Performance of Organic Farming Systems and Implications on Climate Change

Erin Silva, University of Wisconsin

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http://www.extension.org/organic_production
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Performance of Organic Farming Systems and Implications on Climate Change

Erin Silva and Janet Hedtcke
UW-Madison, CIAS and Agronomy Dept.
The Wisconsin Integrated Cropping Systems Trial

Arlington site
Wisconsin’s organics tops the national ranks

- #1 for total organic livestock
- #1 for field crop acreage
- #1 for total organic milk cows (22% of USA total)
- #2 in organic milk sales (64% of organic sales)
- #2 in organic farms (n=1159 farms)
- #10 in vegetables

- **Organic dairy and livestock farms drive market for organic feed**

Source: UW-Madison CIAS/DATCP 2012 status report
WICST was born in 1989

- Two locations:
  - Arlington (well drained silt loam soils)
  - Lakeland (more-poorly drained silt loam soils)

- Over 20 years of data summarized:
  - from 1992 to 2012
  - Trends emerging
    - Economics
    - Soil carbon
    - Yield trends
    - Weed seed
Cash-grain systems

Continuous corn    Strip-till corn-soybean    Organic grain

eOrganic Webinar
Dairy (forage-based) systems

- Conventional Alfalfa
- Organic forage
- Managed grazing
Effect of weed pressure on corn yield

<table>
<thead>
<tr>
<th>Wet Springs (May + June &gt;10” rain)</th>
<th>Normal Springs</th>
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<tbody>
<tr>
<td>ARS</td>
<td>LAC</td>
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<td>-----------------------------------</td>
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<tr>
<td>Conventional (min-till corn-soybean)</td>
<td>160</td>
</tr>
<tr>
<td>Organic (3-yr grain)</td>
<td>115</td>
</tr>
<tr>
<td>Org:conv</td>
<td>72%</td>
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</table>
Effect of weed pressure on soybean yields

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<td>ARS</td>
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<tr>
<td>Conventional (min-till corn-soybean)</td>
<td>48</td>
</tr>
<tr>
<td>Organic (3-yr grain)</td>
<td>38</td>
</tr>
<tr>
<td>Org:conv</td>
<td>79%</td>
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</tbody>
</table>

Economic Webinar
30’ rotary hoe or tine weeder can do ~ 30 acres/hr
Corn yields in extreme weather yrs

- 2008 (flood)
- 2012 (drought)

Bu/acre

- cont. corn
- strip-till corn-sb
- conv. dairy
- organic grain
- organic dairy

eOrganic Webinar
• Corn in the legume-based (left) and conventional (right) plots six weeks after planting during the 1995 drought. The conventional corn is showing signs of water stress.
• Rodale - Organic corn yields were 31% higher than conventional in years of drought
Conventional vs. Organic Corn Yield Trends

- **Conventional Corn**
- **Organic Corn-in 3-yr grain system**

- **Yield, bu/a**
- **Cycle**

EOrganic Webinar
Conventional vs. Organic Corn Yield Trends

- **Conventional Corn**
- **Organic Corn** - in 3-yr forage system

![Graph showing yield trends over cycles for conventional and organic corn.](attachment:graph.png)
Conventional vs. Organic Soybeans

![Graph showing yield comparison between conventional and organic soybeans over four cycles. The graph indicates a trend of decreasing yield for conventional soybeans compared to organic soybeans.](image-url)
Conventional vs. Organic Alfalfa

![Graph comparing Conventional and Organic yields over two cycles.](chart.png)
Base Gross Margins (GM)

- GM = Crop revenue – variable costs
- Grain priced at harvest; hay priced in winter
- Gov’t payments included
- Feed-grade organic premiums included
- Systems scaled up to farm size
  - 1200 acres for conventional grain farms
  - 600 acres for organic grain farm
  - 150 acres of conventional and organic forage farms
Historic GM of grain systems

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<tr>
<td>Conv. min-till corn-sb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic grain (c-sb-w)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conv. min-till corn-sb</td>
<td></td>
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</tr>
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<td>Organic grain (c-sb-w)</td>
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$/acre

- Org premium
- Gov't payment
- Base GM
Historic GM of forage systems

<table>
<thead>
<tr>
<th></th>
<th>Convent. Forage</th>
<th>Organic forage</th>
<th>Convent. Forage</th>
<th>Organic forage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARL (1992-2009)</td>
<td></td>
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</tbody>
</table>

