Using Science and On-Farm Research to Investigate Cover Crops in Iowa

Stefan Gailans
Practical Farmers of Iowa
Annual Conference
Jan. 19, 2019
Cover crops don’t reduce yields if...
Soybeans can be planted “green”
Cereal rye is *the* option unless...
HOW DO WE KNOW THIS?

• Cover crops don’t reduce yields if... properly managed
• Soybeans can be planted “green”
• Cereal rye is the option unless... you diversify
ON-FARM RESEARCH

PRACTICAL FARMERS OF IOWA
COOPERATORS' PROGRAM
FARMER-LED RESEARCH
RANDOMIZED, REPLICATED STRIP TRIALS

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54 COOPERATORS TOOK PART IN 77 RESEARCH TRIALS IN 2018
240 Cooperators have conducted 1,436 research trials since 1987.
DO COVER CROPS AFFECT CROP YIELDS?

• Bill Buman, Harlan
• Randy Caviness, Greenfield
• Jim Funcke, Jefferson
• Devan Green, Conrad
• Rick Juchems, Plainfield
• Mark Pokorny, Clutier
• George Schaefer, Kalona
• Jerry Sindt, Holstein
• Rob Stout, Washington
• Gary & Dave Nelson, Fort Dodge
• Kelly Tobin, New Market
• Whiterock Conservancy, Coon Rapids
DO COVER CROPS AFFECT CROP YIELDS?

12 ON-FARM SITES EST. 2008 & 2009
COVER VS. NO-COVER: CORN

Corn response to cover crop

Yield advantage from cover crop

Yield neutral

Yield drag from cover crop

*P ≤ 0.10
## Cover vs. No-Cover: Avg. Corn Yields

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<thead>
<tr>
<th>Era</th>
<th>Cover</th>
<th>No-cover</th>
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<tbody>
<tr>
<td>2009-2012 (early years)</td>
<td>158 bu/ac</td>
<td>162 bu/ac</td>
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<tr>
<td>2013-2018</td>
<td>197 bu/ac</td>
<td>196 bu/ac</td>
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</table>
COVER VS. NO-COVER: SOYBEANS

Soybean response to cover crop

Yield advantage from cover crop

Yield neutral

Yield drag from cover crop

*P ≤ 0.10

bushels per acre


Coon Rapids  Plainfield  Harlan  Holstein  Jefferson  Kalona  Clutier 1  New Market  Plainfield  West Chester  Fort Dodge  Holstein  Jefferson  Kalona  Clutier 1  Coon Rapids  New Market  Plainfield  Coon Rapids  Kalona  New Market  Plainfield  West Chester  Holstein  Jefferson  New Market  Plainfield  West Chester  Jefferson
## Cover vs. No-Cover: Avg. Soybean Yields

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<thead>
<tr>
<th>Era</th>
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<th>No-cover</th>
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<tr>
<td>2009-2012 (early years)</td>
<td>59 bu/ac</td>
<td>57 bu/ac</td>
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<tr>
<td>2013-2018</td>
<td>58 bu/ac</td>
<td>56 bu/ac</td>
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DO COVER CROPS AFFECT CROP YIELDS?

• Corn
  • No effect in 32/39 trials
  • Mostly yield-neutral
  • Yield drag mostly occurred in “early” years

• Soybeans
  • No effect in 20/29 trials
  • Improved yields in 8/29 trials

PROPER MANAGEMENT IS KEY!
WHEN SHOULD COVER CROPS BE TERMINATED?

• Jack Boyer, Reinbeck
• Jeremy Gustafson, Boone
• Arlyn Kauffman, Weldon
• Tim Sieren, Keota
• Dick Sloan, Rowley
• Loran Steinlage, West Union
• Michael Vittetoe, Washington
WHEN SHOULD COVER CROPS BE TERMINATED?

2-3 weeks before planting cash crop

At-planting of cash crop
TERMINATION DATE: SOYBEAN YIELDS (bu/ac)

NO STATISTICAL DIFFERENCES
PLANTING SOYBEANS DAY OF TERMINATING COVER CROP
(Ensure closure of seed trench!)

