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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 Curtis Thompson, Extension Agronomy State Leader and Weed Management Specialist 785-532-3444 cthompso@ksu.edu.

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1. Some basic points on using anhydrous ammonia for wheat production

As producers start thinking about anhydrous application for wheat this fall, there are a few basic points which they should keep in mind, especially regarding safety. Ammonia is a hazardous material and safety should be the highest priority of the operator.

Safety practices

- Always have your personal safety equipment available and use it. The word "anhydrous" means without water. Ammonia reacts rapidly with the water in tissue if it comes into contact with skin, eyes, and mucous membranes. It is extremely important that when working with ammonia farmers and fertilizer plant employees use all the appropriate personal safety equipment. As a minimum this includes wearing tight-fitting chemical goggles to protect your eyes, chemical-resistant gloves, and a long sleeve shirt or jacket. People working with ammonia should also carry a plastic eyewash bottle of water with them at all times, in addition to having access to safety water tanks on both the ammonia tank and the tractor/applicator.
- Check over the equipment carefully before starting work. Make sure all hoses are in good shape, and valves and break-away disconnects are in good operating condition.

Application methods and ammonia retention

When using ammonia as an N source, there are a number of reactions which come into play that will affect ammonia retention in soils, N response and efficiency. These include chemical reactions, physical factors related to soil conditions, and how deeply the ammonia is applied. One important question many years in Kansas concerns dry soils. Will a dry soil be able to hold anhydrous ammonia or will some or most of the ammonia be lost shortly after application?

- Chemical reactions of ammonia in soil. Ammonia (NH_3) needs to react with water shortly after application in order to convert into ammonium (NH_4^+), which is the molecule that can adhere to clay and organic matter in the soil. Ammonia is very soluble in water. After it is placed in the soil, NH_3 reacts with water in the soil to form ammonium-N (NH_4^+), which is retained on the soil cation exchange sites. This process takes a little time – it does not occur immediately upon contact with the soil. The main controlling factors in the conversion of NH_3 to ammonium-N are soil temperature, soil moisture, and soil pH. The higher the soil temperature and the wetter the soil, the more rapid the conversion occurs. If the ammonia does not react with water, it will remain as a gas that could escape from the soil. Also, a chemical equilibrium between NH_3 and NH_4^+ occurs and is affected by soil pH. More NH_3 will remain unconverted in the soil longer at higher application rates and at higher soil pH levels.
- Physical factors that influence sealing and ammonia loss. Dry soils may be cloddy, with large air spaces where the soil has cracked. Getting the soil sealed properly above the injection slot can be a problem in dry soils. This can allow the gas to physically escape into the air before it has a chance to be converted into ammonium. On the other hand wet soils tend to smear, leaving application channels open to the surface and providing a pathway for ammonia loss also. It is very important to make sure at the time of application that the slot created by the shank is sealed shut and that there is adequate soil moisture present for the NH_3 to be retained in the soil. If the soil is too dry to retain NH_3, or is not sealed well, gaseous NH_3 can escape into the atmosphere and be lost for crop use.
- Importance of application depth. The deeper the ammonia is applied, the more likely it is that

the ammonia will have moisture to react with, and the easier the sealing. Anhydrous ammonia can be applied to dry soils, as long as the ammonia is applied deep enough to get it in some moisture and the soil is well sealed above the injection slot. If the soil is either dry and cloddy, or too wet, there may be considerable losses of ammonia within just a few days of application if the soil is not well sealed above the injection slot and/or the injection point is too shallow. A recent study near Topeka found little or no direct ammonia loss in the week after application when ammonia was applied at 5- or 9-inch depths under good soil conditions. However, under wet conditions, losses as high as 15% of the applied N were seen with shallow application.

Application rate and shank spacing will also have a strong influence on sealing and potential loss. Lower N rates and application with narrow spacings reduces the concentration of N at any one delivery point and reduces the risk of loss.

The human nose is a very good ammonia detector. Producers should be able to tell if anhydrous is escaping from the soil during application or if the ammonia isn't being applied deeply enough. If ammonia can be smelled, the producer should either change the equipment setup to get better sealing or deeper injection, or wait until the soil has better moisture conditions.

Shank spacing

What about shank spacing for wheat? A number of studies have been done looking at the spacing of anhydrous application on wheat yields. The results have been somewhat erratic, but in general, yields tend to be reduced at shank spacings wider than 20 inches. The differences seem to be greater at higher yield levels, on sandy soils, and at lower N rates.

Recent studies in Kansas showed a 5% yield difference between 15- and 30-inch spacings over 5 experiments. One general observation is that a wavy appearance will be common in fields fertilized with ammonia, with plants near or directly over an ammonia band being taller, and those between bands shorter. At low N rates, this will likely lead to a small yield reduction. But at rates more than 100 pounds of N, yields will likely not be impacted, especially on silt loam or heavier soils.

Summary

In short, ammonia is an excellent N source for wheat, but producers need to consider some basic issues to be able to apply it safely and to gain good efficiency.

- Make sure the application equipment is in good condition, that water tanks on the nurse tanks and the applicator/tractor are full of clean water, and that they use their personal safety equipment and have a personal eye wash bottle with them at all times.
- Apply anhydrous ammonia at the proper depth to ensure good sealing.
- Where possible use a narrow shank spacing, less than 20 inches.
- Use covering disks behind the knives or sealing wings ("beaver tails") on the knives of conventional applicators.
- Apply anhydrous ammonia at least 1 to 2 weeks before planting. This waiting period should be even longer if soils are dry.

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While weather conditions have seemingly been favorable, Soybean Sudden Death Syndrome (SDS) has not yet developed in Kansas soybean fields to the levels it did in 2014 when conditions were also extremely favorable.

SDS is a disease caused by the soilborne fungus *Fusarium virguliforme*. This fungus prefers wet conditions and thus is usually most severe in irrigated fields or dryland fields that receive significant amounts of rain during the early- to mid-reproductive stages. SDS tends to be most severe on well-managed soybeans with a high yield potential. It also tends to be more prevalent in fields that are:

- Infested with soybean cyst nematode
- Planted early when soils are cool and wet
- Compacted

While SDS symptoms are now visible in both university and private industry research plots, there has been little of the disease symptoms visible in commercial fields. That doesn't necessarily mean that it isn't there, it may be that it hasn't progressed far enough to be readily visible from a distance.

Historical yield losses from this disease are generally in the range of 1 to 25 percent. In 2014, however, yields in affected areas of fields reached an estimated 50%.

Disease symptoms

Symptoms of SDS are easily recognizable. SDS begins as small, bright, pale green to yellow circular spots on the leaves during late vegetative or early reproductive growth stages. As the disease progresses, the tissue in these spots starts to die and enlarges to form brown streaks between the veins. Symptoms are more pronounced on top leaves.

Figure 1. Scattered yellow spots on some of the greener leaves in the lower right in this photo are the early leaf symptoms of SDS. The leaves in the center foreground have more advanced symptoms of SDS. Photo by Stu Duncan, K-State Research and Extension.

Figure 2. A soybean field in Franklin County with SDS. Photo by Eric Adee, K-State Research and Extension.

Flowers and pods may abort or not fill. Another key symptom of SDS is substantial amounts of root decay and discoloration of roots and crown.

Figure 3. Root rot occurs on plants infected with the SDS pathogen. This symptom distinguishes SDS from brown stem rot and stem canker. Left image by Jim Shroyer, K-State Research and Extension; right image courtesy of Iowa State University.

Diseased plants are easily pulled out of the ground because the taproots and lateral roots have deteriorated. **Symptoms present on both the leaves and roots are diagnostic for SDS.** Positive diagnosis of the inner tap root is key to disease identification because other problems such as triazole fungicide "burn," and the diseases stem canker and brown rot, can give similar foliar symptoms.

Potential yield losses and management considerations

Soybean yield losses from SDS depend on both the variety and stage of crop development when the symptoms first appear. Appearance of the disorder at early pod fill is more damaging than its appearance at a later stage of plant development. Yield reduction is the result of reduced photosynthetic area, defoliation, flower and pod abortion, and reduced seed size.

Effective management of SDS requires an integrated approach. Management starts with the planting of SDS resistant varieties. At K-State, we have been evaluating soybean varieties for SDS resistance in our performance test for the past several years. Most varieties are susceptible to some degree, and very few have excellent resistance. The most susceptible varieties yield 40 to 50 percent less than the resistant varieties at locations where SDS is present and yield levels are in the range of 60+ bushels per acre.

Figure 4. The variety on the right in a recent K-State performance test was susceptible to SDS. The foliage was completely dead by early pod fill. Photo by Bill Schapaugh, K-State Research and Extension.

Seed companies also have SDS ratings for most of their varieties and there is typically a wide variation in ratings. There is little or no correlation between the maturity group of a variety and its SDS resistance rating.

The presence of SDS is strongly correlated with the presence of soybean cyst nematode (SCN). Therefore, where SDS is present, soil samples should be taken to determine the level of SCN present and it will need to be managed along with the SDS. Producers cannot manage SDS simply by selecting varieties that have SCN resistance, however. Some varieties with good resistance to SCN are highly susceptible to SDS and some varieties that are susceptible to SCN are quite resistant to SDS. Ideally, producers should select varieties that are resistant to both SDS and multiple races of SCN.

In addition to resistant varieties, a second line of defense is the use of the planting time seed treatment ILeVO, which contains the active ingredient fluopyram. This product has performed well in several K-State research trials. Other seed treatments that may provide control are currently being evaluated.

Cultural management practices that can reduce the risk of SDS infection include planting SDS infested fields last when soil temperatures are warmer, avoiding planting into overly wet soils, and reducing compaction problems within a field. Producers who have fields with compaction problems should make every effort to correct that problem before planting soybeans next season.

Crop rotation also seems to have some positive effect on SDS, but only if the field is not planted to soybeans for four years or more.

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3. New disease of corn in Kansas and the U. S.

On August 26th, the USDA-Animal and Plant Health Inspection Service (APHIS) announced the presence of a new disease in the U.S. corn crop, with the common name bacterial leaf streak disease of corn. A bacteria scientifically known as *Xanthomonas vasicola* pv. *vasculorum* (Xvv) is the cause of the disease. APHIS does not consider this plant disease to be of quarantine significance and will treat it as other bacterial diseases of corn such as Goss's bacterial blight.

Where did it come from and how did it get here?

There are reports that this disease has occurred on corn in South Africa, but it has been most notably associated with gumming disease of sugarcane. It is not currently known how it made its way to the U.S. nor how long it has been here. The disease was first observed in samples submitted to the University of Nebraska-Lincoln Plant and Pest Diagnostic Clinic in 2014. Lack of historical information and the appropriate diagnostic methods delayed its identification until APHIS positively identified the bacteria from a sample collected in Nebraska in August 2016.

Where is it currently found?

Following its initial confirmation, APHIS, working with state departments of agriculture and Extension plant pathologists, initiated a survey of corn fields across the Western Corn Belt. The disease has currently been identified in nine states including Kansas, Nebraska, Colorado, Iowa, Illinois, Minnesota, South Dakota, Texas, and Oklahoma. In Kansas, it has been positively identified in 12 counties, most of which are located in the High Plains. Three additional counties have had corn with symptoms of the disease, but samples have not yet been confirmed definitively by DNA analysis.

What does it look like?

