North Dakota State University
CROP & PEST REPORT

NDSU EXTENSION

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Entomology

MYSTERY MOTH IN BEAN FIELDS

Green cloverworm moth (J. Knodel, NDSU)

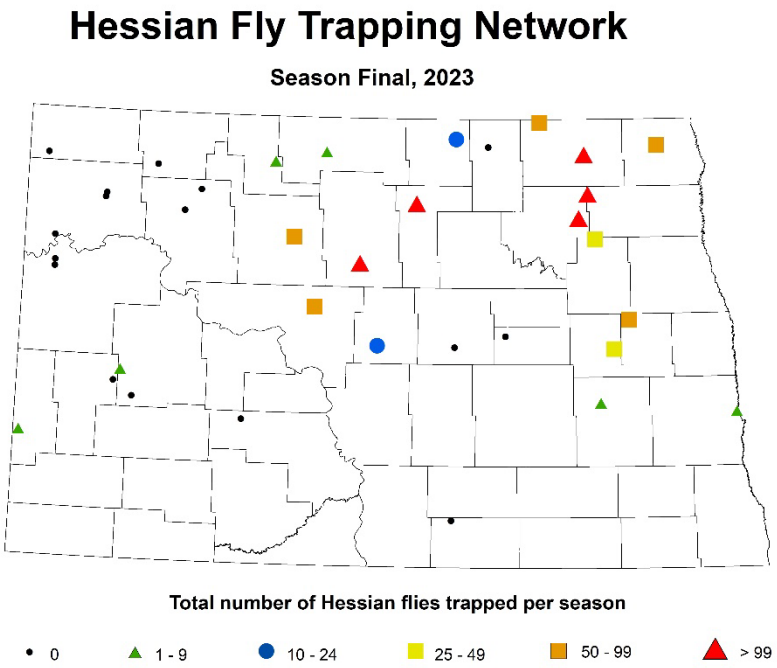
Lots of emails, texts, and phone calls on these dark moths that have been flying around in soybean and dry bean fields and attracted to garden flowers for nectar near homes. This is the adult moth of the green cloverworm, a common pest of beans in North Dakota. Moth is dark brown moth with spots and has a wingspan of 1 inch. When at rest, wings form a triangle. Green cloverworm moths migrate into North Dakota each spring, usually June. It has multiple generations, usually 2-3 generations per year. Green cloverworm does not overwinter here. As soon as a cold, hard frost occurs this fall, all life stages will be killed. It is not economic this late in the season during harvest. No scouting or treatments are necessary now!

HESSIAN FLY INCREASING IN WHEAT

Hessian fly prefers wheat (all types – spring, winter, durum) as a host. Other hosts are barley, rye, triticale, winter rye, and winter barley. In addition, several wild grasses (quack grass, ryegrass) can be infested by Hessian fly as well as volunteer wheat.

Hessian fly has two ***generations per year in the Northern Great Plains.*** The second-generation flies emerge in late August into September from the pupal flaxseed stage between the outer leaves and the stem. Female flies search for suitable hosts to lay eggs in like winter wheat, volunteer wheat, rye cover crops, grassy weed hosts and other seeded grass crops in the fall. Larvae will hatch from the eggs in 3 to 10 days and feed on the plant for two weeks developing into the flaxseed stage. They overwinter in the flaxseed stage. Fall planted grass crops that are infested with Hessian fly are stunted, and will generally die in the four-leaf stage during the winter. Next May, adult flies will emerge and females will lay eggs in spring planted grass crops to continue their life cycle.

A pheromone trapping network for Hessian fly showed that these flies are most common in the northeast, central and east central areas of North Dakota in 2023.



Some sustainable pest management strategies include:

- **Choose suitable cover crops that are not known hosts of Hessian fly.**
  Do not use wheat, barley or rye as cover crops since are infested by Hessian fly for reproduction and feeding. Oats are less favorable to Hessian fly oviposition and feeding. However, Hessian fly appears to be adapting to rye since it is commonly planted as a cover crop and available in the fall for female egg laying.
- **Destroying volunteer wheat in spring before planting**
- **Planting winter wheat and grain cover crops after the "Hessian fly free planting dates": after September 15 in the northern ND and after September 30 in the southern ND.** By destroying the volunteer wheat and planting winter wheat later, the life cycle of Hessian fly is broken. As flies emerge, there is no place for them to lay eggs.
- The high labeled rate of insecticide seed treatments on wheat (Cruiser and Gaucho) can be used at planting time to reduce Hessian fly infestations. Research has shown that a pyrethroid insecticides applied shortly after wheat emerges (at or before the two- to three-leaf stage) have been effective against Hessian fly. If applied at the right time, a pyrethroid insecticides can kill the adult flies and may also kill young larvae before they become embedded behind the leaf sheaths. However, insecticide application is rarely warranted in ND due to typical low populations of Hessian fly.

Adult Hessian fly (Scott Bauer, USDA ARS, Bugwood.org)

Figure 1. Flaxseed stage of the Hessian fly (A. Chirumamilla, LREC)

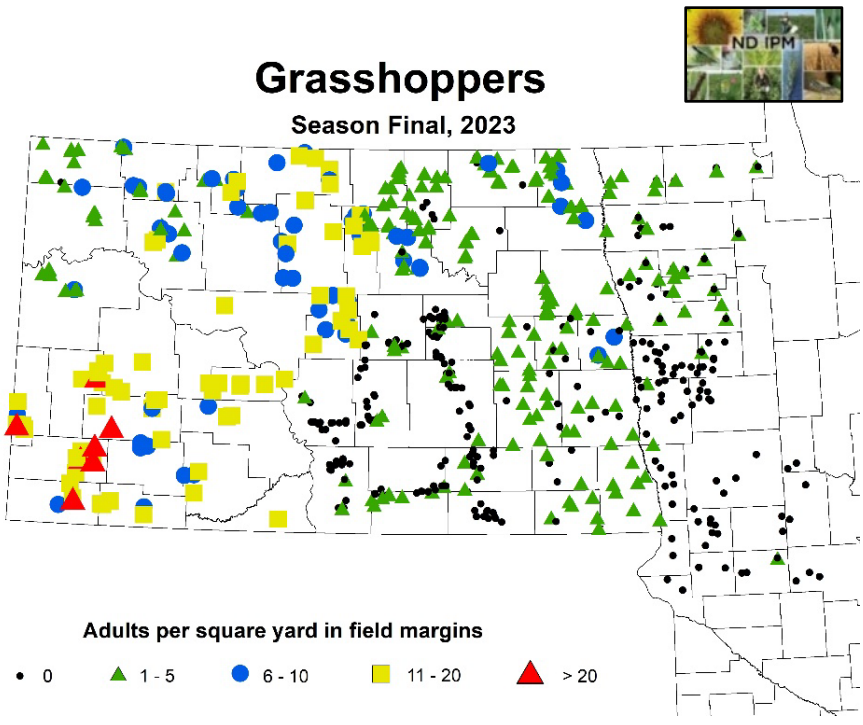
2023 IPM CROP SURVEY – WHEAT AND BARLEY INSECT PESTS

The IPM (Integrated Pest Management) Crop Survey helps ND farmers, crop consultants, and ag audiences stay up-to-date on important diseases and insect pests of wheat and barley grown in North Dakota. Eight IPM scouts and insect trappers operated out of the Dickinson Research Extension Center, the North Central Research Extension Center (Minot), the Carrington Research Extension Center, the Langdon Research Extension Center, the Williston Research Extension Center and the Fargo Agricultural Experiment Station. The NDSU IPM scouts were:

- **Regan Jones**, central and south-central counties, worked out of Carrington REC with Greg Endres
- **Taylor Downing**, southwest and west central counties, worked out of Dickinson REC
- **Alexius Holter and Sawyer Goodwin**, north central counties, worked out of NCREC in Minot
- **Scott Roseth and Samantha Turnquist**, northwest counties, worked out of Williston REC with Charlemagne Lim
- **Tommy Crompton**, southeast and east central counties, worked out of NDSU campus, Fargo with Jan Knodel, Pat Beauzay, Andrew Friskop and Sam Markell
- **Nancy Feil and Natalie Eversvik**, northeast counties, worked out of Langdon REC with Anitha Chirumamilla, and Benson County Extension Office with Scott Knoke.

NDSU IPM field scouts surveyed a total of 496 wheat fields (winter wheat, hard red spring wheat, durum wheat) and 164 barley fields for 18 diseases and 6 insect pests in North Dakota. The survey started on June 1st and continued through August 1st. Crops were surveyed from the 2-leaf stage (seedling) through ripening stages. IPM survey data/maps provided near real-time pest information to North Dakota farmers and others in agriculture to assist with scouting and pest management decision making. Pest maps from the 2023 IPM Survey in North Dakota were uploaded weekly onto the NDSU IPM website. Some of the insect pest highlights for wheat and barley are summarized below. For diseases, see the "Plant Pathology" section of this CPR.

