

Midwest Cover Crops Council  
**Indiana:** Report for February 20-21, 2018 Meeting in Springfield, IL

**Contact Information**

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**Highlights**

*One new Extension publication*

- Zuber, S. and E. Kladivko. 2018. How to understand and interpret soil health tests. AY-366-W. [https://mdc.itap.purdue.edu/item.asp?Item\\_Number=AY-366-W](https://mdc.itap.purdue.edu/item.asp?Item_Number=AY-366-W)
- Kladivko, E., S. Armstrong, and A. Morrow. 2018. Indiana Cover Crop Recipe: Post corn, going to Soybean: Use cereal rye. Published by Midwest Cover Crops Council and Purdue Extension. MCCC-100; Purdue AY-356-W. [https://edustore.purdue.edu/item.asp?Item\\_Number=AY-356-W](https://edustore.purdue.edu/item.asp?Item_Number=AY-356-W)
- Kladivko, E., S. Armstrong, and A. Morrow. 2018. Indiana Cover Crop Recipe: Post soybean, going to corn: Use oats/radish. Published by Midwest Cover Crops Council and Purdue Extension. MCCC-101; Purdue AY-357-W. [https://edustore.purdue.edu/item.asp?Item\\_Number=AY-357-W](https://edustore.purdue.edu/item.asp?Item_Number=AY-357-W)

*Research publications*

- Nevins, C.J., C. Lacey, L. A. Hoagland, R.F. Turco, C. Nakatsu, and S.D. Armstrong. 2018. Characterization of microbial community response to cover crop residue decomposition. *Soil Biology and Biochemistry* 127:39-49.
- Xu, M., C. Lacey, and S.D. Armstrong. 2018. The feasibility of satellite remote sensing and spatial interpolation to estimate cover crop biomass and nitrogen uptake at the watershed scale. *Journal of Soil and Water Conservation* 73:6 682-692.
- Ruffatti, M.D., R. Roth, C. Lacey, and S.D. Armstrong. 2018. Impacts of nitrogen application timing and cover crop inclusion on subsurface drainage water quality. *Agricultural Water Management* 211:81-88.
- Mueller, S.M., H.R. Pasley, L.O. Pico, S.D. Armstrong, R.P. Sripada and T.J.Vyn. 2018. Re-evaluation of soil N sampling strategy effects on statistical power. *Communications in Soil Science and Plant Analysis* 49:16, 2053-2063.
- Kladivko, E.J., L. Holscher, J. Boyle-Warner, B. Fisher, J.D. Rorick, and S.M. Zuber. 2019. State-wide soil health programs for education and on-farm assessment: Lessons

learned. *Journal of Soil and Water Conservation* 74(1):12A-17A,  
doi:10.2489/jswc.74.1.12A.

#### *Graduate students and post-docs*

- 3 Ph.D. students, 9 M.S. students, and 1 post-doc

#### *These and Dissertations Completed*

- Nevins, Clayton. 2018. Soil microbial community dynamics during the decomposition period of winter cover crops. M.S. Thesis, Purdue University. 123pp.
- Xu, Min. 2018. Using digital agriculture methodologies to generate spatial and temporal predictions of n conservation, management and maize yield. Ph.D. Dissertation, Purdue University. 129pp.
- Woodyard, Jennifer D. 2018. Cover crop and no-tillage impacts on soil health and soil nitrogen in Indiana. M.S. Thesis, Purdue University. 244pp.
- Benally, Nicole A. 2018. Soil aggregation and soil carbon measurements to assess cover crop improvements to soil health in Indiana. 108pp.

