Organic Farming Systems Research at the University of Nebraska

Elizabeth Sarno, Charles Shapiro, Richard Little, Vicki Schlegel, Jim Brandle

March 26, 2013

Liz Sarno

Charles Shapiro

Richard Little

Vicki Schlegel

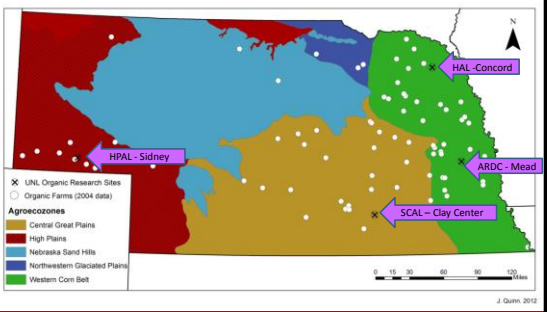
Jim Brandle

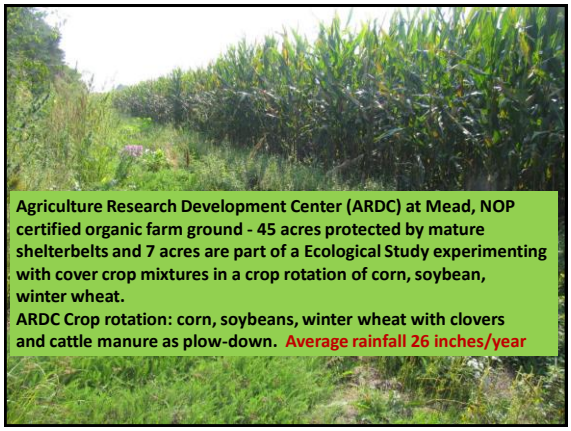
Research funded by USDA - OREI grants on four UNL research farms across three ecoregions in Nebraska

University of Nebraska Lincoln

USDA United States Department of Agriculture National Institute of Food and Agriculture

Developed a network of organically, certified areas across Nebraska





Agriculture Research Development Center (ARDC) at Mead, NOP certified organic farm ground - 45 acres protected by mature shelterbelts and 7 acres are part of a Ecological Study experimenting with cover crop mixtures in a crop rotation of corn, soybean, winter wheat.
ARDC Crop rotation: corn, soybeans, winter wheat with clovers and cattle manure as plow-down. Average rainfall 26 inches/year

Haskell Agricultural Laboratory (HAL) - Concord, 33.81 acres are NOP certified organic farm ground.
Crop rotation: oats/clovers, alfalfa, corn, soybeans, winter wheat, millet, cover crops. Alfalfa is fed to HAL's livestock and used as a green manure crop for three years in the rotation. Mechanically destroyed with blade plow and disked and followed with a corn crop.

The average rainfall 24 inches/year.

South Central Agricultural Laboratory (SCAL) - Clay Center 21.7 acres are certified NOP organic farm ground. The laterally irrigated field strips are set-up in a four year rotation: soybeans, corn/popcorn, winter wheat, alfalfa. (3.1 acre wheat strips are in randomized blocks with tiller radish and compost variables) Alfalfa is in the rotation for three years, mowed periodically, then disked under for a green manure follow with corn.

Average rainfall 25 inches/year.

High Plains Agricultural Laboratory (HPAL) - Sidney, 76 acres NOP certified organic farm ground.

Two three-year crop rotations stacked on top of each other = six-year rotation. The rotation is winter wheat-proso millet-green manure fallow-winter wheat-sunflower-fallow with composted manure.

Fallow every third year, although every other fallow is only a partial fallow using field peas as a green manure for a portion of the fallow period, April through June.

The average rainfall is 16.5 inches.

Extend results to farmers, stakeholders, life-long learners, and institutionalize organic farming principles in resident instruction

Chuck Francis, Agronomy and Horticulture

- **Integrate results from on-station and on-farm organic research into classroom teaching programs, and enhance classroom education programs,**
- **Teach principles and practical knowledge to students and help them envision future agricultural systems,**
- **Summarize and demonstrate results in the field through producer participation.**
- **Provide guidance to Extension and their statewide offices, programs, and publications.**
- **Student-Run Organic Demonstration Farm on the UNL Campus**

NebGuide

Published by University of Nebraska–Lincoln Extension, Institute of Agriculture and Natural Resources

Know how. Know now.

Transitioning to Organic Farming, NebGuide 2145, University of Nebraska Extension.

Developing an Individual Farm Organic System Plan, NebGuide 2146, University of Nebraska Extension.

