



# **ORGANIC AGRICULTURE IN WISCONSIN: 2014 UW-MADISON RESEARCH REPORT**

**Prepared by the UW-Madison Center for Integrated Agricultural Systems and the Wisconsin Department of Agriculture, Trade and Consumer Protection**

**Authors: Erin Silva, Lisa Bauer and Laura Paine**

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The **Center for Integrated Agricultural Systems** (CIAS) is a research center for sustainable agriculture in the College of Agricultural and Life Sciences, University of Wisconsin-Madison. CIAS fosters multidisciplinary inquiry and supports a range of research, curriculum and program development projects. It brings together university faculty, farmers, policy makers and others to study relationships between farming practices, farm profitability, the environment and rural vitality. For more information, visit [www.cias.wisc.edu](http://www.cias.wisc.edu) or call 608-262-5200.

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Media contact: Cris Carusi, CIAS: [cecarusi@wisc.edu](mailto:cecarusi@wisc.edu) or 608-262-8018.

Authors: Erin Silva, Lisa Bauer and Laura Paine.

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# Organic Agriculture in Wisconsin: 2014 UW-Madison Research Report

## Table of contents

Introduction.....	i
UW-Madison organic research updates .....	1
Dairy research projects .....	1
Impact story: Promising potato research to benefit diversified growers.....	3
Specialty crops research projects .....	5
Impact story: Long-term cropping systems trials provide relevant data, holistic view .....	12
Agronomic crops research projects.....	14
Impact story: Organic farmers turn to no-till to save soil, cut costs.....	15
No till and cover crops research projects.....	17
Impact story: Financial record-keeping through Veggie Compass can be a key to profitability .....	21
Management and marketing research projects .....	23
Appendix A: Contact information for researchers.....	25
Appendix B: The Wisconsin Organic Advisory Council .....	27



## Introduction

We are happy to share with you this report describing some of our current research on organic crops and management practices and the impacts that this type of work on is having on Wisconsin farms.

These and similar studies are an important part of our efforts to support Wisconsin's farm economy. Findings from organic research have clear benefits for the state's 1,100 organic farmers, the firms that supply them or process and market their products, and the many consumers who choose to buy organic food products. And the potential benefits extend to all Wisconsin farm enterprises. New knowledge about varieties and cropping practices that reduce reliance on herbicides and other purchased inputs can help cut costs and improve profitability under all types of farming systems.

This year CALS celebrates 125 years of research, teaching and outreach. As part of our quasiquintennial celebration, we're highlighting significant activities and accomplishments of the past 25 years. The research featured in this report falls squarely in that category. So does the establishment of the Center for Integrated Agricultural Systems, which celebrates its 25th anniversary this year. So does the Wisconsin Integrated Cropping Systems Trials, which began in 1989 to address the sustainability of diverse rotations and other low input measures. This is one of the nation's longest-running trials that includes organic management.

We are pleased to join with the Wisconsin Department of Agriculture, Trade and Consumer Protection and with University of Wisconsin-Extension in these important endeavors, and we look forward to another 125 years of partnership.

Wisconsin is a national leader in organic agriculture. We have more organic dairy and beef farms than any other state and rank second in total number of organic farms. We salute the farmers and allied firms that made this happen and look forward to working with them to build on this strength in the years to come.

Kate VandenBosch  
Dean  
College of Agricultural and Life Sciences  
University of Wisconsin-Madison



# UW-Madison organic research updates

Contact information for most researchers listed here is found in Appendix A, beginning on page 25. This is not an exhaustive list of projects; it only represents active or very recently completed projects.



## Dairy

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### Strategies of pasture supplementation on organic and conventional grazing dairies: Assessment of economic, production and environmental outcomes

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**Researchers:** Victor Cabrera (UW-Madison Department of Dairy Science), Rhonda Gildersleeve (University of Wisconsin-Extension), Michel Wattiaux (UW-Madison Department of Dairy Science) and David Combs (UW-Madison Department of Dairy Science)

**Funding and timing:** USDA-National Institute of Food and Agriculture (NIFA) Organic Agriculture Research and Extension Initiative, 2010-2014

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USDA National Organic Program standards for dairy production stress the integration of pastures into feeding strategies. Managed pastures provide abundant, high quality forage, but may also present challenges when balancing dairy rations. This study conducted on-farm interviews with 131 Wisconsin dairy farms (70 organic, 30 grazing, and 31 conventional) to investigate the impacts of pasture and feed supplementation decisions on selected economic, production and environmental variables. Surveyed farms provided retrospective answers from the 2010 production year during face-to face interviews. Two graduate students (C. Hardie and M. Dutreuil) were engaged in the grant activities as part of their respective MS and PhD programs.

C. Hardie's project, titled *General Management and Feeding Strategies on Wisconsin Organic Dairy Farms* (Dept. of Dairy Science, UW-Madison, defended June 2013), includes the following major objectives:

1. Describe general management on Wisconsin organic dairy farms, placing particular emphasis on feeding strategies
2. Identify feeding strategies for lactating cows on Wisconsin organic dairy farms and evaluate their productivity and profitability
3. Describe feeding management of dry cows on Wisconsin organic dairy farms

M. Dutreuil's dissertation (in preparation) includes the following topics:

1. Integrated farm system modeling to assess greenhouse gas (GHG) emissions from organic, grazing and conventional operations
2. Income over feed cost (IOFC) assessed with regression techniques
3. Manure management practices in the three management systems and their impacts



*Dairy cows on pasture.*

Photo: Ruth McNair

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## Quantifying relationships between soil quality, fertility and pasture management and the productivity of organic dairy pastures and milk production

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**Researchers:** Mark J. Renz (UW-Madison Department of Agronomy), Erin M. Silva (UW-Madison Department of Agronomy/CIAS) and Geoffrey Brink (USDA-Agricultural Research Service Dairy Forage Research Center)

**Funding and timing:** The Ceres Trust, 2013-2015

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This project will increase our understanding of the relationships between soil quality, fertility and management of organic pastures, and pasture productivity and milk quality. Through this research, farmers will better understand how various management decisions impact soil health and fertility in their pastures and productivity of their operations. Using a subset of representative organic dairies in the Upper Midwest identified by Organic Valley, this project will:

1. Evaluate the soil quality, health and fertility of organic pastures by measuring several key

indicators: soil physical properties, macro and micronutrients, soil organic matter, particulate organic matter, soil respiration, compaction and crop yield; pasture productivity as measured by yield and forage quality analysis; and milk production and quality

2. Evaluate weed ecology and dynamics in organic pastures
3. Document the range of production practices employed by organic farmers including herd hours spent on pasture, rotational grazing strategies, fertility management practices, weed management practices and supplemental feeding
4. Quantify the correlation between pasture quality (soil and weeds) and management practices using regression tree analysis
5. Further strengthen existing partnerships between farmers, industry and the university to determine the potential practical implementation of this research and define future research needs related to this study.



*Farmers attend a pasture walk on an organic dairy farm.*

Photo: Ruth McNair



**IMPACT STORY****Promising potato research to benefit diversified growers**

In north central Wisconsin, in the northwest corner of Marathon County, University of Wisconsin-Madison scientists introduced growers Kat Becker and Tony Schultz to the Papa Cacho, a potato variety that for them is resilient, yields well and has become a standard on their third generation, highly diversified organic farm.

“This variety did really well in a horrible drought,” Becker said. “It’s done well in freezing cold, low-nitrogen environments. And it’s commercially viable for us, giving us a variety that no one else has.”

Becker and Schultz operate Stoney Acres Farm, which includes a 20-week Community Supported Agriculture (CSA) program; vegetable, herb, fruit and flower production; grass fed-beef, pastured pork and chicken; organic grain; and farm-to-table pizza baked in a wood-fired oven May through November.

Stoney Acres Farm, along with 28 other farms in Wisconsin, North Dakota, Minnesota, Iowa, Michigan and Ohio, works with UW-Madison plant pathologists Ruth Genger, Amy Charkowski and others on their research team to study organic certified seed potato production and new organic potato varieties in the Midwest.

Genger and Charkowski have been working with organic potato farmers since 2007. They set out to research the production of healthy seed potatoes under organic management, since there is a shortage of local, organic seed potatoes and importing planting stock increases the risk of spreading disease.

In working closely with growers, the scientists realized that organic farmers had a limited number of potato varieties to choose from, and they were looking for specialty potatoes that offered flexibility in production, management and marketing.

Since 2010, Genger and Charkowski have partnered with farmers to do on-farm variety trials. Genger said, “We recognize that research station plots, even though they are organic, won’t reflect what’s going on at a real farm.”

At Stoney Acres Farm, potatoes are not the primary crop for Becker and Schultz. But they’re an important part of their CSA operation. They set out to find a variety that performs well in heavy soils with weed pressure. The Papa Cacho, originating in Peru, fit their needs. This variety produces long, skinny tubers with pink-red skin and pinkish to white flesh. Growers note that the foliage is somewhat resistant to late blight. And its unique appearance adds value to the Stoney Acres Farm CSA boxes and to the mixed quarts they sell at farmers’ markets.

“They fit well into our overall system,” Becker said, adding that they can easily sell the Papa Cacho variety at \$2/lb. “The potato project research has really made us think about what other systems might be out there and available for us. Ruth (Genger) has been very supportive. We’ve learned so much about different standards and about disease control.”

