Improving water and nutrient use efficiency with Drainage Water Management
SUL4R-PLUS product is a new pelletized sulfate product that makes sulfur application easier, enhances soil quality and improves production of all crops. SUL4R-PLUS product is a sulfate, so it starts working almost on contact. And since it has a uniform, pelletized size, it can be applied with other dry inputs, and spreads more evenly in a range of weather and humidity conditions. To find out all the advantages SUL4R-PLUS product delivers, visit SUL4R-PLUS.com.
In the Upper Midwest, more and more acres are being placed into tile drainage. Unmanaged tile systems, though, have virtually no control over when and how much water and nutrients are removed. A smarter system using drainage water management puts farmers in the driver seat with better water and nutrient management.
Changes to

*Crops & Soils* magazine

Earlier this year, a survey of the *Crops & Soils* magazine readership was undertaken. As a result of that survey, we are pleased to announce that the following changes to *Crops & Soils* magazine will be implemented over the next few months:

- Beginning with this issue, we will no longer be printing the self-study CEU articles. New CEUs will be distributed via the *Crops & Soils* e-Newsletter (a supplement to the print edition that is emailed to all certificants every other month) and can also be accessed anytime at [www.certifiedcropadviser.org/certifications/self-study](http://www.certifiedcropadviser.org/certifications/self-study), along with the online quiz. The survey results, as well as actual data over the past few years, indicated that very few readers are actually using the CEUs in print, preferring instead to read and take the test online. We will now comply with those desires.

- Beginning with the September–October 2013 issue, *Crops & Soils* magazine will be available in an enhanced digital format form that provides the reader with a more interactive experience than just the paper version. **Please note that the paper version will continue to be delivered.** You now have more choices as to how you wish to read the magazine, including on your smartphone, and in 2014, we will survey the readership again, regarding print vs. electronic preferences. For a sample of what this would look like, please go to: [http://livedemos.texterity.com/crops_soils_demo/](http://livedemos.texterity.com/crops_soils_demo/). To see this sample on a smart device go here: [http://livedemos.texterity.com/crops_soils_demo/20130304](http://livedemos.texterity.com/crops_soils_demo/20130304).

We are interested in your comments, suggestions, and ideas. Please contact me at mmandelbaum@sciencesocieties.org.

**New Journals for ASA, CSSA in 2014**

The American Society for Agronomy (ASA) and the Crop Science Society of America (CSSA) are pleased to announce that starting in January 2014, they will jointly take over the ownership of three journals: *Crop Management*, *Forage and Grazinglands*, and *Applied Turfgrass Science*. These journals were part of the Plant Management Network formerly managed by the American Phytopathological Society (APS). They will be available for Society members to subscribe to, appearing on all members’ renewal forms as an option. In addition, the journals will be included in the Digital Library as well. (*Everything published by ASA, CSSA, and SSSA can now be accessed in one place through our new Digital Library. To learn more and to subscribe, visit [https://dl.sciencesocieties.org/](https://dl.sciencesocieties.org/).*)

APS will continue to publish the journal *Plant Health Progress*, as well as other content (i.e., “Focus on...” series) as part of their APS Crop Protection and Management Series.

Both the APS and the ASA/CSSA collections will also be discoverable through the Plant Management Network web page, beginning January 2014. More information on this change will be available later this year.

As part of the transition plan, ASA/CSSA will begin handling the publication processes (manuscript submissions, peer review, etc.) for the three journals on July 1, 2013, with full transfer to be in place by January 2014.
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Improving water and nutrient use efficiency with Drainage Water

In the Upper Midwest, hundreds of thousands of additional acres have been placed into tile drainage over the past couple of years as the Corn Belt continues to expand. Unmanaged tile systems, though, have virtually no control over when and how much water and nutrients are removed. A smarter system using drainage water management puts farmers in the driver seat with better management over their water and nutrients.
Subsurface tile drainage is getting smarter as farmers continually seek out better ways to get more out of their most valuable inputs like nitrogen. But the investment isn’t just paying off with higher yields. Improved drainage systems are also reducing the amount of nitrogen leaking into rivers, streams, and groundwater.

For years, the purpose of burying drainage tiles below the soil surface was to shed water from the field as quickly as possible to expedite planting during a wet spring. Unmanaged tile systems, though, have virtually no control over when and how much water and nutrient is removed. A smarter system using drainage water management puts farmers in the driver seat with better management over their water and nutrients.

In a managed drainage system, a farmer can raise or lower the outlet level with adjustable riser boards in a water control structure located at the edge of the field.

“The farmer isn’t plugging the tile. He’s just forcing that water table closer to the surface with a control structure before the drainage exits from the system,” explains Matt Helmers, associate professor of agricultural engineering at Iowa State University.

The outlet in the structure typically is raised after harvest to reduce the amount of water delivered to a drainage ditch, then lowered a few weeks prior to planting to allow the field to drain, and then raised again after planting to store water through the growing season.

With this controlled system that limits the amount of water drained from the field, nutrient loads can also be reduced by as much as 45% or more, according to USDA’s Natural Resources Conservation Service (NRCS), which is promoting managed drainage as a way to improve water quality in the U.S.

This new approach to managing drainage is a significant break from the old way of draining excess water from fields, specifically in the Upper Midwest where tile drainage systems are most common, says Leonard Binstock, drainage consultant and executive director of the Agriculture Drainage Management Coalition.

“It’s not necessary to drain 24/7,” Binstock says in reference to the old tile drainage systems that lack a control structure. “That’s one thing that’s been going on for the last 100 years. You put the system in, and it basically drains 24/7.”

With a managed system that controls the water level in the field, drainage happens largely at the farmer’s discretion, he explains. That gives the farmer another tool to control water and nutrient use efficiency with bigger payoffs in higher crop yields.

“If you’re using a tile system and doing...
drainage water management with it—which means you’re not only shutting it off during the off-season, but you’re also controlling the water during the growing season—there can be a yield advantage,” Binstock explains. “We’ve seen some producers in any given year that will have maybe a 10 to 20% yield increase. Now, it’s not going to be constant, and it’s not going to happen every year. But, in a case like last year where we had dry conditions all across the Corn Belt, it made a huge difference in your yields.”

A field can see a one to two-inch increase of additional water to the soil’s profile with a managed system, which can be a significant yield enhancer in years of drought, Helmers says.

“Some people think that when we drain the soil, we’re taking all of the water out. Really, we’re only taking a very small portion of the water out of the soil. Maybe only about 5% is what we would call drainable porosity,” Helmers explains. “So most of the water is still in the soil and is plant-available water.”

Farmers also achieve better utilization of the nitrogen that the tile system otherwise would have carried off the field, Binstock adds. The increase in efficiency can lower the farmers’ overall fertility cost. If water outflows are reduced by 25 to 50%, he explains, nutrient outflows are going to drop that same percentage.

For that reason, NRCS has recently promoted drainage water management as a way to improve water quality, with specific focus on the Upper Midwest states where tile drainage and nitrogen loss are most extensive in the U.S. NRCS also points out other benefits that can result from farmers managing their drainage with a smarter tile system, such as reduced organic matter oxidation to retain soil productivity, reduced wind erosion, and more seasonal soil saturation or shallow flooding habitat for wildlife.

An opportunity for change

Tile drainage is increasing in popularity as farmers seek to get more value out of their water and fertilizer and invest in their farm’s productivity as an alternative to buying high-priced farm ground.