Certification Process for Organic Production, NebGuide 2163, University of Nebraska Extension.

UNL Organic Farming Research, NebGuide 2120, University of Nebraska Extension.

http://cropwatch.unl.edu/web/organic/organic-nebguides

Service Manuals & Training Guides

All are available for download or for order at the Propane MaRC.

Propane-Fueled Flame Weeding in Corn, Soybean, and Sunflower

Propane-Fueled Flame Weeding in Field Corn, Soybean, and Sunflower Crops

This manual is designed to help agricultural producers select and configure the propane-fueled flame weeding equipment that is best for their operation. It provides information on the basics of flame weeding, including its benefits as a weed control method, how it works, and the components and configuration of flame weeding systems. It also recommends the propane dosage, growth stage for different weeds, and growth stages at which corn, soybean, and sunflower should be treated to increase weed control effectiveness while minimizing crop damage. Download an electronic version or to order a printed copy visit the Propane MaRC.

Stevan Knezevic, Avishek Datta, Chris Bruening, and George Gogos

On- Farmer Research for Organic Production

Involve organic farmers to identify topics and conduct well-designed trials on their fields to obtain reliable information.

Technical support from UNL Extension faculty to help set-up the experimental design and collection of data.

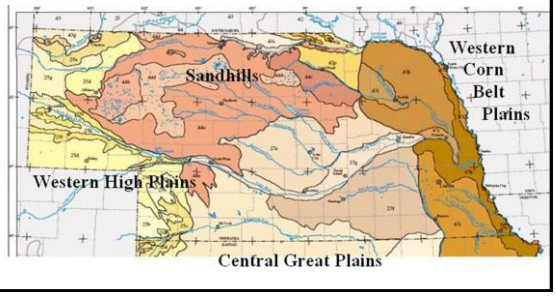
Some of the projects farmers are investigating:

- Forage Teff grass as a cover crop to improve soil tilth;
- Biological control of leafy spurge;
- Use of Neem oil and varietal resistance in soybean aphid management;
- Mob grazing pasture;
- Bio-char as a soil amendment;
- Use of a Rodale Roller/Crimper to roll rye and plant soybeans (organic no-till system)

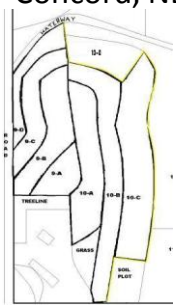
Charles Wortmann, Associate Professor
cwortmann2@unl.edu

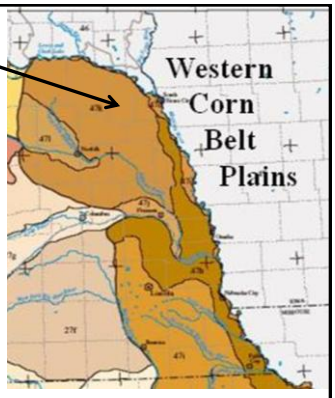
Liz Sarno, Extension
esarno2@unl.edu

Nutrient Management Research in Organic Systems



Haskell Ag Lab
Concord, NE



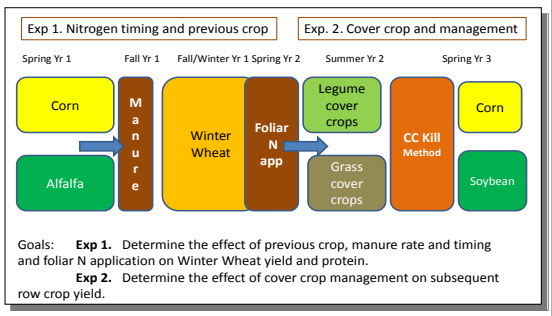


Two Main Projects

- ***Create a cropping system that includes winter wheat in the rotation in eastern Nebraska***
- ***Develop an understanding of the nutrient weed interactions in organic row crop systems***

Winter wheat/row crop system

- ***Establish and manage cover crops after small grain harvest***
- ***Synchronize and manage Nitrogen management for yield and protein***



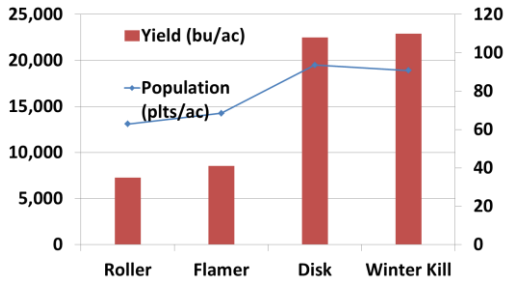
Goals: **Exp 1.** Determine the effect of previous crop, manure rate and timing and foliar N application on Winter Wheat yield and protein.
Exp 2. Determine the effect of cover crop management on subsequent row crop yield.

