North Dakota State University
CROP & PEST REPORT

NDSU EXTENSION

No. 2 March 27, 2025

Inside this Issue...

Entomology

WHEAT MIDGE FORECAST LOW FOR 2025

Soil samples collected in North Dakota wheat fields indicate the lowest populations of overwintering wheat midge larvae (cocoons), since the inception of the survey in 1995. For the fifth year in a row, low populations of wheat midge were present, potentially reducing farmers' inputs for wheat midge management. However, wheat midge can still increase in pockets where timely spring rains occur in 2025. So, it is always good insurance to scout wheat fields during the susceptible crop stages of heading through mid-flowering.

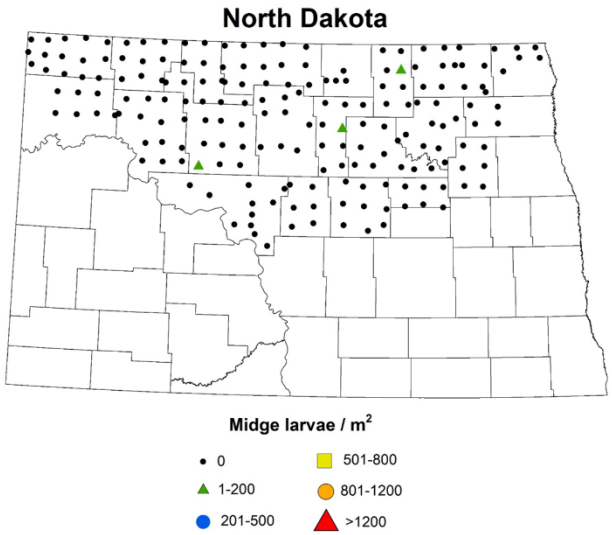
NDSU Extension agents collected a total of 1,920 soil core samples (10 cores per field) from 192 fields in 21 counties from August to October 2024. The distribution of wheat midge is based on unparasitized cocoons found in the soil samples. Historically, wheat midge has caused significant loss in yield and quality in spring wheat and durum wheat in the northern tier of North Dakota counties.

For 2024, wheat midge was positive at only three field sites (2% of the sites sampled) in three counties including Towner in the northeast, Pierce in the north-central region, and Ward in the northwest. These sites had low levels of wheat midge cocoons (1-200 cocoons per square meter), which does not result in yield loss in spring wheat the following year. No soil samples had moderate or high cocoon densities of wheat midge (201 to over 800 midge larvae per square meter).

The majority of the soil samples had zero wheat midge cocoons for the past five years (98% in 2024, 90% in 2023, 97.5% in 2023, 95% in 2022 and 86% in 2021). We believe that the populations of wheat midge are low due to the lengthy drought in North Dakota. Drought also caused wheat midge emergence to be more irregular and out of sync with susceptible crop stages for infestation, resulting in low populations. Dry conditions will delay when wheat midge larvae drop out to the soil for overwintering in late summer. Larvae will remain in the wheat head and are often harvested with the grain, ending up in the grain truck or bin. Dry soil conditions also increase wheat midge mortality by making it difficult for the larvae to dig into the compacted soil for overwintering and by exposing them to predators on the soil surface.

With the very low populations of wheat midge for the fifth year in a row, scouting for wheat midge will be most important in continuous wheat fields. Wheat midge emergence and survival will be favored if North Dakota wheat growing areas receive over 1 inch of spring rains in May into June. Wheat midge cocoons also can remain dormant for several years and adults then emerge in future years when soil moisture is adequate. However, if more favorable environmental conditions, especially spring rains, return to North Dakota, it could favor the development of overwintering larvae in the soil during spring and adult emergence from late June to mid-July. These factors can cause rapid increases in the numbers of emerging adult wheat midge.

2024 Wheat Midge Larval Survey



NORTH DAKOTA WHEAT COMMISSION

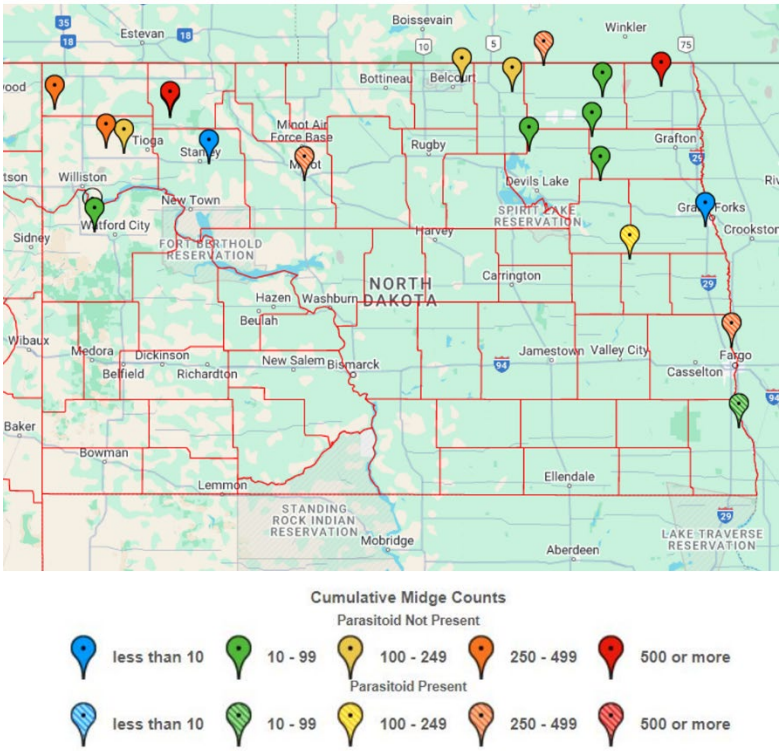
NDSU EXTENSION

IPM scouts and insect trappers also monitored for wheat midge using sex pheromone trapping during the field season. Trap monitoring is more sensitive to low densities of wheat midge in fields and alerts farmers to potential economic infestations. Pheromone traps are used as an 'early warning' system to trigger field scouting if the crop is in the susceptible stage. If more than 10 midges per trap are observed then field scouting should be initiated to determine if a field is at an economic threshold for wheat midge. In short, trapping serves to document the distribution of the wheat midge and its parasitoids, as well as guiding scouting efforts and IPM practices.

A total of 20 pheromone traps were monitored in 18 counties in North Dakota in 2024. The past three years show a general decline in the total number of adult midges captured on traps: 2,287 adults in 2024, 8,446 adults in 2023, and 22,952 adults in 2022. The highest wheat midge counts were concentrated in the northwest and northeast counties of North Dakota.

Green spray-painted delta pheromone trap for wheat midge

2024 Wheat Midge Pheromone Trapping Results in ND



The beneficial parasitoid wasp that attacks and kills wheat midge is dependent on its host for its survival. So, it also continues to decline to low levels along with the wheat midge decline. No field sites had parasitic wasps in the 2024 midge soil samples. Past parasitism rates were low only 5% in 2023, and 0% in 2022 and 2021. Higher parasitism rate was observed in 2020 (15%), 36% in 2019 and 9% in 2018. However, the pheromone trapping found wasps at 35% of the 2024 trap sites, 37% of the trap sites in 2023 and 50% of the trap sites in 2022. Dissecting wheat midge cocoons and trap monitoring for parasitoids help to identify parasitoid distribution and overall success against wheat midge in North Dakota.

In summary, both soil cocoon sampling and trapping results show that wheat midge populations have declined significantly over the past years. However, pheromone trapping indicates that wheat midge is still widespread throughout the wheat-growing areas of the state. As expected, the presence of parasitoid wasps also has declined recently.

NDSU Extension County agents collected the soil samples and larval cocoons were extracted at the NDSU Extension Entomology laboratory. The North Dakota Wheat Commission supports the wheat midge larval soil survey and pheromone trapping.

