North Dakota State University
CROP & PEST REPORT

NDSU EXTENSION

No. 10 July 13, 2023

Inside this Issue...

NDSU FIELD DAYS SET

NDSU Field Days provide an opportunity for farmers, ranchers and others to hear about the latest research and practices in animal science, agronomy and horticulture.

The North Dakota State University Research Extension Centers' annual field days are set. The events take place at the Research Extension Center sites across the state and feature speakers, presentations and tours covering a diverse array of topics. The field days are open to the public.

The dates and locations for the field days are:

July 10 – Central Grasslands Research Extension Center – Streeter (10 a.m.-3 p.m. CDT)

July 11 – Hettinger Research Extension Center (5-7 p.m. MDT followed by supper)

July 12 and 13 – Dickinson Research Extension Center
- July 12 – Livestock tour at Manning Ranch (9 a.m.-noon MDT followed by lunch)
- July 13 – Horticulture tour (9 a.m.-noon MDT followed by lunch), agronomy tour (1:30-5 p.m.)

July 12 and 13 – Williston Research Extension Center
- July 12 – Main site agronomy and horticulture (4-8 p.m. CDT)
- July 13 – Irrigated tour – Nesson Valley Irrigation Research and Development farm, located 23 miles east of Williston on Highway 1804 (8:30 a.m.-Noon CDT)

July 17 – Agronomy Seed Farm – Casselton (5 p.m. CDT agronomy, 7 p.m. supper)

July 18 – Carrington Research Extension Center – Carrington (9:15 a.m.-3:30 p.m. CDT)

July 19 – North Central Research Extension Center – Minot (8:30 a.m.-Noon CDT)

July 20 – Langdon Research Extension Center – Langdon (8:45 a.m.-Noon CDT)

July 25 – Horticulture Research and Demonstration Gardens – Fargo (3-7 p.m. CDT plants, local foods and outdoor spaces)

Aug. 3 – Carrington Research Extension Center's Oakes Irrigation Research Site – Oakes (8:30 a.m.-noon CDT followed by lunch)

Sept. 9 – NDSU Research Arboretum – Amenia (12:30 p.m.)

NDSU Agriculture Communication
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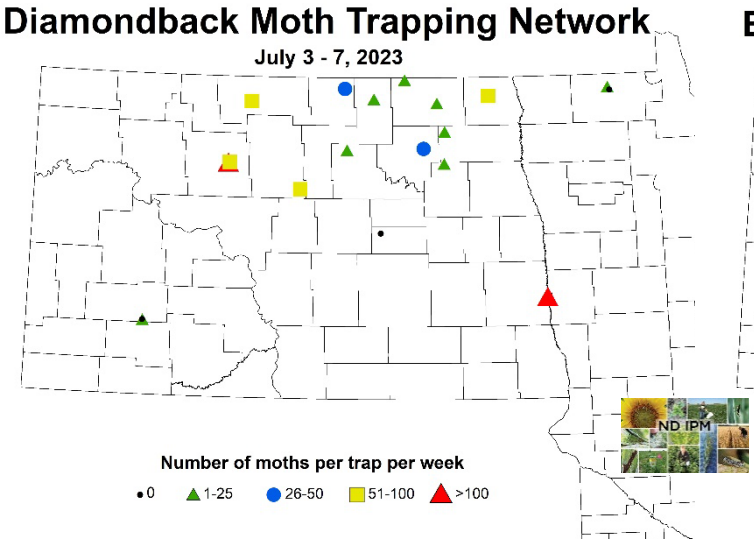
Editor: Elizabeth Cronin, 701-231-5391, elizabeth.cronin@ndsu.edu

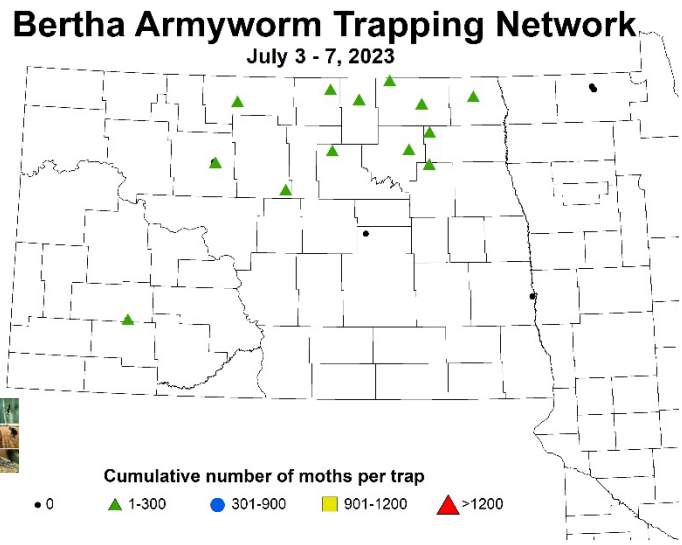
entomology

CANOLA INSECT TRAP UPDATE

Pheromone traps for bertha armyworm and diamondback moth are being monitored by IPM scouts and insect trappers through the IPM Crop Survey Program in 16 counties of North Dakota and 1 county in Minnesota. So far, trap counts for **bertha armyworm** are low (<10 cumulative moths per trap per week) at all trap sites. For **diamondback moth**, traps counts were low from the previous week, but trap counts increased in the north central (Ward County) and northeast (Pembina County) canola production areas. Scouting for diamondback moth is recommended in these areas with **high weekly trap catches of over 100 moths per trap per week**.

We will continue to report weekly trapping results for canola insects on the IPM website and the NDSU Extension Crop & Pest Report. Thanks to the Northern Canola Growers Association and the UDSA NIFA CPPM EIP for support.





EUROPEAN CORN BORER TRAP UPDATE

European corn borer moth (V. Calles Torrez)

This past week, Z-race ECB moths decreased at Gwinner (Sargent County), Shenford (Ransom County), and Mooretown (Richland County). The E-race ECB moth has not been detected in traps. See map on right and Table 1 (next page). Overall, ECB moth trap counts are low so far this year.

We will continue to report weekly trapping results for European corn borer moths on the IPM website and the NDSU Extension Crop & Pest Report. Thanks to the support of the ND Corn Council.

