Midwest Cover Crops Council
2020 Kansas Report

State Representative Information:
Name: DeAnn Presley
Organization: Kansas State University
Email: deann@ksu.edu
Phone: 785-532-1218

Research: New and continued research on cover crops in a variety of crop rotations is occurring at several sites in Kansas. Some of the projects include:

- Chuck Rice – USDA NIFA water cap grant. Advisor to Soil Health Partnership, farmer's standard practices plus one new management. Validation and correlation of Haney and Cornell soil health tests.
- Lucas Haag – Rotation intensification. Colorado State CIG, covers for grazing, two years of data, 4 sites in Kansas. Spring and summer plantings.
- Kraig Roozeboom – Study initiated in 2007, continuing to present, at Ashland Bottoms. Wheat, Grain Sorghum, double crop Soybeans. Intensive insertion of cover crops. Kansas Agricultural Watershed and soybean diseases.
- Nathan Nelson – Kansas Agricultural Watershed (KAW) site, cropping system impacts on water quality, cover crops and fertilizer management and sediment loss, nutrient cycling, soil fertility, soil health parameters. National CIG for water quality and Soil Health – long term No-Till.
- Peter Tomlinson – Kansas Agricultural Watershed site, cropping system impacts on greenhouse gas emissions from agriculture, soil biological measurements. On-farm study to evaluate cover crop options ahead of cotton in south central Kansas.
- DeAnn Presley –Collaboration with N. Nelson and others on the KAW project. Collaboration on large project called Precision Sustainable Agriculture, http://precisionsustainableag.org/ which includes five locations in Kansas.
- Stu Duncan – Brown, Doniphan counties. Highland Community College. 10 treatments, three replications, in a corn-soybean rotation – winter cover. Profile sample out of each plot. Collaborator with P. Tomlinson on new cover crops in cotton project in south central Kansas.
- Dan Devlin – USDA NIFA Water Cap. Grazing of cover crops.
- Gretchen Sassenrath – State CIG – precision conservation using cover crops to improve soil health and profitability, and control weeds; Grazing of cover crops, biomass production of different cover crops in southeast Kansas for extended grazing period, in collaboration with J. Farney. No-Till in SE KS. Focus on Soil Health, No-Till, Cover Crops, soil-borne diseases in soybeans and wheat. Demonstration of Soil Health.
- Augustine Obour – Cover crops in W-S-F – spring planted using as forage – Hay, graze, no graze. Summer planting after wheat. Sorghum replacement. W-SF-CC for sorghum replacement. BD, penetrometer, soil water at planting and termination, soil biology, SOC, Colby – glyphosate resistant weeds. New NCR-SARE funded cover crop research (started in fall 2018).
- John Holman – 12th year – soil water soil organic matter, carbon. Weed suppression, 3years and nine site years of data. Hay or graze – H_2O use efficiency.
- Anita Dille – on farm studies on cover crops and weed suppression.
- Jaymelynn Farney – Animal scientist, grazing cover crops, toxic plants.

Funding for research provided by:
- Kansas Crop Improvement Association
- Kansas Soybean Commission
- USDA NIFA Hatch
- NCR-SARE
- Kansas Corn Commission
- 4R Research Fund
- USDA-NRCS
- Foundation for Food and Agricultural Research (FFAR)
- Kansas Department of Agriculture Division of Conservation
- Kansas Fertilizer Research Fund

Peer-reviewed publications during the reporting period:

Carver, E., N.O. Nelson, K.L. Roozeboom, and M.B. Kirkham. 2020. Species and Termination Method Effects on Phosphorus Loss from Plant Tissue. J. Environ. Qual. (in-press). https://doi.org/10.1002/jeq2.20019

Duncan, E. W., D. L. Osmond, A. L. Shober, L. Starr, P. Tomlinson, J. L. Kovar, T. B. Moorman, H. M. Peterson, N. M. Fiorellino, K. Reid. 2019. Phosphorus and Soil Health Management Practices. Agricultural & Environmental Letters 4 (1). doi:10.2134/ael2019.04.0014.