NEW HANDY BT TRAIT TABLE FOR CORN INSECTS

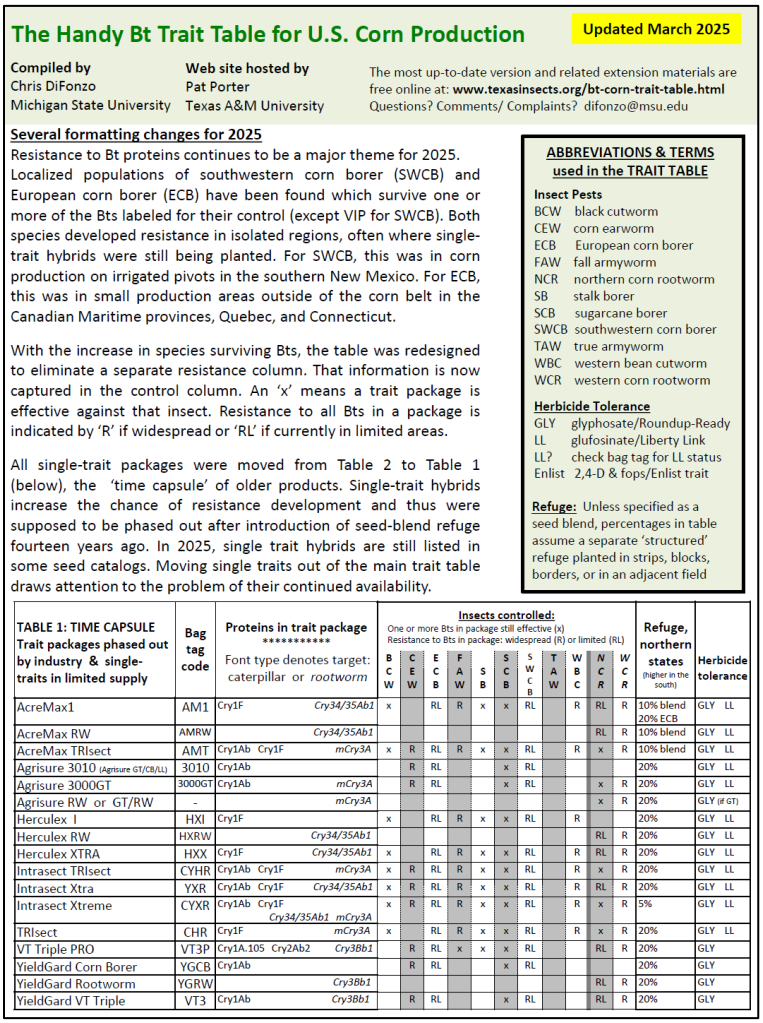
The Handy Bt Trait Table for U.S. Corn Production was updated March 2025 by Dr. Chris DiFonzo of Michigan State University. Valuable information on commercial Bt corn hybrids in the U.S. is listed in the publication including:

- Proteins in Bt trait packages
- Insect pests controlled - various caterpillars (e.g. European corn borer, black cutworm, others) to corn rootworms
- Insect resistance to Bt traits and how widespread the resistance issue is
- Refuge requirements
- Herbicide tolerance

A new table (Table 1) was added to address the older single traits that are being phased out after the start of seed-blend refuges. Examples include AcreMax1, Herculex I, YieldGard Rootworm and others.

Remember to avoid using the same Bt trait repeatedly, year after year, to mitigate the development of insect resistance to Bt traits in the future.

The Handy Bt Trait Tables for U.S. Corn Production is also listed in the *2025 North Dakota Field Crop Insect Management Guide* E1143-25 in the Corn insect section, pages 33-34.



The Handy Bt Trait Table for U.S. Corn Production — Updated March 2025

Compiled by Chris DiFonzo, Michigan State University. Web site hosted by Pat Porter, Texas A&M University. The most up-to-date version and related extension materials are free online at: www.texasinsects.org/bt-corn-trait-table.html. Questions? Comments/ Complaints? difonzo@msu.edu

Several formatting changes for 2025

Resistance to Bt proteins continues to be a major theme for 2025. Localized populations of southwestern corn borer (SWCB) and European corn borer (ECB) have been found which survive one or more of the Bts labeled for their control (except VIP for SWCB). Both species developed resistance in isolated regions, often where single-trait hybrids were still being planted. For SWCB, this was in corn production on irrigated pivots in the southern New Mexico. For ECB, this was in small production areas outside of the corn belt in the Canadian Maritime provinces, Quebec, and Connecticut.

With the increase in species surviving Bts, the table was redesigned to eliminate a separate resistance column. That information is now captured in the control column. An 'x' means a trait package is effective against that insect. Resistance to all Bts in a package is indicated by 'R' if widespread or 'RL' if currently in limited areas.

All single-trait packages were moved from Table 2 to Table 1 (below), the 'time capsule' of older products. Single-trait hybrids increase the chance of resistance development and thus were supposed to be phased out after introduction of seed-blend refuge fourteen years ago. In 2025, single trait hybrids are still listed in some seed catalogs. Moving single traits out of the main trait table draws attention to the problem of their continued availability.

ABBREVIATIONS & TERMS used in the TRAIT TABLE

Insect Pests: BCW black cutworm; CEW corn earworm; ECB European corn borer; FAW fall armyworm; NCR northern corn rootworm; SB stalk borer; SCB sugarcane borer; SWCB southwestern corn borer; TAW true armyworm; WBC western bean cutworm; WCR western corn rootworm

Herbicide Tolerance: GLY glyphosate/Roundup-Ready; LL glufosinate/Liberty Link; LL? check bag tag for LL status; Enlist 2,4-D & fops/Enlist trait

Refuge: Unless specified as a seed blend, percentages in table assume a separate 'structured' refuge planted in strips, blocks, borders, or in an adjacent field

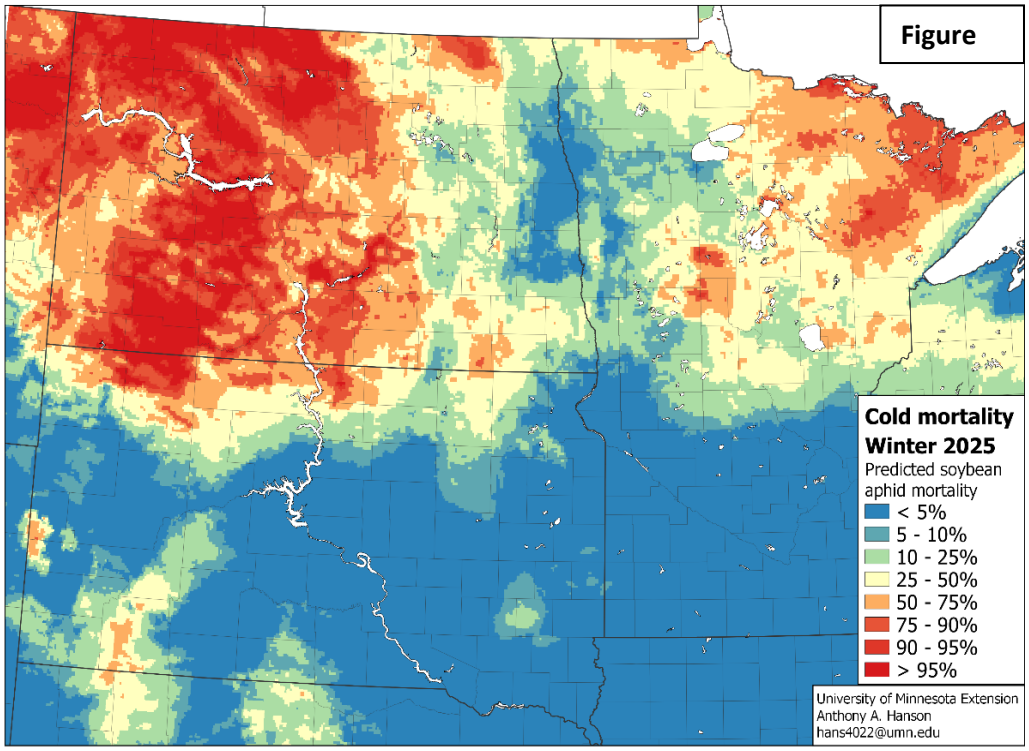
TABLE 1: TIME CAPSULE Trait packages phased out by industry & single-traits in limited supply

Bag tag code	Proteins in trait package (Font type denotes target: caterpillar or *rootworm*)	Insects controlled: BCW	CEW	ECB	FAW	SB	SCB	SWCB	TAW	WBC	NCR	WCR	Refuge, northern states (higher in the south)	Herbicide tolerance
AM1	Cry1F *Cry34/35Ab1*	x		RL	R	x	x	RL		R	RL	R	10% blend 20% ECB	GLY LL
AMRW	*Cry34/35Ab1*										RL	R	10% blend	GLY LL
AMT	Cry1Ab Cry1F *mCry3A*	x	R	RL	R	x	x	RL		R	x	R	10% blend	GLY LL
3010 (Agrisure GT/CB/LL)	Cry1Ab		R	RL			x	RL					20%	GLY LL
3000GT	Cry1Ab *mCry3A*		R	RL			x	RL			x	R	20%	GLY LL
-	*mCry3A*										x	R	20%	GLY (if GT)
HXI	Cry1F	x		RL	R	x	x	RL		R			20%	GLY LL
HXRW	*Cry34/35Ab1*										RL	R	20%	GLY LL
HXX	Cry1F *Cry34/35Ab1*	x		RL	R	x	x	RL		R	RL	R	20%	GLY LL
CYHR	Cry1Ab Cry1F *mCry3A*	x	R	RL	R	x	x	RL		R	x	R	20%	GLY LL
YXR	Cry1Ab Cry1F *Cry34/35Ab1*	x	R	RL	R	x	x	RL		R	RL	R	20%	GLY LL
CYXR	Cry1Ab Cry1F *Cry34/35Ab1 mCry3A*	x	R	RL	R	x	x	RL		R	x	R	5%	GLY LL
CHR	Cry1F *mCry3A*	x		RL	R	x	x	RL		R	x	R	20%	GLY LL
VT3P	Cry1A.105 Cry2Ab2 *Cry3Bb1*		R	RL	x	x	x	RL			RL	R	20%	GLY
YGCB	Cry1Ab		R	RL			x	RL					20%	GLY
YGRW	*Cry3Bb1*										RL	R	20%	GLY
VT3	Cry1Ab *Cry3Bb1*		R	RL			x	RL			RL	R	20%	GLY

