K-STATE
Research and Extension

Cover Crops and their Impact on Weed Suppression

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Soil Health U, Salina

Wed, January 24, 2018

Knowledge for Life

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 …**

April 19, 1 month after Planting

Clay County field site, 2016
Planted cover crops March 10
Surveyed June 1 for cover crop biomass and weed biomass and density

Weeds in:
bare strip
= 14.2 weeds/m^2 (3.3 g/m^2)

oat cover crop = 7.2 weeds/m^2

mixed cover crop = 1.2 weeds/m^2

June 7, 2016

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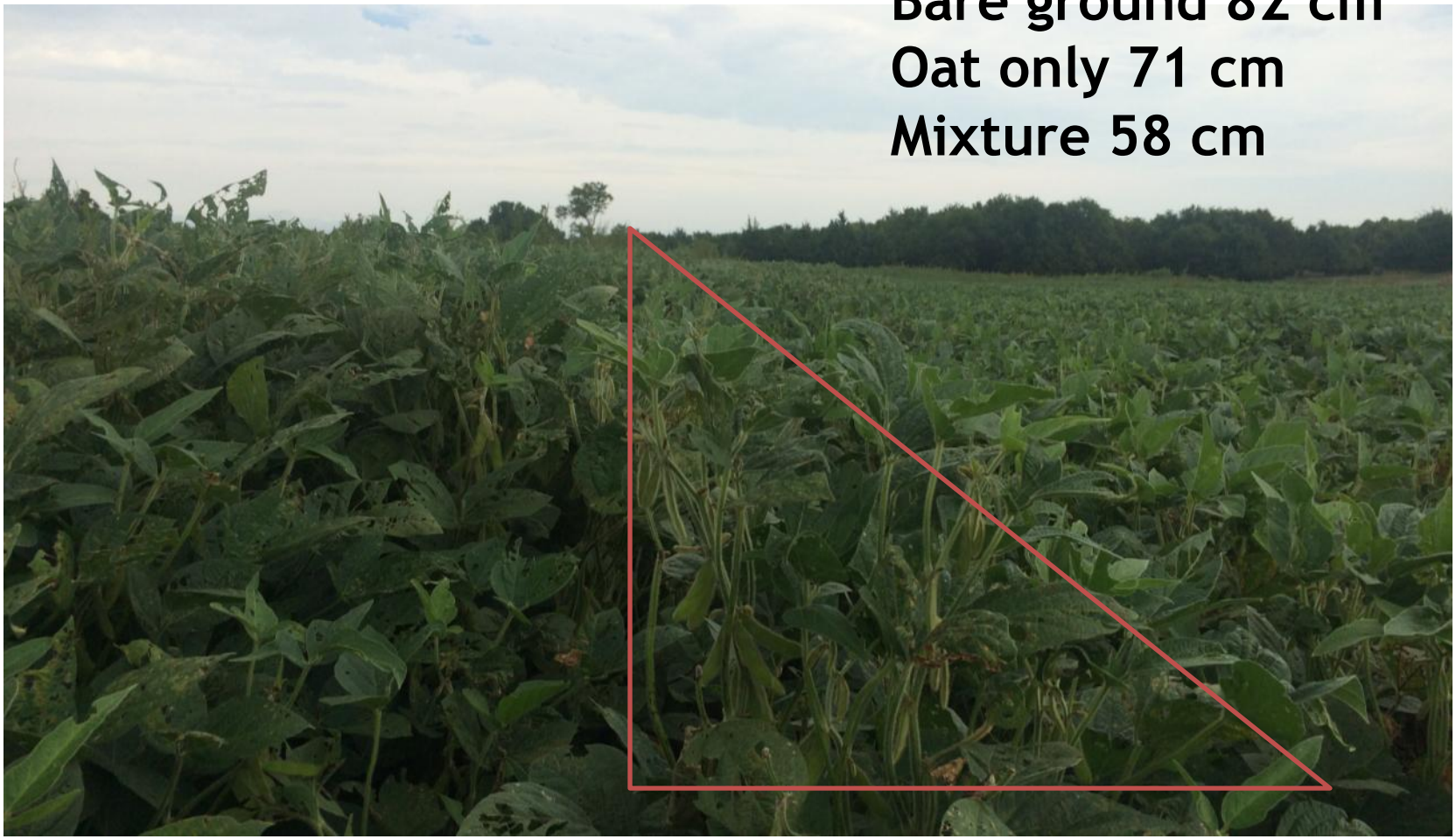
2016 Test Sites Clay County

Knowledge for Life

August 24th

Soybean heights:
Bare ground 82 cm
Oat only 71 cm
Mixture 58 cm



Clay Cty Cover Crop 6-way Mix

Legumes		2%						
Clover -Balansa "FIXatioN"	1.0	2%	L165-15-972-C	OR	80.00%	52.90%	0.00%	47.10%
Grasses		90%						
Spring Oats - Rockford	18.0	34%	MISC.RF_DF_14.1	SD	99.00%	99.56%	0.24%	0.20%
Spring Forage Barley	15.0	29%	TM_NE_14.25	NE	95.00%	99.49%	0.50%	0.01%
Triticale - Spring 141	14.0	27%	Pf-2015	NE	91.00%	99.71%	0.10%	0.19%
Brassicas		4%						
Rapeseed - Trophy	1.1	2%	45033-CAN	ID	85.00%	98.00%	0.50%	1.00%
Other Broadleaves		4%						
Safflower- Finch	2.1	4%	BS-VP-14-01	MT	83.00%	99.96%	0.00%	0.04%

Green Cover Seed 918 Road X Bladen, NE 68928 402-469-67

eller warrants that this seed conforms to the label description as required by federal and state seed laws. We make no othe

