IOWA SOYBEAN ASSOCIATION

RESEARCH

2017 ANNUAL REPORT

IOWA SOYBEAN ASSOCIATION

A mission-driven organization dedicated to increasing the competitiveness of Iowa soybean farmers. ISA Research, comprised of the On-Farm Network®, Environmental Programs & Services, and Analytics, supports this mission by engaging farmers in unbiased agronomic and environmental studies and programming. The research team evaluates and validates practices while investigating and developing novel approaches to increase the productivity, profitability and environmental stewardship of Iowa soybean farmers. Through the collection, analysis and interpretation of individual and aggregated data, ISA research adds value to the information returned to participants and partners.

ISA RESEARCH

Mission: Conceive, conduct and communicate agronomic and conservation research to increase the productivity, profitability and sustainability of Iowa's soybean farmers.

Vision: The ISA research team will be a recognized leader and authoritative source of unbiased and scientifically sound data, information and technical assistance that drives Iowa and Midwestern row crop production agriculture and conservation practices.

Objective: Advance a science-based and data-driven approach to continuously improve agronomic systems, natural resources and environmental quality leading to productive, efficient and profitable soybean production.

THE ISA RESEARCH PROGRAM IS AN INTEGRAL PART OF THE IOWA SOYBEAN ASSOCIATION.

Our On-Farm Network, Environmental Programs & Services and Analytics teams are comprised of some of Iowa's most talented and recognized agronomists and environmental scientists. Working with farmers, universities and industry partners, our teams conduct scientifically-sound in-field and edge-of-field evaluations of products and practices to put meaningful information into the hands of farmers as they make critical management decisions.

The ISA Research Annual Report provides an opportunity to highlight key projects and initiatives. Our mission is to increase the competitiveness of Iowa soybean farmers by communicating results from agronomic and conservation research and programming. The results generated by ISA research will increase farmer productivity, profitability and sustainability if acted on.

As with all annual reports, this publication imparts to our stakeholders how their financial investments and working partnerships with ISA bring value in the form of data, information and decision-making tools. Furthermore, ISA research programs create a broader benefit by leveraging funds from additional sources which are used to complement and extend the work funded by checkoff dollars.

We at ISA are proud to be a leading source of reliable and unbiased data. Providing information and technical assistance to advance Iowa and Midwestern row crop production agriculture, conservation practices, improved soil health, nutrient management and water quality is at the heart of everything we do. We value the close working relationships we have with Iowa soybean farmers. If you are involved with our programs, we thank you. If you do not yet work with our research team, we hope this annual report will inform you about our programs and services, demonstrate the value of our teams and encourage you to get involved with ISA research projects.

This report is also the beginning of a conversation to stimulate ideas and questions for our teams that will help us pursue more innovative research and programming for Iowa's soybean farmers.

We look forward to talking with you soon.

ED ANDERSON, PH.D., ***Senior Director of Research***

Terms and Definitions:

Bioreactors are covered trenches filled with wood chips that drainage water is routed through. Denitrifying bacteria in the wood chips convert nitrate in the drainage water into inert nitrogen gas, reducing the amount of nitrate delivered to the outlet.

Conservation Assessments identify opportunities for improving management of natural resources and agricultural production. With clear goals, farmers can accurately measure improvements, experiment with alternative practices, verify conservation successes and understand how new technologies fit within the operation.

Crop Systems Modeling is a collection of models, software and data to simulate simultaneous soil, crop and climate processes to better manage different crops.

Edge-of-Field Assessments involve evaluating potential sites for suitability for bioreactors and saturated buffers.

Field Surveys are a quick determination through scouting or sampling of individual fields for the presence or absence of a particular condition or pest. Field surveys are used to project estimates of the condition across a larger number of acres.

Guided Stalk Sampling is a tool to evaluate the availability of nitrogen to the corn crop. Nitrate concentrations taken from the lower portion of a corn stalk after physiological maturity is one indicator of nitrogen availability to the plant.

Paired Soil/Water Evaluations are comparisons of two (or more) locations where conditions remain constant for a period of time, then a change is made to one of the locations. Soil and/or water tests are conducted to determine the impact of the change.

Priority Watershed is an area of land which has been identified as a focus for planning, research, monitoring and conservation practice implementation to achieve a soil and/or water improvement.

Profitability Analysis uses input cost, yield, prices, soil and weather data to determine what parts of a field are the most, and least profitable.

Replicated Strip Trials test a product or practice by setting up repeated "strips" of different treatments that cross various soil types and microclimates within a field. The On-Farm Network works with Iowa farmers to conduct trials on a variety of practices on their fields, allowing farmers to learn firsthand what does and does not work for their operation.

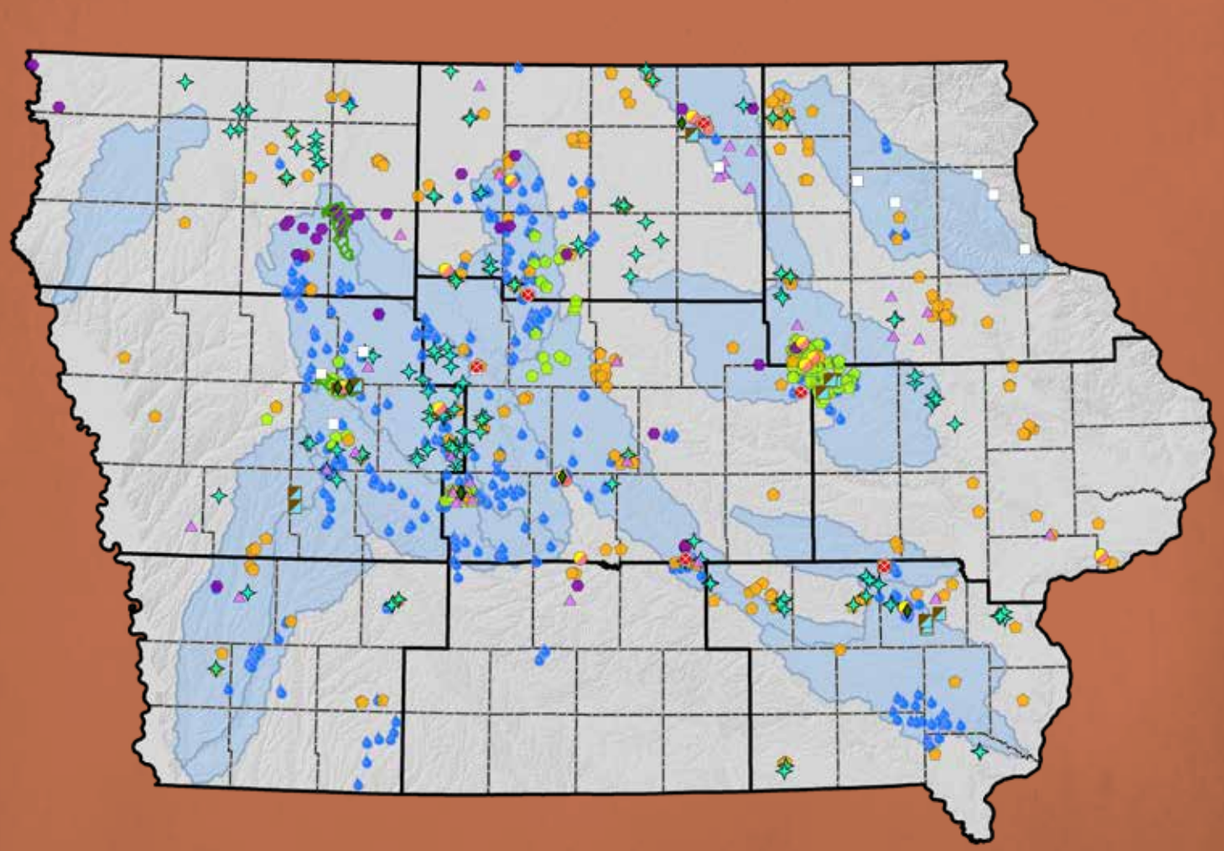
Saturated Buffers use a control structure to divert drainage water within a riparian buffer. Water flows through the soil in the buffer, where it has a chance to interact with plants and microbes for nitrate removal before it enters a stream.