*continued on next page*



*Kat Becker, Stoney Acres Farm*

Photo: Ruth McNair

Genger said the project has expanded to partner with Seed Savers Exchange, a non-profit organization dedicated to saving and sharing heirloom seeds. Seeds Savers, with 500 to 600 potato varieties in their collection, helped Genger test potatoes and identify and eradicate viruses, and they hope to offer some of these new varieties for sale in the future.

Genger further tested potato varieties at the UW West Madison Research Station—50 varieties are being tested in 2013—before sending some of these varieties to their 28 partner farms.

“Farmers have been great about collecting data,” Genger said. “They’ve recorded the appearance of plants during the growing season, how vigorous the plants were, how well they stood up to insect and disease pressure, yield data, even taste tests.”

Genger said farmers have been enthusiastic about trialing new varieties of potatoes, adding, “What I’ve heard from farmers is that they really enjoy being able to see such a wide variety of potatoes. Farmers are innovators, and they want to try new things all the time. When you’re running a diversified farm, it’s very difficult to find time and labor to set up variety trials, so we provide the seed and help them do the work.”

Genger said their approach to the project—breeding for local and regional conditions—is extremely valuable, adding, “When you see results on farms in a wide region, that really gives you a sense that this could be an adaptable variety that would do well in a lot of conditions.”

As the project continues, Genger envisions it could lay the groundwork for some form of a local, cooperative seed industry for organic potato farmers.

“When you’re shipping potatoes, you’re shipping pathogens in the dirt and in the potatoes themselves. Right now most organic seed potatoes come from the East Coast and western states, environments very different than the Midwest, and they introduce disease,” she said. “The next steps for us in this research is to increase local seed potato production while at the same time breeding new potato varieties and helping farmers make more informed variety selection.”



*Potato variety trial in mid-summer 2013 - Antigo, WI*

Photo: Ruth Genger



*Harvested potatoes from variety trial at Abbe Hills Farm, Mt. Vernon, IA*

Photo: Laura Krouse



## Specialty crops

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### High tunnel effects on organic production and nutrient management of raspberries (*Rubus idaeus*, L.)

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**Researchers:** Jesse Dahir-Kahel (UW-Madison Department of Horticulture) and Rebecca Harbut (UW-Madison Department of Horticulture)

**Funding and timing:** North Central Region (NCR) Sustainable Agriculture Research and Education (SARE) Program, 2012-2014

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The goal of this study was to address the need for information by collecting weather, soil and tissue data from high-tunnel (HT) produced berries and berries produced in an outdoor field (OF) to obtain a more thorough understanding of the HT's impact on growing conditions and soil dynamics. The objectives included: 1) determining the effect of the HT on pest levels, cane growth, fruit quality and yield, and 2) evaluating the impact of organic fertilizers for organic HT production. An additional component of this investigation was the evaluation of the cultivars 'Caroline' and 'Heritage' for performance in organic HT production. While the focus of this experiment is on brambles, the information generated about the HT's effect on production and nutrient management will be valuable to producers of many different crops in a HT production system, as well as consultants and extension educators.

The results of this study illustrated that the HT increased yields, cane height and cane biomass. At the beginning of 2012, cane heights from plants grown within the two production systems differed by 200 percent, resulting in the overall biomass in the HT being 125 percent greater than the OF. Berry yields demonstrated similar results, with

up to 249 percent more total berry weight from HT plants compared to OF plants. The protection afforded by the plastic covering of the HT extended the season by approximately two weeks both in the spring and fall. The extension of the production season allowed the HT canes to initiate growth and produce harvestable berries earlier, resulting in increased yield. Wind speed reductions, higher nutrient availability and photosynthetically active radiation (PAR) intensity likely influenced growth and yield as well. The HT canes tended to have increased berry size and reduced pest damage; however, berries produced with the OF production system had higher brix, acids, and total phenolics as well as spotted wing drosophila (SWD) levels compared to those grown in the HT.

The HT's influence on soil dynamics, growth, fruit quality, pest dynamics and yield are based on a particular location's climatic conditions and a grower's management decisions. When it comes to the utilizing HTs for organic and/or raspberry growers, the decision must be based on the production situation. HT production is best suited for locations with low SWD populations and high market demand for premium, local berries produced both in-season and out-of-season. HTs may reduce nutrient loss from leaching and increase mineralization, but may also increase salt levels that potentially reduce yields in salt-intolerant crops. Given the right situation, HTs can offer pest management, fruit quality, growth and yield benefits that more than compensate for their disadvantages.

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### Weed management in organic potato production

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**Researchers:** Ruth K. Genger (UW-Madison Department of Plant Pathology), Doug I. Rouse (UW-Madison Department of Plant Pathology) and A.O. Charkowski, (UW-Madison Department of Plant Pathology)

**Funding and timing:** Project conducted 2012-2013

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*Potato variety trial evaluations in early summer 2012 at West Star Farm, Cottage Grove, WI*

Photo: Ruth Genger

Weed control is one of the biggest problems faced by organic farmers. One criticism of organic farming is that reliance on mechanical cultivation for weed control degrades soil structure and increases erosion. Weed roots damage potato tubers, reducing quality and impeding harvest, in addition to directly competing with potato plants. Mechanical hilling and tine weeding are the most common weed control methods in organic potato production.

In research conducted on organically managed land at the West Madison Agricultural Research Station, this research team compared this mechanical tillage approach with straw mulching. Potato crops were hilled after emergence, and subsequently, 'mulch' plots were covered with 8-10 inches of straw mulch, while 'tine/hill' plots were tine weeded and hilled as required. Straw mulch provided effective weed control through the spring and summer, and improved weed control at the end of the season when mechanical tillage was impossible. In 2013, rain impeded tine weeding in our West Madison ARS plots, but straw mulch provided excellent weed control. In the 2012 drought, 'mulch' plots yielded an additional 8280 lb/A compared to 'tine/hill' plots. In cooler, wetter 2013, yields were not significantly different between the two treatments.

Our continuing research will further investigate the role of straw mulch on working organic farms for weed control, soil health and moisture retention, pest and disease management, and how these effects may impact potato yield. We will also compare the economics of weed management using straw mulch or mechanical tillage.

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## **Integrating crop resistance, pathogen ecology and organically approved fungicides for vegetable crop disease control**

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**Researcher:** Amanda Gevens (UW-Madison Department of Plant Pathology-Vegetable Pathology)

**Funding and timing:** Various sources; research is ongoing

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This program evaluates the component and additive/programmatic efficacy of crop disease resistance, management choices arising from the enhanced understanding of a pathogen in its agricultural environment, and organic-approved fungicides and biorationals for control of common diseases in potato and vegetable crops in Wisconsin. Evaluation of varietal disease resistance and performance, fungicide efficacy (rate, timing, frequency), and pathogen character and response variables in host-pathogen systems materials is carried out both in production fields and in university greenhouses and laboratories. The use of disease forecasting tools to identify critical times for preventative, judicious use of organic approved fungicides is currently being explored. Results are extended to producers at various educational sessions throughout the year and via the Vegetable Crop Updates newsletter from UW-Extension and UW-Madison.

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## **Pest management strategies for Wisconsin's organic vegetable producers**

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**Researcher:** Russell Groves (UW-Madison Department of Entomology)

**Funding and timing:** Various sources; research is ongoing

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In the Vegetable Entomology laboratory at UW-Madison, the responsibilities of the UW-Extension Vegetable Entomology Program include the development, implementation and delivery of a

research-based extension program to support integrated and organic pest management options for the control of insect and mite pests. This program primarily centers on the ecology and management of insects affecting dry-bulb onions, cole crops, potatoes and cucurbits. Moreover, a recent focus in this lab is investigating mature plant resistance as a non-chemical means of controlling non-persistent virus transmission in organically grown potatoes. This program attempts to balance the development of short-term solutions to these immediate and emerging problems, which out of necessity may require purely empirical and, at times, ad hoc approaches, with research to develop long-term sustainable solutions. This extension and research program is the result of a team of collaborators working together, specifically with cooperators from the departments of Entomology, Horticulture, Plant Pathology, and Soil Science at the University of Wisconsin-Madison as well as scientists from other institutions.

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### **Snap bean (*Phaseolus vulgaris* L.) breeding for enhanced nitrogen-use efficiency**

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**Researchers:** Benjamin W. Hughey (UW-Madison Department of Horticulture) and James Nienhuis (UW-Madison Department of Horticulture)

**Funding and timing:** Work completed in 2012-2013; will continue in 2014 with funding, in part, from the Organic Farming Research Foundation

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Wisconsin is the leading producer of processed snap beans (*Phaseolus vulgaris* L.) in the United States. Most of Wisconsin's snap bean acreage is found in the Central Sands where nitrate leaching, partially due to overfertilization, soil type and irrigation, is high. This leaching is a problem in both conventional and organic agricultural systems. For economic and environmental reasons, enhancing nitrogen-use efficiency (NUE) in this crop has, for the most part, been unsuccessful due to the high environmental influence on this trait. Breeding for organic agriculture can be difficult, due in part to the diversity of soils and soil fertility found across

organic systems. This field trial was designed to make selections on genotypes that perform equally in above-ground biomass accumulation under both low and high synthetic nitrogen environments. Significant genotypic effects for NUE were found in two backcross populations, analyzed as augmented designs, over two years in the Central Sands of Wisconsin. Although significant genotype-by-environment interactions were found, narrow sense heritability estimates for two different NUE measures were estimated above 0.50. Selections based on NUE, above-ground biomass and stability of said traits across years were made within each of the two backcross populations for eventual cultivar release. This trait is advantageous to organic and conventional growers interested in more efficiently utilizing the available soil nitrogen, increasing the proportion of total plant nitrogen fixed by *Rhizobia*, or dealing with diverse soil fertility. This study demonstrated that simple field-based phenotyping with thorough replication was significant in making selections for enhanced NUE in snap beans.

