1. Guide to diagnosis of chlorotic and poor vigor wheat in fall

If wheat does not emerge, the problem is usually due to dry soils, a hard crust on the soil surface, or seed with poor germination. If the wheat emerges, but is chlorotic or has poor seedling vigor, several factors may be the cause. Often, a combination of factors is involved.

**Chlorotic wheat**

The most common causes of yellowish, chlorotic wheat in the fall are:

* **Poor root growth.** This may be due to soils that are too dry, soils compacted by a heavy rain, seedlings buried by soil moving into the seed furrow, or poor seedbed conditions at planting time. If the plants have been emerged for several weeks or more, can be pulled up easily, and have only a couple primary roots visible, then the root systems are not extensive enough to provide enough nutrients. This will often cause yellowing.

* **Nitrogen deficiency.** In the seedling stage, nitrogen deficiency causes the plants to look pale or slightly chlorotic. Nitrogen deficiency also results in reduced tillering, top growth, and root growth in the fall. The primary causes of nitrogen deficiency in the fall are poor root growth, insufficient fertilizer rates, leaching from heavy rains, and the presence of heavy amounts of crop residue, which immobilize nitrogen.

* **Leaf rust or tan spot.** If leaf rust infects young seedlings in the fall, the plants may turn yellowish. Fall infections of leaf rust are not common in Kansas, but can occur. Producers will be able to see pustules on the leaves. Tan spot can also cause wheat to turn yellow in the fall. Viral diseases, such as soil-borne mosaic, wheat streak mosaic, and barley yellow dwarf, can infect wheat in the fall, but yellowing symptoms do not normally show up until early spring.
rarely, if ever, pays to treat fields in the fall for leaf rust or tan spot, even if those diseases do cause yellowing. Cold temperatures in the winter normally cure this problem.

* **Cold temperatures.** This has not been a factor yet this year, but if recently planted wheat has not yet emerged, it may not come up until the weather is cold. When temperatures are quite cold at the time wheat emerges, it can result in yellow banding on the leaves. If this is the cause of the yellowing, symptoms should eventually fade away.

* **Mites.** (See items in next section.)

**Other poor vigor problems**

Where wheat stands are thin and lack vigor but are not yellowish and chlorotic, the most common causes are drought stress and aluminum toxicity. Other possible causes include severe phosphorus (P) deficiency, insect or mite feeding injury, root rot and seedling diseases, and herbicide carryover problems.

![Example of a field with poor, uneven germination and fall vigor in October 2011. Photo by Tom Maxwell, K-State Research and Extension, Saline County.](image)

Drought stress is an obvious cause of poor vigor, and needs no explanation or special diagnostic skills. If the wheat is not under drought stress and is not chlorotic or N-deficient, but still has poor vigor, it will take some effort to determine the problem. In this case, the producer should dig up some plants and look at the roots; take a routine soil test for pH, P, and potassium (K); determine the recent history of herbicide applications; examine the field for insects and mites; and examine the crowns and base of tillers for lesions or other signs of disease.
*Low pH.* (See Article No. 2 below for a full discussion.)

*Winter grain mite.* During daylight, winter grain mites can be found around the base of plants or hiding just under the soil surface. They thrive in cool, moist weather and retreat deeper into the soil under hot, dry conditions. Fields with loose, sandy, or loamy soils are more at risk than those with hard, clay soils. Significant infestations are ordinarily confined to central Kansas. Mites feed on plants mostly at night, puncturing individual cells and causing leaves to turn silvery-gray. Leaf tips may turn brown. Young plants are most susceptible and may become stunted, producing little grain. Control may be necessary if large portions of a field show symptoms and mites are abundant in relation to wheat plant growth. Because fall populations develop from eggs laid the previous spring, problems are worse in continuous wheat. Crop rotation is preventive to some degree, but field borders may be affected when mites migrate from wild grasses.

*Brown wheat mite.* The brown wheat mite is a common pest of dryland wheat in western Kansas that can be a problem as far east as U.S. Highway 77 (running from near Wichita to Manhattan) in dry years. The dark brown body is rounded or slightly oval, with the first pair of forelegs notably longer than the others. Affected plants have finely mottled leaves that appear yellowed or bronzed at a distance but lack the webbing produced by the Banks grass mite. Activity is highest in late fall and early spring, with populations usually peaking around mid-April. Outbreak potential is high because all adults are female, and each can produce 70 to 90 winter eggs in a three-week period. Damaging populations are usually limited to continuous wheat fields or those where volunteer wheat was present during the previous spring. Mite populations can be quickly reduced by heavy rains, but if feeding damage is apparent and there is no rain in the forecast, a treatment may be needed.

