

# Field Journal

The Official Publication of the Colorado Corn Promotion Council



**CCPC NEWS  
CORN INDUSTRY NEWS  
SPECIAL RESEARCH EDITION**

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### ABOUT

Field Journal is the official publication of the Colorado Corn Promotion Council (CCPC). The CCPC is funded by a penny per bushel assessment, and focuses on market development, research, sustainability, issues and engagement, providing outreach/education to consumers and elected officials, and promoting Colorado corn for the benefit of all corn producers in the state. ©2023

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COVER  
A CSU graduate student installs a variety of soil moisture sensors for testing and demonstration in furrow irrigated corn.  
*Credit: The CSU Ag Water Quality Program*

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# FROM THE DIRECTOR OF SUSTAINABILITY, RESEARCH AND INDUSTRY RELATIONS

**RYAN TAYLOR**

*Welcome to the Research Special Edition*

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Being a farmer is a tough job. Between managing a business, a family, and participating in community events, there is little time left in the week, and yet so many of you still manage to do your own experimentation on your own dime. Well, the Colorado Corn Promotion Council (CCPC) is determined to find collaborators who will work on research that will meet the needs of our producers.

During our research listening sessions last December, you shared with us that we should be funding research on a variety of issues including water, sustainability, fertilizer costs, innovative technology, and expanding ethanol use in the state. CCPC believes that the research should be funded by objective organizations to ensure that the results are unbiased for farmers to make educated business decisions.

Some of our past research that has directly impacted agriculture in Colorado include precision pivot irrigation, buy and dry alternatives, residue management, Palmer Amaranth and glyphosate resistance, corn hybrid testing, as well as water quality issues that resulted in agriculture being kept non-point source. This is important

because it keeps agriculture unregulated in its application of fertilizer and chemicals on the farm. So, whether it is the variety one chooses, integrating water or pest management plans, residue management, or policy that affects corn producers, Colorado Corn Promotion Council has played a significant role in support of our wonderful Colorado corn producers.

So, what is new in research here in Colorado this year? This year's funding was allocated to five research programs from the Eastern plains to the Western slopes, and include nitrogen use efficiency as well as how much of it sticks around in your soil, salinity issues on the South Platte River, innovative irrigation methods, and integrating livestock seamlessly through the incorporation of virtual fencing.

Our research has historically focused on production efficiency, technology, new uses and increasing demand for corn. Moving forward, we will also include soil health as a focus for our research dollars because we believe this will benefit corn producers in Colorado now and into the future. Soil that has been degraded functions at a certain level, but if it is reconditioned, it

will produce better and under a wider range of conditions, with fewer inputs. We will continue to do the quality research our producers deserve, but we hope that through incorporating this new aspect of research, we will be able to address a wider range of problems from different directions.

Our organization has broad shoulders. Our goal is that we can play a huge role in getting research out in front of what producers are currently doing by imagining what the farm of the future looks like, and getting research in line with what your needs and questions will be in ten years, instead of answering questions that you had 10-20 years ago. Through collaboration with various public and private entities, we hope to address those future issues so that our research dollars are being spent on things you need to improve your operation.

Lastly, it is our goal to share that research with you so that there is accountability and understanding of how that research is progressing. I hope you enjoy the Research Special Edition of the Field Journal, and that the topics help you and your business navigate the uncertainties of agriculture in years to come.

# CCPC LEADERSHIP

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Clean Cities Coalitions  
Colorado Ag Council  
Colorado Agricultural Leadership Program  
Colorado Department of Agriculture  
Colorado FFA Foundation  
Colorado Foundation for Agriculture  
Colorado Livestock Association  
CommonGround  
National Agri-Marketing Association  
National Association of Farm Broadcasters  
National Corn Growers Association  
U.S. Grains Council  
U.S. Meat Export Federation

## ABOUT CCPC

*The Colorado Producer's Council (CCPC) was established over thirty years ago to manage a one-penny-per-bushel assessment collected by first handlers of sales of corn in the state.*

*The CCPC continues to manage the investments of Colorado's corn check-off dollars. This allocation is allowed to be used specifically for research, market development, outreach and education on behalf of corn producers in the state.*

*The administrative committee board members are nominated by corn producers and appointed by the Colorado Commissioner of Agriculture.*

# COLORADO CORN ADMINISTRATIVE COMMITTEE ANNOUNCES REBRAND

On March 7, 2023, the Colorado Corn Administrative Committee (CCAC) announced a major rebranding, including name and logo. The organization has officially rebranded to the Colorado Corn Promotion Council (CCPC). This improved branding will better reflect the organization's mission and its commitment to the Colorado grain corn producers.

“The 2021-2022 year was a big year for our organization. I am excited to announce one of our biggest accomplishments, and that is the rebranding of our organization! We will now be known as the Colorado Corn Promotion Council. This change came from our strategic plan and better reflects the work our organization does day in and day out to promote the corn industry in Colorado,” said Rod Hahn, CCPC President.

Established and led by farmers, the CCPC is a state checkoff agency created in 1987, with passionate volunteer producer-leaders and talented administrative staff, focused on creating larger markets for corn produced in Colorado. The organization manages demand-building programs and research projects on behalf of Colorado grain corn and a one-penny per bushel assessment. For more than 30 years, checkoff assessments have proven to promote the utilization of grain corn and advance the use of the most innovative technology. The rebranding reflects the way the organization has grown, and better represents what they do.

The new brand identity is rooted in the work done through the strategic plan and better embodies the mission of our organization's heritage. “The CCAC has always had a focus on improving the corn industry in Colorado,” said Nicholas Colglazier, Executive Director of Colorado Corn Promotion Council, “our new brand now truly reflects our mission, being the

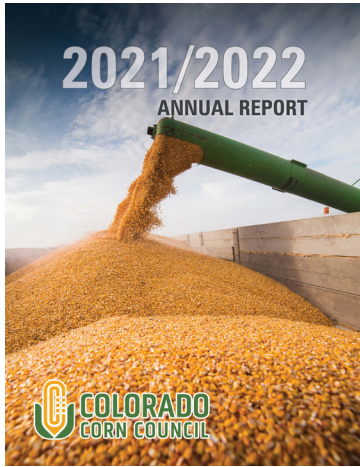
trusted, tireless promoters of corn.” The rebrand marks a milestone as the organization continues to promote Colorado grain corn with a new name and logo that will all work with its new mission, vision, and priorities.

The CCPC engages local communities in ways that showcase the long-term environmental services and important economic impact delivered by Colorado corn producers to communities across the state, and around the world. Domestic and international demand for corn and corn by-products, biofuels, and animal-based products like meat, eggs and milk is built through the work of the CCPC and their partners.



# STATE & NATIONAL INDUSTRY NEWS

## THE 2021/2022 CCPC ANNUAL REPORT IS NOW AVAILABLE!



The Colorado Corn Promotion Council is excited to release our 2021/2022 Annual Report! We are thrilled to share with you everything that we have involved with in the past year.



