K-STATE
Research and Extension

Cover Crops as part of Integrated Weed Management

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Soil Health U, Salina

Wed, January 23, 2019

Knowledge for Life

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Best Management Practices for Herbicide Resistance

WSSA
WEED SCIENCE SOCIETY OF AMERICA

TakeACTION
HERBICIDE-RESISTANCE MANAGEMENT

http://takeactiononweeds.com/wp-content/uploads/HR_BMPs.pdf

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Best Management Practices
for Herbicide Resistance

2 Use a diversified approach toward weed management. Focus on preventing weed-seed production and reducing the number of weed seeds in the soil seedbank.

1 Understand the biology of the weeds present.

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3 Plant into weed-free fields and then keep fields as weed-free as possible.

4 Plant weed-free crop seed.

5 Scout fields routinely.

6 Use multiple herbicide modes of action (MOAs) that are effective against the most troublesome weeds or those most prone to herbicide resistance.

7 Apply the labeled herbicide rate at recommended weed sizes.

8 Emphasize cultural practices that suppress weeds by using crop competitiveness, meaning rapid-growing bushy crops do a better job of suppressing weeds than slow-growing upright crops that produce few leaves.

9 Use mechanical and biological management practices where appropriate.

10 Prevent field-to-field and within-field movement of weed seed or vegetative reproductive structures.

11 Manage weed seed at harvest and after harvest to prevent a buildup of the weed seedbank.

12 Prevent an influx of weeds into the field by managing field borders.

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Best Management Practices
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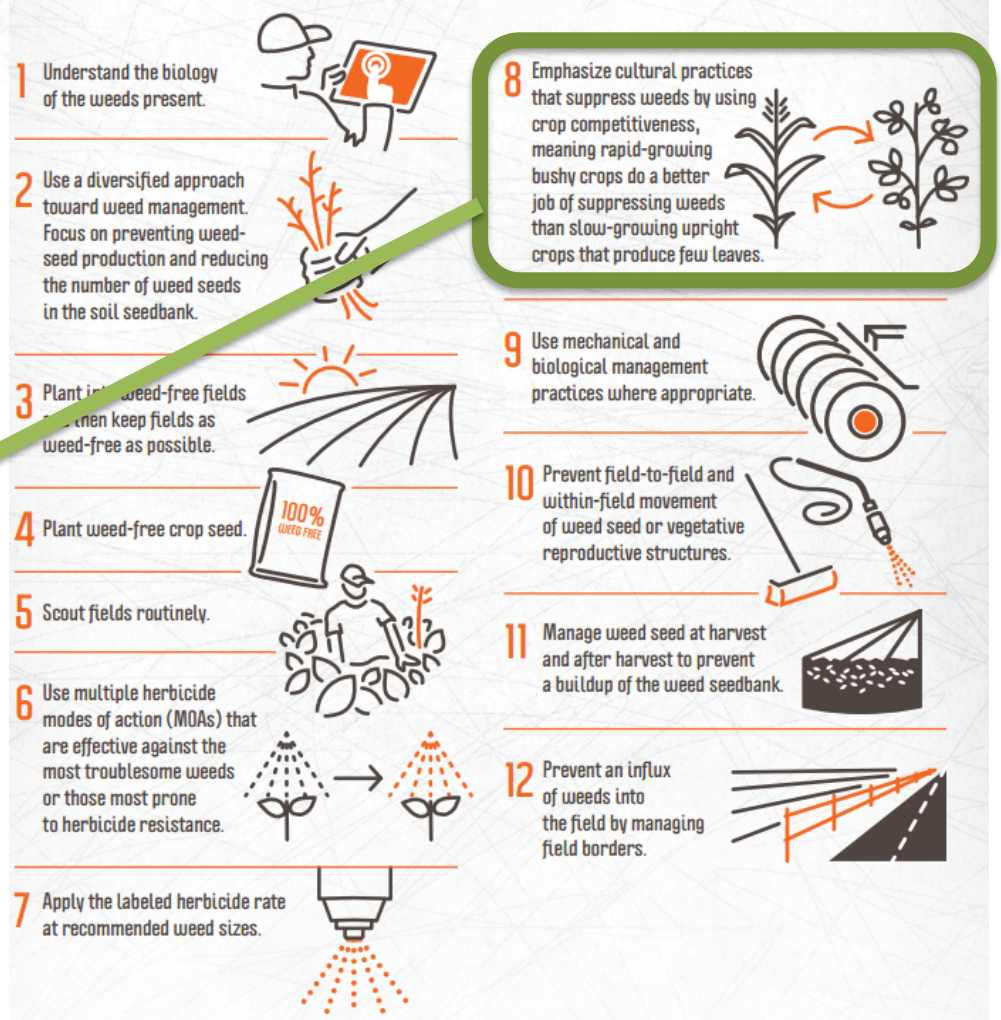

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Introduction

- ✓ Kansas' farmers are demanding information about using cover crops for weed suppression
- ✓ Kansas cropping systems are very diverse from west to east:
  - ✓ Winter wheat-fallow
  - ✓ Winter wheat-grain sorghum-fallow
  - ✓ Grain sorghum or corn-soybean-winter wheat
  - ✓ corn-winter wheat/DC soybean
- ✓ Length of fallow period becomes shorter from west to east

Introduction

- ✓ **Key 'driver' weed species in Kansas, have single or multiple resistance to herbicides:**
  - ✓ **kochia**
  - ✓ **Palmer amaranth**
  - ✓ **waterhemp**
  - ✓ **horseweed (marestail)**

5 Questions

1. What do you want to accomplish with a cover crop?
2. How will you plant it and when?
3. What will precede and what will follow the cover crop in your rotation?
4. Which cover crop will you plant?
5. How will you terminate your cover crop?

Key considerations

1. **What do you want to accomplish with a cover crop?**
   - ✓ **Match choice of a cover crop with your specific goal(s):**
     - ✓ **Provide weed management benefits**
     - ✓ **Reduce or prevent soil erosion, reduce compaction**
     - ✓ **Conserve or use excess soil moisture**
     - ✓ **Protect water quality**
     - ✓ **Provide additional grazing resource**
     - ✓ **Reduce fertilizer inputs (scavenge or fix N)**
     - ✓ **Add organic matter to soil**
     - ✓ **Other …**

K-State HB Ranch,

Hays, KS 2016

Drilled cover crops mid-March

Surveyed June 13 for cover crop biomass and weed biomass and density

Weeds in:
Fallow = 258 weeds/m^2 (95.4 g/m^2)
Spring pea = 68 weeds/m^2 (3.2 g/m^2)
Triticale/oat = 28 weeds/m^2 (0.7 g/m^2)
Spring pea/triticale/oat mix
= 6 weeds/m^2 (0.2 g/m^2)