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### **Diversity prospecting for an open source plant breeding framework**

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**Researchers:** Claire Luby (UW-Madison Department of Horticulture), and Irwin Goldman (UW-Madison Department of Horticulture)

**Funding and timing:** Seed Matters Graduate Student Fellowship, 2013-2018; funded in part by NCR-SARE Program in 2014

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Humans began plant breeding to domesticate crop plants for increased yields, improved flavor and other desirable traits such as non-shattering grains. Genotypes we use today are continually selected for adaptation to new pests and diseases, changing environmental conditions and production characteristics. These successes are directly related to the ability of farmers and plant breeders to access diverse plant genetic resources. We are currently experiencing a dramatic transition in how plant germplasm is distributed, developed and released;

what was once a freely available resource, primarily in the public sector, is increasingly accessible through proprietary structures managed largely by the private sector. Farmers need access to a wide variety of cultivars that suit diverse environments and appeal to their customers. Access to diverse cultivars and the traits they encompass is becoming more restricted due to increasing use of a wide variety of intellectual property rights protections.

Using carrot as a model crop, this project will explore germplasm diversity and its associated intellectual property rights to determine how these forces impact farmers' and plant breeders' access to and sharing of germplasm. A set of nearly all carrot cultivars of every market class available in the United States has been obtained and will be planted in replicated trials at two farms in the Madison, Wisconsin area. Three data sets will be collected: (1) phenotypic diversity such as growth habit, shape, color and human health attributes; (2) DNA sequence information for each cultivar for assessing genotypic diversity; and (3) an accounting of any form of legal protection or restrictions associated with each cultivar that may impact future breeding efforts. These data sets will be used to map clusters of phenotypic and genotypic diversity in carrot, which will be overlaid by a map that indicates where this diversity may be used and where this diversity is restricted for breeding. In addition, the researchers will begin to develop several populations that capture the diversity available for breeding. They will work with the Wisconsin Alumni Research Foundation (WARF)



*UW-Madison plant breeder Irwin Goldman*

Photo: Sevie Kenyon

to try and ensure that populations will be released under a framework ensuring that germplasm diversity will remain available for others to use in breeding programs and on farms in the future. Access to and utilization of diverse germplasm will help facilitate the development of new cultivars with useful traits for farmers, and will ensure genetic diversity essential for resilient agricultural systems.

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### **Improving the quality of labor management decisions for small and medium-sized farm operators**

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**Researchers:** Mary Peabody (University of Vermont), John Hendrickson (UW-Madison CIAS), Seth Wilner (University of New Hampshire) and Carolyn Sachs (Penn State University)

**Funding and timing:** USDA Agricultural Food and Research Initiative (AFRI), 2013-2016

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This project targets small and medium-sized vegetable farmers who are interested in scaling up commercial operations. The goal of the project is to identify key indicators—economic and social—involved in labor decisions on farms. Small and midsize farm operators are faced with three emerging trends that are directly linked to farm labor issues. First, increasing demand for fresh and value-added foods with known qualities and histories (i.e. local, organic and grass-fed) is pushing the limits of direct marketing potential. Second, small farm operators are finding it increasingly difficult to meet their income and family needs (e.g. child care, health care) at current production scales, yet the time and work requirements of the farm make off-farm work difficult to manage and take valuable human resources away from the farm operation. Finally, advances in season-extending growing practices, the availability of new (and re-emerging) crops, changing weather patterns, increasing regulation and the growing demand for value-added foods are increasing both the hours of total labor required and the skills necessary to keep these new-generation farms operating. This project will develop educational materials and an online

decision-support dashboard to assist farmers with labor management planning. This multi-state project includes Vermont, New Hampshire, Pennsylvania and Wisconsin. The project will collect group interviews and a survey to inform the development of educational resources and outreach programs.

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### Participatory breeding of open-pollinated varieties of sweet corn for organic production in Wisconsin

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**Researchers:** Tessa Peters (UW-Madison Department of Agronomy), and William F. Tracy (UW-Madison Department of Agronomy)

**Funding and timing:** Seed Matters Graduate Student Fellowship, 2013-2017, and The Ceres Trust Graduate Student Award, 2013-2014

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Sweet corn is an important fresh market vegetable crop in the Upper Midwest, since farmers' market, farm stand and Community Supported Agriculture (CSA) customers demand this crop. It is also an important part of crop rotations for organic farmers. These farmers desire open-pollinated sweet corn varieties so they can save seed. There is a need for cold tolerant, disease resistant sweet corn varieties bred for organic conditions. Currently, the researchers are working on three participatory projects to develop open pollinated sweet corn for the organic fresh market in the Upper Midwest. First, several top cross varieties will be trialed for an early sweet corn this year at the UW West Madison Ag Research Station and Arlington Research Station, as well as an organic farm in Minnesota. Second, synthetic populations are being developed for both early and late sweet corn varieties. These will be used to produce robust populations in the future. Third, selection for high-density plantings of a late sweet corn population are being made to help increase yield for organic farmers.



*William Tracy and Adrienne Shelton inspect organic sweet corn.*

Photo: Wolfgang Hoffmann

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### Recurrent selection for improvement of two open-pollinated sweet corn (*Zea mays* L.) populations

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**Researchers:** Adrienne C. Shelton (UW-Madison Department of Agronomy), and William F. Tracy (UW-Madison Department of Agronomy)

**Funding and timing:** Organic Farming Research Foundation, 2008, and USDA-NIFA Organic Agriculture Research and Extension Initiative, 2009-2014

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Organic growers face unique challenges when raising sweet corn and benefit from varieties that germinate consistently in cold soils, deter insect pests through ear morphology, resist disease pressure and maintain high eating quality. Genotype by environment rank changes can occur in the performance of cultivars grown on conventional and organic farms, yet few varieties have been bred specifically for organic systems. The objective of this experiment was to improve two open-pollinated sweet corn populations using recurrent selection and a participatory plant breeding (PPB) methodology, with the ultimate goal of releasing a new sweet corn variety adapted for organic farming systems. From 2008 to 2012, five cycles of two open-pollinated sugary-enhancer sweet corn populations were selected on a certified organic farm in Minnesota using a half-sib recurrent selection scheme. Selections were made in collaboration

with breeders and an organic farmer, with selection criteria based on traits identified by the farmer. In 2012 and 2013, the population cycles were evaluated in a randomized complete block design in four certified organic environments in Wisconsin, with four replications in each environment. Replicated growth chamber experiments were also conducted to test germination rates across three seed production environments. Significant differences were found between cycles for agronomic and quality traits. The latest cycle of one population will be commercially released in 2014.

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### **NOVIC: Northern Organic Vegetable Improvement Collaborative**

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**Researchers:** Erin M. Silva (UW-Madison Department of Agronomy/CIAS) and William F. Tracy (UW-Madison Department of Agronomy)

**Funding and timing:** USDA-NIFA Organic Agriculture Research and Extension Initiative, 2009-2014

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The Northern Organic Vegetable Improvement Collaborative (NOVIC) brings together U.S. researchers and organic farmers in northern states to address their seed and plant breeding needs. The collaborative includes researchers and educators from four universities, the Organic Seed Alliance and the USDA. NOVIC is partnering with organic farmers to breed new varieties, identify the best performing existing varieties for organic agriculture, and educate farmers on organic seed production and plant variety improvement. Fundamental to the success of organic agriculture is the use of plant varieties with contemporary productivity traits that perform under organic production challenges such as weed competition, low-input fertility, and pest and disease pressure. In addition, organic markets demand superior flavor, nutrition and local availability. Organic farmers are challenged by the lack of organic seed sources and scarcity of information on variety performance under organic conditions. While organic varieties must meet unique challenges and consumer demands,

few breeding programs are focused specifically on breeding for organic agriculture. Through its participatory breeding and trialing activities, NOVIC aims to increase the number of regionally adapted vegetable varieties appropriate for organic producers.

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### **Carrot improvement for organic agriculture**

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**Researchers:** Philipp W. Simon (USDA-Agricultural Research Service), Erin M. Silva (UW-Madison Department of Agronomy/CIAS), and Jed Colquhoun (UW-Madison Department of Horticulture)

**Funding and timing:** USDA-NIFA Organic Agriculture Research and Extension Initiative, 2012-2016

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Carrot Improvement for Organic Agriculture (CIOA) is a long-term breeding project that addresses critical needs of organic carrot farmers by developing orange and novel colored carrots with improved disease and nematode resistance, better weed competitiveness, and enhanced nutritional value and flavor. This four-year project will also compare the relative performance of breeding material in organic versus conventional environments and investigate whether some carrot varieties perform better under organic soil conditions.

