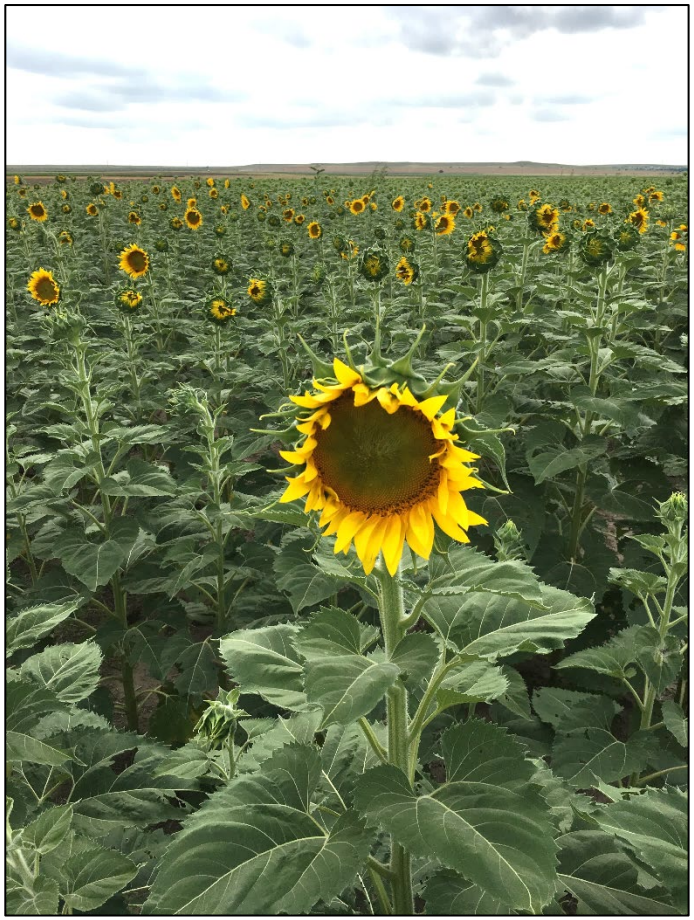
Integrating Cover Crops and Residual Herbicides for Weed Suppression in High Plains Sunflower Production

V. Kumar[1*], J.F. Jonnes[2], N. Lawrence[3], C. Creech[3], and D. O'Brien[2]

[1]K-State Agricultural Research Center, Hays, KS
[2]K-State NW Research-Extension Center, Colby, KS
[3]UNL, Panhandle Research-Extension Center, Scottsbluff, NE

Sunflower Production and Weed Problems

- Total 1.22 million acres harvested in 2021
- Major production in ND, SD, CO, MN, KS, TX, CA, NE, CO
- Kochia and Palmer amaranth are two major problematic weeds in High Plains
- Limited herbicide options make weed control difficult in sunflower
- Herbicide- resistant weeds exacerbate the problem

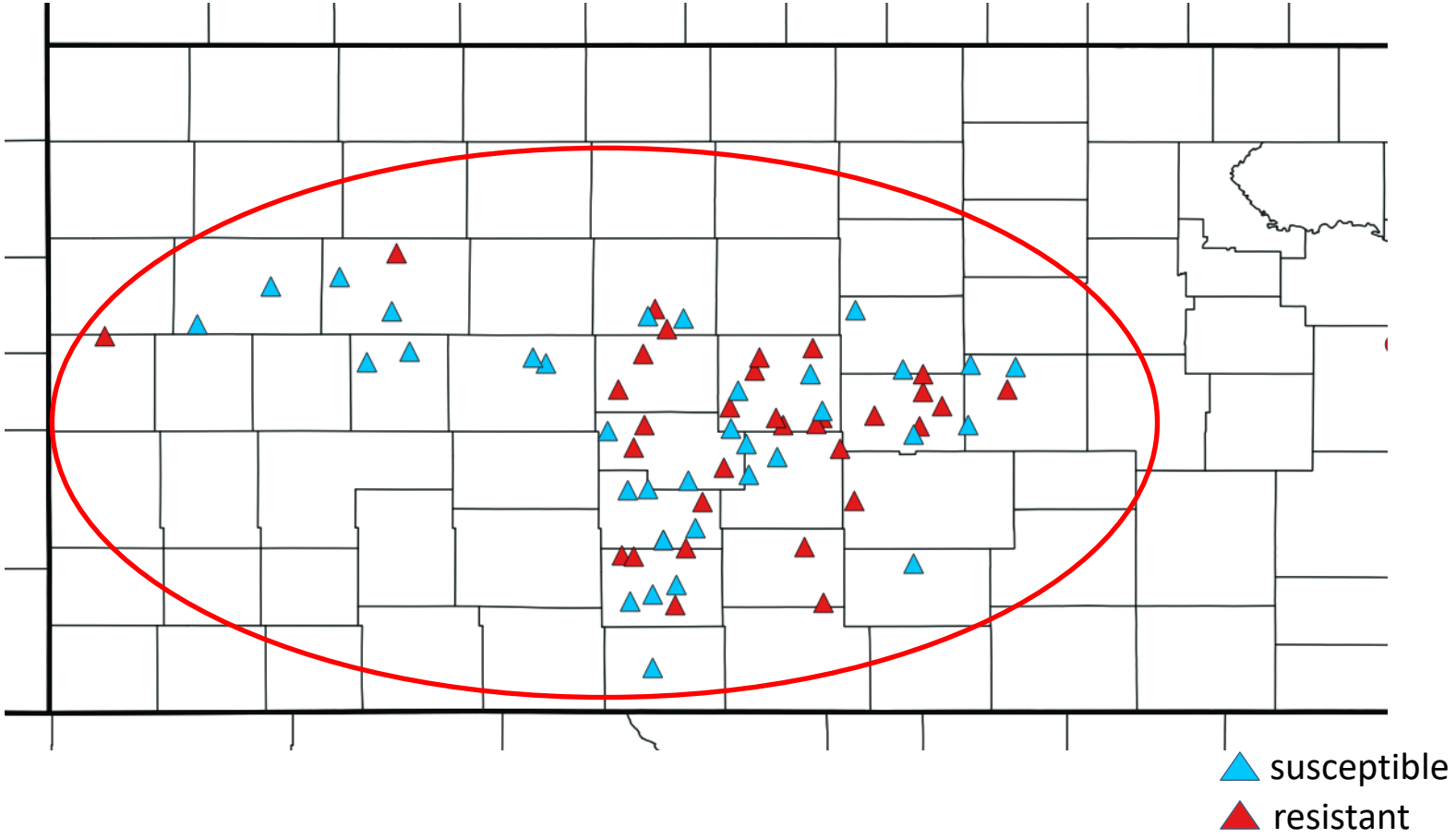


USDA-NASS, Dec 09, 2021

Herbicide-Resistant Weeds in High Plains

Glyphosate-Resistant P. Amaranth in KS

- Resistance based on > 20 % survival in each population to field-use rate (32 fl oz/a) of Roundup



Multiple Resistant Palmer amaranth in KS

A single Palmer amaranth population from central Kansas recently confirmed with multiple resistance to five herbicide site(s) of action:

