Extending the Cover Crop Growing Season

A tool for managing herbicide resistant weeds?

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Acknowledgements

Contributors to ideas and research.

Research & Extension Scientists

- Bill Curran, PSU
- Dave Mortensen, PSU
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- Charlie Martin, ZRX roller
- Corey Dillon, Interseeder Tech
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PSB PENNSYLVANIA SOYBEAN BOARD Progress Powered by U.S. Farmers

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)

Weed management on your farm

Don't wait until it's too late; proactively manage weeds in your fields before they develop resistance. Know your weeds and develop a management program that prevents them from adding seed to the soil. Diversify your management strategies using the following best management practices:

Herbicides

Herbicides are one of the most efficient methods of controlling weeds in your field, but the technology becomes less effective the more you use it. Use herbicides in combination with other weed-control strategies. Be sure to follow the following best management practices when applying herbicides:

- Use multiple herbicide modes of action (MOAs) that are effective on the weeds targeted
- Follow the label: apply the full labeled rate
- Target weeds when they're small

Scout

Scout your fields before herbicide applications. Identify the weeds you find, and determine which herbicides to apply. Get back out there after applying the herbicide to see if any weeds survived the application - this is the first symptom of resistance. Be sure to check field borders, fence rows, ditches and waterways, too.

Clean Equipment

Clean harvest and tillage equipment between fields to prevent the spread of weed seeds. Combines are one of the worst weed-seed dispersal systems, which makes having clean fields prior to harvest that much more important. Cleaning out equipment before moving it to a new field can prevent the accidental introduction of weeds to a new field.

Cover Crops

Don't let weeds get a head-start on you in the spring. Plant a cover crop to block sunlight from reaching the active weed seeds. Planting your main crop into a cover crop can buy your main crop time to close the canopy between rows, giving you a jump start on in-season weed control.

Tillage

Prepare a clean, weed-free seedbed before planting. Tillage can bury the weed seeds in the active layer of the seedbank, reducing the number of weeds that will compete with this year's crop. It can also kill any living weeds. Don't put your crop at a disadvantage by planting in a field with actively growing weeds.

If you prefer reduced tillage or no-till in your fields, consider using a burndown herbicide to ensure a clean field during planting.

Crop Rotation

Different weeds compete with different crops. As with diseases and insects, rotate crops each year to help reduce weed pressure. Crop rotation will also affect your herbicide program, which will slow the evolution of resistant weeds.

WSSA Take ACTION HERBICIDE RESISTANCE MANAGEMENT

Optimizing management for weed suppression

Mechanisms of weed suppression.

Competition w/ emerged weeds

- ✓ soil moisture dynamics
- ✓ nitrogen availability
- ✓ light competition

living cover

Effects on weed seeds in soil

- ✓ alter germination cues
- ✓ enhance seed predator habitat
- ✓ enhance microbial decay

