Managing cover crops to reduce herbicide inputs in no-till systems

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College of Agriculture & Natural Resources

Herbicide management

To meet conservation agriculture goals

1. Herbicides are used as vegetation management tool

2. Herbicides are employed as tool in IPM toolbox

3. Herbicide programs are adjusted to balance weed control & soil health

Image by CCSI, 2014

Cover cropping management goals

Optimizing weed suppression

1. Optimize total biomass production potential

2. Achieve rapid establishment & ground cover

3. Target C:N ratios for management objective

Cover cropping management goals

Agronomic considerations

1. Growing season windows
   - ✓ Early seeding windows
   - ✓ Delayed termination opportunities

2. Seeding & termination method
   - ✓ Drill vs. broadcast
   - ✓ Standing vs. roll-crimped

3. Species selection
   - ✓ Monocultures vs. mixtures
   - ✓ Seed rates & ratios

Cover crop management goals

Fall-seeded cereal rye

Fall planting date

- ✓ Chase combine out of the field to maximize fall GDDs

Fall vs. Spring GDDs

- ✓ 10 to 14 day delay in spring termination can double biomass

Residual nitrogen in fall

- ✓ Previous crop & fertility legacy will determine if N is limiting

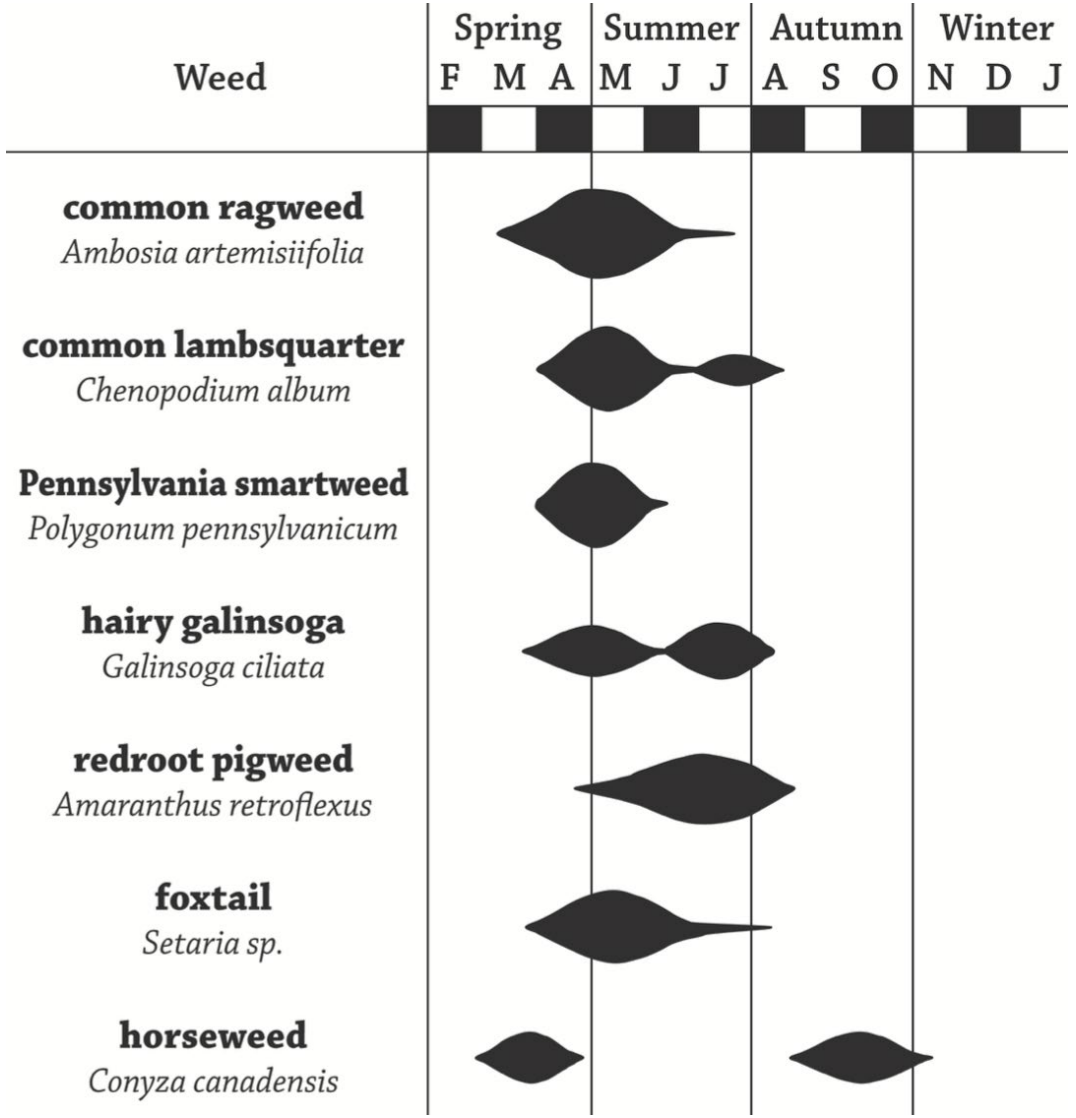
Weed suppression potential

Which species are suppressed?

1. Species w/ overlapping life-cycle

When do weeds wake up?

(Mortensen et al.)

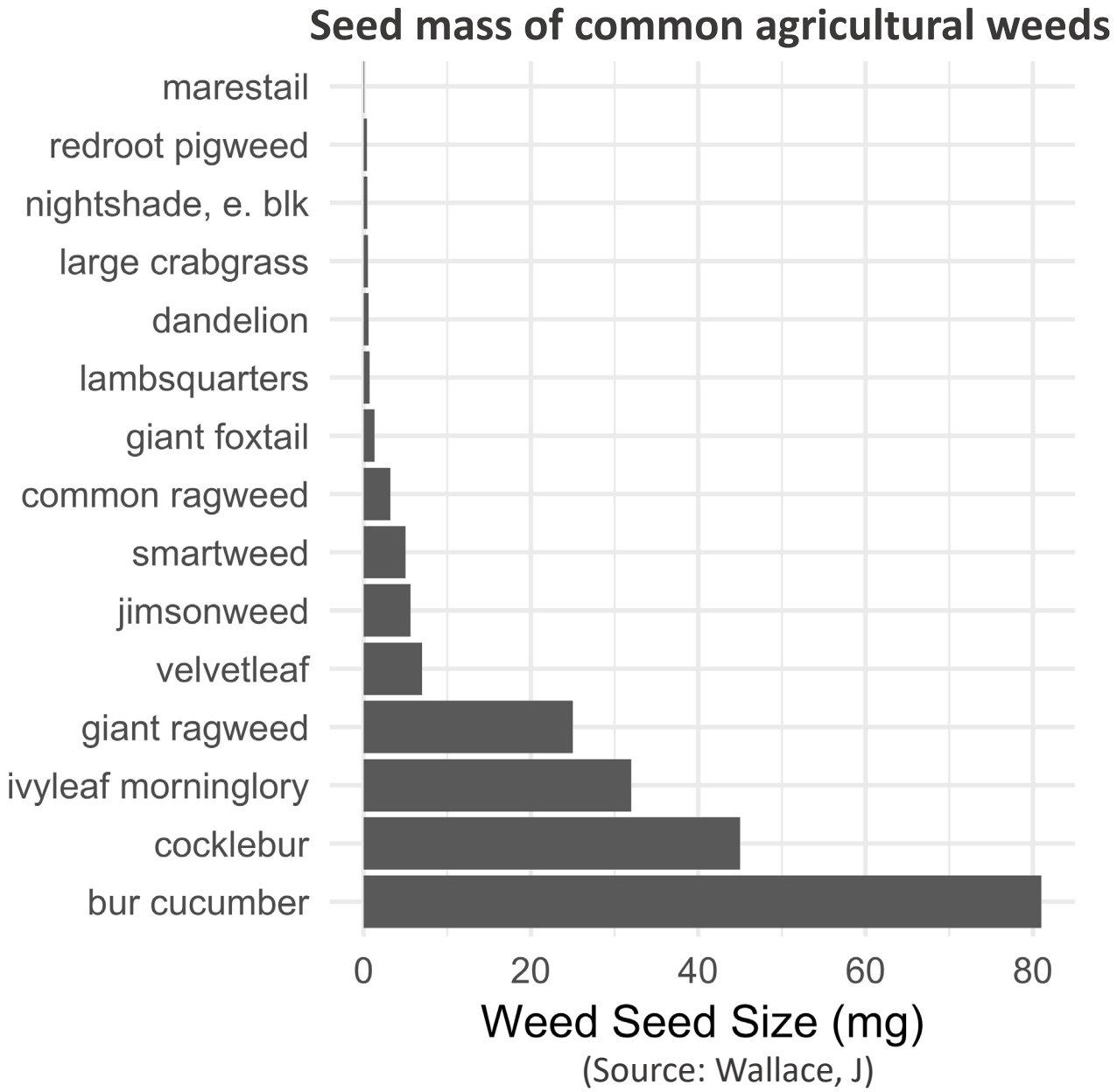


Weed suppression potential

Which species are suppressed?

1. Species w/ overlapping life-cycle

2. Small-seed summer annuals



Weed suppression potential

Which species are MINIMALLY suppressed?