- ✓ 2,4-D (3.2-fold)
- ✓ Roundup (12-fold)
- ✓ Glean (5-fold)
- ✓ AAtrex (14-fold)
- ✓ Callisto (13-fold)

Reduced sensitivity to PPO inhibitors

2,4-D survived Palmer amaranth plant producing seeds in greenhouse

Kumar et al. 2019; 2020

Glyphosate-Resistant Kochia in U.S. Great Plains

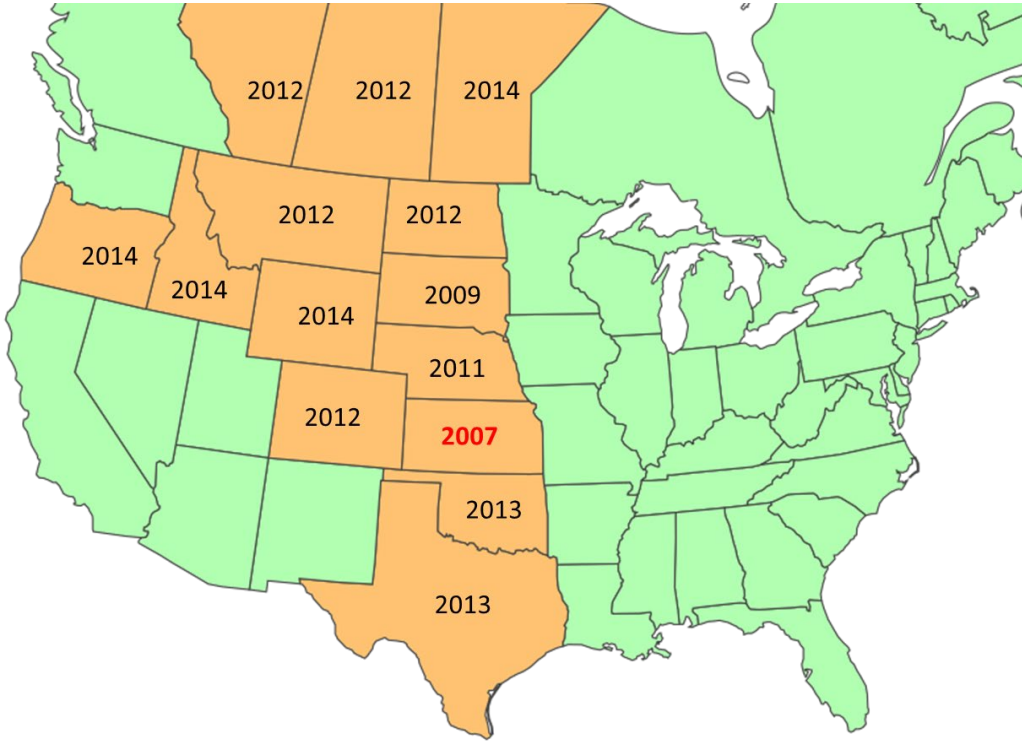


Photo Credit: Dr. Phil Stahlman

Godar and Stahlman 2012: Heap 2021; Kumar et al. 2018

Multiple Herbicide-Resistant Kochia in KS

Sick and recovered kochia plants from POST dicamba

Kochia accessions from Garden City with multiple resistance to:

- Glyphosate (3 to 12-fold)
- Dicamba (3 to 9-fold)
- Fluroxypyr (3 to 8-fold)
- Chlorsulfuron (>25-fold)
- Atrazine (23 to 48-fold)
- Metribuzin (13 to 18-fold)

Kumar et al. 2019a; 2019b; 2021

Integrating cover crops for weed suppression in no-till dryland High Plains

- Benefits
  - Weed Suppression
  - Soil Health
- Challenges in High Plains
  - Water Usage
    - Water limiting environment
      - < 20 inches rainfall per year
    - Soil Type
      - Typically lighter soils
      - No-till production

Project Background

- Spring-planted oat/triticale mixture in fallow phase provided >95% weed suppression
- Delaying cover crop termination can provide maximum cover crop biomass and can help in reducing weed densities in subsequent summer crops
- ***Lack of information on interaction between cover crop termination timings and soil residual herbicides for GR kochia and Palmer amaranth suppression in High Plain sunflower production***

Chism 2019; Obour et al. 2019

Objectives

- Determine the interaction of cover crop termination timing (s) with soil-residual herbicides on GR weed suppression in sunflower

- Determine the economic potential of using cover crops for GR weed suppression in sunflower

Materials and Methods

- Locations: Scottsbluff (NE), Akron (CO), Hays (KS), Tribune (KS)
- Cover crop: Winter wheat (60 lb/a)
- Locally-adopted sunflower variety
- Experiments were conducted in split-split plot design with 4 replication (each split-split plot of 10 by 30 ft)

Factor 1	Factor 2	Factor 3
Cover crop	Early termination (mid-May)	Roundup at 32 fl oz/a
No Cover crop	Late termination (end-May)	Roundup + Authority Supreme at 12 oz/a
		Roundup + Broadaxe at 25 oz/a

Data Collection and Analyses

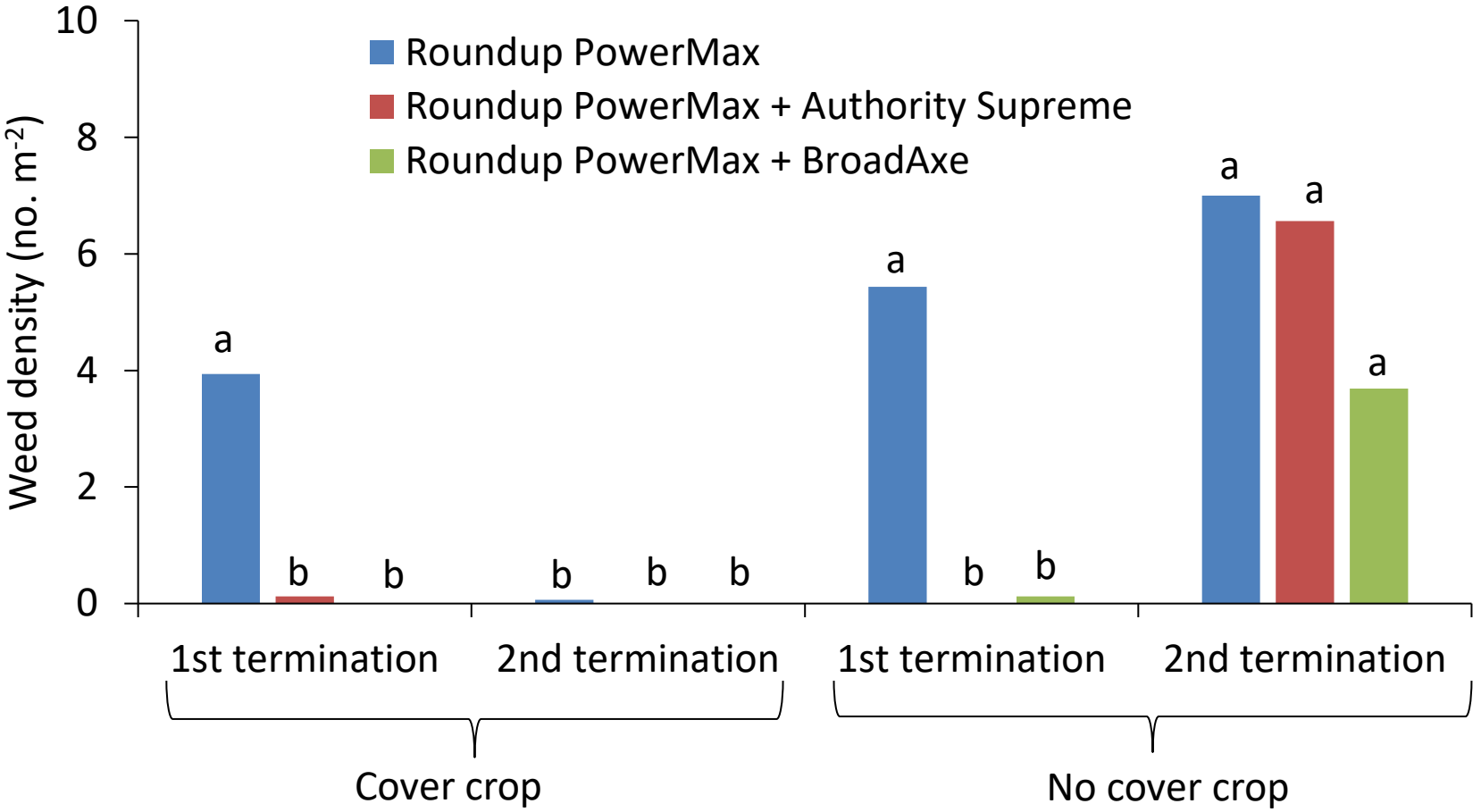
- **Cover Crop:** height, growth stage and biomass at each termination using two 0.5 m^2 quadrats per plot
- **Weeds:** density and visual control at biweekly interval
  - Biomass at maturity using two 0.5 m^2 quadrats per plot
- All data subjected to analysis of variance (ANOVA) using PROC MIXED in SAS
- Means were separated using Fisher's protected LSD test ($\alpha = 0.05$)