Check out <https://bit.ly/CCPC-AR-2022> or scan the QR code above to read up on the 2022 highlights including our partnerships, industry investments, community outreach and producer engagement.

## TAKE THE CCPC ANNUAL SURVEY

The CCPC is conducting our annual survey. It is very important to the Board of Directors and the staff that we are serving the corn producers of the state in the best way that we can - and that means we need your feedback! Please fill out the short survey, and let us know how we are doing. The survey should take less than 10 minutes to complete. Please visit <https://bit.ly/CCPCSurvey23> or scan the code.



## COLORADO CORN PROMOTION COUNCIL CELEBRATES COLORADO AG DAY

Lieutenant Governor Dianne Primavera and Colorado Department of Agriculture Commissioner Kate Greenberg joined state lawmakers and farmers and ranchers from across the state to celebrate Colorado Agriculture Day at the Capitol. Lieutenant Governor Primavera read a proclamation issued by Governor Polis designating March 22, 2023 Colorado Agriculture Day at the state Capitol. Legislators in the House and Senate read a tribute to Colorado agriculture on the floor.

## ON AG DAY, GOV. POLIS SIGNS BIPARTISAN BILL INTO LAW TO SUPPORT COLORADO'S AGRICULTURE INDUSTRY

On March 22, Governor Polis signed bipartisan legislation into law, SB23-050 Eligibility For Agricultural Future Loan Program sponsored by Representatives Richard Holtorf & Karen McCormick, and Senators Cleave Simpson & Dylan Roberts, to build upon the Polis administration's ongoing support for Colorado's thriving agriculture industry. This legislation provides key resources to farmers and ranchers to help grow their farms and ranches.

## CCAC SUPPORTS THREE FFA CHAPTERS THROUGH GRANTS

The Colorado Corn Administrative Committee is pleased to announce that three Colorado FFA chapters have been awarded a grant to help them give students more opportunities.

"The Colorado Corn Administrative Committee is proud to provide grants to these FFA Chapters, so they have the tools to develop agriculture's leaders of the future," said Nicholas Colglazier, Executive Director for the CCAC.

The three chapters who were awarded a grant include:

*SOROCO FFA* (Oak Creek, CO): To improve the capabilities of Soroco Meats (Food Processing Lab and Store Front), which provides lab-based facilities for students to practice food processing, packaging, safety and marketing standards.

"The grant we received from the Colorado Corn Administrative Committee will allow us to purchase essential supplies to operate the meat processing and food lab. Without your support, we would be delayed in our instruction and drastically further away from ensuring this facility is self-sustaining financially," said Reece Melton, Soroco Agricultural Education Instructor.

*North Fork FFA* (Hotchkiss, CO): To purchase laptops and Microsoft Design Edge, to improve students' technology

and design skills in the use of the Plasma CAM equipment and learn career-ready skills in this area.

“Our chapter is working very hard this year to update our shop to a safe learning environment, with up-to-date technology for students to gain career-ready skills. This grant allowed us to purchase laptops so that more than one student can practice designing projects for our plasma cutter. It usually takes much longer to design projects than it takes to cut them. These funds will increase student productivity and accessibility to career skills,” Lindsay Todd, North Fork FFA advisor, said.

*Bethune FFA* (Bethune, CO): Addition of a CNC Plasma cutter as 2nd phase of tech and equipment upgrade to give students an opportunity to acquire skills in metal fabrication.

“As we are still a newly formed chapter and ag program, our resources to purchase updated and relevant equipment have been stressed. The Colorado Corn Administrative Committee Grant will permit the Bethune FFA Chapter and Bethune School District to acquire technology and equipment that is industry-relevant to our students’ interests and pathways,” stated Jerrod Bessire, Bethune FFA advisor.

Each fall, the CCAC puts out an application to all Colorado FFA chapters to apply for a grant for their program. All applications are reviewed by the CCAC Board of Directors. Applicants are selected based on project and need, and the grants are awarded in the spring.

*\*This release was sent out before the rebranding*

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## **U.S. TRADE REP INITIATES CONSULTATION WITH MEXICO OVER BIOTECH CORN**

The U.S. Trade Representative in March initiated a technical consultation with Mexico, a move that puts the U.S. one step away from filing a full dispute settlement under the U.S.-Mexico-Canada Agreement over the aggressive steps Mexico has taken to ban biotech corn. Mexico is a top market for corn, the number one agricultural export from the U.S.

The Colorado Corn Promotion Council and the National Corn Growers Association applauded the development and urged USTR to expedite the process.

“This is welcome news from the USTR to ensure that our agreement/relationship continue with one of Colorado’s largest trading partners,” said Rod Hahn, President of the Colorado Corn Promotion Council. “Bioengineered crops

have been proven safe for human and animal consumption and ensuring the free trade of commodities is beneficial for both the U.S. corn industry and Mexican consumers alike.”

“We are pleased USTR is taking the next step to hold Mexican officials accountable for the commitments they made under USMCA, which include accepting both biotech and non-biotech commodities,” said NCGA President Tom Haag. “Mexico’s position on biotech corn is already creating uncertainty, so we need U.S. officials to move swiftly and do everything it takes to eliminate this trade barrier in the very near future.”

A technical consultation will bring leaders from both countries into formal discussions. As part of the process, which can happen in person or virtually, both countries can tap their experts to share information on agricultural biotechnology.

If this step does not resolve the impasse, the U.S. can then initiate a dispute settlement under USMCA. Once a dispute settlement is filed, a group of experts is empaneled to hear the case and make final determinations based on the commitments both parties signed as part of the free trade agreement.

The dispute over biotech corn stems from a 2020 decree by Mexican President Andrés Manuel López Obrador that sought to ban imports of biotech corn beginning in January 2024. Mexico issued a revised decree in February that banned biotech corn for food usage and left the door open for a future ban on biotech corn for feed, effective immediately.

Most corn grown in the U.S. is biotech corn, and Mexico has historically been one of America’s top customers.

The ban raises concerns for U.S. farmers and rural economies, but also for the people of Mexico. According to a study by World Perspectives, Inc., the decree would raise tortilla prices in Mexico by 40% in the first year and 16% over time.

The CCPC appreciates NCGA and corn grower leaders across the country, who began to sound the alarm last fall and have been calling on the Biden administration to initiate a dispute settlement under USMCA.

Mexico’s decree is not based on sound scientific evidence. Regulators and health organizations around the world, from the World Health Organization to the U.S. Food and Drug Administration, have confirmed the safety and benefits of biotech crops for decades.

# THE VALUE OF PRODUCER ENGAGEMENT IN THE REGULATORY WORLD

Conservation programs and practices are not new to Colorado's farmers. The corn producers in this state work every year to improve their soil health and the impact of their farms on the land they are using.