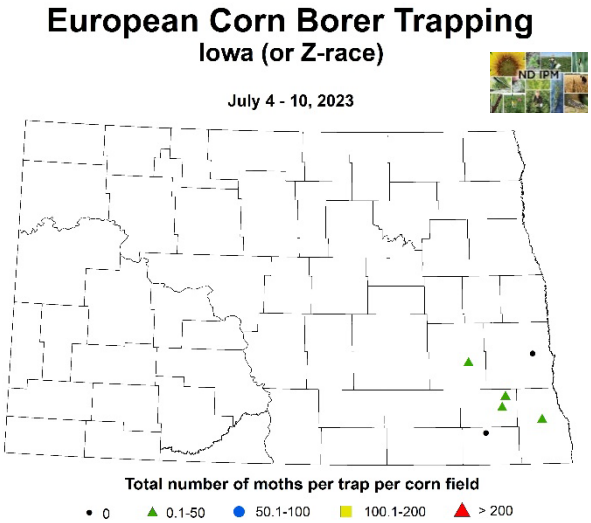


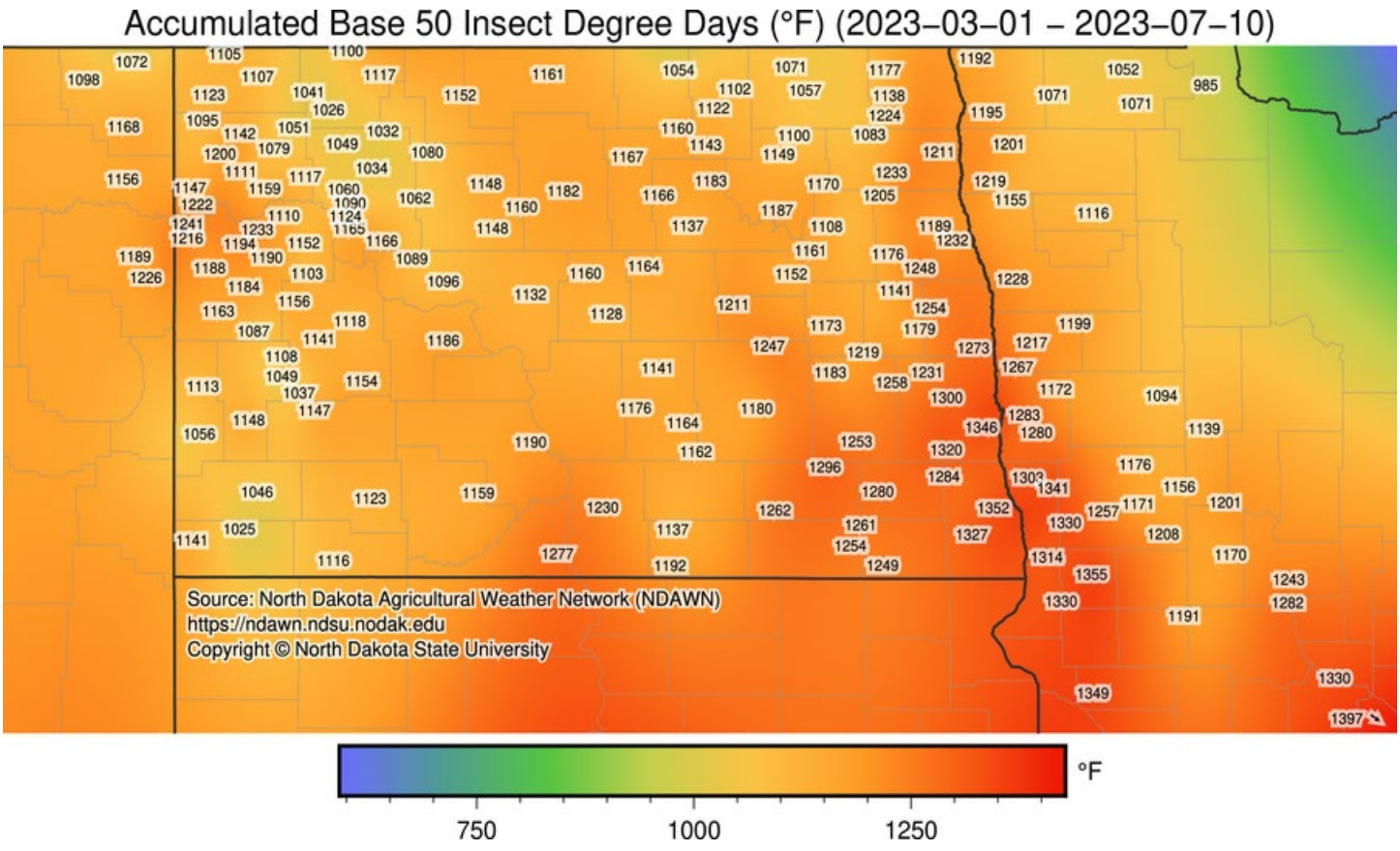
Table 1. 2023 pheromone trap catches for European corn borer (ECB) moths in corn, ND													
Area	County	Nearest town	ECB Z-race moths					ECB E-race moths					
			June 13-19	June 20-26	June 27-July 3	July 4-10	Total trap	June 13-19	June 20-26	June 27-July 3	July 4-10	Total trap
EC	Barnes	Cuba	0	0	0	0	0	0	0	0	0	0
EC	Cass	Mapleton	0	0	1	1	2	0	0	0	0	0
SE	Sargent	Gwinner	0	1	27	23	51	0	0	0	0	0
SE	Ransom	Shenford	0	14	47	14	75	0	0	0	0	0
SE	Ransom	Sheldon	0	0	0	0	0	0	0	0	0	0
SE	Richland	Mooreton	0	1	7	3	11	0	0	0	0	0
Total moths			**0**	**16**	**82**	**41**	**139**	**0**	**0**	**0**	**0**	**0**

Degree Days for Univoltine ECB moth: The accumulated degree days (ADD) indicate a range from about >1000 ADD (50% moths emerged) in the northern half of North Dakota to 1300 ADD (90-100% moths emerged) in southeastern North Dakota (see Table 1 and map below).

Scouting is critical for areas with more than 50% of moths emerged.

Table 1. Degree Day Model for Univoltine ECB Ecotype (base temperature of 50° F)

Accumulate Degree Days	Proportion of Emerged Moths
911	10%
986	25%
1078	50%
1177	75%
1274	90%



SUNFLOWER INSECT TRAP UPDATE

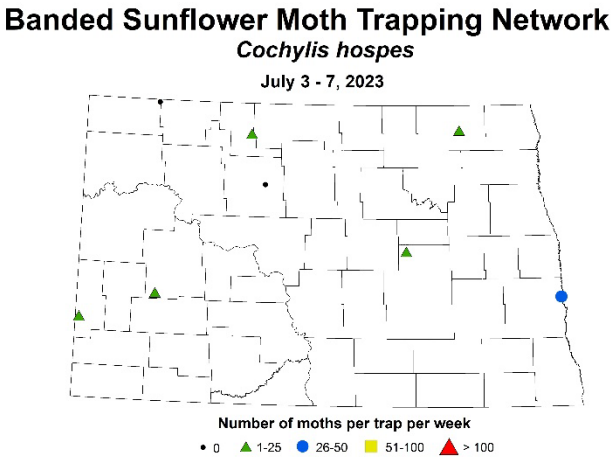
Banded sunflower moth is a small-sized tan-brown moth (¼-inch long) with a wingspan of about ½-inch. Its forewings have a triangular, dark brown band crossing through the middle of the wing. The first moth was detected in the last week of June in pheromone traps located throughout North Dakota. Trap counts are currently low. Within a week after emergence, moths begin to lay eggs on the bracts of the sunflower buds. Females preferentially deposit more eggs on midsized buds (R3) than smaller or larger buds.

