Iowa- MCCC State Report 2014

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Summary of cover crop activities in Iowa for 2014

Cover crop plantings in Iowa may have exceeded 400,000 acres in 2014, nearly 1.7% of annual crop acreage in the state. Although this may seem insubstantial, it is about a 250% increase from the acreage planted to cover crops in 2013. As for 2013, the Iowa Department of Agriculture and Land Stewardship (IDALS) financially supported planting cover crops in 2014, but final statistics on the program were not available when this report was prepared. IDALS personnel compiled an excellent report on cover crop activities within the state in 2014 that is available at the Clean Water Iowa website: (http://www.cleanwateriowa.org/article.aspx?id=120&Cover+Crop+Research+and+Demonstrations+in+Iowa+(list+and+contact+info). The IDALS report documented on-going cover crop research and demonstration projects in 44 of 99 counties in Iowa in 2014. Additionally, utilization of cover crops is a considerable part of the strategy to meet Iowa Nutrient Reduction Strategy goals for reducing nitrate-N, phosphorus, and sediment load in Iowa waterways (http://www.nutrientstrategy.iastate.edu/).

Outreach efforts on cover crops in Iowa reached an impressive number of individuals at over 100 meetings and conferences in 2014. Other current outputs that include cover crops: three refereed journal manuscripts published, and numerous internally produced research and extension reports, radio interviews and blogs. Currently, at least 13 grant-funded projects are underway that include cover crops; 11 of these projects include graduate students in three academic departments at Iowa State University (Agronomy, Entomology, and Horticulture) and two postdoctoral research associates, one each with USDA-ARS and ISU-Agronomy. Although many individuals in Iowa work very hard on developing and conveying information on cover crops, the efforts by Iowa State University graduate students, Practical Farmers of Iowa, and USDA-ARS are particularly noteworthy.

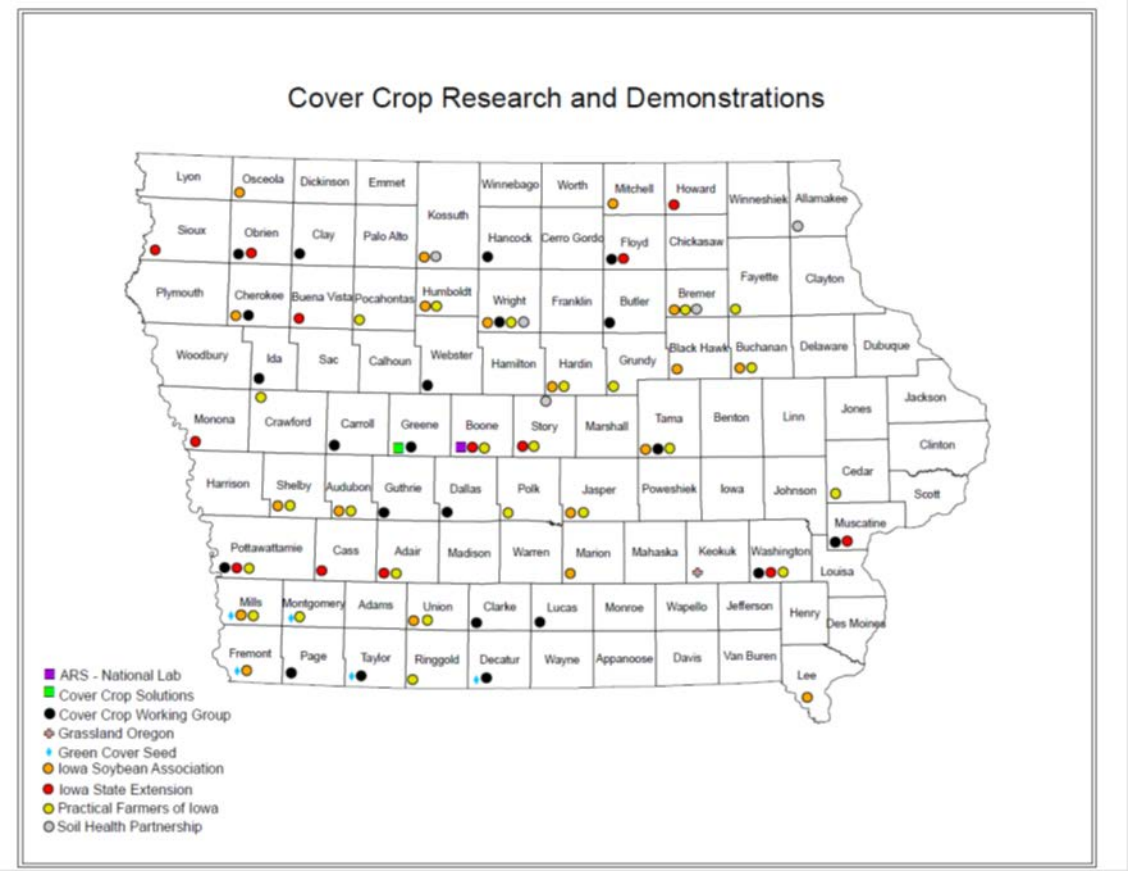


Figure 1. Cover crop research and demonstration projects in Iowa, 2015. Courtesy of Matthew Lechtenberg, Iowa Department of Agriculture and Land Stewardship.

Grant Funding obtained in Iowa that includes cover crop research or outreach activities:

Morton, L.W, et al. (11 institutions) 2011-2015. Cropping systems coordinated agricultural project: Climate change, mitigation, and adaptation in corn-based cropping systems. USDA-NIFA, Award No. 2011-68002-30190.

Martinez-Feria, R., M. Wiedenhoeft. 2014. NC-SARE. Suitability of winter canola (*Brassica napus*) for enhancing summer annual crop rotations in Iowa.

Comito, J., M. Helmers, J. Benning, T. Kaspar. 2014. Management and performance of Iowa cover crops. Leopold Center for Sustainable Agriculture. http://www.leopold.iastate.edu/grants/e2014-02

Miguez, F., J. Tyndall, J.G. Arbuckle, A. Basche and G. Roesch. 2013-2015. Leopold Center for Sustainable Agriculture. Covering the Ground: A transformative approach to scientific learning for greater cover crop adoption in Iowa. http://www.leopold.iastate.edu/grants/e2014-20

Mallarino, A., R. Cruse, M. Helmers, J. Sawyer, D. Jaynes. 2014. Iowa Nutrient Reduction Center. Impacts of cover crops on phosphorus and nitrogen loss with surface runoff. http://www.nutrientstrategy.iastate.edu/sites/default/files/documents/abstracts/coverimpacts.pdf

Lenssen, A.W., S. Carlson, M. Wiedenhoeft. 2013-2014. NCR-SARE Research & Education. Improving cover crop options for the Corn Belt.

Kaspar, T., T. Moorman. 2012-2015. Leopold Center for Sustainable Agriculture. Winter rye cover crop effect on corn seedling pathogens. http://www.leopold.iastate.edu/grants/e2012-03

Kaspar, T., T. Moorman, A. Robertson, A. Lenssen. 2014. Iowa Nutrient Reduction Center. Investigating the causes of corn yield decreases following cereal rye winter cover crop. http://www.nutrientstrategy.iastate.edu/sites/default/files/documents/abstracts/cerealrye.pdf

Miguez, F, J. Tyndall, J.G. Arbuckle, G. Roesch, A. Basche. 2014-2015. Leopold Center for Sustainable Agriculture. A transformative approach to scientific learning for greater cover crop adoption in Iowa.

Moore, K.J, D. Laird, K. Lamkey, A. Lenssen. 2013-2014. NC-SunGrant. Managing perennial cover crops for sustainable corn stover biomass removal.

Nair, A., D. Brainard, A. Shaw, C. Chase, C. Bregendahl. 2014-2017. NCR-SARE Research & Education. Cover crops and strip tillage to promote soil quality, environmental sustainability, food safety, and profitability in cucurbit cropping systems.

Nair, A., K. Delate, C. Bregendahl, G. Artz. 2014-2016. Leopold Center for Sustainable Agriculture. Quantifying nitrogen credits and impacts of cover crops on soil biology and health in vegetable cropping systems in Iowa. http://www.leopold.iastate.edu/grants/e2014-16

Nair, A., V. Lawson, C. Chase. 2014-2015. National Wildlife Federation. Quantifying nitrogen scavenging benefits of non-traditional fall planted cover crops to mitigate nitrogen movement into the Mississippi river basin.

