

North Dakota Agricultural
Experiment Station
NDSU Extension

2018 Annual Highlights



Welcome



Welcome to our 2018 Annual Highlights.

The North Dakota Agricultural Experiment Station (NDAES) and NDSU Extension contribute greatly to the economic success of North Dakota's agriculture and meeting residents' needs. I am pleased to share many of our accomplishments in the 2018 Annual Highlights.

You will read about important research that advances and sustains agriculture as North Dakota's leading economic sector. The agricultural economy faces challenges, and NDAES scientists are applying innovative technology to develop better cultivars, boost crop production levels, increase efficiencies in livestock production and management, and manage one of the state's greatest resources – its highly productive soils.

Agricultural research is a long-term investment that provides excellent returns. Our research efforts in developing new crop disease control methods, growing crops without irrigation, finding better ways to manage grasslands, improving cow herd efficiency and creating new laboratory tests to make sure grains and forages are safe to feed to livestock provide direct benefits to farmers and ranchers.

Extension's mission is to empower North Dakotans to improve their lives and communities through science-based education. Extension extends knowledge to all 53 of North Dakota's counties and the four Native American reservations through locally connected agents and the expertise of state specialists.

In this year's Annual Highlights, you will learn about Extension efforts to help producers combat weeds, deal with continued drought and cope with stress. You'll also read about a youth mentoring program and a health program targeted toward adult males in rural areas primarily working in agriculture. Other highlights include efforts to prevent North Dakotans from developing diabetes, help landowners reclaim land impacted by oil and brine spills, engage youth in STEM (science, technology, engineering and math) activities, and help water resource board members and soil conservation district supervisors be better prepared to lead watershed, conservation and community-based projects to protect water quality for future generations.

In addition, you'll learn about the new NDSU Extension Citizen Advisory Council, which serves as the eyes and ears of Extension's diverse clientele, provides Extension administration with advice and counsel on strategies and statewide impact, and helps develop a greater awareness and understanding of Extension.

I sincerely hope you enjoy reading the 2018 Annual Highlights.

Greg Lardy

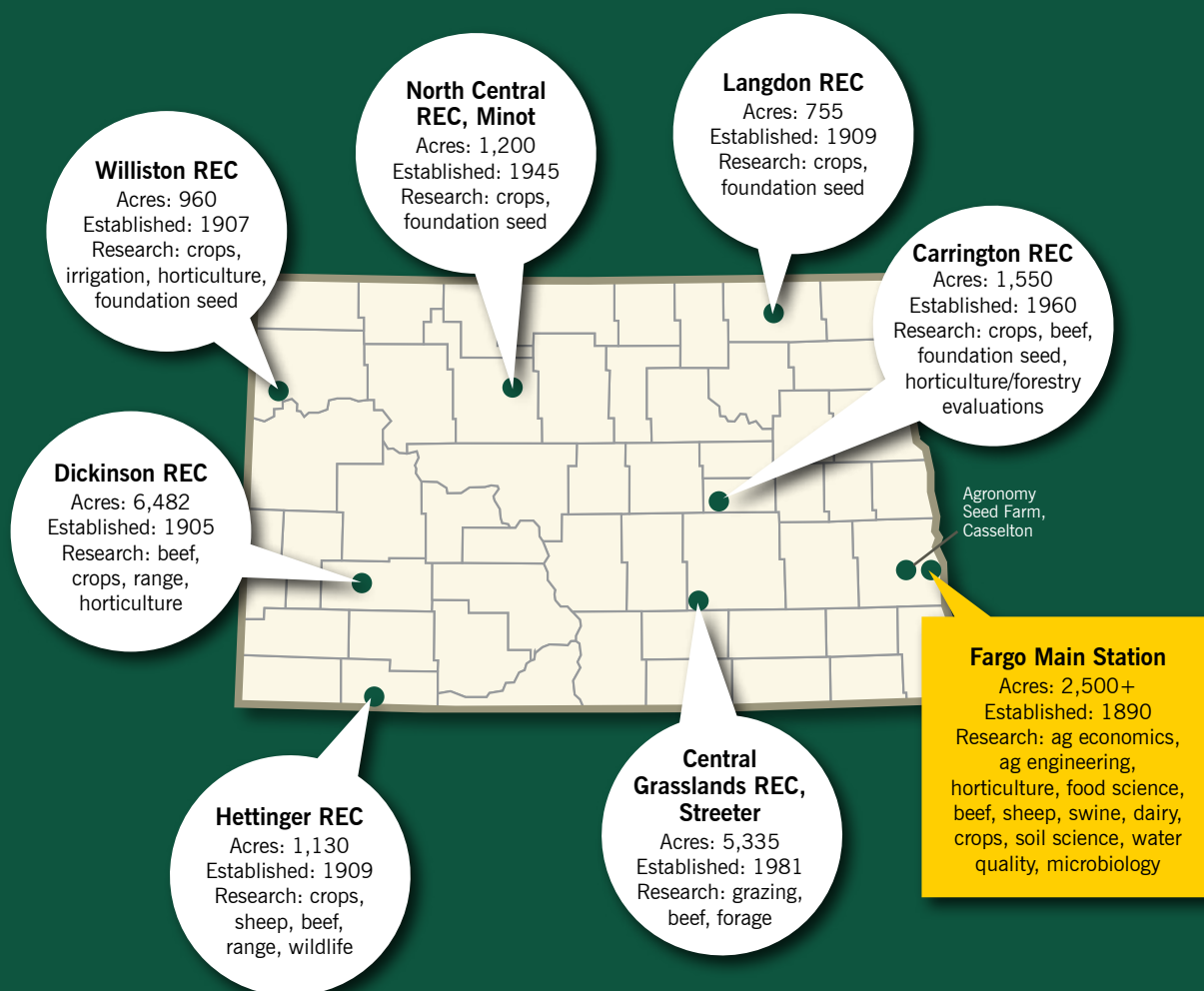
Associate Vice President, Agricultural Affairs

Interim Director, NDSU Extension

Acting Director, North Dakota Agricultural Experiment Station

NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

For the land and its people.



The NDAES has seven Research Extension Centers (REC) placed strategically throughout the state to respond to issues and challenges in a particular area, plus the Main Station in Fargo and the Agronomy Seed Farm in Casselton.

NDSU Research Leads to New Disease Control

NDSU scientists have been instrumental in developing two methods to combat diseases that cause severe damage to sunflowers. One method is a new fungicide; the other involves bees.

New Fungicide

The new seed treatment is a result of a partnership between NDSU and DuPont to find an effective fungicide for downy mildew, a disease that affects approximately 50 percent of sunflower fields every year.

Downy mildew affects sunflower plant roots and often causes seedlings to wither and die. If the plants survive, they produce little, if any, seed. To make matters worse, the pathogen that causes downy mildew developed resistance to a very effective fungicide two decades ago.

“Downy mildew is just an amazing disease,” NDSU plant pathologist Sam Markell says. “Plants infected early in the season will have zero yield, period.”

DuPont came to Markell with a new chemical, and Markell launched a research project with Ph.D. student Ryan Humann to test it. DuPont researchers knew the chemical would be effective on a certain class of pathogens, but they didn’t know if it would work specifically on the pathogen causing sunflower downy mildew, Markell says.

Humann, who grew up around sunflowers on his family’s farm near Hazelton, conducted field experiments to determine the chemical’s effectiveness and the best rate for applying it to seeds. After years of field trials, the new chemical is available to sunflower growers across the U.S. as Plenaris (Syngenta) and Lumisena (Corteva), and soon will be available in countries around the globe.

What makes this fungicide particularly significant is that it has a new mode of action, or the way it inhibits pathogens, according to Markell.

“It is a game changer for the sunflower industry,” he says.

“The sunflower industry owes a great deal of gratitude to Ryan Humann, Sam Markell and others at NDSU for being ‘difference makers’ in helping solve this very important production issue,” says John Sandbakken, executive director of the National Sunflower Association. “This work was an excellent example of what a fantastic public/private partnership can achieve when working together, making a difference for sunflower growers across the globe.”



Bees Deliver

Biocontrol agents that bees deliver to sunflowers have been effective against head rot in the plants, scientists at the North Dakota Agricultural Experiment Station's Langdon Research Extension Center found.

Head rot is a disease that causes major damage, particularly when cool and wet weather occurs when sunflowers are blooming or maturing. As its name implies, the fungal pathogen infects the sunflower head, initially making the tissue soft and spongy and eventually shredding heads and decimating yield.

"Past research on the use of fungicides to control head rot in sunflowers has been insufficient and inconsistent," says Venkat Chapara, assistant research professor at the center.

As a result, he and center research specialist Amanda Arens began studying whether bumble bees or honeybees carrying biocontrol agents to sunflowers, a process known as bee vectoring technology (BVT), would be more effective. Bees pick up the control agents as they leave the hive and deposit the control agents on sunflowers as they forage.

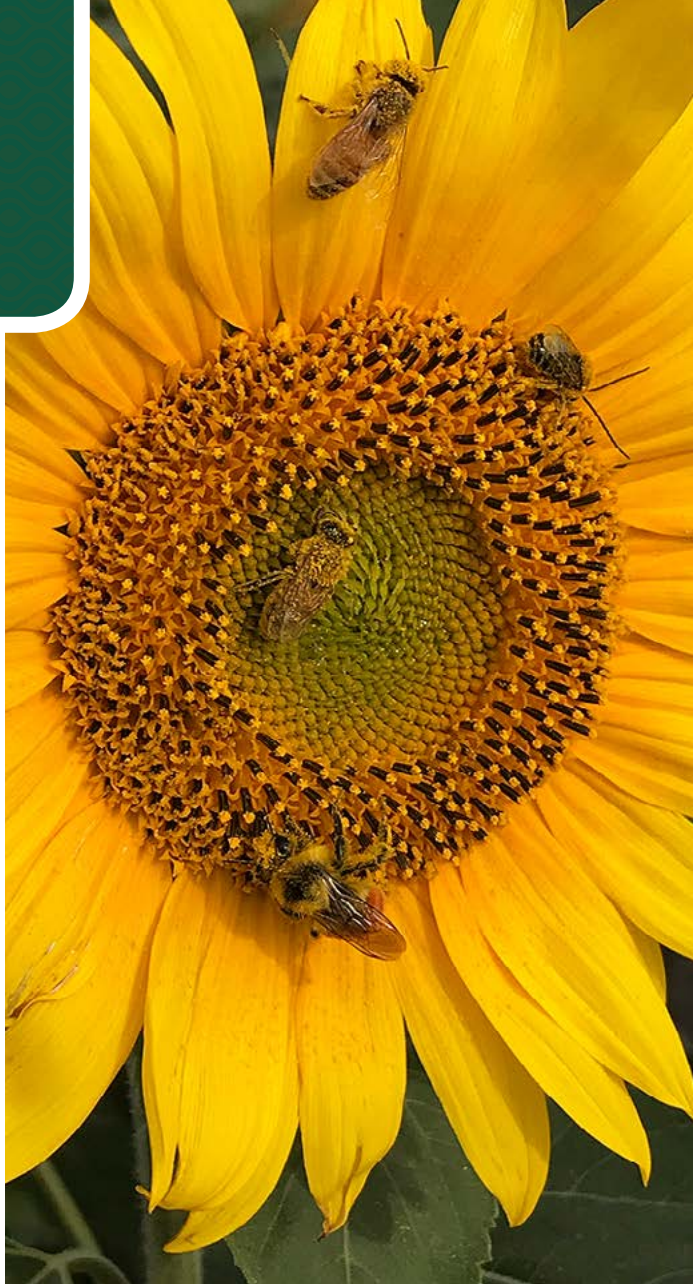
Biocontrol agents that the scientists are studying include CR-7, a strain of *Clonostachys rosea*, which is a mycoparasitic fungus.

"Using bees to vector a biocontrol agent is a very novel way to combat this very serious disease," Chapara says. "More research is needed, but early results are promising."