Water Monitoring is accomplished by field staff and trained volunteers who regularly collect water samples from drainage and streams to analyze for E. coli, nitrate-nitrogen and fluoride. They also test for clarity, alkalinity and ammonia. Sample results are summarized and sent to growers.

Watershed Plans are the process of planning and assessing current conditions, developing goals, outlining strategies and estimating the resources necessary to implement a plan to improve water quality and soil health within the watershed. Through ISA's leadership, many watershed groups have completed the process to develop actionable implementation plans for watershed improvement.

2016-17 RESEARCH PROJECT MAP

- Bioreactors Installed: 22
- Conservation Assessments: 40
- Crop Systems Modeling: 6
- Edge-of-Field Assessments: 37
- Field Surveys: 268
- Guided Stalk Sampling Tests: 152
- Paired Soil/Water Evaluations: 20
- Priority Watersheds: 13
- Profitability Analyses Performed: 10
- Replicated Strip Trials: 214
- Saturated Buffers Installed: 14
- Water Monitoring Sites: 494
- Watershed Plans Completed: 2



MAKING INFORMED DECISIONS

Dave Lubben is well-versed about on-farm research; he's been running tests on his farm since 1989.

"To me, every field is a test plot," said Lubben. "The On-Farm Network allows me to do on-farm research using my management style and my soil type to find reliable data."

Lubben produces corn, soybeans and hay on about 1,000 acres, and runs a feedlot beef cattle operation with his daughter and son-in-law near Monticello.

Working with the Iowa Soybean Association's (ISA) On-Farm Network team, Lubben runs replicated strip trials of at least eight rows, with and without treatment, to get a good comparison. They have researched tillage methods and completed population and fertilizer studies.

"It's pretty simple. You can incorporate it into your cropping system," Lubben said. "Like starter fertilizer—just turn it off, go across the field, get to the other end and turn it back on. When you combine... Boom! You can see if that starter fertilizer gave you an economic benefit. You get the results right now."

Research strips allow Lubben to conduct a variety of product tests. "Sales reps come and try to sell you a product or a concept. We'll try it out for three or four years," he said. "Then we do an economic analysis and an agronomic analysis of that system or product. That's the value we get, that's how we got started."

Lubben works with the On-Farm Network team on what trials to conduct. They meet annually during the winter months and hash out ideas.

"They've got a whole page of stuff and I have some trials that I want to do. I'll bounce my ideas off them," said Lubben. "They will bring me product and I'll put it in the field. They will come out and get planting information and do aerial imaging over the summer. In the fall, we'll send them yield data when we're all done. They crunch the numbers and put it all into a nice binder for us to see what it looks like."

The ISA On-Farm Network field trials can help others across the state. Lubben uses all the data he can to make well-informed decisions.

"On the ISA website, you can look at all the trials—there might be 50 to 100 of them—there are guys throughout the state who are doing them. I might find there are 50 guys who only had a two- or three-bushel increase in yield on a certain trial. And the guy who's trying to sell you the product might be saying there's a 10-to 15-bushel increase. With the field trials, I can see what it's really worth and what I can expect out here in the real world."

Visit iasoybeans.com to learn more about partnering with the On-Farm Network.

THE ON-FARM NETWORK ALLOWS FARMERS TO TEST PRODUCTS AND PRACTICES ON THEIR OWN FIELDS WITH THEIR OWN EQUIPMENT.

"If somebody has a sales promotion that says you'll get a 10 percent increase in yield by using this product, I can test it on my farm. It doesn't cost a fortune to do it."

— DAVE LUBBEN, *farmer from Monticello*

On-Farm Network®

WORKS ON FARMERS' FIELDS USING THEIR OWN EQUIPMENT TO HELP DETER MINE WHAT PRODUCTS AND PRACTICES WORK BEST WITH THEIR OPERATION.

The On-Farm Network partners with farmers, university researchers, companies and government organizations on agronomic topics farmers care about. These relationships allow the On-Farm Network to provide unbiased, third-party information on soybeans and corn to improve farmers' decision-making. The goal: to continuously improve efficiency and profitability of environmentally sound cropping systems. The On-Farm Network focuses on soil health, nutrient management, cropping systems and pest management.

ISA SUPPORTS RESEARCH AT THE STATE, REGIONAL AND NATIONAL LEVELS.

