



## Extension Agronomy

# eUpdate

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*09/08/2017*

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](mailto:swatson@ksu.edu), or Curtis Thompson, Extension Agronomy State Leader and Weed Management Specialist 785-532-3444 [cthompso@ksu.edu](mailto:cthompso@ksu.edu).

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## 1. Early planting of wheat can lead to several problems

The general target date for planting wheat for optimum grain yields in Kansas is within a week of the best pest management planting date, or BPMP (formerly known as the “Hessian fly-free”) date (Figure 1). If forage production is the primary goal, wheat should be planted in early to mid-September as research has demonstrated that delaying planting date largely reduces forage yield; however, if grain yields are the primary goal, then waiting until the BPMP date to start planting is the best approach (Figure 2). In dual-purpose wheat systems where forage yields need to be maximized while reducing the effects of early planting on reduced grain yields, mid-September planting is ideal.

Optimum wheat planting dates in Kansas depend on location within the state. Suggested planting dates by zone are as follows:

**Zone 1:** September 10-30

**Zone 2:** September 15 – October 20

**Zone 3:** September 25 – October 20

**Zone 4:** October 5 - 25

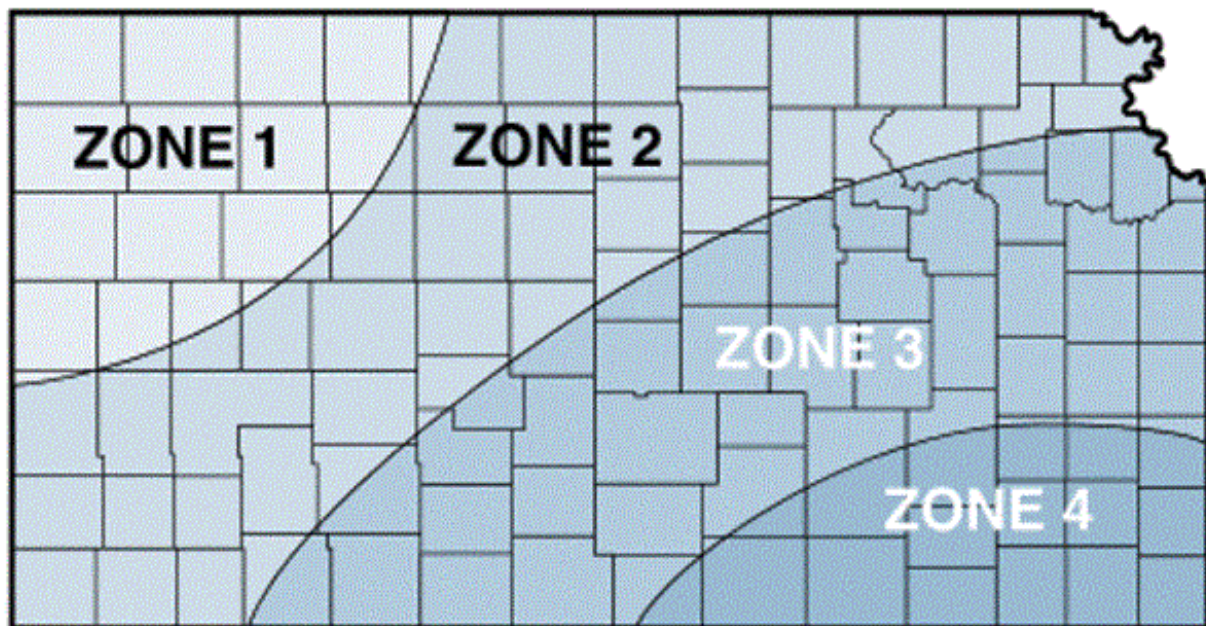
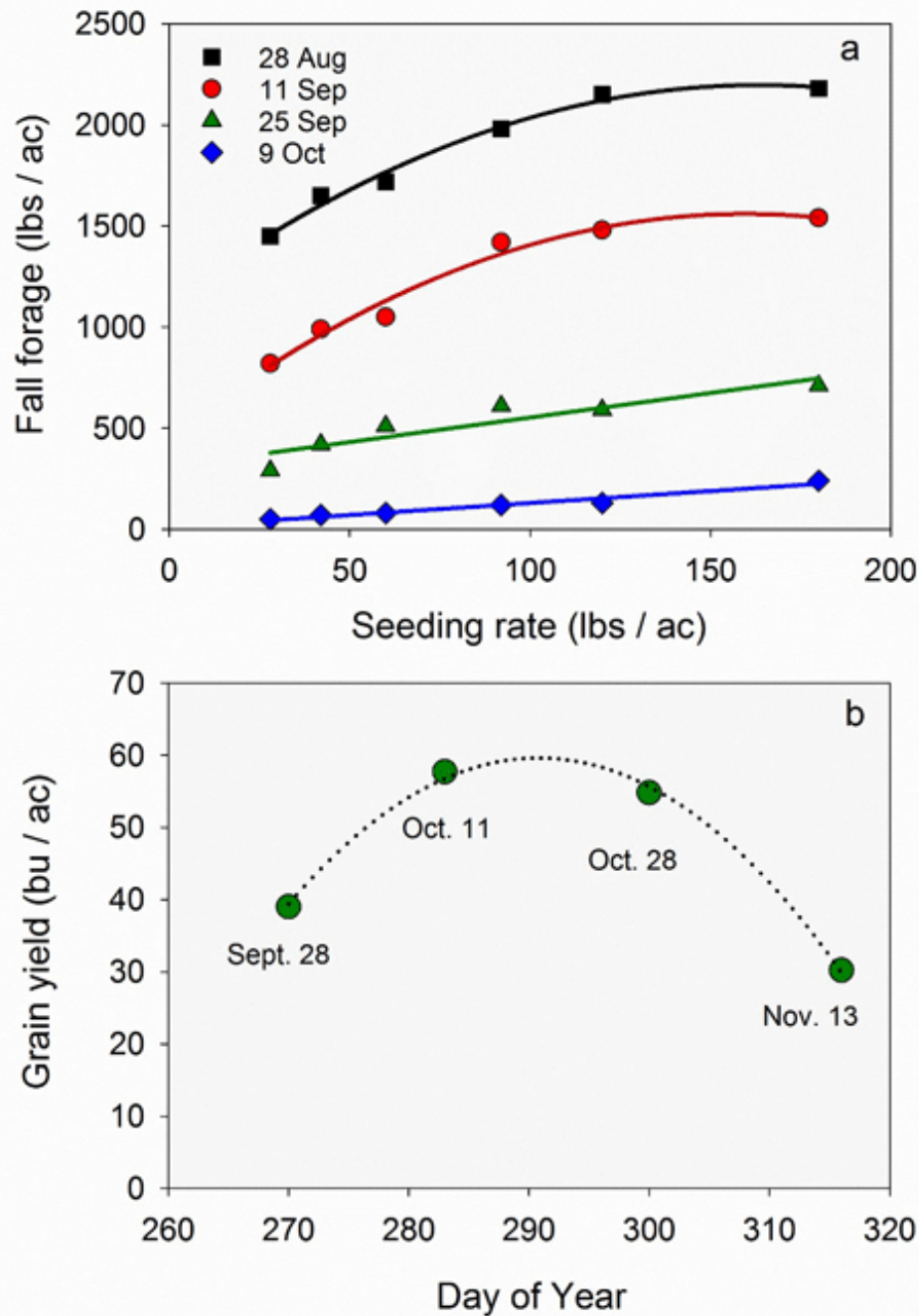


Figure 1. Optimum wheat planting dates by zone in Kansas.



