective of the study was to characterize biomass and chemical properties of cover crop roots and shoots, at varying growth stages. The experimental design was a split-plot, with 5 replicates. Four cover crop species were studied: red clover (*Trifolium pratense* L.), field pea (*Pisum sativum* L.), common vetch (*Vicia sativa* L.), and oat (*Avena sativa* L.). Cover crops were sampled at four growth stages: 4, 6, 8, and 10 weeks. The study was conducted in a growth chamber, with a 16-hour photoperiod period, air temperatures of 21°C (day) and 18°C (night), and air humidity of 70%. Dry biomass and C and N concentrations were measured in both roots and shoots. Shoot:root and C:N ratios were also determined. Preliminary results showed that red clover produced the least amount of root biomass among all four cover crop species tested. Results from this project will help to quantify the respective N contribution of cover crop roots and. On a broader scale, improving our understanding of soil N budget may help to reduce losses from cover crop-based cropping systems. Our results may also be of interest for farmers harvesting aboveground biomass of cover crops through haying or grazing, but still counting on cover crop roots for improving soil fertility and soil health. Further research projects (2016-2021) will evaluate cover crop root mineralization dynamics, respective contribution to soil N supply from cover crop roots vs. shoots, and root N partitioning in various soil N fractions. Funding for this research was provided by National Sciences and Engineering Research Council of Canada (NSERC).

Keywords: cover crop, root, N cycling, C:N ratio

#77 - Poster

THE EFFECT OF GREEN MANURE AND ORGANIC AMENDMENTS ON WHEAT YIELD, NITROGEN UPTAKE AND SOIL MINERAL NITROGEN

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Fertility management is challenging for organic crops. The effect of different crop sequences varying in pre-wheat green manures (GrM); time of GrM incorporation (fall and spring); and an organic biofertilizer (Actisol-pelletized poultry manure), applied @ 0, 40, 80 and 120 kg total N ha^{-1}) before wheat planting were tested in three-year organic wheat rotations in two locations in Canada (Cerom, QC and Truro, NS) in 2014 and 2015. Crop rotations/pre-wheat GrM treatments and Actisol application significantly influenced wheat biomass yield, tissue N content, total N uptake, grain yield and grain protein content. Time of GrM incorporation largely had no impact on these parameters measured. Hairy vetch/oats (HVO) GrM consistently generated the most biomass and N uptake from legume N_2 fixation. On average, around 225, 125 and 100 kg ha^{-1} total N were accumulated in above ground biomass by HVO mix, common vetch/oat (CVO) mix and red clover/oat mix. On average over all locations and years, HVO resulted in the greatest grain yields (~2800 kg ha^{-1}) followed by red clover (~2300 kg ha^{-1}). Wheat grain yields were about 1818 kg ha^{-1} when no Actisol was applied but increased by 25, 40 and 50% in response to 40, 80 and 120 kg (N ha^{-1}) Actisol application treatments, respectively. Grain protein content increased 14 and 18% following RCO and HVO GrM respectively compared to oat GrM (12.87%) and gained by 5, 8 and 11% in response to 40, 80 and 120 kg (N ha^{-1}) Actisol rates, respectively, compared to the control (13.70%). Crop responses corresponded to the pattern of soil mineral N (SMN) measured in the spring [before planting, 30d after planting and residual soil mineral N (RSMN)]. On average over locations and years, 30d total SMN (NO_3-N and NH_4-N) among crop rotations ranged between 19 to 35 kg N ha^{-1}, being the highest with HVO. Among Actisol treatments, 30d total SMN ranged between 18 to 48 kg N ha^{-1} being the highest with 120 kg Actisol N ha^{-1}. Initial SMN and RSMN followed similar trends however, greatly varied between the two locations and years.