Janet J. Knodel
Extension Entomologist

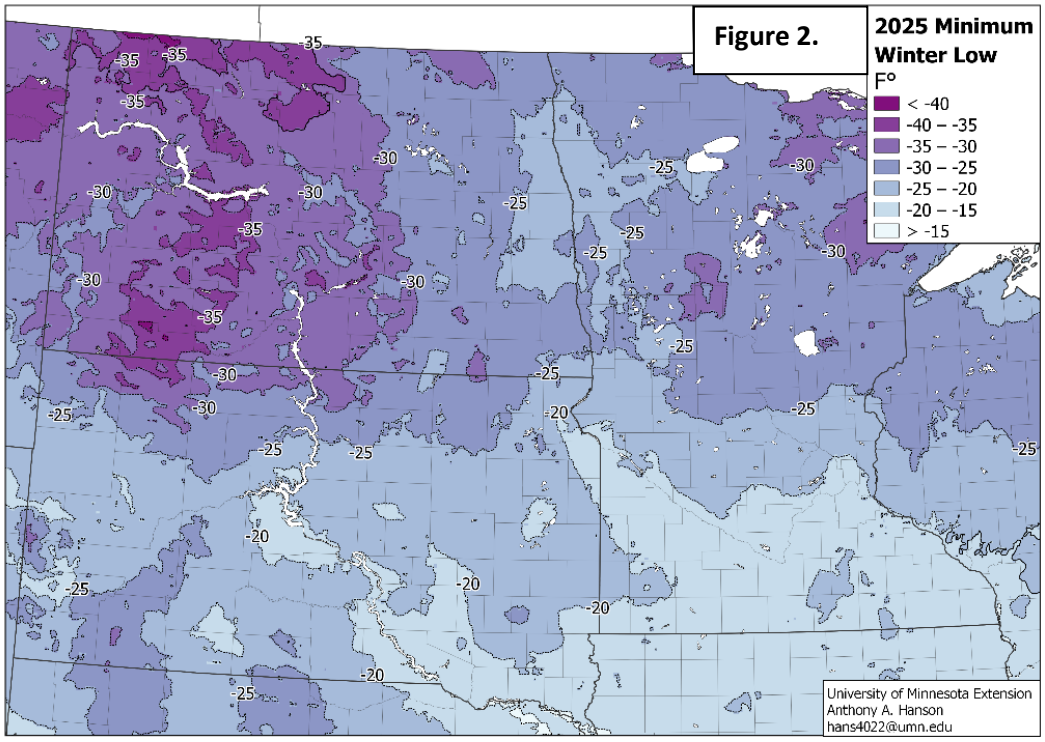
WINTER KILL FOR SOYBEAN APHIDS IN NORTH DAKOTA

Soybean aphid eggs overwinter on the buckthorn buds and will freeze between -25 and -35°F (most freezing around -29°F). Air temperature is a good predictor of cold mortality for soybean aphid eggs in the winter. Other causes of egg mortality are dehydration when temperatures are above freezing during late-fall cold snaps.



For North Dakota, less than 5% to 25% mortality for soybean aphid was predicted in the Red River Valley area of the state where winter low temperatures ranged from -25 to -30°F. As we move further west, the cold mortality increased to 10% to 50% in mortality in the far western part of eastern North Dakota with winter low temperatures ranging from -25 to -30°F. In the central to western areas of North Dakota, predicted soybean aphid mortality was near 50% to 95% or more with winter low temperatures ranging from -30 to -35°F. (Fig. 1 & 2).

Based on winter low temperatures and cold mortality for soybean aphids, the forecast for the 2025 growing season suggests that far eastern areas of North Dakota will be at slightly higher risk for economic populations of soybean aphids, especially in the Red River Valley areas. Looking back to 2018, soybean aphid populations were generally non-economic from 2018-2023 in North Dakota. In spite of the high soybean aphid mortality in central to western North Dakota, soybean aphids can migrate long distances (100+ miles) and arrive in high numbers, especially when



populations are high in neighboring states. So, it is not time to relax and go fishing yet, since soybean aphids have a fast reproductive rate, doubling in 5-7 days when temperatures are favorable in the low 80°s F. Routine scouting for soybean aphids and other insect pests will be smart pest management in 2025. Soybean aphids are usually common in soybean fields later in the season (mid-July into mid-August).

For Minnesota's insect forecast, see following link on the MN Crop News:
https://blog-crop-news.extension.umn.edu/2025/03/winter-2025-and-insect-forecasting.html

Janet J. Knodel
Extension Entomologist

Anthony Hanson
U of MN Regional Extension Educator & Assistant Extension Professor

Patrick Beauzay
State IPM Coordinator
Research Specialist, Extension Entomology

plant pathology

SCN SOIL SAMPLING

For **North Dakota** subscribers, the SCN Soil Sampling will start this summer. For more information, please see these links:

- Summary of SCN Survey 2013-2021
- PP1732 Soybean Cyst Nematode publication
- How to sample for SCN
- Link to get added to SCN Sampling List (Sign up by July 15, 2025)

You are also able to contact your County Extension Agent for bags. Find your Extension Agent HERE. Feel free to contact Wade Webster for more information.

UNDERSTANDING THE BIOLOGY OF SOYBEAN CYST NEMATODE

Soybean cyst nematode (SCN) reigns as the top yield-robbing pest of soybeans in North Dakota, a microscopic menace that silently invades soybean roots and reduces plant vigor. Understanding the biology of this pest is essential for effective management. The SCN life cycle begins when eggs, protected within cysts in the soil, hatch as soybean roots emerge. Juvenile nematodes begin by burrowing into the roots, creating specialized feeding sites called syncytia that hijack water and nutrients from the plant. Female SCN then mature, producing up to 200 eggs inside their bodies, which swell into cysts that eventually release from the roots back into the soil. With two to three generations per growing

season, SCN populations can skyrocket under the correct environmental conditions, making it a great threat to soybean fields across the state.

SCN's ability for surviving North Dakota's brutal winters highlights its strength and resiliency. The cysts act as a protective barrier, shielding eggs from the cold and allowing them to persist in the soil for years without a host plant. These eggs lie dormant through freezing temperatures and harsh conditions, waiting for the warmth of spring soils and developing soybean roots to trigger hatching. This durability means SCN populations do not disappear between seasons. Instead, they linger in fields, ready to strike the next soybean crop. Because of this resilience, proactive management is needed to keep this pest under control as its ability to endure ensures it remains a long-term challenge for farmers. Crop rotation stands out as a key management tactic against SCN. By switching to non-host crops like corn, wheat, or oats, farmers can help prevent SCN from reproducing and removes viable eggs over time. This approach aims to protect future soybean yields by reducing the nematodes presence in fields. However, crops like dry beans can also be a host to SCN, allowing for nematode populations to continue reproduce even in rotation years. When paired with other strategies, rotating with true non-hosts offers an effective way to suppress SCN.