K-State Northwest Research Center, Colby, KS 2016

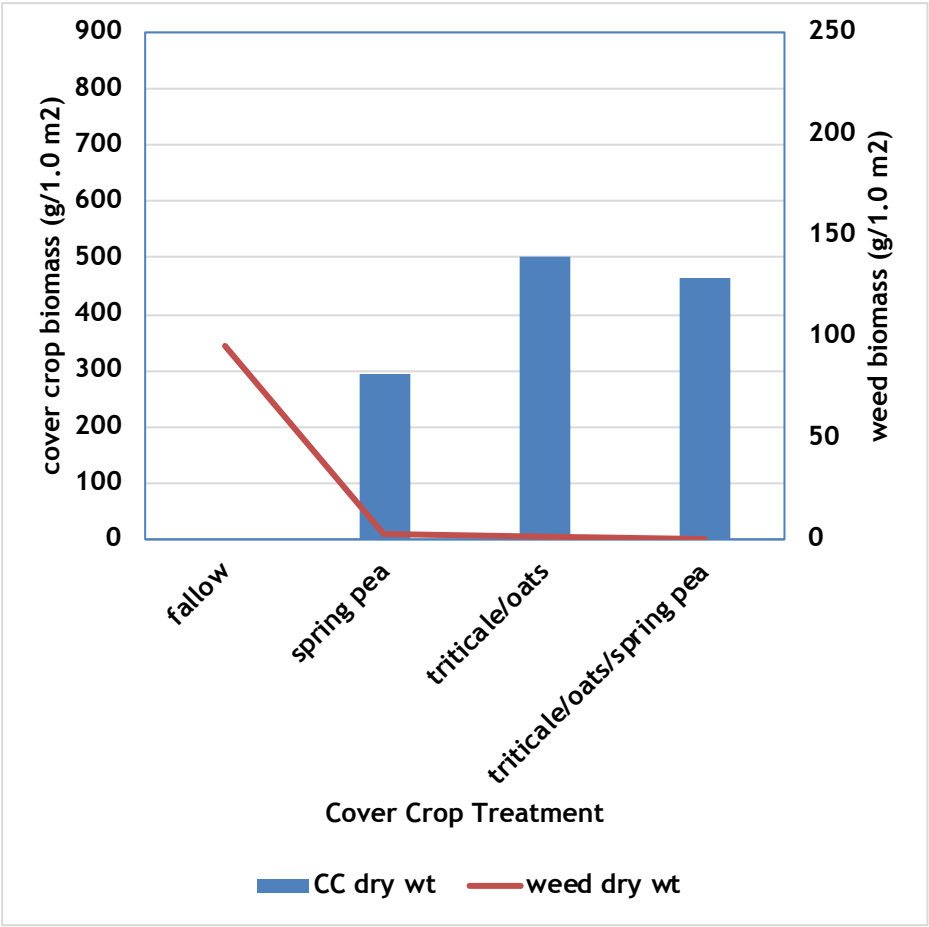
Drilled cover crops mid-March

Surveyed June 13 for cover crop biomass and weed biomass and density

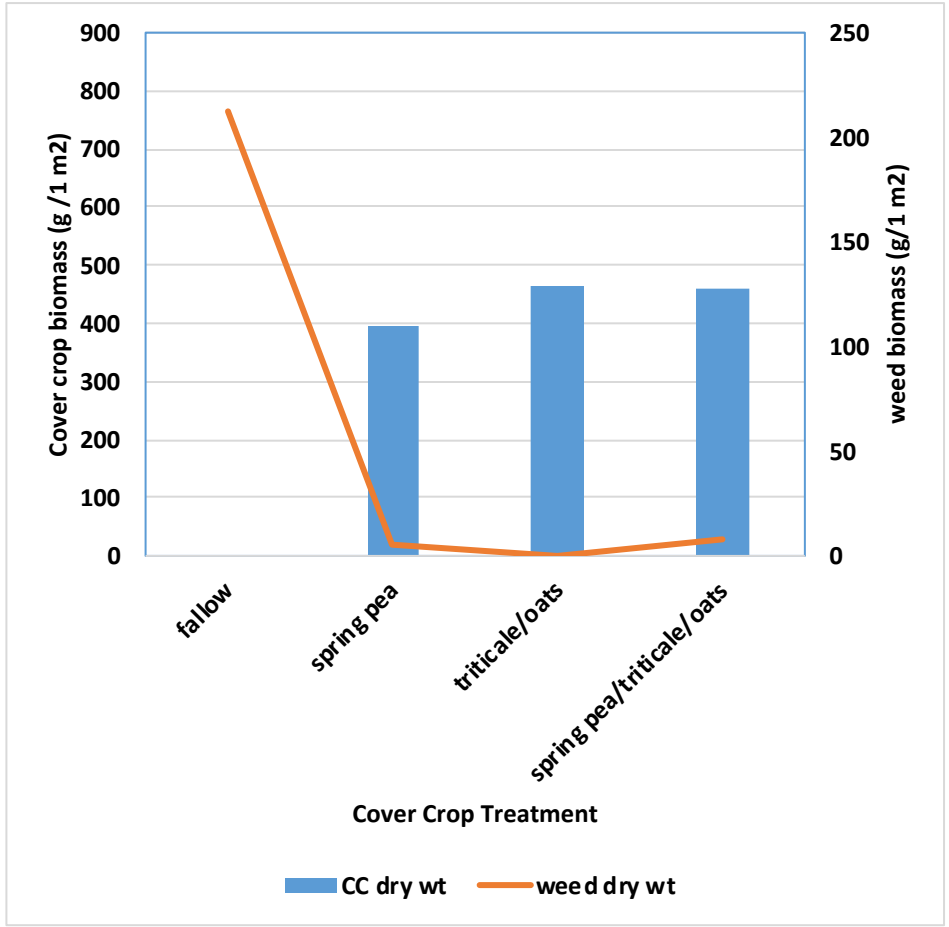
Weeds in:
Fallow = 153 weeds/m^2 (212 g/m^2)
Spring pea = 76 weeds/m^2 (5.8 g/m^2)
Triticale/oat = 0 weeds
Spring pea/triticale/oat mixed
= 32 weeds/m^2 (7.4 g/m^2)

June 13, 2016

HB Ranch, Hays, KS

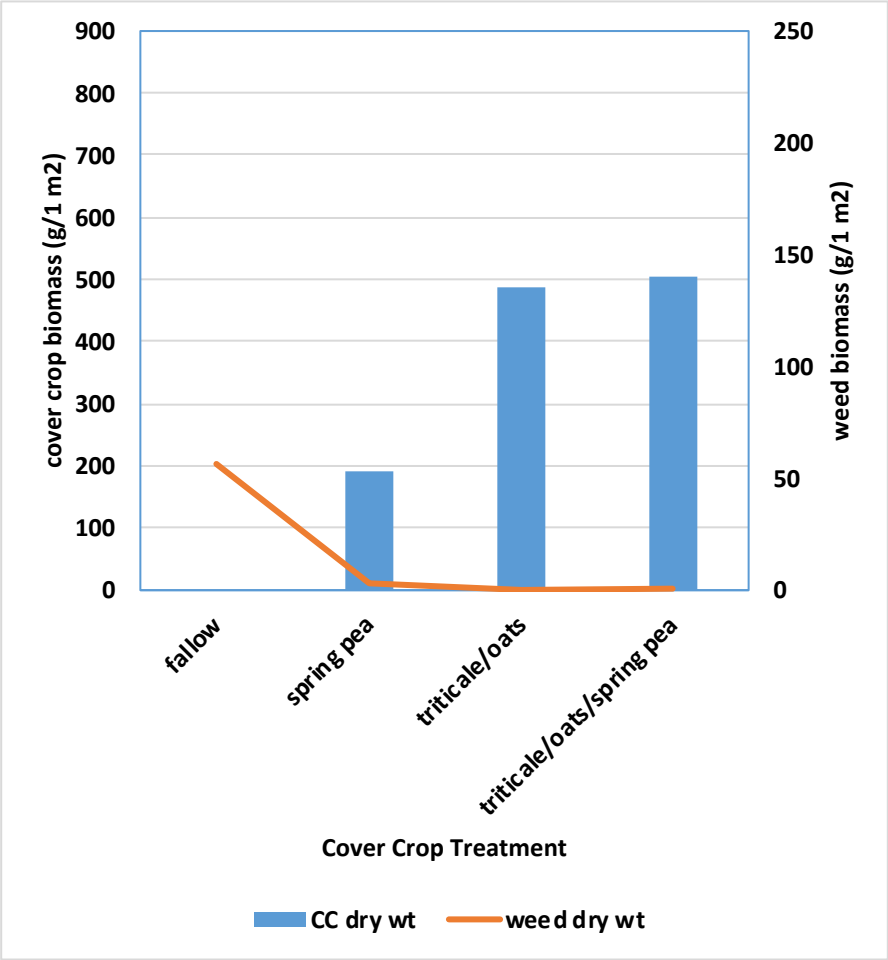


NW Research Ctr, Colby, KS

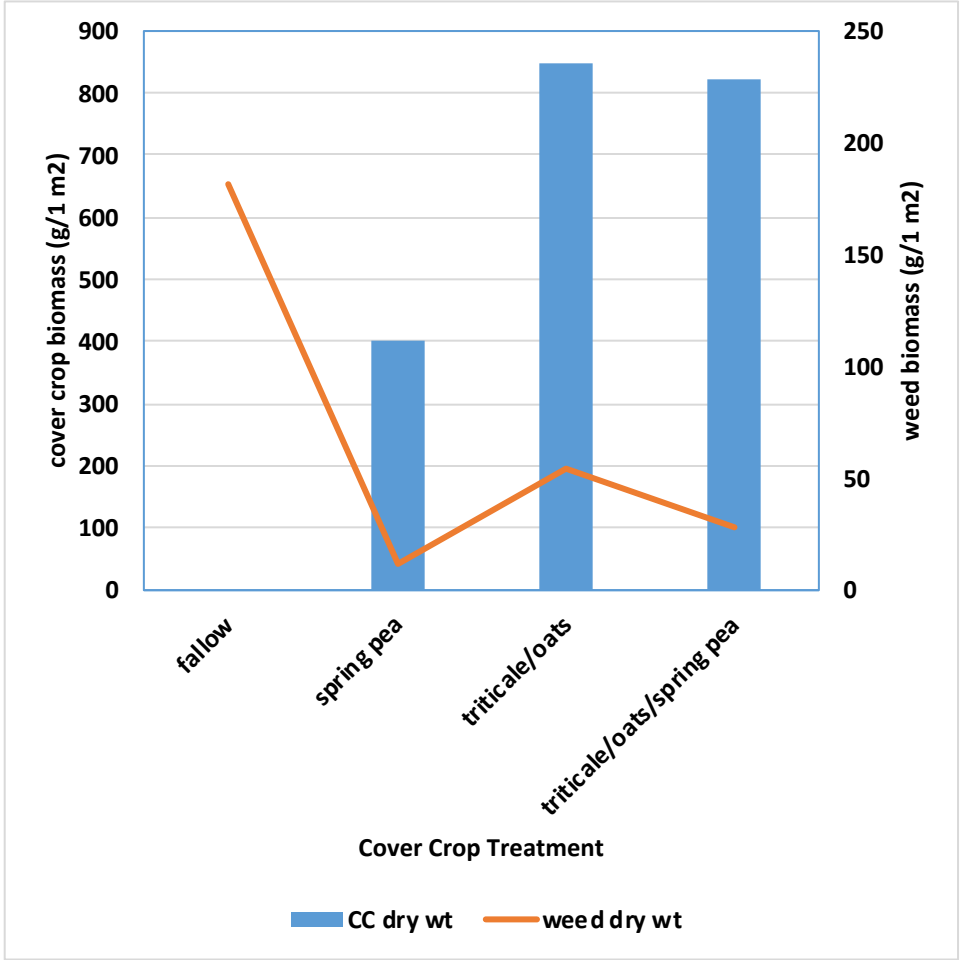


June 6 & 7, 2017

HB Ranch, Hays, KS



NW Research Ctr, Colby, KS



Suppression at on-station fields

- ✓ **Spring-sown cover crops (dominated by cereals) provided:**
  - ✓ **50% or more reduction in individual weed plants**
  - ✓ **95% or more reduction in weed biomass**