Banded sunflower moths captured in sticky bottom of pheromone trap (J. Knodel, NDSU Ext. Entomology)

Scouting for eggs or moths of banded sunflower moth should start at the late bud stage (R3 - immature bud elongates >¾-inch above nearest leaf). Sunflower crop stages vary depending on planting dates and environment. Most fields scouted by NDSU Extension IPM scouts were in the late vegetative stages to R1 (terminal bud forms a miniature floral head). So, it is early for scouting now.

Crop Damage: Larvae cause feeding injury by consuming the florets and kernels. This can negatively impact crop yields and oil quality when populations are at economic levels. Banded sunflower moth usually consumes most of the kernel inside the seed.

More information on scouting and E.T. next week.



SCOUT FOR SOYBEAN APHID

Soybean aphids are a small ⅛-inch long, yellow to lime green aphid with black cornicles (tailpipes). Soybean aphids are being observed at low densities of <10 aphids per plant in some fields in southeast North Dakota. There haven't been any high numbers reported yet. In fact, we haven't seen economic populations of soybean aphids since 2018 in North Dakota. Please send me your field reports for soybean aphid counts and locations.

The **critical growth stages** for making most soybean aphid treatment decisions in North Dakota are from the late vegetative to early reproductive stages (R3 – beginning pod). Assessing aphid populations at these stages is critical. Typically, aphid treatments occur from mid-July to mid-August.

Soybean aphids on underside of leaf. White objects are cast skins (red circle) that are molted as the aphid nymph grows and should NOT be counted as a 'live' aphid.
(P. Beauzay, NDSU Extension Entomology)

Economic Threshold: R1 (beginning of flowering) to R5 (beginning seed) = average of 250 aphids per plant on 80% of plants and when populations are actively increasing.

Soybean aphid with **pyrethroid resistance** was first documented in North Dakota in 2017. For pest management, growers should assume that most of our soybean aphid populations in eastern North Dakota are resistant to pyrethroids and use other insecticide groups for aphid control. To reduce development of insecticide resistance in soybean aphids, Extension Entomology recommends:

- Scout fields regularly beginning in mid-June.
- Use the Economic Threshold to aid in decision-making, prevent unnecessary insecticide applications and conserve natural enemies.
- Rotate mode of action (or insecticide class) if more than one application is necessary in a season.
- Do not use the same mode of action (or insecticide class) repeatedly year after year.
- Avoid using the lowest rate of insecticide on label. Use high rates.
- Do not use premix insecticides containing two insecticides of the same or two different modes of action, because premixes have lower amounts of active ingredient per insecticide and could promote the development of resistance.

Foliar insecticides for control of soybean aphids are listed in Table 1. The bottom three insecticides highlighted in orange are the newer modes of action, which are specific for piercing-sucking insect pests (e.g., soybean aphids). In field efficacy tests conducted by NDSU Extension Entomology, these three insecticides gave 'excellent' control of soybean aphids. On the opposite end of the control spectrum, dimethoate insecticide had 'poor' efficacy against soybean aphids.

Table 1. Foliar insecticides with a single active ingredient that are labeled for soybean aphid management.

Group #	Group	Active Ingredient	Product Examples (Trade Names)
1A	Carbamates	methomyl	Lannate LV, Nudrin LV, others
1B	Organophosphates	acephate	Acephate 97, Orthene 97, others
		dimethoate	Dimethoate 4E, Dimate 4E, others
3A	Pyrethroids and Pyrethrins	alpha-cypermethrin	Fastac CS
		beta-cyfluthrin	Baythroid XL
		bifenthrin	Bifender FC, Bifenture EC, Brigade 2EC, Discipline 2EC, Sniper, Tundra EC, others
		cyfluthrin	Tombstone Helios
		deltamethrin	Delta Gold
		esfenvalerate	Asana XL
		lambda-cyhalothrin	Grizzly Too, Lambda-Cy AG, LambdaStar, Province, Silencer, Warrior II, others
		permethrin	Permethrin, Perm-UP 3.2 EC, Arctic 3.2 EC, others
		zeta-cypermethrin	Mustang Maxx
4A	Neonicotinoids	clothianidin	Belay
		imidacloprid	Admire Pro, Nuprid 4F Max, others
4C	Sulfoxamines	sulfoxaflor	Transform WG
4B	Butenolides	flupyradifurone	Sivanto Prime
9D	Pyropenes	afidopyropen	Sefina

Janet J. Knodel
Extension Entomologist

plant pathology

WHITE MOLD RISK FACTORS

The risk of white mold is variable in the state. Consequently, it is important to consider your local conditions if you are considering a fungicide application. *Depending on growth stage(s) of the crop(s)*, proactive management of white mold could be considered if your risk of the disease is high. Below is a summary of factors that influence white mold risk.

Weather and Microclimate:

- Soil moisture. Soils must have some water to begin the disease cycle (when sclerotia germinate → produce apothecia → produce ascospores). Historically, only 1-2 inches of rain falling in a 1-to-2-week period before plants enter bloom is considered the *minimum* needed for sclerotia to germinate, produce apothecia, and release ascospores.
- Temperatures during bloom. Sclerotinia infection and development is optimal when daytime highs are cooler; especially the 60's and 70's. White mold certainly can occur at higher temperatures, but it requires longer periods of leaf wetness.
- Canopy wetness during bloom. White mold is favored if the plants are wet for long periods of time. Rain, fog, and heavy dews during bloom are all favorable for disease.
- Canopy density and canopy closure. These factors make a BIG difference on the environment in the field, and we also recently learned the impact of spray timing and droplet size (see articles below). Once canopy closure occurs, the crop is likely to have a more favorable microclimate for infection and disease development.

Growth Stages:

- Broadleaf plants become susceptible to white mold only once they begin **blooming** (sunflowers are an exception). This is because the pathogen needs to utilize the flowers as a food source to develop and cause infection.
- In general, the optimal time to manage white mold with a fungicide application will be somewhere in the early bloom stages of the crop. Applications made in later growth stages (and/or when flowers are no longer present) miss the critical window to prevent economically important infections (see articles below).