Regulation 85, *Nutrients Management Control Regulation*, authorized the Water Quality Control Commission in 2012 to "promulgate control regulations to describe prohibitions, standards, concentrations, and effluent limitations on the extent of specifically identified pollutants that any person may discharge into any specific class of state waters."

The Colorado Department of Public Health and Environment (CDPHE) established Reg 85 specifically related to surface waters, and the nutrient discharge that can happen into those waters. They established two different categories for this: point source and nonpoint source.

Point source entities include places such as wastewater treatment plants, and nonpoint sources include agriculture. Point sources are subject to stringent regulations, while nonpoint sources can adhere to the rules on a voluntary basis.

"I think we need to have some appreciation for the early folks who stepped up and allowed someone to monitor their farm, the people who helped craft the language in the bill, and the people who pushed the bill through. This includes people within the Colorado Corn Promotion Council, the Colorado

Farm Bureau and the Colorado Livestock Association specifically," said Erik Wardle, Director of the Ag Water Quality Program (AWQP), Soil and Crop Sciences Department at Colorado State University.

This monitoring allowed the university to research the nutrients that are making it back to surface water. "We can do research at the university on our own, without ag input, as the fact is every field in the state is being modeled by researchers somewhere. However, what is most important is to have real-world data on what is actually happening on farms, and we need producers to be involved," stated Wardle.

He has seen that people want to be involved. "At least 50 percent of the fields we do research on were people reaching out to us. Ag has been proactive in this process and shown that ag is engaged. Even if there is an issue, it's much easier to be proactive," he explained.

Wardle continued, "There is real value in participating and being a part of the conversation. You can help provide real-world data back to the modelers, so they can adjust to reflect real-world farms. Be involved and do not be afraid to show what you are doing."

The Ag Water Quality Program is currently funded through the expansion of legislation, but the base funding is from taxes on fertilizer sales and chemical certification. "I think it's a cool story. Chemical users are saying

*By Robyn Carlson*

here is our money. We think we are doing a good job to make sure we are taking care of the water in the state," he said.

Some of the voluntary compliance includes following best management practices. BMPs are adopted by the vast majority of corn producers in this state. This includes, but is not limited to: minimizing erosion, reducing runoff, the management of fertilizer, and establishing buffer areas.

People from agricultural groups were the driving forces behind making sure that agriculture was considered a nonpoint source, and therefore participation in the regulation stayed voluntary, instead of mandatory. "A lot of people feel disconnected and feel like the government just makes regulations. While it may seem that way, getting involved in the rule making process and doing it early can have a huge impact later on," said Ryan Taylor, CCPC Director of Sustainability, Research and Industry Relations.

He continued "If producers are not engaging at the meaningful level, then the government will come up with a rule that's not feasible."

At the end of the day, Taylor believes this is about soil health, and that is what he is focused on. "We are focused on creating a resilient farmer and keeping ag categorized as a nonpoint source."



# PROTECTING OUR WATER RESOURCES: THE CSU AGRICULTURAL WATER QUALITY PROGRAM (AWQP) AND ONGOING SUPPORT FROM THE CCPC

*By Erik Wardle, Director of the AWQP, Soil and Crop Sciences Department, CSU*

The Agricultural Water Quality Program (AWQP) protects Colorado state waters and the environment from impairment or degradation due to the improper use of agricultural chemicals, while supporting their proper and correct use.

The success of our program is rooted in the strong relationships cultivated over the years working with the agricultural community and numerous private and public entities in the state of Colorado. The program has worked with Colorado corn producers for two decades with support for publications including the Colorado Corn Guide, updated in 2020. Over the years, the Colorado Corn Promotion Council has provided research dollars to the AWQP for work on irrigation and nutrient management to protect water and productivity for corn farmers.

The AWQP is composed of teams within three different organizations: Colorado State

University (CSU), Colorado Department of Agriculture and the Colorado Department of Public Health and Environment. The CSU branch of the AWQP is responsible for providing research, education, and training on agricultural Best Management Practices (BMPs). These BMPs target methods to minimize the impact of fertilizer and pesticide applications on Colorado's drinking water sources. These practices include; conservation tillage, split applied fertilizer, irrigation scheduling, precision agriculture techniques and other common modern farm practices.

The AWQP program builds on a foundation of nearly three decades of research experience, the evaluation of farmer-driven practices, and ongoing stakeholder feedback and contributions.

Agriculture is an unpredictable and ever-changing industry, and the AWQP seeks to adapt, change and focus on the most current needs of

our stakeholders. As an unbiased science-based program, the AWQP pursues data to support producer and policymaker decision making in Colorado.

Improved understanding and engagement on water quality regulations and related issues in agriculture have been supported by the Colorado Corn Promotion Council for nearly 15 years. In Colorado and across the United States, agricultural inputs are being identified as one source of nutrient pollution. Nutrients such as nitrogen and phosphorus run off farmlands and accumulate in surface waterways, causing water quality issues. Most agricultural nutrient pollution is considered "nonpoint source," or difficult to trace to a particular origin.

## **VOLUNTARY ACTION NOW MAY PREVENT FUTURE REGULATION**

Nitrogen (N) and phosphorus (P) are two major essential elements required for crop growth. When lacking in soils, nutrients may be

supplemented with fertilizers. Excess nitrogen and phosphorus that runs off farmland and enters surface water and groundwater can cause:

- Algal blooms
- Reduced dissolved oxygen content
- Harm to aquatic plants and animals
- Impaired drinking water supplies

Starting in 2012, Regulation 85 began more stringent statewide regulation of “point source” nutrient dischargers, such as wastewater treatment plants.

Nonpoint sources, including most of agriculture, are discussed in the regulation, but mandatory-

requirements are currently not implemented. Instead, nonpoint sources are encouraged to adopt BMPs that can help reduce nutrient pollution in surface waterways.

The Colorado Water Quality Control Commission is expected to rule on NPS contributions including agriculture in 2023. The expectation is that no new regulations will be proposed due to the work of the AWQP and engagement from entities like the Colorado Corn Council, Colorado Ag Water Alliance, Colorado Farm Bureau, and Colorado Livestock Association among others. Working together to provide unbiased scientific data to assess and support the agricultural community, State decision-makers, and to protect one of our most

critical resources, water.

### What can producers do?

Many agricultural producers already utilize BMPs that reduce agricultural nonpoint source pollution and nutrient losses. In addition, producers are encouraged to take an active role by:

- Continuing to adopt BMPs
- Participating in projects to monitor and collect water quality data
- Attending Water Quality Control Division meetings
- Encouraging fellow producers to become involved and stay engaged



*A low cost sampler. Photo by Emmanuel Deleon with the Agricultural Water Quality Program at CSU.*



# Reducing Nutrients in Water: What's in it for Colorado Ag Producers?

**Colorado agricultural producers can influence what happens next with state regulation of nutrients and water quality.**

## BACKGROUND

In Colorado and across the United States, agriculture is being identified as one source of nutrient pollution. Nutrients such as nitrogen and phosphorus run off farmlands and accumulate in surface waterways, causing water quality issues. Most agricultural nutrient pollution is considered “nonpoint source,” or difficult to trace to a particular origin.