Keywords: green manure, wheat, organic amendment, Actisol, mineral nitrogen

#78 - Poster

ASSESSING NUTRIENT STATUS OF ORGANIC GRAIN FARMS ON THE CANADIAN PRAIRIE

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The sustainability of organic production systems depends on maintenance of soil fertility and adequate nutrient supply to crops. Many organic grain farms in the Canadian prairie region take a "low-input" approach to crop production, relying on biological fixation by legumes for nitrogen (N) supply and inherent soil fertility for other nutrients (P, K, S, Ca and micronutrients). Sub-optimal crop yields and low soil test levels of certain nutrients suggest that many prairie organic farms have not optimized their nutrient management. In this study, we developed tools for assessing nutrient status on organic farms and conducted a pilot study using these tools on organic farms in Manitoba and Saskatchewan in 2014-2015. The tools include: 1) whole-farm nutrient budgets to identify nutrient surpluses and deficits and 2) green manure crop bioassays to assess nutrient-supplying power of the soil. These tools are components of a "farm system co-design" process that brings together farmer knowledge and the agronomic expertise of researchers or consultants to support sound, farm-specific decision-making. Nutrient budgets were constructed for 4 farms in 2014 and 9 farms in 2015, based on information provided by the farmers, nutrient analysis of farm inputs and outputs, and appropriate estimates. The information gathered for the budgets (i.e. crop acreages and yields; use of green manures, livestock manure and other inputs; etc.), as well as the nutrient balances themselves, provide insights not only into the status of farms in the budget year but also into the effects of past management on performance of the current crop. Green manure bioassays were conducted on 3 fields on 2 farms in 2014 and 17 fields on 11 farms in 2015. Green manure plant biomass production was assessed and plant nutrient concentration was analyzed. Relationships between soil test results, green manure nutrient status and performance of the subsequent crop are being investigated. Preliminary results indicate that soils on some farms are unable to supply sufficient P to green manure crops. K and S are not limiting to plant growth on most farms included in the study.

Keywords: soil fertility, nutrients, green manure, grain

#79 - Poster

IMPACT OF AMF INOCULATIONS ON THE FUNGAL ASSEMBLAGES INHABITING PULSE ROOTS UNDER ORGANIC FARMING WITH AMF INOCULATION

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Organic farming is considered to be more sustainable than conventional farming practices. Phosphate is one of the most critical nutrients limiting plant growth and yield. The efficiency of P-utilization can be improved by introducing beneficial microorganisms, such as Arbuscular Mycorrhizal Fungi (AMF), to the crops. However, the impact of AMF addition on the root-associated fungal assemblages, which may influence crop health and yield, are not well known. Here we present a study using different phosphate inputs and forms (rock and manure), and AMF inoculation (AGTIV™) on the two pulses (lentil in Swift Current, SK [SC] and pea in Beaverlodge, AB [BV]) in the Canadian prairies. We analyzed the composition of the fungal community closely related with crop roots using Illumina MiSeq sequencing of ITS fragments. The aims were to understand 1) the fungal community structure, 2) the fungal diversity, and 3) the significant fungi in the core microbiomes under different P-additions and AMF-inoculation. The fungal community associated with pea roots in BV tended to be more diverse than that of lentil in SC. The communities were mainly composed of members of the Ascomycota (>95% in SC and > 80% in BV). Interestingly, AMF inoculation did not increase the relative abundances of Glomeromycota. Fusarium was the dominant genus among Ascomycota (>40% in SC and >30% in BV). The overall fungal compositions significantly differed in the two experiments, and with the inoculation-P fertilization interaction. However, the P-source did not significantly influence the composition of the fungal community. Heat maps of the relative abundances of fungal taxa showed different fungal core microbiomes in pea roots in BV and lentil roots in SC. According to our results, the fungi selected by the crops depended on the location/identity of the crop, and the interaction between AMF inoculation and P-addition, indicating that organic farming practices influence the fungal assemblages associated with crop roots. A better knowledge of this impact is needed since the fungal community associated with crop roots may strongly affect crop health and abiotic stress-resistance.

