Integrated Pest & Crop Management

Corn Foliage Diseases

by Laura Sweets

This is shaping up to be another "interesting" year for corn in Missouri and most of the Midwest. Prolonged periods of wet weather and then flooding delayed planting or led to replanting. Overall the corn crop is behind normal. There is also a wide range in growth stages of corn across the state and even in individual fields. We have not received many samples or calls related to corn foliage diseases but with the most recent bout of wet weather, it is likely that corn foliage diseases may begin to show up in fields.

So far the corn fields I have seen have very uneven growth with smaller plants having yellowed lower leaves. The very lowest leaves showed symptoms of anthracnose although the anthracnose was not unusually severe. **Anthracnose leaf blight,** caused by the fungus *Colletotrichum graminicola,* usually occurs early in the season on the lower leaves of young corn plants. Anthracnose lesions tend to be brown, oval to spindle-shaped lesions with yellow to pinkish to reddish-brown borders. Lesions may be 0.2 to 0.6 inch in length. Lesions may merge or coalesce to kill larger areas of leaf tissue. Concentric rings or zones are sometimes apparent within the diseased areas of leaf tissue. Lesions may be concentrated towards the leaf tip (or portion of the leaf that was emerged when rain occurred) giving the leaves a fired appearance that might be mistaken for nutrient deficiency or herbicide injury.

The fungus which causes anthracnose leaf blight produces fruiting bodies in the dead leaf tissue. Dark, hair like structures called setae are produced in association with the fruiting bodies. It is possible to see the setae on infected plant material in the field if a hand lens is used.

Anthracnose tends to be most common early in the season on the lower leaves of young corn plants. These leaves may be severely affected, yellow and die prematurely. Generally the disease stops at this point because of drier, warmer weather conditions and is not considered a significant problem. Under favorable weather conditions, the fungus may move up the plant causing foliage symptoms on higher leaves. If favorable weather conditions occur mid-season (especially wet), anthracnose may actually move up to the ear leaf. The anthracnose fungus can also cause top dieback and stalk rot later in the season. High temperatures and extended periods of wet weather favor anthracnose. Anthracnose leaf blight is more likely to occur if corn is planted following corn.

In a normal year anthracnose leaf blight in Missouri is not serious and would not warrant a fungicide application. It is a little too early in the season to know how severe anthracnose will be or to know if it might spread beyond the very lowest leaves on the plants. Following the weather patterns over the next several weeks and keeping an eye on disease development or lack of development will be important.

We have also received samples with symptoms suggestive of either Holcus leaf spot or herbicide injury. **Holcus leaf spot** is caused by the bacterium *Pseudomonas syringae* pv. *syringae*. Lesions are usually oval to elliptical and range in size from 0.25 to 1.0 inch. Initially they are dark green and water-soaked. Later they become dry and turn light brown with a reddish margin.

The bacteria that cause holcus leaf spot are spread by wind-driven rain or splashing rain, so outbreaks frequently occur several days after a rainstorm or storm with strong wind-driven rains. Since holcus leaf spot is caused by a bacterium, common corn fungicides will have little effect on this disease.

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Corn Foliage Diseases continued

We are beginning to receive corn samples with northern corn leaf blight, gray leaf spot and common rust. However, thus far, these corn foliage diseases do not appear to be as severe as other states in the Corn Belt are reporting. It will be important to scout for these and other corn foliage diseases over the next few weeks.

The fungus that causes **northern corn leaf blight** has undergone a number of name changes over the years but the most recently accepted name for the asexual stage of the pathogen is *Exserohilum turcicum.*

Figure 1: Northern Corn Leaf Blight

Northern corn leaf blight lesions are long, elliptical, grayish green lesions ranging from 1.0 to 6.0 inches in length. As the lesions mature they may become more tan in color. During damp or humid weather, dark olive green to black spores may be produced across the surface of the lesions. Northern corn leaf blight usually begins on the lower leaves of the plants. As the season progresses, nearly all leaves of a susceptible plant may be covered with lesions, giving the plants the appearance it has been injured by frost.