FOR MORE INFORMATION:

Sam Markell, 701-231-7056, samuel.markell@ndsu.edu
Venkat Chapara, 701-566-3685, venkata.chapara@ndsu.edu
www.ag.ndsu.edu/crops/sunflower

"This work was an excellent example of what a fantastic public/private partnership can achieve when working together, making a difference for sunflower growers across the globe."





Leafy Spurge Under Control



NDSU hired Rod Lym in 1979 as a two-year postdoc during the leafy spurge crisis.

At that time, the yellow-flowered perennial weed was invading several western states with no sign of stopping. Many ranchers teetered on the edge of bankruptcy because of the damage leafy spurge caused.

Lym, now a professor in NDSU's Plant Sciences Department, spent the next 39 years combatting the weed, and he has good news.

"We've stopped the expansion and are starting to reduce the infestation," he says.

Leafy spurge first was spotted in North Dakota in Fargo in 1909. It made the state's noxious weed list in 1935, when it was found in all but 10 counties.

Statewide leafy spurge control programs that NDSU and the North Dakota Department of Agriculture (NDDA) led were unable to halt its spread. The weed doubled in area every 10 years, infesting nearly 1.8 million acres by the 1980s. Its white sap is toxic to cattle and horses. Only sheep and goats can graze it.

The early emerging weed outcompetes other plants and spreads by seed and root. One stem can produce 140 seeds, and each seed remains viable in the soil for up to eight years. Roots extend to 30 feet, enabling the weed to withstand drought.

The Agricultural Experiment Stations in Montana, Nebraska, North and South Dakota, and Wyoming, with North Dakota taking the lead, launched a cooperative project following the inaugural Leafy Spurge Symposium in 1979. Lym joined the newly established task force of entomologists, range scientists, soil scientists, plant pathologists, economists, botanists and other experts from state and federal agencies.

"The problem was huge," Lym says. "We could not have done it without the cooperation of everyone."

The initial research focused on the herbicides 2,4-D, Banvel and Tordon in the 1980s.

"Tordon was \$60 an acre, and people just couldn't afford it," Lym says.

By the late 1980s, efforts shifted to biocontrol with the introduction of the flea beetle, a natural predator

successful in Europe. Establishing the beetles near Valley City and Minot, was a slow process, with no movement until a helicopter accidentally oversprayed the Minot insectary with herbicide.

"The beetles took off," Lym says. "The interaction between the herbicide and flea beetles was synergistic.

"All the Aphanthia flea beetles redistributed in North America originally came from these two sites," he adds. "The problem started in North Dakota and so did success from biological control."

In many areas, neither herbicide nor flea beetles alone could control leafy spurge. The two tools were more successful when used together, Lym says. The beetles' larvae feed on the root system, making the weed more susceptible to herbicides.

Grazing by sheep and goats is a third tool to control leafy spurge. Grazing early in the spring slows the weed's spread.

By 2004, infested acres dropped to 800,000, the lowest since 1979.

Today, a dozen herbicide options are available. The various Aphanthia beetle species work well in one-third of the state and moderately well in another third, but not in sandy, shady or flooded areas.

Flea beetles have nearly eliminated leafy spurge near Medora, since their introduction in 1999, when the weed made up 70 percent of the soil seed bank.

"When flea beetles remove leafy spurge, the native plants begin to return," Lym says.

"Dr. Lym was an invaluable asset, revolutionizing the way land managers manage leafy spurge across all boundaries," says Chad Prosser, Rangeland and Noxious Weed Program manager, U.S. Forest Service, Dakota Prairie Grassland. "Through Rod's vast knowledge of herbicides, integrated pest management and vision within the program, he exemplified the future of weed management.

"His skill in fostering a team approach is evident by his publication record, and his ability to develop relationships is unparalleled," Prosser adds. "Rod has provided excellent advice to many federal, state and local agencies, and I truly value his honesty, integrity and doing the right thing for the resource based on the science."

FOR MORE INFORMATION:

Rod Lym, 701-231-8996, rod.lym@ndsu.edu

CO₂ Could Have Role in Crop Production

The rapid increase in carbon dioxide (CO₂) concentration in the Earth's atmosphere is being blamed for a rise in the Earth's temperature.

Scientists at the NDAES Carrington Research Extension Center (CREC) wondered if the colorless, odorless gas produced by burning carbon and organic compounds could be put to good use. For two years, they've conducted greenhouse and field research to see whether applying carbonated water would benefit corn and wheat.

"Such a solution would decrease the carbon footprint of the energy industry while also improving agricultural productivity, while both sectors could demonstrate environmental stewardship and enhance their increasingly important public perception," says Mike Ostlie, a CREC agronomist and the greenhouse study's lead investigator.

On the NDSU campus, high-value crops specialist Harlene Hatterman-Valenti and her project team spent the past year investigating the effect of elevated CO₂ levels on the growth and production of leafy green vegetables. Their goal is to determine the optimum CO₂ level for maximum vegetable production and CO₂ use.

"This would enable local industries to grow local produce more rapidly by using waste byproducts from North Dakota coal," Hatterman-Valenti says.

These research projects stemmed from a collaboration of the North American Coal Corp. and Great River Energy, both based in Underwood, and Knorr Farms in Minot. They want to demonstrate the effectiveness of greenhouse agriculture and open-field carbon use in North Dakota using residual heat and flue gas from Great River Energy's Coal Creek Station power plant and CO₂ from Blue Flint Ethanol.

The research shows promise.

"The results to date suggest that there are likely benefits to introducing CO₂ to water used for crop production," says Blaine Schatz, CREC director.

Hatterman-Valenti says her team's preliminary results suggest that CO₂ enrichment increased production by as much as 77 percent in some of the leafy greens. They also found that all the vegetable cultivars had heightened carbon content in their tissues after being exposed to elevated CO₂ concentrations, indicating the greens could capture more CO₂ than they need for increased growth.

"These preliminary results suggest the inclusion of greenhouses with CO₂ enrichment in the North Dakota landscape could result in turning wasted carbon into edible products and regional production opportunities," she says.

CREC Field Study

"The project will address questions regarding the feasibility of applying carbonated water to corn fields as a way to increase yields and to mitigate emission of CO₂ to the atmosphere," explains Paulo Flores, the CREC's precision agriculture specialist and lead investigator on this study.

CREC scientists are evaluating corn's response to carbonated water in surface and subsurface irrigation systems. They've also been measuring how much CO₂ returns to the atmosphere from the soil to estimate the irrigation systems' efficiency in retaining CO₂ in the soil. Their third objective is to evaluate the changes in soil pH (acidity or alkalinity) due to irrigation with carbonated water.

CREC Greenhouse Study

The scientists are evaluating corn and wheat's response to water with three different CO₂ concentrations with and without mulch to see if mulch will slow CO₂ loss from the soil.

"For this study, the primary indicator of success will be whether there is greater dry-matter accumulation at the end of the trial period," Ostlie says.

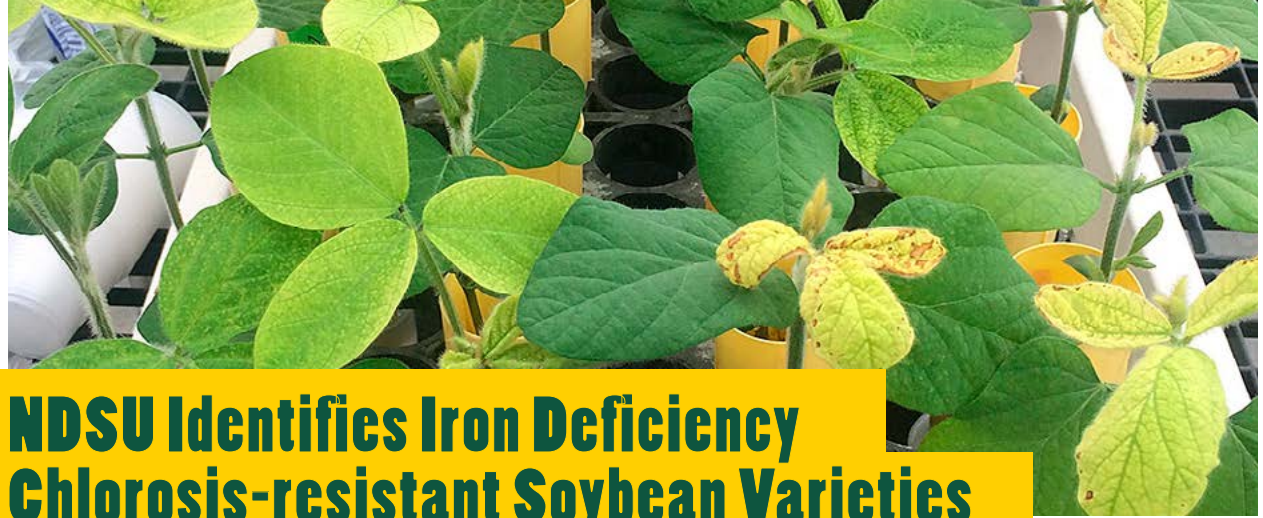
The scientists also use remote sensing equipment to collect thermal and color images from the plants to detect possible effects of the different treatments on plant health.

"The challenge has been to dissolve the CO₂ gas effectively into the water being used," Schatz says. "If techniques can be advanced that address the issue of dissolving CO₂ gas effectively and efficiently into a water supply, we would look forward to continuing these investigations."

FOR MORE INFORMATION:

Mike Ostlie, 701-652-2951, mike.ostlie@ndsu.edu
Paulo Flores, 701-652-2951, paulo.flores@ndsu.edu
Harlene Hatterman-Valenti, 701-231-8536, h.hatterman.valenti@ndsu.edu
www.ag.ndsu.edu/carringtonrec





NDSU Identifies Iron Deficiency Chlorosis-resistant Soybean Varieties

Each year, North Dakota soybean producers lose a portion of their yield to iron deficiency chlorosis (IDC).

Two NDSU scientists are on the front line in the battle against IDC. Soybean breeder Ted Helms evaluates commercial varieties for resistance to IDC in field trials. Soil scientist R. Jay Goos works to reduce the deficiency's impact by evaluating iron fertilizers. He also is in the process of developing a rapid greenhouse test to determine which varieties offer the most resistance.

"Finding a chlorosis-resistant variety has always been the No. 1 priority," Goos says. "There is no fertilizer, foliar spray or other cultural practice that can turn a weak variety into a strong one."

Soybeans grown on alkaline soils with a high water table are more susceptible to IDC. Iron is abundant in all North Dakota soils, but soybeans have a difficult time taking up enough, especially early in the growing season.

Unlike most other nutrient deficiencies, IDC strikes the youngest tissues first, turning the tissue between the leaf's veins yellow.

"Plants can become horribly stunted and never recover," Goos says.

Twenty years ago, soybean varieties had a commercial lifespan of five years or more. Today, new varieties are released about every three years. With new products released regularly on the market, NDSU's research assists seed companies and dealerships in finding the most resistant varieties for land prone to IDC. The disorder affects the North Central region, which includes eastern North Dakota, western Minnesota and north-central Iowa.

Goos is developing protocols for the rapid greenhouse test at the Agricultural Experiment Station Research Greenhouse Complex on the NDSU campus. Soybeans are grown in a mixture of sand and alkaline soil, and subirrigated with solutions that intensify the severity of IDC so that resistant varieties can be separated from susceptible varieties. The goal is to develop a rapid test that will determine within four weeks whether a soybean variety will be IDC-resistant.

"After the protocol is finalized, hopefully this fall or winter, I hope to run a small pilot program with one or two local retail dealerships to determine if our test agrees with their observations in 2019," Goos says.

If planting an IDC-resistant variety isn't enough to prevent chlorosis, soybean producers should add a second level of defense of an in-furrow application of an effective iron fertilizer or planting in wider rows with heavier seeding rates. The third level of defense is to use all three strategies together.

"Sometimes, it does take all three control measures to reduce IDC to acceptable levels," Goos says.