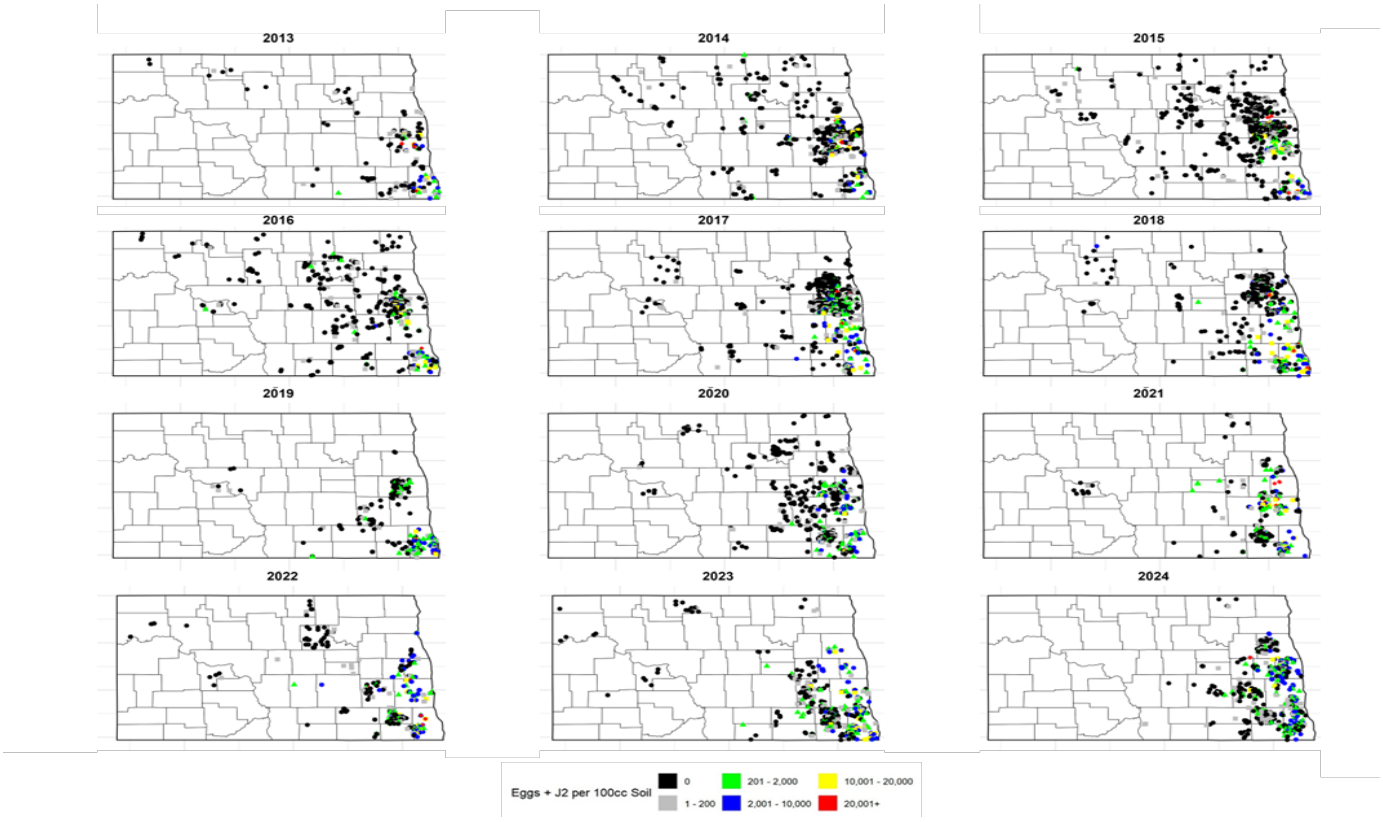


Figure 1. SCN samples collected each year from 2013 to 2024 across the state of North Dakota.

Resistant soybean varieties are a vital weapon in the SCN fight, with PI88788 and Peking as the primary sources of resistance. These varieties slow SCN reproduction by disrupting the nematode's feeding sites, reducing population growth and protecting soybean yields. PI88788, the most prevalent source of resistance in soybean cultivars has faced pressure as some SCN populations have begun adapting to overcome it. Peking, an alternative resistance source, can still effectively control these adapted nematode populations, offering a secondary line of defense. Rotating between these

two sources of resistance, or even among varieties within the same source, helps to slow SCN's ability to evolve resistance, preserving the effectiveness of these varieties and protecting long-term control efforts.

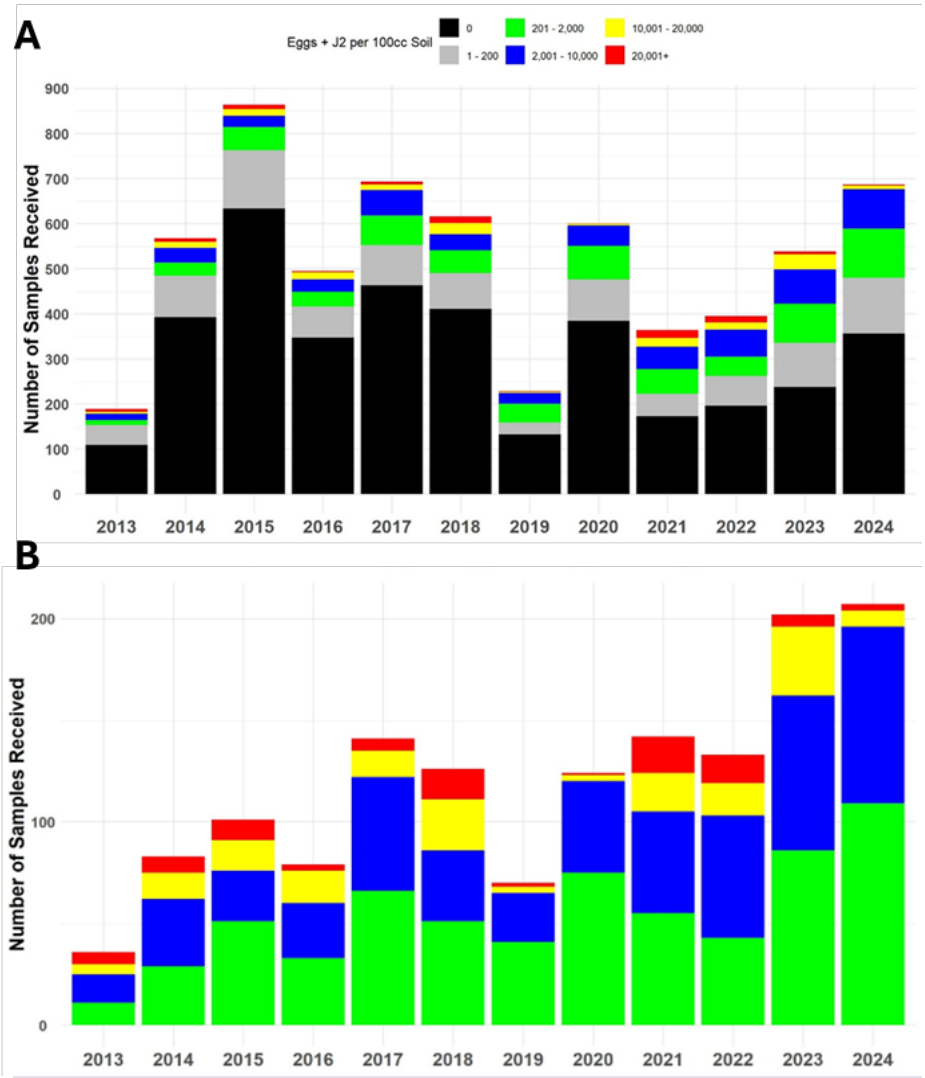


Figure 2. Number of SCN samples received from the NDSU SCN sampling program.

Soil sampling is a powerful tool for SCN management, allowing for early detection in fields without a history of this pest. Testing soil for SCN eggs reveals the pest's presence and population density, giving farmers the data to choose specific rotations or resistant varieties to combat this issue. The North Dakota SCN Sampling Program, funded by the North Dakota Soybean Council and managed through NDSU, has shown its worth, with 2024 marking a record high in positive samples (Figs. 1 and 2). This free program tracks SCN's spread, even into new regions such as Western North Dakota, and empowers farmers to proactively get ahead of this pest. Regular sampling through this initiative helps farmers stay ahead of SCN, protecting soybean production for many years to come.

For more information on how to collect samples or to request sampling bags, contact your local county Extension agent or visit the NDSU SCN Sampling Program webpage.

Wade Webster
Extension Plant Pathology, Soybeans

soils

SMALL AREAS WITH TROUBLE, SALINE AND SODIC AREAS

In planning for the 2025 season, think back to last year and remember those saline and/or sodic areas and what do you do about them. First what is saline and sodic mean and what is the difference and then how to deal with it this year.

Saline soils will have excessive levels of water-soluble salts in the soil water, which are a combination of positively and negatively charged ions (for example, table salt; Na^+Cl^-). High levels of ions (positive and negative) from soluble salts restrict normal water uptake by plant roots, even when soils are visibly wet, resulting in drought-stressed plants (osmotic effect). Essentially, salinity or excess water-soluble salts create "artificial drought" like conditions. In a true drought, soils will not have much plant available water and will be dry. However, under saline conditions, despite having decent levels of soil water/moisture, seed and plant roots are not able to absorb soil water due to competition between salts versus seed and plant roots for water. This effect will be more prominent under dry weather as when it rains, the availability of free water increases, lessening the competition for water between salts versus seed and plant roots.

In contrast to saline soils, sodic soils are highly saturated with Na^+ ions at the soil cation exchange sites (negative charges of clay and humus particles that attract positively charged chemical ions). High Na^+ levels compared to Ca^{2+} in combination with low salt levels can promote "soil dispersion", which is the opposite of flocculation. Soil dispersion causes the breakdown of soil aggregates, resulting in poor soil structure (low "tilth" qualities). Due to the poor soil structure, sodic soils have dense soil layers, resulting in very slow permeability of water through the soil profile. Due to poor soil structure, when wet, sodic soils will be gummy and may seem as if they have "no bottom" to them, and when dry, they can be very hard.

Note:

- If Na^+ is present as a salt, it will not cause dispersion as the positive charges of Na^+ ions will be neutralized by the negatively charged chemical ions such as sulfates (SO_4^{2-}) or chloride (Cl^-).
- However, due to the constant exchange of positively charged ions like Ca^{2+}, Mg^{2+} and Na^+ between soil water and the soil clay and humus particle negative charges, high levels of Na^+ based salts in the soil water can result in sodicity as more negative charges will be saturated with Na^+.