#### *Conference Abstracts*

- Chen, K.R., J. Ackerson, and S.D. Armstrong. Using Satellite Indices to Estimate Winter Cover Crop Adoption in Boone County, Indiana. 2018. In Annual Meetings ASA, CSSA, SSSA. Baltimore.
- Xu M., Haishun Yang, Tony J. Vyn, Tonglin Zhang, and S.D. Armstrong. 2018. A New Modeling Approach: Big Data and Multivariate Spatial Statistics to Generate in-Season Field-Specific Maize Yield Predictions. In Annual Meetings ASA, CSSA, SSSA. Baltimore, MD.
- Xu M., C.G. Lacey, and S.D. Armstrong The Feasibility of Satellite Remote Sensing and Spatial Interpolation to Estimate Cover Crop Biomass and Nitrogen Uptake in a Small Watershed. 2018. In Annual Meetings ASA, CSSA, SSSA. Baltimore, MD.
- Roth R.T., C.G. Lacey, S.D. Armstrong. 2018. Understanding Cereal Rye Nitrogen Decomposition and Its Transition into Inorganic and Organic Soil Nitrogen Pools. In Annual Meetings ASA, CSSA, SSSA. Baltimore, MD.
- Armstrong, S.D., C. O'Reily, C.G. Lacey, M. Xu, R.T. Roth, M.D. Ruffatti. 2018. Cover Crop Performance on a Watershed Scale: Potential Impacts on Water Quality. In Annual Meetings ASA. Baltimore, MD.
- Ruffatti M.D., R.T. Roth, S.D. Armstrong. 2018. Cover Crop Inclusion Impacts on Dissolved Reactive Phosphorus Soil Distribution and Subsurface Drainage Losses. In Annual Meetings ASA, CSSA, SSSA. Baltimore, MD.
- Lacey, C.G., S. Armstrong, C. Nevins, H. Miller. Cover Crop Decomposition and Residue Nitrogen Release Dynamics. Cover Crop Management Oral 1. 2018. In Annual Meetings ASA, CSSA, SSSA. Baltimore, MD.
- Miller, Houston., S.D. Armstrong, J. Camberato, and R. Nielsen. Investigation of Corn Yield Improvement Following Cereal Rye Using Starter Nitrogen Fertilizer. 2018. In Annual Meetings ASA, CSSA, SSSA Baltimore, MD.

- Lacey, C.G., S. Armstrong, C. Nevins, H. Miller. Cover Crop Decomposition and Residue Nitrogen Release Dynamics. 2018. In Annual Meetings North Central Extension Industry Soil Fertility Conference. Des Moines, IA.
- Lacey, C.G., S. Armstrong. The Impact of Cover Crops on Nitrogen Fate and Availability in Corn and Soybean Systems. 2018. Boone County Cover Crops Field Day. Lebanon, IN.
- Hodgekiss, C., and W. G. Johnson. 2018. Utilizing cereal rye and crimson clover for weed suppression within, and outside of, buffer areas in dicamba and 2,4-D tolerant soybeans (NCWSS 2018)
- Hodgekiss, C., and W. G. Johnson. 2018. Cover Crops: Do they Really Contribute to the Control of Palmer Amaranth (*Amaranthus palmeri*) (MCCC 2018)
- Peterson, W., and W. G. Johnson. 2018. Interactions Between Residual Herbicides and Termination Timing in Cereal Rye on Summer Annual Weed Control (NCWSS 2018)
- Peterson, W., and W. G. Johnson. 2018. Influence of Crimson Clover and Cereal Rye Termination Timing on Corn Yield and Weed Control (NCWSS 2018)
- Desimini, S., and W. G. Johnson. 2018. Evaluation of Cereal Rye and Canola Termination Timing on Horseweed and Giant Ragweed Control (NCWSS 2018)
- Desimini, S., and W. G. Johnson. 2018. Evaluation of Canola and Cereal Rye Termination Timing on Crop Yield and Summer Annual Weed Control in the Eastern Cornbelt. (NCWSS 2018)
- Desimini, S., and W. G. Johnson. 2018. Evaluation of Cereal Rye and Canola Termination Timing on Winter and Summer Annual Weed Control (MCCC 2018)

### **Research**

Ongoing studies by Dr. Eileen Kladvko ([kladvko@purdue.edu](mailto:kladvko@purdue.edu)) and graduate students include:

- Effects of cover crops on soil health. This research is conducted at Purdue Agricultural Centers and on cooperating farmers' fields. Measurements include a variety of commercial soil health tests (PLFA, Cornell, Haney), other soil physical properties, soil nitrate, cover crop biomass and N uptake, and cash crop yields. Two M.S. students and a post-doc are involved in various aspects of this work.