Organic growers require vegetable varieties that are adapted to organic growing conditions and hold market qualities demanded by organic consumers, including superior nutrition and exceptional flavor. Significant progress has been made in carrot breeding for conventional production systems, such as breeding for nutritionally superior varieties across multiple color classes including orange, red, purple and yellow. While these high-value carrot varieties are in demand, much of this germplasm has not been improved for organic systems. Organic producers need varieties that germinate rapidly with good seedling vigor, compete with weeds, resist pests, take up nutrients efficiently and



are broadly adapted to organic growing conditions. The majority of the conventional U.S. carrot crop is threatened due to loss of chemical fumigants and sprays to control nematodes and *Alternaria* leaf blight. Organic production has no obvious means for economical carrot production when either of these pests threatens the crop. The Carrot Improvement for Organic Agriculture project will deliver improved carrot varieties, greater understanding of the influence of organic and conventional farming systems on variety performance, and a breeding model for organic systems that is adaptable to other crops.

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### **Fertility management of organic sweet corn production on sandy soils**

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**Researchers:** Jaimie West (UW-Madison Department of Soil Science), Matthew D. Ruark (UW-Madison Department of Soil Science), Jed Colquhoun (UW-Madison Department of Horticulture), Erin M. Silva (UW-Madison Department of Agronomy/CIAS) and A.J. Bussan (UW-Madison Department of Horticulture)

**Funding and timing:** USDA Hatch Act Formula Funds, 2011-2013

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The Wisconsin Central Sands region is defined by processing vegetable crop production on irrigated, sandy soil. Interest in the organic market for high value specialty crops and a desire to mitigate the environmental impacts of intensive farming dictate a need for alternative methods of nutrient management in this region. The potential for rapid leaching of nitrogen (N) combined with high N demand of these crops exacerbates elevated groundwater nitrate concentrations that significantly exceed the drinking water standard.

This research team conducted a study evaluating organic sweet corn production using early season manure applications alone and in combination with in-season feather meal applications. The study was conducted in 2011 and 2012 at the UW

Hancock Agricultural Research Station (Waushara County) on overhead irrigated Plainfield loamy sand soil. Two early-season manure treatments were evaluated and included spring-seeded field pea and pelletized composted poultry manure (CPM, 4-5-3). The field pea green manure had 29 and 81 lb N ac<sup>-1</sup> in 2011 and 2012, respectively. The CPM was applied at a rate of 68 lb N ac<sup>-1</sup> (2011) and 81 lb N ac<sup>-1</sup> (2012). Crumbled feather meal (11-0-0) was broadcast applied in two equal split sidedress applications at the V4 and V8 sweet corn growth stages at 100, 150, 200, and 250 lb N ac<sup>-1</sup>.

Results underscored the well-known potential for N loss on sandy soils. Early season manure applications failed to increase yields when used alone, and failed to reduce N application in combination with feather meal. Lack of yield effect was likely due to rapid decomposition and deep drainage of N during rain events in 2011 and excessive irrigation in 2012. Feather meal was a suitable source of N when split applied at V4 and V8, resulting in sweet corn yields that equaled or exceeded conventional yields from concurrent studies. Optimal feather meal-N rate in 2011 was 200 lb N ac<sup>-1</sup> with a yield of 8.3 ton ac<sup>-1</sup> (20,000 ears ac<sup>-1</sup>). In 2012, 100 lb N ac<sup>-1</sup> was the optimum feather meal-N rate with 9.6 ton ac<sup>-1</sup> yield (23,000 ears ac<sup>-1</sup>), with no significant response to increased N rates. Seasonal differences and resulting water management differences are likely responsible for overall increased yield during the 2012 drought.

Organic management is desirable for many reasons, including reduced herbicide and pesticide use and value added market access, but leaching of nitrate to groundwater on sandy soil will persist regardless of N source. The wide variability of nutrient behavior on sandy soil indicates the need for adaptive management; that is, using weather and plant health indicators to prompt additional N applications. Reduced late-season N application may be justified in years with minimal leaching events. Similarly, heavy irrigation in drought years may garner N credits for nitrate applied through irrigation water.

**IMPACT STORY**

**Long-term cropping systems trials provide relevant data, holistic view**

Since 1989, a group of UW-Madison scientists have studied the sustainability of alternative farming by comparing a variety of production systems at two agricultural research stations. That’s nearly a quarter century of solid data from the Wisconsin Integrated Cropping Systems Trial (WICST).

“We don’t have a lot of mature cropping systems trials that allow us to extract real discrete data sets,” said Bill Stangel, who uses data from WICST to help his clients at Soil Solutions Consulting. “The WICST trial does that. It’s provided a fantastic platform for systems comparisons that answer a lot of relevant questions. It’s a frequent stopping point for information.”

The hub of the WICST project is two crop rotation trials at Arlington Agricultural Research Station in Columbia County (affiliated with the University of Wisconsin) and the Lakeland Agricultural Complex in Walworth County (the county-owned farm).

These trials compare three cash grain and three forage-based production systems: a conventional continuous corn system, a conventional corn/soybean (no-till) system, an organic corn/soybean/wheat system, a conventional dairy, an organic dairy and a rotationally grazed pasture system (Figure 1).

Around this framework of trials, WICST has developed a wide range of projects examining biofuels, cover crops, managed grazing, manure management, organic and low-input systems, and small grains, among other research offshoots.

Stangel has used data from the study in his work with farmers over the years. For example, WICST research examining red clover, its various methods of establishment and pitfalls in growing it, provided Stangel with solid learning points to take directly to his farmers when they were planting similar seedings of clover and wheat.

“The whole-systems approach really gave me insight in terms of what I was doing in the field with farmers as it relates to forage and grain rotations,” he said. “I could see outcomes in this study that I could apply directly to a field, such as modifications to a tillage system or crop rotation.”

Stangel said a producer recently asked him about using berseem clover in a rotation. Stangel was able to share specific data from the WICST organic trial with this farmer, adding, “It’s great to have the information there when the question comes up.”

Stangel added, “Work done on cover cropping in the WICST project and satellite studies really provides some excellent insight today in terms of what works and what doesn’t. That data is really hard to come by in many locales, but WICST has a substantial data set.”

A collaborative effort between citizens, nonprofit organizations and the UW-Madison, the WICST team expanded to include not only researchers, but also crop consultants, farmers, County Extension personnel and the Michael Fields Agricultural Institute.

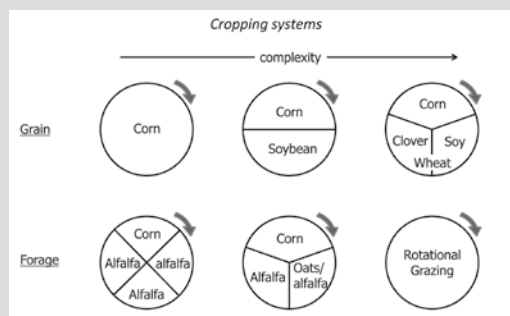


Figure 1: WICST cropping systems

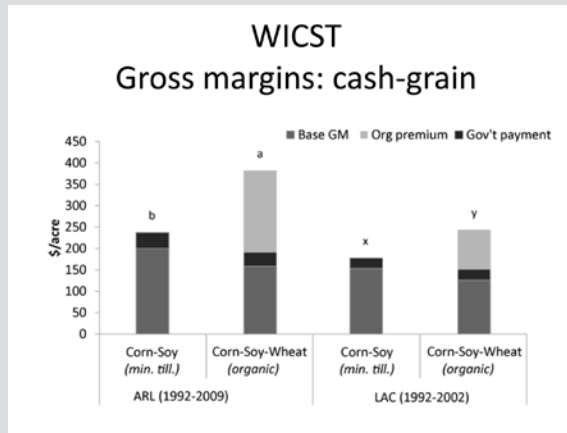


Figure 2

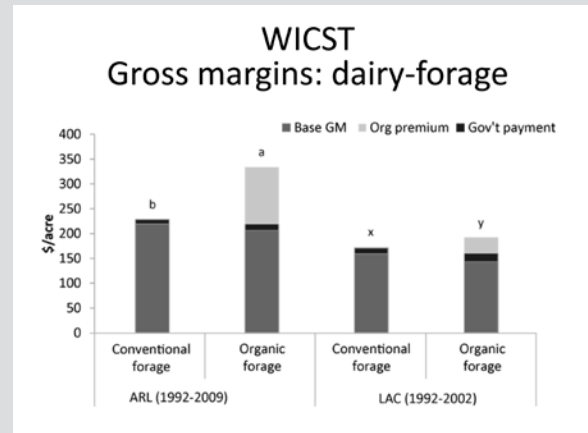


Figure 3

And it was always intended to be long-term.

“WICST was set up with the idea that it would run as long as possible, since it could take a decade or more to capture environmental and economic trends,” said agronomist Gregg Sanford, who’s worked on WICST for almost a decade.

WICST results to date show that diversified, reduced input systems, including organic systems, are promising. Well-managed low-input systems are no riskier than high-input systems, and low-input systems offer potential environmental benefits.

“We’ve published a number of interesting results,” Sanford said. “From an economic standpoint, under fair market conditions, organic systems are much more profitable than conventional systems, even though yields are slightly lower.” (Figures 2 and 3)

And in good years, when wet weather doesn’t interfere with spring tillage for weed control, Sanford said they’ve found that organic systems can easily produce more than 90 percent as well as conventional systems.