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

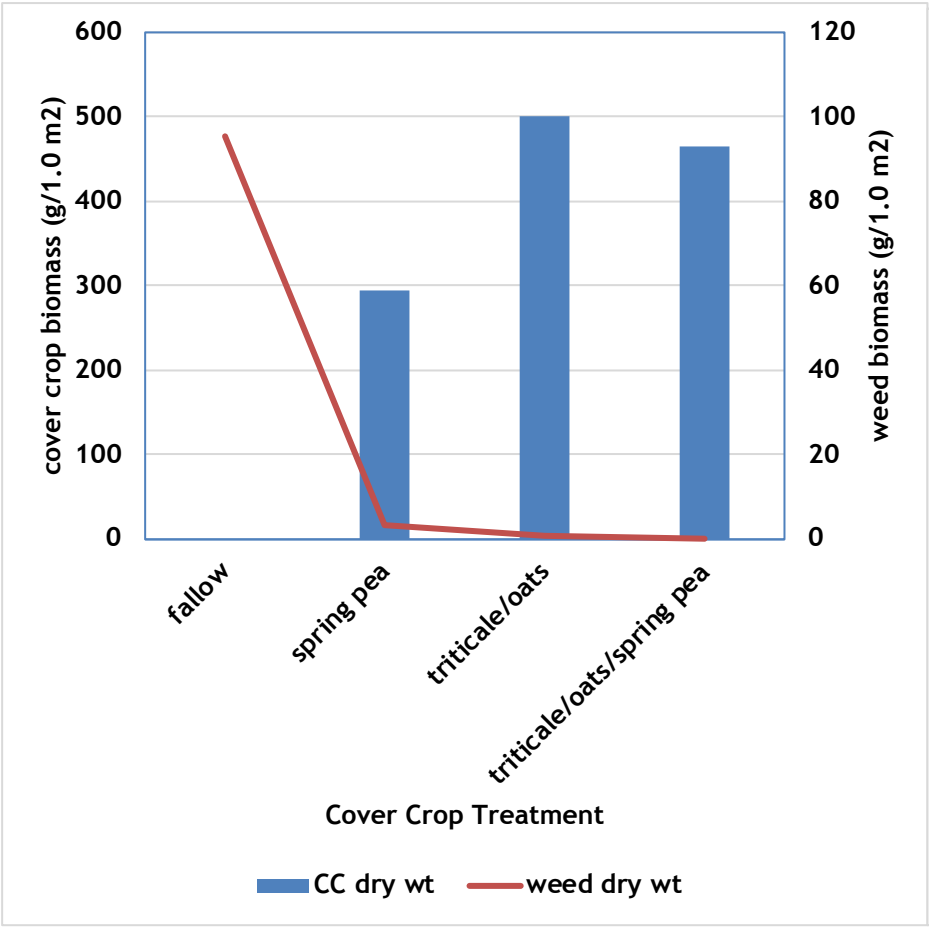
Drilled cover crops mid-March

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

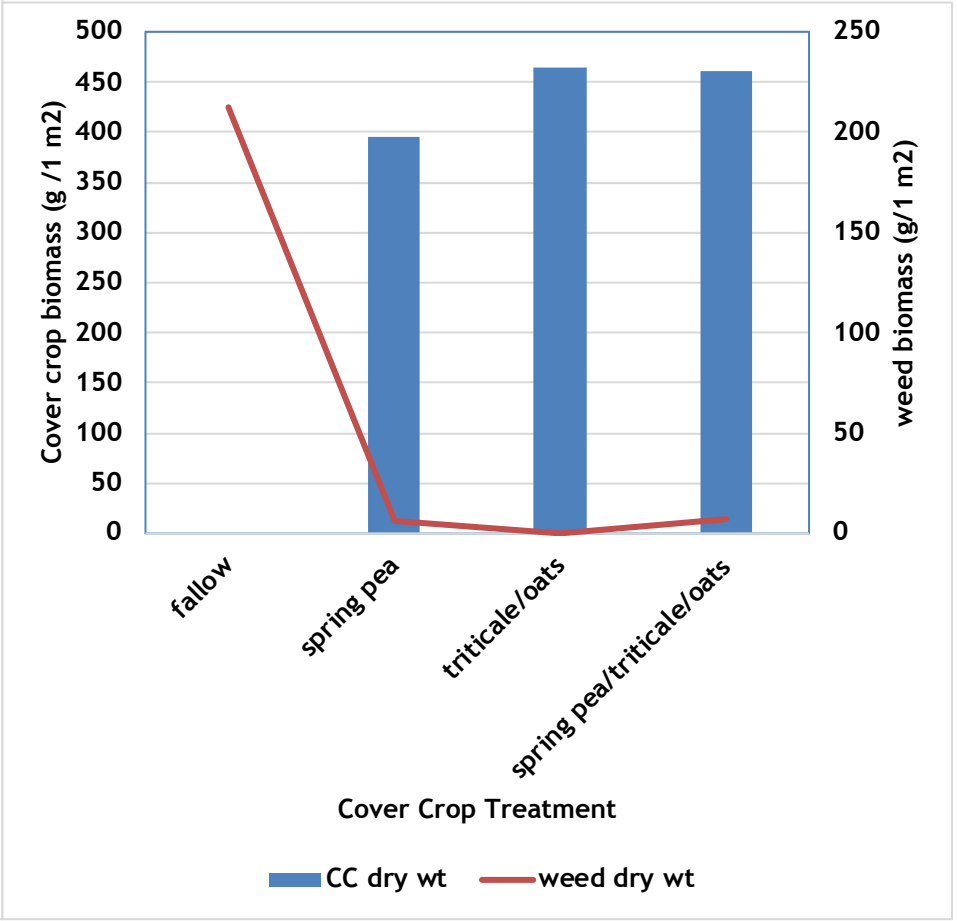
Weeds in:
Fallow = 153 weeds/m^2 (212 g/m^2)
Spring pea = 76 weeds/m^2 (5.8 g/m^2)
Triticale/oat = 0 weeds
Spring pea/triticale/oat mixed
= 32 weeds/m^2 (7.4 g/m^2)

June 13, 2016

HB Ranch, Hays, KS



NW Research Ctr, Colby, KS



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

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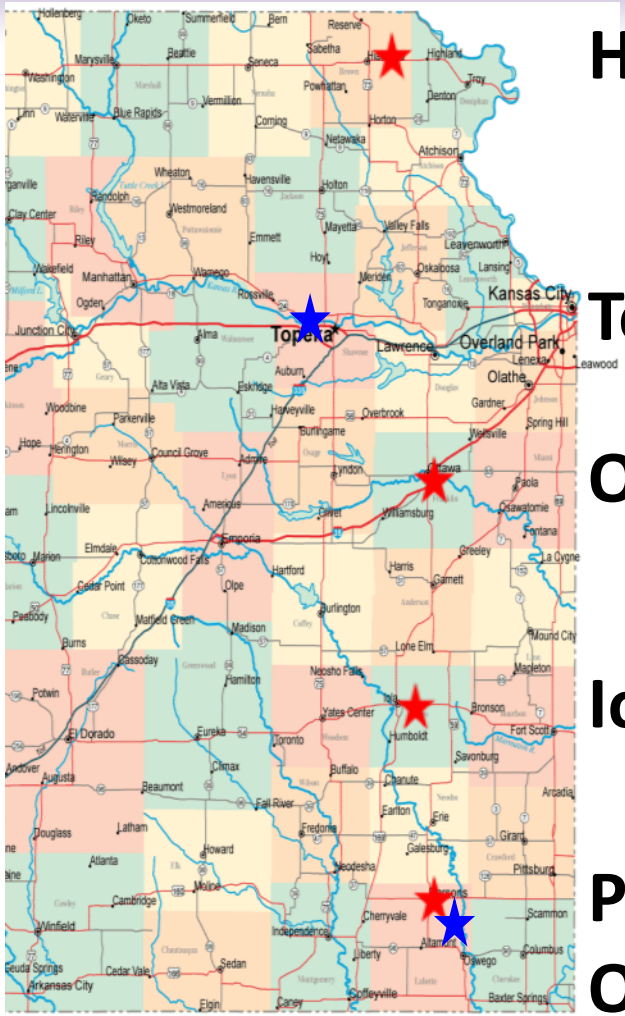
Locations

