VIRTUAL FIELD DAYS

Following is a tentative list of 2020 Annual Field Days events. Due to the COVID-19 pandemic, 2020 REC field days primarily will be virtual. Most will have prerecorded videos go live on their scheduled field day date, some will have a live Zoom on their date (registration required) and some will have both. A few live events will happen for small groups of people with preregistration required. Please visit the Research Extension Center and Agronomy Seed Farm websites for more details.

July 7 - Hettinger Research Extension Center
July 8 - Dickinson Research Extension Center
July 8 - Williston Research Extension Center
July 13 - Agronomy Seed Farm, Casselton (5 p.m.)
July 14 - Carrington Research Extension Center
July 15 - North Central Research Extension Center, Minot (includes pulse crops and canola field day)
July 16 - Langdon Research Extension Center (9:00 a.m.)
July 28 - Central Grasslands Research Extension Center, Streeter (10 a.m.)

Other:
Aug. 4 - Oakes Irrigation Research Site: Robert Titus Research Farm
Aug. 27 - Carrington Research Extension Center Row Crop Day
SOYBEAN APHID LOW

Little pockets of soybean aphids are starting to pop up in the SE area of North Dakota. Low densities of soybean aphids and <1% of the plant infested were observed in Cass County near Harwood, Grand Forks County near Emerado, and Ransom County near Lisbon.

Scout fields for this yellowish-green, tiny (about \( \frac{1}{16} \) inch long) pear-shaped aphid with two black cornicles. They are commonly found feeding on the underside of the leaf and in the top ‘tender’ leaves of vegetative soybeans. Look for predators like lady beetles, lacewing larvae, syphrid fly larvae as signs that soybean aphids are present since they prey on aphids. However, it is early and lots of thunderstorms are in the forecast, hot temperatures, which can wipe out aphid colonies fast! Stay tuned and please share your soybean aphid field reports with me.

MYSTERY INSECT

This insect was found feeding in corn?
Is it a pest?

Answer: This is the common stalk borer, which feeds on giant ragweed, industrial hemp, corn, grasses, vegetables, fruits, flowers, and more. It most commonly observed in June through July in field crops. It is often confused as a larvae of European corn borer, because it feeds in whorl stage corn causing holes in a row on leaves, and frass in the whorl like corn borer. Other feeding injury symptoms on corn are a stunted, twisted, or bent plants. It is usually not economic in field corn. As corn matures, it can tolerate more feeding injury.
SCOUT FOR BARLEY THRIPS

Increasing numbers of barley thrips have been observed in some dry areas of North Dakota, such as central/eastern areas of Rolette County, and Rugby (Pierce County) to York (Benson County) (red spot on map). In some cases, fields were at the economic threshold levels for barley thrips (>6-11 thrips per stem depending on insecticide + application costs), and will require insecticide applications. Typically, hot dry weather conditions favor barley thrips development that may result in economic loss. Non-economic populations of barley thrips also were detected in Cass, McHenry, McLean and Ramsey counties.

Barley thrips are small dark brown to black insects about 1-2 mm long. Females have feathery wings while males are wingless. Immature larvae are wingless, pale yellow, white or green with red eyespots. Larvae are difficult to see due to their light, almost transparent color and extremely small size. Adult and immature thrips have a long, narrow body shape.

Female thrips overwinter as adults in debris in fields and shelterbelts. Thrips emerge in late May and early June and move into winter wheat/rye and eventually to early seeded barley (preferred host). Occasionally, barley thrips will feed on hard red spring wheat and durum as well. There is one generation per year.

Adult and immature thrips cause damage by feeding on succulent plant tissues. Feeding injury symptoms are a whitened or bleached appearance with gooseneck-shaped stems and heads under severe pressures. Intensive feeding at the beginning of head formation produces small, shrunken grains. Often there is no seed development at the top and bottom of the head and intermediate grains are shriveled. When thrips feeding is severe on the flag leaf, kernels do not fill properly and seed weight is reduced. One thrips per stem results in a 0.4 bushel per acre loss.
Scout for barley thrips from flag leaf to heading. Barley thrips can be found by unrolling the flag leaf away from the stem. Remember, populations will probably be higher at the field edges, so check at least 5 locations and 10 plants per location by walking a W pattern in field.

The 2020 calculated economic thresholds using the cost of control as $8-12/acres (insecticide + application cost) are:
- Malt barley $3.50/bu = 6-9 barley thrips per stem
- Feed barley $2.75/bu = 7-11 barley thrips per stem

After the barley head emerges, the insect damage is done and NO insecticide treatment is advised. Most insecticides approved for use on barley do NOT have ‘barley thrips’ listed on the label, such as Warrior II / generics (lambda-cyhalothrin), Baythroid XL (beta-cyfluthrin) and malathion. However, it is legal to apply an insecticide if it is labeled for use in the crop. If the target pest is not listed for that crop, efficacy is not implied by the manufacturer and growers who choose to use the product assume their own liability for any unsatisfactory performance.

Although many growers want to wait to tank-mix the insecticide with a fungicide for scab control at Feekes 10.5 (head fully emerged), NDSU Extension Entomology does NOT recommend waiting for the insecticide application to coincide with the optimal timing of a fungicide application for scab control. This is too late for effective barley thrips control and the damage/yield loss is already done by then.

WHEAT MIDGE UPDATE
Due to the hot temperatures pushing Degree Day units, the female wheat midge is emerging in the northern tier of North Dakota. Accumulated degree days ranged from 1257 to 1551 indicating about 10–50 percent of females will have emerged (see map). Scouting for wheat midge is critical for wheat in the heading to early flowering stage, susceptible crop stages.

Again, I want to remind producers to use the ‘Wheat GDD/Midge DD’ model to predict the emergence of wheat midge to help determine when to scout and to find out if their wheat crop is at risk. Producers can access the Wheat GDD/Midge DD model on North Dakota Agricultural Weather Network (NDAWN) at: https://ndawn.ndsu.nodak.edu/wheat-growing-degree-days.html
Select your nearest NDAWN station and enter your wheat planting date. The output will indicate the expected growth stage of the wheat and whether the crop is susceptible to midge infestation, as well as how far along wheat midge emergence is. See examples of output for Harvey and May 15, 2020 planting date, and Crary and May 1, 2020 planting date below. The earlier planted wheat at Crary is susceptible to wheat midge and should be scouted for economic densities of wheat midge.