1. Large-seeded summer annuals

Weed suppression potential

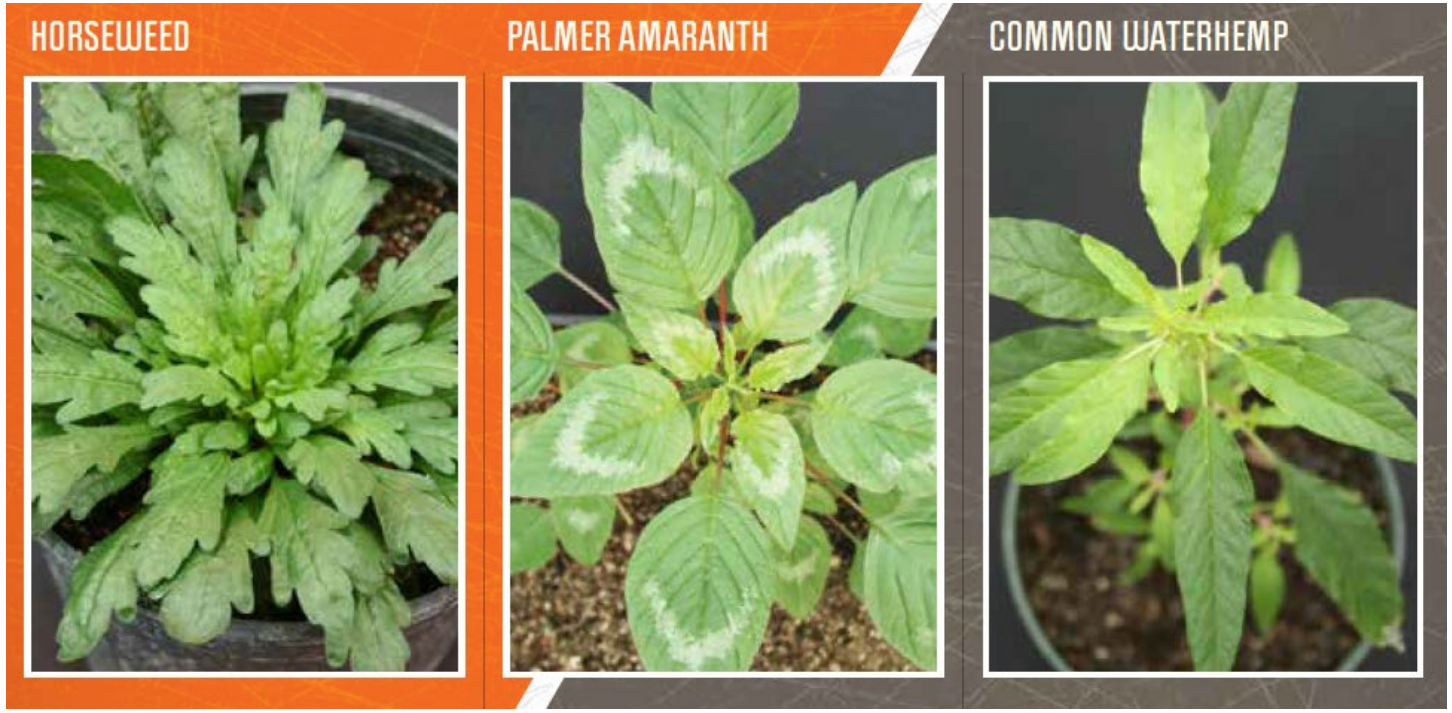
Which species are MINIMALLY suppressed?

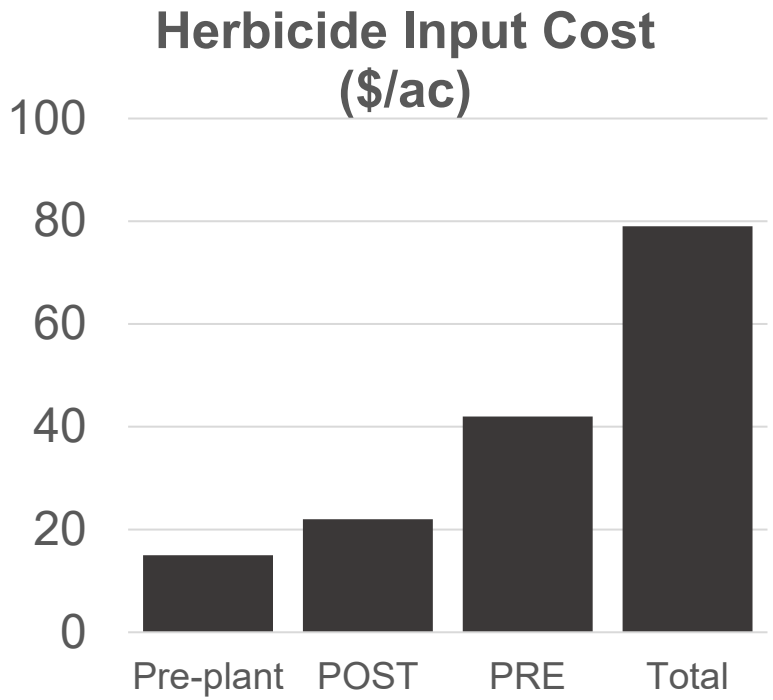
1. Large-seeded summer annuals

2. Taprooted & creeping perennials

Weed suppression potential

Many problematic, herbicide-resistant weed species are small seeded annuals





Multiple herbicide-resistant *spp.*

Species with multiple-resistance

Herbicide-based weed control requires
"zero seed rain" to manage resistant weeds

Cover crops & diverse crop rotations increase resilience to weed pressure & slow herbicide-resistance evolution

Winter annual weeds

Case study: glyphosate-resistant marestail

1. Reduce or slow the spread of herbicide resistance evolution

2. Lengthen windows for making effective herbicide applications

3. Potentially eliminate the need for additional herbicide passes or inputs

Winter annual weeds

Case study: glyphosate-resistant marestail

- prolific seed producer
- small seeded winter annual
- emerges fall through spring
- multiple resistant (SOAs 9 & 2)

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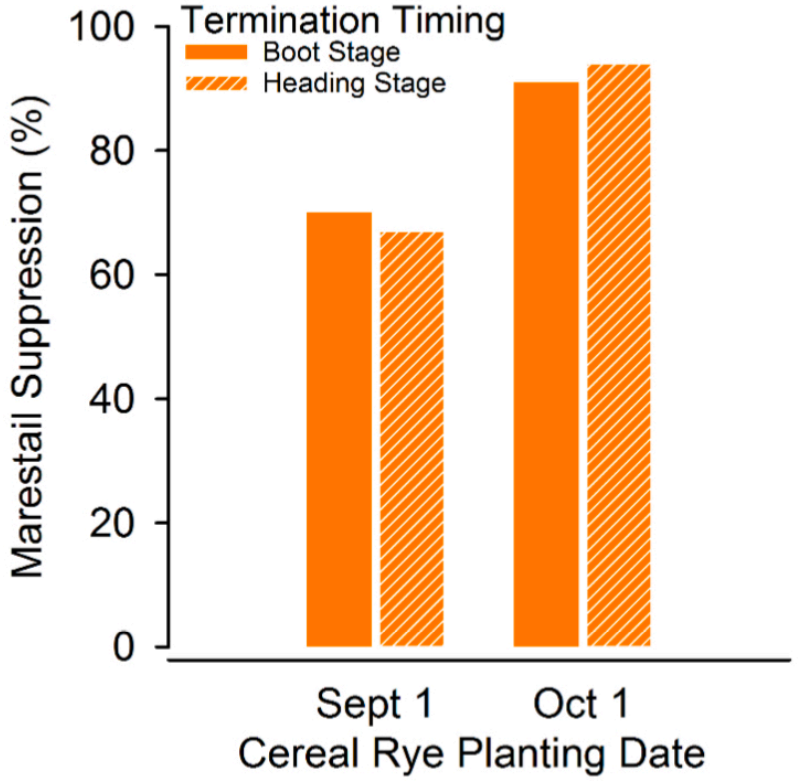
Case study: glyphosate-resistant marestail

Management tip: Starting clean & providing cover crops with a competitive advantage can result in high levels of weed suppression.

