Effects of Cover Crops in No-Tillage Crop Rotations in Eastern & Western Kansas

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Introduction

Precipitation patterns in Kansas vary greatly across the state. Western KS is prone to low and variable precipitation patterns, and producers rely on a fallow period (approximately 14 months) to increase plant available water. In western KS, winter wheat/fallow is the primary dryland crop rotation. No-tillage systems allow producers to intensify the cropping system due to increased stored available water. In eastern KS, the fallow period after wheat harvest is shorter (typically 9 to 10 months) and summer annual grain crops are usually included in the rotation. Annual precipitation is greater than in western KS, but precipitation amount and distribution often vary. Including a cover crop in rotations in either area could increase fallow use efficiency, increase soil nitrogen, and reduce weed pressure in no-tillage cropping systems. In addition, cover crops can accumulate large amounts of biomass, and increase the amount of organic carbon in the soil system. Cover crop harvest is flexible because it can be left in place or harvested for forage or for grain, depending on plant available soil water status and anticipated precipitation.

Objectives

- To evaluate the effects of cover crops on subsequent grain crops.
- To determine the suitability of various cover crops in different cropping systems and environments.

Materials and Methods

Western Kansas Study

- Near Garden City, Kansas
- No-tillage cropping system with two-year rotations of winter wheat/fallow, winter wheat/cover crop, or continuous winter wheat.
- Cover crop treatments were established the year following wheat harvest.

Fall Cover Crops	Spring Cover Crops
Clover (CL)	Spring lentil (L)
Clover/Winter Triticale (CLWT)	Spring lentil/Spring triticale (LST)
Winter pea (forage) (WPF)	Spring pea (SP)
Winter pea (grain) (WPG)	Spring pea/Spring triticale (SPST)
Winter pea/Winter triticale (WPWT)	Spring triticale (ST)
Winter triticale (WT)	Wheat/Fallow (Fallow)
Vetch (V)	Continuous winter wheat (WW)
Vetch/Winter triticale (VWT)	
Winter lentil (WL)	
Winter lentil/Winter triticale (WLWT)	
Wheat/Fallow (Fallow)	
Continuous winter wheat (WW)	

- Within each cover crop treatment, half the plot was harvested for forage and half was left as standing cover.
- Wheat yields and cover crop aboveground biomass were recorded.

Eastern Kansas Study

- Near Manhattan, Kansas
- No-tillage cropping system with three-year rotation of winter wheat/grain sorghum/soybean.
- Six cover crop treatments in the fallow period following wheat harvest.

Summer Cover Crops	Winter Cover Crops
Sorghum-sudangrass	Winter pea
Double-crop soybean	Canola
Late maturing soybean	
Chemical fallow	

- Five nitrogen (N) treatments within each cover crop were applied before planting grain sorghum.

0 kg	90 kg
45 kg	135 kg
	180 kg

- Biomass yields and N accumulation in the aboveground biomass were determined for each cover crop.
- Grain yields were recorded for all grain crops as well as flag leaf N and grain N for the grain sorghum.

Results – Western Kansas

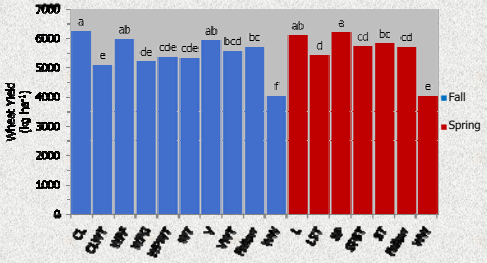

Figure 1. Western Kansas 2009 winter wheat grain yields averaged across cover crop termination treatments. Fall and spring cover crops were analyzed separately. Bars with the same letter within each group of cover crops are not different at α= 0.05.

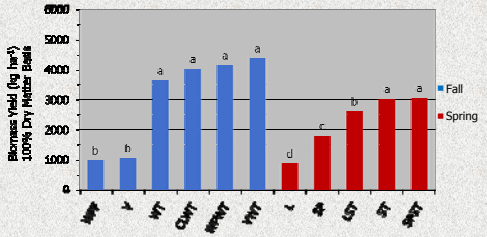

Figure 2. Western Kansas 2008 cover crop aboveground biomass yields. Fall and spring cover crops were analyzed separately. Bars with the same letter within each group of cover crops are not different at α= 0.05.

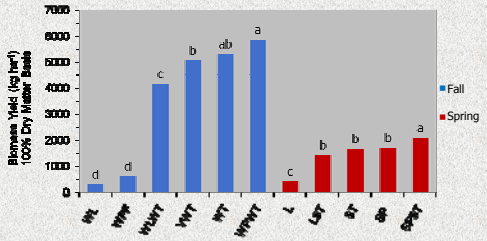

Figure 3. Western Kansas 2009 cover crop aboveground biomass yields. Fall and spring cover crops were analyzed separately. Bars with the same letter within each group of cover crops are not different at α= 0.05.