Chelsea McCall, 2017
MS Research Project



Highland

Topeka

Ottawa

Iola

Parsons

Oswego

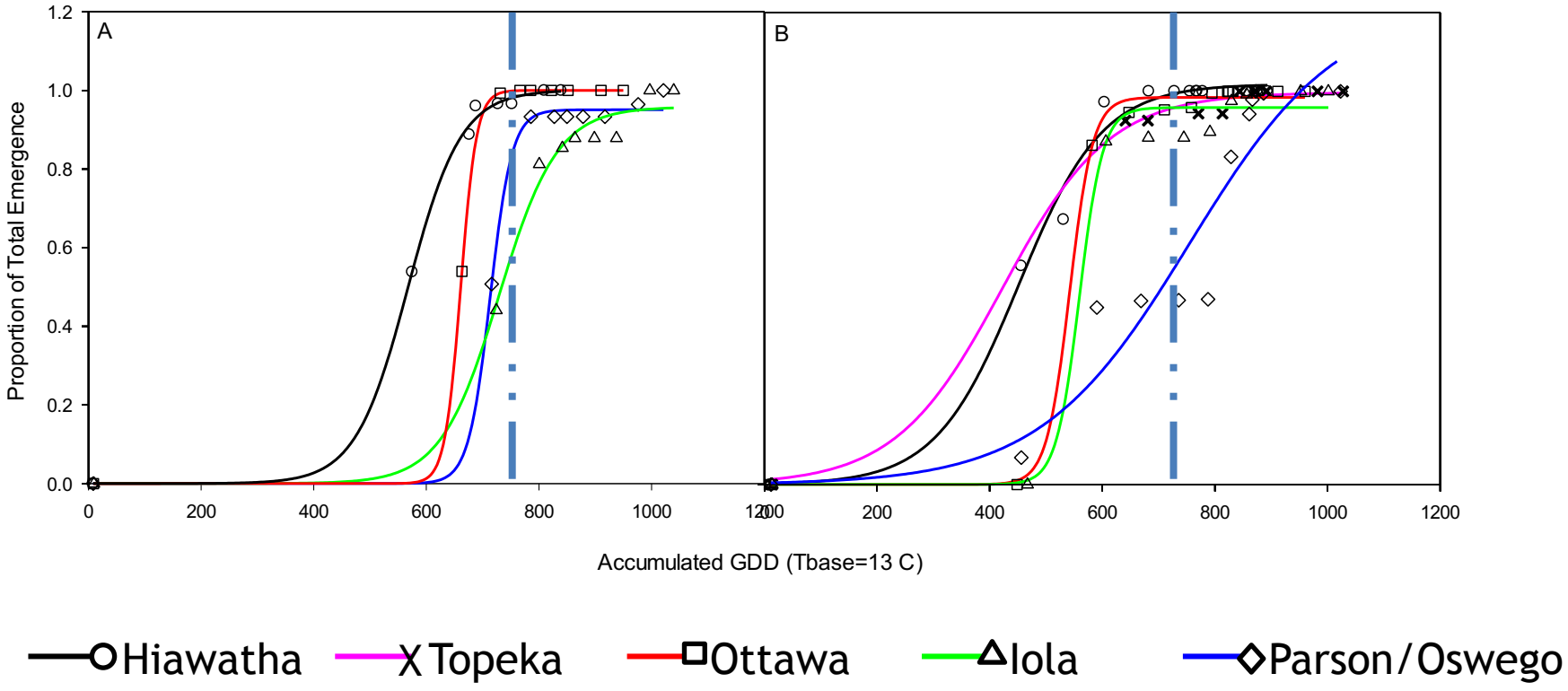
★ 2014-2015-2016

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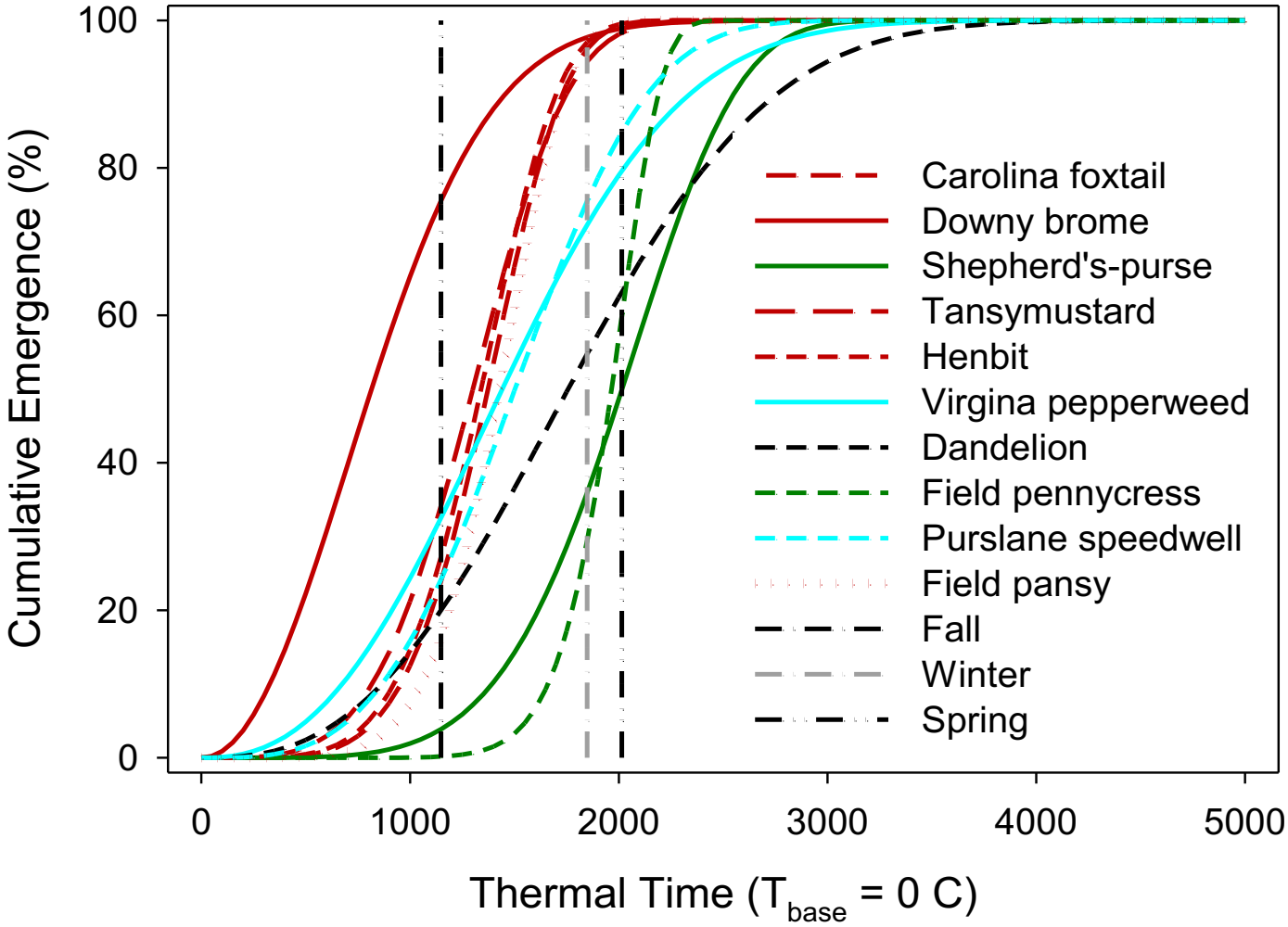
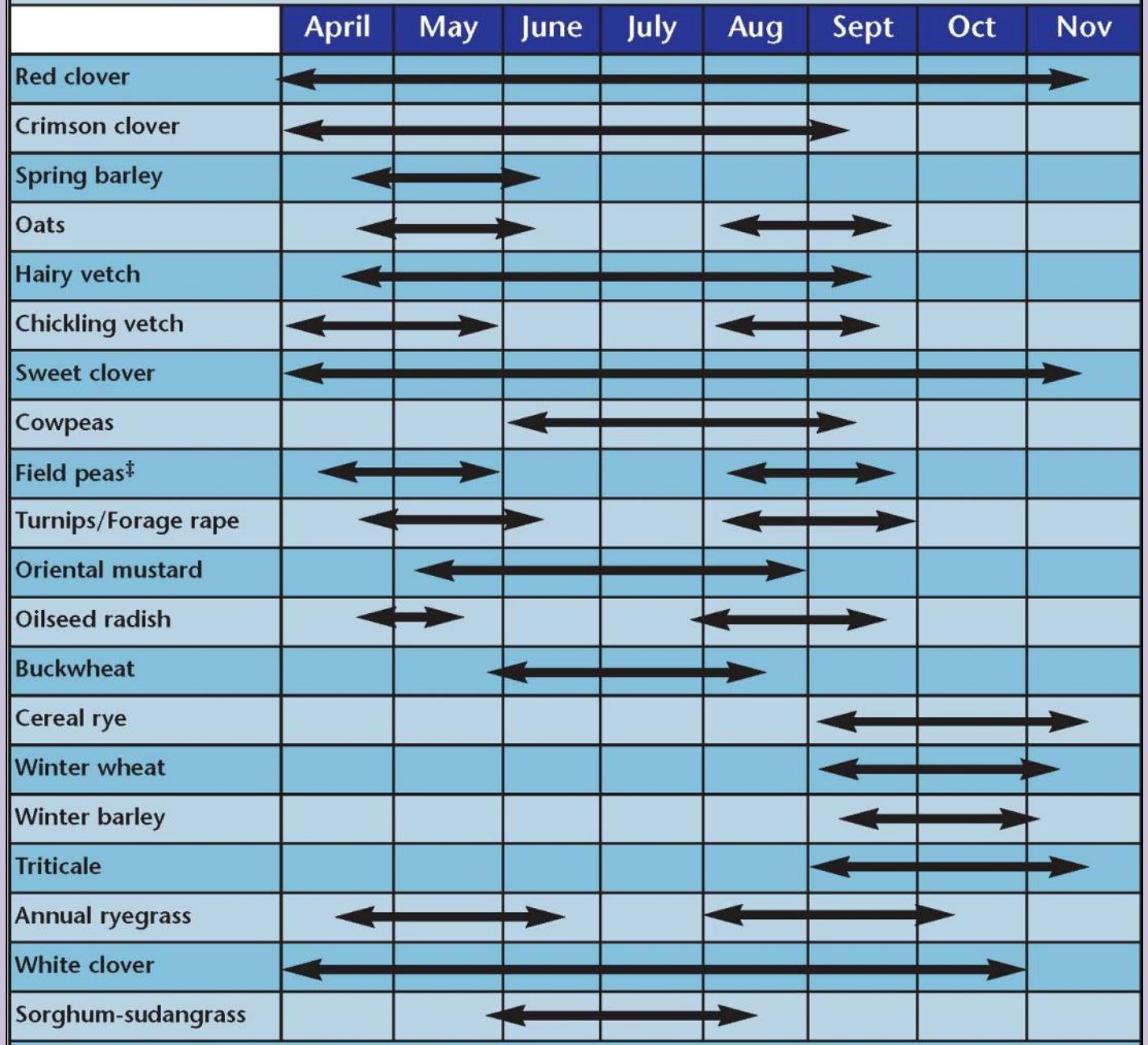
Observations of winter annual weed emergence in Nebraska, 2010 and 2011