200+ REPLICATED STRIP TRIALS

300+ LOCATIONS SURVEYED FOR PESTS

24 PROJECTS COVERING MORE THAN 11,300 ACRES

1,000+ TRIALS PROCESSED FOR RESEARCH PARTNERS

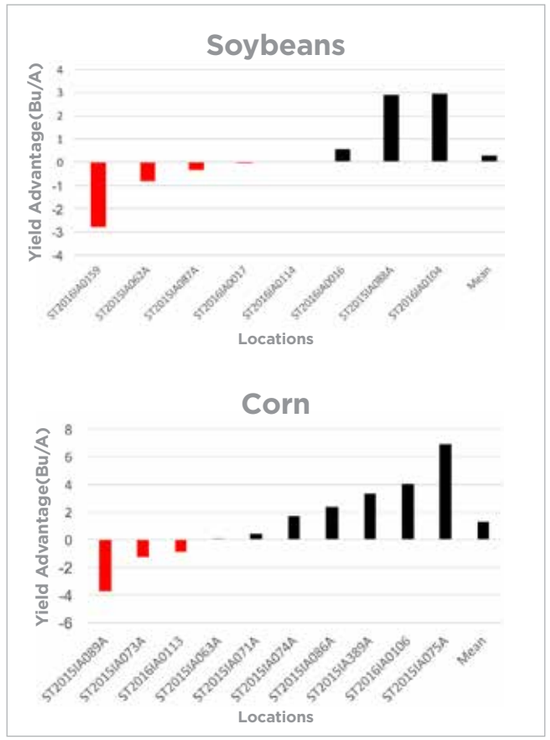
Keeping soil healthy and in place

Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans. This definition speaks to the importance of managing soils so they are sustainable for future generations. In Iowa, the estimated average soil loss to erosion is 5.8 tons/acre and increasing. This rate of erosion is not sustainable as modern farming cannot replenish the topsoil at the rate it is being lost.

The group has several projects involving soil health including long-term cover cropping and reduced tillage studies. The purpose of the long-term cover crop study is to better understand the economics of building soil health over time. Do soil organic matter levels change after several years when cover crops are added? Are there any changes in soil health that affect yield advantage over time?

The accompanying chart shows results from past cover crop studies in soybeans and corn. Note there is not a significant yield disadvantage for cover cropping with cereal rye in either soybeans or corn. As cover crop vs. no cover crop comparisons on the same fields accumulate, the long-term economic benefits of cover crops become clear.

Studies were also conducted comparing no-tillage or reduced tillage with full conventional tillage to better understand and solve the issues with reduced tillage in Iowa. In future years, the group will place an emphasis on strip-tillage and strip-tillage with cover crops as a potential solution to poor stands under reduced tillage in poorly drained soils. Also, a study is planned to look at whether reduced or no-tillage negatively impacts yield in soybean production.



Data on responses of soybeans and corn to cereal rye cover crop.

Nutrient management on the farm

The Iowa Nutrient Reduction Strategy seeks to reduce nitrogen and phosphorous loss by 45 percent in Iowa's receiving waters. There are various strategies for meeting this nutrient loss reduction, including management practices, land use and edge-of-field practices. The On-Farm Network focuses mainly on in-field management practices such as the 4R's (Right source, Right rate, Right timing, Right placement).

In 2017, 10 field studies were conducted comparing The Climate Corporation nitrogen rate recommendations with the farmer's standard rate. This data will be used by The Climate Corporation as feedback to the performance of their model as well as provide data to fine tune the model for future years.

Regarding form and placement, research was conducted at six locations looking at the efficacy of stabilized nitrogen as well as effects of various placement methods on corn yield. In addition, a series of nitrogen rate trials were conducted at 10 locations. The objectives of this research were to demonstrate and engage farmers on determining optimum nitrogen rates for their regions, and the best practices for creating management zones for variable rate nitrogen application. It also sought to improve ISA research models and tools for optimizing nitrogen rates for corn in Iowa. These projects were funded with non-checkoff monies and will be repeated in 2018.

Reports from basic research indicate the combination of free-living nitrogen-fixing bacteria with rhizobium will increase nodulation and yield in soybeans. To follow up on this research, the On-Farm Network arranged to test Terramax™, a product containing free-living nitrogen-fixing bacteria. In 2018, the Terramax™ product as well as some other promising seed treatment inoculants for improved nitrogen fixation and yield will be retested.

Another nutrient-related microorganism is called EndoPrime™ (Valent). From basic research, the primary agent in EndoPrime™, mycorrhizae, has been shown to increase phosphorus uptake and yield in corn.

The On-Farm Network's final contribution to the nutrient loss reduction goal in 2017 involved soil testing. The series of trials demonstrated the value of denser soil grid sampling (1.25 acre grids) vs. standard soil sampling (2.5 acre grids). In these trials, denser grid sampling created better fertilizer recommendations compared to 2.5 acre grids in fields with high variability in soil types and topography. The cost savings in reduced fertilizer usage far outweighed the extra costs from denser soil sampling in fields with high variability.

Pest management studies hallmark to ISA

The On-Farm Network has a strong tradition of documenting disease and pest management practices with Iowa farmers, not the least of which is our long history of soybean fungicide work. Through 2016, the online trial database includes results from 490 trials testing fungicides on soybeans. This robust bank of information allows us to provide and continually improve tools like our fungicide calculator.

Building on that dataset in 2017, growers were offered the opportunity to test Priaxor® fungicide. In 22 trials from 2013 to 2016, Priaxor showed an average return of 2.1 bu/acre. These additional trials not only give more farmers exposure to the product, but add to our understanding of the locales and weather conditions most suited to fungicide profitability.

Recently, an abundance of new seed treatments has provided new pest management options for Iowa soybean farmers. The On-Farm Network has provided thorough multi-year examinations of Clariva® Complete Beans, Intego® Suite, ILeVO® and Gaucho® seed treatments. These products attempt to alleviate problems from insects, diseases and nematode pests.

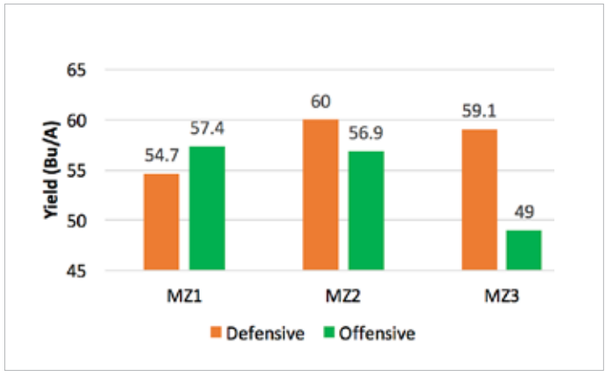
In 2017, Heads Up® organic seed treatment was examined. Heads Up is promoted as a low-cost plant protectant with activity against Sudden Death Syndrome and white mold. Independent trials in some locations have indicated promise.

In recent years, the On-Farm Network's role in promoting good practices in pest management hasn't been limited to strip trials. In 2016 and 2017, data was collected and contributed to a corporate partner that will lead to the development of an online tool to assist growers with decisions on fungicide applications for corn. Specifically, weather data and detailed infestation measurements for Gray Leaf Spot and Northern Corn Leaf Blight were collected at five Iowa locations.

This year marked the fourth consecutive year the group surveyed fields across the state to determine the spread, penetration and intensity of soybean cyst nematode. This survey paints a picture of the dynamics of this key soybean pest, and helps identify candidate fields for future testing of control methods and products. At least one new nematode control product is expected to be tested extensively in 2018.