Results and Discussion: Akron site

Cover Crop Biomass

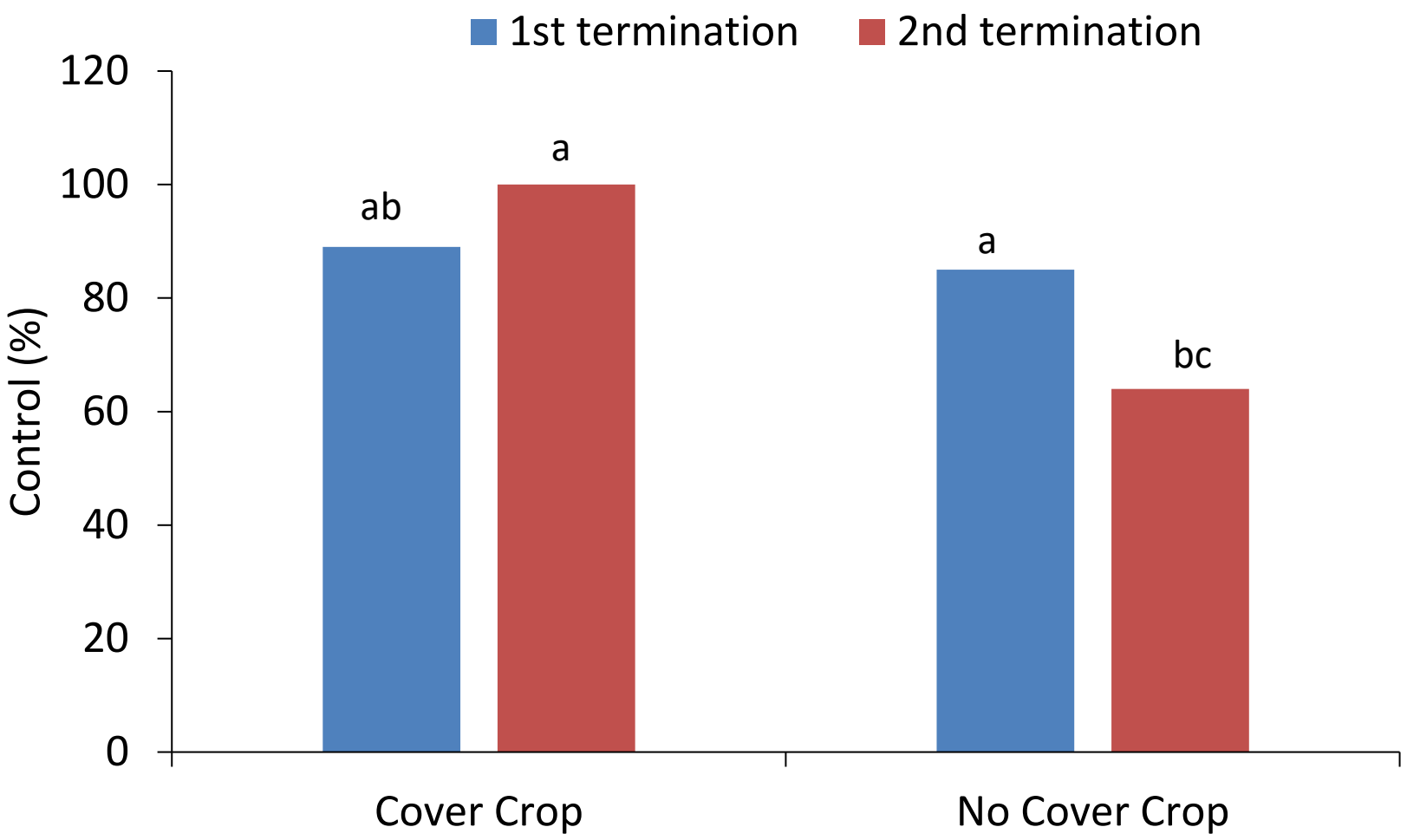
CC termination	CC Biomass	
	g/m2	kg/ha
Mid-May	120	2391
End-May	279	5570

Total Weed Density



CC*herb*term interaction was significant (P < 0.001)