>7,000 lb/ac
COVER CROP TERMINATED AT SOYBEAN PLANTING
COVER CROP TERMINATED AT SOYBEAN PLANTING
OFFSETTING COSTS

• Cost of cover crop (seed + application) = $25-30
• Savings in weed control (1 less pass) = $30-40
• BALANCE = $0-15
SHOULD I ROLL DOWN ALL THAT COVER CROP RESIDUE?

• Jack Boyer, Reinbeck

Cover crop biomass = ~12,000 lb/ac

Drill/plant in mid-May

Roll in early June
DRILL SOYBEANS IN 10-IN. ROWS & ROLL?

Mid-July

Drilled in 10-in. rows & not rolled

Drilled in 10-in. rows & rolled
PLANT SOYBEANS IN 30-IN. ROWS & ROLL?

- Planted in 30-in. rows & not rolled
- Planted in 30-in. rows & rolled

Mid-July
SHOULD I ROLL DOWN ALL THAT COVER CROP RESIDUE?

Cover crop biomass = ~12,000 lb/ac

*SOYBEAN YIELD REDUCED WHEN PLANTED IN 30-IN. ROWS AND NOT ROLLED (rye residue interfered with harvest)
Cover crop terminated
May 30
21 days after planting

Cover crop terminated
May 16
7 days after planting

JULY 11 AT BOYER FARM
PUSHING THE TERMINATION DATE: SOYBEAN YIELDS (bu/ac)

*YIELD DRAG FROM DELAYED TERMINATION ....BUT LESS WEED PRESSURE?
WHAT ABOUT FOR CORN?
**TERMINATION DATE: CORN YIELDS (bu/ac)**

*SIGNIFICANT YIELD DRAG FROM TERMINATING COVER CROP AT CORN PLANTING (~14 bu/ac)*

[Bar chart showing bushels per acre for different locations and years, with annotations indicating significant yield drag.]
COVER CROP BIOMASS AT TERMINATION

~1,000 lb/ac when terminating 2-3 weeks before planting

>4,000 lb/ac when terminating at-planting

SOIL NUTRIENT/SEEDLING DISEASE ISSUES?
SOLUTION: TWIN-ROW COVER CROPS?
**TWIN-ROW COVER CROPS & TERMINATION DATE: CORN YIELDS (bu/ac)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Farm</th>
<th>3 weeks before planting</th>
<th>Near planting</th>
<th>1 week after planting</th>
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<tbody>
<tr>
<td>2018</td>
<td>Steinlage</td>
<td>238</td>
<td>229</td>
<td>229</td>
</tr>
<tr>
<td></td>
<td>Vittetoe</td>
<td>--</td>
<td>236</td>
<td>228</td>
</tr>
</tbody>
</table>

- **Steinlage**
  - Corn planted May 18
  - No effect of cover crop termination date

- **Vittetoe**
  - Corn planted May 1
  - 8 bu/ac benefit to terminating near corn planting
SHOULD N-RATE FOR CORN BE INCREASED AFTER COVER CROP?

“NORMAL” VS. “HIGH” SIDE-DRESS N RATE
N-RATE AFTER COVER CROP: CORN YIELDS

*NO ADVANTAGE TO “HIGH” N RATE IN 5/8 TRIALS

High rate = 30-50 lb N/ac above “normal” rate at each farm
WHEN SHOULD COVER CROPS BE TERMINATED?

- **Corn**
  - Abide by the “rule-of-thumb”
  - 2-3 weeks prior to corn planting
  - Twin-row cover crops may allow for exceptions to rule
  - N timing and placement important
    - Likely do not need more N applied than “normal”
    - Future research further exploring this

- **Soybeans**
  - Plant “green”
    - Terminate cover crop within 5 days of planting
    - Consider rolling residue if planting in wider rows
  - Potential weed control benefits
  - Improved soil conservation when “letting the rye run in the spring”
    - More biomass
WHAT ABOUT OTHER COVER CROPS (NOT RYE)?