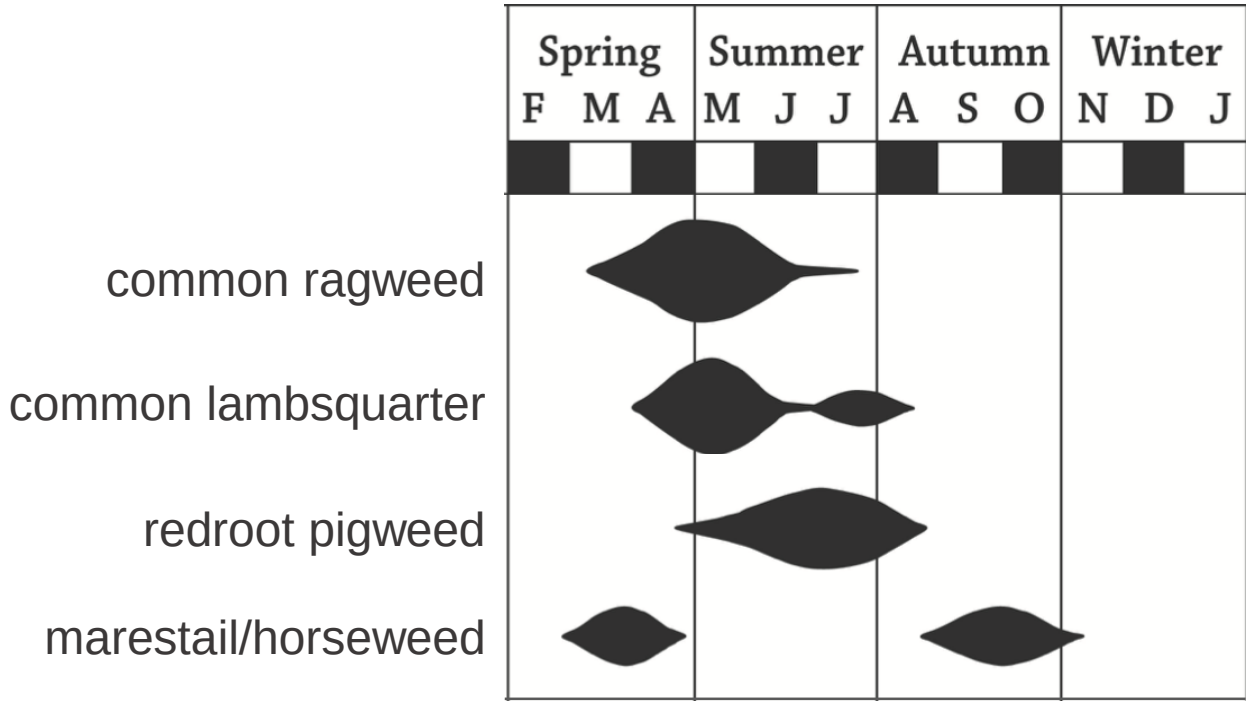
surface mulch

Optimizing management for weed suppression

Necessary changes to management practices.

1. **Manage like a cash crop**
2. **Extend the growing season**

Weed Emergence Patterns



When do weeds wake up? Mortensen et al.

Alternative practices: soybean example

Extending the cover crop growing season.