Keywords: organic farming, phosphate, AMF, MiSeq, fungal assemblages, Fusarium, lentil, pea, pulse

#80 - Poster

ORGANIC SOYBEAN PRODUCTION WITH INFLUENCES OF CROP ROTATION, WEED POPULATIONS AND MANAGEMENT ON MYCORRHIZAL GROWTH AND SOIL HEALTH

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Soybeans (*Glycine max* L.) are an important agricultural crop in many parts of Canada for their use in both livestock and human food products. Soil mycorrhizal associations with soybean roots form an important beneficial symbiotic relationship that enhances biological nitrogen fixation. However, in organic systems, frequent tillage and low residues returned to the soil from soybeans may negatively affect soil health. The Cornell Soil Health test (CSHT) combines a selected series of tests of soil physical, chemical and biological properties, but needs regional validation. The objectives of this organic project are: 1) to determine what influence crop rotation, weed presence and composition have on soybean nitrogen uptake and yields, soil microbial community diversity using phospholipid fatty acid (PLFA) techniques; and the abundance of soybean root mycorrhizal infection; 2) to evaluate the robustness of the CSHT and assess the influence of crop rotation, rotation phase, and weed presence or absence in the soybean phase, on soil health. This project, which is expected to run from late summer of 2016 to the spring of 2018, will be conducted on existing cereal cropping system studies at Dal-AC in Truro. The fully-phased experimental design is composed of 3–year crop rotations with soybeans following wheat, which was preceded by a green manure of red clover, common vetch and oats (CVO), or hairy vetch and oats (HVO). Also included are a 2-year soybean-wheat sequence, and continuous bare fallow. In the soybean phase two subplots per plot are maintained as weed-free throughout the growing season. In July each year weed biomass sampling will be done to quantify the weed species diversity, community composition, and biomass. Repeated soybean sampling will determine the shoot and root biomass, shoot N uptake, crop yields, and root mycorrhizal infection levels. Soil sampling and other field measurements will also be done, followed by the appropriate lab analysis for each chosen CSHT property and PLFA analysis.

Keywords: organic, soybeans, crop rotation, weed management, mycorrhizae, Cornell Soil Health Test

#81 - Poster

SOIL HEALTH: COMPARING FARMERS' PERCEPTIONS AND METHODS OF ASSESSMENTS

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Decades of research have debated the concept of soil health, but definitions of the term remain disputed (Kibblewhite et al., 2008). Doran et al. (1996) propose that soil health is the combination of physical, chemical and biological properties that promote the ability of a soil to support human, plant and animal needs while maintaining or enhancing environmental quality. Such broad definitions give rise to questions of how to measure or assess soil health on a practical basis. Cornell's Comprehensive Assessment of Soil Health is one well-known recent attempt to develop a robust test of soil health, and there is interest in validating this test across farms in Atlantic Canada. Additional lab-based approaches include the use of *Folsomia candida* (Willem) as a bioindicator of agricultural soil quality (Nelson et al., 2011), and the measurement of soil phospholipid fatty acid (PLFA) profiles to quantify microbial functional groups in the soil under different agricultural management strategeis (de Vries *et al*., 2013). Farmers play a major role in determining the soil health at the field, farm and regional level, however, there may be a wide gap between farmer and scientist interpretations of "soil health". This study explores Maritime farmers' perceptions of soil health, how farmers assess soils on their farm, and how well farmer assessments relate with three lab-based assessments: the Cornell Soil Health Test; growth of the bio-indicator *F. candida*; and phospholipid fatty acid analysis (PLFA). In addition, links will be drawn between the soil health of a field, and the intensity of management, as measured by tillage, organic matter return, degree of monoculture, and use of fertilizers/herbicides. These questions will be explored by use of farm soil surveys and farmer surveys across Nova Scotia, New Brunswick and PEI. Both organic and conventional farmers will be surveyed to allow for comparison between these two groups. This work will provide insights into the accuracy of farmers' soil assessments as an indicator of how knowledgeable farmers are about soil processes. The results will identify gaps between farmer's soil health perceptions and laboratory soil health assessments, and assess robustness of different lab based tests, to help provide direction for extension workers.