<table>
<thead>
<tr>
<th>Date</th>
<th>Max Air Temp (°F)</th>
<th>Min Air Temp (°F)</th>
<th>Total Rainfall (inch)</th>
<th>Wheat GDD (°F)</th>
<th>Wheat AGDD (°F)</th>
<th>Est. Haun Growth Stage</th>
<th>Growth Stage Comment</th>
<th>Wheat Suscept. to Midge</th>
<th>Midge DD (°F)</th>
<th>Midge ADD (°F)</th>
<th>Midge Comment</th>
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<tr>
<td>2020-06-26</td>
<td>83</td>
<td>58</td>
<td>0.00</td>
<td>39</td>
<td>1270</td>
<td>8.1</td>
<td>Fl. L Emrg.</td>
<td>No</td>
<td>31</td>
<td>1327</td>
<td>10% of females emerged</td>
</tr>
<tr>
<td>2020-06-27</td>
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<td>56</td>
<td>0.00</td>
<td>42</td>
<td>1312</td>
<td>8.4</td>
<td>No</td>
<td>34</td>
<td>1361</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020-06-28</td>
<td>90</td>
<td>68</td>
<td>0.00</td>
<td>47</td>
<td>1359</td>
<td>8.7</td>
<td>No</td>
<td>39</td>
<td>1400</td>
<td></td>
<td></td>
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<tr>
<td>2020-06-29</td>
<td>89</td>
<td>63</td>
<td>0.00</td>
<td>44</td>
<td>1403</td>
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<td>Boot Swell</td>
<td>No</td>
<td>36</td>
<td>1436</td>
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<table>
<thead>
<tr>
<th>Date</th>
<th>Max Air Temp (°F)</th>
<th>Min Air Temp (°F)</th>
<th>Total Rainfall (inch)</th>
<th>Wheat GDD (°F)</th>
<th>Wheat AGDD (°F)</th>
<th>Est. Haun Growth Stage</th>
<th>Growth Stage Comment</th>
<th>Wheat Suscept. to Midge</th>
<th>Midge DD (°F)</th>
<th>Midge ADD (°F)</th>
<th>Midge Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020-06-26</td>
<td>82</td>
<td>60</td>
<td>0.00</td>
<td>39</td>
<td>1473</td>
<td>9.5</td>
<td>No</td>
<td>31</td>
<td>1275</td>
<td></td>
<td>10% of females emerged</td>
</tr>
<tr>
<td>2020-06-27</td>
<td>87</td>
<td>58</td>
<td>0.00</td>
<td>40</td>
<td>1513</td>
<td>9.8</td>
<td>No</td>
<td>32</td>
<td>1307</td>
<td></td>
<td></td>
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<tr>
<td>2020-06-28</td>
<td>86</td>
<td>64</td>
<td>0.00</td>
<td>43</td>
<td>1556</td>
<td>10.1 Boot Cmplt.</td>
<td>Yes</td>
<td>35</td>
<td>1342</td>
<td></td>
<td></td>
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<tr>
<td>2020-06-29</td>
<td>87</td>
<td>67</td>
<td>0.00</td>
<td>45</td>
<td>1601</td>
<td>10.4 Head Beg.</td>
<td>Yes</td>
<td>37</td>
<td>1379</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The annual soil survey for wheat midge cocoons indicated that the hot spots were located in northwestern Wells County and southwest Ramsey County in 2020. These populations are high enough that an insecticide will probably be needed to reduce potential yield loss from wheat midge depending on the wheat planting date and weather conditions. Other areas at the moderate risk level (501-800 midge larvae per square meter) were in northeast Bottineau, central Mountrail and northeast McLean County. Remember, moist conditions are more favorable for wheat midge emergence and survival. Please see last week’s Crop and Pest Report (Issue 8) for more information on scouting and map for wheat midge risk.
SUNFLOWER MOTH ARRIVES EARLY TO ND

Sunflower moth migrates into North Dakota from the southern states each year. Because of its migratory nature, we don’t know when it will become more problematic in sunflowers of North Dakota. Sunflowers are in the early crops stages V4-V6 now. Pheromone traps are specific to that species, so you get few non-target moths. Traps also determine when the sunflower moth arrives further north and its relative population densities, which is important for making pest management decisions.

Trap catches for the sunflower moths were observed at only 2 of the 9 trap sites in 7 counties (see map; Source: NDSU IPM Crop Survey insect trapping network). Only one moth per trap per week were observed in Cass and Foster Counties. These trap catches are considered non-economic (so far).

Scouting: The adult moth is about ¾ inch long, grayish-tan and has a cigar-shaped appearance when at rest. Moths move into fields during early bloom. It deposits its eggs on the face of the flower. Damage is caused by the larvae feeding on seeds and tunneling in head. Walk at W pattern in field and count moths on 20 plants at 5 sampling sites and calculate an average number of moths per 5 plants. Since female moths lay eggs on the face of sunflower heads, insecticide should be applied during early flowering (R5.1 - R5.3).

2020 Sunflower Moth Threshold
Trap threshold:
28 moths per trap per week
Field scouting threshold:
1-2 moths per 5 plants

Sunflower Moth Trapping Network
Homoeosoma electellum
June 15 - June 26, 2020

Number of moths per trap per week
- 0 ▲ 1-10 △ 11-25 ▲ > 25

Red Indicates Economic threshold level in trap during R2-R5
EUROPEAN CORN BORER EMERGING

Thanks to the support of the North Dakota Corn Council, we are monitoring a trapping network for flights of European corn borer (ECB) in conventional non-Bt corn fields again in 2020. We have 11 trap sites in 8 counties of ND including Barnes, Cass, Grand Forks, Ransom, Richland, Sargent, Steele, and Ward Counties. The Z-race ECB is just starting to emerge in V6 to V8 field corn, except in Barnes and Grand Forks Counties. This is the univoltine flight (one flight per year) of ECB, which emerges in July. We will be posting weekly maps of the trapping results for European corn borer moths on the IPM website.

A degree day model has been developed to forecast the emergence of the univoltine ECB moths (Table 1). Go to the NDAWN, select Applications, and then select ‘Insect DD’ and the nearest town; or select ‘map’ for the whole state North Dakota and the base temperature of ‘50 F’. As you can see, the southeastern area of North Dakota has accumulated 800-980 degree days (see map below), which indicates that the univoltine ECB moths are 10-25% emerged.