Northern corn leaf blight is most severe when temperatures are in the range of 64 to 80 degrees F and when prolonged periods of dew or wet, overcast weather keep the foliage wet for extended periods of time. Hybrids may vary greatly in their susceptibility to northern corn leaf blight.

Gray leaf spot, caused by the fungus *Cercospora zeae-maydis*, has become a serious problem across much of the Corn Belt. Initially, small, round to oval, reddish brown lesions with yellow haloes develop between the leaf veins. These lesions increase in size, but since growth of the causal fungus is restricted by leaf veins, the lesions develop parallel edges which give them a rectangular or blocky appearance.

Figure 2: Gray leaf spot and common rust

Older lesions are pale brown to reddish brown in color and blocky to rectangular in shape. They may range from 0.5 to 2 or more inches in length. During periods of wet weather or high humidity, the pathogen may sporulate across the lesion, giving the lesion a grayish cast. Lesions may merge, resulting in large areas of dead leaf tissue. Lesions typically develop first on lower leaves but under favorable conditions, extensive leaf blighting over the entire plant may occur.

The fungus that causes gray leaf spot survives in infested residues left on the soil surface. Gray leaf spot is more severe when corn is planted after corn. Spores produced on infested residues are spread by wind or splashing rain to corn plants. Prolonged periods of overcast weather, heavy dews or fog favor the development of gray leaf spot.

Although gray leaf spot may not be evident in a field until after silking, the disease can build up rapidly during the latter part of the season, completely blighting leaves and causing premature death of plants. Corn hybrids vary greatly in their susceptibility to gray leaf spot.

Common rust is caused by the fungus Puccinia sorghi. Rust pustules begin as small, circular, light green to yellow spots in the leaf tissue. These lesions develop into circular to elongate, golden-brown to reddish-brown, raised pustules. The rust pustules may be in bands or concentrated patches on the leaf as a result of infection that occurred while the leaf was still in the whorl.

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Figure 3: Common rust

The pustules quickly rupture to reveal masses of rusty brown spores. As plants mature, the pustules become brownish black in color. Common rust pustules may develop on both upper and lower leaf surfaces as well as on leaf sheaths, husks and stalks. When rust is severe, leaves and leaf sheaths may yellow and die prematurely.

Puccinia sorghi does not survive on infested residues left in the field. Rather infection during a growing season occurs as spores are blown in from more southern locations. The incidence and severity of common rust during a season depends in part on how early in the season rust inoculum reaches Missouri. The earlier in the season that rust spores arrive, the greater the potential for rust problems to develop.

Temperatures in the range of 60 to 77 degrees F and high relative humidity favor the development of common rust. Younger leaf tissue is more susceptible to infection than is older, mature leaf tissue. Most commercial corn hybrids are fairly resistant to common rust.

Management of Corn Foliage Diseases:

Generally speaking with the corn foliage diseases, the later in the season (especially the longer after pollination) that the foliage disease becomes established, the lower direct yield losses will be. Highest yield losses occur if diseases such as rust or gray leaf spot develop prior to pollination. Also, most of the corn foliage diseases are favored by extended periods of free moisture on the leaf surfaces. This moisture can be from rain, overhead irrigation or heavy dews that stay late in the day. Fields with poor air movement, river bottom fields or shaded portions of fields may also have higher levels of corn foliage diseases.

Most of the control recommendations for minimizing losses due to corn foliage diseases are preventative measures such as planting resistant hybrids, rotating crops so the corn doesn't follow corn in the same field or tillage to reduce the amount of infected residue left on the soil surface. Several fungicides are labeled for use on corn to control foliage diseases. See the 2015 Missouri Pest Management Guide: Corn, Grain Sorghum, Soybean and Winter Wheat M171 for fungicides labeled for use on field corn. Printed copies of this bulletin are available from the Extension Publications Distribution Center, 2800 Maguire Blvd., Columbia, MO, 573-882-7216 or online at www.extension.missouri.edu/p/M171 .

