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Management and performance of Iowa cover crops

Abstract:

Cover crops are valued by a growing number of Midwest corn and soybean growers for their ability to improve soil quality, combat soil compaction, minimize soil erosion, maximize soil nutrient capture, and protect water quality. This project allowed Iowa Learning Farms to collect significant additional data on Iowa cover crop production.

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Budget:

\$32,110 for year one

Q What is the long-term impact of cereal rye usage on cash crop yields?

A After seven years of continuous cereal rye cover crop usage, this project clearly shows that the impact of cover crop production on yield is neutral. Since this is on-farm research being conducted by farmer partners, it makes the finding even more important and eliminates one of the major concerns about cereal rye cover crop usage.



ECOLOGY

Background

In 2008, with State Soil Conservation Committee (SSCC) funding, the Iowa Cover Crop Working Group (ICCWG) established a five-year, multi-faceted cover crop demonstration, research and education program distributed across Iowa's five major soil regions. Since that time, ICCWG partners have documented and assessed the management and performance of cover crops on 10 on-farm sites. The funding for this project was used to expand the project to collect seven years of information.

Objectives for the project were: 1) Collection and analysis of yearly management, yield and biomass data from seven of the original 10 farmer partner cover crop demonstrations to support the wider-scale adoption of cover crops in Iowa, and 2) Creation of a database and summary document of all agronomic, management, and soil data for the first seven years of the project (2008-2015).

Approach and methods

- Twelve sites were monitored over the course of this study; six participating in 2014 and seven participating in 2015. All sites are in corn-soybean rotations.
- Cooperators established and maintained replicated strips on the length of their fields for duration of the study. Each replication has one strip with cover crops and one without. In autumn 2014 and 2015, cooperators seeded cereal rye cover crop aerially or with a drill at seeding rates ranging between 56-84 lb/ac.
- Cover crop termination was accomplished primarily with herbicide applied prior to cash crop planting the following spring.
- Soil samples were taken to a depth of 6 inches in June 2015 and sent to Ward Laboratories in Kearney, Nebraska. The Haney Test was used for analysis of these soil health indicators:
 - Organic matter
 - Water extracted total organic C
 - Water extracted organic N
 - Nitrate concentration
 - Soil microbial activity (Solvita CO₂-C burst)
 - Soil Health Calculation



Iowa Learning Farms summer intern Anna Chott collects water infiltration data May 16, 2014, in Ida County. (Photo courtesy ILF and Practical Farmers of Iowa)

Results and discussion

Winter Cereal Rye Cover Crop Effect on Soil

Soil organic matter, total organic carbon (C), and organic nitrogen (N):

Organic matter and total organic C were not affected by the cover crop at any of the locations. Detectable changes in soil C fractions can take many years to appear, as shown by studies in Iowa and Maryland that also failed to detect changes in organic C after three years and 12 years, respectively. Organic N also was not affected by the cover crop, except for one location (Jefferson) where the no-cover treatment actually resulted in slightly greater organic N.

Soil nitrate concentration: Nitrate concentrations in the soil generally were not affected by the cover crop; except at Kalona where there was a greater nitrate concentration in cover crop treatments. These results show that the cover crop is not tying up plant-available N at a critical point in cash crop development (mid-June).

Soil microbial activity (Solvita CO_2 -C burst): The Solvita burst is used in the Haney Test to measure soil microbial respiration. This can be considered a proxy for soil microbial activity. There was no effect of cover crop on the Solvita burst at any of the sites.

Winter Cereal Rye Cover Crop Effect on Cash Crop Yield

Cover crop biomass: Above-ground cover crop biomass was determined at most locations at the time of cover crop termination. Above-ground cover crop biomass at the surveyed locations ranged from trace amounts to 2,407 lb/ac prior to corn and from 55- 2,475 lb/ac prior to soybeans. Cover crop typically was terminated 7 to 10 days prior to planting.

Corn yields: In general, corn yields were equivalent regardless of cover crop treatment as determined by statistical analysis (t-test). Only at Jefferson (2009), Coon Rapids (2010), and Harlan (2010) were corn yields reduced in the cover crop strips. It should be noted that these instances occurred only in the first two growing seasons of the trial. Cooperators identified insufficient cover crop termination (Jefferson 2009) or improper planter settings (Coon Rapids, Harlan 2010) as reasons for the average yield decrease of 27 bu/ac. In the remaining cases, corn yield was not affected by the cover crop. At all but one location, which suffered a hail storm in June, corn yields were near or above 200 bu/ac in 2014 and 2015.