Keywords: soil health, farmers' perceptions, Atlantic Canada, soil quality, Cornell soil health assessment

#82 - Poster

EFFECT OF GROUND COVER MANAGEMENT ON YIELD AND LEAF NUTRIENT CONCENTRATIONS IN AN ORGANIC HONEYCRISP APPLE ORCHARD IN NOVA SCOTIA CANADA

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Suitable cover crops and residue management systems need to be identified for organic orchards to improve soil and yield productivity. This study investigated the effect of various cover crops treatments on organic apple (*Malus domestica* Borkh cv. Honeycrisp) yield and leaf nutrient concentrations in Nova Scotia over three years. Various cover crop mixtures including legumes, cereals and grasses were planted using a modified Swiss Sandwich System. The different treatments did not affect apple yield. In addition to C and N contribution of legume-based cover crops, they affect K availability. Soil available K concentration was increased in the third year of the study compared with the initial values in the bare strip across cover crop treatments. Bare ground (BG), triple mix and alfalfa (ALF) resulted in higher leaf Mn concentration in only 2012 and BG, sweet clover/oats mixture (SCOM), ALF resulted in higher leaf P concentration in 2014 compared with other treatments, while lowest Mn and P concentrations were measured in red clover/oats mixture (RCOM) in corresponding years. The RCOM, pea/oats/vetch mixture (POVM), and TM treatments appeared to add the greatest amount of available K to the soil among treatments. Our results suggest the importance of the cover crops for managing nutrient efficiently in organic apple orchards.

Keywords: ground cover management, leaf nutrient concentrations, organic Honeycrisp apple

LACK OF SOCIAL INFLUENCE ON THE DEVELOPMENT OF GRAZING BEHAVIOUR IN DAIRY HEIFERS

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The objective of this experiment was to test the influence of previous social housing and pasturing with an experienced grazer on the development of grazing behaviour in heifers. A 2X2 factorial experiment (previous social housing: individual versus paired; grazing experience of companion: naïve versus experienced) was conducted over two grazing seasons with two groups of 12 Holstein heifers of similar age (131±13.0 d). Before entering the experiment, animals had been reared in hutches with an outdoor pen, either individually or in pairs. In each season, experimental heifers with no prior grazing experience were randomly assigned to 12 pasture sections (5 X 50 m), and paired with a heifer with a 4-wk grazing experience or with another naive heifer. Experimental sections of pasture were separated by buffer sections of equal size to reduce influence of one treatment on another, and animals were moved to new pasture sections every 2 to 5 d to ensure a fresh supply of forage. Live observations were conducted by two observers using scan sampling for 6 h on d 2, 3, 4, 11 and 18 following introduction to pasture. Previous social housing or pasturing with an experienced companion did not affect time spent grazing, but heifers grazed more on d 18 (52.8±1.71%) than on d 2 (42.4±2.90%; P=0.023), 3 (38.9±2.70%; P<0.001), 4 (35.9±3.46%; P<0.001), and 11 (44.4±2.73%; P=0.026). In line with grazing, rumination was higher on d 18 (19.9±3.02%) compared to d 2 (9.1±3.02%; P<0.001), 3 (8.6±3.02%; P<0.001), 4 (10.2±3.02%; P<0.001), and 11 (11.2±3.02%; P<0.001). Analysis between groups of companion heifers revealed that naive companions grazed more than experienced companions (40.8±1.53% vs. 34.9±1.53%, P=0.009), and both experienced and naive companion heifers grazed more on d 18 (44.8±2.53%) than on d 3 (31.2±2.53%; P=0.002) and 4 (34.6±2.53%; P=0.023), suggesting that temporal variations in grazing were not due to learning. In conclusion, previous experience with social housing and the presence of a companion with grazing experience did not affect grazing behaviour in heifers, despite behavioural differences between experienced and naive companions. Experienced heifers spent less time grazing than naive ones, suggesting a higher grazing efficiency.