Refereed journal articles

Kladivko, E.J., Kaspar, T.C., Jaynes, D.B., Malone, R.W., Singer, J., Morin, X.K., Searchinger, T. 2014. Cover crops in the upper Midwest USA: Potential adoption and reduction of nitrate leaching in the Mississippi River Basin. Journal of Soil and Water Conservation. 69:279-291.

Malone, R., D. Jaynes, T. Kaspar, E. Kladivko, L. Ma, D. James, J. Singer, X. Morin, T. Searchinger. 2014. Simulated potential water quality impact of fall-planted cover crops across the Midwestern USA. Journal of Soil and Water Conservation 69:292-305.

Moore, E.B., Kaspar, T.C., Wiedenhoeft, M.H., Cambardella, C.A. 2014. Rye cover crop effects on soil quality in no-till corn silage-soybean cropping systems. Soil Science Society of America Journal 78:968-976.

Proceedings

Sawyer, J.E., J.L. Pantoja, and D.W. Barker. 2014. Corn nitrogen rate response and crop yield in a rye cover crop system. p. 59-63. *In* Proc. Forty-Fourth North Central Extension-Industry Soil Fertility Conf., Des Moines, IA. 19-20 Nov. 2014. Vol. 30. International Plant Nutrition Inst., Brookings, SD. (208 attendees)

Sawyer, J.E., J. Pantoja, and D. Barker. 2014. Corn and soybean production with a winter rye cover crop. RFR-A13118. *In* Northeast Research and Demonstration Farm annual report ISRF13-13. Iowa State University, Ames, IA.

Reports

Sawyer, J.E., J. Pantoja, and D. Barker. 2014. Corn and soybean production with a winter rye cover crop. RFR-A13118. *In* Agricultural Engineering/Agronomy Research Farms annual report ISRF13-16, 30. Iowa State University, Ames, IA.

Graduate students with research projects on cover crops, Iowa State University and USDA-ARS NLAE.

Name	Major Professor	Title
Appelgate, Seth	A. Lenssen & M. Wiedenhoeft	Improved cover crop options for the Corn Belt
Bartel, Cynthia	A. Lenssen & K. Moore	Managing perennial cover crops for sustainable corn stover biomass production
Basche, Andrea	F. Miguez	Climate-smart management in Iowa cover crops: evaluating the benefits and tradeoffs of cover crop incorporation
Jokela, Dana	Ajay Nair	Conservation tillage systems in organic pepper and broccoli production
Kruse, Raymond	Ajay Nair	Summer cover crops for fall vegetable production
Martinez-Feria, Rafael	M. Wiedenhoeft	Suitability of winter canola for enhancing summer annual crop rotations in Iowa
Patel, Swetabh	J. Sawyer	Rye cover crop
Schenck, Lara	T. Kaspar & A. Robinson	Winter rye cover crop effect on corn seedling pathogens

Sklenar, Tim	A. Lenssen	Cover crop termination timing and biomass removal: Impact on soybean systems
Tillman, Jennifer	Ajay Nair	Strip tillage systems in cucurbit production

Post-doctoral researchers and research associates with projects on cover crops at Iowa State University and USDA-ARS NLAE.

Name	Co-workers	Title
Ms. Jyotsna Archaya	A. Robinson	Investigating the causes of corn yield decreases following cereal rye winter cover crop
Dr. Matt Bakker	T. Kaspar & T. Moorman	Investigating the causes of corn yield decreases following cereal rye winter cover crop
Dr. Chumki Banik	D. Laird	Managing perennial cover crops for sustainable corn stover biomass production: Temporal variation in soil nitrate-N

Meeting Abstracts and Poster-Oral presentations at scientific meetings:

Andrea Diane Basche, F. Miguez, S. Archontoulis, T.C. Kaspar. **Iowa** State University and USDA-ARS-NLAE. 2014. The use of cover crops as climate-smart management in Midwest cropping systems. American Geophysical Union fall meeting, 15-19 December 2014, San Francisco, CA.

Andrea Diane Basche, Iowa State University, Ames, IA, Fernando Miguez, Iowa State University, Department of Agronomy, Ames, IA and Thomas C. Kaspar, National Laboratory for Agriculture and the Environment, Ames, IA . **Long term soil water improvements in Iowa using a winter rye cover crop.** ASA-CSSA-SSSA international annual meetings, 2-5 November 2014, Long Beach, CA.
Our goal is to understand how cover crops impact soil water dynamics on a long term research site in Central Iowa and to see if soil water offers any explanation for differences in cash crop growth dynamics. We collected two years of cash crop growth, leaf area and C/N allocation data (soybeans in 2013, corn in 2014) to better understand if there are differences in cash crop growth dynamics with the incorporation of a winter rye cover crop. No significant differences were found in soybean biomass, leaf area, N allocation or final yields between cover crop and no cover crop treatments. Corn data will be analyzed following the growing season. We also analyzed soil moisture data from 2008-2012 to determine how soil water storage varied from year to year and how winter rye growth impacted soil moisture at the start of the cash crop growing seasons. Further, we sampled intact cores to 30-cm depth for a water retention curve analysis. We measured volumetric water content at field capacity and permanent wilting point to determine if there were differences between treatments. In the cover crop plots, we found neutral to positive effects of soil moisture in both wet and dry years at several soil depths. We found minimal evidence that the growing winter rye cover crop depleted early season soil moisture; therefore it did not leave the cover crop plots in soil water deficit ahead of corn or soybean planting. Further, the water retention analysis found significant differences in the plant available water where the cover crop plots had an average of 4mm additional water available. Therefore when analyzed together, the crop growth and soil water dynamics from this long term site who neutral impacts on cash crop growth and positive impacts on soil water storage.

Rosemary Bulyaba, Iowa State University, Ames, IA and Andrew W. Lenssen, ISU, Iowa State University, Ames, IA. **Bradyrhizobium and seed fungicide application influence pulse biomass and grain yield.** ASA-CSSA-SSSA international annual meetings, 2-5 November 2014, Long Beach, CA.
Land degradation and loss of soil fertility remain an important global concern because of the adverse effects on agricultural production, food security and the environment. Nitrogen is one of the most

important nutrients to plants yet declining soil fertility causes limitations on its availability in crop production around the world. The lack of adequate nitrogen in most soils limits farmers' goals of increasing yield per unit area and thus need for research on alternative nitrogen sources. In addition, more research is needed to develop a combination of fungicides and seed inoculation that will not negatively affect nodulation and yield. A field study was conducted for 2 years to determine the existence of interactions between fungicide and bradyrhizobium, ascertain the abundance and effectiveness of indigenous rhizobia in the soil and how they affect the potential for improving biological nitrogen fixation through inoculation. The research also determined what percentage of nodules formed on the roots were actually fixing nitrogen to the soil. The plants were uprooted at R_4 just before pod filling. Results revealed that nitrogen fixation by nodules peaked and then rapidly decreases when pod filling begun. All treatments were not significantly different from each other. However, soybean plots that received both bradyrhizobia and fungicide had higher mean values of yield per hectare compared to other treatments. Soybean plots that received only fungicide but no rhizobia had the lowest mean yield. High yield in plots with no rhizobia would be an indication of presence of already existing competitive indigenous rhizobia strains in the soil. Soybeans were the most efficient at nitrogen fixation followed by CA46 cowpeas.

Robert Malone, D. Jaynes, T. Kaspar, K. Thorp, L. Ma, D. James, E. Kladivko, and J. Singer. 2014. **Water quality improvement from management practices in agricultural watersheds.** ASABE international meetings.
A fall-planted cover crop is a management practice with multiple benefits including reducing nitrate losses from artificially drained fields. We used the Root Zone Water Quality Model (RZWQM) to simulate the impact of a cereal rye cover crop on reducing nitrate losses from drained fields across five states in the Midwest. Within the five states, we estimate that a minimum of 3.6 million ha of drained land used to grow corn in rotation with soybean are immediately suitable for cover crops, because they are currently in no-till or ridge-till or are not tilled in the fall. An additional 3 million ha would be suitable, but delaying tillage until spring on these lands would be more difficult to integrate into the current farming systems. Considering the estimated area within the five states that drains to the Mississippi River, cover crops have the potential to reduce nitrate losses from drained fields by 89 million kg yr-1, or about 11% of the total nitrate load in the Mississippi River. We estimate that the cost per kg of nitrate removed in drainage water with cover crops would be from US$3.87 to $10.33 (kg-N)-1, a cost quite competitive with other management practices for reducing nitrate loads in surface waters.