Cover Crop-based Organic Reduced-Till

Credit: C. Keene

High-Residue Conventional No-till

Credit: J. Wallace

Organic no-till soybean

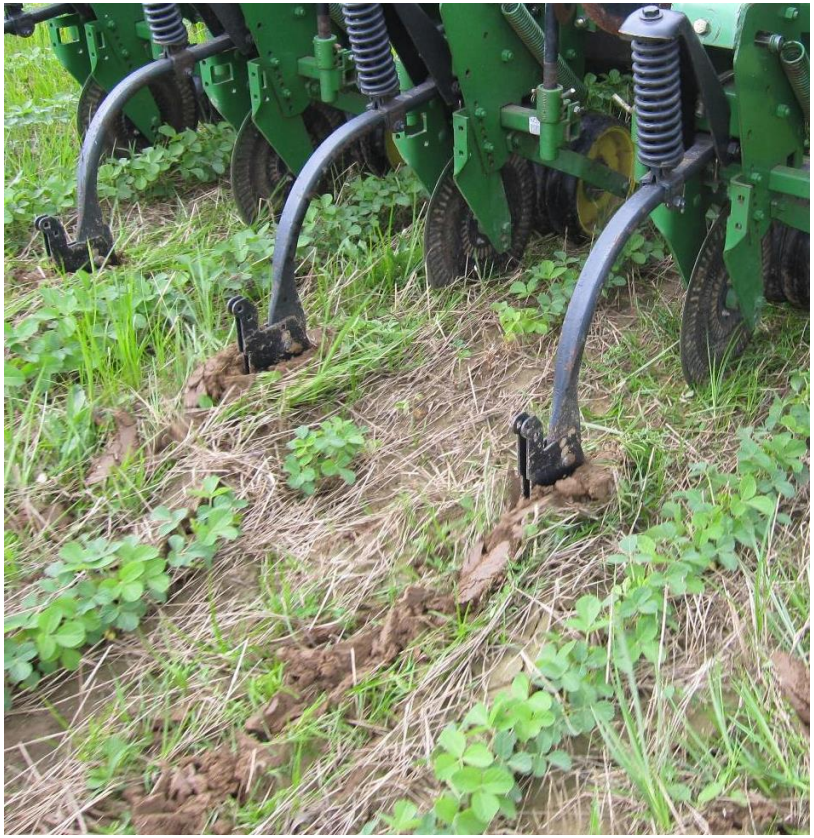
Cover crop and cash crop management

- 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

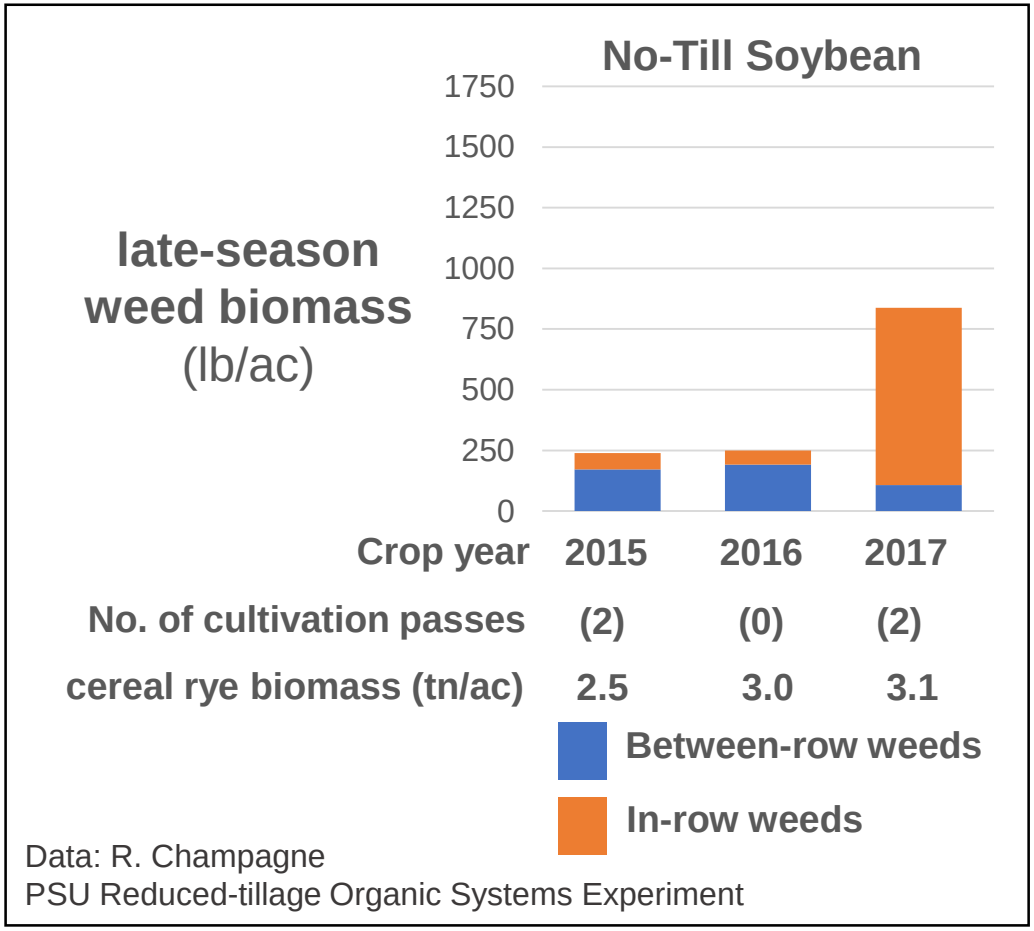


high-residue cultivation 4 and 5 weeks after planting in no-till soybean

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

