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Cover Crops and Crop Nutrients

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With input from Peter Tomlinson

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Text **KSU** to **22333** once to join

How many years have you planted cover crops?


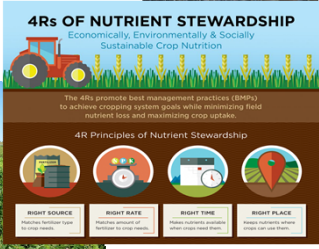


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Why Cover crops?

- Cover crops have been used to enhance the sustainability of cropping systems (Lu et al. 2000)
 - Improving soil quality and health
 - Reducing environmental pollution
 - Soil erosion
 - Nutrient leaching
 - Nutrient runoff, etc.
 - Enhancing nutrient cycling
 - Reducing N losses

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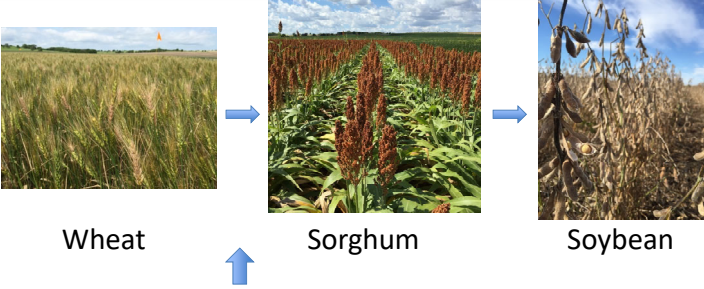
Cover crops and nutrients

- Grow it: Legumes fix atmospheric N
- Bring it: On sandy soils especially, any cover crop can be used to scavenge N and keep it from leaching from the soil profile
- Keep it: Cover crops slow runoff, so this deters sediment-bound nutrients from leaving the field as easily
- Speed it: Will a healthier soil (more microbes, more diversity) lead to more rapid nutrient cycling?

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Crop rotation



Wheat Sorghum Soybean

- Chemical Fallow (CF)
- Double Crop Soybean (DSB)
- Summer non-legume (SL) – sorghum-sudan
- Summer legume (SNL) – forage soybean
- Winter non-legume (WL) – radish
- Winter legume (WNL) – crimson clover

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Cover crop	Dry matter (ton ac ⁻¹)	N content (lb ac ⁻¹)	C:N ratio
----- 2013 -----			
Summer legume	0.6 b†	42.3 b	14:1b
Summer non-legume	2.6 a	60.3 a	39:1a
----- 2014 -----			
Summer legume	1.5 b	88.5 a	16:1b
Summer non-legume	2.7 a	67.3 b	39:1a
Winter legume	1.3 bc	70.9 b	18:1b
Winter non-legume	1.1 c	37.7 c	24:1c
----- 2015 -----			
Summer legume	3.4 b	256 a	14:1b
Summer non-legume	6.0 a	147 b	45:1a
Winter legume	1.3 c	73.5 c	17:1b
Winter non-legume	0.7 c	28.7 c	17:1b

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Objective

Determine how legacy effects of legume and non-legume summer and winter cover crops between wheat and sorghum impact:

- N availability in the cropping system
- Yield response of sorghum to N fertilization




