# Organic Agriculture Centre of Canada






2003 Annual Report

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## INTRODUCTION

The Organic Agriculture Centre of Canada (OACC), which was founded in 2001, is a timely initiative in research and education. The OACC is the only institution of its kind in Canada. Our vision is to "strengthen the science and practice of organic agriculture in Canada" and our mission is to "conduct, coordinate, and disseminate producer-oriented research and education that will contribute to sustainable communities." The team at OACC is vigorous, with a high degree of enthusiasm for our mission and a strong commitment to academic rigour.

The OACC is funded primarily by the Canadian Adaptation and Rural Development program of Agriculture and Agri-Food Canada (AAFC) and the Natural Sciences and Engineering Research Council (NSERC). Additional funding is provided by the Canadian Wheat Board, the Laidlaw Foundation, and the provinces of Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, Nova Scotia, and Prince Edward Island.

In affiliation with agricultural schools at the universities of British Columbia, Alberta, Saskatchewan, Manitoba, Guelph, McGill, Laval and the Nova Scotia Agricultural College, the OACC coordinates and collaboratively develops research projects and web-based courses in organic agriculture. We also collaborate in research with AAFC researchers across Canada. Currently there are 5 courses available in English and within another year, there will be 9 courses available in English and 5 courses available in French. All courses are accredited for university students and are also available on a non-credit basis for farmers.

OACC staff participate in on-farm research and report to conferences and field days of the Canadian Organic Growers, the Certified Organic Associations of British Columbia, the Alberta Organic Associations, the Saskatchewan Organic Directorate, the Organic Producers Association of Manitoba, the Ecological Farmers Association of Ontario, the Centre Agriculture Biologique du Quebéc, and the Atlantic Canadian Organic Regional Network. As well, we regularly publish research results and information geared to help farmers and other practitioners of organic agriculture. These are published in farm papers across Canada, including *The Western Producer*, *Ontario Farmer*, *Quebec Farmers Advocate*, *La Terre de Chez Nous*, and *Farm Focus*.

The OACC website (www.organicagcentre.ca) provides research summaries, files of all OACC newspaper articles, links to Canadian organic organizations, virtual farm tours, and many other resources. Since June 2002 our website hits have exceeded 2.5 million and we have had over 30,000 different visitors.

The OACC provided leadership for the National Organic Strategic Plan and is currently developing the second phase. We have also initiated a National Expert Committee on Organic Agriculture and actively participate in the National Organic Standard revisions.

## OACC STAFF

| Name | Contact Information |
|---|---|
| Dr. Ralph C. Martin, Director | Telephone: (902) 893-6679<br>E-mail: rmartin@nsac.ns.ca |
| Dr. Derek Lynch, Research Professor | Telephone: (902) 893-7621<br>E-mail: dlynch@nsac.ns.ca |
| Dr. Andrew Hammermeister, Research Associate | Telephone: (902) 893-8037<br>E-mail: ahammermeister@nsac.ns.ca |
| Dr. Brenda Frick, Prairie Co-ordinator | Telephone: (306) 966-4975<br>E-mail: brenda.frick@usask.ca |
| Ms. Shannon Urbaniak, Research Technician | Telephone: (902) 893-7791<br>E-mail: surbaniak@nsac.ns.ca |
| Ms. Marlene Allen, Administrative Assistant | Telephone: (902) 893-7256<br>E-mail: mallen@nsac.ns.ca |
| Ms. Carla Cushing, Clerical Assistant | Telephone: (902) 893-7256<br>E-mail: ccushing@nsac.ns.ca |
| Mr. Glen Munroe, Advancement Officer | Telephone: (902) 893-7256<br>E-mail: gmunroe@nsac.ns.ca |
| Ms. Jane Morrigan, Website Co-ordinator | Telephone: (902) 893-8096<br>E-mail: jmorrigan@nsac.ns.ca |
| Mr. Graham Johnston, Website Technician | Telephone: (902) 893-6275<br>E-mail: gjohnston@nsac.ns.ca |
| Ms. Rosaria Campbell, Editor and Writer | Telephone: (902) 893-3951<br>E-mail: rcampbell@nsac.ns.ca |

## Contact Information

Organic Agriculture Centre of Canada
Nova Scotia Agricultural College
P.O. Box 550,
Truro, NS B2N 5E3

E-mail: oacc@nsac.ns.ca
Website: www.organicagcentre.ca
Tel: (902) 893-7256 Fax: (902) 893-3430

## 2003 Research Staff

In 2003 the OACC employed and/or collaborated with research associates, research assistants, and summer students across Canada to help conduct projects at research sites and on participating farms.

*Research Associates:*

Daniel Dierker
Gisela Duerr
Alireza Navabi

*Technicians:*

Byron Cordero
Jeanine Cudmore
Michael David
Angie Forbes
Rachelle German
Ravinder Grewal
Ekaterina Jeliazkova
Alain Joseph
Katriona MacNeil
Karen Maitland
Sherry Matheson
Stuart McMillan
Aaron Miller
Lee-Ann Nunn
Kim Osepchook
Brenda VandePol

*Summer Students:*

Emile Day
Melvin Fajardo
Kathryn Farrell
Jennifer Herbin
Susan Howse
Dione Littun
Fred Roy
Andreas Runnels
Dani Xu

## Course Development/Delivery and Extension

John Dietz
Maggie Hope-Simpson
Rupert Jannasch
Desirée Jans
Fernando Moncayo

## Graduate Students

The OACC actively supports graduate student training as part of its research activities. Listed below are graduate students whose programs were funded in whole or in part by the OACC in 2003.

*Name (Program):*

Roxanne Beavers (M.Sc.)
Kui Liu (Ph.D.)
Ardhini Maharning (Ph.D.)
Tara Moreau (M.Sc.)
Kala Muthusami (M.Sc.)
Alison Nelson (M.Sc.)
Pavol Otepka (Ph.D.)
Andres Riofrio (M.Sc.)
Cory Roberts (Ph.D.)
Shankar Shanmugam (M.Sc.)
Karl Slawinski (M.Sc.)
Mathew Wiens (M.Sc.)

## FARMER AND INDUSTRY COLLABORATORS

Archibald Farms, NS
Francine Boissonnault et François Bertrand, QC
Sophie Boudreau, QC
John Cooper, SK
Fred Dollar, PE
Janet and Bruce Duncan, ON
John Duynisfeld, NS
Jolly Farmer, NB
Larry Frith, AB
Serge Giard, QC
Rosemary Giberson, AB
Robert Guilford, MB
Larry Hoffman, SK
Wayne Hovdebo, SK
Robert Howse, SK
Brian Ives, NS
Andrew Kernohan, NS
Elmer Laird, SK
Marc Loiselle, SK
Raymond Loo, PE
Kirby McCuaig, SK
Ron Meakin, SK
Martin Meinert, SK
Herman Mentink, NS
Reed Miller, SK
Glenn Munroe, NS
Cathy Richmond, SK
Jim Robbins, SK
Robinson's Farms, PE
Alex Scott, MB
Arnold Taylor, SK
Dietmar Tholen, NS
Cyril Welsh, NS
Wayne Willner, SK