Rafael A Martinez-Feria, Agronomy, Iowa State University, Ames, IA, Thomas C. Kaspar, National Laboratory for Agriculture and the Environment, Ames, IA and Mary H. Wiedenhoeft, Iowa State University, Ames, IA. **An empirical approach for estimating seeding dates for winter canola in Iowa.** ASA-CSSA-SSSA international annual meetings, 2-5 November 2014, Long Beach, CA.
Corn (*Zea mays* L.) and soybean (*Glycine max* (L) Merr.) only provide significant soil cover and uptake of nutrients during the height of the growing season, rendering Iowa cropland vulnerable to erosive forces and loss of nutrients throughout the rest of the year. Replacing these bare fallow periods with growing crops can slow soil erosion and retain nutrients in the field during the fall, winter and spring. We hypothesize that in Iowa, winter canola (*Brassica napus*) will be a suitable crop for soil and water conservation purposes while having the potential to produce a marketable crop in mid-summer. However, establishing winter canola in the fall represents a challenge in the cooler climates of the Upper Midwest. Moreover, seeding timing greatly affects winter canola's readiness for overwintering. This is because ideally winter canola plants should have enough time to develop at least five leaves before the occurrence of the first killing frost to maximize potential winter hardiness. Thus, determining reliable seeding dates for this crop in Iowa is needed. Here, we present an empirical approach for estimating reliable seeding dates based on historical weather data and growth data from experimental plots. A preliminary analysis with this method for Ames, Iowa, suggests that in general, winter canola seeded by 4-September will have enough heat units available for reliable establishment and growth. Seeding may be done as late as 17-September, but frost damage and winterkill is increasingly likely. This information will be crucial in

assessing the agronomic and economic feasibility of incorporating winter canola into corn-soybean rotations in this state.

Lara Schenck[1], Thomas C. Kaspar[2], Thomas B. Moorman[3], Matt Bakker[2] and Thomas E. Loynachan[1], (1)Iowa State University, Ames, IA; (2)National Laboratory for Agriculture and the Environment, Ames, IA
(3)2110 University Blvd., USDA-ARS National Laboratory for Agriculture and the Environment, Ames, IA. Winter rye cover crop effect on corn seedling pathogens. ASA-CSSA-SSSA international annual meetings, 2-5 November 2014, Long Beach, CA.
Cover crops have been grown successfully in Iowa, but sometimes a cereal rye cover crop preceding corn can reduce corn yields. Our research examines the effect of a rye cover crop on infections of the succeeding corn crop by soil fungal pathogens. Plant measurements included: growth stage, height, radicle length, nodal root number, dry weight, fraction of diseased radicles, and fraction of diseased mesocotyls. In controlled growth chamber experiments, corn plants following a rye cover crop revealed significantly diminished performance when compared to corn plants following no rye cover crop.

Timothy Sklenar[1], Andrew W. Lenssen[2], Mary H. Wiedenhoeft[1] and Thomas C. Kaspar[3], (1)Iowa State University, Ames, IA; (2)ISU, Iowa State University, Ames, IA; (3)National Laboratory for Agriculture and the Environment, Ames, IA. 2014. **Cover crop termination timing and biomass removal: impact on soybean systems.** ASA-CSSA-SSSA international annual meetings, 2-5 November 2014, Long Beach, CA.
Iowa often has extreme weather events in the spring, a time when few fields in the state have a living cover, leading to nutrient leaching and erosion issues. These intense rain events also lead to excess soil moisture and runoff. While cover crops help address these issues and more, there has been little adoption of cover crops in Iowa (less than 1% of farmed acres). A commonly cited worry is that cover crops aren't worth the money that a farmer must invest. To offset costs, some farmers use their cover crops for haying or grazing, but a major constraint is access to federal crop insurance for main crops. To address this, an experiment was designed to determine whether the USDA RMA cover crop haying and grazing guideline date (May 10) had an influence on soybean grain yields in Iowa. A replicated plot study was conducted near Ames, Iowa during the 2012-2013 and 2013-2014 growing seasons to investigate the effects of cover crop species, termination date and residue removal on subsequent soybean grain yield. Cover crop entries included Secale cereale ‘Spooner’, Brassica napus ‘Sitro’, Camelina sativa ‘Bison’, B. rapa ‘Purple Top’, and a no-cover crop control. The first year of the study found the only factor with a statistically significant effect on yield was aboveground biomass removal. Plots with biomass removed yielded 3818 kg/ha compared to 3668 kg/ha where biomass was left in place. Cover crop species also had a significant effect on weed pressure and accumulated biomass, carbon and nitrogen. Removal and use of aboveground biomass could serve as a powerful argument to help increase farmer adoption of cover crops.

Cynthia Bartel, Kenneth Moore, David Laird, Andrew Lenssen. 2014. **Managing Perennial Cover Crops for Sustainable Corn Stover Biomass Production**, as funded by the North Central Sun Grant Initiative, functions to ascertain the impact of perennial cover established within row crop systems. Given the increasing demand for and removal of corn stover for either cellulosic biofuels or livestock-related purposes for bedding and feedstuffs, a need exists to ensure that natural resources-related issues resulting from the practice of stover removal can be managed appropriately. Soil erosion and nitrate leaching, for example, must be mitigated, and sufficient organic matter must be maintained and managed in an appropriate fashion. Management of natural resources-related issues would most desirably be attained without compromising yield of the crop of primary economic interest or placing extreme infrastructure burdens on operators, which would both function as economic disincentives. Perennial covers may then act to alleviate problems which arise from the removal of stover in conventional systems.

Within the Sun Grant-funded project, perennial cover was established with Kentucky Bluegrass and Creeping Red Fescue prior to the planting of both corn and soybean, as the crops of primary economic interest. Data gathered from research plots includes phenology, Light Area Index (LAI), Normalized Difference Vegetation Index (NDVI), biomass, and grain yield, among other parameters. Statistical analysis of corn yield for 2014 found no differences between the twelve treatments. Additionally, the average yield difference between the conventional and zone tillage plots, as well as the yield differences between those plots with perennial groundcover and those with bare soil, was nonsignificant. Analysis of variance showed soybean yield differed significantly for treatment. Additionally, the average difference between the conventional and zone tillage factors, as well as those plots with perennial groundcover and those with bare soil was significant. For the 2014 field season, the mean corn yield in plots with conventional tillage and no groundcover was 188.1 bushels $acre^{-1}$, while the mean corn yield in plots with zone tillage and perennial groundcover was 178.7 bushels $acre^{-1}$. The mean soybean yield in plots with conventional tillage and no groundcover was 50.2 bushels $acre^{-1}$, while the mean soybean yield in plots with zone tillage and perennial groundcover was 27.3 bushels $acre^{-1}$.

Ajay Nair, Jennifer Tillman, and Raymond Kruse. 2014. **Summer Cover Crops and Plastic Mulch Affect Fall Lettuce (*Lactuca sativa* L.) Production.** 2014 American Society for Horticultural Science Annual Conference, July28-30, 2014, Orlando, FL