**Figure 2. Effect of planting date and seeding rate on wheat fall forage yield in Lahoma, north-central Oklahoma (a) and effect of planting date on wheat grain yield near Hutchinson, south-central Kansas (b). Figure adapted from KSRE numbered publication MF3375.**

While the effects of planting date on wheat yield shown above will hold true for most years, they will largely depend on environmental conditions and disease pressure during the growing season. In some years, earlier-planted wheat does best and some years the later-planted wheat does best. For instance, early-planted fields during 2016-17 had a better final stand as compared to later-planted ones in western Kansas, mostly due to lack of moisture for later planted fields. If fields become too wet to plant by mid-October and stay that way through the remainder of the fall, then producers end up planting much later than the optimum planting date, and this is an incentive to start planting earlier than the fly-free date if soil conditions are good.

Ideally, producers should not start planting much earlier than the BPMP date, which can seem quite late to some especially in south central Kansas. Several problems can arise from planting too early:

- Increased risk of **wheat streak mosaic** and related diseases. Wheat curl mites survive over the summer on living plant tissue of volunteer wheat and certain other grasses. As soon as those host plants die off, the wheat curl mites leave and start searching for a new source of living plant tissue. Wheat that is planted early is likely to become infested, and thus become infected with wheat streak mosaic, high plains virus, and Triticum mosaic virus. The wheat curl mites can normally move only about a half mile or more through the air before dying, so if wheat is planted early, make sure all volunteer wheat within a half-mile is completely dead at least two weeks before planting.
- Increased risk of **Hessian fly**. Over the summer, Hessian fly pupae live in the old crowns of wheat residue. After the first good soaking rain in late summer or early fall, these pupae (or “flaxseed”) will hatch out as adult Hessian flies and start looking for live wheat plants to lay eggs on. They are most likely to find either volunteer wheat or early-planted wheat at that time. After the BPMP date, many of the adult Hessian fly in a given area will have laid their eggs, so there is generally less risk of Hessian fly infestation for wheat planted after that date. Hessian fly adult activity has been noted through November or even early December in Kansas.
- Increased risk of **barley yellow dwarf**. The vectors of barley yellow dwarf are greenbugs and bird cherry-oat aphids. These insects are more likely to infest wheat during warm weather early in the fall than during cooler weather. There are 25+ species of aphids capable of vectoring barley yellow dwarf of which bird cherry oat aphids and greenbugs are probably the most common in Kansas.
- Increased risk of **excessive fall growth and excessive fall tillering**. For optimum grain yields and winter survival, the goal is for wheat plants to head into winter with established crown roots and 3-5 tillers. Wheat that is planted early can grow much more than this, especially if moisture and nitrogen levels are good. If wheat gets too lush in the fall, it can use up too much soil moisture in unproductive vegetative growth and become more susceptible to drought stress in the spring if conditions are dry.
- Increased risk of **take-all, dryland foot rot, and common root rot**. Take-all is usually worse on early-planted wheat than on later-planted wheat. In addition, one of the ways to avoid dryland foot rot (*Fusarium graminearum* and other *Fusarium* species) is to avoid early seeding. This practice promotes large plants that more often become water stressed in the fall

predisposing them to invasion by the fungi. Early planting of wheat also favors common root rot because this gives the root rot fungi more time to invade and colonize root and crown tissue.

- **Grassy weed infestations** become more expensive to control. If cheatgrass, downy brome, Japanese brome, or annual rye come up before the wheat is planted, they can be controlled with glyphosate or tillage. If wheat is planted early and these grassy weeds come up after the wheat has emerged, producers will have to use an appropriate grass herbicide to control them.
- Germination problems due to **high soil temperatures**. Early planted wheat is sown in hotter soils, which may become problematic as some wheat varieties have high-temperature germination sensitivity. In other words, some varieties won't germinate when soil temperatures are greater than 85°F. If planting early, it is important to select varieties that do not have high-temperature germination sensitivity and sow sensitive varieties later in the fall, when soil temperatures have cooled down.
- Germination problems due to **shortened coleoptile length**. Hotter soils tend to decrease the coleoptile length of the germinating wheat. Therefore, deeply planted wheat may not have a long-enough coleoptile to break through the soil surface and may result in decreased emergence and poor stand establishment. Because of the shortened coleoptile length, it is preferable to dust the wheat in at a shallower depth (3/4 to 1 inch deep) when early planting wheat than trying to reach moisture in deeper layers if soil moisture is absent from the top inch of the soil profile.

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## 2. Sudden Death Syndrome in soybeans - 2017 update

The first sudden death syndrome (SDS) infected soybean plants arrived in the K-State Plant Disease Diagnostic Lab the week of August 21st. The two samples originated in Cherokee and Johnson Counties. In areas that have a history of SDS, recent rains or irrigation can stimulate the development of the disease, so scouting should be going on now.

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

Historical yield losses from this disease are generally in the range of 1 to 25 percent.

### **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. As the disease further develops, the leaflets drop off but the petioles remain attached.



**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 Adey, 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. 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. 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 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. However, producers cannot manage SDS simply by selecting varieties that have SCN resistance. 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 have been evaluated were not as effective as ILeVO. The cost of ILeVO is significant so it is recommended for use only in fields with an established history of SDS. Prophylactic use of the product as “insurance” is not cost effective.

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
- 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. Estimating sorghum yield potential

Estimating 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 yield potential: A web-based app. <http://ksu.ag/2vwC2QN> (August 25, 2017 - eUpdate 648)
- Estimating corn yield potential. <http://ksu.ag/2uOzGfB> (August 11, 2017 - eUpdate 646)

This article discusses how to get simple but fairly good estimates of sorghum yield potential. As with soybeans, sorghum can 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 factors 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 and 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 ahead to the next page, but it will help to know how sorghum yield components develop.*

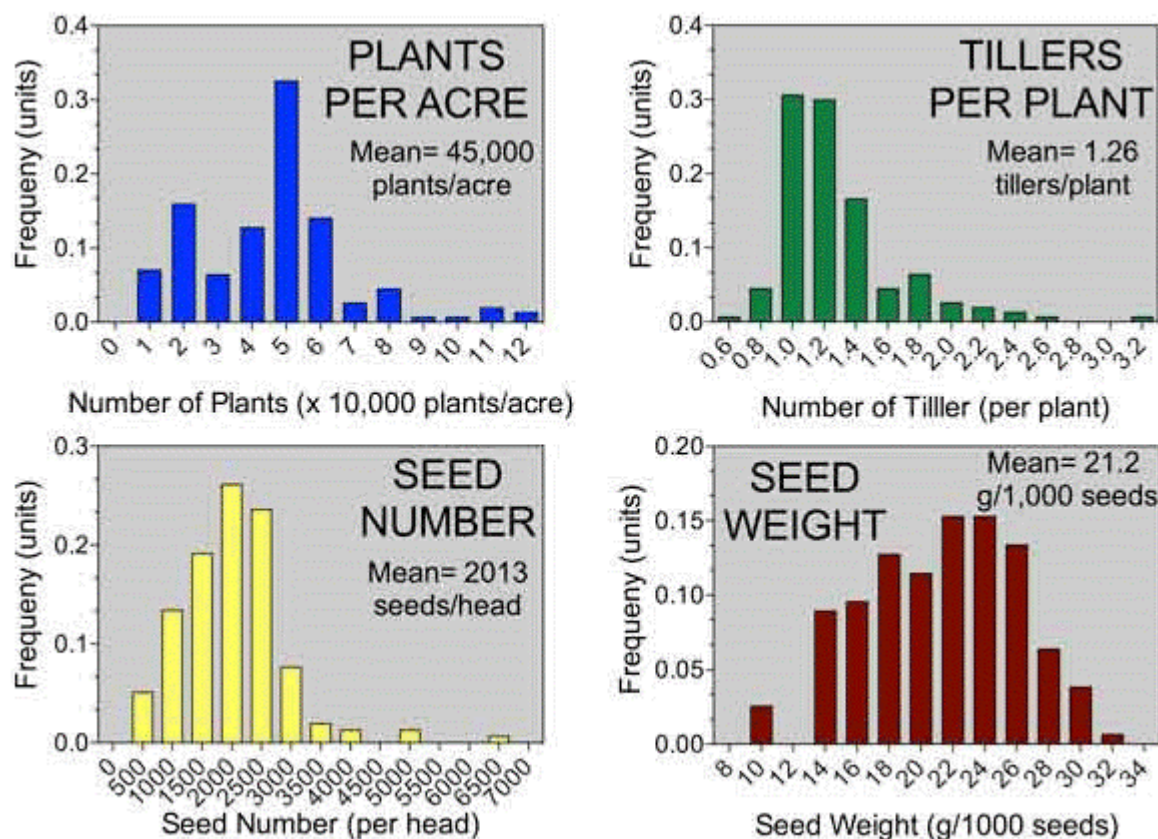
Increasing the number of plants per acre potentially increases competition for resources, which can diminish the plant's capacity to produce tillers. In addition, the interaction of planting date with plant density can have a similar effect. As planting date is delayed, the capacity of the plant to produce 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). Seed 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 seed 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:

1. Total number of heads per unit area [number of plants per acre x heads per plant] **(1)**
2. Total number of seeds per head **(2)**
3. Number of seeds per pound **(3)**
4. Pounds per bushel, or test weight, which for sorghum is **56 lbs/bushel (4)**

The final equation for estimating sorghum yields:

$$[(1) \times (2) / (3)] / (4) = \text{Sorghum yield in bushels/acre}$$

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 1/1000<sup>th</sup> the 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 1/1000<sup>th</sup> 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 needs to be estimated. The total number of seeds per head can vary from 100 to 5,000 seeds per head (Figure 1), but almost  $\frac{3}{4}$  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.**

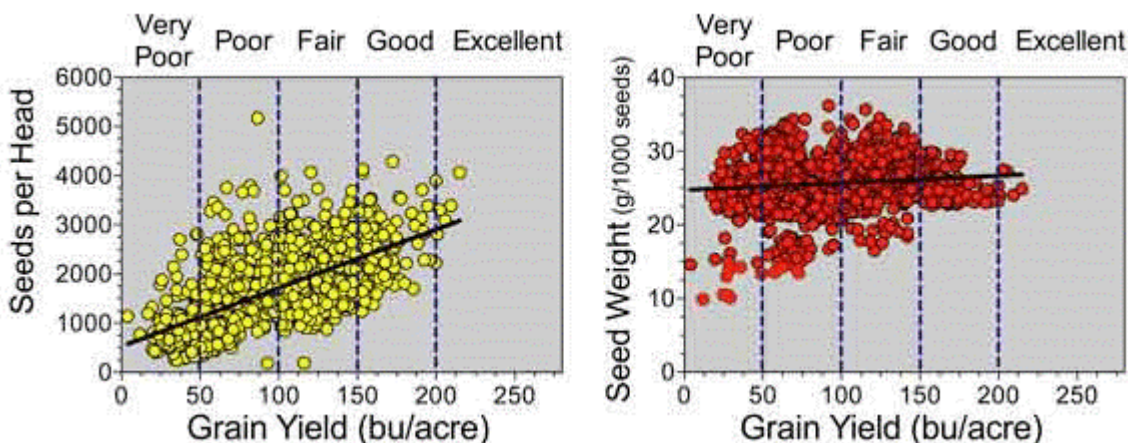
Another quick method uses an estimate of seed counts per head based on determinations of general yield environment conditions. From previously published information from K-State (provided by K-State professors Richard Vanderlip, emeritus, and Kraig Roozeboom), we can utilize a very simple association 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 the 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 range from 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<br>(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<br>(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. Final calculation using “On-Farm” Yield Estimation Approach:**

$[(\text{Heads} \times \text{Seeds per Head}) \times 1,000 \div \text{Seeds per Pound}] \div \text{Pounds per bushel}$

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:

$(48 \text{ plants in } 17.4 \text{ foot} - 1/1000^{\text{th}} \text{ of an acre} \times 1.3 \text{ fertile tillers per plant}) = 62 \text{ heads}$

**Yield Estimation** =  $[(62 \times 2,500) \times 1,000 \div 17,723] \div 56 = \mathbf{156 \text{ bu/acre}}$

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** =  $[(52 \times 1,500) \times 1,000 \div 17,723] \div 56 = \mathbf{79 \text{ bu/acre}}$

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** =  $[(40 * 900) * 1,000 \div 18,520] \div 56 = \mathbf{35 \text{ bu/acre}}$

## 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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#### 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 part of the plant.

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 the leaves and stem. 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).