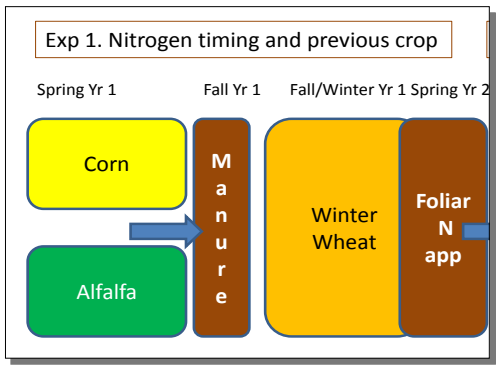
Cover Crop Management Objectives:

Determine how over-winter CC species and CC termination method affect subsequent annual row crop yield in field conditions of eastern Nebraska.

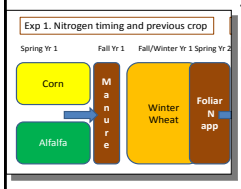
Quantify cover crop termination method on row crop yield.

Effect of cover crop management on corn population and yield (2009, 2010)





Alfalfa/Corn, 2008
Fall 2008:
manure
winter wheat
Spring 2009:
manure
joint stage N app
Repeat 2010-11

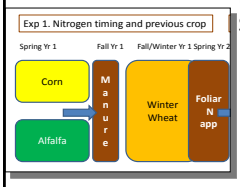


First cycle (2009):
Did not kill alfalfa completely
Spring manure damaged wheat

Best treatments:
Corn-Fall Manure
20 ton/acre
No Foliar N: 66 vs 54 bu/acre

Alfalfa- Fall Manure
40 ton 60 vs 54 bu/acre

Grain protein was all high > 13%

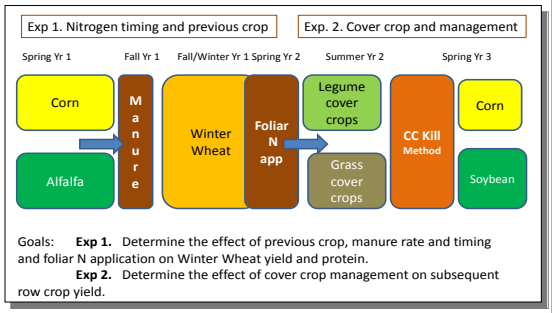


Second cycle (2011):
Alfalfa killed completely
Dry fall, poor stands early
Spring manure damaged wheat

Best treatments:
Corn-Fall Manure
20 ton/acre
No Foliar N: 62 vs 50 bu/acre

Alfalfa- Fall Manure
20 ton 65 vs 58 bu/acre

Grain protein was all high = 13%



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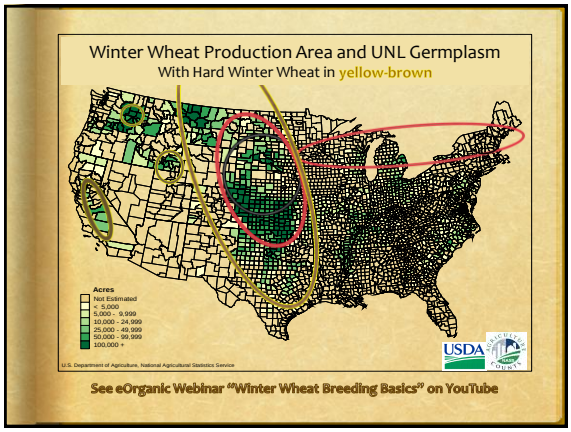
Exp 2. Determine the effect of cover crop management on subsequent row crop yield.