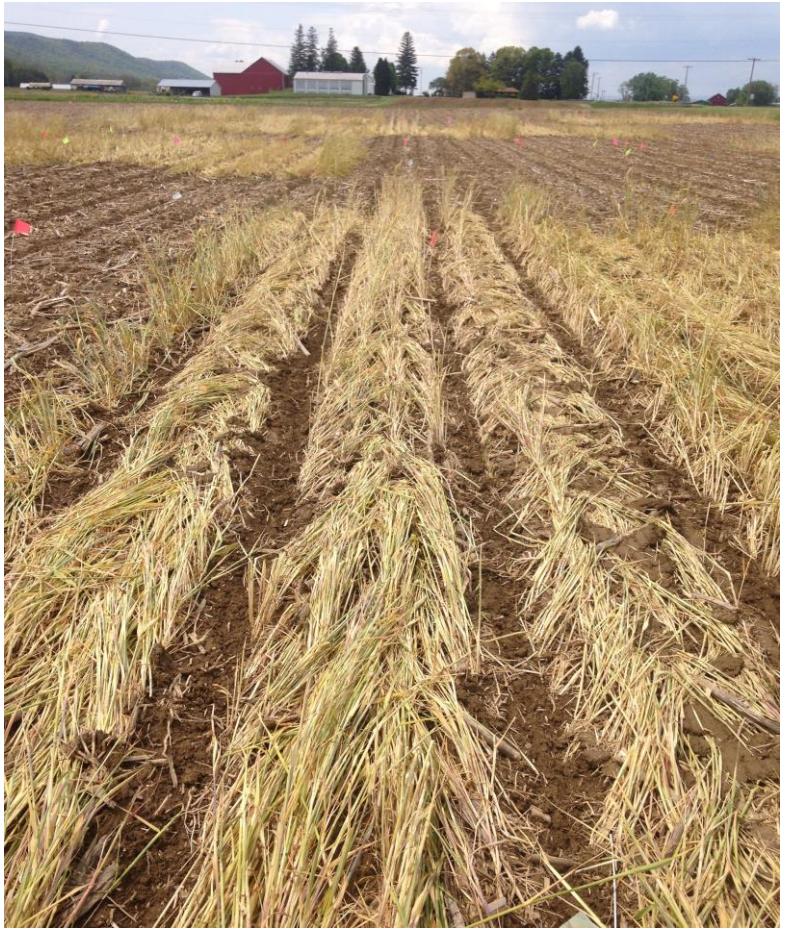


Data: R. Champagne
PSU Reduced-tillage Organic Systems Experiment

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

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”

USDA PSB Pennsylvania Soybean Board Progress Powered by U.S. Farmers University of Delaware Penn State Extension

High-residue cover cropping

A tool for managing the evolution of herbicide resistance?