Carl Bradley, former Extension Plant Pathologist at the University of Illinois and now at the University of Kentucky, wrote a last article for the University of Illinois Pest Alert that contained information on the results of his foliar fungicide trials over the last several years. See http://bulletin.ipm.illinois.edu/?p=3330 for that article.

In making the decision on whether or not to apply a foliar fungicide to corn it is important to consider the yield potential of each individual field. If fields are uneven and struggling because of wet conditions, foliar fungicides are less likely to give significant increases in yield. If nitrogen loss is a problem again because of wet conditions, it may be more beneficial to correct the nitrogen deficiency than apply a fungicide. Foliar fungicides may give greater yield increases on susceptible hybrids than on hybrids with resistance to the foliage disease present. With foliar fungicides it is important to be scouting fields so that products are applied before the disease has built up to high levels. Later planted fields which will have plants at earlier growth stages later in the season may also benefit more from fungicide application if diseases are occurring than early planted fields which are at more advanced growth stages.

With the wide range in planting dates and plant vigor across the state it is impossible to make blanket assessments of the incidence or severity of corn foliage diseases or to make statewide management recommendations. Individual fields need to be monitored for stand, vigor and yield potential, for other issues such as nitrogen loss or weed escape problems, for the foliage diseases present and the severity of those diseases as well as for the forecast weather conditions in the area before deciding to apply a foliar fungicide.

Fields with high levels of various foliage diseases may also show higher levels of stalk rot this fall. As harvest approaches, check fields which have had foliage disease problems for stalk rot and try to harvest problem fields promptly.

Losing and Replacing Nitrogen

by Peter C. Scharf

On the first of June, it looked like there would probably be a few corn fields with nitrogen problems in Missouri. Now, on the first of July, it looks like there will probably be a few corn fields that don't have nitrogen problems. All but the southeastern corner of the state has received over 12 inches of rain in May and June (http://plantsci.missouri.edu/nutrientmanagement/Nitrogen/Nitrogen_watch_2015/poorly-drained_Midwest_Jun_30.htm), which is my rule of thumb for when N issues will occur on most poorly-drained fields. The area with excess rainfall extends across nearly all of Illinois, northern Indiana, northwest Ohio, southern Iowa, eastern Kansas, and southeastern Nebraska.

That's a lot of corn.

Many are aware of the nitrogen issues. They can be hard to miss driving down the road. But the same unrelenting wetness that has prevented soybean planting from being finished has also prevented ground application of extra nitrogen fertilizer on most fields.

Fortunately an unprecedented level of aerial application has stepped in to take up the slack. I have heard of at least 18 planes applying N to corn in Missouri, with at least half a dozen more in both eastern Kansas and western Illinois. Mostly they are flying on 100 pounds of urea/acre (46 pounds N/acre), but in some cases 150-based on the level of deficiency I've seen in many fields, I think the higher rate is a good idea.

On June 30 (Tuesday), I flew from Moberly to Centralia, Mexico, Laddonia, Monroe City, and back to Moberly. In the southern parts of that trip, I would say that 90% of the fields needed more N, and in the northern parts, 50%. It was not unusual to see a field that badly needed more N next to a field that looked pretty good, as in the photo at the left. This suggests that N management, as well as soil and rainfall, can play a big role in the crop's N status and appearance.

I've heard from a number of sources that many farmers are balking at spending any more money on this crop. Extended wetness on poorly-drained soils has probably in some cases damaged the crop's yield potential. However, I am still convinced that for most of the N-stressed fields I have seen, even the ones with 3 inches of standing water in them, an investment in additional nitrogen will double or triple the money spent. In my experiments with rescue N, the worse the corn looked, the bigger its response to rescue N.

