Alternative WEED CONTROL RESEARCH *from Kansas*

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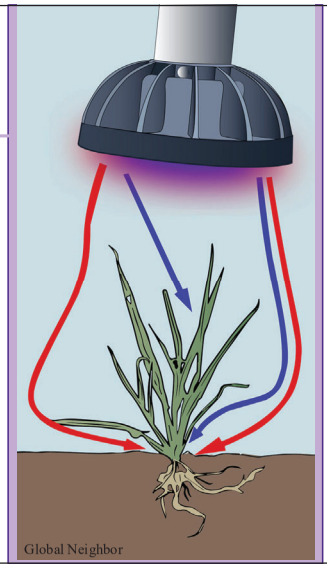
Outline

Alternative weed control background

Weed electrocution

Harvest weed seed control



Driver weeds in Kansas

- Palmer amaranth
  - *Resistance to*
  - HG's 2, 4, 5, 9, 14, 27
  - 6-way
- Waterhemp
  - *Resistance to*
  - HG's 2, 5, 9, 14
  - 2-way
- Kochia
  - *Resistance to*
  - HG's 2, 4, 5, 9
  - 4-way

Herbicide-resistance in the US

Herbicide group (example herbicide)	Number of cases		Year (and state) of first report	
	Palmer amaranth	Kochia	Palmer amaranth	Kochia
9, EPSPS inhibitor (glyphosate)	41	13	2005 (GA)	2007 (KS)
5, PSII inhibitors (atrazine)	10	13	1993 (TX)	1976 (KS)
27, HPPD inhibitors (mesotrione)	6		2009 (KS)	
14, PPO inhibitors (fomesafen)	4		2011 (AR)	
4, Growth regulators (2,4-D, dicamba)	3	7	2015 (KS)	1994 (MT)
15, VLCFA inhibitors (S-metolachlor)	2		2016 (AR)	
10, Glutamine synthetase inhibitor (glufosinate)	1		2020 (AR)	

Weedscience.org; *Not in database

Metabolic resistance

Herbicide converted to inactive forms before plant is killed
- Cytochrome P450s and glutathione S-transfersases

We ***must*** rethink assumptions regarding herbicide resistance
- Reduced effectiveness of mixing and rotating herbicides
  - Minimize weed seed bank
  - Adopt alternative management strategies

Shyam et al. 2019; *metabolic resistance

Why manage weed seed banks

Seed rain year 1
Assume escapes of 100 plants per acre

$$350{,}000\ \frac{seeds}{acre} \times 15\% = 52{,}500\ \frac{viable\ seeds}{acre}$$

Plants emerged year 2

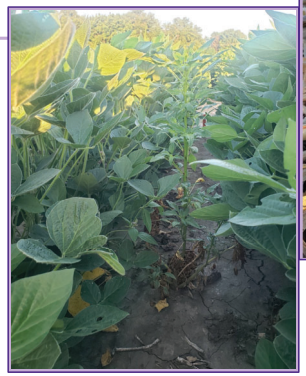
$$52{,}500\ seeds\ \times 20\% = 10{,}500\ \frac{plants}{acre}$$

