DOGBANE BEETLES WIDELY REPORTED

With all of the recent media attention surrounding Japanese beetles in North Dakota, and our request to document and report any suspect insects, NDSU Extension Entomology has received several insect identification requests via photographs and actual samples. Without exception, all specimens have been dogbane beetles. Dogbane beetles can be easily confused with Japanese beetles, but these illustrations should help. Both beetles have green thoraxes and red-coppery wing covers and are about the same size, but dogbane beetles are more rounded with almost mirror-like iridescence, while Japanese beetles have flattened backs and are not as shiny. Dogbane beetles have slender antennae that only gradually widen at the ends, while Japanese beetles have antennae that end in a layered club. Also, Japanese beetles have white hair patches along the sides of the abdomen – dogbane beetles lack these hair patches.

Dogbane beetles are found on or close to their host plant species, dogbane (also known as Indian hemp). They can be found occasionally on milkweed.

We very much appreciate the insect identification requests on Japanese beetle! Please continue to be vigilant through the summer months and report any suspect Japanese beetles to your local County Extension office, to the NDSU Plant Diagnostic Lab, or directly to NDSU Extension Entomology.

Patrick Beauzay
Research Specialist, Extension Entomology

Dogbane beetle. Image by Patrick Beauzay, NDSU Extension Entomology.

CEREAL APHIDS ON WHEAT HEADS

IPM scouts and numerous calls/emails from crop consultants, growers and ag dealers have reported increasing cereal aphid population, especially English grain aphids, on heads of wheat. In some cases, the wheat heads have many aphids on the wheat heads (see photo). White aphids are casted skins of aphids from molting and not alive. Dr. Philip Glogoza, University of Minnesota, also reported increasing numbers of aphids in the west central region of Minnesota this past week. However, cereal aphids usually impact yield prior to the completion of heading. Currently, the crop stage is well past heading and flowering, near milk stage. Extension Entomologists would regard these aphid populations as non-economic. Typically, after heading the only yield parameter that can be affected is test weight, though research concluded that populations are not sustained long enough to even do that. Drought is probably a bigger factor negatively impacting yield and test weight in most areas of North Dakota. Any late planting wheat that is still heading or earlier crop stages will be at higher risk for cereal aphids now. These fields should be scouting for economic populations of cereal aphids of **85% incidence prior to the completion of heading**.
SOYBEAN APHIDS & SPIDER MITES INCREASING

Soybean aphids and spider mites are starting to increase in soybean fields. Most soybean aphids are still non-economic and averaging about <10 aphids per plant. However, there are a few hot spot in fields with higher numbers. Spider mites are more spotty and mainly being found on field edges. Hot, dry weather will favor mite development; however, soybean aphids prefer more moderate temperatures in the lows 80s. Scouting is important now as soybeans are near R1 (beginning bloom).

In addition, they are still some thistle caterpillars being reported, but most caterpillars have matured and near the end of their feeding period (defoliation of foliage). They will be forming a chrysalis and then developing into the painted lady butterfly. Scouting is critical for all 3 insect pests of soybean, especially soybean aphid and spider mites.

A review of thresholds and which insecticides are appropriate to use for soybean aphid and spider mites.

**Soybean aphid economic threshold:** Average of >250 aphids/plant and when populations are actively increasing in 80% of field form R1 through R5 (beginning seed). The benefit of any insecticide application is reduced after soybeans reach the R6 (full seed) growth stage.
Spider mites: Mites are small and magnification (10x hand lens) is required to see them. A quick sampling procedure to determine whether mites are present is to hold a piece of white paper below leaves then slap them to dislodge the mites. Or, pulling plants and examining the underside of the leaves from the bottom of plants upwards. The mites appear as tiny dust specks; however, they will move after being knocked off the leaf. Feeding damage by mites first appears as small yellow spots ("stippling"). As feeding activity increases, leaves become yellow, bronzed or brown, and eventually shed from the plant. Mite webbing may be present on plants as mites balloon on webs to disperse within and between fields. Watch the NDSU Extension YouTube video for more information on scouting for Spider Mites in Soybeans.

Mite Threshold: Deciding whether to treat is difficult. Sample plants at least 100 feet into the field and walk in a “U” pattern sampling two plants per location at 20 different locations. A general action threshold is to treat when heavy stippling on lower leaves with some stippling progressing into middle canopy; mites present in middle canopy with scattered colonies in upper canopy; and lower leaf yellowing common. (Source: University of Minnesota, Ostlie & Potter)

Insecticides for soybean aphids and spider mites: If spider mites are a problem along with soybean aphids, the only pyrethroid, IRAC 3A, that will work is bifenthrin (Tundra, Sniper, Brigade, Fanfare, Bifenture, etc.) in soybeans. While other pyrethroids, such as lambda-cyhalothrin (Warrior, Silencer, etc.) will control aphids, they will cause spider mites to flare up and then you may well have to spray again with bifenthrin or an organophosphate (OP) insecticide, IRAC 1B.

Two active ingredients of OP insecticides for control of soybean aphids and spider mites are chlorpyrifos and dimethoate in soybeans. Dimethoate is weak on soybean aphid control, and has a shorter residual than bifenthrin. We think it’s realistic to expect about a 7 to 10 day residual from bifenthrin (If it is hot, residual may be decreased), a 4 to 7 day residual from chlorpyrifos, and a 3 to 5 day residual from dimethoate. The efficacy of an insecticide can be improved significantly with sufficient coverage >18 GPA of water by ground and 3-5 GPA by air and application at high pressure to penetrate foliage.