<table>
<thead>
<tr>
<th>Accumulated Degree</th>
<th>Proportion of Emerged Moths</th>
</tr>
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<tbody>
<tr>
<td>911</td>
<td>10 %</td>
</tr>
<tr>
<td>986</td>
<td>25 %</td>
</tr>
<tr>
<td>1078</td>
<td>50 %</td>
</tr>
<tr>
<td>1177</td>
<td>75 %</td>
</tr>
<tr>
<td>1274</td>
<td>90 %</td>
</tr>
</tbody>
</table>

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

Accumulated Base 50 Insect Degree Days (°F) (2020-03-01 – 2020-06-29)

Janet J. Knodel
Extension Entomologist
SOYBEAN NODULATION

A study was conducted to understand the impact of nitrogen (N) on soybean nodulation. Plant observations took place at the V4 and R4 soybean growth stages. There were 41% more nodules per plant at R4 compared to V4 (38 vs 27 nodules per plant, respectively). At all site-years there were significantly ($P \leq 0.05$) more nodules at the R4 growth stage compared with the V4 growth stage, including the ‘Average,’ except at 2016 Lisbon and 2015 Mooreton site-years (Figure 1). The percent increase in average nodule number between V4 and R4 was different between site-years. In 2016, the average nodule number per plant increased 5% and 73% in Lisbon and Hope, respectively (Figure 1). Possible explanations for difference in nodule numbers at each site-year and between V4 and R4 observations include factors such soil type, previous crop, precipitation, and level of soil N at the start of the experiment.

![Figure 1. Average nodules per plant at V4 and R4 in each site-year.](image)

Adding N fertilizer decreased root nodulation (from 32 to 24 nodules per plant) and decreased nodule size (Table 1).

Table 1. Nitrogen effect on average nodules per plant, and percent small, medium, and large nodules per plant across all site-years at V4 and R4.

<table>
<thead>
<tr>
<th>Rate</th>
<th>AN a</th>
<th>Sm</th>
<th>M</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AN</td>
<td>Sm</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>V4</td>
<td>R4</td>
<td>V4</td>
<td>R4</td>
</tr>
<tr>
<td>lb N/acre</td>
<td>Nodule plant¹</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>32a</td>
<td>44a</td>
<td>20b</td>
<td>22c</td>
</tr>
<tr>
<td>125</td>
<td>27b</td>
<td>37b</td>
<td>30a</td>
<td>26b</td>
</tr>
<tr>
<td>250</td>
<td>24b</td>
<td>34b</td>
<td>36a</td>
<td>32a</td>
</tr>
</tbody>
</table>

Means in a column followed by a different letter are significantly different at ($P \leq 0.05$).

aAN = average nodule number, Sm = small (<1 mm) nodules per plant, M = medium (1-4 mm) nodules per plant, L = large (>4 mm) nodules per plant.
This is a good time of the year to check for soybean nodules on the roots as nodules begin to form starting at the early vegetative growth stage. Use a spade or gardening tool to dig up the plants (Figure 2). Do not pull the plants out of the soil, as this will cause nodules to be removed from the roots. Bring a small bucket of water into the field and wash off the soil from the roots. Check roots in several locations within the field and examine roots of a few plants per location.

Healthy and actively N fixing nodules have a pink or reddish inside color. If the soybean plant does not have nodules or the nodules are not healthy and discolored inside, the plant may show yellowing due to a lack of N, assuming there was limited residual plant available N. Under normal conditions, N fertilization is not recommended for most legumes, but if the yellowing is indeed due to poor nodulation and N deficiency, a rescue top-dress application with N may be warranted.


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**ASSESSING THE YIELD POTENTIAL OF THIS YEAR’S WHEAT CROP**

I received a phone call earlier last week from a grower wanting to estimate the yield of his winter wheat crop. The formula he was using was not working so I provided him an alternative, one that I use frequently. Estimating yield using a formula that is based on yield components can also give you insight into how environmental and management factors are influencing crop yield this season. The formula I like to use for predicting yield can be applied soon after the crop has headed. Most of the early planted crop is now in this stage. The three components that contribute to yield in wheat are the number of spikes per area, the number of kernels per spike and kernel weight. Kernel weight can vary by variety and the environment and cannot be accurately ascertained until maturity. This is one of the reasons that estimating yield is just that, an estimate with the potential of some level of variance from the actual. The formula described below uses a historic average for kernel weight to allow for an estimation prior to maturity and harvest. That value and other conversion factors are incorporated into the value “0.142” included in the numerator. Since small differences in the numbers used in this formula can result in large differences in the estimated yield, multiple samples taken from representative areas of the field will help improve the accuracy of the estimate.

\[
\text{Bushels/acre} = \frac{(\text{spikes per 3 ft of row} \times \text{spikelets per spike} \times \text{kernels per spikelet} \times 0.142)}{\text{Row spacing in inches}}
\]

**Directions for obtaining the values for this formula:**

1. Count the number of spikes in a three-foot length of row (taking an average of several counts improves the estimate). Do not count small heads that will not significantly contribute to yield. If the crop was planted with an
air seeder in bands or as paired rows, count the spikes from the entire width of the band or both rows in the pair.

2. Count the number of spikelets in six or more randomly selected spikes. Omit the top and bottom spikelets as they contribute little to the overall yield. Spikelets are the primary branches on the spike.

3. The number of kernels per spikelet can be determined by hand threshing the head and counting the kernels and then dividing that number by the number of spikelets. Previous experience, however, has shown that 2.3 kernels per spikelet gives a more accurate yield estimate, unless the crop has been stressed, then 2.1 kernels per spikelet should be used.

4. If not known, determine the row spacing by measure the distance between several rows or bands of wheat. Most double disc drills are set at 6, 7, or 8 inch row spacings. The width of air seeded bands can vary. To determine the row spacing of the bands, measure the distance between the edge of one band to the same edge of the adjacent band.

Estimates from plots near Fargo this year (see Figure 1):
This was the earliest planted spring in our program (4/25/20).
(64 spikes in three foot row X 14.3 spikelets per spike X 2.3 kernels per spike X 0.142)/(7 inch row spacing) = 43 bu/acre

Comments on crop development in this plots:
Plant height was very short probably due to abnormally warm temperature during the period of when stem cells were developing.
Plants did not completely fill-in all inter-row space (see Figure 1). The number of spikes per three-foot row was about 50% fewer than we observed last year in same field. Low spike density can be attributed either poor tillering or an inadequate seeding rate. Though the hot weather during tillering probably took a toll on spike density (note the aborted tillers in Figure 2), the plant population in this area was also lower than optimum either because of too few seeds sown or poor emergence of the seeds that were sown. I definitely think we would have seen a yield bump by increasing the seeding rate at this location this year (or achieved better emergence).
Spike size is sensitive to temperature during early reproductive development. Nevertheless, the spikelet numbers per spike this season were similar to what we observed in previous years, even though temperatures there were periods when the temperatures were much higher than higher than optimum during that phase of development.