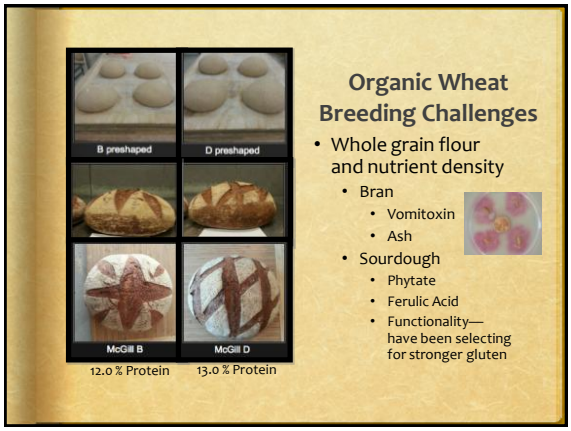
Summary

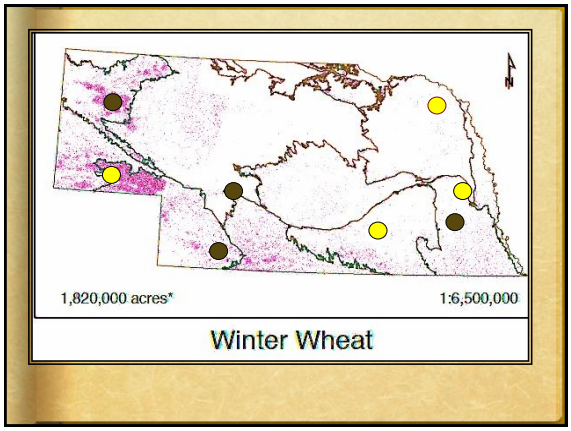
- Cover crop growth varied by rainfall in August and spring
- Crimping alone was not sufficient to smoother weeds and reduced corn yields 68% and soybeans yields 36%
- Influencing winter wheat yield and protein was difficult due to **high native fertility,** but alfalfa was mostly adequate without manure, **spring manure** caused more damage than benefit, **foliar N late** in the season was not effective in influencing protein levels, but the controls were high

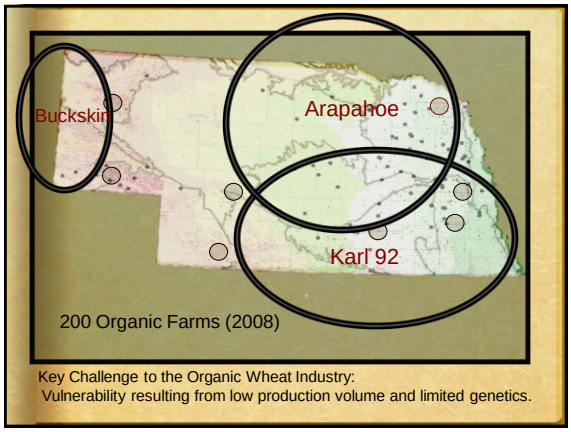
Promising Wheat Lines for Organic Production and Markets

Cultivar	Major Selection Criteria	High Yield Organic Test Locations	Years Tested Organic	Coleoptile length	Baking at 12.0 % grain protein content in 2010	Bread Quality 2008-2010	Anti-oxidant Content 2009-2011	Bunt 2012	Black Tip 2012	Pre-Harvest Sprout Suscep-tibility	DON Suscep-tibility	FHB Suscep-tibility
Camelot NW07505 (W) Wahoo McGill												
NE07444 NE02558 Expedition NE06607												
NW03681 (W) Hatcher												
Karl 92 NE05425 Alice (W) Pronghorn Buckskin												
Goodstreak Overland												
NW03666 (W) Danby (W)												


Winter Wheat Production Area and UNL Germplasm
With Hard Winter Wheat in yellow-brown
Acres
Not Estimated
< 5,000
5,000 - 9,999
10,000 - 24,999
25,000 - 49,999
50,000 - 99,999
100,000 +
U.S. Department of Agriculture, National Agricultural Statistics Service
USDA
See eOrganic Webinar "Winter Wheat Breeding Basics" on YouTube


B preshaped
D preshaped
McGill B
McGill D
12.0 % Protein
13.0 % Protein
Organic Wheat Breeding Challenges
Whole grain flour and nutrient density
Bran
Vomitoxin
Ash
Sourdough
Phytate
Ferulic Acid
Functionality—have been selecting for stronger gluten

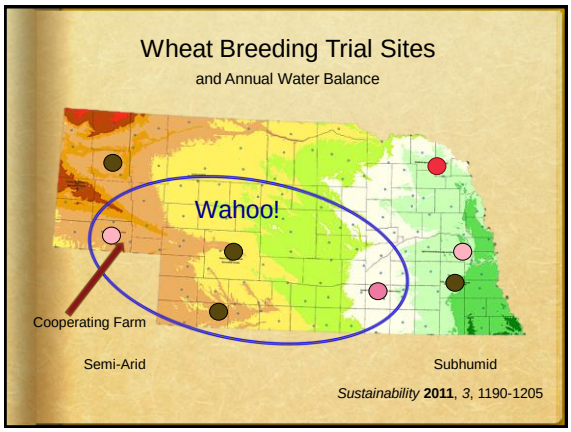

1,820,000 acres*
1:6,500,000
Winter Wheat



Key Challenge to the Organic Wheat Industry:
Vulnerability resulting from low production volume and limited genetics.