The WICST trials have also shown environmental benefits of the organic systems. Aggregate stability—a key soil health indicator—is higher in organic systems. Sanford’s research has shown that pasture systems are the only farming systems that build soil carbon, while organic cropping systems do no worse than conventional when it comes to losing soil carbon.

“The information coming out of WICST is unbiased and very robust because we have 25 years of data,” Sanford added. “It’s not painting organic in any miraculous light and it’s not demonizing conventional production.”

Stangel added, “This project is a big tent approach in terms of including a range of farmers. It’s not focused only on organic production or only on a conventional perspective. It brings everyone together to contribute and take away what they can.”

WICST has always cultivated mutually beneficial relationships between farmers and scientists. Stangel said, “The WICST trial is a great environment for sharing information. It’s never been a one-way exchange.” Sanford added, “WICST has always been guided by and benefited from farmer input.”



## Agronomic crops

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### Crop plant nutrition and insect response to soil fertility in organic field crops

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**Researchers:** Eileen Cullen (UW Madison Department of Entomology), Kevin Shelley (UW-Madison Nutrient and Pest Management Program) and Phillip Barak (UW-Madison Department of Soil Science)

**Funding and timing:** USDA-NIFA Organic Agriculture Research and Extension Initiative, 2006-2014

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Since 2006, the lab of Dr. Eileen Cullen in the Entomology department, along with collaborators Kevin Shelley (Nutrient and Pest Management program), and Dr. Phil Barak (Soil Science), has conducted a long-term study in organic Integrated Pest Management (IPM) at Arlington Research Station. The goal of this project is to determine how soil fertilization practices affect organic crop plant nutrition, crop damage by insect pests and natural enemy insect response.

Thirty-two randomized plots have been grown in a four-year alfalfa-alfalfa-corn-soybean rotation, with a companion oat crop in the alfalfa seeding year. Sixteen plots have been fertilized annually with manure only (“standard organic” fertilization, or STD); the remaining plots have received manure fertilization plus gypsum additions every two to three years (“soil balance” fertilization, or BAL).

The research team collected field data on soil and plant tissue nutrients, and pest insect abundances. Using field soil from the experimental plots, they also conducted greenhouse experiments in 2012 on

the effects of these fertilization practices on larval and adult European corn borers (ECBs). In 2013, they conducted trials of ECB performance and ECB egg predation on corn plants in field plots.

Results to date:

1. Supplementation of the field plots with gypsum did not increase calcium in crops, but consistently increased sulfur in crop tissues in the BAL plots between 2008-2010 (tissue data not collected in 2011 and 2012; 2013 data are forthcoming). This indicates that the sulfur in the gypsum is having a greater effect on plant nutrition than the calcium. Differences in pest insect populations and crop yields between soil treatments have been minimal.
2. In the 2012 greenhouse studies, ECB larvae developed faster on corn reared in BAL soil than in corn reared in STD soil (with a conventional treatment intermediate); also, ECB adults laid more eggs on plants reared in BAL soil over plants reared in STD soil. This preference of adult ECBs for BAL plants seems to be positively linked to the amount of sulfur in the plant tissues.
3. In the 2013 field study, ECB larvae developed faster on BAL corn plants than on STD corn plants, consistent with the greenhouse study. Predation of ECB eggs was also higher in STD plots than in BAL plots. While the team is still collecting data on this study, results so far suggest that gypsum additions (1) increase plant sulfur content, but not crop yield, and (2) may attract greater numbers of ECBs and improve ECB performance. Furthermore, predation pressure on ECB eggs was higher under standard organic fertilization than gypsum amended plots.

**IMPACT STORY****Organic farmers turn to no-till to save soil, cut costs**

R & G Miller and Sons, Inc., is a fifth generation family dairy farm that's been certified organic since 1997. Growing more than 1,500 acres of corn, soybeans, alfalfa, triticale, rye, barley, oats, wheat and pastures for their herd of 700 cows and young stock, R & G thrives on a diversity of plants and management strategies as well as a diversity of ideas.

“Organic farming is an ongoing experiment,” said Jim Miller, fourth generation farmer at R & G, near Columbus. “You always want to try different things. You have to have a lot of options open for you.”

With the support of Erin Silva and other scientists at UW-Madison, Miller has adopted a specialized no-till system that allows him to forego a suite of tillage operations in some fields that may reduce soil quality, increase erosion and compaction and drive up the cost of production.

The benefits of no-till production, including reduced fuel and labor costs, have been hard for organic producers to capture since no-till often requires the use of heavy chemicals to fight weeds.

But the no-till system studied since 2006 by Silva and her colleagues shows promise for organic row-crop producers.

“This project is designed to be very applicable for farmers,” Silva said. “And it has involved farmers in implementation and evaluation.”

The system in Wisconsin involves seeding a cover crop in the early fall, letting it establish and overwinter, and killing it in the spring. This creates a thick mulch residue on the surface that blocks the sunlight needed for weed germination. Farmers can then plant a grain or seed crop directly into the killed cover crop and combine that crop in the fall.

Killing the cover crop and seeding the grain or seed crop can be done together in one operation, versus the four to six operations it could take with tillage.

“Overall, we've found very promising results of the system,” Silva said. “There is definitely variability, depending on weed pressures in the field, but in most cases, the yields have been comparable with typical organic systems, on average yielding 40 to 45 bushels per acre of soybeans in most years.”

Miller said he has planted beans into standing rye with a no-till drill with good results, adding, “That was probably the nicest field we have ever seen. There might have been five weeds in the entire field. It was beautiful and yielded very well. If the stand of rye is thick and the yield is good, this definitely translates into savings.”

In organic no-till systems, the cover crop is typically knocked down before seeding with a front- or rear-mounted, ground-driven roller/crimper device. Roller-crimpers can be purchased for \$3,000 to \$4,200, or farmers can acquire plans to build them.

*continued on next page*

In their research with this organic no-till system, Bernstein et al, in 2011, found labor to be 2.5 hours per acre for a tilled production system and less than 1.5 hours per acre for the no-tilled crimped rye system. They also found a tilled system cost \$25 to \$30 for diesel fuel per acre compared to just above \$15 per acre for the no-till system.

Silva said there are on-farm demonstration sites across the state, with many organic farms from the Driftless region showing interest in this option for weed management and soil conservation on hilly fields.

Miller added that the nitrogen provided by cover crops is another advantage of the no-till soybean system.

“Applying manure before we plant our beans isn’t necessary because the beans don’t need it, and it just enhances the weeds,” Miller said. “The slow release of nitrogen through cover crops works much better.”

Both Miller and Silva agree that one key to success in this system is establishing adequate biomass with the cover crop.

“We found out that if you don’t get your rye in early enough and get a thick stand, you will have weedy beans,” Miller said. “This year we didn’t have any beans planted at all in mid-June, and we had to do something, so we planted into a weedy stand of rye. Everything was late due to a cold and wet spring. We’re still trying to combine those beans in early December.”

No-till organic production also offers an important advantage over tillage systems in wet years when farmers cannot get out to cultivate.

“If we continue to see more wet years and more weather extremes, the no-till option could really help with weed management and decrease soil erosion. It just gives farmers more flexibility,” said Silva.



*Soybeans grown using organic no-till techniques at the UW Arlington Agricultural Research station*

Photo: Erin Silva

That flexibility is precisely what farmers like Miller seek.

“We really need to have options in our system,” Miller added. “It’s an experiment where some years something will work, and the next year it won’t. But that’s the nature of organic farming.”

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Bernstein, E.R, J.L Posner, D.E. Stoltenberg, and J.L. Hedtcke. 2011. “Organically Managed No-Tillage Rye-Soybean Systems: Agronomic, Economic, and Environmental Assessment.” *Agron J.* 103:1169-1179.



## No-till and cover crops

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### Improving soil health through cover crop based no-till organic vegetable production

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**Researchers:** Anne Pfeiffer (UW-Madison Department of Horticulture), Eric Bietila (UW-Madison Agroecology Program), Erin Silva (UW-Madison Department of Agronomy/CIAS), Amy Charkowski (UW-Madison Plant Pathology), and Jed Colquhoun (UW-Madison Department of Horticulture)

**Funding and timing:** The Ceres Trust Graduate Student Award, 2013-2014

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No-till techniques have gained attention as a means to reduce the negative impacts of intensive tillage, which is routinely used by organic farmers for weed control. Significant questions remain about the viability of no-till techniques in organic vegetable systems. This project will compare cover crop species as part of a organic no-till vegetable system, as measured by impacts on vegetable quality, yield and soil health.