Keywords: grazing, behaviour, dairy heifer, experience

OPTIMISATION DE L'EXTRACTION ET DE LA SÉPARATION DE LA LUTÉINE ET DE LA CHLOROPHYLLE DE L'ÉPINARD PAR LA MÉTHODE DES SURFACES DE RÉPONSES

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L'épinard contient une quantité importante de biomolécules dont la chlorophylle et la lutéine, ayant des effets santé avérés par de nombreux auteurs. L'industrie maraichère génère une quantité importante de sous produits d'épinards pouvant être valorisés pour leurs contenus en ces deux biomolécules. Plus spécifiquement, l'objectif de ce projet est l'optimisation de procédés d'extraction et de séparation de la lutéine ainsi que de la chlorophylle de l'épinard ainsi que le développement de nouveaux extraits potentiellement bioactifs. Les techniques d'extraction et de séparation utilisées dans ce projet respectent les principes de la chimie verte avec l'utilisation de solvants et d'excipients verts, en partenariat avec une entreprise d'extraction : Nutra-Canada. Pour séparer et extraire la lutéine et la chlorophylle, nous avons utilisé la technique de la saponification, avec une solution d'hydroxyde de sodium (NaOH) aqueux. Le NaOH estérifie la queue phytole de la chlorophylle, lui conférant son caractère apolaire, et va donc permettre de transformer la chlorophylle en un dérivé polaire soluble dans l'eau. La lutéine, non saponifiable, demeure apolaire et reste donc dans la matrice qui est reprise par la suite dans de l'éthanol 95% pour l'extraction de cette molécule. Une optimisation des conditions de saponification était nécessaire afin de trouver les paramètres permettant de retirer le plus de chlorophylle à l'extrait tout en préservant au maximum la lutéine, qui est sensible au NaOH. Pour cela, différentes combinaisons de temps, température de saponification ainsi que la concentration de NaOH ont été testées selon la technique des surfaces de réponses (Box Benhken design). Les résultats obtenus, analysés statistiquement par le logiciel SAS, selon la procédure SREG, montrent que les meilleurs paramètres de saponification permettant l'obtention d'extraits de lutéine avec des quantités de chlorophylle négligeables sont 16h, 20°C et 17% de NaOH. Avec ces paramètres, l'extrait de lutéine final présente une couleur jaune, caractéristique de cette molécule. La chlorophylle a donc bien été séparée et purifiée de l'extrait de lutéine avec l'utilisation de solvants et d'excipients écologiques.

Keywords: épinard, biomolécules, chimie verte, extraction, séparation

#85 - Poster

OPTIMISATION DE L'EXTRACTION DES POLYPHÉNOLS, DES FLAVONOÏDES ET DES SAPONINES À PARTIR DE L'ASPERGE (ASPARAGUS OFFICINALIS)

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Plants are an abundant source of inexhaustible active ingredients that have been used in traditional medical practices since ages. These bioactive ingredients, include polyphenols, flavonoids and saponins, provide varied beneficial health properties such as, anti-microbial, antioxidant, anti-inflamatory, anti-cancerous and cardio-protective effects. Increasing demand for health promoting ingredients has led to the development of extracts rich in these active ingredients from plant materials. Plants belonging to the Asparagaceae family especially asparagus (*Asparagus officinalis*) are rich in a wide range of bioactive molecules. In addition, a large quantity of waste generated from the asparagus agri-food industry make this plant a good choice for the extraction of bioactive molecules. In this work we have characterised different segments of asparagus spear (top and bottom) for its polyphenol content using UPLC-MS/MS. In addition, optimization of polyphenols and flavonoids extraction form the bottom segment was studied using different ethanol concentrations at varied contact time. Saponins determination was carried out using three protocols: two gravimetric methods and one spectrophotometric method. Moreover, the extract rich in saponins was tested for its antimicrobial activity against Escherichia coli, ATCC 25922; Staphylococcus aureus, ATCC 6538 and Salmonella. Our studies showed that asparagus contained 13 different polyphenols, the most abundant was rutin. Comparing different segments of asparagus spear indicated that the top segment had higher polyphenolic content than the bottom segment and the optimized extraction parameters were ethanol 100% for 30-60 min. The antimicrobial activity test showed a negative result against the three tested strains. Developing extract rich in active ingredients form byproducts not only enable us to protect the environment form its negative effects but also add value to these residues.