Fontes GP, Tomlinson PJ, Roozeboom KL, Warren J, Diaz DR. Nitrogen fertilization offsets the N2O mitigating effects of cover-crops and double-crop soybean in a wheat-sorghum system. Agron J. Accepted 12/2019. https://doi.org/10.1002/agj2.20095

Reports of Progress (non-peer reviewed):

Chism, L. I.; Dille, J. A.; and Sassenrath, G. F. (2019) "Using Cover Crops as an Effective Weed Control Method in Southeast Kansas," *Kansas Agricultural Experiment Station Research Reports*: Vol. 5: Iss. 2. https://doi.org/10.4148/2378-5977.7743

Farney, J. K. (2019) "Cattle Preference for Annual Forages," *Kansas Agricultural Experiment Station Research Reports*: Vol. 5: Iss. 2. https://doi.org/10.4148/2378-5977.7732

Farney, J. K. and Sassenrath, G. F. (2019) "Evaluating Single and Multi-Species Summer Cover Crops for Biomass Yield," *Kansas Agricultural Experiment Station Research Reports*: Vol. 5: Iss. 2. https://doi.org/10.4148/2378-5977.7733

Holman, J.; Obour, A.; Schlegel, A.; Roberts, T.; and Maxwell, S. (2019) "Determining Profitable Forage Rotations," *Kansas Agricultural Experiment Station Research Reports*: Vol. 5: Iss. 7. https://doi.org/10.4148/2378-5977.7806

Obour, A. K.; Holman, J. D.; Dille, J. A.; and Kumar, V. (2019) "Effects of Spring-Planted Cover Crops on Weed Suppression and Winter Wheat Grain Yield in Western Kansas," *Kansas Agricultural Experiment Station Research Reports*: Vol. 5: Iss. 6. https://doi.org/10.4148/2378-5977.7784

Obour, A. K.; Holman, J. D.; and Jaeger, J. R. (2019) "Cover Crop Management Effects on Soil Water Content and Winter Wheat Yield in Dryland Systems," *Kansas Agricultural Experiment Station Research Reports*: Vol. 5: Iss. 6. https://doi.org/10.4148/2378-5977.7785

Sassenrath, G. F. and Farney, J. K. (2019) "Biomass Production of Single Species Cover Crop," *Kansas Agricultural Experiment Station Research Reports*: Vol. 5: Iss. 2. https://doi.org/10.4148/2378-5977.7744

Sassenrath, G. F.; Little, C.; Roozeboom, K.; Lin, X.; and Jardine, D. (2019) "Controlling Soil-Borne Disease in Soybean With a Mustard Cover Crop," *Kansas Agricultural Experiment Station Research Reports*: Vol. 5: Iss. 2. https://doi.org/10.4148/2378-5977.7740

Starr, L. M.; Tomlinson, P. J.; Nelson, N. O.; Stewart, C. L.; Roozeboom, K. L.; Kluitenberg, G. J.; and Presley, D. R. (2019) "Effects of Cover Crops and Phosphorus Fertilizer Management on Soil Health Parameters in a No-Till Corn-Soybean Cropping System in Riley County, Kansas," *Kansas Agricultural Experiment Station Research Reports*: Vol. 5: Iss. 6. https://doi.org/10.4148/2378-5977.7802

Extension & Outreach:

- Many new and ongoing extension programs are active in Kansas. Many cover crop field days and meetings occurred throughout the state with cooperation between Kansas State University Research and Extension, the Kansas NRCS, county Conservation Districts, and non-profit organizations such as the Kansas Alliance of Wetlands and Streams.
    - The Kansas NRCS and/or Conservation Districts have assisted with or been a part of 52 field days, tours, presentations, or workshops on soil health, cover crops, no-till, etc., during the reporting period.
    - The Kansas NRCS and the Plant Materials Center located in Manhattan, KS are collecting data on the growth and performance of different types of cover crop cultivars (Thomas Roth, Jason Waite, and others).
    - Numerous Kansas State University faculty giving presentations at local, state, and national level research or extension meetings on the topic of cover crops. The following is considered to be a partial listing of some of the talks given by KSRE faculty during the reporting period.