Wheat Breeding Trial Sites

and Annual Water Balance



Sustainability **2011**, *3*, 1190-1205

Organic Wheat Breeding Challenges

- Whole grain flour
  - Bran and vomitoxin
- Coleoptile Length

Organic Wheat Breeding Challenges

- Whole grain flour
  - Bran and vomitoxin
- Coleoptile Length
- Test Weight
- Diseases
  - Fusarium Head Blight
    - Lyman, Expedition
    - Overland, Goodstreak

Organic Wheat Breeding Challenges

- Whole grain flour
  - Bran and vomitoxin
- Coleoptile Length
- Test Weight
- Diseases
  - Fusarium Head Blight
  - Black Tip
  - Common bunt

Dilemmas with Yield and Quality

- Yield vs. protein
  - McGill
    - Short on expectations for bread quality
    - Positive response to N top-dressing
- Yield vs. antioxidants
  - Overland and McGill
  - Buckskin
- Protein content vs. protein quality

Summary

Cultivar	Major Selection Criteria	High Yield Organic Test Locations	Years Tested Organic	Coleoptile length	Baking at 12.0 % grain protein content in 2010	Bread Quality 2008-2010	Anti-oxidant Content 2009-2011	Bunt 2012	Black Tip 2012	Pre-Harvest Sprout Suscep-tibility	DON Suscep-tibility	FHB Suscep-tibility
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Overland												
NW03666 (W)												
Danby (W)												

Very few selections have:

- **Adequate resistance to seed-borne diseases and FHB**
- **Very long coleoptiles**
- **Both high yield and excellent bread quality.**

See Nebguide for table details.

Conclusion

A focus on selecting for yield in organic environments:

- resulted in several promising lines for organic production that overlap with recommended lines for conventional production;
- but did little to improve the chances of obtaining lines with the optimal combination of traits.

Recommendations

- Before testing in replicated organic yield trials, selected lines:
  - should be grown in a low-nitrogen environment and screened with a micro-quality test designed to predict whole-wheat bread quality;
  - For sub-humid ecozones should have resistance to seed-borne diseases and FHB;
  - For semi-arid ecozones should have long coleoptiles.

http://agronomy.unl.edu/web/agronomy/breedingorgsys

Organic Crops Grown in Nebraska: Phenolic Based Antioxidants.

Vicki Schlegel, Ph.D.
Associate Professor,
Department of Food Science and Technology
University of Nebraska – Lincoln
Lincoln, NE 68583-0919

Nebraska

Webinar – March 26, 2013

Outline

- What are Phenolic Compounds.
- Goal / Outcomes
- Example of Research
- Data and Results from One Study
- Other On-going studies.
- Final Impacts

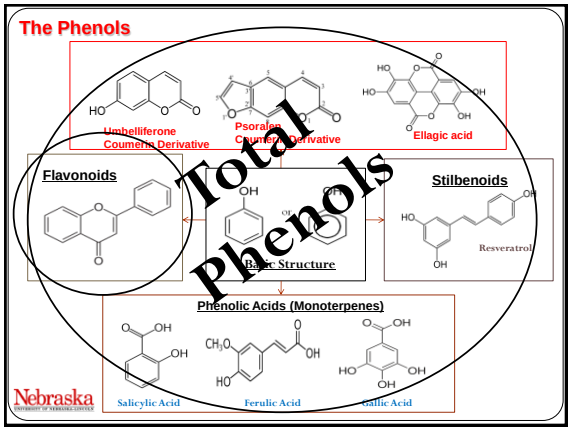
Nebraska

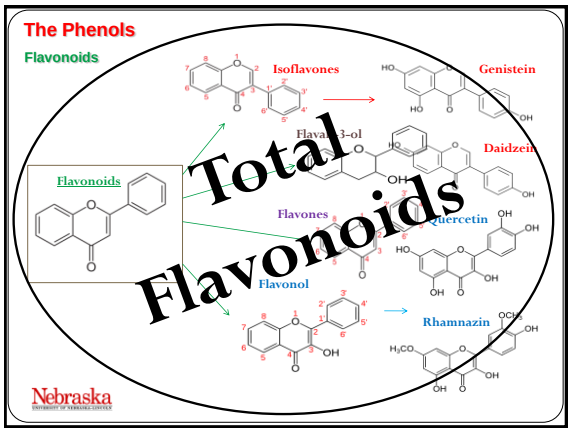
The Phenols -- Plant Based Antioxidants

General Information:

- **Phytochemicals that are widely distributed throughout nature.**
- **Present in small amounts.**
- **Chemically diverse.**
- **Consumption by humans have been linked to lower risks for**
  - **-- Cancer**
  - **-- Heart disease**
  - **-- Arthritis**
  - **-- Alzheimer's**
  - **-- Diabetes**
  - **-- Parkinson's**

Nebraska





Antioxidants - Phenols

Secondary metabolites synthesized by different plants in response to as stress

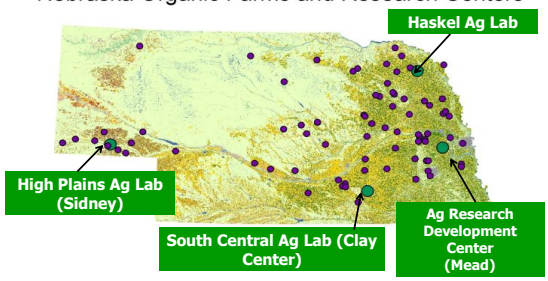
- -- wounding
- -- stage of growth
- -- drought
- -- weed / insect pressure
- -- UV radiation
- -- soil nutrient content
- -- location
- -- infection
- -- cultivar

Goal: To determine the phenol /flavonoid levels of organically grown crops in response to different effectors.

Outcome: To provide information on the optimal crops, cultivars and /or organic farming practices to implement in different areas throughout Nebraska that promotes "healthy crops".

Nebraska

Nebraska Organic Farms and Research Centers



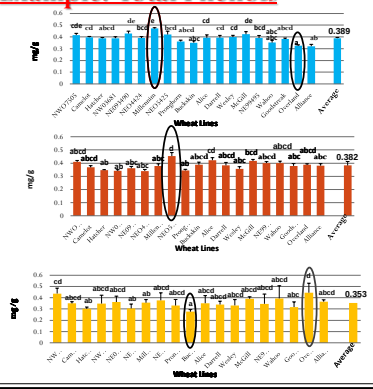
Nebraska map showing locations where organic crops were grown in additional to other organic farms throughout our state. (Image provided by John Quinn (School of Natural Resources) on behalf of the UNL Organic Group (http://organic.unl.edu/).

Example:

- Nineteen different wheat lines. were grown Grown under organic conditions
- Grown in 4 locations throughout Nebraska
- Monitored for their total phenol / flavonoid Composition.
- Monitored for antioxidative capacity.
- Peroximates (in progress).
- Long-term related back to yield and other Quality characteristics.

Nebraska

Example: Total Phenols

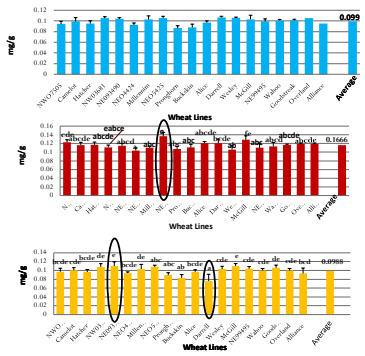


Haskel Ag Lab

Ag Research Development Center (Mead)

South Central Ag Lab (Clay Center)

Example: Total Flavonoids



Haskel Ag Lab

Average Antioxidant: 4008 µmole/100g

Ag Research Development Center (Mead)

Average Antioxidant: 3524 µmole/100g

South Central Ag Lab (Clay Center)

Average Antioxidant: 4040 µmole/100g

Antioxidants -- Experimental Design:

Organically grown crops are being evaluated for phenolic compounds and health promoting prosperities across:

- -- Crops Type.
- -- Cultivars.
- -- Locations.
- -- Nutrient Treatments.
- -- Years.
- -- Disease stressors.
- -- Weed / Insect Pressures
- -- Conventional Crops.

Soy Beans

Corn

Wheat

Sunflower Seeds

Nebraska

Final Long-Term Impact:

To produce "healthy" crops.

Thank You.

Nebraska

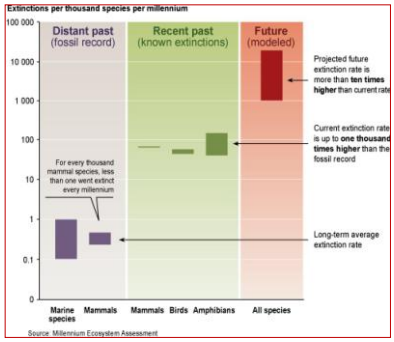
BIODIVERSITY AND ORGANIC AGRICULTURE

James R. Brandle, UNL
John E. Quinn, Furnam Univ.
R.J. Johnson, Clemson Univ.