Winter annual weeds

Case study: glyphosate-resistant marestail

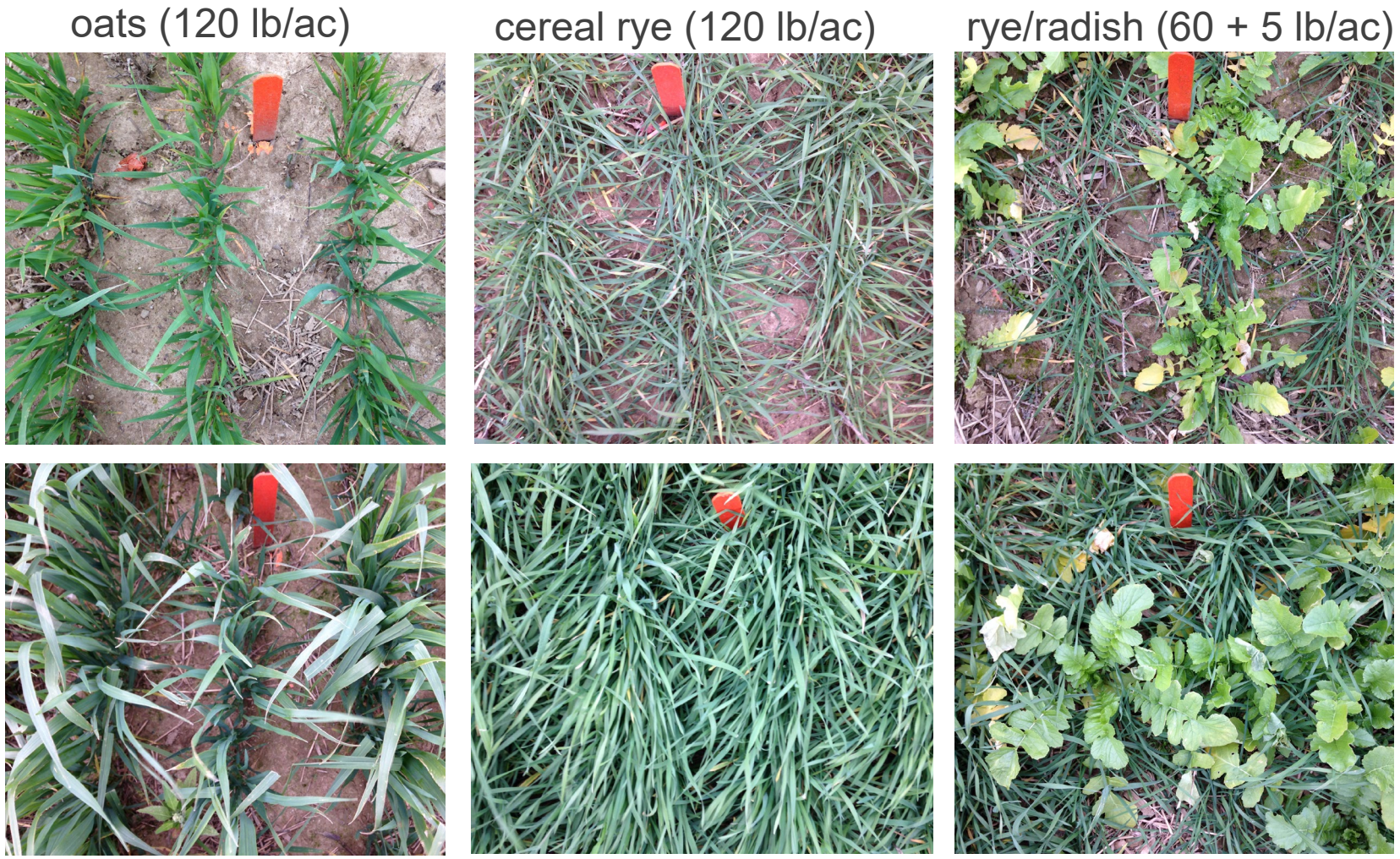
Management tip: For winter annuals, fall management and growth is more important that cover crop termination timing



Bunchek et al. (*unpublished*)

Winter annual weeds

Case study: marestail



Management tip: Biomass **AND ground cover** matter.

Species selection and soil fertility drive biomass/cover.

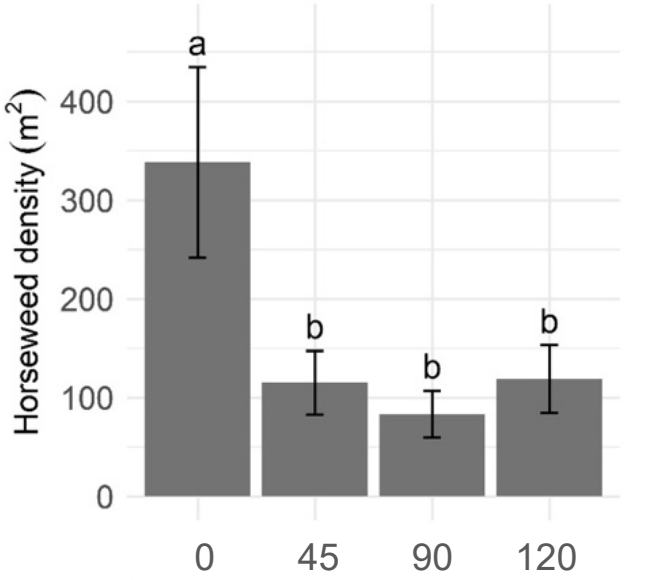
Wallace et al. (2019)

Winter annual weeds

Case study: glyphosate-resistant marestail

Management tip: Under optimal fall growing conditions, low rye seeding rates can result in high levels of weed suppression, equal to higher seeding rates

Cereal rye inputs (avg)	
rate (lb/ac)	cost ($/ac)
30	9
60	18
90	27
120	36



Ficks et al. (*in prep*)

Winter annual weeds

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Management tip: Consider managing hard to control weeds in the cover crop

Cover crop species selection dictates herbicide options.

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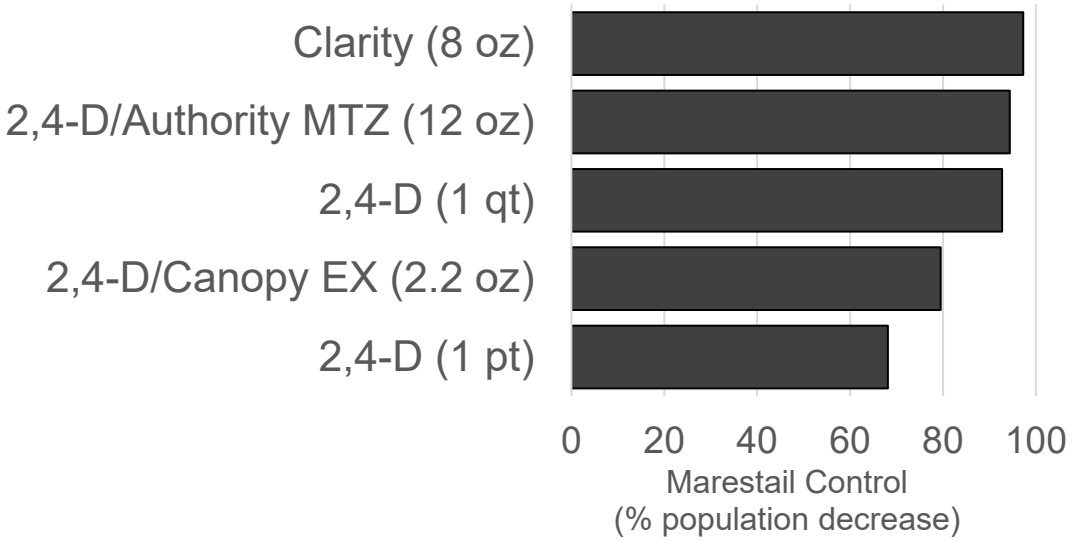
Spring (Apr) application in **rye cover crop**

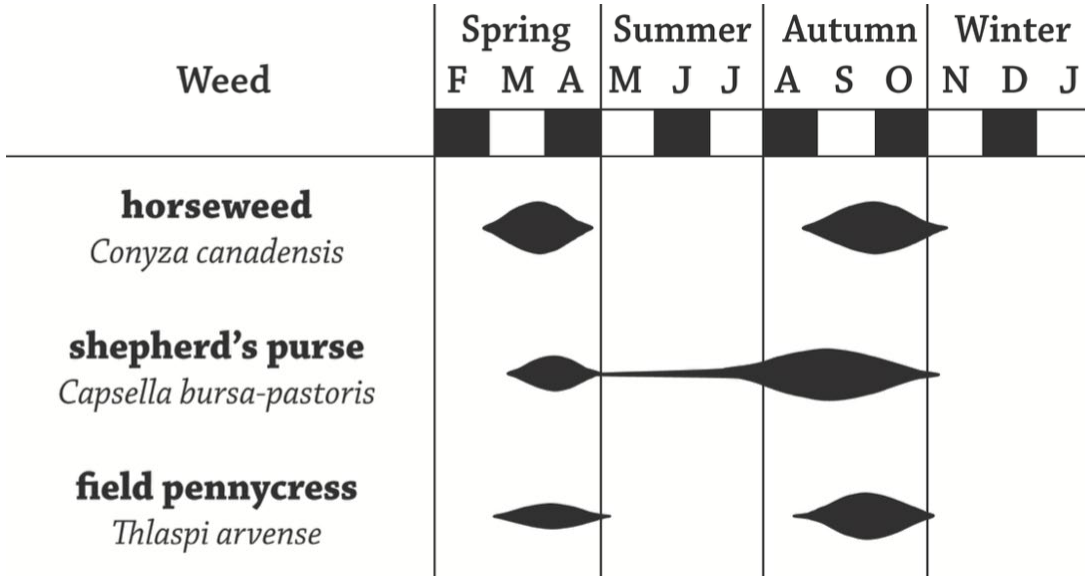


Wallace & Lingenfelter (*unpublished*)

Summary: cover crop management

For winter annual weed suppression

- Manage for biomass & ground cover
  - ✓ Seeding method
  - ✓ Fall GDDs
  - ✓ Soil N availability
- Starting clean leads to success & have a plan for managing weeds in cover
- Have a plan for terminating the cover crop (monocultures & mixtures)



Cover crop termination

Mechanical termination

- Optimal termination aligns with reproductive maturity of cover crops
- Reproductive maturity of species in mixture need to align to be effective
- Waiting too leads to cover crop seed production
- Rolling too early leads to regrowth