## NUTRIENTS

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Excess nitrogen and phosphorus that runs off farmland and enters surface water and groundwater can cause:

- algal blooms
- reduced dissolved oxygen content
- harm to aquatic plants and animals
- impaired drinking water supplies



## REGULATION 85

Starting in 2012, Regulation 85 began more stringent regulation of “point source” nutrient dischargers, such as wastewater treatment plants. Nonpoint sources, including most of agriculture, are discussed in the regulation, but mandatory requirements are currently not implemented. Instead, nonpoint sources are encouraged to adopt best management practices that can help reduce nutrient pollution in surface waterways.

### VOLUNTARY ACTION NOW MAY PREVENT FUTURE REGULATION

Regulation 85 sets a 2022 deadline for evaluation of a voluntary approach for reducing nutrient pollution.

Nonpoint sources, including agriculture, and their contributions to nutrient levels will be assessed.

Additional regulations may be considered, depending on the success of voluntary efforts.

## WHAT ARE BEST MANAGEMENT PRACTICES?

Best management practices (BMPs) can include improvements in the management of fertilizer, irrigation, manure handling, and soil erosion. BMPs improve water quality and have agronomic and economic benefits. Examples include:

- Optimizing fertilizer usage through rate, placement, timing and source
- Reducing runoff through improved irrigation systems and scheduling
- Minimizing erosion through conservation tillage
- Installing buffer strips near waterways



## WHAT'S THE BENEFIT TO AGRICULTURE?

Widespread adoption of best management practices:

- allows landowners to make the most of their soil and water resources without government intervention
- increases the efficiency of fertilizer and water application
- maintains or improves the land's productivity by reducing runoff and erosion
- reduces nutrient pollution to avoid the need for future regulation



## WHAT CAN PRODUCERS DO?

Many agricultural producers already utilize BMPs that reduce agricultural nonpoint source pollution. In addition, producers are encouraged to take an active role by:

- continuing to adopt best management practices
- participating in projects to monitor and collect water quality data
- attending Water Quality Control Division meetings
- encouraging fellow producers to become involved and stay engaged

## POINT AND NONPOINT SOURCES

A point source is a single, easily identifiable source of pollution. Examples include:

- pipe or drain
- industrial discharge
- wastewater treatment plant

A nonpoint source is diffuse and more difficult to pinpoint. Examples include:

- most agriculture
- forestland
- some urban stormwater areas

## WHAT HELP IS AVAILABLE FOR PRODUCERS TO ADOPT BMPS?

The Natural Resources Conservation Service (NRCS) offers technical and financial assistance. Contact a local NRCS office or visit [nrcs.usda.gov](http://nrcs.usda.gov).

Colorado State University Extension offers numerous publications and factsheets on best management practices for Colorado agriculture. Contact your local county extension office or visit [ColoradoAgNutrients.org](http://ColoradoAgNutrients.org).

## COLORADO AG WATER QUALITY

Colorado Ag Water Quality is an outreach and education program produced by:



**Colorado State University**  
EXTENSION



**COLORADO**  
Department of Public  
Health & Environment

# OPTIMIZING NITROGEN USE

In Colorado, grain corn is grown on 1.48 million acres and silage corn occupies 200,000 acres. Nitrogen is a critical major nutrient that supports corn growth and metabolism. Improving the nitrogen use efficiency (NUE) is key for sustainable agriculture. It benefits producers by reducing the expenditure on nitrogen fertilizer and helps the environment by way of minimizing the fertilizer leaching to precious water bodies of Colorado. Most of the producers use nitrogen to the extent of 300 lbs/acre and a significant amount of the applied nitrogen is lost through denitrification and leaching causing great concern to environmental sustainability.

The Colorado Corn Promotion Council has recently awarded a research project to Drs. Pinnamaneni and Ballard based at Western Colorado Research Center-Grand

Valley, Fruita to optimize the nitrogen use in corn flex hybrids under conventional till and reduced till systems. This study will not only focus on improving the NUE but how much nitrogen will be supplied by the leguminous and non-leguminous cover crop species such as hairy vetch, cereal rye, and a mixture hairy vetch + cereal rye in the following corn production cycle by measuring the nitrogen availability from the decomposition of cover crop residue at different growth stages (V5, VT, R2 and R7). This project is expected to shed light on potential benefits of regenerative agricultural practices such as reduced till and leguminous as well as non-leguminous cover crop species incorporation in corn production systems of Colorado and thus help produceres who want to implement these practices in their farms.

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## NITROGEN TRACER STUDY

The use of nitrogen fertilizer can be described as a double-edged sword in that it can increase corn yield, profits, and improve soil fertility, but losing nitrogen to the surrounding environment can result in economic losses as well as air and water quality degradation. Proper nitrogen fertilizer management is challenging because nitrogen is mobile in the soil. Additionally, nitrogen fertilizer decisions are generally made before the growing season, but the “ideal” nitrogen management can vary from year to year. A hot, dry growing season may decrease the amount of nitrogen corn needs. In this scenario, an over-application can lead to both environmental and economic losses. However, a warm, wet growing season could increase the amount of nitrogen corn needs and an appropriate amount of nitrogen is needed for the crop to reach its full potential. In addition

to nitrogen management early in the season, soil fertility can decline over time if more nitrogen is removed in plant biomass and grain at harvest than is added as fertilizer. This nitrogen budget, the additions and losses lead to a complexity of tradeoffs associated with nitrogen fertilizer management. There is a knowledge gap of exactly where nitrogen moves in the system, and this is why we proposed a “tracer” study.

The tracer study proposed will use isotopically labeled <sup>15</sup>N fertilizer to map the movement of nitrogen through the ecosystem. By adding known amounts of <sup>15</sup>N enriched fertilizer it is possible to calculate the percentage of nitrogen fertilizer recovered by the plants, how much stays in the soil, and how much is lost. The proposed study will take place at the USDA-ARS Central Plains Experimental Research

Station in Akron, CO during the 2023 growing season. This experiment will use six nitrogen fertilizer treatments capturing low, optimal, and high nitrogen additions as well as two irrigation treatments capturing full irrigation and near dryland conditions for the region. Yield data will be collected along with soil and plant samples at the end of the growing season for analysis which will show us how much of the labeled nitrogen is in each pool. By understanding where the nitrogen is located, and under which conditions, we can help farmers put together a nitrogen budget for any scenario a farmer may face throughout their rotation. Using these results we are confident that we can create another tool for farmers that can increase yields, profits, and soil fertility while simultaneously increasing nitrogen use efficiency.