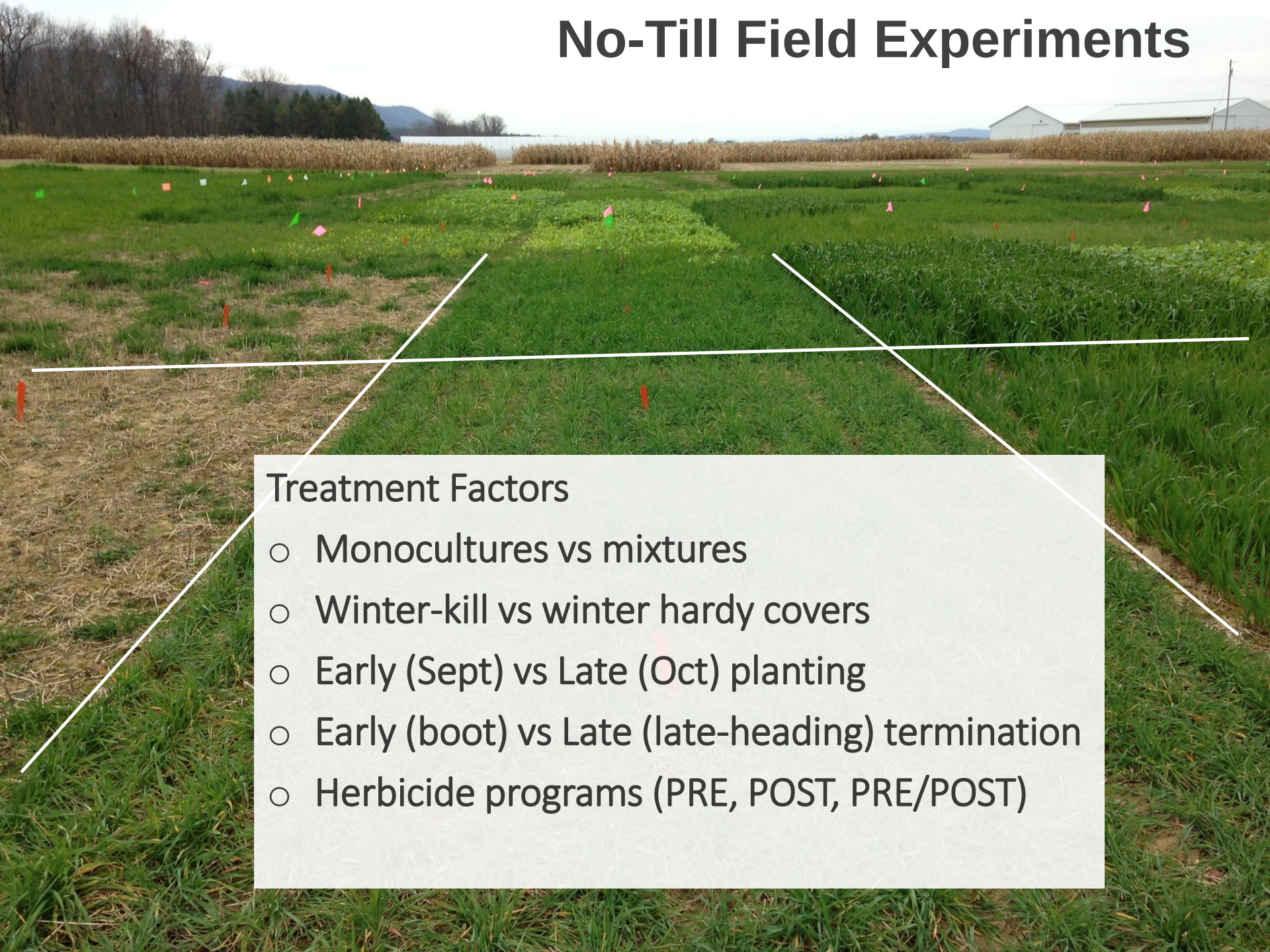
GOAL: COMPLEMENTARITY

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

120 lb/ac + Low N

120 lb/ac + High N

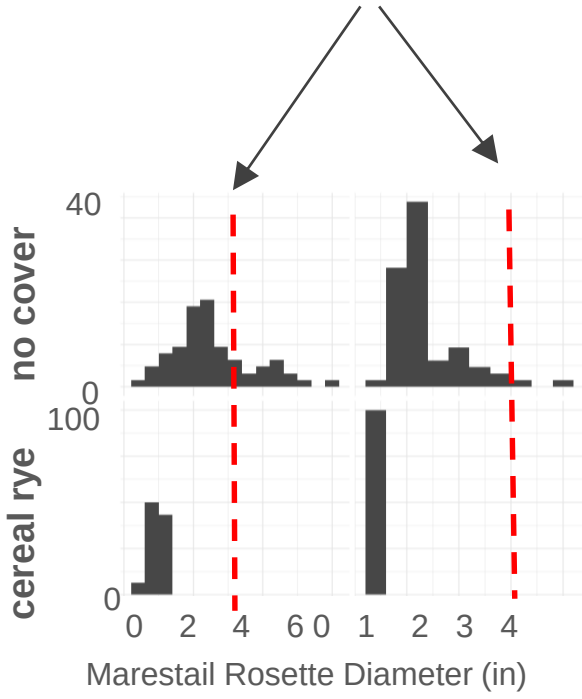
Data Source: Wallace et al. (2017, in prep)

Spray smaller weeds?

Increased herbicide efficacy at burndown?

Marestail in winter fallow.

Marestail in a cereal rye cover crop.