Crop and History:

- Field history. Fields that have a history of white mold are often more likely to experience epidemics. Sclerotia (the pathogens survival structure) can survive for many years in a field, so an epidemic a few years earlier may still be influencing this year's growing season. Consequently, recent dry years don't necessarily mean we won't have disease, although disastrous epidemics may be less likely.
- Crop rotation. A field with a short rotation among susceptible broadleaf crops is more likely to have white mold problems than a field with no white mold history and/or long crop rotations.

- Genetics. While most broadleaf crops do not have 'resistant' varieties, some varieties will be less sensitive than others. In soybeans, the variability in susceptibility is very pronounced, and soybeans with longer maturity groups are generally more susceptible due to longer bloom periods.

Wade Webster
Soybean Pathologist

Sam Markell
Extension Plant Pathologist, Broad-leaf Crops

OPTIMAL FUNGICIDE TIMING FOR MANAGEMENT OF WHITE MOLD IN DRY BEANS.

In recent years, research to optimize white mold management has been led by Dr. Michael Wunsch at the Carrington Research Extension Center. Below is a brief summary of the findings. Additional updates on management of white mold in dry beans, including timing, droplet size, row spacing, and seeding rate can be found at the Carrington REC website here or directly at , and efficacy information can be found here.

Over the years, research results demonstrate that the two most important predictors of optimum fungicide application timing are ***percent canopy closure*** *and* ***percent of plants with one or more initial pods***:

- When the canopy was at or near closure (more than 95% of the ground is covered):
  - Fungicide timing was optimal when 10-20% of the plants had initial pin-pods (R2 growth stage).
- When the canopy was not closed (less than 95% of the ground covered):
  - In pinto beans, fungicide timing was optimal when 30-85% of the plants had initial pin-pods.
  - In navy, black and kidney beans, results were similar when applications were made when 10-20% of the plants had pin-pods. More work is ongoing to refine the data.
- The optimal timing above is the same for a single application, OR, for the first application (if you are applying again).

OPTIMAL FUNGICIDE TIMING AND DROPLET SIZE FOR MANAGEMENT OF WHITE MOLD IN SOYBEANS.

As with dry beans, research conducted at the Carrington REC has greatly increased our ability to optimize white mold management in soybeans. Below is a brief summary of optimal fungicide timing and droplet size for soybeans. Additional updates on management of white mold in soybeans, including timing, droplet size, row spacing, and seeding rate can be found at the Carrington REC website here or directly at and efficacy information can be found here.

Timing:
Results of research at the Carrington REC found that, when (if) conditions are favorable for white mold when soybeans bloom (wet canopy, cool-moderate temps, adequate soil moisture for apothecia germination) optimal timing is related to canopy closure:

- If the canopy closes early (R1 or early R2), fungicide application timing is optimized shortly before canopy closure.
- Otherwise (even if the canopy is open), fungicide application timing is optimized by applying as soon as 100% of the plants reach growth stage R2.

Droplet Size:
Research updates demonstrate the *yield response to fungicide applications can be nearly doubled*, when droplet size (calibrated relative to nozzle manufacturer) and soybean canopy closure are considered. I repeat this statement *'yield response to fungicide applications can be nearly doubled'*.

Two very important concepts have recently been demonstrated in Michael Wunsch's droplet size work. First, as the canopy approaches closure, coarser droplets are needed to penetrate the canopy and deliver the fungicide to the target. Second, droplet size ratings among nozzle manufacturers are not calibrated among one another (i.e., one manufactures 'coarse' may be another's 'very coarse').

Using **TeeJet** extended-range flat-fan nozzles, when conditions favored white mold and fungicides were applied at R2 (as above), optimal application occurred:

- When the average canopy was very open (less than 80% closure), *fine to medium* droplets (assigned by manufacturer) were used.
- When the average canopy closure was open (80%-89% closure), *medium* droplets were used.
- When the average canopy was at or near closure, *coarse* droplets were used.

Using **Wilger** Combo-Jet flat-fan nozzles, when conditions favored white mold and fungicides were applied at R2 (as above), optimal application occurred:

- When the average canopy was open, *coarse* droplets (assigned by manufacturer) were used.
- When the average canopy closure was at or near closure, *very coarse* droplets were used.

Sam Markell
Extension Plant Pathologist

Michael Wunsch
Plant Pathologist
Carrington REC

soils

CONSIDERATIONS REGARDING DEVELOPMENT OF BIOLOGICAL FERTILIZER REPLACEMENT PRODUCTS FOR MARKET

Since publication of the summary of commercial asymbiotic N-fixing bacteria product performance this spring (https://www.ndsu.edu/agriculture/extension/publications/performance-selected-commercially-available-asymbiotic-n-fixing-products) my colleagues and I have visited with several start-up biological fertilizer replacement product companies regarding what might be important for them to provide strongly performing products to customers. The following are thoughts towards a more agronomically successful product introduction:

1) Ensure the organism is alive in the container at the date of application.
If the organism is dependent on a narrow range of transportation and storage temperatures, determining how restrictions can be met based on the logistics of transport and storage is very important. One of the products I tested in 2022 stated that storage between 39° and 46°F was essential, so a refrigerator was calibrated to 42°F and the product

was transferred to the field in a cooler with an ice pack and used within 3 hours of leaving the refrigerator. Another product label states that the product is best stored and handled at room temperature (72°F) and not to expose the product to temperatures below 39°F. Depending on the product, does the manufacturer have the transportation and storage facilities to deliver organisms to a distributor? Do the distributors have climate-control truck beds to deliver the products to retailers? Do distributors and retailers have a huge walk-in cooler available to keep the organisms at the required temperature? Does the farmer have similar facilities to store the season's supply of organisms until planting (planting is sometimes delayed by rain, so ability to store for a few weeks is essential). Performing viability testing to ensure robustness of the product to the expected transportation and storage conditions prior to application is essential.

2) Ensure the organism is alive in the field after application, either in the soil or the plant tissue, depending on the nature of the organism.
Determining the persistence of the applied microbe in real soil conditions is crucial where it will be required to compete with the natural microbiota for occupancy of the plant/soil microbiome niche space. Next-generation sequencing technologies that provide a cost-effective way to survey the composition of the plant and soil microbial communities could be applied to trials across time and compared to an untreated control to verify the presence of the applied microbe in the soil/plant microbiome throughout the season and especially at time-points where the product is expected to contribute the most (e.g. late vegetative stages when applied N is used up). This testing could first be performed in greenhouse experiments but should be extended to the field and considered in a wide range of soil conditions (e.g. saline or acidic), environmental conditions (e.g. drought vs abundant moisture) and a selection of plant hosts as well as multiple different varieties of those hosts where the product is advertised as functioning.