He describes Colfax as ground zero for IDC in soybeans in North Dakota. In 2017, he and Chandra Langseth, NDSU Extension's agriculture and natural resources agent in Richland County, formed the Colfax Chlorosis Club with Colfax Farmers Elevator agronomist Chelsea Pizel to help hard-hit soybean producers.

"Dr. Goos has been studying IDC for the majority of his career, and he brings a wealth of knowledge to the club," Pizel says. "He coordinates a lot of research with varieties. We realize that variety selection is probably the No. 1 strategy in battling IDC. There are other avenues we've been exploring, such as cover crops and chelated iron products."

In the winter, club members learn about NDSU's variety trials, field-specific best management practices and implementation strategies. Members commit to trying a new strategy in their toughest fields. A field tour held in the summer when IDC is most prominent allows members to see the experiments.

The club meets again in the winter to consider what to try the next year.

"We have a blunt discussion of what works and what worked for a while," Goos says. "We pool our knowledge."

The North Dakota Soybean Council supports Goos' and Helms' research on IDC.

FOR MORE INFORMATION:

R. Jay Goos, 701-231-8581, rj.goos@ndsu.edu
Ted Helms, 701-231-8136, ted.helms@ndsu.edu



U.S. Wheat and Barley Scab Initiative Making a Difference

The U.S. Wheat and Barley Scab Initiative has made a positive impact in North Dakota and throughout the U.S.

The national multi-disciplinary, multi-institutional research system develops control measures to minimize the threat to wheat and barley from fusarium head blight (also known as scab) and deoxynivalenol (DON), a mycotoxin associated with scab. Since 1997, scientists from NDSU and other universities throughout the U.S., the U.S. Department of Agriculture's Agricultural Research Service and private companies have worked closely with producers, input providers, millers and food processors to reach that goal.

Their efforts resulted in an estimated savings in hard red spring and winter wheats, soft red wheat, durum and barley of \$9.6 billion from 1997 through 2014 nationwide, according to a study William Wilson, distinguished professor in NDSU's Agribusiness and Applied Economics Department; department chair William Nganje; research scientists Dean Bangsund and Bruce Dahl; and former colleague Greg McKee conducted. North Dakota saw a \$1.1 billion economic gain from scab reduction during that period.

Scab and DON cause major problems, including yield losses and market discounts for excessive DON in grain, forcing producers to use more costly management practices. As a result, some producers have shifted to growing less risky crops. Scab and DON also impact other parts of the supply chain by raising costs for testing and cleaning grain, and breeding resistant wheat and barley varieties.

Each year, NDSU scientists on campus and at the NDAES Research Extension Centers across the state are involved in research funded through the initiative. The scientists have developed some of the nation's top scab-resistant crop varieties. They've also been instrumental in determining ways to use fungicide to combat scab successfully, evaluating the effects of cropping practices on scab, finding new disease resistance sources, and pioneering gene discovery and transformation.

The authors of the scab initiative's impact study say that of the risk mitigation tools developed as a result of the initiative, two are particularly significant.

"One is fungicide use, which has increased from virtually nil in the 1990s to being applied to 70 to 80 percent of the cereals area planted in recent years," Wilson says.

The development and adoption of resistant varieties is the other key mitigation factor.

"Fungicide and resistant varieties are complementary and have an interdependent impact on reducing DON," Wilson says.

The study's authors also found that the scab initiative is very cost effective. The initiative spent \$76 million from 1997 through 2014, which resulted in a net savings of nearly \$5.4 billion from

reduced production. That is \$71 in benefits for every \$1 invested.

"This is significant and compares very favorably to other studies on agriculture research," Nganje says. "The return on investment for expenditures on the scab initiative (including in-kind costs) is in the area of 34 percent, which is substantial."

FOR MORE INFORMATION:

William Wilson, 701-231-7472, william.wilson@ndsu.edu
William Nganje, 701-231-8587, william.nganje@ndsu.edu
<http://ageconsearch.umn.edu/record/264672>

"The return on investment for expenditures on the scab initiative (including in-kind costs) is in the area of 34 percent, which is substantial."



Research Improves Rangeland for Livestock,

Kentucky bluegrass, an aggressive non-native perennial grass, is displacing North Dakota's mixed-grass prairie species and altering its ecosystem, and NDSU scientists are studying its impact and how to control it.

This collaborative effort involves on-campus scientists and the NDAES Central Grasslands Research Extension Center (CGREC) near Streeter. For example, Caley Gasch, soil scientist in the School of Natural Resource Sciences (SNRS), is evaluating Kentucky bluegrass's impact on water and soil at the center. Ryan Limb, range scientist in the SNRS, is analyzing how Kentucky bluegrass at the center responds to grazing management strategies such as patch-burn burning and intensive grazing early in the growing season.

"If we can determine how Kentucky bluegrass changes soil function and health, then we can determine management strategies that best enhance plant community function while sustaining our livestock herd," says Kevin Sedivec, the CGREC's interim director.

On-campus scientists also work with the CGREC on other range and soil issues affecting livestock and wildlife. Devan McGranahan, range scientist in the SNRS, is researching the impact of rotational patch-burn grazing on forage and vegetation, while Torre Hovick, another range scientist in the SNRS, is assessing the influence of two types of patch-burn

grazing and season-long grazing without fire on the butterfly community. Hovick also is studying the impact of patch-burn grazing on bird nesting and breeding.

Patch-burn grazing is a grasslands management strategy that involves burning a portion of prairie. Livestock concentrate their grazing on the new growth in that patch, allowing previously burned and unburned patches to recover.

In related research, scientists from the Hettinger Research Extension Center (HREC) and Range Sciences Program are analyzing the impact of patch-burn grazing on pastures previously enrolled in the Conservation Reserve Program (CRP) when sheep or cattle are the main grazers.

"While the use of cattle in a patch-burn grazing format has been previously evaluated elsewhere, no information exists concerning sheep performance and grazing preference in a patch-burn grazing management strategy, making our research in western North Dakota novel," says Ben Geaumont, HREC wildlife and range research assistant professor.

"In addition to livestock performance, hunting and beekeeping are also important aspects of our local economies, so we also spend a fair amount of time evaluating how ring-necked pheasant, sharp-tailed grouse, ducks and pollinators are using our pastures," he notes.



Wildlife, Pollinators

The scientists also overseed native forbs into areas burned the previous year to see if they can increase species diversity in post-CRP grasslands.

“While the data we are collecting will be crucial in determining if there is potential for a patch-burn grazing system to be deployed on post-CRP, the act of putting fire on the ground has also been a positive because if we expect producers to implement a patch-burn grazing system on their lands, we will have to show that prescribed fire can be done in a safe manner,” Beaumont says.

Preliminary results from Gasch’s study indicate that Kentucky bluegrass dominance and land management practices may play a role in soil water infiltration.

“Soil water infiltration, in turn, affects plant growth and, thus, nutritional value for grazing livestock,” she says. “Future research will help provide important characterization of soil properties, water dynamics and the rebounding nature of these grassland ecosystems following a fire disturbance.”

Limb’s preliminary research indicates prescribed burns may be an effective management tool on Kentucky bluegrass invasion, but that may not be enough.

“Research has shown that burning alone can reduce Kentucky bluegrass for a year, but a return to preburn levels the following year suggests that additional disturbance is necessary,” he notes.

McGranahan found the livestock in his study prefer grazing in the recently burned patches, even though those areas have less forage available, which is good news.

“Although patches are intensively grazed for a season, the subsequent seasons of rest ensure the long-term sustainability of the forage base,” he says.

Hovick found the patch-burn grazing also seems to increase the number of butterflies and butterfly species. Patch-burn grazing also can benefit birds by providing a diversity of habitat, he says.

Sedivec recently initiated another study to evaluate the effects of patch grazing without the fire. The new study will mimic patch burning through different grazing intensities.

“If we can modify the grazing intensity across a pasture to create heavy use, full use and light to no use without fire, maybe we can negatively impact Kentucky bluegrass while enhancing native broadleaf and grass production,” he says.

FOR MORE INFORMATION:

Kevin Sedivec, 701-424-3606, kevin.sedivec@ndsu.edu
Ben Geaumont, 701-567-4323, benjamin.geaumont@ndsu.edu
www.ag.ndsu.edu/centralgrasslandsrec



NDSU Helps EPA Survey State's Wetlands

The U.S. Environmental Protection Agency surveys the nation's coastal waters, rivers, streams and lakes every five years to track their integrity.

When the EPA decided to start assessing the nation's wetlands, it turned to NDSU scientist Shawn DeKeyser to develop vegetation protocols. He worked with a team of leading national experts to develop assessment methods that would be statistically relevant whether the wetlands were in woodlands or grasslands.

Wetlands are characterized by the presence of water for two weeks or longer, soil that's been changed by the water and plants that have adapted to thrive in the water, explains DeKeyser, who is NDSU's Natural Resources Management Program leader.

Once the protocols were established, the EPA randomly selected 1,179 sites nationwide for its National Wetland Condition Assessment (NWCA) in 2011. It targeted 11 North Dakota sites in the Prairie Pothole Region, which extends from central Canada to central Iowa.

The region is of great interest to the EPA. It comprises 10 percent of North America's waterfowl breeding grounds and produces 50 percent or more of its waterfowl annually, DeKeyser says. More than half of its potholes have been drained for agricultural or commercial development.

In addition to the EPA reporting on the condition of the nation's wetlands, the North Dakota Department of Health's Division of Water Quality monitors and reports on the state's wetlands to the EPA. NDSU collaborated with Mike Eil of the Water Quality Division and soil scientists with the Natural Resources Conservation Service (NRCS) in the assessment. NDSU and its partners intensified the effort by adding roughly 40 additional sites to the NWCA in 2011. They used three region-specific assessments that DeKeyser developed to enhance state data.

NDSU led the field efforts in sampling vegetation, with the NRCS sampling soil and the Health Department sampling water. DeKeyser, along with NDSU scientists Christina Hargiss, Jack Norland and Tom DeSutter, and a small group of graduate students, sampled vegetation from early July until the start of the fall semester.

The team needed to obtain permission to conduct assessments because the randomly chosen sites were all on private property.

"It took eight to nine months to contact landowners," DeKeyser says. "We called, knocked on doors and mailed letters. Getting permission took more time than the actual surveys."

He praises the landowners' willingness to allow the assessments.

"There are really good people in North Dakota," he says.

The EPA conducts the NWCA every five years. In 2016, NDSU and its partners collaborated with the NWCA and once again added roughly 40 survey sites.

In addition to providing critical habitats for migratory waterfowl and other wildlife, wetlands are able to clean water as plants adapt to take in and trap nutrients and chemical contaminants, DeKeyser says. They provide nutritious forage for cattle and wildlife. In times of flooding, wetlands help slow water moving across landscapes, reducing flooding's impact.

The 2011 and 2016 NWCAs, along with the intensified state assessments, represent the first quantitative assessment of the wetland condition. The data provide a baseline to evaluate trends in the quality of wetlands.

"As wetlands are degraded, our rivers and streams and lakes are degraded because those wetlands serve as a buffer for protecting those other resources," Eil says. "That's why NDSU's work is so important. It provides valuable information to policymakers and the public on the condition of the state's wetlands."

"We know a lot about wetlands, in terms of acres lost through drainage or development or gains through restoration, but very little about the quality of our remaining wetlands or how well they are performing important ecological, hydrological and water quality functions," he adds.

The information will help NDSU and its partners determine if they are going in the right direction with wetland restoration and land management practices, DeKeyser says.

"There are better ways we can manage the land and still be profitable in other aspects for the land to become a better habitat for wildlife and to better manage to clean water while still getting agricultural products off the land," he notes. "I think this is one step in that direction."