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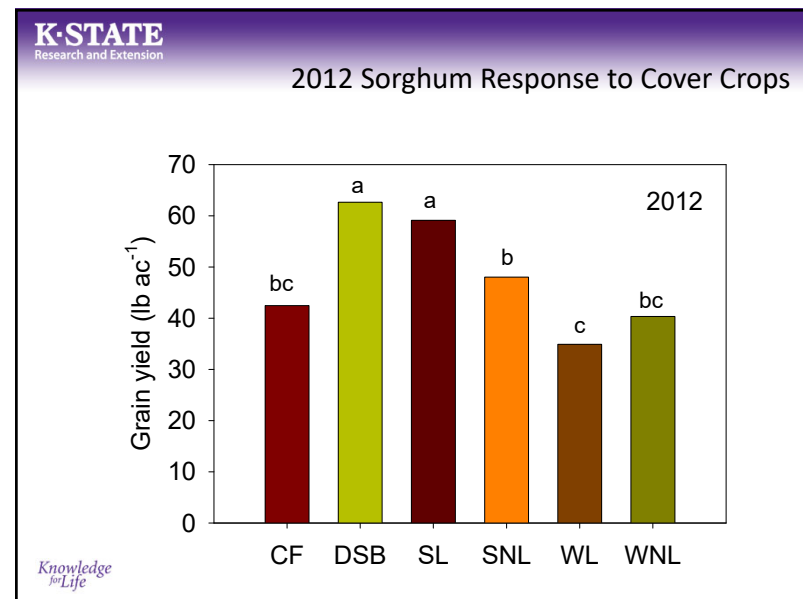
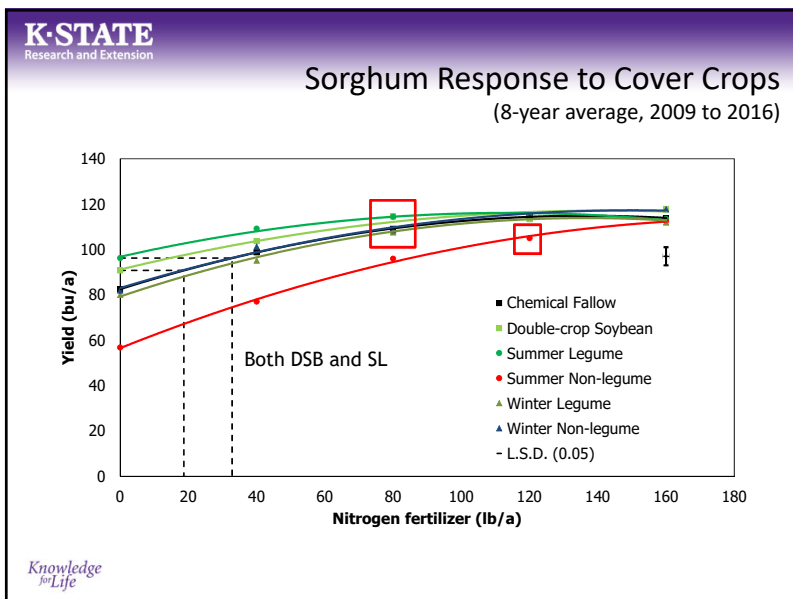
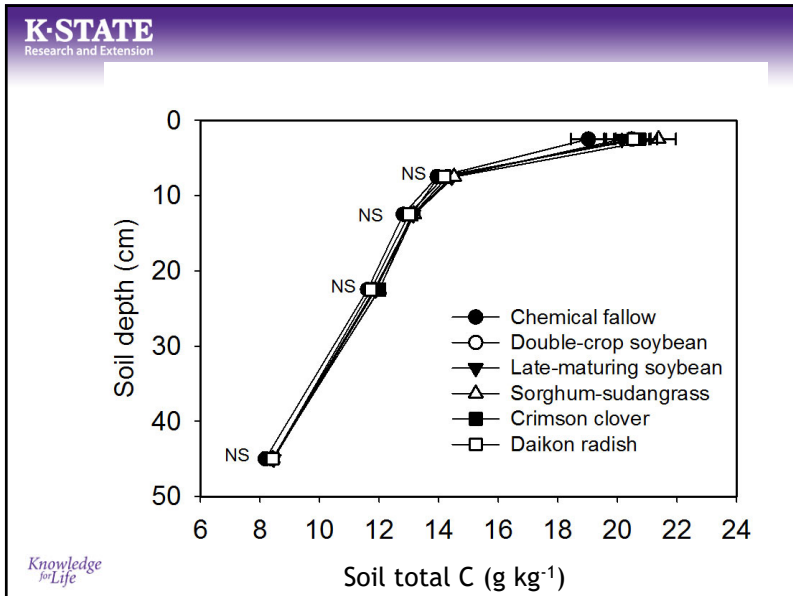
Sorghum Planting and Fertility

N fertilizer management

- 0, 40, 80, 120, & 160 lbs N ac⁻¹
- 28% UAN subsurface banded
- Straight flat-coulters liquid fertilizer applicator
- Following sorghum planting