Extension presentations by K-State Research and Extension:

2/6/19 Kaw Valley Irrigators meeting, Cover Crops and Soil Health. Manhattan, KS. – Peter Tomlinson

02/12/19 Golden Prairie District Producer Meeting, organizer & speaker, *Reducing heifer development costs through increased grazing*, Quinter, KS – Sandy Johnson

02/12/19 Rawlins County Producer Meeting, organizer & speaker, *Reducing heifer development costs through increased grazing*, Atwood, KS – Sandy Johnson

03/08/2019 Dirt Day in Neodesha, speaker, *Soils and Geology of southeast Kansas*. Neodesha, KS. – DeAnn Presley

4/25/19 Geary Co, Cover Crops and Coffee. Junction City, Kansas. – Peter Tomlinson

07/08/19 to 07/12/19 Kansas Ag Retailers Association Summer Field School, *Soil Compaction.* Manhattan, KS. – DeAnn Presley

9/5/19 Hillsdale WRAPS meeting, No-till, Cover Crops and Phosphorous Management. Hillsdale, KS. – Peter Tomlinson

9/20/19 Kansas State University Agronomy Department Field Day, Resilient Soils Through Conservation Practices – Peter Tomlinson

09/21/19 First International Cover Crops Conference, *Evaluating soil health, soil water, and crop yield effects of cover crops in no-till on-farm experiments in Kansas and the Great Plains.* Lanzhou, China. – DeAnn Presley

11/06/19 Grant County Producer Meeting, speaker, *Making Cover Crops Work in Western Kansas*, Ulysses, KS, –John Holman and Sandy Johnson

11/21/19 NRCS Conservation Webinar, *Integrating grazed cover crops into Dryland Cropping Systems of the High Plains,* http://www.conservationwebinars.net/webinars/integrating-grazed-cover-crops-into-dryland-cropping-systems-of-the-high-plains/?sr=wp~ondemand - Augustine Obour and Sandy Johnson

11/25/19 NE Region Agronomy Update, Environmental Quality: Connecting Environmental Aspects of Nutrient Management and Conservation Planning. Manhattan, KS. – Peter Tomlinson

12/5/19-12/6/19 Kansas Agricultural Retailers Association Crop Production Update Conference, Cover Crops, Nitrogen, and Conservation Planning – Peter Tomlinson

01/14/20 and 01/15/20 Cover Your Acres Winter Conference, *Cover Crops as a Weed Management Tool*. Oberlin, KS. - Luke Chism and Malynda O'Day,

Determining cover crop biomass production for grazing

Jaymelynn Farney and Gretchen Sassenrath

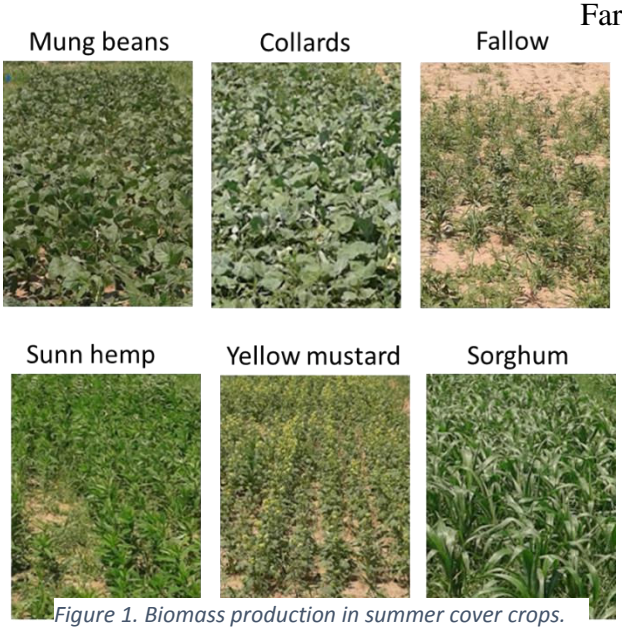


Figure 1. Biomass production in summer cover crops.

Farmers in southeast Kansas are interesting in cover crops for grazing. Biomass production was measured in 17 different single species summer cover crops and a fallow control. Grass species produced more biomass than brassicas, with legumes, broadleaves, and fallow yielding intermediate amounts of biomass. Within the grass species, pearl millet, BMR sorghum sudan, and sorghum sudan produced more biomass than proso millet; German millet and browntop millet had intermediate biomass production. Within the brassicas, both brown and yellow mustards produced more biomass than collards. There were no difference in biomass within the broadleaf species or the legume species tested. Plots that produced high biomass also had fewer weeds, indicating the potential for cover crops to reduce weed growth and establishment. The cost of biomass production varied widely between the cover crops, with the broadleaf and grass species being the least expensive. Choice of a cover crop depends on the goals. Based on cost, weed suppression, and grazing potential, the most suitable cover crops identified in this study were pearl millet, BMR sorghum, sorghum sudan, German millet, okra, and cowpea.

