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CANOLA FLEA BEETLES EMERGING

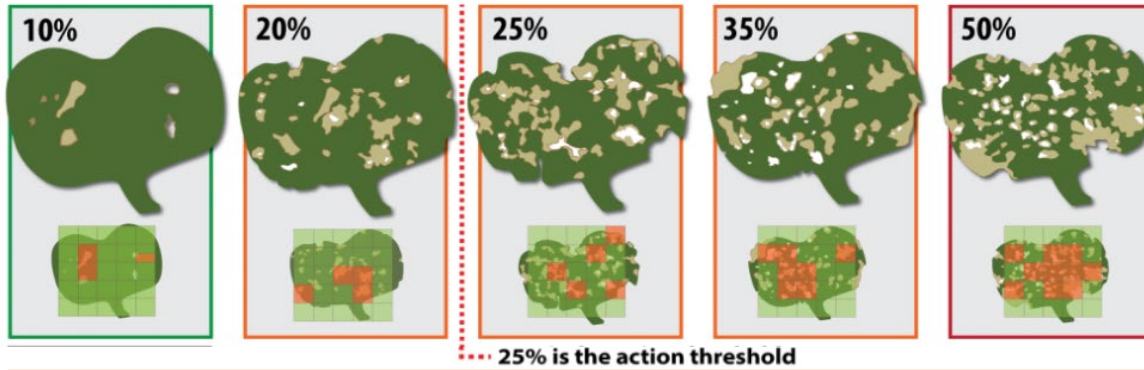
Spring temperatures have warmed up above 60° F causing the flea beetles to emerge from overwintering areas and search for volunteer canola and other Brassicaceae weeds (wild mustard) to feed on. Crucifer and striped flea beetles have been observed in the northeast (Anitha Chirumamilla, LREC), Benson County (Scott Knoke) and northwest Minnesota (Dave Grafstrom). Both the striped flea beetle and the crucifer flea beetle have been observed with the crucifer flea beetle being more common. Flea beetles are easy to identify in the field by their flea-like hopping behavior. The crucifer flea beetle adult is a small, oval-shaped, dark beetle with an iridescent blue sheen on the black wing covers, measuring about 1/8 inch long. The striped flea beetle adult is similar to the crucifer flea beetle in size and has two yellow stripes on its black wing covers.



Flea beetle feeding on volunteer canola (on left) and yellow sticky traps used to monitor adult beetles (Anitha Chirumamilla, LREC) (P. Beauzay)

As canola is planted, farmers and crop consultants need to plan to **scout for flea beetles as soon as the crop emerges**, at least 2-3 times a week. Insecticide seed treatments need to be confirmed they are working and providing good protection against flea beetle damage during the first 3 weeks after canola emergence. Feeding damage is often worst with hot temperatures, low moisture and low plant stands. Continue to scout until canola is in the 6-8 leaf stage when the crop can tolerate most flea beetle feeding pressure.

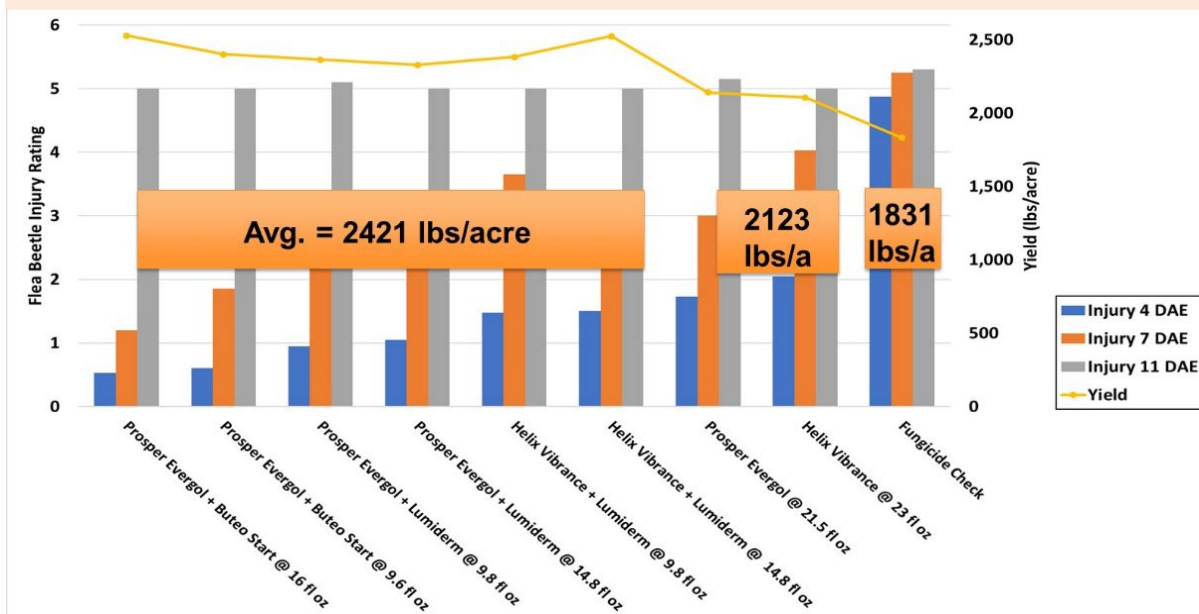
If more than 25% defoliation is observed in canola fields, a foliar insecticide spray is warranted to prevent yield loss. Pyrethroids (3A) are the only class of insecticide registered for foliar control of flea beetles in canola (active ingredients - bifenthrin, deltamethrin, lambda-cyhalothrin, zeta-cypermethrin). One premix is labeled as Besiege (chlorantraniliprole + lambda-cyhalothrin). For insecticides registered for control of flea beetles for canola, please refer to the [2023 North Dakota Field Crop Insect Management Guide](#).



Source: Canola Council of Canada, <https://www.canolacouncil.org/canola-encyclopedia/insects/flea-beetles/#action-thresholds-and-economic-injury>

Our Fargo 2022 insecticide seed treatment trials against flea beetles examined thiamethoxam (Helix) at 23 fl oz / cwt alone and in combination with cyantraniliprole (Lumiderm, Fortenza), and clothianidin (Prosper) at 21.5 fl oz / cwt alone, in combination with cyantraniliprole (Lumiderm, Fortenza), and in combination with flupyradifurone (Buteo Start) (see Table 1). Flea beetle populations were about 75% striped flea beetle and 25% crucifer flea beetle. For feeding injury ratings, we observed slightly higher feeding injury when thiamethoxam and clothianidin were used alone compared to those same actives in combination with either cyantraniliprole or flupyradifurone. Yield also was significantly higher for

Table 1. Seed Treatment Means for Flea Beetle Injury Rating and Yield at Fargo, 2022



the combination of two active ingredients (average of 2421 lbs/acre), compared to the single active ingredient (average of 2123 lbs/acre) and the untreated check (1831 lbs/acre).

Janet J. Knodel
Extension Entomologist



NATIONAL SCREENING OF COMMERCIALY AVAILABLE BIOLOGICAL SEED TREATMENT FOR SOYBEAN

Biological seed treatment is a growing market in the US, and soybean growers are interested in understanding the benefits of applying biological products to the seed. In many cases, there is little or no third-party evidence regarding the ability of these biological seed treatments to improve soybean yield and profitability. Therefore, the objective of this study was to evaluate it there are situations where biological seed treatments improve soybean grain yield.

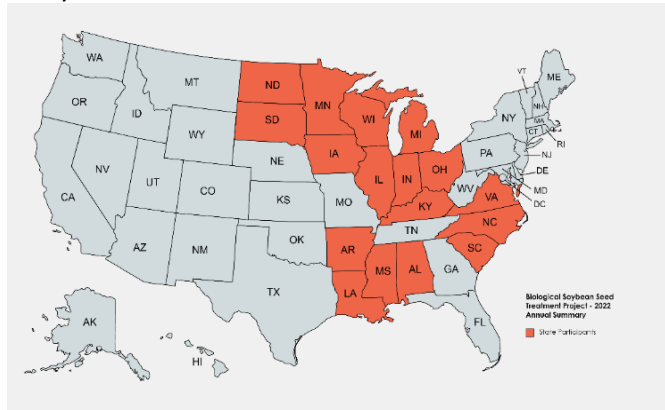


Figure 1. Map of state participants in this project in 2022 (in red).