Ongoing studies led by Dr. Shalamar Armstrong ([sarmstro@purdue.edu](mailto:sarmstro@purdue.edu)) and graduate students

- The influence of cover crop inclusion on soil microbiome diversity and functionality. Experimental factors consist of crop rotation, tillage, and above ground cover crop diversity. On both soil and cover crop residue, measurements of enzymatic activity are being used to indirectly quantify the cycling of carbon and nitrogen with time. Furthermore, selected soil samples are being analyzed for microbial diversity to determine the impact of the treatment on the soil microbiome functionality.
- The synchronization of cover crop N release with the N demand of cash crops. At ACRE in West Lafayette, IN and the Nitrogen Management Research Field Station (NMRFS) in Lexington, IL, cover crop residue decomposition and N release are being measured within multiple crop rotations, (Corn-Corn and Soybean-Corn), and tillage systems (No-till and Spring Till). In addition to monitoring cover crop residue decomposition, we established research methodology to track the fate of fertilizer N using <sup>15</sup>N stable isotope

techniques. This methodology will allow us to quantify the interaction of cover crops with fertilizer N, the release of scavenged N from cover crop residue, and the absorption of cover crop N by a subsequent corn crop.

- Optimization of nitrogen management for competitive corn yield following cover crop adoption. Two new research projects have been established in multiple locations across the state of IN (1) investigating the rate of starter fertilizer nitrogen on corn yield following cereal rye adoption and (2) swine manure injection and red clover inclusion rate after wheat impact on nitrogen rate needed for optimum corn yield.
- Impacts of nitrogen application timing and cover crops on crop production and water quality. This research is being conducted at the NMRFS that consists of 15 individually monitored tiled-drained 1.6-acre fields in Lexington, IL. The study analyzes three nutrient loss reduction strategy scenarios (1) moving nitrogen application from fall to spring, (2) moving nitrogen application from fall to spring with the addition of cover crops, and (3) fall applying a dominant portion of the annual N rate into a living stand of cover crops. Tile water flow and velocity are monitored automatically to discern the influence of treatments on discharge.
- The effect of cover crops on surface water quality: A paired watershed experiment in the Lake Bloomington watershed. We are investigating the impact of mass adoption of cover crops on water quality and spring soil nitrogen concentrations. In the Lake Bloomington watershed of Towanda, IL we identified two sub-watersheds, one of 1100 acres and another of 700 acres. Fifty percent of the larger watershed was cover cropped and no cover crops were applied to the 700-acre watershed. Continuous water samples are collected on a flow-proportional basis at the outlet of each watershed. Water samples are analyzed for nitrate, total phosphorus, and sediments. To determine the impact of cover crops on spring soil inorganic N form and location within the soil profile, spring soil samples are collected and are analyzed for ammonium and nitrate.

Ongoing studies by Dr. Keith Johnson, Dept. of Agronomy ([johnsonk@purdue.edu](mailto:johnsonk@purdue.edu))

- Utilizing cover crops and summer annuals as double cropped forages following wheat . The objective is to determine the suitability and forage quality of ten crop species at varying nitrogen application rates. The crops that are being investigated are; grain amaranth, BMR sorghum sudangrass, pearl millet, teff, foxtail millet, oat, chickling vetch, forage turnip, and oilseed radish.

Ongoing studies by Dr. Lori Hoagland, Dept. of Horticulture ([lhoaglan@purdue.edu](mailto:lhoaglan@purdue.edu))

- The long-term goal of Dr. Hoagland's research program is to identify management practices that will improve nutrient-use efficiency, help plants withstand biotic and abiotic stress, and reduce colonization by human pathogens. To this end, she studies how management practices, including cover crops, affect the composition and activity of soil microbial communities. The majority of her research is currently being conducted in

intensively managed vegetable production systems, but she has also worked in grain production systems as well. Recent studies have provided evidence that including cover crops and amending soil with compost can increase the diversity and abundance of arbuscular mycorrhizal fungi, and thereby help plants withstand drought stress. Soils fertilized with leguminous cover crops are better able to withstand infection by soil-borne plant pathogens, and have lower abundance of potential human pathogens than soils fertilized with urea. Finally, growing certain species and varieties of cover crops increase populations of microbial taxa with biocontrol activity and ameliorate disease incidence in soil infested with long-lived soil-borne plant pathogens.