**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.**

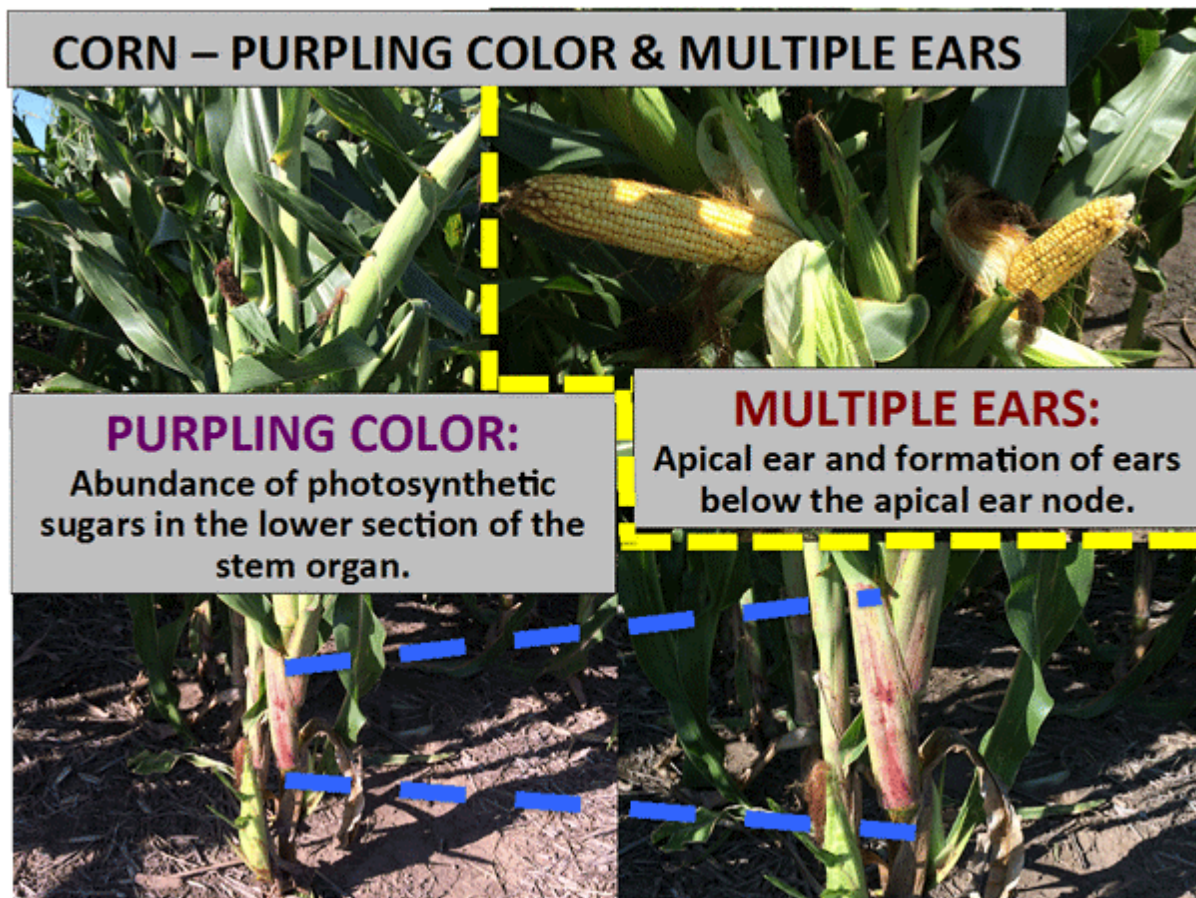


With corn now nearing physiological maturity (black layer), the crop is advancing into the grain-fill period and reaching the end of its life cycle. As this process continues, water and nitrogen uptake by the roots will be decreasing until the end of the season. The root system has a very high demand 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 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 an imbalance between source:sink (e.g., poor kernel set).

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## 5. Using cover crops to improve nitrogen availability for grain sorghum

Cover crops grown between periods of primary cash crop production can offer many benefits to the sustainability of cropping systems. Improvements in soil quality resulting from cover crops may include increases in soil organic matter, reduced soil compaction, or increased soil microbial activity. Cover crops can be an important management tool to reduce environmental pollution from soil erosion, leaching, and surface runoff. Past research in other regions has found mixed results ranging from increases in corn and sorghum yields after summer legume cover crops to no yield advantage following non-legume or winter legume cover crops.

An ongoing study is being conducted by researchers at K-State to determine how long-term effects of legume and non-legume summer and winter cover crops grown before grain sorghum impact nitrogen (N) availability and the response of sorghum yield to N fertilization.

The crop rotation was wheat-grain sorghum-soybean. Treatments included four different cover crops (see below), double crop soybeans (DSB) as a cash crop alternative, and a chemical fallow (CF) check. These treatments were imposed following wheat harvest so grain sorghum is the crop in the rotation most likely to be affected. The four cover crop treatments included:

- Summer legume (SL) – forage soybean
- Summer non-legume (SNL) – sorghum-sudangrass
- Winter legume (WL) – crimson clover
- Winter non-legume (WNL) – daikon radish



Nitrogen fertilizer was applied after grain sorghum planting in a subsurface band at 0, 40, 80, 120, and 160 lb N/acre.

After three cycles of cover crops, yields of grain sorghum with no N fertilizer applied were highest following the summer legume cover crop treatment (Figure 1). A minimum of about 35 lb N/acre of



added N fertilizer would be required for sorghum yields to reach similar yield levels with the CF and other cover crop treatments.

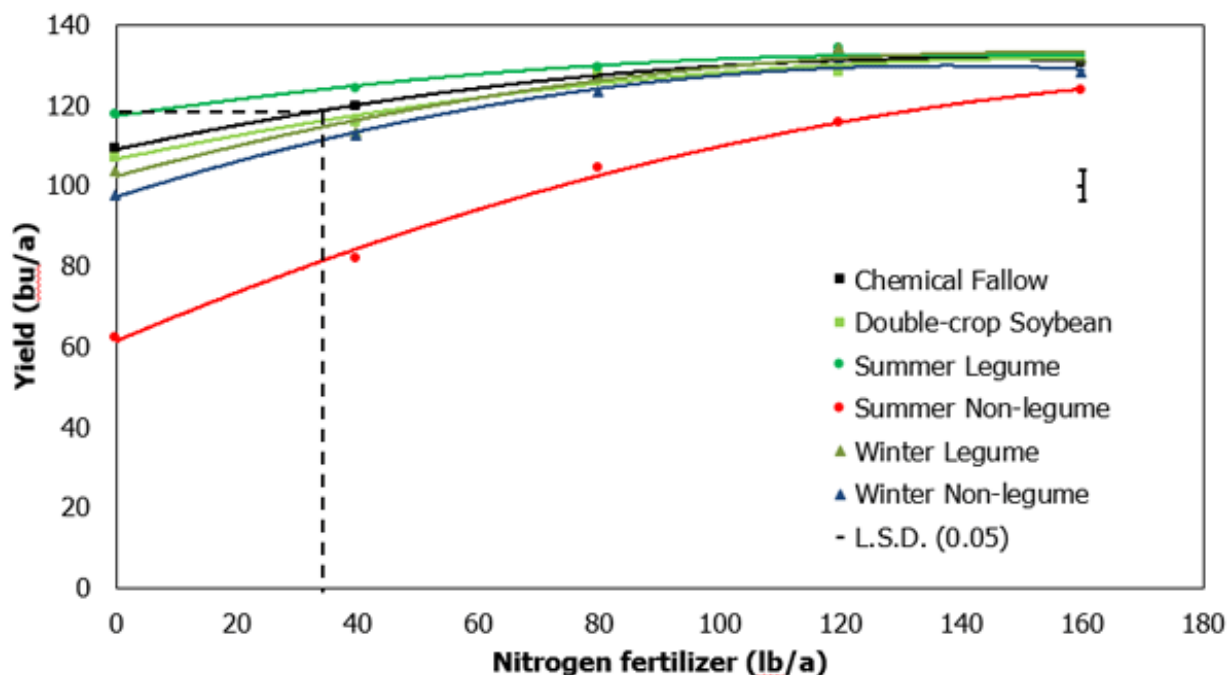


Figure 1. Sorghum response to 3rd cycle of cover crops (3-year average, 2014 to 2016)

Sorghum yield response to cover crops over an 8-year average is shown in Table 1. Grain sorghum planted after the summer legume and double-crop soybean cover crops produced significantly greater yields than the other treatments when no fertilizer N was added. There is potential to replace a portion of the cash crop N requirement with summer legume cover crops. The summer legume cover crop contributed an average of 33 lb N/acre to the grain sorghum during the growing season. Double-crop soybean contributed an average of 19 lb N/acre.

On the other extreme, sorghum sudangrass, a summer non-legume, removed an average of 47 lb N/acre from the plant-available soil N pool (Table 1). Sorghum sudangrass has a relatively high carbon-to-nitrogen (C:N) ratio which leads to immobilization (tie-up) of available soil N. For cover crops with high C:N ratios, additional N input by the grower may be necessary to maintain sorghum or corn yields.

Table 1. Nitrogen fertilizer replacement value and sorghum yield (8-year average)

| Cover Crop Treatment | Sorghum Grain Yield at 0-N<br>(bu ac <sup>-1</sup> ) | Fertilizer N Replacement Value<br>(lb ac <sup>-1</sup> ) |
|----------------------|--|--|
| Chemical fallow      | 83 b   | -  |
| Double-crop soybean  | 91 ab  | 19   |
| Summer legume        | 96 a   | 33   |
| Summer non-legume    | 57 c   | -47  |
| Winter legume        | 80 b   | -5   |
| Winter non-legume    | 82 b   | -2   |

<sup>1</sup>Means with different letters within columns are significantly different (LSD=0.05)

Although there was no significant improvement in yield or N supply from winter cover crops, these plants may reduce N loss by leaching over the winter through N uptake before it moves out of the rooting zone as well as a providing residue to protect the soil surface and help reduce erosion.