Methodology

In 2022, we established small plot trials in 25 locations across 17 states (Figure 1), including North Dakota. In each location, we evaluated the influence of nine biological soybean seed treatments and one untreated control on grain yield. The experiment design was a randomized complete block design with six to eight replications at all sites. Products were applied to the seeds before planting, and the application protocol used was according to each product's recommendations (labels). Each state collaborator obtained the soybean varieties recommended for their region. All seed came treated with fungicide + insecticide to represent practices adopted by farmers. Soybean yield was adjusted to 13% moisture concentration prior to data analysis.

| Treatment (product) | Active ingredients |
|---------------------|---|
| 1 | <i>Azospirillum brasilense, Bacillus licheniformis, Bacillus amyloliquefaciens, Bacillus subtilis, Pseudomonas fluorescens, Rhizobium</i> |
| 2 | <i>Trichoderma virens</i> |
| 3 | <i>Bradyrhizobium spp.</i> |
| 4 | <i>Bacillus subtilis, Bacillus amyloliquefaciens, Bradyrhizobium japonicum</i> |
| 5 | <i>Pantoea agglomerans</i> |
| 6 | <i>Pseudomonas brassicacearum</i> |
| 7 | <i>Bradyrhizobium elkanii, Delftia acidovorans + Bacillus velezensis</i> |
| 8 | <i>Bacillus velezensis</i> |
| 9 | <i>Glomus intraradices, Glomus mosseae, Glomus aggregatum, Glomus etunicatum</i> |
| 10 | Untreated Control |

Table 1. List of treatments (products) and active ingredients in each biological product.

Results

A summary of the average grain yield (in bu/acre) by product across sites is shown in Figure 1. There were no significant soybean yield differences between products. The untreated control is indicated in green. The experiment will be repeated in 2023 (The multi-year research project is coordinated by Fabiano Colet, Emma Matcham, and Laura E. Lindsey, The Ohio State University).

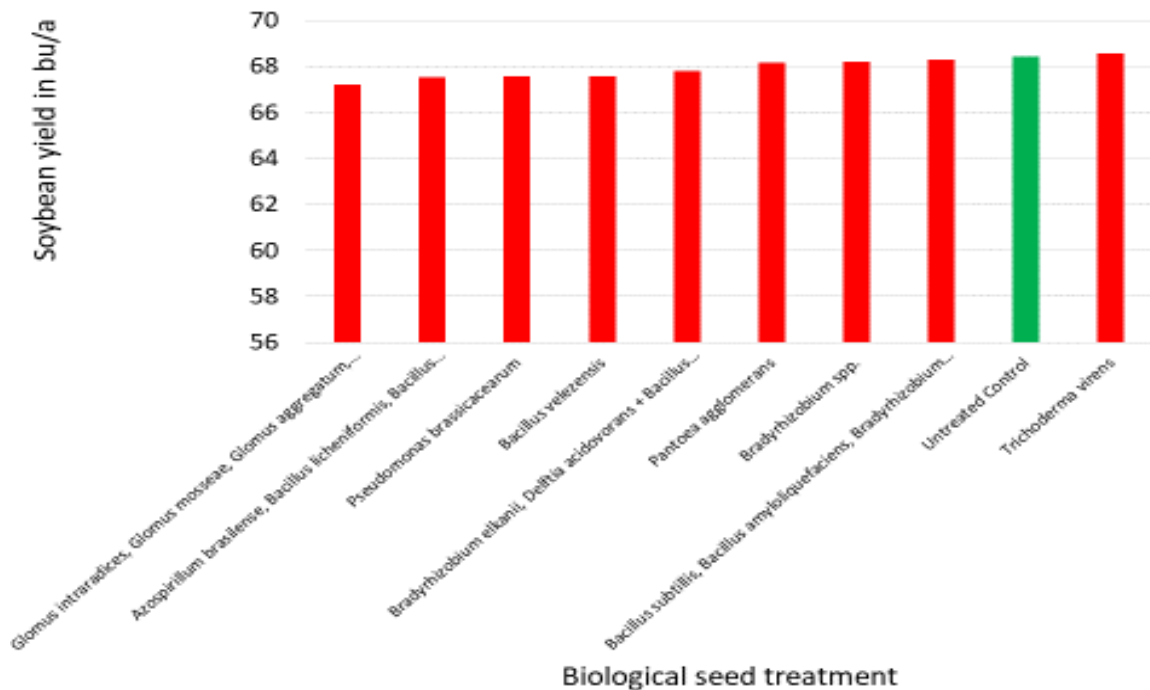
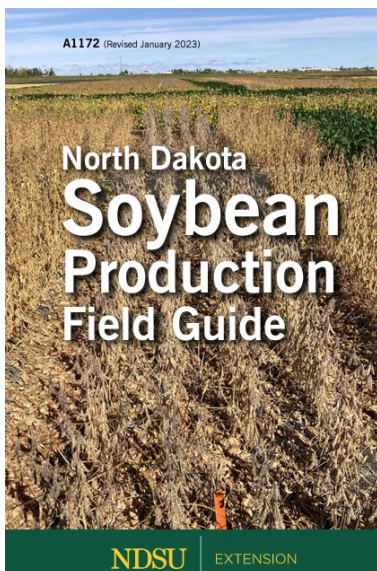


Figure 1. Average soybean yield in bushel per acre, from lowest to highest yield, for biological seed treatments at 25 US environments, in 2022.

NDSU EXTENSION UPDATED SOYBEAN PRODUCTION FIELD GUIDE



Producers, agricultural consultants, and others interested in agriculture can use the updated “Soybean Production Field Guide for North Dakota” (Publication A1172) to get the latest information on soybean production. The update has major revisions about irrigation, disease, insect and weed management, and several management practices.

An online version of the updated publication is available at <https://www.ndsu.edu/agriculture/sites/default/files/2023-01/a1172.pdf>

Topics covered in the publication include understanding the growth and development of soybean plants, field selection and preparation, planting date guidelines, seeding rates, frost tolerance and damage, soil fertility requirements, information on irrigation, weed control, insect pest and disease management, harvesting, drying and storage. At the end of the publication, there are several photos of agronomy issues, insects and diseases common in soybean production.

The publication is also available in print at NDSU Research Extension Centers, NDSU Extension county offices, or at the NDSU Distribution Center in Fargo by calling 701-231-7883 or emailing ndsu.distributionctr@ndsu.edu.

What does the soybean crop need to maximize yield?

Green plants use the energy in sunlight to power photosynthesis. This process uses water, carbon dioxide from the air and light energy to produce sugars. Sugars are converted into plant dry matter. Chlorophyll in green leaves, stems and pods gathers light for photosynthesis. During vegetative growth, plant dry matter distributed to leaves, stems and roots prepares the plant for the reproductive phase, when the plant will be producing seed.

The amount and distribution of leaf area together make up the *canopy*, and canopy cover increases as leaf area increases. Leaf area is measured as the leaf area index (LAI) or the acres of leaf area per acre of crop. Because leaves are not uniformly distributed, an LAI of 'one' does not mean that the canopy is complete. Light interception increases as the canopy adequately develops, from less than 1% of the amount of sunlight that falls on an acre as plants emerge, to nearly 100% during seed fill. Since a single leaf cannot utilize all of the light energy incident upon it, multiple layers of leaves, or LAI, are required to optimize photosynthetic output of the crop. Because intercepted light is the foundation for yield, having a complete canopy throughout seed fill is a major goal.

Stage VC to V3

Small plants with little leaf area do not intercept very much sunlight, so when plants stay small during the lengthening days of May and June, they grow slowly.

- Early planting helps to start the photosynthesis process quicker, as long as temperatures allow for timely emergence and vigorous growth after emergence.
- Plants early in the season growing under cool or wet conditions often have poor leaf color, usually related to limited root development and low availability of nutrients from the soil.
- Plants growing in narrow rows (<30) develop leaf area at about the same rate as plants in wide rows, but the leaf area is better distributed, so light interception is higher during early vegetative growth in narrow rows. Narrow rows provide an advantage in the shorter vegetative development periods in northern environments or in late-planted soybeans.
- Increasing seeding rate and therefore established plants, usually also increases the light interception during the early vegetative phase.