# WATER IRRIGATION SCHEDULER FOR EFFICIENCY TOOL AVAILABLE

Since 2018, the Irrigation Innovation Consortium (IIC) has funded more than 40 collaborative research projects focused on accelerating the development and adoption of efficient irrigation technologies and practices. All of IIC's projects involve public and private partners working with researchers to address key practice and knowledge gaps. The resulting network of irrigation practitioners, industry leaders, researchers and others, has helped incubate, select, and/or support research projects to improve irrigation hardware and software, remote sensing applications and decision support tools, and systems knowledge useful for agricultural and landscape irrigators.

One of these projects, supported by the Colorado Corn Promotion Council, sought to improve irrigation scheduling decisions using the online Water Irrigation Scheduler for Efficiency (WISE) tool. WISE runs on algorithms involving widely-accepted coefficients to estimate crop evapotranspiration (ET) and related irrigation application needs, timing, and amounts. A wide range of field conditions contributes to variation in crop ET rates, however, which complicates irrigation decisions. To address this challenge, the research team evaluated a new approach involving remote sensing that could perhaps better account for on-site conditions in near real-time and improve ET estimates and the WISE tool's irrigation recommendations.

The team compared a few approaches for generating ET values and evaluating their accuracy using a surface irrigated corn crop grown in 2020 at a field located at IIC headquarters near Fort

Collins, Colorado. Space-borne remote sensing microsattellites provided multispectral images used to map the corn's actual evapotranspiration rates mid- and late in season, with that data that was ground-truthed using an eddy covariance system. Crop coefficient estimations compared by the team involved the ReSET (Remote Sensing of ET)-Raster surface energy balance model approach, along with FAO-56 and FAO-56 Hybrid approaches that involve crop coefficient values previously estimated for northeast Colorado. A one-source surface energy balance (SEB) approach to estimating crop coefficients was also used, which involves a surface aerodynamic temperature model for sensible heat flux and incorporates multispectral reflectance and thermal canopy response to account for actual field soil water content, nutrients, and weather conditions. The SEB method outperformed the others, and the WISE crop coefficient curve using data produced through SEB method

increased the accuracy of the tool's ET estimates for corn by 46% (Figure 1).

This project, which took place at the height of the pandemic, was limited to mid- and late-season data collection. Additional work is needed to gather data for early and vegetative growth stages for corn, using multiple fields irrigated with different types of systems, to explore the use and limits of this new approach for full-season corn production. This work was presented by the research team as part of the World Environmental and Water Resources Congress in 2022.

Using extensive input gathered from industry and other partners and colleagues in 2021, the IIC updated its 2022 call for research proposals, seeking projects focused on:

- Evaluating and improving technologies and recommendations
- Improving integration of tools and strategies

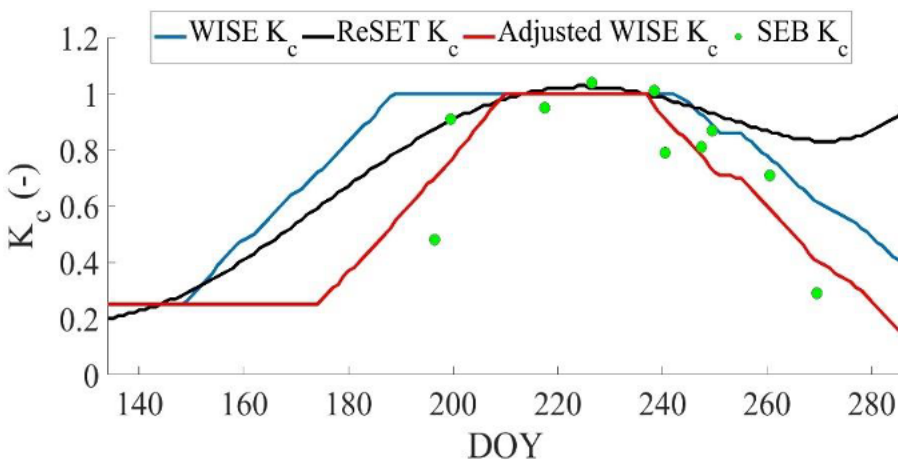


Figure 1. This figure shows a time series of different crop coefficient value methods. The WISE scheduling tool shows promising improvements in determining corn ET after adjustment using the SEB crop coefficient approach. The ReSET crop coefficient curve only agrees with the WISE curve and SEB Kc from DOY (day of year) 210 to DOY 240, before diverging later in the growing season.

- Data synthesis to inform decision making
- Clarifying water use benchmarks, targets, and protocols
- Quantifying potential benefits (biophysical, practical, economic) of advanced irrigation management

A key goal in using these themes is to help clarify the critical role and impact of effective irrigation in mitigating agricultural risk and supporting sustainable water management.

One project funded via the 2022 call for proposals is comparing irrigation water pumping estimates for ten agricultural irrigation wells in western Nebraska near Sutherland using electrical run time and flow test results against real water delivery measured with calibrated flow meters placed on four of the wells. The team is testing their electrical run time algorithms to make sure that water delivery volume estimates remain accurate when end guns are used and in situations where aquifer levels drop measurably near wells during the growing season (Figure 2).

This unique approach takes advantage of using the rural power smart grid to gather reliable, cost-effective data and transform it so that irrigators and water district leaders can monitor and manage field- and watershed-level water use in near real-time. The data that is generated is also valuable for improving understanding of hydrogeologic systems in heavily irrigated areas. The results of this research are being widely shared with irrigators enrolled in Nebraska’s Twin Platte Natural Resources District’s Water Data Program as well as irrigators and water managers elsewhere in Nebraska and the High Plains. This research has been also been presented at several research conferences including the Geological Society of America’s “GSA Connects” 2021 meeting.

A third and final project example, which was also funded in 2022, has mobilized a large team of researchers from across the High Plains to synthesize data generated since 2017 through the Testing Ag Performance Solutions (TAPS) program. Since launching in 2017 at the University of Nebraska-Lincoln’s North Platte research farm, and subsequent expansion to the Oklahoma Panhandle at an Oklahoma State University research farm near Eva in 2019, TAPS has involved hundreds of participants from Nebraska, Colorado, Kansas, and elsewhere in the High Plains and beyond. The program format, which reflects real-world farm conditions and circumstances, is based around a growing season-length competition that engages participants in showcasing and comparing their decision-making skills in crop and irrigation management and marketing with that of their peers.

TAPS provides a truly unique, low-risk approach for participants to test out different sensor technologies and interfaces and crop management and marketing strategies. TAPS participants are provided with data that streams from sensors to an online portal where they enter their management decisions, which are imposed on randomized, replicated plots at a university-based research farm. Researchers can then analyze this

information to identify how the timing and types of participants’ management choices and decisions contribute most to productivity, profitability, and/or input-use efficiency, and why. The research team involved in studying historical TAPS data is exploring crop hybrid response to water and nitrogen application timing and amount, the influence of participants’ use of soil moisture sensors on crop management outcomes, and how improving water and N use efficiency is likely to impact greenhouse gas emissions.