Results – Eastern Kansas

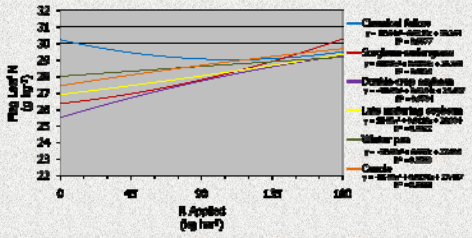

Figure 4. Eastern Kansas 2008 sorghum flag leaf N as a function of N rate and cover crop.

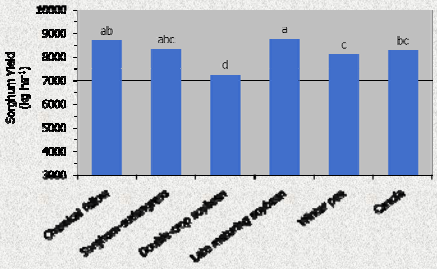

Figure 5. Eastern Kansas 2008 sorghum grain yields. Bars with the same letter are not different at α= 0.05.

Table 1. Eastern Kansas cover crop aboveground biomass and nitrogen accumulation. Values within a column with the same letter are not different at α= 0.05.

Year	2007-2008	2008-2009	2009-2010	2007-2008	2008-2009
	Biomass (kg ha^{-1})			Nitrogen Accumulation (kg ha^{-1})	
Sorghum-sudangrass	6981 a	9287 a	9095 a	114 a	84 a
Late Season Soybean	3927 b	4548 b	5626 b	114 a	88 a
Winter Pea	2685 c	110 c	--	85 b	11 b
Canola	386 d	68 c	--	28 c	2 b
	Grain Yield (kg ha^{-1})				
Double-Crop Soybean	1362	1566	--	--	--

Results cont. – Eastern Kansas

Table 2. Significance of cover crop and nitrogen effects and their interactions for flag leaf N and sorghum yield at Eastern Kansas location.

	Flag Leaf N	Sorghum Yield
Cover Crop	NS	**
Nitrogen	**	NS
Cover Crop x Nitrogen	*	NS

* Significant at α= 0.05.
** Significant at α= 0.01.

Discussion

Western Kansas Study

- Among fall-planted cover crops, wheat yields were greatest following clover (CL), winter pea (WPF), and vetch (V) (Figure 1).
- Among spring planted cover crops, wheat yields were greatest following spring lentil (L) and spring pea (SP) (Figure 1).
- Continuous winter wheat produced the least grain yield (Figure 1).
- Method of cover crop termination did not cause differences in subsequent wheat yields (data not shown).
- Wheat yields following treatments containing triticale were less than wheat yields following the fallow (Figure 1).
- Cover crop aboveground biomass was greatest in treatments containing triticale alone or in a mix with other species (Figures 2 and 3).

Eastern Kansas Study

- Grain sorghum flag leaf N content was greatest after chemical fallow and least after sorghum-sudangrass and double crop soybeans at 0 and 45 kg applied N (Figure 4).
- Sorghum flag leaf N content did not differ with preceding cover crop with 90 or more kg applied N (Figure 4).
- Sorghum grain yields showed no response to nitrogen treatments (Table 2).
- Sorghum grain yields were greatest after late maturing soybean, chemical fallow, and sorghum-sudangrass (Figure 5).
- Sorghum grain yield after double crop soybean was significantly less than after all other treatments (Figure 5).
- Sorghum-sudangrass produced the greatest amount of biomass in both years (Table 1).
- Summer cover crops produced greater amounts of biomass compared to the winter cover crops (Table 1).
- Double-crop soybean yields (Table 1) were similar to long-term yield averages reported by farmers (data not shown).

Conclusions

Western Kansas Study

- Cover crops can be grown during the fallow period without decreasing wheat yields.
- High biomass cover crops may not be as beneficial as low biomass cover crops.
- Cover crops containing triticale produced more biomass than other cover crops but resulted in less wheat yield.

Eastern Kansas Study

- Sorghum yielded more after late maturing soybean, chemical fallow, and sorghum-sudangrass than after other cover crops.
- Sorghum yielded less after double-crop soybean than after cover crops and chemical fallow.
- All cover crops in this experiment show promise for wheat/sorghum/soybean rotations.
- The large amount of biomass produced by sorghum-sudangrass made planting more difficult and slowed emergence (data not shown).

Acknowledgements

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