The disease consists of narrow tan to brown streaks on the leaf that can range from less than an inch in length to several inches long (Figure 1). To the untrained eye, the disease can look very similar to the common fungal foliar disease, gray leaf spot.One diagnostic key is that bacterial leaf steak has narrow, wavy-edged lesions compared to gray leaf spot, which has very sharp, straight-edged lesions that follow the veins in the leaf (Figure 2). Sometimes the lesions occur close to the midrib; in other cases, they occur across the leaf blade. A second diagnostic key is that when backlit, light passes through bacterial streak lesions in a translucent manner compared to gray leaf spot, which blocks the light and appears opaque. (Figure 3). Disease symptoms have been observed as early as growth stage V7 with lesions appearing on lower leaves first. Lesions can expand over time to cover larger areas and under favorable conditions, they spread to the upper leaves. In extreme cases, lesions may extend the entire length of the leaf and coalesce to form large, necrotic areas.

Figure 1. Bacterial leaf streak disease in corn. Photo by Tamra Jackson-Ziems, University of Nebraska-Lincoln.

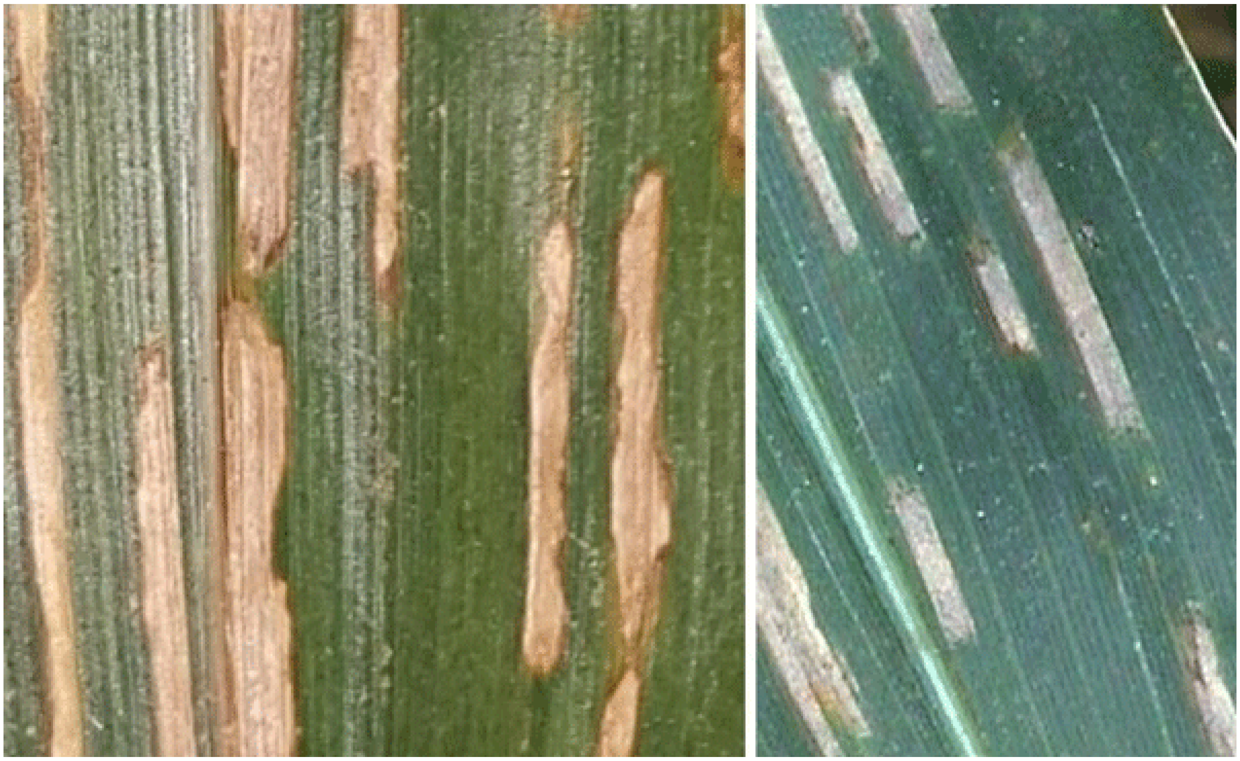

Figure 2. Bacterial streak with wavy-edged lesions (left) and gray leaf spot with straight-edged lesions (right). Photo credit: (left) Tamra Jackson-Ziems, University of Nebraska-Lincoln.

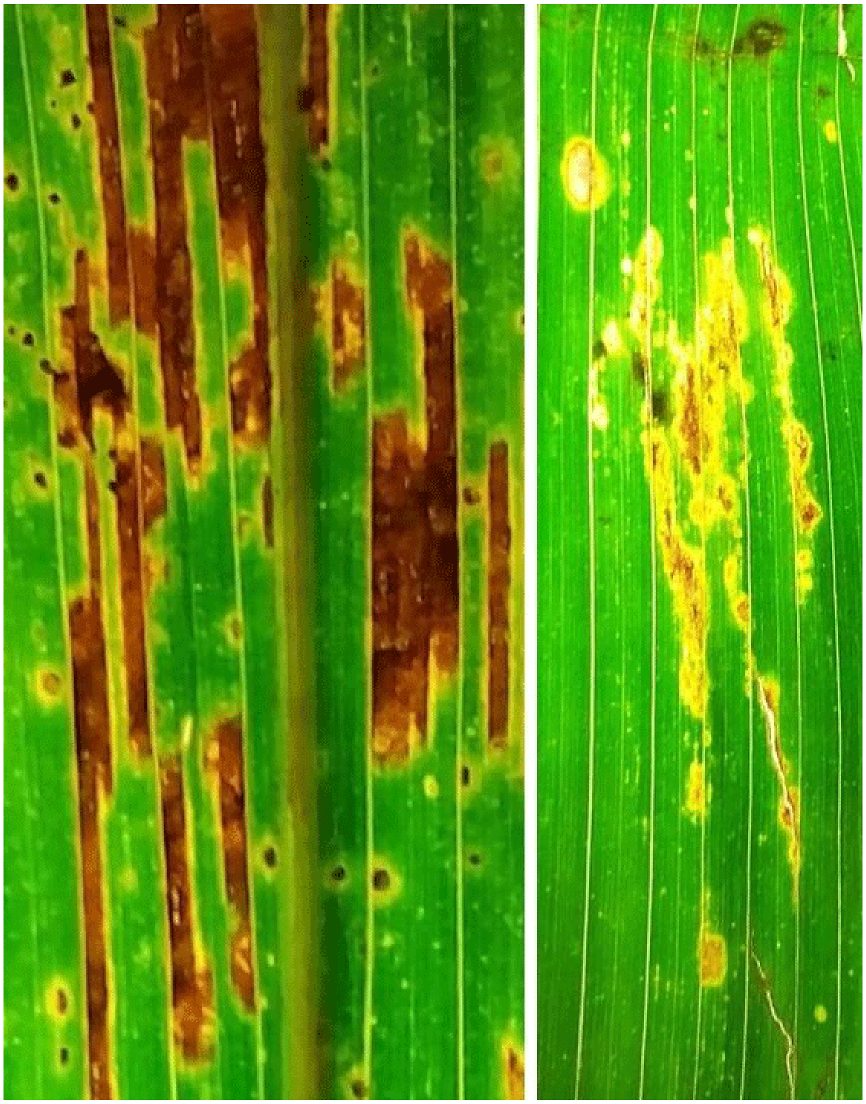

Figure 3. Gray leaf spot lesions are opaque when backlit (left) compared to bacterial streak lesions which are translucent (right).

How does it spread?

It is not currently known how the disease has spread to so many states, but a current hypothesis is that it is seed transmitted. Movement within a field or from field to field may be by the bacteria blowing in the aerosols created by big, blowing thunderstorms. Unlike Goss's blight, it does not appear that this bacterium needs a wound to aid it in getting into the plant.

Under what conditions is it likely to occur?

By far the single largest scenario associated with the disease is a continuous, no-till, sprinkler irrigated corn production system. This is likely the reason that most counties in Kansas where the disease has been confirmed are in the western part of the state. However, the disease has also been found in furrow irrigated fields, as well as dryland fields in a strict corn-soybean rotation.

Will there be a yield loss and how do I manage the disease?

No research has been conducted to date to determine if there will be any impact on yield. Disease management options are currently limited. Since this is a bacterial disease, fungicides are not effective. Because of the highly erodible nature of most Kansas soils, residue management will not likely be an option except perhaps in southeast Kansas. We do not know how long the bacteria can reside in old crop debris, but observationally, it can survive through the rotational year to soybeans. Observations in hybrid demonstration trials in Nebraska indicate that there are differences in hybrid response to the disease, with some hybrids being much more susceptible than others. Long term, hybrid selection, as with Goss's blight, will be the primary means of management.

What do I do if I think I have the disease in one of my fields?

As with any crop disease, samples can be submitted to the KSU Plant Disease Diagnostic clinic through any county Extension office, or directly to the clinic. Information on sample submission can be found at tinyurl.com/hm9eale.

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4. Late-season purpling in corn

Issues with purple coloration of corn plants sometimes occur about mid-August or later. It is perhaps more common for purple coloration in corn to occur early in the season, often a result of a phosphorus deficiency or cold temperature stress.

When purple coloration occurs later in the season on the leaf, stem, husk, silk, or anther tissues, this can be related to the production and accumulation of a pigment called anthocyanin. Anthocyanin is derived from another pigment, "anthocyanidin," that is comprised of a sugar-like molecule. The accumulation of anthocyanin occurs when the plant is not capable of translocating sugars to different plant organs.

Source (leaves):Sink (grains) Imbalance Issue

The late-season purple coloration phenomenon takes place when photosynthetically active tissues of the plants are acting as sources of sugars, while the sinks (ears – when present) are not utilizing sugars as fast as the sugars are being produced. When this happens, the flow of sugars within the plants is disrupted and the sugars can accumulate in various areas of the plants, causing an unusual purple coloration. This could be a result of several different factors:

- *Environment-by-genetic interaction*: There may be a specific hybrid response to environmental conditions, such as cool nights followed by sunny days, causing a buildup of sugars. The presence or absence of the genes associated with the production of anthocyanin is specific to certain hybrids.

- *Restricted root development*: Restrictions in root growth, which may be due to several different factors -- such as drought stress, saturated soils, soil compaction, cool temperatures, herbicide injury, insect feeding, or shallow planting -- may cause a reduced demand for sugars, thus increasing purple coloration. This situation is more likely to occur early in the vegetative stages.

- *Poor ear development or barren plants*: Ear development may be impaired by any number of factors (biotic and abiotic stresses), causing a disruption in the demand for sugars from photosynthesis. Barren plants, when ears are not present, tend to show this purpling in leaves and stem organs. This can occur at almost any reproductive stage of the crop season.

Regardless of the specific factor that causes anthocyanin accumulation, the production of the purple coloration is associated with some kind of restriction in the utilization of carbohydrates produced during photosynthesis.

Purple coloration can occur on the stems or leaves (Figure 1). Purple coloration can also be seen in the reproductive structures such as husk, silk, and anther tissues (Figure 2).

With corn now nearing physiological maturity (black layer), the crop is advancing into the grain-fill period and reaching the end of its life cycle. As this process continues, water and nitrogen uptake by the roots will be decreasing until the end of the season. The root system has a very high demand for sugars at its peak of activity. As it decreases in physiological activity, sugars may accumulate in the lower sections of the stem (Figures 3 and 4).