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

Table 2. Seeding timing of various cover crops.



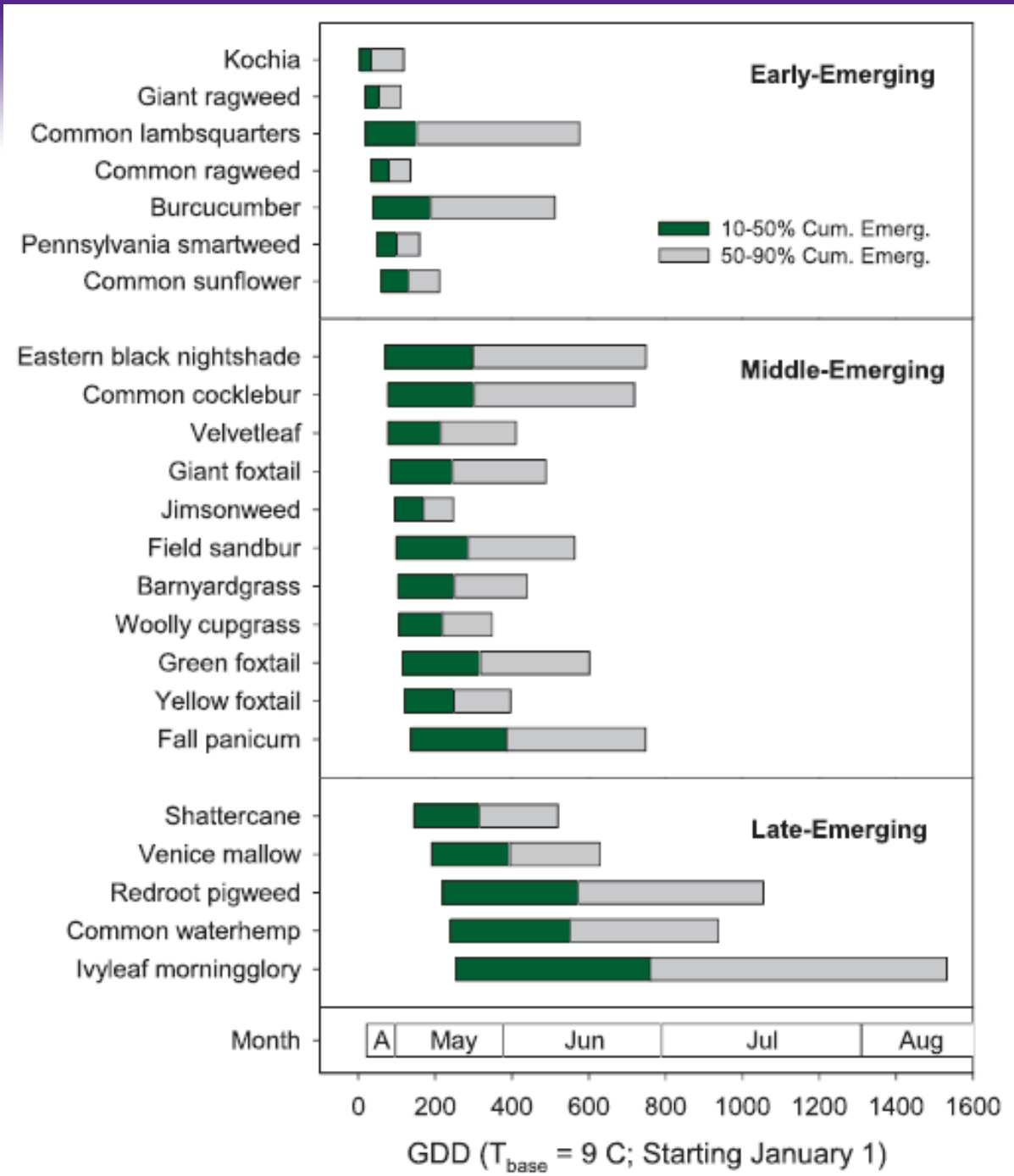
‡Also known as Austrian winter peas (black peas), Canadian field peas (spring peas).

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.