NOTE: For treatment options and a description of the appearance of both winter grain mite and brown wheat mite, see *Wheat Insect Management 2011* at your local Extension office, or at: http://www.ksre.ksu.edu/library/ENTML2/MF745.PDF
* **Hessian fly.** Seedlings infested by Hessian fly in the fall are typically not yellow, but are often stunted. Affected plants usually have an unusually large, broad greenish leaf for about a month in the fall. Stem elongation is typically much shorter than normal.

* **Flea beetles.** These tiny insects cause whitish streaks on the upper surfaces of leaves. If streaking is severe, plants may die.

* **Poor quality seed.** Seed with unusually low test weights may emerge, but have poor seedling vigor. Certified seed in Kansas has a minimum test weight of 56 pounds per bushel. If test weights are less than that, seedling vigor may be less than desired. Seed size does not in itself have an impact on seedling vigor. Some varieties tend to have small seed, but this does not have any impact on seedling vigor. If the seed is smaller than normal for a particular variety and has low test weight (in the low 50s or less), this can result in poor seedling vigor, however.

* **Seedling blight.** This is one of the most common causes of post-emergence seedling death or sickliness. If the plants may emerge just fine, then seem to “go backwards” in the fall, the root system or coleoptile region may be diseased or dead. Several fungi cause seedling blight, and these diseases are often worse on early-planted wheat. Seedling blight may not kill the seedlings outright, but can lead to later problems with common root rot, crown rot, sharp eyespot, and dryland root rot (also known as dryland foot rot). Suspected plants can be sent to the K-State Plant Diagnostic Lab in the Department of Plant Pathology for diagnosis. Contact your county Extension agent for more information on submitting samples.

* **Atrazine carryover.** Wheat planted into soils with atrazine residue emerges then dies back from the tips of the oldest leaves first. Atrazine carryover is most likely to occur where there were high application rates, high soil pH, coarse-textured soils, and under dry conditions.

* **Low soil P levels.** Phosphorus deficiency symptoms are not common on seedling wheat, but can occur under extreme conditions. Symptoms will include stunting and purpling of the leaves.

-- Jim Shroyer, Extension Agronomy State Leader
jshroyer@ksu.edu

-- Dorivar Ruiz Diaz, Nutrient Management Specialist
ruizdiaz@ksu.edu

-- Erick DeWolf, Extension Plant Pathologist
Dewolf1@ksu.edu

-- Jeff Whitworth, Extension Entomologist
jwhitwor@ksu.edu

2. **Symptoms of aluminum toxicity of wheat on low-pH soils**

Aluminum toxicity begins to occur where soil pH levels are less than 5.0 and KCl-extractable free aluminum levels are greater than 25 ppm. The symptoms of aluminum toxicity include poor tillering and sometimes (but not always) a purplish color. Older leaves may appear drought
stressed and withered. Plants will either be stunted throughout the season even with adequate moisture and nitrogen, or may even die.

High concentrations of aluminum will reduce development of the roots, giving them a short stubby appearance. The roots will often have a brownish color, and the root tips may have a burned appearance. This effect on roots will limit nutrient uptake, and plants may show some deficiency symptoms even with good nutrient levels. In addition, low soil pH (below 5.0) can also reduce the availability of plant nutrients such as calcium, magnesium, phosphorus, and potassium.

There’s not much a producer can do to correct aluminum toxicity problems once the wheat has emerged. However, the producer should make a note of this condition and take action before planting another crop on that field. Lime application on low-pH soil should be considered a high priority. Even half-rates of lime will do some good.

For fields showing mild cases of this problem this fall, wheat may grow out of the condition later in the season. This is assuming that soil pH deeper in the profile is higher and growing roots can reach these areas with better pH levels as plants develop later in the season. However, even for a crop that may grow out of this, the effect on yield potential can be significant.

In addition to liming, it also helps to use P starter fertilizer when planting wheat on low-pH soils, which would help to reduce free aluminum in the soil solution. Some varieties of wheat, such as Everest and Overley, have better tolerance than Fuller to low-pH soils and high aluminum levels.

A field of Fuller wheat with poor tillering and low vigor, growing on a field with a soil pH of 4.6. Photo by Brian Waldschmidt, K-State Research and Extension, Harper County.

-- Dorivar Ruiz Diaz, Nutrient Management Specialist
ruizdiaz@ksu.edu
3. Considerations for planting wheat into grain sorghum, soybean, or sunflower residue

Where row crops are just now being harvested and moisture is adequate, producers may still be planning to plant wheat, even in late October. There are several important factors to consider when planting wheat into sorghum, soybean, or sunflower residue.

* How much nitrogen (N) should be applied? Ideally, this should be based on the results of a soil profile N test. But there’s often not enough time to do this before planting the wheat. As a result, the N rate to use is usually based primarily on yield goals.