3) Robust testing for yield improvements. When satisfied that the organism is up to the challenge of surviving transportation, application and persisting in the field, then it is essential to test it in the field in replicated strips, with varying N rate (including a zero applied check) or test in replicated N rate experimental blocks in different areas of the country where marketing is planned. The most important metric for commercialization is yield for corn, and for some crops, including wheat, cotton, sugar beet, sunflower, quality due to N status is also important. If the organism can produce N to supplement the fertilizer rate, it would be able to demonstrate it based on N rate experiments. To further back up the assertion that extra yield was due to greater N supply to the plant using the organisms, a plant analysis may be helpful, although an increased N concentration would not be economically helpful to the farmer, and if excessive plant N was produced, it might be a negative environmental consequence of their use.

Dave Franzen
Extension Soil Specialist
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Barney Geddes
NDSU Assistant Professor
Microbiological Sciences

around the state

AROUND THE STATE

NORTHEAST ND

Summary:

We got very little rain in the past week, and it continues to be dry in many areas. Crops in the areas that received no moisture are showing moisture stress symptoms. Overall, the crops are looking good for now but absence of rain in the coming days might impact the crop development. The majority of the crops are in the heading and flowering stages. Fungicide sprayings are happening in small grains for scab and leaf spots. Bacterial leaf streak and spot blotch were seen in wheat and barley respectively. Cereal aphid populations are also increasing in wheat and barley. Canola is in full bloom.

Wheat Field Days

Griggs County is hosting a Wheat Field Day next Monday, July 17th. Please take the time to attend this great field day and the tour of the new Finley Farmers Grain and Elevator Facility! Greg Endres and Jeff Stachler will be speaking. There are 5 wheat varieties in the variety trial to observe. Come learn which one has fared our weather conditions the best.

The Walsh County Wheat Variety Trial Plot Tour is on Monday, July 17 at 6:00 p.m. at the Park River Extension office. A meal will be catered by Jim's SuperValu of Park River, beginning at 6:00 p.m., with speakers to follow at 6:30 p.m.

Spot blotch in barley
Photo: Nancy Feil, NE IPM Scout

Cereal aphids in wheat
Photo: Anitha Chirumamilla

Canola in full bloom
Photo: Anitha Chirumamilla

Anitha Chirumamilla
Extension Cropping Systems Specialist
Langdon Research Extension Center

NORTHWEST ND

The northwest counties could really use some more rain. Since June 3, the northwest did not receive any precipitation except for the scattered rain events last Saturday (July 7). As per NDAWN weather data, the scattered rain and thunderstorms last Saturday brought precipitation ranging from 0.01 inches in Ross in Mountrail County to 0.65 inches in Alamo in Williams County, with most areas in the northwest receiving less than 0.08 inches and in some areas none. The past week started cooler with daytime temperatures in the 60s to mid-70s°F (July 4 to 5), however, temperatures got hot fast by the end of the week. Highest daytime temperatures from July 6 to 9 were in the 80s and reached up to the low 90s°F. The Williston NDAWN weather station recorded a daytime maximum of 91°F at 2:44 last Sunday. As of July 9, soil moisture in the top 4 inches in the northwest region ranged from 4.9% to 20% with an average of 11.7% (as per NDAWN soil moisture data). Depending on the soil type and soil water holding capacity, these numbers may approach a point where water in the soil is tightly bound by the soil and unavailable for root uptake. Most areas in northwest ND have soil moisture less than the average above. Soil moisture is even lesser in the top 2 inches of the soil where most of our crop root systems occupy. Crops are showing symptoms such as leaf curling and rolling due to insufficient soil moisture in combination with the hot weather conditions and high winds. The 12-18 mph winds and gust peaks of up to 33 mph experienced last Sunday late afternoon and early evening likely exacerbated the drought and hot conditions. However, the cooler temperatures and precipitation forecast for this week will give northwest ND the needed break from the dry and hot spell. The precipitation that the northwest got on Tuesday (July 11) was a blessing. Williston REC received 0.22 inches of rain that morning.

Sunflower at V9 curling its leaves on a hot, dry, and windy late afternoon. Photo taken on July 9 at the Williston Research Extension Center dryland research farm in Williston, ND.

Field pea beginning maturity as leaves and lower pods turn yellow. Photo taken on July 9 west of Mountrail County.

Corn rolling its leaves due to hot, windy, and dry soil conditions. More leaf rolling can be seen in corn in the background. Photo taken on July 9 in Williams County.

Field peas are at full pod to beginning of maturity (yellowing of lower pods and leaves), lentils and chickpeas at late flowering to early seed formation, soybean at 3rd trifoliate to flowering (for irrigated and dryland), flax at late flowering to capsules forming, wheat at flowering to late milk stage and fields starting to turn yellow, and corn at V9 to V12 (for irrigated and dryland). After insecticide applications a couple weeks ago, which lowered the nymph population, grasshoppers in adult form are making a comeback in some our small grain crops.

Charlemagne "Charlie" Lim
Extension Cropping Systems Specialist
NDSU Williston Research Extension Center

SOUTH-CENTRAL/SOUTHEAST ND

According to NDAWN, accumulated rain received in this region during May 1-July 10 ranged from 4.6 inches (8.6) at Milnor to 10.5 inches (7.8) at Jamestown, with the Carrington Research Extension Center (CREC) receiving 7.8 inches (7.8). *Numbers in parentheses are long-term averages for the same period.*

Accumulated growing degree day units compared to long-term average for May 10 planted corn range from **plus** 142 (Wing) to plus 318 (Pillsbury); and for May 25 planted corn, range from **plus** 91 (Wing) to plus 235 (Tappen). First-half May planted corn is nearing or at the tassel (VT) to silking (R1) stages.

Corn beginning silk stage (planted May 12)

Pinto bean at 'pin pod' stage (planted May 25).

The last full week of May planted soybean at are at full flower (R2) to early pod development (R3), and dry beans are at flowering (R1) to early pod development (R2-4). Soybean at R2 stage has accumulated about 25% of its dry weight and is at half its height (about 50% node number) versus at plant maturity. Nitrogen fixation is rapidly occurring. R3 occurs about 2 weeks after initial soybean flowering, and at this stage the plant is adding pods besides continuing to add foliage and blossoms. A critical time for fungicide application to suppress white mold in dry bean is at the pin pod stage.

CREC crop tours :

*Field Day, July 18
*Barnes County – Dazey, July 27
*Tri-county – Wishek, August 1
*Oakes Irrigation Research Site, August 3
*Barnes County – Fingal (corn), August 10
*Row Crop, August 31

Greg Endres
Extension Cropping Systems Specialist
NDSU Carrington Research Extension Center

weather

WEATHER FORECAST

I'll have to keep my weather report brief this week, as I have some fieldwork that needs attention. Be sure to check out the NDAWN and NDAWN.INFO websites for growing degree days, soil moisture, disease forecasting, and more. Temperatures trended below normal for the past week across North Dakota (Figure 1). Rainfall also was below normal across most of the state (Figure 2), although areas in western ND received from 0.5 to 2 inches (Figure 3). As I write this on the morning of July 12, showers are moving across ND between Highway 200 and the international border. Hopefully we'll see at least some relief to drought stressed areas in Cavalier and Pembina counties.

