Precision Farming & Organic Crops

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Roger Knutson
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Knutson Family Farms
Hubbard, Iowa  Roger & Mary Knutson
Acknowledgements

• Lindsay Bolson
• Roger & Mary Knutson
• Sarah Carlson & PFI
Location
Organic crop strategy

• 1999 organic introduction

• Primary crops
  • Corn (36” rows; 32,500)
  • Soybeans (36” rows; 160,000)
  • Oats (8” rows)

• Secondary crops
  • Buckwheat
  • Wheat
  • Alfalfa & clover
  • Rye
Enterprise crop strategy

• Organic
  • Corn
  • Soybeans
  • Oats

• Sustainable
  • Conventional (non-GMO) soybeans
  • Conventional (non-GMO) corn
  • Conventional oats
Crop management tools
Current/traditional

• Pre-plant tillage
  • Plow
  • Disc
  • Field cultivator
  • Drag

• Post-plant/pre-emerge tillage
  • Tine harrow
  • Rotary hoe

• Post-emerge cultivation
  • Rolling cultivator
  • Traditional shovel/sweep cultivator
Crop management tools
Current/traditional
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Current/traditional
Crop management tools
Additional/legacy opportunities
Crop management tools
Additional/legacy opportunities

John Koschmeder, Riceville, IA
Crop management tools
Additional/legacy opportunities
Crop management tools
Additional/legacy opportunities

www.organicweedpuller.com
Precision farming
What is it?

Precision Agronomics

- Soil sampling
- Prescription-based application rates
- Remote sensing
- Yield monitoring
Precision farming
What is it?

- Vehicle control
  - Steering (autosteer)
  - Steering (assisted steering)
  - Steering (passive)
  - Steering (active)
- Implement control
  - Planter row unit control
Precision farming
What is it?

- Precision Mechanization
- Vehicle control
  - Steering (autosteer)
  - Steering (assisted steering)
  - Steering (passive)
  - Steering (active)
- Implement control
  - Planter row unit control
Precision farming integration
2007: Autoguidance

www.ravenprecision.com
Precision farming integration
2012: Assisted steering, RTK

www.topconpa.com
Precision farming integration
2013: Assisted steering, ultrasonic sensors

www.reichhardt.com
Precision farming

So what does precision mechanization mean to an organic farmer?
Precision organic mechanization is *not new*! 
....except it has been human powered or human assisted.
Precision mechanization
Yesterday
Precision mechanization
Yesterday
Precision mechanization
Yesterday
Precision mechanization
Yesterday

www.organicweedpuller.com
Precision mechanization

Yesterday
Precision mechanization
Yesterday
Precision mechanization
Today

What about today? What opportunities have arisen because of precision mechanization?
Precision mechanization (today)
Cultivation
Precision mechanization (today)
Hands-free cultivation
Precision mechanization (today)
Enhanced blind cultivation

BLIND CULTIVATION

“Blind cultivation” is the easiest and best opportunity to destroy the weeds that would be growing within the rows and presenting direct competition to the crop. In blind cultivation, the entire field is tilled shallowly with the implement, paying little attention to where the rows are.

The point of blind cultivation is to stir the top 1 to 2 inches of soil, adding air and causing the millions of tiny germinating weed seeds to dry out and die. The larger crop seeds germinate below the level of the cultivation and are not usually damaged by this operation. Weed seedlings are very vulnerable to drying out and to burying at this stage, and by doing an effective job of blind cultivation, you can achieve the biggest possible crop/weed size differential from the start. Blind cultivation also can break a soil crust, allowing crop seedlings to emerge.

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August 2003 • Vol. 32, No. 8

Organic Weed Control
Cultural & Mechanical Methods
Precision mechanization (today)
Alternative cropping practices

Controlled traffic

www.mitchellfarm.com
Precision mechanization (today)
Alternative cropping practices

Strip intercropping: 2010, 230 bu/ac

www.cornandsoybeandigest.com
Precision mechanization (today)
Alternative cropping practices
Precision mechanization
Tomorrow

So what’s the future? What are the emerging opportunities? What are our goals?
Precision mechanization
Tomorrow

Erosion
Precision mechanization
Tomorrow

http://www.maswcd.org/Youth_Education/StudyGuides/Soils_study_guide.htm
Precision mechanization
Tomorrow

Labor
Precision mechanization
Tomorrow

Labor investment

Simple task

Challenging task

Human capital requirement

Low investment

High investment
Precision mechanization

Tomorrow

Human capital requirement

Challenging task

Simple task

Labor investment

Low investment

High investment

Simple tasks require low labor investment, while challenging tasks require high labor investment.
Precision mechanization
Tomorrow

Challenging task

Human capital requirement

Simple task

Labor investment

Low investment

High investment
Precision mechanization
Tomorrow

Challenging task

Human capital requirement

Simple task

Labor investment

Automate it!