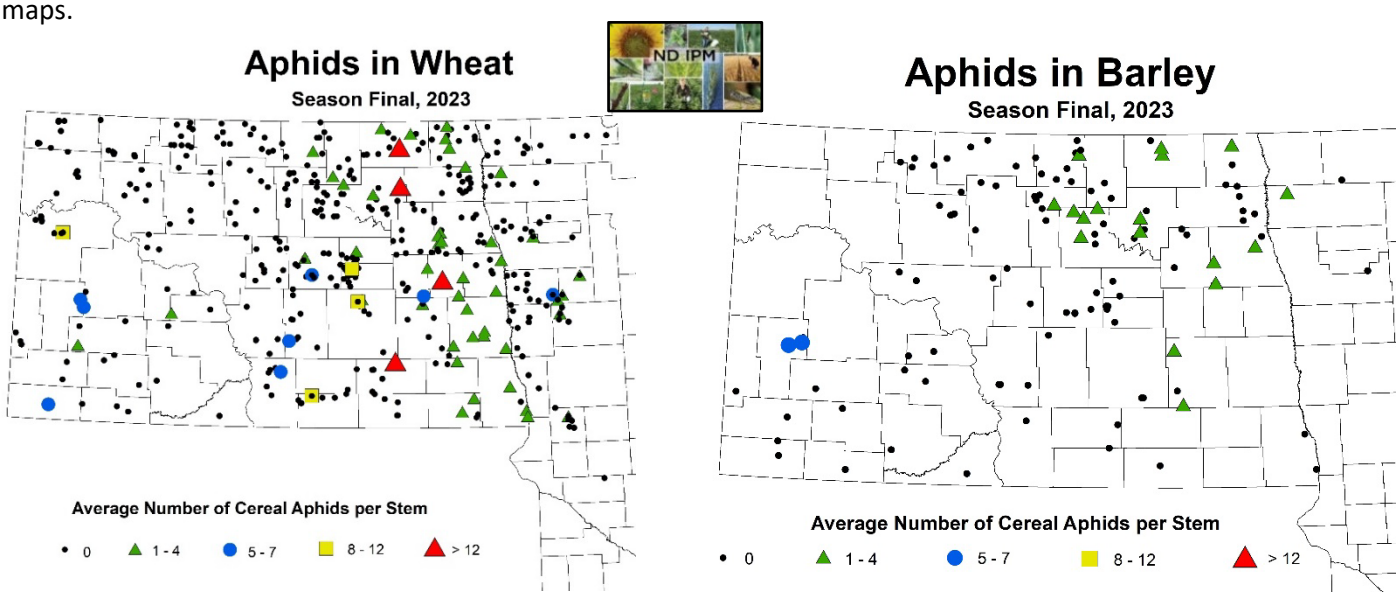
Grasshoppers – Grasshoppers were surveyed for in all crops including wheat, barley, soybeans and sunflowers. Adult grasshoppers were observed in 68% of the fields surveyed. This shows lower frequency of grasshoppers in 2023 compared to the last four years: 90% in 2022, 91% in 2021 and 2020, 86% in 2019 and 75% in 2018. The number of adult grasshoppers per 4 sweeps (1 yd^2) ranged from 0 to 27, which was lower than 2022, 0 to 69. The highest densities of grasshoppers were observed in central and western North Dakota again.



Although the drought area was reduced from the past three years, it continued to favored grasshopper reproduction and increasing populations. Defoliation was common on field edges early in the season and then in-fields later in the summer throughout most of the state. Whole-field treatments were necessary in areas where grasshopper populations were high (see yellow and red areas on grasshopper map).

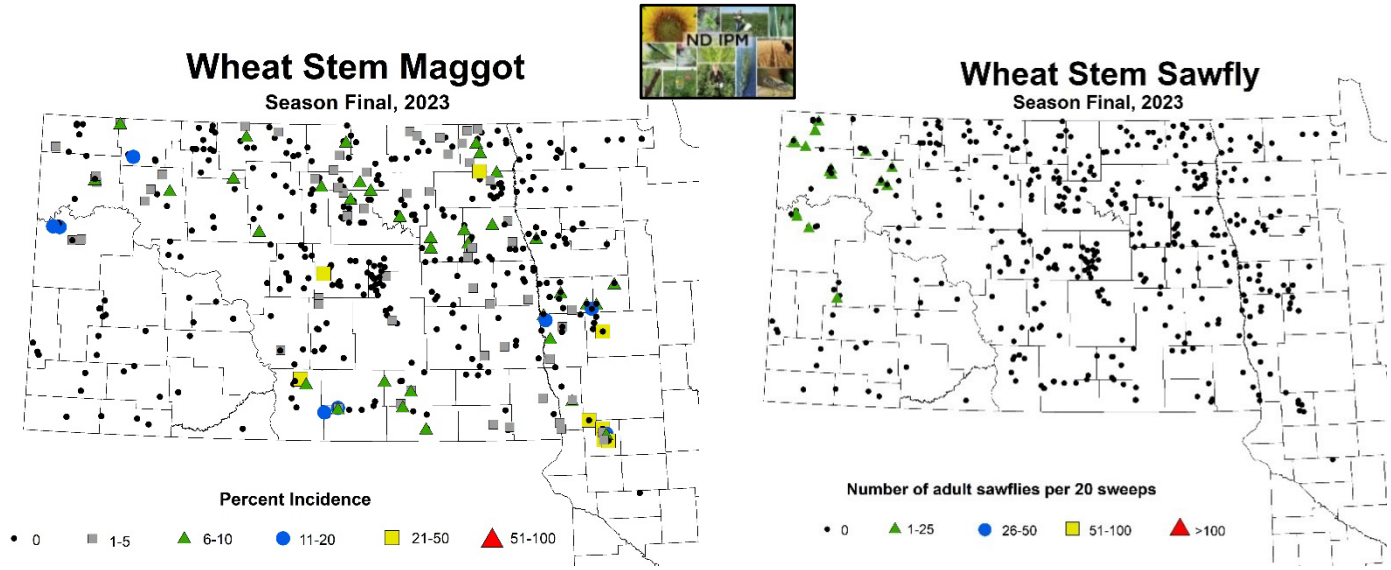
Insect Pests of Small Grains:

Grain aphids were observed in 13% of the wheat fields and 16% of the barley fields surveyed in 2023. Grain aphids were first detected in late June with highest populations in mid to late July in the central and northeast areas of the state. In wheat, the average number of aphids per stem ranged from 1-38. In barley, average number of aphids per stem ranged from 1-22. Wheat and barley fields that needed an insecticide application are shown in yellow squares and red triangles on maps.



Wheat stem maggot was observed in 18% of wheat fields surveyed in ND from late June through early August, and damaged white heads ranged from 1 to 50% of plants sampled. In 2023, wheat fields with ≥20% damaged heads were observed in Emmons, McIntosh, Walsh and Wells counties.

Wheat stem sawfly was collected with sweep nets in 6% of the wheat fields surveyed from late June through mid-July in 2023. Wheat stem sawflies were most common in the northwest (Burke, Divide, McKenzie, Williams Counties), north central (Mountrail County) and southwest (Dunn County). Visual observations of wheat stem sawfly in wheat fields located in Griggs County (east central North Dakota) also were observed by the County Extension Agent, Jeff Stachler.



Cereal leaf beetle was not detected in wheat or barley, or in any new counties of North Dakota in 2023. The counties of North Dakota that are known to have cereal leaf beetle are Burke, Divide, McKenzie, Mountrail and Williams counties in northwest; Renville, McHenry and Ward counties in north central; and Cavalier and Nelson counties in northeast. Cereal leaf beetle was detected in Minnesota for the first time in Clay, Mahnomen and Norman counties. This is new state record for Minnesota including the three new county records.

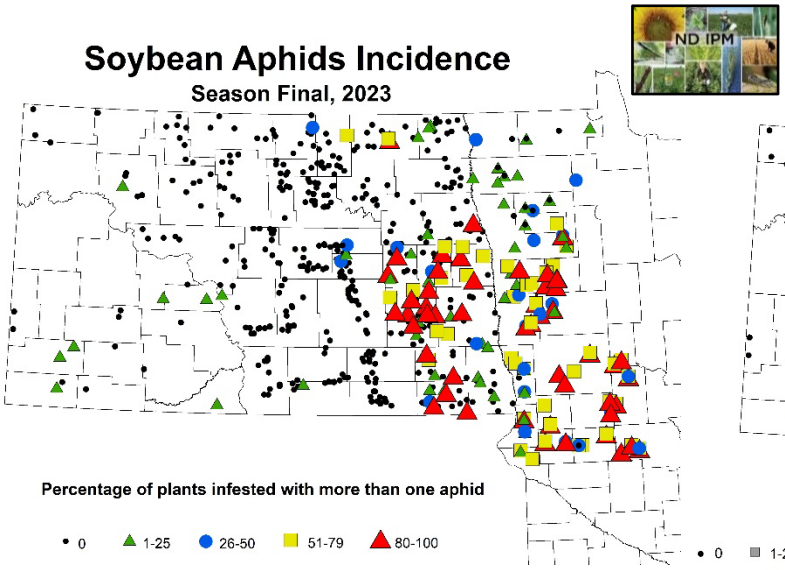
Barley thrips were low and observed in only 3% of barley fields surveyed in North Dakota in 2023.

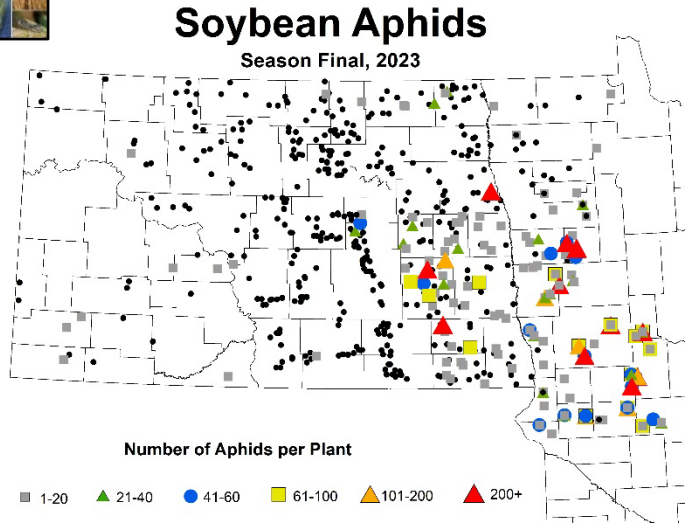
2023 IPM CROP SURVEY- SOYBEAN AND SUNFLOWER INSECT PESTS

NDSU IPM scouts surveyed a total of 581 soybean fields and 169 sunflower fields in North Dakota during 2023. The survey was initiated in early June and continued through August 18. Crops were surveyed from the 2-leaf stage through R6 growth stage in soybeans and R5.9 growth stage in sunflowers. Some of the insect pest highlights for soybean and sunflower are summarized below.

