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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- 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

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![Graph showing late-season weed biomass in lb/ac](image)

- **Crop year**
  - 2015
  - 2016
  - 2017

- **No. of cultivation passes**
  - (2)
  - (0)
  - (2)

- **Cereal rye biomass (tn/ac)**
  - 2.5
  - 3.0
  - 3.1

**Legend:**
- Blue: Between-row weeds
- Orange: In-row weeds

**Data:** R. Champagne
PSU Reduced-tillage Organic Systems Experiment

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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
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?
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
Maintain herbicide efficacy?
Reduced herbicide spray coverage. A negative effect?

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?
Questions & Discussion

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Cornell University
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