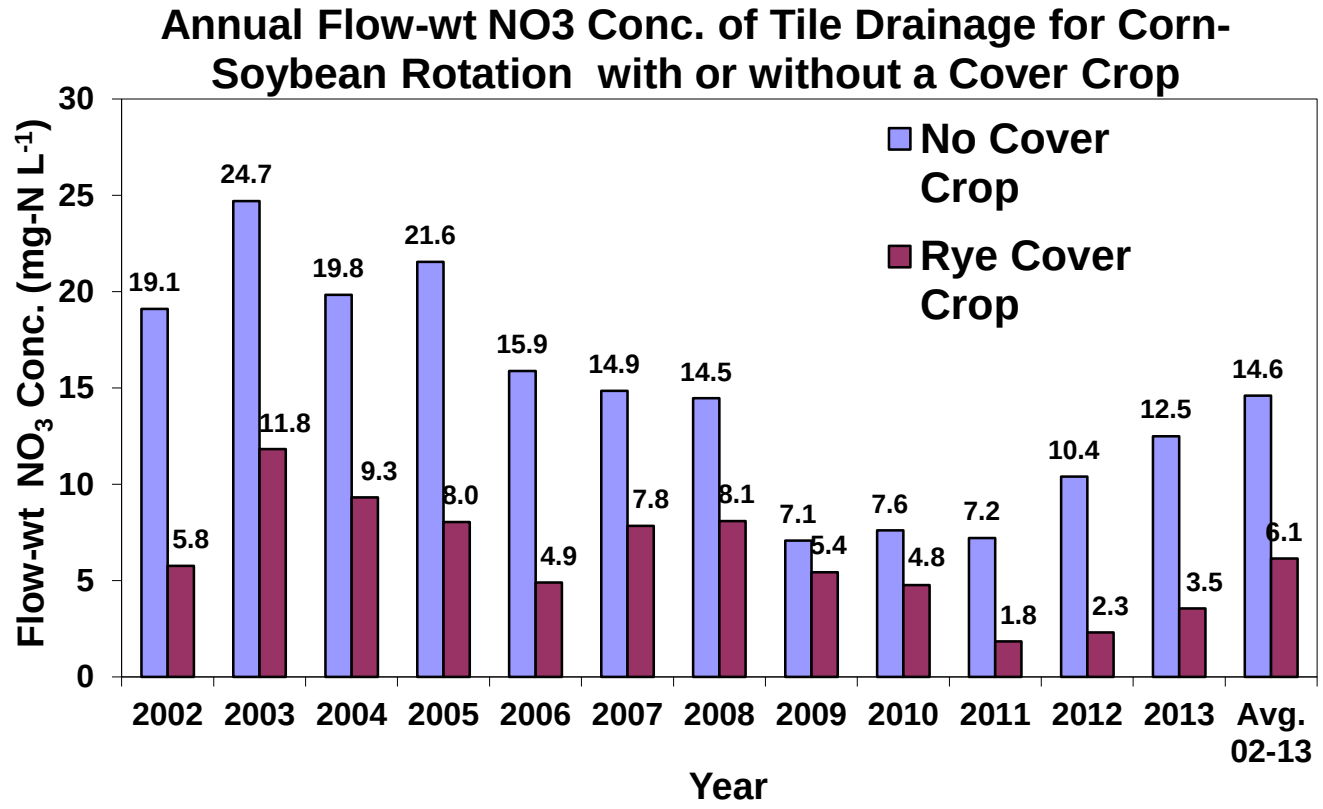
Abstract: Cover crops have generated wide interests among fruit and vegetable growers in the country. In vegetable cropping systems, in addition to traditionally grown cover crops such as cereal rye and hairy vetch, there are wide choices available. Short duration summer cover crops such as cowpea, sorghum sudangrass, buckwheat, etc. are being increasingly utilized to add organic matter, suppress weeds, and enhance soil quality and health. Another product that has become ubiquitous in vegetable production is black plastic mulch. Black plastic mulch provides benefits such as weed suppression, moisture retention, and reduced nutrient leaching, but it can also increase soil temperature to a level that could hurt plant roots. Vegetables such as lettuce could be affected due to high soil temperatures. This study investigated effects of three summer cover crops (buckwheat, cowpea, sorghum sudangrass, or no-cover crop) and four mulch treatments (black, blue, red, and white plastic mulch) on fall lettuce production. The study was conducted at the Horticulture Research Station, Ames, IA. Experimental design was a split-plot design with four replications. Cover crops were the whole plot and mulch treatments were the split plot factors. Cover crops were seeded on 20 June, and 10 July in 2012 and 2013, respectively. Cover crops were terminated 60 days after seeding and lettuce 'Nancy' was transplanted on raised bed with plastic mulch treatments. Plants were fertigated using drip irrigation. Cover crops significantly affected marketable lettuce yield. Lettuce growing in the cowpea treatment produced the highest marketable weight followed by no-cover crop and buckwheat treatment. Sorghum sudangrass did not produce any marketable lettuce. Lettuce in the sorghum sudangrass treatment showed poor growth and severe stunting. There was no effect of mulch treatments on marketable weight; however, lettuce plants growing on red plastic mulch had the highest total leaf area. Lettuce in cowpea or no-cover crop treatment had higher number of leaves than buckwheat or sorghum sudangrass. Results from this study indicate a detrimental effect of buckwheat and sorghum sudangrass on lettuce yield and quality. This could be due to allelopathic properties of those cover crops. Growers could minimize this risk by planting lettuce 10–14 days after cover crop termination. Although plastic mulch did not affect marketable yield, they have the potential to alter leaf number and leaf area

Jennifer Tillman and Ajay Nair. 2014. **Strip-tillage and Row Cover Use in Organic and Conventional Cucurbit Crops.** 2014 American Society for Horticultural Science Annual Conference, July28-30, 2014, Orlando, FL

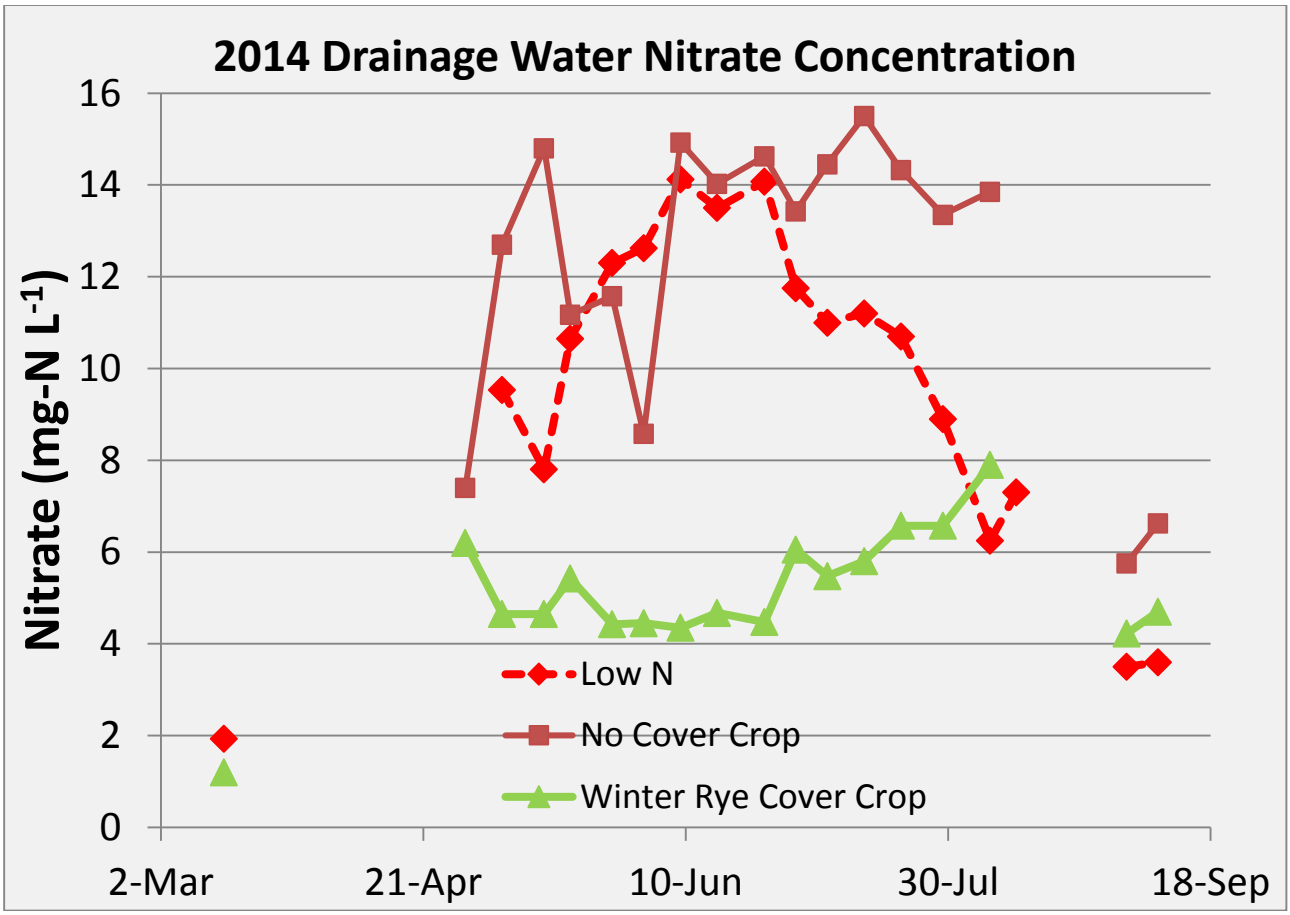
Abstract: Growing cucurbit crops in a more sustainable way involves multiple management practices. Cover crops are often incorporated into the soil before planting the cash crop. However, they can also be "rolled" and used as a ground cover throughout the growing season. The cash crop is then planted in small, tilled strips within the residue. This "strip-tillage" technique provides a weed-controlling, moisture-retaining mat that does not need to be removed at the season's end, as plastic mulch