Weed Control at Akron



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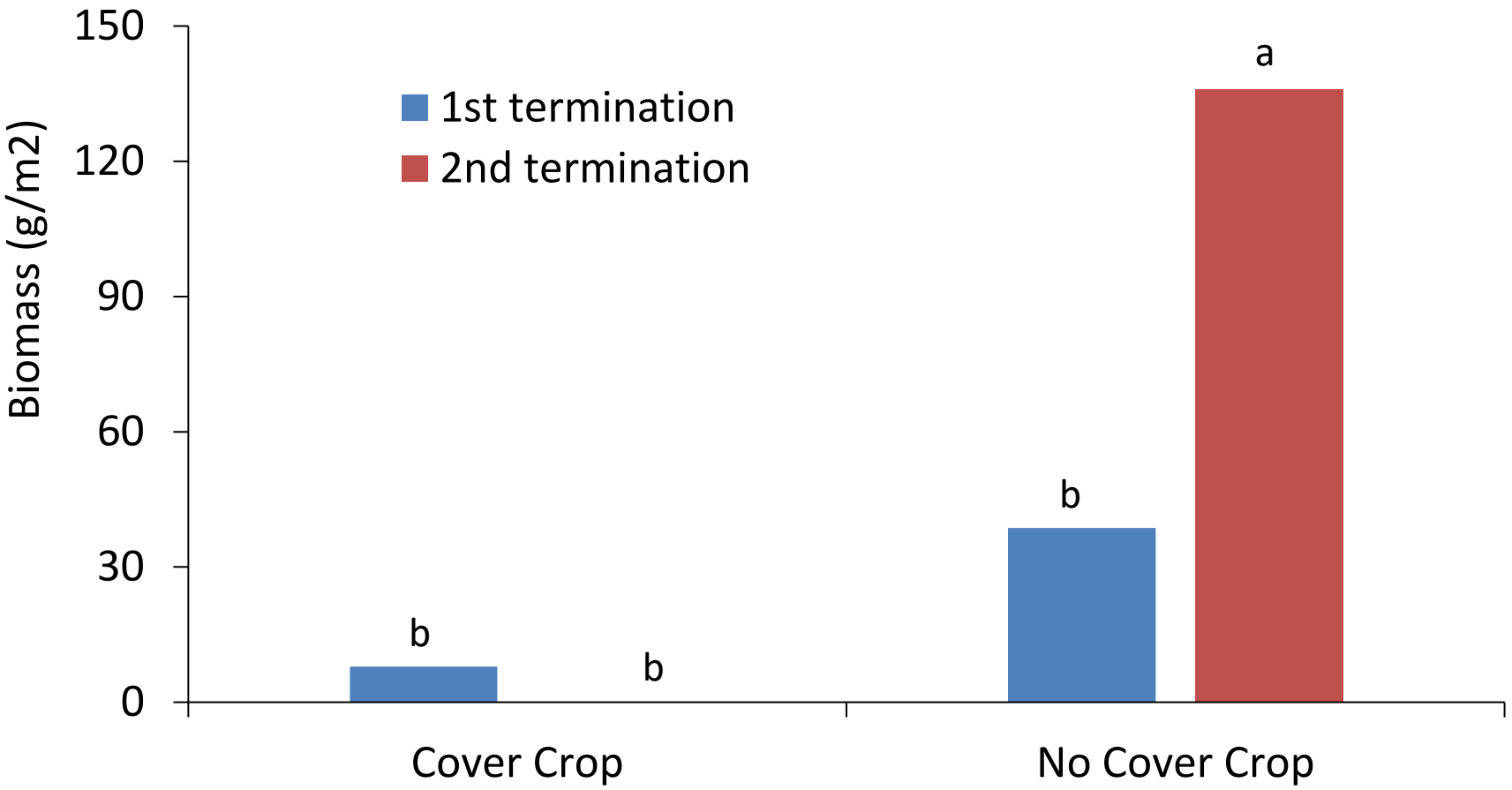
Weed Biomass at Akron



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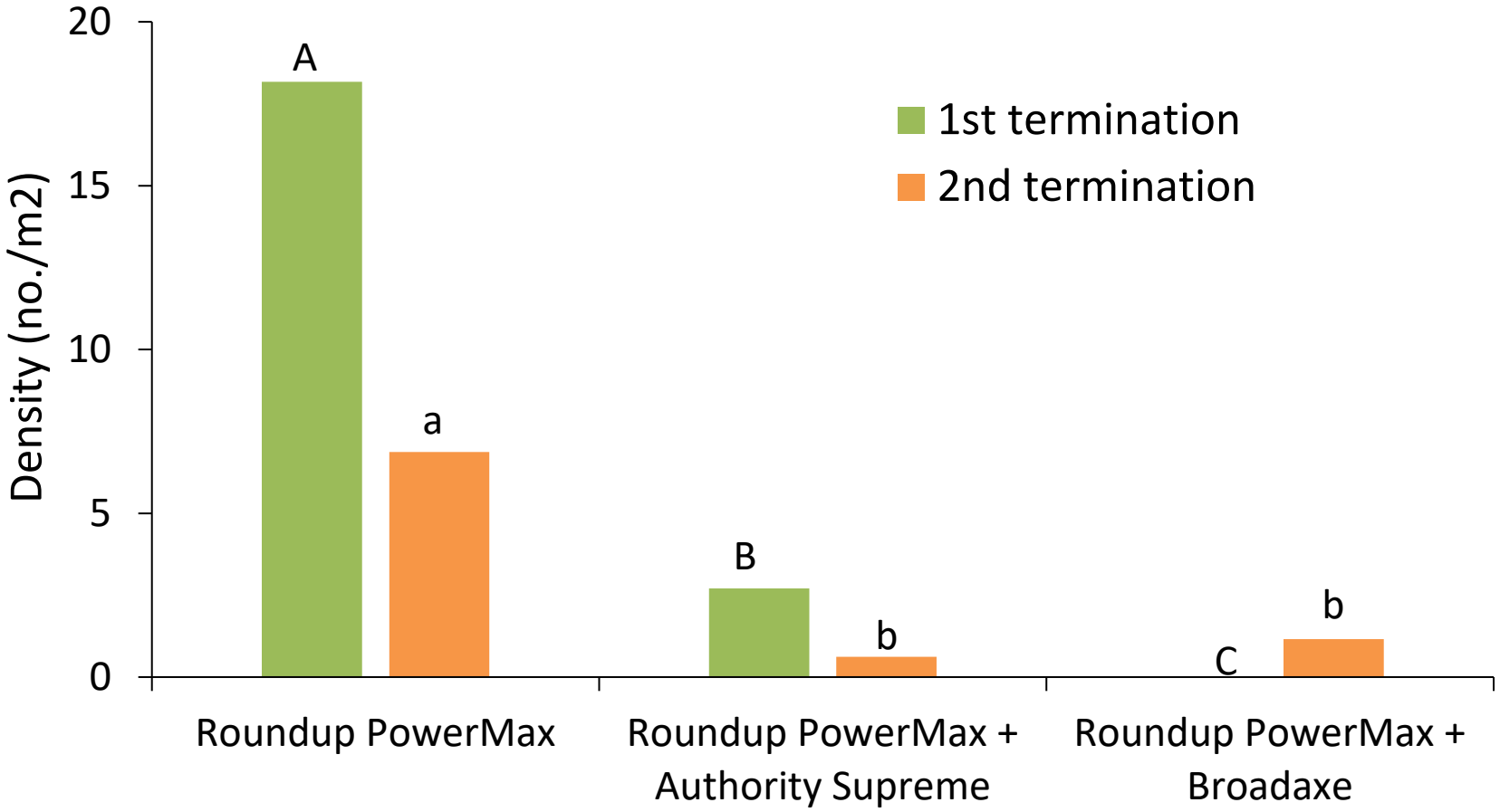
Results and Discussion: Scottsbluff Site