## RESEARCH AND EXTENSION COLLABORATORS

Sina Adl, Dalhousie University
Wendy Asbil, University of Guelph
Tess Astatkie, Nova Scotia Agricultural College
Charles-Eugène Bergeron, Consultant, QC
Claude Berthélémé, NB Department of Agriculture, Fisheries and Aquaculture
Art Bomke, University of British Columbia
Stewart Brandt, Agriculture and Agri-Food Canada
Peter Burgess, Agrapoint
Jason Burnham, Nova Scotia Agricultural College
Rosaria Campbell, Nova Scotia Agricultural College
Rachael Cheverie, PEI Department of Agriculture and Forestry
Jill Clapperton, Agriculture and Agri-Food Canada
Ann Clark, University of Guelph
Daniel Cloutier, Consultant, QC
John Cranfield, University of Guelph
Peggy Dixon, Agriculture and Agri-Food Canada
Mike Dolinsky, Alberta Agriculture, Food and Rural Development
Jean Duval, Consultant, QC
Leonard Eaton, Nova Scotia Agricultural College
Rochelle Eisen, Certified Organic Growers of British Columbia
Charlie Embree, Agriculture and Agri-Food Canada
Martin Entz, University of Manitoba
Silivina Fernandez, Consultant, ON
Alan Fredeen, Nova Scotia Agricultural College
Arlan Frick, Saskatchewan Crop Insurance Commission
Jane Froese, University of Manitoba
Hartley Furtan, University of Saskatchewan
Jan Gadus, Slovak University of Agriculture
Sonia Gaul, Agriculture and Agri-Food Canada
Alex Georgallas, Nova Scotia Agricultural College
Janine Gibson, Canadian Organic Growers
Kathleen Glover, Azar Consultants, NS
Cynthia Grant, Agriculture and Agri-Food Canada
Heather-Anne Grant, Agrapoint
Ken Greer, Western Ag Innovations, SK
Claire Hanlon Smith, Nova Scotia Department of Agriculture and Fisheries
Peter Havard, Nova Scotia Agricultural College
John Henning, McGill University
Roger Henry, Consultant, PEI
Spencer Henson, University of Guelph
Paul Hildebrand, Agriculture and Agri-Food Canada
John Hollinger, Manitoba Agriculture and Food
Jeff Hoyle, Nova Scotia Agricultural College

## RESEARCH AND EXTENSION COLLABORATORS (CONT'D)

Kevin Jeffreys, Consultant, PEI
David Jennings, NL Dept. of Forest Resources and Agrifoods
Eric Johnson, Agriculture and Agri-Food Canada
Dan Johnston, Agriculture and Agri-Food Canada
Diane Knight, University of Saskatchewan
Ladislav Kosik, Slovak University of Agriculture
Magda Lacko-Bartosova, Slovak University of Agriculture
Maryse Leblanc, Institut de recherche et de développement en agroenvironnement
Linda Macdonald, Nova Scotia Department of Agriculture and Fisheries
Susan MacKinnon, PEI Department of Agriculture and Forestry
Rod MacRae, Consultant, ON
Hugh Martin, Ontario Ministry of Agriculture and Food
Brenda McIntyre, Agriculture and Agri-Food Canada
Dale McIsaac, Agrapoint
Nancy McLean, Nova Scotia Agricultural College
Jennifer Melanson, Atlantic Canadian Organic Regional Network
Debbie Miller, Organic Crop Improvement Association, SK
James Miller, Nova Scotia Agricultural College
Sara Murphy, Agrapoint
Hans Nass, Agriculture and Agri-Food Canada
David Patriquin, Dalhousie University
David Percival, Nova Scotia Agricultural College
Orville Pulsifer, Pulsifer Associates, NS
Blaine Recksiedler, Saskatchewan Agriculture and Food
Nabil Rifai, Nova Scotia Agricultural College
Paola Rozzi, Consultant, ON
David Sangster, Wild Blueberry Producers Association of NS
Graham Scoles, University of Saskatchewan
Lorelle Selinger, Canadian Wheat Board
Steve Shirtliffe, University of Saskatchewan
Av Singh, Agrapoint
Dean Spaner, University of Alberta
Peter Stonehouse, University of Guelph
Tony Sturz, PEI Department of Agriculture and Forestry
Annette Verhagen, Ecological Farmers Association of Ontario
John VanLeeuwen, Agriculture and Agri-Food Canada
Paul Voroney, University of Guelph
Phil Warman, Nova Scotia Agricultural College
Simon Weseen, University of Saskatchewan
Ken Wichert, Drawbridge Consulting, NS
Emmanuel Yiridoe, Nova Scotia Agricultural College
Donna Youngdahl, Canadian Wheat Board
Bernie Zebarth, Agriculture and Agri-Food Canada

## OACC ADVISORY BOARD MEMBERS

Jeanne Cruikshank Canadian Council of Grocery Distributors
Gary Ducommun, Transition Farmer, BC
Martin Entz, University of Manitoba
Robert Guilford, Organic Farmer, MB and Canadian Organic Growers
Mike Leclair, Agriculture and Agri-Food Canada
Susan MacKinnon, PEI Department of Agriculture and Forestry
Clark Phillips, Organic Farmer, NB
Phil Warman, NSAC

## OACC SPONSORS AND PARTNERS

- Atlantic Canadian Organic Regional Network
- Agriculture and Agri-Food Canada
- Alberta Organic Associations
- Canadian Adaptation and Rural Development Program
- Canadian Organic Growers
- Canadian Wheat Board
- Centre d'agriculture biologique du Québec
- Certified Organic Associations of British Columbia
- EcoAction of Environment Canada
- Ecological Farmers Association of Ontario
- Green Municipal Enabling Fund
- Industrial Research Assistance Program
- Laidlaw Foundation
- Natural Sciences and Engineering Research Council - Strategic grant to faculty at the Nova Scotia Agricultural College and the University of Manitoba
- Nova Scotia Department of Agriculture and Fisheries – Technology Development Program
- Organic Producers Association of Manitoba
- Provinces of Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, Nova Scotia, and Prince Edward Island
- Saskatchewan Organic Directorate
- Universities of British Columbia, Alberta, Saskatchewan, Manitoba, Guelph, McGill, and Laval, and the Nova Scotia Agricultural College

# RESEARCH – EASTERN CANADA

## The Integration of Forages, Livestock, and Soil Amendments in Organic Systems

In practice there are three different types of organic systems: stockless (i.e. cash crops grown without access to livestock), monogastric livestock (e.g. chickens and pigs), and ruminant livestock (e.g. cattle and sheep). In stockless systems, forage-based crop rotations and soil amendments play an important role in building soil structure and maintaining fertility. In livestock systems, however, forage rotations and composted manure will be the main sources of soil nutrients. In this experiment we are trying to find the best combination of livestock system and number of years of forage in a rotation. The ideal combination will optimize soil fertility and quality in the different systems. The basic crop rotation is wheat, soybean, barley, and potato, with forages replacing soybean and/or barley in the rotations including forages. Amendments that are appropriate to each of the three types of organic systems will provide supplemental nutrients. We will measure the total amount of nutrients in the soil using Plant Root Simulator (PRS™) probes (www.westernag.ca), and determine the amount of nutrients taken up by the plants. We will also measure soil bulk density and assess how active the soil microorganisms are by using tests such as soil enzyme activity (dehydrogenase, phosphatase), soil microbial biomass, and nitrogen mineralization.

In year one (2002), there were no significant differences in wheat biomass or total nitrogen uptake among the different types of farming systems or among the different forage levels (0, 1, or 2 years in a 4 year rotation). In the second year, there was a significant residual N carryover from the amendments applied in 2002. There were no significant differences in total plant nitrogen uptake or cumulative soil nitrogen supply among the different farming systems, but there were significant differences among the forage levels. Soil bulk density was not different among the different farming systems, or among the different forage levels.

*Researchers:*
Kui Liu, OACC, Department Plant and Animal Sciences, NSAC (Graduate Student)
Andy Hammermeister, OACC, Department of Plant and Animal Sciences, NSAC
Phil Warman, Department of Environmental Sciences, NSAC
Ralph Martin, OACC, Department of Plant and Animal Sciences, NSAC
Martin Entz, Department of Plant Science, University of Manitoba

*Collaborators:*
Ken Greer, Western Ag Innovations, SK

*Funding Sources:*
Funding for this project was provided by the Natural Sciences and Engineering Research Council (NSERC).

**Using Forage as Mulch for Wheat**

There are many benefits to including forages on an organic farm, ranging from building the soil to breaking disease and pest cycles. Farms without livestock, however, may have a difficult time including perennial forages in their rotations, especially if the forage is not sold off-farm. Therefore, investigating the best use of forages on an organic farm is the focus of several research projects at the OACC. In a related study (see above) we are trying to find out how critical it is to include forages in organic systems. In this study we are looking at options for using forage as mulch on stockless organic farms. The use of forage for mulch in row crops is well established, but more work is needed to evaluate its usefulness for cereal crops. Therefore, we are testing several rates of chopped and unchopped forage mulch spread evenly over a wheat crop, either before emergence or at the three-leaf stage.