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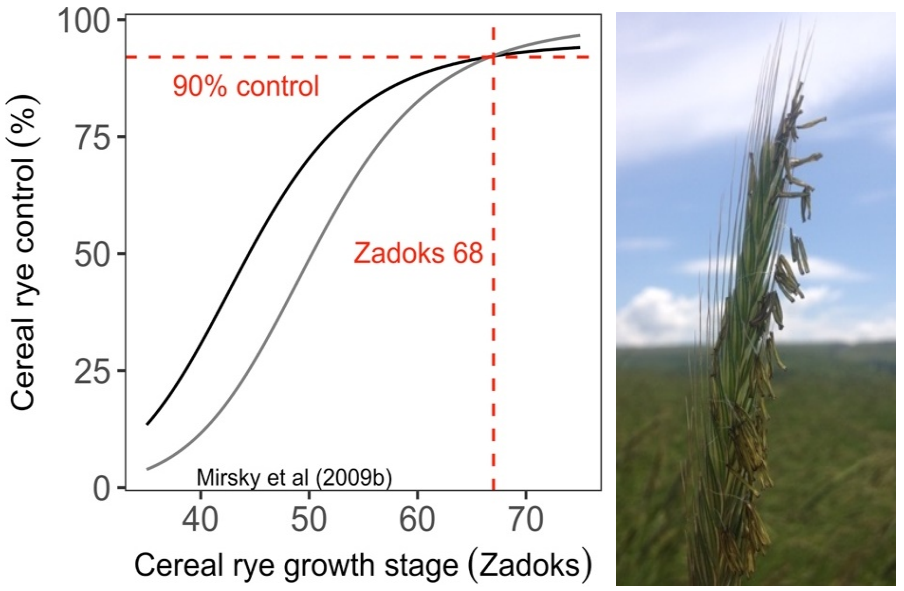
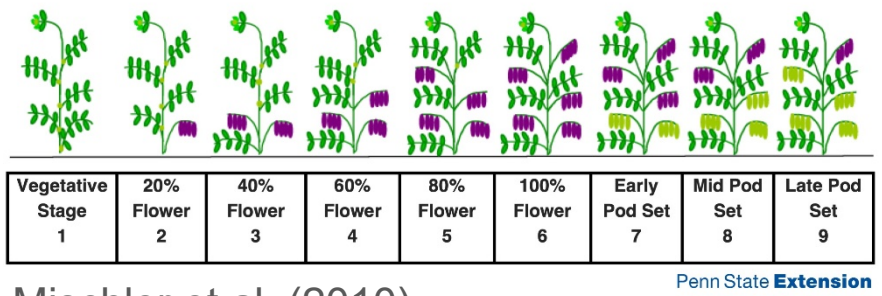
Rye termination (anthesis)



Mirsky et al. (2009)



Mischler et al. (2010)

Cover crop termination

Herbicide termination

- Timing is more flexible than mechanical
- Herbicide options differ by cover crop species
- Crimson clover easier to kill than hairy vetch

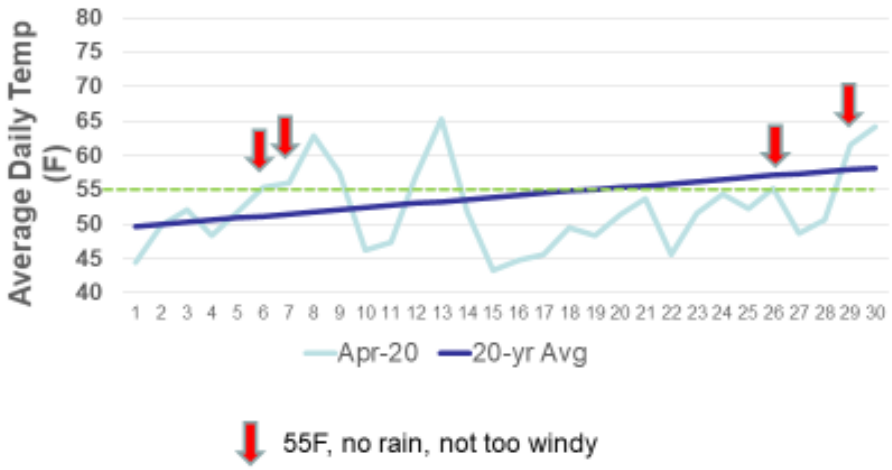
Cereal rye	Annual / Italian ryegrass	Hairy vetch / Clovers*	Radishes / Mustards
glyhosate	glyphosate (high rate, 1.5 qt)	2,4-D	glyphosate+2,4-D
paraquat	ACC-ase	dicamba	
		paraquat + trzn	glyphosate+Sharpen
			glyphosate+dicamba
		glyphosate alone poor to fair	paraquat+atrzn+meso
			glyphosate alone poor to fair

Cover crop termination

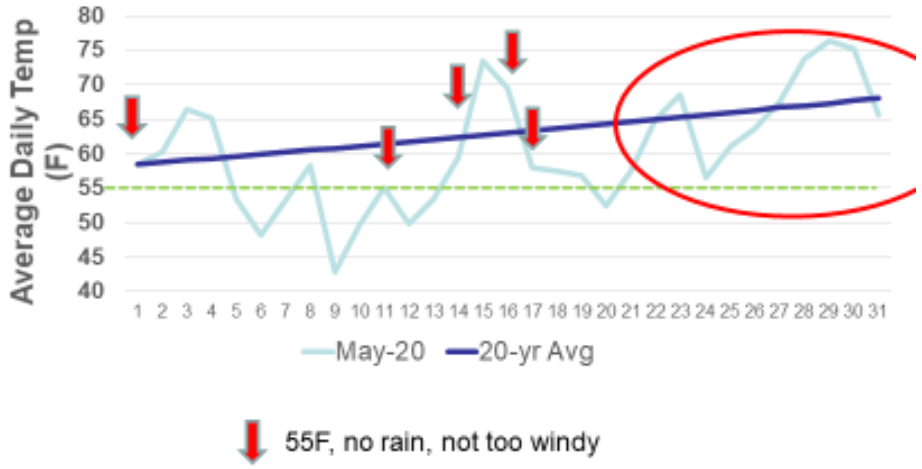
Herbicide termination

- Delayed termination improves chance of better spraying conditions

April



May



Residue challenges

Planter considerations

Management tip: Consider seed furrow closure & depth placement

- ✓ Planter weight (or) hydraulic down force on row units?
- ✓ Configuration of row cleaners, coulters, closing wheels?

Residue challenges

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Residue challenges

Management tip: Roll-crimping importance depends on termination timing.

Residue challenges

Management tip: Easier to plant into dead or green cover than “dying” cover

Residue challenges

Planter considerations

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Residue challenges

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Planter considerations

Soybean seedlings will adapt by grower taller

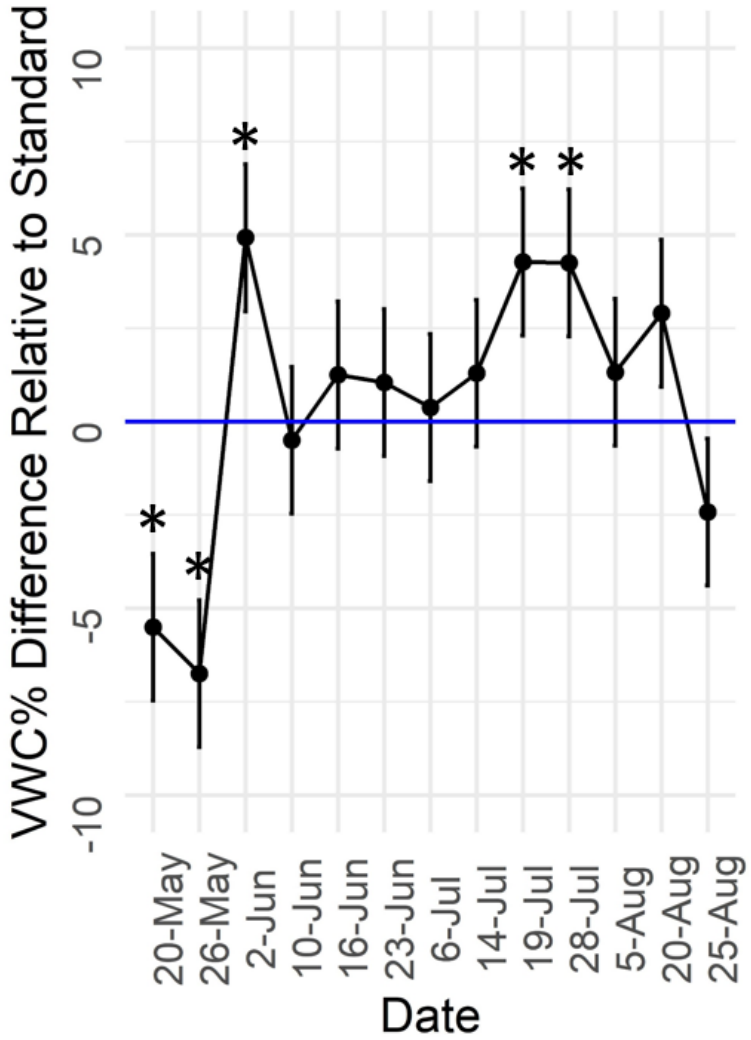
Residue challenges

Management tip: Adaptive management of cover crop termination is needed based on weather conditions

Residue challenges

Management tip: Adaptive management of cover crop termination is needed based on weather conditions

Delaying termination can create soil-water deficits at planting, but can conserve soil-water later due to mulch persistence