Biodiversity crisis

What role can sustainable practices play and can organic systems contribute more to biodiversity?

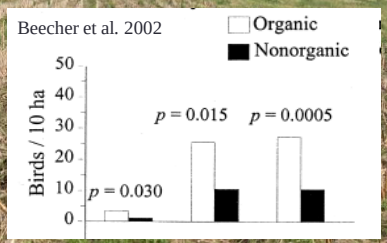
If so how do we measure our impacts and help organic farmers spend their money wisely?



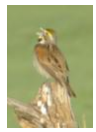
MEA 2005, Rockström et al. 2009

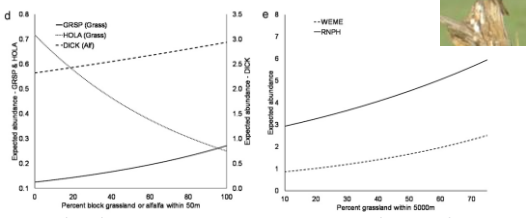
Benefits of organic for biodiversity

In SE Nebraska bird abundance and richness 2x greater in organic then non-organic farm systems



Within organic





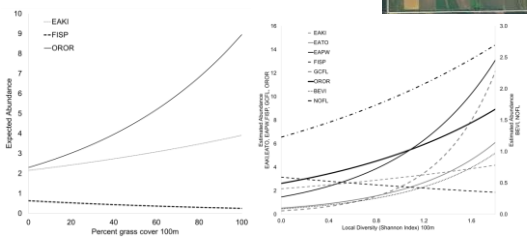
Local Scale

Landscape Scale

Grassland Birds

Quinn et al. 2012

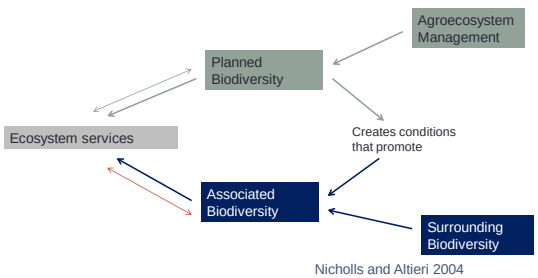
Within organic



Shrubland birds

Quinn et al. in prep

Biodiversity and Ecosystem Services



Nicholls and Altieri 2004

Healthy Farm Index

Biodiversity		Ecosystem Services		
Species	Ecosystems	Provisioning	Regulating	Cultural
Bird Diversity		Crop Yields		

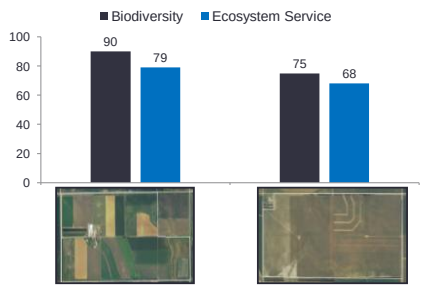
Quinn et al. 2013

Healthy Farm Index

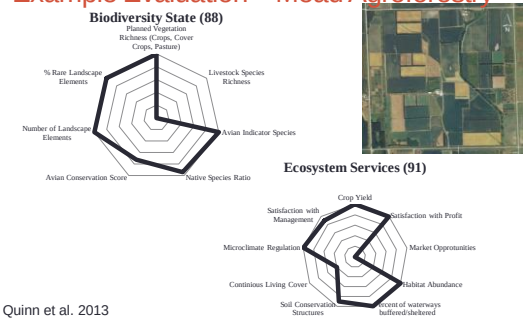
Biodiversity						Ecosystem Services				
Species						Provisioning	Regulating			Cultural
Bird Diversity	Crop Richness	Livestock Richness	% Non-crop	Ecosystem Richness	Rare landscape elements	Crop Yields	Market Opp	Soil Conservation	Water Conservation	Satisfaction	Tenure

Quinn et al. 2013

Farm Scores



Example Evaluation – Mead Agroforestry

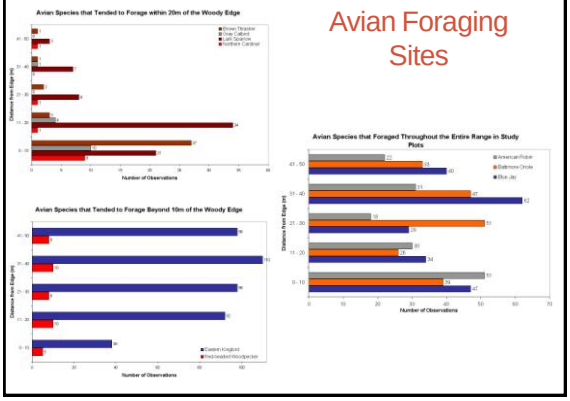


Quinn et al. 2013

Habitat Diversity

Habitat Diversity

Avian Foraging Sites



For More Information Contact

- **John Quinn**
- Furman University
- john.quinn@furman.edu

- **On the web -** http://hfi.unl.edu
- **Video of Bell's Vireo at the nest -** http://www.youtube.com/watch?v=N53Kndb7Lmo