LEGSUMES?
BRASSICAS?
COVER CROP VARIETY TRIAL, 2012-2017

- Art Behrens, Carroll
- Jerry Depew, Laurens
- Jeremy Gustafson, Boone
- Stephanie Hyde, Marshalltown
- Chad Ingels, Randalia
- ISU Agronomy Farm, Boone
- Paul Kassel, Spencer
- Greg King, DeWitt
- Clarke McGrath, Clearfield
- Steve McGrew, Emerson
- Mark Peterson, Stanton
- Myron Rees, Crawfordsville
- Dave & Meg Schmidt, Exira
- Bil Schrader, Rake
- Mike VerSteeg, Inwood
- Neal Williamsen, Emmetsburg
### Cover Crop Variety Trial, 2012-2017

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<thead>
<tr>
<th>Grasses</th>
<th>Brassicas</th>
<th>Legumes</th>
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<tbody>
<tr>
<td>Oats</td>
<td>Radish</td>
<td>Hairy vetch</td>
</tr>
<tr>
<td>Cereal rye</td>
<td>Rapeseed</td>
<td>Crimson clover</td>
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<tr>
<td>Winter wheat</td>
<td>Mustard</td>
<td>Winter pea</td>
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<tr>
<td>Winter triticale</td>
<td>Turnips</td>
<td></td>
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<tr>
<td>Winter barley</td>
<td>Pennycress</td>
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<tr>
<td>Annual rye grass</td>
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Entries hand-seeded into corn or soybeans in Aug/Sept into replicated 7’ x 25’ plots.
COVER CROP VARIETY TRIAL, 2012-2017

GROUND COVER ASSESSED IN FALL & SPRING
SPRING COVER RELATIVE TO CEREAL RYE

spring cover index ± SE

1 = cereal rye

Cereal rye or winter small grain in the mix

Pennycress!
WHAT COVER CROP SHOULD I USE?  CEREAL RYE
HOW TO DIVERSIFY?

SMALL GRAINS +
“GREEN MANURE”
COVER CROPS
SMALL GRAINS SUMMER HARVEST PRESENTS OPPORTUNITIES

Tim Sieren
July 19, 2016
SMALL GRAINS PRESENT OPPORTUNITIES

Feb/March frost-seeding

June under canopy

July post-harvest

FROST-SEED RED CLOVER TO SMALL GRAIN IN LATE FEB/EARYL MARCH
10-spp mix planted after rye harvest
Stanton (SW Iowa)
REALISTIC EXPECTATIONS

Planted in mid-August (after small grain)

Planted in late September (after soy/corn)

Or
WHY GREEN MANURES?:
LEGUME COVER CROPS ACCESS ATMOSPHERIC N

Rhzobia – symbiotic N-fixing bacteria
HOW MUCH N FERTILIZER CAN BE REPLACED BY RED CLOVER “GREEN MANURE” COVER CROP?

• Tim Sieren, Keota
N FERT. REPLACEMENT OF CLOVER: CORN YIELDS

CLOVER + 100#N = NO-CLOVER + 190#N

*N FERTILIZER REPLACEMENT = 90 lb N/ac
HOW ELSE TO DIVERSIFY?

GET CREATIVE!
NEXT HORIZONS

60-in. corn row-widths?

Camelina as a fall-seeded cover crop?

Credit: Seth Appelgate
60- VS. 30-IN. CORN ROW-WIDTHS FOR INTERSEEDING

- Fred Abels, Holland
- Jack Boyer, Reinbeck
- Brian & Heather Kessel and Jim Johnson, Lamoni
- Chris Teachout, Shenandoah

Cowpeas interseeded to interrows

30-in. row-width

60-in. row-width
60- VS. 30-IN. CORN ROW-WIDTHS FOR INTERSEEDING

*CORN YIELD REDUCED AT TWO FARMS
+CORN YIELD SIMILAR AT TWO FARMS
## 60- vs. 30-in. Corn Row-Widths for Interseeding

<table>
<thead>
<tr>
<th>Farm</th>
<th>Cover crop biomass (lb/ac)</th>
<th>Cover crop N (lb N/ac)</th>
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<tbody>
<tr>
<td></td>
<td>30-in.</td>
<td>60-in.</td>
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<tr>
<td>Abels</td>
<td>3,681</td>
<td>4,225</td>
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<tr>
<td>Boyer</td>
<td>339</td>
<td>3,870</td>
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<tr>
<td>Kessel/Johnson</td>
<td>964</td>
<td>3,766</td>
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**More cover crop biomass and N at 2 farms**
60- VS. 30-IN. CORN ROW-WIDTHS FOR INTERSEEDING

Potential for:
--Forage to graze
--N for succeeding crops
ON THE HORIZON: CAMELINA COVER CROP?