Keywords: asparagus, byproducts, polyphenols, flavonoids, UPLC-MS/MS, saponins

#86 - Poster

IDENTIFICATION AND QUANTIFICATION OF PLANT BIOACTIVES FROM BRASSICA OLERACEA BY-PRODUCTS USING UPLC – MS/MS

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The agrifood industry produces tons of waste and substandard products that are discarded at great expense. These by-products may be very rich in bioactive compounds making them suitable for functional food development. The by-products of broccoli (*Brassica oleracea* var. *italica*) are rich in health promoting compounds like glucosinolates and polyphenols. These bioactive molecules confer to its anti-microbial, anti-diabetic, anti-cancerous and anti-inflammatory activity. In this research we mainly focus on the identification, characterisation and quantification of the main bioactive molecules present in broccoli by-products (florets, stalk, mixture of the previous and the seeds of 10 broccoli varieties) using UPLC MS/MS. In broccoli, the total quantity of glucosinolates (TG) was between 0.4 and 2% of the dry weight (DW). Twelve glucosinolates were identified; of which glucoraphanin was the most predominant (44 - 65% of the TG). Total polyphenols (TP) content (75 – 250 mg/kg DW) was less important compared with other vegetables. It mainly comprises of sinapic acid and caffeoylquinic acid. The extraction of bioactive molecules from by-products can lead to the valorisation of these residues and further enable the production of high value functional food supplements moreover, saving the environment from agrifood industrial waste.

Keywords: by-products, broccoli, glucosinolates, polyphenols, UPLC MS/MS

#87 - Poster

IDENTIFICATION AND QUANTIFICATION OF PLANT BIOACTIVES FROM ALLIUM PORRUM BY-PRODUCTS USING UPLC – MS/MS

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The agrifood industry produces tons of waste and substandard products that are discarded at great expense. These by-products may be very rich in bioactive compounds making them suitable for functional food development. The by-products of leek (*Allium porrum* L.) are rich in health promoting compounds like polyphenols and organosulphur compounds. These bioactive molecules confer to its anti-microbial, anti-diabetic, anti-cancerous and anti-inflammatory activity. In this research we mainly focus on the identification, characterisation and quantification of the main bioactive molecules present in leek by-product using UPLC MS/MS. In leek, 6 organosulphur compounds and 2 glutamyl peptides were identified. The major organosulphur present in leek were alliin (3431- 3184 mg/kg DW) and isoalliin (1244- 1286 mgE allin/ kg DW). The glutamyl peptides ☒-L-glutamyl-S-(2-propenyl)-L- cysteine and ☒-L-glutamyl-S-(trans-1-propenyl)-L-cysteine is the precursor for alliin and isoallin respectively which were identified with the same method. The TP content (23-50mg/kg DW) was very less when compared to the other allium species. It predominantly consists of ferulic acid that corresponds to 40-60% of the TP. The extraction of bioactive molecules from by-products can lead to the valorisation of these residues and further enable the production of high value functional food supplements moreover, saving the environment from agrifood industrial waste.

Keywords: by-products, leek, polyphenols, organosulphur compounds, UPLC MS/MS

#88 - Poster

VERMITECHNOLOGY: A SUSTAINABLE APPROACH TOWARDS AGRO-BASED WASTE MANAGEMENT.