Joel Ransom
Extension Agronomist, Cereal Crops
FUNGICIDES (AND FUNGICIDE RESISTANCE) ON ASCOCHYTA BLIGHT OF FIELD PEAS

When conditions favor Ascochyta blight as field peas enter bloom, fungicides targeting Ascochyta blight of field peas should be applied when 100% of plants have an open blossom, and the first pods are full-length but flat. Preliminary research conducted on droplet size in 2019 using TeeJet and Wilger nozzles indicated that fungicide performance against Ascochyta blight on peas is optimized with fine droplets.

Importantly, pathogen resistance to QoI (FRAC 11) fungicides, including Quadris (azoxystrobin) and Headline (pyraclostrobin), has been confirmed in North Dakota. This had resulted in reduced efficacy of QoI fungicides in field trials and also in producer fields. Where this resistance occurs, fungicides will not adequately protect yield. In fungicide efficacy testing conducted on irrigated field peas in Carrington, applications of Headline conferred an average 8.0 bu/ac yield gain from 2010-2015 (prior to fungicide resistance development) but no yield gain from 2016-2019 (after resistance developed). Miravis Top, Proline, and Provysol are highly effective alternatives where QoI resistance is a problem.

The prevalence of QoI resistance across the state is variable, and likely in flux. In North Dakota, two different pathogens cause Ascochyta blight on peas, Peyronellaea pinoides and Ascochyta pisi. Survey work conducted in the last three years found that about 60% of the disease in peas was caused by P. pinoides, and that about 70% of those P. pinoides isolates were resistant to QoI. Consequently, a very general rule of thumb is that we expect somewhere around half of the Ascochyta blight occurring on peas to be cause by QoI-resistant pathogens.

Sam Markell
Extension Plant Pathologist, Broad-leaf Crops

Michael Wunsch
Research and Extension Pathologist
NDSU Carrington REC

Julie Pasche
Research Plant Pathologist
NDSU Dept. of Plant Pathology

Dimitri Fonseka
Extension Plant Pathology Research Specialist

WHEAT DISEASE UPDATE: LEAF RUST

The first report of leaf rust in wheat this year was confirmed last Wednesday (June 24) on a susceptible winter wheat variety in Casselton and a susceptible spring wheat variety in Fargo. Leaf rust was at very low incidence at both locations and only a few pustules were found (Figure 1). Management of leaf rust in ND is primarily accomplished through the use of resistant varieties. However, if a susceptible variety is being used, a fungicide application may be needed. One important thing to keep in mind is that the need for a fungicide will depend on the variety that is grown and when (growth stage) rust is detected in the field. Research conducted at NDSU in 2016-2018 has shown that when rust diseases are first observed at the early tillering stages and conducive weather (ie: morning dews) occurs, the best time for a fungicide is at flag leaf. However, if rust is detected on a susceptible variety at boot stage or beyond, a fungicide application may not be needed or a fungicide application at early flowering (Fusarium head blight timing) will manage rust and protect yield.

Figure 1. Leaf rust pustule found on winter wheat in Casselton.
WHEAT DISEASE UPDATE: BACTERIAL LEAF STREAK

A few areas last week had high winds accompanied by hard driving rain. These type of events often signal the start of bacterial diseases in wheat and corn. After visiting a few field sites last week, I noticed the development of bacterial leaf streak (BLS) in both wheat and barley (Figures 1 and 2). At both field sites, the disease was in the early stages of development (water-soaking) and mostly confined to the edges of the plot that are most exposed to wind damage. Over the past couple years, we have noticed that high levels of BLS develop after strong thunderstorms occur on wheat that is at flag leaf (or beyond). This week also has a chance of severe thunderstorms and it is likely that we may see a higher prevalence of BLS in the coming weeks. The best way to manage BLS is using host resistance (5 or lower in the variety guide). Previous work has suggested inconsistent responses from a copper application when applied on a susceptible variety. To help better understand efficacy of copper on BLS, this summer we have established an experiment (funded by North Dakota Wheat Commission) to evaluate copper applications on multiple hard red spring wheat varieties varying in BLS resistance.

WHEAT DISEASE UPDATE: FUSARIUM HEAD BLIGHT RISK

According to the National Fusarium Risk model, risk continues to remain high for susceptible varieties that are flowering in Eastern ND and for an area in northwest North Dakota (Figure 1). For moderately susceptible varieties, risk is low for most of the state (Figure 2). Currently, the National model and NDSU model differ in scab risk projections and I would suggest that the NDSU model is too conservative in the assessment of FHB risk. Recent rain events and higher nighttime humidity will likely increase FHB risk on susceptible varieties for several areas in the state. Continue to monitor the growth stage in small grain fields to determine the best time to apply a fungicide (if warranted). The best time to apply a fungicide in wheat is at early flowering and up to seven days after the start of flowering (Figure 3). In barley, the best time to apply is at full-head and up to seven days after full-head (Figure 4).

(see figures on the next two pages)
Figure 1. Fusarium head blight risk for susceptible varieties.

Figure 2. Fusarium head blight risk for moderately susceptible varieties.
Figure 3. The center wheat spike represents early-flowering.

Figure 4. Arrows point to barley spikes at full-head growth stage.

Andrew Friskop
Extension Plant Pathology, Cereal Crops
WHITE MOLD REVIEW

As broadleaf crops begin to flower, white mold becomes a concern. However, white mold is heavily dependent on weather conditions, and depending where you are in the state, rainfall has ranged from far below average to well above average. Consequently, it is very important to consider the conditions in your area as you think about white mold. Below is a review of white mold.

Q. What crops are at risk for white mold?
A. The pathogen that causes white mold can infect all broadleaf crops and broadleaf weeds.

Q. When are the crops at risk?
A. With the exception of sunflowers, none of our crops are at risk until they begin flowering.

