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

John Wallace
Cornell University
Acknowledgements
Contributors to ideas and research.

Research & Extension Scientists
• Bill Curran, PSU
• Dave Mortensen, PSU
• Mark VanGessel, U. Delaware
• Steven Mirsky, USDA-ARS
• Matt Ryan, Cornell
• Clair Keene, NDSU
• Jess Bunchek, PSU
• Rebecca Champagne, PSU
• Greg Roth, PSU

Farming Innovators
• J. Moyer, Rodale Institute
• Charlie Martin, ZRX roller
• Corey Dillon, Interseeder Tech
• PA No-Till Alliance
• Long list of early adopters and on-farm collaborators

Research Funding
CPPM (2014)
OREI (2014)

Penn State Extension
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

Weed Emergence Patterns

- common ragweed
- common lambsquarter
- redroot pigweed
- marestail/horseweed

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?
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?

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?
Questions & Discussion

John Wallace
jwallace@cornell.edu
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