Adapted from a Science for Success publication. For more information see: 'The Soybean Growth Cycle: Important Risk, Management, and Misconceptions' click [here](#). For explanation about soybean vegetative growth, see NDSU [video](#).

[Hans Kandel](#)

Extension Agronomist Broadleaf Crops

NDSU SEED YIELD SUMMARY OF DRY BEAN PLANT ESTABLISHMENT FACTORS

Table 1 displays a seed yield summary for two options among each of six dry bean plant establishment factors. With exceptions (tillage system and planting dates), using option A results in increased yield compared to option B, based on

multiple NDSU field trials conducted during the period of 2007-22. Pinto bean was the market class included in tests among all factors, but black and navy bean were included in planting date and row spacing trials.

- **Variety selection** – Data from seven 2022 variety trials with pinto bean were reviewed. Varieties yielding above the trial average ranged from 1-11% greater yield, with an average of 6%.
- **Tillage system** – Yield was similar among five pinto bean trials at the Carrington REC comparing performance with strip-till versus conventional. Benefits of this reduced tillage system can be obtained without sacrifice of yield.
- **Planting date** – Among six site-years of trials at Carrington and Prosper, planting pinto, black and navy bean early or late did not improve yield compared to the generally normal planting period of the last 7-10 days of May through the first 7-10 days of June.
- **Plant stand** – Among three trials at Carrington and Langdon, pinto bean yield averaged 1650 pounds per acre at 87,000 plants per acre compared to 1570 pounds per acre with a stand of 72,000 plants per acre.
- **Row spacing** – Using reduced row spacing (14- to 22-inch) with pinto, black, and navy bean, yield increased 20, 9, and 22%, respectively, compared to wide rows (28- or 30-inch). The field trials were conducted without presence of white mold (sclerotinia). The economics of field equipment replacement needs to be considered if needed for transition from wide- to intermediate-row spacing.
- **Seed inoculation with rhizobia bacteria** – Among 10 trials averaged across five North Dakota locations, a modest yield increase of 2% was obtained with seed inoculation.
- **Phosphorus (P) fertilizer application** – Modest rates of 10-34-0 liquid fertilizer (generally about 3 gallons per acre) applied with the seed (in-furrow) or within two inches of the seed at planting in low-P testing soils substantially increased yield compared to a broadcast application at one-third higher rate. In-furrow applied fertilizer at greater rates than tested or with dry soil conditions may result in reduced plant stands.

| Factor | Option A | A Yield > B (%) | Option B | NDSU trials (2004-22) |
|--|--------------------------------|-----------------|------------------------|-----------------------|
| 1. Variety selection | above trial average | 6 | trial average | 7 |
| 2. Tillage system | strip-till | similar | conventional | 5 |
| 3. Planting date (pinto, black and navy) | early (May 11-24) | similar | normal (May 22-June 5) | 6 |
| | late (June 5-18) | | | |
| 4. Plant stand (Plants per acre) | 87,000 | 5 | 72,000 | 3 |
| 5. Row spacing -pinto -black -navy | intermediate (14-22 inches) | 20 | wide | 11 |
| | | 9 | | 4 |
| | | 22 | | 3 |
| 6. Seed inoculation with rhizobia bacteria | yes | 2 | no | 10 |
| 7. P fertilizer application | in-furrow or band ² | 16 | broadcast | 3 |

¹Pinto bean unless other market classes identified.
²10-34-0 at 3-6 gpa (two-third of broadcast rate); band=2 inches from seed.

Compiled by Greg Endres, Extension agronomist (May 2023)

Table 1. Summary of dry bean seed yield response with plant establishment factors based on NDSU research, 2007-2022

[Greg Endres](#)

NDSU Extension Agronomist
 Carrington Research Extension Center

[Hans Kandel](#), NDSU Extension Agronomist – Broadleaf Crops

BROADLEAF WEEDS ARE EMERGING IN FIELDS

What a difference a week makes! Broadleaf weeds including kochia, common ragweed, common lambsquarters, Venice mallow, and waterhemp are emerging in fields in the Fargo area in response to rains, warm temperatures or a combination of both. Weeds emerging before slow growing crops like sugarbeet must be actively managed for optimum yield. Evans and Dexter reported sugarbeet recoverable sucrose per acres was best when sugarbeet emerged before redroot pigweed emerged (Table). Sugarbeet emerging at the same time or sugarbeet emerging after pigweed sustained a 6% or a 44% yield reduction, respectively. Well, reality is its after May 15th and there is still sugarbeet to be planted. What can we do about it?

Planting date, environment and weed emergence in sugarbeet (Evans and Dexter, 1978)

| Weed | Extractable sucrose per acre | | |
|--------------------------|------------------------------|--------|-----------|
| | Glyndon | Fargo | Crookston |
| | -----% loss----- | | |
| 3 pigweed plants / M row | 44 | 6 | 1 |
| Plant | May 10 | May 4 | April 28 |
| Sugarbeet emergence | May 23 | May 16 | May 11 |
| Pigweed emergence | May 18 | May 19 | May 18 |

Fields should start clean by tilling fields with emerged weeds, even in fields with a good seedbed. It is likely the kochia, common ragweed, and waterhemp are all glyphosate resistant biotypes so there is no guarantee they will be controlled with glyphosate. That stated, the weeds should be sprayed when they are small; less than 1-inch tall if you elect to forgo another tillage pass. NDSU research has reported that waterhemp with resistant alleles can be partially controlled with full rates of glyphosate when they are less than 1-inch tall. Allowing them to grow to 2-inches tall will further reduce control.

We reported last week that paraquat might be a strategy to control weeds that have emerged before the crop. However, it is critical that you carefully scout fields to ensure the crop is not emerging. Using a preemergence herbicide is absolutely critical in areas where waterhemp is identified as the most important production challenge. Waiting until lay-by to initiate a waterhemp control program will be too late. Consider ethofumesate, Dual Magnum, ethofumesate plus Dual Magnum or Ro-Neet SB for waterhemp control. We recommend ethofumesate plus Dual Magnum applied preemergence since preplant treatment may dilute both ethofumesate and Dual Magnum. Ethofumesate alone, especially at 5 to 6 pint per acre, can be shallow incorporated to ensure that it is immediately activated.



Image 1. Kochia along railroad tracks near Kragnes, ND, May 15, 2023



Image 2. Waterhemp found in a field by Cody Wahlstrom, Agriculturist, Minn-Dak Farmers Coop, May 15, 2023

[Tom Peters](#)

Extension Sugarbeet Agronomist
NDSU & U of MN



UPDATE ON HERBICIDE RESISTANT WATERHEMP

Waterhemp began emerging in the Fargo area last week, indicating we are in for another long campaign to keep fields free of waterhemp all season. Last year we confirmed waterhemp with resistance to PPO-inhibiting (Group 14) herbicides in 7 different counties in North Dakota. This winter, testing in the greenhouse confirmed Group 14-resistant waterhemp in 1 additional county (Benson).



Figure 1. Waterhemp seedlings near Fargo, ND on May 13, 2023.

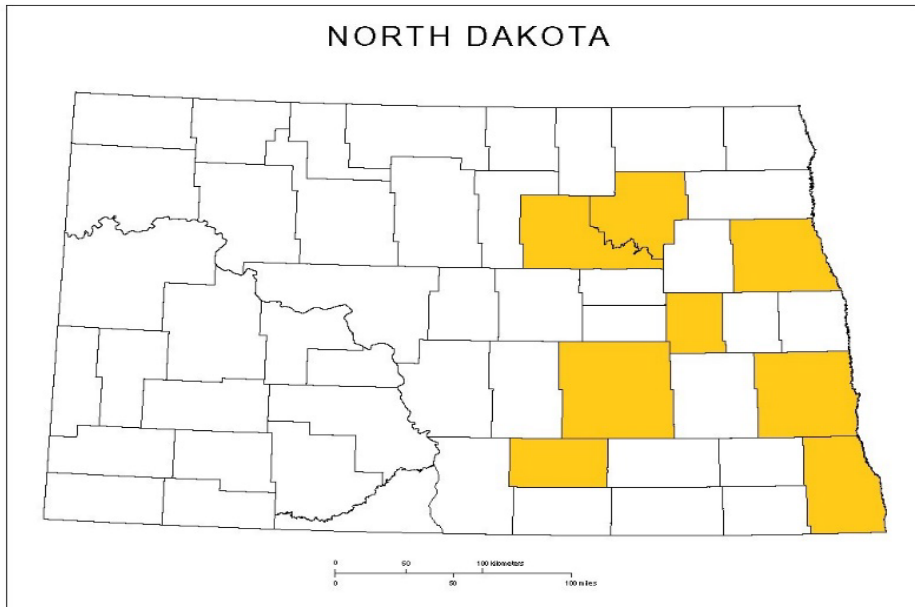


Figure 2. Map of counties in North Dakota with waterhemp resistant to PPO-inhibiting (group 14) herbicides. Counties in gold have at least one population with confirmed Group 14 resistance.