For wheat being planted into soybean residue, producers should use their normal rate of N. For wheat following grain sorghum or sunflowers, add an extra 30 pounds of N per acre to the normal N rate. If previous crop yields were severely reduced, it would be good if at all possible to take a profile N test to assess potential carryover nitrogen, which can be significant after a crop failure.

If the wheat will be no-tilled, an additional 20 pounds of N above your normal rate is suggested. In any cropping system, it’s a good idea to use some starter fertilizer (such as 18-46-0, 11-52-0, or 10-34-0) if equipment is available. The remainder of the N needed can be applied during the late fall or winter months.

* What seeding rate should be used? Wheat doublecropped after soybeans or sunflowers should be planted at the rate of at least 90 pounds per acre. For wheat doublecropped after grain sorghum, producers should use 120 pounds of seed per acre.

* What’s the best variety to use? Use the same variety you would use for full-season wheat.

One other note: Producers should make sure the sorghum crop has died before planting wheat, since living sorghum will continue to take up water and nutrients, and produce allelopathic toxins. If a freeze hasn’t killed the sorghum, it may need to be sprayed with glyphosate prior to planting wheat.

-- Jim Shroyer, Extension Agronomy State Leader
jshroyer@ksu.edu

-- Dorivar Ruiz Diaz, Nutrient Management Specialist
ruizdiaz@ksu.edu

4. Failed sorghum, planted wheat, and nitrogen rates

Research in Kansas has shown that wheat planted directly into grain sorghum stubble yields less than wheat planted directly into soybean or corn stubble. When planting wheat into sorghum fields, producers are advised to use an additional 30 lbs/acre nitrogen (N) over the recommended rate based
Research by Ken Kelley (now retired) and Dan Sweeney at the Southeast Agricultural Research Center has shown how the higher nitrogen rate is helpful to wheat yields when planting no-till into sorghum residue. Their research was conducted for several years. A good example of the results can be found in the 2004 Agricultural Research report from the Southeast ARC:
www.ksre.ksu.edu/library/crpsl2/SRP926.pdf

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<th>Soybeans</th>
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Source: 2004 Agricultural Research, Southeast Agricultural Research Center, SRP-926

The gain in grain yield observed with each incremental increase in nitrogen rate was generally greater for wheat planted no-till into grain sorghum residue than into corn or soybean residue. The higher nitrogen rate when planting into grain sorghum residue is needed to compensate for:
* The amount of nitrogen immobilization expected by the sorghum residue
* Possible allelopathic effect of grain sorghum residue on wheat
* The low fall tillering potential of late-planted wheat

This year, producers may have planted wheat into fields of grain sorghum that failed because of some combination of drought and heat. If most of the residue from the failed crop is remaining on the soil surface, the residue (especially the stalks) may well have higher levels of nitrogen than normal. The soil may also have more residual N in the soil profile than normal if the sorghum crop died prematurely. If the sorghum plants remained alive, however, they may have continued to take up N. Under these conditions, will it still be necessary to apply the additional 30 lbs/acre of N for the wheat crop planted into failed sorghum?

The short answer is “yes,” it would still be a good idea to use a higher N rate if the wheat is being planted into sorghum residue than if it were being planted into corn or soybean residue, or into fallow.

Even though failed sorghum residue likely contains more N than normal, resulting in a lower Carbon:Nitrogen ratio than normal, this residue can still cause N immobilization in the fall.

The amount of N left in the soil may be higher than normal if the sorghum crop failed, but there’s no way to know for sure without taking a profile N soil test. If there’s no time to do so before planting the wheat, then it’s best to assume there will be little or no extra N in the soil especially if the plants remained alive. If the plants died prematurely, there may be higher-than-normal levels of residual N in the soil and producers may not need quite as much extra N as normal, this is a situation where the use of soil nitrate test can be particularly important for an accurate N rate application.

In any case, the allelopathic effect of sorghum residue on wheat is unaffected by whether the crop failed or yielded normally. The wheat will need extra N to overcome this effect and produce normal
yields. And the wheat will need some extra N to account for the late planting date, regardless of the condition of the preceding sorghum crop.

Therefore, it will still be a good idea to apply the recommended extra 30 lbs/acre of N to wheat being planted into failed sorghum. Is possible that residual nitrogen remains in the soil and a profile soil test will provide valuable information. That extra N should be added to the topdressing done this winter or early spring, as long as the wheat crop seems to have at least average yield potential.

-- Dorivar Ruiz Diaz, Nutrient Management Specialist
ruizdiaz@ksu.edu

5. Comparative Vegetation Condition Report: October 11 – 24

K-State’s Ecology and Agriculture Spatial Analysis Laboratory (EASAL) produces weekly Vegetation Condition Report maps. These maps can be a valuable tool for making crop selection and marketing decisions.