Results for the Nova Scotia trials have been evaluated. In 2002, all rates of mulch application reduced yields in comparison to a control where no mulch was applied. High application rates either suppressed crop establishment or smothered the crop. In 2003 we adjusted our mulch application rates, and although high application rates still suppressed yields, there was a yield benefit from several treatments. A late application of chopped mulch at 1 t $ha^{-1}$ gave the highest yield benefit, with a gross return of roughly \$80 $ha^{-1}$ more than the control. An early application of 2 t $ha^{-1}$ also produced higher yields, with a gross return of roughly \$17 $ha^{-1}$. An application rate of 4 t $ha^{-1}$ proved to be excessive, resulting in low yields and, surprisingly, greater weed problems. It appears that a late application of chopped mulch at 1 t $ha^{-1}$ would be the most economical, as it has higher returns, lower application costs, and lower requirements for forage land area. However, more work is needed to determine if the yield benefit can be obtained consistently.

This project also includes trials in Manitoba. Results will be reported as they become available.

*Researchers:*
Andy Hammermeister, OACC, Department of Plant and Animal Sciences, NSAC
Stuart McMillan, OACC, Department of Plant and Animal Sciences, NSAC (Technician)
Ralph Martin, OACC, Department of Plant and Animal Sciences, NSAC
Mathew Weins, Department of Plant Science, University of Manitoba (Graduate Student)
Martin Entz, Department of Plant Science, University of Manitoba

*Collaborators:*
Ken Greer, Western Ag Innovations, SK

*Funding Sources:*
Funding for this project was provided by the Natural Sciences and Engineering Research Council (NSERC).

**Integrated Nutrient Management for Organic Dairying in Ontario**

Improving nutrient use efficiency is a major environmental, economic, and regulatory challenge for dairy production systems. However, while the production characteristics and economic performance of organic dairy farms in Ontario has been documented, the efficiency of nutrient use on these farms is less well understood. Recent research from Europe suggests that organic dairying systems may be prone to phosphorus (P) deficiencies in the long term, and there is a need to evaluate whether such trends might be important on Canadian farms. To help provide current information in this area, this collaborative research will evaluate an integrated approach to nutrient management. Twenty commercial organic and conventional dairy farms in Ontario will be studied. Managed net nutrient inputs to the soil and livestock will be quantified in order to identify opportunities for improving the P status of the whole farm system. For example, one such opportunity might be in reducing dietary P levels without compromising reproductive rates or bone integrity. The research will also generate a database of case studies for use in on-farm nutrient management planning and as a support tool for dairy farmers interested in converting to organic dairying.

In addition, plot research trials will be used to assess the phosphorus supplying ability of igneous rock P, which has been approved for use in organic production and is now commercially available in Ontario. The research will also investigate alternatives to standard soil testing procedures, which may be inadequate for organic systems, and look at additional non-chemical parameters that may provide better indices of soil fertility in these systems. Key indices of soil biological activity will be evaluated as a soil management tool, and used in the development of recommendations for improved phosphorous use efficiency in organic systems.

The project was started in September, 2003. Soil sampling of all fields on the participating farms has been completed and the samples are currently being analyzed.

*Researchers:*
Derek Lynch, OACC, Department Plant and Animal Sciences, NSAC
Paul Voroney, Department of Land Resource Science, University of Guelph
Ralph Martin, OACC, Department of Plant and Animal Sciences, NSAC
Alan Fredeen, Department of Plant and Animal Sciences, NSAC
Cory Roberts, Department of Land Resource Science, University of Guelph (Graduate Student)

*Funding Sources:*
Funding for this project was provided by the New Directions Program of the Ontario Ministry of Agriculture and Food.

**Field Pea and Cereal Mixtures For Organic Feed Production**

Meeting the farm's requirement for high protein feeds continues to be one of the biggest challenges for organic livestock production. Peas are an option as a protein source on organic farms, and when grown for livestock feed can be grown alone or in combination with cereal crops. The mixtures may have certain agronomic advantages such as improved pest and weed control, improved use of nutrients, light, and water, and reduced lodging in comparison to peas grown in monocrop. However, in Atlantic Canada there are currently no recommended pea varieties, since peas have largely been replaced by soybeans, which remain difficult to produce organically. Therefore, there is a need to evaluate the feasibility of growing field peas in mixtures with oats and barley to produce high protein grain supplements for organic livestock production in the region. In response to this need, this OACC research project will focus on protein and feed quality, and assess whether these factors are affected by seeding rate and pea variety under organic management. Starting in 2003, a total of 20 varieties and mixtures will be evaluated at the OACC/NSAC site in Brookside, NS and the AAFC site in Harrington, PEI. A subset of the mixtures will also be evaluated on three NB farms (Franks Agricultural Ltd., Sussex; Anbar Farms, Rexton; and Bunnett Family Farms, Havelock).

Results to date indicate that the barley and oat monocrops yielded between 2 to 3 t $ha^{-1}$, whereas the three pea cultivars achieved yields of 4 t $ha^{-1}$ or more. Lodging was considerably reduced in line 746-3 as compared to Miami and Carrera, but mixed cropping did not reduce lodging unless the peas were included at the lowest (40%) seeding rate. The protein content of the mixtures averaged above 15% and 20% when the peas were included at the 40% and the 60% to 90% seeding rates, respectively.

*Researchers:*
Derek Lynch, OACC, Department of Plant and Animal Sciences, NSAC
Hans Nass, Agriculture and Agri-Food Canada, Charlottetown, PEI
Claude Berthélémé, NB Department of Agriculture, Fisheries and Aquaculture

*Funding Sources:*
Funding for this project was provided by the NB Department of Agriculture, Fisheries and Aquaculture, the PEI Department of Agriculture and Forestry, and the NS Department of Agriculture and Fisheries.

**Wheat-Weed Interactions at Variable Seeding Rates**

Many organic producers seed grains at rates that are higher than those recommended for conventional production. At a higher seeding rate, the grain crop is expected to make more efficient use of resources and become a stronger competitor with weeds. However, the effectiveness of this practice may vary, depending on the growing conditions and the type of weeds present. The objective of this research is to determine whether increased seeding rates for spring wheat can be used to enhance weed control in organic systems without affecting crop yield and quality. The first trial is being conducted at the OACC/NSAC research site in Brookside, NS. Five seeding rates (control with no seed; conventional rate; and 1.25X, 1.5X, and 2X the conventional rate) will be evaluated at two levels of fertility. The second trial is being conducted on organic farms across Canada, and will assess the effects of different seeding rates on crop density and biomass production, yield components, and grain quality. The effect of seeding rate on weed biomass production, the proportion of nitrogen uptake in the weeds as compared to the crop, soil moisture levels, and light penetration will also be measured.

Initial results from the 2003 season suggest that, in general, wheat yield did increase at higher seeding rates, although the increase was not always statistically significant. The results also showed that weed competition was much higher in the fertilized plots, which negatively affected wheat yields. Grain quality results are currently being evaluated.

*Researchers:*
Roxanne Beavers, OACC, Department of Plant and Animal Sciences, NSAC (Graduate Student)
Andy Hammermeister, OACC, Department of Plant and Animal Sciences, NSAC
Ralph Martin, OACC, Department of Plant and Animal Sciences, NSAC
Brenda Frick, OACC, College of Agriculture, University of Saskatchewan

*Collaborators:*
Wendy Asbil, University of Guelph, Kemptville ON
Francine Boissonnault et François Bertrand, St-Alban, QC
Sophie Boudreau, Club Agri-avenir, St. Hugues, QC
Fred Dollar, Winsloe, PE
Janet and Bruce Duncan, Almonte, ON
Serge Giard, St. Hugues, QC
Ken Greer, Western Ag Innovations, SK
Robert Guilford, Clearwater, MB
Andrew Kernohan, Parrsboro, NS
Marc Loiselle, Vonda, SK
Martin Meinert, Swift Current, SK
Reed Miller, Frontier, SK
Steve Shirtliffe, University of Saskatchewan, Vonda and Elbow, SK
Cyril Welsh, George's River, NS

*Funding Sources:*
Funding for this project was provided by the Natural Sciences and Engineering Research Council (NSERC).