does. The reduction in tillage can improve soil structure and health. Row covers can be placed over newly planted seedlings to provide a better microclimate and a physical barrier to pests. Row covers can help prevent the spread of bacterial wilt, a disease caused by the bacterium *Erwinia tracheiphila*, spread by cucumber beetles. This study investigated how tillage and row covers affected plant size, yield, and soil health in organic and conventionally grown summer squash (*Cucurbita pepo*) and muskmelon (*Cucumis melo*). The first year of this two-year study was conducted in 2013 at the Muscatine Island Research Farm in Muscatine, Iowa on sandy soil. We used a double split-plot, randomized design with four replications. The field treatments included two cucurbit crops (Athena muskmelon and Lioness summer squash), two farming methods (organic and conventional), two tillage treatments (conventional tillage with black plastic and strip-tillage into rolled rye), and two row cover treatments (no row covers and row covers). Row cover treatments tended to produce more plant vegetation but not higher marketable yields when compared to treatments without row covers. Row covers helped reduce the number of insecticide sprays needed in squash, and reduced the presence of bacterial wilt in melons. Strip-tillage treatments produced smaller plants and smaller marketable yields compared to conventionally tilled treatments. The effects of tillage and row cover use did not depend on the method of farming (organic versus conventional). Strip-tillage tended to reduce between-row weed pressure early in the season when compared to the conventionally tilled treatments due to the presence of the rolled rye mulch between rows in the strip-tillage treatments. Strip-tillage treatments had lower soil microbial biomass than conventionally tilled treatments. Conventional tillage with black plastic mulch increases soil temperature compared to strip-tillage into rolled rye, which likely lead to the increased growth of these warm season crops.

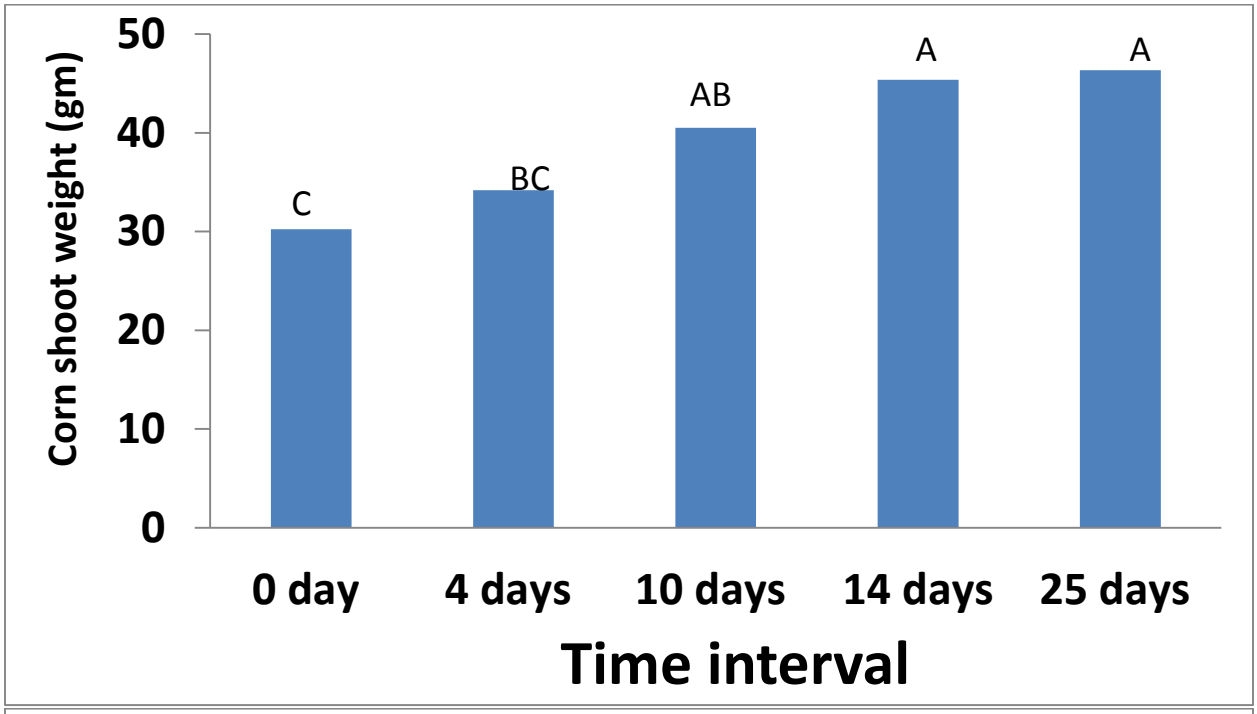
Cereal rye and oat cover crop effects on nitrate leaching in a tile-drained field. USDA-ARS, Tom Kaspar, Dan Jaynes, Tim Parkin, and Tom Moorman.
Long-term study now in its 14th year of data collection comparing nitrate loss in tile drainage of a no-till corn-soybean rotation with and without a winter rye cover crop. New treatments started in recent years include a fall chisel plow corn-soybean rotation with and without a fall oat cover crop and a very-low N no-till corn-soybean rotation. Throughout the 12 year period analyzed so far, the annual flow-weighted nitrate concentration of the tile drainage water has been reduced by an average of 58% when a winter rye cover crop was included.

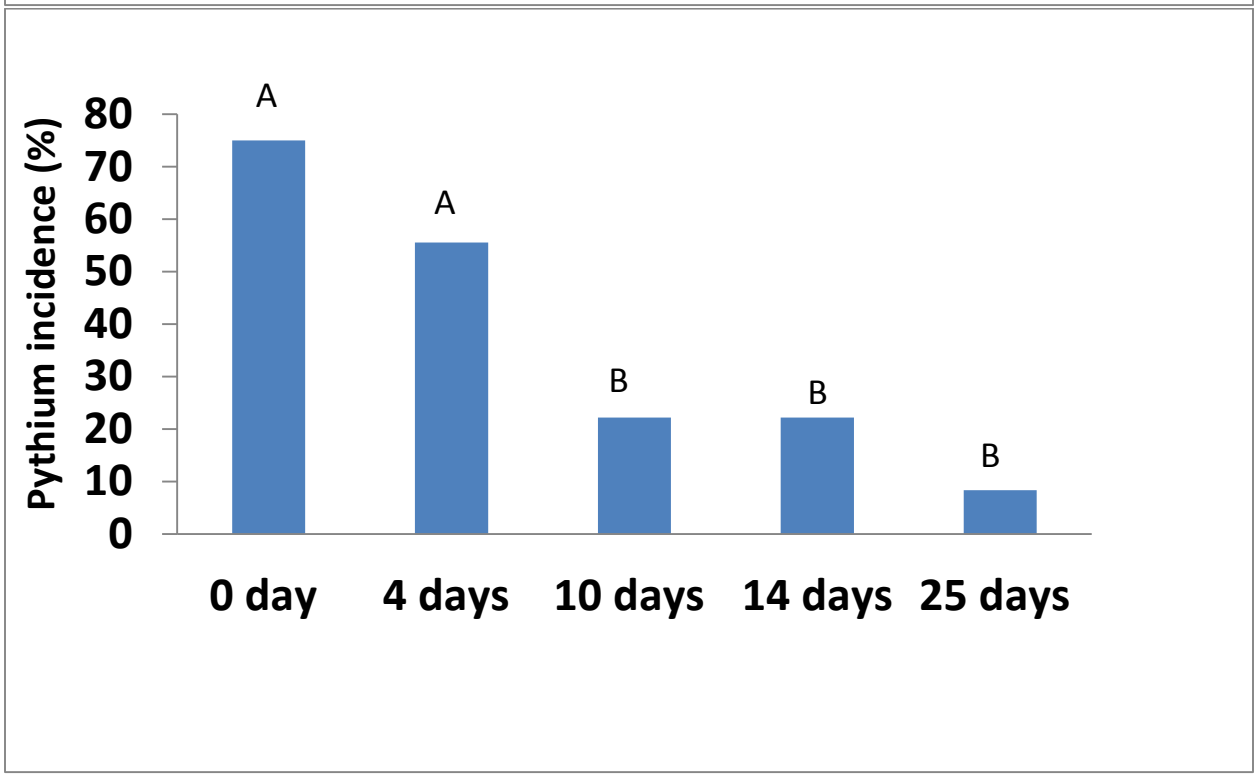


Additionally, in 2014 a corn year, the rye and no rye treatments showed similar trends. Of particular interest is the low N treatment, which has not received any N fertilizers since the fall of 2011. The tile drainage water nitrate concentration of the low N treatment is no different from the No Cover Crop treatment that received normal N fertilization for corn production in both 2012 and 2014. This indicates that nitrate losses in drainage water are not coming only from fertilizer nitrogen and that part of the cover crop effect is presence or absence of plants during the period from the previous crop's maturity to planting and establishment of the next crop.