Plants escaped year 2

$$10{,}500\ plants\ \times 95\% = 525\ \frac{plants}{acre}$$

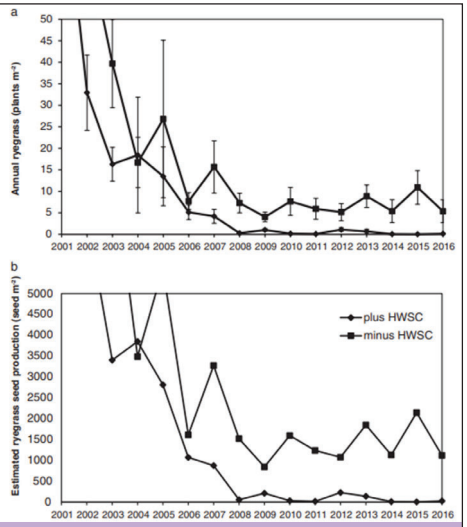
Seed rain year 2

$$525\ plants\ \times 487\ \frac{seeds}{plant} = 255{,}639\ \frac{seeds}{acre}$$

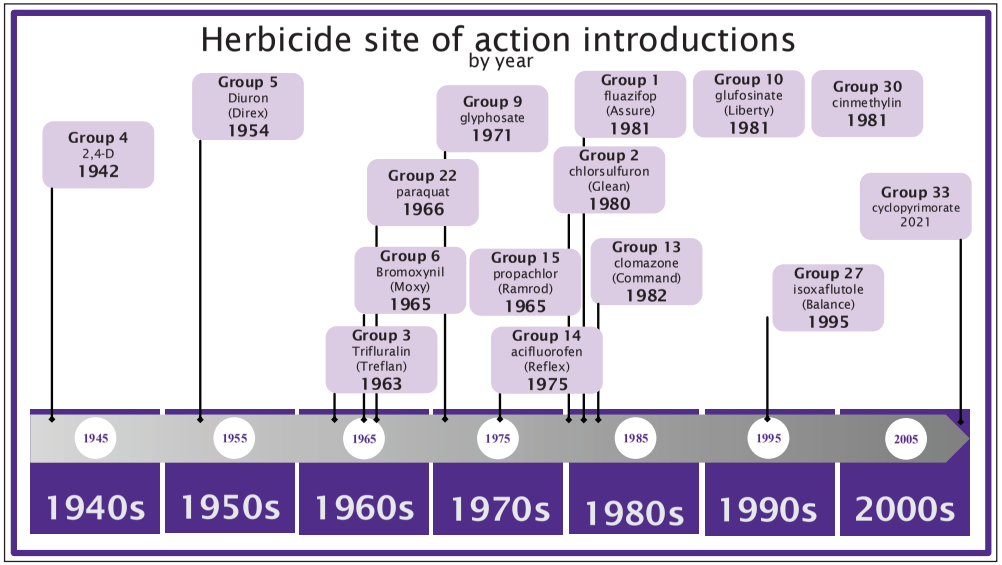


Korres et al. 2018 ; Werner et al. 2020

Harvest weed seed control can <u>complement</u> herbicides to manage seedbank



Walsh et al. 2017



Insanity

is doing the ***same*** thing over and over and expecting ***different*** results

Challenge

How will you **change** weed management to ***better*** steward current and future herbicides?

The Art of War

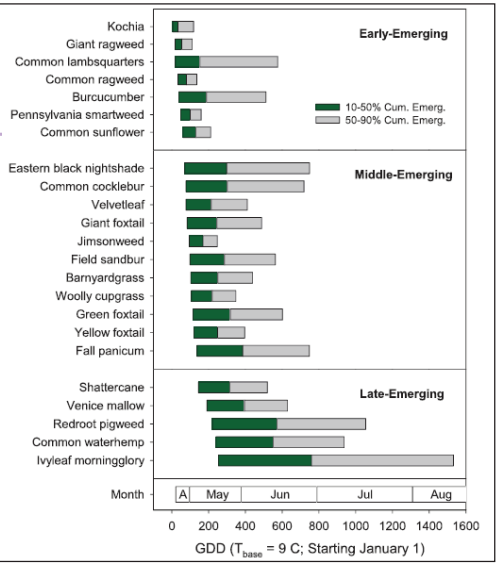
*If you **know the enemy and know yourself**, you need not fear the result of a hundred battles.*

If you know yourself but not the enemy, for every victory gained you will also suffer a defeat.

If you know neither the enemy nor yourself, you will succumb in every battle.

Know thy enemy

- Emergence and other lifecycle characteristics
- Method of pollination and other reproductive characteristics
- Canopy and root structure and other factors that influence competitiveness



Werle et al., 2014

"Alternative" can mean cultural

- Crop rotation
- Fertility
- Planting date
- Plant population
- Row spacing

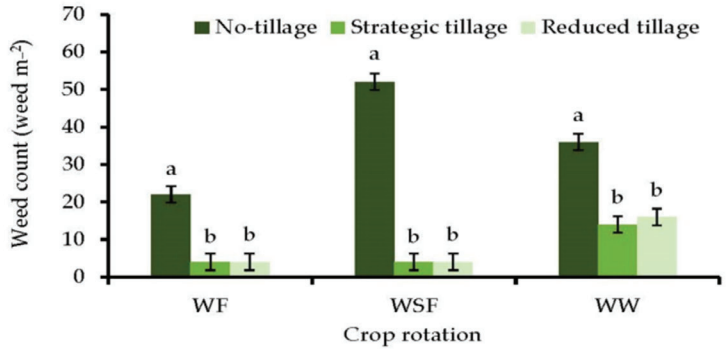
"Dark is a good herbicide"