Also, 2017 marked the second year fields across Iowa were surveyed for corn rootworm beetles. Together with a couple of corporate partners, 200 fields were surveyed. Instances were found of significant beetle populations in corn after soybeans in some fields. There were also significant beetle populations in fields where multiple control methods were employed. It's theorized that a mild winter and a dry spring were favorable for larval survival going into the summer. Partners are eager to continue this work in 2018. Results from all of these studies can be found on the ISA online database.

Cropping system trials prove valuable to farmers



Value of multi-genetic planting in soybeans. MZ1= zone of high productivity, MZ2= zone of moderate productivity, MZ3= zone of poor productivity.

In 2017, the group demonstrated the potential value of multi-genetic planting in soybeans. The accompanying chart is an example of the yield response for multi-genetic planting in a field of high variability. "Race horse" or offensive varieties, were placed in optimum yield zones, and defensive, or "work horse," varieties were placed in lower yielding zones within the field. Results indicated a significant advantage compared to solid seeding either an offensive or defensive variety.

Other cropping systems studies conducted in 2017 were soybean row spacing and soybean populations. The key driver in the soybean population research is to discover optimum ways to create management zones for variable rate seeding in soybeans. These studies will be repeated in 2018.

Collaborative regional research

The On-Farm Network has partnered with several state and independent groups over the last few years to help conduct soybean research, establish new state programs and share methodologies across states on protocols, products and practices.

In 2015, the group partnered with the Indiana Corn and Soybean Marketing Council to direct and manage a multi-state project — utilizing existing row crop research programs and partners — to conduct soybean research across the upper Midwest. Universities, extension services, government agencies, non-government organizations and commodity groups, both within states and between states, all had roles in this research.

In 2017, the third year of conducting multi-state research utilizing replicated strip trials, the On-Farm Network led the project with support from the North Central Soybean Research Program (NCSRP) that assessed the following management practices:

- Soybean row spacing
- In-furrow fungicide
- Starter fertilizer
- Soybean population
- Foliar zinc application

Through the state partnerships, yield data, stand counts and aerial imagery were collected and analyzed for each trial location. Final results will be generated in reports and posted online for public viewing in an online database.

A multi-year agreement with the Soil Health Partnership (SHP) to study the effects of cover crops vs. no cover crops over five or more years was also established. The two groups currently collaborate on two joint research sites in Iowa where they host field days, conduct research and establish additional outreach.

In addition to those joint sites, the On-Farm Network uses its quality control methodologies to analyze and produce reports for SHP participants across the country. In 2017, SHP conducted more than 100 cover crop, nutrient management and tillage trials. The On-Farm Network will process the yield data for these trials and generate final reports to be shared with growers and the public.

RIGHT IN YOUR BACK POCKET

After reading about the Iowa Soybean Association (ISA) On-Farm Network research trials, Suzanne Shirbroun and her husband Joe decided to try setting up some trials themselves. That was the start of a strong connection to ISA.

"We've done seeding populations, lime and tillage trials most recently," said Shirbroun, an ISA director for District 3 in northeast Iowa. "I think the most important part of the On-Farm Network is adding credibility to what we're seeing in the field."

Shirbroun has taken what she learned through conducting replicated strip trials with the On-Farm Network and applied it to her entire operation. For example, after conducting pelleted lime trials on a small test area, Shirbroun looked at the data and determined their traditional lime formulation was more economical. Participating in seeding population trials allowed them to drop their soybean population to 140,000 from 152,000 without seeing a yield hit.

"We learned we could drop the population and still obtain great yields," Shirbroun said. "That's adding right to the bottom line, taking input dollars out of the equation and increasing profit potential."

As with many farmer participants, Shirbroun started working with ISA research through the On-Farm Network and she intends to expand and work with the Environmental Programs and Services and Analytics teams.

Shirbroun has been an advocate for conservation, using practices such as conservation tillage, cover crops, contour farming and establishing terraces on her farm. In the future, she would like to collect tile water samples from her fields with and without cover crops and with and without tillage to assess the differences. Ideas like this are always welcomed by the ISA research team.

ISA's team of research experts is the reason Shirbroun keeps coming back to conduct more trials. She appreciates the help with management decision-making and considers the team a valuable resource to use on her farm.

"Working with the On-Farm Network and ISA research gets me true data. With the numbers crunched by the ISA experts versus us just making observations, it's adding credibility," she said. "It's like having your own research team in your back pocket. They're there to help you. You're paying into the soybean checkoff so you might as well take full advantage of the tools and people available to you."

Visit iasoybeans.com to learn how to get involved with ISA research.

ISA RESEARCH COLLECTS AERIAL IMAGES FOR ANALYSIS ON THOUSANDS OF IOWA ACRES EACH YEAR.

"You're paying into the soybean checkoff. You might as well take full advantage of the tools and people available to you."

— SUZANNE SHIRBROUN, *farmer from Farmersburg*

WORKING WITH ISA RESEARCH EXPERTS ADDS CREDIBILITY TO FARMER OBSERVATIONS.

ON-FARM TRIAL RESULTS ALLOWED SUZANNE SHIRBROUN TO REDUCE HER SEEDING POPULATION BY 12,000 SEEDS PER ACRE.

Environmental Programs & Services

ADVANCES SCIENCE-BASED, DATA-DRIVEN RESEARCH RESULTS TO IMPROVE ENVIRONMENTAL QUALITY AND MORE EFFICIENT AND PROFITABLE SOYBEAN PRODUCTION.

Environmental Programs and Services (EPS) strives to improve farmer competitiveness while protecting natural resources. It engages farmers to be conscious of how their management choices impact their land and downstream stakeholders. By working directly with farmers and other stakeholders in their geographic settings, the EPS team embraces robust assessment, data collection and statistical analytics in the planning and decision-making process. They provide technical assistance, leadership and support for farmers to improve productivity and protect natural resources.

30 PROJECTS WERE COMPLETED THAT SUPPORT THE IOWA NUTRIENT REDUCTION STRATEGY.

4,121 WATER SAMPLES ANALYZED **56** FIELD DAYS & EVENTS

333 DRAINAGE SYSTEMS MONITORED **22** BIOREACTORS INSTALLED

Leadership and partnerships

As Iowa farmers work to meet the needs of growing populations on the global stage, their land management decisions are fundamental for ensuring the productive capacity of Iowa's agricultural system. Continued natural resource improvements on private farmland can positively impact the environment at landscape and watershed scales.

The Environmental Programs and Services (EPS) team recognizes that leadership and partnerships are needed to protect natural resources. When there is collaboration, issues lead to outcomes, often different and better than what would have been achieved if this work was done alone.