Other modes of action for spider mite control only include: IRAC 6 abamectin (Agri-Mek SC) and a miticides IRAC 10B etoxazole (Zeal SC). There also are several combination products with two modes of action that will control soybean aphids and spider mites: Tundra Supreme (bifenthrin + chlorpyrifos), Match-Up (chlorpyrifos + bifenthrin), Brigadier (bifenthrin + imidacloprid), Cobalt Advanced (chlorpyrifos + lambda-cyhalothrin), and Hero (bifenthrin + zeta-cypermethrin). Some combination products contain active ingredients that aggravate mites, such as lambda-cyhalothrin, imidacloprid and zeta-cypermethrin.

It is extremely important to scout and monitor for recurring soybean aphid and spider mite populations after spraying. Check your fields five days after treatment and again at regular intervals to make sure your product is holding. If newly hatched spider mites are observed after 5 days, a second treatment may be necessary with a different insecticide mode of action. For example, if you use bifenthrin (pyrethroid, IRAC 3A) for the first application, use a non-pyrethroid product, such as dimethoate or chlorpyrifos (OP, IRAC 1B), for the second application. Look for different IRAC (Insecticide Resistance Action Committee) numbers on label to indicate different Mode of Action labelling of insecticides. We want to prevent the development of insecticide resistance that has been observed in Minnesota for soybean aphids and spider mites.

Note: Mention of a product does not constitute an endorsement by NDSU Extension Service or the author.
**BANDED SUNFLOWER MOTH FLYING**

Banded sunflower moth has just started to emerge based on pheromone trapping data from IPM scouts in North Dakota. Sunflower is still in the late vegetative to R1 (terminal bud forms miniature floral head), so it is too early for scouting. Sunflower is susceptible during the flowering period. Banded sunflower moth can be identified by its small size (1/4 inch long), and its forewings with a triangular, dark brown band across the middle of the wing. It is an economic insect pest of oil and confection sunflowers and larvae feed and tunnel through the florets and developing seeds. Oil content of sunflower also can be reduced when moth populations are economic. More on scouting and thresholds in the next issue of *Crop & Pest Report*.

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**BLOOMING PROGRESS**

Most of the broadleaf crops in our area have transitioned from the vegetative stage to the reproductive phase of their life cycle. This 2017 growing seasons has started relatively cool, and in some cases, somewhat dry. Due to the continued dry conditions, some crops are delayed in their development. In Figure 1, the percent bloom is indicated for July 9, comparing 2016 and 2017. All the crops represented in the graph started blooming later than in 2016.

The first soybean flowers, in some of my research plots, were observed during the first week in July. Usually, after 4-6 trifoliolate leaves have been produced, the soybean plant begins the reproductive period. The first flower can be found lower on the stem and this stage is called R1 and depicted in photo 1 (R stands for reproductive). Full flowering or bloom (R2 growth stage) is reached when a flower is open at the node immediately below the uppermost node with a completely unrolled leaf. The soybean plants will continue to develop new leaves during the flowering period. As weeds...
are still emerging, it is important to recognize that herbicides usually have a specific growth stage after which application should not take place. It is important to always follow labeled instructions.

Figure 1. Percent bloom for soybean, dry bean, sunflower, flax, canola and field pea for 2016 and 2017 (Source: USDA North Dakota National Agricultural Statistics Service).

ESTIMATING WHEAT YIELD

For early-planted wheat, there are several methods for estimating yield based on yield components. One used by the Wheat Quality Council’s spring wheat tours for many years estimates yield using the number of spikes per area, the number of kernels per spike, and kernel weight. Since kernel weight cannot be precisely determined until harvest, the formula described below uses a historic average to estimate kernel weight prior to harvest. The value 0.142 is a constant that incorporates kernel weight and unit conversion factors. Since small differences in the numbers used in the formula can result in large differences in estimated yield, multiple samples taken from representative areas of the field will improve the accuracy of the yield estimate.

Bushels/acre = (spikes per 3 ft. of row X spikelets per spike X kernels per spikelet X 0.142)

Row spacing (in.)

To calculate the values for this formula:

1. Count the number of spikes in a three-foot length of row. Do not count small heads that will not significantly contribute to yield. If the crop was air seeded in bands or paired rows, count the number of 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 because they contribute little to yield.
3. The number of kernels per spikelet can be determined by hand threshing the head, counting the number of kernels, and dividing the number of kernels by the number of spikelets. Previous experience has shown that 2.3 kernels per spikelet gives an accurate yield estimate. If the crop has experienced stress, use 2.1 kernels per spikelet.
4. Determine row spacing by measuring the distance between several rows or bands of wheat. Most double disc drills are set at 6, 7, or 8 in. row spacings. The width of air seeded bands can vary significantly. 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.

Examples from research plots in Prosper:

Winter wheat
(113 spikes in three foot row X 15.3 spikelets per spike X 2.3 kernels per spike X 0.142)/(7 inch row spacing) = 81 bu/acre

Spring wheat earliest planted (4/13/17)
(94 spikes in three foot row X 14.3 spikelets per spike X 2.3 kernels per spike X 0.142)/(7 inch row spacing) = 63 bu/acre

Figure 1. Spike size has a significant impact on yield and varies in research plots this year by class (winter wheat on the right) and planting date (late-planted spring wheat on the left) compared to early-planted spring wheat in the center.
Spring wheat latest planted (4/22/17)
(93 spikes in three foot row X 12.3 spikelets per spike X 2.1* kernels per spike X 0.142)/(7 inch row spacing) = 48
bu/acre
*This assume fewer kernels will fill per spike due to stress.