Purple coloration problems have also been observed in situations with multiple ears, without indication of problems in ear size or grain set, and in plants located near field borders with sufficient soil-air resources. This indicates that the plant has an imbalance between sugar accumulation and allocation (Figure 4).

Figure 1. Purple color on stem and leaves of corn plants during the vegetative period (five-leaf stage), due to buildup of anthocyanin. Photo by Ignacio Ciampitti, K-State Research and Extension.

Figure 2. Purple color on leaves of corn plants during the reproductive period. Photo by Ignacio Ciampitti, K-State Research and Extension.

Figure 3. Darker purple color on the lower stem section of corn plants, due to buildup of anthocyanin. Photo by Doug Shoup, K-State Research and Extension.

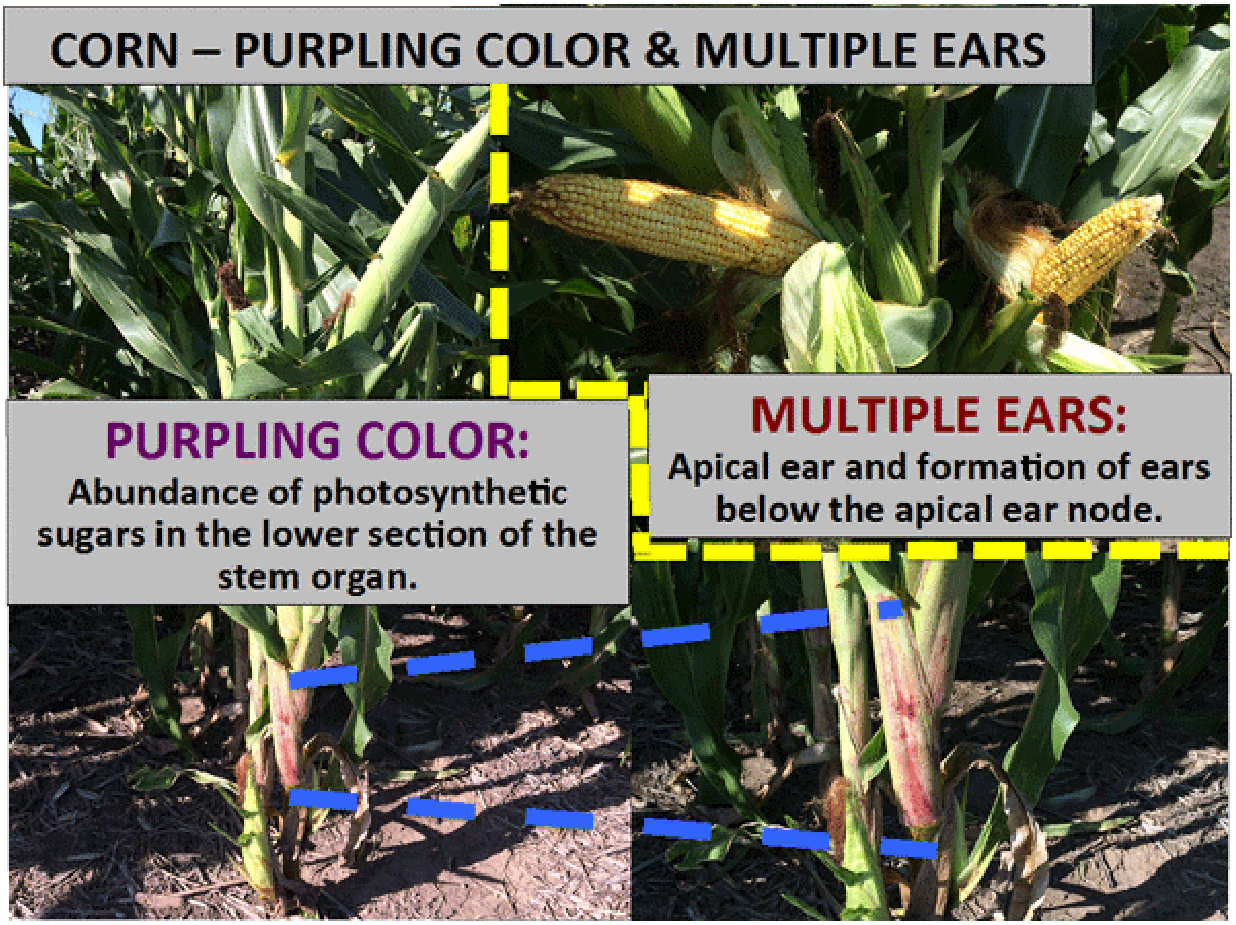

Figure 4. Purple color on the lower section of the stem on plants around milk stage (R3, reproductive stage) with the presence of multiple ears. Photo by Ignacio Ciampitti, K-State Research and Extension.

In summary, purpling is an indication of a surplus of photosynthetic sugars, generally promoted by imbalance between source:sink (e.g., poor kernel set). Either way, purple coloration is often a warning sign, and fields should be scouted for these signs.

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The estimation of crop yields before harvest can be erratic, but producers often like to know about the potential yield of their crops. In previous K-State Agronomy eUpdates we discussed the calculation of the potential yield for soybean and corn. These articles are:

- Estimating soybean yields. http://bit.ly/SoybeanEstY (August 19, 2016 - eUpdate 585)

- Estimating corn yields. http://bit.ly/CornEstY (August 5, 2016 - eUpdate 583)

This article will discuss how to get simple but fairly good estimates of sorghum yield potential. As with soybeans, sorghum can also compensate for abiotic or biotic stresses. Sorghum compensates through changes in head sizes (grain number and weight) and number of tillers.

Before going into the procedure to estimate sorghum yields, we need to understand the main plant components of sorghum yield. The main yield-driving forces are:

- Number of plants
- Number of tillers per plant
- Total number of seeds per head
- Seeds per pound

The number of plants and the number of tillers per plant are two of the main components, which are determined well before the end of the crop growing season. Those two yield components are influenced by the initial plant density, planting date, and the environment, among other factors.

Those who want to get right to the formula can skip to the next paragraph, but it will help to know how sorghum yield components develop. Increasing the number of plants per acre potentially increases competition for resources, which can diminish the plant's capacity to produce tillers. In addition, the interaction of planting date with plant density can have a similar effect. As planting date is delayed, the capacity of the plant to produce tillers will be reduced; thus, plant population needs to be increased to compensate for the reduction in the number of tillers. Previous research at K-State showed sorghum produces more tillers when planted early (mid-to-late May) at lower plant populations as compared with late planting dates (mid-to-late June). The environment also plays an important role in the final number of heads per unit area. Heat and drought stress will reduce the plant's ability to produce more tillers, and also could severely reduce the tiller survival rate. The total number of seeds per head will be determined within the one- or two-week period before flowering until milk to soft dough stages (approximately two to three weeks after flowering). Kernel size will be determined close to the end of the season. In the 15 to 25 days after flowering, during the soft dough stage, sorghum grains have already accumulated about 50% of the final dry mass. Thus, the period around flowering is critical for defining not only the final number of grains per head but also the potential maximum kernel size. Final seed weight will be determined when the grains reach physiological maturity (visualized as a "black-layer" near the seed base). From this time until harvest the grains will dry down from approximately 35% to 20% moisture content.

The interaction among all four components will determine the actual yield, but a wide range of variation can be expected in all these main yield driving forces (Figure 1).

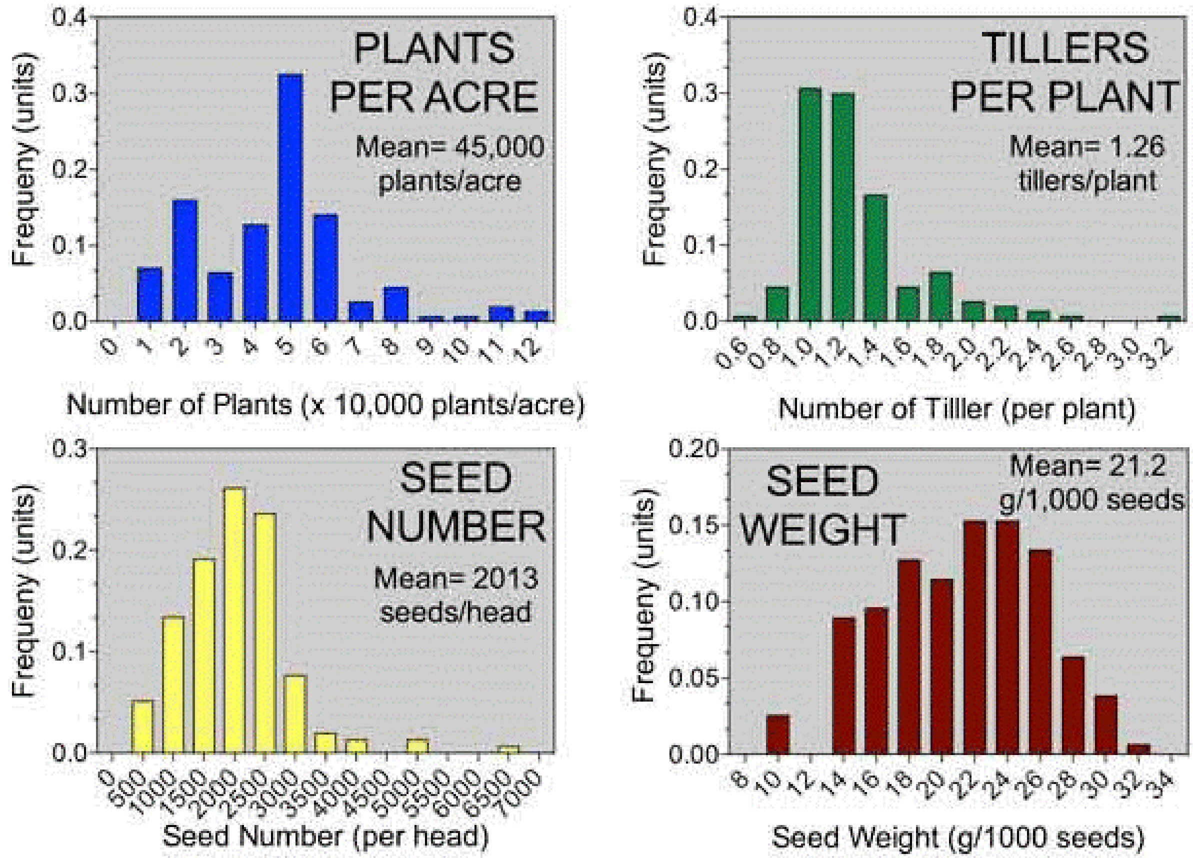


Figure 1. Example of the variation expected to be found in the main sorghum yield components. The number of tillers per plant can also be interpreted as the number of heads per plant, considering that all tillers have one fertile head.

When can I start making sorghum yield estimates?

As the sorghum crop gets closer to full maturity, yield estimates will be more accurate because the kernel weight will be closer to being set. Nonetheless, we can start taking yield estimations three to four weeks after flowering (from soft to hard dough stages). At these stages, the final seed number can still change. In addition to the seed number, the seed weight will be only partially determined -- approximately 50 to 75% of dry mass accumulation as compared to the final weight.