Q. How does white mold occur?
A. Sclerotinia survives in the soil as sclerotia; hard, black structures. When there is ample soil moisture, at least 1 to 2 inches of water a week or two before flowering, the sclerotia will germinate (Figure 1), produce apothecia (little mushrooms) (Figure 2), and release ascospores. Once spores are released, they need to land on a nutritional source to begin the infection process; usually the flower petals. This is the reason that most broadleaf crops are considered susceptible once they begin to flower. Once the flower petals become colonized (Figure 3), the pathogen easily grows into the plant. Lesions will become light tan/white (resembling dried bone) and may be covered with white fluffy fungal growth, (Figure 4), shred and contain or be covered with black sclerotia (Figure 5).

QUICK FACTS ABOUT WHITE MOLD
- Affects all broadleaf crops
- Crops susceptible during flowering
- Crops at greatest risk when:
  - Rainfall before flowering keeping the soil wet.
  - Cool to moderate temperatures during bloom.
  - Long wet periods (rain/heavy dew/fog) during flowering.
  - Dense canopies that create a wet microclimate
- Preventative fungicide applications may help in some crops
What are favorable conditions for white mold?

1. Soils need to be moist before flowering. Generally, 1-2 inches of rain falling in a 1-2 week period before plants flower is the *minimum* needed for sclerotia to germinate, produce apothecia, and release ascospores.

2. Moderate temperatures and wetness during flowering. Optional conditions for infection and disease development are when daytime highs are cooler (60°F-70°F). High temperatures above 85 degrees F inhibit disease, although the disease will still can occur in periods of cooler weather.

3. The canopy *needs* to be wet for infection and disease development. Frequent rain, fog, and heavy dews during bloom are all favorable for disease. Paying attention to the long-term rain forecast is important if deciding to make a fungicide application.

4. Canopy density and canopy closure make a huge difference on the microclimate in the field. Once canopy closure occurs, the crop is likely to have a more favorable environment for infection and disease development.

5. Crop rotation and field history make a difference. A field with a history or white mold and short (or no) rotations among broadleaf crops is more likely to have white mold problems than a field with no white mold history and/or long crop rotations. That said, no field is immune from white mold.

Q. How do you manage white mold with fungicides?

A. Fungicides can help manage the disease. Dry bean applications can be very beneficial in favorable environments; canola application can be as well. Response to fungicide applications and economic return on soybeans are more variable. This is due in part to a wide range of susceptibility among soybean varieties. Pulse crops are also susceptible, and fungicide applications may help prevent yield loss in high risk situations. Flax, while susceptible, is generally less impacted by white mold than many other broadleaf crops. Fungicide applications in sunflower are not generally efficacious.

Multiple fungicides from several different FRAC groups can be efficacious against white mold, and data is available on most crops. If you choose to make a fungicide application, timing is very important. Applications made relatively early in the flowering stages are preferred because it helps manage infections that can occur right after the plant begins flowering. The early infections tend to do the most damage because they have the greatest time to develop through the season. Later applications may also prevent infections, but those later infections do less damage. However, factors such as canopy closure can impact optimal timing, and need to be considered.

Q. What’s the latest on fungicide applications recommendations in soybeans?

A. Recent research has begun to refine management recommendations for soybeans. Multi-location field studies conducted across North Dakota indicate that when conditions favor white mold as soybeans enter bloom, fungicides should be applied when 100% of plants reach the R2 growth stage, unless the canopy closes earlier. Applications at the late R1 (>60% of plants at with at least one open blossom) or early R2 (<100% of plants with an open blossom at one of the top two nodes of the plant) growth stages have only been optimal if the canopy is closed. In testing conducted with TeeJet nozzles, applying fungicides with coarse droplets optimized white mold management in soybeans when the soybean canopy was at or near closure (92-100% average canopy closure). Applying fungicides with fine to medium droplets optimized white mold management in soybeans when the soybean canopy was open (<90% average canopy closure). Preliminary testing conducted with Wilger nozzles has produced similar results. Several fungicides efficacious on white mold are available for soybeans. More information is available at the plant pathology page on the Carrington REC website (link below).

Q. What’s the latest on fungicide application recommendations in dry beans?

A. In fungicide application timing research conducted on pinto and black beans in Oakes and Carrington in 2017, fungicides were most effective when applications were delayed until 80 to 100% of plants had an open flower and the first pin-shaped pods (0.5 to 1.0 inch long) were present in the canopy. In spray technology studies conducted in Carrington in 2018 and 2019, applying fungicides with medium to coarse droplets optimized white mold management in black, navy and kidney beans, with medium droplets optimal except when the canopy was very dense. Follow-up
fungicide timing and droplet size research is in progress. Like soybeans, multiple efficacious fungicides are available for dry beans. More information is available at the plant pathology page on the Carrington REC website (link below).

Q. What additional resources are available?
A. We strongly encourage everyone considering a white mold application to visit the Carrington REC plant pathology web page at [https://www.ag.ndsu.edu/CarringtonREC/plant-pathology-1](https://www.ag.ndsu.edu/CarringtonREC/plant-pathology-1). Dr. Michael Wunsch has organized and made available recent presentations on optimization of fungicides for white mold on multiple crops.

The canola sclerotinia risk map and risk calculator uses environmental conditions favorable for white mold on canola, but it can also be helpful for all broadleaf crops (see next article). [http://www.ag.ndsu.edu/sclerotinia/](http://www.ag.ndsu.edu/sclerotinia/)

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Extension Plant Pathologist, Broad-leaf Crops

Michael Wunsch  
Research and Extension Pathologist  
NDSU Carrington REC

USING THE CANOLA RISK MAP AND RISK CALCULATOR FOR WHITE MOLD

The Sclerotinia risk map and risk calculator provides information to growers that may be considering a fungicide application. The tool is available at NDSU ([https://www.ag.ndsu.edu/sclerotinia/riskmap.html](https://www.ag.ndsu.edu/sclerotinia/riskmap.html)) or through the Northern Canola Growers Association ([https://www.northerncanola.com/growers/Forecast-Maps/](https://www.northerncanola.com/growers/Forecast-Maps/)), the Minnesota Canola Council ([http://www.mncanola.org/maps.php](http://www.mncanola.org/maps.php)), and the NDSU canola pathology program websites ([https://www.ag.ndsu.edu/sclerotinia/](https://www.ag.ndsu.edu/sclerotinia/)).

The color-coded Risk Map is designed to estimate risk of white mold development; low (green), moderate (yellow) and high (red). Maps are refreshed on a daily basis. Clicking on any NDAWN station in the map will show the estimated percentage of risk of disease development for that station. This information will help growers make a more informed spraying decision.