Joel Ransom
Extension Agronomist for Cereal Crops

WHITE MOLD REVIEW
While much of the state is experiencing a drought, some locations in the North have had adequate water where
white mold may be a concern in broadleaf crops. However, many other factors will help determine how much of a
concern white mold will be in field, such as temperature and canopy wetness during bloom, disease history, canopy
density and variety susceptibility. As a result, assessing your risk for white mold is very important in managing the
disease. I am modifying an article that I originally posted a couple years back to help everyone understand what
conditions favor white mold.

How does white mold occur?
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 bloom, the sclerotia will germinate, produce apothecia (little mushrooms) and
release ascospores.

Once spores are released, they need to land on a nutritional source to begin the infection process; usually the
flower petals. Once the flower petals become colonized, the pathogen easily penetrates the plant and produces the
characteristic light tan / white lesion (it looks like dry bone), takes on a shredded appearance, and black sclerotia are
produced.

What are favorable conditions for white mold?
1. 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 cause infection.
2. Soils need to be moist before bloom. Generally, 1-2 inches of rain falling in a 1-2 week period before plants
enter bloom is the minimum needed for sclerotia to germinate, produce apothecia, and release ascospores.
3. Moderate temperatures and wetness during bloom. High temperatures above 85 degrees F inhibit disease.
   In years where we hit the 90’s F consistently during bloom, we rarely have white mold. Sclerotinia infection
   and development is best when daytime highs are cooler; 60’s- 70’s.
4. The canopy needs to be wet. 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.
5. Canopy density and canopy closure make a big difference on the environment in the field. Once canopy
   closure occurs, the crop is likely to have a more favorable environment for infection and disease
   development.
6. Although not environmental, crop rotation and white mold history make a difference. A field with a history
   or white mold and short 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.
7. Crop makes a difference. Not all broadleaf crops are equally susceptible to white mold. Sunflowers and
dry edible beans consistently seem to be very susceptible, and little resistance is available. Similarly, canola
   can be hit hard when the environment is favorable. Soybeans can be infected, but they typically do not
   experience the yield loss the other crops do. Additionally, some varieties of soybean are much less
   susceptible to white mold than others. Peas can get white mold, but it is less common than other crops.
How do you manage white mold with fungicides?
Fungicides can help manage the disease and on some crops they can be very effective. Dry bean applications can be very beneficial in favorable environments; canola application can be as well. Fungicide applications to soybeans are much more variable however and favorable economic returns are less common. Part of the reason is soybeans are naturally less susceptible that dry beans or canola. Sunflower is very susceptible to white mold, but fungicides are not recommended because they are generally not effective at reducing disease.

If you choose to make a fungicide application, timing is very important. Applications made relatively early in the bloom stages are preferred because it helps manage infections that can occur right after the plant enters bloom. In some cases, canopy closure is a very important consideration that may alter timing strategy slightly. 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.

What resources are available?
Excellent data on white mold applications on soybeans and dry beans and other pathosystems can be found through the Carrington Research Extension Center website. Carrington has one of the best (perhaps the best) white mold research programs in the world. I would strongly recommend visiting this site at http://www.ag.ndsu.edu/CarringtonREC/plant-pathology

The canola sclerotinia risk map uses environmental conditions favorable for sclerotinia, so it can be helpful for all broadleaf crops. http://www.ag.ndsu.edu/sclerotinia/

Colorado and Nebraska have developed a fungicide decision checklist for dry beans, found at http://extensionpublications.unl.edu/assets/pdf/g1786.pdf

Sam Markell
Extension Plant Pathologist, Broad-leaf Crops

MANAGING BACTERIAL BLIGHT IN DRY BEANS
Recent thunderstorms in Northeast ND and Northwest MN have created a favorable environment for bacterial blight in dry beans. In response to last year’s bacterial blight epidemics, Amanda Beck a Ph.D. student in the plant pathology department working for dry bean pathologist Julie Pasche, evaluated a many products (new and old) against the most common bacterial blight disease in our region ‘Common Blight’. We emphasize that this is only one year of data, and are reticent to make recommendations based on this data alone, but it is important to share it with the dry bean community.

Information about the treatments. The treatments used in these trials are a combination of plant growth enhancers, copper-based products or peroxide based products. In some cases, we have very limited additional information about the products. However, product information is available online and can be found relatively quickly using an internet search tool.

Trials Information. Each of the trials were conducted on NDSU Agriculture Experiment Station sites. ‘Early’ treatments [Wakeup Summer (Early) and eA300 (Early)] were applied only once and in late June. In Oakes and Prosper, the remaining chemical treatments were applied twice, with the first application occurring in mid-July (July 18th and July 20th) and the second in approximately 2-3 weeks later (August 1st and August 6th). Treatments were applied only once in Fargo (August 9th). In all trials, plots were sandblasted to mimic wounding from thunderstorm damage, and inoculated with the pathogen during late flowering. Oakes was under irrigation. Disease severity was calculated by visually examining leaf tissue and plot damage.

Results. Disease severity was moderate in Fargo and very high in Proposer and Oakes (Table 1). Reduced disease severity was observed from all products in at least one location. ‘Early’ applications were generally less effective at managing disease (numerically or statistically) than a two spray program beginning in July. On average, the lowest disease severity was observed on plots applied with Oxidate or Kocide 3000, however, a high level of variation in disease control among products existed in each of the trials, and other products were comparable in specific trials.
No yield differences in any of the trials were observed. However, a rust epidemic occurred in Fargo, and a white mold epidemic occurred in Oakes. Both of these diseases confounded yield data. Consequently, it is unclear if the reductions in disease severity from bacterial blight with these chemical treatments would have protected yield.