Common Lambsquarters Density



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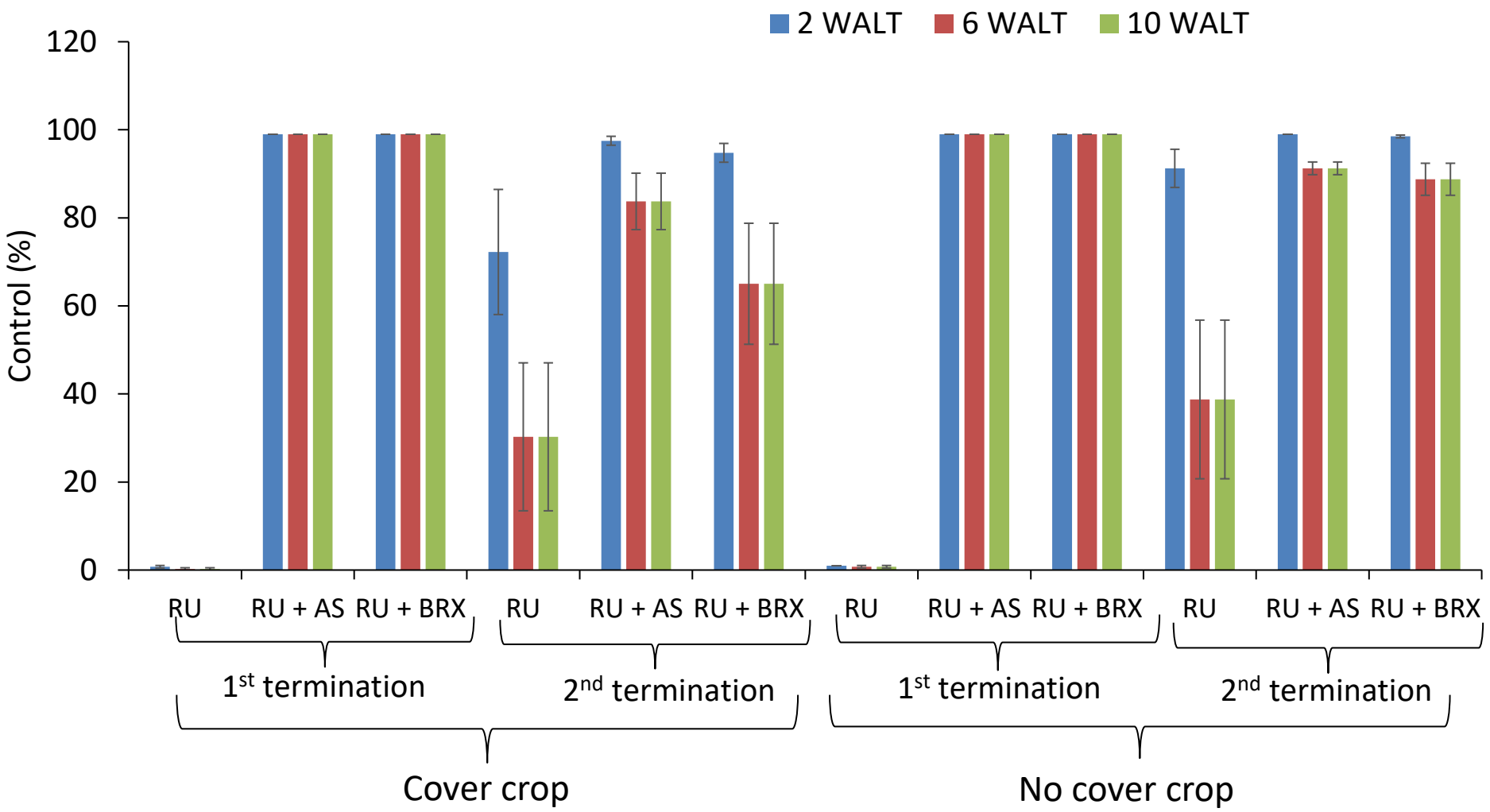
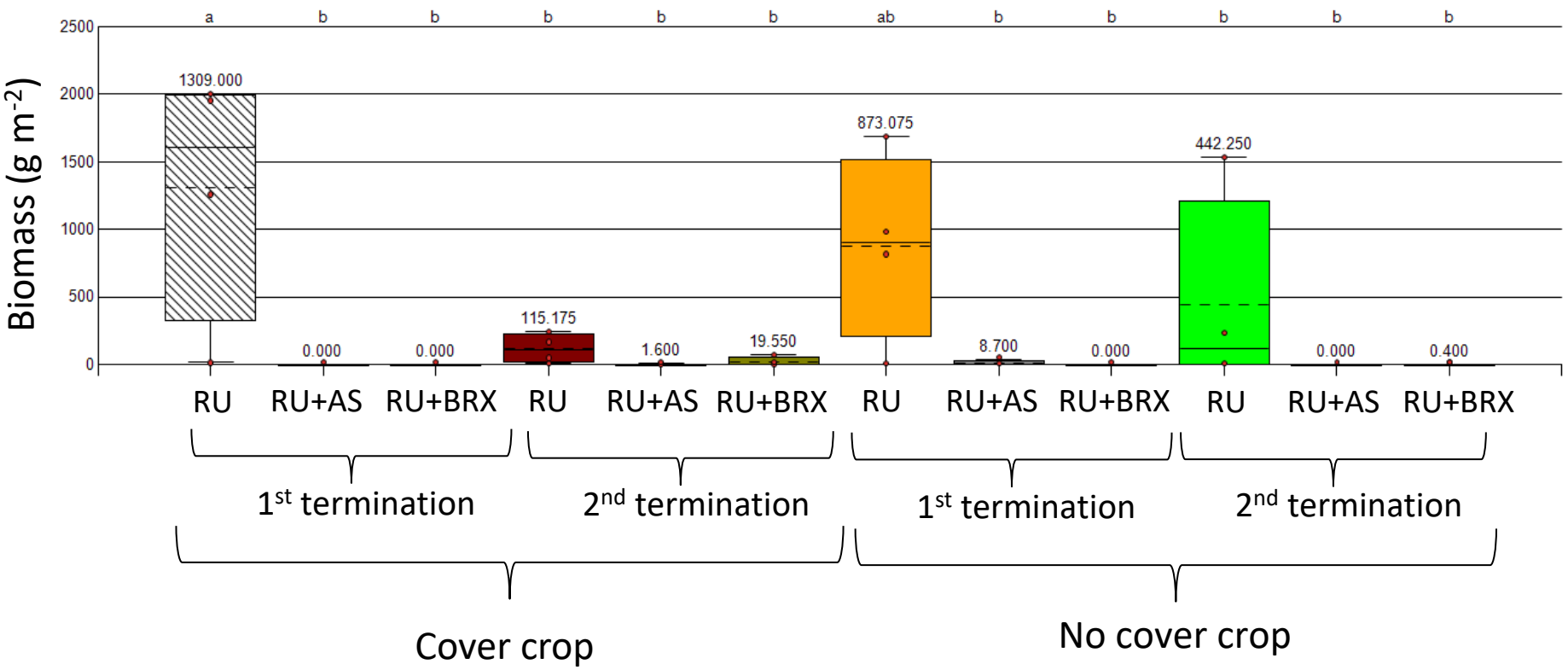
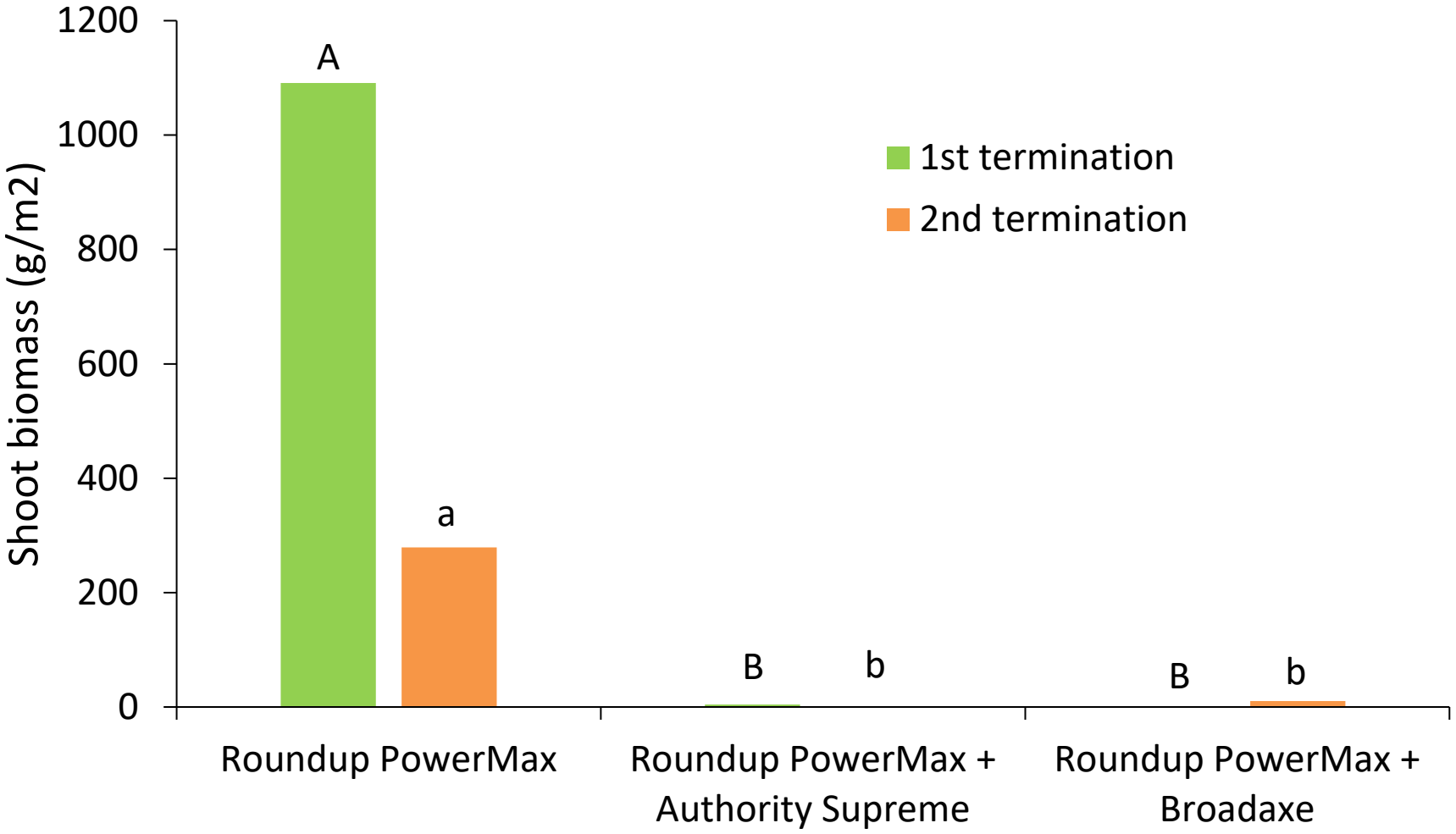
Common Lambsquarters Control