The agronomically optimum fertilizer rate for sorghum after an 8-year average of yield data was approximately 80 lb N/acre for all treatments except where a summer non-legume cover crop (sorghum-sudangrass) was used. With the summer non-legume cover crop, the agronomically optimum fertilizer rate was 120 lb N/acre.

Appropriate management adjustments will need to be made if you are incorporating cover crops into your wheat-grain sorghum or similar cropping system. Cover crops are likely to affect N availability and uptake by the subsequent crop. Fertilizer N applications should be adjusted according to specific cover crop species and management to maximize yield.

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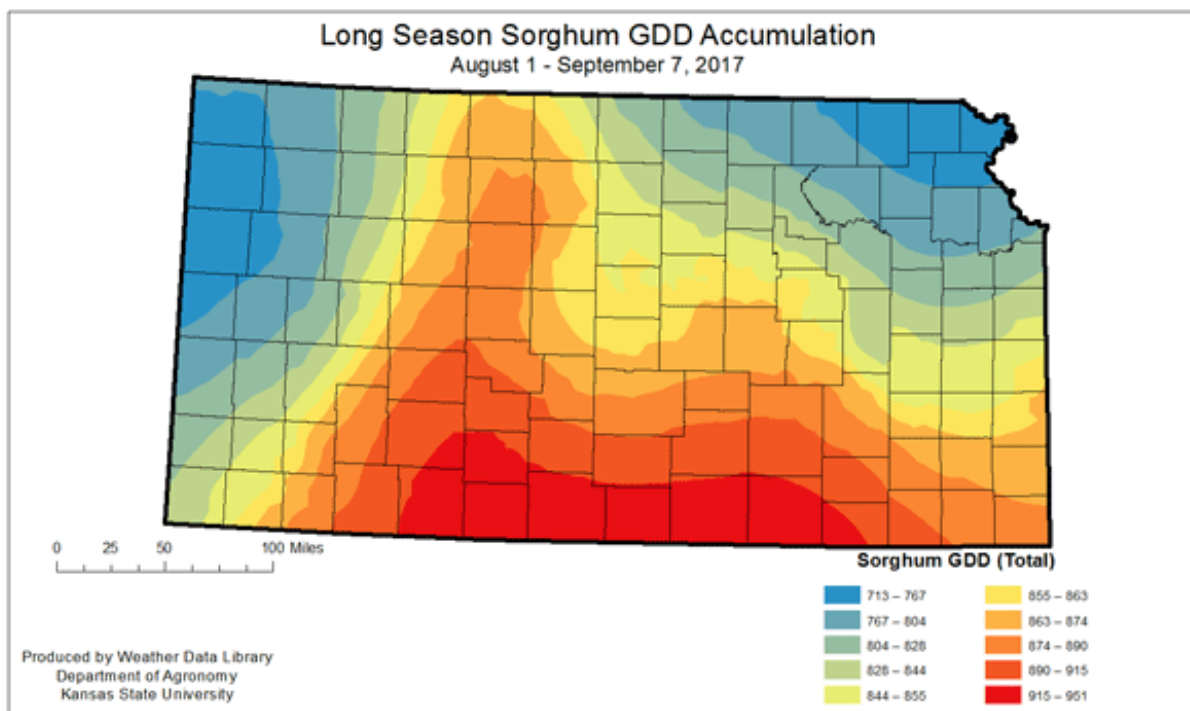
## 6. Effect of low temperatures on summer row crops

Low temperatures could present a bigger problem for sorghum and soybeans than for corn. At this point, corn is reaching maturity and the potential impacts of lower temperatures will have little (depending on the absolute value, the duration of the stress, and phenology of the crop) or no impact on expected corn yields. The main challenges of low temperatures will occur for soybeans in the coming weeks during the final reproductive stage, with the potential of impacting final seed weight (either affecting the rate of accumulation of dry matter on the seeds or by interrupting this process) if temperatures drop below 32 degrees.

### Temperature effect on crops

#### Sorghum:

Wet conditions delayed sorghum planting in some areas of the state thus delaying heading. During August, cooler-than-normal temperatures dominated the state. A delay in flowering time could jeopardize yields if the crop is exposed to heat around blooming or if low temperatures occur during grain fill. The long-season growing-degree-day (GDD) accumulation from August 1 to September 7 portrays a lower GDD accumulation for the north central and eastern parts of the state (Figure 1). The largest departure of GDD accumulation was recorded in the south central, southeastern, and northeast-north central portions of the state (Figure 2).

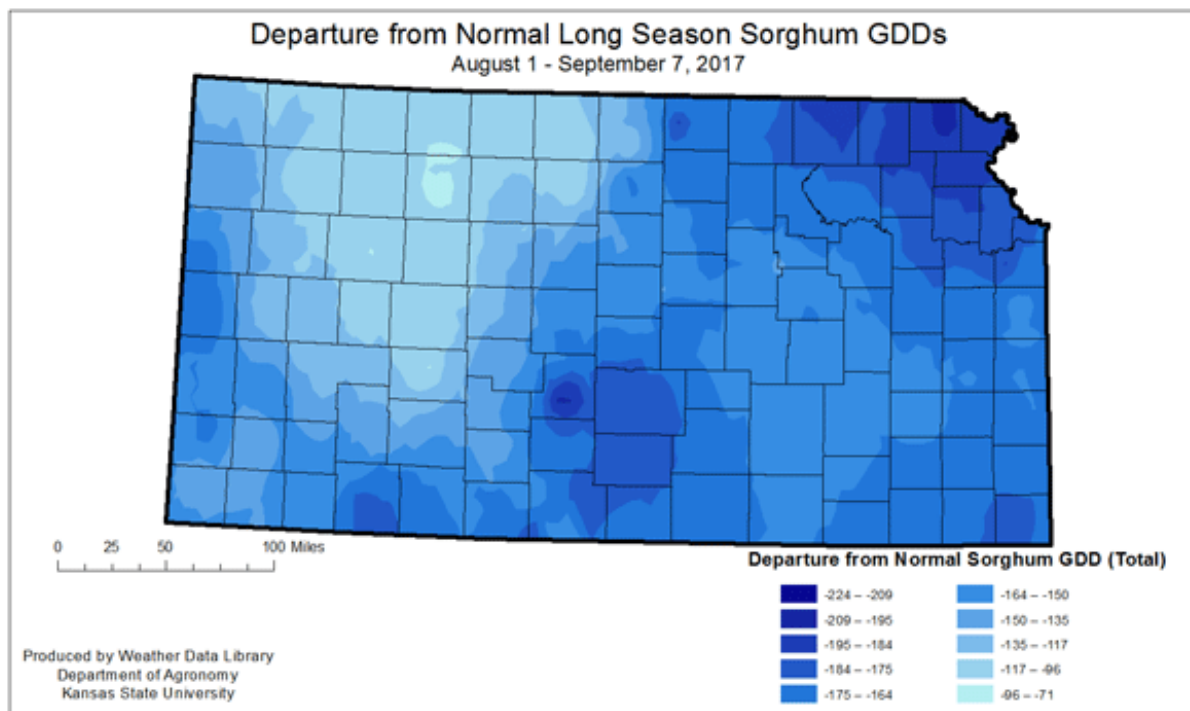


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**Figure 1. Accumulated Long Season Sorghum Growing Degree Days.**



**Figure 2. Departure from normal accumulation of long season Sorghum GDDs.**

Low temperatures will reduce seed growth and affect final test weight and seed quality. Temperatures below 40 degrees F will inhibit growth. A freeze will kill sorghum if the stalks are frozen, impairing the flow of assimilates and nutrients to the grain. A freeze at the hard-dough stage (before grain matures) will produce lower weight and chaffy seeds.