Variability within the field

Variability between plants needs to be properly accounted for when estimating sorghum yields using the on-farm approach (see next section). Another important factor is the variation between different areas in the field. In general, it is recommended to perform yield estimations in at least 5 to 10 sections of the field to account for field variability.

On-farm approach for estimating sorghum yields

The estimation of sorghum yields should consider the main driving forces:

Total number of heads per unit area [number of plants per acre x heads per plant] (1)

Total number of seeds per head (2)

Number of seeds per pound (3)

Pounds per bushel, or test weight, which for sorghum is 56 lbs/bushel (4)

The final equation for estimating sorghum yields:

[(1) x (2) / (3)] / (4) = Sorghum yield in bushels/acre

The following steps should be taken for making sorghum yield estimates:

Step 1 -Number of Heads per Unit Area:

For this on-farm approach, start by counting the number of heads from a 17.4 foot length of row when the sorghum is in 30-inch rows. This sample area represents 1/1000th area of an acre. If the sorghum is in 15-inch rows, then the number of heads in 2 rows should be counted. For a 7.5-inch spacing, 4 rows will be measured. In each of these scenarios, the area counted will be equal to 1/1000th of an acre.

Head counts should be taken in several different areas of the field to properly account for the potential yield variability. If the proportion of smaller heads, less than 3 inches in height, is very low (less than 5%), these heads could be avoided due to the smaller proportion they will represent when determining the final yield.

Step 2 –Estimation of the Number of Seeds per Head:

The seed number is, by far, one of the most complicated yield components that need to be estimated. The total number of seeds per head can vary from 100 to 5,000 seeds per head (Figure 1), but almost ¾ of the seed number distribution is around 1,500 to 2,500 seeds per head. A previous report on sorghum yield estimation (Vogel, 1970), suggested as an alternative to estimate the number of nodes, and branches within nodes, for each sample of sorghum heads, and then to count the number of grains in a subsample of nodes and branches.

This approach is still very tedious. A simpler method of estimating the number grains per head would be very helpful.

Figure 2. To estimate the total number of heads per acre, count the number of heads in a sample area 17.4 feet in length, for 30-inch row spacings. Photo by Ignacio Ciampitti, K-State Research and Extension.

Figure 3. There is no easy shortcut yet for counting the number of seeds per head. Photo by Ignacio Ciampitti, K-State Research and Extension.

Another quick method uses an estimate of seed counts per head based on determinations of general yield environment conditions. From previously published information from K-State (provided by K-State professors Richard Vanderlip, emeritus, and Kraig Roozeboom), we can utilize a very simple association between the yield level, conditions around pollination/grain set time, and the number of grains per heads (Figure 4). In their work, Vanderlip and Roozeboom counted the average number of seeds per head and average seed weight for different yield environments, after harvest.

We can use this relationship to give us a general idea of the kind of seed count per head we can expect based on the general yield environment, using primarily the environmental conditions during the period of first week before flowering to two to three weeks after flowering, when pollination and grain set are being determined. We can then use that estimated seed count per head, and multiply it by the number of heads per acre. The number of seeds per pounds, or seed weight, is also a factor we need to estimate, but the work by Vanderlip and Roozeboom found that to be much less of a factor in yield than seed count per head.

If conditions were very poor during pollination and grain set, around the first week before and two to three weeks after flowering, and the general yield environment is low then the total number of seeds per head will average around 500-1,000 seeds per head (900; Table 1). On the opposite extreme, if the conditions around flowering were very favorable for good pollination and grain set development, and the general yield environment is very high, then the number of seeds per head could be around 1,500 to 3,500 (2,500; Table 1). Intermediate yield environment scenarios can occur if a portion of the three-to-four week period around flowering was favorable and part of it was unfavorable. In that case, the number of seeds per head could be between 1,000-3,500, with an overall average of around 1,745 seeds per head.

This information is provided only for general guidance on estimating sorghum yield potential using the on-farm approach. Different responses between yield and its components might be expected for the complexity of diverse genotypes, crop production practices, and environments.

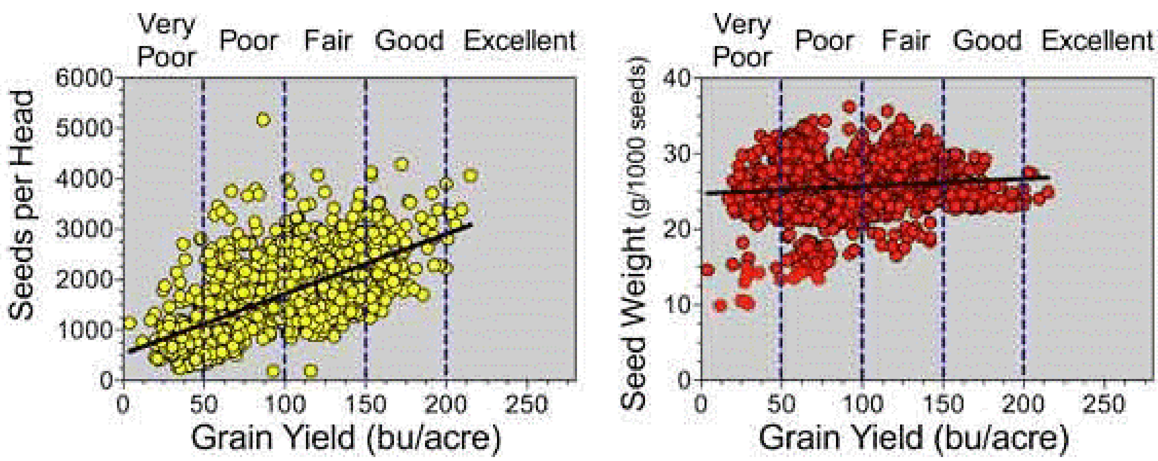


Figure 4. Relationship between grain yield and yield components, seeds per head (yellow points, left panel) and seed weight (red data points, right panel). The number of seeds per head has the most direct relationship with yield.

Table 1. Total number of seeds per head and seed weight components.

Yield Range (bu/acre)	Crop Condition	Average Seeds per Head	Average Seed Weight (g/1,000)	Number of Observations
<50	Very Poor	**900**	**24.5**	**154**
50-100	Poor	**1,500**	**25.5**	**391**
100-150	Fair	**2,000**	**26.2**	**495**
150-200	Good	**2,500**	**25.6**	**129**
>200	Excellent	**3,330**	**25.5**	**5**

Step 3 –Estimation of the Seed Weight:

A similar procedure can be followed to estimate the seed weight (Table 1). For the seed weight component, the variation documented in the dataset showed a very narrow seed weight variation as compared with the variability found in the seed number component. In general, it seems that lower seed weight is expected at low yield ranges, but the difference among yield levels is negligible. Table 2 shows the conversion from average seed weight to seeds per pound, and from seeds per pound to the seed size factor employed in the examples below for sorghum yield estimation.

Table 2. Seed weight, seeds per pound.

Yield Range (bu/acre)	Crop Condition	Average Seed Weight (g/1,000)	Seeds Per Pound
<50	Very Poor	**24.5**	**18,520**
50-100	Poor	**25.5**	**17,793**
100-150	Fair	**26.2**	**17,318**
150-200	Good	**25.6**	**17,723**
>200	Excellent	**25.5**	**17,793**

Step 4- Examples of "On-Farm" Yield Estimation Approach:

[(Heads x Seeds per Head)*1,000 ÷ Seeds per Pound] ÷ Pounds per bushel

Examples:

A. Good Crop Condition:

Irrigated sorghum with adequate plant density (48,000 plants/acre), average number of tillers per plant of 1.3, and good yield environment with adequate flowering and grain filling periods:

(48 plants in 17.4 foot -1/1000th of an acre- x 1.3 fertile tillers per plant) = 62 heads

Yield Estimation = [(62 * 2,500)*1,000 ÷ 17,723] ÷ 56 = **156 bu/acre**

B. Poor to Fair Crop Condition:

Dryland sorghum with adequate plant density (40,000 plants/acre), average number of tillers per plant of 1.3, and poor flowering but fair grain filling period:

Yield Estimation = [(52 * 1,500)*1,000 ÷ 17,723] ÷ 56 = **79 bu/acre**

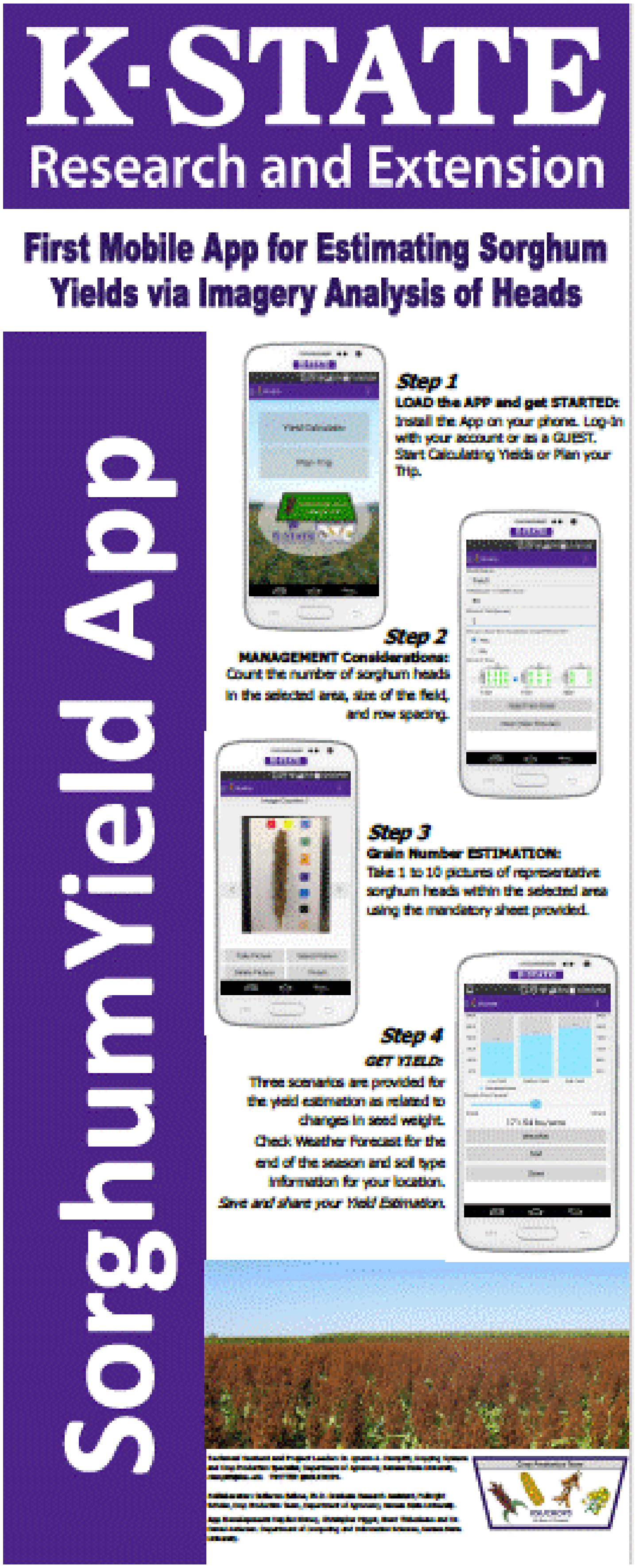
C. Very Poor Crop Condition:

Dryland sorghum with adequate plant density (40,000 plants/acre), average number of tillers per plant of 1.0, and poor yield environment and growing season (poor flowering and grain filling period):

Yield Estimation = [(40 * 900)*1,000 ÷ 18,520] ÷ 56 = **35 bu/acre**

An app for predicting sorghum yields

An app is close to being released with the final goal of estimating sorghum yields before harvest. The next version iOS (Apple) is under the last stages of testing evaluation at the field-scale (on-farm calibration). More information about this project and the release of the app will be included in upcoming issues of the Agronomy e-Update. Stay tuned for more information!