However, the bigger news with waterhemp is that we also confirmed resistance to dicamba this winter in greenhouse screenings. We ran a full dose response on one population from Traill county (compared to a known susceptible population) to confirm resistance. We did find samples from Griggs and Ramsey county where plants survived 3x rates of dicamba, with a similar phenotypic response to the Traill county population.



Figure 3. Dose response treatments on a waterhemp population that is susceptible to dicamba. Rates from left to right are dicamba at 0, 0.0625, 0.125, 0.25, 0.5, 1, 2 lbs per acre. Picture taken 21 days after treatment.



Figure 4. Dose response treatments on a waterhemp population that is resistant to dicamba. Rates from left to right are dicamba at 0, 0.0625, 0.125, 0.25, 0.5, 1, 2 lbs per acre. Picture taken 21 days after treatment.

We also wanted to determine how well preemergence dicamba application would control this waterhemp population. We conducted a small study evaluating one rate (0.5 lb/A or 1x) and dicamba provided suppression across the different replications. In most pots treated with dicamba, there were fewer plants than compared to the non-treated controls, indicating that a percentage of the population was controlled. Those plants that did survive treatment were generally smaller, but actively growing at trial conclusion (28 days after planting).



Figure 5. Dicamba (0.5 lb per acre) applied preemergence to a dicamba-resistant waterhemp population. Pot on the left is non-treated, while the pot on the right was treated with dicamba directly after planting. Picture taken 28 days after treatment.

This is obviously troubling news for anyone who prefers to use dicamba for waterhemp control. The good news is that the population with confirmed resistance is still susceptible to glufosinate (Liberty) and 2,4-D (Enlist). While we still do have some postemergence options for control of waterhemp in soybean, this resistance to dicamba should serve as a warning to be vigilant about rotating chemistry and spraying weeds when they are small. In the rush to get all of our crop planted this spring, it will be important to apply preemergence herbicides in fields with a history of waterhemp. The use of a residual will alleviate selection pressure of postemergence chemistry (which should be applied when waterhemp is 3 inches or smaller).

DETERMINING HERBICIDE RESISTANCE

Last week and this week we have given some updates on herbicide resistance in kochia and waterhemp. This is also a good time to review how we can determine herbicide resistance in the field following an application. There are several reasons why an herbicide might fail to control weeds, and resistance is only one of them. Here are a few important points to consider when determining the success of an application.

Expectations of the chemistry

There are a different set of expectations when it comes to different herbicide chemistries. For postemergence applications, the simplest difference to consider is contact vs systemic herbicides. Contact herbicides will perform better when an application maximizes coverage. They should be applied with more carrier volume (minimum 15 gallons per acre) and smaller droplets (Medium to Coarse). Most contact herbicides also perform best in sunny, humid, and warm weather. Many also require certain adjuvant classes for optimal performance. Contact herbicides generally do not move within the plant, so the goal is to maximize coverage and ensure the herbicide will penetrate the weed's cuticles. Lastly, these contact herbicides tend to work quickly, and one should be able to determine the success of an application within 7 days after treatment.

Systemic herbicides have the benefit of moving within the plant after absorption. This generally means applications can effectively be made with lower carrier volume and larger droplets (Very Coarse to Ultra Coarse). These systemic

herbicides also often require the correct adjuvants for best performance. Systemic herbicides are also slower at controlling weeds than contact products, so it may take upwards of 10 to 14 days to determine success of the application (or longer in cool, cloudy weather).

Weed size at application (density and height)

While many prefer to use very low carrier volumes, it is important to consider the size and density of weeds during application. Weeds like kochia and waterhemp can grow in very dense patches, with several thousand plants per square yard (and plenty of overlapping leaves protecting those below them from droplets). Even though systemic herbicides can move throughout the plant, we still need to ensure all plants receive coverage. If dense patches of weeds are present, consider raising the carrier volume to 15 or even 20 GPA, regardless of the chemistry applied.

Glyphosate might just be the best product in the world when it comes to making us collectively forget how to measure weed height. It is vital to spray weeds when they are small to control glyphosate-resistant and other problematic weeds. Once weeds like kochia or waterhemp are over 3 inches tall, the expectation of control should start to lower considerably, especially for contact herbicides. For a quick reference point, the smart phone you are reading this on will be 5 to 7 inches tall. Or even better, the width of most smart phones is about 2.5 to 3 inches across (and if you still have a flip phone, that will be about 3 to 4 inches tall when closed).

Weed spectrum

An important consideration when scouting after an application is the composition of weed species that were not controlled by the application. If many different species are still alive, there is likely some other cause of failure, and not resistance. If a single, or only a few, species remain alive, while nearly everything else is dead, then resistance could be the cause. For example, one of the Group 14 resistant kochia populations was discovered due to an observation that kochia was surviving an application of saflufenacil (Sharpen) while horseweed and common lambsquarters were all completely controlled. Pay attention to any patterns in the field as well, as skips will often have higher species diversity than spots of the field where adequate coverages were obtained.

Weather and other environmental factors

Spring in North Dakota is often full of temperature swings. In general, temperatures between 50 and 85 degrees are desired for best performance of herbicides. One metric I pay close attention to this time of year is overnight lows. Once we get lows below 40 degrees, systemic herbicide performance can suffer if plants are not actively growing. A spring frost will slow down growth of weeds, and it could take a couple days before they are actively growing again. Humidity is another important factor, as herbicides will perform better in higher humidity. In general, if we get a stretch of weather where temperatures are between 50 and 85 with adequate humidity and sunlight, I expect failures due to environment to be minimal.

Rainfall is the other environmental factor that can influence herbicide efficacy. Rainfall will be needed to incorporate residual herbicide into the soil. Rainfall occurring too quickly following a postemergence application could lead to the herbicide being washed off the leaves prior to adequate absorption. Page 81 in the 2023 ND Weed Guide has a table with the minimum interval between application and rain for maximum control (i.e. rainfast: https://www.ndsu.edu/agriculture/sites/default/files/2022-12/223214_Weed_Color.pdf).

Water quality

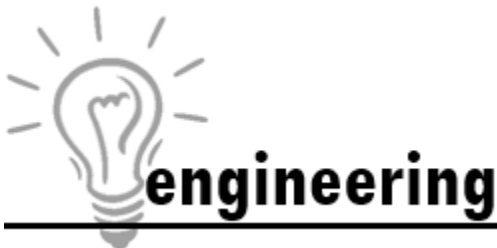
Water quality is a factor that negatively influences some herbicides. Glyphosate is the standard example when it comes to hard water antagonism. However, any weak acid herbicide can be impacted by hard water, as the cations in the water

can bind to the negatively charged herbicides. In many cases, a quality water conditioner (added to the tank before the herbicide) can avoid this antagonism. Water pH is another important, often overlooked, water quality factor. Some herbicide families are more soluble at higher pH (sulfonyleureas, many Group 14 products), while others are more soluble at lower pH (glyphosate). Knowing the pH of your spray solution can help troubleshoot problems in the field. The pH strips sold for testing pool/spa water are fairly accurate for a quick determination. Those wishing to get a more exact measurement should invest in a higher quality pH meter.

These are just a few points to consider when trying to determine if resistance is the reason why a weed, or weeds, were not controlled by a herbicide application. We are continuing to find and report more cases of herbicide resistance across the state, and the knee-jerk reaction to weeds not being controlled has become “it must be resistance.” In many cases that will be true, but it is also important to fully analyze the results of an application to rule out other possibilities.

[Joe Ikley](#)

Extension Weed Specialist



CHECK NOZZLE OUTPUT BEFORE THE 2023 SPRAY SEASON

Have you recently replaced your sprayer nozzles or tested their output? Might they be worn? Nothing lasts forever and your sprayer nozzles are no exception. Now is a good time to make sure your sprayer nozzles are ready for the busy spray season, especially on days when field conditions limit your planting progress.