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N Fertilizer Replacement Value

Cover crop treatment	Mean grain yield at 0 N rate (bu/ac)	Fertilizer N equivalent credit (lb N/ac)	Fertilizer N value @ \$0.33/lb N (\$/ac)
Chemical fallow	88 b	-	-
Double-crop soybean	91 b	8 b	2.64
Summer legume	100 a	30 a	9.90
Summer non-legume	64 c	-45 c	-14.85
Winter legume	87 b	-1 b	-0.33
Winter non-legume	87 b	-3 b	-0.99

¹Means with different letters within columns are significantly different (LSD=0.05)

- Regression equation of grain yield for chemical fallow as a function of N fertilizer rate
- Solved the equation substituting the mean grain yield at 0-N for each cover crop treatment

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N Fertilizer Replacement Value

Cover crop treatment	Mean grain yield at 0 N rate (bu/ac)	Fertilizer N equivalent credit (lb N/ac)	Fertilizer N value @ \$0.90/lb N (\$/ac)
Chemical fallow	88 b	-	-
Double-crop soybean	91 b	8 b	7.20
Summer legume	100 a	30 a	27.00
Summer non-legume	64 c	-45 c	-40.50
Winter legume	87 b	-1 b	-0.90
Winter non-legume	87 b	-3 b	-2.70

¹Means with different letters within columns are significantly different (LSD=0.05)

- Regression equation of grain yield for chemical fallow as a function of N fertilizer rate
- Solved the equation substituting the mean grain yield at 0-N for each cover crop treatment

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What are your main reasons for planting cover crops?



- To fix nitrogen
- To be more sustainable (such as less erosion, store carbon in soil, etc.)
- For grazing
- Weed control
- More than one of these reasons

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Management Implications

- Cover crop selection and N management will impact sorghum productivity
 - Potential to replace a portion of cash crop N requirement with summer legume cover crops
 - 30 lbs N/ac contributed by late maturing soybeans
 - High C:N ratio cover crop such as sorghum-sudangrass, will required additional N input.

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Management Implications

- Although no significant improvement on N supply with winter cover crops, there may be other potential benefits.
 - Reduce potential N losses
- N rate to optimize sorghum yields (8-yr avg) after:
 - SNL: ~ 120 lbs N ac⁻¹
 - Other cover crops and DSB: ~ 80 lbs N ac⁻¹

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EFFECTS OF LATE-MATURING SOYBEAN AND SUNN HEMP SUMMER COVER CROPS AND NITROGEN RATE IN A NO-TILL WHEAT-GRAIN SORGHUM ROTATION

<https://newprairiepress.org/cgi/viewcontent.cgi?article=3381&context=kaesrr>

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Cover crops at Hesston

- From mid 1990's to 2009, much research on legume cover crops done at Hesston Experiment Field by Dr. Mark Claassen
- Grew wheat-sorghum, with cover crops in between
- For 8 years he used hairy vetch, but changed because of cost, availability of seed, interference with control of volunteer wheat and winter annual weeds, and possibility of hairy vetch becoming a weed in wheat after sorghum
- Benefit of hairy vetch was large amounts of dry matter that produced 100 lbs of N

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Hesston cover crops

- Wheat-no cover-sorghum
- Wheat-late soybeans as a cover-sorghum
- Wheat-sunn hemp as a cover-sorghum
- Soybean produced 3.68 ton/ac dry matter with N content of 2.64% or 195 lb/ac N
- Sunn hemp produced 4.13 ton/ac dry matter with N content of 1.78% or 146 lb/ac N
- Both provided 91-100% weed control

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N rates

- There was also an N rate component of this study, with 0, 30, 60, and 90 lb N/ac applied to the grain sorghum
- Late-maturing soybean increased grain sorghum yields at N rates of 60 lb/a or less, but generally had no yield benefit vs. no cover crop when N rate increased to 90 lb/a.
- Sunn hemp tended to increase yields of sorghum at all N rates, although to a lesser extent at the highest N level. When averaged over N rate, the 25 Harvey County Experiment Field long-term grain sorghum yield benefits from late-maturing soybean and sunn hemp amounted to 8.8 and 14.9 bu/a, respectively.