The Risk Calculator is an interactive tool that gives more precise risk for a specific field by allowing growers to enter important information about their field (such as crop rotation and disease history) into the forecasting model.

Frequently Asked Questions

Q. How do the risk map and risk calculator help me?
A. Both tools help you understand your risk for white mold, which can help you decide whether or not to apply a fungicide. We always encourage growers to make the most informed decisions they can using as much information as possible; these tools can help you make those decisions.

Q. When should I start using the risk map and risk calculator?
A. The risk map and risk calculator are only applicable when your canola is in bloom. Canola petals are necessary for infection by *Sclerotinia* ascospores to occur. Thus, canola is only susceptible when it is blooming. From colonized petals, the fungus spreads to healthy green tissues and eventually, large yield-robbing lesions will develop on the stem and branches.

Q. How does the risk map work?
A. The *Sclerotinia risk map* is created from weather data collected from NDAWN weather stations to determine if conditions are favorable for ascospore dispersal and disease development. Green, yellow and red areas signify areas of low, medium and high risk.

Q. How does the risk calculator work?
A. The Sclerotinia risk calculator uses the same data collected from NDAWN, but also takes into account additional data that grower can enter into the site. The additional data adds personalization and precision to Sclerotinia risk forecasts and is especially helpful when fields are in areas of intermediate risk.

Q. What limitations do the risk map and risk calculator have?
A. 1) Canola is only at risk during flowering and consequently the Risk Map and Calculator are only applicable during flowering.
2) The maps are only as good as the data received from NDAWN, and rainfall is notoriously variable. If you know that your fields have had more (or less) rain that the nearby station your risk may be higher (or lower).

Q. Who developed the risk map and risk calculator?
A. The tools were developed by NDSU canola pathologist Luis del Rio with funding from the Northern Canola Growers Association.

Estimated risk of Sclerotinia stem rot development for 6/30/2020

Figure 1. Risk map for June 30th, 2020

<table>
<thead>
<tr>
<th>Previous risk maps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select date:</td>
</tr>
<tr>
<td>Get Map</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk calculator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closest NDAWN Station:</td>
</tr>
<tr>
<td>Last time planted to canola:</td>
</tr>
<tr>
<td>Sclerotinia on last canola:</td>
</tr>
<tr>
<td>Last year’s crop in this field:</td>
</tr>
<tr>
<td>Tillage last year:</td>
</tr>
<tr>
<td>Canola Row Spacing:</td>
</tr>
<tr>
<td>Canola type:</td>
</tr>
<tr>
<td>Date of Planting:</td>
</tr>
<tr>
<td>Calculate Risk</td>
</tr>
</tbody>
</table>

Estimation of the risk of sclerotinia stem rot development is based on temperature and precipitation patterns prevalent in the region as recorded by NDAWN stations. Areas where conditions are favorable for infection are presented in red; if apothecia are present in these fields fungicide applications may be warranted. Fields in yellow areas should be scouted for apothecia and changing weather conditions. Fields in green areas have low risk of disease development. The estimation of risk applies to canola fields that are in the flowering period only.
DISEASES IN DROUGHT YEARS

We have received questions regarding what diseases are most likely to be problematic in dry/drought years. In some cases, drought conditions directly impact disease by making the environment more favorable for pathogen infection, disease development and/or disease spread. In other cases, drought may not directly impact the pathogen or infection, but the impact of the disease on the plants can be much higher when the crop is already water-stressed. Damage from many of the diseases causing yield loss in dry years is not visible until mid-way through the growing season (or later), and we expect that some may begin to show soon. Importantly, damage from diseases in dry years is often mistaken for water stress, so we have provided some information on what diseases to expect and/or look for. Please keep in mind that the weather can change quickly!

Root Rots: Some true fungal pathogens (such as *Fusarium* and *Rhizoctonia*) do not need much water to cause root rots. And when they occur in dry years, their impact on yield is often more severe because the crop is already water stressed. While some damage is evident shortly after emergence, much of the damage may not be noticeable until mid-way through the growing season. A good example is Fusarium Crown Rot of wheat. Although the pathogen infects early, it is not until after heading that you will see the damage on a water stressed plant (Figure 1). Alternately, fungal-like root rot pathogens (such as *Phytophthora*, *Aphanomyces* and *Pythium*), need lots of soil moisture to cause infection, and tend to be less severe in dry years. The exception to this rule are diseases that need sufficient moisture for only a short amount of time. For example, downy mildew of sunflower only needs wet soils after planting to cause systemic infection, that will result in plant death regardless of the environmental conditions.

Stem Diseases and Wilts: Stem diseases caused from soil-borne pathogens may be unaffected by drought and are likely to cause high levels of damage and wilts to water stressed plants. Typically, the greatest damage isn’t observed until later in the season and may be mistaken for water-stress and premature senescence. The most notable example of this is Charcoal rot, which impacts soybeans, sunflower and corn. A localized epidemic of Charcoal rot occurred in 2017 and 2018 in Cass and Traill Counties, and if 2020 continues to be hot and dry, we expect the disease to appear this year. The good news, the most common (and devastating) stem and wilt diseases are heavily dependent on ample moisture for infection and spread. Thus, we anticipate seeing less white mold (Sclerotinia) on broadleaf crops in drought years (see previous article for a review on conditions favorable for white mold).

Fungal Leaf Diseases: The most dramatic shift in diseases that occur in wet and dry years are among leaf diseases. Pathogens causing rusts and powdery mildew need only brief periods of free moisture (such as dew) to infect plants, and only need wind to spread. Although these diseases may or may not necessarily be more common in drought years, the damage they cause to crops experiencing moisture stress are much worse. These diseases have the ability to desiccate a water-stressed crop very quickly. However, leaf spotting diseases that need rainfall for infection and spread are far less common in dry years. This includes Ascochyta of pulse crops, Septoria diseases of many crops (Septoria leaf spot of wheat, Septoria brown spot of soybeans, Pasmo of Flax, etc) and many others.

Head diseases: The great majority of head diseases need water and are less severe in droughts (Fusarium head blight, Sclerotinia head rot of sunflower, etc.). Exceptions include pathogens favored by heat and plant damage, such as Rhizopus head rot of sunflower.