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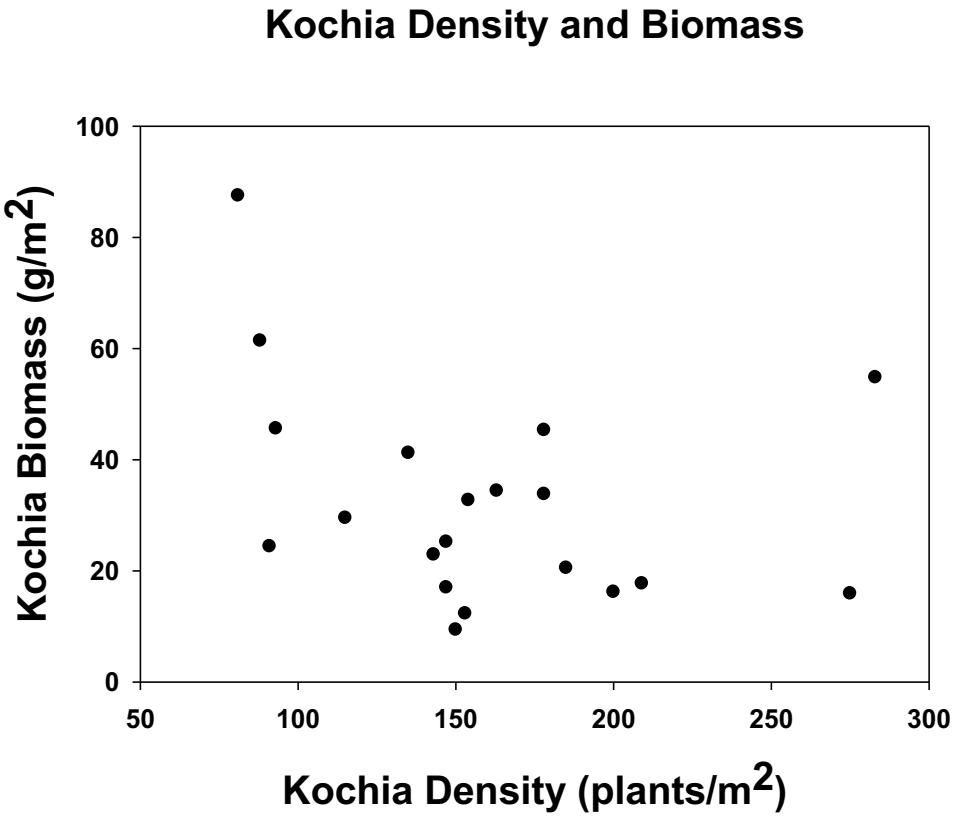
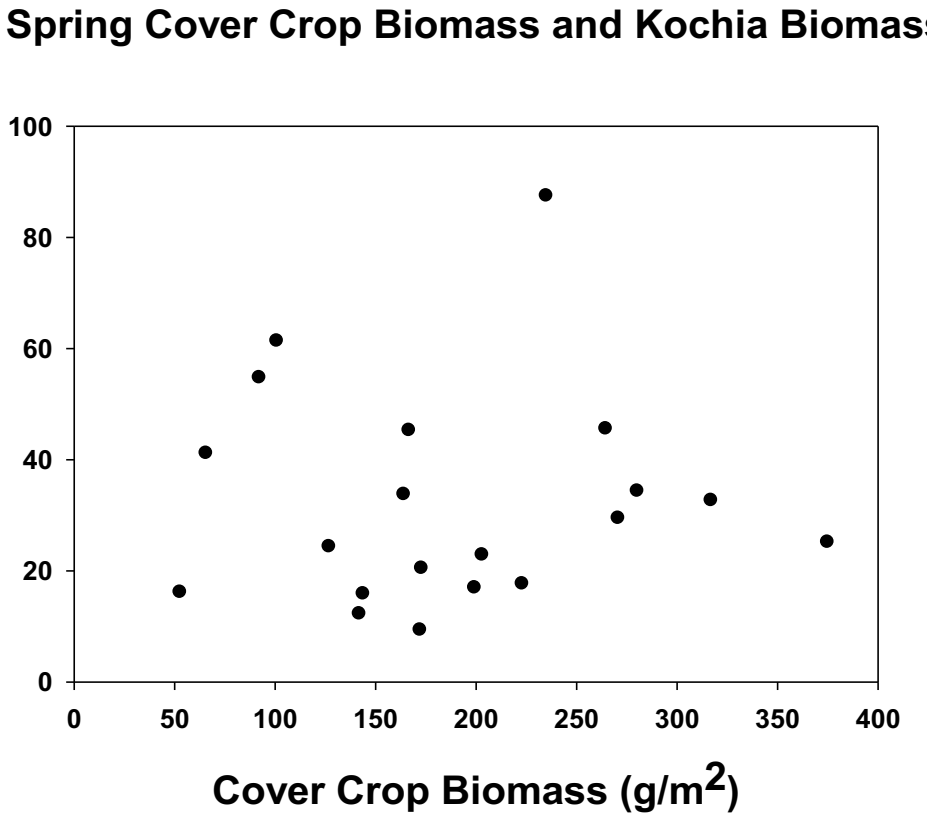
Kochia response to Spring Cover Crops





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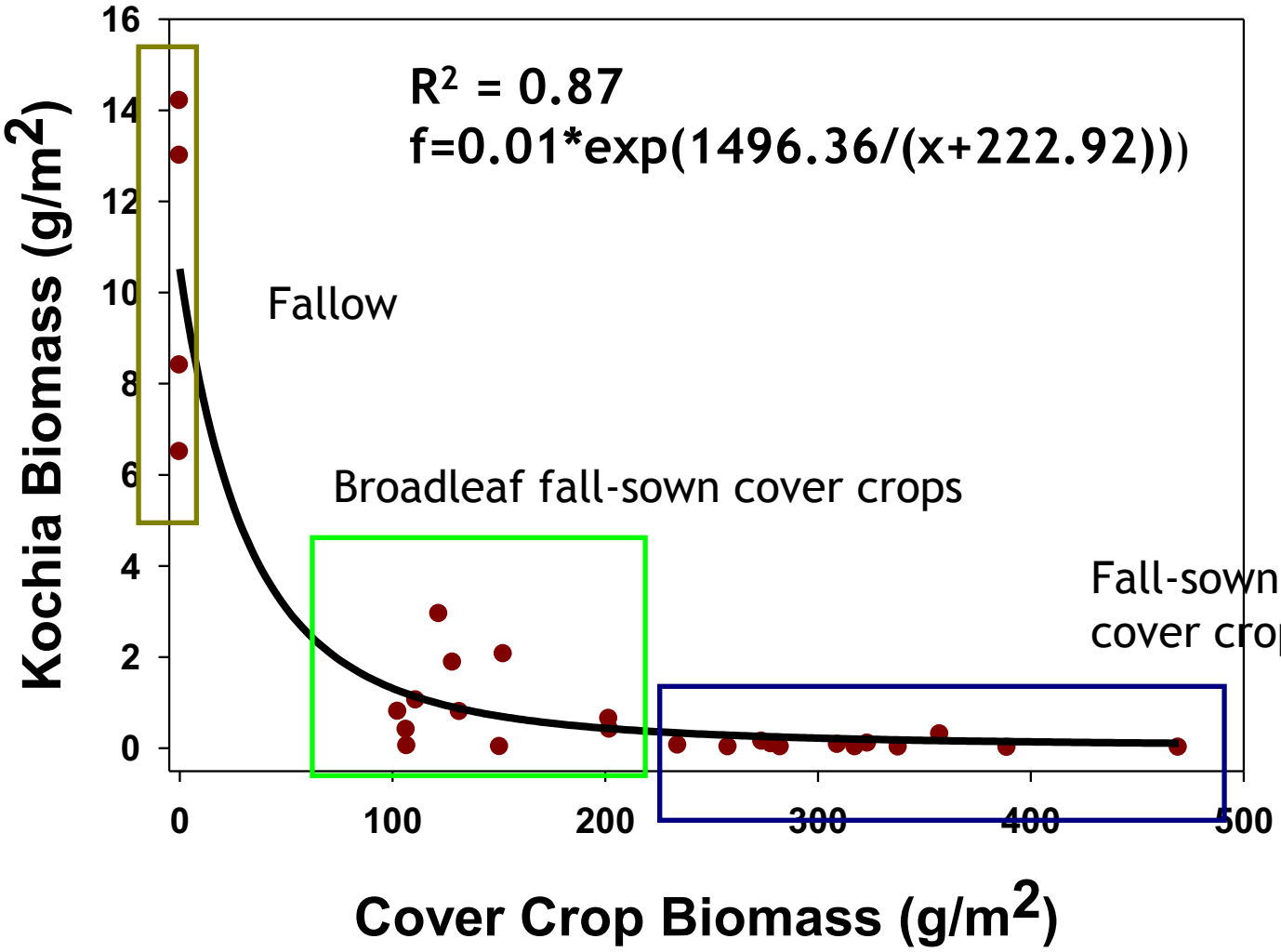
Petrosino et al. 2015, Crop, Forage & Turfgrass Mgmt 1