Why does this matter? Worn nozzles provide increased flow, leading to pesticide overapplication if ground speed or operating pressure is not adjusted to compensate. More importantly, worn nozzles will output a deteriorated spray pattern. This distorts the droplet size distribution and creates uneven coverage, both of which lessen the effectiveness of pesticide transport to its target, which can result in suboptimum pest control. Simply put - properly atomizing the spray droplets is the first link in the chain of an effective pesticide application.

The most thorough and effective method for checking nozzle output is to:

1. collect water from each nozzle on the boom for one minute
2. weigh each nozzle's output
3. convert the weight output to a volume output (fl oz = g × 0.034 OR oz × 0.96)

That said, I realize that checking nozzle output is rarely a producer's top priority. And I get it – the process can be awkward and time-consuming, a large sprayer can have 200+ nozzles, and there are tradeoffs between thoroughness and efficiency. If the method outlined above is not feasible for your operation, here are some alternative options:

- *Don't check, replace.* As an alternative to checking output, you could replace the entire set of nozzles at regular intervals (e.g., every year, every other year). The downside of this approach is that the proper replacement interval is an educated guess, as it depends on the time spent spraying and the nozzle wear rate, which itself

depends on orifice size, construction material (e.g., brass, stainless steel, ceramic, polymer), and the types of pesticide formulations that have passed through the nozzle.

- *Check a subset of nozzles.* Checking a subset of nozzles (every second, third, fourth, etc.) rather than every nozzle will save considerable time while providing a reasonable estimate of whether your nozzle set is worn. Of course, you may miss an individual worn nozzle.
- *Use a flow rate “gadget”.* Digital calibrators are designed to measure nozzle flow rate in less than one minute. Jason Deveau, Application Technology Specialist with OMAFRA (Ontario Ministry of Agriculture, Food and Rural Affairs), [recently tested](#) nine measurement methods (Figure 1) and found that the Spot On Digital Calibrator obtained reasonably accurate results in less than 12 seconds per nozzle.

When testing nozzle flow rates, record the output from each tested nozzle. Then, calculate the average output across nozzles. Once flow rates have been checked, here are action recommendations:

- Clean or replace individual nozzles with output exceeding $\pm 5\%$ of the average output
- Replace individual nozzles with output exceeding $\pm 10\%$ of manufacturer specifications (consider $\pm 5\%$ for a more stringent threshold)
- If 3 or more nozzles exceed manufacturer specifications, replace the entire nozzle set

Note: Brand names are provided for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned.

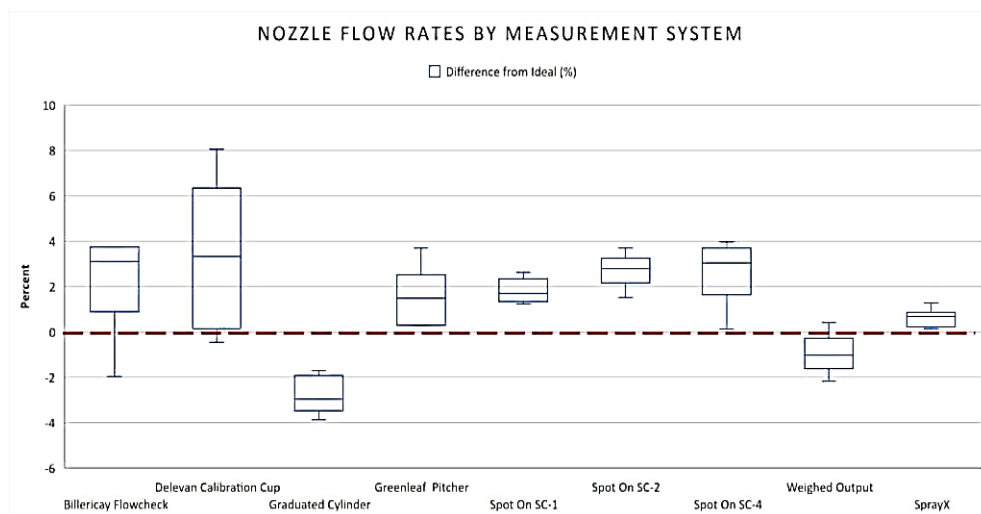


Figure 1. For nine methods of determining nozzle flow rate, the percent deviation of measured flow rate from manufacturer-specified flow rate. [Boxplots](#) summarize six measurements – three of a new TeeJet XR8004 at ~40 psi and three of a new TeeJet AIXR11004 at ~70 psi. From [Sprayers101 - Methods for Determining Nozzle Flow Rate](#).

[Rob Proulx](#)

Extension Agriculture Technology Systems Specialist



horticulture

TICK SEASON STARTS

Ticks are out and looking for mammal hosts like you, deer, dogs and others to feed on! In moist conditions, they are more likely to survive, so tick populations may be higher this year. Here's some updated information.

The most common ticks in North Dakota include the smaller black legged tick (or deer tick), *Ixodes scapularis*, and the larger American dog tick, *Dermacentor variabilis* (see photographs). **Black legged tick is the species that vectors Lyme disease.** Ticks can be a significant threat to anyone's health if you enjoy hiking, camping, hunting, playing or working outside in undisturbed grassy or wooded areas. **Be safe this summer and do periodic 'tick inspections' every 2-3 hours when outdoors to prevent tick-borne diseases.**

If you find a tick, remove it right away. See the [Center for Disease Control and Prevention](https://www.cdc.gov/ticks/) (CDC) instructions (below) on how to remove a tick:



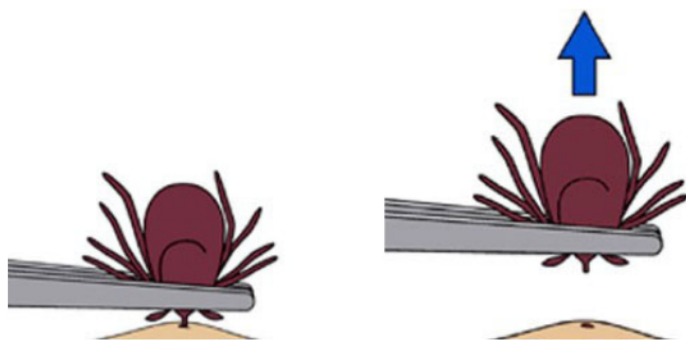
Black legged tick or deer tick, *Ixodes scapularis* (vectors Lyme disease). (P. Beauzay)



American dog tick, *Dermacentor variabilis*. (Gary Albert, Harvard University, (P. Beauzay))

How to remove a tick

1. Use fine-tipped tweezers to grasp the tick as close to the skin's surface as possible.
2. Pull upward with steady, even pressure. Don't twist or jerk the tick; this can cause the mouth-parts to break off and remain in the skin. If this happens, remove the mouth-parts with tweezers. If you are unable to remove the mouth easily with clean tweezers, leave it alone and let the skin heal.
3. After removing the tick, thoroughly clean the bite area and your hands with rubbing alcohol or soap and water.
4. Never crush a tick with your fingers. Dispose of a live tick by putting it in alcohol, placing it in a sealed bag/container, wrapping it tightly in tape, or flushing it down the toilet.



The CDC states that Lyme disease is the most commonly reported vector borne illness in the United States. Lyme disease is concentrated in in the Northeast and upper Midwest. The black legged tick occurs in eastern North Dakota and has spread to western North Dakota now. Lyme disease was observed in the following counties in 2020: Adams, Bottineau, Burleigh, Cass, Pembina, Ramsey, Traill and Ward (Source: <https://www.cdc.gov/lyme/stats/tables.html>). Cass County had the highest number of cases (21).