**Variety Performance and Nitrogen Use Efficiency in Organic Potato Production**

The market for certified organic potatoes is growing rapidly and as production expands to meet this demand there will be a need for information on suitable varieties and management options for organic production. However, many potato varieties have never been evaluated for performance under organic management. There is also a need for data that can be used in developing efficient strategies for providing supplemental nitrogen (N) in organic potato production. To help address these research needs, the OACC is evaluating the yield, blight susceptibility, quality, and consumer preference of potato varieties managed according to certified organic protocols. We are also looking at the effects of different supplemental N inputs on potato yields and specific gravity, plant N uptake, and tuber nitrate levels. Soil N and moisture dynamics in response to the different N inputs will be monitored during the growing season and the post harvest period using standard soil and plant tissue sampling techniques, Theta soil moisture probes, and anion/cation exchange Plant Root Simulator (PRS™) probes (www.westernag.ca).

In 2002, the performance of eleven potato varieties (Gold Rush, Yukon Gold, Blue Bell, Midas, Innovator, Island Sunset, Chieftain, Carlingford, Navan, Fabula, and Divina) was compared at Springwillow Farm in Kensington, PEI. Most varieties yielded at least 28 t $ha^{-1}$ (250 cwt $acre^{-1}$) and some (Fabula, Divina) yielded over 35 t $ha^{-1}$ (310 cwt $acre^{-1}$). At harvest, soil residual nitrate levels at 18 (0-30 cm depth) and 11 (30-60 cm depth ) kg N $ha^{-1}$, were well below regional averages of 50-100 kg nitrate N $ha^{-1}$. Losses due to the Colorado potato beetle were minimized by Bt application and hand picking of adults. Late blight pressure was light and late season only.

The N and moisture dynamics study commenced in 2003 at five locations: OACC Brookside site; Timber River Eco Farms and Goodspring Farm in New Brunswick; and Springwillow Farm and Kentdale Farms in PEI. It is evaluating two supplemental N sources (a commercial compost and a pelletized dehydrated manure) applied to the potato varieties Fabula, Shepody, and Kildare (provisional name of a selection supplied by McCain produce Inc., Florenceville, NB). Results for the first year of this trial will be available in 2004.

*Researchers:*
Derek Lynch, OACC, Department of Plant and Animal Sciences, NSAC
Susan MacKinnon, PEI Department of Agriculture and Forestry
Claude Berthélémé, NB Department of Agriculture, Fisheries and Aquaculture
Raymond Loo, Springwillow Farm, Kensington, PEI
Bernie Zebarth, Agriculture and Agri-Food Canada, Fredericton, NB

*Collaborators:*
Ken Greer, Western Ag Innovations, SK

*Funding Sources:*
Funding for this project was provided by the PEI Department of Agriculture and Forestry and the NB Department of Agriculture, Fisheries and Aquaculture.

**Nutrient Supply from Organic Soil Amendments**

Many cash crops require extra nutrients to reach their full yield potential. On organic farms these nutrients are supplied in soil amendments such as livestock manure and compost, animal and fish processing byproducts (e.g. feather meal, crab meal), and harvested plant materials (e.g. alfalfa meal, seaweed). Unlike chemical fertilizers, the quantity and timing of the nutrient supply from these amendments is hard to predict. In this growth room experiment, we are comparing the amount and timing of release of several nutrients from alfalfa meal, feather meal, vermicastings (i.e. earthworm castings), and poultry manure compost. We are also testing yield response in lettuce and orchard grass planted one week after amendment application. Amendments are applied at rates to deliver equal amounts of total, rather than plant available, nitrogen.

Results show that the feather meal and poultry manure compost initially either stunted the plants or killed them, especially when applied to lettuce at higher rates. Allowing more time between amendment application and planting will likely prevent this problem. Although the lettuce plants never fully recovered, the orchard grass was more tolerant and also had more time to recover. The vermicastings gave the lettuce and orchard grass a good boost at the start of the experiment and also gave the highest lettuce yields. In the longer running orchard grass experiment, however, the early stimulation was not sustained, and the poultry manure and feather meal produced higher yields.

Results obtained with the Plant Root Simulator probe (PRS™; www.westernag.ca) showed that the kinds and amount of nitrogen initially available to the crop varies with the amendments. The amendments also supplied varying quantities of other nutrients such as phosphorus, potassium, and sulphur. It is therefore likely that blending different amendments will be the best approach to managing crop nutrition.

*Researchers:*
Andy Hammermeister, OACC, Department of Plant and Animal Sciences, NSAC
Ekaterina Jelizkova, OACC, Department of Plant and Animal Sciences, NSAC
Ralph Martin, OACC, Department of Plant and Animal Sciences, NSAC
Tess Astatkie, Department of Engineering, NSAC
Phil Warman, Department of Environmental Sciences, NSAC

*Collaborators:*
Archibald Farms, Port Williams, NS
Atlantic Canadian Organic Regional Network (ACORN)
Ken Greer, Western Ag Innovations, SK
Brian Ives, Truro, NS
Jolly Farmer, Northampton, NB

*Funding Sources:*
Funding for this project was provided by the Technology Development Program of the NS Department of Agriculture and Fisheries, and the Natural Sciences and Engineering Research Council (NSERC).

**Vermicomposting Development for Organic Farms**

Vermicomposting, or composting with worms, is becoming recognized as an effective means of recycling organic wastes. The worms initially break down organic matter through their digestion process and make it easier for microbes to finish the job of composting the material. Vermicomposting has also been shown to produce a variety of plant growth promoting substances that are not produced in the normal composting process. These positive characteristics suggest that the vermicomposting warrants further investigation and testing as an option for organic farms. Therefore, the OACC has initiated a vermicomposting research program that includes growth room, laboratory, and field trials. We are using farm manure from two different sources, each of which will be split into the following treatments: (a) regularly composted manure; (b) vermicomposted manure; (c) a blend of regular and vermicomposted manure; and (d) a mixture of vermicomposted manure and shredded cardboard.

In the growth room experiment, which started in December 2003, we will be testing the treatments on two soils. We will be using Plant Root Simulator (PRS™) probes (www.westernag.ca) to monitor the nutrient supply and testing yield response in lettuce. Based on the results of an earlier experiment using vermicastings (see above), we want to determine if vermicastings will provide an initial boost in plant growth as compared to regular compost. In 2004 we will use the same treatments in field studies at a minimum of 2 locations, with manure coming from two or three sources.

*Researchers:*
Andy Hammermeister, OACC, Department of Plant and Animal Sciences, NSAC
Ekaterina Jelizkova, OACC, Department of Plant and Animal Sciences, NSAC
Ralph Martin, OACC, Department of Plant and Animal Sciences, NSAC
Tess Astatkie, Department of Engineering, NSAC
Phil Warman, Department of Environmental Sciences, NSAC

*Collaborators:*
John Duynisfeld, Holdanca Farms
Ken Greer, Western Ag Innovations, SK
Herman Mentink, Kipawa Holsteins
Glenn Munroe, New Ground
Dietmar Tholen, The Good Earth Organic Resources Group Ltd.

*Funding Sources:*
Funding for this research was provided by the National Research Council's Industrial Research Assistance Program (IRAP), the Nova Scotia Green Municipal Enabling Fund, and EcoAction Canada.