Research plots will be seeded in the fall with four cover crop varieties, along with a control plot with no cover, in randomized complete block design including four replications. Cover crops will be hand sown and lightly incorporated with a tractor-mounted tiller at rates of three bushels/acre for winter wheat (variety not specified) and winter rye (variety not specified), 40 pounds/acre for hairy vetch (variety: Purple prosperity), and rye-vetch mix (3 bushels/acre rye plus 40 pounds/acre vetch). Cover crops will be terminated with a sickle-bar mower in late spring prior to vegetable planting. Vetch will be clipped at 100 percent bloom, while rye and wheat will be clipped at anthesis. Vegetable planting strips will be tilled with a narrow walk-

behind cultivator. Bell peppers and snap beans will be planted into strips in early June, and broccoli will be transplanted in August. Two rows of each vegetable will be planted in each plot on 30-inch centered row spacing. ‘Tavera’ French filet green beans will be sown directly with a walk behind seeder at a rate of six seeds per row foot. Pepper (variety: Revolution) and broccoli (variety: Imperial) transplants will be set on 18 inches in-row spacing. One week following vegetable seeding or transplanting, granulated composted chicken manure (3.5-3-5) will be side dressed at a rate of 40 pounds/acre for beans and 80 pounds/acre for peppers and broccoli.

Beans will be harvested in late July by randomly selecting one 10-foot section from each of the two rows in each plot. Peppers will be harvested in late August at the green-ripe stage. All peppers from each plot will be harvested. Broccoli will be harvested in September or October. All broccoli heads from each plot will be harvested. Produce from each plot will be sorted into marketable and non-marketable groups, counted, weighed and assessed for quality. Weed suppression will be evaluated throughout the production season.

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### Integrating living mulches as a cover cropping strategy for small-scale organic vegetable production

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**Researchers:** Anne Pfeiffer (UW-Madison Department of Horticulture), Erin Silva (UW-Madison Department of Agronomy/CIAS) and Jed Colquhoun (UW-Madison Department of Horticulture)

**Funding and timing:** USDA-NIFA, 2011-2016

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Many small-scale organic growers look to cover crops to build their soils, but struggle to fit non-cash crops into rotations on a limited land base. Living mulches were explored in this research as a potential means for growers to gain the benefit

of cover crops while simultaneously producing crops for food and income. A cover crop trial was designed with the goal of identifying effective living mulch systems for small-scale organic vegetable production. Four cover crops: buckwheat (*Fagopyrum esculentum*), field peas (*Pisum sativum*), crimson clover (*Trifolium incarnatum*) and medium red clover (*Trifolium pratense*), as well as a cultivated control of no cover were planted in early spring. Cover crops were mowed and left as living mulch immediately prior to vegetable planting. Snap beans and bell peppers were planted in early June. Snap beans were planted into an eight-inch wide tilled strip. Bell peppers were transplanted directly into living mulch. Fall broccoli seedlings were transplanted directly into living mulch in early August. Throughout the season, living mulches and weeds were mown approximately every 10 to 14 days as needed to prevent shading of vegetable plants or weed seed maturity. After each mowing, in-row spaces adjacent to plants were cultivated by hand.

Vegetable production was less in all cover cropped plots relative to the cultivated control. Broccoli did not produce a crop in the presence of cover crops. Head formation was delayed in all plots and non-existent in most cover cropped plots. Cover cropped plots did produce bell peppers and snap beans, but yields were less than the cultivated control for all cover crop treatments.

Cultivation time, including mowing and in-row hand weeding, varied by cover crop and sample date. In 2012, crimson clover was the only cover crop treatment to require more time than the cultivated control. In 2013, crimson clover and medium red clover both required more time than the cultivated control. Cultivation time also varied between mowings, though no linear pattern was noted.

Weed density was less in the cultivated control relative to all other cover crop treatments at each sample date in both years. Weed biomass varied between cover crop treatments and throughout the season. In general, buckwheat and field peas had the highest biomass and lowest weed pressure

early in the season, but provided very little mid- and late-season weed control. Crimson clover and medium red clover developed greater biomass later in the season, but failed to provide significant weed control.

Though all cover crop treatments in this experiment resulted in low vegetable yields, it is hypothesized that the primary shortcomings are likely a result of the close proximity between cover crops and vegetables. A strip tillage system rather than punch planting into living mulch may achieve many of the same benefits of reduced erosion and soil building without the detrimental effect on the primary crop. A strip tillage system also offers the benefit of easier in-row management. Due to the extreme drought during collection of this data, cover crops were observed to compete for rather than conserve soil moisture. Under different environmental conditions, this aspect of inter-planting could be expected to produce dramatically different results.

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## No-till production using the roller-crimper and cover crops in the Upper Midwest

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**Researcher:** Erin M. Silva (UW-Madison Department of Agronomy/CIAS)

**Funding and timing:** USDA-NIFA Integrated Organic Program, 2008-2013, NCR-SARE, 2009-2013, and The Ceres Trust, 2013-2015

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No-till production has become a common practice in conventional cropping systems across the United States. Approximately 35.5 percent of U.S. cropland planted to eight major crops (barley, corn, cotton, oats, rice, sorghum, soybeans and wheat) was managed through no-till operations in 2009. No-till systems provide environmental benefits such as reduced soil erosion, increased soil organic matter, decreased runoff and improved soil infiltration, and improved soil structure and aggregate stability. No-till systems can also provide economic



benefits with reduced fuel and labor costs due to fewer tractor passes over the field.

Current practices used in no-till production systems rely on herbicides for weed management, thus preventing certified organic and herbicide-free growers from integrating these practices into their operations. However, research demonstrates the potential for herbicide-free no-till systems utilizing cover crops that produce high levels of residue biomass, suppressing weed emergence through the creation of a physical barrier with a dense, killed mulch. Managed in this fashion, cover crops can inhibit weed growth by preventing light from reaching the soil surface or through allelopathy. The quantity of mulch produced through cover crop management is highly correlated with the degree of weed suppression attained.

The objective of this study was to evaluate the biomass production and weed suppression of five different cover crops: winter rye (*Secale cereal* L.), winter triticale (*x Triticosecale* spp. L.), winter barley (*Hordeum vulgare* L.), Austrian winter pea (*Lathyrus hirsutus* L.) and hairy vetch (*Vicia villosa* L.) when integrated into no-till organic systems and terminated using two different methods: roll-crimping and sickle-bar mowing.

Initial weed populations prior to termination (disking, crimping, or mowing) differed significantly by year and cover crop variety. In 2010, initial weed densities were greater in the vetch (46.6 weeds m<sup>-2</sup>), and barley (43.3 weeds m<sup>-2</sup>) and lowest in the Austrian winter pea plots (18.4 weeds m<sup>-2</sup>). In 2011, overall weed densities were lower in the cover crop treatments and showed different trends, with densities greatest in the triticale (25.6 weeds m<sup>-2</sup>) and lowest in the hairy vetch (3.6 weeds m<sup>-2</sup>) and rye (0.9 weeds m<sup>-2</sup>) plots.

Weed suppression of mowed and crimped cover crops 12 weeks after planting differed significantly by year and by mode of termination (MOT) as measured by both weed density and weed biomass. In 2010, significant differences in densities of perennial grasses, annual grasses and perennial



*No-till field day at an organic farm*

Photo: Erin Silva

broadleaf weeds were observed in the roll-crimped versus mowed treatments, with higher densities of grasses in the roll-crimped plots and perennial broadleaves growing at higher densities in the mowed plots. No significant differences were observed in annual broadleaf densities or the total weed biomass in the roll-crimped and mowed plots. In 2011, no significant differences for MOT were observed for weed densities or biomass of the weed classes.

Weed biomass at 12 weeks after planting differed by cover crop treatment as well. The small grain plots demonstrated similar weed suppression as measured by total biomass in the crimped treatments and significantly different in the mowed plots. Significant differences were observed in the ability of the small grain cover crops to suppress weeds, as measured by total weed biomass.

New directions for this research include the investigation of best management practices for nutrient management using the cover crop-based no-till system. In addition, continued research will investigate the feasibility of growing corn using cover crop-based no-till techniques.

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## **Increasing varietal suitability and availability of cowpea and oilseed radish cover crop seed for northern climates**

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**Researcher:** Erin M. Silva (UW-Madison Department of Agronomy/CIAS)

**Funding and timing:** NCR SARE, 2013-2016

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Organic, no-till and sustainable producers require the availability of regionally adapted cover crop seed with appropriate traits to enhance performance and maximize the benefits of cover cropping. These benefits include restoring year-round living cover on rural landscapes, providing effective tools to reduce soil erosion, increasing nutrient cycling and decreasing soil and nutrient loading of waterways. Other potential benefits include improved soil quality, pest management, fertility management, water availability, landscape diversity and wildlife habitat.

The evaluation and development of cover crop varieties with desirable traits and suitability for



*Tillage radish and oat planted as a summer cover crop*

Photo: Erin Silva

local seed production is of great interest to organic producers. Forage radish, a cool-season cover crop, is popular for its potential to improve soil health due to its ability to scavenge nutrients from deep in the soil profile. Cowpea, a warm-season cover crop, fixes 100-150 lbs of nitrogen/acre, tolerates heat and drought, and winter kills, providing a good seedbed for no-till operations. This project aims to increase farmers' access to cowpea and forage radish seed varieties with useful cover crop traits and the ability to mature quality seed in northern climates.

**IMPACT STORY****Financial record-keeping through Veggie Compass can be a key to profitability**

“Veggie Compass has definitely had an impact on my business,” said Tricia Bross, of Luna Circle Farm in Rio.

Bross has a background in accounting, which is one reason she was initially attracted to using Veggie Compass, the whole-farm profit management tool that grew out of a partnership between UW-Madison and Jim Munsch, an organic farmer and farm management consultant in southwestern Wisconsin.