The team will channel its research insights into open-source publications and summaries, videos, presentations, fact sheets and other outreach efforts. This summer, the team will gain additional data to inform this research effort, thanks to the expansion of TAPS with a new program starting in Colorado. CSU-TAPS will be hosted at CSU’s Agricultural Research, Development and Education Center (ARDEC) research farm. CCPC, along with other program partners, was on hand April 6 for the program’s official kick-off event involving this year’s program participants. For more information please contact IIC’s Executive Director Tim Martin at [Timothy.Martin@colostate.edu](mailto:Timothy.Martin@colostate.edu). Follow along with CSU-TAPS by signing up for the program newsletter at [www.irrigationinnovation.org/news-events](http://www.irrigationinnovation.org/news-events).

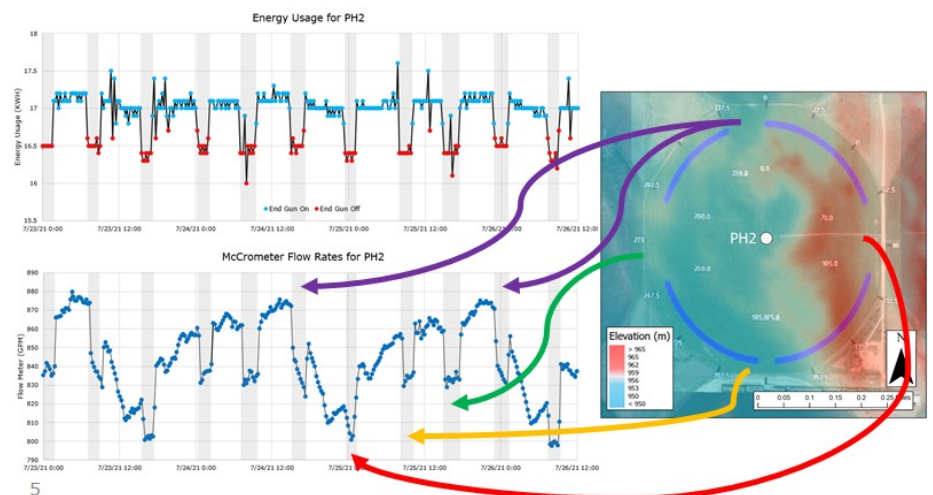


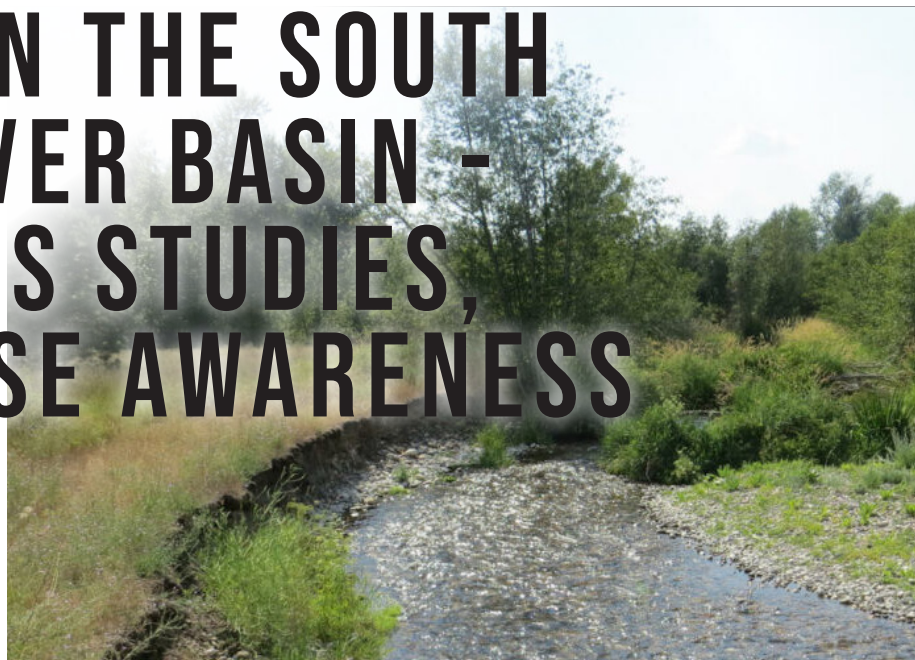
Figure 2. Power consumption and flow rate changes (left) with end guns on and off and elevation change (right) for one of the study wells.

# SALINITY IN THE SOUTH PLATTE RIVER BASIN - CCPC FUNDS STUDIES, HELPS RAISE AWARENESS

By Grady O'Brien,  
Neirbo Hydrogeology

Salinity is always a concern for agriculture. Emerging evidence reveals that Colorado's South Platte River Basin (SPRB), like many other intensively irrigated agricultural regions worldwide, suffers from salinization. Salinity can decrease crop yields, decrease crop diversity, and can ultimately lead to collapse of agricultural regions. The risk can be masked by technological advances that increase crop yields in the short term. Increasingly salt tolerant crops can be planted...in the short term. Salinity has traditionally been managed at the farm level by flushing salts through the soil with excess water...resulting in shallow saline water tables where evaporative up-flux accelerates soil salinization.

Increasing demand for water heightens the need to reduce water use with more efficient irrigation methods, which can reduce salt leaching and limit salinity management on the farm. A hotter and dryer climate will make prolonged drought more common, increase water demand, and increase evaporative salt concentration. Water reuse will continue to expand, which will also increase salinity. Irrigated agriculture needs to keep its eye on salinity before soil damage becomes irreversible and the land is unsuitable for cultivation.



The Colorado Corn Promotion Council has been an industry leader by investing in salinity research and raising awareness. Over the past several years, the CCPC has contributed funds to advance our understanding of salinization in the SPRB. An initial 3-day study in 2018 by NEIRBO Hydrogeology sampled South Platte River water from upstream of Denver to Julesburg. These samples confirmed that salinity was at levels that pose a threat to the sustainability of irrigated agriculture and the problem deserved further study.

There had been water quality studies in the 1990s that indicated there was elevated salinity in the South Platte. The agriculture community had largely adjusted, so was it really a problem? Was salinity getting worse? NEIRBO undertook a historical look at salinity to see if it was increasing. Salinity data from 1995 through 2018 was analyzed for long-term trends. The analysis showed that after adjusting concentrations for changing streamflow, there were increasing salinity trends in the upper South Platte River reaches. The trends in the lower basin reaches were inconclusive

due to a pervasive lack of data, which highlighted the lack of data problem.

These studies increased awareness of salinity and the threats it posed to irrigated agriculture and municipal water supplies. This led to the formation of a salinity stakeholder group representing farmers, water delivery, municipal water and wastewater, and others. It was clear that salinity is a shared problem, and it will take a cooperative approach to develop solutions. The stakeholders have been coalescing over the past 2 years and recently the Colorado Water Center was engaged to facilitate this group and to foster cooperation and lead outreach activities.