- $/acre
- Org premium
- Gov't payment
- Base GM

Webinar
Corn and soybean feed-price trends (at harvest)
Fertilizer cost in corn phase at ARL ($/acre)

- $- 
- $50 
- $100 
- $150 
- $200 
- $250 
- $300 
- $350 

- conventional (c-sb) 
- organic (c-sb-w) 
- PEPs corn grain 

Corn seeding cost at ARL ($/acre)

- **Conv**
- **Organic**
- **PEPs, grain**

Reseeded arrow pointing to a specific year on the graph.
Soybean seeding cost at ARL ($/acre)
Total expense in grain systems (ARL)
Total expense in forage systems (ARL)
Gross margins in 2000 decade-ARL

Era (E): p<0.0078
System (S): p<0.0001
E*S: p<0.0001

cont corn
strip-till corn
conv. dairy
organic grain
organic dairy

Era (E): p<0.0078
System (S): p<0.0001
E*S: p<0.0001
Soil Organic C changes over 20 yrs-ARL

![Bar chart showing changes in Soil Organic C over 20 years for different farming practices.](image-url)
Soil C inputs on WICST

<table>
<thead>
<tr>
<th>System</th>
<th>ARL (‘92-’09)</th>
<th>LAC (‘92-’02)</th>
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</thead>
<tbody>
<tr>
<td>Cont. corn</td>
<td>5390</td>
<td>3301</td>
</tr>
<tr>
<td>Min-till corn-sb</td>
<td>4081</td>
<td>3324</td>
</tr>
<tr>
<td>Org grain (c-sb-w)</td>
<td>3038</td>
<td>2297</td>
</tr>
<tr>
<td>Conv. Forage</td>
<td>6075</td>
<td>6353</td>
</tr>
<tr>
<td>Organic Forage</td>
<td>6377</td>
<td>7145</td>
</tr>
<tr>
<td>Pasture with managed grazing</td>
<td>5380</td>
<td>5548</td>
</tr>
</tbody>
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RUSLE2 Soil loss estimates† (18-yr avg, ARL)

† assuming 4% slope, 150 ft run, contours
N$_2$O emissions/unit of N harvested - ARL

eOrganic Webinar
C and N changes in other Long-Term Studies

• LTAR (Iowa) - Total nitrogen increased by 33 percent in the organic plots
  – higher concentrations of carbon, potassium, phosphorous, magnesium and calcium
  – results suggest that organic farming can foster greater efficiency in nutrient use and higher potential for sequestrating carbon
• Rodale FST - in both organic and conventional systems, the highest overall GHG emissions were caused by soil processes fueled by nitrogen fertilizer, compost, and crop residues
Rodale FST

- Organic system uses 45% less energy – mainly from not allowing conventional fertilizers
• Demand for non-renewable energy resources of the farming systems in the DOC experiment (1985–1998) per hectare and year (columns) and per kg dry matter (DM, line) (Nemecek et al., 2011)
LTRAS (California)

Conclusions

• Yields: Org:Conv >90% when weeds controlled
• Organic yields better than continuous GM corn in extreme weather years
• Organic yields similar to rotated GM corn in extreme weather years
• Yield trends
  – Corn increased at 2.5 bu/a/yr (same for organic and conventional)
  – Soybeans had slight gain at 0.2 bu/a/yr (same for organic and conventional)
  – Alfalfa –no real trend yet
Conclusion (cont’d)

• Profitability: organic > conventional
  – Gross margin higher in last 5 yrs. vs. previous 5 yr
  – Large part of the profitability is coming from strong and steady premiums (in this study feed premiums)
  – Inputs (seed, fuel, and nutrients) are driving up expenses, often near to the cost of conventional inputs

• Ecosystem Services
  – All systems losing carbon other than pasture
  – Expand rotation with alfalfa can reduce soil loss
  – GHG lower under rotations but not necessary due to organic management
Find the slides and recording of this presentation at http://www.extension.org/pages/67347

Register for upcoming webinars and view recorded eOrganic webinars at http://www.extension.org/pages/25242

Additional organic farming questions? Ask them at https://ask.extension.org/groups/1668

We need your feedback! Please fill out our follow-up email survey!