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Increased intensive agriculture, human populations and industrialisation has led to accumulation of solid organic wastes, agricultural wastes being one of them. Considerable amounts of agricultural wastes are burnt off in many countries, contributing massively to air pollution. The disposal and efficient management of these wastes has become one of the utmost challenges we face today. Reutilisation of these agricultural wastes through sustainable organic farming practices is an eco friendly approach to increase productivity and resource recycling. Thus, making vermicomposting an important tool for creating a healthy quality of environment. The present study was designed to assess the efficacy and potential of *Eisenia fetida* in composting agricultural wastes, especially rice residues. Paddy straw (PS), Spent mushroom paddy straw (SMPS) and Rice husk (RH) were mixed with farm yard manure in the ratio 1:1. The earthworms showed high affinity towards all the agro- origin substrates used for the study. The time taken for the completion of vermicomposting process was in the order: Spent mushroom paddy straw > Paddy straw> Rice Husk. The vermicompost and vermiwash obtained at the end of the experiment were also subjected to nutrient analysis. The vermicomposts and vermiwash showed increased nitrogen, phosphorus and potassium (NPK) levels, carried a near neutral pH and exhibited lower levels of total organic carbon, making them an effective biofertilizer. The study further foregrounds the two fold use of vermitechnology, wherein the wastes are primarily recycled through the process of vermicomposting and subsequently the vermicompost and vermiwash obtained are utilized as organic soil fertilizers. Vermicomposting, therefore proves to be a sustainable option for the effective management and disposal of wastes generated through agricultural activities.

Keywords: agricultural wastes, Eisenia fetida, organic farming, vermicomposting, waste management

#89 - Poster

REUTILIZATION OF SPENT MUSHROOM PADDY STRAW FROM *VOLVARIELLA VOLVACEA* FOR VALUE ADDED COMPOST: QUANTITATIVE ANALYSIS

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Mushrooms are widely cultivated around the world and are considered to be a rich source of fibre, vitamins and antioxidants. *Volvariella volvacea*, is a species of mushroom exclusively grown on paddy straw for a period of 21 days. The protein rich substrate left after the harvest of mushrooms, entangled with innumerable mycelia is usually discarded as spent mushroom paddy straw. There arises a need for developing a technology for reutilization of spent mushroom straw. Vermicomposting is a technology with an environmentally sound approach for the management of spent mushroom paddy straw substrate. The spent paddy straw procured after the cultivation of mushrooms serves as an excellent substrate for the earthworms. The present study deals with the bioconversion of spent mushroom paddy straw (SMPS) mixed with farmyard manure (FYM) in the ratio 1:1, into value added compost with the help of *Eisenia fetida*. A control was setup with the same ratio but without the introduction of earthworms. The samples of compost were drawn every 15 days beginning 30 days after the setup of the experiment to a maximum of 90 days. The collected samples were subjected to nutrient analysis and were further compared with the control samples. The bioconversion of spent mushroom paddy straw into vermicompost occurred in 75 days, the earthworms exhibited a short life cycle of 54.33 days, high cocoon production and up to 4 hatchlings per cocoon. The nutrient values of the experiment were found to be higher as compared to the control. The nutrient analysis of the vermicompost obtained at the end of the experiment revealed a near neutral pH (7.74), high nitrogen (1.89%), phosphorus (0.99%), potassium (1.71%) and low organic carbon levels (15.41%). Thus, the spent mushroom paddy straw obtained from mushroom industry was successfully reutilized and turned into a value added compost rich in nutrients. The study unveils the high economical value of spent mushroom paddy straw wherein the paddy is first used to grow the mushrooms and consequently turned into a nutrient rich organic fertilizer by the earthworms.

Keywords: *Eisenia fetida*, spent mushroom paddy straw, value added compost, vermicomposting, *Volvariella volvacea*