Soybean yields: Soybean yields typically were equivalent, regardless of cover crop treatment as determined by statistical analysis (t-test). Notably, in seven cases, soybean yields were improved by the cover crop. Increases in soybean yield ranged from 3 to 8 bu/ac, with an average increase of 5 bu/ac in these cases. As with corn, soybean yield was not affected greatly by the cover crop. Soybean yields in 2015 ranged between 41 and 63 bu/ac.

Conclusions

Impact on Soil Properties: There were generally no differences in soil health variables between the no-cover and cover treatments at the locations. Many soil changes take years to become noticeable or significant. An earlier study took 10 years of winter rye treatments to detect significant organic matter content and soil nitrogen cycling



Washington County field site with drilled cereal rye near West Chester, April 2015. (Photo courtesy ILF and Practical Farmers of Iowa)

differences between rye cover and no cover treatments. The mechanisms by which rye cover crops influence soil properties across different soil regions and the amount of time that any such changes may need to occur are not well understood.

Impact on Cash Crop Yields: Since 2008, there have been 30 site-years dedicated to determining the effect on corn yields and 23 site-years to gauge the effect on soybean yields. After their first year of introducing cereal rye into their operations, the farmer partners made adjustments to their planter settings to handle more residue and planned to terminate the cover crop 7 to 10 days before planting to minimize negative impacts on yield. After seven years in the study, the farmer partners have reported little to no effect of the cereal rye cover crop on corn and soybean yield.

Impact of results

After seven years of continuous cereal rye cover crop usage, this project clearly shows that the impact of the cover crop production on yield is neutral. Since this is on-farm research being conducted by farmer partners, it makes the finding even more important. It eliminates one of the major concerns about cereal rye cover crop usage and may lead to more cover crop adoption in Iowa. More farmers can add a cereal rye cover crop to their corn-soybean rotation with confidence that with good management, it will not impact their corn yields, and in some situations it could increase their soybean yields.

Thoughts about Future Research: There seem to be tensions between what farmers observe as improved soil health outcomes as a result of cover crops and what scientists are able to measure at a feasible cost and timeframe. Further research is needed to document farmer knowledge about indicators of soil health as a result of cover crop usage on their farms. There is much to be learned from innovative, early adopters of cover crops. Their experience and observations can help improve the scientific approach to measuring soil health, enhance education and outreach messages, and merge the scientific approach with farmer knowledge of how their soil is performing and the economic benefits of improved soil health.

Education and outreach

Sixteen reports on issues related to cover crops were published over the two-year period of the project. Three were joint ILF/Practical Farmers of Iowa productions, two were prepared by ILF, two were from ISU Extension and nine came from PFI. Twenty-two articles were printed in *Wallaces Farmer* between November 2014 and May 2016. Many of these dealt with cover crop planting, production, management, economics, and conservation benefits.

Iowa Learning Farms held 56 field days in 2014-2015 with 2,450 attendees, and cover crops were discussed at every field day. ILF posted 87 blogs on cover crops during that two-year period. Practical Farmers of Iowa posted 75 cover crop blogs. Eight cover-crop-intensive webinars/farminars were hosted by ILF/PFI.

Leveraged funds

Additional funds leveraged by this grant included two grants from the Iowa Department of Agriculture and Land Stewardship: Economic Exploration of Cover

Crop Benefits to Crop and Livestock Systems, \$42,128; and Conservation Learning Lab (CLL): Implementation, Demonstration and Monitoring at the Watershed Scale in Iowa, \$159,083. The PIs also received funding from the USDA-Natural Resources Conservation Service for three more projects: Farmer Education on Soil Health and Nutrient Strategies Through Adoption of Cover Crops, Prairie Strips, and Grazing, \$50,000; Iowa Learning Farms Field Days and Webinars: Learning and Leadership—Engaging Women in Conservation from Economics, Implementation, and Management, \$50,000; and Earthworms and Cover Crops: Unlocking the Secrets of Soil Health Through an Early Biological Indicator, \$74,481.

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