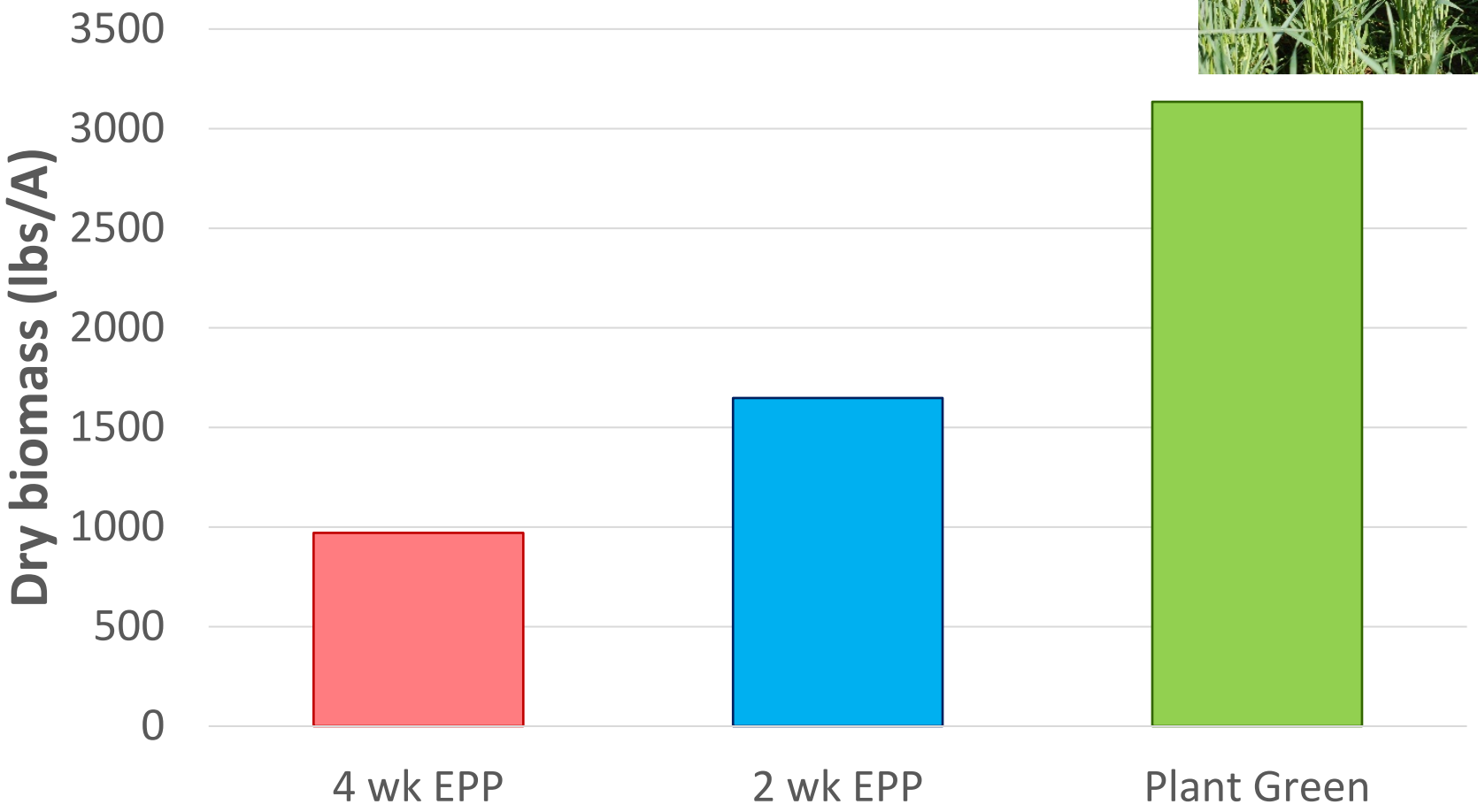


Ficks et al. (in prep)

Figure. Difference in soil volumetric water content (%VWC) at 4” depth in delayed terminated cereal rye (i.e., planting green) compared to standard pre-plant termination (14-17 d pre-plant)

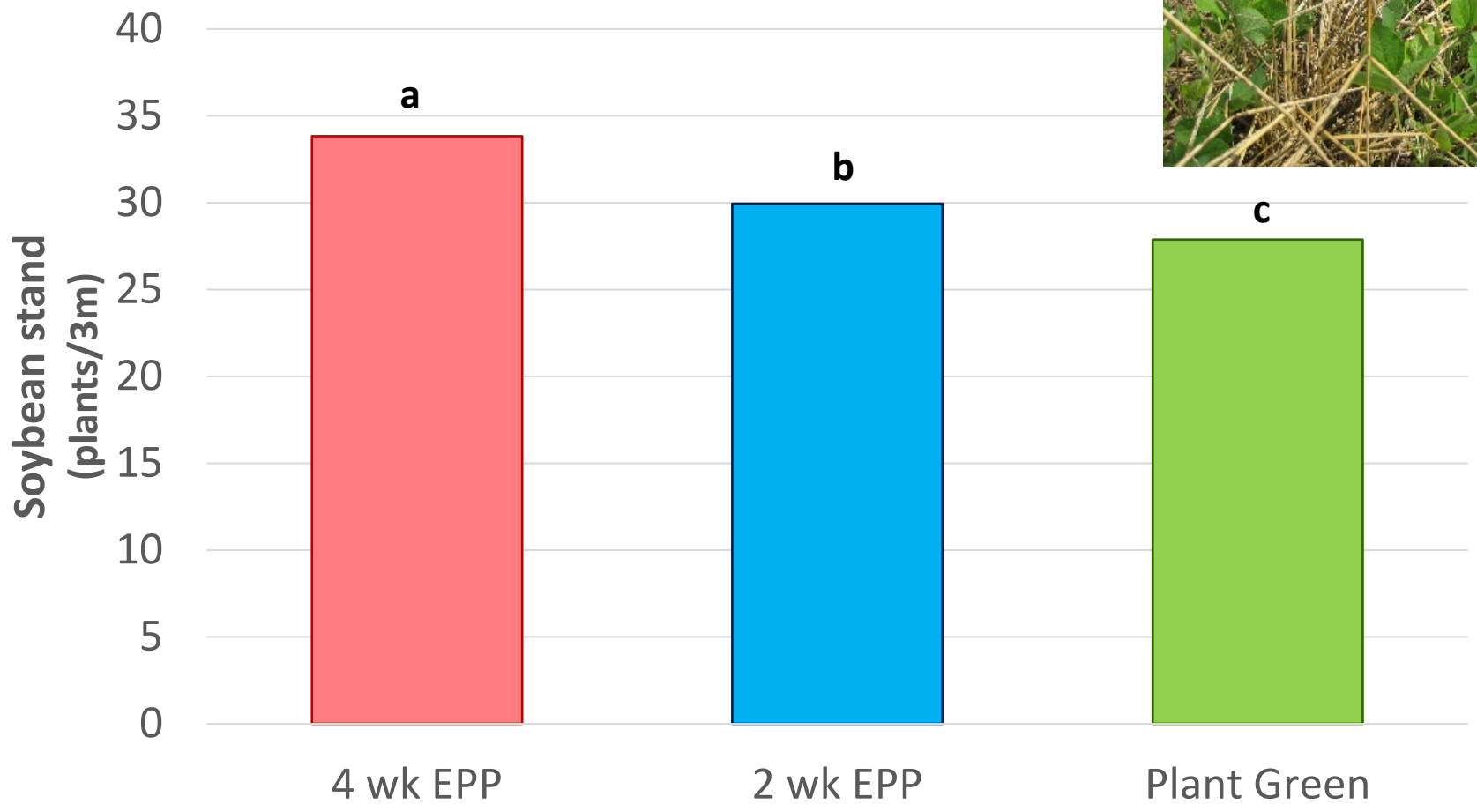
Cereal rye biomass

at time of termination



Soybean stand

6 wks after planting



DSB2-19

Palmer amaranth

September rating

DSB2-19
lsd= 17

Delayed cover crop termination

1. Reduce or slow the spread of herbicide resistance evolution

2. Lengthen windows for making effective herbicide applications

3. Potentially eliminate the need for additional herbicide passes or inputs

Multiple resistant waterhemp

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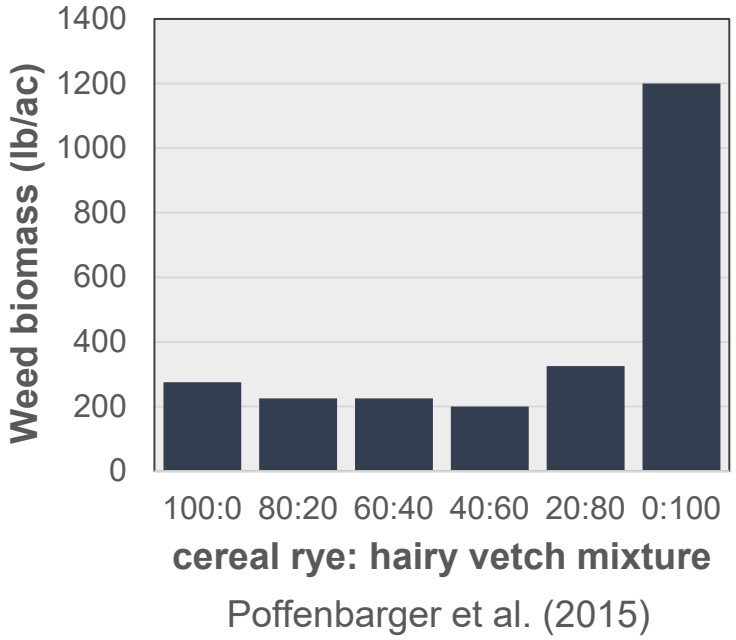
Cover crop mixtures

Weed management tip: grass-legume mixtures result in (1) higher nitrogen availability and (2) shorter residue persistence compared to grass monocultures



Poffenbarger et al. (2015)