“One of the things that had always bothered me was that I couldn’t figure out how much it cost to grow a pound of tomatoes,” Bross said. “The missing piece was labor.”

With 3.5 acres of produce and five hoopouses, Bross and her employees recorded time spent working in radishes, salad mix, winter squash and various kinds of tomatoes—field work, harvesting and packing—for an entire season.

Thanks to Veggie Compass and an accounting firm that helped her set up QuickBooks, Bross figured out how much of her payroll went for each crop. She also calculated her overhead and income per crop, calculating overall profit.

Profitability is crucial to sustaining and expanding organic fresh market vegetable production in the Midwest, and understanding production costs is critical to profitability. Many organic growers produce a wide variety of vegetables and sell in several market channels such as CSA, farmers’ markets, restaurants and wholesale. While it’s difficult for organic vegetable growers to obtain timely, accurate costs for different crops and markets, this information is necessary for financially driven farm decisions.

Many growers inadvertently make a myriad of decisions based on instinct rather than data. This observation led to the Veggie Compass project.

Veggie Compass includes forms for collecting labor data and a multi-page spreadsheet designed for intuitive data organization. Growers enter farm expenses, sales information and labor hours on three different spreadsheet pages. The spreadsheet uses the data to calculate each crop’s cost per pound, breakeven price and gross margin by market channel. All forms are available for free download at [www.veggiecompass.com](http://www.veggiecompass.com).

“I really found some interesting things,” Bross said of her experience using

*continued on next page*



*Veggie Compass is particularly helpful for farmers growing a variety of crops.*

Photo: John Hendrickson

Veggie Compass. “Winter squash was making no money. I was probably losing money on it. Because of a hot summer, salad mix was not making money either.”

But Bross found she hit the jackpot with her tomatoes.

“On the opposite end of the scale, I discovered how much money tomatoes are making me,” she added. “I thought, ‘Wow, if could sell an acre of tomatoes, that’s all I would need to grow.’”

With a 50-member CSA and sales at the Dane County Farmers’ Market, Bross wanted to maintain a diverse farm, but she did significantly decrease her acres of winter squash, replacing some with watermelon.

John Hendrickson, outreach specialist with the UW-Madison Center for Integrated Agricultural Systems, said the developers of Veggie Compass continue to seek a better way for farmers to collect and analyze labor records.

“Labor record-keeping can be an obstacle,” said Hendrickson, who’s also an organic farmer. “It’s difficult for me to keep track of my own labor by crop, let alone the labor of my employees.”

Because of the challenge of tracking labor by crop, Hendrickson and his colleagues have attempted to come up with standardized benchmark labor values for different crops. However, data from collaborating farms has been tremendously variable.

“There is a really powerful lesson here that we hope to communicate to growers,” he added. “If there’s such a variation in labor—the most significant cost factor on a vegetable farm—that tells us that producers need to be paying close attention to their numbers when pricing their products.”

Bross added, “Figuring out our cost of production is really key for diversified growers. I can tell you that walking around the farmers’ market, looking at a vast array of prices, I sometimes think that farmers have no clue how to price their products.”

Veggie Compass has not only helped Wisconsin producers, such as Bross. Munsch and others have traveled to southern states to give workshops on using the tool.

A survey following one of these workshops found that 87 percent of participants said the training impacted the way they thought about their farms, and 88 percent reported they had started using tools from the training.

One workshop participant added, “The workshop has had a great impact on how I think about my farming operation. We are tracking costs in each enterprise and thinking more about profit margins, trying to use this information to make better decisions about what to grow and what to sell.”

Hendrickson said by continuing to consult with farmers, they will improve Veggie Compass, and perhaps someday soon they will develop an app. One thing is for certain; the need is great for this whole-farm accounting tool.

“What we hope is that this is going to provide a tool for folks to get serious about what crops are more profitable, and get them to pay more attention to efficiency, cost, labor management and training employees, to be more sustainable,” Hendrickson said. “There have been farms that have used Veggie Compass and really gotten powerful lessons out of it.”



## Management and marketing

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### Seed and plant breeding for Wisconsin's organic vegetable sector: Understanding farmers' needs and practices

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**Researchers:** Alexandra Lyon (UW-Madison Nelson Institute for Environmental Studies), Erin Silva (UW-Madison Department of Agronomy/ CIAS) and Michael Bell (UW-Madison Department of Community and Environment Sociology/ CIAS)

**Funding and timing:** The Ceres Trust Graduate Student Award, 2012-2013

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In 2012, the research team conducted a survey of 208 certified organic vegetable growers, covering questions about plant breeding and seed availability. The goal of this research was to use quantitative data to create a picture of the practices, needs, and opinions of Wisconsin organic vegetable growers in order to guide future efforts to improve their access to appropriate, high-quality seeds and varieties. Analysis focuses on four areas: 1) general characteristics and farm practices; 2) challenges these growers face in accessing appropriate, high quality, certified organic seed; 3) growers' plant breeding priorities; and 4) how their access to appropriate plant breeding and seed systems can be improved. Respondents were comparable to those in the 2007 Census of Agriculture and other nation-wide surveys of organic farmers in terms of age, gender, farm size, years of farming experience, and length of time in organic certification.

Results suggest that growers had more difficulty accessing satisfactory varieties than accessing seed of satisfactory quality, and that those growers with over 25 acres of vegetable production had more

difficulty accessing both satisfactory varieties and seed than growers with smaller operations. With the notable exception of tomatoes, which were ranked highest in terms of economic value by multiple types of growers, our results suggest that Wisconsin organic vegetable growers have diversified operations and depend on many different vegetable crops for their income. Similarly, results failed to display a consensus about which crops most need improvement through plant breeding. Answers were more consistent with regard to plant traits, naming disease tolerance as a top priority regardless of crop. Still, our results suggest that a crop-by-crop approach is appropriate both for choosing which traits to address and for decisions about using open-pollinated or hybrid breeding schemes.

We found that an unexpectedly high percentage of growers (55 percent) produced at least some seed for their own use. In addition, a high percentage of respondents (85 percent) had performed some sort of on-farm variety trials, although very few had engaged in on-farm plant breeding. These results suggest that basic skills and interests related to plant breeding and seed production exist in the Midwest, supporting the possibility of participatory plant breeding and regional seed production as pathways to better access to appropriate seed and varieties for organic farmers in this region. Efforts to build on farmers' existing practices should include not only education about variety trialing, seed production, and plant breeding, but also efforts to develop methods that provide the best possible results while working within farmers' practical constraints.

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### Principles for transitioning to organic farming: e-Learning materials and decision case studies for educators

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**Researchers:** Craig Sheaffer (U of MN- Agronomy and Plant Genetics), Michelle Miller (UW-Madison CIAS), Thomas Michaels (U of MN-Horticultural Sciences), John Lamb (U of MN-Soil, Water and Climate), Jeffrey Gunsolus (U of

MN-Agronomy & Plant Genetics), Jody Padgham (Midwest Organic and Sustainable Education Service), and Harriet Behar (Midwest Organic and Sustainable Education Service)

**Funding and timing:** USDA-NIFA Organic Transitions Program, 2013-2016

This project team is developing a series of online, interactive educational modules with a focus on the fundamentals of organic agriculture and how to transition to organic farming. Modules will cover important crop production topics including crop rotation, soil fertility, crops to grow during transition, weed and pest management, and other subjects for both agronomic and horticultural producers. Each module will consist of a core-principle component and a decision case study. The core-principle component will be designed to provide fundamental information that will be combined with interactive learning such as self-guided quizzes and tests, as well as video, music and narration. The decision case studies will engage higher-level learning in each subject through the study of dilemmas based on the experiences of organic producers in our region. Much like farm tours, the decision cases use storytelling to provide a rich picture of risks and opportunities. By utilizing e-learning tools and teaching methods that enhance critical thinking skills, we will increase the value and availability of educational resources on making the transition to organic agriculture. The modules will be developed for use by university instructors, extension educators and regional sustainable agriculture organizations to help them educate transitioning farmers, undergraduate students and organic consultants. These modules will be adaptable to multiple uses including workshops, farmer intensive courses and undergraduate classes.



*Veggie Compass helps vegetable farmers track crop costs.*

Photo: John Hendrickson

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## **Veggie Compass: A cost-of-production tool for organic diversified vegetable producers**

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**Researchers:** Erin M. Silva (UW-Madison Department of Agronomy/CIAS), John Hendrickson (UW-Madison CIAS) and Paul D. Mitchell (UW-Madison Department of Agricultural and Applied Economics)

**Funding and timing:** USDA Risk Management Agency, 2008-2012, The Ceres Trust, 2010-2014, USDA Specialty Crop Block Grant, 2013-2015

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Veggie Compass is a spreadsheet tool created to assist growers in tracking their operational costs and determining crop-specific and market-specific costs of production, break-even prices and gross profits. The spreadsheet uses farm-specific data regarding expenses, sales and labor inputs in its calculations. Continued refinement of the spreadsheet tool and supporting documents in collaboration with farmers has improved the program. A significant obstacle to widespread adoption of this tool is the burden of tracking labor inputs by crop on farms during the hectic growing season. However, farm collaborators who have successfully used Veggie Compass report learning significant lessons about their costs of production, and this has led them to adjust prices to more accurately reflect operational costs. To help address the challenge of tracking labor inputs, UW researchers have worked with collaborating farms to gather and compile data to determine if general “baseline” labor data could be used in the absence of farm specific data. Analysis of more than three years of data is in progress, but results suggest that labor varies significantly from farm-to-farm and from year-to-year. This suggests that it is even more imperative that growers know and understand their own costs so that they can set appropriate prices and make efforts to reduce costs. A Specialty Crop Block Grant will enable UW researchers to conduct detailed “time and technique” studies to help identify those practices, systems, tools and equipment that increase farm efficiency and reduce labor costs.