Conclusions. Limited data exists on many of these products and these trials represent only one year of data. Consequently, this information should be interpreted with caution. In other parts of the U.S. such as Eastern Colorado and Western Nebraska, a 2-4 spray program is used to actively manage bacterial blights. Historically, a multi-application bacterial blight program has not been commonly used in our region because it was not cost effective. However, we will continue to evaluate chemicals and timing for bacterial blights in order to re-evaluate bacterial blight management.

Table 1. Bacterial blight severity data from dry bean trials conducted at three North Dakota locations in 2016.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate</th>
<th>Fargo</th>
<th>Prosper</th>
<th>Oakes</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-treated</td>
<td></td>
<td>43.8 a</td>
<td>95.8 a</td>
<td>79.5 a</td>
<td>73.0</td>
</tr>
<tr>
<td>Wakeup Summer (Early)</td>
<td>5 OZ/A</td>
<td>37.0 b</td>
<td>89.5 ab</td>
<td>77.3 ab</td>
<td>67.9</td>
</tr>
<tr>
<td>Badge SC</td>
<td>2 PT/A</td>
<td>34.0 bc</td>
<td>86.5 bc</td>
<td>76.8 a-e</td>
<td>65.8</td>
</tr>
<tr>
<td>Wakeup Summer</td>
<td>5 OZ/A</td>
<td>32.8 bcd</td>
<td>87.0 bc</td>
<td>75.5 a-d</td>
<td>65.1</td>
</tr>
<tr>
<td>eA300 (Early)</td>
<td>2.5 OZ/A</td>
<td>34.0 bc</td>
<td>85.0 bc</td>
<td>72.0 a-e</td>
<td>63.7</td>
</tr>
<tr>
<td>MasterCop</td>
<td>1 PT/A</td>
<td>32.5 cd</td>
<td>83.8 bc</td>
<td>66.8 def</td>
<td>61.0</td>
</tr>
<tr>
<td>SaniDate 12.0</td>
<td>2.56%</td>
<td>29.3 de</td>
<td>83.0 cd</td>
<td>67.5 c-f</td>
<td>59.9</td>
</tr>
<tr>
<td>eA300</td>
<td>2.5 OZ/A</td>
<td>29.0 de</td>
<td>80.8 cd</td>
<td>69.3 b-e</td>
<td>59.7</td>
</tr>
<tr>
<td>GoldShield</td>
<td>20%</td>
<td>34.0 bc</td>
<td>80.0 bcd</td>
<td>64.3 ef</td>
<td>59.4</td>
</tr>
<tr>
<td>Kocide 3000</td>
<td>1.24 LB/A</td>
<td>31.0 cd</td>
<td>75.5 de</td>
<td>67.5 c-f</td>
<td>58.0</td>
</tr>
<tr>
<td>OxiDate 2.0</td>
<td>0.5%</td>
<td>29.3 de</td>
<td>80.5 cd</td>
<td>59.0 f</td>
<td>56.3</td>
</tr>
<tr>
<td>OxiDate 2.0</td>
<td>1%</td>
<td>25.8 e</td>
<td>72.0 e</td>
<td>64.5 ef</td>
<td>54.1</td>
</tr>
</tbody>
</table>

Pr>F <0.0001 <0.0001 0.0029

If letters following disease severity values are the same among treatments within trial locations, there is no statistical difference between treatments. If letters following disease severity values are different among treatments within trial locations, there is a statistical difference. For example, ‘Wakeup Summer (Early)’ has a value of 37.0 ‘b’ which is statistically better than the Non-treated control (43.8 ‘a’) but statistically the same as Badge SC (34.0 ‘bc’).

See Photos on the next Page
Figure 1. Non-treated control plot at Prosper, ND

Figure 2. Kocide 3000 treated plot at Prosper, ND

Figure 3. Oxidate 1% treated plot at Prosper, ND.
NDSU CANOLA DOCTOR APP

The NDSU Canola Doctor App (Figure 1) delivers critical information on diseases and pests, including alerts, the Sclerotinia risk map and risk calculator, images and management tools to optimize canola production in North Dakota. It also contains up-to-date information from NDSU canola pathologists, entomologists and Extension specialists, illustrations of common diseases and insect pests (Figure 2), information on pesticides, and provides quick access to the Sclerotinia risk map and risk calculator (Figure 3).

The App can be downloaded from the Google Play store or scan the QR code (Figure 4).

For more information, please contact us!

Luis del Rio
NDSU Plant Pathology Professor

Kishore Chittem
NDSU Plant Pathology Research Associate
EXPECTATIONS OF FUNGICIDES APPLIED TO WHEAT AT FLOWERING UNDER DRY CONDITIONS

Severe Fusarium head blight problems over the past couple growing seasons have plagued durum and spring wheat growers in northcentral and northwestern North Dakota. This year, the field conditions are drier, with less rainfall and lower humidity than previous years, resulting in a lower scab risk. However, there are questions pertaining to the value of applying a fungicide for yield and test weight protection. To help answer this question, I examined research data since 2011 to find situations where fungicides were applied at flowering in an environment with low scab risk and low fungal leaf spot incidence. After sorting the data, 14 trials were conducted under low disease environments. From these trials, the yield and test weight data from Prosaro and Caramba applications at flowering were compared to the non-treated control. Tebuconazole data was available from one trial, but the data was not used due to lack of observations across years. In addition, since Prosaro and Caramba treatments did not appear in each trial, the data was combined and was not individually separated. Yield responses of fungicides applied at flowering under low disease environments were highly variable. When compared to the non-treated control, mean yield values of flowering fungicide applications were 2.8% higher and ranged from -9.2% (no response) to 9.3%. For test weight, differences were negligible (mean value of 0.01%), with a range of -1.8% (no response) to 0.6%. For both agronomic traits, a fungicide applied at flowering under low disease environments does not provide a consistent response.

