

Cover Crop Effects on Soybean in a Soybean/Corn Rotation

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Procedures

The trial was initiated in 2011 after corn harvest at the K-State East Central experiment field near Ottawa and in 2015 at the K-State Ashland Bottoms research farm near Manhattan. Fall plantings were established on September 13, 2011; September 27, 2013; September 23, 2014; September 11, 2015; and October 20, 2016.

Table 1. Cover crop treatments and seeding rate at the K-State experiment fields near Ottawa and Ashland Bottoms.

Cover crop	Seeding rate (lb/a)
Unplanted check	-
Wheat (2012)	100
Cereal rye (2014-2016)	75
Triticale was substituted for all rye treatments (2017)	75
Radish (2012, 2014-2017)	6
Turnip (2012)	4
Rye + radish (2014-2016, triticale for rye in 2017)	60 + 4
Canola (2012)	5
Rye + radish + buckwheat (2014)	50 + 3 + 3
Rye + radish + alfalfa (2015)	50 + 3 + 3
Rye + radish + winter pea (2016, triticale for rye in 2017)	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, triticale for rye in 2017)	50 + 3 + 1 + 20 + 20 + 3 + 1

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; June 6, 2016; and May 5, 2017. Prior to cover crop termination in the first week of May at both locations, soil samples were taken to a 6-in depth in each plot. Samples were shipped to Ward Labs in Kearney, NE where samples were analyzed for traditional soil analysis, Haney analysis, Solvita analysis, and PFLA microbial analysis.

PRECIPITATION. Total monthly rainfall at the K-State experiment fields near Ottawa 2012 and 2014-2017.

Year	March	April	May	June	July	August	September
	precipitation (in.)						
30-year average	2.7	3.8	5.4	5.6	4.1	4.0	4.1
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

SOYBEAN. Soybean yield as affected by cover crop treatment at the K-State experiment fields near Ottawa and Ashland.

Cover crop	Soybean yield (bu/a)					
	2012*	2014	2015	2016 Ottawa	2016 Ashland	
Check	29.4 a	33.9 b	53.6 a	60.2 a	67.3 a	
Radish	- -	31.7 b	54.3 a	59.4 a	69.9 a	
Rye	25.2 b	37.6 a	49.4 b	60.3 a	71.3 a	
Rye + radish	26.0 b	37.3 a	52.3 a	59.6 a	72.1 a	
3-specie mix	27.6 ab	35.7 ab	51.8 ab	59.3 a	64.2 a	
>6-specie mix	27.4 ab	37.2 a	51.6 ab	59.0 a	69.8 a	

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

CORN. Corn yield as affected by cover crop treatment at the KSU East Central Experiment Field near Ottawa.

Cover crop	Corn yield (bu/acre)		
	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

SOIL NUTRIENTS. Soil characteristics as affected by cover crop treatments at K-State experiment fields near Ottawa and Ashland Bottoms. Soil samples to a 6-inch depth were taken the first week of May, 2017 prior to cover crop termination.

Location	Treatment	Soil pH	Organic Matter %	Phosphorus ppm	Potassium ppm	Traditional Nitrogen Lb/ac	Haney Test Nitrogen Lb/ac	Organic C:N	Soil Health Calculation
Ottawa	Check	6.4 b	3.1 c	34 a	120 b	5 bc	44 a	12 a	15 a
Ottawa	Radish	6.6 a	3.2 c	32 a	129 a	6 a	45 a	11 a	17 a
Ottawa	Triticale	6.6 a	3.4 a	33 a	123 ab	4 c	47 a	12 a	17 a
Ottawa	Triticale and radish	6.5 ab	3.4 a	28 a	117 b	5 ab	46 a	12 a	18 a
Ottawa	Triticale, radish, winter pea	6.6 a	3.2 bc	28 a	118 b	6 ab	44 a	12 a	16 a
Ottawa	Triticale, oat, radish, turnip, winter pea, crimson clover, sorghum	6.6 a	3.3 ab	28 a	127 a	5 bc	44 a	11 a	16 a
Manhattan	Check	6.1 a	2.7 c	11 a	290 a	6 a	22 a	16 a	6 a
Manhattan	Radish	6.2 a	2.8 b	10 a	279 a	3 a	15 a	18 a	6 a
Manhattan	Triticale	6.1 a	2.9 a	11 a	270 a	6 a	19 a	18 a	7 a
Manhattan	Triticale and radish	6.2 a	2.8 b	7 a	249 a	4 a	17 a	18 a	6 a
Manhattan	Triticale, radish, winter pea	6.2 a	2.8 ab	9 a	283 a	7 a	22 a	18 a	7 a
Manhattan	Triticale, oat, radish, turnip, winter pea, crimson clover, sorghum	6.2 a	2.8 ab	8 a	266 a	5 a	16 a	18 a	6 a

