Extending the Cover Crop Growing Season
A tool for managing herbicide resistant weeds?

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Contributors to ideas and research.

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Research Funding
CPPM (2014)
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Cover crops
Integrated Weed Management Tool in No-Till Systems?

Some recent research results:

✔ 47% control of common waterhemp w/ cereal rye in soybean (Loux et al. 2017)

✔ Legume CC mix provides early season control (58-62%) of Palmer in corn (Wiggins et al. 2015)

✔ Cover crops reduced waterhemp emergence 21 to 40% in soybean (Cornelius & Bradley 2017)
Optimizing management for weed suppression
Mechanisms of weed suppression.

**Competition w/ emerged weeds**
- soil moisture dynamics
- nitrogen availability
- light competition

**Effects on weed seeds in soil**
- alter germination cues
- enhance seed predator habitat
- enhance microbial decay
Optimizing management for weed suppression
Necessary changes to management practices.

1. Manage like a cash crop

2. Extend the growing season

When do weeds wake up? Mortensen et al.
Alternative practices: soybean example
Extending the cover crop growing season.

Cover Crop-based Organic Reduced-Till

High-Residue Conventional No-till

Credit: C. Keene

Credit: J. Wallace
Organic no-till soybean
Cover crop and cash crop management

- Prioritize fall cover crop establishment
  - Corn silage or shorter-season grain corn varieties

- High seeding and planting rates
  - Drill-seed cereal rye at 2 bu/ac
  - Plant soybean at 225,000 plt/ac

- Delayed cover crop termination & planting
  - Cereal rye termination at full anthesis
  - Soybean planting mid- to late-May

- Specialized equipment
  - No-till planters equipped w/ aggressive residue managers, added weight, etc.
Organic no-till
Supplemental weed control.

John Deere
high-residue cultivator

high-residue cultivation
4 and 5 weeks after planting
in no-till soybean
Cover crop-based, organic no-till

Lessons learned.

1. Comparable weed suppression to organic no-till
2. Susceptible to in-row weed control failures
3. High weed seedbanks require a multi-tactic approach
4. Cover crop termination w/ roller crimper can be challenging

Data: R. Champagne
PSU Reduced-tillage Organic Systems Experiment
High-residue mulch systems
Opportunities in conventional no-till.

Added cover crop termination flexibility w/ burndown herbicides

Opportunities for reducing PRE-residual or POST herbicide programs
High-residue mulch systems
Opportunities in conventional no-till.

ZRX roller-crimper & row cleaner
on parallel linkage
Dawn Biologic ®

Residue managers in the row for improved
crop establishment

John Wallace / National Soil Health Conference (Dec 17)
Cover crops & herbicide resistant weeds
Setting goals for IWM with cover crops.

Our view: Cover crops are an effective IWM tool if at the time of herbicide application....

1. Emerged weed populations are lower
   - removed selection pressure away from herbicide

2. Reduced average weed size
   - increased phytotoxicity of herbicide spray

3. Neutral or positive effect on herbicide efficacy
   - cover crop interference of herbicide deposition?

"Finger Rule"

"Soda Can Rule"
High-residue cover cropping
A tool for managing the evolution of herbicide resistance?

**GOAL: COMPLEMENTARITY**

1. Spray fewer weeds
2. Spray smaller weeds
3. Maintain herbicide efficacy
No-Till Field Experiments

Treatment Factors
- Monocultures vs mixtures
- Winter-kill vs winter hardy covers
- Early (Sept) vs Late (Oct) planting
- Early (boot) vs Late (late-heading) termination
- Herbicide programs (PRE, POST, PRE/POST)
Spray fewer weeds?
Marestail (horseweed) at time of **burndown** application.

- Cover crops can reduce horseweed density **35 to >95%** at spring burndown
- Cover crop management should aim to optimize **foliar cover and biomass**
- **Residual fertility** influences foliar cover and horseweed suppression
- **Earlier cover crop establishment** results in greater horseweed suppression

Data Source: Wallace et al. (2017, in prep)
Spray smaller weeds? Increased herbicide efficacy at **burndown**?

Marestail in winter fallow.

Marestail in a cereal rye cover crop.

Data Source: Wallace et al. (2017, in prep)
Spray fewer weeds?
Smooth pigweed density at time of POST application.

- Cereal rye can reduce pigweed density \(~ 50-75\%\) at time of POST application (3WAP)

- **Delayed termination** (heading stage) can decrease summer annual weed density at POST

- **Fall planting timing** is less important compared to delayed termination

- **Avoid legumes in cover crop mixtures** if summer annual weed suppression is management goal

Data Source: J Bunchek, PSU
Spray smaller weeds?
Smooth pigweed size at time of POST application.

Pigweed in winter fallow plot.

Pigweed in rye cover crop plot.

Data Source: J Bunchek, PSU

Relative Frequency Distribution

Pigweed height (in) at POST application

no cover
cereal rye

0 2.5 5.0 7.5 10
Maintain herbicide efficacy?
Reduced herbicide spray coverage. A negative effect?

Herbicide Spray Coverage (%)

% Vegetative Cover

- control
- cereal rye
- rye/hairy vetch

Data: J. Bunchek
Picture: J. Bunchek
Summary
High-residue mulch systems.

Herbicide-resistance management tool?
✓ Redefine goals. Aim for complementarity.
✓ HR management is one of multiple potential ecosystem services.

Enhancing weed suppression potential
✓ Manage cover crop like a cash crop.
✓ Extend the cover crop growing season.

Managing for potential tradeoffs
✓ Reduced herbicide efficacy?
✓ Adding additional pest pressure?
✓ Yield drag due to shortened season?
✓ Additional management complexity?

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Questions & Discussion

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Cover crop-based, organic no-till
High-residue mulch systems.

Cereal rye termination w/ roller crimper
(3-4 tn/ac of dry matter)

Weed suppressive mulch in no-till
planted soybean