The next question is how to interpret the data? First, fungicides applied at early-flowering are used to help manage scab and DON/VOM under environments of elevated scab risk (prolonged periods of moisture and high humidity). This in turn can result in a higher chance of return on investment by reducing DON/VOM levels, while protecting yield and test weight. When scab risk is low, the same benefits will likely not be observed. Secondly, scab fungicide applications can provide late-season flag leaf protection for foliar diseases. Usually under low scab risk environments, the risk for fungal leaf diseases is low (unless there are several mornings of prolonged dews to favor fungal infection), and a fungicide application at flowering will not contribute much to yield and test weight. Thirdly, the economic potential of a wheat crop under dry conditions can be low, so keep this in mind before making a fungicide application at flowering. In the table below, I provided some yield potentials and provided the estimated yield benefit of a scab fungicide under low disease environments. As you can see, the estimated yield benefit of flowering application under low disease environments will not offset cost of application. Although, this is from a relatively small data set, the message is that fungicides are best used to manage fungal diseases, which in turn can protect yield and test weight. Do not expect a fungicide to help a water-stressed wheat crop.

<table>
<thead>
<tr>
<th>Yield Potential</th>
<th>Estimated Yield Benefit of a Flowering Application Under Dry Conditions (using data above at 2.8%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 bu/A</td>
<td>1.0 bu/A</td>
</tr>
<tr>
<td>40 bu/A</td>
<td>1.1 bu/A</td>
</tr>
<tr>
<td>45 bu/A</td>
<td>1.3 bu/A</td>
</tr>
<tr>
<td>50 bu/A</td>
<td>1.4 bu/A</td>
</tr>
<tr>
<td>60 bu/A</td>
<td>1.7 bu/A</td>
</tr>
</tbody>
</table>

Andrew Friskop  
Extension Plant Pathology, Cereal Crops

Joel Ransom  
Extension Agronomist for Cereal Crops
WATERHEMP IS BEGINNING TO FLOWER

I was collecting notes in one of my waterhemp control experiments last week and observed evidence of flowering (see attached image). Why is flowering important? Because female waterhemp plants produce a tremendous amount of seed and seed remains viable for 4 to 6 years. Waterhemp plants growing in noncompetitive environments can produce greater than 500,000 seeds per plant (fewer under competitive environments).

A few scattered waterhemp plants in a sugarbeet or soybean field do not rob yield. However, they make seed and great seed production facilitates the rapid spread of waterhemp, especially when the seeds are scattered by harvesting and tillage equipment. Applying herbicide to waterhemp approaching the flowering stage is not recommended because this practice does not significantly reduce the amount of seed waterhemp plants produce.

Researchers at Iowa State University and the University of Illinois examined how long it takes female waterhemp plants to produce viable seed after the flowers were pollinated. Female waterhemp plants were pollinated for 24 hours and then separated from the male plants in the Illinois study. Branches from female plants were harvested at various intervals after pollination and placed under either warm (86 degrees Fahrenheit) or cold (-4 degrees Fahrenheit) conditions for 48 hours, then stored at room temperature. Researchers then measured germination to determine how soon after pollination seeds were viable. They found seeds stored for 48 hours under warm conditions were viable 7 to 9 days after pollination; seeds stored under cold conditions were viable 11 days after pollination.

Hand-weeding is recommended for removing scattered, flowering waterhemp plants from a field, especially near the borders of field. Take a plastic garbage bag to carry out any female plants since seed might already be viable.

SUB-LETHAL RATES OF DICAMBA

Recent published research shows Palmer amaranth plants that survive sub-lethal rates of dicamba can pass a greater level tolerance to successive generations. Registration of dicamba-resistant crops will provide an alternative management option to control many weeds, including waterhemp and herbicide-resistant Palmer amaranth populations, including those with resistance to herbicide Groups 2, 3, 5, 9, 14, and 27. However, repeated use of sublethal doses of dicamba may lead to rapid evolution of herbicide resistance, especially in Palmer amaranth—a species with a strong tendency to evolve resistance.

Selection experiments with dicamba were conducted on Palmer amaranth using sublethal doses. In the greenhouse, a known susceptible Palmer amaranth population was subjected to sublethal dicamba doses for three generations (P1–P3). Susceptibility of the plants to dicamba was evaluated, and susceptibility to 2,4-D was also characterized. Researchers exposed dicamba-susceptible pigweed to low doses of dicamba for three successive generations where surviving weeds were allowed to cross-pollinate with one another, similar to a natural environment.
The initial population was called P₀ and successive populations were named P₁, P₂, and P₃. The labeled rate of dicamba on dicamba-resistant soybean is 0.5 lb ai/A (8 oz ai/A) and was applied 4 to 5 leaf pigweed. The first generation (P₀) was exposed to ¼ dose, P₁ a ½ dose, P₂ a ¾ dose and P₃ a full dose as per the table below.