Table 1. Benefits and agronomics of cover crops used in the study

Cover Crop	Benefits*	Agronomics

	Residue	Good Grazing	Soil Builder	Weed Fighter	Nitrogen Source	Seeding rate, lb/a	Price $/a
Brassica							
Collards[1]	1	4	3	3	0	8	15.20
Brown Mustard	1	0	2	3	0	8	15.60
Yellow Mustard	1	0	2	3	0	8	29.25
Broadleaf							
Okra[1]	2	2	2	2	0	5	5.00
Baldy Safflower	3	0	1	1	0	15	11.20
Safflower	3	0	1	1	0	15	11.20
Grass							
BMR Sorghum	4	3	4	4	0	20	33.30
Sorghum Sudan	4	4	4	4	0	20	27.00
Brown Top Millet	3	3	3	3	0	20	13.00
German Millet	3	3	3	3	0	20	10.00
Pearl Millet	4	4	4	4	0	20	26.75
Proso Millet	3	3	3	3	0	20	7.50
Legume							
Cowpea	1	3	3	2	4	50	49.20
Mung bean	1	2	1	1	3	15	5.10
Spring Forage Pea	1	3	1	1	3	50	31.20
Common Vetch	1	0	2	2	3	25	5.70
Sunn Hemp	4	1	3	3	4	15	18.60

*: 0-Poor; 1-Fair; 2-Good; 3-Very Good; 4-Excellent; from the Midwest Cover Crop Council

[1]Information from GreenCoverSeed.com

Cover crops for weed control in southeast Kansas
J. Anita Dille, L. Chism, G. Sassenrath

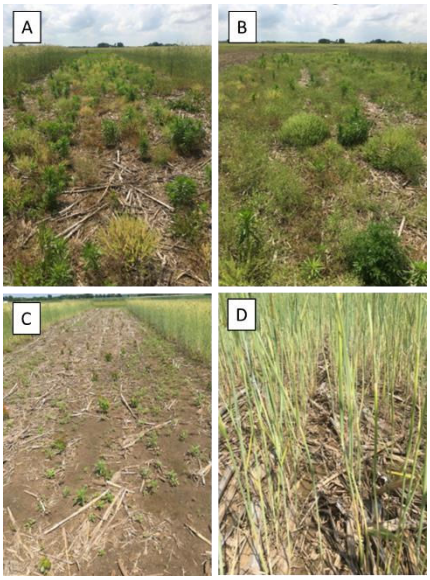


Figure 1. Weed control comparison test. A. Non-treated check. B. Mechanical control – vertical tillage in fall. C. Chemical control – fall-applied herbicide. D. Cereal rye cover crop.

Weed control is important to optimize crop production. The effectiveness of different methods of fall-implemented weed control strategies was testing, including different cover crop mixes, chemical control, and mechanical control. The cover crop mixes included six different commonly-planted winter cover crops. The chemical control was a fall applied-burndown, and the mechanical control was vertical tillage. Cover crop mixes that contained cereal rye provided the most weed control; the second-best control was the chemical herbicide application. Three cover crop mixes containing spring oats still provided 50% reduction in weed biomass in the spring, even though the oats were winter-killed. The fall tillage increased the weed biomass.