Bacterial Diseases: Most bacterial diseases are heavily dependent on plant wounding and water splashing for infection and spread. This is frequently associated with heavy thunderstorms, so it is logical that we may see fewer of them in dry years. While this is generally true, its unfortunately not quite that simple. A severe thunderstorm can still occur in a dry year, thus allowing a bacterial pathogen to infect crop tissue. An example of a bacterial disease that is strongly favored by severe thunderstorms is Goss’s wilt of corn.
**Nematodes**: Dry soils may provide a favorable environment for nematodes. Additionally, damage caused by nematodes in drought years is often more severe than when ample water is available. The most concerning nematode in North Dakota is Soybean Cyst Nematode (SCN). SCN can cause extreme damage in warm dry years, and will exacerbate impacts from other associated diseases (such as Sudden Death Syndrome and Brown Stem Rot). Like many of the root rot and stem diseases, the damage is often mistaken for water stress and premature senescence.

**Viruses**: Viruses are not often impacted by drought. However, if an insect vector is more common in drought conditions, viruses are more likely to spread.

*Figure 1. Wheat plants impacted by Fusarium crown rot will often have white heads and a poorly developed root system.*
PLANT ANALYSIS

Plant analysis can be a useful tool to determine in-season deficiencies of nutrients. It is best to take a sample from a ‘good’ area of the field and from one ‘not-as-good’. The lab conducting the plant analysis will have tables on file of ‘sufficiency’ and ‘deficiency’ ranges, but these are meant as general guides. There is great variability in nutrient critical levels for varieties within a crop. Therefore, taking the paired samples in a field from good and not-so-good will help determine whether a nutrient is out of line for that variety.

For most nutrient analysis washing plants is not necessary, except when a heavy rain has splashed excessive mud onto leaves. However, for iron (Fe) analysis, it is absolutely necessary to wash the leaves/plant with distilled water, pat dry with clean paper towels, before drying and or shipping to the laboratory. It is best to take the samples directly to the lab for analysis, or dry well. If fresh sample sits in an envelope, say over the 4th of July weekend, the sample may turn to silage and be unusable.

INCREASING PROTEIN IN SPRING WHEAT

There are a few areas in the state that have received ample rainfall to support an excellent spring wheat crop, and few additional areas where excessive rainfall may have resulted in N loss. It is impossible right now to predict what will happen to protein premiums, or discounts. However, if a grower believes it necessary to increase spring wheat protein, here is the well-researched ‘recipe’ for doing so:

- The application should be made for best effect immediately post-anthesis
- Apply 30 lb N as either 10 gallon 28% (UAN), diluted with 10 gallon water.
  Alternatively, the 30 lb N can be made with a urea solution to deliver 30 lb N- no water is necessary if using a straight urea solution.
- Apply in the cool of the day- very early morning until late morning. In the evening after a hot day, the plants may still be recovering from the hot conditions and be more susceptible to burning.
- Apply using flat fan nozzles (not stream-bars).

Expect some burning, but this has been shown to be superficial and has not resulted in yield loss in numerous trials.

There is no experiment support from NDSU studies for the use of low rates of ‘very efficient’ N fertilizers. Experiments using a number of these products show that it still takes 30 lb N from them to achieve similar results as 30 lb N from UAN. A summary of studies at NDSU on immediate post-anthesis N application can be accessed on my webpage at https://www.ndsu.edu/fileadmin/snrs/2020_Website_Revamp/postanthesiscompilation.pdf
A white-paper on use of high-efficiency foliar N fertilizer can likewise be accessed on my webpage at https://www.ndsu.edu/fileadmin/snrs/2020_Website_Revamp/foliarNreport.pdf

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Extension Soil Specialist
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Around the State

North Central ND

Severe weather impacted part of the region this weekend with some heavy rain, strong winds, and hail. Here are the observed reports of precipitation throughout the area for the last week (week starting June 21st): Minot: 1.06” (NCREC: 1.18”); Bottineau: 0.14”; Garrison: 0.01”; Karlsruhe: 1.56”; Mohall: 0.10”; Plaza: 0.04”; and Rugby: 0.08”. Bare soil temperatures at the NCREC was observed at 79°F as of June 29th. Continued precipitation chances are part of the forecast.

A few entomology related calls continue to come into my office. A couple forage fields in McHenry County were found with armyworm populations above the recommended economic thresholds. Those growers have since applied a chemical application since that report came in last week. Grasshoppers continue to build in populations, but still relatively low. Growers are continuing to scout those populations in the region. Again, small grain aphids are being noted, but rain may help keep populations low, along with the beneficial insects that are in the area. Wheat Midge is growing in numbers in a couple traps near Minot but has stayed low in the other traps at his point. However, it is important to note that there is no correlation between numbers of male wheat midge captured in the traps and that of an economic threshold of female wheat midge in fields, since males tend to swarm in large numbers. Growers are welcome to utilize the wheat midge degree day model on the NDAWN website to help evaluate if wheat midge emergence will impact their wheat fields based on its planting date and whether wheat will be in the susceptible stages to wheat midge. This model also is useful in helping growers determine when to scout area fields for wheat midge. IPM scouting has identified some tan spot in small grain fields, but incidence is low.

TJ Prochaska
Extension Crop Protection Specialist
NDSU North Central Research Extension Center

Northwest ND

Some areas of Williams and Divide Counties had rainfall overnight Saturday into Sunday this past weekend. NDAWN stations recorded 0.8” at Williston, 0.5” at Alamo, and 1.1” in Crosby but no rainfall was measured in Watford City or Bowbells. The rain that fell was badly needed and will help small grains starting to head and flower, but more will be needed to support good kernel fill. Overall, dry conditions persist in the Northwest. We have a strong chance of thunderstorms Tuesday, June 30th which could help crops significantly if we get good rain. Calmer winds late last week allowed spraying to get done and the break in the wind is being put to good use. High temperatures for the coming week are predicted to be in the 80’s.

Canola is flowering and small grains are heading throughout the county. Peas and lentils are flowering and early planted peas have a few pods visible. Stands of early planted crops tend to look better than later planted ones due to the lack of rainfall.

Clair Keene
Extension Cropping Systems Specialist
NDSU Williston Research Extension Center
NORTHEAST ND

Field activity is moving along with most all aspects of farming, however rain is needed across the region. Much drier to the west with crops and pastures showing drought stress however Walsh county reporting around an inch county wide. Small grains are in the boot stage or heading in most areas and most all other crops are progressing nicely. Canola has started blooming with flea beetle activity still present. Corn has really shown a growth spurt with the very warm temperatures. High winds and very warm temperatures have limited some spraying activity and with the Dicamba deadline approaching most farmers were trying to complete that application. Scab models for the region show moderate to high risk potential and aphid activity is increasing. Grasshopper activity has increased with insecticide border applications being applied to help stop grasshopper activity. Cover crops are being planted and some are taking a reducing Prevent Plant payment rate to qualify for haying. Fungicide applications are starting and will be region wide likely, next week.