Soybean Insect Pests:

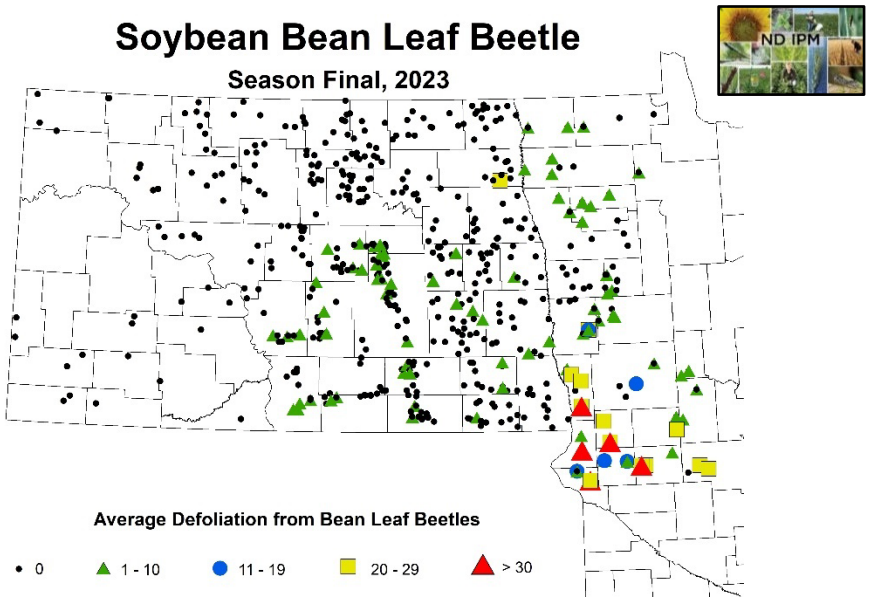
Soybean aphids - Soybean aphids were observed in 12% of the soybean fields surveyed in 2023. This breaks the four-year record of no to low densities of soybean aphids observed from 2019 to 2022. Soybean aphids were observed from late July through mid-August in mainly the Red River Valley area of North Dakota and Minnesota. The percent of plants infested with soybean aphids in fields had an average of 49% of plants infested and ranged from 1 to 100% of plants infested. The average number of aphids per plant was 30 aphids per plant and ranged from 1 to 450 aphids per plant. Most of the positive fields were located in the eastern part of North Dakota. Among the fields surveyed, soybean aphids reached the economic threshold (E.T.) level in Barnes, Cass, Grand Forks and Ransom Counties (average of 250 aphids per plant, 80% of plants infested with one or more aphids and increasing population levels).





Bean leaf beetles are becoming a more common pest of soybean in North Dakota and spreading further west and north. See map on next page Beetles were detected in sweep net samples and defoliation estimates in soybean. Defoliation was observed in 8% of the fields scouted and ranged from 1 to 25% defoliation. The second generation of adult bean leaf beetles occurred in August, and were easier to observe by IPM scouts. It was present in southeastern North Dakota, but also was found in south central and east central North Dakota. Bean leaf beetle was present at economic levels in a

small percentage of soybean fields in 2023, often with other foliage-feeding caterpillars, such as thistle caterpillar or green cloverworm.

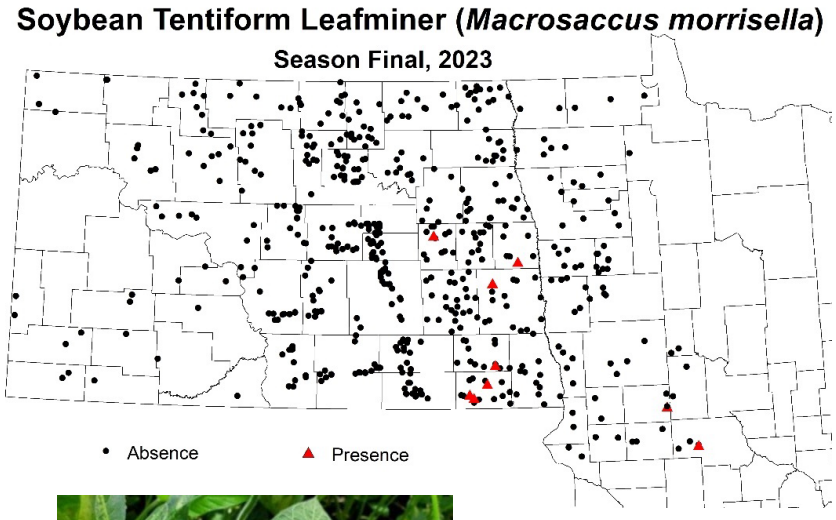


Spider mites were observed in 6% of the soybean fields scouted and most common on field edges late in the season.

Soybean gall midge, *Resseliella maxima*, was not detected in any new counties of North Dakota in 2023. So far, the only positive detection is Sargent County near Gwinner in 2022. A total of 581 fields in 50 counties were scouted and found to be negative for soybean gall midge. Good news for the North Dakota soybean growers!

Soybean tentiform leafminer (*Macrosaccus morrisella*), a potential new insect pest of soybean, was observed in five counties (Cass, Griggs, Ransom, Sargent and Trail) of North Dakota in 2023. This is a new insect was originally found on soybeans in Minnesota in 2022. Larvae create tentlike leaf mines in foliage causing defoliation. Little is known in the literature about its biology. It's pest status is 'unknown' right now, since the insect has not causing any yield losses in soybeans at this time.

See University of Minnesota weblink for more information and pictures on soybean tentiform leafminer.



Leaf mines caused by soybean tentiform leafminer. (Robert Koch, UMN)

Sunflower Insect Pests:

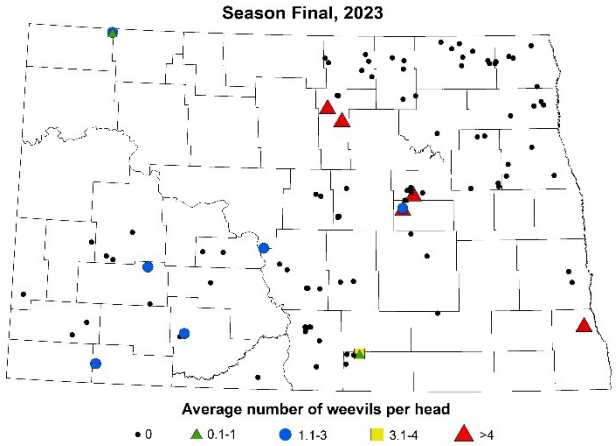
Red sunflower seed weevils were observed during R3 through flowering from late July through mid-August. The average number of weevils per head ranged from 1 to 12 weevils per head depending on field site. In 2023, the E.T. for red sunflower seed weevils was 7-9 weevils per head for oilseed sunflowers. Approximately 16% of the fields surveyed were above the E.T. and these fields required an insecticide application. The highest populations were located in north central area of North Dakota.

Banded sunflower moth were monitored for using winged pheromone traps. Moths were collected at all 8 trap sites in 8 counties throughout the sunflower acreage in ND. The first moth was trapped early July and peak moth catch occurred in early August during peak flowering. Traps that captured more than 500 banded sunflower moths per trap per season were located in 3 of the 8 trap sites in Cass, Cavalier, and Renville Counties. A total of 3,132 banded sunflower moths were captured among all trap sites.

Sunflower moth was collected at only 2 of the 8 trap sites, Renville and Ward Counties. Sunflower moth migrates into ND and was first detected during early July. Peak catch occurred during late July through mid-August during peak flowering. The Economic Threshold for trapping is when the numbers of sunflower moths is $\geq$ 25 moths per trap per week, but no trap site reached this level in 2023. A low total of only 9 sunflower moths were captured among all trap sites.

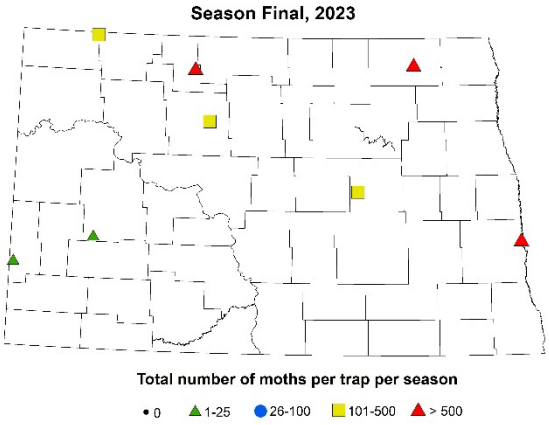
Acknowledgments: Sincere thanks to the hard-working field scouts and insect trappers! We also appreciate the help of Darla Bakko, NDSU Dept. of Plant Pathology, for data compilation, and Dr. Honggang Bu, NDSU Dept. of Soil Science, for ArcMap programming and webwork. This survey is supported by the Crop Protection and Pest Management Program - Extension Implementation Program, award number 2021-70006-35330 from the USDA National Institute of Food and Agriculture, and the North Dakota Department of Agriculture CAPS Program.

Red Sunflower Seed Weevils in Sunflower



Banded Sunflower Moth Trapping Network

Cochylis hospes



IPM Scout, Regan Jones, scouting for insect and disease pests of barley (Greg Endres)

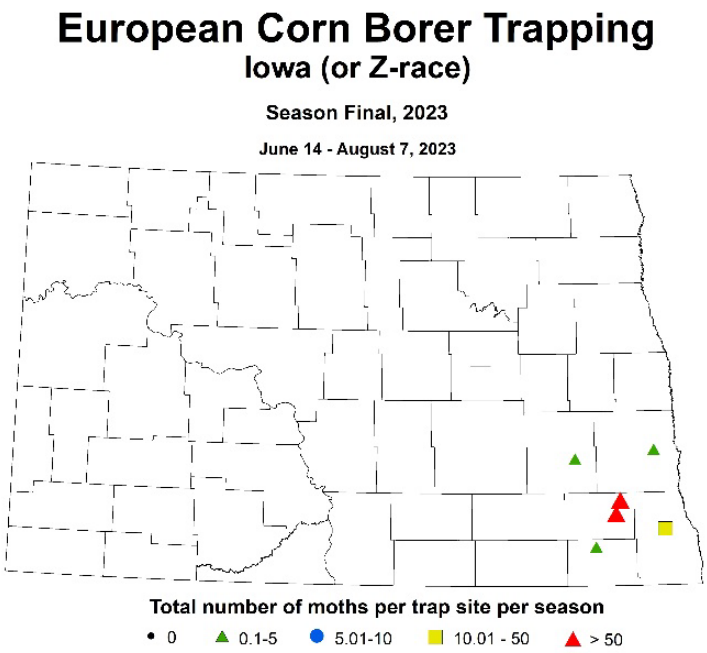
Janet J. Knodel
Extension Entomologist

Patrick Beauzay
State IPM Coordinator and Research Specialist

2023 CORN INSECT TRAPPING – SEASON REVIEW

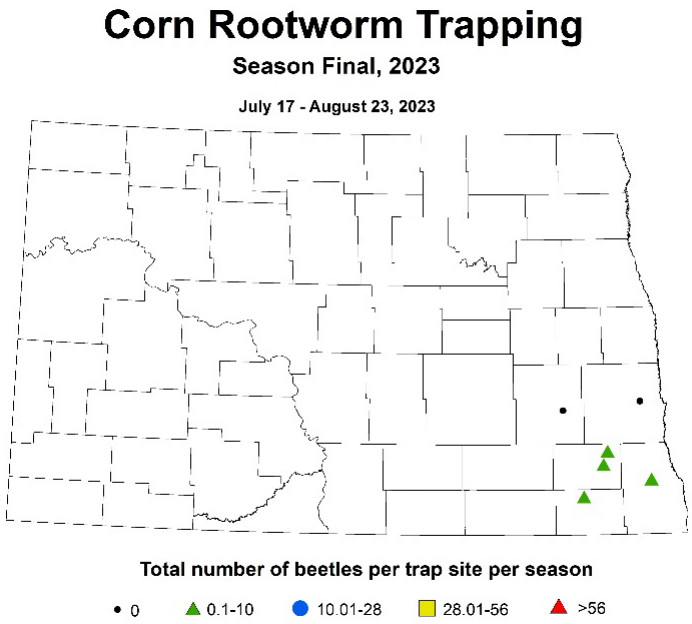
We want to thank to the *North Dakota Corn Council* for their support for the European corn borer and corn rootworm trapping networks. Field data are posted on the NDSU IPM website.