- Jack Boyer, Reinbeck
- Wade Dooley, Albion
- Bill Frederick, Jefferson
- Wendy Johnson, Mason City
- Rob Stout, Washington
(with Dr. Andy Lenssen, ISU)

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ON THE HORIZON: CAMELINA COVER CROP?

Bill Frederick
Oct. 13, 2018
Seeded: Oct. 5, 2018
ON THE HORIZON: CAMELINA COVER CROP?

Rob Stout
Dec. 17, 2018
Seeded: Oct. 18, 2018
SO... WHAT HAS ON-FARM RESEARCH TAUGHT US?
CROP YIELDS CAN BE MAINTAINED – WITH PROPER MANAGEMENT!
PROPER MANAGEMENT IS...

• Termination date
• Residue management
  • Close the seed trench
  • Roll residue if planter/drill left it standing
• N rate, timing
  • Applying N at corn planting likely vital for success
CEREAL RYE IS KING UNLESS....

DIVERSIFICATION, CREATIVITY
WHY COVER CROPS?
WHY COVER CROPS? – SCIENTIFIC EVIDENCE POINTS TO SOIL IMPROVEMENT

- Reduce soil erosion
- Reduce nutrient loss
- Alleviate soil compaction
- Improve soil physical structure
WHY COVER CROPS? –
PFI EVIDENCE POINTS TO ECONOMICS
WEED CONTROL IN SOYBEANS
WHY COVER CROPS? – PFI EVIDENCE POINTS TO ECONOMICS IN FERTILIZER REPLACEMENT WITH DIVERSE ROTATIONS
WHY COVER CROPS? – PFI EVIDENCE POINTS TO ECONOMICS
FORAGE FOR GRAZING LIVESTOCK
WHY COVER CROPS?

Because it’s the right thing to do.

-Rob Stout
PFI Cooperators’ Dinner
Dec. 13, 2018
No matter the trial, I’ve always learned valuable information by doing them, and generated more questions that make me want to try doing more with cover crops.

-Tim Sieren

CONTACT ME (STEFAN) IF YOU’D LIKE TO GET INVOLVED
stefan@practicalfarmers.org
NEW WEBSITE!

practicalfarmers.org/research
PFI RESEARCH REPORTS CITED IN THIS PRESENTATION

- Winter Cereal Rye Cover Crop Effect of Cash Crop Yield – Year 10

- Cereal Rye Cover Crop Termination Date Ahead of Soybeans, 2016 Update

- Rolling Cover Crops and Soybean Row-Width
  - https://practicalfarmers.org/research/rolling-cover-crops-and-soybean-row-width/

- Cover Crop Termination Date Ahead of Corn
  - https://practicalfarmers.org/research/cover-crop-termination-date-ahead-of-corn/

- N Fertilizer Strategies for Corn Following Cover Crop
  - https://practicalfarmers.org/research/n-fertilizer-strategies-for-corn-following-cover-crop/

- Side-Dressing Corn Following a Winter Rye Cover Crop – Updated 2014

- Cover Crop Variety Trial 2016-2017 (and previous years)

- Nitrogen Replacement Value of Red Clover

- Economic Impact of Grazing Cover Crops in Cow-Calf Operations

- Winter Feed Monitoring on a Grass-Fed Cattle Farm
• Planting Corn in 60-in. Row-Widths for Interseeding Cover Crops

• Terminating Cover Crops after Seeding Soybeans
• Cover Crop Termination Date Before Corn
  • Includes twin-row cover crop seeding method
• Camelina as a Cover Crop