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Cover Crops and Crop Nutrients

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With input from Peter Tomlinson

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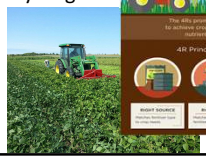
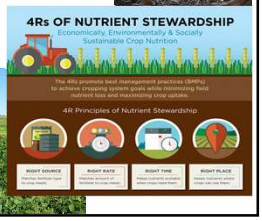
Why Cover crops?

- 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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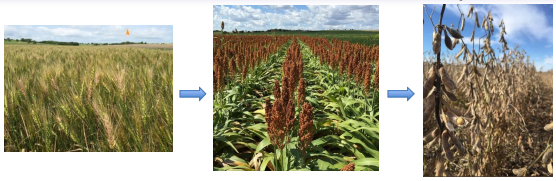
Crop rotation



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-coulter liquid fertilizer applicator
- Following sorghum planting

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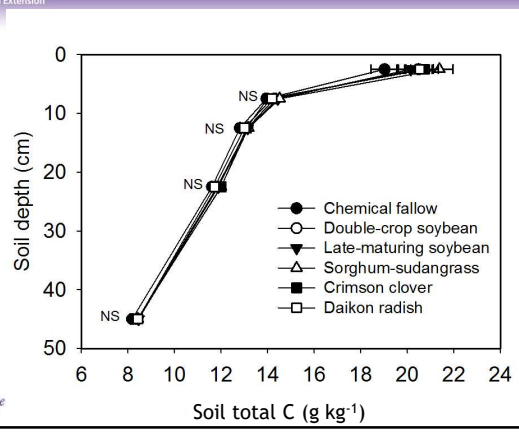

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Nitrogen Response

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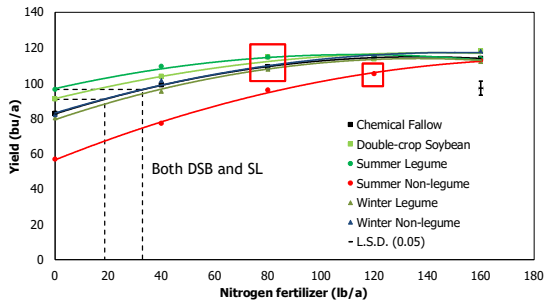
Sorghum Response to Cover Crops
(8-year average, 2009 to 2016)



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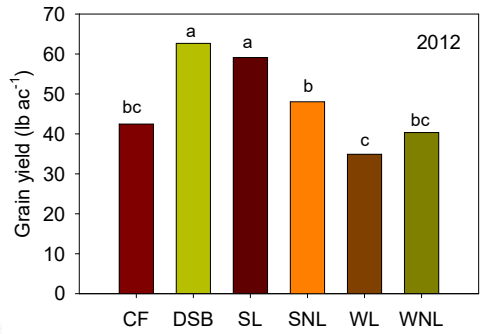
2012 Sorghum Response to Cover Crops



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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

[1]Means 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

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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

[1]Means 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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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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MIDWEST COVER CROPS COUNCIL SELECTOR TOOL

https://mccc.msu.edu/

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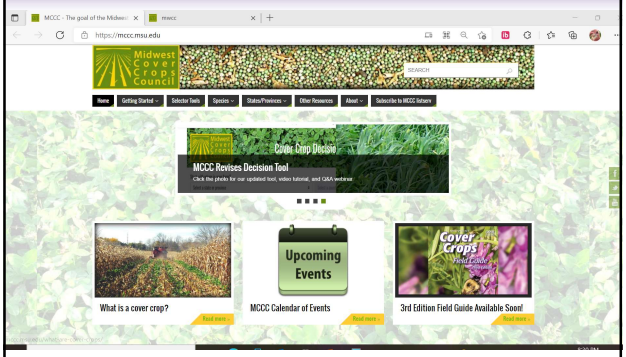

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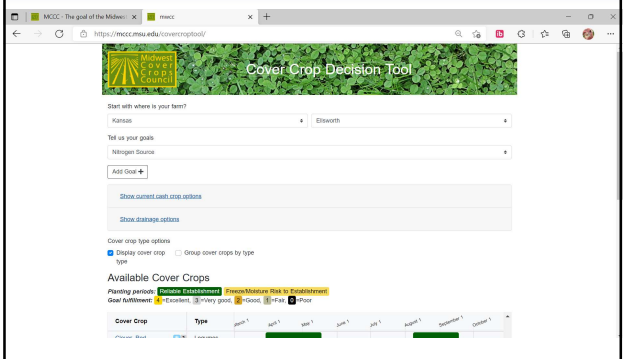

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N from legume cover crops

- 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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