Cereal rye cover crop effects on corn seedling root diseases. USDA-ARS and Iowa State University. Tom Kaspar, Matt Bakker, Tom Moorman, Alison Robertson, and Andy Lenssen.
A number of studies are going on for this project including both controlled environment and field studies. Some of the results from the first year of field study comparing corn population, ear number, grain yield, early growth, and root disease incidence when a cereal rye cover crop was terminated 25, 14, 10, or 3 days before planting or 1 day after planting compared with corn without a rye cover crop. Grain yield of the rye treatments terminated 3 days before corn planting and 1 day after planting were significantly less than the no cover crop treatment. The rye treatment terminated 1 day after planting also had fewer plants and ears at harvest ($Pr < 0.10$). Early growth of corn showed similar trends with corn shoot weight declining as the winter rye cover crop was terminated closer to the time of corn planting and with no difference between the no rye treatments and rye terminated 14 or 15 days before corn planting. Lastly the incidence of Pythium infection of corn roots increased as time between cover crop termination and corn planting decreased.


Corn shoot weight (gm)
50
40
30
20
10
0
C
BC
AB
A
A
0 day
4 days
10 days
14 days
25 days
Time interval


Pythium incidence (%)
80
70
60
50
40
30
20
10
0
A
A
B
B
B
0 day
4 days
10 days
14 days
25 days

The following 9 pages of cover crop efforts are from the Practical Farmers of Iowa Cover Crop program for 2014

1. Publications
TV and Radio
Published **7** TV and Radio stories on cover crops;

January 20, 2014. "Iowa Farmers Start to Mix It Up: Cover Crop "Cocktails" http://www.publicnewsservice.org/2014-01-20/rural-farming/iowa-farmers-start-to-mix-it-up-cover-crop-cocktails/a36938-1

February 28, 2014. Sarah Carlson radio interview about cover crops on WHO Des Moines.

March 4, 2014. Sarah Carlson radio interview about cover crops on WHO Des Moines.

May 2, 2014. Branstad: "Nothing like seeing it first-hand." KMA Land. http://www.kmaland.com/ag/nothing-like-seeing-it-first-hand/article_ba1dacce-d20e-11e3-8d2f-001a4bcf6878.html

June 16, 2014. Public News Service. Landscape Changes As IA Farmers Look Beyond Corn and Beans. http://www.publicnewsservice.org/2014-06-16/rural-farming/landscape-changes-as-ia-farmers-look-beyond-corn-and-beans/a39943-1#sthash.alCLgztI.dpuf

September 11, 2014. Get in-the-know on Cover Crops. KMA Land.

July 22, 2014. Don't Farm Naked. KHOI Radio.

Newspaper and trade publications
Secured **21** articles in 2014;

Sloan, D. March 29, 2014. Good options to choose from. *Cedar Rapids Gazette*. http://thegazette.com/2014/02/02/good-options-to-choose-from/

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Practical Farmers research reports

Published **11** reports from on-farm research trials where farmers compared the ecological and economic resilience of cover crop systems to a control on their farms.

"Interseeding Winter Rye with Rye Clover" Practical Farmers Research Report. Stefan Gailans and Sarah Carlson. January 2014.

"Winter Cereal Rye Cover Crop Effect on Cash Crop Yield: Year 5" Practical Farmers Research Report. Stefan Gailans. March 2014.

"Herbicide Carryover Injury to Cover Crops" Practical Farmers Research Report. Stefan Gailans and Sarah Carlson. June 2014.

"Cover Crop Variety Trial 2013-2014" Practical Farmers Research Report. Stefan Gailans and Sarah Carlson. August 2014.

"Grazing Cover Crops on Corn Ground" Practical Farmers Research Report. Margaret Chamas. November 2014.

"Grazing Cover Crops for Winter Feed" Practical Farmers Research Report. Margaret Chamas. November 2014.

"Quick Turnaround Cover Crops for Horticulture—Update 2014" Practical Farmers Research Report. Liz Kolbe. December 2014.

"Side-dressing Corn following a Winter Rye Cover Crop—Updated 2014" Practical Farmers Research Report. Stefan Gailans. December 2014.

"Nitrogen Replacement Value of Red Clover" Practical Farmers Research Report. Stefan Gailans. December 2014.

"Green Manure Cover Crops Established with Small Grains." Practical Farmers Research Report. Stefan Gailans. December 2014.

"Summer Squash Following Winter Rye" Practical Farmers Research Report. Liz Kolbe. December 2014.

PFI Newsletter

Published **3** newsletter articles on cover crops;

"Cover Crops and One Farm's Story: Weed Control, Soil Protection and Weed Resistance Prevention." Sarah Carlson. The Practical Farmer. Vol. 29. No.1. Winter 2014.

"Cereal Rye "Rules" in Iowa" Stefan Gailans. The Practical Farmer. Vol. 30. No.3. Summer 2014.

"Building Soil at Maple Edge Farm" Stefan Gailans. The Practical Farmer. Vol. 30. No. 4. Fall 2014.

Practical Farmers blog

Published **24** blog posts related to cover crops;

"Study: Cover Crops Can Ward off Soybean Diseases." Practical Farmers Blog. Sarah Carlson. January 10, 2014. http://practicalfarmers.org/blog/2014/study-cover-crops-can-ward-off-soybean-diseases

"Cover Crops & Crop Insurance News Items." Practical Farmers Blog. Sarah Carlson. January 21, 2014. http://practicalfarmers.org/blog/2014/cover-crops-crop-insurance-news-items

"Iowa Farmers Talk Cover Crops." Practical Farmers Blog. Sarah Carlson. February, 6, 2014. http://practicalfarmers.org/blog/2014/iowa-farmers-talk-cover-crops

"Six Cover Crop learning options this spring." Practical Farmers Blog. Sarah Carlson. February 14, 2014. http://practicalfarmers.org/blog/2014/six-cover-crop-learning-options-this-spring

"March and April are Cover Crop Months in the Midwest." Practical Farmers Blog. Sarah Carlson. February 28, 2014. http://practicalfarmers.org/blog/2014/march-and-april-are-cover-crop-month-in-the-midwest

"New Cover Crop Research Report Available." Practical Farmers Blog. Drake Larsen. March 11, 2014. http://practicalfarmers.org/blog/2014/new-cover-crop-research-report-available

"I would like to use cover crops on my land…?" Practical Farmers Blog. Drake Larsen. April 10, 2014. http://practicalfarmers.org/blog/2014/04/10/like-use-cover-crops-land/

"Does a cover crop affect corn or soybean yields?" Practical Farmers Blog. Stefan Gailans. April 16, 2014. http://practicalfarmers.org/blog/2014/04/16/cover-crop-affect-corn-soybean-yields/

"Thinking about letting a winter cereal cover crop go to grain?" Practical Farmers Blog. Stefan Gailans. April 24, 2014. http://practicalfarmers.org/blog/2014/04/24/thinking-letting-winter-cereal-cover-crop-go-grain/

"Cover Crop Seed Selection and Planting." Practical Farmers Blog. Sarah Carlson. April 25, 2014. http://practicalfarmers.org/blog/2014/04/25/cover-crop-seed-selection-planting/

"Cover Crops Management and Termination." Practical Farmers Blog. Sarah Carlson. April 25, 2014. http://practicalfarmers.org/blog/2014/04/25/cover-crops-management-termination/

"# of cover crop acres larger than previously estimated." Practical Farmers Blog. Sarah Carlson. May 2, 2014. http://practicalfarmers.org/blog/2014/05/02/cover-crop-acres-larger-previously-estimated/

"Summertime Cover Crop Workshops." Practical Farmers Blog. Sarah Carlson. May 29, 2014. http://practicalfarmers.org/blog/2014/05/29/summertime-cover-crop-workshops-june-10-11-12/

"Roller Crimper and Strip Tillage Field Day at ISU Horticulture Research Station." Practical Farmers Blog. Tomoko Ogawa. June 13, 2014. http://practicalfarmers.org/blog/2014/06/13/roller-crimper-strip-tillage-field-day-isu-horticulture-research-station/