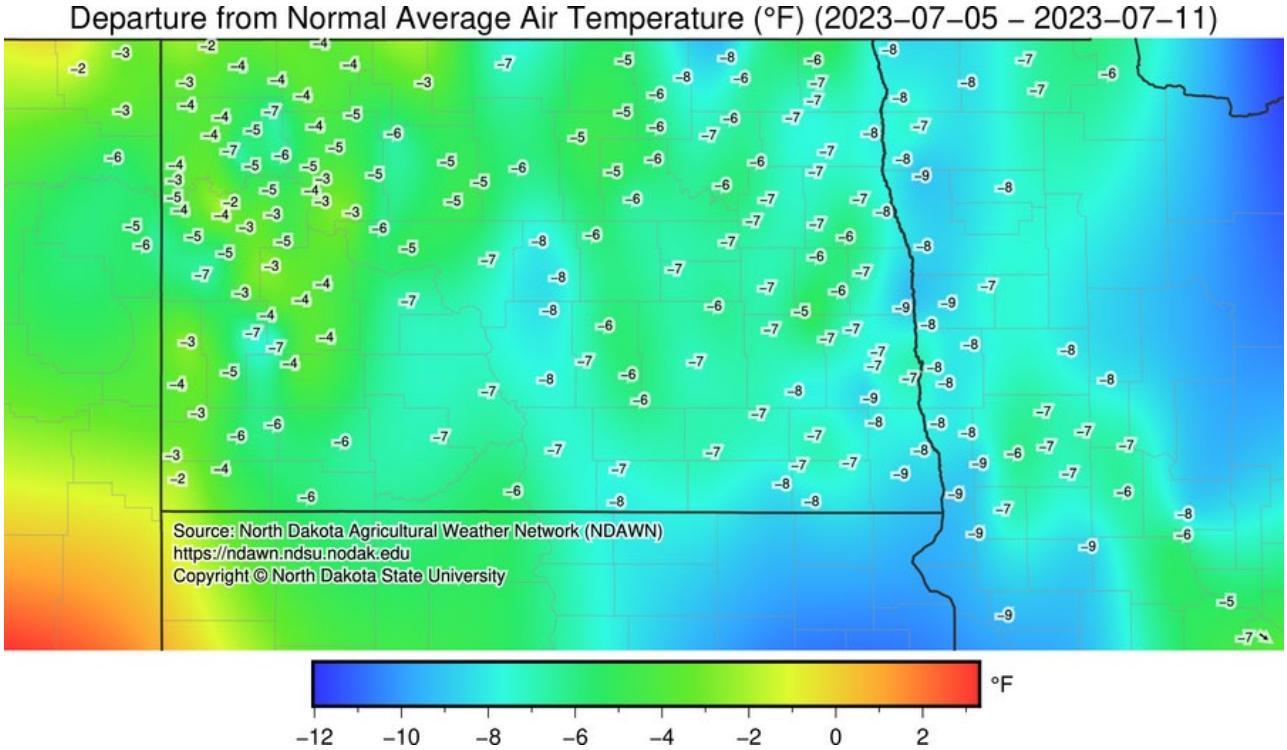

Figure 1. Average air temperature departure from normal from July 5 through July 11.

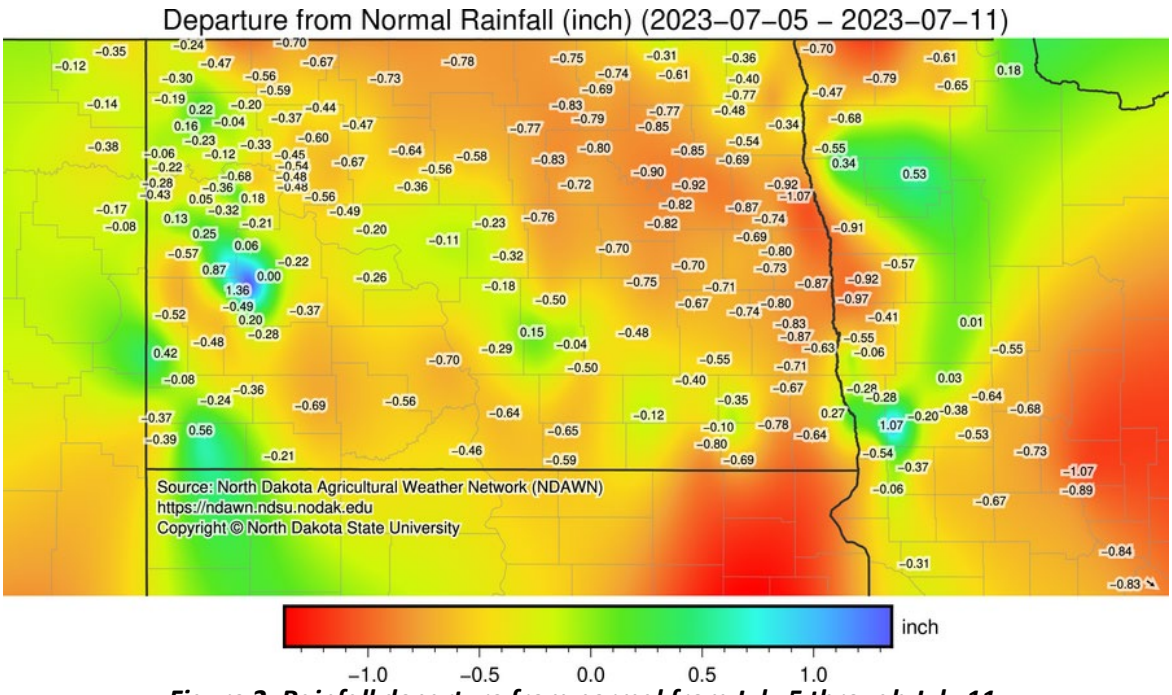

Figure 2. Rainfall departure from normal from July 5 through July 11.