Alex Echols, consultant at the Sand County Foundation in Alexandria, VA, says the recent surge in interest among farmers for smarter drainage systems is an opportunity that can’t be missed if the U.S. wants to improve water quality. In the Upper Midwest region alone, between 60 and 80% of the roughly 100 million acres planted to row crops have had their hydrology substantially modified through drainage systems, he says.

However, less than 1,000 farms currently have controlled drainage in place in the U.S., Nichols notes. That number is expected to double in the next year and possibly double again the following year.

“In the Upper Midwest, we have put hundreds of thousands of additional acres into tile drainage over the past couple of years that hadn’t been drained previously,” Echols says.

Most of the new tiling development, Binstock says, has come about as the Corn Belt continues to expand north and west.

“Twenty years ago, there wasn’t that much corn growing in the two Dakotas, and those have become major corn-growing states. And the farmers there are finding out the
same things the eastern Corn Belt realized 50 to 60 years ago. You need good drainage to grow good row crops. So, they’re doing a lot of tiling in the two Dakotas just to get to the same level as the other farm states as far as productivity. The one thing they’ve had going for them is the fact that they can put in the right system the first time, if they have access to it.”

The eastern Corn Belt states like Ohio, Indiana, Illinois, and parts of Michigan, where existing tile drainage systems are 60 to 90 years old, are also opportunities to upgrade to smart systems, he says. As farmers replace lines that have maxed out their usefulness and need to be replaced, farmers can install a smart system that meets best management practices if the farmer is aware of the technology and its benefits.

This renewed interest in tile drainage across the Corn Belt creates an opportunity to get drainage done right and to make some significant steps forward in reducing the amount of fertilizer making its way into water supplies in the future, Binstock says.

Farmers today are also more educated about nutrient outflow via tile drainage and the effects on the environment, Helmers notes. The improved public knowledge at the farm level, he says, is an opportunity to promote managed drainage as farmers continue to see improved tiling systems as an investment that can pay off for years in the future.

“I think there’s becoming more recognition about what can we do to reduce or minimize the amount of nitrate that is leaving the field,” Helmers says. “And so, that’s where people are looking at a shallower drain placement in areas, or drainage water management where we put an outlet at the exit of the drainage system and try to manage the water table back in the field.”

**Install a new system or upgrade the old?**

Farmers are also more quickly realizing the benefits of upgrading their current tile systems through field mapping. With the aid of GPS technology, farmers can easily see on a screen where potential improvements can be made with their existing tile.

“Yield monitors really help highlight areas of the field that may be too wet. And as a result, you see depressed yields,” Helmers says. “So, that’s helped promote more interest with some farmers in upgrading their drainage.”

The problem farmers often face with the old tile systems, Binstock says, is that tile lines might be spaced...
too far apart, creating a field that doesn’t drain as efficiently as possible.

“With some of the older systems that were put in during the ’50s, ’60s, and ’70s, the laterals were placed farther apart. So a lot of the farmers today are splitting the old lines,” he says. “They’ve got old lines that are spaced 100 to 120 ft apart, and they’re splitting those down to 50 and 60 ft, which gives you more uniformity across the field. Your water table is more constant, your soil works better, you have better seed-to-soil contact and better production.”

If a farmer is interested in making that kind of investment in his tile system, he says, that would be an opportunity for the farmer to go the next step and convert it to a managed system with a control structure installed at the edge of the field.

However, not every field with existing tile lines can easily be retrofitted for managed drainage, Helmers notes. If a field is laid out in a pattern where the drain lines follow along the contour, he says, it might be possible to retrofit that field. Otherwise, upgrading a current system might not work as well and a new system would have to be installed.

“To do drainage water management and to reduce outflows, you have to have the systems designed to where they’re fairly even level topography,” Binstock explains. “Unfortunately, a lot of the older systems were put together with the main at the bottom of the hill and the laterals running up the hill, so everything’s running downhill on gravity. The new recommendation on designing systems is to run the main up the hill and run the laterals across the grade. That way you can use control structures stepping up your main to give you the zones that you can manage and, because your lines are running across the slope, they do a better job of catching the water as it runs down the slope underground.”

Cost and profit of drainage water management

A yield benefit from managing drainage averages a 5% increase, with the biggest increases in productivity occurring during drier periods when water stored in the soil has the biggest payoff, Echols says.

Binstock agrees that potentially an average 5% yield increase can be expected by installing an improved tile drainage system.

“That may seem like a small amount, but at today’s commodity prices, it’s an investment that creates a return for the farmer in the long term,” he says.

Cost of the control structures are anywhere from $1,000 to $2,000, Helmers adds. However, with NRCS sharing the cost of a Drainage Water Management Plan under the Environmental Quality Incentives Program (EQIP), the overall cost to the farmer is greatly reduced.

The economics of installing an updated system are even more enticing when the cost is spread out over time and acres, Binstock points out.

“Most of the controls have cost-share under EQIP funding of up to 75%,” he says. “That’s a 25% cost to the farmer. So if a control structure is going to run about $1,600, the farmer’s going to have $400 of out-of-pocket cost. But that one structure may control 20 to 30 acres. So when you think about that over the long term, it’s not a very high cost on a yearly basis. Once you put the structure in the ground, it’s there the same life as your drainage system. That’d be $400 for every 20 to 30 acres. If you’ve got a $20/acre cost out of pocket and you amortize it over 20 years, you’re talking about less than a dollar per acre per year. So really, the costs aren’t that great to the farmer.”

The time it takes the farmer to manage a controlled drainage system also has to be factored, Binstock says.

“The cost to manage a system is time for most producers. You’re going to have to go out there to move the boards up or down in the control structures. If the farmer doesn’t want to do that, there are automatic controls where the producer can sit at his computer and move the boards in their control structures.”

For $2,500, Echols says, the farmer can add a sensor, solar panel, and motor to manage the structure remotely. A remote-controlled system, he adds, would make managing the system simpler, particularly if the control structure is located in an inaccessible location of the field.
CCAs—the connecting point for farmers

CCAs play an integral role for farmers as they are often the connecting point for information about drainage water management and the benefits it provides in terms of improved crop yields and cleaner water, Helmers says. The more CCAs can help farmers with fine-tuning their water and nitrogen management, the more they can help with their client’s bottom line while helping the environment in the process.

“I think there’s an opportunity here,” Helmers stresses. “I don’t think the demand for cleaner water is going to go away, and I think our CCAs can be heavily involved to provide a service to the farmer to make sure that they are implementing practices that have the potential to reduce the nutrient export from their land.”

Because CCAs are often times the farmer’s point of information and the influencer on their farming practices, that puts the CCA in the unique role of educating farmers on the costs and benefits of a smarter tiling systems.

Binstock also recommends CCAs to increase their own knowledge and training in regards to managed drainage as demand for improved yields and cleaner water grows in the future.

“CCAs can become TSPs (Technical Service Providers) for drainage water management,” Binstock advises. “As a matter of fact, that’s one of my recommendations as something they could add to their portfolio. So when they talk to the farmer, that just gives them another opportunity to be of service to their clients.”

The greatest obstacle CCAs have with educating their clients is changing the farmer’s understanding of best management practices with tile drainage, he says. Just because tile drainage has always been done one way doesn’t mean it’s the right method that can meet the challenges of the future.

“It’s really hard for people to change something they’ve done a certain way for so long,” Binstock warns. “It’d be like for all of us Americans who drive on the right side of the road to change over to the European type of driving a car on left side. It takes time to make that happen.”