European corn borer - European corn borer (ECB) moths were monitored in conventional non-Bt and Bt corn fields from mid-June to late August using modified Hartstack traps with pheromone lures. We had 6 trap sites in 5 counties including Barnes, Cass, Sargent, Ransom, and Richland (southeast ND).



A grand total of 219 moths were trapped this year, which is about 37% fewer moths than last year. The ECB Z-race moths (univoltine) had 217 individuals and was by far the more common than the ECB E-race moths (bivoltine). The first ECB Z-race moths were trapped the third week of June from Sheldon and Shenford (Ransom County) corn sites. The peak flight of ECB Z-race moths occurred from July 3 to 17 during V5 to VT (tasseling) stages at most sites. The ECB E-race moths were found at low numbers (a total of 2 individuals) at only two sites: Mapleton (Cass County) and Sheldon (Ransom County). No ECB E-race moths were trapped at the other 4 of the 6 corn sites.

Corn rootworms - Corn rootworm beetles were monitored using four unbaited Pherocon AM® yellow sticky traps in a linear transect at each of the 6 sites in 5 counties for four weeks during pollination. A total of 71 corn rootworm individuals were counted from these traps. From the 2023, 69% of collected beetles were northern corn rootworm and 31% were western corn rootworm. Forty six percent of the fields had corn rootworms present in the traps during trap sampling in 2023 compared to 50% in 2022 and 66% in 2021.



Overall, all corn fields trapped were below the economic threshold (E.T.) of >2 beetles (either species or in combination of the 2 species) per trap per day (or ≥56 beetles per trap per season (or 4 weeks trapping duration). If above E.T., a high corn rootworm population is expected the following year and a corn rootworm management tool will likely be necessary to protect the following year's corn crop.

Janet J. Knodel
Extension Entomologist

plant pathology

SUNFLOWER STEM DISEASES

Numerous stem diseases on sunflower can be observed this time of year. Many of the pathogens that cause those diseases can survive for years, so understanding what's in your field today can help you plan to manage them in the future. This article is written to give you some basic information on the importance and symptoms of what you might be seeing in your fields. More information can be found in the Sunflower Disease Diagnostic Series (link to: https://www.ndsu.edu/agriculture/ag-hub/publications/sunflower-disease-diagnostic-series).

Sclerotinia Stem Rot

Sunflower plant with both mid-stalk rot and basal stem rot. Note large tan-colored lesions, white fungal growth and shredding.

This is a common disease that causes can cause yield loss and lodging. This is caused by the same pathogen (*Sclerotinia sclerotiorum*) that causes yield loss on other broadleaf crops (canola, dry edible beans, pulse crops, soybean, etc.), and Sclerotinia head rot in sunflower.

Key symptoms:
Large (often greater than 6 inches) tan to cream colored stem lesion centered on a petiole, or, appearing to creep up from the soil line (Figure 1). White fungal growth and black fungal bodies may appear on or in stem. Stem frequently shreds and lodges.

Phomopsis Stem Canker

This is currently the most important sunflower stem disease in our region, and severe yield loss can occur in an epidemic. Infections begin on the leaves and quickly spread into the stem. Lesions commonly degrade the pith, resulting in yield loss and lodging.

Key Symptoms:
Large (often greater than 6 inches) brown lesion centered on a petiole. Stem becomes hollow underneath the lesion, and is easily punctured with thumb pressure. Lodging may occur.

Large brown Phomopsis stem canker lesion lodging a sunflower plant.

Phoma Black Stem

Phoma black stem lesions centered on petioles.

Phoma is the most common stem disease in our region, but is very rarely economically important.

Key Symptoms:
1-2 inch coal-black lesion centered on a petiole, usually superficial. Many lesions may occur on the same stem. Lesions generally do not impact stem integrity.

Verticillium wilt

Verticillium wilt occurs in our region, but is often less common than other stem diseases. Its distribution in a field is often spotty or patchy. Where it appears, complete wilt and premature plant death can occur.

Key Symptoms:
At mid-season, symptoms may first be observed as severe interveinal chlorosis and necrosis on the leaves, with severity decreasing towards the top of the plan. A cut stem will reveal a brown 'ring' around the pith. In the later season (now) an external gray lesion on stalk may occur. If the stem is cut, the pith will be shrunken/compressed and covered with black microsclertia. The inside of the pith will remain white.

Cut stem symptoms of Verticillium wilt include a brown vascular ring (mid-season) and compressed and blacked pith (late-season).

Foliar symptoms of Verticillium wilt appear as severe interveinal chlorosis and necrosis.

Charcoal Rot

Charcoal rot is caused by *Macrophomina phaseolina*, the same pathogen that causes charcoal rot on soybeans, corn and other crops. Charcoal rot is more common in dry years, and more frequently seen in soybeans than sunflower. Yield loss to sunflower is thought to be rare.

Key Symptoms: Premature senescence, gray lesion at the soil line appearing to spreading up the stalk, small black specks (microsclerotia) in the stem.

Gray lesion spreading up stem

Small black microsclerotia in stem tissue.

Sam Markell
Extension Plant Pathologist, Broad-leaf Crops

THE SCN PROFIT CHECKER TOOL

The SCN Coalition launched a new tool to help growers understand how much SCN may be costing them. The tool uses data from more than 25,000 plots collected over a decade at Iowa State University, and we believe should be accurate for our area as well. The tool is available at the SCN Coalition website. https://www.thescncoalition.com/profitchecker/

The tool considers several key factors that contribute to SCN reproduction and yield loss, including; sand content of the soil, soil pH, SCN egg count, and SCN female index. Most growers will know the sand content and pH of the soil already. The SCN egg count is determined by an SCN soil test. *If you haven't sampled for SCN yet, I strongly encourage you to do so. The SCN sampling program supported by the North Dakota Soybean Council makes this easy, and covers the lab fees* 16 CPR September 7 2023. Very few growers will not know the SCN female index of their field, but that's OK! NDSU nematologists and pathologists have entered a default number (based on research conducted in the state) for ND into the tool.

The value of the tool is to understand the economic loss that SCN may be causing in your field, which gives you critical information when determining the value of management tools. As a reminder, management tools include crop rotation, rotation of varieties with SCN resistance, and consideration of a seed treatment. For more information, visit www.thescncoalition.com

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Soybean Pathology

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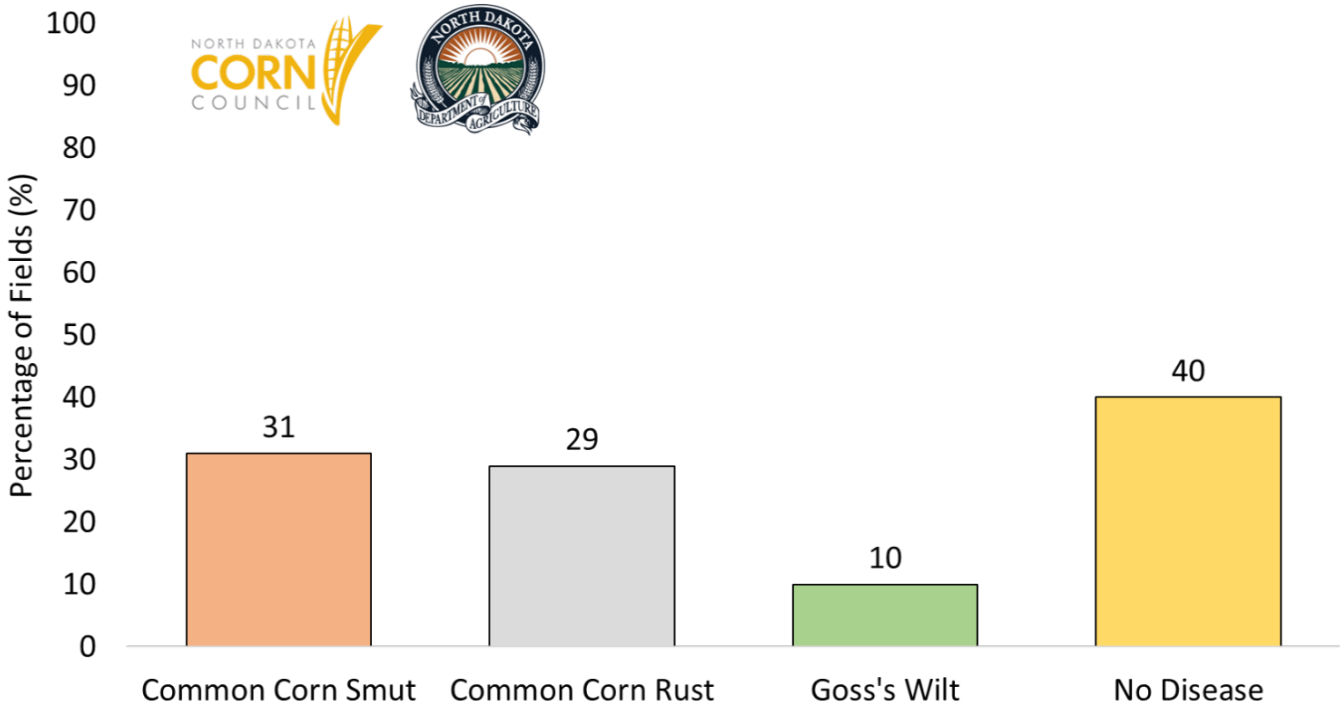
2023 CORN DISEASE SURVEY RESULTS – LOW OCCURRENCE OF DISEASE

Results from the 2023 corn disease survey indicated another low disease year for North Dakota corn producers. The Cereal Crop Extension pathology team visited 103 corn fields (growth stages VT to R3) across 12 counties. The most commonly identified corn diseases were common corn smut, common corn rust, and Goss's wilt (Figure 1). Regardless of the corn disease detected, field incidence of a disease (how many plants infected) was very low. This year approximately 40% of the scouted fields did not have a corn disease identified.