Key considerations

1. **What do you want to accomplish with a cover crop?**
   - ✓ **Be aware of costs associated with cover crops:**
     - ✓ **Cost of seed**
     - ✓ **Availability of equipment to plant cover crop**
     - ✓ **One or more additional passes through the field for planting, terminating**
     - ✓ **Use of soil moisture**
     - ✓ **Becomes a volunteer weed, volunteer wheat, or other pest problems**
     - ✓ **Timing and ability to terminate (mowing, tilling, rolling, spraying, etc).**

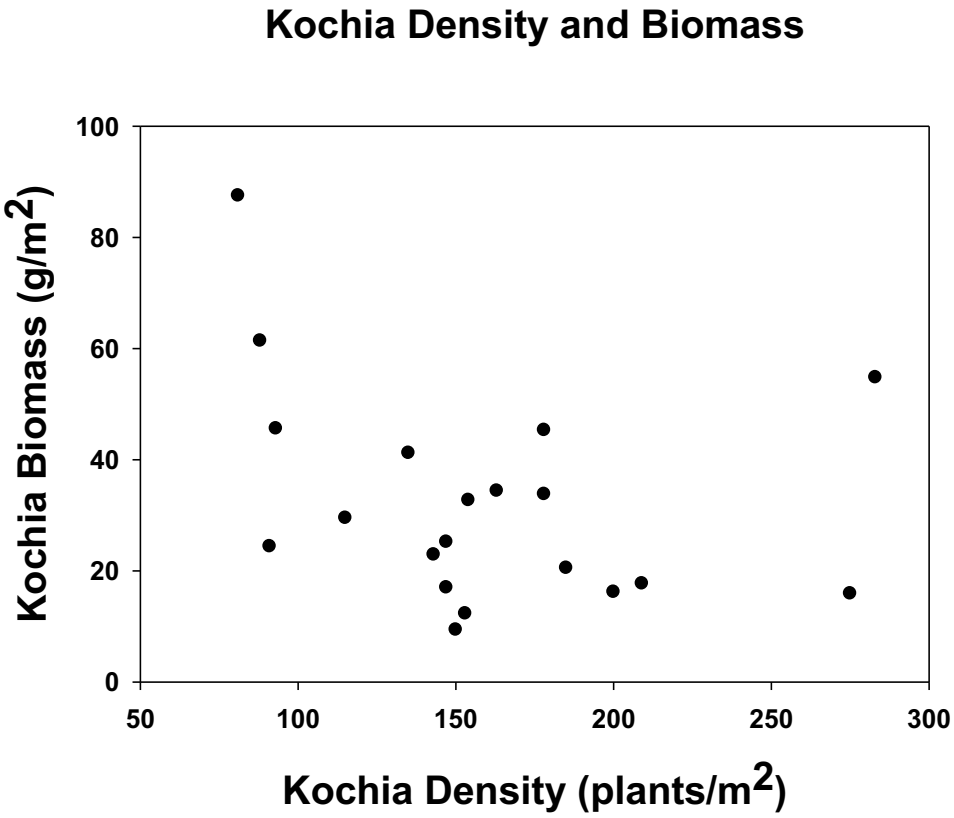
Key considerations

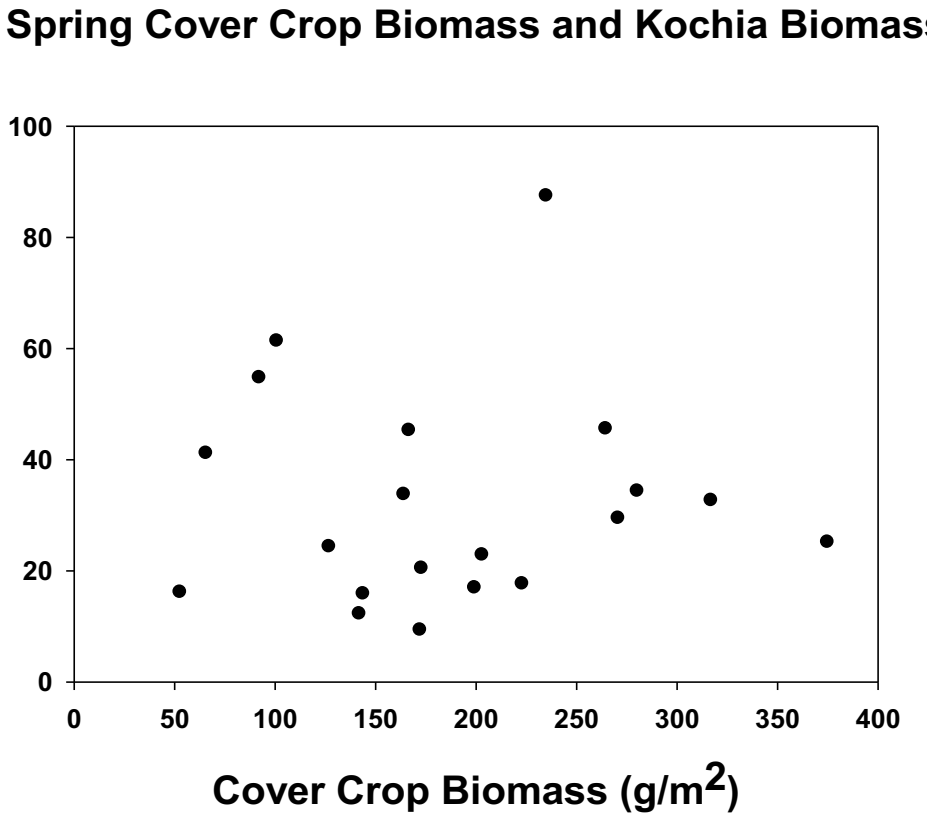
2. How will you plant it, and when?

- ✓ Consider your crop rotation sequence and where a cover crop can fit
  - ✓ Change the crop rotation
  - ✓ Change time of crop planting