A technical team was also formed to begin systematic and comprehensive salinity studies. NEIRBO has been collaborating with technical experts from Colorado State University (CSU), Colorado Geological Survey (CGS), Colorado School of Mines, and the Colorado Department of Public Health and Environment. An ongoing NEIRBO study in the final stages of reporting was tasked with investigating natural, geologic salinity sources. Groundwater



and streams can leach salts from the aquifers and rocks they flow through in the basin. Groundwater beneath the South Platte River and major tributaries were sampled with temporary piezometers and river samples were collected. These samples were analyzed for a suite of chemical constituents that form common salt compounds. Water chemistry changes and possible natural salinity sources have been identified.

On-going collaboration with CSU includes projects sponsored by the Colorado Water Center, the Colorado Agricultural Experiment Station, and Colorado Corn. These studies are compiling, assessing, and distributing existing information on the nature and extent of SPRB salinity and its impacts. These studies will also develop extensive data collection plans and initiate additional data collection.

NEIRBO will combine funds provided

by the Colorado Corn Promotion Council in 2022 and requested in 2023 to initiate long-term monitoring sites collaboratively planned by the Salinity Technical Team. The larger team of researchers has been working through details of implementing monitoring for the past 18 months. The CCPC sponsored projects will install shallow alluvial groundwater monitoring wells in and near croplands during the summer of 2023. These wells will be instrumented to continuously monitor water levels and salinity. Periodic water sampling will provide additional details on the types of salts present and their movement and variability in agricultural areas.

As the salinity monitoring program develops with additional grant funding it will expand to include long-term groundwater and surface water chemistry, soil chemistry, soil texture, soil conductivity, and remote sensing monitoring. Efforts

are underway to further extend this monitoring network by collaborating with ongoing nutrient studies being conducted by CSU and the Colorado Department of Agriculture. This systematic, collaborative, and long-term monitoring approach will provide a comprehensive assessment of salinity in the groundwater, surface water, and soils in the SPRB.

These data will define the nature and extent of the salinity problem, which will lead to the development of focused solutions. Negating salinity impacts on soils and improving water quality will ensure the sustainability of irrigated agriculture and domestic water supplies in the South Platte Basin. The Colorado Corn Promotion Council has been a trusted partner and is leading the Salinity Stakeholder Group by funding projects that will benefit the entire Basin.

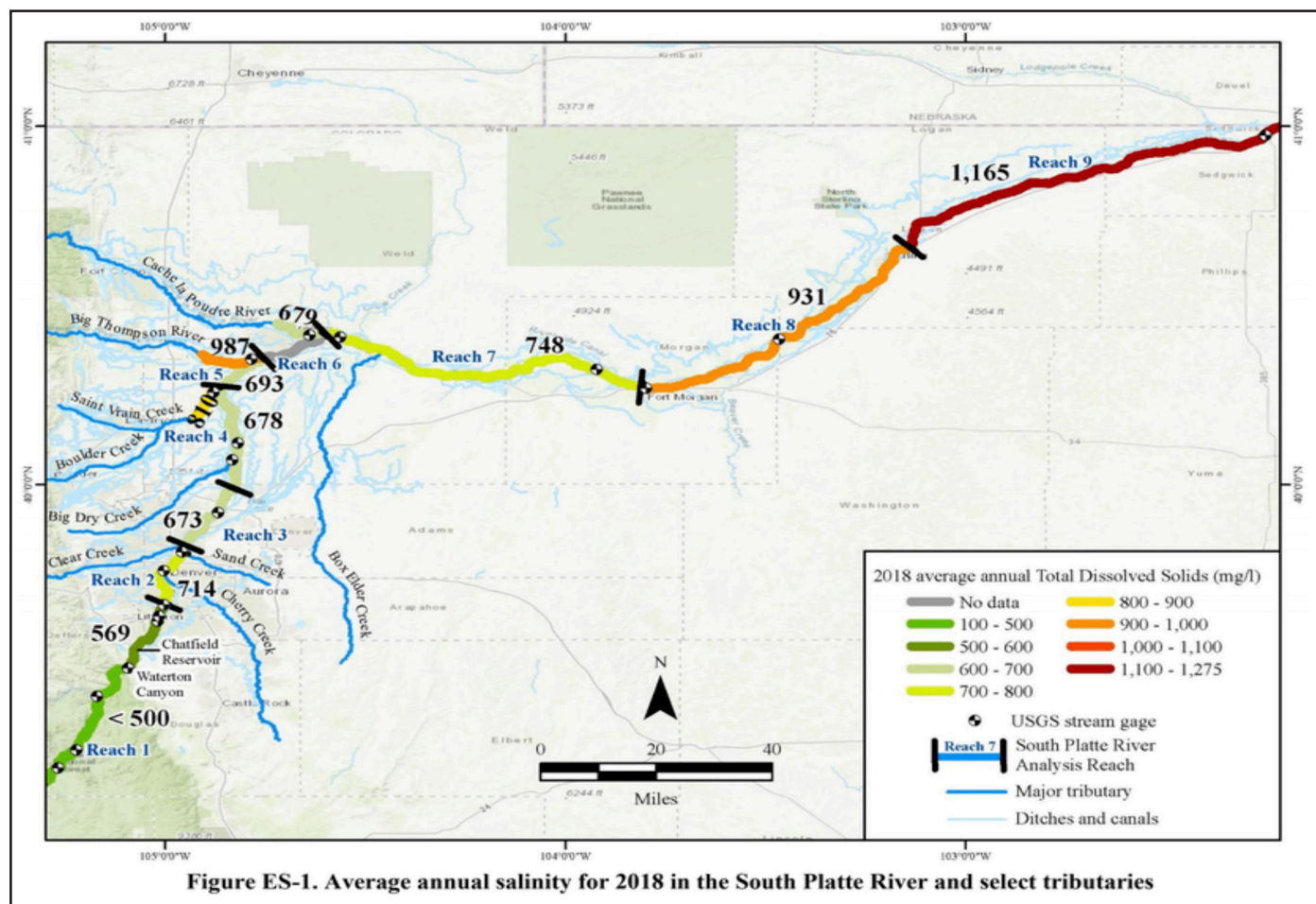


Figure ES-1. Average annual salinity for 2018 in the South Platte River and select tributaries

# OPTIONS FOR OPTIMIZING LIMITED ON-FARM IRRIGATION IN THE NORTHERN GREAT PLAINS

Field corn is the preferred agronomic crop for many irrigated farms in the Northern Great Plains, but many farms do not have enough irrigation water to maximize yield on all acres in all years. Grain yield drops quickly with the reduction in water when crop water use is below 80% of the water needed to produce maximum yield (Comas et al., 2019) (Figure 1).

There are a few options for farms, depending on when the shortfall in water supply is realized, and more options if incentives or water leases are included. Additionally, alternative crops that require less irrigation and at different times than the critical periods needed by corn may also help optimize limited agricultural water.