**APPENDIX A****Contact information for researchers**

Phillip Barak  
UW-Madison Department of  
Soil Science  
608-890-0689  
pwbarak@wisc.edu

Michael Bell  
UW-Madison Department of  
Community and Environment  
Sociology/CIAS  
608-265-9930  
michaelbell@wisc.edu

Eric Bietila  
UW-Madison Agroecology  
Master's Program  
608-251-0167  
bietila@wisc.edu

Geoffrey Brink  
USDA-Agricultural Research  
Service  
608-890-0052  
geoffrey.brink@ars.usda.gov

A.J. Bussan  
UW-Madison Department of  
Horticulture  
608-262-3519  
ajbussan@wisc.edu

Victor Cabrera  
UW-Madison Department of  
Dairy Science  
608-265-8506  
vcabrera@wisc.edu

Amy Charkowski  
UW-Madison Plant Pathology  
608-262-7911  
amyc@plantpath.wisc.edu

Jed Colquhoun  
UW-Madison Department of  
Horticulture  
608-890-0980  
colquhoun@wisc.edu

David Combs  
UW-Madison Department of  
Dairy Science  
608-263-4844  
dkcombs@wisc.edu

Eileen Cullen  
UW Madison Department of  
Entomology  
608-261-1507  
cullen@entomology.wisc.edu

Ruth K. Genger  
UW-Madison Department of  
Plant Pathology  
608-265-3056  
rkgenger@wisc.edu

Amanda Gevens  
UW-Madison Department of  
Plant Pathology-Vegetable  
Pathology  
608-890-3072  
gevens@wisc.edu

Rhonda Gildersleeve  
University of Wisconsin-  
Extension  
608-723-6243  
rgildersleev@wisc.edu

Irwin Goldman  
UW-Madison Department of  
Horticulture  
608-262-7781  
ilgoldma@wisc.edu

Russell Groves  
UW-Madison Department of  
Entomology  
608-262-3229  
groves@entomology.wisc.edu

Jeffrey Gunsolus  
U of MN-Agronomy & Plant  
Genetics  
612-625-8130  
gunso001@umn.edu

John Hendrickson  
UW-Madison CIAS  
608-265-3704  
jhendric@wisc.edu

John Lamb  
U of MN-Soil, Water and  
Climate  
612-625-1772  
johnlamb@umn.edu

*continued on next page*

Claire Luby  
UW-Madison Department of  
Horticulture  
608-262-9543  
cluby@wisc.edu

Thomas Michaels  
U of MN-Horticultural Sciences  
612-624-7711  
michaels@umn.edu

Michelle Miller  
UW-Madison CIAS  
608-262-7135  
mmmille6@wisc.edu

Paul D. Mitchell  
UW-Madison Department of  
Agricultural and Applied  
Economics  
608-265-6514  
pdmitchell@wisc.edu

James Nienhuis  
UW-Madison Department of  
Horticulture  
608-262-6975  
nienhuis@wisc.edu

Mary Peabody  
University of Vermont  
802-598-4878  
Mary.Peabody@uvm.edu

Tessa Peters  
UW-Madison Department of  
Agronomy  
970-412-9489  
tepeters2@wisc.edu

Anne Pfeiffer  
UW-Madison Department of  
Horticulture  
608-262-6965  
acpfeiff@wisc.edu

Mark J. Renz  
UW-Madison Department of  
Agronomy  
608-263-7437  
mrenz@wisc.edu

Doug I. Rouse  
UW-Madison Department of  
Plant Pathology  
608-262-1395  
dir@plantpath.wisc.edu

Matthew D. Ruark  
UW-Madison Department of  
Soil Science  
608-263-2889  
mdruark@wisc.edu

Carolyn Sachs  
Penn State Department of  
Agricultural Economics,  
Sociology, and Education  
814-863-8641  
xyl@psu.edu

Craig Sheaffer  
U of MN-Agronomy & Plant  
Genetics  
612-625-7224  
sheaf001@umn.edu

Kevin Shelley  
UW-Madison Nutrient and Pest  
Management Program  
608-262-7846  
kshelley@wisc.edu

Adrienne C. Shelton  
UW-Madison Department of  
Agronomy  
608-262-1390  
acshelton@wisc.edu

Erin M. Silva  
UW-Madison Department of  
Agronomy/CIAS  
608-890-1503  
emsilva@wisc.edu

Philipp W. Simon  
USDA-Agricultural Research  
Service  
608-262-1248  
Philipp.Simon@ars.usda.gov

William F. Tracy  
UW-Madison Department of  
Agronomy  
608-262-2587  
wftracy@wisc.edu

Michel Wattiaux  
UW-Madison Department of  
Dairy Science  
608-263-3493  
wattiaux@wisc.edu

Jaimie West  
UW-Madison Department of  
Soil Science  
608-262-0383  
jrwest@wisc.edu

Seth Wilner  
University of New Hampshire  
603-863-9200  
Seth.Wilner@unh.edu





**APPENDIX B**

**The Wisconsin Organic Advisory Council**

The 12-member, private-sector Wisconsin Organic Advisory Council includes organic farmers and businesses, as well as certifier, nonprofit and consumer representatives. The purpose of this council is to provide Wisconsin agencies with guidance on educational, market development, policy and regulatory issues as they relate to organic farming, food production and marketing. The council meets regularly with an interagency team including representatives of agriculture-related state and federal agencies. It is a standing council of the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP).

Priorities identified by the task force included creation of an educational and promotional program for Wisconsin organic products; establishment of programs that facilitate networking among organic farmers; development of coursework, degree programs and research on organic agriculture at University of Wisconsin campuses and the state’s technical colleges; and support and technical assistance for enhancing organic processing capac-

ity. The task force’s report to the governor can be found at [www.organic.wisc.edu](http://www.organic.wisc.edu).

The Advisory Council membership includes three organic farmers, three organic business representatives, a certifier, a representative of a non-profit educational organization, a consumer representative and three at-large members. Members are appointed by the DATCP Agriculture Board to three-year, staggered terms. The Advisory Council was initially seated in February 2007 and has since met three to four times annually.

Council members and agency staff work together to support and promote organic farming. Their activities can be divided into several broad categories, including projects undertaken under the auspices of the Organic Advisory Council and the council members’ participation in the efforts of outside organizations and agencies. The Organic Advisory Council also provides input, recommendations and support for programs and policies made at the state and federal levels.

**Current Organic Advisory Council members**

**Organic Farmers**

Rebecca Goodman (term ends 4/30/14)  
Northwood Farm  
Wonewoc, WI

Craig Dunnum (term ends 4/30/15)  
Dunn-Hill Farms  
Westby, WI

Steve Pincus (term ends 4/30/2016)  
Tipi Produce  
Evansville, WI

**Organic Business Representatives**

Elena Byrne (term ends 4/30/16)  
Organic Processing Institute  
Middleton, WI

Jerry McGeorge (term ends 4/30/15)  
Organic Valley  
La Farge, WI

Ken Seguire (term ends 4/30/14)  
Hay River Pumpkin Seed Oil  
Prairie Farm, WI

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**Non-Profit Representative**

Harriet Behar (term ends  
4/30/14)  
Midwest Organic and Sustainable Education Services  
Sweet Earth Farm  
Gays Mills

**Consumer Representative**

Jennifer Casey, RD, CD (term ends 4/30/16)  
Gerald L Ignace Indian Health-Center  
Milwaukee, WI

**Certification Representative**

Steve Walker (term ends 4/30/15)  
Midwest Organic Services Association  
Viroqua, WI

**At-Large Members**

Bill Stoneman (term ends 4/30/15)  
W.F. Stoneman Company LLC and Biopesticide Industry Alliance Inc. (BPIA)  
McFarland, WI

Christine Mason (term ends 4/30/14)

Standard Process, Inc.  
Palmyra, WI

Inga Witscher (term ends 4/30/16)

St. Isidore's Mead Organic Dairy  
Osseo, WI 54758

**Interagency Team**

Pat Murphy  
NRCS State Office

Laurie Makos  
Iowa County FSA Office

Kevin B. Shelley  
UW Nutrient & Pest Management Program

Jed Colquhoun  
UW-Extension Horticulture

Val Dantoin Adamski  
Northeast WI Technical College

Molly Jahn  
UW-CALS

Duane Klein  
WI DATCP-ARM

Sally Kefer  
WI DNR

Amy Kox  
Northeast WI Technical College

Christine Lilek  
WI DNR

Cate Rahmlow  
WEDC

Dan Smith  
WI DATCP-DAD

Randy Zogbaum  
WI Technical College System

**Coordinators**

Laura Paine  
Grazing & Organic Ag Specialist  
WI DATCP-DAD

Erin Silva  
UW-Madison Agronomy Department/CIAS