- ✓ Know when your key weed species germinates and emerges in the field

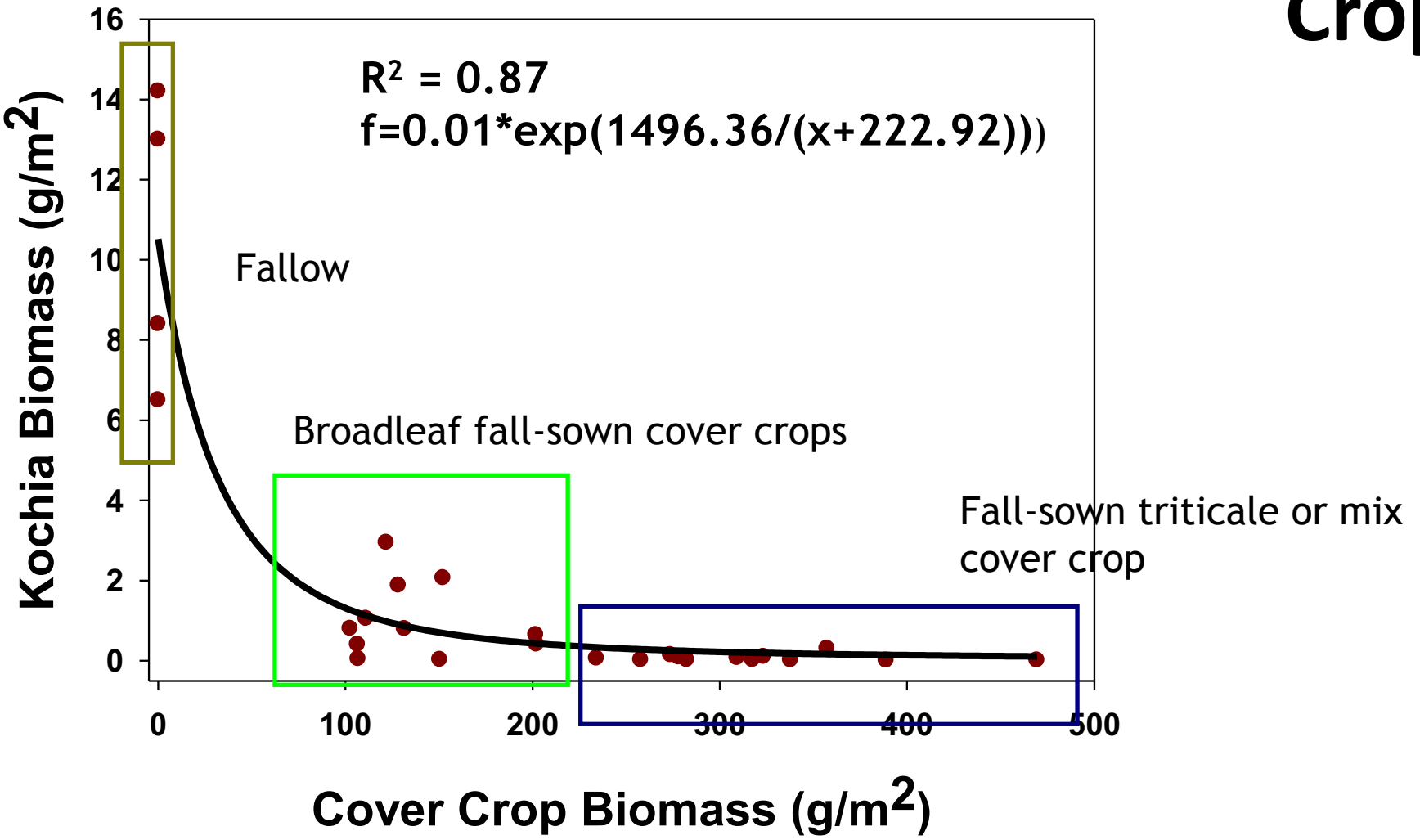
Kochia response to Spring Cover Crops





Petrosino et al. 2015, Crop, Forage & Turfgrass Mgmt 1

Kochia Response to Fall Cover Crops



Petrosino et al. 2015, Crop, Forage & Turfgrass Mgmt 1

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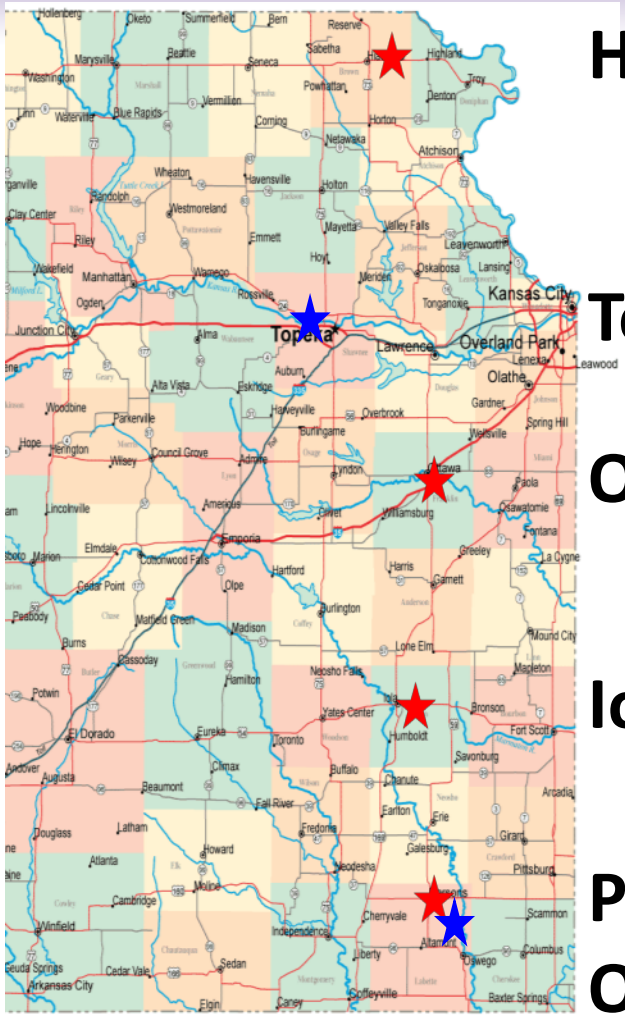
Locations

Chelsea McCall, 2018
MS Research Project



Highland

Topeka

Ottawa

Iola

Parsons

Oswego

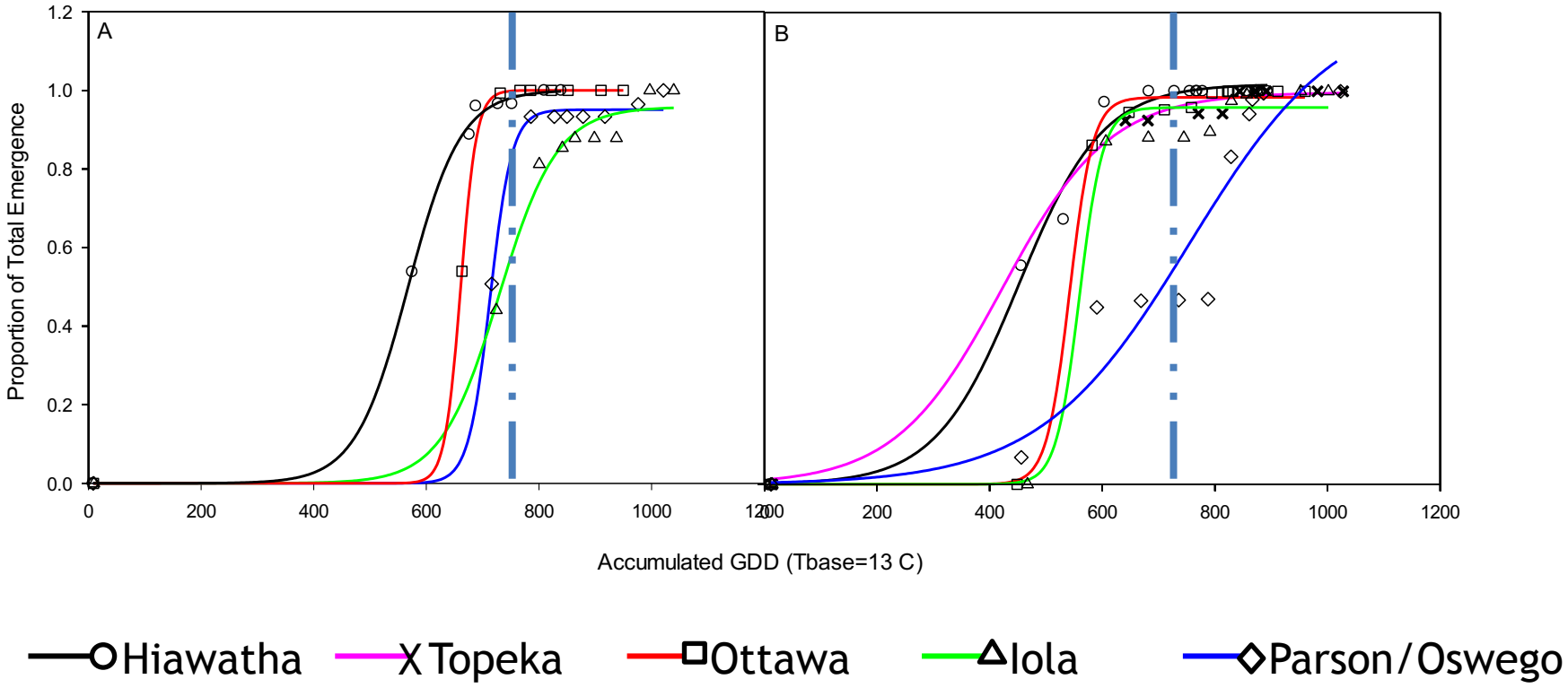
★ 2014-2015-2016

★ 2015-2016

Knowledge for Life

Horseweed emergence patterns

Cumulative proportion of total horseweed emergence in the absence of competition in (A) 2014-2015 and (B) 2015-2016



