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Cover Crop Effects on Soybean in a Soybean/Corn Rotation

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Abstract

A research study was established in 2011 in a soybean and corn rotation with cover crops planted soon after each crop harvest in the fall. A variety of complex cover crop mixtures were evaluated ranging from single specie to 7 specie mixtures. Cover crops were terminated in the spring soon after anthesis of the cool season cereal in the cover crop. Soybean yield responded differently among the four years of the study. In an extreme drought year of 2012, the unplanted check yielded 29.4 bu/a. Soybean yield was significantly reduced by 4.2 and 3.4 bu/a in treatments with wheat or turnip cover crop, respectively. In 2014, the unplanted check yielded 33.9 bu/a and cover crop treatments rye, rye + radish, and >6-species mix had significantly greater soybean yield at 3.7, 3.4, and 3.3 bu/a, respectively. In 2015, only the rye cover crop treatment significantly reduced soybean yield compared to the unplanted check at a 4.2 bu/a yield loss. No significant yield differences were observed in any cover crop treatment in 2016.

Keywords

cover crop, soybean, rye, radish

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Summary

A research study was established in 2011 in a soybean and corn rotation with cover crops planted soon after each crop harvest in the fall. A variety of complex cover crop mixtures were evaluated ranging from single specie to 7 specie mixtures. Cover crops were terminated in the spring soon after anthesis of the cool season cereal in the cover crop. Soybean yield responded differently among the four years of the study. In an extreme drought year of 2012, the unplanted check yielded 29.4 bu/a. Soybean yield was significantly reduced by 4.2 and 3.4 bu/a in treatments with wheat or turnip cover crop, respectively. In 2014, the unplanted check yielded 33.9 bu/a and cover crop treatments rye, rye + radish, and >6-species mix had significantly greater soybean yield at 3.7, 3.4, and 3.3 bu/a, respectively. In 2015, only the rye cover crop treatment significantly reduced soybean yield compared to the unplanted check at a 4.2 bu/a yield loss. No significant yield differences were observed in any cover crop treatment in 2016.

Introduction

Cover crops are being used by more producers throughout Kansas. Reasons for the adoption of cover crops include reduced soil 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 studies have evaluated the effect of cover crops in a soybean/corn rotation.

Kansas has a diverse geography, with many of the soybean/corn crop rotations occurring in the eastern third of the state. There can be quite a range in growing season from south to north, with an average of 25-days difference from the last freeze in the spring to the first frost in the fall. These 25 days can impact the amount of fall growth a cover crop can establish before winter sets in. While it is a challenge to establish cover crops after soybean harvest, it is more likely to be successful following corn harvest prior to soybean planting the following spring. Regardless of the planting challenges, soybean's response to cover crops established immediately after corn harvest in a soybean/corn rotation needs to be evaluated.

Procedures

This trial was initiated in 2011 after corn harvest at the K-State East Central experiment field near Ottawa. Fall plantings were established on September 13, 2011; September 27, 2013; September 23, 2014; and September 11, 2015.

Five cover crop mixtures and one unplanted check were established, ranging in species complexity (Table 1). In the first year of the study, mostly single species were used, but in subsequent years, more complex mixtures replaced the original treatment structure. In general, rye and/or radish were the base species for each treatment, 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 just after anthesis of the cool season cereal in late April with glyphosate plus additional soybean burndown herbicides. Soybean was no-tilled into the standing residue on May 29, 2012; May 22, 2014; June 10, 2015; and June 6, 2016.

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

Results

2012 Yields

During the first year of the study, soybean yields were below average due to extremely dry conditions in June, July, and August; only 1.78 inches of rain fell across those three months (Table 2). The unplanted check yielded the highest across all cover crop treatments, with an average of 29.4 bu/a (Table 3). The two cover crop treatments that had significantly lower yield than the check were the wheat and the turnip treatments, which reduced yield by 4.2 and 3.4 bu/a, respectively. Reduction in yield was likely due to the cover crop using soil moisture that could have maintained the soybean plant later in the growing season.

2014 Yields

Opposite to the previous year, several cover crop treatments significantly increased yield when compared to the unplanted check. The highest soybean yields were observed after rye, rye + radish, and the >6-specie mix treatment, with 37.6, 37.3, and 37.2 bu/a, respectively (Table 3). Two treatments that yielded significantly lower than the top yielding cover crop treatments were the unplanted check and the radish, at 33.9 and 31.7 bu/a, respectively.

2015 Yields

Excellent yields were observed in 2015, with 2.3 to 4.4 inches of precipitation falling each month from June to September (Table 2). Only one cover crop treatment significantly reduced yield, with the soybean planted after rye yielding 49.4 bu/a compared to the unplanted check at 53.6 bu/a (Table 3).

2016 Yields

Record soybean yields were achieved in Kansas in 2016. The unplanted check yielded 60.2 bu/a (Table 3). No significant differences among all cover crop treatments were observed.

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

Cover crop	Seeding rate (lb/a)
Unplanted check	---
Wheat (2012)	100
Cereal rye (2014-2016)	75
Radish (2012, 2014-2016)	6
Turnip (2012)	4
Rye + radish (2014-2016)	60 + 4
Canola (2012)	5
Rye + radish + buckwheat (2014)	50 + 3 + 3
Rye + radish + alfalfa (2015)	50 + 3 + 3
Rye + radish + winter pea (2016)	50 + 3 + 20
Wheat + radish + winter pea (2012)	20 + 1 + 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 from 2012 and 2014-2016

Year	March	April	May	June	July	August	September
	precipitation (in.)						
30-year average	2.67	3.84	5.41	5.63	4.09	4.04	4.12
2012	4.7	1.6	3.8	0.0	1.2	0.6	3.4
2014	0.6	3.5	1.2	7.1	0.9	2.9	3.4
2015	0.6	3.5	10.7	4.4	3.3	2.3	2.8
2016	2.0	3.9	6.1	1.9	5.6	6.5	5.8

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

	Soybean yield (bu/a)			
Cover crop	2012*	2014	2015	2016
Check	29.4 a	33.9 b	53.6 a	60.2 a
Radish	--- ---	31.7 b	54.3 a	59.4 a
Rye	25.2 b	37.6 a	49.4 b	60.3 a
Rye + radish	26.0 b	37.3 a	52.3 a	59.6 a
3-specie mix	27.6 ab	35.7 ab	51.8 ab	59.3 a
>6-specie mix	27.4 ab	37.2 a	51.6 ab	59.0 a

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