<table>
<thead>
<tr>
<th>Selected populations</th>
<th>Dicamba dose</th>
<th>Seedlings treated (no.)</th>
<th>Survivors (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P₀</td>
<td>0.063 lb ai/A (2.75 fl oz XtendiMax)</td>
<td>384</td>
<td>53</td>
</tr>
<tr>
<td>P₁</td>
<td>0.125 lb ai/A (5.5 fl oz XtendiMax)</td>
<td>300</td>
<td>32</td>
</tr>
<tr>
<td>P₂</td>
<td>0.25 lb ai/A (11 fl oz XtendiMax)</td>
<td>380</td>
<td>71</td>
</tr>
<tr>
<td>P₃</td>
<td>0.5 lb ai/A (22 fl oz XtendiMax)</td>
<td>280</td>
<td>21</td>
</tr>
</tbody>
</table>

Results show exposing pigweed to three successive low doses of dicamba led to a roughly three-fold increase in resistance. Approximately 25% of the P₃ generation survived the label rate of dicamba.

The pigweed selected with dicamba in this study were also tested with 2,4-D, another auxinic herbicide and surprisingly, reduced susceptibility of the P₃ generation to 2,4-D was also evident. Approximately, a 2-fold resistance to 2,4-D was observed for the P₃ generation with 25% of pigweed in the P₁ generation surviving a rate of 2,4-D that gave 100% control of the P₀ population.

It is likely that low-dose recurrent selection leads to accumulation of “genes with small additive effects”. Low-dose recurrent selection is much slower in self-pollinated species such as wild oat and fastest in species that must cross pollinate such as Palmer amaranth and waterhemp.


Application of this information: Several have asked if NDSU has conducted studies similar to this done by Norsworthy in Arkansas. NDSU has not conducted similar research although growers have been unknowingly doing this same selection pressure for decades by spraying low dicamba rates in corn (4 fl oz/A) and wheat (2 fl oz/A). There is ample evidence that low doses of herbicides (not just auxins) often produces resistant populations from surviving plants within a few generations. Positive news is that few weeds have developed resistance except kochia. Dicamba resistant kochia has been identified but increase in geography and level of resistance has been slow and small. We don’t really understand why this is, so it is difficult to predict what a large-scale change in dicamba usage will produce. Plant (weed) specie response to dicamba will be weed specific – some weeds, like Palmer amaranth and possibly waterhemp may express higher levels of resistance faster than others, like kochia. To delay resistance it is assumed, based on basic population genetics, that using multiple applications of dicamba at high rates in one cropping season (only 1 year of 2 or more years) will LIKELY delay weed resistance more than using just one dicamba application in each growing season (example: once in wheat, once in DT soy, once in corn, etc.). Multiple applications in one season will likely kill more of the same population thereby decreasing the risk of higher levels of resistance to be passed on to surviving progeny. This confirms my motto: Dead weeds don’t make seed.

Summary: This research was conducted on Palmer amaranth but waterhemp is also much like Palmer amaranth. Waterhemp is dioecious (male and female flowers grow on separate plants and they must cross-pollinate to produce seed) and waterhemp has become resistant to most herbicide classes, similar to Palmer amaranth. Waterhemp is well established in eastern North Dakota, with spread into central North Dakota. Dicamba-resistant soybean may become a dominant soybean technology used by growers in ND and the U.S. It would be accurate to anticipate that waterhemp surviving dicamba in dicamba-resistant soybean may develop an increased tolerance to dicamba and 2,4-D. This information validates many of the Weed Management Strategies we recommend on page 97 in the ND Weed Guide, namely:

1. Scout fields... before and after application and at the end of the season.

5. Apply effective POST herbicides... that include multiple mechanisms of action in tank-mix or in sequential applications.
6. Use high herbicide rates and effective adjuvants. Full rates kill weeds with low-level resistance and dead plants cannot produce resistant progeny. Reduced rates allow plants with low-level resistance to survive, hybridize, and produce progeny with elevated resistance. Hybrid plants (>1 resistance gene) express a higher level of resistance and require even higher herbicide rates to kill the plant. Dead weeds means zero tolerance (no seed production, zero resistant progeny) and is effective resistance weed management.

7. Spray small annual weeds. Generally, small weeds (<3 inches) are more susceptible to herbicides than large weeds. Even weeds with low level herbicide resistance are more susceptible at 1 inch than at larger growth stages.

8. Practice Zero Tolerance... seed from escaped weeds will contribute to the weed seedbank and will require diversified weed management strategies of mowing, cultivation/tillage, and hand weeding to achieve near 100% weed control.

9. Control weeds in field perimeters, drown out, and non-crop areas. Weeds surviving a partial herbicide dose on field borders can be a repository for the introduction of resistant weeds into a field.

10. Rotate herbicides with different mechanisms of action in consecutive years. Diverse crop rotations can introduce herbicides with different mechanisms of action to delay herbicide resistance.

12. Evaluate weed management at the end of each season and revise to improve weed control the next year.

Rich Zollinger
Extension Weed Specialist
TAKING CARE OF TREES AFTER A STORM.

While most of the discussion recently has been focused on drought, some parts of the state are dealing with the aftermath of heavy storms. These storms caused quite a bit of damage to trees in cities and towns, in yards and in rural shelterbelts. Properly dealing with this damage can help trees recover more quickly and help to prevent future damage.

Before beginning any tree work, be aware of power lines that may have come down during the storms. Don’t touch them, and don’t touch anything that is contacting them. Fences, broken branches and even pruning tools can conduct electricity, causing indirect contact with the power line. Also, look around for hanging branches in the remaining tree crowns or in power lines, that may present a hazard.