Ongoing studies by Dr. William Johnson addresses the following 9 topics:

- Evaluation of Herbicide Treatments for Termination of Canola as a Winter Cover Crop. Influence of Fall Establishment and Spring Termination Timings of Annual Ryegrass on Corn Yields.
- The role of cover crops in the epidemiology of Goss's wilt
- Palmer amaranth control provided by annual ryegrass and cereal rye
- Spring termination of cover crops with herbicides
- The effect of herbicide residues on cover crop establishment.
- The effect of planting green on corn and soybean yield
- The effect of a failed cover termination on corn and soybean yield.
- The effect of cover crops on control of herbicide resistant weeds in corn.

Ongoing studies by Dr. Bryan Young, and Dr. Bill Johnson, Dept. of Botany and Plant Pathology ([BryanYoung@purdue.edu](mailto:BryanYoung@purdue.edu); [WGJ@purdue.edu](mailto:WGJ@purdue.edu))

Young--We have two projects with the United Soybean Board that are being conducted collaboratively with the Univ. of WI, Univ. of MO, Univ. of TN, and Univ. of AR.

- Evaluation of herbicides for spring termination of cover crops.
- Evaluation of potential herbicide carryover to fall-seeded cover crops.
  - Johnson--conducts applied research on weed control provided by cover crops, spring termination of cover crops with herbicides, and the effect of herbicide residues on cover crop establishment.
- Field research investigating the interaction of soil residual herbicides applied in the spring with cereal rye on control of Palmer amaranth and tall waterhemp in soybean production.
- The effect of cover crops on herbicide persistence will be initiated by a new Ph.D. student in 2019.

Christian Krupke, Dept. of Entomology ([ckrupke@purdue.edu](mailto:ckrupke@purdue.edu)) —Extension work speaking with producers and consultants about the insect pest management challenges associated with cover crops, and how to scout for and manage them.

Some long-term or always ongoing studies continues:

- Cereal rye or other cover crops used in tile drainage research project, where nitrate is measured in tile drainflow. Long-term (25+yrs) but no simultaneous comparison without

cover crop. Could make more measurements related to N cycling, if regional collaboration.

- Biomass crops, new and old work (Miscanthus, switchgrass)
- Ongoing work on pest suppression (disease, nematode, weeds) and in vegetable production (Dept. of Botany and Plant Pathology; Dept. of Horticulture)
- Always ongoing work on forages for hay or grazing (Dr. Keith Johnson, Dept. of Agronomy, [johnsonk@purdue.edu](mailto:johnsonk@purdue.edu))

### **Extension/Education/Outreach/On-farm trials**

- Cover crop interest and adoption continues to grow in Indiana. The Indiana Conservation Partnership (NRCS, Soil and Water Conservation Districts (SWCD), Conservation Cropping Systems Initiative (CCSI), Indiana State Department of Agriculture (ISDA), State Soil Board, and Purdue Extension) continues to provide core cover crop training and advanced trainings to conservation field staff, and to host or partner on numerous workshops and field days aimed at farmers. We also work with farmers conducting on-farm trials of cover crops vs. no cover crops and often use those farmers as part of the training cadre for field staff and farmers. Education about soil health is embedded within almost all activities and educational events. Dr. William Johnson of Purdue University (Weed Science) extended knowledge on the subjects of (1) spring residual herbicide and cover crop interaction, (2) spring cover crop termination, (3) reemergence of cover crops in during corn or soybean growing season and (4) seed contamination issues and rape seed mixtures. He also leads the development of a regional extension publication developed that addresses the ability of cover crops to control weeds, insect and crop disease on a regional scale. (<http://cropprotectionnetwork.org/general-crop-management/cpn-4002-cover-crops-dos-donts/> Dr. Johnson also conducted three ½ day spring workshops in both 2017 and 2018 on weed identification and control and cover crop management for NRCS field specialists.