Soybeans 6 WAP in 15" and 30" rows
Photos by Chad Lammers

"Alternative" can mean physical/mechanical

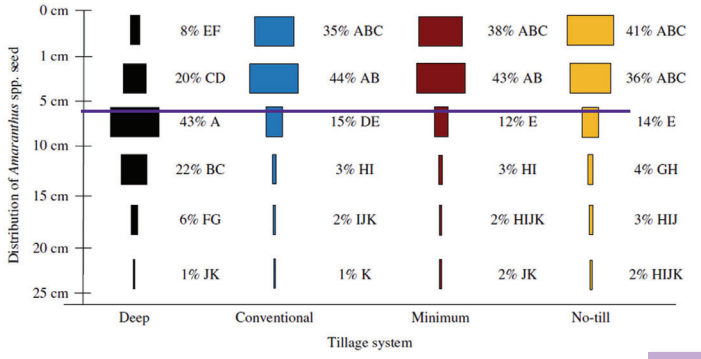
- Cover crops
- Strategic tillage
- Flaming
- Electrocution
- Harvest weed seed control

Strategic tillage



Obour et al. 2021

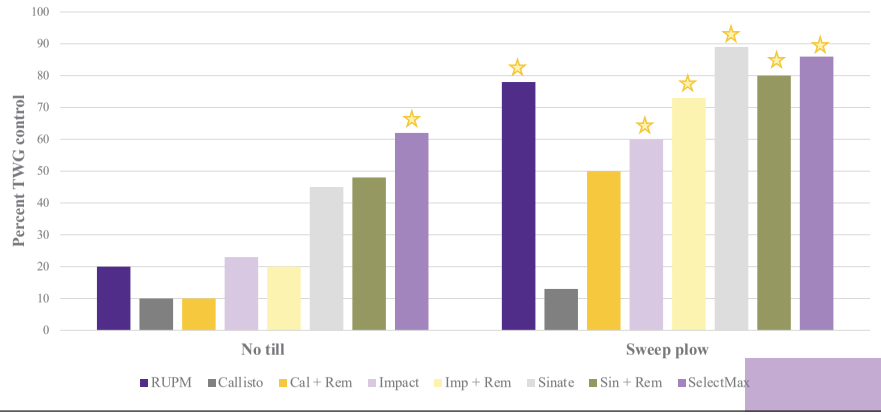
Strategic tillage

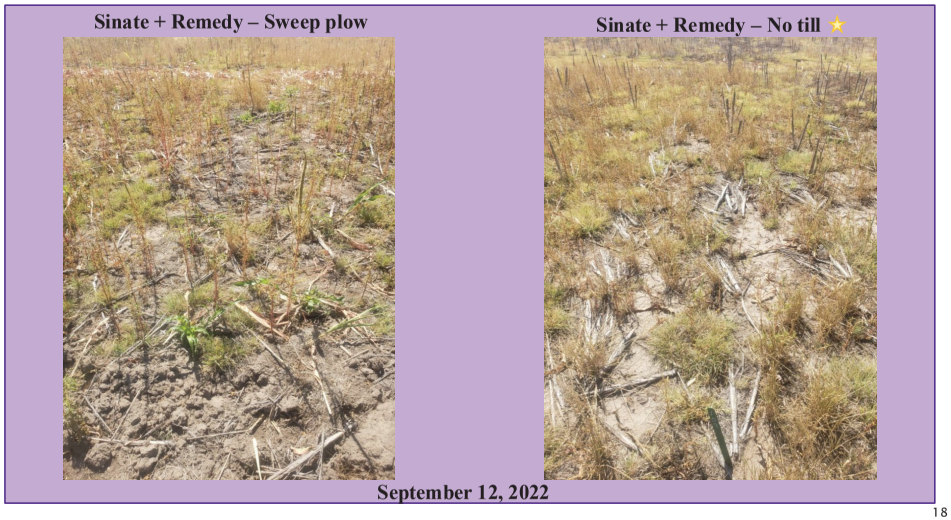


Farmer et al. 2017

Tillage/herbicide interactions

Stars indicate statistically greatest control Sept. 12, 2022



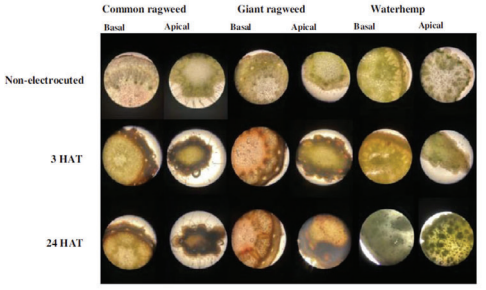


Electrocution

- Electricity transferred through copper boom
  - Safety concerns

Electrocution