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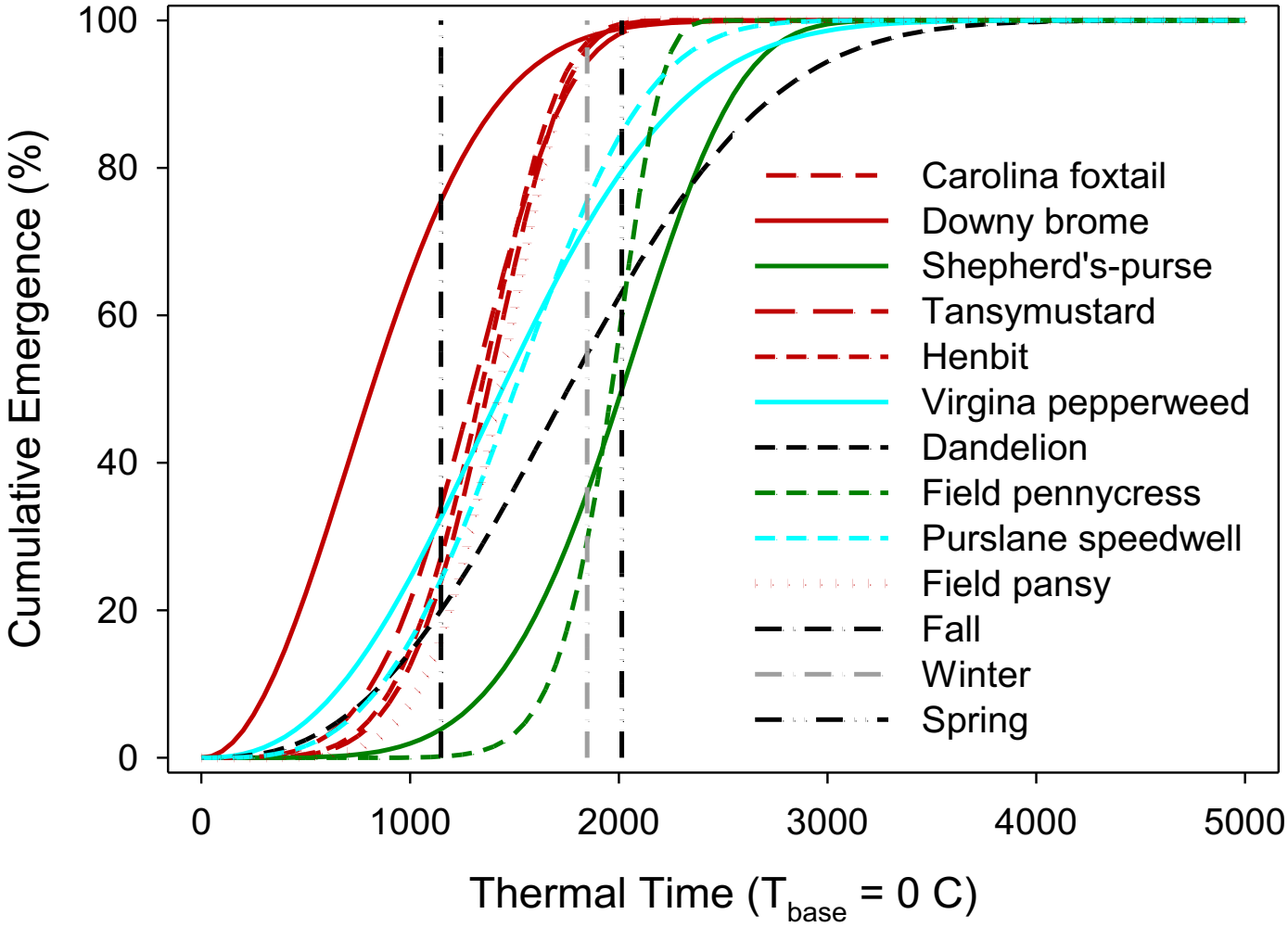
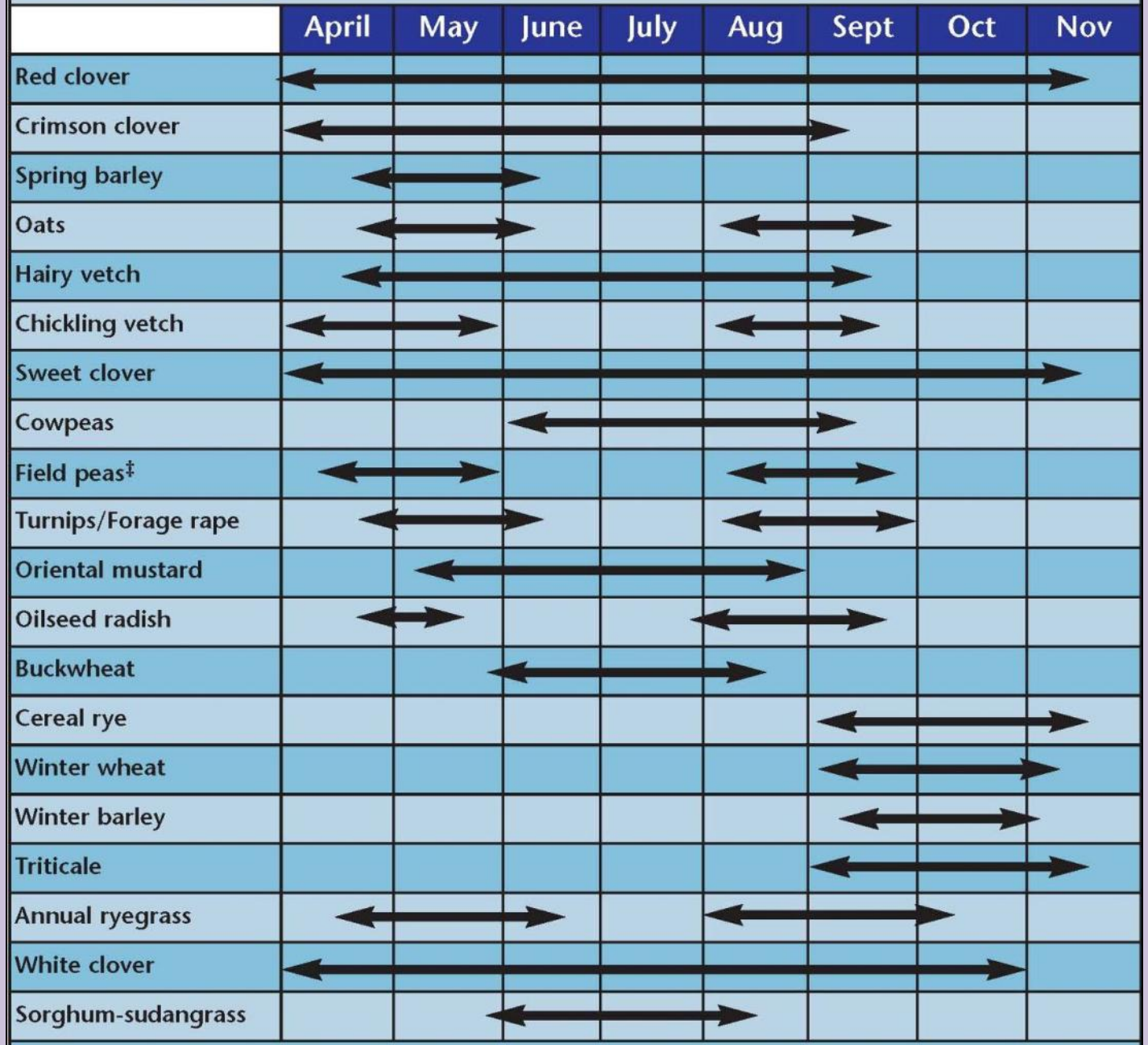
Observations of winter annual weed emergence in Nebraska, 2010 and 2011



Werle et al. 2014
Weed Sci. 62:83-96.

Table 2. Seeding timing of various cover crops.



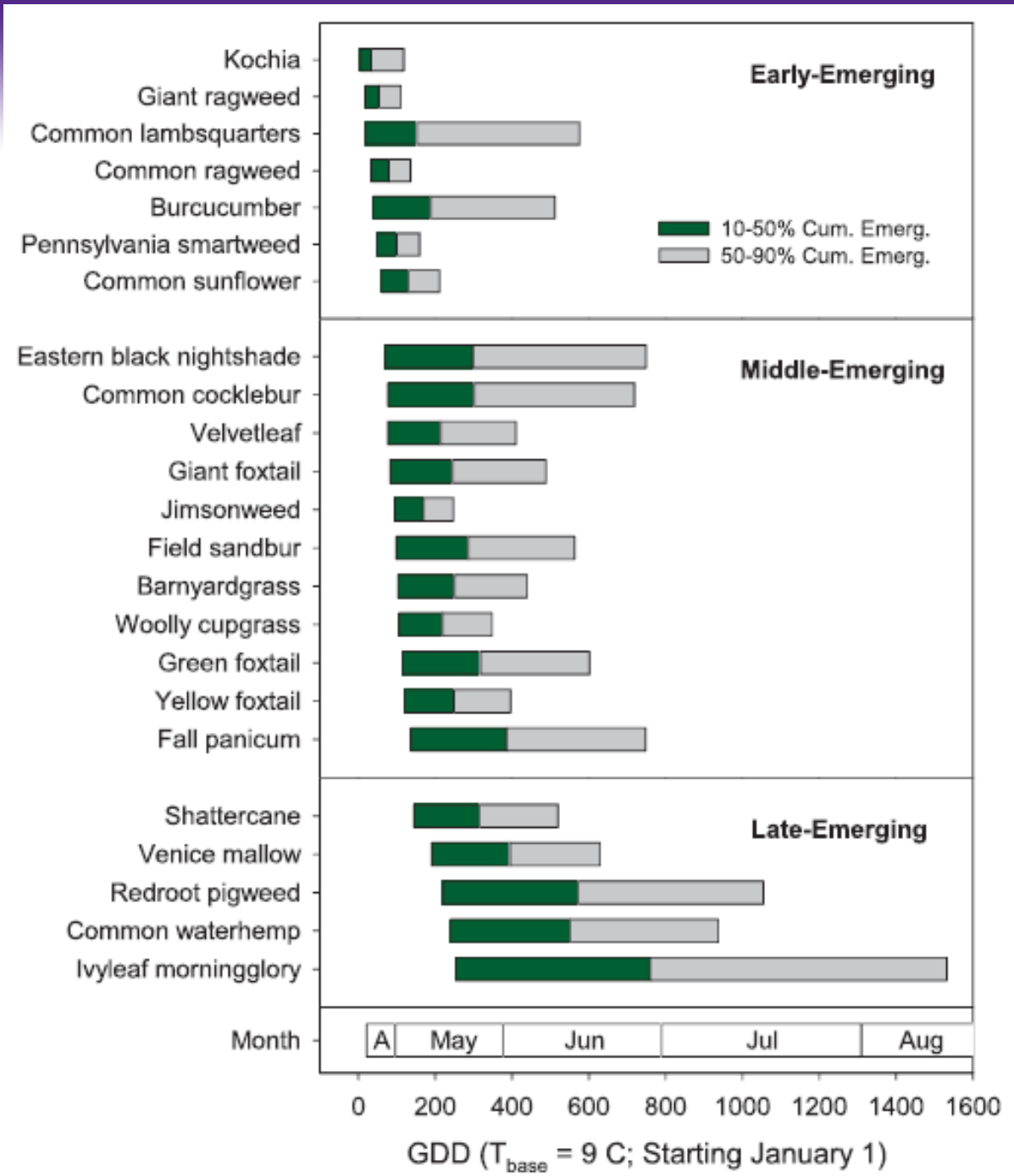
‡Also known as Austrian winter peas (black peas), Canadian field peas (spring peas).