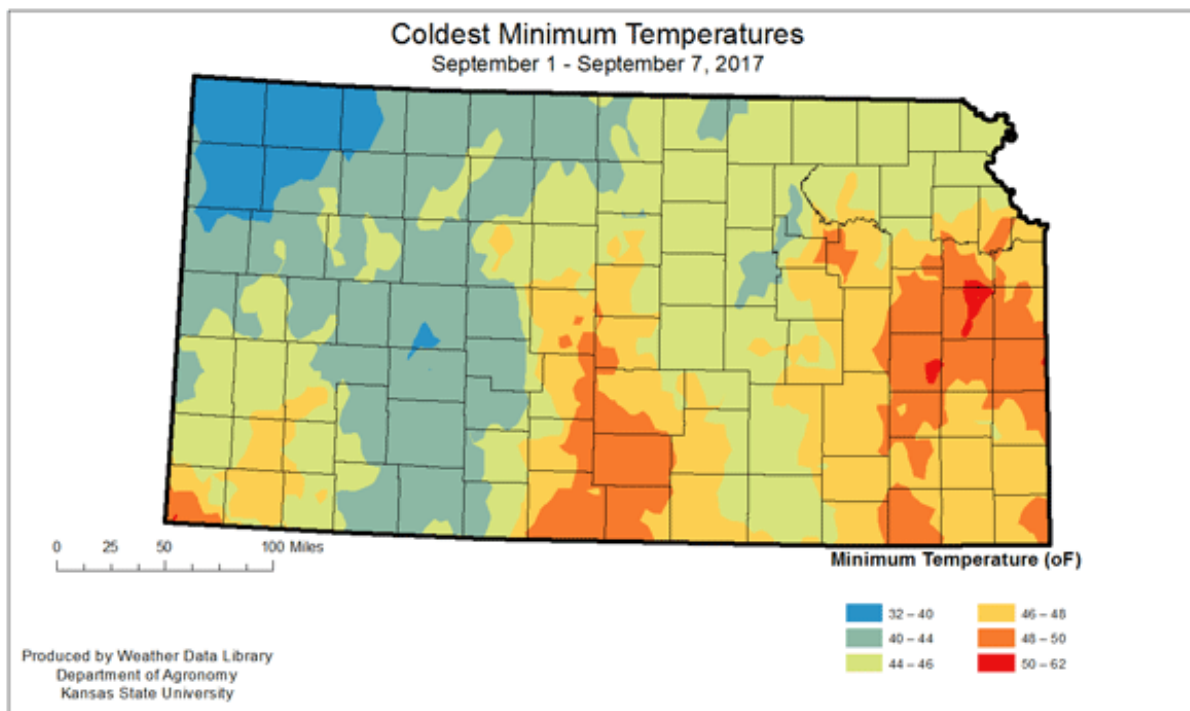
The likelihood of sorghum maturing before a freeze is related to the following factors (as affected by weather and hybrid):

- planting date
- plant growth rate during the season
- date of half-bloom.

When the crop flowers in late August or early September, it may not reach maturity before the first fall freeze in some parts of the state. In the last week, the minimum temperature recorded across the state was between 32-40 degrees F for the northwest portion of the state (Figure 3). For the northwest, western, and north central areas, the question that will remain unanswered is if sorghum



will be able to reach maturity before the first fall freeze? As emphasized above, the answer depends on factors such as planting date, date of half-bloom, hybrid (maturity), and more importantly, projected temperatures for the next coming weeks.



**Figure 3. Map of the lowest temperatures recorded for September 1-7. Dark blue refers to low temperatures (32-40 degrees F); dark red refers to high temperatures (51-55 degrees F).**

#### Corn:

Corn is affected when temperatures are below or at 32 degrees F. Temperatures below 32 degrees F can produce equivalent or greater damage even when the exposure time is relatively short. Clear skies, low humidity, and calm wind conditions increase freeze damage even with temperatures above 32 degrees F. Any freeze damage at this point in the season will hardly produce any visible symptoms, but can impact the final test weight and potentially seed quality - depending on the growth stage. Corn is not affected by freeze once it reaches the black layer stage.

#### Soybeans:

For soybeans, temperatures below 32 degrees can interrupt grain filling and impact yield, meaning lower test weight and seed quality. Necrosis of the leaf canopy is a visible symptom of freeze damage in soybeans. Absolute temperature is more important than the duration of the cold stress – especially if temperatures drop below 28 degrees F. The timing of the freeze effect will increase the

likelihood of impacting yields. As the crop approaches maturity, the impact of a freeze event on soybean yields declines.

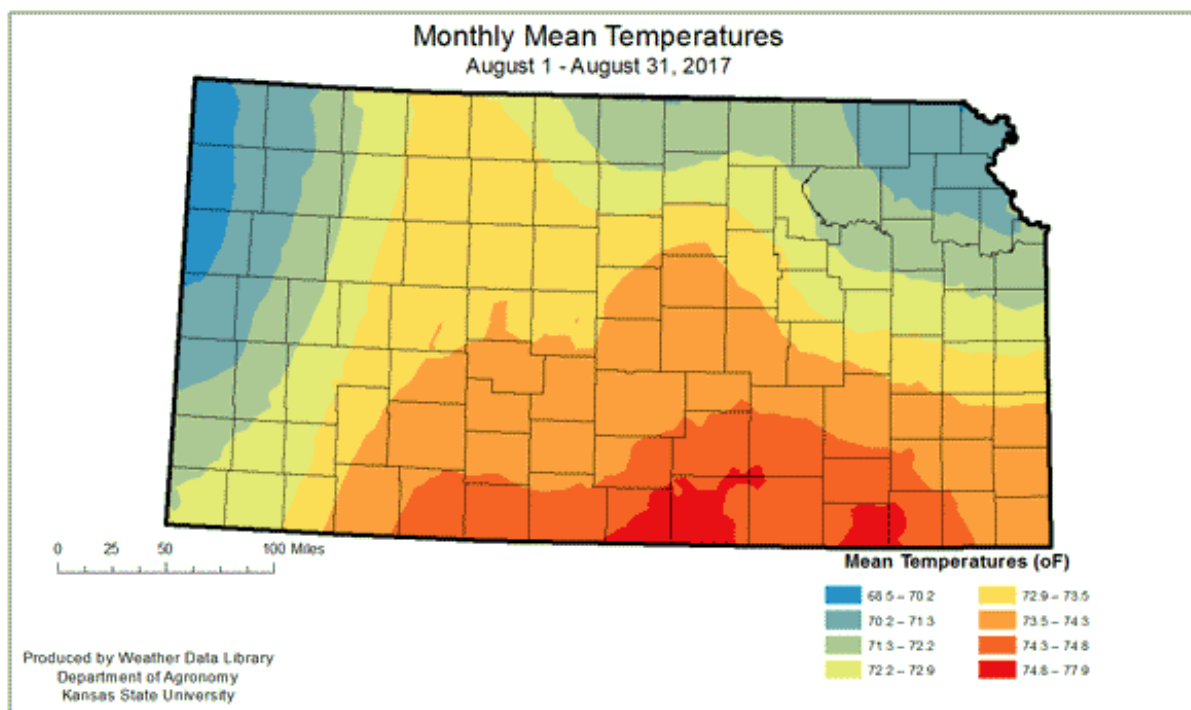
As weather changes develop in the coming weeks, stay tuned for more information about potential freeze injury on sorghum in future eUpdate issues.