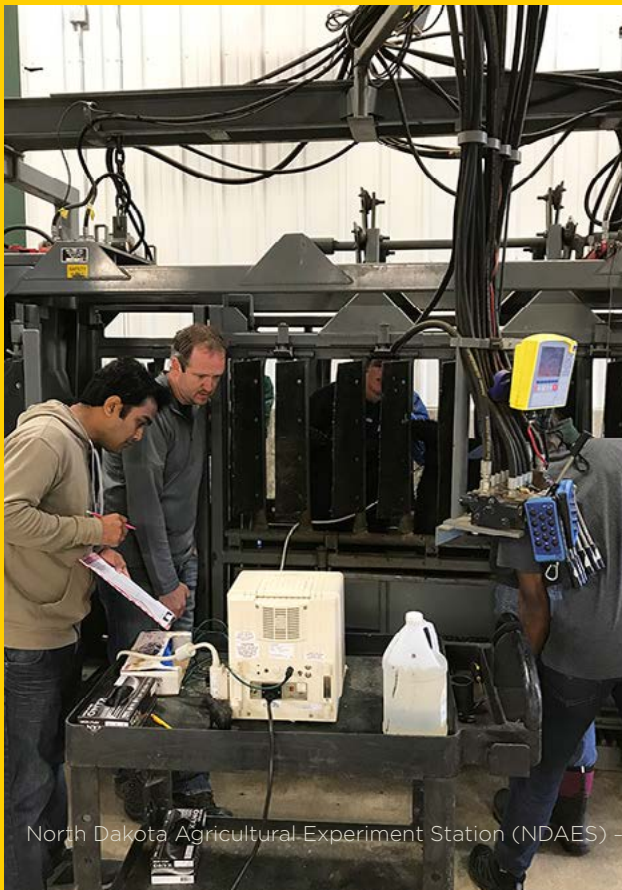
FOR MORE INFORMATION:

Shawn DeKeyser, 701-231-8180, edward.dekeyser@ndsu.edu



“NDSU’s work provides valuable information to policymakers and the public on the condition of the state’s wetlands.”





Efficiency Key to Cattle Profitability

Just what is the right cow size?

That's a question NDSU scientists are working to answer through studies such as the one Lauren Hanna, an assistant professor in the Animal Sciences Department, is leading. Hanna, professor Kendall Swanson and associate professor Carl Dahlen, in collaboration with associate professor and Extension veterinarian Gerald Stokka and livestock scientists at the NDAES Dickinson Research Extension Center (DREC), are evaluating how a cow's frame size affects beef production factors such as feed needs and reproduction, as well as early indicators of longevity.

They also are collecting genomic data that could help producers select animals with desirable traits for breeding.

"Efficiency and profitability in the production of meat animals is key to producers within North Dakota, across the U.S. and worldwide," Hanna says. "Without sustainable and efficient production practices, there is concern that agricultural production may not meet demands in the next 50 years due to the ever-increasing human population."

For the past four years, the scientists have conducted summer feed trials at NDSU's Beef Cattle Research Complex (BCRC) in Fargo on 1-year-old heifers of differing frame sizes from the DREC. Preliminary data can provide information on issues such as how much feed cows of varying sizes need, what pastures to place them on and what size calves the cows will produce, which can help producers decide on the right type and number of cattle to fit their operating system and goals, Hanna says.

Swanson says that among their findings so far, larger cattle appear to be more efficient at using feed for growth, while smaller cattle wean more calf for their weight.

While the cows are at the BCRC, they are bred to various sized bulls, and the pregnant cows get sent back to the DREC for the winter. The scientists

"Efficiency and profitability in the production of meat animals is key to producers within North Dakota, across the U.S. and worldwide."

continue to track the cows while they are at the center for traits such as good udder conformation, calving ease and temperament.

The scientists plan to have the cows go through the study again in 2020 to compare the mature cows' performance with their performance as heifers.

This study is a continuation of research on cow size and efficiency issues the DREC has been conducting since the mid-1990s. In 2008, the center created two cow herds to help with this research.

One herd consists of smaller-framed cows for range research projects and the other has moderate-framed cows for beef research. The smaller-framed cows have a mature body weight of about 300 pounds less than the larger-framed cows when the calf is weaned. Scientists have looked at issues such as calving ease, growth and calf weight as a percentage of the cows' weight.

"From a cow-calf perspective, looking at biological efficiency, the calves from the larger cows have an advantage when a cattle system is evaluated based on calves as the unit of production," says Kris Ringwall, DREC director emeritus. "From the same cow-calf perspective, looking at economic efficiency, the calves from the smaller cows, based on acres as the unit of production, have an advantage.

"As the center continues to evolve and explore thoughts regarding the efficiency of the beef cow, more and more pieces will evolve," he adds. "Putting the pieces in play within the industry is not easy. But for now, finding the pieces that fit is good."

FOR MORE INFORMATION:

Lauren Hanna, 701-231-7636, lauren.hanna@ndsu.edu

Kendall Swanson, 701-231-6502, kendall.swanson@ndsu.edu

Dryland Cropping Research Finds Promising Strategies

Northwestern North Dakota is semiarid, receiving an average of only 15 inches of rain a year, which makes growing crops difficult.

Scientists at the NDAES Williston Research Extension Center (WREC) conduct dryland and irrigated cropping research to find ways to increase agricultural productivity in the area while conserving natural resources. One project is dryland cropping research they started in 2013 in collaboration with researchers from the U.S. Department of Agriculture – Agricultural Research Service’s Northern Plains Agricultural Research Laboratory in Sidney, Mont.

They are developing agricultural systems that improve soil health, crop production, precipitation use and the economic stability of no-till dryland (without irrigation) farming in the northern Great Plains.

“This 20-year project will comprehensively describe the changes in soil health, moisture, chemistry and microbiology that result from adoption of cover crops and diverse crop rotations under no-till management in dryland agriculture in western North Dakota,” says Jerry Bergman, WREC director. “It is hoped that this project will increase adoption of these practices so that the next generation of farmers can manage profitable, resilient and sustainable operations in western North Dakota.”

Several researchers from multiple disciplines are involved in this project. The crops they are studying include cool- and warm-season grasses, broadleaves and cover-crop mixes. They also grow durum in one of the crop rotations each year to serve as a comparison.

The scientists measure:

- Crop performance, such as grain yield, protein or oil content, total dry matter, above-ground biomass production and water use
- Soil quality, such as water infiltration, aggregate ability, bulk density, salinity and plant-available levels of nitrogen, phosphorus and potassium
- Incidence of diseases, insects and weeds
- Soil health, such as microbial biomass carbon and potential carbon mineralization (the active fraction of carbon in the soil) because high levels are associated with a healthy soil, and the presence of beneficial fungi that colonize plant roots and help the plant with nutrient and water uptake
- Water use efficiency of durum in different crop sequences
- Yield, quality and economic returns of crops under different crop rotations

Preliminary results show that a cropping sequence of durum followed by a fallow season, then durum and another fallow season is the least favorable for semiarid, no-till growing conditions. The cropping sequence with the next lowest return is durum followed by winter wheat and a cover-crop mix seeded after harvesting winter wheat, then peas and a cover-crop mix seeded after peas in the fall, followed by corn and then safflowers.

“The low economic return of the latter cropping sequence was the failure of the fall-seeded cover crops to establish in two out of four years,” Bergman says.

Scientists also found that the microbial biomass carbon was significantly higher in safflowers than corn, and the potential carbon mineralization also was significantly higher following the safflower crop than after winter wheat, durum or a fallow period. The beneficial fungi populations were highest in perennial grasses and lowest in the fallow period.

“The practice of no-tillage, diverse crop rotations and adoption of cover crops are promising strategies to preserve soil moisture and overall health in these systems by changing exposure to wind and sun and by feeding the soil microbiome to improve soil nutrient cycling and increase soil organic matter,” says Audrey Kalil, WREC plant pathologist and dryland cropping research team member.

FOR MORE INFORMATION:

Jerry Bergman, 701-774-4315, gerald.bergman@ndsu.edu
www.ag.ndsu.edu/WillistonREC/dryland-research-1



NDSU Scientists Evaluating Cold-hardy Grapes

Growing wine-worthy grapes in North Dakota is no easy feat.

Winters are long and often brutal. Growing seasons, especially in the northern part of the state, are short. Native grapes lack favorable wine characteristics.

That's why the North Dakota Grape and Wine Program Committee turned to the NDAES to produce a cold-hardy grape cultivar that could survive the state's winters. The North Dakota Legislature established the committee in 2009 and granted it \$250,000 for grape and wine research, promotion, education and marketing.

In 2013, scientists at the NDAES North Central Research Extension Center (NCREC) near Minot, began planting hybrid lines made from cold-hardy and commercially available varieties. The goal is to produce at least one red and one white wine grape that are cold-hardy and competitive in the industry. Each of the 5,000 vines came from hand-pollinated seeds, says Chris Asmundson, NCREC agricultural research technician.

"The ideal variety must have early bud break and grow a sizeable amount of fruit that ripens prior to frost," says Shana Forster, NCREC director. "The average frost-free time period in Minot is 125 days."

Research so far has been promising, but developing new cultivars is a long-term effort, according to Asmundson.

The evaluation process can take up to five years before a vine is capable of producing enough grapes to make a small batch of wine for evaluation. The NCREC does not have an alcohol production license, so it partnered with North Dakota's first winery in nearby Burlington. This year, Pointe of View Winery owner Jeff Peterson provided his license, guidance, expertise and space at his facility for the NCREC to make its experimental batches of wine.

During the winter, a wine test panel will sample and evaluate the wines based on industry standards for color, flavor and aroma. After a grape produces good-quality wine, scientists need to do further research to determine whether the vine is capable of consistent grape production.

A grape that can be grown successfully in Minot would be able to thrive anywhere in the state, Forster says.

NDSU also is conducting cold-hardy grape research near Absaraka. Harlene Hatterman-Valenti, professor and high-value crops specialist, began her work there in 2011 with initial grape crosses. Each environment enables researchers to evaluate different growing conditions.

More than 19 licensed wineries operate in the state and use North Dakota-grown fruit when possible.

"Most winemakers want to be able to grow grapes from their region," Peterson says.

Once NDSU patents a successful grape variety, it could be sold to nurseries in other cold-climate states, Forster says. Proceeds would fund continued research in North Dakota.

The patenting process is in its early stages on a few promising lines, Asmundson says. Collecting the required data at every stage of growth could take up to three years.

Wineries are an important part of the state's growing agricultural tourism and function as destination businesses.

"There is passion in our industry," Peterson says. "We are watching to see what grapes will become available in the state."

FOR MORE INFORMATION:

Shana Forster, 701-857-7677, shana.forster@ndsu.edu
Harlene Hatterman-Valenti, 701-231-8536,
h.hatterman.valenti@ndsu.edu
www.ag.ndsu.edu/northcentralrec





New Tests Will Make Livestock Feed Safer

New tests NDSU Veterinary Diagnostic Laboratory (VDL) scientists are developing will help determine whether grains and forages are safe to feed to livestock.

Wet conditions in this region and elsewhere in the U.S., as well as no-till and organic farming practices, have resulted in an increase in ergot, a fungal disease that can develop in crops. Ergot contains alkaloids (organic compounds of fungal origin) that are toxic to livestock.

Ergot is common in cereal grains such as wheat and rye, according to VDL director Brett Webb.

“We’re seeing it in forages as well, such as timothy and bromegrass,” he says.

Depending on the type of ergotism, symptoms in livestock include the death of cells in the tip of the ears, tail and tongue, and the area just above the hoof; lameness; poor body temperature regulation; decreased feed intake; and low weight gain and milk production.

Kelly Benson, a chemist at the lab, has spent the last year working on a method to test for the main ergot alkaloids, as well as their alternate forms, or isomers, in cereal grains and grasses using the liquid chromatography-mass spectrometry technique.

Testing of isomers is critical to accurately determine the risk of toxicity because

alternate isomers can increase during grain storage, scientists say. The lab received a U.S. Food and Drug Administration grant to help develop and validate the assay. NDSU’s VDL will be the first to offer testing for both forms of ergot alkaloids.

“Given the way the weather has been going, we’ve got to look at some of these problems,” VDL toxicologist Michelle Mostrom says.

VDL scientists also are developing more sensitive tests to detect mycotoxins in stored grain. Mycotoxins are toxic compounds produced by certain types of molds, and they can affect the liver and kidneys in livestock and humans.