Bill Hodous
Ext Agent/Ramsey County
NDSU Ext County Programs

SOUTH-CENTRAL/SOUTHEAST ND

According to NDAWN, rainfall during May 1- June 29 ranged from 1.4 inches (Robinson) to 10.0 inches (Oakes), with the Carrington Research Extension Center (CREC) receiving 1.7 inches. The CREC has only received 0.5 inch of rain during June 1-29 but it appears we may receive some moisture on the last day of the month. Except in the southeast (Barnes County south to Dickey and Sargent counties) of this region, dry topsoil and high air temperatures have caused short small grain with firing of lower leaves and likely reduced yield potential. Corn growing degree day units for May through June are similar or slightly exceed the long-term average for these two months.

Winter cereals are in the seed-fill stages with some rye reaching maturity. Barley and spring wheat seeded late April are in the heading to watery ripe stages. The early seeded barley at the CREC has erratic head emergence, with many spikes pushing out the side of the boot (see picture 1), while later seeded barley appears to have normal head emergence. Late-April planted corn has up to 8 leaves and soybean is at full flower (R2 stage). Early planted field pea has 2- to 3-inch pods with seed starting to develop (see picture 2). Dry bean and sunflower are rapidly moving through the vegetative stages.

1. April 24 seeded barley with abnormal head emergence.
2. Field pea with developing seed

Greg Endres
Extension Cropping Systems Specialist
NDSU Carrington Research Extension Center
SOUTHWEST ND

On June 29th and 30th the region received some much needed rain. Some areas also received heavy winds with the weather system and others received rain faster than the ground could soak it up. According to NDawn on June 29th Dickinson received 0.47 inch and with the rain we are getting as this is written on the 30th we are past the 1 inch mark. On the same day June 29th Mott received 1.97 inch according to NDawn but there are reports of some surrounding patches getting more. Before the rain on the 29th crops were beginning to wilt and yield loss seems apparent especially with the lack of tillers and canopy cover in small grains. The high temperatures we are receiving during flowering are not ideal for both small grains and canola. Our soybean trial we are conducting near Lefor, ND has plants that are about 10 inches tall and are starting to flower with the variety ND17009GT, moisture stress during emergence has resulted in low stands. Next week we will be having a virtual field tour at 9am on July 8th as well as an in-person tour at 5pm on July 8th with an overview of the trials we have this year and a tour of soil pits with our director Dr. Chris Augustin. Registration for the in-person tour and online session is required and you can find more information and register at https://www.ag.ndsu.edu/dickinsonrec/drec-field-day-2. If you aren’t able to join us on July 8th but would still like a personalized tour of agronomic research at the Dickinson REC or just to visit please contact me at ryan.buetow@ndsu.edu or call my office phone at 701-456-1106.

Ryan Buetow
Extension Cropping Systems Specialist
NDSU Dickinson Research Extension Center
Weather Forecast

The July 2 to July 8, 2020 Weather Summary and Outlook

Last week in my Crop and Pest Report I mentioned that a more favorable pattern for thunderstorms looks to be moving into the region next week. Of course, that was referencing early this week. In my numerous private conversations I had mentioned that I really thought this was an opportunity in some locations to “save” the crop as it had been so dry in spots. As most of you are aware, not only did we the region get rain, some areas ended up recording too much of a good thing with several locations recording over 2 inches of rain and a few NDAWN stations recording over 4 inches of rain from the thunderstorms earlier this week.

![Figure 1. Total rain from June 24 through June 30, 2020 at NDAWN stations](image)

With all that additional rain that fell earlier this week, the region went from approximately 80% dry and 20% wet to a noticeable decrease in the percent of the region that would be considered exceptionally dry or in drought. Even with the very heavy rains from earlier this week, it only took some areas back to average since May 1, a testament to how dry it had been before the widespread rains from earlier this week (Figure 2). Going into July, there is some significant differences in the state, with some areas still in great need of rain and other areas that definitely need a long break from any additional precipitation.
The rain amounts varied across the region, but generally, temperatures were all above average, although, parts of northwestern North Dakota and northeastern Montana were near the average (Figure 3). As has been the case more often than not this summer, these next 7 days will average above normal for temperatures in most of the region with areas near the North Dakota/Montana border probably the coolest, per the average.

With the recent rain we have recorded, plus, there with some additional hit and miss thunderstorms on a few occasions over the next week, the number of hours that relative humidity values above 85% these next 7 days will be quite high. Of course, the areas with saturated soils versus dry areas will vary, but overall, expect high relative humidity values most nights during this forecasted period (Figure 4).
The projected growing degree days (GDDs) base 50°, 44° and 32° for the period of July 2 through July 8, 2020 can be found in Figure 5. With the expectation of the above average temperatures to continue, these next 7 days will have similar heat units to what was recorded last week especially in eastern North Dakota and northwestern Minnesota.

Using May 1 as a planting date, accumulated growing degree days for wheat (base temperature 32°) is given in Figure 6. You can calculate wheat growing degree days based on your exact planting date(s) here: https://ndawn.ndsu.nodak.edu/wheat-growing-degree-days.html
**Figure 6. Accumulated Growing Degree Days for Wheat (Base 32°) since May 1, 2020**

Using May 20 as a planting date, accumulated growing degree days for corn (base temperature 50°) is given in Figure 7. You can calculate corn growing degree days based on your exact planting date(s) here: [https://ndawn.ndsu.nodak.edu/corn-growing-degree-days.html](https://ndawn.ndsu.nodak.edu/corn-growing-degree-days.html).

**Figure 7. Accumulated Growing Degree Days for Corn (Base 50°) since May 20, 2020**

Soybeans also use base 50° like corn, but NDAWN has a special tool for soybeans that based on your planting date and cultivar can estimate maturity dates based on average temperatures, as well as give you GDDs based on your planting date(s) you set. That tool can be found here: [https://ndawn.ndsu.nodak.edu/soybean-growing-degree-days.html](https://ndawn.ndsu.nodak.edu/soybean-growing-degree-days.html)

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