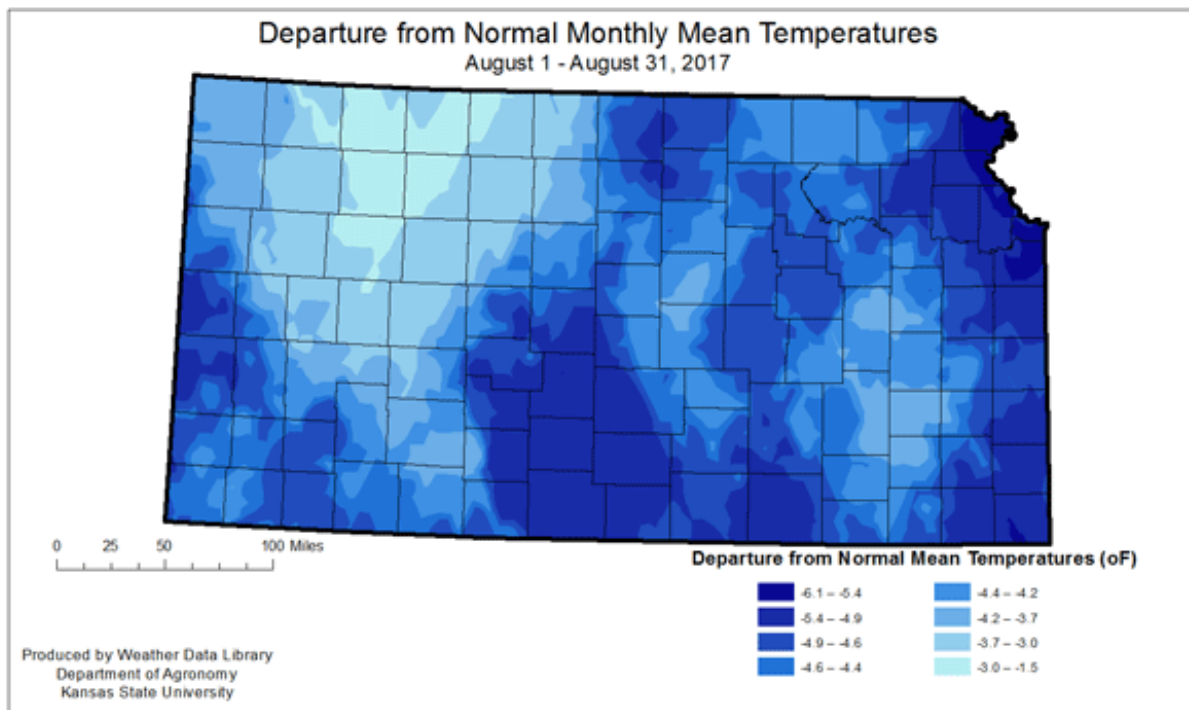
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## 7. Kansas weather summary for August - Unseasonably cool

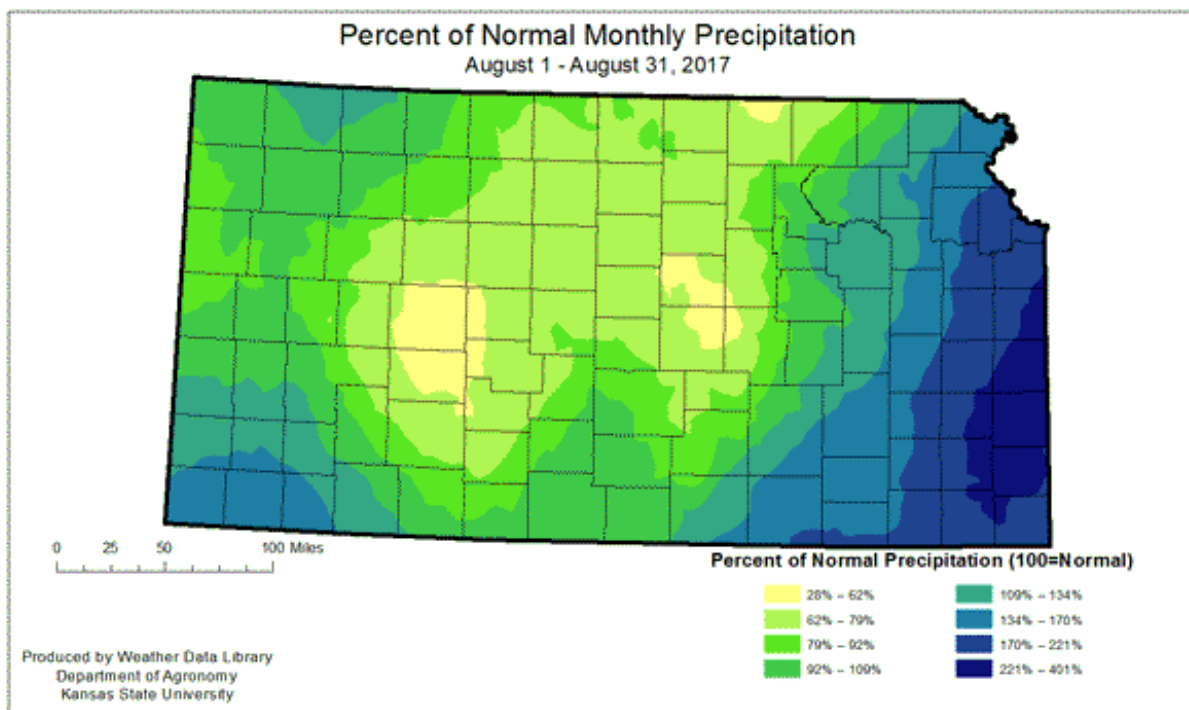
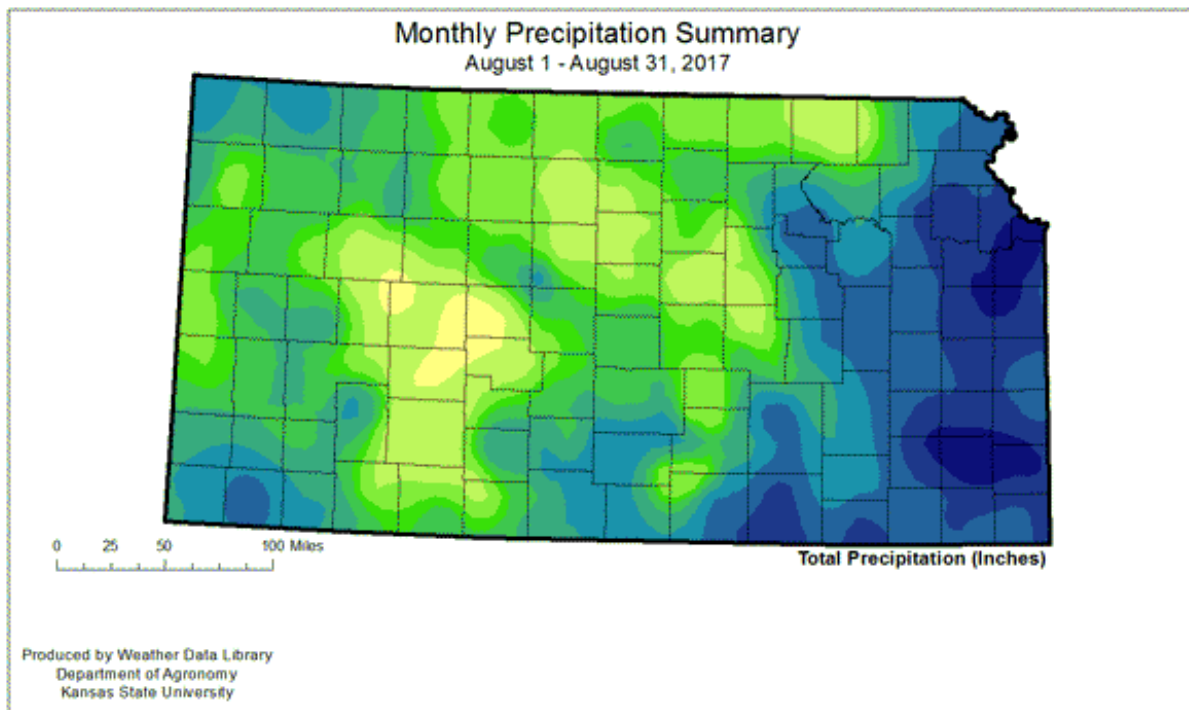
The most notable weather feature for August was the cooler-than-normal temperatures. The state-wide average temperature was 72.7 degrees F, which is 4.4 degrees cooler than normal. All divisions were in the cooler than normal range. The Northwest Division was closest to normal with an average temperature of 71.1 degrees F, or 3.6 degrees cooler than normal. The East Central Division had the greatest departure; the average for that division was 72.1 degrees F which was 5.0 degrees cooler than normal. Only the three eastern divisions failed to break the 100 degree mark. The warmest reading was 104 degrees F, reported at Larned #2, Pawnee County, on August 21st. The coldest reading was 43 degrees F, reported at Brewster 4W, Thomas County, on the 28th. Not surprisingly, there were no new record high maximum temperatures and only three new record high minimum temperatures. On the other hand, there were 49 new record low daily maximum temperatures and 16 new record low minimum temperatures. None of the temperature records were records for the month.