Echols stresses that drainage water management is just one tool among many that are needed to help farmers achieve greater usage of their nitrogen and to reduce the amount that ends up in the public water supply. Agronomic practices such as cover crops and employing the 4Rs of nutrient management—applying the right source at the right rate, at the right time, and in the right place—are also integral in the goal of reducing nitrogen loss.

Routing drainage water through wetlands, buffers, and bioreactors in order to capture nutrients that have escaped the agricultural production zone, he adds, are additional practices farmers can adopt to help reduce nitrogen loss.

But those improved systems and farming practices begin with sharing knowledge with farmers, Binstock says. If the right information isn’t passed on from the CCA to his or her client, the costs can reach far into the future, particularly when it comes to installing a tile drainage system that could be in place for generations into the future.

“If they put in the wrong system,” he says, “you’re going to be living with it for 60 years.”

USDA-NRCS’ Paul Sweeney shows a drainage water management system in Iowa. Photo courtesy of Iowa NRCS.
This fall, join the American Society of Agronomy (ASA), Crop Science Society of America (CSSA), and Soil Science Society of America (SSSA) at the 2013 Annual Meetings, November 3–6, in Tampa, FL, under the theme, “Water, Food, Energy & Innovation for a Sustainable World.” View/search the program or browse by dates and Section/Division at: www.acsmeetings.org/program.

Earn CEUs

Approximately 3,000 poster and oral papers will be presented in sessions throughout the week, covering such topics as nutrient management, soil and water management, integrated pest management, crop management, and professional development. New this year: Opportunities will be available to view presentations streaming live.

Certified professionals can attend paper sessions and self-report their CEUs following the meeting. CCAs may only receive CEUs for structured oral presentations; open poster sessions do not qualify for CCA CEUs. Self-reporting of CEUs is available online at www.soils.org/certifications or www.certifiedcropadviser.org.

Certified professionals working in the agronomic, crop, soil, and related sciences can learn about the latest advances in production agriculture, network with colleagues, view products and services in the exhibit hall, and attend professional development programs. Certified professionals are encouraged to attend ASA Section and Community business meetings, held throughout the week. View the program for more information.

Meeting highlights

CCAs and other professionals are encouraged to attend sessions throughout the week sponsored by the ASA Education and Extension Section: http://scisoc.confex.com/scisoc/2013am/webprogram/A01.html, including the Applied Agronomic Research and Extension Session on Monday, November 4. This topical session features numerous oral papers on applied research and extension programs and approaches in crop and forage production, soil management, pest management, and resource conservation.

Professional soil scientists and other professionals are encouraged to attend sessions throughout the week sponsored by the SSSA Consulting Soil Scientists Division: http://scisoc.confex.com/scisoc/2013am/webprogram/Z03.html, including the following oral sessions on Tuesday, November 5: “Nutrient Management under Permit,” “Ecosystem Services: Beyond Stormwater,” and the event, “Careers in Consulting: Q&A with Consulting Scientists.”

Career opportunities

If you are looking for an employee or a job, tap into the services of the Annual Meetings on-site Career Center. Open Sunday through Wednesday in the exhibit hall, the Career Center assists employers and employees with job opportunities and facilitates interviews. In addition, this year the Societies will host a Career Fair on Monday, November 4 from 3 to 6 pm. Visit the Career Fair to meet prospective employers and industry leaders in the Career Center. For information, visit www.careerplacement.org or contact Teri Barthelmes at 608-268-3972 or tbarthelmes@sciencesocieties.org.

Meeting registration

Register for the meetings by September 17 to receive the early registration discount or by September 24 to receive the pre-registration discount. Early registration by September 17 is $500 for ASA, CSSA, or SSSA members and $710 for non-members. After September 17, the registration fee increases to $565 for members and $770 for non-members. Both one- and two-day rates are available. Members receive substantial registration discounts. In most cases, it costs less to join or renew and register for the Annual Meetings than it does to attend at the nonmember fee. For more information, visit www.acsmeetings.org/register.
Grow Your Professional Knowledge
Don’t miss these upcoming online educational opportunities for CEU credit.

Growing Season Webinar Series
August 8 & 22, 2013
sponsored by DuPont Pioneer
These one-hour webinars are held every other Thursday at 12:00 Noon Central time through August. Each session features at least one subject matter expert, covering topics related to nutrient management, soils, crop production, crop diseases, weeds, and insect concerns in agronomic crops. The exact speakers and topics will be announced several days prior to each webinar and will be adapted to reflect the unique conditions and situations that the 2013 growing season will bring.
See www.agronomy.org/education.

Fundamentals in Soil Science
August 21—November 6, 2013
This course is an introductory course designed for the practitioner hoping to build their knowledge and skills in the topics most needed for a fundamental understanding of soil science. The course is taught online, using distance education technologies.
See www.soils.org/education.

Soil & Water Management—Ag Perspectives
August 22—September 19, 2013
This course is designed to provide the student with an understanding of the complexities and challenges facing agriculture today. The course will focus on soil and water management as it relates to relevant issues surrounding agriculture and sustainability.
See www.soils.org/education.

Fundamentals in Applied Agronomy
October 1—December 17, 2013
This course is an introductory agronomy course designed for the practitioner hoping to build their knowledge and skills in the topics most needed for a fundamental understanding of agronomy.
See www.agronomy.org/education.
Dates subject to change
CCA candidates:
The future of agronomy

The USDA projects 53,500 qualified graduates will be available for about 54,400 jobs annually in agricultural and food systems, renewable energy, and the environment. The shortage of agronomy graduates and lack of opportunity in other sectors of industry will draw students with varying backgrounds to this in-demand career path. The appeal of gaining a degree that lends itself to an industry with limitless potential and an entrepreneurial attitude is hard to ignore.

The students who traditionally seek out a degree in agronomy or a related major have had a background in agriculture or have lived in the vicinity of rural farming operations in some capacity. The potential for a shift in those backgrounds is very evident. We may start to see more students with a focus in majors such as business, horticulture, and biology alter their intended track of study to incorporate varying degrees of agronomy or environmental science. This is a great realization for agriculture. However, it will raise some questions: Can you consider these “young professionals” qualified and do they have enough real-word, practical experience in agriculture to meet the demands of their potential employers?

To help answer the questions posed above, the CCA program has renewed its focus on the next generation of
agronomy professionals. The program puts a system of uniform standards in place that are designed to maintain the quality of individuals giving qualified agricultural and environmental recommendations. Several agricultural-industry employers and prominent colleges and technical schools have turned to the benchmarks set by the American Society of Agronomy to evaluate the talent pool of young professionals in the marketplace.

The heightened effort to reach out to students and young professionals has been spearheaded by the state, regional, and provincial boards throughout North America. The programs that several boards have put into place have all focused on encouraging students to take the international and local board CCA exams during the spring semester of their senior year. Testing and evaluation is the ultimate goal, but the entire “student program” is made up of much more than encouragement. The local CCA boards work to get CCAs in the classroom, cultivate relationships with educational institutions, and steer students towards evaluating their knowledge base.

It does not matter whether the school is a technical school, community college, or university. Local boards strive to educate students during the fall semester of their senior year. The education is not simply a pitch for the CCA program; it encompasses current agronomy topics and examples of career opportunities related to their majors. Local CCAs volunteer their time to discuss the program and its benefits to agronomy clubs and in agronomy or agri-business classrooms. This provides access to a working professional who has realized how the CCA program is essential to the future of agronomy.