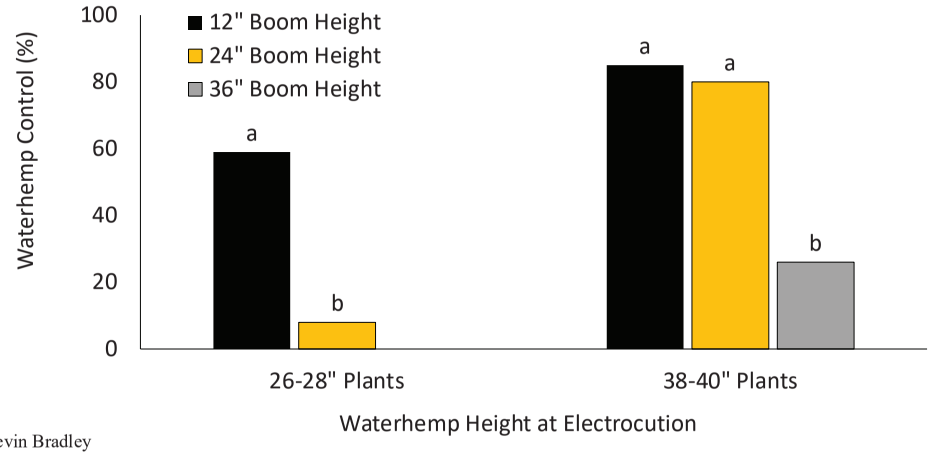
- Requires height separation between weeds and crop
  - More is better
- Multiple passes might improve control
- Main factors are voltage (≈3 to 8 kV) and time (≈ 4 to 20 s)
- Greater weed density requires more energy
- Control increases as weeds mature



Effect of electrocution on weeds.

Schrier et al. 2021; Coleman et al. 2019; Diprose & Benson 1981; Diprose et al. 1980

Influence of Electrocution Boom Height on Waterhemp Control



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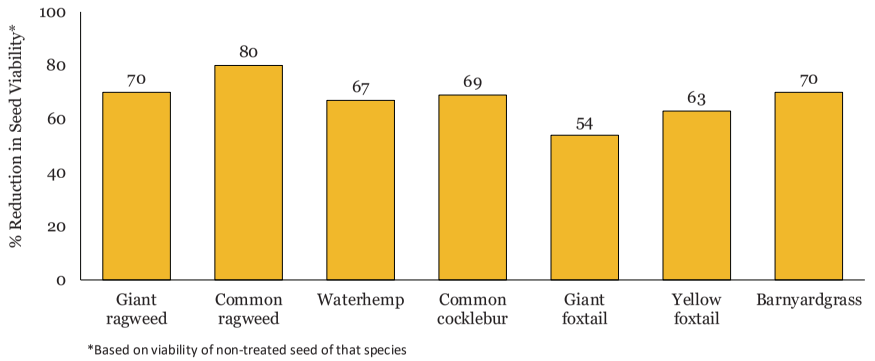
Influence of Electrocution on Weed Seed Viability