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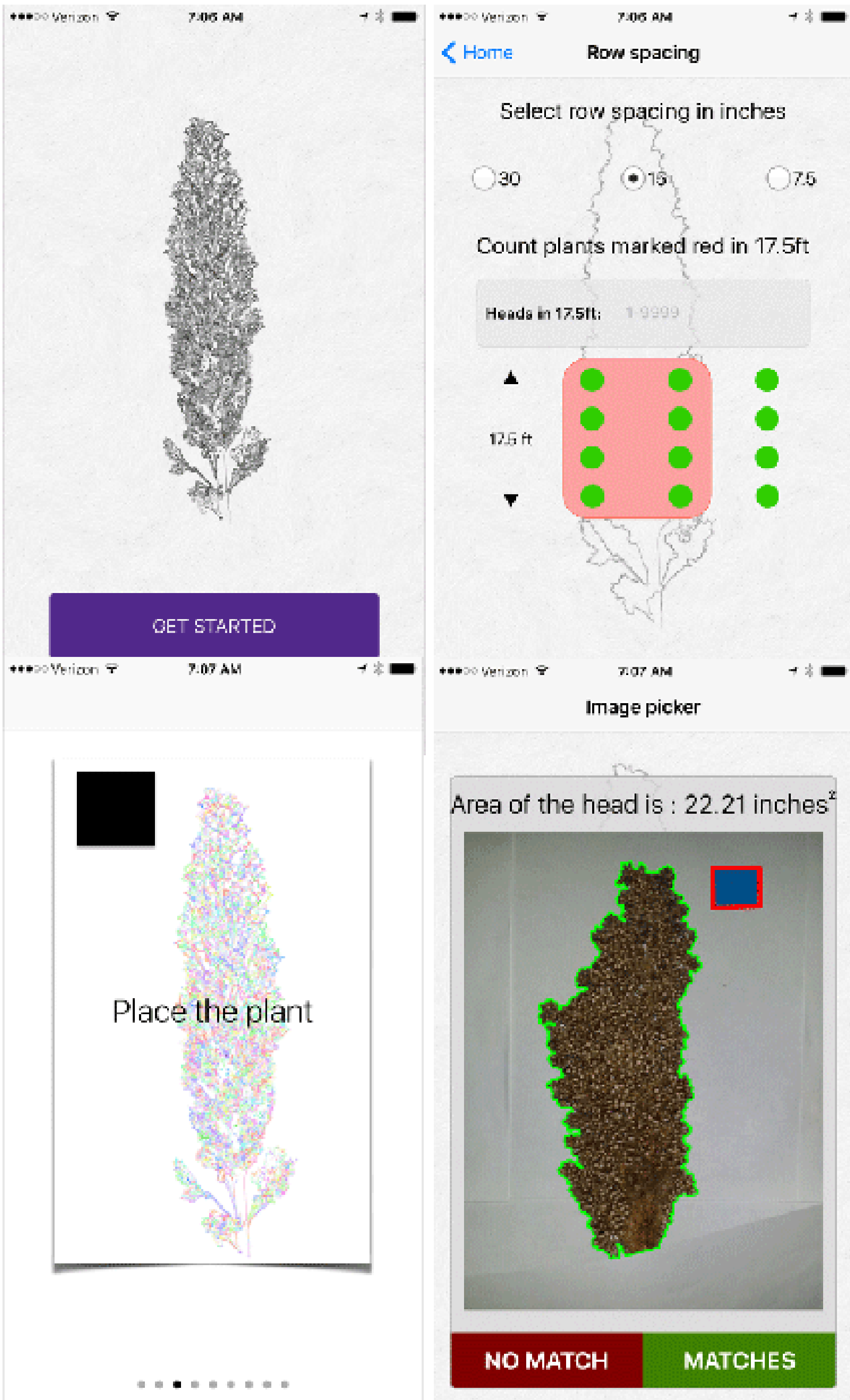
NEW Sorghum App



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Summary

Seed number is the main driving force of sorghum yield. On-farm estimations can be roughly based on environmental conditions during the week before and the two- to three-week period after flowering, which is the critical period of pollination and grain set. Actual seed counts per head would make the estimates much more accurate, but requires considerable time and effort. Future work will focus on getting more exact, rapid estimates of the number of seeds per head through the use of pragmatic and simple techniques, which will simplify the "on-farm approach" described in this article, and on the release of the new sorghum yield predictor app.

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6. Fungicide seed treatments for wheat

Fungicide seed treatments may help with wheat stand establishment in certain situations. For seed production fields, a systemic seed treatment is highly recommended to help keep seedborne pathogens such as bunt, flag smut and loose smut out of seed stocks. Due to the high value of the seed produced, even small yield increases can justify the use of seed treatments.

For grain production fields, seed treatment economics are less certain. Conditions favoring use of standard seed treatments in grain production fields include: 1) high yield potential field, 2) seed saved from field with loose smut, flag smut, common bunt, or Fusarium head blight last year, 3) expensive seed, 4) low planting rates, or 5) planting under poor germination conditions, especially very early or late planting

If planting that late or into heavy residue, it's probably a good idea to use a fungicide seed treatment, even on seed that has high test weight and good germination. Planting wheat late into cool wet soils often delays emergence, reduces tillering capacity and lowers yield potential of the crop. Seed treatment fungicides can help prevent stand losses and maintain yield potential.

There are many different seed treatments available for wheat. Although most seed treatment ingredients are fungicides, some will also contain imidacloprid or other insecticides. Each ingredient has certain strengths and weaknesses which may depend on the particular rates used. Many commercial formulations are complementary combinations of ingredients in order to provide a broader spectrum of protection.

The most important use of seed treatments is for the control of seed-borne diseases such as smuts and bunts. Loose smut control requires a systemic fungicide like tebuconazole or difenoconazole. Common bunt, sometimes called, "stinking smut", can be controlled, very effectively, with most commercial treatments. Some elevators around the district have reported affected wheat with common bunt in recent years. Flag smut was also fund at low levels in many areas of the state again this year. If you are planning to keep your seed from a location that has been confirmed with common bunt, or flag smut seed treatment is critical.

Most treatments do at least a fair job of controlling seed rots and seedling blights. Scab and black point are two seed-borne diseases that can reduce seed germination. If a seed lot has either of these, it should be cleaned to remove all light test weight seeds and then tested for germination rate. If the germination rate is low (less than 90%), a seed treatment could help increase the germination rate. Several products are available if wireworms are expected to be a problem in stand establishment.

Some seed treatments also offer limited control of fall-season foliar diseases. Tebuconazole and difenoconazole provide some protection against fall infections of powdery mildew, leaf rust, and Stagonospora nodorum leaf blotch. A seed treatment will not prevent the disease from becoming reestablished in the spring.

Triadimenol, tebuconazole, and imazalil can shorten the coleoptile, so avoid deep planting when using these treatments.

Producers must balance the possible benefits against the cost and the possibility of having leftover treated seed. Leftover treated seed can be avoided by using hopper box treatments. If seed is treated on-farm, pay close attention to thorough coverage of the seed.

For more information, see K-State publication MF2955, *Seed Treatment Fungicide Wheat Disease Management* at: http://www.ksre.ksu.edu/bookstore/pubs/MF2955.pdf

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7. New website offers soil health webinar resources

A team of K-State Research and Extension specialists has developed a website called "Soil Health BootCamp" as part of a vegetable production webinar development project. As part of that project, some excellent resources on soil health were produced that agricultural producers might find useful.

Below is a list of topics that can be accessed on the website under the "Webinars" link: Here's some info:

1. Soil Physical Properties (~16 min)
2. Soil as a Living Ecosystem (~21 min)
3. Cover Crops I – Functions of Cover Crops (~23 min)
4. Cover Crops II – Specific applications to Vegetables (~33 min)
5. Vegetable Production -Equipment, Fertigation, No-till (~33 min)
6. Diseases (~31 min)
7. Pollinators and Beneficials (~15 min)
8. Insect Pests (~7 min)

As part of this effort, a series of workshops to "train the trainers" is being held for Extension and other educators. Details and registration can be found at the "Soil Health BootCamp" web site. The next workshop is October 5 in Liberal. Workshops will be available in other locations in Kansas in 2017. There is no cost to attend, and lunch is provided.

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SOIL HEALTH BOOTCAMP

and applications to vegetable production

Professional Development for Agriculture and Natural Resource Educators

www.soilhealthbootcamp.com info@soilhealthbootcamp.com

SARE
Sustainable Agriculture Research & Education

Do you answer questions from landowners or producers about soil and/or vegetables? If you answered "yes" then this training might be for you.

The overall goal of this K-State led train-the-trainer project is to provide a comprehensive training program for extension agents and other educators about soil health with specific applications to vegetable cropping. The project is sponsored by North Central SARE.

Details are available at www.soilhealthbootcamp.com

The core of the program are hands-on workshops being offered in several locations around the state. We held workshops in Olathe and Courtland in May 2016.

The next workshop is October 5, 2016, in Liberal, KS. Other locations will be offered in 2017.

Lunch will be provided, and there is no cost to attend.

To minimize "classroom time" and maximize active hands-on learning and field visits, participants will be asked to view about eight 30-minute (max) webinars prior to the workshop which are available at the above website.

During the fall/winter after each series of workshops we will offer some additional online activities to push into more detail for those who are interested.

Got questions?
You can contact Megan Kennelly (kennelly@ksu.edu) or Kim Oxley (koxley@ksu.edu).

8. Dale Fjell, former Crop Production Specialist, retires

Dale Fjell

Dale Fjell, former State Extension Crop Production Specialist at K-State, retired on Sept. 1, 2016. At the time of his retirement, Fjell was the Northeast Area Extension Director.

Fjell, a native of Nebraska, first came to K-State in the fall of 1974 to go to graduate school in Biochemistry. He eventually decided to change directions a bit. Fjell accepted an offer from Gary Paulsen, professor of crop physiology, for a full-time research assistant position.

"The research grant we were working on was from NASA. They wanted to use satellite data to try to predict wheat yields in Russia. Our job was to take similar satellite data from the U.S. and certain countries we could work with and correlate it with actual wheat yields and weather records. In other words, we worked on ground-truthing the satellite data against what actually happened in several locations and over several years," Fjell recalled.

Fjell then went on to get his M.S. and Ph.D. degrees under Paulsen, earning his Ph.D. in 1982. During his time in graduate school, he also worked with Ted Walter, Crop Performance Testing Coordinator. This gave him lots of practical experience that proved important in his future Extension work.

"We put out plot after plot, all over the state, year after year. I'd give talks about the performance tests at field days, which was good training for Extension work," Fjell said.

“I’ll always be grateful to Dr. Paulsen for taking a chance on me, since I did not have any agronomy degrees at the time he hired me. And to Ted Walter for allowing me to get so much practical experience in putting out plots and giving field tours and talks,” he added.