If you are unsure about whether a rescue N application will pay, a yield loss map from NVision Ag is my recommendation for the best way to balance cost against need. Yield loss estimates are based on crop color in an aerial photo. I own this company, so I have a conflict of interest that you should be aware of. However, I've been saying for many years before having this financial conflict that aerial photos are the best way to evaluate whether more N is needed. We're using technology developed at, patented by, and licensed from the University of Missouri.

NVision Ag can also turn the aerial photo into a rate control file to put the N where it's needed. Nitrogen loss is patchy in many fields (right). The wet areas lose a lot of N, and the less wet areas can have enough left to produce full yield.

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Losing and Replacing Nitrogen continued.

Over the fields analyzed by NVision Ag so far this year, average predicted yield loss due to N deficiency is just shy of 40 bushels/acre (range 17 to 85), and average N rate recommendation has been about 55 pounds of N/acre. The bulk of these fields have been in the western half of Missouri, where (outside of the river bottoms) N deficiency is less severe than what I've seen in eastern Missouri.

However, few planes can apply nitrogen variably, and few ground rigs have been able to get into fields. Even when it dries out, corn is now tall enough in most fields to interfere with the spread pattern on high-clearance spinner spreaders. In severely stressed fields, and there are a lot of them out there (photo below), running a high-clearance spinner on a narrower-than-usual swath width will be a lot better than doing nothing. High-clearance sprayers with drops will remain an excellent treatment option on many fields, and one that allows for variable-rate application.

Planes will remain an option physically, but in practice the pilots will bolt from N application to fungicide work if it's available. Getting a plane in to apply N as soon as possible is probably the best option for many farmers as I write this.

Although it's been the most difficult spring I've seen in my 20 years in Missouri, I have to say that I am thrilled with the response of farmers and the fertilizer industry to the N deficiencies that have developed this year. We are light-years beyond where we were in 2010, the last year when I saw a LOT of yellow corn in Missouri. The number of fields getting the nitrogen they need to express their full yield potential is way up from 2010. And I feel that yield potential is still good in many fields. Despite the stress from excess water, we have a soil profile that is full of water on July 1. In a state where corn yields are usually limited by water availability in July, this is a great situation.

Winter Wheat Disease Update

by Laura Sweets

According to the July 6, 2015, Missouri Crop Progress and Condition report put out by the USDA, National Agricultural Statistics Service, Heartland Regional Field Office, winter wheat harvest was 68 percent complete, 20 percentage points behind the 5-year average. With the continued wet conditions through much of the state, the quality of the wheat still in the field is deteriorating. Fusarium head blight or scab was widespread in most regions of the state this season and its impact on yields and grain quality is being seen as fields are harvested and grain taken to elevators. The wet conditions and high humidity have also led to widespread occurrence of "black wheat." Both of these diseases were covered in IPCM alerts earlier this season.

Now there are questions related to saving seed from this year's crop for seed for planting this coming fall. With the high levels of scabby kernels and the overall lower quality of grain, this is not a good year to consider saving seed for planting. But if this alternative is still being considered there are certain steps to take in making the decision of whether or not to use saved seed for planting. The remainder of this article focuses on evaluating winter wheat seed quality for possible planting use.

Fusarium head blight or scab was widespread, and in some fields severe, this season. The fungus which causes this disease may infect kernels and can affect stands if infected seed is planted. If wheat is going to be saved for seed, this is certainly a year to pay careful attention to the quality of seed being saved. Initial reports from both the Missouri Seed Improvement Association and the Missouri Department of Agriculture indicate lower germination test results on wheat from this year's crop from some regions of the state. Visibly fungus infected seed are common.