Common Lambsquarters Biomass

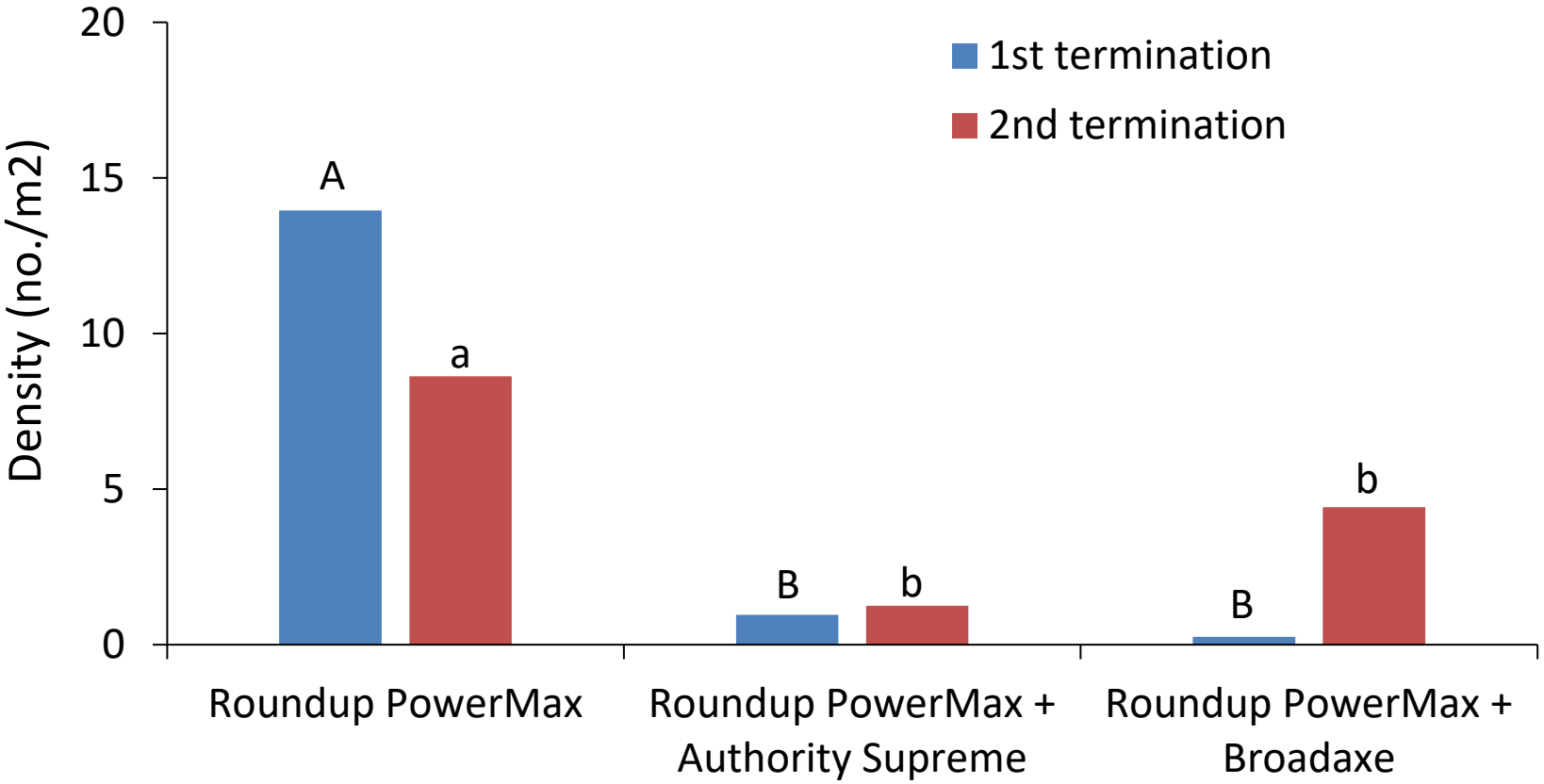


Common Lambsquarters biomass



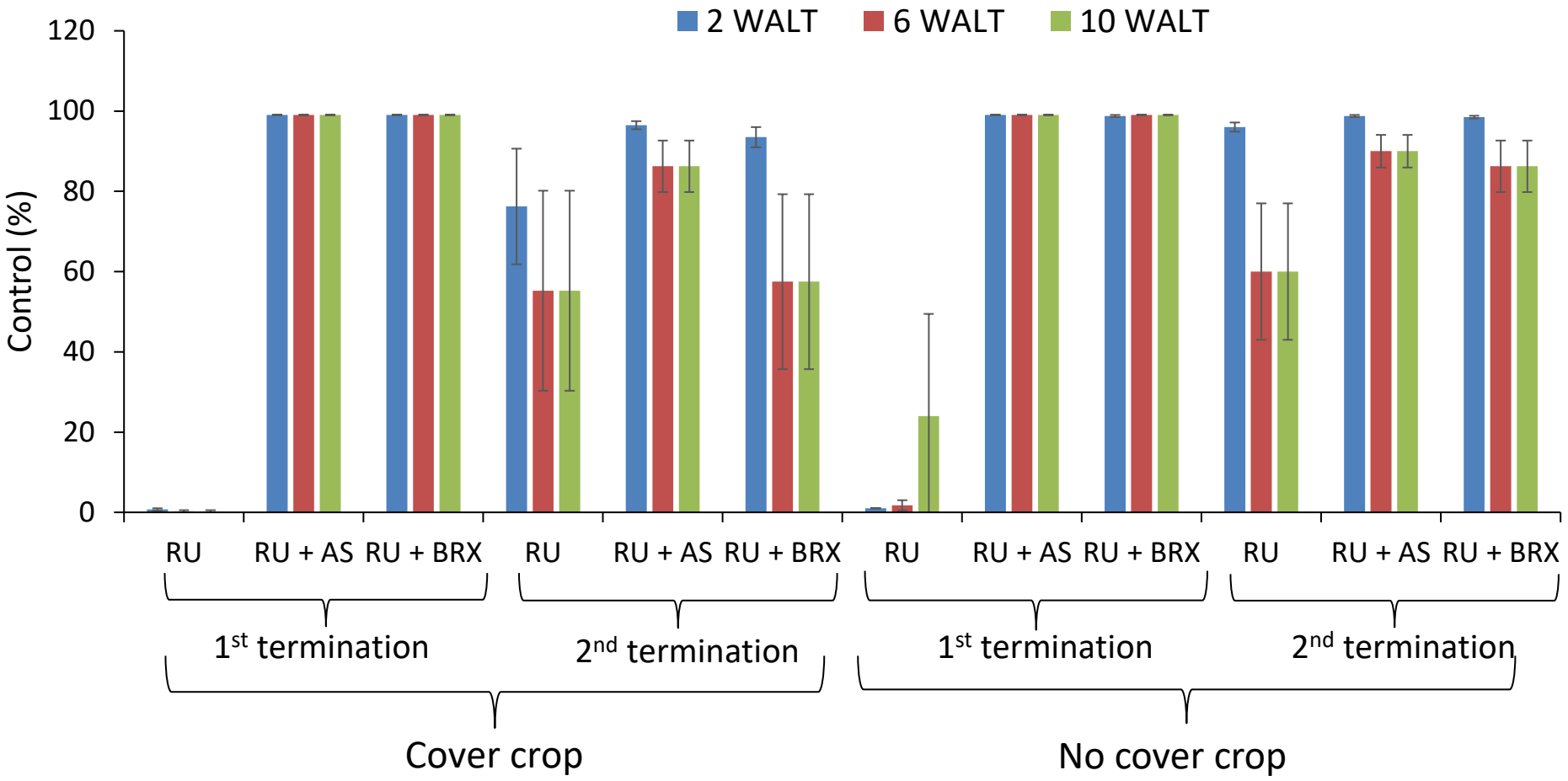