After receiving his Ph.D., Fjell became K-State’s South Central Area Extension Agronomist, based in Hutchinson. He served in this role from 1982 until 1990. During this time, Fjell greatly increased the number of late-summer preplant wheat schools and the number of wheat tours in late spring.

At the time he started as South Central Area Agronomist, there was only one preplant wheat school in his Extension area. By the time he left, there were 17-18 preplant wheat schools and about 40 spring wheat tours.

“There were some other wheat production meetings being held in the area, but it seemed to me the most useful time to have in-depth wheat schools would be before planting, in August. So I made a big push to increase the number of wheat schools we did in that timeframe,” Fjell said.

In 1990, Fjell became one of two state Extension crop production specialists at K-State, based in Manhattan. There, he worked primarily with row crops such as corn, soybeans, and grain sorghum. He continued to put out hundreds of on-farm research plots all over the state. He also worked with other K-State Extension agronomists in transitioning producers in Kansas to different cropping systems, such as wheat-corn-fallow and wheat-sorghum-fallow. The concept of early-corn-early was also introduced in Kansas during his tenure.

In 2005, Fjell left the Department of Agronomy to become the Northeast Area Extension Director, where he remained until his retirement.

Throughout his career, Fjell has been known for his ready smile, good humor, and friendly attitude toward all he met – in addition to his practical knowledge of crops and agriculture.

During his time at K-State, Fjell said his favorite memories are of giving talks at meetings and field days, and interacting with farmers all over this state. But he won’t be giving this up.

Starting in September 2016, Fjell will become director of research and stewardship for the Kansas Corn Growers Association. He’s excited about this new role, since in many ways it will be going back to his roots.

“I will be finishing up my career back in agronomy, interacting with farmers directly again instead of indirectly as an administrator. I’m really looking forward to working again with farmers, evaluating research, and giving talks. There’s nothing I like better,” Fjell concluded.

Fjell and his wife Sheryl will continue to live in Manhattan. Anyone who would like to reach him can still send an email to his K-State email address: dfjell@ksu.edu

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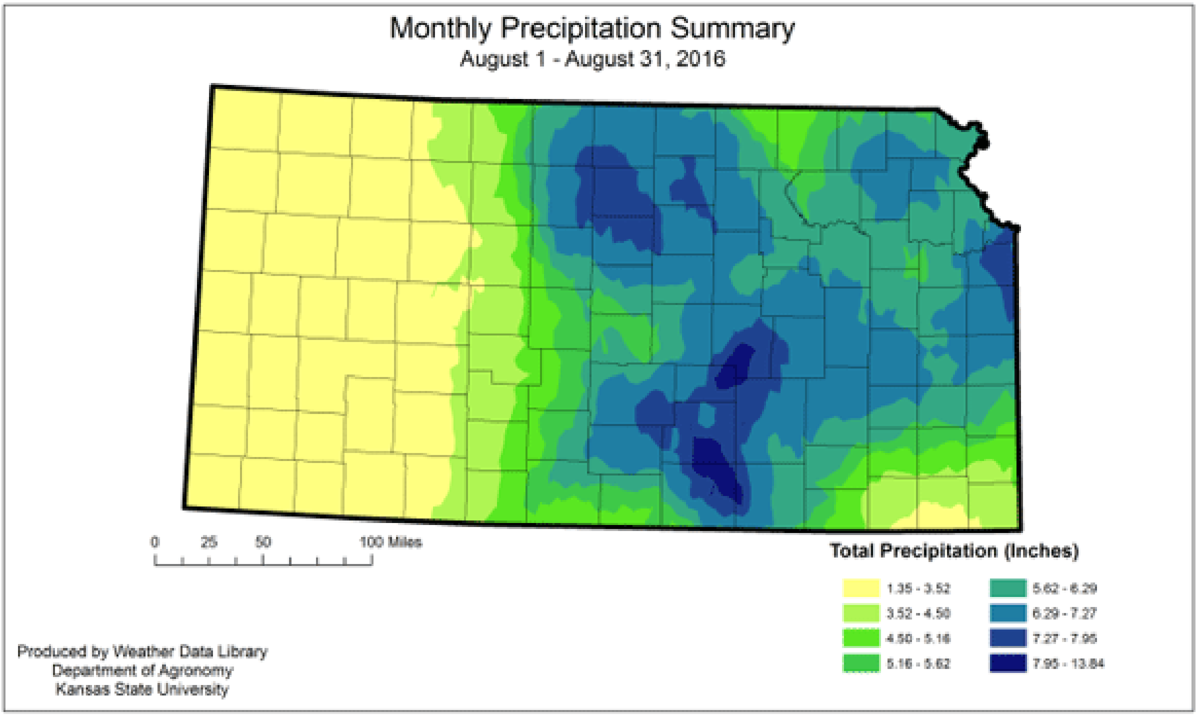
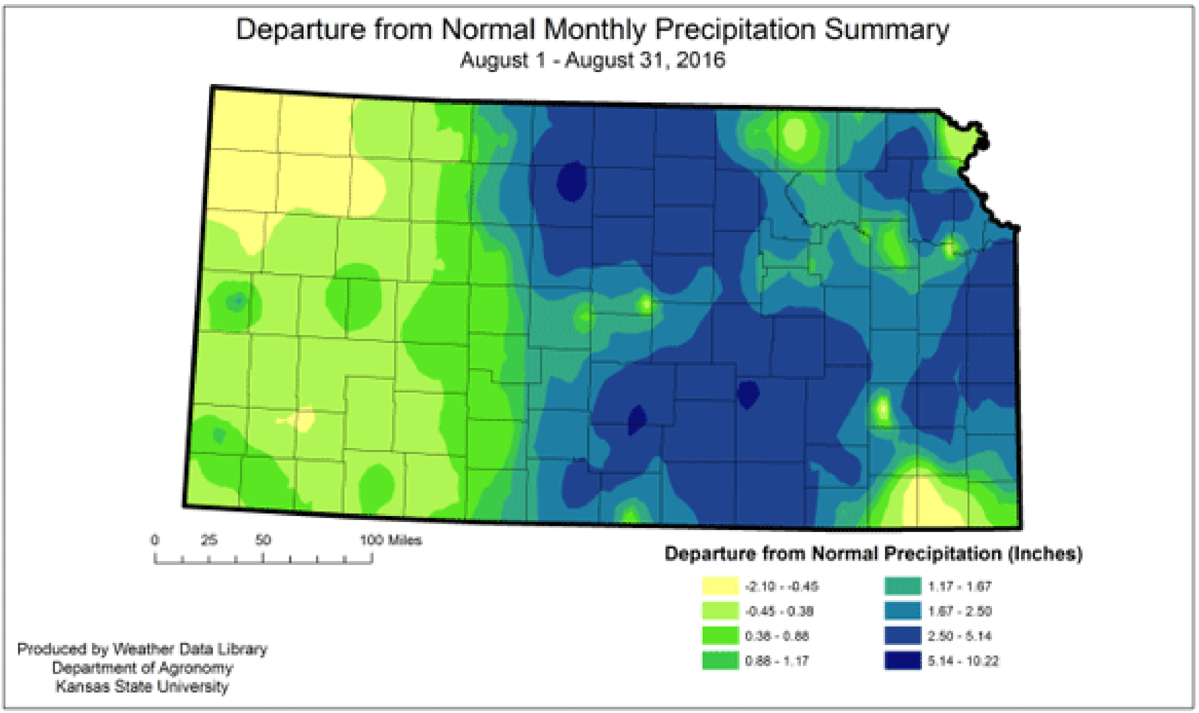
9. Wet August in Kansas

Total August precipitation for many of the Kansas stations is available now, and has shown some interesting patterns.

Overall the state was wet. Normal statewide August average precipitation is 3.28 inches. However, this year the statewide average is 4.71 inches, or 144 percent of normal. Naturally, some parts of the state didn't have as much beneficial rainfall, particularly in the Northwestern Division. However, there were three areas of the state that were extremely wet: the Scandia area in Republic County, Sedgwick County, and the Olathe area. Below are maps showing the August precipitation and departures from normal:





These heavy totals contributed to flooding problems in these areas. Flooding, however, is affected not only but the totals but by the intensity. Below are some of the highest rainfall rates, based on 5-minute data from the KSRE Mesonet stations:

KSRE Mesonet stations with the highest rainfall rates

Stations	**Max 5 minute (in)**	**Time of Max 5min**	**Date of Daily Max (in)**	**August total (in)**
Olathe	0.26	8/24/2016 20:15	2.04	5.67
Mitchell	0.30	8/19/2016 13:50	1.86	6.85
Scandia	0.38	8/19/2016 14:20	1.80	7.60
Haysville	0.43	8/6/2016 5:45	6.41	12.11
Butler	0.47	8/30/2016 17:45	1.49	5.24

Looking at it slightly differently, you can see those highest intensity rates didn't all match with the stations with the highest rainfall totals:

KSRE Mesonet stations with highest totals

Stations	August Totals
Olathe	5.67
Hutchinson 10SW	7.85
Clay	8.18
Haysville	12.11
Osborne	12.62

Amazingly, there were 18 stations among the rainfall monitoring networks in Kansas with more than 10 inches total for the month:

KSRE Mesonet/NWS COOP/ CoCoRaHS stations with greater than 10" of precipitation in August

Stations	August Totals
PECK 2 S	13.84
Osborne	12.62
Haysville	12.11
HAYSVILLE 3SE	11.93
POTWIN	11.81

MULVANE 4.3 WSW	11.77
OLATHE JOHNSON CO AP	11.70
BARNARD 7.5 ENE	11.52
OVERLAND PARK S 87TH	11.03
HILLSBORO 5.3 S	10.83
HUNTER 7.6 WSW	10.81
BELOIT 9.9 SSW	10.74
PRETTY PRAIRIE 1 N	10.57
PRETTY PRAIRIE 3.1 ENE	10.55
IONIA	10.49
DERBY 2.9 N	10.29
BURNS 1S	10.23
CHENEY 0.5 NNE	10.21

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Christopher Redmond, Weather Data Library
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10. Comparative Vegetation Condition Report: August 23 - 29

The weekly Vegetation Condition Report maps below can be a valuable tool for making crop selection and marketing decisions.

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 27-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 Vegetation Condition Report (VCR) maps were originally developed by Dr. Kevin Price, K-State professor emeritus of agronomy and geography. His pioneering work in this area is gratefully acknowledged.

The maps have recently been revised, using newer technology and enhanced sources of data. Dr. Nan An, Imaging Scientist, collaborated with Dr. Antonio Ray Asebedo, assistant professor and lab director of the Precision Agriculture Lab in the Department of Agronomy at Kansas State University, on the new VCR development. Multiple improvements have been made, such as new image processing algorithms with new remotely sensed data from EROS Data Center.

These improvements increase sensitivity for capturing more variability in plant biomass and photosynthetic capacity. However, the same format as the previous versions of the VCR maps was retained, thus allowing the transition to be as seamless as possible for the end user. For this spring, it was decided not to incorporate the snow cover data, which had been used in past years. However, this feature will be added back at a later date. In addition, production of the Corn Belt maps has been stopped, as the continental U.S. maps will provide the same data for these areas. Dr. Asebedo and Dr. An will continue development and improvement of the VCRs and other advanced maps.