Fusarium head blight or scab infection may result in shriveled and shrunken kernels, lightweight bleached or tombstone kernels or kernels that have a pinkish cast or discoloration. Lots with high levels of scab may have lower germination rates. The fungus that causes scab can also cause a seedling blight of wheat. If scab infected seed is used for planting, seedling blights and stand establishment problems may occur. Management of Fusarium seedling blight is through the planting of disease-free seed or a combination of thoroughly cleaning the seed lot, having a germination test run, adjusting the seeding rate to compensate for germination rate and using a fungicide seed treatment effective against seed-borne Fusarium or scab.

Because scab can decrease germination, a germination test may be especially useful in determining if a particular lot should be used for seed. The minimum germination rate for certified seed is 85% germination. It is possible that lower germination rates might be successfully used for seed if the seeding rate is adjusted to compensate for the low germination rate. But this can be risky, especially if weather conditions at and after planting are not favorable for germination and emergence. Fungicide seed treatments can provide some benefit but they cannot resurrect dead seed.

If seed from a field that had Fusarium head blight or scab is being considered for use as seed this fall, it is important to get an accurate germination test and use this information in deciding whether or not to use the lot for seed, whether the seeding rate will need to be increased and whether or not to apply a seed treatment fungicide.

Before submitting a sample for a germination test it is important to thoroughly clean the seed. The wheat seed should be cleaned to remove small and damaged seed and to eliminate weed seeds. With the amount of scab is some lots this year, thoroughly cleaning a lot may clean out 25-30% of the seed in the lot. But a thorough cleaning will give more reliable germination test results and removing small and damaged seed will not only aid in crop establishment it will also provide a more uniform wheat seedling stand. Removing small and damaged seed will also increase the thousand-kernel weight (TKW), which serves as a measure of seed quality. Wheat seed lots with TKW values greater than 30 grams tend to have increased fall tiller number and seedling vigor.

The next step is to perform a germination test. Germination tests can either be completed at home or by sending a sample to the Missouri Seed Improvement Association or the Missouri Department of Agriculture.

A home test can be performed by counting out 100 seeds and placing them in a damp paper towel. Place the paper towel into a plastic bag to conserve moisture and store in a warm location out of direct sunlight. After five days, count the number of germinated seeds that have both an intact root and shoot. This will give the grower an estimate of % germination. It is important to choose random seeds throughout the entire seed lot and conduct at least five 100 seed counts.

The Missouri Seed Improvement Association performs germination tests. The test requires one pound of seed and costs $14.25. For details email MOSEED@AOL.com or

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check the Missouri Seed Improvement Association web site at http://www.moseed.org/.

The State Seed Control Laboratory at the Missouri Department of Agriculture also performs germination tests. The test requires one pint to one quart of seed. From June 1 through August 31 tests are free for Missouri farmers but between September 1 and November 1 there is a $12.00 fee per sample and a limit of four samples per farmer. Information and a submission form can be obtained on the Missouri Department of Agriculture web site, http://mda.mo.gov/plants/seed/ and then clicking on Submitting Seed Service Samples.

If germination is below 85% it is important to increase the seeding rate to compensate; however seeding any wheat with a germination test below 80% would not be recommended.

The next step is to decide whether a fungicide seed treatment is necessary. A number of fungicides are labeled for use as seed treatment fungicides on winter wheat. These seed treatment fungicides protect germinating seed and young seedlings from seedborne and soilborne pathogens. Seed treatment fungicides will not improve germination of seed that has been injured by environmental factors and will not resurrect dead seed. A correct assessment of the cause of poor seed quality or poor germination rates is the first step in deciding if a seed treatment fungicide is necessary.

Fungicide seed treatments for winter wheat are included in the 2015 Pest Management Guide: Corn, Grain Sorghum, Soybean, Winter Wheat, Rice and Cotton, Extension Publication M171. Printed copies of this bulletin are available from the Extension Publications Distribution Center, 2800 Maguire Blvd., Columbia, MO, 573-882-7216 or online at www.extension.missouri.edu/p/M171.