**Organic Amendments for Strawberries and Half-High Blueberries**

There is a growing interest among consumers in organically produced fruits and berries. To help producers meet this growing demand, there is a need for more scientific research on specific aspects of small fruit production. This three-year study will help provide information on the feasibility of using organic amendments in place of chemical fertilizers in strawberry and blueberry production. The field experiments were initiated in May 2002, at Boutilier's Point near Halifax, NS, on a Gibraltar brown sandy loam soil. The four organic amendments (alfalfa meal + rock phosphate + wood ash; Lunenburg municipal solid waste (MSW) compost; yard waste, manure, and food waste compost (YMFC); and ruminant compost) will be compared with chemical NPK fertilizers. The amendments will be applied to give equivalent amounts of total N, with N availability from the organic amendments assumed to be 25%. The effects of the treatments on crop nutrition, soil fertility, and crop yields in three strawberry and two half-high blueberry cultivars will be evaluated.

Results from 2002 showed that the ruminant compost treatment produced higher levels of extractable K in the soil and also produced higher levels of available K in the tissue. The MSW compost application produced the highest level of extractable Na in all cultivars, and the chemical fertilizer treatment gave higher levels of extractable soil sulphur in both strawberries and blueberries. Results for 2003 show that there was no significant difference between the treatments with respect to the yield of strawberries. However, the half-high blueberries did not produce a consistent yield and there was non-uniform ripening of fruits.

*Researchers:*
Shankar Ganapathi Shanmugam, OACC, Department of Plant and Animal Sciences, NSAC (Graduate Student)
Phil Warman, Department of Environmental Sciences, NSAC

*Collaborators:*
Jeff Hoyle, Department of Environmental Sciences, NSAC
David Percival, Department of Environmental Sciences, NSAC

*Funding Sources:*
Funding for this project was provided by the Agrifocus program of the Nova Scotia Department of Agriculture and Fisheries and a Natural Sciences and Engineering Research Council (NSERC) Discovery grant.

**Alternative Methods for Controlling Colorado Potato Beetles**

The Colorado potato beetle is a major insect pest of the potato crop and alternative methods of control are needed if organic potato production is to expand to meet future market demand. Insect control options that are available to organic producers include thermal and pneumatic (i.e. vacuum or blowing airstreams) methods, and the use of acceptable bio-insecticides. To provide more information on options for organic control of the Colorado potato beetle, we tested the effectiveness of four different methods (hot steam, open flame, pneumatic collection, and the bio-insecticide NOVODOR®) under field conditions. The hot steam equipment was tested at driving speeds of 1.0, 1.5, 2.5, and 3.5 km/h, and the flame and pneumatic equipment was tested at driving speeds of 1.5, 2.5, and 3.5 km/h. All methods were tested on the larval and the adult life stages of the Colorado potato beetle.

This research demonstrates the potential for these methods in organic production and identifies the optimum life stages and driving speeds for best results. The results suggest that the best time to control the Colorado potato beetle using NOVODOR® is at the first and second larval stages, when 86% effectiveness was achieved. When averaged across driving speeds, the open flame equipment performed better than the hot steam or pneumatic equipment, with 56% control for the first and second stage larvae, and 45-50% control for the third and fourth stage larvae and the adult. However, at a driving speed of 1.0 km/h hot steam gave good control of this pest (63% for the first and second stage larvae and 52-54% for the third and fourth stage larvae and the adults). The pneumatic collector worked better on the third and fourth stage larvae than on the first and second stage larvae or the adults. The lowest control rate (7%) was obtained with pneumatic collection of the adult beetles.

*Researchers:*
Nabil Rifai, Department of Engineering, NSAC
Tess Astatkie, Department of Engineering, NSAC
Magda Lacko-Bartosova, Slovak University of Agriculture
Pavol Otepka, Faculty of Agrobiology and Food Resources, Slovak University of Agriculture, (Graduate Student)

**Alternative Weed Control Methods for Organic Crop Production**

Weed management can be a major challenge in organic crop production and ecologically sound alternatives for weed control are needed. Thermal weed control methods are one option for organic production, but there is a need for more information on their effectiveness for a variety of weed species and on their overall energy efficiency. In this experiment we the evaluated the percentage of weeds killed and the energy inputs for hot steam, open flame, and infrared thermal units operated at driving speeds of 1.5, 2.5, and 3.5 km/h. The equipment was used on several weed species (redroot pigweed, common lamb's-quarters, redleg, and white mustard) at various growth stages (<6, 6–8, and >8 true leaves).

Hot steam was the least effective in controlling the weeds, with only 0 to 48% kill at driving speeds of 1.5, 2.5, and 3.5 km/h. The infrared unit, when operated at speeds of 1.5 and 2.5 km/h, killed 100% of all weed species in a growth stage of <6 true leaves. When operated at these speeds the flame weeder also killed 100% of young redroot pigweed, common lamb's-quarters, and redleg, but not white mustard. The infrared unit used over four times more fuel than the hot steam and open flame units, which used similar amounts of fuel. Therefore, the energy efficiency of the flame weeder was higher than that of the infrared weeder, which was in turn higher than that of hot steam weeder. All units had the best energy efficiency at a driving speed of 2.5 km/h speed. Overall, we found that the flame weeder operated at 2.5 km/h and used when weeds are in the early growth stages provides the most effective and energy efficient control of most of these weed species.

*Researchers:*
Tess Astatkie, Department of Engineering, NSAC
Nabil Rifai, Department of Engineering, NSAC
Peter Havard, Department of Engineering, NSAC
Magda Lacko-Bartosova, Slovak University of Agriculture
Pavol Otepka, Faculty of Agrobiology and Food Resources, Slovak University of Agriculture, (Graduate Student)

**Evaluation of Three Thermal Units for Weed and Pest Control**

In order to provide more information on the suitability of thermal equipment for organic weed and pest control we compared the performance and energy efficiency of three different propane-fueled units (infrared radiation, open flame, and hot steam). We compared the ease of installation and adjustment during operation, safety, and reliability of the units, and measured the temperature development by passing the equipment over thermocouples at groundspeeds of 1.5, 2.5, and 3.5 km/h. Exposure times, fuel consumption, and energy inputs were calculated for each unit.

At a groundspeed of 1.5 km/h the hot water-steam unit a temperature of only 43.6ºC, whereas the infrared and open flame units developed temperatures of 620.9 and 186.1ºC, respectively. Propane consumption was one of the main factors causing this difference in temperature. At this groundspeed the infrared unit had a propane consumption of 165.2 kg/ha, compared with 24.5 and 29.8 kg/ha for the hot steam and open flame units respectively. We found that the hot steam unit was the safest of the thermal units because the flames were contained within the boiler. Also, the hot water would cause minimal damage to the soil and would create minimal risk of fire during operation. The infrared unit would create the greatest risk of fire, and it is recommended that some form of fire retardant be present when this unit is in operation. The thermal unit has the greatest potential in thermal weed and pest management since it is the easiest to use, and since the design allows for both nonselective (e.g. pre-emergence broadcast weeding) and selective (e.g. between- or in-row weeding) applications. The infrared radiation unit would be most suitable for pre-emergence, broadcast weed control, and the hot steam unit would be most suited to pest management.

*Researchers:*
Nabil Rifai, Department of Engineering, NSAC
James Miller, Department of Engineering, NSAC
Jan Gadus, Faculty of Agricultural Engineering, Slovak University of Agriculture
Pavol Otepka, Faculty of Agrobiology and Food Resources, Slovak University of Agriculture, (Graduate Student)
Ladislav Kosik, Slovak University of Agriculture

# RESEARCH – WESTERN CANADA

**Historical and Modern Wheat Varieties in Conventional and Organic Systems**

Would organic producers benefit from crops bred specifically for them? To help answer this question, we conducted field experiments at Edmonton to compare the agronomic performance of 32 heritage and modern wheat cultivars under both organic and conventional management. We are looking for traits that may be specifically useful under organic conditions, and looking at how a century of wheat breeding has changed such traits. The results will guide breeders in developing crops for organic production.

Results showed that under the drought conditions of 2002, all of the CWRS wheat varieties performed better under organic management than under conventional management. In 2003, cultivars in the conventionally managed plots outyielded those grown under organic conditions, with the exception of the cultivars Red Fife and Early Red Fife. In the same year, grain yield increase over a century of wheat breeding was greater under conventional management than under organic management. Increased yield potential appeared to be associated with increased harvest index and kernel weight, and decreased plant height and lodging. Plant height was negatively correlated with yield under conventional management, but under organic management, no correlation was found between yield and plant height. This may be a result of the ability of taller varieties to withstand the stresses associated with low input systems.