In 2017, EPS continued to provide leadership and support of partnerships. One example is the U.S. Water Alliance, a national nonprofit organization representing a variety of water champions advancing a "One Water" movement. EPS provided leadership on the Alliance board of directors and was part of the Iowa delegation to the One Water Summit in New Orleans. Several Iowa farmers were part of the delegation, giving presentations and engaging in the national conversation.

Efforts to implement the recommendations in the Iowa Nutrient Reduction Strategy (INRS) illustrate how leadership and partnerships can achieve synergy. Launched in 2013, the INRS brings together state and federal agencies, the research community, municipalities and private industry to address nutrient loss and the negative impacts on receiving waters. ISA is committed to fulfilling the INRS by conducting 30 projects addressing soil conservation, water quality and more. These projects are engaging 405 farmers and 86 partner collaborators. Also, the ISA has dedicated funding of $2,821,481 toward INRS efforts. This includes state and federal grants, contracts and soybean checkoff investments.

Other areas of leadership by EPS in 2017 include the Upper Mississippi River Fishers and Farmers Partnership and the Iowa Source Water Ag Collaborative. With EPS leadership, Iowa is ensured a credible seat at the table among diverse stakeholder communities.

Assisting farmers today for future conservation

EPS provides farmers with technical assistance and feedback to help them make better conservation management decisions. The assistance can be through conservation assessments, soil and water testing or protocols for evaluating an alternative practice.

In 2017, ISA agronomists conducted 40 assessments, which means that for each farm, a performance baseline is established. The assessments include potential impacts that could be seen after adopting practices such as reduced tillage or cover crops, and cost share recommendations for financial assistance to install these practices.

EPS is working with 10 farmers on a project evaluating in-field testing equipment, now in its second year. Special equipment is reviewed for its ability to document impacts of conservation practices in farm fields. If successful, the equipment could be used by individuals, inexpensively and in real time.

More than 50 farmers received conservation technical assistance this year to better understand the impacts of their current management practices compared to alternative choices, helping to advance the INRS goals.

EPS work ranges from in-field to entire watersheds

Watershed plans provide a pathway for reaching farmer-established goals that align with the INRS. The watershed plan for the Headwaters of Cedar Creek, one of two completed by EPS in 2017, outlines ways farmers can reduce soil erosion and reduce losses of nitrogen and phosphorus. The planning process helps watershed stakeholders focus on reaching goals and allows watershed coordinators to visualize the next steps for farmers and landowners. The EPS team is on track to finish nine watershed plans by early 2018.

In 2017, EPS focused on securing additional resources to connect urban and agricultural stakeholders around a watershed plan. Groundwork done with Des Moines, Charles City and Eagle Grove will lead to partnerships with farmers to complete projects that improve water quality in and around these communities. Financing for the projects will leverage loans that communities use to pay for permitted water quality upgrades. Working with the Iowa Department of Natural Resources and the State Revolving Loan Fund, communities can apply for an interest rate modification to their loan. This allows them to fund both the permitted project and nonpoint source practices in the watershed, such as a bioreactor installation, for the same cost as the single project. This "two for the price of one" concept benefits both urban and rural residents.

Transforming Iowa's landscape through research

When research projects look good on paper, it takes commitment, leadership, money and people to apply them to real-world situations. ISA EPS is involved with several research projects that have moved beyond paper and applied them to real farms.

In 2017, a unique saturated buffer was installed near Perry that ties together seven drainage outlets into several distribution lines. It would have required seven bioreactors to cover the same drainage area of farmland. EPS is evaluating how this structure impacts water flow and nitrate removal in the buffer. Another project, funded by a Natural Resources Conservation Service - Conservation Innovation Grant, will evaluate how deep-rooted poplar trees added in a saturated buffer will improve performance.

EPS provides design services for edge-of-field practices including bioreactors and saturated buffers through a contract with Iowa Department of Agriculture and Land Stewardship, which has led to further implementation. Through these efforts, there were 34 design requests, 26 sites surveyed, 10 designs completed and 36 structures installed in 2017.

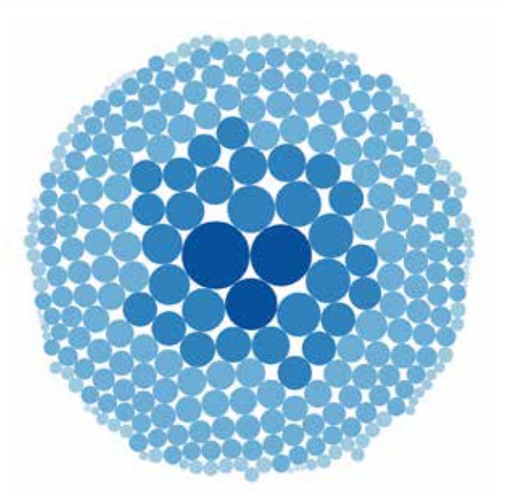
ISA continues to be a collaborator on the USDA-funded multi-state Transforming Drainage project, which explores future drainage design and implementation to include water retention and water recycling. EPS has evaluated the water supply, irrigation demand, and yield benefits of supplemental irrigation for drainage water recycling systems in Iowa.

In 2017, the EPS team collected more than 2,500 water samples at 333 subsurface drainage systems in Iowa. Many partners supported this work: Agriculture's Clean Water Alliance, Practical Farmers of Iowa, Audubon Soil and Water Conservation District and Water Quality Initiative projects including the watersheds of Boone River, Miller Creek, Benton/Tama, West Fork of Crooked Creek, Lower Skunk River, Walnut Creek and Van Zante.

Water samples were analyzed at ISA's accredited water laboratory in Ankeny and results were shared with the farmers. Aggregate summaries are provided so farmers can compare themselves with others. Farmers provide information on their fields that drain to the tile system including crop rotation, tillage or no-tillage, cover crops, nutrient management as well as the number of acres draining. For 2017, overall mean Nitrate-N concentration was 12.6 mg/L.

Nitrate-N Concentrations from 2017

Category	Nitrate-N Concentration mg/L	No. of Sites	% of Sites
Very Low	0 - 5	27	8%
Low	5 - 10	79	24%
Average	10 - 20	197	59%
High	20 - 30	29	9%
Very High	30 +	1	0%



Packed circle graphic illustrates Nitrate-N concentrations from all samples, where each circle represents one site, the size of the circle represents the average nitrate-N concentration and the color represents the category.

Collaborative cover crop research

Dedicated ISA research projects help catalyze leadership, target actions, implement management solutions and research practices best suited to farmers' resource concerns. In 2017, multiple examples showcased these efforts and are ongoing. These projects are integrated with other ISA departments and externally with collaborators and partners.