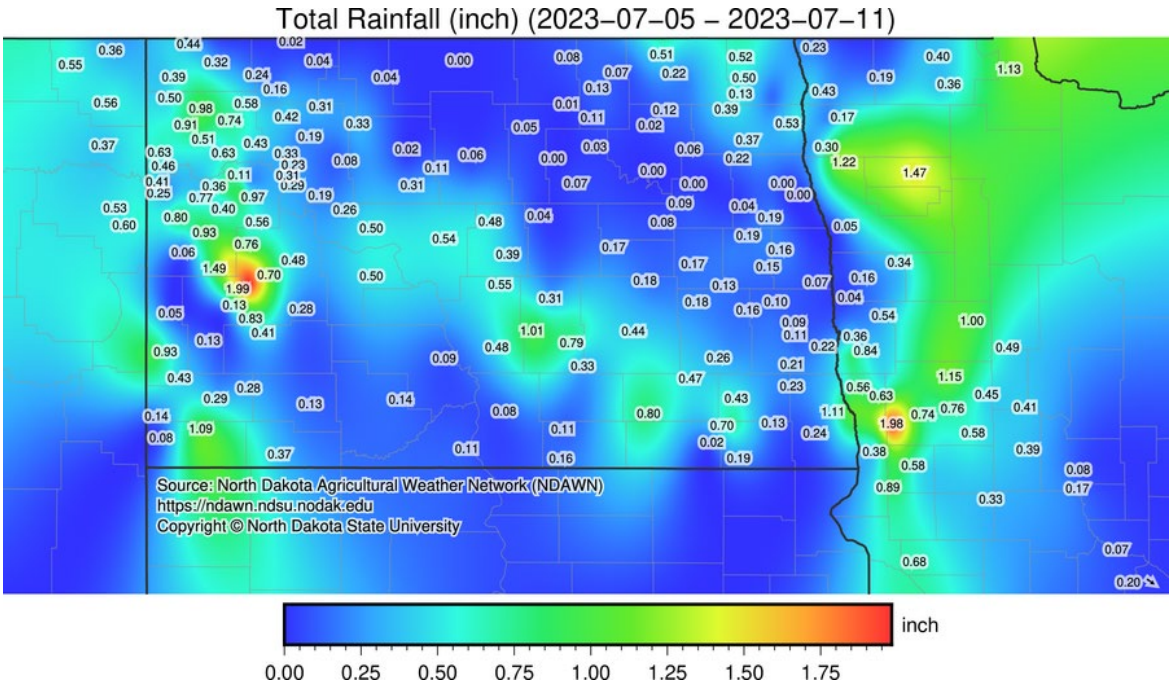

Figure 3. Total rainfall from July 5 through July 11.

A low-pressure system is still parked over northeastern Manitoba near Hudson Bay, and high pressure is still in place over much of the western United States. We'll continue to have a northwesterly flow aloft over the northern Great Plains, which again will bring a couple of rain chances to our area through early next. Rainfall amounts for the 7-day period look rather light (Figure 4), although heavier amounts can be expected where stronger thunderstorms occur. No significant severe weather is in the forecast, although isolated strong storms can't be ruled out. Forecast models show the low-pressure system over the Hudson Bay area moving southeastwards early next week, while high pressure moves over the northern Great Plains. Temperatures through the weekend should remain near to slightly below normal, and

then warm to near normal early next week. Looking farther ahead, the 6-10-day temperature and precipitation forecasts call for near normal temperatures (Figure 5) and near to slightly above normal rainfall (Figure 6). The 8-14-day temperature outlook calls for above normal temperatures (Figure 7) and near normal precipitation ((Figure 8).

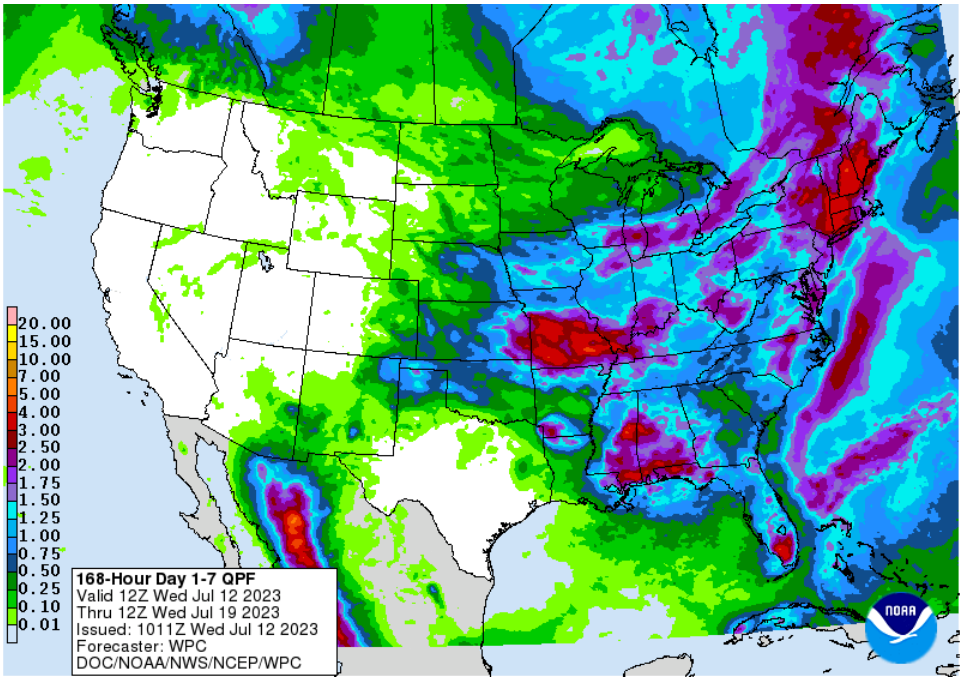

Figure 4. Rainfall forecast from 7:00 a.m. July 12 through 7:00 a.m. July 19.

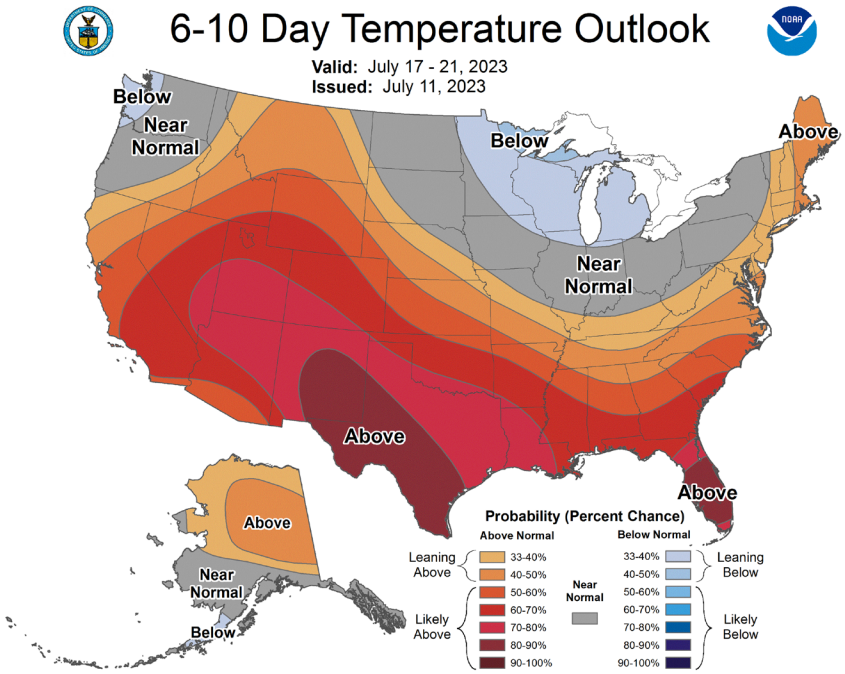

Figure 5. Temperature outlook for the continental United States and Alaska for July 17 to July 21.