Schools see the testing as an opportunity to validate their educational programs and use the tests as accreditation exams. The CCA program hopes that this connection to the schools and the evaluation of the students, as in any professional certification, is something that continues beyond the foreseeable future. Some schools, along with their local boards, have gone as far as to contribute money to discount the exam to their students and show their commitment to their undergraduates.

Soon-to-be “young professionals” can prove their competencies in the four major areas of agronomy—nutrient management, soil and water management, integrated pest management, and crop management—via testing. Once they have passed both exams, they establish their relationship with the CCA program by applying to become a CCA-Candidate. The CCA-Candidate status allows the student to show that they have the necessary knowledge base to enter the field of agronomy while they work towards gaining the necessary experience to become fully certified. It demonstrates a student’s commitment to their chosen profession.

However, having the right knowledge does not necessarily mean they know how to use it. That is why the local CCA boards select and work with educational programs focused on a combination of applied agronomic fieldwork and classroom studies. In-field experience and practical application, along with the program’s system of standards, are what’s needed to meet the demands of today’s employers.

The professional CCA credential is something that should be considered as important to its industry as a Certified Public Accountant credential is to accounting. The program is on the right path, and it is solely due to the dedication of individual volunteers and our local CCA boards. Please reach out to your local board to get involved. Your support will be appreciated. Think of it as an investment in the future of agronomy.
Newly certified

The following list includes newly certified individuals and those who have added additional certifications since the last issue of *Crops & Soils* magazine.

**Canada**

**Alberta**

Barron, Roger, St. Albert, AB (CCA-PP)
Glimsdale, Braden, Claresholm, AB (CCA-PP)
Labby, Rachelle, Colinton, AB (CCA-PP)
Morgan, Robert, Sturgeon County, AB (CCA-PP)
Pritchard, Simon, Vulcan, AB (CCA-PP)
Stradeski, Bruce, Lloydminster, AB (CCA-PP)

**Manitoba**

Fordsyce, Adam, Kenton, MB (CCA-PP)
Galbraith, Katlyn, Westbourne, MB (CCA-PP)
McKee, Kurtis, Bagot, MB (CCA-PP)
Pinette, Guy, Ste Rose du Lac, MB (CCA-PP)
Poiron, Michel, Somerset, MB (CCA-PP)
Rabe, Ronald, Alexander, MB (CCA-PP)
Van Mol, Michael, Pilot Mound, MB (CCA-PP)
Warkentin, Thomas, Dauphin, MB (CCA-PP)

**Saskatchewan**

Bartolf, Garry, Oxbow, SK (CCA-PP)
Bilan, Kelly, Canora, SK (CCA-PP)
Denomie, Raeanne, Wadena, SK (CCA-PP)
Fullerton, Leah, Biggar, SK (CCA-PP)
Goodwin, Ryan, Regina, SK (CCA-PP)
Ofukany, Trent, Moose Jaw, SK (CCA-PP)
Simonson, Eric, Outlook, SK (CCA-PP)
Strand, Tess, Preeceville, SK (CCA-PP)
Tolley, Ward, Prince Albert, SK (CCA-PP)

**United States**

**California**

Cardoza, John, San Joaquin, CA (CCA-CA)
Carlson, Russell, Arvin, CA (CCA-CA)
Culbertson, Jason, Walnut Grove, CA (CCA-CA)
De Niz, Nicholas, Lodi, CA (CCA-CA)
DiGrazia, Nicholas, Chico, CA (CCA-CA)
Hafen, Matthew, Blythe, CA (CCA-CA)
Heinz, Matthew, Clovis, CA (CCA-CA)
Johl, Malkit, Live Oak, CA (CCA-CA)
Jones, Ronald, Madera, CA (CCA-CA)
Konyn, Luke, Chico, CA (CCA-CA)
Moyer, Gerald M., Riverbank, CA (CCA-CA)
Neubert, Matthew, Yuba City, CA (CCA-CA)
Rice, Andrew, Yuba City, CA (CCA-CA)
Smith, Benjamin, Wasco, CA (CCA-CA)
Stemwedel, Timothy, Fresno, CA (CCA-CA)
Taylor, Christian, Willows, CA (CCA-CA)

**Iowa**

Dobson, Mark, Donnellson, IA (CCA-IA)
Folkmann, Aaron, Waterloo, IA (CCA-IA)
Henderson, Ethan, Independence, IA (CCA-IA)
Hlde, Nicholas, Parnell, IA (CCA-IA)

**Indiana**

Baute, John, Charlestown, IN (CCA-IN)
Dietmeier, Derek, Bloomington, IN (CCA-IN)
Edwards, Tyson, Plymouth, IN (CCA-IN)
Miller, Darian, Ligonier, IN (CCA-IN)
Reichhart, David, Columbia City, IN (CCA-IN)
Wagoner, Matthew, Vincennes, IN (CCA-IN)

**Minnesota**

Carman, Paul, Grand Meadow, MN (CCA-WI)
Crawford, Chase, Sherburn, MN (CCA-MN)
Dunsmore, Christopher, Renville, MN (CCA-MN)

**North Dakota**

Jaehning, John, Wahpeton, ND (CCA-MN)

**Wisconsin**

Habermann, Daniel, Manitowoc, WI (CCA-WI)
Mugg, John, Plum City, WI (CCA-WI)

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We’ve made tremendous strides in improving pesticide stewardship and sustainability since the Integrated Pest Management (IPM) approach was formalized some 50 years ago. Global pesticide use has leveled off in the past 15 years. In the U.S., applications of the most broadly toxic pesticides declined by more than 50% between 1997 and 2007 as a result of regulations and more targeted alternatives developed by industry. The bald eagle, a poster child for pesticide impacts on wildlife, was removed from the endangered and threatened species lists by 2007. This success was due in part to regulatory action to eliminate uses of pesticides toxic to the birds and their young.

Many of the new pesticides registered in the U.S. in the past decade have been low-risk biopesticides, naturally occurring substances, or pesticides that have met USEPA’s criteria for reduced risk. These criteria include low use rates; low impact on human health; low potential for groundwater contamination; low toxicity to birds, fish, and other non-targets; and compatibility with IPM.

Biopesticides include microorganisms, plant extracts, and other biochemicals. *Bacillus thuringiensis*, or Bt, is a market-leading biopesticide with conventional applications as well as incorporation into plants through genetic modification. Although biopesticide sales have been less than 5% of the more than $36 billion annual pesticide market, their sales growth has exceeded conventional pesticides by 14% over the past decade due to reduced residues, shorter re-entry times after application, and improved efficacy in conventional and organic production.

Opportunities for improvement

Worldwide, we continue to suffer unsustainable losses from pest activity. Each year, the pest damage results in losses of crop value estimated at $5 billion a year from sucking insects, $40 billion a year due to weeds, $80 billion from plant-parasitic nematodes, and $300 billion in post-harvest losses due to insects, fungi, and other causes. We need more effective strategies and tools, especially as we look to feed two billion more mouths over the next 30 years.