This year, the EPS, On-Farm Network and Analytics teams are collaborating on a project exploring the use of corn and soybean planters to seed cereal rye cover crops. The project compares how this method is different from other seeding methods through on-farm research demonstrations. Funded by the Iowa Nutrient Research Center (INRC), the on-farm trials will measure crop yield, rye biomass, plant population, growth stage, soil nitrate and ammonium, ground cover and cornstalk nitrate tests. The project will also examine agronomic system performance, cost effectiveness and potential for yield risk mitigation.

The teams also are collaborating through watershed management work. As part of a watershed planning project, the teams conducted cornstalk nitrate sampling in the Swan Lake Branch watershed in Dallas County. Approximately 30 percent of the corn acres in this watershed had samples collected. Results help farmers better understand their nutrient use and help inform the watershed plan. This test was also conducted in the Elk Run, Middle Cedar and South Skunk watersheds.

As ISA continues to build farmer engagement across the state, look for more integrated efforts across all of ISA research, along with the strong team efforts of ISA communications, marketing and producer services.

KEVIN SPRUNG'S SATURATED BUFFER CAPTURES 160 ACRES OF SUBSURFACE DRAINAGE.

IMPLEMENTING CONSERVATION PRACTICES HELPS MEET THE GOALS OF THE IOWA NUTRIENT REDUCTION STRATEGY.

IT STARTS WITH ONE

Farmer Kevin Sprung first became interested in working with the Iowa Soybean Association (ISA) research team on conservation practices two years ago when he heard about the possibilities at a Rock Creek watershed meeting.

After the initial meeting, Sprung worked with ISA's Environmental Programs and Services (EPS) team to install a saturated buffer on 160 acres of his Mitchell County farmland. He believes lessening his farm's environmental impact is part of his duty as a farmer.

"It's the right thing to do to meet the goals of the Iowa Nutrient Reduction Strategy," Sprung said. "I feel as farmers we need to step up and do what we can. We all have to try to work toward that goal and make it happen on our farms."

Sprung consulted ISA EPS to determine what practices to use in certain situations. Incorporating Sprung's goals, an EPS assessment of his land, and the objectives of the Rock Creek Watershed project, EPS recommended and designed the most effective practices for his farm. While he originally contacted EPS about a bioreactor, the field he was looking at was more conducive to a saturated buffer.

In addition to the saturated buffer, Sprung also has installed pollinator habitat and buffer strips along with introducing strip-till and nitrogen stabilizers on his row crop farm. This year, after hearing the benefits at various meetings and continuing to work with EPS, Sprung added cover crops to his suite of conservation efforts.

"We're going into it one field at a time to gain experience," Sprung said of planting cover crops. "We're being a little careful — we need to learn as we go — but the main goal is to expand these practices in our neighborhood and have other neighbors do the same thing."

The next step for Sprung is to install a bioreactor next spring on a 60-acre field. While his saturated buffer hasn't been in place long enough to collect research data, he looks forward to collecting water samples from both the saturated buffer and the bioreactor and then sharing the results with consumers.

"They (consumers) want us to be as environmentally friendly as we can to produce the food they're buying," Sprung said. "We all need to take on a facet of conservation to improve our farms each year."

Visit iasoybeans.com to learn more about working with EPS.

BIOREACTORS HELP IMPROVE WATER QUALITY BY REDUCING THE AMOUNT OF NITRATE DELIVERED TO THE OUTLET.

"I can't say there's a direct economic benefit now on the bioreactor or the saturated buffer but it's what we need to do as farmers to meet the goals of the nutrient reduction strategy."

— KEVIN SPRUNG, *farmer from Osage*

Analytics

COLLECTS DATA THROUGH ALL ISA RESEARCH CHANNELS AND TUR NS IT INTO UNDERSTANDABLE, USABLE INFORMATION FOR FARMERS.

The ISA Analytics team works collaboratively with internal research teams, university and industry partners to collect, process and analyze spatial and non-spatial agronomic and environmental on-farm data. Strategic areas of focus include developing online tools for farmers and agronomists, leading projects in remote sensing, statistics and predictive modeling, and processing and analyzing data to create summary reports for study participants. The Analytics team also publishes technical communication materials and provides comprehensive summaries and information to farmers. One of the primary benefits of Analytics is to demonstrate how analytical projects are increasing the predicting power of agronomic and environmental data.

ANALYTICS FLIES THOUSANDS OF ACRES EVERY YEAR TO IMPROVE THE QUALITY OF AERIAL IMAGERY.

152 GUIDED STALK SAMPLING REPORTS

180 REPLICATED STRIP TRIAL REPORTS

75 SOYBEAN CYST NEMATODE REPORTS

125 REPORTS FOR PARTNERS IN OTHER STATES

Economic analyses of fungicides and insecticides on soybean yields

Summaries and agronomic decisions based on data representing different years, geographies and management practices are more reliable than those collected from only a few locations or during a single crop year. Even so, it is not always easy to draw conclusions from aggregate data.

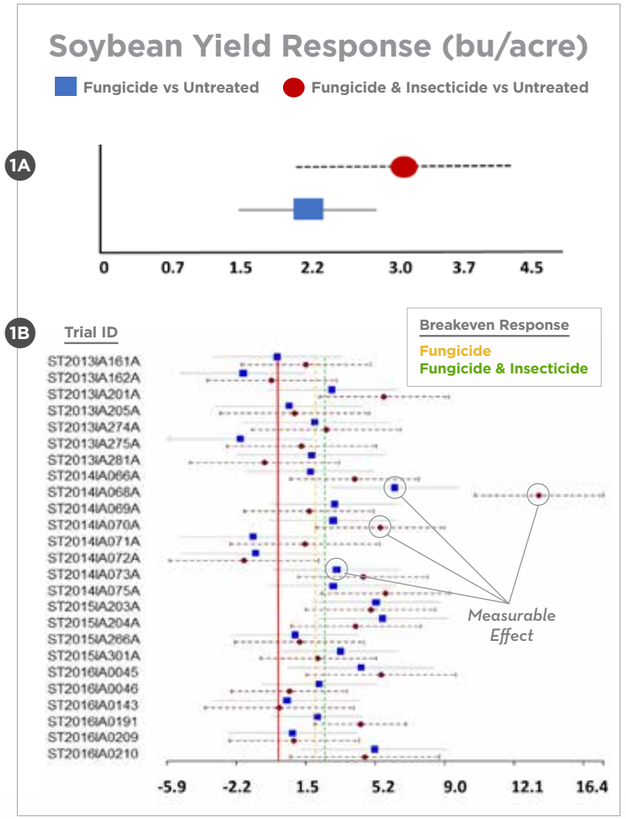
It's not uncommon for farmers to use different pesticide products over time, and the information collected between trials and years may not be consistent or not balanced in the field of interest. While economic analyses are often based solely on field averages, knowing the degree of noise and variability in on-farm trials can be critical in making better decisions under economic and production uncertainties.