*Researchers:*
Heather Mason, Department of Agricultural, Food and Nutritional Sciences, University of Alberta (Graduate Student)
Dean Spaner, Department of Agricultural, Food and Nutritional Sciences, University of Alberta
Brenda Frick, OACC, College of Agriculture, University of Saskatchewan

*Funding Sources:*
Funding for this research was provided by a Canadian Wheat Board scholarship and a Natural Sciences and Engineering Research Council (NSERC) Discovery grant.

## Cover Crop Evaluation

Cover crops are a valued component of organic cropping systems since they can return organic matter and nutrients to the soil. Specific crops may also have additional characteristics that can benefit the cropping system. Legume and pulse cover crops host bacteria that can fix nitrogen. Cereals grow quickly and provide abundant organic matter, whereas crops such as buckwheat may make phosphorous more available to following crops. To assess the value of a variety of cover crop options, 18 crops were grown in 15 different mixtures at Lethbridge and Edmonton. The mixtures were evaluated for their ability to grow and produce biomass in the first year.

In the seeding year, crop biomass in Lethbridge was limited by drought conditions. More vigorous stands developed in Edmonton, and performance of the cover crops is now being compiled. The performance of the crops following the cover crops will also be used to further evaluate the usefulness of these options.

*Researchers:*
Jill Clapperton, Agriculture and Agri-Food Canada, Lethbridge, AB
Gisela Duerr, OACC, Lethbridge, AB
Dean Spaner, Department of Agricultural, Food and Nutritional Sciences, University of Alberta
Brenda Frick, OACC, College of Agriculture, University of Saskatchewan

## Seeding Rates for Green Manure Crops in Weedy and Weed Free Conditions

Legume green manure crops that are grown to feed the soil rather than for harvest are valuable summer fallow replacements. They can increase soil nitrogen, reduce erosion, increase organic matter, and reduce weed pressure. However, they can be costly to produce and may also use valuable soil moisture. To help expand the options available to organic farmers, this research will compare lentils, chickling vetch, and peas as green manure crops when seeded at different densities and grown under weedy and weed free conditions. We hope to determine optimal seeding rates, and see if the optimum rate varies under different weed pressures. The results will guide producers in determining seeding rates for green manure crops under their farm conditions.

The first field season has been completed, and the results are now being compiled.

*Researchers:*
Yvonne Lawley, Department of Plant Sciences, University of Saskatchewan (Graduate Student)
Steve Shirtliffe, Department of Plant Sciences, University of Saskatchewan
Brenda Frick, OACC, College of Agriculture, University of Saskatchewan

*Funding Sources:*
Funding for this project was provided by the Agriculture Development Fund, Saskatchewan Agriculture, Food and Rural Revitalization.

**Intercropping Flax or Wheat with Peas or Lentils**

Interest in intercropping is growing among organic farmers, who see it as a potential way to reduce risks from unpredictable environments, weeds, and pests. Also, intercropping a legume may allow them some of the advantages of green manure without sacrificing a year's income. To examine the feasibility of this option for green manure, preliminary studies were established on two organic farms in 2003. Flax or wheat planted at full seeding rates were intercropped with peas or lentils, planted at half seeding rate. Weed biomass and crop yields were determined for the different treatments.

The crops at one site were not harvestable, due to the combined effects of drought and grasshoppers. At the second site, intercropped peas or lentils had no significant effect on either weed biomass or flax or wheat yields. However, the high variability may have obscured treatment effects. The intercropped legumes did not significantly reduce the yields of the main crops in this trial, but further work needs to be done in this area.

*Researcher:*
Brenda Frick, OACC, College of Agriculture, University of Saskatchewan
Steve Shirtliffe, Department of Plant Sciences, University of Saskatchewan

*Collaborators:*
Marc Loiselle, Vonda, SK
Cathy Richmond, Outlook, SK

**Intercropping Flax: On-Farm Demonstration**

Conventional farmers are often concerned that the transition to organic farming might be accompanied by unmanageable levels of weeds or other pests. Intercropping may be one option for managing these problems in organic systems. At the Back to the Farm Research Foundation Elmer Laird grows demonstration plots for a variety of crop and crop mixtures, to allow producers to come and see for themselves what works and what doesn't work. This year Elmer devoted 120 acres (49 ha) to demonstration, including 60 acres (24 ha) of flax and flax intercrops, 40 acres (16 ha) of other intercrops, and 20 acres (8 ha) of hemp.

The plots where flax was intercropped with barley and oats had greatly reduced lamb's-quarters populations, although the flax population was also reduced in the oats intercrop. In general, the emergence of pulses was poor this year, due to poor moisture conditions. Also, the pulse intercrops did not reduce the number of lamb's-quarters. Oilseed radish was a strong crop with few weeds. The hemp crop had tremendous late season growth, but was weedy because of its slow growth early in the season.

*Researchers:*
Elmer Laird, Back to the Farm Research Foundation, Davidson, SK
Brenda Frick, OACC, College of Agriculture, University of Saskatchewan

**Mitigation of Soil Erodibility on Organic Farms Through Crop Rotation**

Soil erosion is a serious agricultural issue and minimizing soil erosion is one of the main objectives of organic agriculture. Tillage increases the risk of erosion, but crop rotations can be used to ameliorate that risk in organic systems. In this research we are collecting information on the types of rotations that organic farmers use to conserve soil, and examining the soil's resistance to erosion under various crop rotations. The results of this project will guide producers in developing rotational tools to protect valuable soil resources on organic farms.

Surveys have been distributed to organic producers across Canada and results are beginning to come in. Compilation of the survey data and selection of sites for field sampling will take place in the spring.

*Researchers:*
Alison Nelson, Department of Plant Science, University of Manitoba (Graduate Student)
Jane Froese, Department of Plant Science, University of Manitoba
Brenda Frick, OACC, College of Agriculture, University of Saskatchewan

*Funding Sources:*
Funding for this project was provided by the Natural Sciences and Engineering Council (NSERC).

**Grasshopper Management**

Grasshoppers continued to cause concern in 2003, and in response to this problem we tested a number of grasshopper deterrent products in the lab. Grasshoppers in the 3rd to 5th instar were offered wheat plants sprayed with caffeine, garlic oil, or neem oil, or were dusted with diatomaceous earth.

None of the grasshopper management treatments showed consistent effects against the grasshoppers.

*Researchers:*
Meg McCluskie, University of Lethbridge (Graduate Student)
Dan Johnson, Agriculture and Agri-Food Canada, Lethbridge, AB
Gisela Duerr, OACC, Lethbridge, AB
Brenda Frick, OACC, College of Agriculture, University of Saskatchewan

**Post-Emergence Harrowing: On-Farm Trial**

Post-emergence harrowing can be an effective way to reduce weed populations in some crops, but it can also damage the crop. A preliminary study examined the success of this technique, as practiced on organic farms near Saskatoon. Nine producers allowed us to monitor their harrowing operations on a total of 19 fields of cereals or peas. For 13 of these fields, we counted plants, by species, before harrowing and again one month after harrowing. This allowed us to determine the survival of both the crop and the weeds. For 7 of these fields, the producers agreed to leave strips that were not harrowed, so we could also compare the weight of the weeds in harrowed and non-harrowed strips.

Post-emergence harrowing was used with variable success on these farms. In some cases the crop was apparently undamaged, while the weeds were virtually eliminated by the harrowing operation. In other cases, the crop was so damaged that the weeds actually gained a competitive edge. The results indicate that there is a need for further research and extension in this area, to make this practice less risky for producers.