I received several photos of corn smut infecting different parts of the corn plant (Figure 2). As a reminder, common smut is not considered an economically important disease and galls are often found on plants that have experienced damage (ie: hail, wind, etc.), poor pollination, or experienced water stress. Common corn rust is another disease that is not economically important. The pathogen does not overwinter in the state and is dependent on southerly winds to carry spores northward. Goss's wilt has the potential to be the most damaging corn disease in North Dakota, but selection of resistant hybrids and crop rotation has lessened occurrences of economic damage.

Figure 1. Corn disease prevalence (positive observation of a corn disease) for fields scouted in 2023.



Common smut can be found on stems, ears, tassels, and leaves (Photo credit: top left corner – Dave Carruth – BASF; Rest of photos Andrew Friskop)

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Research Specialist/Manager

Andrew Friskop
Extension Plant Pathology, Cereal Crops

SMALL GRAIN DISEASE OBSERVATIONS FOR 2023

The 2023 growing season had low levels of disease in both wheat and barley. Although some of the common diseases were still observed, they occurred at lower frequencies. Using the IPM survey data, I summarized the information into the occurrence of early-season leaf disease (emergence to flag leaf), late-season leaf disease (flag-leaf and beyond), and head disease for both wheat and barley.

Wheat and Barley - Early-season leaf disease (prior to flag leaf)

Disease observations in wheat during the early development stages were infrequent. Tan spot (Figure 1) was considered to be the most common disease, yet was only reported in 1% of the fields. This could be attributed to a couple reasons. First, tan spot thrives in conditions that include prolonged dews, cool weather and frequent rain. Those conditions were rare in late May and throughout June. Second, most of the commonly grown hard red spring wheat varieties have average to above average levels of resistance that can reduced tan spot severity. Finally, it is a common practice to include a fungicide with the first herbicide pass due to the availability of effective and inexpensive fungicide options. The combination of these events likely inhibited development of tan spot in 2023.

Figure 1. Tan spot on the oldest leaves of hard red spring wheat in southwest North Dakota.

Figure 2. Early-season development of bacterial leaf streak in barley. Note areas and segments of water-soaking.

Similar to wheat, very low levels of disease were observed in barley during the first portion of the growing season. The most commonly observed barley disease prior to flag leaf was bacterial leaf streak (Figure 2) and was recorded in 5% of the fields with average field incidence levels of 6%. As opposed to a fungal leaf spot, host resistance to bacterial leaf streak is lacking in most barley varieties and fungicides do not work on this disease.

Wheat and Barley - Late-season leaf disease (flag leaf and beyond)

The two most commonly observed late-season leaf diseases in wheat were bacterial leaf streak (7% of the fields) and tan spot (6% of the fields). Moderate temperatures in July combined with precipitation and frequent dews provided favorable conditions for these diseases. Yield losses associated with bacterial leaf streak (Figure 3) will range between <1% and up to 60% depending on the level of susceptibility in a variety. Research at NDSU suggests selecting a variety with a bacterial leaf streak score of 5 or less (scores can be found in the NDSU Extension Hard Red Spring Wheat Variety Selection and Performance Guide) to minimize yield loss risk.

Figure 3. Flag leaf with substantial damage by bacterial leaf streak. Note brown-yellow streaks running parallel to the leaf veins.

Spot blotch (Figure 4) was the most frequently identified late-season barley disease and was found in 12% of the fields. There were several reports of a “late flush” of spot blotch in fields, but yield loss was likely minimal given the timing of the disease epidemic. The second most commonly identified late-season barley disease was bacterial leaf streak and was identified in 4% of the surveyed fields.

Figure 4. Lower canopy of a barley research plot with high levels of fungal leaf spot with most being spot blotch.

Wheat and Barley – Head Diseases

The three most commonly identified head diseases in wheat were loose smut (9% of the fields), Fusarium head blight (4% of the fields; Figure 5) and ergot (2% of the fields). Although Fusarium head blight and ergot were identified, both diseases were found at very low frequencies. Similar head disease reports occurred with barley. Loose smut was identified in 28% of the fields, Fusarium head blight (Figure 5) in 5% of the fields, and ergot in 8% of the fields. The frequency of these diseases within an affected field were very low. To date, I have not received any quality concerns caused by Fusarium head blight or ergot.

Figure 5. Fusarium head blight (scab) on hard red spring wheat (left) and two-row spring barley (right).

Andrew Friskop
Extension Plant Pathology, Cereal Crops

plant science

CORN SEASON WRAP-UP

Corn harvest started as early as the first week of September for some fields suffering the most from drought. Unfortunately, there are corn fields scattered across central and eastern ND that matured earlier than normal due to moisture stress. In these fields, kernel number is likely reduced due to poor pollination and/ or abortion during early grain fill due to insufficient moisture. Additionally, it is expected that some if not most of the grain from drought-stricken fields will have lower-than-normal test weight as photosynthesis and grain fill was cut short by dry conditions. Though there are a number of poor corn fields in the state due to drought, there are also many decent if not good fields as well. While checking on our southern locations of corn variety trial plots over the past two weeks, we saw fields that may struggle to reach 150 bushels but also a few where yields should hit 200 bushels. The timing and amount of rainfall was everything this year. Going in to harvest, I suggest growers scout corn fields carefully to look for fields that are maturing ahead of schedule and need to be harvested first to avoid dropping ears or excessively dry corn. In fields that received either more total rainfall, or at least more rainfall during especially critical growth stages, harvest will likely proceed on a somewhat normal schedule, reaching black layer in mid-September and drying down to harvest-ready around mid-October. Ideally, corn should be harvested around 20% moisture to avoid kernel breakage and harvest losses on the low end and drying costs on the high end. In droughty areas, keep in mind that stalk strength is likely compromised and

plants may be more prone to lodging and ear shanks more prone to breaking during dry down. If a field seems drier than expected, prioritize it for early harvest to avoid grain loss in the field.

At our corn plot tours in Richland and Sargent Counties last week, we saw evidence of corn rootworm activity. We saw some root lodging (corn plants leaning over at ground level, as opposed to a break in the stalk higher up) at our Abercrombie location, very likely due to corn rootworm feeding on the roots. Northern corn rootworm adults (small green beetles) seemed especially abundant in Sargent County at our plot near Gwinner. Dr. Janet Knodel spoke about the northern corn rootworm life cycle and options for management. Crop rotation is still an excellent way to control corn rootworm as the larvae need corn roots to complete their lifecycle. A corn-soybean rotation has typically kept corn rootworm populations in check, but growers and agronomists should be aware that there are populations of northern corn rootworm with what is called extended diapause. Extended diapause occurs when the overwintering eggs remain viable in the soil for two winters, as opposed to one, waiting for corn to return to the field in a two-year rotation. Extended diapause has been identified in rootworm populations from southern Minnesota and Iowa but this behavior isn't well documented in corn rootworm populations in North Dakota. If growers are able to include a third crop in their rotation, corn-soybean-spring wheat or corn-soybean-canola are good options for reducing corn rootworm populations.

Corn ear showing feeding damage from northern corn rootworm, taken at Gwinner plot tour on 9/14/2023.

COVER CROPS, INTERCROPPING, AND SOIL HEALTH FIELD DAY RE-CAP

On Tuesday, September 19 Dr. Marisol Berti and I co-hosted the Cover Crops, Intercropping, and Soil Health field day held at Hickson, ND and on the NDSU main campus in Fargo. We had a great turn out with 50 people joining us for the morning to learn about intercropping sunflowers and corn with sainfoin (a drought-tolerant perennial legume) and alfalfa. New iterations of this research are comparing the forage value of sainfoin to alfalfa and exploring novel ways of planting corn to enhance forage establishment; for example, leaving intentional, alternating gaps in the corn stand to allow more light to get through the corn canopy for the alfalfa. In the photo to right, Dr. Marisol Berti and her graduate students discuss sunflower-forage intercropping. At the NDSU campus, we learned about research investigating alfalfa varieties and their relationship with Rhizobia and efforts to enhance beneficial symbiosis and reduce alfalfa-microbe interactions that do not directly benefit the plant.

I spoke about the perennial small grain Kernza and Chantel Mertz, a graduate student in soil science discussed her work investigating the salt tolerance of Kernza in the greenhouse and the field. So far, Kernza is showing promising levels of salt tolerance and may have a fit in saline soil reclamation situations. We also heard about research with forage sorghum. The picture (left) is of forage sorghum plots on the Fargo campus. Some of the varieties were over 8 feet tall. As Dr. Berti told us, nothing produces biomass in limited rainfall environments like sorghum. If producers are looking for forage options, they should consider forage-type sorghums. For specific variety recommendations, you are welcome to contact Dr. Berti.

Best wishes to all for a safe and happy harvest season!

Clair Keene
Extension Agronomist Small Grains and Corn

soils

IF YOU EVER WANTED TO KNOW WHY N RECOMMENDATIONS HAVE CHANGED IN NORTH DAKOTA, WHY I AM PASSIONATE ABOUT NO-TILL AND WHAT GOES ON INSIDE DAVE FRANZEN'S HEAD

As I am now 10 months and about 20 days away from retirement, it might be time to explain why I am passionate about no-till, why the big changes to state N recommendations including the no-till credit, why zone sampling and my great failing. The following 'No-till Farmer' podcast is probably the best interview anyone has done with me in my nearly 30 years at NDSU:
https://www.no-tillfarmer.com/articles/12392-podcast-no-till-soil-health-education-with-north-dakota-states-dave-franzen

EXPLANATION OF FERTILIZERS WITH REDUCED CARBON EMISSIONS AND PRODUCED WITH RECYCLED MATERIAL

There is growing public and government pressure to produce fertilizers with a reduced environmental footprint. The 'colors' of ammonia manufacture appear in many popular articles and manufacturing facilities promote their ammonia color manufacture commonly. Here is a table which explains very generally what ammonia color manufacture means.