Using different statistical and graphical tools, the ISA Analytics and On-Farm Network teams recently summarized the historical data of on-farm trials that tested the economic benefits of joint applications of fungicides and insecticides on soybean in one pass. One of the datasets, 25 trials from 2013 to 2016, had three treatments: fungicide alone, a fungicide and insecticide mix and untreated controls.

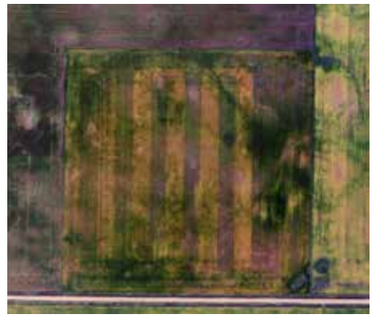
Across all trials, the average soybean yield response to the fungicide and insecticide mix was about 3 bu/acre (Figure 1A). The two chemicals produced a significant response in 11 trials. However, the average response to the fungicide alone was 2.1 bu/acre. The fungicide applications alone also produced a significant response in 11 of the trials.

Insecticides produced a measurable (but not always significant) yield response in only five trials (Figure 1B) where aphid pressure was likely above the economic threshold. Most of the responses were due to the fungicides and not insecticides. Despite insecticides being relatively low cost, insurance applications of insecticides with fungicides did not increase yields or profit significantly. Adding insecticides increased variability in yield response (Figure 1A), and if aphids are not present or had low populations, the extra insecticides might increase pest resistance.

In summary, pesticide application decisions should be based on field observations of disease and insect pressures along with an analysis of decision tools that predict an economic return-on-investment.



Average yield response to joint application of fungicide and insecticide and fungicide alone on soybean. The break-even response was estimated using soybean price of $10/bu, fungicide $15/acre and insecticide $8/acre.



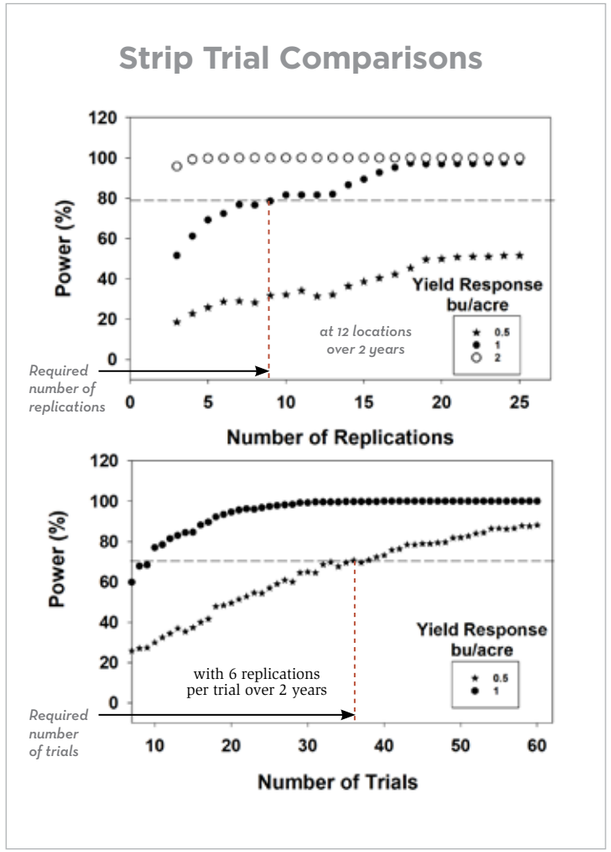
Statistical analysis of on-farm research

On-farm research can be done using field-scale strip trials, small plot experiments or large side-by-side blocks. Researchers can disagree which is the best method for conducting on-farm research. The ISA Analytics team, together with researchers from the Department of Plant Pathology and Microbiology at Iowa State University, took a deep dive into the historical soybean foliar fungicide data collected by the two groups to compare replicated strip trials to small plots.

While yield responses to fungicides were similar in small plot vs. on-farm trials (around 2-3 bu/acre in the absence of fungal foliar diseases), the on-farm trials had a slightly higher power to detect yield responses. The power is the odds of detecting an effect when it is real. Based on the data from 2008 and 2009, to estimate a yield response of 1 bu/acre in on-farm trials, about 10 replications are needed at 12 locations (pictured at the right) To estimate a response of 0.5 bu/acre, the number of locations should be increased to 35 and with six replications. The variability in soybean yield that cannot be explained is often smaller in on-farm studies due to larger areas of yield measurements.

The study emphasized that while both plot sizes similarly estimated yield response, on-farm strip trials are more appropriate to answer questions such as "when and where" a specific fungicide or chemistry works while small plot trials are more suitable to test specific purposes (such as the control of specific diseases like white mold) and test many fungicide chemistries and application timings at the same location. Farmers can learn more using data from on-farm trials that better represent the application methods and equipment used under their specific conditions and management practices. The results of this research were recently published in the Journal of Plant Disease.

In the future, similar analytical methods will help researchers and farmers target areas with specific weather patterns and fields with different management and crop history.



Example of power analysis to estimate the number of replications and on-farm trial locations required to detect statistically significant soybean yield responses of 0.5, 1 and 2 bu/acres to foliar fungicides.

Potential benefits of aerial imagery in soybean management

Lately there has been a rapid increase in the number of providers of analytical tools and remote sensing/imagery products for agriculture. Farmers can also collect imagery using unmanned aerial vehicles (UAV). Important questions remain about the standards, quality control and use of the imagery in managing different crops.

The ISA Analytics team works with several commercial imagery providers and university partners to identify the best practices of collecting, calibrating, checking quality, analyzing and interpreting aerial imagery. The table below describes key management practices, issues, benefits and requirements for aerial imagery in soybean production.

It is recommended for farmers to check regulations before operating a UAV.

Potential benefits and requirements for digital aerial imagery in soybean management.