Concerns about pollinators and pesticides have been well documented. The March 2013 *Report on the National Stakeholders Conference on Honey Bee Health*, published by USDA, indicated that based on laboratory analysis of bees and bee products, bee exposures to pesticides are common and that “Acute and sub-lethal effects of pesticides on honeybees have been increasingly

**NRCS assessments shed light on adoption and effectiveness of conservation practices and IPM**

By Thomas Green, Ph.D., CCA, TSP, President, IPM Institute of North America
documented and are a primary concern.” One issue is pollinator exposure to potentially harmful concentrations of pesticides in dust generated when planting insecticide-treated seeds, documented in both U.S. and European studies. The report concluded additional field research is needed to accurately determine risks.

Weed resistance to herbicides has been well covered in recent issues of Crops & Soils magazine. Resistance is also a continuing concern for insects, diseases, and other pests. Corn rootworm, which has a long history of developing resistance to insecticides as well as overcoming crop rotation as a control strategy, has shown the ability to develop resistance to the Cry3Bb1 toxin contained in some genetically modified corn hybrids. Colorado potato beetle, diamondback moth, several cotton pests, and the fungal diseases late blight and apple scab are among the many pest organisms that have successfully overcome multiple chemical control options since the 1920s when insect resistance to insecticides was first documented. In that instance, lead arsenate insecticide was reported to be losing effectiveness against codling moth, a pest of tree fruit.

Lead and arsenic are very stable and can still be found in orchard and former-orchard soils, presenting a risk including the potential for uptake by crops grown in those soils. Environmental and human health impacts from pesticide use continue to be reported; fortunately in many instances, by the time the research is published, regulatory or market changes in pesticide use have mitigated the identified concerns.

There are additional important reasons why we should continue to pay attention to opportunities to improve stewardship and reduce pesticide risk. Although many countries have vigorous regulatory programs, they do not eliminate risk. Regulators recognize that pesticides vary in level of risk; hence, USEPA’s Reduced-Risk Pesticide Initiative and the “Danger,” “Warning,” and “Caution” signal words on pesticide labels. Pesticide application methods and application sites also engender varying levels of risk. Finally, history holds many examples where, despite best efforts by manufacturers and regulators, we learned about specific risks that required modification, withdrawal, or cancellation of registered pesticide uses only after the products had been on the market for a time.

CEAP and IPM

Since June of 2010, USDA-NRCS has been publishing a series of watershed-based conservation assessments on cultivated cropland, which report on adoption and effectiveness of conservation practices and IPM. These Conservation Effects Assessment Program (CEAP) reports are comprehensive, multi-agency efforts that have been completed for six watersheds to date.
Integrated Pest Management

In the most recent report, released in May for the Arkansas White-Red River Basin, only 5% of cropland acres benefited from a relatively high level of IPM during the 2003–2006 study period. This compares with 25% of cropland fully meeting nutrient management criteria for rate, timing, and method for both nitrogen and phosphorus and 18% receiving a high level of tillage management to reduce sediment, nutrient, and agrichemical losses from cropland.

In the Chesapeake Bay Region, 9.4% of cropland acres were reported to be under high-level IPM compared with 4.8% in the Ohio-Tennessee River Basin, 5.8% in the Great Lakes Region, and 7% in the Missouri River Basin. Ten percent of cropland acres in the Upper Mississippi Basin scored in the high-level IPM category.

Each report provides additional detail on practices. Pesticides were applied on 98% of cropland acres in the Upper Mississippi River Basin. Routine or preventative treatments were reported on 58% of acres. Biological pesticides were reported for 7%. Pesticides with different modes of action were rotated or tank-mixed to delay resistance on 37%. Dealer recommendations were reported as the primary factor in pesticide decisions on 17% of acres, followed by crop consultants at 3% and university extension at less than 1%.

Deliberate scouting, or systematic observing for pests or pest damage, was practiced on 50% of cropland acres in the Upper Mississippi River Basin. Informal scouting, making general observations while doing other tasks, was practiced on 40%. Weather data were used to guide pesticide applications on 66% of acres. Crops were rotated to manage pests on 77%. Crop varieties resistant to pests were used on 44% of acres. Planting locations were selected to avoid pests on 10%.

In each watershed, researchers used computer modeling to estimate the percentage of acres with low, moderate, and high need for additional practices to address concerns. In the Upper Mississippi River Basin, a 44% reduction in pesticide losses and a 21% reduction in risk to aquatic organisms and humans could be achieved by addressing the 9 million acres with high needs for additional practices. Options include IPM practices, tillage management, buffers, filter strips, windbreaks, and other strategies that reduce or eliminate the potential for pesticide losses from cropland due to runoff, leaching, erosion, or drift.

Adding value to our services

The most striking results from the CEAP reports for CCAs may be the opportunity to more actively engage with our clients on pesticide application decisions. On average, more than half of the acres surveyed receive routine treatments or preventative scheduling. Dealer or crop consultant recommendations are the primary decision factor on less than 20% of cropland acres. These data suggest enormous growth potential to apply our knowledge and skill to improve crop quality and yields, preserve effective pesticide products, and promote reduced-risk options.

What might you do to identify producers in your area or in your current client base who could improve their performance by taking greater advantage of your expertise? Are there strategies you or your colleagues have found effective in improving producer engagement and influence?

Another key lesson from the CEAP reports is that not all cropland acres are equally vulnerable to pesticide losses through runoff, leaching, or drift. Soil type, tillage system, proximity to ground and surface water, and the type and quality of vegetation between application sites and surface water all contribute to increasing or decreasing potential for losses. Pesticide losses equal reduced efficacy and lost value to your clients. What can you do to improve your skills in recognizing cropland most vulnerable to pesticide losses and recommending pesticides appropriate for those vulnerabilities? Is there potential for you to provide additional planning services, or to partner with an individual or firm to do so, perhaps in conjunction with NRCS Conservation Activity Plans for IPM described in the May–June 2013 issue of Crops & Soils magazine?

Where might you develop your business model to increase value-added services? Do you provide scouting services for a fee? Would your clients benefit from professional application equipment calibration? The pilot calibration project that we described in the January–February 2013 issue of Crops & Soils magazine, which delivered better coverage and cost savings to fruit tree growers in Minnesota and Wisconsin, has now become a standard service offering to our scouting clients.

Finally, how can you improve your skills in addressing “inappropriate behaviors”? Pete Nowak, professor emeritus at the University of Wisconsin, has taught many CCAs and others about the importance of disproportionality, i.e., many of the stewardship challenges we face result from the actions of a minority of producers. When you see something that’s not quite right, do you know how to effectively identify the reason and contribute to a balanced solution that makes sense for the producer and environmental stewardship?

Let’s take the opportunity to learn as much as possible from our public investment in the CEAP research. To view the CEAP reports and report summaries, visit www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/ceap.
People around the world are focused on looking at the food chain and how to provide a sustainable food supply for a growing world population. That is why we invested $72 million to build an Advanced Crop Laboratory at the Syngenta RTP Innovation Center in North Carolina. Syngenta is a leading agribusiness company with 27,000 employees in 90 countries focused on our company purpose of Bringing plant potential to life.

This global center provides scientists with the capability to explore plants in search of safe, sustainable and environmentally-responsible ways to help farmers grow more from less. Our new facility will allow us to develop ways to enhance crop productivity faster and with more precision than ever before.

The new Advanced Crop Lab allows us to study multiple crops from multiple regions—simultaneously. Housing 30 climate-controlled growth environments in all-glass greenhouses, we can simulate conditions from Iowa in one room and from Africa right next to it. This flexibility allows company researchers to focus on developing agriculture traits that optimize crop yields, use resources efficiently and resist various stresses that farmers face every day across the globe.