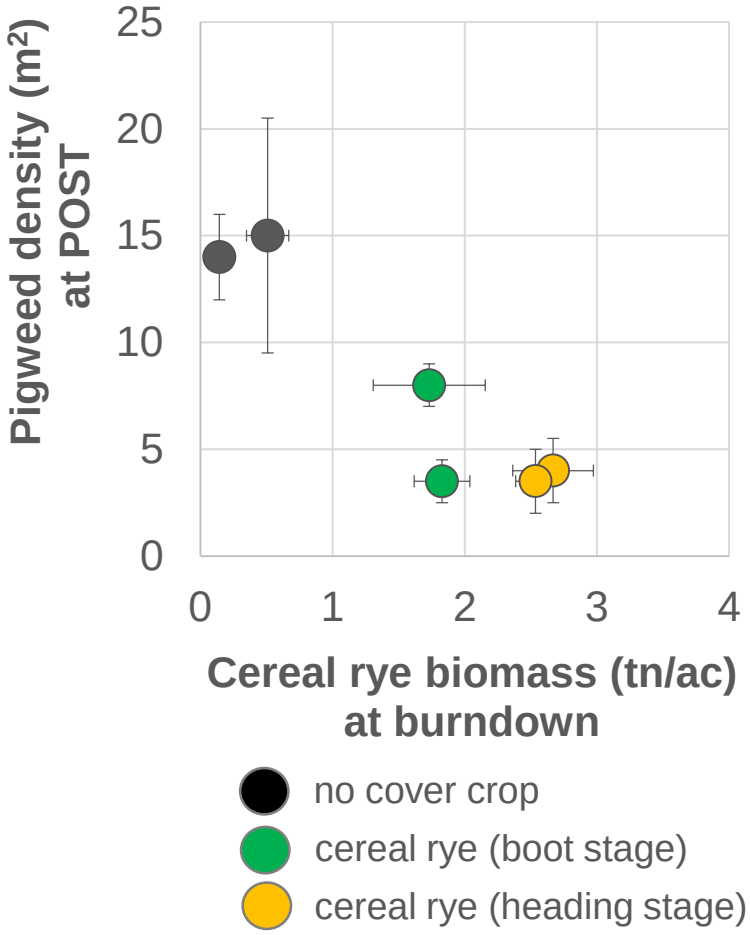


Data Source: Wallace et al. (2017, in prep)

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



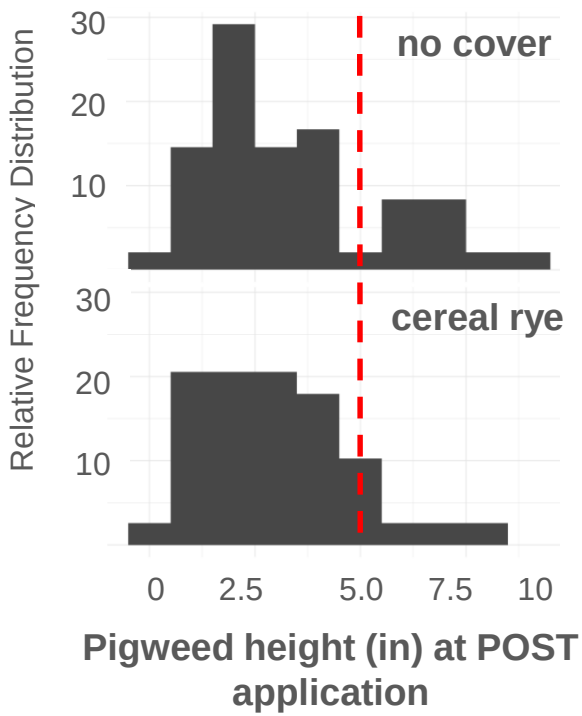
Data Source: J Bunchek, PSU

Spray smaller weeds?

Smooth pigweed size at time of POST application.

Pigweed in winter fallow plot.

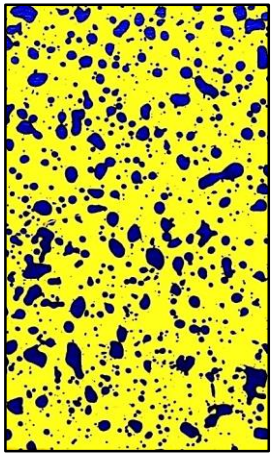
Pigweed in rye cover crop plot.