Lyme disease is caused by the bacterium *Borrelia burgdorferi*. Symptoms of Lyme disease include: Bull's eye rash, headache, fever and fatigue. In a worst-case scenario, infections can cause arthritic joints, and affect the nervous system, causing facial paralysis, and spinal cord, brain or heart problems. Lyme disease must be treated immediately with antibiotics. It can take 2 to 3 weeks to recover if treated early. The later you wait for treatment, your symptoms will become more severe and more difficult to cure. A vaccine for Lyme disease is not currently available for people. For more information, please see the [CDC website: https://www.cdc.gov/lyme/prev/vaccine.html](https://www.cdc.gov/lyme/prev/vaccine.html) and <https://www.cdc.gov/ticks/tickbornediseases/lyme.html>

The Center for Disease Control and Prevention (CDC) recommends the following strategies for field workers to prevent tick bites:

- Minimizing direct contact with ticks by avoiding walking in woody and tall grass areas, and walking in the center of trails. Ticks are most active in May through August in North Dakota.
- Wear light-colored protective clothing, so it is easier to see ticks crawling up.
- Tuck pant legs into socks.
- Spray bug repellent with 20-30% DEET or 20% picaridin (synthesized pepper plant compound) on exposed skin and clothing, especially on lower legs. This should provide some protection up to 12 hours. Or wear clothing treated with permethrin, which can be washed up to 70 times before losing effectiveness.
- Quickly find and remove any ticks from body by using a tweezers. Grasp tick close to skin and pull straight up to avoid breaking off the tick's mouthparts in the skin. Clean bite area with rubbing alcohol or soap and water. Apply an antiseptic to the bite site.
- Inspect yourself every 2-3 hours to find any ticks crawling on you and to remove them before they attach to feed on your blood. Ticks like to hide in hair, behind ears and other areas and may be difficult to find.
- Quickly wash any clothing that you were wearing, and then dry in high heat for an hour to kill any ticks. Otherwise, ticks can attach to you later after hitchhiking on your clothes you wore into your home.
- Reduce tick habitat near home.
 - Keep lawns mowed around home.
 - Place a 3-ft wide barrier of wood chips or gravel between lawns, patio or play areas and wooded areas to prevent tick movement.
 - Exclude wildlife (especially deer) that may be carrying ticks into your yard.
- Some insecticides registered for control of ticks by homeowners in residential areas (yards) include: carbaryl (Sevin®), cyfluthrin (Tempo®, Powerforce™), permethrin (Astro®, Ortho® products, Bonide® products), and pyrethrin (Pyrenone®, Kicker®). Always read and follow the EPA approved label on the product container.

[Janet J. Knodel](#)

Extension Entomologist



around the state

NORTH CENTRAL ND

The rain that was received last week imposed a bit more delay in the planting activities in the North Central region. From May 9 to May 16 the NCREC received about 3.25" of rainfall. The following are precipitation observations across the area as noted by local NDAWN stations: Bottineau: 1.28"; Garrison: 1.55"; Karlsruhe: 1.96"; Mohall: 3.17"; Plaza: 2.99"; and Rugby: 0.26". The average soil temperature for those locations was 56^o F.

There are few fields that emerged in the area that are mostly spring wheat and pulses. The crop conditions are good in those fields (Figure 1). Weed control and fertilizer application was observed in some fields in the region. With no rain in the forecast for the next 10 days, plus the temperature in the 70's during the day and wind will help the soil to reach good conditions for planting.



Figure 1. From top left, clockwise: Field in McLean County; Field pea in Mountrail Co; Spring wheat in McLean Co; Field condition in Ward Co.

[Leo Bortolon](#)

Extension Cropping Systems Specialist
NDSU North Central Research Extension Center

NORTHEAST ND

Temperatures in the NE region are climbing into the upper 80's. Compared to the rest of the state, the precipitation in this region was minimal and variable in each county. Soil temperatures ranged between 55- 79°F making it ideal for planting many crops. The high temperatures and lack of rain helped the fields to dry out, allowing the field activities like tilling, fertilizer application and plantings all over the region. Small grains, field peas, canola, sugarbeets, potatoes, dry beans, corn and soybeans are being planted. Soil moisture levels in the top four inches have dropped considerably (8-10%) compared to the last week. While soil moisture is adequate in most of the fields, hill tops are getting drier. Warmer temperatures triggered the emergence of canola flea beetles from their overwintering sites in Cavalier and Benson Counties. Both striped and crucifer flea beetles are seen in high numbers feeding on volunteer canola. Striped flea beetles appeared to be about 10% of the total population with crucifers being the majority. As the fields are drying out, white saline patches are showing up in the headlands and low spots. Pastures are greening up. Kochia is coming up and foxtail barley is seen in bad spots.



Tilling at the Langdon Research Extension Center
Photo: Anitha Chirumamilla



Wheat planted in Cavalier County
Photo: Anitha Chirumamilla



Canola flea beetles trapped on yellow sticky cards and flea beetles feeding on volunteer canola at the Langdon Research Extension Center
Photos: Anitha Chirumamilla

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 Extension Cropping Systems Specialist
 Langdon Research Extension Center

NORTHWEST ND

Williams, Divide, McKenzie, Mountrail, and Burke counties received a good amount of rain last weekend. According to NDAWN weather stations, rainfall totals received within the past week (May 9 to 15) in the northwest areas ranged from 1.13 inches (in Fortuna) to 3.77 inches (in Berthold). These values represent 224 to 803% of the usual (percent of the normal) rainfall received for that week. This greatly improves the moisture conditions in the northwest region. Before the rain event, areas in the northwest were either abnormally dry (D0) or in moderate drought (D1) conditions. As per NDAWN data, daily maximum air temperatures in northwest ND averaged in the upper 60s (°F) and daily minimum air temperatures averaged in upper 40s (°F) in the past seven days. On Tuesday evening, however, the temperature reached 82°F in Williston, which is unusual for this time of the year. Daily soil temperatures at the 4-inch depth averaged in the upper 50s in the past seven days. There's moisture in hilltops. Low-lying areas are either wet or flooded. This year, planting in the northwestern counties is generally behind by two weeks. As of this publication, many fields have already been planted but also many have yet to be planted. As the weather transitions to warmer conditions in the coming days and fields start to dry, planting and spraying to burndown of emerged weeds will be more frequent.

At the NDSU Williston Research Extension Center (WREC), spring wheat is off to a good start (leftmost picture below). Most of the cool-season broadleaf crops already have been planted. Weeds have also come up in the past 2-3 weeks. Kochia started to emerge about 2-3 weeks ago and now large mats can be seen in fields. We've also seen large densities of emerged common lambsquarters. Dandelions have produced flowers. Other weeds that we've seen come up are marestail, wild buckwheat, pepperweed, field pennycress, flixweed, prickly lettuce, and narrowleaf hawksbeard.



[Charlemagne "Charlie" Lim](#)

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WEATHER SUMMARY AND OUTLOOK FOR MAY 18 THROUGH MAY 24

Most of North Dakota received rainfall from May 11 through May 13, with the exception of the northeast (Figure 1). Widespread 1-to-3-inch totals were reported across western ND. The NDAWN station near at Hettinger, ND, recorded 4.16 inches, the NDAWN station near Genoa in McHenry County received 4.31 inches, and the big winner was 5.1 inches recorded at the NDAWN station south of Sawyer in Ward County. Generally, the heaviest rainfall totals were in Ward, Renville, and Mountrail Counties in the northwest, and Hettinger and Adams Counties in the southwest.