(Table produced from information provided by Blaylock, A. 2022. The Ammonia Rainbow In: North Central Extension Industry Soil Fertility Conference Proceedings. https://northcentralfertility.com/proceedings/?action=abstract&id=9394&title=The+Ammonia+Rainbow&search=authors

THE AMMONIA COLOR PALETTE			
Name	**Method of Manufacture**	**Carbon Intensity**	**Notes**
Brown/ Black	Coal gasification to produce H_2, CO & CO_2. H_2 separated	Very high CO_2 emitted; CO release, high energy use	Used by China, Dakota Gasification
Grey	Steam reforms natural gas into H_2 & CO_2	High CO_2 emitted, high Energy use	Most prevalent in NH_3 manufacture ~ 96% of world production
Blue	Steam reforms natural gas into H_2 & CO_2, followed by CO_2 capture, storage or reuse	Potential for lower overall C; currently about 10-20% of CO_2 not captured.	Carbon Capture and Sequestration value is uncertain
Green	Electrolysis of H_2O, producing H_2 and O_2, using renewable energy source	Low/no CO_2 emission, but Higher energy use compared to grey	Most desirable
Yellow	Electrolysis of H_2O using exclusively solar power	Low/no CO_2 emission, Higher energy use	Same as Green, but energy is only solar
Turquoise	High temperature methane (natural gas) pyrolysis into H_2 + solid C	Low/no CO_2 emission, High energy use	Experimental
Pink	Electrolysis of H_2O into H_2 + O_2 using nuclear power	Low/no CO_2 emission, Higher energy use, Hazardous nuclear waste	Nuclear not considered sustainable energy by some

Phosphorus is a pollution concern that when lost from the field contributes to eutrophication of surface water, resulting in 'dead zones' in river outlets to lakes (i.e. Lake Erie, Lake Winnipeg) and oceans (i.e. Gulf of Mexico, Sea of Japan). The mineral struvite (magnesium ammonium phosphate) is being produced from waste water treatment facilities, and through P rate research it is taken up by crops similar to MAP and DAP in broadcast applications. Questions still remain whether struvite is useful as a row-starter application, and long-term effects; however, in a broadcast application it has value for producers of crops contracted to food-industry groups with a requirement for more sustainable fertilizer inputs for the crops they purchase. There are quite a few manufacturers of struvite-based products in the USA. Some market struvite from wastes exclusively, while some incorporate MAP into the manufacture to supplement waste P supply in order to fill tonnage demand.

NEW NDSU SOIL HEALTH PAGE

Over the next few weeks, the NDSU Extension Soil Health website will be transitioning to a new platform and with the change we also have a new website address. To continue to access science-based soil health information you can rely on for your farming decisions, navigate to www.ag.ndsu.edu/soilhealth. The old website will be taken down in the coming days. Also, be on the lookout for new videos from this summer's field days on the NDSU Soil Health YouTube channel (https://www.youtube.com/channel/UCco9hmhuIafRu1VxAPOrNgA).

Brady Goettl,
NDSU Research Technician
Soil Health program

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UAS REMOTE ID ENFORCEMENT DATE EXTENDED SIX MONTHS

In the September 7 *Crop and Pest Report*, I shared that enforcement of FAA Part 89, which requires remote ID for Unmanned Aerial Systems (UAS), would begin September 16, 2023. The FAA has delayed this enforcement date by six months, to March 16, 2024.

If you are seeking to upgrade a non-compliant drone with an external Remote ID Broadcast Module, I encourage you to order one as soon as possible. These items are on backorder at many retailers, and the unanticipated issues operators are having in obtaining modules is the primary reason given by the FAA for the delay.

See my entry in the September 7 Crop and Pest Report for further details on the Remote ID requirement.

TIPS FOR THE SPRAYER OFFSEASON

This final Crop and Pest Report of 2023 is a clear signpost – the growing season is winding down and fall is here. Before winter arrives, it will be time to prepare your sprayer for next year.

Below are two resources from Sprayers101 to help guide you the process. Sprayers101 is an excellent resource authored and maintained by two application specialists in Canada, Drs. Tom Wolf (Saskatchewan) and Jason Deveau (Ontario). Although some of the tips shared throughout the site are specific to the Canadian audience, most advice is also applicable to North Dakota.

- End of Spraying Season Checklist. This convenient checklist outlines processes for winterization, sprayer inspection, and reflecting on your experiences during the past spray season.
- Clean Your Nozzles. Consider cleaning your nozzle tips during the offseason, and this article offers helpful tips. Nozzle tip cleaning can be delayed until winter rather than competing with fall's numerous time-sensitive tasks, as long as you remove and set aside the tips after winterizing your sprayer.

Rob Proulx
Extension Agriculture Technology Systems Specialist

forestry

WINTER PREP FOR TREES

This past year has been pretty variable across the state, especially in terms of tree stress. While early-season moisture was good throughout North Dakota, drought conditions have slowly crept back into several of the north-central and northeastern counties. As we prepare for winter, there are simple management actions that we can take to help trees survive the winter and even thrive next summer. For conifers, it's very important that they go into winter fully hydrated. Conifers that are drought-stressed are more prone to the type of damage that is generically called 'winter injury'. Winter injury takes many forms and has several potential causes; nevertheless, studies have shown that trees that are well-hydrated going into winter are less likely to suffer damage over the cold season. Watering should get the soil moist, but not saturated, to as deep as you can get it. Remember also that tree roots extend far beyond the edge of the tree crown. The larger the area that can be watered, the better.

A young apple tree, with simple protection from winter problems such as sunscald, or wildlife such as rabbits and other rodents.

Foliar diseases were more prominent in 2023 because of the early-season moisture, and mid-season moisture in the Missouri River valley. If your trees had foliar fungal problems such as *Melampsora* leaf rust, apple scab, oak leaf blister, or one of the anthracnose diseases, then be sure to rake up and remove or destroy all the fallen leaves this autumn. Fungal spores over-winter in the fallen leaves so getting rid of this source of inoculum will go a long way towards preventing foliar diseases next year.

Finally, make sure to protect the stems of young/small trees from the various ravages of winter. Often, this means putting some type of white wrap or corrugated white pipe on the stem to help prevent sunscald (another form of winter injury). More importantly, these products can help prevent damage from deer, rabbits or voles. Make sure that the wrap goes high enough that it will reach well beyond the expected snowpack, as rabbits can climb the drifts and girdle stems or even branches of deciduous trees. Sometimes, it may even be better to place a fence further out from the stem, to keep the deer away from the lower branches.

Joe Zeleznik
NDSU Extension Forestry Specialist

weather

WEATHER FORECAST

Season Summary

From May 1 through September 15, we ran above normal for average air temperature across almost all of ND (Figure 1), generally from 2° to 4° F above normal.

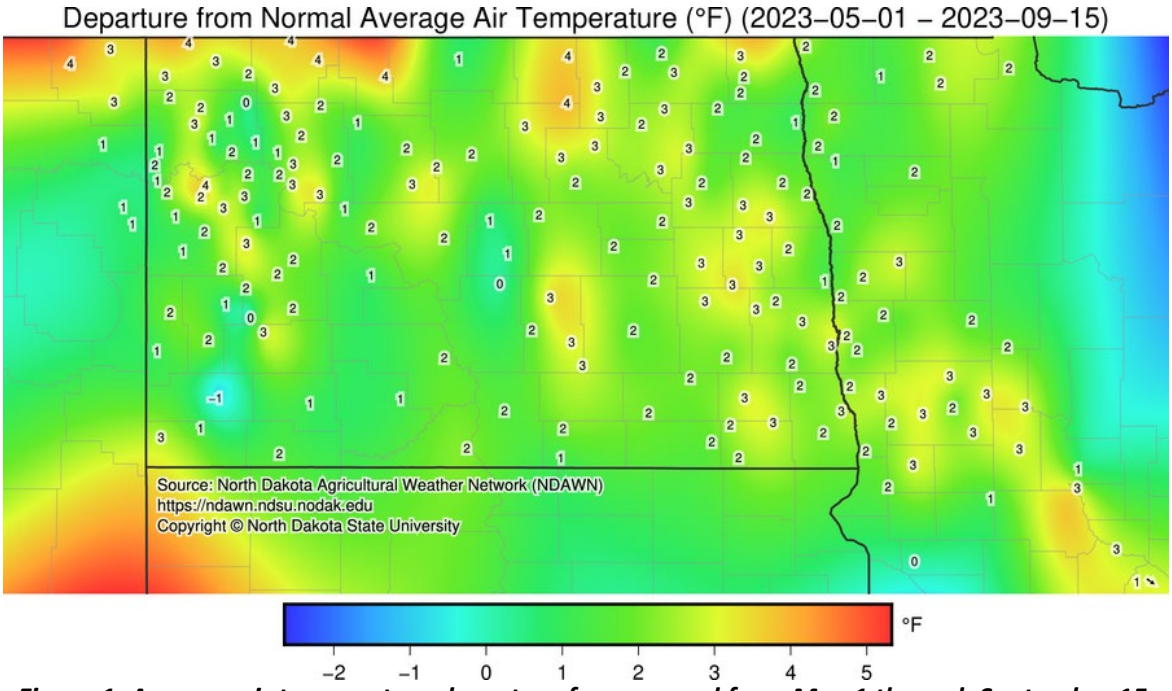

Figure 1. Average air temperature departure from normal from May 1 through September 15.

Rainfall totals for the same time period (Figure 2) ranged from a scant 5.11 inches at the NDAWN station near Clyde in Cavalier County, ND, to a whopping 20.12 inches at the station near Carson in Grant County, ND. To put that in better perspective, that's 8.73 inches below normal at Clyde and 8.67 inches above normal at Carson. Figure 3 shows rainfall departure from normal across all NDAWN stations from May 1 through September 15. Figure 4 shows percent of normal rainfall for the same time period.