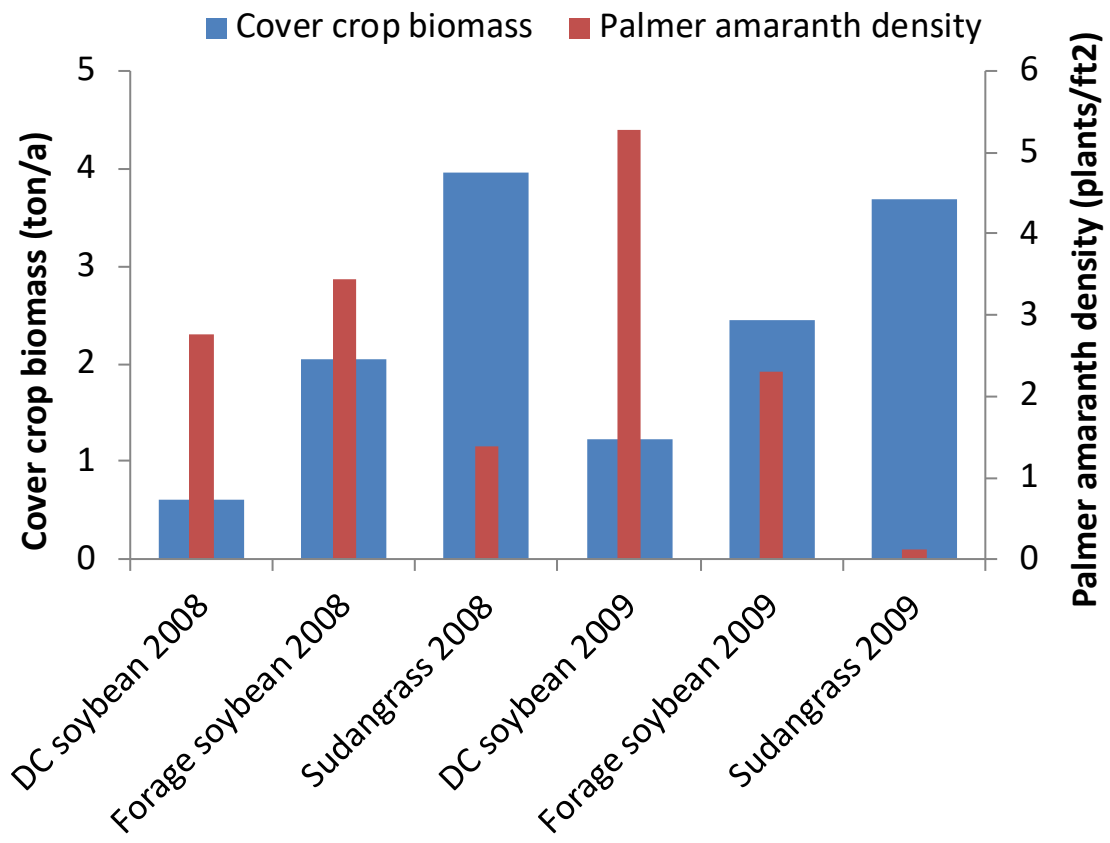
Kochia Response to Fall Cover Crops

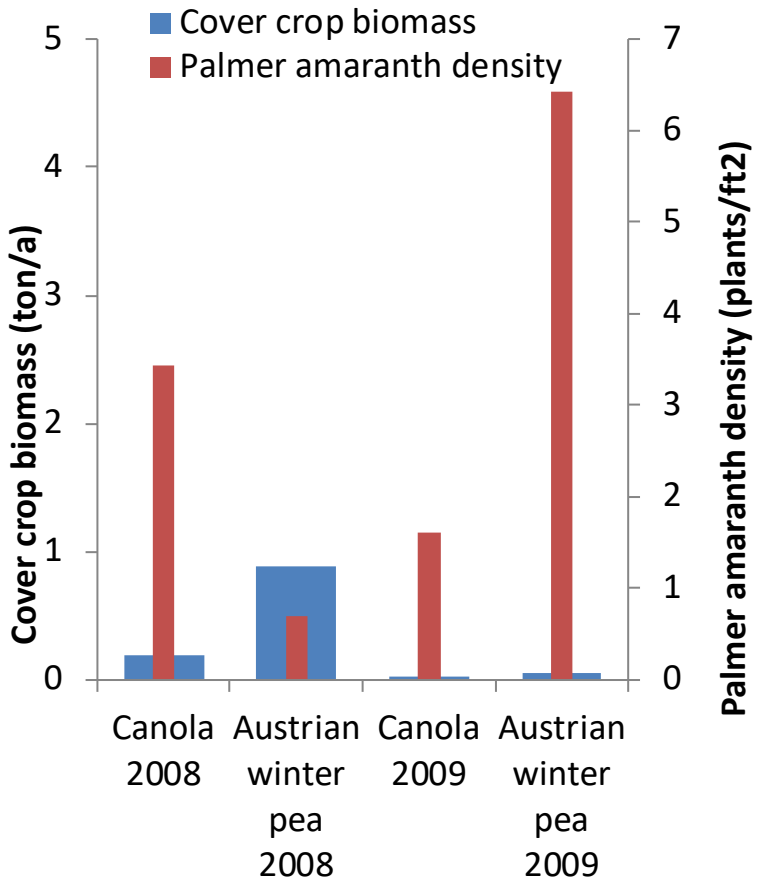


Petrosino et al. 2015, Crop, Forage & Turfgrass Mgmt 1

Palmer amaranth Suppression

- Cover crops in wheat stubble, before grain sorghum
- Every 900 lb/ac increase in cover crop biomass reduced Palmer amaranth biomass by 4% (Petrosino, 2010)