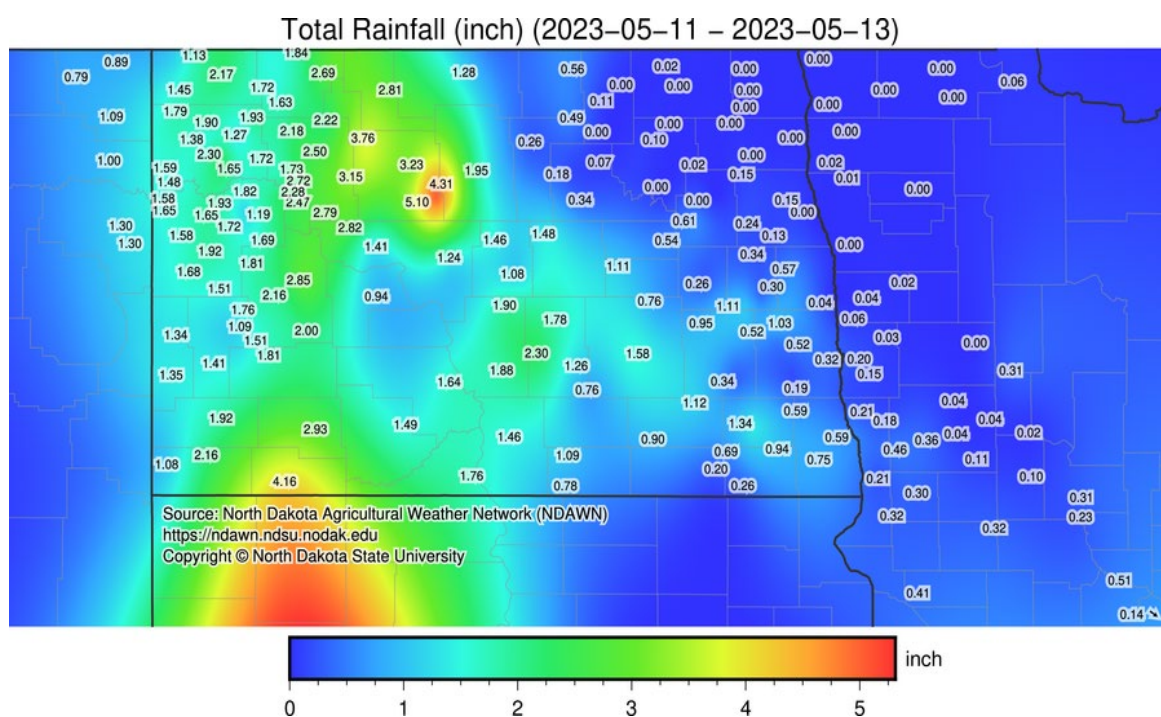


Figure 1. Total rainfall from May 11 through May 13 at NDAWN stations.

Hopefully, this will improve the drought status for western ND. The new [drought condition report](#) will be issued around 11:00 a.m. CDT today. Please consider reporting conditions in your area using the [Condition Monitoring Observer Reports \(CMOR\)](#) system. Reports can be submitted using your desktop or laptop computer or through a smart device app. The website provides a [training video](#) and a [factsheet](#) on how to use the app. I also recommend becoming a [CoCoRaHS](#) weather observer. Please visit the Join [CoCoRaHS](#) webpage and their training resources for more information. CoCoRaHS observers can enter condition monitoring reports. U.S. Drought Monitor forecasters use both the CMOR and CoCoRaHS reports in formulating current drought condition reports and outlooks.

Soil temperatures at the 4-inch and 8-inch depths have warmed above 50°F across the state. Soil moisture at the 4-inch (Figure 2) and 8-inch (Figure 3) depths is optimum to excessive across most of the NDAWN stations.

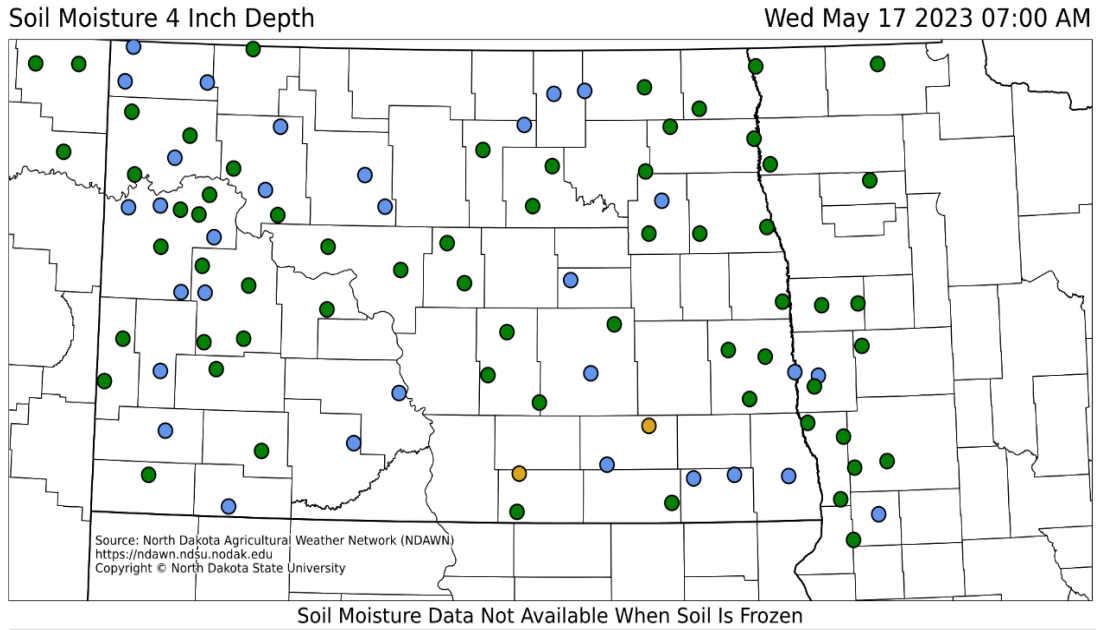


Figure 2. Soil moisture at 4-inch depth at 7:00 a.m. CDT on Wednesday May 17, 2023 at NDAWN stations.

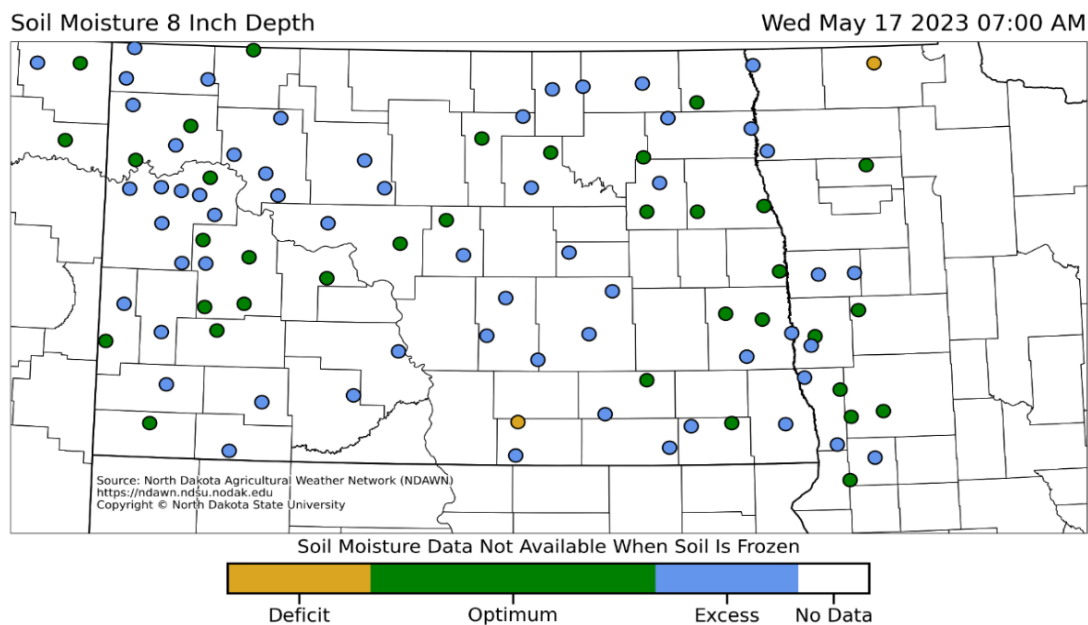


Figure 3. Soil moisture at 8-inch depth at 7:00 a.m. CDT on Wednesday May 17, 2023 at NDAWN stations.

Average daily air temperatures for the past week (Figure 4) were above normal across all of North Dakota, especially in the northeast where less (or no) rain fell. This has helped warm the soil in areas of the northeast. For the month of May, temperatures have been slightly above normal.