Mycotoxins are especially a problem now because producers are having to store their grain in less-than-ideal places, such as piles and bags on the ground, as a result of trade disputes that limit their ability to sell their grain for the export market, Mostrom says. The piles can get wet and bags can be damaged, letting in moisture, which leads to mold development in the grain.

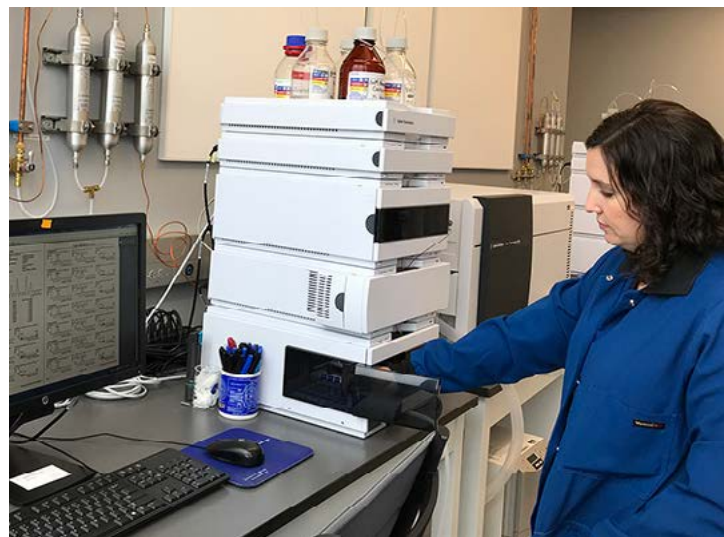
The new mycotoxin tests also can help producers decide what to include in their livestock’s feed rations, Webb says. Today’s producers are feeding many more components and byproducts than just hay.

FOR MORE INFORMATION:

Brett Webb, 701-231-5271, brett.webb@ndsu.edu

Michelle Mostrom, 701-231-7529, michelle.mostrom@ndsu.edu

www.vdl.ndsu.edu



NDSU Releases New Crop Varieties

The NDAES released two new crop varieties in 2018: ND18008GT soybean and ND Hammond flax.



ND18008GT Soybean

NDSU's soybean breeding program developed ND18008GT. It's a glyphosate-resistant soybean variety with a relative maturity of 00.8, which makes it a good fit for the northern growing areas of North Dakota.

This variety is tolerant to soybean aphid and resistant to race 4 of phytophthora root rot. It is sensitive to metribuzin herbicide.

ND18008GT was developed with funding from the North Dakota Soybean Council.



ND Hammond Flax

NDSU's flax breeding program developed ND Hammond. It is a brown-seeded flax variety that is adapted to the north-central flax-growing region of the U.S.

ND Hammond has high yield potential and medium maturity. It also has good oil drying quality and resistance to flax wilt.

The variety was named in honor of longtime NDSU flax breeder James Hammond, who made significant contributions to flax research.



ND Eagle Lentil

Seed was available for the first time in 2018 for ND Eagle, the NDAES 2016 lentil release.

NDSU's pulse breeding program developed ND Eagle. It is an Eston-type small green lentil that has excellent agronomic performance.

The variety has high yield potential in North Dakota environments and is similar to CDC Viceroy. ND Eagle also has high seed quality, with no observations of speckled variants.

To ensure genetic purity, these varieties are protected under Plant Variety Protection Title V and must be sold as a class of certified seed.

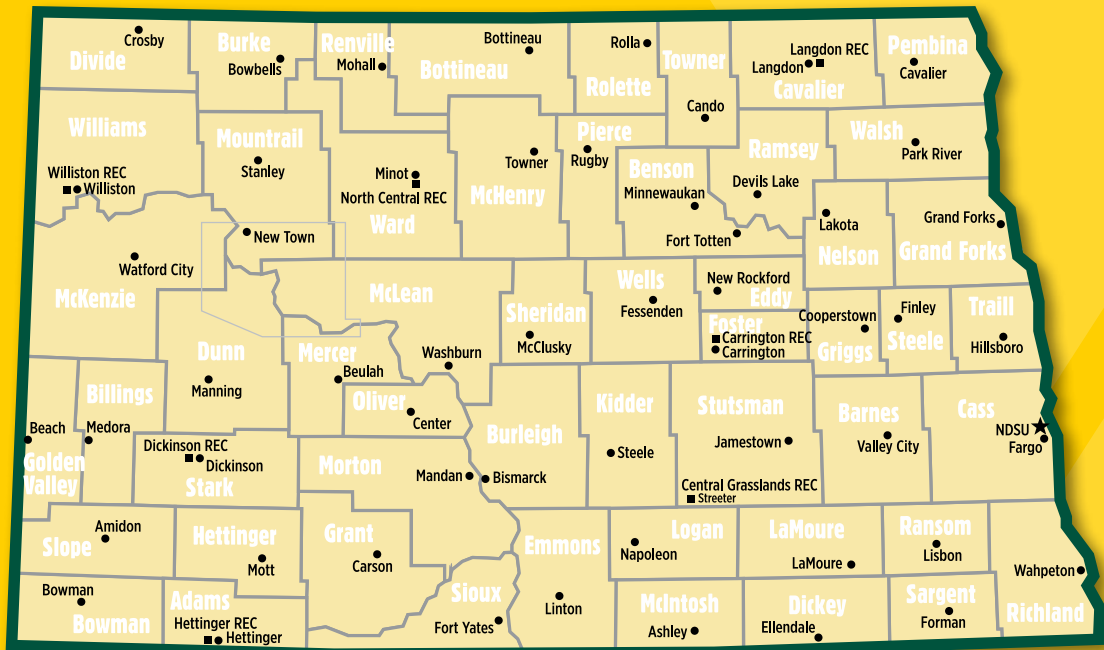
FOR MORE INFORMATION:

Richard Horsley, 701-231-8142,
richard.horsley@ndsu.edu

NDSU

EXTENSION

Extending knowledge. Changing lives.



NDSU Extension Offices



Producers Battle Weeds With Extension's Help



Identifying weeds is the first step in controlling them, especially Palmer amaranth, a very aggressive weed found in North Dakota for the first time in 2018.

“Early identification of Palmer amaranth is important to make sure we catch it before it gets a chance to grow or spread,” says Alicia Harstad, an NDSU Extension agent in Stutsman County.

“Study images of the plant to give yourself some familiarity with its appearance,” advises Beth Burdolski, an agent in Burleigh County. “Scout your fields, pastures and gardens for plants that might be Palmer amaranth.”

However, Palmer amaranth can be difficult to identify because it resembles other pigweeds, so Extension developed a website and posters to help distinguish it from other plants, and provided recommendations for chemical control.

“Ideally, these weeds should be pulled and removed from the field,” says Brian Jenks, weed scientist at the NDAES North Central Research Extension Center. “However, we may not see every Palmer amaranth plant. Although a preharvest burn-down in soybeans is not common, it may stop or reduce seed production of plants that were missed.”

Many Troublesome Weeds

Palmer amaranth isn't the only concerning weed. Extension specialists involved with weed issues have named stinkgrass the weed of the year for 2019. Like Palmer amaranth, it's difficult to control.

Other worrisome weeds include kochia, waterhemp, marehail and common ragweed because of their resistance to glyphosate, one of the most widely used herbicides in the U.S. To make matters worse, other herbicides may not work well, either.

“Pesticides that are used in other states aren't necessarily good North Dakota choices because of the various other crops planted in the cropping sequence,” says Tom Peters, Extension sugar beet specialist. “Also, the switch to no-till or conservation-tillage practices has placed more emphasis on chemical control that has resulted in more or different weeds in certain situations.”

For instance, common ragweed is a bigger weed control challenge because soybean production has replaced wheat acres, where ragweed is easier to control. Waterhemp, a member of the pigweed family, is believed to cross-pollinate with native pigweeds, allowing it to adapt to the state's environment.

To combat the growing weed problem, agents and specialists work with producers to determine which control methods, whether chemical (herbicides), mechanical (tillage) or cultural (planting cover crops), or combination of them are the best options.

Extension's Weed Management Education Committee developed a training program for agents. It includes weed management options and a website to help agents identify weeds in a producer's field or plants producers bring them. Agents also receive

weed seeds to grow for “show and tell” at pesticide training programs they conduct.

“The living weed exhibit at the NDAES Carrington Research Extension Center and greenhouse-grown weeds provide agents with other opportunities to see and share with farmers what weeds look like,” says Greg Endres, Extension cropping systems specialist at the center.

New Approaches in Western N.D.

Clair Keene, Extension cropping systems specialist at the NDAES Williston Research Extension Center, is very concerned about herbicide-resistant weeds in western North Dakota.

“I think we are close to losing our ability to select which crop to plant based on price,” she warns. “We will soon have to select crops based on whether or not we can control the weeds.”

She encourages producers to consider light cultivation, but not plowing, in the fall or spring to control winter annual weeds such as narrowleaf hawksbeard, also called false dandelion, which has become very troublesome. She suggests planting cover crops such as sweet clover in wheat to suppress weeds in the fall and spring, and planting a full-season cover crop and baling it in the fall to combat summer annual weeds.

“The truth is that we need a different approach,” Keene says.

FOR MORE INFORMATION:

Tom Peters, 701-231-8131, thomas.j.peters@ndsu.edu
Brian Jenks, 701-857-7677, brian.jenks@ndsu.edu
Greg Endres, 701-653-2951, gregory.endres@ndsu.edu
Clair Keene, 701-774-4315, clair.keene@ndsu.edu
www.ag.ndsu.edu/weeds
www.ag.ndsu.edu/palmeramaranth

Extension Citizen Advisory Council Provides Feedback and Counsel

NDSU Extension often seeks citizen input to help fulfill its commitment to empower North Dakotans to improve their lives and communities through science-based education.

That input comes from local, county, regional and program-specific citizen groups. In 2018, the organization created the NDSU Extension Citizen Advisory Council for feedback and counsel at the state level as well.

“NDSU Extension has added great value to North Dakota citizens and agriculture over the past many years of existence,” says Dale Ihry, council chair and executive director of the North Dakota Corn Utilization Council and North Dakota Corn Growers Association. “Our hope is to keep viable programs being offered by Extension available to North Dakotans.”

The 15-member council helps develop a greater awareness and understanding of Extension and, with a grassroots perspective, advises administration on Extension’s operations, strategies and statewide impacts.

Establishing the state advisory council and increasing the number of county advisory councils was a recommendation from the State Board of Agricultural Research and Education’s 2017 review to increase Extension’s effectiveness and efficiency. Most counties have an advisory council.

“Extension uses us as a resource to find out what we are missing in the community, and also identify any missing partners who can help with programming,” says Kim Lipetzky, a member of Cass County’s advisory council and Fargo Cass Public Health public health nutritionist.

“The council helps us define our scope of work,” says Rita Ussatis, an agent in Extension’s Cass County office. “They’re a really good sounding board.”

County advisory council members also are beneficial in other ways.

“They have been helpful in spreading the word about what Extension does,” says Crystal Schaunaman, an Extension agent in McIntosh County.

“Extension is making the right adjustments to be able to continue their longstanding programs and also find their way to better communication with the newer and younger users of the multitude of science-based programs being offered,” Ihry says.

FOR MORE INFORMATION:

Greg Lardy, 701-231-8944, gregory.lardy@ndsu.edu

www.ag.ndsu.edu/extension/about-us/ndsu-extension-citizen-advisory-council-cac

“Extension uses us as a resource to find out what we are missing in the community, and also identify any missing partners who can help with programming.”



Extension Education Helping Reduce Dicamba Problems

For the last two growing seasons, North Dakota soybean producers faced an unprecedented problem: a herbicide so powerful that a miniscule amount can cause widespread damage to beans not genetically engineered to resist it.

In 2016, when the Environmental Protection Agency (EPA) approved new formulations of dicamba to control weeds in dicamba-tolerant (DT) soybeans, NDSU weed scientists raised concerns because they knew of non-DT soybeans' sensitivity to the herbicide.