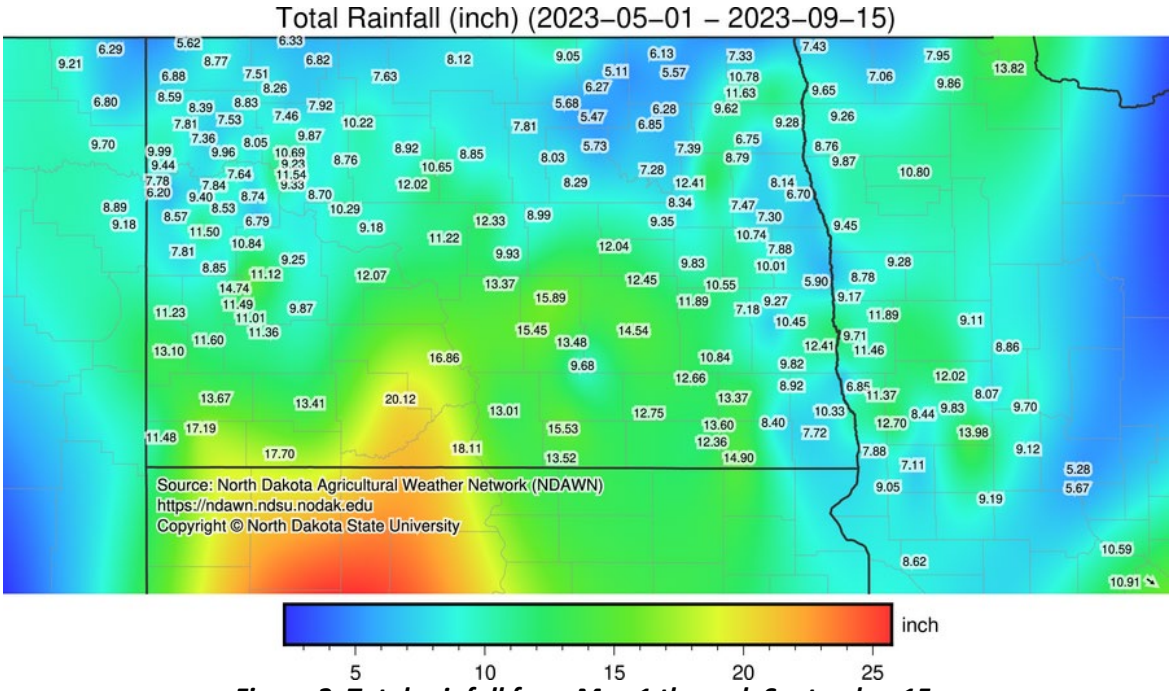

Figure 2. Total rainfall from May 1 through September 15.

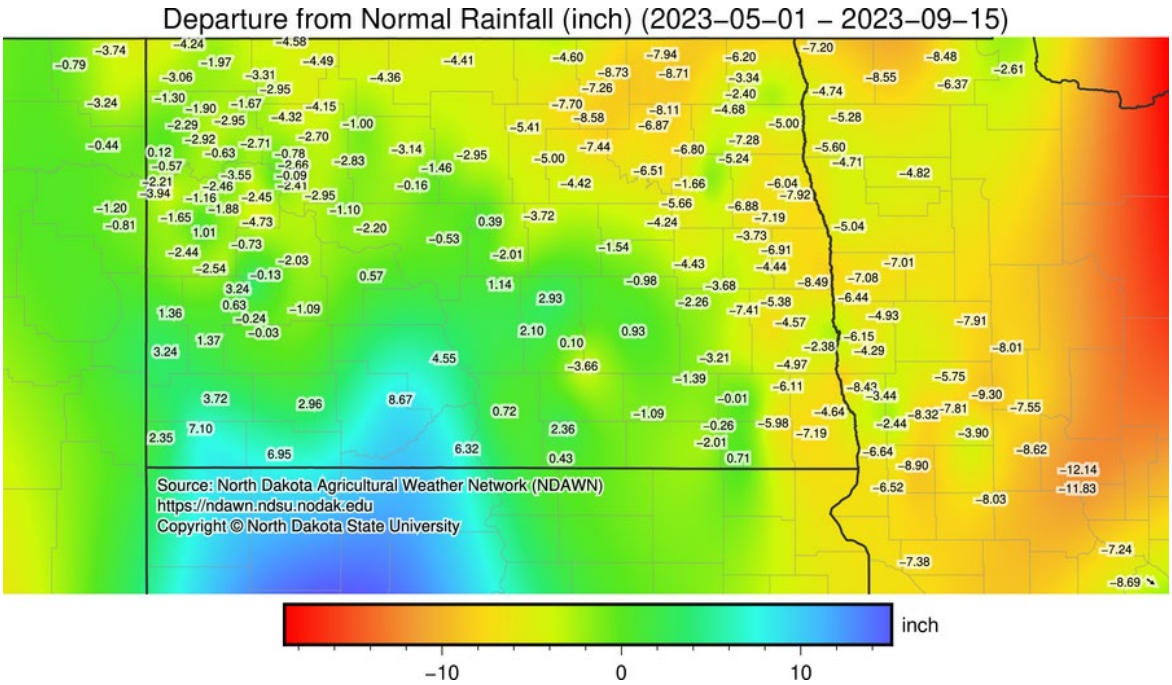

Figure 3. Rainfall departure from normal from May 1 through September 15.

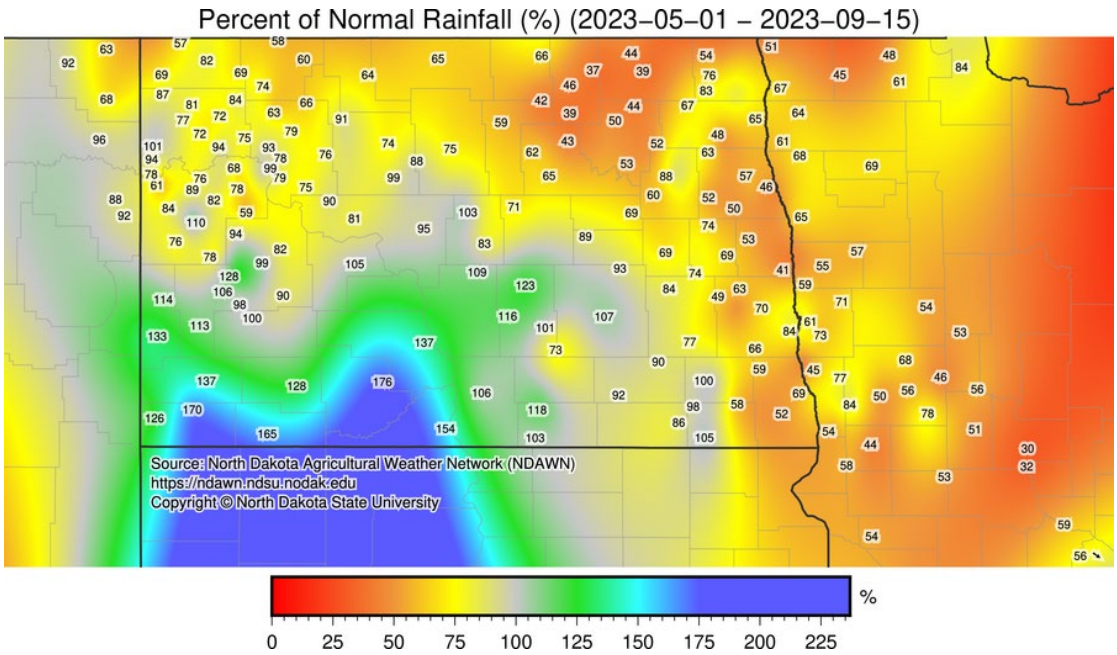

Figure 4. Percent of normal rainfall from May 1 through September 15.

Dry north and east, normal to wet across southern ND. The rainfall totals are reflected in the US drought maps depicted in Figure 5, which shows monthly drought condition changes from June through September. Drought progression is especially notable across northern and eastern ND, and all of MN.

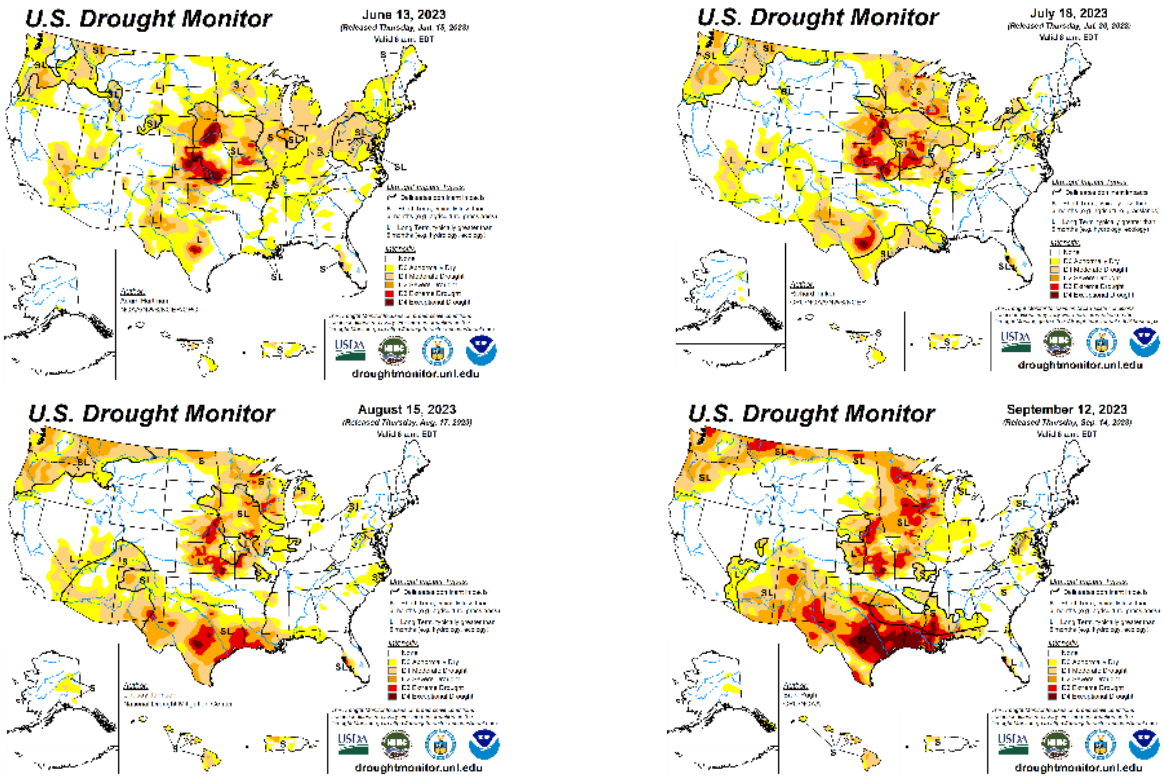

Figure 5. Monthly drought conditions for June, July, August and September.