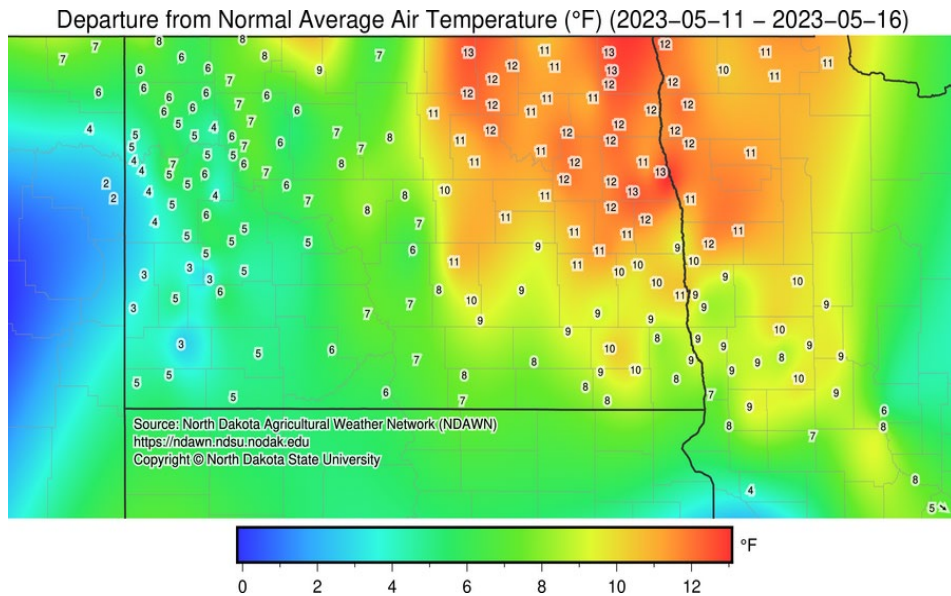


Figure 4. Average air temperature departure from normal from May 11 through May 16 at NDAWN stations.

Growing degree day forecasts for base 32°F and base 50°F are depicted in Figures 5 and 6. Please visit the Growing Degree Days webpages at the NDAWN.INFO website for current growing degree days for corn, soybean, wheat, sugarbeet, canola and sunflower. Be sure to check out accumulated degree days for those crops, and as I wrote in [last week's article](#), use the main NDAWN website for accumulated growing degrees for your crops at the nearest NDAWN location.

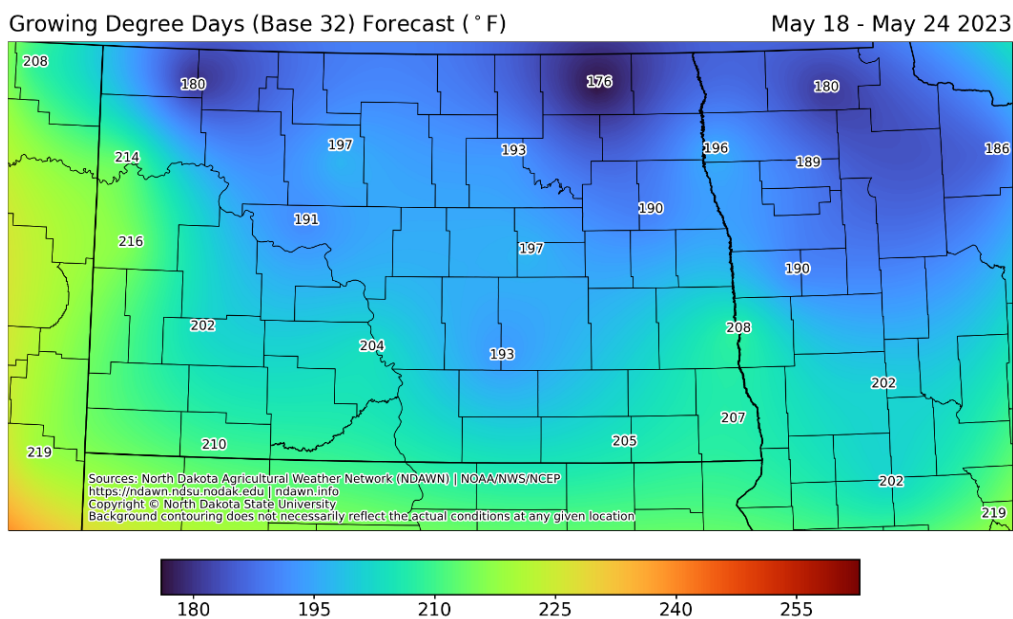


Figure 5. Growing degree day forecast (base 32°F) for May 18 through May 24.

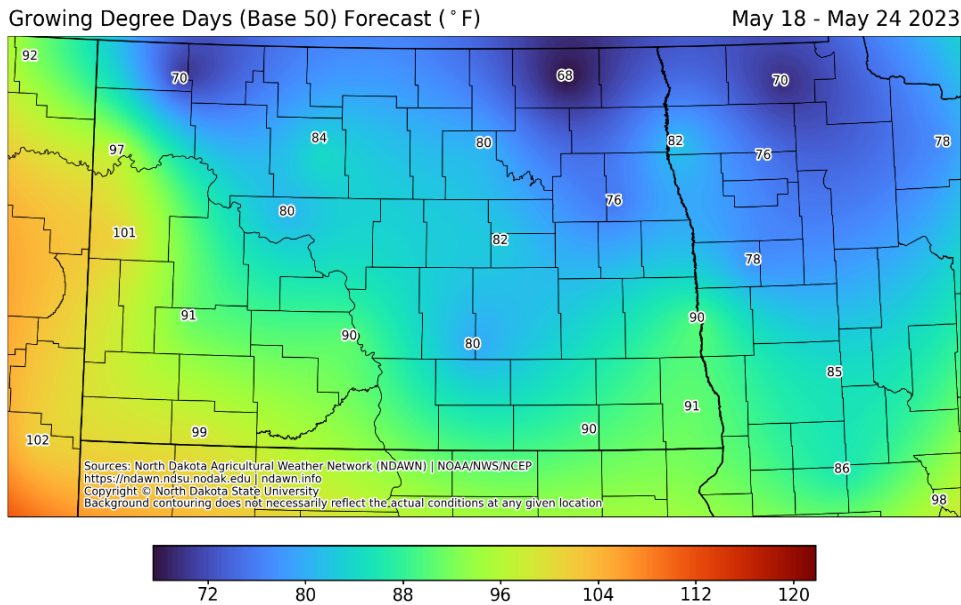


Figure 6. Growing degree day forecast (base 50°F) for May 18 through May 24.

Outlook for the Week Ahead

Our mid- and upper-level air flow has changed from a southwesterly flow to a northwesterly flow, due to the development of a high-pressure ridge over the Pacific Northwest. A low-pressure system will drop out of Manitoba into northwestern Minnesota early this morning along the eastern side of the high. Showers and possibly a thunderstorm will form ahead of the advancing cold front from northwestern ND on Wednesday May 17 through southeastern ND this morning. This system does not have nearly as much moisture to work with as last week’s system, and rainfall amounts

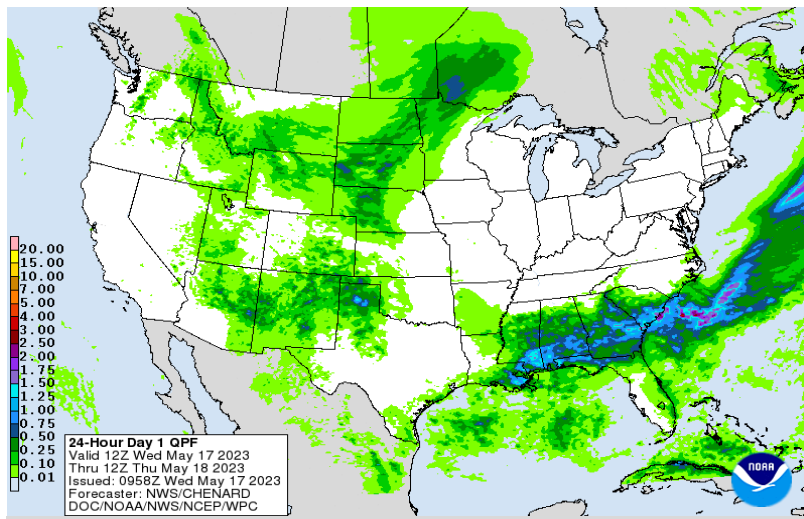


Figure 7. Precipitation potential for the continental United States from 7:00 a.m. CDT May 17 through 7:00 a.m. CDT May 18.

shouldn’t exceed much more than 0.25 inch (Figure 7). This same northwesterly flow is bringing us smoke from wildfires in Alberta and Saskatchewan. High pressure moving in behind the front will usher in plenty of sunshine but cooler temperatures. Overnight lows Thursday into Friday morning may approach 32°F in our northern and western counties, with areas of frost possible. Sunshine and seasonable temperatures should persist through early next week. Beyond that, weather models indicate precipitation from Tuesday into Wednesday of next week.

If there is anything you’d like me to include in future weather columns for the *Crop & Pest Report*, feel free to email me!

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