NDSU Extension specialists and agents then talked with farm chemical industry representatives about ways to avoid problems. Specialists and agents also educated herbicide applicators on using dicamba properly and not using volatile generic dicamba formulations, made presentations at numerous grower meetings, and provided information through newsletters and the news media about the damage dicamba can cause if it moves off target.

"NDSU Extension is the only source most growers have for research-based information on vapor drift," says Randy Grueneich, an Extension agent in Barnes County.

But dicamba moved into neighboring fields in some areas of North Dakota in 2017, damaging 250,000 soybean acres, and Extension agents moved quickly to help producers.

"I educated the producers on the symptoms and effects, if any, at particular growth stages," says Julianne Racine, an agent in LaMoure County.

Extension also partnered with the North Dakota Department of Agriculture (NDDA) on a survey to determine the extent of the damage. Extension agents helped producers document their losses so they could receive compensation.

In addition, Extension advised the NDDA on rules to mitigate problems in 2018 and collaborated on a white paper to help the EPA create new information on preparing, using and storing dicamba safely. In addition, Extension created a dicamba training verification system to ensure compliance with new specialized training requirements.

Andrew Thostenson, Extension's pesticide program specialist, says 2018 was a better year for several reasons: Extension and NDDA educational efforts were working, more producers planted DT soybeans and the weather cooperated during peak spraying times, keeping dicamba from drifting.

FOR MORE INFORMATION:

Andrew Thostenson, 701-231-8050, andrew.thostenson@ndsu.edu
www.ag.ndsu.edu/extension/pesticides

"NDSU Extension is the only source most growers have for research-based information on vapor drift."

Information Sharing



Aids Reclamation Efforts

Oil production benefits North Dakota, but it also causes ecological problems such as oil and saltwater (brine) spills that impact soil health, agricultural production, rangeland and wildlife.

In response, NDSU Extension collaborated with Dickinson State University, the Society for Range Management, the U.S. Department of Agriculture's Agricultural Research Service and BKS Environmental Associates to host the North Dakota Reclamation Conference for the last six years. Experts share case studies on reclamation methods, and research on soil remediation, vegetation establishment in affected areas and spill cleanup.

"As energy development exploded over the past decade, reclamation of the impacted land was often poor," says Kevin Sedivec, Extension rangeland management specialist. "NDSU Extension saw a need for developing programs to help landowners, mineral rights owners and private industry implement better reclamation and remediation practices."

Extension also hosted six informal discussions in western North Dakota to give landowners and gas and oil industry representatives opportunities to discuss issues such as how to reduce spills, improved spill detection technology and who is responsible for inspecting pipelines. Officials from the North Dakota Health Department, and Oil and Gas Division of the North Dakota Industrial Commission's Department of Mineral Resources were available to answer questions.

"These events are unique in that they bring together landowners, industry and agencies for an open discussion on a topic that is of concern to all the parties involved," says Extension livestock environmental stewardship specialist Miranda Meehan. She facilitates the discussions with Extension soil health specialist Chris Augustin and NDSU soil scientist Tom DeSutter. More discussions will be scheduled in 2019.

"NDSU Extension's efforts to educate the public on reclamation have been fruitful," says Tony Coons, Northwest Landowners Association chairman. "Landowners are more proactive and better educated on what to do when a spill is discovered."

Extension specialists and NDSU soil scientists also collaborated on a publication (<https://tinyurl.com/BrineSpills-NDSU>) on brine's environmental impacts and spill remediation.

FOR MORE INFORMATION:

Kevin Sedivec, 701-424-3606, kevin.sedivec@ndsu.edu
Miranda Meehan, 701-231-7683, miranda.meehan@ndsu.edu
www.ag.ndsu.edu/naturalresources/reclamation

"NDSU Extension's efforts to educate the public on reclamation have been fruitful. Landowners are more proactive and better educated on what to do when a spill is discovered."





Extension Helps Producers Deal With Soybean Marketing, Storage Challenges

When Frayne Olson heard that a few North Dakota elevators no longer were accepting soybeans in mid-August because of a U.S. trade dispute with China, the NDSU Extension crops economist knew Extension could help—and quickly.

Extension agricultural engineer Ken Hellevang, Extension family science specialist Sean Brotherson and Olson immediately took a three-pronged approach. Through news releases, podcasts, mass media interviews, social media posts and other outlets, they shared the market situation, soybean storage options and how producers can cope with the stress this brings.

Olson explained that no export sales of soybeans were being booked out of Pacific Northwest ports to China.

“That meant farmers needed to figure out how to store them for later delivery,” he says.

However, soybeans are a challenge to store, Hellevang says. Grain can be stored in many types of facilities, but all options should keep the grain dry and provide adequate aeration to control grain temperature.

This situation adds to the stress many farmers already are facing, according to Brotherson.

“The pileup of stressors can leave producers feeling powerless and frustrated,” he says. “Talking with others, taking time to assess options and developing proactive steps to pursue are valuable steps in being able to regain a sense of control when facing challenges.

“Reach out to a loved one, friend, clergy or neighbor to talk about how you are feeling,” he adds. “Or call 2-1-1 for listening support, suicidal thoughts, mental health issues, crisis and referral. Support is available.”

Extension also created a new website at www.ag.ndsu.edu/alerts for up-to-date information on quickly emerging topics such as these.

FOR MORE INFORMATION:

Frayne Olson, 701-231-7377, frayne.olson@ndsu.edu
Ken Hellevang, 701-231-7243, kenneth.hellevang@ndsu.edu
Sean Brotherson, 701-231-6143, sean.brotherson@ndsu.edu
www.ag.ndsu.edu/alerts

NDSU Extension LRP Education Benefits Producers Nationwide

Increasing U.S. inventories, record high meat production, trade agreement negotiations and tariff disputes contributed to livestock price volatility in 2018.

To help offset the uncertainty, Extension agricultural economics and livestock specialists educated producers about Livestock Risk Protection (LRP) insurance from the U.S. Department of Agriculture’s Risk Management Agency (RMA).

“It was developed to protect livestock producers from catastrophic price declines for livestock they will market in the future,” says livestock economist Tim Petry. “LRP was created especially for producers who raise small numbers or those who prefer to pre-price only a few animals at a time.”

The insurance is available for feeder and fed steers and heifers, market swine and lambs.

Extension specialists spoke to livestock producers, marketing clubs, agribusiness groups, NDSU and Dickinson State University classes, Extension agents and North Dakota Farm Business Management instructors about LRP.

“There are very few livestock marketing economists providing LRP education in the U.S., so NDSU Extension LRP resources are being used nationally,” Petry says. “Total U.S. LRP indemnity payments for the 2018 insurance year amounted to \$7,399,097, so the financial impact of livestock risk protection education to the state, region and country has been significant.”

From July 1, 2017, to June 30, 2018, North Dakota livestock producers insured 5,965 lambs, 3,448 feeder cattle and 574 fed cattle and received a total of \$242,305.

FOR MORE INFORMATION:

Tim Petry, 701-231-7469, tim.petry@ndsu.edu
www.ag.ndsu.edu/livestockeconomics/presentations

Academy Prepares Water and Soil Conservation Leaders

Attending NDSU Extension's new North Dakota Soil and Water Conservation Leadership Academy was enlightening for the West McLean Soil Conservation District board.

One topic presenters covered was soil conservation and watershed leaders' roles and responsibilities in conservation, stewardship and watershed management.

"That opened the eyes to many that they had more power than they thought," district manager Corey Bittner says.

Extension partnered with the North Dakota Health Department's Watershed Management Program and State Soil Conservation Committee to create the academy to help water resource board members and soil conservation district supervisors be better prepared to lead watershed, conservation and community-based projects to protect water quality for future generations.

"What stuck in my mind the most was how and what we need to do to host a meeting and get the public to come in so they can listen to our speakers on some problems that occur in the area, and then have the public respond with what they see as they drive through the county," Bittner says. "Get them to come in and make a list of what they see, and maybe all together we can identify the problem and come up with a solution."

Other academy topics include watershed hydrology basics, managing nutrients in watersheds, impacts of human activities on watersheds, components of an effective meeting, navigating conflicts successfully, group facilitation and the role of citizens in watershed planning, according to Bruce Schmidt, Extension coordinator for the academy.

"Armed with a wealth of information and training, academy graduates can return to their respective counties and take an active approach to resource management," North Dakota Health Department environmental scientist Jim Collins Jr. says. "It is expected that soil conservation districts will create plans to conserve the state's soil resources and control and prevent soil erosion."

FOR MORE INFORMATION:

Bruce Schmidt, 701-328-9717, bruce.schmidt@ndsu.edu
www.ag.ndsu.edu/ndssc/leadership-academy



"Armed with a wealth of information and training, academy graduates can return to their respective counties and take an active approach to resource management."



Of **441 participants** who completed evaluations on the **sun safety lesson**:



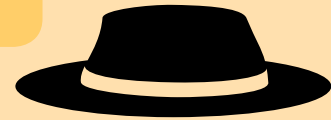
73% planned to let a doctor know of changes in their skin



72% planned to do skin self-checks



68% planned to wear SPF 30 sunscreen



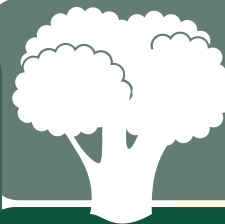
67% planned to wear a hat with a brim

HEALTHWISE FOR **GUYS**

Of **312 participants** who completed evaluations on the **colon/prostate cancer lessons**:



75% indicated they would eat more fruit



73% would eat more vegetables

63% would get more physical activity



57% would eat a diet with more fiber



3,944 views



1,000 views

Health Program Targets Males

Human bodies and vehicles have something in common – both need to be maintained – and preventive maintenance helps humans avoid major health issues.

That's why NDSU Extension food and nutrition specialist Julie Garden-Robinson and agents Kristi Berdal (Nelson and Steele counties) and Cindy Klapperich (Sargent County) created Healthwise for Guys, a program for adult males in rural areas primarily working in agriculture.

The team developed a website, PowerPoint presentations, displays, toolkits with handouts and other material such as games and experiments/demonstrations for interactive learning, and Facebook and Twitter posts with information on heart disease, cancer, diabetes and obesity.

Healthwise for Guys launched in January 2018. Extension agents in several counties offered classes and interactive displays. In addition, Extension agriculture and natural resource agents integrated education on preventing skin cancer from prolonged sun exposure into their pesticide use and safety training. Extension also partnered with registered nurses from local public health units who helped teach sessions on two sensitive topics: prostate and colon cancer.

Nelson County producer Russell Hoge is protecting his skin and encouraging his family to do the same after learning about skin cancer prevention during pesticide certification training.

"I try to use sunscreen more often and wear long sleeves," he says. "I'm after my wife and kids all the time to cover their skin."

Program developers hoped at least 300 participants would respond to follow-up surveys. They heard from 753.

Keys to the program's success include distributing an online survey to learn what men want to know about health and the do-it/see-it-for-yourself experiments and demonstrations during classes, the developers say.

The program's information isn't just for men, though.

"As a leading source of health information, spouses or significant others also need to arm themselves with accurate content for these important face-to-face conversations with all the men in their lives," Garden-Robinson says.

FOR MORE INFORMATION:

Julie Garden-Robinson, 701-231-7187, julie.garden-robinson@ndsu.edu
www.ag.ndsu.edu/healthwiseforguys

Young Adults Gain Life Skills and Confidence

The cost of renting your first apartment can be quite a shock.

How to select the right housing and budget for it is one of the lessons that emerging adults ages 17 to 25 are learning in #Adulting. It's NDSU Extension's new program to ease the transition to adulthood by helping young adults gain necessary knowledge.

Extension's community health and nutrition specialist Nikki Johnson, personal and family finance specialist Carrie Johnson and Extension associate Stacy Wang created the #Adulting program in 2017. They collaborated with experts in several NDSU departments.

A group of first-year students in the Seim Hall (NDSU residence hall) Living and Learning Community participated in a pilot program in 2017, and #Adulting expanded to all on-campus residents in 2018.