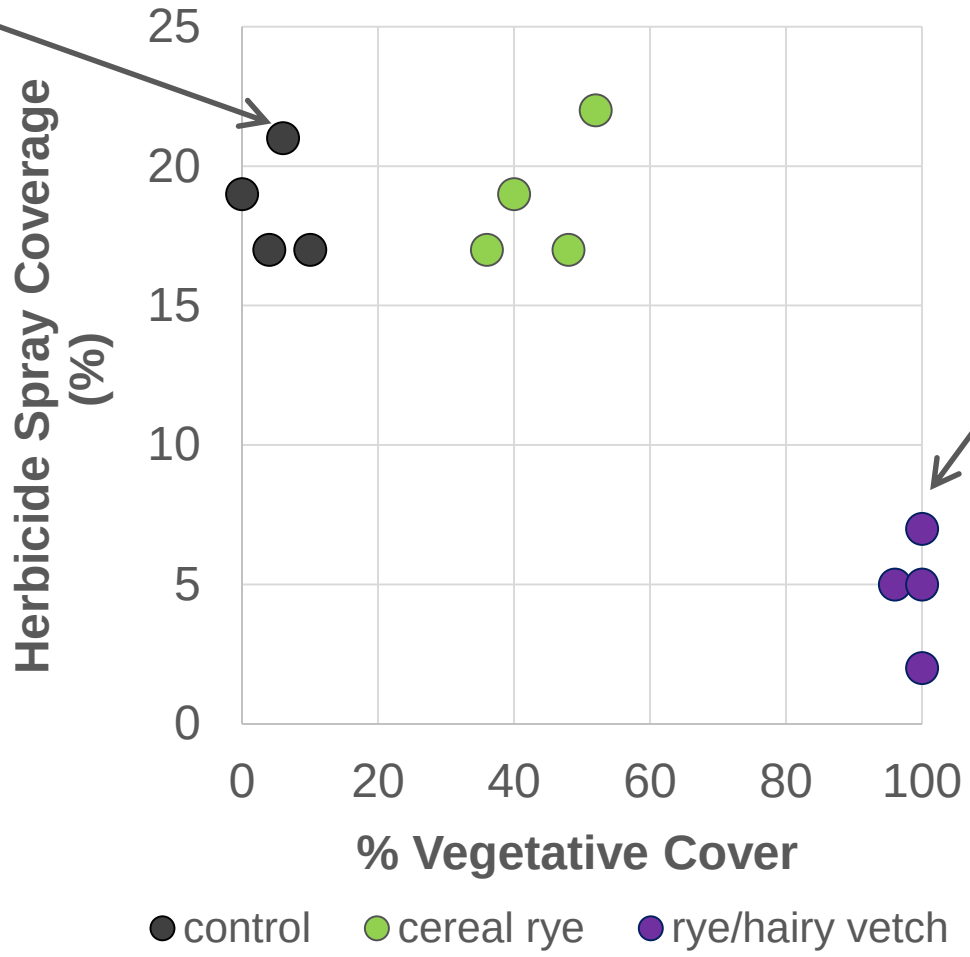


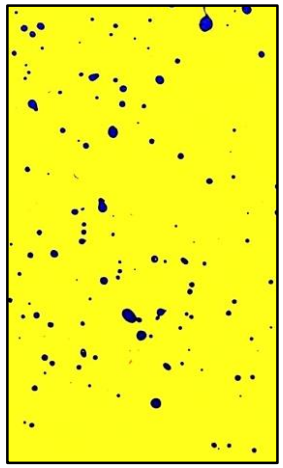
Data Source: J Bunchek, PSU

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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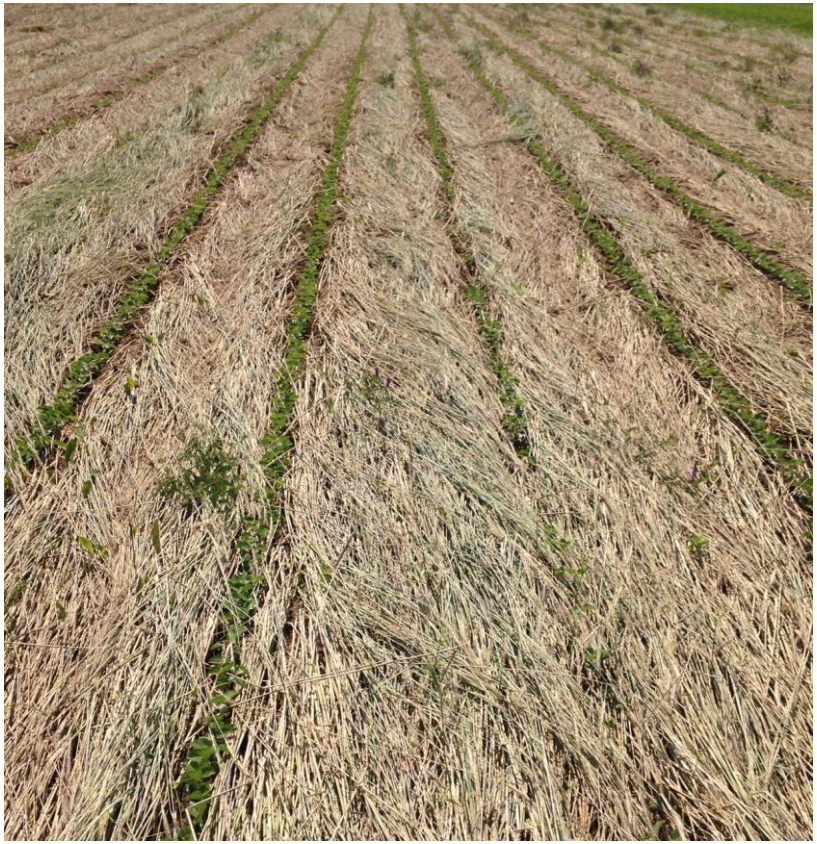
Cornell CALS College of Agriculture and Life Sciences

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

USDA