"Field Day Recap: Row Crops, Fences and Watermelons." Practical Farmers Blog. Margaret Dunn. July 7, 2014. http://practicalfarmers.org/blog/2014/07/07/field-day-recap-row-crops-fences-watermelons/

"Field Day Recap: Sustaining the Black Gold." Practical Farmers Blog. Margaret Dunn. July 7, 2014. http://practicalfarmers.org/blog/2014/07/07/field-day-recap-sustaining-black-gold/

"Field Day Recap: Farming Across Generations." Practical Farmers Blog. Stefan Gailans. July 23, 2014. http://practicalfarmers.org/blog/2014/07/23/field-day-recap-farming-across-generations/

"Soybeans in Asparagus." Practical Farmers Blog. Tomoko Ogawa. August 8, 2014.

http://practicalfarmers.org/blog/2014/08/08/soybeans-asparagus/

"Cover Crop Variety Trial, 2013-2014." Practical Farmers Blog. Stefan Gailans. August 19, 2014. http://practicalfarmers.org/blog/2014/08/19/cover-crop-variety-trial-2013-2014/

"Field Day Recap: Maple Edge Farm." Practical Farmers Blog. Stefan Gailans. August 28, 2014. http://practicalfarmers.org/blog/2014/08/28/field-day-recap-maple-edge-farm/

"Field Day Recap: Bent Gate Farm, Sept. 12" Practical Farmers Blog. Stefan Gailans. September 24, 2014. http://practicalfarmers.org/blog/2014/09/24/field-day-recap-bent-gate-farm-sept-12/.

"Recap: November 2014 ILF Cover Crop Workshops" Practical Farmers Blog. Stefan Gailans. November 19, 2014. http://practicalfarmers.org/blog/2014/11/19/recap-november-2014-ilf-cover-crop-workshops/

"Study of Iowa Farmers Finds 23% Using Cover Crops" Practical Farmers Blog. Sarah Carlson. December 3, 2014. http://practicalfarmers.org/blog/2014/12/03/study-iowa-farmers-finds-23-using-cover-crops/

"PFI Interview: Get to know expert cover cropper Blake Vince ahead of the annual conference" Practical Farmers Blog. Stefan Gailans. December 17, 2014. http://practicalfarmers.org/blog/2014/12/17/get-know-expert-cover-cropper-blake-vince-ahead-annual-conference/

"Learn about Cover Crops across Iowa in January" Practical Farmers Blog. Sarah Carlson. December 23, 2014. http://practicalfarmers.org/blog/2014/12/23/learn-cover-crops-across-iowa-january/

Other publication materials

- "Biomass Sampling – Cover Crop Research" Video. Drake Larsen. November 19, 2014. https://www.youtube.com/watch?v=vM3yvL4fCl4
- "Intro to Cover Crops" packet sent to 3900 farmers enrolled in the IDALS cover crop cost share program
- Updated Iowa Cover Crop Business Directory

2. On-farm research projects

- Working with 36 PFI farmers who are conducting 16 experiments related to cover crops in 2014.
- Spring, Summer, Fall 2014 Practical Farmers of Iowa, Iowa Learning Farms and Iowa State University Farmer Association Farms evaluated a pure cover crop and a cover crop mix's effect on cover crop growth, soil fertility, and nitrate in shallow groundwater at six regional research farms in Iowa. The project began in 2013 and continues into 2015.
- Fall 2014 Practical Farmers of Iowa and Iowa Learning Farms began a project on 10 commercial farms across the state seeking to determine the effect of aerially seeding cover crops on cover crop growth and commodity crop yield.

- Fall 2014 Practical Farmers of Iowa, Iowa Learning Farms, and Hagie Manufacturing began a project on three farms comparing cover crop seeding methods and cover crop selection on cover crop growth and commodity crop yield. Seeding methods compared include broadcasting into standing commodity crop with a modified high-clearance sprayer vs. drilling after commodity crop harvest. Cover crop selections compared include pure stands vs. mixes.

3. Outreach

Field Days/Workshops

Organized and held **70 cover crop field days and workshops** at different locations around Iowa with a total number of **4720** people attending.

January 3, 2014	Cover Crop Workshop, Hardin County (30 attendees)
January 18, 2014	Workshop @ Sustainable Agriculture Conference, Wells, MN (25 attendees)
February 1, 2014	Clarke Cover Crop Roundtable, Clarke County, IA (35 attendees)
February 4, 2014	Cover Crop Workshop, Carroll, IA (50 attendees)
February 18, 2014	Cover Crop and Livestock Field Day, Winterset, IA (35 attendees)
February 21, 2014	Cover Crop Workshop, Traer, IA (35 attendees)
February 25, 2014	Innovations in Cover Crops & Grazing Workshop. (30 attendees)
February 27, 2014	Cover Crop Workshop, Northwood, IA (50 attendees)
February 27, 2014	Cover Crop Workshop, Aurelia, IA (50 attendees)
March 4, 2014	Conservation and Corn Growers Workshop, Buchanan County, IA (15 attendees)
March 4, 2014	Cover Crop Field Day, Booneville, MO (250 attendees)
March 11, 2014	Cover Crop Workshop, Noble County, MN (130 attendees)
March 11, 2014	Cover Crop Workshop, Sac County, IA (34 attendees)
March 12, 2014	Farm Profit and Productivity in the 21st Century: A Farmers Workshop on Soil Health (60 attendees)
March 12, 2014	Cover Crop Workshop, Cass County, IA (40 attendees)
March 13, 2014	American Farmland Trust Cover Crop Workshop (100 attendees)
March 14, 2014	Cover Crop Workshop, Champaign, IL (35 attendees)
March 15, 2014	WFAN Field Day, Pocahontas, IA (26 attendees)
March 19, 2014	Cover Crop for the Livestock Producer Field Day, Carroll City, IA (30 attendees)
March 25, 2014	Workshop on Cover Crop Management, Osage, IA (49 attendees)
March 26, 2014	Workshop on Cover Crop Management, Chariton, IA (45 attendees)
March 31, 2014	WFAN Field Day, Boone, IA (14 attendees)
April 1, 2014	Cover Crop Workshop, Des Moines County, IA (50 attendees)
April 3, 2014	Cover Crop Field Day, Malcom, IA (71 attendees) (ILF)
April 8, 2014	Cover Crop Workshop, Arcadia, IA (33 attendees) (ILF)
April 9, 2014	Cover Crop Workshop, Oakland, IA (18 attendees) (ILF)
April 14, 2014	WFAN Field Day, Jefferson, IA (19 attendees)
April 17, 2014	Spring Cover Crop Field Day, Preston, IA (20 attendees) (ILF)
May 13, 2014	WFAN Field Day, Union, IA (15 attendees)
June 10, 2014	Winter Cereal Rye for Cover and Cash Grain Field Day, Keota, IA (66 attendees)
June 19, 2014	Three-Crop Rotations, Cover Crops & Prairie for Conservation Field Day, Rowley, IA (65 attendees)
June 20, 2014	Cover Crop Workshop, Hardin County, IA (15 attendees)
June 25, 2014	Making Diverse Cover Crop Selections Using Haney Test Results, Williamsburg, IA (50 attendees)
June 26, 2014	Sustaining the Black Gold: Cover Crops, Grazing and Soil Tests Field Day, Holland, IA (50 attendees)
June 30, 2014	Cover Crop Field Day, Blackhawk County, IA (55 attendees)
July 1, 2014	Cover Crop Workshop, Sac County, IA (41 attendees)
July 9, 2014	Nutrient Reduction Workshop, Cass County, IA (35 attendees)