Herb*term interaction was significant (P<0.001)

Palmer amaranth Density

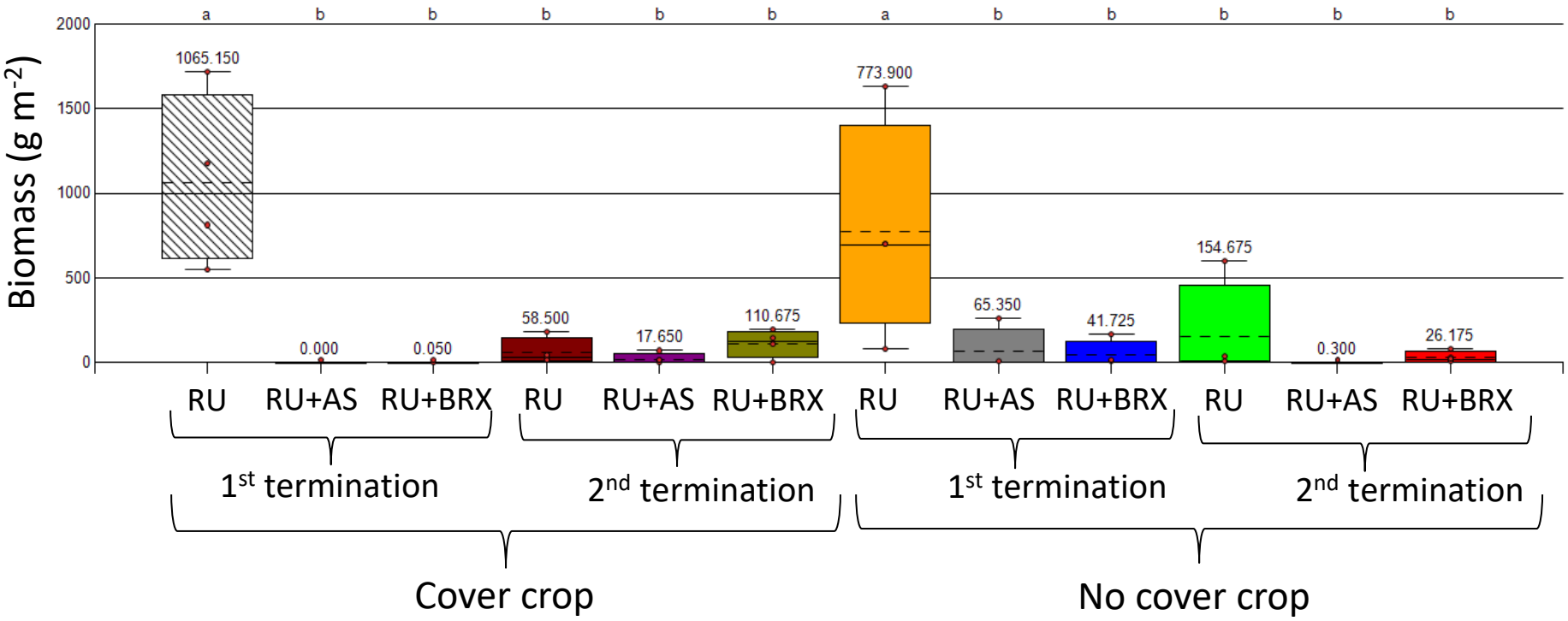


Herb*term interaction was significant (P < 0.001)