The Week Ahead

Some good news for drought-stricken areas is that we have a good chance of a multi-day soaking rain event beginning Thursday. A low-pressure system is forecast to move out of the Rockies into the central Great Plains. The exact track of the system is still not certain, but the system will pull in ample low-level moisture from the Gulf of Mexico. The current 7-day precipitation forecast (Figure 6) calls for rain across all of the northern Great Plains, with generally up to 1 inch across the northern tier of ND counties, 2 inches in the eastern Dakotas and much of MN, and up to 3 inches across southern ND and northern SD. Locally heavier amounts are possible. This won't be a drought-buster, but those droughty areas desperately need rain. Looking further ahead, the 6 to 10 and 8 to 14 day outlooks favor much above normal temperatures and a slight chance for above normal precipitation (Figures 7 and 8).

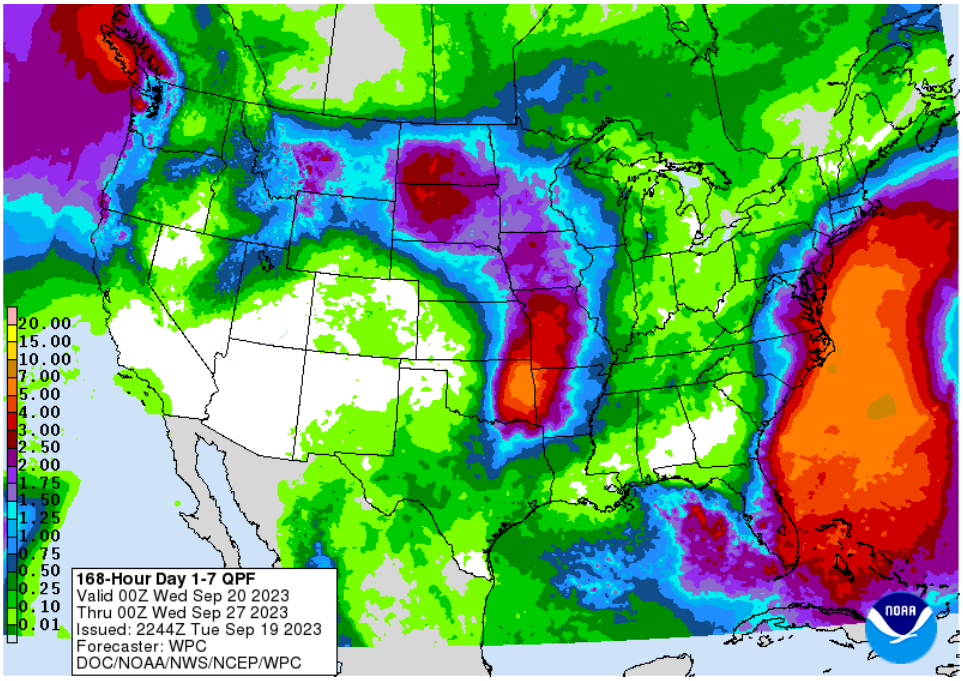

Figure 6. Seven day precipitation forecast from 7:00 PM September 19 through 7:00 PM September 26.

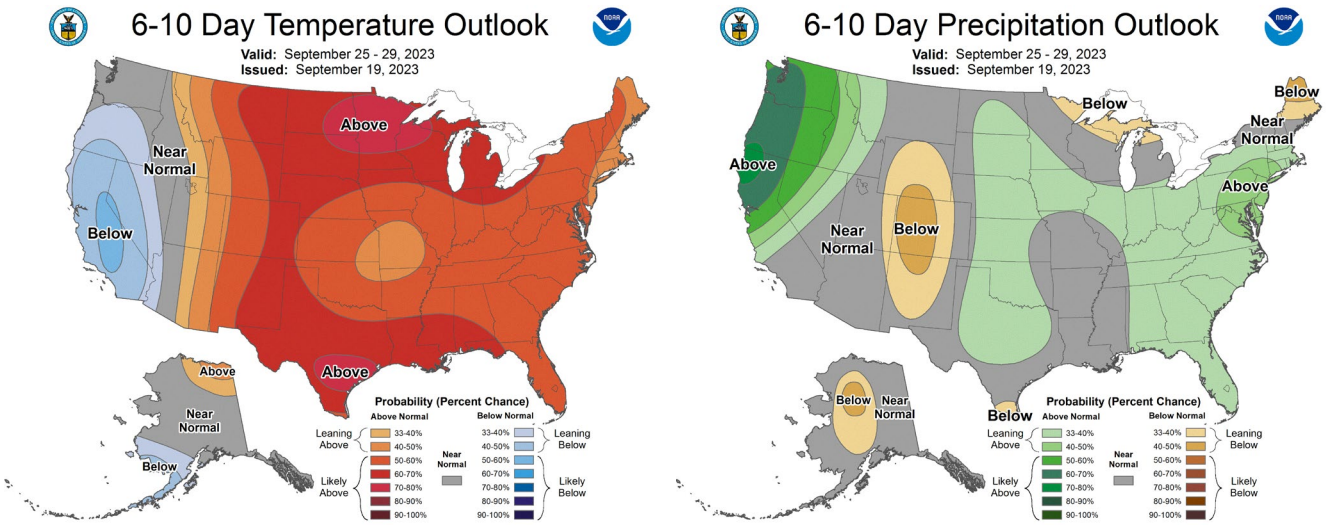

Figure 7. Temperature and precipitation outlooks from September 25 through September 29.

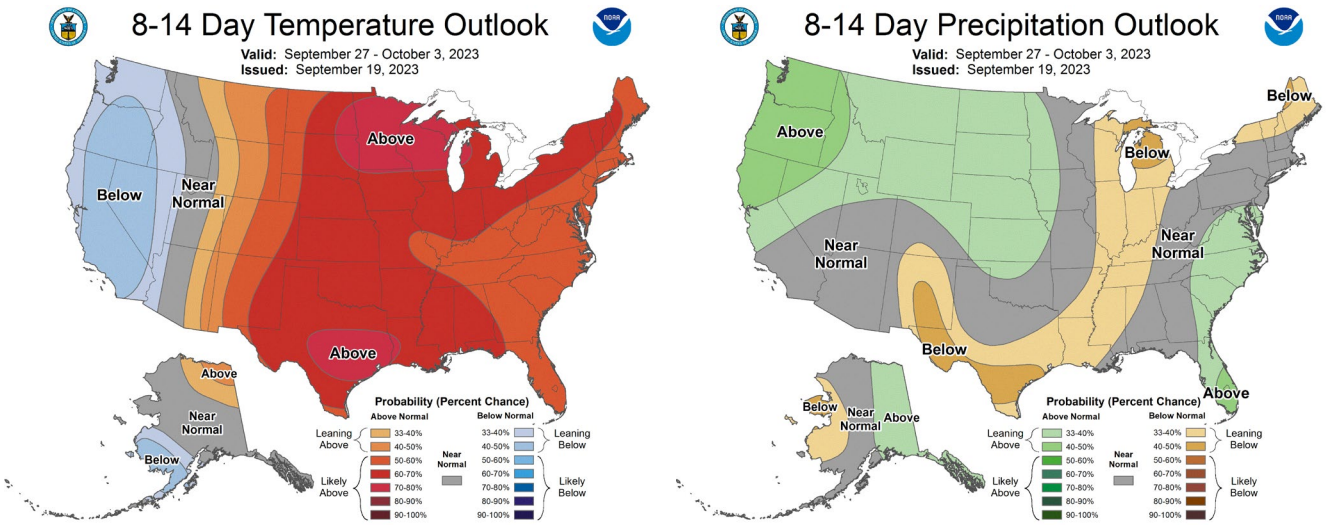

Figure 8. Temperature and precipitation outlooks from September 27 through October 3.

Winter Outlook

You've probably heard that a strong El Niño is expected to last through the winter, but what is El Niño, and what can we expect for the northern Great Plains? El Niño is one phase of a larger climate phenomenon called the El Niño-Southern Oscillation (ENSO). During an El Niño, easterly trade winds along the equator weaken, and warm surface water moves eastward across the Pacific Ocean to the west coasts of the Americas. A low-pressure system is present in the northern Pacific Ocean south of the Aleutian Islands, and this combination causes the Pacific Jet Stream to track across the southern United States, keeping the storm track to our south and along the east coast of the US. The northern Pacific low also keeps the polar jet stream flowing from west to east across Canada. The result is that the northern Great Plains typically experiences warm, dry conditions during El Niño winters. The opposite occurs during a La Niña, which is the other strong phase of ENSO. During La Niña, easterly trade winds keep warm surface water confined to the western and central equatorial Pacific. A high-pressure system is in place south of the Aleutians, and this allows the polar jet stream to move further south across the central United States. We typically have colder, snowier weather in the northern Great Plains during a La Niña winter. You've probably also heard of the Polar Vortex (PV), especially in recent years associated with arctic outbreaks that drop temperatures well below 0F. As the northern hemisphere tilts further away from the sun going into late autumn and winter, a strong low-pressure cyclone develops over the north pole. Like ENSO, there are two phases of the Polar Vortex - either strong and stable, or weak and wavy. These two phases make up the Arctic Oscillation. When the Polar Vortex is stable, the polar jet stays north and that brutally cold air is kept in place around the arctic. When the polar vortex is weak, waves form in the polar jet which allows cold air to push out of the arctic into much of the United States, depending on where the waves set up. These waves can interact with warm, moist air and produce storms, including violent tornadic thunderstorms in winter in the southeastern US. A strong El Niño (or a strong La Niña) in winter increases the chances for a weaker polar vortex. So what's my final prognostication for the winter? I think overall we'll see above normal temperatures, below normal snowfall, but also a few arctic outbreaks of very cold temperatures.

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