Treatment	Horseweed Suppression 2013	2014
	%	
Untreated Control	0 d	0 d
Annual ryegrass	21 cd	59 c
Winter wheat	20 cd	93 ab
Winter barley	35 c	90 ab
Winter rye	94 ab	96 a
Spring oats	14 cd	-
Spring rye	-	89 ab
Winter rye/spring no residual	100 a	100 a
Fall residual	100 a	99 a
Fall no residual	94 ab	75 bc
Spring residual	98 a	85 ab
Spring no residual	97 ab	100 a

Andi Marie Christenson. 2015. Cover crops for horseweed [*Conyza canadensis* (L.)] control before and during a soybean crop. MS Thesis. Kansas State University.

Werle et al., 2014. Weed Science 62(2):267-279.

Figure 3. Emergence sequence and duration (10 to 90% of total emergence) of 23 summer annual weeds in Iowa.



Cover crop impacts on Palmer amaranth

May 13, 2015

July 13, 2015

No cover

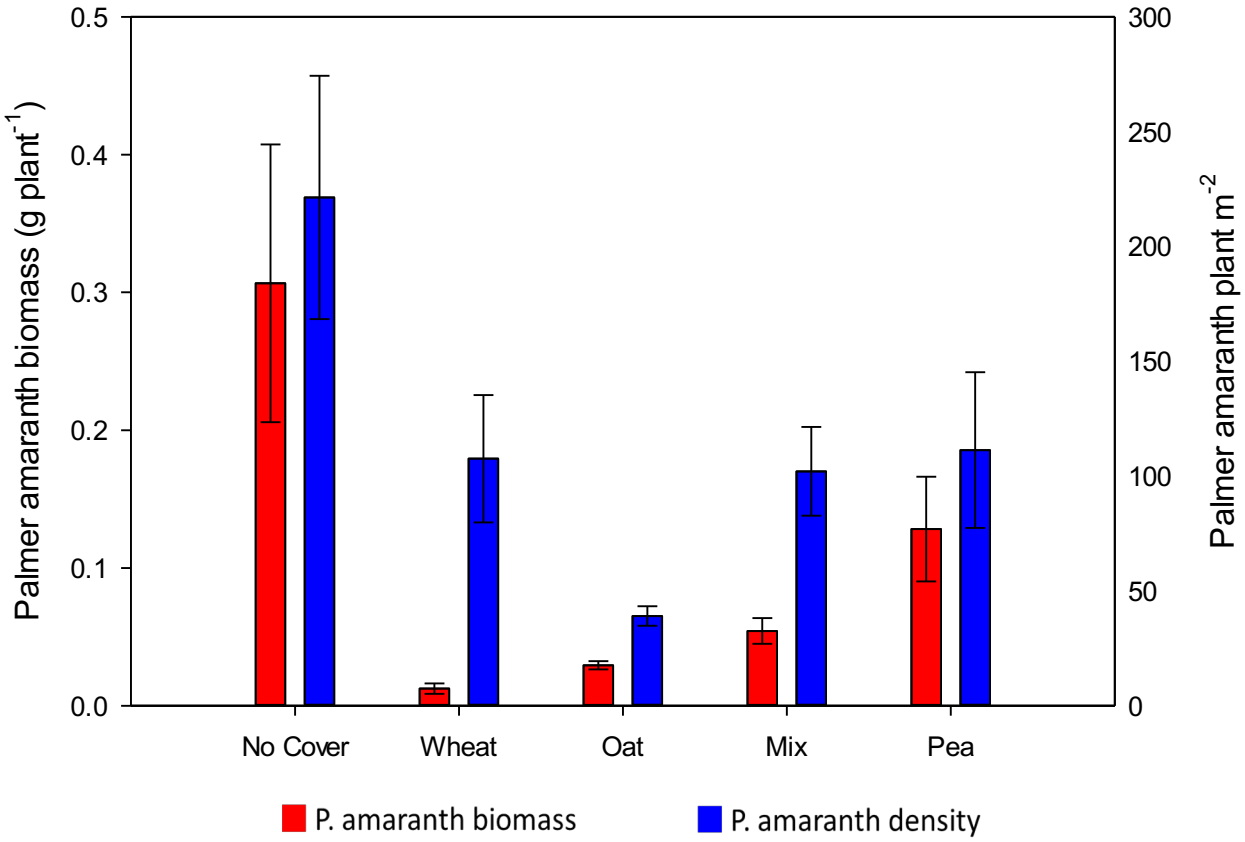
Terminated Winter wheat Cover crop

Chelsea McCall, 2018, MS research project

Cover crop impacts on Palmer amaranth

Chelsea McCall, 2018, MS research project

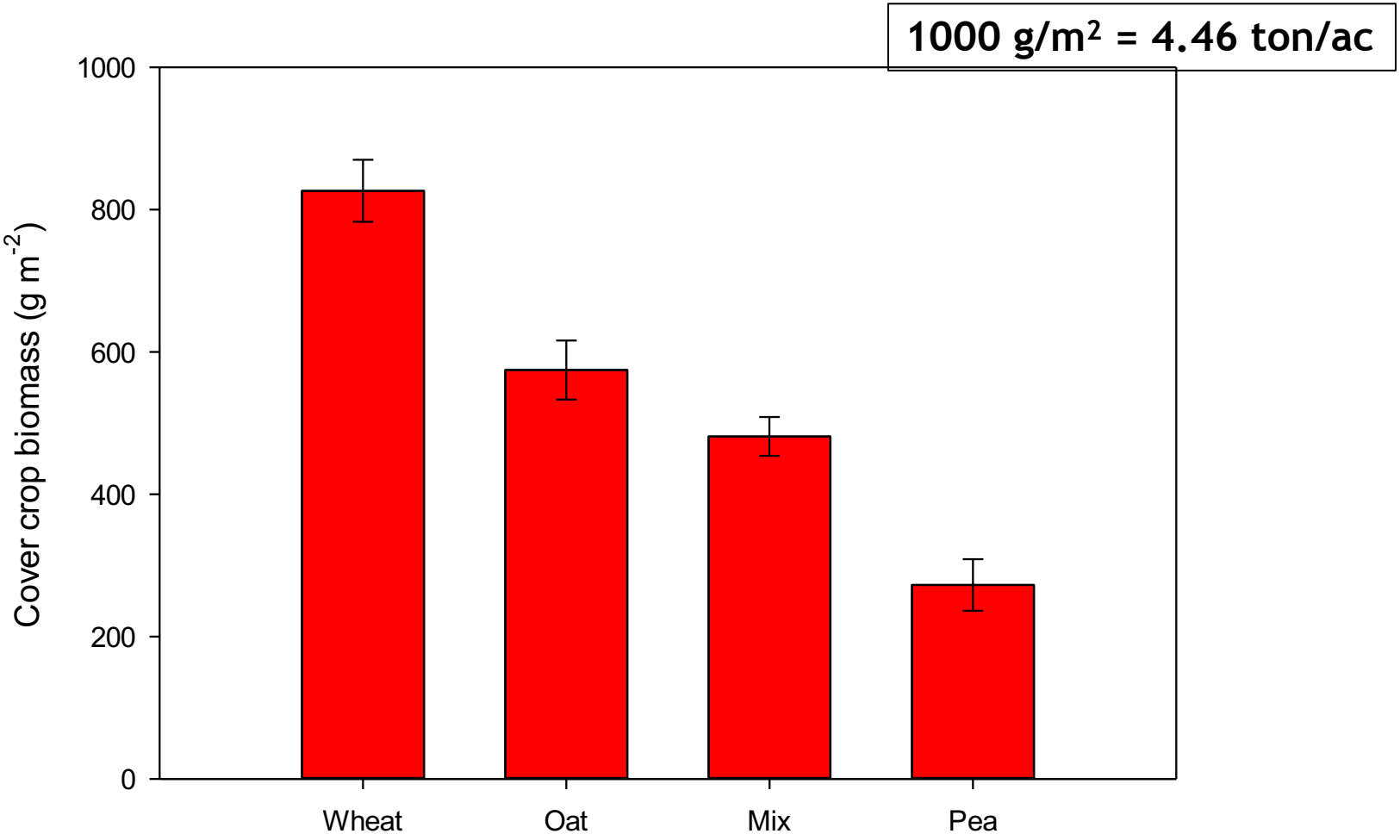
Palmer amaranth biomass and density prior to cover crop termination, May 18, 2015.