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Table 1. Effects of soybean and sunn hemp summer cover crops and nitrogen rate on no-till grain sorghum after wheat, Hesston, KS, 2009

Cover crop ¹	Cover crop yield ¹			Grain Sorghum						
	N Rate ² lb/a	Forage N ton/a	Forage N lb/a	Yield ⁴		Test weight lb/bu	Stand 1,000 s/a	Half-bloom ⁵ days	Heads/plant no.	Leaf N ⁶ %
				2009 bu/a	6-year avg. bu/a					
None	0	---	---	75.2	62.7	55.1	34.6	63	1.13	2.17
	30	---	---	102.5	80.1	56.5	34.5	61	1.30	2.45
	60	---	---	109.2	93.3	57.2	33.8	61	1.37	2.46
	90	---	---	114.7	98.8	56.6	34.8	61	1.44	2.59
Soybean	0	3.75	201	116.5	80.5	57.1	35.0	60	1.41	2.45
	30	3.59	204	119.3	91.2	57.2	36.2	60	1.38	2.50
	60	3.93	203	118.6	100.4	57.2	36.4	60	1.35	2.53
	90	3.47	172	113.6	97.7	56.8	35.3	61	1.45	2.50
Sunn hemp	0	4.45	147	110.2	89.1	57.1	36.7	60	1.26	2.29
	30	3.81	142	114.8	96.3	57.0	36.1	61	1.32	2.59
	60	3.90	149	118.3	103.4	56.6	35.7	61	1.37	2.37
	90	4.35	145	119.7	105.7	57.2	35.4	60	1.46	2.69
LSD (0.05)	0.91	45		12.8		1.0	1.4	1.9	0.14	0.22
Means:										
Cover crop										
None	---	---		100.4	83.7	56.4	34.4	61	1.31	2.42
Soybean	3.68	195		117.0	92.5	57.1	35.7	60	1.40	2.49
Sunn hemp	4.13	146		115.7	98.6	57.0	36.0	60	1.35	2.48
LSD (0.05)	0.46	23		6.4		0.5	0.7	0.9	0.07	NS
N rate										
0	4.10	174		100.6	77.4	56.5	35.4	61	1.27	2.30
30	3.70	173		112.2	89.2	56.9	35.6	61	1.33	2.51
60	3.92	176		115.3	99.0	57.0	35.3	61	1.37	2.45
90	3.91	159		116.0	100.7	56.9	35.2	60	1.45	2.59
LSD (0.05)	NS	NS		7.4		NS	NS	NS	0.08	0.13

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Table 2. Residual effects of soybean and sunn hemp summer cover crops and nitrogen rate on no-till wheat after grain sorghum, Hesston, KS, 2009

Cover crop ¹	Cover crop yield ³			Wheat						
	N rate ² lb/a	Forage N ton/a	Forage N lb/a	Sorghum yield			Yield ⁴			
				2008 bu/a	2009 bu/a	5-year avg. bu/a	Test weight lb/bu	Plant height in.	Plant N ⁵ %	
None	0	---	---	69.4	7.7	59.6	19	1.32		
	30	---	---	91.8	15.0	19.7	60.1	23	1.09	
	60	---	---	115.6	27.5	29.5	59.9	29	1.11	
	90	---	---	125.3	36.7	35.7	60.1	30	1.36	
Soybean	0	0.49	32	72.2	7.6	10.5	59.8	19	1.36	
	30	1.05	63	106.5	18.7	22.7	60.1	25	1.12	
	60	1.25	76	125.2	30.5	32.2	60.2	30	1.24	
	90	1.46	88	125.9	35.8	35.9	60.0	30	1.37	
Sunn hemp	0	3.26	160	102.8	11.9	11.2	59.7	21	1.20	
	30	3.29	150	117.8	21.7	24.1	59.8	26	1.12	
	60	3.96	202	130.6	31.5	32.2	60.4	30	1.28	
	90	3.51	149	129.7	38.4	36.6	60.0	31	1.61	
LSD (0.05)	0.96	57		12.0	4.6		NS	3	0.17	
Means:										
Cover crop										
None	---	---		100.5	21.7	23.1	59.9	25	1.22	
Soybean	1.06	65		107.5	23.1	25.3	60.0	26	1.27	
Sunn hemp	3.50	165		120.2	25.9	26.0	60.0	27	1.30	
LSD (0.05)	0.48	28		6.0	2.3		NS	1	NS	
N rate										
0	1.87	96		81.5	9.0		59.7	20	1.29	
30	2.17	106		105.4	18.5	9.8	60.0	25	1.11	
60	2.60	139		123.8	29.8	22.2	60.2	29	1.21	
90	2.48	118		127.0	36.9	31.3	60.0	30	1.44	
LSD (0.05)	NS	NS		7.0	2.7	36.1	NS	1	0.10	