*Researcher:*
Brenda Frick, OACC, College of Agriculture, University of Saskatchewan
Susan Howse, University of Saskatchewan (Summer Student)

*Collaborators:*
John Cooper, Handel, SK
Larry Hoffman, Spalding SK
Wayne Hovdebo, Birch Hills, SK
Robert Howse, Carragana, SK
Kirby McCuaig, Eastend, SK
Ron Meakin, Langham, SK
Jim Robbins, Delisle, SK
Arnold Taylor, Kenaston, SK
Wayne Willner, Davidson, SK

## EVENTS

| Field Days | | | Attended | Presented | Organized |
|---|---|---|---|---|---|
| July | Interlake Field Day | Winnipeg, MB | ✓ | | |
| July | Organic Field Day | Scott, SK | ✓ | ✓ | |
| July | OCIA Chapter 8 | Chaplin and Coderre, SK | ✓ | | |
| July | OACC Field Day | Truro, NS | ✓ | ✓ | ✓ |
| July | Gleanlea Field Day | Glenlea, MB | ✓ | | |
| July | Organic Field Days | Maine, USA | ✓ | | |
| August | OCIA Chapter 3 | Muenster, SK | ✓ | | |
| August | NSAC Cropping Systems Tour | Truro, NS | ✓ | | |
| September | Organic Potato Research Field Day | Kensington, PE | ✓ | ✓ | |
| September | Compost Tea Trial Field Day | Borden, PE | ✓ | | |
| September | Everdale Farm | Hillsburgh, ON | ✓ | | |
| September | Nappan Project | Nappan, NS | ✓ | | |
| September | Springwillow Farm | Kensington, PE | ✓ | | |

| Farm Visits/Tours | | | Attended | Presented | Organized |
|---|---|---|---|---|---|
| June | NSAC/OACC Tour - Brazilian Visitors | Truro, NS | ✓ | ✓ | ✓ |
| July | Ian Cushon | Oxbow, SK | ✓ | | |
| July | Robert Guilford | Clearwater, MB | ✓ | | |
| July | Jack Lovell | Manitou, MB | ✓ | | |
| July | Clarence Gardipy | Duck Lake, SK | ✓ | | |
| July | Kirby McCuaig | Eastend, SK | ✓ | | |
| July | Steve Snider | New Norway, AB | ✓ | | |
| July | Wayne Hovdebo | Birch Hills, SK | ✓ | | |
| July | Arnold Taylor | Kenaston, SK | ✓ | | |
| July | Wayne Willner | Davidson, SK | ✓ | | |
| July | Solange Bakker | Saskatoon, SK | ✓ | | |
| July | Jim Robbins | Delisle, SK | ✓ | | |
| July | John Cooper | Handel, SK | ✓ | | |
| July | Ron Meakin | Langham, SK | ✓ | | |
| July | Larry Hoffman | Spalding, SK | ✓ | | |
| August | Robert Howse | Carragana, SK | ✓ | | |
| August | Keith Neu | Hudson Bay, SK | ✓ | | |
| August | Prairie Sun Organic Market | Winnipeg, MB | ✓ | | |
| Multiple Visits | Elmer Laird | Davidson, SK | ✓ | | |
| Multiple Visits | Marc Loiselle | Vonda, SK | ✓ | | |
| November | Organic Centres | Great Britain and Ireland | ✓ | | |

| Seminars/Workshops/Conferences | | | Attended | Presented | Organized |
|---|---|---|---|---|---|
| January | Canadian Society of Agronomy – Atlantic Region Conference | Charlottetown, PE | ✓ | ✓ | ✓ |
| January | Guelph Organic Conference | Guelph, ON | ✓ | ✓ | |
| January | Guelph Organic Conference - OACC Advisory Forum | Guelph, ON | ✓ | ✓ | ✓ |
| January | Golden K Club | Truro, NS | ✓ | ✓ | |
| January | Atlantic Agricultural Coordinating Committee | Waverly, NS | ✓ | ✓ | |
| February | Alberta Organic Conference | Red Deer, AB | ✓ | ✓ | |
| February | Alberta Organic Conference - OACC Advisory Forum | Red Deer, AB | ✓ | ✓ | ✓ |
| February | Going Organic | Red Deer, AB | ✓ | | |
| February | Organic Apple Production Workshop | Kentville, NS | ✓ | ✓ | |
| February | Organic Update | Yorkton, SK | ✓ | ✓ | |
| February | NSAC Seminar, Andrew Kernohan | Truro, NS | ✓ | | ✓ |
| February | Seaspray Atlantic Workshop | Charlottetown, PE | ✓ | | |
| February | COABC Annual Meeting | White Rock, BC | ✓ | ✓ | |
| February | Comitté agriculture biologique, CRAAQ - Forum on Research and Innovation in Biological Agriculture | Plessisville, QC | ✓ | ✓ | |
| February | Eco Farm Day, Conference and Trade Show | Cornwall, ON | ✓ | | |

| Seminars/Workshops/Conferences | | | Attended | Presented | Organized |
|---|---|---|---|---|---|
| March | ACORN Organic Production Course | Truro, NS | ✓ | ✓ | |
| March | ACORN Conference | Halifax, NS | ✓ | ✓ | |
| March | ACORN Conference – OACC Advisory Forum | Halifax, NS | ✓ | ✓ | ✓ |
| March | CWB Conference | Saskatoon, SK | ✓ | | |
| March | Crop Talk | Scott, SK | ✓ | ✓ | |
| March | NSAC Graduate Research Symposium | Truro, NS | ✓ | ✓ | |
| March | Composting Council of Canada | Moncton, NB | ✓ | ✓ | |
| April | NSAC Seminar, Tuma Young | Truro, NS | ✓ | | ✓ |
| June | Ecosystems Health Conference | London, ON | ✓ | | |
| June | NSAC Seminar, Rebecca Eisses | Truro, NS | ✓ | | ✓ |
| August | Canadian Society of Soil Science – International Conference on Mycorrhizae | Montreal, QC | ✓ | ✓ | |
| October | NSAC Seminar, Derek Lynch | Truro, NS | ✓ | | ✓ |
| October | NSAC Seminar, Guido Haas | Truro, NS | ✓ | ✓ | ✓ |
| November | University of Saskatchewan Seminar | Saskatoon, SK | ✓ | ✓ | |

| Seminars/Workshops/Conferences | | | Attended | Presented | Organized |
|---|---|---|---|---|---|
| December | NSAC Seminar, Brenda Frick | Truro, NS | ✓ | ✓ | ✓ |
| December | NSAC Organic Information Session | Truro, NS | ✓ | ✓ | ✓ |
| December | University of Manitoba Seminar | Winnipeg, MB | ✓ | ✓ | |

| Meetings/Consultations | | | Attended | Presented | Organized |
|---|---|---|---|---|---|
| January | OACC Selection Committee for Prairie Co-ordinator | Saskatoon, SK | ✓ | | ✓ |
| January | Golden K Club | Truro, NS | ✓ | ✓ | |
| March | OPAM AGM | Brandon, MB | ✓ | ✓ | |
| April | SOD AGM | Moose Jaw, SK | ✓ | ✓ | |
| April | OCIA Chapter 8 | Moose Jaw, SK | ✓ | ✓ | |
| June | Saskatchewan Herb and Spice Association | Saskatoon, SK | ✓ | ✓ | |
| June | Cape Breton Food Producers and Processors Association | Pt. Edward, NS | ✓ | ✓ | |
| June | SAFRR Regional Agrologists | Teleconference | ✓ | | |
| June | Organic Research Unit, University of Saskatchewan | Saskatoon, SK | ✓ | | |
| July | Crop Breeders meeting | Winnipeg, MB | ✓ | ✓ | |
| August | Buyers' Delegation | Saskatoon, SK | ✓ | ✓ | |

| Meetings/Consultations | | | Attended | Presented | Organized |
|---|---|---|---|---|---|
| September | Organic Research Unit, University of Saskatchewan | Saskatoon, SK | ✓ | | |
| October | OCIA Chapter 2 | North Battleford, SK | ✓ | ✓ | |
| November | Saskatchewan Environmental Society | Saskatoon, SK | ✓ | ✓ | |
| November | SAFRR Regional Agrologists | Teleconference | ✓ | | |
| November | OCIA Chapter 5 | Humboldt, SK | ✓ | | ✓ |
| November | OCIA Chapter 5 | St Mary's, SK | ✓ | ✓ | |
| November | MCOG AGM | Memramcook, NB | ✓ | | |
| November | PEI Trout River Environmental Committee | Trout River , PE | ✓ | | ✓ |
| November | Consultation/Update | Lethbridge, AB | ✓ | ✓ | |
| November | Consultation/Update | Lacombe, AB | ✓ | ✓ | |
| November | Consultation/Update | Grande Prairie, AB | ✓ | ✓ | |
| December | CWSS Annual Meeting | Halifax, NS | ✓ | ✓ | |