## Planning to Use Less Irrigation

Regulated deficit irrigation (RDI) are strategic irrigation shortfalls within the season during targeted growth stages. To a degree, RDI can maintain economic yields while saving crop water use. After plants are established, the most critical growth period to apply irrigation for corn is during pollination and early critical seed set, followed by the grain filling as the second most critical period, after kernel milk stage but prior to maturity.

We achieved a similar yield to fully irrigating with approximately 17% less crop water used by applying targeted irrigation shortfall in the last half of the vegetative stage (the 5-week period prior to tassel) (Figure 1). In 2019, grain corn sold at about \$4/bushel, netting about \$2/bushel per Colorado State University production cost tables. Incentives at \$350/acre-foot of the 17% saved water and maintaining yield would give producers a 30% increase in net profit over fully irrigating.

Many producers, however, lack flexibility to apply RDI. Sprinkler systems often lack the capacity to refill the soil in a short period of time after the corn root zone is substantially depleted; but producers could perhaps apply RDI if irrigation capacity could be increased. Furrow systems require water to reach the end of the field, but producers could achieve RDI by supplying fewer irrigations, assuming these irrigations can be accommodated by the ditch schedule.

## Alternatives to RDI When Shortfalls are Known Prior to Planting

If a farm needs to use less water, fully irrigating a smaller portion of a farm in field corn may be

economically and logistically preferable to RDI, but producing an alternative crop on the remainder of the farm could offset some of the drawbacks of fallow (such as weed management) or otherwise contribute towards fixed land costs (Trout and Manning, 2019).

Silage corn uses less water because its season is shorter by about one month or more. Sorghum is one alternative since it's planted on a similar row spacing as corn, but it has a shorter season. Maximum grain sorghum yield in Greeley, CO required approximately 65% of the crop water use of field corn, with forage sorghum using even less water. Likewise, dry beans and wheat use less water than corn due to their shorter season, but they also require different equipment. Other options include grain or hay millet, which is extremely productive with little water in a short season, although it's typically planted on a similar spacing to wheat. Grain millet currently has a limited market, but it stores well and has had price peaks at recurrent intervals. Hay crops can provide additional opportunities, especially if used on the farm. Alternatively, hay production would need to meet quantity needs of large cattle operations.

### Options When Unplanned Water Shortfalls Occur After Planting

Significant yield losses can occur when corn is fully irrigated through the first half of the growing season but has limited irrigation during grain fill. If there is risk of irrigation shortfall later in the season and flexibility in irrigation scheduling, it may be prudent to reduce applications during the late vegetative period rather than risk irrigation shortfall at the end of the season (Comas et al., 2019) (Figure 1).

### Conclusion

Irrigation shortfalls can be used strategically, to a degree, to save agricultural water or to serve as important buffers from worse yield losses resulting from late-season shortfalls. However, if water shortages are anticipated, planting corn on a smaller portion of the farm and alternative or short-season crops (if late-season shortfalls are expected) on the remainder may be optimal. Economic models based on crop water productivity and cost analyses provide guidance on the prices needed to augment farm income for profitability (Manning et al., 2018; Trout and Manning, 2019) and to inform ATMs and Augmented Deficit Following programs. Assistance for optimizing on-farm water use, such as the Natural Resources Conservation Service Agricultural Management Assistance program, may also provide improved irrigation flexibility. Ultimately, economic models that can evaluate multiple options and diverse solutions will be useful tools for decision-making considering the volatility of the prices and costs involved.

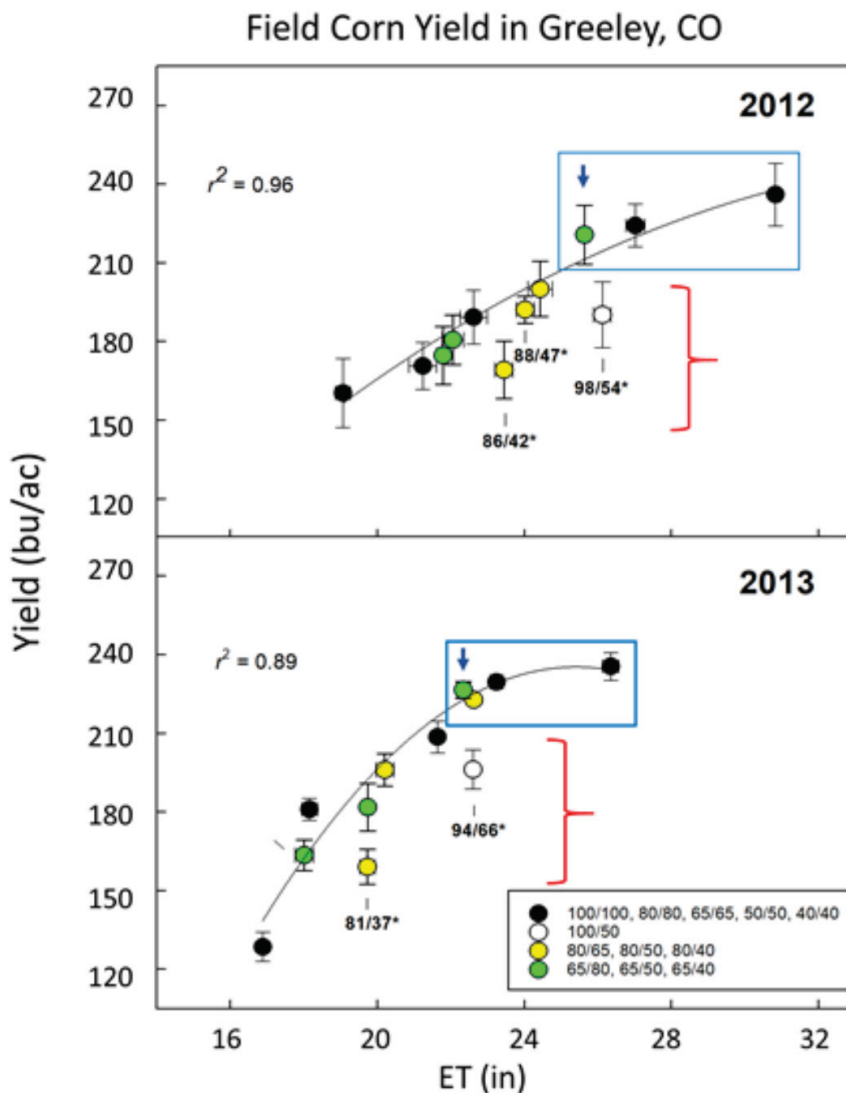


Figure 1. The relationship between harvested corn grain yield and annual evapotranspiration (ET) used by the cropping system from planting to grain maturity. Each point represents data from an average of four treatment plots. Color-coded treatments display a percentage of irrigation less than full for late vegetative period/grain fill period. Blue arrows highlight treatments with water savings (approximately 17%) that maintained full yield (treatment 65/80). Red brackets highlight treatments with similar water use but less yield due to water shortages at the end of the season during grain-filling. The numbers in bold under these points give actual ET during the targeted stress periods.

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