SOYBEAN MANAGEMENT PRACTICES OR ISSUES	IMAGERY SOURCE	RADIOMETRIC CALIBRATION	NUMBER OF FLIGHTS DURING THE SEASON	POTENTIAL ECONOMIC BENEFITS FROM USING IMAGERY
General scouting for detecting pest, disease and insects and equipment problems	Satellite UAV aerial	Not needed	As needed	High if problems exist and can be addressed
Quantifying plant stand problems	UAV aerial	Not needed	One-early season	High if problems exist and can be addressed
Detecting damaged areas due to flooding, hail, or other	Satellite UAV aerial	Preferred but not required	Before and after damage	High if problems exist and can be addressed
Guiding soil and plant tissue collection	Satellite UAV aerial	Not needed	As needed	High to medium
Identifying zones of yield variability	Satellite UAV aerial	Required	Multiple images across years	Medium (depends on the use)
Early detection of diseased areas before disease is visible	Satellite UAV aerial	Required	Multiple images during the season	High to medium
Detecting weeds	UAV aerial	Preferred	Multiple images during the season	High to medium
Detecting and quantifying iron chlorosis areas	UAV aerial	Preferred	Two images during the season or historical imagery	Medium/low
Quantifying cover crop stand and biomass variation	Satellite UAV aerial	Preferred not absolutely needed	One late fall and another in spring before cover crop termination	Medium
Yield modeling/ predictions	Satellite UAV aerial	Required	Multiple within season at critical crop stages	Medium
Early detection of water stress	Thermal	Required	Multiple within season at critical crop stages	High to medium
Quantifying crop residue distribution	Satellite UAV aerial	Preferred but not absolutely needed	Historical image of bare soil with late fall image	Medium to low
Detecting tile drainage problems	UAV aerial	Not needed	Historical bare soil imagery and bare soil image after rainfall	High
Herbicide and planting overlapped detection	UAV aerial	Not needed	Early season	High

Predictive analytics using on-farm agronomic and environmental data

Use of cover crops is one management practice that can improve soil and water quality within Iowa corn-soybean cropping systems. The rapid adoption of cover crops in Iowa, however, is hindered by several crop management, economic and climate constraints.

Predictive modeling can be combined with agronomic and environmental data to identify different scenarios in which cover crops can be agronomically successful, economically viable and environmentally significant especially reducing the risk of nitrate loss.

A joint project between ISA and Iowa State University is attempting to develop different scenarios of planting and terminating winter rye cover crop to study the impact of these combinations on the rye biomass accumulation and nitrate loss. Intensive ground-truthing was involved in calibrating the model to fine tune its predictive capabilities for a field in south central Iowa:

- Scenario 1: Planted Oct. 15, terminated May 1 (hypothetical case).
- Scenario 2: Planted Oct. 15, terminated April 1 (farmer practice).
- Scenario 3: Planted Sept. 15, terminated May 1 (hypothetical case).
- Scenario 4: No rye (hypothetical case).

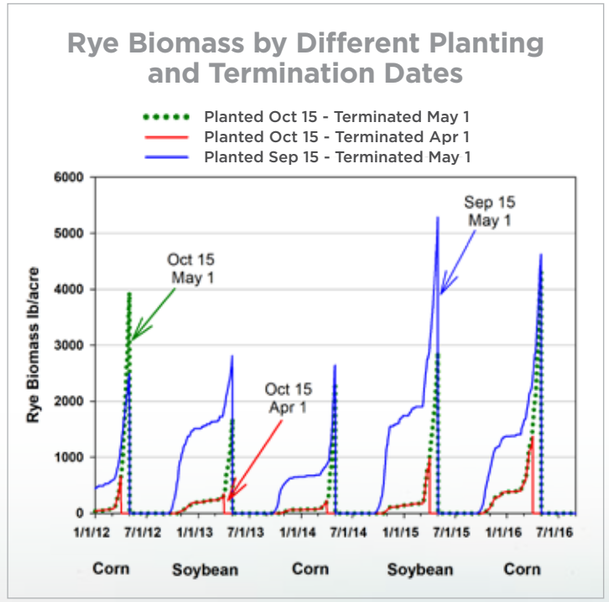
The maximum biomass accumulation was predicted from Sept. 15-May 1 planting termination combination in 2015 (Figure 3). The farmer practice, Oct. 15-April 1, had the maximum rye biomass accumulation of about 1,200 lbs /acre in 2016, which would remove about 45 lbs. of nitrogen per acre.

The lowest nitrate loss was predicted when the rye was planted early and terminated late (see chart). The late termination of cover crop may impact corn yield.

The largest reduction in nitrate loss from using the cover crop was predicted in 2013 after the 2012 drought and in 2016.

Another observation from these simulations is the need for early planting to ensure rye is taking up a substantial amount of residual nitrogen which would be vulnerable to loss in the early spring. Early termination of rye can also reduce potential benefits of cover crop on water quality.

The use of these tools can assist farmers to estimate effects of differences in cover crop management and refine use of cover crops to meet both agronomic and environmental goals.



Winter rye biomass accumulation from three hypothetical scenarios of planting and terminating winter rye cover crop in a farmer field located in South Central Iowa.

2016-17 FINANCIAL REVIEW

YEAR ENDING SEPTEMBER 30, 2017

The teams within ISA research work together to improve farmer decision-making. The integration of the three groups has led to more high quality unbiased information for Iowa farmers, especially when combined with research contracted through ISA checkoff-funded programs at Iowa State University and other state universities through the 12 state soybean associations making up the North Central Soybean Research Program. In addition, the ISA research team leverages checkoff funding with other funding sources to complement and extend research efforts.

CHECKOFF FUNDING

Research Coordination:
$926,963

Contract Research:
$2,107,688

On-Farm Network:
$1,179,328

Environmental Programs & Services:
$822,622

Analytics:
$39,000

TOTAL: $5,075,601

LEVERAGED FUNDING

Research Coordination:
$75,000

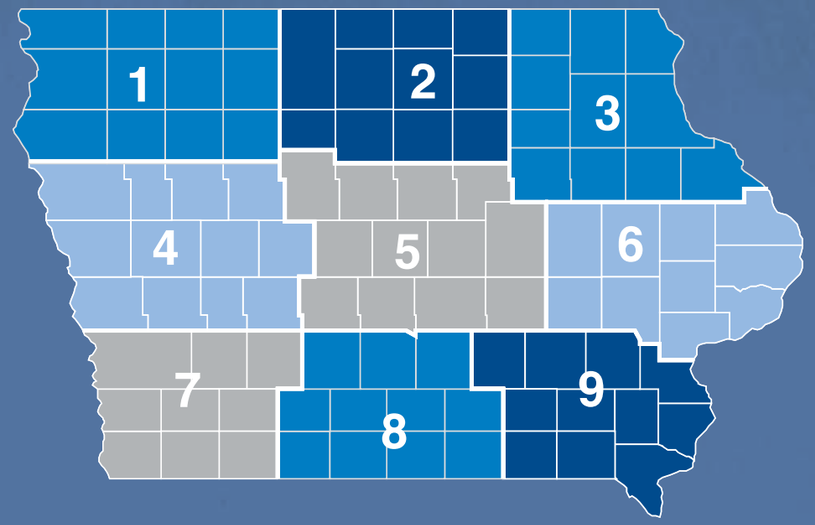
Contract Research:
$0

On-Farm Network:
$911,550

Environmental Programs & Services:
$992,989

Analytics:
$0

TOTAL: $1,979,539



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