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Cover Crop Effects on Corn in a Corn/Soybean Rotation

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Abstract
A research study was established in 2013 in a corn and soybean rotation with cover crops planted soon after each crop harvest. A variety of complex cover crop mixtures were evaluated ranging from single-specie to 7-specie mixtures. Cover crops were terminated in the spring prior to corn planting. Corn yield responded differently among the three years of the study. In general, 2014 and 2016 showed a similar trend of decreased corn yield as the complexity of cover crop specie mixtures increased. Significant corn yield losses ranged from 8.6 to 15.1 bu/a across all cover crop treatments in 2014. In 2016, corn yield loss was 8.1, 9.7, and 12.0 bu/a for the 3-specie mix, rye, and 7-specie mix, respectively. In 2015, however, an opposite trend was observed in the trial with increasing corn yield across all cover crop treatments. A dry fall following soybean harvest resulted in poor germination of all cover crops, so no biomass accumulated prior to corn planting. Corn yield increases ranged from 10.5 to 16.4 bu/a in 2015.

Keywords
cover crop, corn, rye, radish

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Summary

A research study was established in 2013 in a corn and soybean rotation with cover crops planted soon after each crop harvest. A variety of complex cover crop mixtures were evaluated ranging from single-specie to 7-specie mixtures. Cover crops were terminated in the spring prior to corn planting. Corn yield responded differently among the three years of the study. In general, 2014 and 2016 showed a similar trend of decreased corn yield as the complexity of cover crop specie mixtures increased. Significant corn yield losses ranged from 8.6 to 15.1 bu/a across all cover crop treatments in 2014. In 2016, corn yield loss was 8.1, 9.7, and 12.0 bu/a for the 3-specie mix, rye, and 7-specie mix, respectively. In 2015, however, an opposite trend was observed in the trial with increasing corn yield across all cover crop treatments. A dry fall following soybean harvest resulted in poor germination of all cover crops, so no biomass accumulated prior to corn planting. Corn yield increases ranged from 10.5 to 16.4 bu/a in 2015.

Introduction

Cover crops are being utilized by more producers throughout Kansas. Reasons for the adoption of cover crops include reduced erosion, nutrient cycling, weed suppression, compaction alleviation, increased soil organic matter, and biological activity. Kansas State University has evaluated cover crops extensively for the last two decades in various crop rotations; however, few have evaluated the effect of cover crops in a corn/soybean rotation.

The challenge with establishing cover crops in a corn/soybean rotation is the shortened window of cover crop growing season following harvest. If cover crops are planted soon after corn harvest, there usually are one to two months of growing season in southern Kansas before the first killing freeze. However, the length of frost free days following soybean harvest is much shorter in Kansas, resulting in an even more suppressed cover crop growth. Regardless of the planting challenges, corn's response to cover crops established immediately after harvest in a corn/soybean rotation needs to be evaluated.

Procedures

The trial was initiated in 2013 at the K-State East Central experiment fields near Ottawa. In the first year of the trial, cover crops were planted after corn, but a corn/soybean rotation was implemented for future rotation. Fall plantings were established on September 27, 2013; November 3, 2014; and October 30, 2015.

Five cover crop mixtures and one unplanted check were established, ranging in species complexity (Table 1). Base species included rye and radish, but other species were interchanged depending on seed availability in that given year. Seeding rates of individual species were adjusted as the number of species in the mixture increased to avoid extremely high plant populations. Plots were 10-ft wide by 90-ft long and drilled on 7-inch spacings with a cone drill for uniform seed distribution throughout the plot.

Cover crops were terminated in late March with glyphosate plus additional corn preemergence residual herbicides. Corn was no-tilled into the standing residue on April 9, 2014; April 2, 2015; and April 7, 2016. Liquid fertilizer at a rate of 120-40-13 nitrogen-phosphorus-potassium (N-P-K) were applied with the planter as a 2 × 2 application.

Experiments were arranged in a randomized complete block design with 4 replications. Corn plots were harvested, and plot weights, moisture, and test weights were determined. Bartlett's homogeneity of variance was tested and data were analyzed using ANOVA. Means were separated by using a P value of 0.10.