The maps in this issue of the newsletter show the current state of photosynthetic activity in Kansas, and the continental U.S., with comments from Mary Knapp, assistant state climatologist:

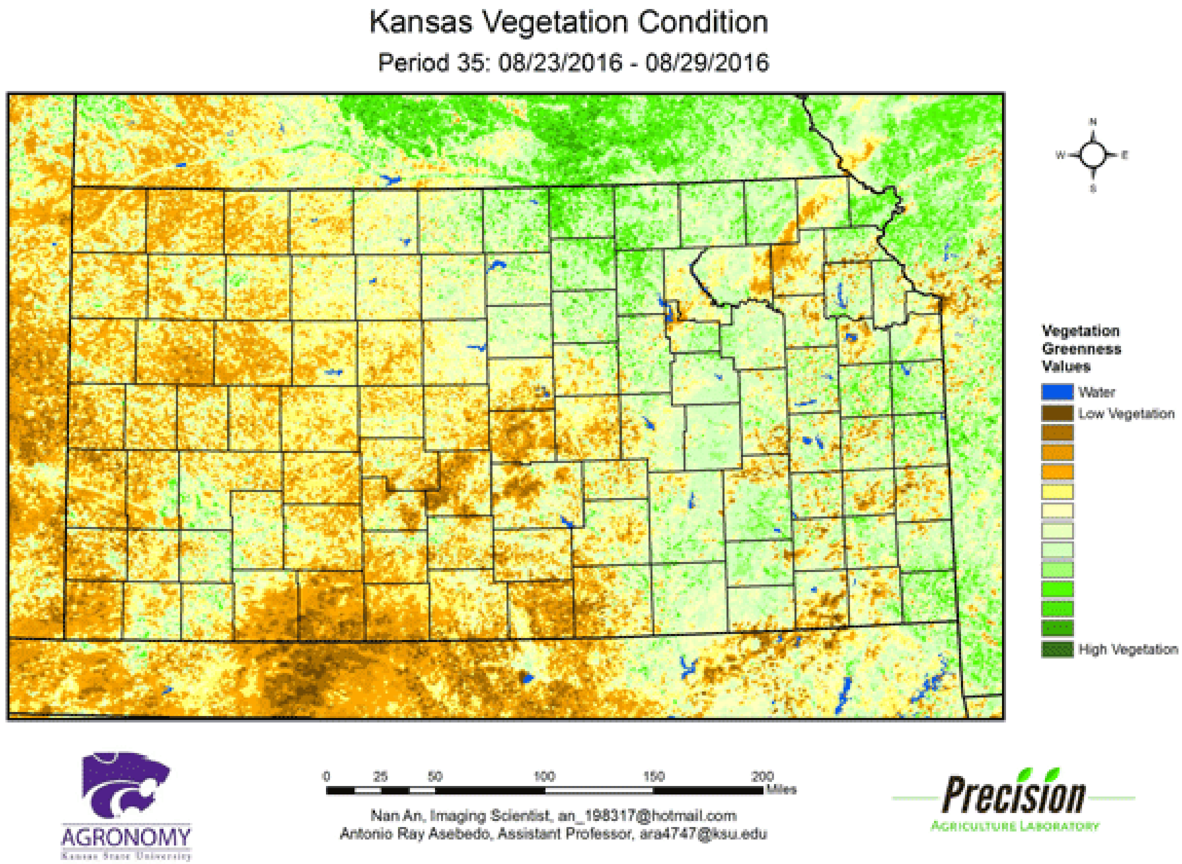

Figure 1. The Vegetation Condition Report for Kansas for August 23– August 29, 2016 from K-State's Precision Agriculture Laboratory shows fewer areas of high NDVI values. Such areas are mainly across the eastern third of the state. Low NDVI values are most visible in parts of central Kansas. While moderate drought continues in northwest Kansas, heavy rains and saturated soils have dominated the central parts of the state.

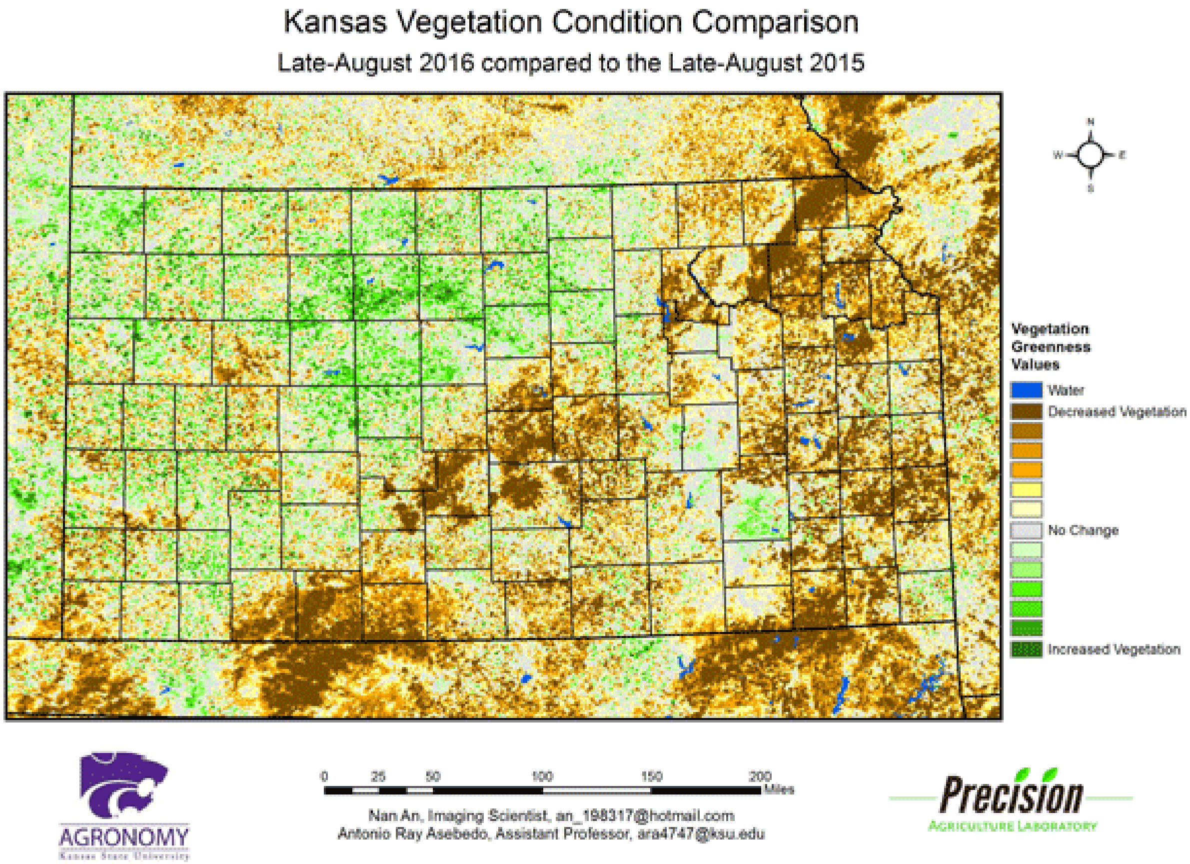

Figure 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for August 23 – August 29, 2016 from K-State's Precision Agriculture Laboratory shows lower NDVI values across the southeastern section of the state. This is due to persistent rain and cloud cover compared to last year at this time. Many locations reported rainfall in excess of 4 inches for the period. One station near Overland Park recorded 8.54 inches for the period compared to 1.45 inches in 2015.

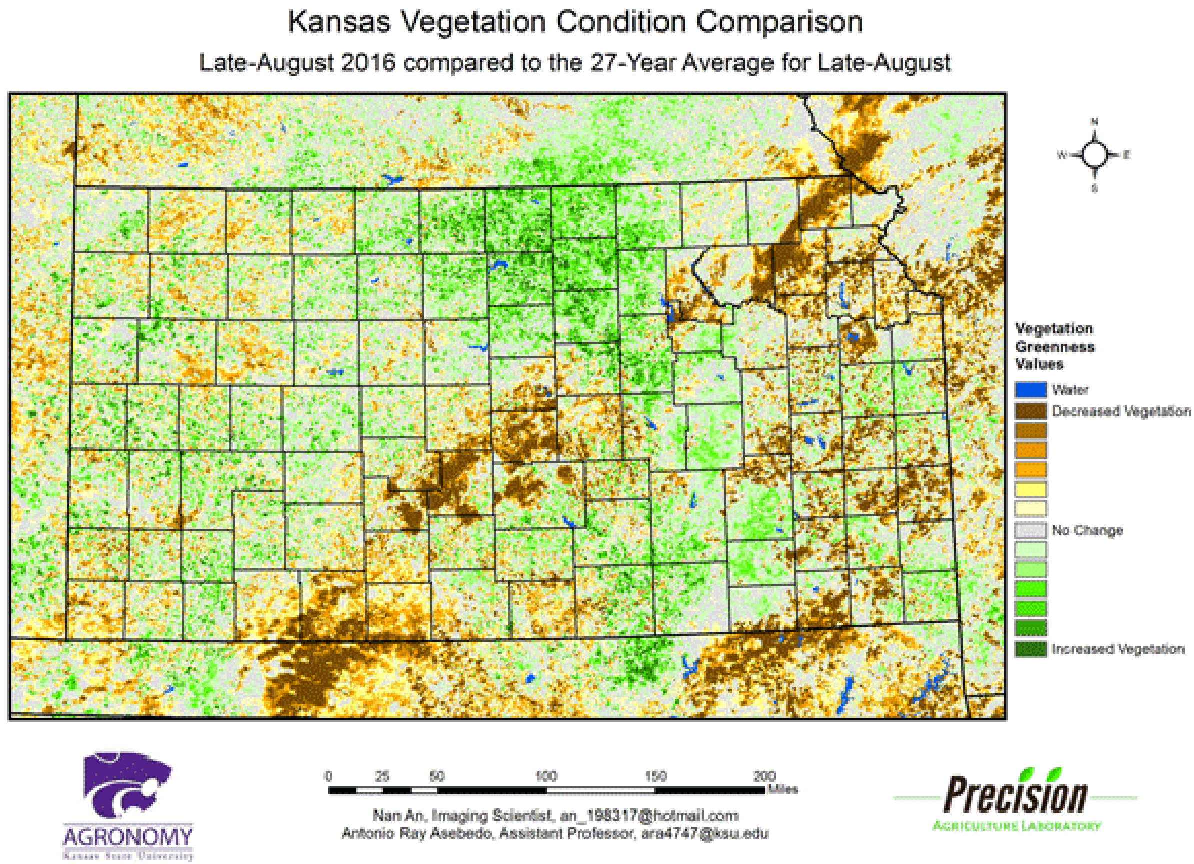

Figure 3. Compared to the 27-year average at this time for Kansas, this year's Vegetation Condition Report for August 23 – August 29, 2016 from K-State's Precision Agriculture Laboratory shows below-average vegetative activity in a band from southwest to northeast Kansas. That parallels the line of heavy rain and cloud cover that dominated the period. In contrast, the area of below-average vegetative activity in the Northwestern Division has been reduced, thanks to timely rains and favorable temperatures.