*Based on viability of non-treated seed of that species

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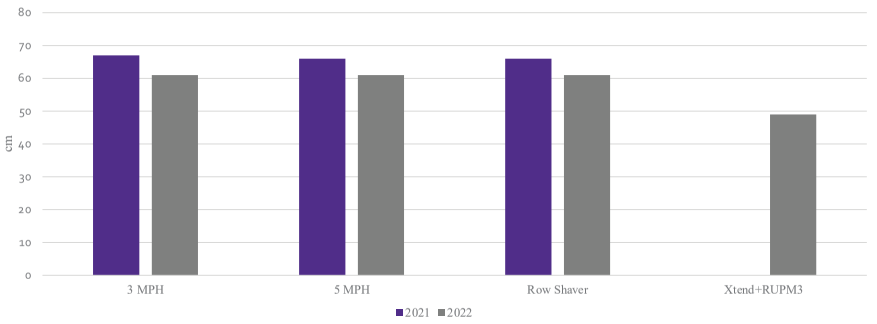
Zapper experiment in KS

- On-farm
  - Great Bend
    - 2021
      - Nontreated, 3 MPH, 5 MPH, Row Shaver
    - 2022
      - Nontreated, 3 MPH, 5 MPH, Row Shaver, Xtend+RUPM3

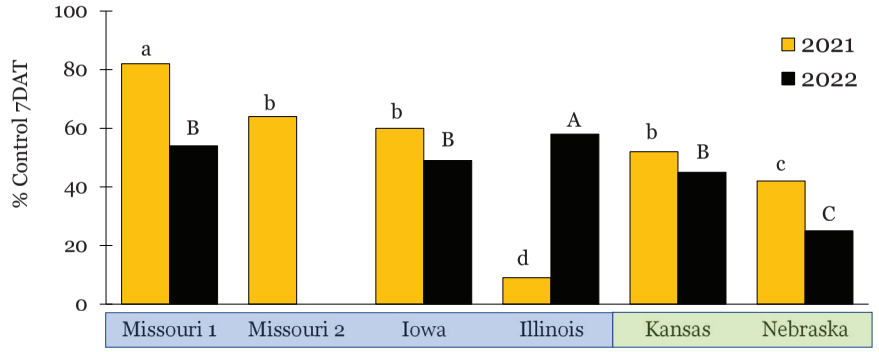
Soybean height at harvest



Palmer amaranth control 2 WAT

Similar letters indicate similar control.

Response of Pigweed Species To Electrocution



*Bars followed by the same letter within a year are not different, LSD <0.05

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What we think we've learned so far…

- This is NOT a weed management tool – it is a weed rescue tool
- Can be effective on troublesome resistant weeds
  - Varies with Size, plant moisture, boom height – not soil moisture (in MO)
- Can reduce weed seed viability

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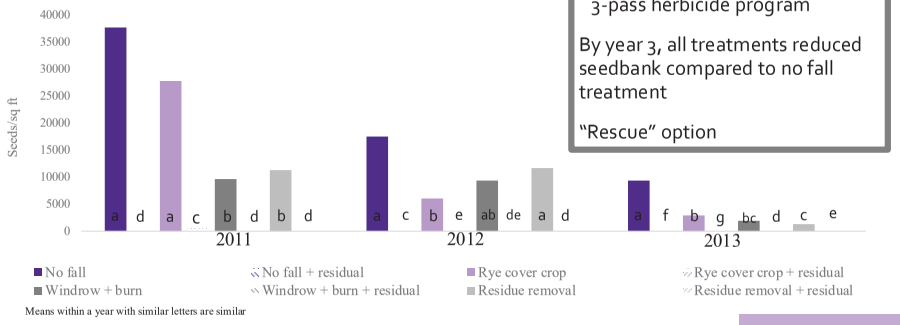
Harvest weed seed control

- HWSC used on 80% of Australian farms
- Chaff lining (ideally in wheel tracks)
- Windrow burning
- Impact mills
  - Redekop
  - Seed Terminator
  - iHSD

Walsh et al., 2017

HWSC effects on Palmer amaranth seedbank at soybean harvest



Means within a year with similar letters are similar

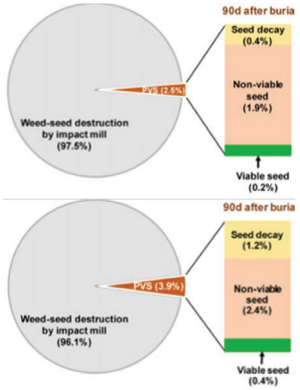
Seed bank decreased over time
3-pass herbicide program