Results

2014 Yields

During the first year of the study, corn yields were relatively lower, likely due to corn being the previous crop and depressed yields from lack of crop rotation. In addition, a light freeze occurred on May 16, resulting in damaged corn leaves only in the cover crop treatments. Damage was likely due to cover crop residue preventing soil heat from buffering against the cold air temperature. Corn did recover; however, below-normal precipitation fell during the months of May and July, critical periods for corn yield determination (Table 2). All cover crop treatments significantly reduced corn yield when compared to the check (Table 3). Yield losses in 2014 ranged from 8.6 to 15.1 bu/a.

2015 Yields

Cover crops were planted after the 2014 soybean harvest; however, an extremely cold and dry winter prevented any of the cover crop species from emerging. Consequently, corn was planted into bare soybean residue in 2015.

Opposite to the previous year, several cover crop treatments significantly increased yield when compared to the check. The highest yield was in the 3-specie cover crop at 136.1 bu/a, which yielded significantly greater than the rye, and check treatments at 130.1 and 119.7 bu/a, respectively (Table 3).

An extremely wet May resulted in significant denitrification as indicated by results in other nitrogen-application timing studies in southeast Kansas (Sweeney and Shoup, 2016) (Table 2). This may explain the cover crop effects in 2015 if additional organic matter from previous cover crops had mineralized later in the growing season, supplying additional nitrogen.

2016 Yields

Although cover crops had limited growth prior to termination in the spring, biomass did accumulate approximately 6 inches of growth. Favorable moisture throughout the growing season resulted in greater than average yields exceeding 145 bu/a (Table 3). Corn yields responded to cover crops in a similar way as in 2014, with decreasing yields as the species complexity increased. The check and radish treatments yielded significantly greater than the rye, 3-specie mix, and 7-specie mix. Yield losses ranged from 8.1 to 12.0 bu/a.

Table 1. Cover crop treatments and seeding rate at the Kansas State University East Central experiment fields near Ottawa, KS

Cover crop	Seeding rate (lb/a)
Unplanted check	
Cereal rye	75
Tillage radish	6
Rye + radish	60 + 4
Rye + radish + buckwheat (2014)	50 + 3 + 3
Rye + radish + alfalfa (2015)	50 + 3 + 3
Rye + radish + winter pea (2016)	50 + 3 + 20
Rye + radish + turnip + buckwheat + rapeseed + sorghum (2014)	50 + 3 + 3 + 1 + 1 + 1
Rye + radish + turnip + alfalfa + rapeseed + wheat + sorghum (2015)	50 + 3 + 1 + 3 + 1 + 20 + 1
Rye + radish + turnip + winter pea + oat + crimson clover + sorghum (2016)	50 + 3 + 1 + 20 + 20 + 3 + 1

Table 2. Total monthly rainfall at the Kansas State University East Central experiment fields near Ottawa, KS, from 2014-2016

Year	March	April	May	June	July	August	September
	------- precipitation (in.) -------						
30-yr average	2.67	3.84	5.41	5.63	4.09	4.04	4.12
2014	0.57	3.49	1.18	7.1	0.85	2.88	3.39
2015	0.58	3.45	10.65	4.37	3.27	2.33	2.83
2016	1.96	3.91	6.06	1.87	5.64	6.53	5.81

Table 3. Corn yield as affected by cover crop treatment at the Kansas State University East Central experiment fields near Ottawa, KS

	Corn yield (bu/a)		
Cover crop	2014*	2015	2016
Check	108.2 a	119.7 c	157.3 a
Radish	99.6 b	131.1 ab	158.3 a
Rye	93.1 c	130.1 b	147.5 b
Rye + radish	95.3 bc	134.7 ab	151.0 ab
3-specie mix	96.2 bc	136.1 a	149.1 b
>6-specie mix	94.9 bc	134.3 ab	145.3 b

*Means followed by the same letter are not significantly different at $P = 0.10$.