The best thing that can be done for storm-damaged trees, quite simply, is to properly prune out the damaged limbs. Removing any dead or broken branches will allow the trees to recover more quickly and will also minimize the chances of infection by insects or diseases. Do not over-prune or top the tree. These actions will create very large wounds and remove healthy branches that are vital to supporting the leaves that are needed for creating new food and energy that are critical to healing and re-growth. If the tree’s appearance isn’t quite perfect, that’s okay. The tree will fill in bare spots quickly. To learn more about proper pruning techniques, see ‘Basic Guidelines for Pruning Trees and Shrubs’, NDSU Extension publication H-1036.

Finally, know when to say goodbye. If trees have lost more than 50% of their crowns, they may be good candidates for removal. That’s a lot of damage for a tree to sustain, and though it’s possible that the tree could recover, it will likely take a long time and the tree will be more susceptible to insects and diseases during that period.
AROUND THE STATE

NORTH CENTRAL ND

Drought continues to grasp many areas of the state over the past week with only scattered showers occurring during that time. Most of the North Central regional NDAWN weather stations received less than 0.05” of rain since July 2nd. The two exceptions would be Bottineau and Rugby, where spotted showers resulted in about 0.70”. Temperatures are expected to be warm over the next week. These conditions should not promote disease in area crops, however, the NDSU Small Grains Disease Model is a helpful tool to estimate risk in a given area and when field scouting may be appropriate. At this time, risk appears low.

In last week’s edition of the Crop & Pest Report, I briefly mentioned some small populations of wheat midge being observed in McLean, McHenry, Pierce, and Renville Counties by the IPM scout. Since then, traps in those regions have seen a steady climb in numbers. The increase in these numbers should trigger some evening scouting in those regions. Economic thresholds can vary based on crop value and wheat variety. Please refer to the NDSU Wheat Midge Extension publication for more information regarding economic thresholds.

Upcoming Events:

**Pierce County Agricultural Improvement Association Annual Crop Tour**
Join us Monday, July 17th at 9:00 am at the NCREC Pierce County plots located 3 miles west of Rugby on Hwy 2 for a short program with updates on current ag research in NC North Dakota. Dr. Brian Jenks will discuss current weed issues, Eric Eriksmoen will provide a comparison on featured small grain varieties, and Dr. TJ Prochaska will provide a pest and disease update.

**NCREC Field Day**
On Wednesday, July 19th, the NCREC will open its doors for its annual field day with activities beginning at 9 am CDT at the NCREC located 1 mile south of Minot on Hwy 83. Crop production and technology will be the focus of the July 19th field tour. Lunch will follow the tour.

**Renville-Bottineau County Agricultural Improvement Association Annual Crop Tour**
On Thursday, July 20th at 2:00 pm, join us at Mouse River Park located west of Mohall on Hwy 5 for a short program with updates on current ag research. Eric Eriksmoen will provide a comparison on featured small grain varieties, Dr. Shana Forster will discuss fungicides in chickpea, and Dr. TJ Prochaska will provide a pest and disease update. Supper will follow.

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

NORTHWEST ND

Northwest ND is still hot and dry. Over the last week, almost no significant rain fell in Divide, Williams, and Mountrail Counties. Southern McKenzie County picked up ½”-1” of rain, but this likely too late to make much of a difference for most of the crops in that area. Scattered areas of Burke had ¾”, but drought conditions are persistent and widespread.

Here at the Williston REC, we estimate that we'll start harvest of some of our earliest planted small grains next week. With more hot weather on the way, spring wheat and durum won’t be far behind and harvest will likely start the last week of July. We were a bit cooler today (Tuesday) and tomorrow doesn’t look bad either, but starting Friday, 100⁰ and then 90’s are predicted for the next 10 days.

(Cont. on next page)
For those of you out haying or getting ready to start harvest, please use caution as conditions are favorable for fires. Keep a water truck and fire extinguishers handy just in case.

Up-coming Events

**WREC Dryland Field Day:** Thursday, July 13th at the WREC 4.5 miles west of Williston. Coffee and doughnuts at 8:00 am, tour starts at 9:00 am Central. Choose from either the dryland agronomy or horticulture tours. Free chicken lunch served at noon. Afternoon program will highlight saline seep and pipeline disturbed soil reclamation. The afternoon session is eligible for 2.5 CEU’s for Certified Crop Advisors in the Soil & Water Management category.

**WREC Irrigated Field Day:** Friday, July 14th at the Nesson Valley irrigated site located 23 miles east of Williston on Hwy 1804. Refreshments available at 8:30 am, tour starts at 9:00 am Central, and a free lunch is served at noon. The tour will highlight variety trials and plant pathology work under irrigated conditions.

Clair Keene
Area Extension Specialist/Cropping Systems
NDSU Williston Research Extension Center

NORTHEAST ND

Stripe rust is observed in selected barley and spring wheat fields. Confirmed reports are from Pembina and Ramsey Counties. Many small grains fields have received fungicide applications in the last week which are also effective against stripe rust infection. Those with a late seeded wheat should continue to scout. Looking at NDSU scab forecast models, many northeast locations have been estimating low risk for the past week with exception of moderate to high risk around the 4th of July in Cavalier, Pembina, Walsh, Nelson and Grand Forks locations for varieties with susceptibility. For head damage in small grains, I’ve observed a minute amount of wheat stem maggot, root rot and loose smut. Wheat midge DD’s have reached 50% emergence this week along the northern tier counties; which means wheat growth has outpaced damage window in most cases.