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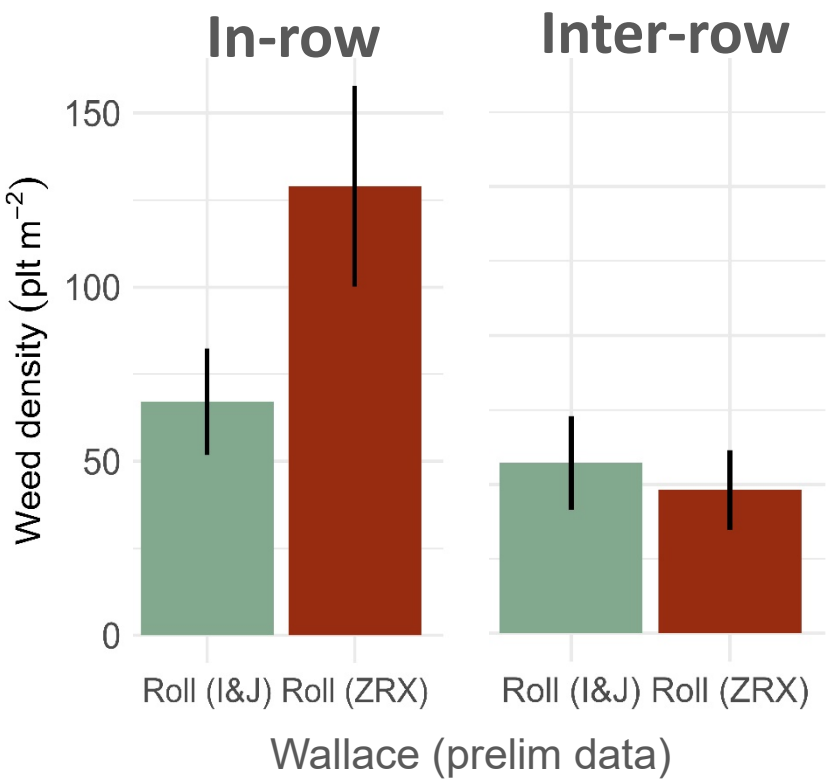
Summer annual weeds

Weed management tip: Row-cleaning can lead to increased in-season weed pressure



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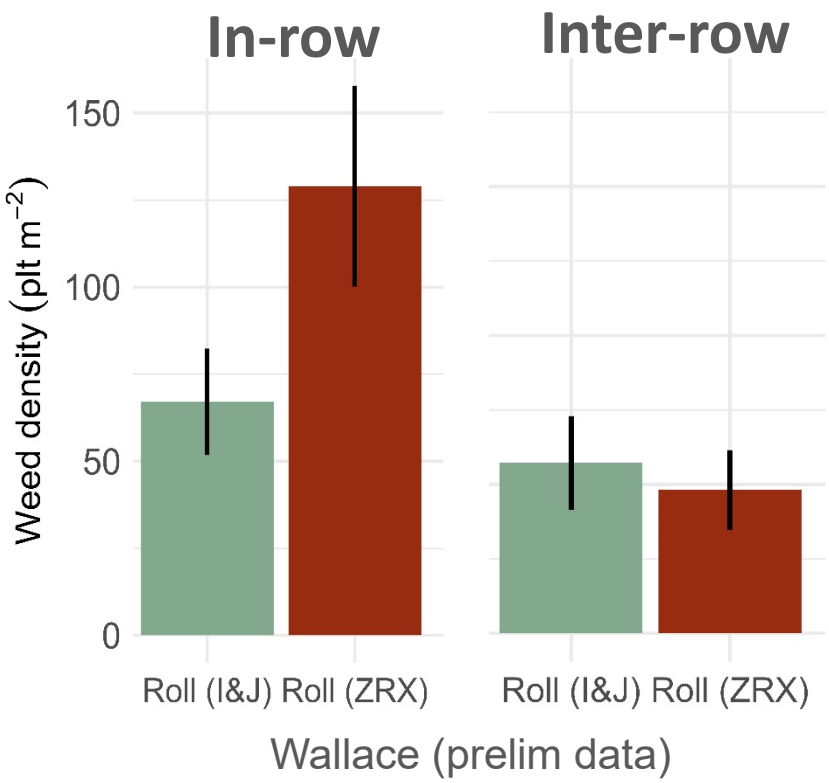

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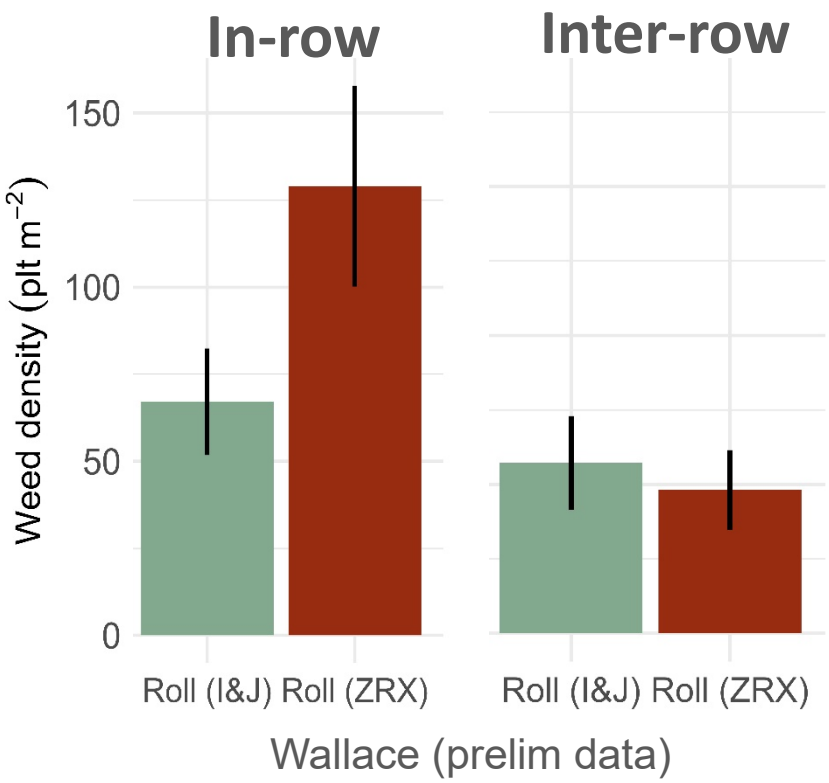

Summer annual weeds

Weed management tip: Cover crop residue can slow weed emergence & growth rates, allowing for longer windows for POST sprays

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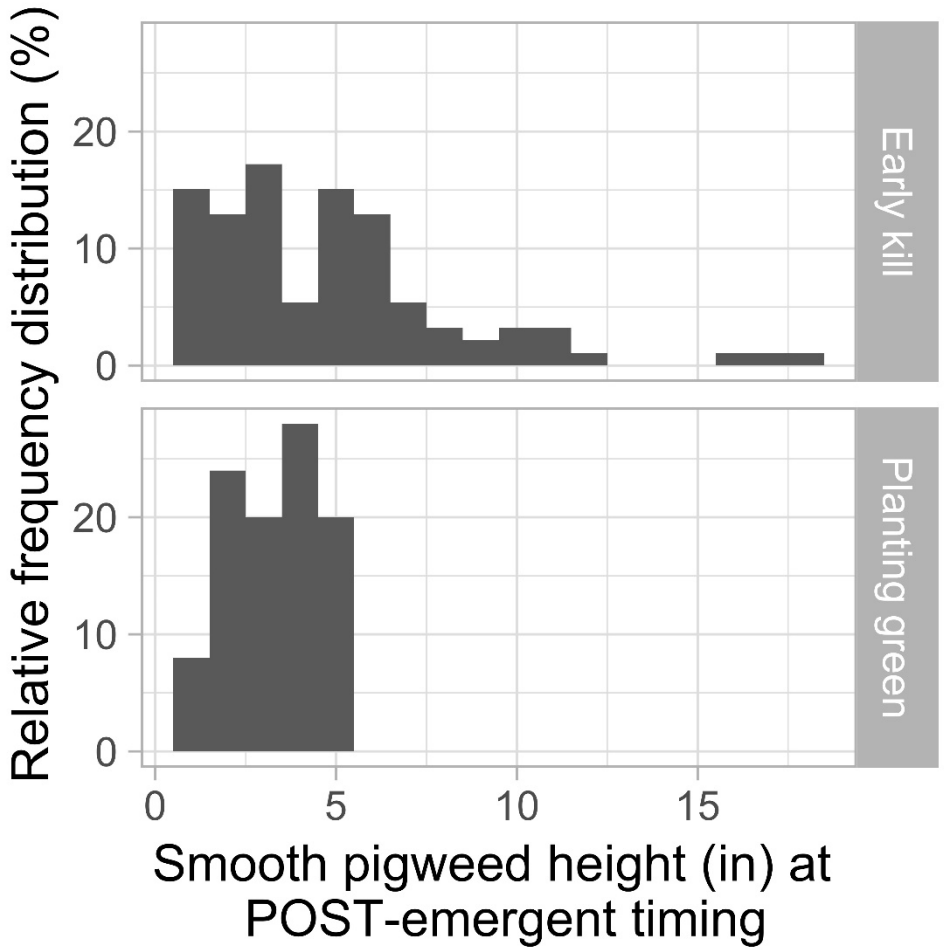

Ficks et al. (in prep)