#Adulting classes are intentionally short with hands-on activities, such as creating healthful snacks and calculating rental start-up costs.

"Students walk away with new information that they can put into practice right away," Nikki Johnson says.

Most students also have other money-related questions. The #BudgetBoss session walks students through a simulated budget and provides resources for students to create their own.

"Learning to budget money effectively at a young age will help avoid future financial problems," Carrie Johnson says.

Other class topics include winter travel safety and choosing healthful food options. Resources are available online. #Adulting's presence on Facebook, Twitter, Pinterest and Instagram helps reach this age group.

#Adulting also went statewide in October 2018. Extension agents can teach classes at college campuses, in high schools or in the community. Classes are open to students and nonstudents.

FOR MORE INFORMATION:

Nikki Johnson, 701-231-5165, nikki.a.johnson@nds.u.edu
Carrie Johnson, 701-231-8593, carrie.johnson@nds.u.edu
www.ag.ndsu.edu/adulting





4-H STEM Projects Excite Youth



How do you put toothpaste on a toothbrush in seven steps?

You build a Rube Goldberg contraption, of course.

Goldberg (1883-1970) was a Pulitzer Prize-winning cartoonist known for his wacky inventions in his cartoons. Now, a Rube Goldberg contraption is a complex device made of everyday items that does a simple task.

It's also the basis for the Rube Goldberg Challenge, a new 4-H program that encourages critical thinking, creativity, innovation and problem-solving in youth from fourth through 12th grade. In 2018, the program's first year, 15 North Dakota 4-H teams used their STEM (science, technology, engineering and math) knowledge to solve the toothpaste-on-a-toothbrush puzzle at the county level; six of those teams competed at the North Dakota State Fair.

"Our team worked hard creating their Rube Goldberg machine," recalls Acacia Stuckle, an NDSU Extension agent in Emmons County. "There were nights when everyone wanted to go home and go to bed, but they kept persevering. It seemed the project would never come to completion, and they were still making last-minute touches until the competition. However, all the frustrations were erased when they received grand champion at the State Fair."

Team member Henry Stuckle says, "It was fun. I learned how to work with other kids. It was frustrating when we were building it and it didn't work how we wanted it to. But it was really fun once it did, and it was so cool seeing the whole machine go without any problems."

Stuckle is excited that other youth indicated they want to be part of a Rube Goldberg team in 2018-19.

"The Rube Goldberg challenge facilitates youth to build their teamwork, communication and problem-solving skills while learning about engineering and physics," she says. "These skills will be important to them in everything they do the rest of their lives."

More 4-H STEM Activities

North Dakota 4-H also engages youth in STEM through a \$23,000 Microsoft grant. The grant allows older 4-H youth to plan and lead digital activities for elementary and middle school students.

In 2018, the older 4-H'ers worked weekly with students from two middle schools – Fargo's Carl Ben Eielson and West Fargo's Cheney – and Fargo's CHARISM program on computer science activities. The 4-H'ers also were involved in Microsoft's Hour of Code computer coding event for elementary students at Kindred School.

FOR MORE INFORMATION:

Lindsey Leker, 701-231-7039, lindsey.leker@ndsu.edu
www.ndsu.edu/4h/programs_events/state_4_h_contests/rube_goldberg/

Extension Helps Producers Cope With Water Issues

Whether North Dakota has too much water or not enough, NDSU Extension helps producers cope.

Drought Lingered

As drought lingered into 2018, agents continued to report the conditions in their county on an online drought monitoring form Extension specialists created. The agents' data helped determine official drought severity designations, which the Farm Service Agency uses as a basis for disaster payments.

Extension specialists and agents also warned that cattle producers likely would see a reduction in forage on their pastures and rangeland in 2018 because of the drought. Rick Schmidt, an agent in Oliver County, had clear evidence of the looming problem.

"In 2017, western wheatgrass had reached the 3½-leaf stage, or grazing readiness, on May 9," he says. "However, this spring, it had only 1½ leaves on May 14."

He and other agents and specialists began educating producers on the importance of reducing the number of cattle grazing on drought-affected pastures and rangeland.

Agents and specialists also cautioned that many ponds and dugouts dried up because of the drought, and the quality of any water remaining in others might not be good. They urged producers to get their water tested and consider installing other water sources, such as wells and tanks. In addition, specialists developed resources to help producers collect and submit water samples correctly.

Subsurface Water Management

Extension agronomist Hans Kandel and colleagues such as Extension agricultural engineer Tom Scherer spent considerable time educating producers about the benefits of managing subsurface water through tile drainage during events such as an annual tile drainage design workshop. The demand for information was so high in 2018 that Extension added a second workshop.

"Farmers are looking for a deeper understanding of how to manage subsurface water by using tile to remove excess water early in the growing season and then using control structures to retain water for later use by the crop," Kandel says.

Tile drainage has other benefits as well, according to Kandel. For example, it can help get rid of salt in the soil, which is damaging to crops. Tile drainage also reduces

the need for producers to till heavy clay soils in the fall after harvest. Less tillage allows crop residue to remain in the field to protect the soil from winter erosion, and the soil will be dry enough to till in the spring.

In addition, tile drainage keeps the fields dry enough so producers can plant cover crops in the fall and terminate them in the spring to further reduce soil erosion and use excess moisture in the soil.

Water Quality

Extension specialists and agents improved the state's water quality by educating producers on proper livestock manure-handling techniques and facilities. Runoff water can carry nutrients such as nitrogen and phosphorus from manure into rivers, streams and lakes, reducing the quality of the water and increasing the potential for toxic blue-green algae (cyanobacteria) blooms. Agents and specialists also encouraged producers to use livestock manure as fertilizer for crops.

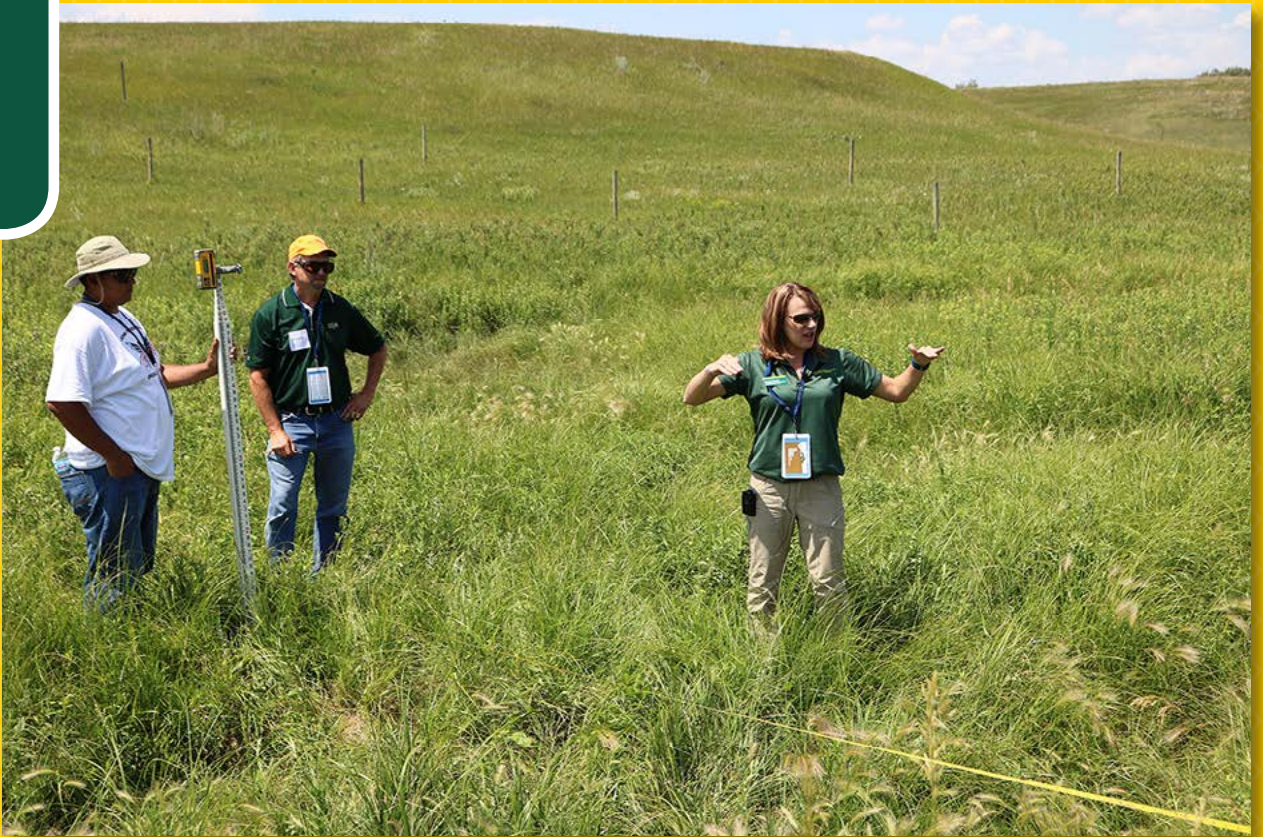
"Learning to make manure a high-quality fertilizer makes money sense as it is a readily available resource for North Dakota producers," says Mary Keena, Extension livestock environmental management specialist at the NDAES Carrington Research Extension Center.

Specialists and agents educated producers about water quality through numerous methods, including face-to-face consultations, social media, news releases, workshops, presentations, publications and news media interviews. They also held workshops for others working in the water quality field, such as Natural Resources Conservation Service and soil conservation district personnel, and watershed coordinators.

"We want to make sure we send a consistent message and we are reaching as many people as we can with that message," says Miranda Meehan, Extension livestock environmental stewardship specialist.

FOR MORE INFORMATION:

Miranda Meehan, 701-231-7683, miranda.meehan@ndsu.edu
Hans Kandel, 701-231-8135, hans.kandel@ndsu.edu
Mary Keena, 701-652-2951, mary.berg@ndsu.edu
www.ag.ndsu.edu/extension/natural-resources





Early Detection, Tree Diversification Keys to Preparing for Emerald Ash Borer

NDSU Extension forester Joe Zeleznik is educating North Dakotans about a pest making its way to the state.

The emerald ash borer (EAB) has killed millions of ash trees elsewhere in the U.S. It first was discovered in the U.S. near Detroit, Mich., in 2002, likely arriving from China in a shipping crate. The small, metallic green beetle spread from Michigan, mainly by people moving infested firewood.

Extension collaborates with the North Dakota Department of Agriculture and North Dakota Forest Service (NDFS) to equip North Dakotans to detect EAB as early as possible and diversify tree populations before the pest arrives.

“Extension has been a member on the planning team from the very beginning,” says Lezlee Johnson, NDFS forest health manager.

North Dakota has about 92 million green ash trees. Green ash replaced diseased elm trees and makes up 35 to 80 percent of urban forests. Zeleznik and his colleagues educate city foresters and other managers to identify unhealthy ash trees that can be removed and replaced with other species.

“There is time to diversify, but it is important to start now,” Zeleznik says.

Since 2010, Zeleznik has co-trained more than 250 natural resources professionals to become early detectors. These professionals gain real-life skills in searching for EAB by peeling back bark from logs that native insects infested. To delay EAB’s arrival, Zeleznik reminds everyone to buy firewood where they burn it.

Extension’s updated EAB publications are invaluable in helping people identify the pest and know who to call if they suspect they have spotted it, Johnson says. Extension also selected sites in a collaborative effort to place 300 EAB traps in 2018.

EAB infestation costs would be substantial through tree removal and replacement, chemical treatment and the loss of ashes’ benefits, including shade, beauty, windbreaks and storm water retention, Zeleznik says.

FOR MORE INFORMATION:

Joe Zeleznik, 701-231-8143, joseph.zeleznik@ndsu.edu
www.ndinvasives.org/emerald-ash-borer

Mentoring Program Benefits Sioux County Youth

Youth in Sioux County are gaining valuable life skills through a national 4-H youth mentoring program.