SOIL MICROBIAL CHARACTERISTICS. Biological soil analysis (PFLA) and Solvita analysis on soil as affected by cover crop treatments at the K-State Experiment Field in Ottawa (2015-2017) and Ashland Bottoms (2017). Soil samples were taken prior to spring cover crop termination ahead of soybean planting. LSD (P=.10)

Treatment	Year	Total Biomass	Diversity Index	Arbusular Mycorrhizal %	Fungi:Bacteria	Solvita CO2
		ng/g		% of total	ratio	ppm
Check	2015	2461 a	1.5 a	2.4 a	0.17 a	45 b
Radish	2015	1965 a	1.4 a	1.9 a	0.14 a	41 b
Rye	2015	2280 a	1.5 a	2.6 a	0.16 a	58 a
Rye and radish	2015	1830 a	1.5 a	2.1 a	0.18 a	50 ab
Rye, radish, alfalfa	2015	3098 a	1.5 a	2.4 a	0.19 a	50 ab
Radish, turnip, pasja, rye, wheat, alfalfa, sorghum	2015	2487 a	1.5 a	2.5 a	0.18 a	57 a

Treatment	Year	Total Biomass	Diversity Index	Arbusular Mycorrhizal %	Fungi:Bacteria	Solvita CO2
		ng/g		ratio	ratio	ppm
Check	2016	3075 a	1.5 a	2.4 a	0.20 a	101 a
Radish	2016	2915 a	1.4 a	2.5 a	0.17 a	109 a
Rye	2016	2166 a	1.6 a	3.0 a	0.20 a	105 a
Rye and radish	2016	2150 a	1.5 a	2.5 a	0.18 a	96 a
Rye, radish, winter pea	2016	2408 a	1.5 a	2.9 a	0.19 a	113 a
Rye, radish, winter pea, turnip, oat, crimson clover, sorghum	2016	1863 a	1.3 a	1.9 a	0.12 a	103 a

Location	Treatment	Total Microb		Diversity		Total		Total		Fungi:Bacteria	Solvita				
		Biomass	ng/g	Index		Bacteria	Fungi	Mycorrhizal	CO ₂ ppm						
Ottawa 2017	Check	2787	a	1.6	a	45	a	10	a	2	a	0.22	ab	136	a
Ottawa 2017	Radish	2675	a	1.6	a	49	a	11	a	3	a	0.22	ab	146	a
Ottawa 2017	Triticale	2423	a	1.6	a	54	a	13	a	4	a	0.23	a	148	a
Ottawa 2017	Triticale and radish	2964	a	1.4	a	52	a	8	a	2	a	0.15	c	162	a
Ottawa 2017	Triticale, radish, winter pea	4076	a	1.6	a	51	a	12	a	3	a	0.24	a	142	a
Ottawa 2017	Triticale, oat, radish, turnip, winter pea, crimson clover, sorghum	2200	a	1.5	a	55	a	10	a	3	a	0.18	bc	136	a
Ashlnd 2017	Check	1490	a	1.5	a	51	a	9	a	2	a	0.18	a	58	a
Ashlnd 2017	Radish	2549	a	1.5	a	43	a	12	a	1	a	0.27	a	64	a
Ashlnd 2017	Triticale	3087	a	1.5	a	46	a	9	a	2	a	0.21	a	83	a
Ashlnd 2017	Triticale and radish	2207	a	1.5	a	49	a	11	a	2	a	0.22	a	69	a
Ashlnd 2017	Triticale, radish, winter pea	1999	a	1.5	a	47	a	9	a	2	a	0.19	a	86	a
Ashlnd 2017	Triticale, oat, radish, turnip, winter pea, crimson clover, sorghum	1937	a	1.5	a	55	a	10	a	2	a	0.18	a	55	a