Two short videos of Dr. Kevin Price explaining the development of these maps can be viewed on YouTube at:
http://www.youtube.com/watch?v=CRP3Y5NIggw
http://www.youtube.com/watch?v=tUdOK94efxc

The objective of these reports is to provide users with a means of assessing the relative condition of crops and grassland. The maps can be used to assess current plant growth rates, as well as comparisons to the previous year and relative to the 21-year average. The report is used by individual farmers and ranchers, the commodities market, and political leaders for assessing factors such as production potential and drought impact across their state.

The maps below show the current vegetation conditions in Kansas, the Corn Belt, and the continental U.S, with comments from Mary Knapp, state climatologist:
Map 1. The Vegetation Condition Report for Kansas for October 11 – 24 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that there continues to be moderate levels of photosynthetic activity in the extreme southeastern portions of the state. There are also small pockets of higher activity in the northeast along the Kansas River Valley and in southwestern Kansas in the Arkansas River Valley.
Map 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for October 11 – 24 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that conditions are slightly more favorable in west central Kansas, along the Highway 96 corridor. In contrast to last year, there has been sufficient fall moisture to allow winter wheat to emerge. Very noticeable are the poorer conditions in the east central and southeast parts of the state. Much lower rainfall this year has begun to show an effect. Differences aren’t as noticeable in far southwest Kansas, as there has been little change in the overall poor condition in the area.
Map 3. Compared to the 22-year average at this time for Kansas, this year’s Vegetation Condition Report for October 11 – 24 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that there was a quick response to the available moisture in central and west central Kansas. There was also some continuing photosynthetic activity in extreme southeast Kansas, where early October rainfall was heaviest.
Map 4. The Vegetation Condition Report for the Corn Belt for October 11 – 24 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the highest of photosynthetic activity was confined to the southern and eastern edges of the region. A large area of reduced photosynthetic activity can be seen from southern Minnesota to Central Indiana. This corresponds to an area of moderate to severe drought that has emerged in the region.
Map 5. The comparison to last year in the Corn Belt for the period October 11 – 24 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that South Dakota, Eastern Kansas and Northern Missouri have the biggest reduction in photosynthetic activity. Indiana, Ohio, and Northern Kentucky show the greatest increase in photosynthetic activity. The area saw 2 to 4 inches of rain. In Kentucky, topsoil moisture is 78 percent adequate and only 8 percent surplus.
Map 6. Compared to the 22-year average at this time for the Corn Belt, this year’s Vegetation Condition Report for October 11 – 24 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that most of the region has average to slightly above-average photosynthetic activity. Areas of southwest Kansas and northern Missouri show below-average photosynthetic activity. This corresponds to areas of increasing drought in northern Missouri and persistent drought in southwest Kansas.
Map 7. The Vegetation Condition Report for the U.S. for October 11 – 24 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the southeastern areas of the country continue to have the greatest level of photosynthetic activity, along with the Pacific Northwest.
Map 8. The U.S. comparison to last year at this time for the period October 11 – 24 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that Texas and parts of Montana have the biggest decrease in the level of photosynthetic activity. The drought situation in Texas shows little sign of improvement, despite some significant rains in the central region of the state.
Map 9. The U.S. comparison to the 22-year average for the period October 11 – 24 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows much of the area has normal or above-normal levels of photosynthetic activity. Areas of continued reduction in photosynthetic activity are most notable from Texas to southwestern Kansas and in northern Missouri.

Note to readers: The maps above represent a subset of the maps available from the EASAL group. If you’d like digital copies of the entire map series please contact us at kpprice@ksu.edu and we can place you on our email list to receive the entire dataset each week as they are produced. The maps are normally first available on Wednesday of each week, unless there is a delay in the posting of the data by EROS Data Center where we obtain the raw data used to make the maps. These maps are provided for free as a service of the Department of Agronomy and K-State Research and Extension.

-- Mary Knapp, State Climatologist
mknapp@ksu.edu

-- Kevin Price, Agronomy and Geography, Remote Sensing, Natural Resources, GIS
kpprice@ksu.edu

-- Nan An, Graduate Research Assistant, Ecology & Agriculture Spatial Analysis Laboratory (EASAL)
nanan@ksu.edu

These e-Updates are a regular weekly item from K-State Extension Agronomy and Steve Watson, Agronomy e-Update Editor. All of the Research and Extension faculty in Agronomy will be involved as sources from time to time.
If you have any questions or suggestions for topics you’d like to have us address in this weekly update, contact Steve Watson, 785-532-7105 swatson@ksu.edu, or Jim Shroyer, Research and Extension Crop Production Specialist and State Extension Agronomy Leader 785-532-0397 jshroyer@ksu.edu.