Cover crop impacts on Palmer amaranth

Chelsea McCall, 2018, MS research project

Aboveground cover crop biomass at termination, May 18, 2015



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Cover crop impacts on Palmer amaranth

Chelsea McCall, 2017 MS research project

	May 13, 2015	July 13, 2015
Spring pea		
Spring oat		

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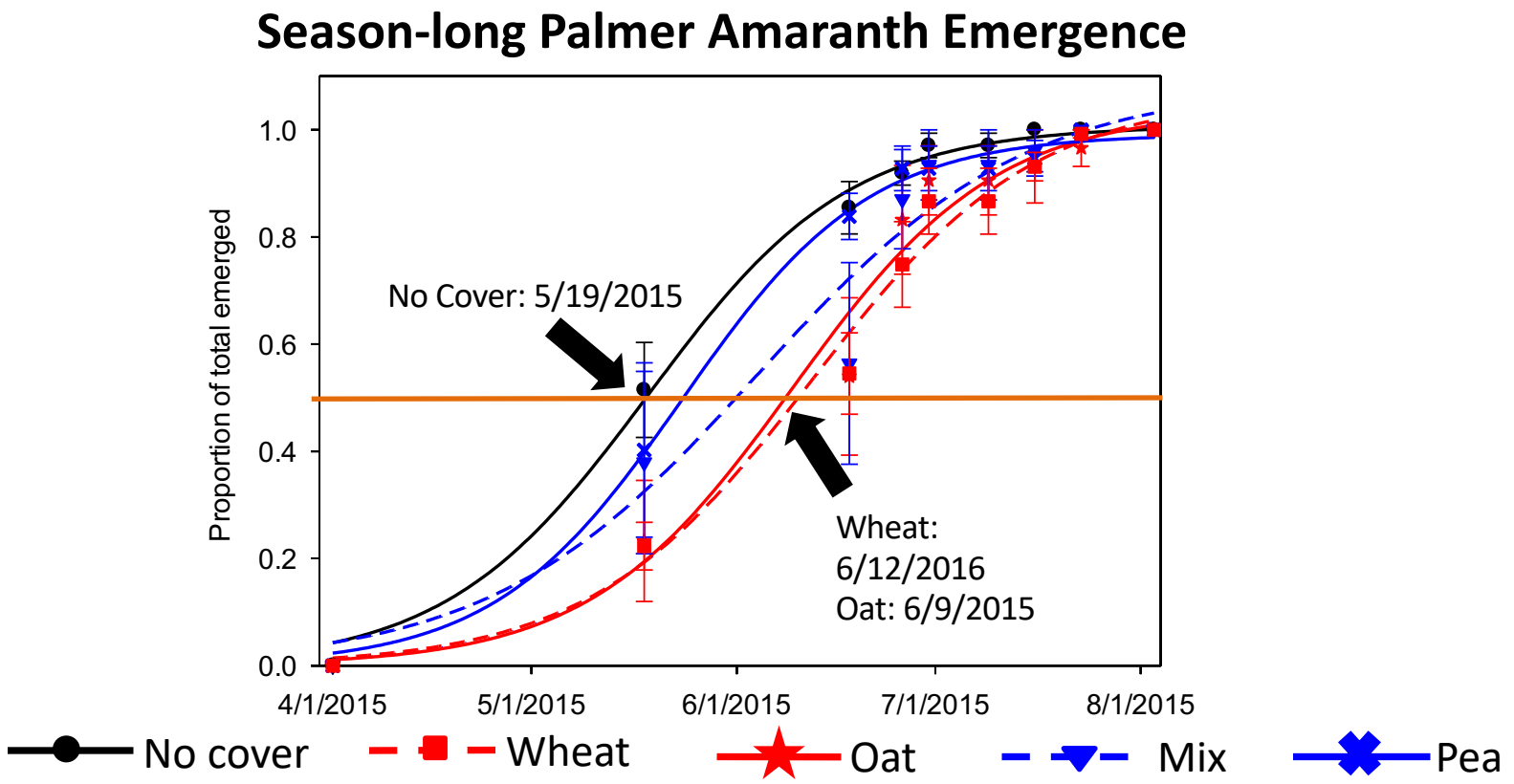
Cover crop impacts on Palmer amaranth

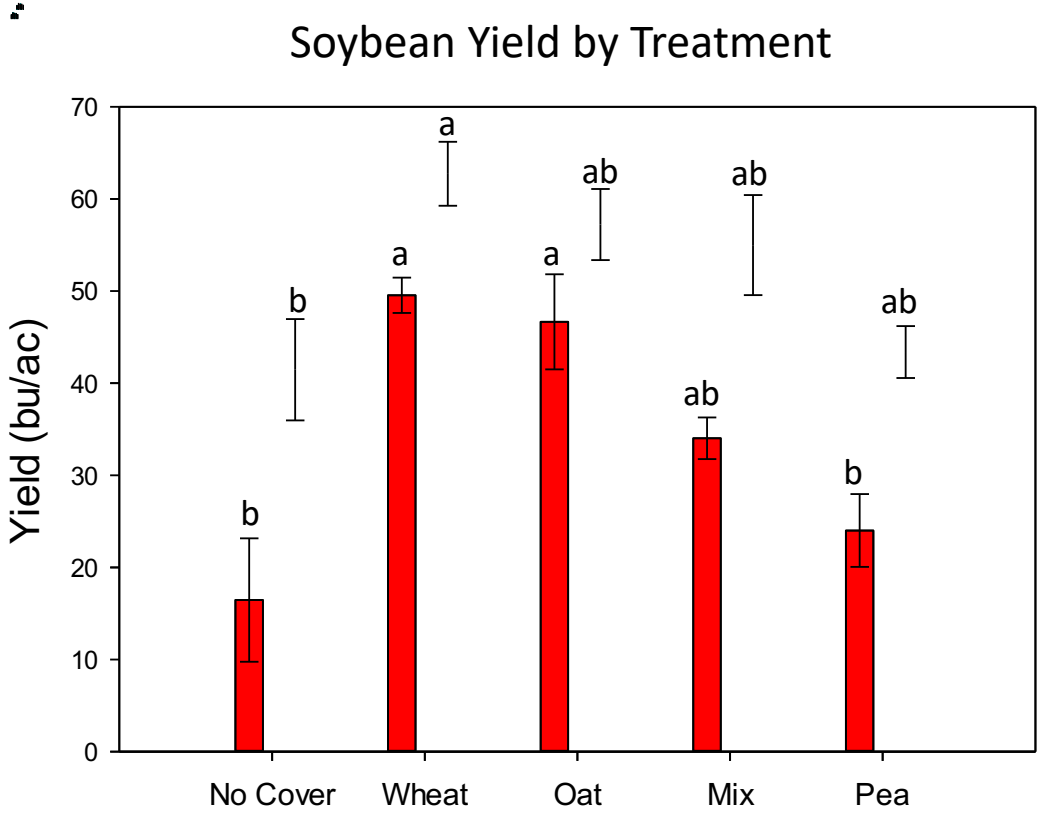


Chelsea McCall, 2018, MS research project

Cover crop impacts on Palmer amaranth

Without residual

With residual



Chelsea McCall, 2018, MS research project

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Key considerations

2. How will you plant it, and when?

- ✓ Establish the cover crop prior to that key point in lifecycle of weed species for greatest weed suppression impact; Why?
  - ✓ Reduce sunlight reaching soil surface; residue or living mulch to smother and outcompete emerging weeds for light, water, and nutrients
  - ✓ Alter microenvironment (moisture, temperature) during weed seed germination
  - ✓ Release of chemicals from roots or decaying residue to inhibit weed seed germination (allelopathy)

Allelopathy

- ✓ Many plant species have allelopathic characteristics, that is, can produce chemicals that affect other plant species
  - ✓ Weed suppression with cover crops?
    - ✓ Due to a physical barrier of residue, or
    - ✓ Due to allelopathy

- ✓ DIBOA, allelochemical isolated from rye, suppresses growth of plants, insects, fungi.

Allelopathy

- ✓ Cereal rye produces DIBOA:
  - ✓ Glucose molecule attached to DIBOA provides stability, prevents toxicity in plant
  - ✓ Toxic DIBOA is released when mixing DIBOA-glucoside with glucosidase upon plant wounding
  - ✓ As rye cover crops breakdown, toxic DIBOA or degradation products provide weed suppression (Yenish et al. 1995. Weed Sci 43:18-20)

May 2, 2018

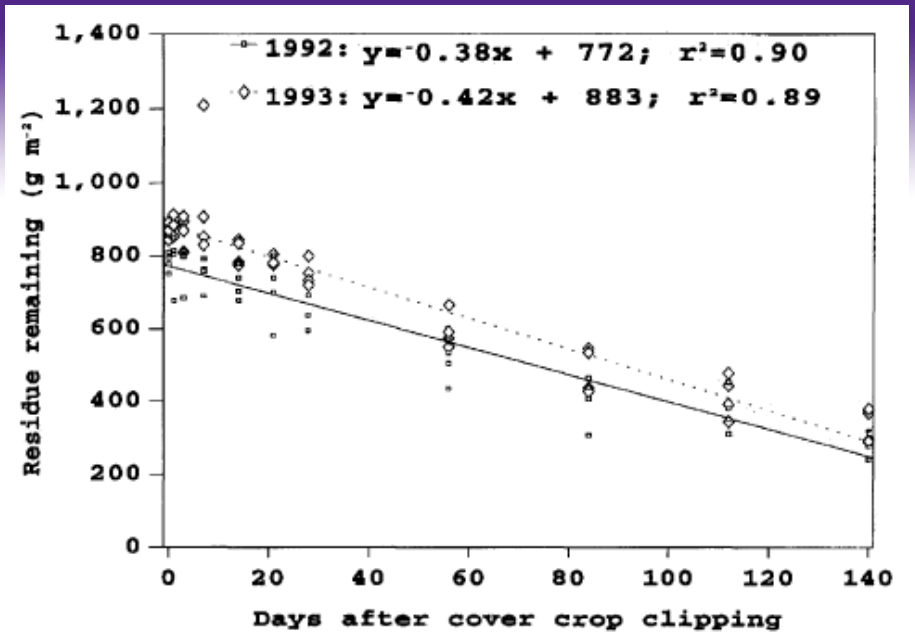

Figure 2. Disappearance of rye cover crop residue over time under field conditions in 1992 and 1993 at Clayton, NC.