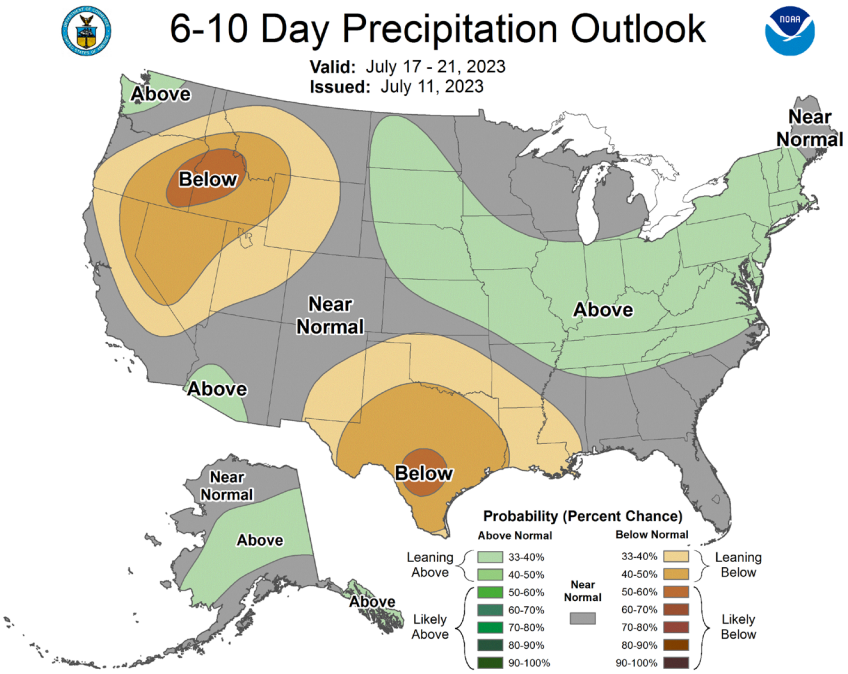

Figure 6. Precipitation outlook for the continental United States and Alaska for July 17 to July 21.

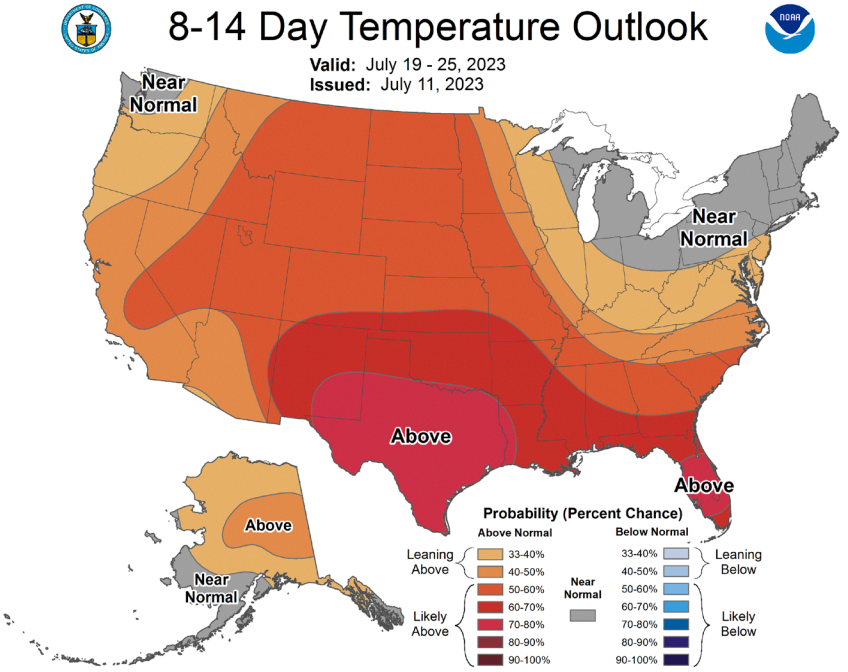

Figure 7. Temperature outlook for the continental United States and Alaska for July 19 to July 25.

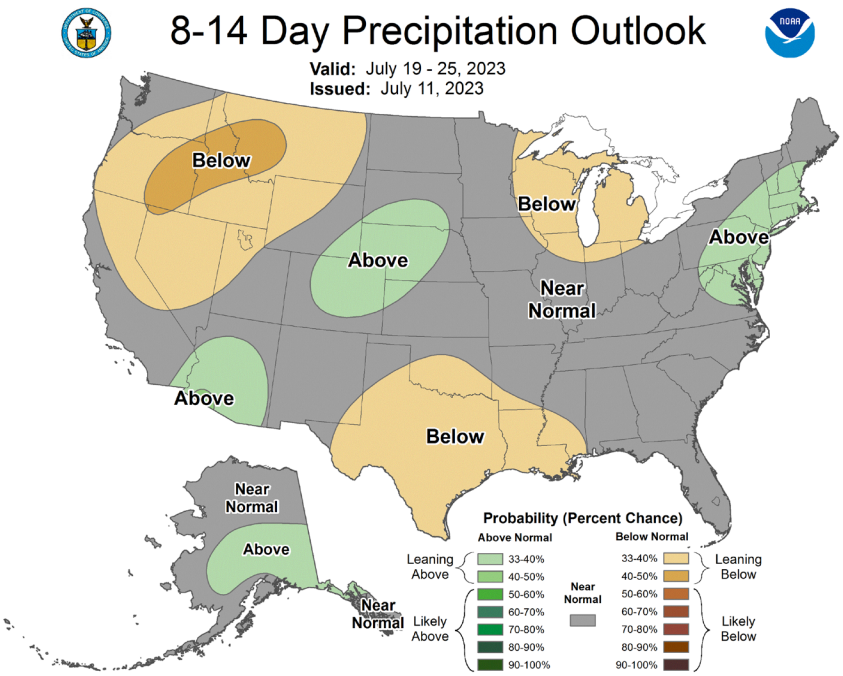

Figure 8. Precipitation outlook for the continental United States and Alaska for July 19 to July 25.

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