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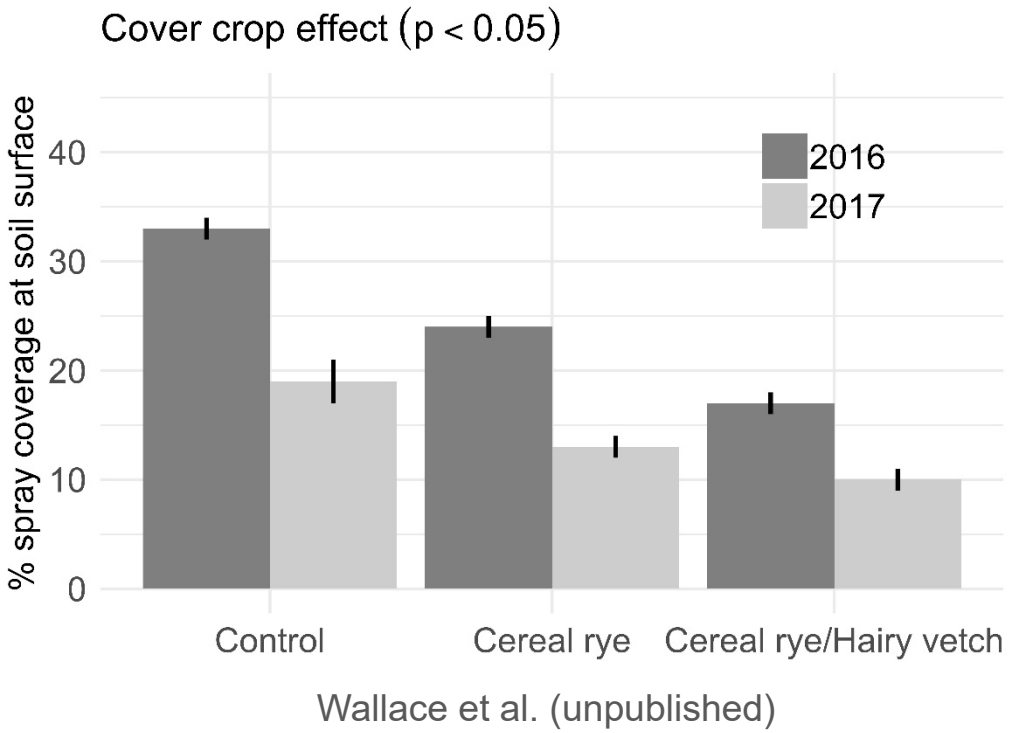
Herbicide applications

Weed management tip: High-residue cover crops have the potential to reduce deposition of foliar-applied herbicides, reducing weed coverage



Other Considerations

Cover crops can increase resiliency for weed control

Rye cover crop can be beneficial in wet spring, allow access to the fields sooner than no cover

Benefits may extend beyond harvest

Final Thoughts

Cover crops for weed control require planning – and flexibility

Like all weed management tools, effectiveness various by weed species

Requires adequate/uniform stand and biomass production across the field

- although does not require “lots and lots” of biomass

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Final Thoughts

Rye can replace the early preplant (non-selective) herbicide application

Delayed termination can replace use of residual herbicides early preplant

More work is needed for further herbicide reductions in-crop

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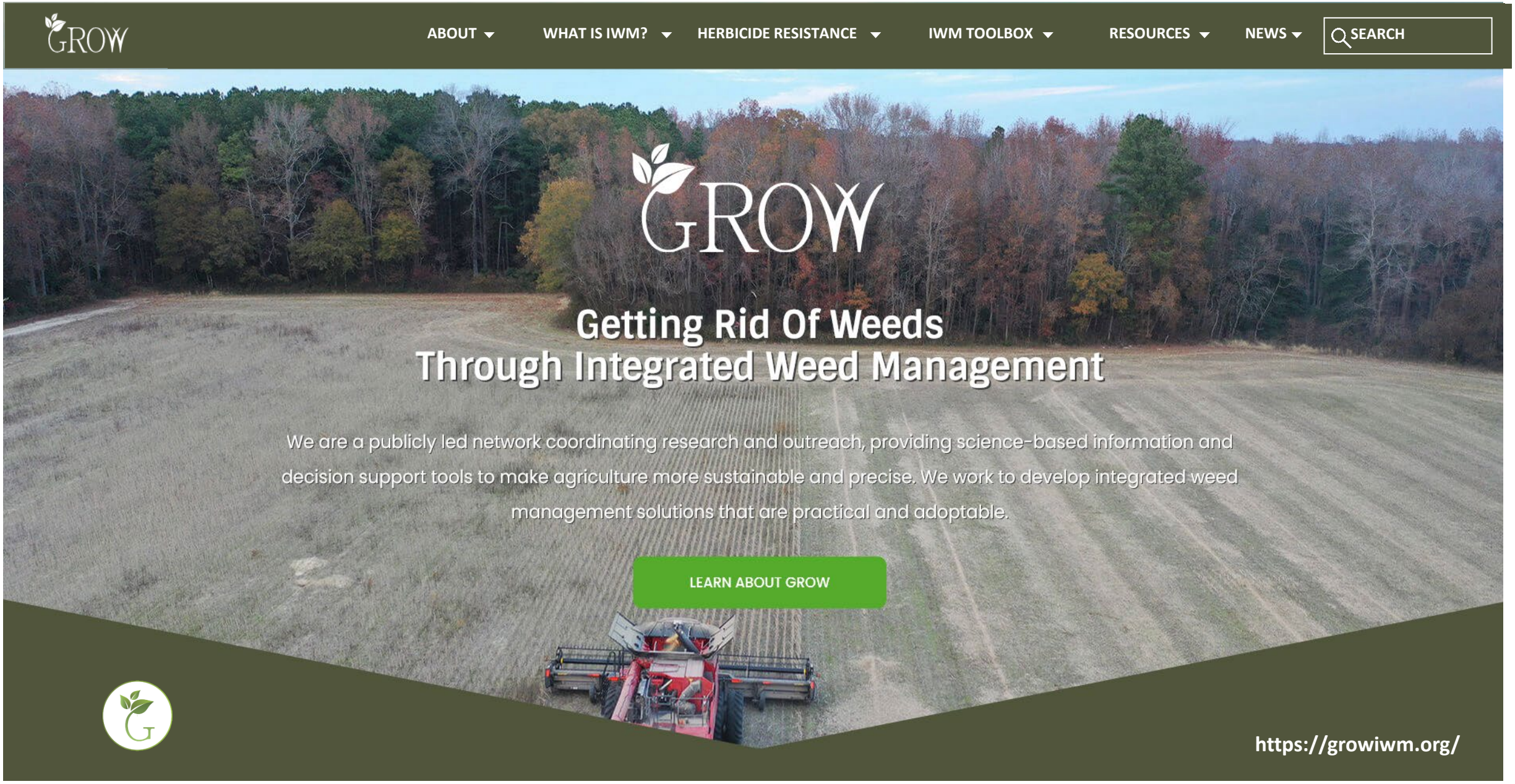
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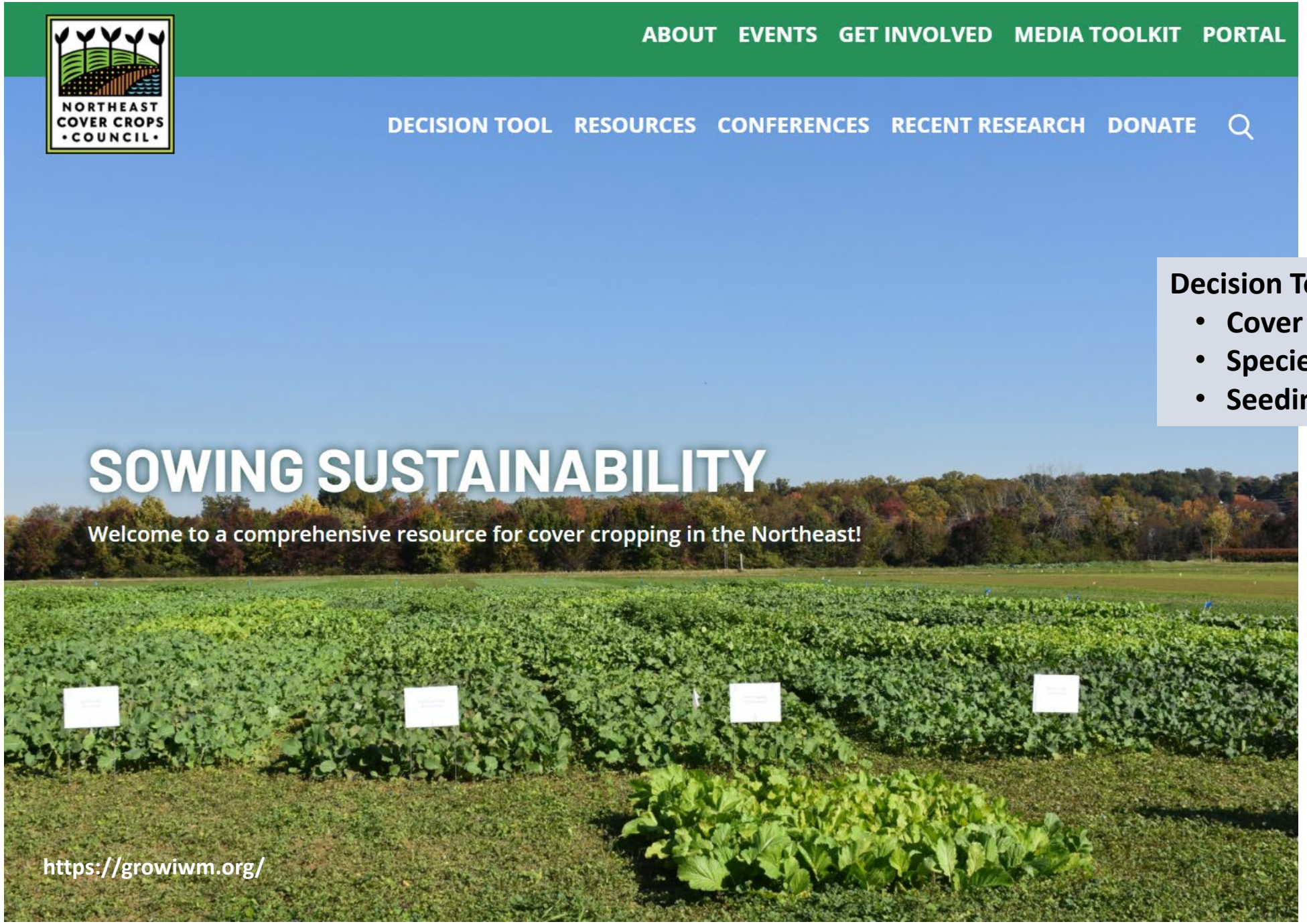
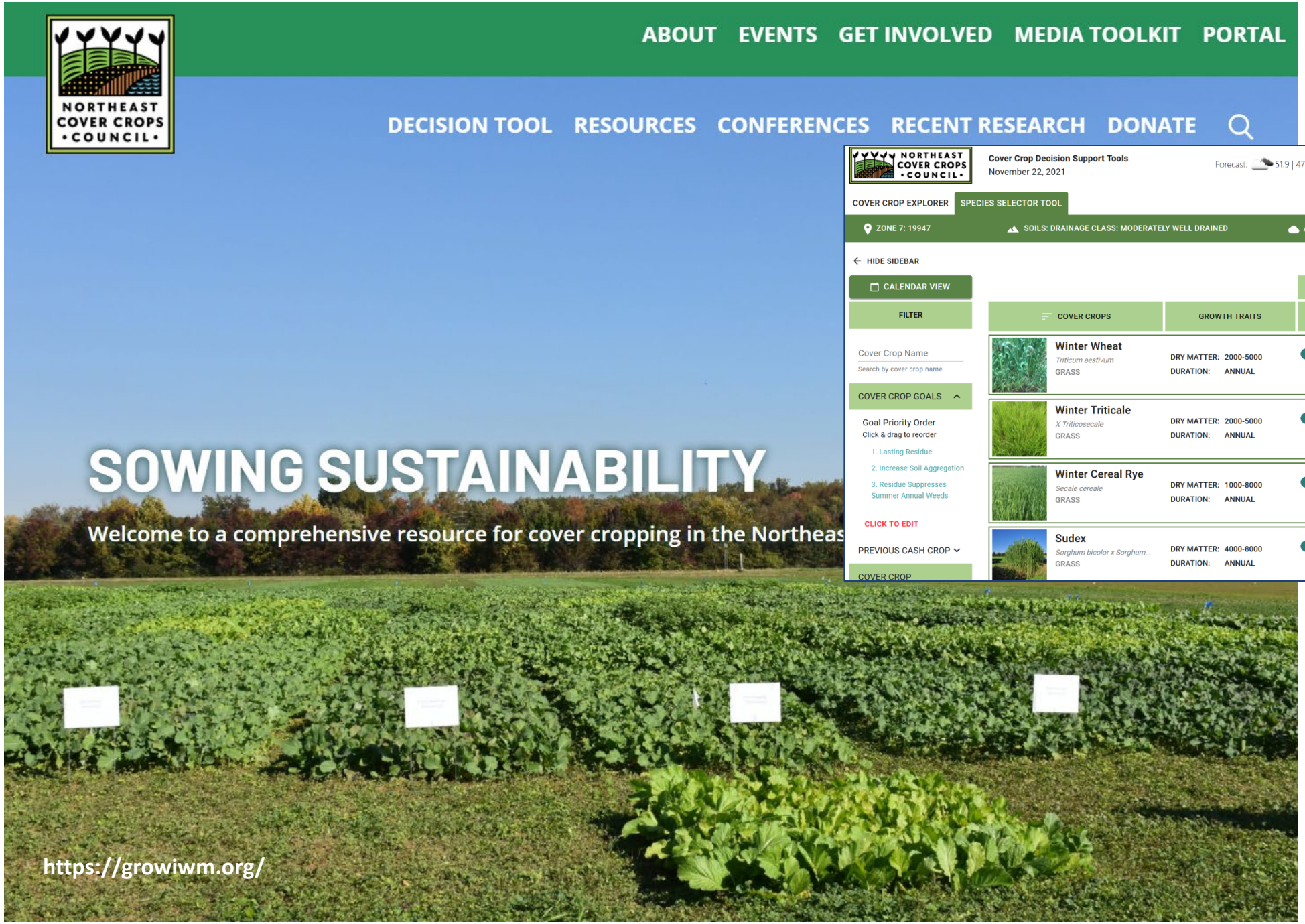