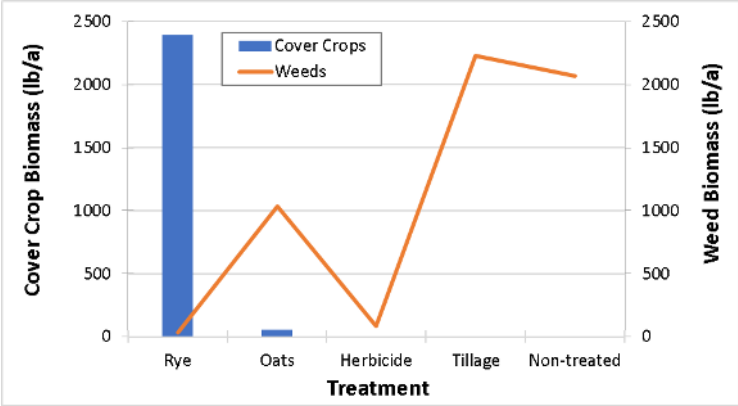


Figure 2. Weed biomass response to treatments (orange line, right axis) and total cover crop biomass production (blue bars, left axis).

Cover crops to improve soil health and reduce erosion
Gretchen Sassenrath, Stacey Kulesza, Jaymelynn Farney, and Mark Mathis

Figure 3. Mr. Mark Matthis II, Kansas State University M.S. graduate student, gives an in-field demonstration of erosion measurement methods during a field day event.

Erosion of productive topsoil leads to declining crop yields and contributes to nonpoint source water contamination. Crop rooting structures may help prevent topsoil erosion, and different rooting structures may vary in their effectiveness for mitigating erosion. The impact of different crop rooting structures on soil erodibility of claypan soils was evaluated for three different crops: sorghum, pearl millet, and corn.

Soil erosion occurs when the applied stress on the soil surface is greater than the soil's resistance against external stresses. The stress at which soil resistance is overcome and erosion begins is the critical shear stress. The higher the critical shear stress, the more resistant the soil is to erosion.

The measured rates of soil erosion with plants of different rooting structure were inconclusive due to the high variability of surface roughness. Use of a larger flume will be required to accurately determine the change in rate of soil erosion with plant rooting structures. Other field results indicated that the clay layer was significantly more resistant to erosion than the silt loam soil. However, the clay layer was much less productive for crop production.

Figure 4. Side (top) and overhead (bottom) images of rooting structures of three different plants (pearl millet, sorghum and corn) used to measure the impact of plant roots on soil loss.

Precision conservation to improve profitability and long-term sustainability of soil health
Gretchen Sassenrath, Jaymelynn Farney, Stacey Kulesza

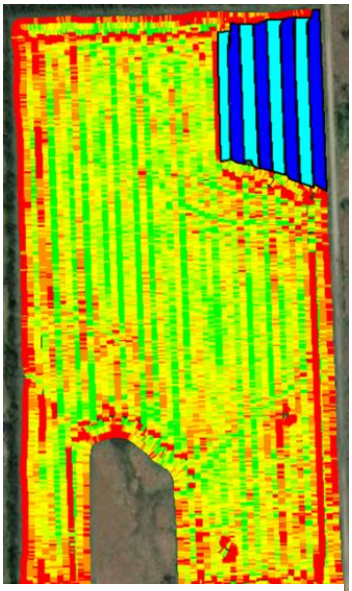
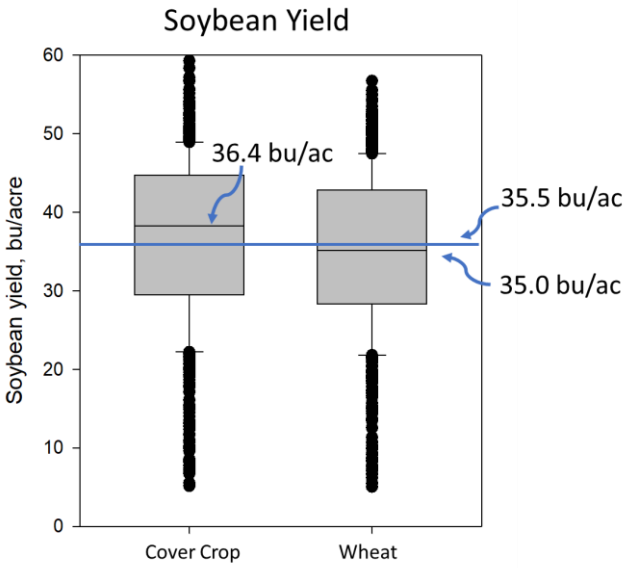


Figure 5. Strips of cover crops (dark blue: oats and tillage radish) were planted adjacent to the wheat strips (light blue). Wheat was planted in the rest of the field.