The Standing Rock Reservation covers the south-central North Dakota county and extends into South Dakota. Sioux County has the state's lowest average high school graduation rate, and 72.4 percent of youth birth to age 17 live in poverty.

Since 2012, NDSU Extension's Center for 4-H Youth Development has received grants annually from the National 4-H Council to implement Youth and Families With Promise, a mentoring program designed to reduce youth delinquency and strengthen at-risk students' academic and social skills.

"The mentoring program gives the youth a consistent and stable relationship with their mentor, ranging from teachers to community members," says Sue Isbell, Extension agent in Sioux County. "I'm excited to see the youth gain lifetime skills that could possibly move them into a career following high school."

The mentoring project appears to be contributing to the increase in graduation rates and students pursuing post-secondary education. Youth possess more confidence and business-related skills, according to annual program surveys. Many youth are mentoring younger students. A ripple effect also has emerged, with parents, grandparents and community members feeling pride in the students' progress.

Youth are leading efforts to make community changes, including operating a local gymnasium, starting an anti-bullying project, beginning a school recycling program and hosting a community 5K race.

"Without the opportunity to learn valuable business skills, I would not have finished high school, let alone enrolled in college," one former student says.

FOR MORE INFORMATION:

Sue Isbell, 701-854-3412, sue.isbell@ndsu.edu



New Sunflower Fertility Recommendations Saving Money

NDSU Extension has drastically revised its soil fertility recommendations for sunflowers, which will translate into considerable cost savings for producers.

Extension soil specialist Dave Franzen and some students spent two growing seasons conducting nitrogen and phosphorus application rate studies at 30 sites on cooperating producers' farms statewide. The National Sunflower Association provided \$100,000 for the research.

"One of the things we found right away was that phosphate is not a factor in increasing yield," he says.

As a result, he no longer recommends sunflower producers apply phosphorus. He estimates that will save North Dakota producers \$18 million annually in fertilizer expense. North Dakota is the second largest sunflower producer in the U.S.

This is the first time sunflower fertility recommendations have been updated in more than 40 years.

Franzen also found that, like his experiences with wheat and corn, nitrogen rate and yield are not related between fields or years. Producing the maximum yield/profit takes the same nitrogen rate in a favorable

environment as an unfavorable one, so new nitrogen rates are not yield goal-based.

Also as with wheat and corn, long-term no-till sites require less nitrogen than conventional-tillage sites. Plus, confection and oil-seed sunflowers require different nitrogen amounts.

Another new recommendation is an upper limit on the amount of nitrogen to apply. As the nitrogen increases, sunflower height increases, making plants more susceptible to lodging, or plant stalks bending or breaking, making harvesting difficult and reducing yields. Higher nitrogen amounts also increase sunflower susceptibility to certain diseases.

Extension's North Dakota Sunflower Nitrogen Calculator helps producers determine the right application rate for their farm. The calculator is available online at www.ndsu.edu/pubweb/soils/sunflower/ and as an app for Android and Apple devices.

Bismarck-based crop consultant Bob Amstrup is happy to see new recommendations.

"They've worked out quite well," he says.

FOR MORE INFORMATION:

Dave Franzen, 701-799-2565, david.franzen@ndsu.edu
www.ag.ndsu.edu/publications/crops/fertilizing-sunflower

**By not applying phosphorus,
North Dakota producers will save
an estimated \$18 million annually
in fertilizer expense.**



Diabetes Prevention Program Empowers Lifestyle Changes

North Dakotans with prediabetes are finding hope.

An estimated 198,000 North Dakotans have prediabetes, or sugar levels that are above normal but not high enough to be diabetes. Diabetes costs North Dakota \$902 million annually.

NDSU Extension agents in 17 counties are helping prediabetic adults delay or prevent diabetes through the Diabetes Prevention Program. The Centers for Disease Control and Prevention designed the community program, which promotes weight loss of 5 to 7 percent through long-term healthful eating and 150 minutes of physical activity weekly. Participants meet weekly for 16 weeks, then monthly for eight months. The class is offered free or at a nominal fee.

“The program is not a diet plan, but rather a lifestyle change program individualized to each participant to empower them with knowledge to make long-term healthy choices,” says Extension community health and nutrition specialist Nikki Johnson.

In the program, Extension agents, along with public health staff and local health-care providers, serve as a team of trained lifestyle coaches. Participants track fat grams and calories to gain awareness of food choices that could derail their success. They also learn to identify portion sizes, read food labels and move more.

Gary McCullough, Valley City, lost 20 pounds in the class led by Sue Milender, an Extension agent in Barnes County.

“I thought to lose weight, I could just eat less of the same kinds of foods,” McCullough says.

He learned to make better food choices and took over meal preparation. He also exercises 150 minutes weekly.

McCullough praises Milender and the two other lifestyle coaches.

“Their hearts are in what they are doing,” he says. “It’s a matter of if we want the help, it’s there. I want the help and do the best to do what they tell us.”

FOR MORE INFORMATION:

Nikki Johnson, 701-231-5165, nikki.a.johnson@ndsu.edu

www.ag.ndsu.edu/food/news/lifestyle-coach-training-national-diabetes-prevention-program





Bovine Emergency Response Plan Program Prepares First Responders

Each year, hundreds of thousands of livestock are transported on U.S. roadways and, inevitably, crashes involving livestock trailers occur. Emergency responders are trained to deal with injured humans at the scene of an accident, but not always livestock.

NDSU Extension livestock specialist Lisa Pederson has helped change that.

Pederson developed the Bovine Emergency Response Plan (BERP) program in 2015 with help from former Extension veterinarian Charlie Stoltenow, now the Extension assistant director for agriculture and natural resources. Their aim was to help emergency responders and law enforcement more appropriately address accidents involving livestock transport vehicles.

“Imagine that a semi loaded with cattle has crashed and rolled over,” Pederson says. “It’s dark outside and cattle are injured inside the semitrailer and loose on the scene. Our plan helps emergency personnel know how to assess the situation, make critical decisions, and keep themselves and the public safe.”

Since 2015, the training has been presented to more than 30 emergency response teams in 14 states. In 2018, BERP trainings were conducted in Almont, Steele, Rugby, Ellendale and Buffalo, as well as the North Dakota Firefighter’s Association fire school in Minot.

“This training was appropriate and eye-opening for myself, our sheriff and fire department staff that took it,” says Charles Russell, Dickey County Emergency Management director. “There were things we had not thought about, like documentation, media involvement and urban versus rural accident scenes. I would absolutely take the training again.”

In addition to a decision tree for dispatchers receiving and dispatching calls, the plan has guidelines for:

- Arrival protocols
- Scene assessment
- Scene security and containment
- Extrication of cattle
- Humane euthanasia
- Relocation of cattle
- Mortality disposal
- Righting of the vehicle
- Debriefing

The Bovine Emergency Response Plan was created in collaboration with Extension staff at NDSU, West Virginia University, Iowa State University and the University of Tennessee, and funded through the National Beef Quality Assurance program using Beef Checkoff funds, and the U.S. Department of Agriculture’s National Institute of Food and Agriculture’s Smith-Lever Special Needs Grant.

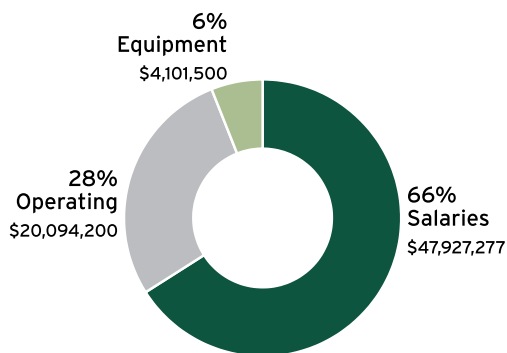
FOR MORE INFORMATION:

Lisa Pederson, 701-424-3606, lisa.pederson@ndsu.edu

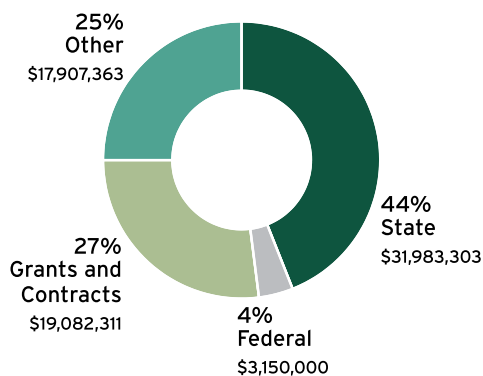
Year 2 Summary of 2017-2019 Biennium
 2018-2019 Annual Budget Book – Authorization
 Excludes Capital

■ North Dakota Agricultural Experiment Station

Budgeted Expenses

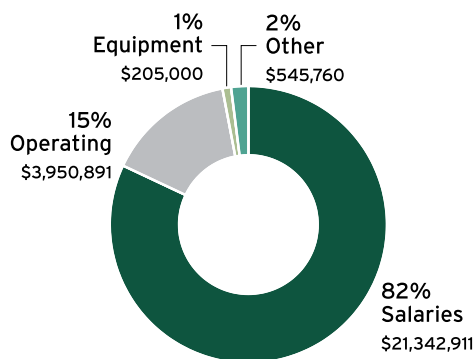


Funding Source

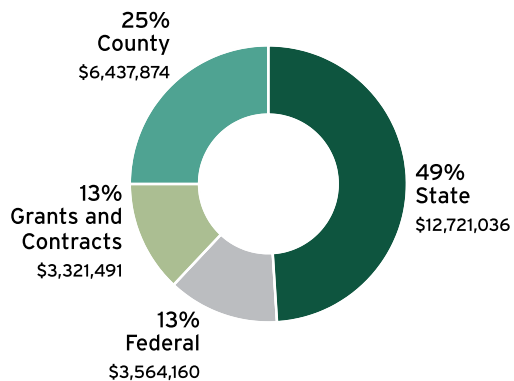


■ NDSU Extension

Budgeted Expenses



Funding Source



NDSU

Agricultural Affairs

North Dakota State University
Dept 7520, PO Box 6050
Fargo, ND 58108-6050

Non Profit Org.
U.S. Postage

Paid

Permit No. 818
Fargo, N.D.

www.ag.ndsu.edu



Agriculture and Extension at North Dakota State University

The North Dakota Agricultural Experiment Station consists of seven Research Extension Centers placed strategically throughout the state, the Agronomy Seed Farm in Casselton and the Main Station in Fargo. We work to develop techniques and technologies to enhance the production and use of food, feed, fiber and fuel from crop and livestock enterprises.

NDSU Extension empowers North Dakotans to improve their lives and communities through science-based education. We serve all people of the state through our 52 county and Fort Berthold offices, seven Research Extension Centers and the main campus in Fargo.

NDSU NORTH DAKOTA STATE UNIVERSITY

If you would like more information on the programs in this publication, contact the faculty and staff listed. If you would like more information about our other programs or have questions, comments or suggestions, please contact me.

Greg Lardy

Associate Vice President for Agricultural Affairs
Interim Director, NDSU Extension
Acting Director, North Dakota Agricultural Experiment Station

NDSU Dept. 7520
314 Morrill Hall, Box 6050
Fargo, ND 58108-6050

701-231-7655
gregory.lardy@ndsu.edu

This publication was produced by NDSU Agriculture Communication.
Writers: Ellen Crawford, Denise Pinkney, Becky Koch and Kelli Anderson
Graphic Designers: Deb Tanner and David Haasser
Photography: NDSU, North Dakota Agricultural Experiment Station and NDSU Extension faculty and staff

NDSU does not discriminate in its programs and activities on the basis of age, color, gender expression/identity, genetic information, marital status, national origin, participation in lawful off-campus activity, physical or mental disability, pregnancy, public assistance status, race, religion, sex, sexual orientation, spousal relationship to current employee, or veteran status, as applicable. Direct inquiries to Vice Provost for Title IX/ADA Coordinator, Old Main 201, NDSU Main Campus, 701-231-7708, ndsu.eoaa@ndsu.edu. This publication will be made available in alternative formats for people with disabilities upon request, 701-231-7881.