Clayey soils will infiltrate water slower than sandy soils, however, higher sodicity levels can drastically reduce the soil water infiltration irrespective of soil texture. A clayey soil without dispersion issues will infiltrate water much faster than the same clay soil having dispersion.

How to deal with it now to prevent future issues. The first step is to soil test. Measuring the soil down to 4 feet is the best protocol. These samples will need to be analyzed by a soil test lab for EC, SAR, pH, Ca, Mg, Na, Cl, SO_4, CO_3 and HCO_3 using "saturated paste extract method". If sodicity is established, the top six or twelve inches will also need to be analyzed for cation exchange capacity (CEC) using "sodium saturation and ammonium extraction method" for calculating the rates of soil amendments such as gypsum, beetlime or calcium chloride salt. From there, work through the numbers to understand the issue of saline and sodic and what levels change the management plan. Often, remediation using gypsum is needed. Then, a selection of perennial salt-tolerant grasses will be planted once the gypsum is incorporated if needed. A pound or two of a winter hardy alfalfa variety maybe added to the perennial salt-tolerant grass mix as it has been noted at two different saline and sodic sites that alfalfa started germinating three-years after planting with the

grass mix. Adding alfalfa can help add value to the perennial grass area that can be hayed. While the value of haying can be less than harvesting a quality planted cash crop, this is for areas that are impacted to the level that income is not occurring. If you think about the seed cost for cash crops and all other costs for management, when the plants don't survive is a net loss. Changing the small impacted area to the perennial system can provide a little income but, more importantly, doesn't result in a net loss. Besides balancing the books, this helps the soil build health and quality.

Chandler Gruener
Extension Soil Health Specialist

Naeem Kalwar
Extension Soil Health Specialist

WHAT ABOUT SULFUR?

More often than not this meeting season, regardless of the fertility topic I spoke about, somebody asked the question "what about sulfur?" While the importance of sulfur (S) applications in North Dakota have well been known beginning with the work of Dr. Ed Deibert in the 1990s, it seems farmers and consultants have had a resurging interest in S fertility lately. Crops satisfy their S needs only through the uptake of sulfate-S (SO_4^{-2}-S) from the soil (or foliar applications). Historically in cropping systems, manure application, crop residue/organic matter decomposition, and atmospheric deposition of S usually was enough to meet the crop needs—this began to change in the 1970s with the passage of the Air Quality Act and Clean Air Acts. From 1970 to 2023 total S emissions from coal and fossil fuel combustion decreased from 31,000 to 1,701 thousand tons of SO_2/year (Figure 1). With the decreasing atmospheric S deposition (which means less acid rain!), crop S deficiency has become much more common across the US, prompting the need for more fertilizer-S applications to meet crop needs. Additionally, several new S products are being sold this growing season with the full-force of their marketing teams behind them—and questions about the effectiveness of these products have been making their way to my office. Going into the 2025 growing season, there are a few key points we need to keep in mind for successful and profitable S-fertility management: 1) S source matters; 2) since sulfate-S soil tests are not good predictors of crop response, soil and weather factors should be used to determine S applications; 3) rate of S depends on crop demand.

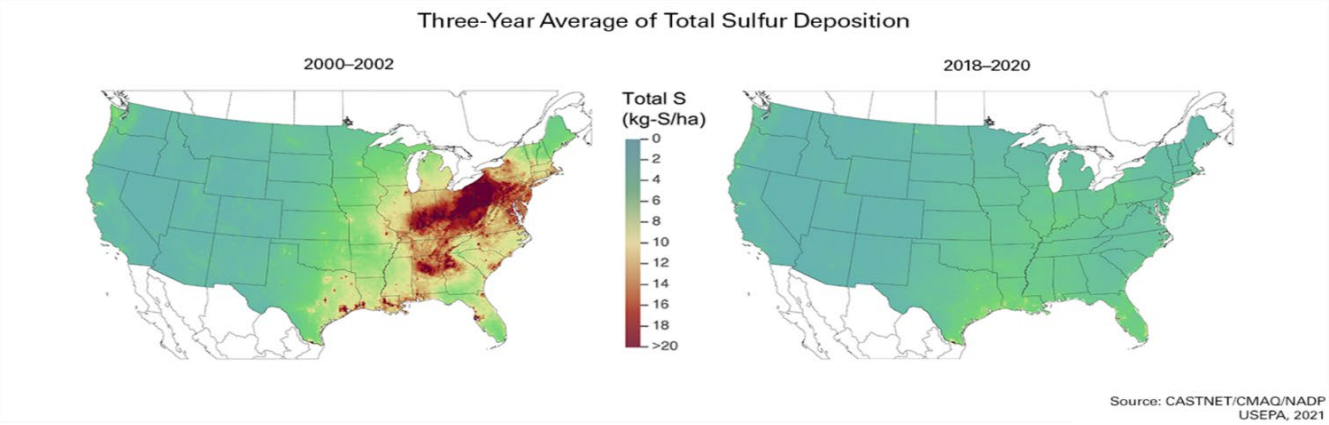


Figure 1. Changes in atmospheric deposition of sulfur across the United States from 2000-2002 to 2018-2020. (Source: https://www3.epa.gov/airmarkets/progress/reports_2020/acid_deposition_figures.html)

As previously mentioned, crops take-up sulfate-S to satisfy crop needs. This means the most effective S fertilizer will be those also in the sulfate-S form, the most common being ammonium sulfate (AMS, 24% S) and calcium sulfate (gypsum, 17% S). While both AMS and gypsum provide readily available sulfate-S, there are benefits and drawbacks of each product. AMS is much more soluble than gypsum, meaning it will dissolve much more easily, which is important in dry

years. Since gypsum is less soluble, dry conditions may delay the movement of the sulfate into the soil solution. However, AMS has a high salt index (88) limiting its usefulness as an in-furrow fertilizer compared to the low salt index of gypsum (8). Regardless of the sulfate source, research has shown similar effectiveness of surface and incorporated applications—speaking to the mobility of sulfate in the soil, which is why sulfate-S should only be applied in the spring. Elemental S, on the other hand, is a whole different conversation. In order for elemental S to be of any use to the crop, it much first be oxidized; oxidation is a microbial process where the S is converted to sulfate-S and the rate it occurs depends on particle size of the S, contact with soil/incorporation, soil moisture, and soil temperature. Given the propensity of out soils in ND to be dry or frozen a good part of the year, oxidation rate of elemental S is unpredictable, which is why it is not recommended for use in fields where S deficiency is expected or as a rescue treatment. If, for some unfortunate reason, elemental S is used, it is best incorporated to increase its ability to oxidize.

While it is immensely important to regularly soil test for nitrate-N, P, and K levels, sulfate-S does not make the list of important soil tests. While sulfate-S tests are available, unfortunately they are not good predictors of crop yield response (Figure 2). Rather than relying on the sulfate-S tests, several weather and soil characteristic factors should be considered when determining the likelihood of S deficiency. Since sulfate-S readily leaches or can be lost in a gaseous form from waterlogged soil, years with above average rainfall increase the likelihood of S losses and deficiency. Sandy soils are more prone to leaching losses compared to fine-textures soils, meaning there is a higher chance for sulfate leaching. While the correlation between the sulfate-S soil test and crop response is weak, there is a strong relationship between organic matter and crop response to S; soils with organic matter less than 3% are much more prone to S deficiency. If any of these factors are occurring in your fields, or you have a history of S deficiency, a sulfate-S application is strongly recommended.

If S deficiency is expected in any field, a 10 lbs/ac application of sulfate-S is generally adequate to meet crop needs for many of our common field crops in North Dakota. Canola and other brassica crops, regardless of weather and soil conditions, should always receive 20-30 lbs/ac of sulfate-S. Canola has a high S demand and S deficiency is particularly detrimental to yield. Work done in north-central North Dakota reported canola yield increases of nearly 6,000% when 40 lbs/ac of S from AMS was applied to a deficient area (Table 1). Also in Table 1, the lower yield response to elemental S compared to sulfate-S from AMS should be noted.