Design elements of the new facility include insulated glass walls that provide a virtually shadowless indoor environment, a liquid “fertigation” system to feed and water the plants, and an automated roof-washing system. The building is Green Globes® Certified, which recognizes the company’s sustainable construction process.

Through our world class science, global reach and commitment to our customers, we’ll continue our tradition of increasing crop productivity, protecting the environment, and improving health and quality of life.

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Denitrification loss of fertilizer nitrogen during drought year under soil with high clay content

Nitrous oxide formation through denitrification is commonly linked to excess water due to soil pores blocked by water leading to anaerobic soil conditions conducive for nitrous oxide formation. However, for soils with poor drainage like high clay soils of the Red River Valley, North Dakota, loss of nitrogen fertilizer through denitrification was observed even under a dry growing season (Fig. 1). In 2012, significant precipitation deficits from May through August resulted in large areas of the Great Plains in drought conditions. Denitrification loss of nitrogen was determined for Urea-N applications with and without addition of the nitrification inhibitor, nitrapyrin, for corn and sugarbeet, prime consumers of nitrogenous fertilizers.

This study was conducted at a North Dakota State University research plot near Fargo, ND with a soil type of Fargo-Ryan silty clay complex. The field was set up in randomized block design with four replications, and each plot measured 20 ft long and 10 ft wide. Nitrogen (N) fertilizer treatments for corn were (1) 160 lb N/ac (recommended N rate), (2) 200 lb N/ac, and (3) 200 lb N/ac with nitrapyrin; N fertilizer treatments for sugarbeet were (1) 130 lb N/ac, (2) 160 lb N/ac, and (3) 130 lb N/ac with nitrapyrin. Corn variety PH-8640 RIB at 35,640 seeds/ac was planted on April 30, and sugarbeet variety Crystal 985 Roundup Ready was planted at 63,400 seeds/ac. Corn and sugarbeet were harvested on October 9 and September 17, respectively.

Soil samples for total inorganic (NH₄⁺ + NO₃⁻) N analysis were collected every month following the application of N-fertilizer treatments. Three soil cores were taken from each plot in between the rows from the upper 12-inch soil profile using a soil probe (2-cm internal diameter) and composited. Soil samples were transferred to the laboratory in a cooler and stored at 25°F until analyzed. In the laboratory, a subsample of the moist soil was analyzed for KCl-extractable NH₄⁺–N and NO₃⁻–N contents using an automated TL-2800 ammonia analyzer (Timberline Instruments, Boulder, CO). Total inorganic N availabilities for the treatments were then calculated from the summation of corresponding NH₄⁺–N and NO₃⁻–N contents.

Nitrous oxide emission rate from surface soil was measured using semi-permanent vented static PVC chamber (10-inch internal diameter and 4-inch height) following the GRACEnet project protocol outlined by Parkin and Venterea (2010). Gas samples were collected between 8:00 am and noon of the day, assuming to represent the average flux of the day. The gas samples were analyzed...
Fig. 2. Nitrogen management effect on yield (lb/ac), available N (ppm) within 30 cm, and nitrous oxide nitrogen loss (lb/ac/d) of corn and sugarbeet during 2012 growing season in Fargo, ND.
Foliar-applied nitrogen fertilizers in spring wheat production

By Olga S. Walsh, Robin J. Christiaens, and Arjun Pandey, Montana State University, Western Triangle Agricultural Research Center (WTARC), Conrad

The Northern Great Plains region is traditionally recognized worldwide for production of premium quality wheat. Spring wheat continues to be the key cereal crop for the region. While nitrogen (N) is considered the most common nutrient limiting yield of wheat and other cereal crops, N use efficiency (NUE) is currently only about 40 to 50% for most crop production systems (Gupta and Khosla, 2012). A substantial increase from the previously estimated 33% NUE in the late 1990s (Raun and Johnson, 1999) is primarily due to advances in precision nutrient management. Developing an effective N management system, improving N recommendations, and increasing NUE are central issues that should be addressed to maintain and increase the sustainability of wheat production in the future. Spring wheat's primary value is its quality, represented by high grain protein content. Thus, when evaluating use efficiency for spring wheat, combining yield and protein into protein yield, as proposed by Jackson (2001), makes sense because N is vital to both yield and protein production. Continuous advances in novel fertilizer technologies, and the active promotion of liquid products as more efficient, have renewed growers’ interest in liquid fertilizers.

Foliar nutrition mechanisms and application conditions

The scientific community and crop producers alike are debating whether foliar-applied N fertilizers are more efficient compared with the soil-applied fertilizers. Plants are known to attain water and various solutes through foliage (Wittwer and Teubner, 1959). Permeation studies by Below et al. (1985) showed that leaf stomata facilitate the mineral nutrient uptake. Foliar fertilization can assist in correcting deficiencies or preventing nutrient shortages during critical growth stages due to rapid nutrient absorption and utilization. On the other hand, unlike roots, plant leaves are not adapted to take up great volumes of nutrients and to meet the bulk of the nutrient requirement (Mikkelsen, 2008). The recent work by Fernandez et al. (2013) outlines the four consecutive steps of foliar nutrition as adsorption (adherence to the leaf surface), movement through the leaf surface, absorption (cellular compartmentalization), and translocation and utilization by the plant. Work by Stiegler et al. (2011) in bermudagrass, Angus and Fischer (1991) in winter wheat, and Woolfolk et al. (2002) in spring wheat showed that 25 to 55% of foliar-applied N is taken up through the leaves. Ling and Silberbush (2002) noted that nutrient interaction must be taken into account when several nutrients are supplied as a complex foliar fertilizer because one nutrient may enhance or inhibit the uptake of another nutrient. Finally, studies by Angus (2011) illustrated those foliar fertilizers are likely to be cost effective if the price of foliar products is no more than 15% greater than traditional granular fertilizer sources such as urea.

Potential and challenges of foliar nutrition

Some support the idea that the application of N fertilizer to the leaves is more efficient because the many possible pathways for N loss, associated with the application of nutrients to the soil, are avoided (Mosali et al., 2006). Instead, N is directly “fed” to the plant, and the available N is readily taken up, translocated, and utilized. Therefore, smaller amounts of fertilizer should be sufficient to satisfy crop N requirements and to effectively correct N deficiency midseason. Some advantages of foliar fertilization according to market media include: immediate benefits, prolonged flowering, increased yields, enhanced growth during dry spells, increased cold and heat tolerance, increased pest and disease resistance, maximized plant health and quality, and improved internal circulation of the plant (Chalker-
Scott, 2012). Some research results have suggested that foliar feeding is 8, 10, or even 20 times more effective than traditional soil application (EcoChem, 2011; U.S. Ag LLC, 2011). Most foliar N fertilizers are highly compatible with other fertilizers and many chemicals like herbicides. This could save time, labor, and money by combined application of fertilizers and herbicides. Most foliar fertilizer solutions are easy to transport, store, and calibrate for precise application.