Decision Tools

- **Cover Crop Explorer**
- **Species Selection Tool**
- **Seeding Rate Calculator**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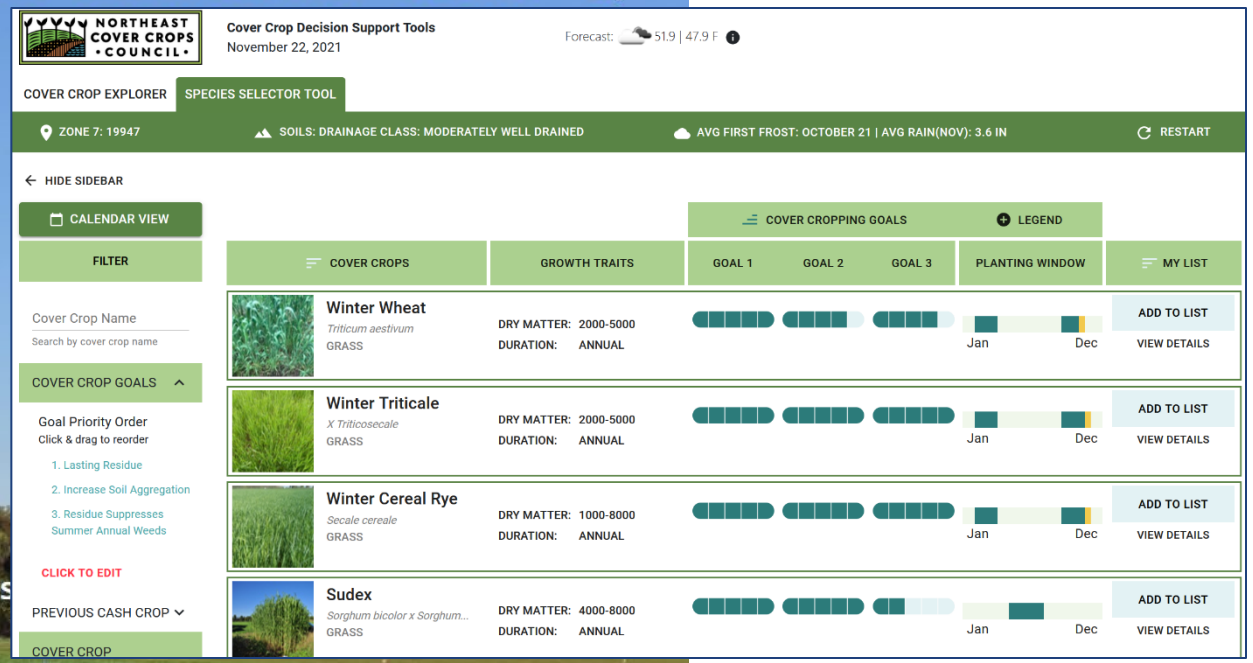
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November 22, 2021
Forecast: 51.9 | 47.9 F
COVER CROP EXPLORER
SPECIES SELECTOR TOOL
ZONE 7: 19947
SOILS: DRAINAGE CLASS: MODERATELY WELL DRAINED
AVG FIRST FROST: OCTOBER 21 | AVG RAIN(NOV): 3.6 IN
RESTART
HIDE SIDEBAR
CALENDAR VIEW
FILTER
Cover Crop Name
Search by cover crop name
COVER CROP GOALS
Goal Priority Order
Click & drag to reorder
1. Lasting Residue
2. Increase Soil Aggregation
3. Residue Suppresses Summer Annual Weeds
CLICK TO EDIT
PREVIOUS CASH CROP
COVER CROP
COVER CROPPING GOALS
LEGEND
COVER CROPS
GROWTH TRAITS
GOAL 1
GOAL 2
GOAL 3
PLANTING WINDOW
MY LIST
Winter Wheat
Triticum aestivum
GRASS
DRY MATTER: 2000-5000
DURATION: ANNUAL
Jan
Dec
ADD TO LIST
VIEW DETAILS
Winter Triticale
X Triticosecale
GRASS
DRY MATTER: 2000-5000
DURATION: ANNUAL
Jan
Dec
ADD TO LIST
VIEW DETAILS
Winter Cereal Rye
Secale cereale
GRASS
DRY MATTER: 1000-8000
DURATION: ANNUAL
Jan
Dec
ADD TO LIST
VIEW DETAILS
Sudex
Sorghum bicolor x Sorghum...
GRASS
DRY MATTER: 4000-8000
DURATION: ANNUAL
Jan
Dec
ADD TO LIST
VIEW DETAILS


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Questions

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