Low investment

High investment
Precision mechanization
Tomorrow
“What about robotics? .... The vision of robots working on a farm is not too farm into the future.”
Dr. Simon Blackmore, FutureFarm
“Speaking from experience. .... By combining traditional farming lessons – using nature as a guide – with state-of-the-art technology, and by combining flexible thinking with the proper government policies, we can integrate the best of our past, current, and future practices. Our future dividends will be substantial, but only if we protect our agricultural capital.”
Howard Buffett, Howard G. Buffett Foundation
Precision mechanization (tomorrow)
ASABE Farm of the Future

“What does the specialty crop farm of the future look like? .... Automation that replaces human labor.... Economic forces will demand it, and engineers will provide it.”
Francis Pierce, Washington State University
Precision mechanization (tomorrow)
Herbicide resistance

Figure 2. Confirmed glyphosate-resistant weed populations in North America, 2002-2012 (Heap 2012).
Precision mechanization (tomorrow)
Herbicide resistance

Hoosier Ag Today, 04 March 2012, “The End of the Chemical Era”
“We may soon run out of chemicals to control weeds.... Stachler sees a future with robotic weed control.”
Dr. Jeff Stachler, North Dakota State University
Precision mechanization (tomorrow)
Biopesticides

What are Biopesticides?

Natural products derived from plants, micro and other organisms
LOWEST RISK Category of Pest Management Products

<table>
<thead>
<tr>
<th>Microbials</th>
<th>Biochemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fungi</td>
<td>Pheromones</td>
</tr>
<tr>
<td>Bacteria</td>
<td>Plant Extracts</td>
</tr>
<tr>
<td>Viruses</td>
<td>Soaps/Fatty Acids</td>
</tr>
<tr>
<td>Protozoa</td>
<td></td>
</tr>
</tbody>
</table>

Tim Johnson, Global Product Development Director
Marrone Bio Innovations
Precision mechanization (tomorrow)

Biopesticides

**Biopesticide Growth Exceeds Chemicals**

**Biopesticide Benefits**
- No chemical residues - good for export
- Manage pest/pathogen resistance
- Spray in AM, return to field in PM (safer to workers)
- Environmental safety
- Growth of organic market

**Biopesticide Growth Outpaces Chemical Growth**
(15.6% vs. 3.6% CAGR)

(source: BCC Research)

*Most biopesticides are used in conventional farming as part of IPM programs*

Tim Johnson, Global Product Development Director
Marrone Bio Innovations
Precision mechanization (tomorrow)
Cover crops
Precision mechanization (tomorrow)
Cover crops
Organic weed management
Corn cobs

“Air-propelled abrasive grit for postemergence in-row weed control in field corn”
Dr. Frank Forcella, USDA Morris, MN research station

www.ars.usda.gov
Precision mechanization (tomorrow)
Farm automation: Master-slave robotics

Fendt GuideConnect: Two tractors, one driver
RTK-guided autosteer + V2V wireless communication

www.fendt.com
Precision mechanization (tomorrow)
Future farm automation

Blue River Technology provides an alternative to chemical weed control

1. Capture image of plants
2. Classify all plants
3. Mechanically eliminate weeds

By identifying, classifying and measuring the location of every plant, our system provides a weed-free field without chemicals for:
- Corn
- Soybeans
- Cotton

Product will be available regionally in 2015 and nationally in 2017

Jorge Heraud, CEO, Blue River Technology
Precision mechanization (tomorrow)
Future farm automation

Dr. Lie Tang, Iowa State University
Precision mechanization (tomorrow)
Future farm automation

An autonomous platform for management tasks in taller corn, such as:
• side dressing N
• seeding cover crops

Kent Cavender-Bares, Rowbot, Inc.
We know that we need to continue to find ways to increase the productivity of land on a per unit basis. Agriculture has started to add computerization and automation to the current machinery with things like GPS based precision farming systems that can autonomously drive tractors, monitor yield, and apply fertilizer. However, these aftermarket add-ons are built around the single most expensive and awkward part of the equipment. The person controlling the tractor.
Organic weed management

Conclusions

1. Precision vehicle and implement control is not new

2. RTK GPS-guided autosteer has opened additional opportunities

3. Future advancements will focus on master-slave automation and stand-alone robotics, with scalable technology to fit a wide array of farm sizes
Questions

Thank you!

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