Cover crop impacts on Palmer amaranth

May 13, 2015

July 13, 2015

No cover

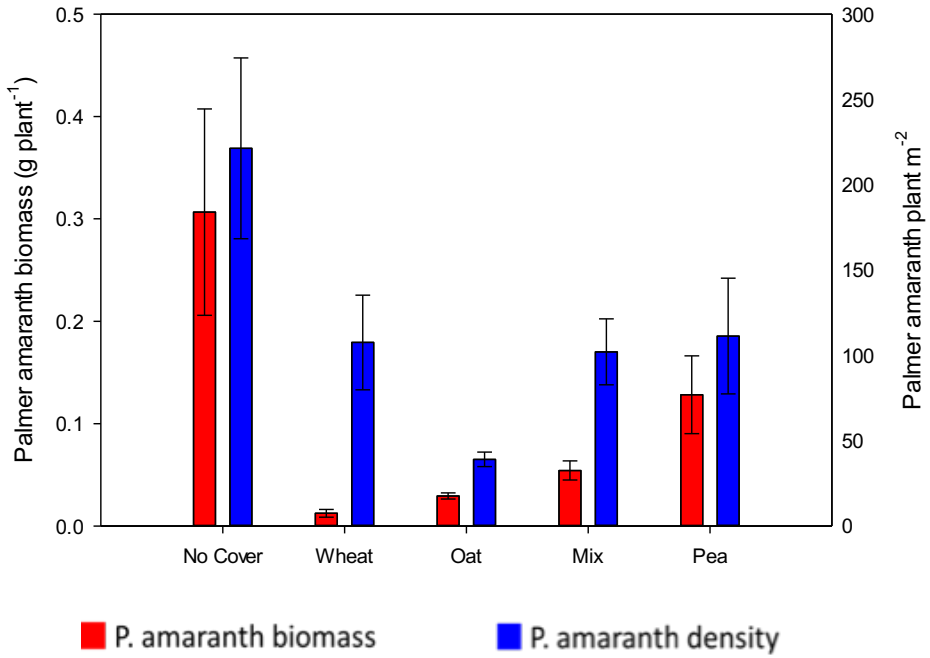
Terminated Winter wheat Cover crop

Chelsea McCall, 2017, MS research project

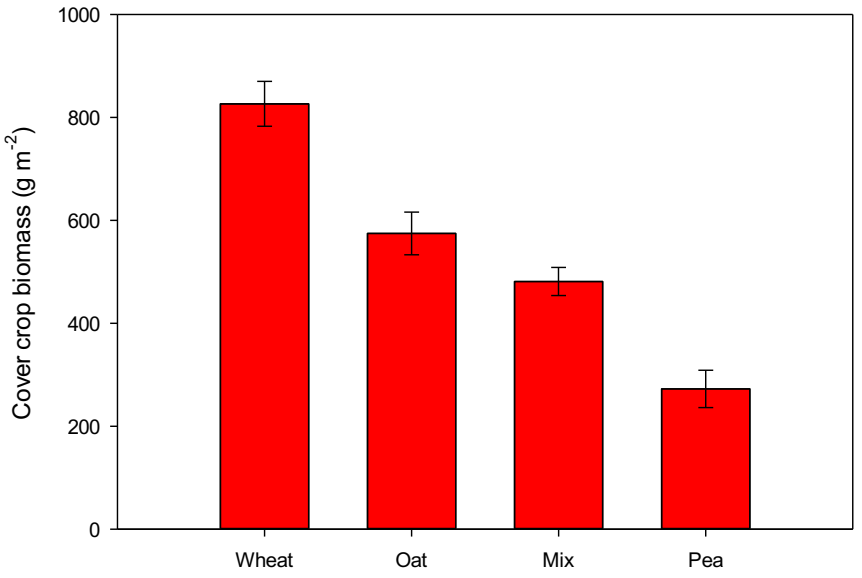
Cover crop impacts on Palmer amaranth

Chelsea McCall, 2017, MS research project

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



Aboveground cover crop biomass at termination, May 18, 2015



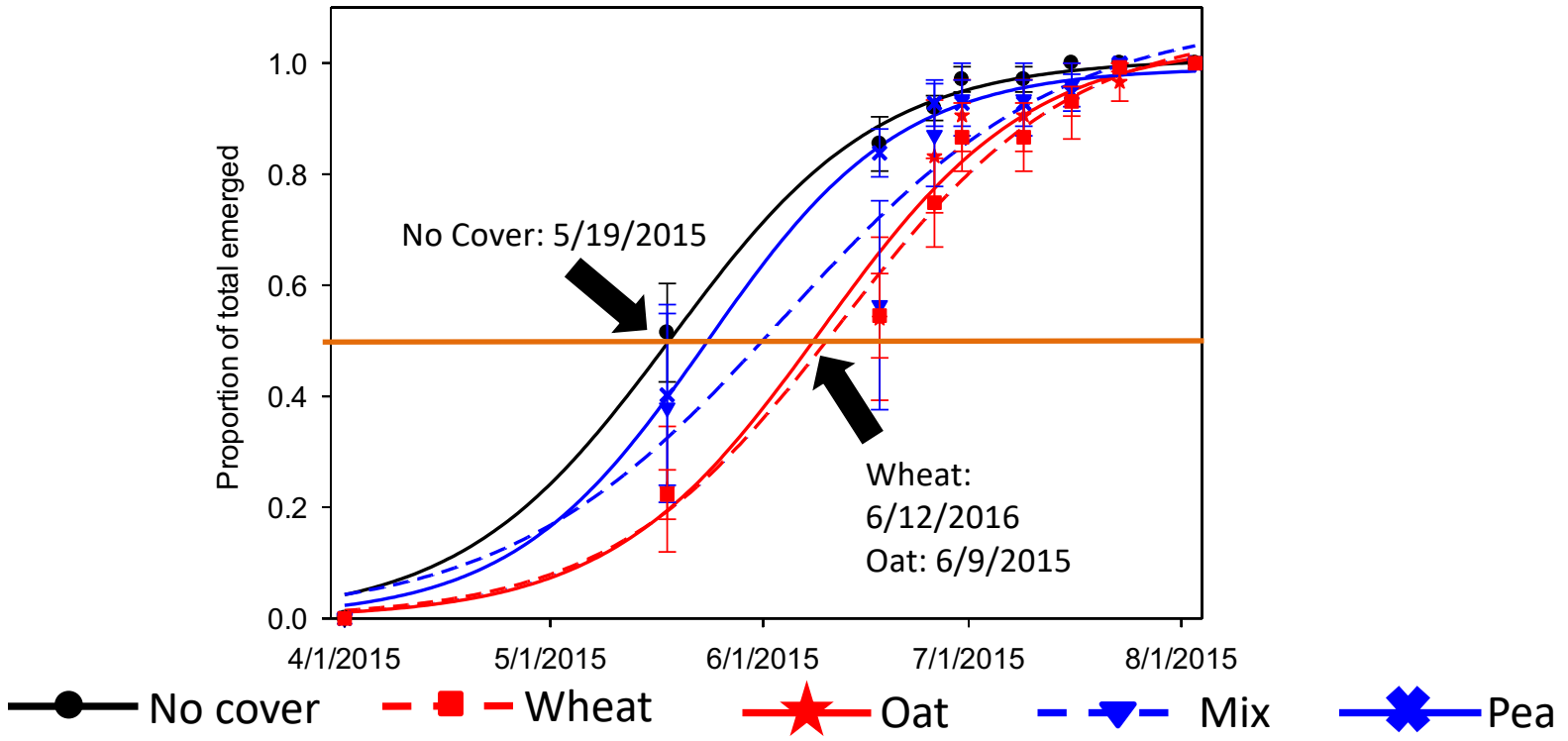
1000 g/m^2 = 4.46 ton/ac

Cover crop impacts on Palmer amaranth

Chelsea McCall, 2017 MS research project

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

Season-long Palmer Amaranth Emergence



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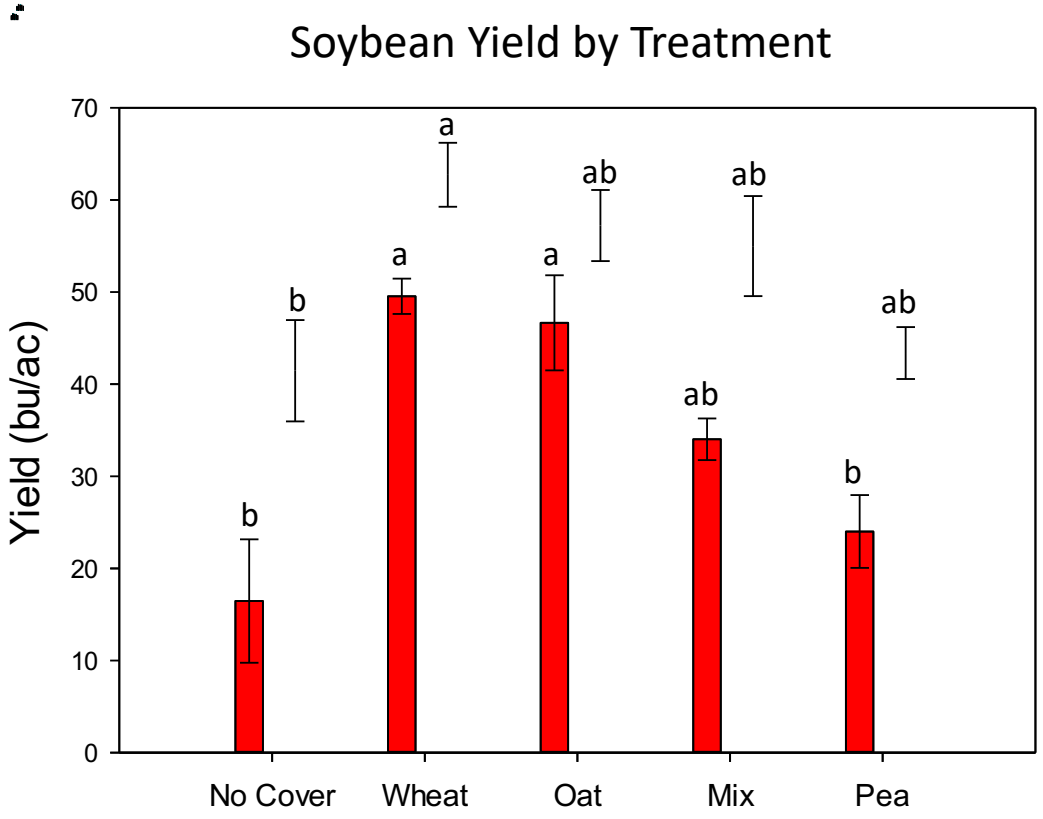
Without residual

With residual



Chelsea McCall, 2017, MS research project

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)
  - ✓ Improve overall soil health; enhance crop vigor

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)**
  - ✓ **Question .. if rye can provide 4 weeks of weed suppression (no emergence), than allelopathy contributes more than persistence of rye residue….**

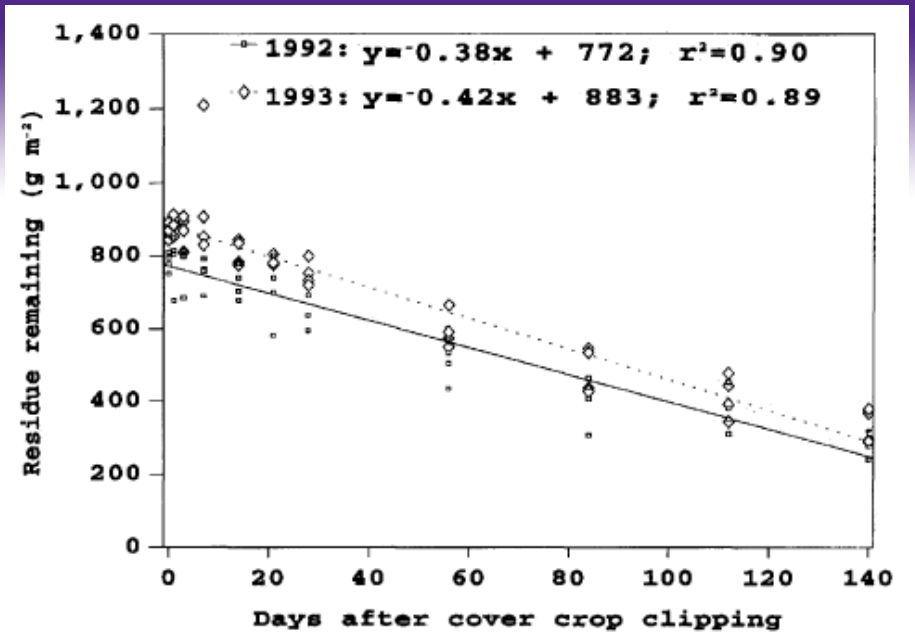


Figure 2. Disappearance of rye cover crop residue over time under field conditions in 1992 and 1993 at Clayton, NC.

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