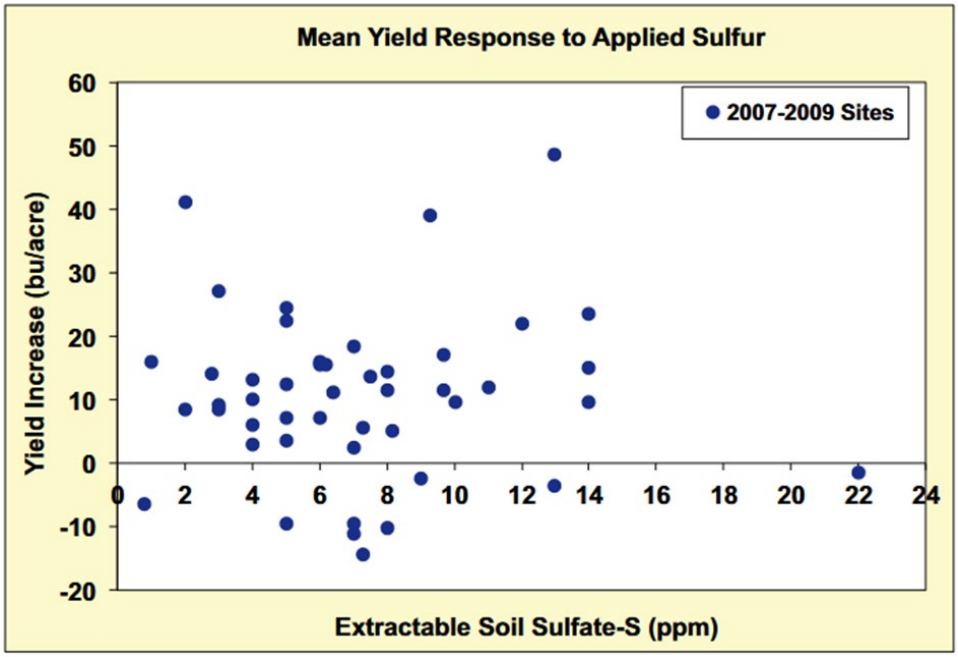


Figure 2. Corn grain yield response to S application as related to extractable soil sulfate-S concentration (0- to 6-inch soil depth) in the no-S control, 2007–2009 (Source: https://store.extension.iastate.edu/Product/CROP3072-pdf)

Table 1. Canola yield response to sulfur study conducted by Dr. Ed Deibert in 1996 in north-central North Dakota.

		Canola Yield (lb/ac)		
S rate (lb/ac)	S source	Hilltop	Slope	Footslope
0		30	240	1,460
20	AMS	1,650	1,670	1,720
40	AMS	1,800	1,860	2,170
40	Elemental	620	1,060	1,630

As we move into the 2025 growing season keeping a few key points in mind should lead to successful and economical S management:

- Apply S in the sulfate form to maximize effectiveness and crop response. Elemental S is not immediately available and should be avoided, especially as a rescue treatment or in canola production systems.
- Sulfate-S soil tests are not diagnostic of impending deficiency or crop response. If above average rainfall is received, the field is sandy, or organic matter is <3%, strongly consider a sulfate-S application.
- Generally, 10 lbs/ac of sulfate-S is adequate to prevent deficiency of most field crops in North Dakota. Canola should receive between 20 and 30 lbs/ac of sulfate-S each year, regardless of weather or soil characteristics.
- When considering a "new" S product, check out the ingredient list and compare the cost to other fertilizer products. Several of the products I have been asked about recently are simply calcium sulfate with added proprietary binding agents—these products will likely be equally effective to other calcium sulfate products. Here's a tip: with any new product, check out the material safety data sheet (SDS) as it will list out the actual contents of the fertilizer product being marketed.

Brady Goettl
Extension Soil Science Specialist

WAKE UP CALL [2]

Over the past couple of months, we've been actively engaged in numerous meetings, with January and February being especially busy and filled with incredible events. While we truly enjoy traveling across the state to connect with farmers, ranchers, agronomists, and NDSU colleagues, we've noticed that erosion continues to be the biggest threat to soil health in North Dakota. This issue isn't just limited to our state but is a challenge that can be observed throughout the Midwest. Our soils are much like the human body. We can't afford to lose blood, just as we can't afford to lose soil. Both are vital to sustaining life, and without them, everything else starts to suffer. Stop the soil bleed!

Here we are summarizing an almost 10-year-old article that Dr. Dave Franzen (emeritus NDSU professor) published in the Crop and Pest Report Issue of May 7, 2015.

"This Winter we had the unhappy reminder that we live in a very windy place. The Fargo radio abuzz with calls about "black snow". The real reason was that the fall favored tillage, and many acres were tilled; and many were tilled to excess. Wind erosion of soil is always three-dimensional. Soil moves with surface creep (usually larger particles that start to move), followed by saltation (particles hitting particles, combining particle energy with wind energy to move the larger particles into the air) and suspension (usually small clay/silt-sized particles, at least with winds less than 50 mph). Soil moving by surface creep moves into the ditch and into the neighbor's fields. This is what we see. Suspended soil is the real soil loss, estimated at about 10 times what you see in the ditch. Suspended soil does not land in the ditch, it lands in the Atlantic Ocean, or Ohio, or Pennsylvania, or New York, or London. It is lost forever.

Back in 2014, Dr. David Hopkins (emeritus NDSU professor) and his student Brandon Montgomery worked on a project where they visited the exact locations of several soils characterized about 1960 by the then SCS, now NRCS. One soil in Walsh County had 34 inches of soil above the C horizon (unadulterated, little-changed parent material). When they visited it in 2014, there was 15 inches of soil above the C; A loss in 50 years of 19 inches of soil. Can you really call it topsoil anymore? The 'topsoil' is a weak blend of a small amount of the original topsoil mixed with a large amount of subsoil".

We echo Dr. Franzen's words. In 2025, we observed very similar trends across the state. The most straightforward way to minimize soil loss is through limiting fall tillage and shifting toward no-till farming. The most effective way to prevent soil loss is to leave the soil structure intact and protected by crop residue. No-till offers numerous benefits to soils, such as improved soil structure, increased organic matter, increased water infiltration, and enhanced soil biology. There are successful no-till farmers all across the state who can serve as an example of how to minimize erosion. Strip-till also surges as a practice that can reduce erosion. Strip-till corn and no-till soybeans can offer erosion control benefits and reduced equipment and labor costs compared to chisel plowing and disking every year.

Ultimately, following soil health principles (Figure 1) will not only reduce erosion but also increase carbon sequestration and provide a wide range of additional benefits, from enhanced soil fertility to improved resilience against extreme weather events.

Figure 1. Soil Health Principles.

- Minimize Soil Disturbance – Practices include no-tillage, minimum tillage, and strip tillage.
- Maximize Soil Cover – Protect the soil surface with vegetation (cover crops, cash crops, perennials).
- Maximize Biodiversity – Promote plant diversity with cash and cover crops and integrate crop-livestock systems whenever possible.
- Maximize Continuous Living Roots – Utilize cover crops and perennials in degraded areas.

Carlos Pires
Extension Soil Health Specialist

Brady Goettl
Extension Soil Science Specialist

Weeds

RAPID GENETIC TESTS FOR CONFIRMATION OF HERBICIDE-RESISTANT KOCHIA AND PIGWEEDS AVAILABLE

We are happy to announce that the DNA-based testing program for herbicide resistance in kochia and pigweeds is being offered again at no charge for North Dakota residents in 2025. These tests offer quick confirmation of target-site mutations that confer resistance to herbicide Groups 2 (ALS-inhibitors), 9 (EPSPS-inhibitors), and 14 (PPO-inhibitors) in kochia and waterhemp. Group 2 resistance can also be confirmed in any pigweed species. Standard turnaround time for results will be 7 days from sample arrival at the National Agricultural Genotyping Center (NAGC).

Thanks to sponsorships from the North Dakota Corn Utilization Council, North Dakota Soybean Council, North Dakota Specialty Crop Block Grant, and Minor Crop Utilization Grants, funding is available to test the first 1,000 North Dakota pigweed or kochia samples for no charge. County Extension offices may have a limited supply of testing kits on hand with instructions on how to collect and send samples. Once kits run out at county offices, samples can be submitted following the self-mailing instructions and submission form: https://genotypingcenter.com/product/kochia/. Free testing is currently limited to 4 samples per farming operation. Additional tests, as well as samples originating from outside of North Dakota, will have charges listed in Table 1. Please use the non-ND submission form also provided at NAGC's website.

Table 1. Cost of DNA test for herbicide resistance in pigweeds and kochia for non-ND residents.

Marker	Pigweed (Individual Test)	Kochia (Individual Test)	All three tests (Waterhemp or Kochia)
ALS	$ 75	$ 75	$ 195
EPSPS	$ 75	$ 75	
PPO	$ 75	$ 135	

It is important to note that these tests can only detect target-site mutations that confer herbicide resistance. Additionally, only the most commonly reported mutations are covered by these tests. The tests are highly accurate for these known mutations, but it is important to know that resistance mechanisms exist that are not detected by these tests. There are many mechanisms that confer resistance to Group 2 and 9 herbicides. However, we are confident in detecting most cases of resistance to Group 14 herbicides based on known resistance mechanisms within the state. To get the most impactful information from these DNA tests, leaves should be collected from plants that survive the herbicide in question. The application will remove susceptible plants and increase confidence of the resistance determination. Individual sample results will remain confidential. Test results will be sent directly from the NAGC to the e-mail provided on the submission form. The NAGC will aggregate results to provide data at the county-level, but no individual information will be released. The attached map (Figure 1) highlights counties where populations of waterhemp and kochia have been reported to contain resistance to all 3 groups tested.