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So does it pay?

- Does the N contribution of the cover crop save you from applying some N, and does that outweigh the cost of the cover crop seed?
- Depends on the cost of the cover crop seed and the price of N.
- And what's available.
- And cost-share programs for planting cover crops.
- And other programs such as carbon markets which reward planting cover crops.

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How many lbs of N do you think you have fixed with cover crops on your farm?



- 0
- 1-10 lbs per acre
- 11-25 lbs per acre
- 26-50 lbs per acre
- More than 50 lbs per acre
- I'm not really sure

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MIDWEST COVER CROPS COUNCIL SELECTOR TOOL

<https://mccc.msu.edu/>

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MCCC - The goal of the Midwest: [mccc](https://mccc.msu.edu)

<https://mccc.msu.edu>

Midwest Cover Crops Council

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Cover Crop Decision

MCCC Revises Decision Tool

Click the photos for our updated tool, video tutorial, and CEER webinar.

- What is a cover crop? [Read more](#)
- MCCC Calendar of Events [Read more](#)
- 3rd Edition Field Guide Available Soon! [Read more](#)

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<https://mccc.msu.edu/covercroptool/>

Cover Crop Decision Tool

Start with where is your farm?
Kansas | Ellsworth

Tell us your goals
Nitrogen Source

Unit Fertil

[Show current cash crop regions](#)

[Show statewide regions](#)

Cover crop type options
 Display cover crop Group cover crops by type

Available Cover Crops

Planting periods: Reliable Establishment Freeze/Moisture Risk to Establishment

Goal fulfillment: Excellent Very good Good Fair Poor

Cover Crop	Type	Jan 1	Apr 1	May 1	Jun 1	Jul 1	Aug 1	September 1	October 1
Annual Ryegrass	Grass	Excellent	Very good	Good	Fair	Poor			

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N from legume cover crops

- 4: Cowpeas: 10-80 lbs
- 4: Sunn hemp: 20-120 lbs N
- 4: Sweetclover: 5-50 lbs N
- 4: Hairy vetch: 5-100 lbs N

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N from legume cover crops

- 3: Mung beans: 10-80 lbs N
- 3: Red clover: 5-100 lbs N
- 3: Spring field pea: 5-50 lbs N
- 3: Winter pea: 5-60 lbs N
- 3: Soybeans: 10-75 lbs N
- 3: Chickling vetch: 5-50 lbs N
- 3: Common vetch: 5-50 lbs N

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N from legume cover crops


- 2: Crimson clover: 5-70 lbs N
- 2: Guar: 2-120 lbs N
- 2: Spring lentils: 5-20 lbs N
- 2: Winter lentils: 5-20 lbs N

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N release

- Decomposition of cover crops and nutrient release is still actively being researched



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Sensors and decomp bags

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Decomposition and N-release

- Clip cover crops right before we spray them out
- Stuff a known amount into the bag, stake them to the ground
- Pick them up every 2-4 weeks
- Samples are being analyzed for C, N, ash, etc. and along with the mass and the soil temperature and moisture data, will be used in the development/refinement of nutrient availability models

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Please type in your favorite cover crops that you have used



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