Rye residue disappearance linear over time, with 50% remaining after 105 d (Fig 2)

(Yenish et al. 1995)

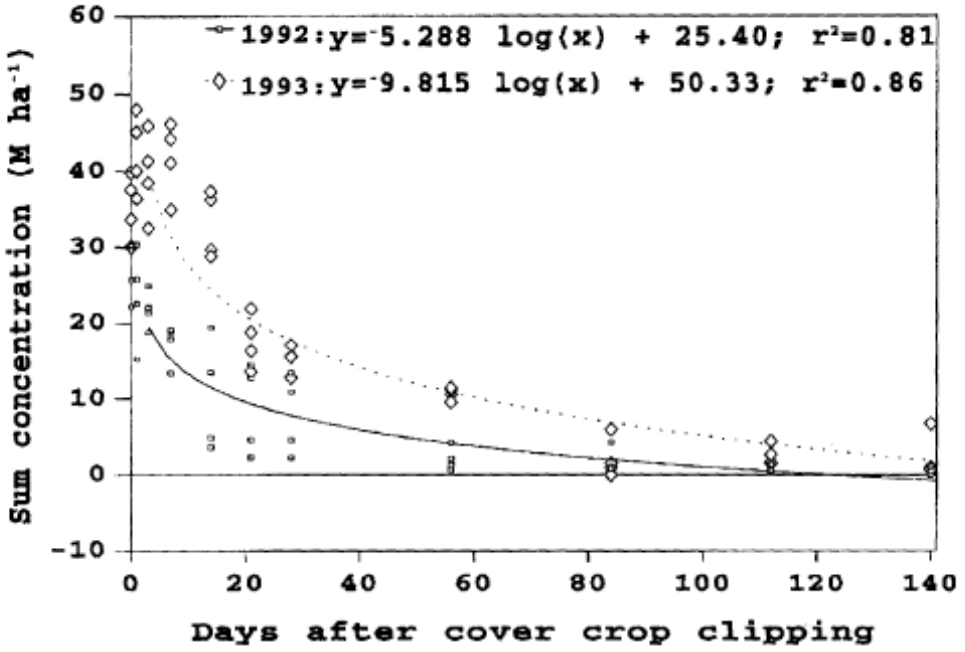

Figure 3. Total concentration of DIBOA-glucoside, DIBOA, and BOA in rye residue over time under field conditions in 1992 and 1993 at Clayton, NC.

Total concentration of allelochemicals follow logarithmic regression pattern (Fig 3), with 50% levels at 10 and 12 d after corn planting.

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Cereal rye shoot biomass and allelochemical concentration

Rye cultivar	Field study shoot biomass	DIBOA	Total allelochemical
	g m^{-2}	ug g^{-1}	
Aroostok	589	367	443
Bates	820	167	191
Bonel	557	1,240	1,469
Elbon	741	299	339
Maron	820	329	390
Oklon	618	132	155
Pastar	422	112	137
Wintercross	688	205	232
LSD (0.05)	21	115	127

Burgos et al. 1999. Weed Sci 47:481-485

Key considerations

3. **What will precede and what will follow the cover crop in your rotation?**
   - ✓ **Consider carbon-to-nitrogen ratio of cover crops**
     - ✓ **Changes rate of residue breakdown, release of nutrients for subsequent crop**
   - ✓ **Consider preemergence herbicides applied in previous crop, persisting into late summer or fall, and impacting establishment of some cover crop species**

Response of fall-seeded cover crops to herbicide residues applied 3-mo prior.

		Shoot dry weight (g/m^2)			
Herbicide	Herbicide		2012	2013	
treatment	Rate	Oat	Oilseed radish		Cereal rye
	(g/ha)	8 WAE	8 WAE		37 WAE
untreated	0	406a	325a	342a	375a
Verdict	735	419a	320a	332a	376a
Verdict	1470	404a	323a	343a	372a
~Lumax	2280 + 140	397a	321a	344a	384a
~Lumax	5760 + 280	393a	313ab	345a	361a
Pursuit	100	447a	308ab	329a	379a
Pursuit	200	419a	213b	331a	374a

Yu et al. 2015. Crop Protection 75:11-17

Key considerations

4. Which cover crop will you plant?

- ✓ **Resources available to help select:**
  - ✓ **Midwest Cover Crop Council**
    - ✓ **Cover Crop Decision Tool, data for Kansas available now**
    - ✓ **Integrating Cover Crops in Soybean Rotations publication**
  - ✓ **"Managing Cover Crops Profitably", 3rd Edition, SARE publication**
  - ✓ **Field days! See what grows in your area…**

October 7, 2015
Leonardville, KS

Leonardville, KS October 14, 2016

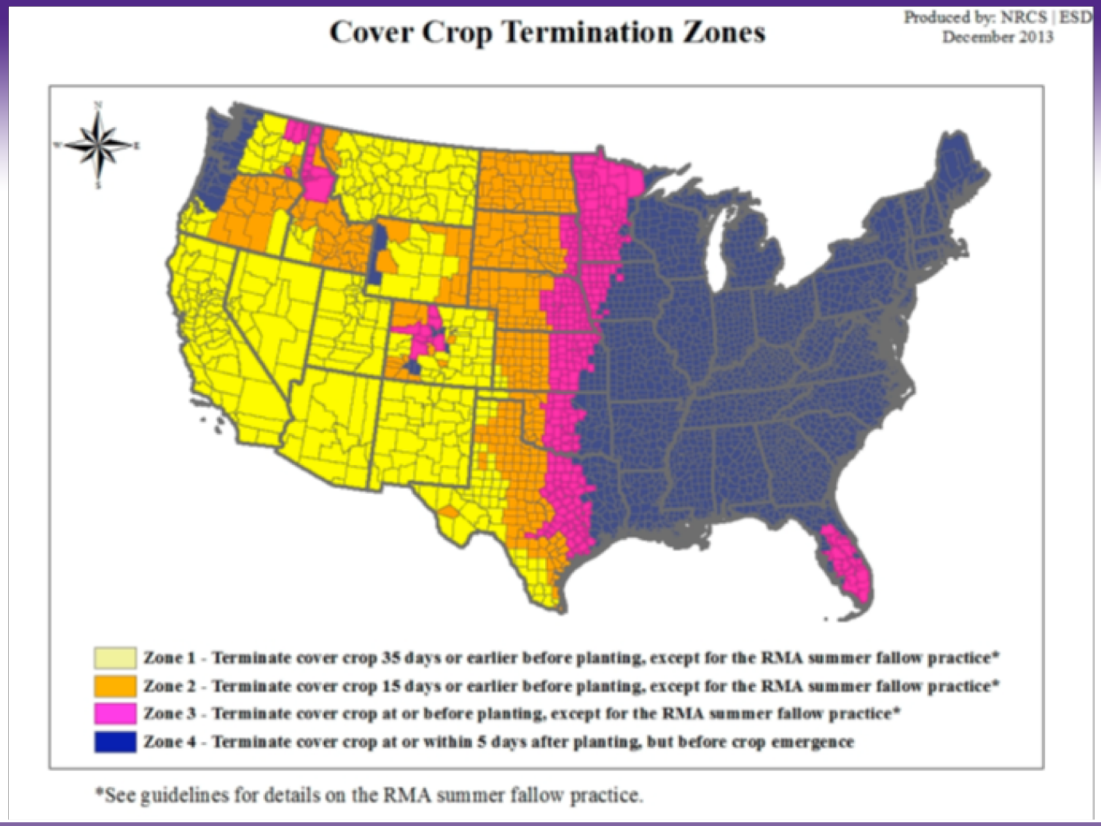
October 27, 2016
East of Larned, KS

Key considerations

5. How will you terminate your cover crop?

- ✓ Consider both the cover crop and potential weed species present or will yet emerge
  - ✓ Some will freeze out
  - ✓ Some require specific timing and methods
  - ✓ Include a residual herbicide in termination / burndown application mixture

- ✓ Standard recommendation is at least 2 weeks prior to planting summer row crop
- ✓ Check with insurance providers, USDA-FSA, or NRCS for local rules on termination timing



Zone	Cover crop termination period guidance	
Zone 2	**For late spring to fall seeded crops** Terminate CC 15 days or earlier prior to planting crop	**For early spring seeded crops** Terminate CC as soon as practical prior to planting the crop
Zone 3	Terminate cover crop at or before planting of the crop	
Zone 4	Terminate cover crop at or within 5 days after planting, but before crop emergence	

Termination timing

Observations of corn and weeds on June 6, 2018 on Chuck Steven's farm near Rexford, KS

Termination time re: corn	Termination date	Height of cereal rye	Observations on June 6, 2018		
		cm	Corn stage	Height of corn (cm)	Weed counts (# /0.25 m^2)
2 wk prior	April 11	13	V7	75	112
Planting date	April 28	20	V7	75	98
1 wk post	May 9	30	V7	75	42
No termination	--	--	V5	58	22

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Termination timing

Observations of soybean and weeds on June 7, 2018 on Josh Lloyd's farm near Oak Hill, KS

Term. time re: soybean planting	Term. date	Growth stage of cereal rye	Observations on June 7, 2018			Mean soybean yield (error)
			Soybean stage	Soybean (cm)	Weed counts (#/0.25 m^2)	Yield (kg ha^{-1})
1 wk prior	May 8	25 cm	V3	23	16	2935 (194)
At planting	May 15	Boot	V3	23	6	3050 (81)
1 wk post	May 23	heading	V1	13	0	3000 (195)

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Questions?

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