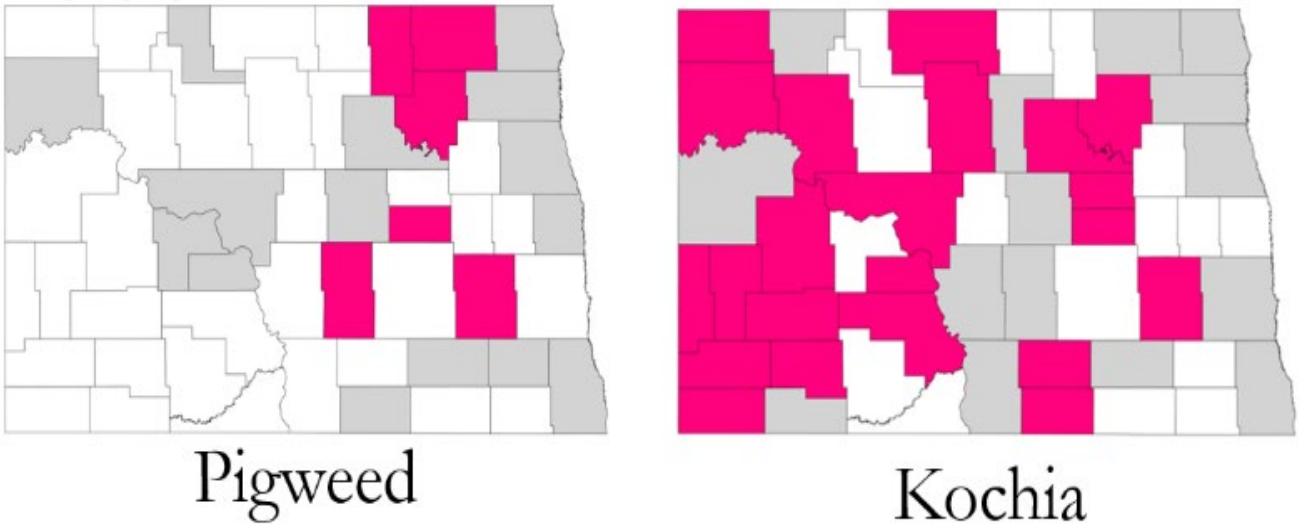


Figure 1. Counties in pink contain at least one population of pigweed (left) or kochia (right) with genetically confirmed resistance to Groups 2, 9, and 14 herbicides. Gray counties are those that submitted samples, but did not have resistance to all three herbicide groups.

This sampling program using DNA testing began in the Fall of 2023. To date, the NAGC has received 441 kochia samples from 37 counties in North Dakota. Results found 40% of samples contained a mutation that confers resistance to Group 14 herbicides, 58% of samples contained a mutation that confers resistance to glyphosate, and 24% of samples contained mutations that confer resistance to Group 2 herbicides. For pigweeds, 79 samples have been submitted from 21 counties, with 18% containing a mutation conferring resistance to Group 14, 27% containing a mutation conferring resistance to Group 9, and 33% containing a mutation conferring resistance to Group 2. For pigweeds, Group 2 results are pooled across all species, while Groups 9 and 14 were waterhemp only. It is important to note that DNA testing can only detect known target-site mutations that confer resistance. There could be unknown mutations, or other mechanisms of resistance that these tests cannot detect. There are several known non-target site mechanisms of resistance to Herbicide Groups 2 and 9.

Collection Instructions

1. Locate pigweeds or kochia in the field. Proper ID is important before collecting leaf samples.

2. Collect two leaves near the top of the plant (leaves must be larger than a standard hole-punch to allow for adequate DNA extraction). Place two (2) leaves from a single plant into one (1) zipper bag or small envelope. DO NOT mix leaves from multiple plants.

3. With a marker, label the outside of the collection bag with a unique Sample ID. The Sample ID can be in the following format: Year-Month-County-Personal Field ID (Example: 24-05-Cass-SE4). Make sure to also write the Sample ID on the submission form.

4. Sample additional weeds in fields of your choice by following Steps 1-3. **Send a max of four (4) total plants for testing.** Keep samples dry and at room temperature before shipping.

5. Mail the submission form and individually-packaged samples in a large business envelope to:

National Ag Genotyping Center
1616 Albrecht Blvd N
Fargo, ND 58102

We are expanding the sampling program next year to include green foxtail and wild oat. NAGC is now accepting leaf samples from these weeds for DNA test development. Please submit 1-2 leaf samples from green foxtail and wild oat that escaped Group 1 and/or Group 2 herbicide applications in North Dakota fields. Please note that results of samples for wild oat and green foxtail may not arrive until 2026, as these tests are still being validated. The goal for 2026 is to have the same 7-day turnaround that is currently possible with pigweeds and kochia.

Joe Ikley
Assistant Professor/Extension Weed Specialist

Zack Bateson
NAGC Research Director

NORTH DAKOTA WEED RESISTANCE MANAGEMENT SURVEY

Managing herbicide resistant weeds can be challenge. Integrated weed management can help slow the development and spread of herbicide resistant weeds. However, several factors including agronomic, economic, environmental and social issues influence how farmers adopt integrated weed management practices. During an NDSU Extension weed management bus tour to Nebraska, a participant stated, “The social science aspect of weed resistance is also important.” That comment has stuck with me and sparked my interest in researching this topic. I am currently a Ph.D. candidate in the Environmental Conservation Sciences program and my research focuses on understanding economic and social influences on North Dakota farmers’ weed management decisions. We invite North Dakota farmers and those who advise North Dakota farmers on weed management to participate in this research survey. It should take about 20 minutes to complete. Please go here to fill out the survey. Thank you for your time and support of this research project.

2019 Weed Management Bus Tour in Nebraska

Alicia Harstad
NDSU Extension – Barnes County Extension Agent

CONFIRM YOUR 2025 ETHOFUMESATE DELIVERY

I have heard reports that delivery of certain ethofumesate brands to retailers might be delayed. Please verify your ethofumesate order and plan a contingency plan in the event your order is hindered by supply chain challenges.

NEW HERBICIDES IN SUGARBEET IN 2025

Here we go; it's another new season. I like to begin the season by reviewing label changes with sugarbeet weed control products from the previous year.

Maxtron™ 4SC herbicide, Albaugh Crop Protection. Maxtron is an ethofumesate product for use preplant, preemergence, and postemergence in sugarbeet. Maxtron is effective for broadleaf and grass weed control including glyphosate resistant kochia and waterhemp in sugarbeet.

Enversa™ herbicide, Corteva agriscience. Enversa is an encapsulated acetochlor product for use postemergence in sugarbeet. Enversa is effective on broadleaf and grass weeds.

Ultra Blazer® herbicide, UPL. The Section 18 Emergence Exemption for glyphosate resistant waterhemp control in sugarbeet in Minnesota and North Dakota expired in July 2024. We intend to apply for a new emergency exemption in 2025 for sugarbeet greater than the 6-leaf stage.

PREPARING FOR FIELDS TO BE PLANTED TO SUGARBEET IN 2026

I get that its plant 2025 but why not jump ahead and begin planning for 2026, especially for 2025 fields scheduled to be planted to sugarbeet in 2026. Consider the following best management practices as you prepare for 2025 but anticipate 2026.

1. Determine the most important and the second most important weed control challenge in field and plan your 2025 weed control program accordingly.
2. Weed biology should be a consideration as you plan ahead for sugarbeet. For example, we know that kochia seed is viable 1- to 2-years. Thus, double-down on kochia control in 2025 before sugarbeet in 2026. You may reconsider a 2025 field loaded with waterhemp and scheduled for sugarbeet in 2026.
3. Try to select herbicides from site of action families that are unique or different from weed control products intended for use in sugarbeet in 2026.
4. Be mindful of crop rotational restrictions that may prohibit sugarbeet planting or injure sugarbeet in 2026. Most herbicides are degraded by soil microbes requiring moisture and warm soil temperatures. Many factors effect herbicide persistence including moisture in June, July, and August, soil PH, soil texture, soil organic matter, and tillage system.
5. Plan your after-harvest activities including drainage, spent lime application, and fall tillage, as examples. If possible, consider if fall seeded cover crops fit into your schedule to reduce the likelihood of blowing soil during the winter.
6. Avoid planting sugarbeet into fields with no or limited previous experiences. Learning the weed species, sensitive or resistant weeds, and spatial pattern of weeds across the landscapes in 2025 makes for an easier transition to sugarbeet in 2026 than no experiences.

Tom Peters
Extension Sugarbeet Agronomist
NDSU & U of MN

AROUND THE STATE

SOUTH-CENTRAL/SOUTHEAST ND

The meeting season is nearly over. Now it's time to wait to get into the field which looks like it will be quite awhile for at least most of this part of the state.