Others argue that nutrients applied to the leaves do not always travel through the entire plant as well as they do through traditional root uptake. Instead, they continue to concentrate in the leaves that received the application or within the nearby tissues. Also, many studies imply that foliar fertilization is most advantageous when soil conditions limit nutrient availability. For example, alkaline soils do not readily release most metallic nutrients like iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), magnesium (Mg), molybdenum (Mo), boron (B), and calcium (Ca) that have been applied to foliage to successfully alleviate nutrient deficiencies, but nitrogen is a macronutrient needed in larger quantities compared with these micronutrients. Also, N is highly mobile element, so many argue that it is pointless to apply N to leaves that are not able to take up N in amounts adequate to satisfy the entire plants’ needs (Chalker-Scott, 2012). Furthermore, foliar application of high concentrations of such nutrients often results in leaf burn as water evaporates and the fertilizer salts remain behind. Some researchers concluded that significant ammonia loss occurs from foliar-applied N fertilizers, which in fact decreases NUE (Watson et al., 1992).

Foliar fertilization using liquid N sources is often associated with leaf burn. The plant injury levels as well as increase in wheat grain yield vary greatly and depend on N rate applied and other factors like temperature and moisture. Wesley et al. (1998) recorded a significant loss in yield when UAN was applied at 40 lb/ac. The following solutions were suggested to minimize concerns associated with leaf burn: using stream-jet or flood nozzles, mixing the liquid N with additional water, applying less than 58 lb/ac per appli-
cation, and avoiding applications on very warm or very cold, windy days.

**Foliar nitrogen products**

Several foliar N fertilizers are currently available on the market. These products vary in analysis and can include N products or mixtures of N plus other macro- and micro-nutrients. Some of N foliar fertilizers include urea ammonium nitrate (UAN), liquid urea (LU), and High NRG-N. The most widely used foliar N fertilizer is UAN (28–0–0 or 32–0–0), which is a non-pressurized solution that can be used in a variety of application practices. The liquid mix of urea and ammonium nitrate has been on the market for a long time. It provides fast-acting and long-lasting plant nutrient supply in a combination of three forms of nitrogen. Nitrate-N provides quick response, ammonic-N a longer-lasting response, and the water soluble organic N in urea a sustained feeding (Simplot, 2012). However, foliar application of UAN has been recognized as the least recommended option for N application by some researchers (Fernandez, 2010). Early in the growing season, foliar application of UAN may cause leaf burn, but mid- and late-season application can reduce grain yields due to burn injury caused to leaves.

Liquid urea is a water-based urea solution (20–0–0) whose proposed benefits include slower uptake by the plant, which helps to maintains N levels within the soil–plant system. Liquid urea is recommended for application during the warm growing months of the year for rapid correction of N deficiency (Fertizona, 2012). However, research on LU is very limited. Generally, it is noted that where dry urea functions effectively, LU should perform equally well or better due to having advantage of higher uniformity over some dry urea sources (Overdahl et al., 1991).

High NRG-N has been on the market for more than 20 years and is considered one of the most effective direct-applied N sources.

![Fig. 1. Applying foliar N fertilizers to spring wheat plots using an ATV-mounted stream bar sprayer, Western Triangle Agricultural Research Center, Conrad, MT, 2012.](image)

**Table 1. Treatment structure, and mean spring wheat grain yield at Patton, WTARC, and WARC in 2012.**

<table>
<thead>
<tr>
<th>Trt</th>
<th>Preplant N fertilizer (urea) rate, lb/ac</th>
<th>Topdress N fertilizer source</th>
<th>Topdress N fertilizer rate, lb/ac</th>
<th>Topdress N fertilizer/water ratio, %</th>
<th>Mean spring wheat grain yield, bu/ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>37.6 (bcd) 80.0 (c) 83.8 (abc)</td>
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<tr>
<td>2</td>
<td>80</td>
<td>UAN</td>
<td>40</td>
<td>100/0</td>
<td>31.6 (ed) 89.0 (ab) 90.0 (abc)</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>UAN</td>
<td>40</td>
<td>66/33</td>
<td>33.3 (cde) 86.5 (bc) 85.0 (abc)</td>
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<tr>
<td>4</td>
<td>80</td>
<td>UAN</td>
<td>40</td>
<td>33/66</td>
<td>31.1 (e) 87.0 (bc) 94.6 (ab)</td>
</tr>
<tr>
<td>5</td>
<td>80</td>
<td>LU</td>
<td>40</td>
<td>100/0</td>
<td>38.4 (bc) 90.0 (ab) 80.5 (c)</td>
</tr>
<tr>
<td>6</td>
<td>80</td>
<td>LU</td>
<td>40</td>
<td>66/33</td>
<td>38.4 (bc) 92.2 (ab) 80.7 (bc)</td>
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<tr>
<td>7</td>
<td>80</td>
<td>LU</td>
<td>40</td>
<td>33/66</td>
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<tr>
<td>8</td>
<td>80</td>
<td>HNRGN</td>
<td>40</td>
<td>100/0</td>
<td>41.9 (ab) 95.0 (ab) 95.6 (a)</td>
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<tr>
<td>9</td>
<td>80</td>
<td>HNRGN</td>
<td>40</td>
<td>66/33</td>
<td>39.0 (bc) 95.0 (ab) 93.6 (abc)</td>
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<tr>
<td>10</td>
<td>80</td>
<td>HNRGN</td>
<td>40</td>
<td>33/66</td>
<td>45.1 (a) 96.1 (a) 91.5 (abc)</td>
</tr>
</tbody>
</table>

The means in the same column followed by the same letter are not significantly different, $p < 0.05$. 

![Image 2. Applying foliar N fertilizers to spring wheat plots using an ATV-mounted stream bar sprayer, Western Triangle Agricultural Research Center, Conrad, MT, 2012.](image)
It contains several forms of N, S, and trace amounts of Fe, Mg, Mn, and Zn (chlorophyll-building elements) as well as several unique enhancements. The product is very low in free ammonia and formulated for minimized loss and increased plant uptake. High NRG-N has reduced salt index, and thus, is less corrosive than UAN (Agro-Culture Liquid Fertilizers, 2012).

Montana field study in spring wheat

The primary incentive for foliar N fertilization in wheat is improved quality (i.e., increased protein content in grain). Previous studies in winter wheat showed that protein content was increased from 10.8 to 21% (Finney et al., 1957) and from 14.9 to 16.5% (Woolfolk et al., 2002). Most success in protein increase is reported when foliar application was done just prior to flowering (Woolfolk et al., 2002) or immediately post flowering (Blandino and Reyneri, 2009; Gholami et al., 2011). Many wheat growers in the Great Plains area are already using foliar products or considering including them in their nutrient management. These producers are in need of up-to-date and unbiased information about currently marketed foliar N fertilizers.

This study aimed to answer the following questions: (1) Are LU and High NRG-N agronomically and economically superior to UAN in improving spring wheat grain yield and protein content? And (2) what is the optimum dilution ratio of foliar fertilizers and the threshold at which spring wheat grain yield is reduced due to leaf burn? The field study, funded by the Montana Fertilizer Tax Advisory Committee, was initiated in the spring of 2012. Three experimental sites were established: two dryland, at WTARC (near Conrad, MT) and in a cooperating producer’s field (Jack Patton, Choteau County, MT), and one irrigated, at WARC (near Corvallis, MT) using Choteau spring wheat. At each location, treatment structure reported in Table 1 was employed. Treatment 1 was established as an unfertilized check plot. A preplant N rate of 80 lb N/ac was applied as sidebanded urea. At growth stage Feekes 5, topdress N was foliar-applied utilizing an ATV-mounted stream bar sprayers (Fig. 1) using three N sources: UAN, LU, and High NRG-N. Topdress rate of 40 lb N/ac, and three dilution ratios (100/0, 66/33, and 33/66 fertilizer %/water %) were evaluated. Because High NRG-N contains S, Fe, Mg, Mn, and Zn, soil analysis was used to ensure that any of these nutrients are not deficient, and can be corrected, prior to topdress application. Each treatment was replicated four times. The plot size was 5 by 25 ft. Grain yield and protein content is determined at harvest, and N use efficiency is determined using the difference method (Varvel and Peterson, 1990) by deducting the total N uptake in wheat from the N-unfertilized treatment (check plot) from total N uptake in wheat from fertilized plots and then dividing by the rate of N fertilizer applied. Grain N uptake was calculated by multiplying grain yield by total N concentration. Grain yield, protein content, N uptake, and NUE were evaluated using statistical procedures.