- **Key papers**

- Quinn, J.E., J. Brandle, and R. Johnson. 2013. A farm-scale biodiversity and ecosystem services assessment tool: The Healthy Farm Index. International Journal of Agricultural Sustainability. DOI:10.1080/14735903.2012.726854.
- Quinn, J.E., J. Brandle, and R. Johnson. 2012. The effects of land sparing and wildlife-friendly practices on grassland bird abundance within organic farmlands. Agriculture Ecosystems, & Environment. 161:10-16.

Importance of Developing Partnerships

OCIA Research and Education (OCIA R&E) their mission is to support farmer driven research, on farm and at research institutions. OCIA R&E helped with the certification costs and our research appears in their workshops and publications: http://www.ocia.org/RE/RandEBoard.aspx

Nebraska Sustainable Ag Society (NSAS) cooperator - provides updates on our projects and research results to farmers through the NSAS newsletter and at the Rural Advantage/Healthy Farms Conference http://www.nebsusag.org/

- **Organic Farmer Advisor Committee** provide guidance on research ideas and review projects to assure organic farmers' production needs are being addressed.

UNL Organic Working Group - Researchers and Technicians

Agricultural Research and Development Center (ARDC) near Mead
1. James Brandle, Forestry and Site Manager - PI
2. Ron J. Johnson Clemson University, Dept. Forestry & Natural Resources
3. John Quinn – Conservation Ecologist - Healthy Farm Index
Sam Wortman, UNL PhD candidate in Agronomy
Mike Cieslik, Organic Field Technician
Katja Koehler Cole, Graduate Student, Jianru Shi, Graduate Student,
Angela Tran, Graduate Student

Haskell Agriculture Laboratory (HAL), near Concord
4. Charles Shapiro, Soil Scientist - Crop Nutrition – PI
5. Stevan Knezevic, Integrated Weed Management
6. Liz Sarno, Extension Educator, Organic Project Coordinator
Avishek Datta, PhD Post Doctoral Research Associate
David Glett, UNL Graduate Student
Mike Mainz, Organic Field Technologist
Lynn Junck - Organic Field Technologist
Ana Obradovic, Foreign Student
Strahinja Stepanovic, Graduate Student
Dejan Nedeljkovic, Foreign Student
Twyla Hansen, Technical Support

South Central Agricultural Laboratory, (SCAL) near Clay Center
7. Robert Wright, Professor Entomology – PI
8. Richard B. Ferguson, Professor of Soil Science
Dave Althouse, Farm Manager
Edward Barnes, Organic Field Technician

High Plains Agricultural Laboratory (HPAL) near Sidney
9. Drew Lyon, Cropping Systems –PI
10. Dipak Santra, Alternative Crops
11. Gary Hergert, Professor, Extension Specialist
Vernon Florke, Organic Field Technician
Thomas Nightingale, Farm Manager

University of Nebraska – Lincoln
12. Stephen Baenziger, Small Grains Breeding
Richard Little, Organic Wheat Breeding Specialist
13. Vicki Schlegel, Food Science
14. Lan Xu, Agronomy & Horticulture, Research Mgr. Lab I
15. Devin Rose, Food Science & Technology
16. Gary Hein, Director Doctor of Plant Health Program
17. Stephen Wegulo, Plant Pathology
18. Teshome Regassa, State Variety Trial Testing
19. Chuck Francis, Agronomy and Horticulture
19. Charles Wortmann, Agronomy and Horticulture
21. Laurie Hodges, Agronomy and Horticulture
22. Roger K. Wilson, Agricultural Economics
23. Rhae A Dribjer, Agronomy and Horticulture
24. George Gogos, Professor, Mechanical Engineering
Chris Bruening, Graduate Student, Engineering
Brian Neilson, Graduate Student, Engineering
Douglas Schrader, Technician

-The End-

For More Information Go To:

Organic Working Group
http://organic.unl.edu/

CropWatch Organics
http://cropwatch.unl.edu/web/organic/home

Contact Liz Sarno esarno2@unl.edu or 402-309-0944