By year 3, all treatments reduced seedbank compared to no fall treatment

"Rescue" option

Norsworthy et al., 2019

Harvest weed seed control



Weed seeds buried overwinter

Urbana-Champaign 2015-16 (top): Waterhemp, common lambsquarters, giant foxtail, velvetleaf, ivyleaf morningglory, giant ragweed , common cocklebur

Beltsville 2017-18 (bottom): Smooth pigweed, common ragweed jimsonweed, common lambsquarters, velvetleaf

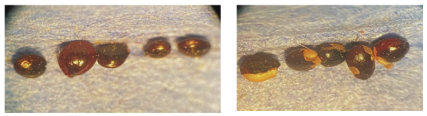
Shergill et al. 2019

Palmer amaranth seed destruction in grain sorghum

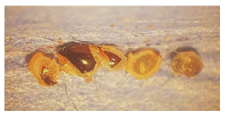
- No of samples collected = 4/strip
- No of passes = 4

Category	%
No damage	5
Slightly cracked	28
Moderately cracked	64
Fully pulverized	3

95% of total seeds were destructed


Full seeds

Slightly cracked


Moderately cracked


Fully pulverized

Vipan Kumar

K-STATE Research and Extension

Knowledge for Life

Pigweed seed retention at soybean maturity

	State	Seed Retention (%)	
		2013	2014
Palmer amaranth	AR	99.98 ± 0.00	99.85 ± 0.05
	IL	99.95 ± 0.03	--
	NE	98.89 ± 0.23	99.93 ± 0.02
	MO	99.98 ± 0.00	99.67 ± 0.20
	TN	99.96 ± 0.01	--
Waterhemp	IL	99.98 ± 0.01	94.98 ± 0.94
	NE	99.99 ± 0.00	99.63 ± 0.10
	MO	100.00 ± 0.00	99.84 ± 0.04
	WI	99.96 ± 0.01	98.80 ± 0.30

Schwartz et al., 2016

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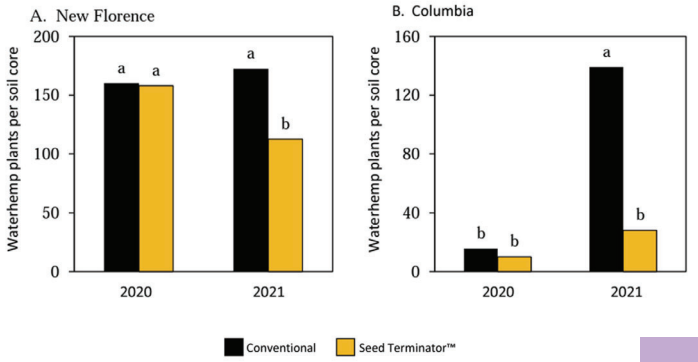
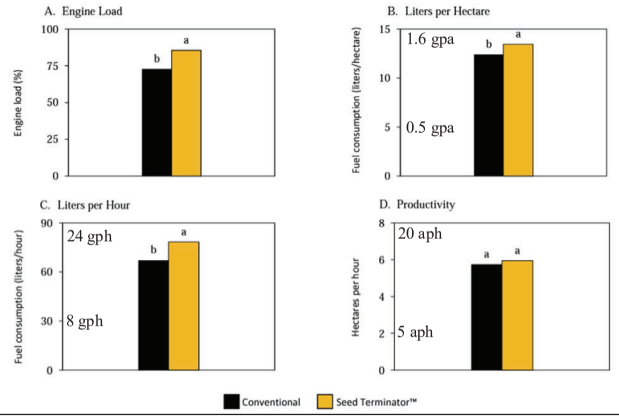
Waterhemp density spring following treatment



Winans 2022

Seed Terminator changes combine efficiency



Take aways

- This is NOT a stand-alone weed control tool
- Reducing the weed seedbank will take time, especially if initially large
- Effectiveness influenced by weed seed retention, cutting height, weed seed getting to mill
- Does result in added engine load and fuel use

Future research on 'alternative' weed control in KS

On-farm studies
- Seed destructor in wheat
- IWM for tumble windmillgrass
- Weed Zapper?
- Row Shaver?

Small plot studies
- Cover crops
- Planting date/row-spacing interactions

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