For this year I have chosen 27 NDAWN stations in this region to cover the greatest parts of this region. The average maximum daily air temperature from February 25 through March 24, 2025 from these stations ranged from 40 degrees Fahrenheit near Finley in Steele County and McHenry in Eddy County to 49 degrees Fahrenheit near Brampton in Sargent County, Livona in Emmons County, and Oakes in Dickey County with the average for the region of these stations being 44 degrees Fahrenheit! The average daily maximum air temperature near Cooperstown in Griggs was 42 degrees Fahrenheit during this period, 11.2 degrees Fahrenheit above the historical average for the period, making it the third warmest period on record near Cooperstown and the top record being 45.3 degrees Fahrenheit in 2012! The minimum daily air temperature from February 25 through March 24, 2025 for the region ranged from 16 degrees Fahrenheit near Hope in Steele County to 23 degrees Fahrenheit near Livona in Emmons County and Sonora in Richland County with the average for the region being 19.4 degrees Fahrenheit. The average daily minimum air temperature near Cooperstown was 17 degrees Fahrenheit, 5.8 degrees Fahrenheit above the historical average for Cooperstown, making it the sixth warmest minimum air temperature for the period near Cooperstown!

For these 27 NDAWN stations across the region, the liquid equivalent for the above-mentioned period ranged from 0.02 inch near Tappen in Kidder County and near Wing in Burleigh County to 0.73 inch near Mooreton in Richland County with the average for the region being 0.22 inch! Cooperstown received 0.31 liquid equivalent of rainfall during this period, 0.32 inch below the historical data, making it the third driest period on record for Cooperstown! Based upon those sites with above freezing temperatures, Linton in Emmons County and Pickardville in Sheridan have 0% soil saturation at 39 inches in the soil, so these areas are very dry. Mooreton in Richland County on the other hand has a soil saturation right now of 91%. The average soil moisture for the region for those sites unthawed at 39 inches is only 56% of soil saturation. The far western counties of this region received the lowest liquid equivalent during this time period and have the lest subsoil moisture at this moment making them very dry to start the season.

These warmer than normal air temperatures have allowed complete frost removal from the soil profile near Linton and Livona in Emmons County, near Pickardsville in Sheridan County, and near Wishek in McIntosh County. The deepest frost depth yet in the region is 49 inches near Robinson in Kidder County and Wing in Burleigh County. The average frost depth for the region is 20 inches. The highest 4-inch bare soil temperature on March 25, 2025 was 45 degrees Fahrenheit near Livona in Emmons County!

The long-range forecast doesn't look good for early planting in the entire region as there are no days with the low temperature forecasted to be above freezing until April 22, 2025! Not much precipitation is forecasted either for April, especially for the entire region, especially those farther west.

As you are purchasing soybean seed, if you have had problems with phytophthora and pythium in the past, be sure to purchase seed with fungicide seed treatments that have the most effective active ingredients and rates to protect the young germinating and emerging seedlings, especially since it looks to be cold.

Remember high rates of dicamba cannot be applied legally to Xtend and XtendFlex soybean varieties this spring as preemergence or postemergence applications. If you are planting these types of soybeans and have had problems controlling kochia and waterhemp, please consider using paraquat at high rates as a burndown in no-tillage fields and include the most effective herbicides and rates of preemergence herbicides for kochia and waterhemp. Please include metribuzin at 0.5 pounds active ingredient along with sulfentrazone at 0.25 pounds active ingredient in all soybean fields with history of dense populations of kochia and waterhemp or where kochia and waterhemp have been difficult to control with postemergence herbicides. Please be careful and understand soil pH, soil texture, and soil organic matter and reduce the rates of these two herbicides if you believe soybean injury will occur.

Jeff Stachler
Extension Cropping Systems Specialist
Carrington Research Extension Center

SOUTHWEST ND

Beware of Thin Stands in Winter Wheat

Although winter wheat acres in North Dakota are less common than spring wheat, the USDA NASS estimates that 120,000 acres were seeded to winter wheat last fall. Due to persistent drought conditions, winter wheat germination and emergence was significantly delayed last fall, with some acres still below the soil surface (Figure 1) and others just beginning to emerge. Given reports of patchy fields, now and in the coming weeks may be a good time to assess stands for emergence and uniformity.

In dry years like this, multiple factors can hinder stand establishment. Drought reduces seed germination and seedling emergence, while low soil moisture can slow fertilizer mineralization, limiting nutrient availability for plant uptake. By checking winter wheat stands early in the season, growers can plan for a 'rescue' nitrogen fertilization ahead of time. If stands are thin, consider applying nitrogen to encourage tillering. However, avoid excessive nitrogen, as it can lead to nitrate accumulation.

The ideal timing for nitrogen application to enhance tillering is between tillering (Feekes 2-3) and the green-up stage (Feekes 4-5), when the plants are actively growing, but before jointing. Applying nitrogen too early, especially under the current dry conditions, may result in losses due to volatilization before the crop can effectively use it.
For detailed NDSU winter wheat fertility recommendations tailored to different yield potential scenarios (low, medium, or high), refer to this NDSU Extension's publication.

Late-Emerged Winter Wheat and Vernalization Concerns

Winter wheat requires a period of cold weather (<48°F) for vernalization, a physiological process necessary for transitioning into the reproductive stage and producing a grain head. The required duration of cold exposure typically ranges from 4 to 8 weeks, depending on the variety.

In addition to the patchy, thin stands observed in winter wheat fields across western North Dakota, another concern is whether late-emerged winter wheat will vernalize and produce productive tillers in the spring. Fortunately, winter wheat does not need to emerge aboveground to vernalize—as long as the seed has

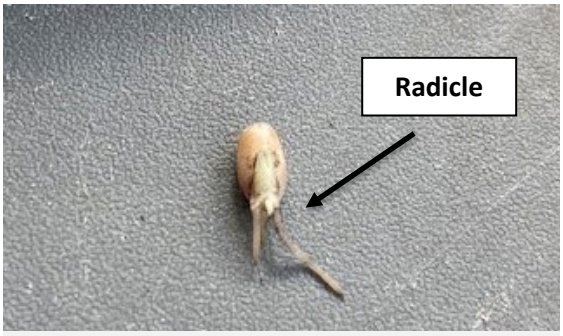


Figure 1. Winter wheat seed showing early signs of germination (radicle emerged from seed). Dickinson, ND, 3/17/2025. Photo credit: Victor Gomes.

germinated, it can still undergo vernalization and develop productive tillers. To assess your crop's status, scout fields that have not yet emerged and dig into the seed furrow to evaluate seed germination. Germination is identified by the protrusion of the radicle (the first seminal root) (Figure 1).

Plants that have emerged or at least germinated in the ground by early-mid March, will likely experience a sufficiently long cold period through March and April to meet vernalization requirements. However, if seeds remain dormant in the soil with no signs of germination, the timing of germination may become an issue.

Another potential challenge in fields with uneven germination and emergence is variability in growth stages, which could complicate management decisions later in the season. More information on winter wheat vernalization can be found here.

Despite these concerns, USDA reports from the week of March 3rd rated winter wheat conditions at 47% fair and 39% good statewide. However, given the high within-field variability caused by dry conditions at planting, field scouting will be essential this spring.

Considerations for Fertilization This Time of Year

Over the past couple of weeks, field activity has picked up, with growers taking advantage of favorable weather to apply fertilizer. While the early end to winter and thawing soils are encouraging, a few key considerations should be kept in mind.

Figure 2. Surface applied urea and ammonium sulfate near Scranton, ND on March 17, 2025. Photo credit: Filipe Patussi.

The risk of nutrient losses from early fertilizer applications is not limited to winter wheat fields. With warmer soil temperatures and dry conditions, nitrogen losses—especially from surface-applied fertilizer—could be significant. Some farmers reported cutting back their nitrogen rates by about 20-30% to cope with potential losses. While this is a valid economical consideration, there are other factors to bear in mind. Brady Goettl, Soil Science & Extension Soil Science Specialist, says that "given the high fertilizer prices this year, the best nitrogen management strategy will be to delay application until close to or during active plant growth, this is the best first step for increasing fertilizer efficiency and maximizing profitability."

Furthermore, other strategies to minimize nitrogen losses includes banding or injecting it into the soil. Using a urease or nitrification inhibitor is advisable, as conditions favorable for volatilization—such as extended dry periods with evaporative winds—are likely to persist for several days after application. Keep in mind that urea requires at least half an inch of rainfall within 48 hours to minimize volatilization losses, unless temperatures remain relatively cool.

Victor Gomes
Extension Cropping Systems Specialist
Dickinson Research Extension Center

North Dakota State University
CROP & PEST REPORT
NDSU Dept. 7660; PO Box 6050
Fargo, ND 58108-6050

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Janet Knodel
R. Wade Webster
Co-Editor

Entomology
701-231-7915

Plant Sciences
701-231-7971

Soils
701-231-8881

Sam Markell
Marcia McMullen
Co-Editors

Plant Pathology
701-231-8363

Weeds
701-231-7972

Ag Engineering
701-231-7261

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This publication will be made available in alternative formats for people with disabilities upon request (701) 231-7881.
This publication is supported in part by the National Institute of Food and Agriculture, Crop Protection and Pest Management - Extension Implementation Program, award number 2024-70006-43752.