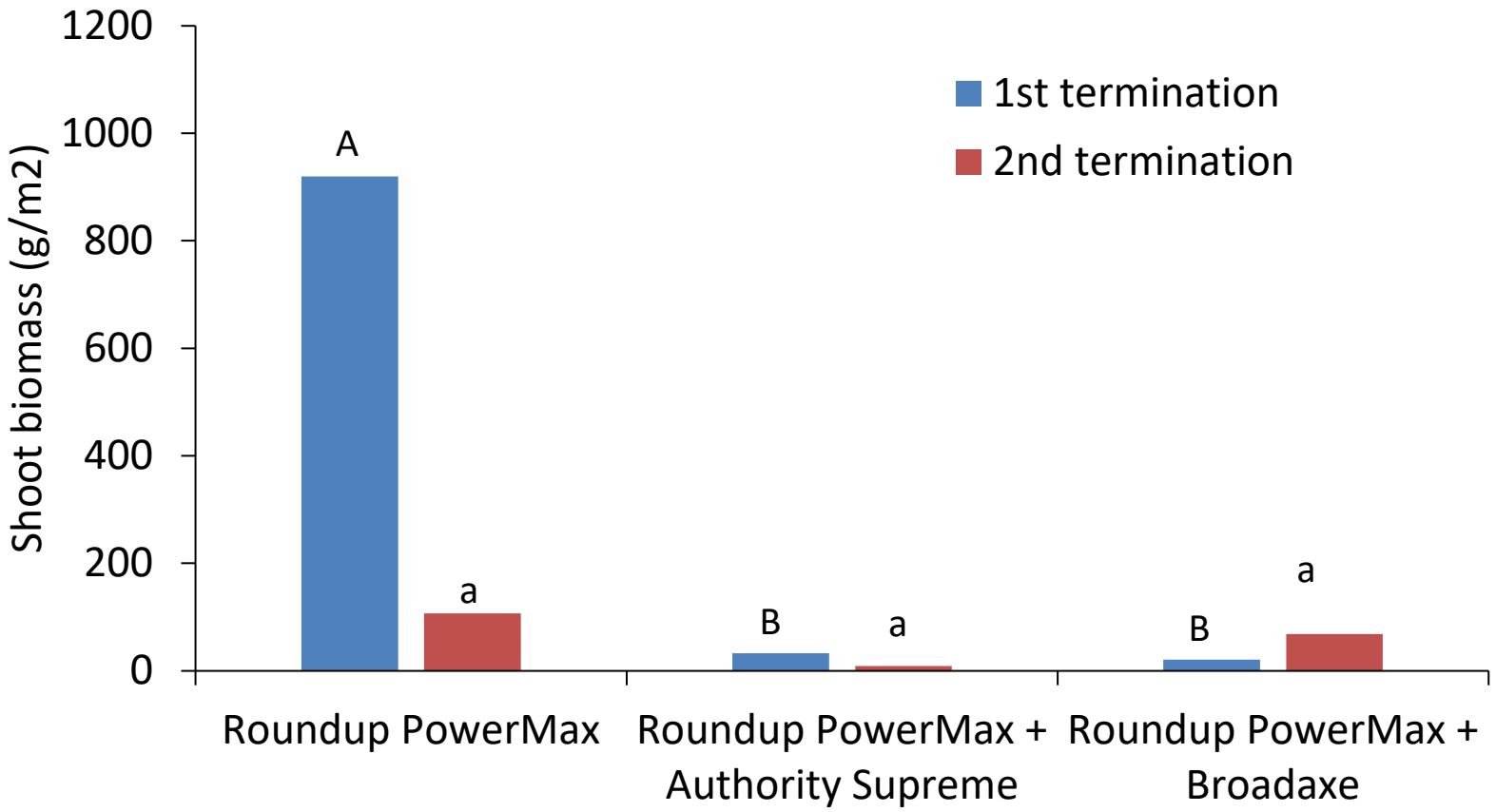
Palmer amaranth Control



Palmer amaranth biomass



Palmer amaranth biomass



Herb*term interaction was significant ($P < 0.001$)

No Cover Crop—Roundup PowerMax at 32 fl oz/a


July 1, 2021
Mid-May Terminated Cover Crop with Roundup + Broadaxe

End-May Terminated Cover Crop with Roundup + Authority Supreme

Summary

- Akron site
  - ✓ Delay in cover crop (CC) termination had 2.3-times higher CC biomass
  - ✓ Applying residual herbicides at CC termination resulted in significant reduction in total weed density and biomass
  - ✓ Late CC termination provided higher weed control compared to no CC

- Scottsbluff site
  - ✓ Combination of residual herbicides with both CC termination resulted in significant reduction in density and biomass of Palmer amaranth and common labsquarters
  - ✓ Late terminated CC with residual herbicides had comparatively lower end-season weed control

Acknowledgments

We greatly appreciate the financial support of following sponsors to conduct this research.

National Sunflower Association

Harvest Weed Seed Control

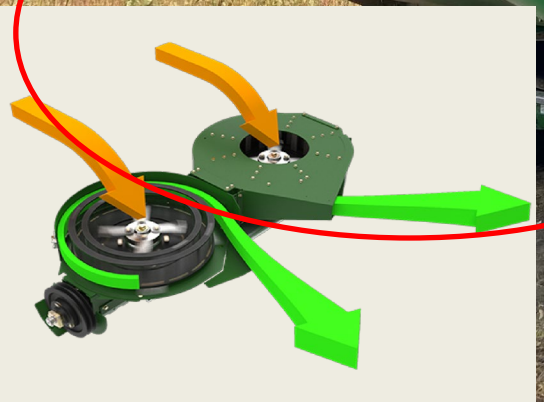
- Harvest weed seed destructor (HWSD) is a novel IWM concept in the U.S. that involves collection and/or destruction of weed seeds during crop harvest
- Success of HWSD relies on the propensity of annual weed species to retain seeds
- Previous studies reported > 90% seed retention for Palmer amaranth and waterhemp at soybean maturity in Arkansas, Tennessee, Illinois, Missouri, Nebraska, and Wisconsin

there is a near lack of research from the Midwestern U.S. on: 1) the efficacy of HWSD method to manage MHR weed seedbanks, and more importantly, 2) how to best integrate this novel approach of HWSD (end-season ecological tactic) into current herbicide-based weed resistance management programs at a system level

Walsh et al. 2013; 2017; 2018; Schwartz et al. 2017

2014 JOHN DEERE S670 STS

Redekop weed seed destructor




JOHN DEERE
S670
635D

Questions?