## EXTENSION ARTICLES

| Month | Publication | Title[1] | Authors |
|---|---|---|---|
| January | *Farm Focus* | Managing Internal Parasites in Organic Livestock[1] | Av Singh |
| March | *Farm Focus* | Pests in Organic Systems and Promising Solutions[1] | Av Singh |
| March | *Farm Focus* | Energizing Pastures and Grazing Cows[1] | Rupert Jannasch |
| April | *Western Producer* | Planning for Next Year's Crop of Weeds[1] | Brenda Frick |
| April | *Farm Focus* | Demystifying Compost: A Closer Look Into the Pile[1] | Av Singh |
| April | OACC Website | Pneumatic Weed Control for Organic Production[1] | Rosaria Campbell |
| April | OACC Website | Thermal Weed Control for Organic Production[1] | Rosaria Campbell |
| May | *SOD Newsletter* | Prairie Co-ordinator's Report – May Update | Brenda Frick |
| May | *OPAM Newsletter* | Prairie Co-ordinator's Report – May Update | Brenda Frick |
| May | *ProCert Newsletter* | Prairie Co-ordinator's Report – May Update | Brenda Frick |
| May | *Western Producer* | Making Good Use of Organic Crop Rotations[1] | Brenda Frick |
| May | *Farm Focus* | A Fine Balance. . . Organic Soil Amendments and Fertilizers[1] | Av Singh |
| June | *Western Producer* | Plan to Reduce Grasshopper Risk[1] | Brenda Frick |
| June | *Farm Focus* | Controlling the Cucumber Beetle[1] | Rupert Jannasch |

[1] Available on OACC Website (www.organicagcentre.ca).

| Month | Publication | Title[1] | Authors |
|---|---|---|---|
| July | *Western Producer* | It Can Be A Harrowing Experience[1] | Brenda Frick |
| July | *Farm Focus, Ontario Farmer* | Refining Nutrient Management in Organic Systems[1] | Derek Lynch |
| July | *Farm Focus* | Livestock and Forages: Essentials of Organic Farming?[1] | Andy Hammermeister |
| August | *Western Producer* | Cover Crops Cover All the Bases[1] | Gisela Duerr and Brenda Frick |
| August | *Farm Focus* | Cover Cropping with Fall Rye? Careful![1] | Rupert Jannasch |
| August | *SOD Newsletter* | Prairie Co-ordinator's Report – August Update | Brenda Frick |
| August | *OPAM Newsletter* | Prairie Co-ordinator's Report – August Update | Brenda Frick |
| September | *Western Producer* | Interest in Intercropping Increasing[1] | Brenda Frick |
| September | *Farm Focus* | Organic Seed Regulations Tighten[1] | Rupert Jannasch |
| September | OACC Website | Virtual Farm Tour - OACC Brookside Field Site[1] | OACC Staff |
| October | *Western Producer* | Resisting the "Biotic Potential" of Grasshoppers[1] | Brenda Frick |

[1] Available on OACC Website (www.organicagcentre.ca).

| Month | Publication | Title[1] | Authors |
|---|---|---|---|
| October | *Ontario Farmer* | To Market ,To Market?: Lower Prices Signal Increasing Organic Industry Strength[1] | Rupert Jannasch |
| November | *Western Producer* | Breeding for Organic Production[1] | Brenda Frick |
| November | *Farm Focus* | Growing in Water or Soil[1] | Rupert Jannasch |
| December | *Western Producer* | Benefits of Biodiversity[1] | Brenda Frick |
| December | *ProCert Newsletter* | Prairie Co-ordinator's Report – December Update | Brenda Frick |
| December | *Farm Focus* | Mixing Soil for Organic Transplants[1] | Rupert Jannasch |
| December | OACC Website | Alberta Organic Grower Earns Outstanding Title[1] | John Dietz |
| December | OACC Website | Organic Reality – Living With Weeds[1] | John Dietz |
| December | OACC Website | Small, Mixed Organic Farm Supports Family[1] | John Dietz |

[1] Available on OACC Website (www.organicagcentre.ca).

## EDUCATION

OACC web-based courses are available to farmers, students, and others involved in organic agriculture. Participants can register for the courses regardless of their location and participate in the course material during the hours most suitable to them. Many students have found the interactive approach to be enjoyable and educational. It can be a valuable experience to interact with the instructor and with classmates with similar interests and questions while sitting comfortably at home.

A recent course participant told us that she wanted to look at the "why" behind the "how-to" she had acquired. She wanted to build on her experience with more formalized, university-level academic knowledge:

> *"In a nutshell I was ready for the science and theory but I still needed a course that was realistic and practical. Being in a rural location and having a family made daily travel to a university impossible. I needed the right courses offered with the right mix of theory and practice in a distance education format - online. A pretty tall order! My experience with the OACC courses has been overwhelmingly positive."*

Other students affirmed that their guided practical experience was supporting the theory:

> *"On day 11 the average pile temperature is 63$^{o}$C and I am hoping to heat to 65$^{o}$C to kill weed seeds and fly larvae. There is no odour. I am so proud!"*
>
> *"The pile has shrunk to 25 cm and is at 56$^{o}$C. There are lots of actinomycetes (fungi) in the centre core with no odour. I am learning lots and having fun!"*

Throughout the courses, participants engage in discussion groups and are directed to current organic information available on the internet. Background reading material is provided to all who register in the courses, and other required materials are clearly identified in the registration process for each course.

The OACC courses are offered for credit at a second-year degree level through the Nova Scotia Agricultural College, the University of Guelph, the University of Manitoba, and the University of British Columbia. For those who prefer to have full access to the instructors and the course material without completing assignments and writing exams, the courses can also be taken on a non-credit basis. Farmers in particular are encouraged to register for these courses. Your input and questions keep us sharp and on track.

The web-based courses available to date are:

- Composting Skills
- Key Indicators of Sustainable Agriculture
- Organic Crop Production on the Prairies
- Organic Field Crop Management
- Organic Livestock Production
- Organic Marketing
- Transition to Organic Farming

In the near future there will be new web-based courses on Organic Horticultural Crops, Soil Ecology, and Organic Weed Management. At least 5 courses will be available in French.

## Certificate of Specialization in Organic Agriculture

The Nova Scotia Agricultural College (NSAC) is now offering a new "Certificate of Specialization in Organic Agriculture." This initiative will provide students with an opportunity to specialize in the expanding field of organic agriculture. The certificate will enable students to approach organic agriculture from their area of interest, and to know they can be recognized for this accomplishment while continuing to take other courses towards a degree in agriculture.

To date the total organic sector accounts for about 1-2% of agriculture overall. However, the employment opportunities are expected to increase in an industry that is growing at a rate of 20% per year. There are also opportunities for self-employment on smaller farms than might be profitable under conventional production.

Any student who has successfully completed four of the eligible organic agriculture credit courses (including at least two courses from NSAC), and who has an overall average of at least 60% in these courses can apply to receive a Certificate of Specialization in Organic Agriculture.

For more information or to register for a course please visit the OACC website:

http://www.organicagcentre.ca/courses_web.html

Agriculture and Agri-Food Canada (AAFC) is pleased to participate in the production of this publication. AAFC is committed to working with our industry partners to increase public awareness of the importance of the agri-food industry to Canada. Opinions expressed in this document are those of OACC and not necessarily the department's."