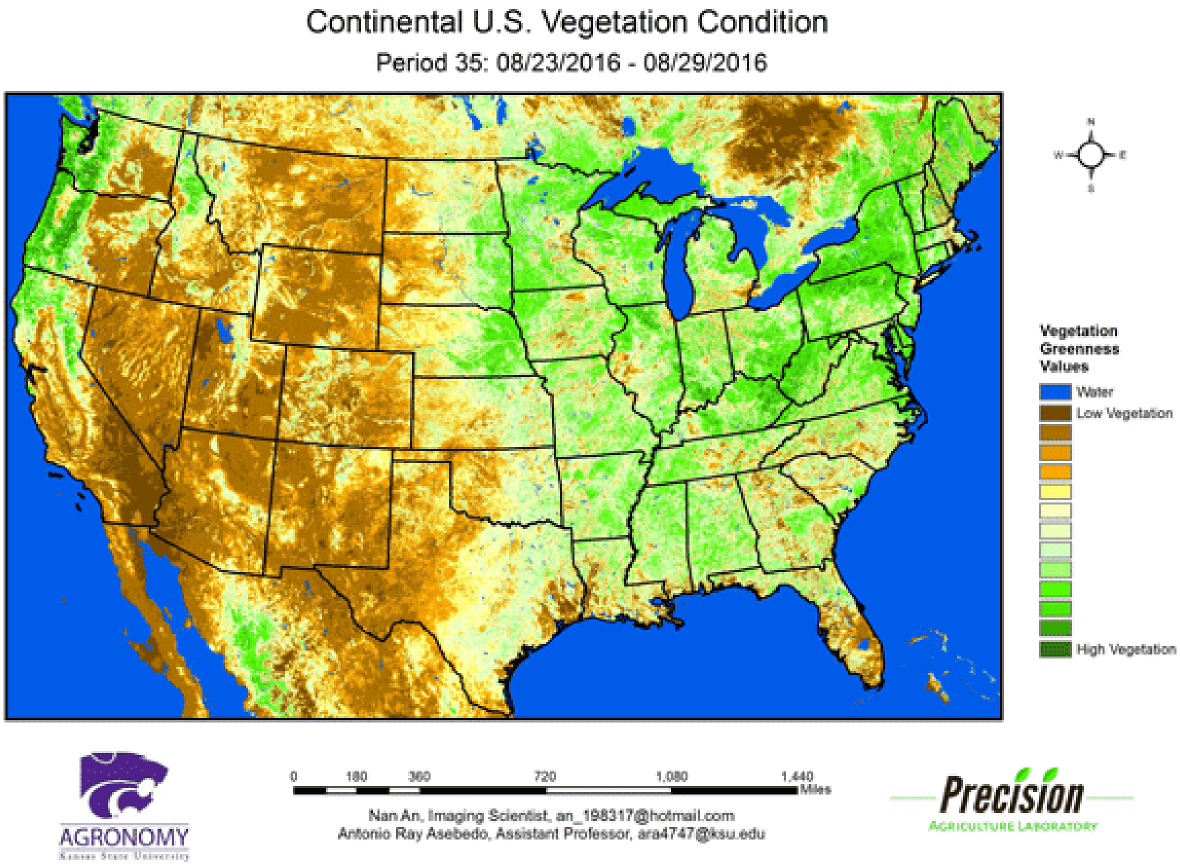

Figure 4. The Vegetation Condition Report for the U.S for August 23 – August 29, 2016 from K-State's Precision Agriculture Laboratory shows high NDVI values continue in the western Corn Belt, particularly Iowa and eastern Nebraska. Favorable rainfall and more seasonal temperatures continue to favor photosynthetic activity across this region. Low NDVI values due to excessive rains have developed in the southeast, particularly in the Carolinas and southern Florida. The low NDVI values continue in southern Louisiana and eastern Texas, as the region is still experiencing high waters/flooding from the recent rains.

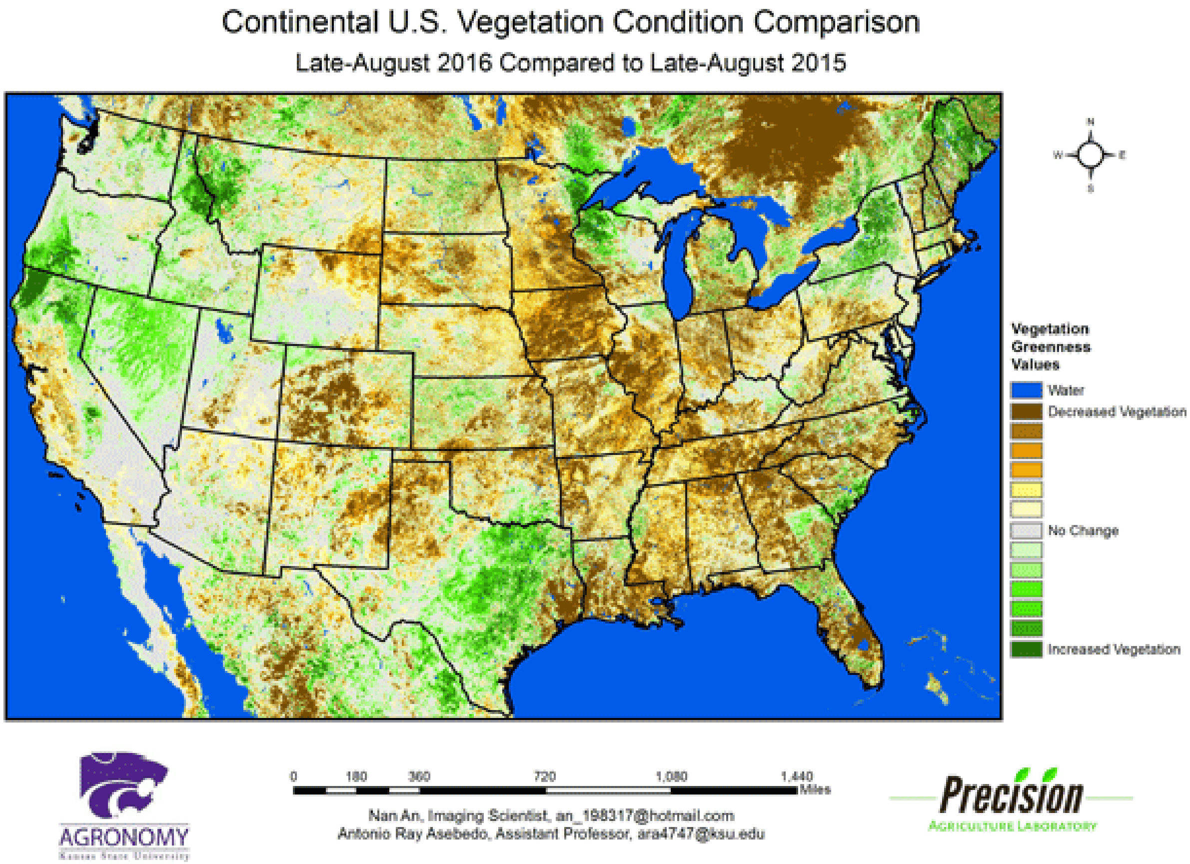

Figure 5. The U.S. comparison to last year at this time for August 23 – August 29, 2016 from K-State's Precision Agriculture Laboratory shows that lower NDVI values continue across much of the eastern U.S. west of the Rockies. Persistent rain continues to mask vegetative activity in the region. There are lower NDVI values in parts of the east due to persistent cloud cover. However, western New York and southern New England didn't have that masking effect from the clouds, and missed the beneficial rainfall. This area shows higher NDVI values even with worse drought conditions. In contrast the low NDVI values in eastern Wyoming, western Nebraska, and much of South Dakota are due entirely to the increasing drought in these areas. There is a small pocket of much higher vegetative activity in northern California, where favorable rains have reduced some of the long-term drought impacts.

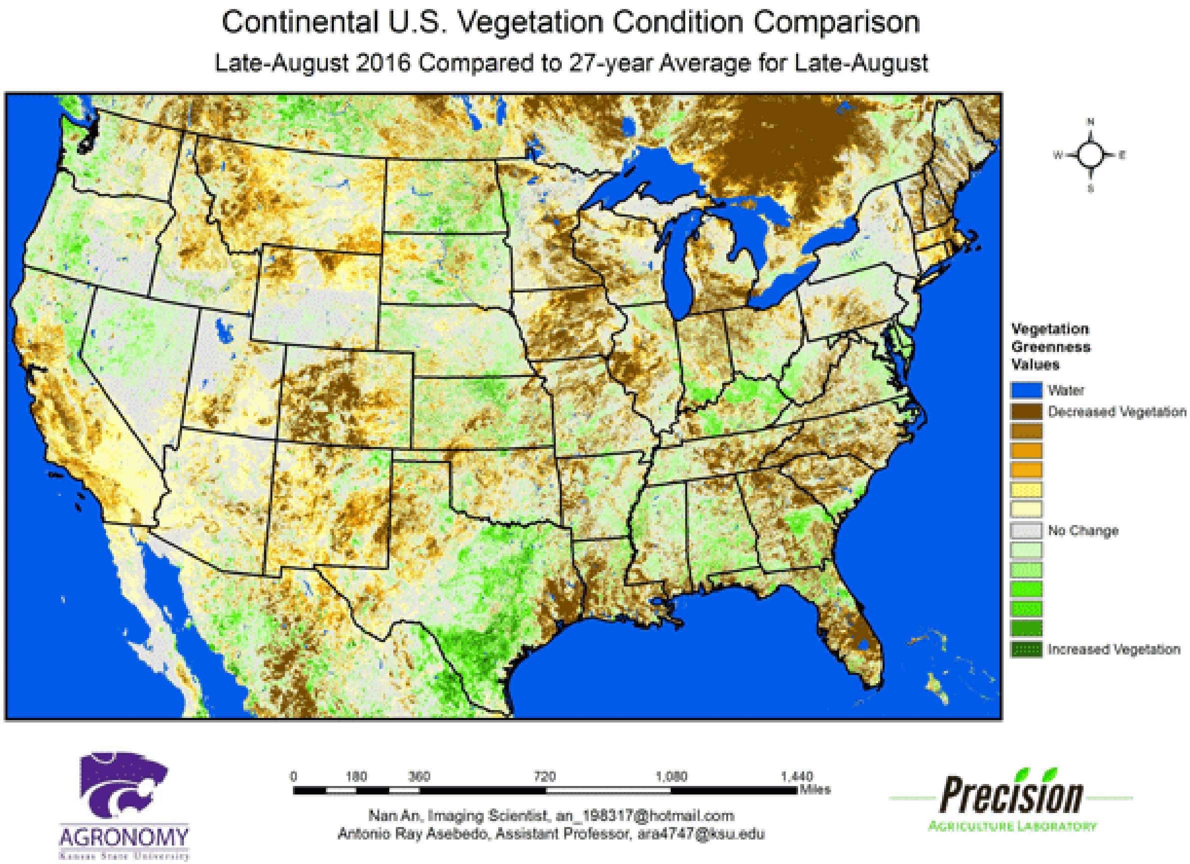

Figure 6. The U.S. comparison to the 27-year average for the period August 23 – August 29, 2016 from K-State's Precision Agriculture Laboratory shows areas of below-average photosynthetic activity in the Desert Southwest. Onset of the monsoon season has resulted in heavy rains and persistent clouds in the area. Similar patterns can be seen along the Gulf Coast and the mid-Atlantic. Flooding continues to be an issue in Louisiana. Below-average vegetative activity in New England and northern Georgia is due to moderate to severe drought in the region.

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