Unproductive areas of crop production fields were taken out of production. Precision conservation practices were implemented to improve the profitability of the production system and boost soil health for production of the next crop in the rotation. Studies were conducted in the winter, replacing winter wheat with oat and radish cover crops, and in the summer, replacing corn with grasses and legumes. Strips of crops were planted adjacent to the strips of cover crops for comparison.

- Replicated cover crop strips planted in production fields
  - ✓ Winter cover crops: grass (oats, cereal rye or wheat), brassica (radish or turnip), legume (winter pea or clover)
  - ✓ Summer cover crops: grasses (sorghum sudan, millets), legume (sunn hemp),
- Crop yield of subsequent cash crop recorded
- Weed emergence; soil nutrients; soil microbial activity
- Partial cost return budgets calculated for cover crop versus conventional crop rotation



Soybean production in the strips with cover crops was higher (36.4 bu/acre) than the field average of 35.5 bu/acre (Figure 15). Conversely, the soybeans in the wheat strips was 0.5 bu/acre lower than the field average. Because of low wheat prices, wheat production had a negative return for production levels less than approximately 50 bu/acre. Therefore, although the cover crop produced no harvestable crop, the cost to produce cover crop was less than the cost to produce very low yielding wheat (-$43.11/acre for cover crop production versus -$62.70 to produce wheat at an average of 32 bu wheat/acre in the unproductive area of the field). In contrast, soybeans following cover crops produced more than soybeans following wheat, for an additional return of almost $12/acre. The overall profitability of the one-year rotation (wheat/soybeans or cover crops/soybeans) showed an additional increased potential return of $31/acre more net return for cover crops than for wheat. Note that this is for the specific low-producing region of the field. Areas of the field that had wheat production in excess of 50 bu/acre would have been more profitability for wheat than for cover crops.

Cover crops for grazing: Cattle preference
Jaymelynn Farney and Gretchen Sassenrath

Figure 6. Dr. Jaymelynn Farney described cover crop production and preference for cattle grazing at a field day presentation.

Cover crops have multiple benefits to integrated agricultural production systems. However, information is needed on best species and mixes to use. In this one-year study, the single species grass cover crops produced the most biomass. Spring forage peas did not perform well as a summer cover crop, yielding the same biomass as the fallow areas.

Adding collards to the mixtures generally reduced total biomass production compared to single species of grasses alone. Total biomass production was affected by the number of plants in the mixture. Yields of grass-only plots were ~868 lb of dry matter (DM) per acre more than cover crop mixtures composed of two or three plant species. Plots with cover crop mixes yielded on average 1,348 lb DM/acre more than single species plots with legumes or collards. Grasses composed the greatest proportion of the total biomass (> 77% of total DM biomass was from grass species in mixtures).

Figure 7. Cattle grazing summer cover crop mixtures.

Cover crops to control charcoal rot.
Gretchen Sassenrath, Chris Little, Xiaomao Lin, and Kraig Roozeboom

Figure 8. Charcoal rot, caused by the fungus Macrophomina phaseolina causes a grey, charcoal-colored growth in infected soybean roots. The roots atrophy and die as disease progresses, limiting seed development and reducing yield.

Charcoal rot is a soil-borne disease that is prevalent in southeast Kansas. The disease infects multiple crops, including soybean, and causes yield reductions. A high-glucosinolate mustard with biofumigant properties reduced the population levels in soil and in soybean plants of the fungus (*Macrophomina phaseolina*) that causes charcoal rot. Management practices that incorporate use of mustard as a cover crop in soybean production systems were tested. Results indicate that tillage increases the charcoal rot fungus. Rolling the mustard plant prior to soybean planted provided the greatest disease reduction. The mustard cover crop was tested in field studies for its impact on soil health, fungal disease and propagules, and soybean growth and yield.

Figure 9. Might Mustard (Brassica juncea) planted as a cover crop prior to soybean planting.

Four different cover crop treatments and one control with no cover crop were used to determine how to manage the mustard residue for optimal pathogen control, including:

- *control:* no mustard cover crop
- *no incorporation*: plant into standing mustard
- *no incorporation*: cover crop rolled
- *no incorporation*: cover crop mowed
- *incorporation*: cover crop disked (tillage)