### Table 2. Mean spring wheat grain protein content and protein yield at Patton, WTARC, and WARC in 2012.

<table>
<thead>
<tr>
<th>Trt</th>
<th>PATTON</th>
<th>WTARC</th>
<th>WARC</th>
<th>Trt</th>
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<td>312 (d)</td>
<td>517 (b)</td>
<td>673 (b)</td>
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<td>14.4 (bcde)</td>
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<td>16.8 (ab)</td>
<td>13.2 (ab)</td>
<td>13.9 (def)</td>
<td>336 (cd)</td>
<td>687 (a)</td>
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<td>740 (a)</td>
<td>767 (ab)</td>
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The means in the same column followed by the same letter are not significantly different, p < 0.05.

### Table 3. Mean spring wheat N uptake and NUE at Patton, WTARC, and WARC in 2012.

<table>
<thead>
<tr>
<th>Trt</th>
<th>PATTON</th>
<th>WTARC</th>
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<th>PATTON</th>
<th>WTARC</th>
<th>WARC</th>
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<td>54 (d)</td>
<td>88 (b)</td>
<td>115 (b)</td>
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<td>56 (d)</td>
<td>117 (a)</td>
<td>132 (ab)</td>
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<td>58 (cd)</td>
<td>118 (a)</td>
<td>121 (ab)</td>
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<td>54 (d)</td>
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<td>66 (bc)</td>
<td>122 (a)</td>
<td>125 (ab)</td>
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<tr>
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<td>66 (bc)</td>
<td>129 (a)</td>
<td>124 (ab)</td>
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<tr>
<td>7</td>
<td>68 (b)</td>
<td>124 (a)</td>
<td>126 (ab)</td>
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<td>69 (b)</td>
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<td>131 (ab)</td>
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The means in the same column followed by the same letter are not significantly different, p < 0.05.
While similar grain yields were obtained with LU and High NRG-N at dryland sites, the lowest yields were achieved with UAN. At the irrigated site, UAN and High NRG-N produced similar yields, and the lowest yields were obtained with LU (Table 1 and Fig. 2). There was no apparent trend in grain protein content associated with fertilizer N source (Table 2 and Fig. 3). At both dryland sites, higher protein yields were observed with High NRG-N, while at the irrigated site, all three fertilizer N sources performed similarly (Table 2 and Fig. 4). At all three sites, the highest NUE was achieved with High NRG-N (Table 3 and Fig. 5). The differences were significant at both dryland sites, and substantial, while not statistically significant, at the irrigated site. The lowest NUE was observed with UAN at the dryland sites and with LU at the irrigated site (Table 3). Overall, the results indicated that from the agronomic point of view, High NRG-N has an advantage in terms of protein yield and NUE in spring wheat production in Montana. This project will be conducted for one more growing season (2013) at three experimental locations to verify these preliminary findings.

References:


U.S. North-Central

[continued from p. 24]

within a day of their samplings, using a DANI Master GC equipped with an electron capture detector.

Results are presented in Fig. 2. Corn or sugarbeet yield did not show any response to nitrogen application rate or addition of nitrification inhibitor at the 95% significance level. Severe soil moisture deficit might mask the nitrogen management effect. However, soil nitrogen availability significantly changed throughout the growing season for corn. Two different N rates did not show any differences in soil nitrogen availability and indicated a significant loss of fertilizer N with a higher N application rate. Addition of nitrapyrin increased inorganic nitrogen concentrations compared with the other two nitrogen treatments. Statistically significant differences in inorganic N availability occurred when nitrapyrin was added and not added, particularly late in the growing season when corn N uptake significantly dropped.

Available soil nitrate-N is directly proportional to N₂O efflux, and high fertilizer N application rates increased the chance of denitrification N loss. Substantial fertilizer-N was lost due to N₂O emission during the early growing season when soil NO₃–N was abundant and soil was relatively wet. Higher fertilizer N application rates than recommended lead to higher N₂O efflux for both corn and sugarbeet even during an overall drought year but was not significant (P > 0.05) mainly due to high spatial variability of N₂O emissions.

Application of soil test based recommended fertilizer N is the key to reduce denitrification loss of N. Excess application of N did not increase yield under dry conditions but rather increased the N loss. Addition of a nitrification inhibitor increased soil N availability but did not improve corn or sugarbeet yield. Soils with high clay content are prone to denitrification loss of N and require more attention in terms of fertilizer N management than light-textured soils.

References

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On August 13–15, agronomists, crop and soil scientists, extension agents, economists, growers, and other agricultural experts will gather at a conference in Kansas City, MO to discuss nutrient use efficiency and the barriers and opportunities for improving implementation.

“I’m encouraging all crop advisers to join us and some of the top nitrogen use efficiency (NUE) experts in the country,” says CCA Cliff Snyder with the International Plant Nutrition Institute (IPNI). “This is going to be a real open exchange of ideas about the best nitrogen use efficiency practices that are out there today, including our industry’s 4R nutrient stewardship strategy.”

CCAs who attend the conference can earn continuing education credits.

“We know there can be a real tension between the production side and those on the environmental side at times,” says CPSS, CPAg, and CCA Dave Mengel, Kansas State University. “What’s different about this conference is we’re bringing both of these sides together to share ideas, because we all want clean water, profitable farming, and good yields.”

“We’ve located this in Kansas City so that crop advisers who work in the heart of corn production in the Midwest can attend, share their perspectives, and learn new techniques,” says CPSS Carrie Laboski, University of Wisconsin–Madison.

In addition to the sessions where case studies and successes are presented, coffee and beer breaks offer informal opportunities for sharing ideas.

“One of the highlights will be a roundtable discussion that features seven experienced ‘boots on the ground’ practitioners of various types of nutrient management in crop and livestock systems,” says Ron Gehl of North Carolina State University, who will be moderating the discussion. The experts will each speak for 10 minutes about their personal experiences and their reactions to the morning’s presentations. This will be followed by 45 minutes of discussion among the panel members and the audience.

Invited roundtable panelists include: Laboski, Douglas Busdeker (Northern Farm Centers, Anderson Inc.), Joshua McGrath (University of Maryland), Chris Mann (White Oaks Farm), CCA Todd Schaumberg (Polenske Agronomic Consulting), and Gabrielle Onorata (International Farming Corporation).

For more information and a complete agenda, visit: [www.soils.org/meetings/specialized/nitrogen-use-efficiency](http://www.soils.org/meetings/specialized/nitrogen-use-efficiency).

The workshop is sponsored by the Woods Hole Research Center (WHRC), International Plant Nutrition Institute (IPNI), and The Fertilizer Institute (TFI). Co-sponsors include the Soil Science Society of America (SSSA), American Geophysical Union (AGU), and International Nitrogen Initiative (INI).

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