

Midwest Cover Crops Council  
**Indiana:** Report for February 11-13, 2020 Meeting in Kansas City, MO

**Contact Information**

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**Highlights**

*One new Extension publication*

Prevented planting was a big issue in the exceptionally wet spring of 2019. We were involved with numerous colleagues within Purdue system and state/national agencies and surrounding states, to provide guidance on options for prevented planting acres with cover crops. The MCCC put out some information on our website. The MCCC also worked with partners (especially Ryan Stockwell and Rob Myers) on drafting guidelines to help provide “written advice” for producers using the new RMA cover crop termination guidelines that came out in June 2019. We also revised a Purdue Extension publication on Prevented Planting:

- Kladivko, E. and B. Fisher. 2019. Cover crops for prevented planting acres. Purdue Exten. Publ. AY-355-W. [https://mdc.itap.purdue.edu/item.asp?Item\\_Number=AY-355-W](https://mdc.itap.purdue.edu/item.asp?Item_Number=AY-355-W)

*Research publications*

- Nevins, C.J., C. Lacey and S.D. Armstrong. 2019. The synchrony of cover crop decomposition, enzyme activity, and nitrogen availability in a corn agroecosystem. (Accepted to Soil and Tillage Research)
- Thompson, N., S.D. Armstrong, R. Roth, and M.D. Ruffatti. 2019. Direct short-run economic returns to a predominantly cereal rye cover crop mix in a traditional midwest corn-soybean rotation. (*In Press*, Agronomy Journal)
- Lacey, C., C. J. Nevins, J. Camberato, E. Kladivko, and S.D. Armstrong. 2019. Carbon and nitrogen release from cover crop residues and implications for cropping systems management. (*In Press*, Journal of Soil and Water Conservation).
- Ruffatti, M.D., R. Roth, C. Lacey, and S.D. Armstrong. 2019. Impacts of nitrogen application timing and cover crop inclusion on subsurface drainage water quality. *Agricultural Water Management* 211:81-88.
- Campbell, T.M., J. T. Ikley, W.G. Johnson, and K. A. Wise. 2019. Impact of inoculum concentration on Goss’s Wil development on corn and alternative hosts. *Plant Health Progress* 20 (3): 155-159.

### *Graduate students and post-docs*

- 4Ph.D. students, 4 M.S. students,

### *These and Dissertations Completed*

### *Conference Abstracts*

- Eagen, Sarah Seehaver; Ackroyd, Victoria J.; Golden, Lauren; Morrow, Anna Lee; Kladivko, Eileen J.; Reberg-Horton, Chris; Mirsky, Steven B. 2019. Cover Crops Councils: United in a Digital Environment. Agron. Abs.
- Hodgkiss, C., and W. G. Johnson 2019. Utilizing Cover Crops as a Form of Weed Suppression Prior to Auxin-Resistant Soybeans in Indiana. Proc. NCWSS
- Peterson, W., and W. G. Johnson. 2019. Cocklebur emergence under cereal rye residue before and after residual herbicide application. Proc. NCWSS
- Maia, L., W. Peterson, and W. G. Johnson. 2019. Impact of cereal rye termination on acetochlor weed control efficacy. Proc. NCWSS
- Armstrong, S.D., R.T. Roth, and M.D. Ruffatti. 2019. Impacts of cover crops on spring soil nitrogen distribution and concentration. SSSA International Soils Meeting, San Diego, CA.
- Roth R.T., C.G. Lacey, and S.D. Armstrong. 2019. Determining the fate of cereal rye nitrogen within the soil profile. SSSA International Soils Meeting, San Diego, CA.
- Roth, R.T. and S.D. Armstrong. 2020. Is Cereal Rye an Effective Conduit for Sustainable Intensification of Agriculture in the Midwest? In Purdue Agronomy Graduate Student Organization Graduate Student Seminar Series. West Lafayette.
- Roth, R.T., Reeling, C.J., Armstrong, S.D. 2019. Stochastic Analysis of Economic Risk and Uncertainty Following Cover Crop Adoption. In Annual Meetings ASA. San Antonio.
- Roth R.T. and S.D. Armstrong. 2019. Understanding Cereal Rye Nitrogen Decomposition and Its Transition into Inorganic and Organic Soil Nitrogen Pools. In Annual Meetings ASA. San Antonio.
- Roth R.T. and S.D. Armstrong. 2019. Digital Cover Crop Phenotyping. In Purdue University College of Agriculture Digital Agriculture Roundtable. West Lafayette.
- Roth R.T. and S.D. Armstrong. 2019. Cover Crop Impact on Nitrogen Fate and Cash Crop Yield. In Universities Council on Water Resources Annual Conference. Snowbird.
- Armstrong, S.D., R.T. Roth, M.D. Ruffatti. 2019. Impacts of Cover Crops on Spring Soil Nitrogen Distribution and Concentration. In Annual Meetings SSSA. San Diego.

### **Research**

*New research project:* (Mirsky et al.). Indiana is participating in common experiments, on-farm trials (Shalamar Armstrong), data architecture and tools (Ankita Raturi), social science (Linda Prokopy), and MCCC and leadership team (Anna Morrow, Eileen Kladivko).

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

- Effects of cover crops on soil health and crop yield. In 2019 this research was conducted at Purdue Agricultural Centers but had previously also included cooperating farmers' fields. Measurements have included a variety of commercial soil health tests, other soil physical properties, soil nitrate, cover crop biomass and N uptake, and cash crop yields.

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:

- Utilizing cover crops for weed suppression in buffer areas of auxin tolerant soybeans. Goal is to see if there is a weed control benefit in areas where 2,4-D or dicamba cannot be used in the label mandated buffer areas.
- Utilizing cover crops for weed suppression in no-till corn. Goal is to see if we can obtain weed control benefits to using cereal rye based cover crop systems in no-till corn.
- Impact of cover crops on residual herbicide degradation. Goal is to see if cover crops speed up degradation of residual herbicides.

- 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.
- *Additional Topics:* 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 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 (United Soybean Board Funded).
- 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 continue to be strong in Indiana. Purdue Extension is an active partner in 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). The Partnership continues to provide core cover crop training and advanced soil health and cover crop 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. Mr. Joe Rorick is the Conservation Agronomist working with CCSI and Purdue; others heavily involved with CCSI programs include Stephanie McLain and Barry Fisher (NRCS), Lisa Holscher (CCSI, SWCD), and Eileen Kladvko, Shalamar Armstrong, and Walt Sell (Purdue).

- In 2019, CCSI provided technical, logistical and promotional support for 70 events, reaching nearly 7000 attendees.
  - These included CCSI-SARE PDP train the trainer series, 10 events, over 300 attendees, Core Cover Crops, Core Soil Health Systems, Advanced Cover Crops, Advanced Soil Health Systems, Soil Health and Sustainability for Midwestern Field Staff, 10 invited talks to over 550 people including farmers, ICP staff, and crop advisors.
  - 12 Soil Health Podcasts with Hoosier Ag Today – typically featuring a soil health farmer + an ag/conservation professional
  - John Kempf Workshops - 400+ attendees, with 80% from Amish and Mennonite communities. Partners included SWCDs, NRCS, ISDA and Extension (from 7 counties) along with Byron Seed
  - National FFA Convention - Soil health and cover crop demonstrations to 2366 attendees from 42 states. Partners include the Indiana Soil Health Teams, USDA-NRCS, CCSI, National FFA, Wrangler Jeans.