(Yenish et al. 1995)

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

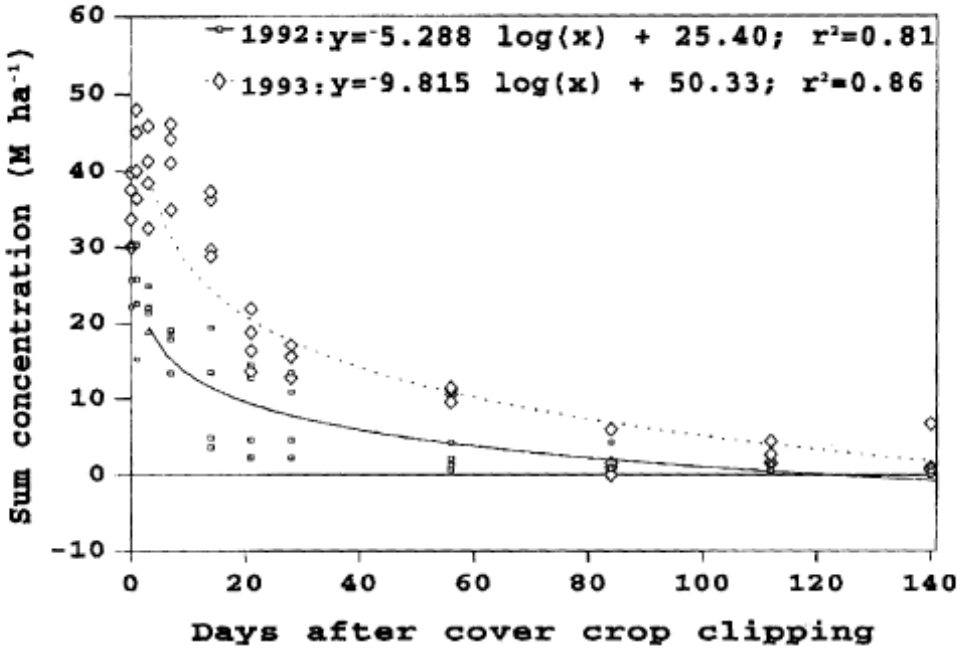


Figure 3. Total concentration of DIBOA-glucoside, DIBOA, and BOA in rye residue over time under field conditions in 1992 and 1993 at Clayton, NC.

Knowledge for Life

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

Table 3. Cover crop management strategies.				
Cover crop	**Winter kill**	**Tillage – timing or size of cover crop**	**Herbicide**	**Roller/crimper**
Red clover	No	2 to 4 weeks before planting	2,4-D ester + Glyphosate	Not recommended
Crimson clover	No	2 to 4 weeks before planting	2,4-D ester + Glyphosate	Not recommended
Alfalfa	No	2 to 4 weeks before planting	2,4-D ester + Glyphosate	Not recommended
Hairy vetch	No	2 to 4 weeks before planting	2,4-D ester + Glyphosate	Not recommended
Oilseed radish	Yes	—	—	—
Oriental mustard	Yes	—	—	—
Buckwheat	Yes	—	—	—
Field pea (Austrian pea)	Yes	—	—	—
Cereal rye	No	9 to 12 inches	Glyphosate	Soft dough stage
Wheat	No	9 to 12 inches	Glyphosate	Soft dough stage
Oats	Yes	—	—	—

Tables 2 and 3 – Taylor E, Renner K, Sprague C (2008) Integrated Weed Management: Fine Tuning the System. Extension Bulletin E-3065. East Lansing, Mich.: Michigan State University.

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Questions?

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