The NDSU sclerotinia risk map is estimating moderate to high risk for the entire northeast. Many fields of canola received fungicide treatment in the last 10 days. Dry beans are gearing up for flowering. I am commonly asked if I have seen apothecia. At the LREC, we have not. It’s been fairly dry here until yesterday (Wednesday) for the past four weeks; however, we have had some heavy morning dews.

Lesley Lubenow
Area Extension Specialist/Agronomy
NDSU Langdon Research Extension Center

SOUTH-CENTRAL/EAST ND

The region’s NDAWN stations indicate rainfall during the past week (July 5-11) ranging from 0.4 inch (Cooperstown and Dazey), 0.25 inch (Carrington) to 0-0.2 inch at the rest of the tosites. Total rainfall from April 1 to July 11 ranges from 8.8 inches (Cooperstown) to 2.3 inches (Wishek). Estimated water use by corn and soybean during the past week ranges from 2.2 to 2.4 inches. Rain would be welcome throughout the region but critically needed in counties intersected by or west of Hwy 3.

Winter rye and wheat are in the hard-dough to mature stages of growth. Barley and spring wheat are in the dough stages. Corn planted mid-April through the first week in May has 10- to 12-collars. Based on NDAWN growing degree day units accumulated from a May 1 planting date to July 11, the region’s corn ranges from -21 units (Marion) to 134 units (Wishek) compared to the long-term average. Early planted soybean is in the full flower stage (R2); sunflower is in the initial reproductive stage (R1); flax is flowering with initial boll production; and dry bean are nearing the flower stage (R1).

(Cont. on next page)
Upcoming Carrington REC crop tours:
* Barnes County small grain and soybean – Dazey: July 13 (6:30 p.m.)
* Field Day – Carrington: July 18 (9:30 a.m.)
* Corn, dry bean, soybean and sunflower – Carrington: August 24
* Field Day – Oakes: September 7

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

Crops in the region are stunted and maturing ahead of schedule. The few soybean fields in the region that I’ve seen are very short and have begun flowering already. Most corn is anywhere from ankle to knee-high and is twisted from the drought and heat stress. Peas are extremely stunted and have set pods. Barley and other cereals are turning color and many kernels have either aborted or will be very light. Many are still baling small grains. With the hot and dry conditions, any moisture in the soil is evaporating, leaving behind salts at the surface. Saline areas, or white spots in fields are expanding and further stressing the crops that are there.

Pea field in the Richardton area, most pea fields in the region are about a foot tall and maturing quickly.

Salts accumulating on the edge of a wheat field near Richardton. Within the field, the stands are thin from a lack of tillers, and the edge of the fields look extremely sparse.

Ryan Buetow
Area Extension Specialist/Cropping Systems
NDSU Dickinson Research Extension Center
WEATHER FORECAST:
The July 13 through July 19, 2017 Weather Summary/Outlook

There were several rain events in the past week, but they generally produced light and spotty precipitation totals with one notable exception and that was some localized one to two inch or more rains that fell on Tuesday, July 11, 2017. Much of the rain that day came from a couple of strong thunderstorms, one in northeastern North Dakota and the other from a very strong thunderstorm that produced a large tornado that moved from north of Mayville, ND into west central Minnesota. The higher rain totals were in eastern North Dakota and northwestern Minnesota with western North Dakota once again recording little or no rain. It appears that these next 7 days will once again produce little rainfall in the parched western portion of the state and even eastern areas look to be dry as well.

Western North Dakota not only was dry, but also quite warm with temperatures 7° to 10° above normal. Several North Dakota Agricultural Weather Network (NDAWN) stations recorded a maximum of 100° or greater on one or more days during the past week in that part of the state. An additional day or two near or above 100° looks to be occurring during the next seven days as well, in those same locations that recorded triple digit heat last week.
North Dakota will be on the boundary of some very warm temperatures through the middle of next week. This boundary will shift slightly north and south bringing with it some noticeable changes in daily temperatures with one day hot and the next day not so hot. This boundary will also mean temperatures in northern North Dakota and far northwestern Minnesota will be significantly cooler than southern areas on some days. Overall, there will be more above normal days than below normal days meaning another period with above average temperatures, yet, even with that boundary occasionally shifting back and forth through the region, very little rain is expected.

The projected growing degree days (GDDs), base 32°, 44° and 50° for the period July 13 through July 19 is presented below. Most of North Dakota and northwestern Minnesota will record about the same number of GDDs as last week.

With an expectation of mostly dry and warm conditions through the middle of next week, another period of lower than normal relative humidity hours above 85% is expected during this forecast period. The projected hours for the period July 13 through July 19, 2017 is presented in the graphic below.
Using May 10, 2017 as an average planting date, the number of corn growing degree days (Base 50°) accumulated through July 11 is depicted below. The exact numbers based on your actual planting date(s) can be found here: [https://ndawn.ndsu.nodak.edu/corn-growing-degree-days.html](https://ndawn.ndsu.nodak.edu/corn-growing-degree-days.html)

![Corn Accumulated Growing Degree Days (°F) (2017–05–11 – 2017–07–11)](image1)

Using a planting date of May 1, 2017, the number of wheat growing degree days (Base 32°) accumulated through July 11 is presented below. The exact numbers based on your actual planting date(s) can be found here: [https://ndawn.ndsu.nodak.edu/wheat-growing-degree-days.html](https://ndawn.ndsu.nodak.edu/wheat-growing-degree-days.html)

![Accumulated Wheat Growing Degree Days (°F) (2017–05–02 – 2017–07–11)](image2)

Daryl Ritchison
Meteorologist
Interim Director of the North Dakota Agricultural Weather Network
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