July 11, 2014 Cover Crop Workshop, Montgomery County, IA (65 attendees)
July 29-30, 2014 Cover Crop Boot Camp, Ames, IA (35 attendees)
August 5, 2014 Cover Crop Workshop, Shelby, IA (4 attendees)
August 5, 2014 PFI Cover Crop Research Update (115 attendees)
August 6, 2014 DNR/PFI Cover Crop Workshop (12 attendees)
August 15, 2014 Cover Crop Workshop, Independence, IA (35 attendees)
August 19, 2014 Cover Crop Field Day (114 attendees) (ILF)
August 20, 2014 Cover Crop Field Day, Oelwin, IA (55 attendees)
August 20, 2014 Cover Crop Field Day, Waverly, IA (25 attendees)
August 26, 2014 Soil Stewardship With Cover Crops, Rotations & Grazing Field Day, Hastings, IA (55 attendees)
September 9, 2014 Women Landowners Workshop, Nashua, IA (10 attendees)
September 11, 2014 Cover Crop Field Day, Scott County, MN (60 attendees)
September 12, 2014 Working with Cover Crops: From Start to Finish Field Day, Stanton, IA (33 attendees)
September 12, 2014 Iowa Farm Bureau Cover Crop Workshop (80 attendees)
September 22, 2014 Cover Crop Workshop, Wapello County, IA (25 attendees)
September 25, 2014 ISU Extension Cover Crop Workshop (40 attendees)
September 25, 2014 National Extension Tour Field Day (75 attendees)
October 3, 2014 ISU Agronomy Class Cover Crop Workshop (70 attendees)
October 13, 2014 WFAN Field Day, Poweshiek County, IA (10 attendees)
October 14, 2014 WFAN Field Day, Winneshiek County, IA (35 attendees)
October 15, 2014 WFAN Field Day, Buchanan County, IA (30 attendees)
October 16, 2014 WFAN Field Day, Boone-Polk City, IA (10 attendees)
October 23, 2014 WFAN Field Day, Okoboji, IA (28 attendees)
November 10, 2014 Cover Crop Workshop, Keokuk County, IA (30 attendees)
November 12, 2014 Cover Crops Today and Tomorrow Workshop, Lewis, IA (30 attendees) (ILF)
November 14, 2014 WFAN Conference (45 attendees)
November 18, 2014 Cover Crops Today and Tomorrow Workshop, Nashua, IA (30 attendees) (ILF)
November 19, 2014 Cover Crops Today and Tomorrow Workshop, Kanawha, IA (30 attendees) (ILF)
November 20, 2014 Cover Crop Workshop, Albert Lea, MN (100 attendees)
November 25, 2014 Cover Crop Workshop, Truro, IA (30 attendees) (ILF)
December 1, 2014 Cover Crop Workshop, Monroe, IA (50 attendees)
December 10, 2014 American Seed Trade Association Conference, Chicago, IL (80 attendees)

Webinars

March 13, 20, and 27, 2014. Webinar series on Cover Crops. American Society of Agronomy Hosted; ~2468 views. https://www.agronomy.org/education/online-courses

April 22, 2014. Yale Center for Enviro Law & Policy webinar series "Driving Sustainability: Empowering Growers with On-Farm Research."

June 17, 2014 National Agriculture Aviation Association (NAAA) and Practical Farmers of Iowa (PFI) hosted the webinar titled “Successfully Aerially Seeding Cover Crops” (44 live participants/199 archived views). http://practicalfarmers.org/farmer-knowledge/farminar-archive/successfully-aerially-seeding-cover-crops/

November 25, 2014. Extending the Rotation Beyond Corn and Beans. Dick Sloan and Matt Liebman. PFI Farminar. 15 live participants/123 archived views. http://practicalfarmers.org/farmer-knowledge/farminar-archive/extending-rotation-beyond-corn-beans/

December 16, 2014. Haney & PLFA Soil Tests: What? How? Why? PFI Farminar. Fred Abels and Lance Gunderson. 44 live participants/396 archived views. http://practicalfarmers.org/farmer-knowledge/farminar-archive/haney-plfa-soil-tests/

Conference

January 24-25, 2014	Practical Farmers of Iowa Annual Conference
January 28-30, 2014	Iowa Power Farming Show
February 11, 2014	Agribusiness Showcase and Conference
February 17-19, 2014	National Conference on Cover Crops and Soil Health
March 4, 2014	Wildlife benefits of cover crops Information Meeting
March 11, 2014	Soil Health Meeting
March 13, 2014	Wisconsin Cover Crop Conference - Your Farm, Your Options
March 14, 2014	Roots for Improvement III

Interviews and presentations

PFI staff presented or were interviewed on cover crops at **3** occasions;

- On February 11 2014, PFI staff presented at Agribusiness Showcase and Conference in Des Moines, IA. The session title was "Cover Crops in Iowa" and approximately 100 people attended.

- July, 2014, Sarah Carlson gave a presentation titled "Find & Promote more cover crop research" to NWF Cover Crop Champions conference call/presentation.

- September 16, 2014: Teresa Opheim discussed with Beth Nelson from SARE on reducing barriers to increasing cover crop funding.

Events

Practical Farmers of Iowa hosted Cover Crop Boot Camp on July 29 and 30, 2014 in Ames, Iowa. 35 people attended the boot camp, where attendees learned about the latest cover crop researches and science, and practiced how to communicate this science to other farmers and public in general. Speakers included researchers from Iowa State University and United States Department of Agriculture.
August 26-28, 2014 Cover Crop Champions, Sarah Carlson, Stefan Gailans attended the Farm Progress Show in Boone, Iowa. More than 2500 farmers were asked their most pressing cover crop research questions and had access to two cover crop experts at any time to answer their questions.

Meetings

Hosted and/or participated in **12** meetings related to cover crops;

March 4, 2014	Cover Crop Wildlife meetings on wildlife benefits from cover crops.
March 4, 2014	Cover Crop Meeting, Hazelton, IA (20 attendees) (ILF)
March 5, 2014	Working meeting with DNR, NRCS, Bradford Research and Extension Center
March 12, 2014	Meeting with DNR on cover crops.
April 8-9, 2014	Midwest Cover Crops Council Meeting, Warsaw, IN (40 attendees)
May 8, 2014	Wildlife/Cover Crop Conference Call-discussed research needs for wildlife community
June 5, 2014	Wildlife/Cover Crop Conference Call-discussed status of cover crop/wildlife research in Illinois
June 27, 2014	Wildlife/Cover Crop Conference Call-held third wildlife/cover crop Networked graduate student Cassandra Wilcoxen with NWF CC Champion Marcus Maier as a potential research location. Also provided Lara with Cassandra's information and suggested a winter wildlife/cover crop researchers check-in call from the NWF funded projects.
July 2014	Meeting including members from Field to Market. Followed up with Field to Market staff about ways to incorporate cover crop data into the Field Print Calculator.
August 12-14, 2014.	Attended Multi-LCC Mississippi River Basin / Gulf Hypoxia Initiative in Memphis Tennessee and attended one follow up conference call.

December 5, 2014. Cover Crops 101. Iowa Drainage District Association Annual Conference. Fort Dodge, IA (100+ attendees)

December 8-9, 2014. Practical Farmers of Iowa Annual Cooperators' Meeting. Ames, IA (54 attendees)

Other communications

- Held a conference call with staff from NRCS IA, NRCS MO and the Plant Materials Center about cover crop work going on in each state.

- Held one conference call and shared five email correspondence with cover crop researchers who study nitrogen release in their work. Created a group from which ideas about needs for more research were determined.

- Held two conference calls with cover crop researchers to improve the MCCC Cover Crop Decision-making Tool. Used top priorities determined from the N-release conference call and email correspondence to imbed into an updated tool.

- Held two Cover Crop Decision-making Tool conference calls. Brought in an additional researcher whose expertise with models meets a need outlined on farmers' research list.

Iowa State University Extension meetings (Title and attendees)

Date	Event	Topic	People attended
2/25/2014	Cover Crop Workshop, Kalona, IA	Cover Crops in Vegetable Production	47
3/18/2014	Cover crop talk for market gardeners, Columbus Junction, IA	Cover crop options for vegetable production	18
6/3/2014	Central IA Ag Team (CIAT) tour	Cover crops and Conservation tillage in organic vegetable production	35
6/5/2014	Cover crop field day, Ames, IA	Talk 1 _ Dana Jokela (No-till broccoli and pepper production)	30
6/5/2014	Cover crop field day, Ames, IA	Talk 2 _ Jennifer Tillman (Strip till melon and squash production)	30
7/8/2014	Geisler field day, Bondurant, IA	On-farm cover crop trial (pumpkin production)	45
8/9/2014	Northeast Research Farm, Nashua	Cover crop for backyard and community gardens	25
8/15/2014	Cover Crop Workshop, Independence, IA	Cover Crops in Vegetable Production	38
9/22/2014	Cover Crop Workshop, Sioux City, IA	Integrating cover crops in vegetable production-Nair	20
9/22/2014	Cover Crop Workshop, Sioux City, IA	Talk 2 _ Jennifer Tillman (Strip till melon and squash production)	20
9/22/2014	Demo at Elementary school as well	Seeding of cover crops for school kids	50
10/16/2014	Cover Crop Workshop, Cresco, IA	Selecting the right cover crop in your vegetable crop rotation	15
10/16/2014	Cover Crop Workshop, Cresco, IA	Summer cover crops in vegetable production-Raymond Kruse	15