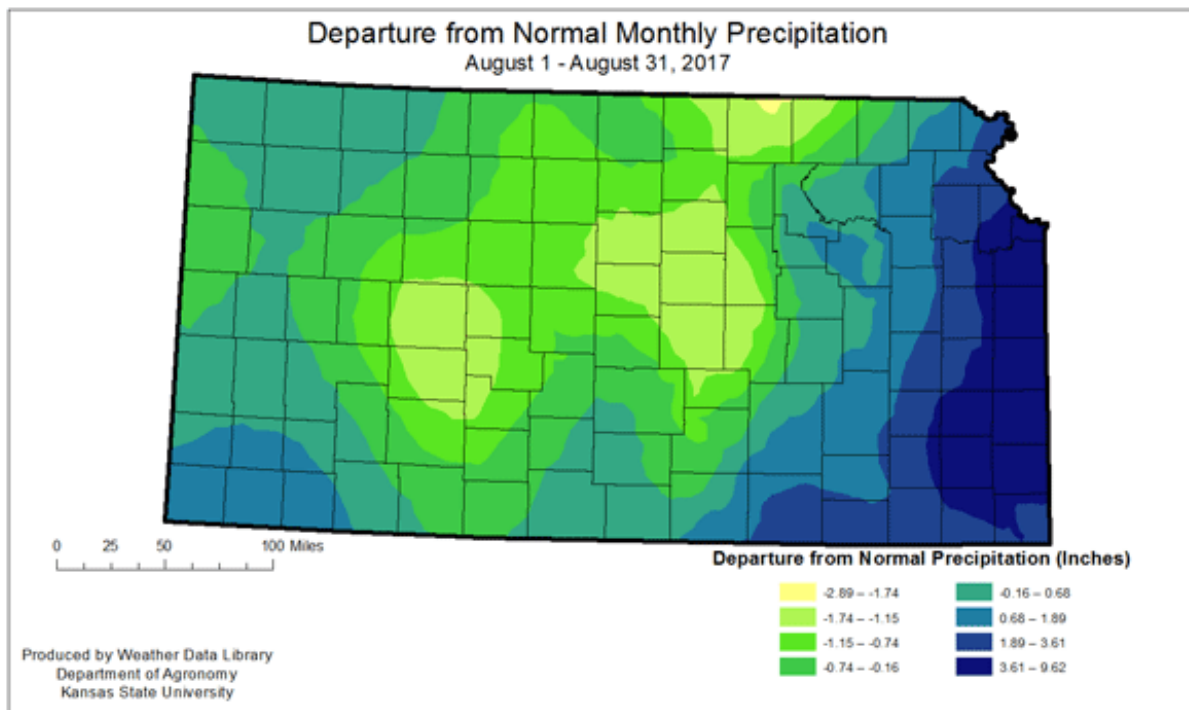




August had closer to normal precipitation than July, but was skewed heavily to the east. Statewide precipitation averaged 3.46 inches or 104 percent of normal. All three eastern divisions plus the South Central division averaged at or above normal for August. The Central and West Central divisions tied for the lowest percent of normal at 60 percent each. For the Central Division that meant an average of 2.51 inches or 1.42 inches below normal. For the West Central that was an average of 1.56 inches or 1.05 inches below normal. The greatest daily precipitation total reported at a National Weather Service Coop (NWS) station was 8.85 inches at Hillsdale Lake, Miami County, on the 22nd. The greatest daily total reported at a Community Collaborative Rain Hail and Snow network station (CoCoRaHS) was 8.30 inches at Wellsville 3.6 NNW, Douglas County, also on the 22nd. The monthly extremes for both networks were 12.52 inches at Erie, Neosho County (NWS) and 13.00 inches at Overland Park 1.7 NE, Johnson County (CoCoRaHS).





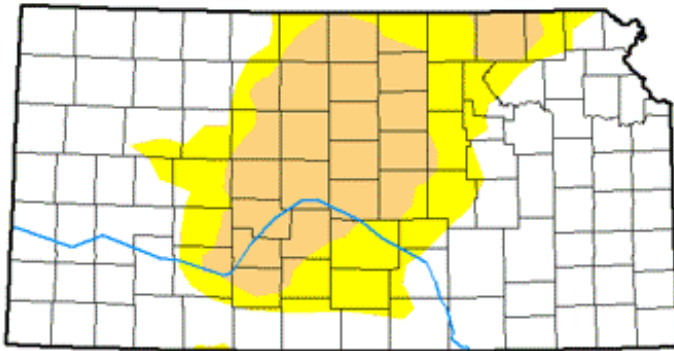


Severe weather was again limited this month, with most of the events in the form of hail and high winds. There was one reported tornado, which is less than the 1950-2016 average of 3 tornadoes in August. In addition to the tornado, there were 56 hail reports and 63 high wind reports. The most damaging event of the month was the flooding in Eastern Kansas following the heavy rains on August 5th and 6th. Flooding was reported along several local streams, including areas that had been flooded at the end of July.

The near normal precipitation coupled with cooler-than-normal temperatures limited the expansion of the abnormally dry condition. However, areas of the state with much lower-than-normal precipitation had an expansion of moderate drought. The September outlook calls for drier-than-normal conditions statewide. This is coupled with increased chances of below-normal temperatures in the eastern half of the state, with equal chances of above- or below-normal temperatures across the rest of the state. The much cooler-than-normal temperatures that have started this month will reduce some of the evaporative demand. However, extended dry weather will result in further intensification of the drought.

# U.S. Drought Monitor Kansas

**August 29, 2017**  
(Released Thursday, Aug. 31, 2017)  
Valid 8 a.m. EDT



Author:  
Chris Fenimore  
NCEI/NESDIS/NOAA



<http://droughtmonitor.unl.edu/>

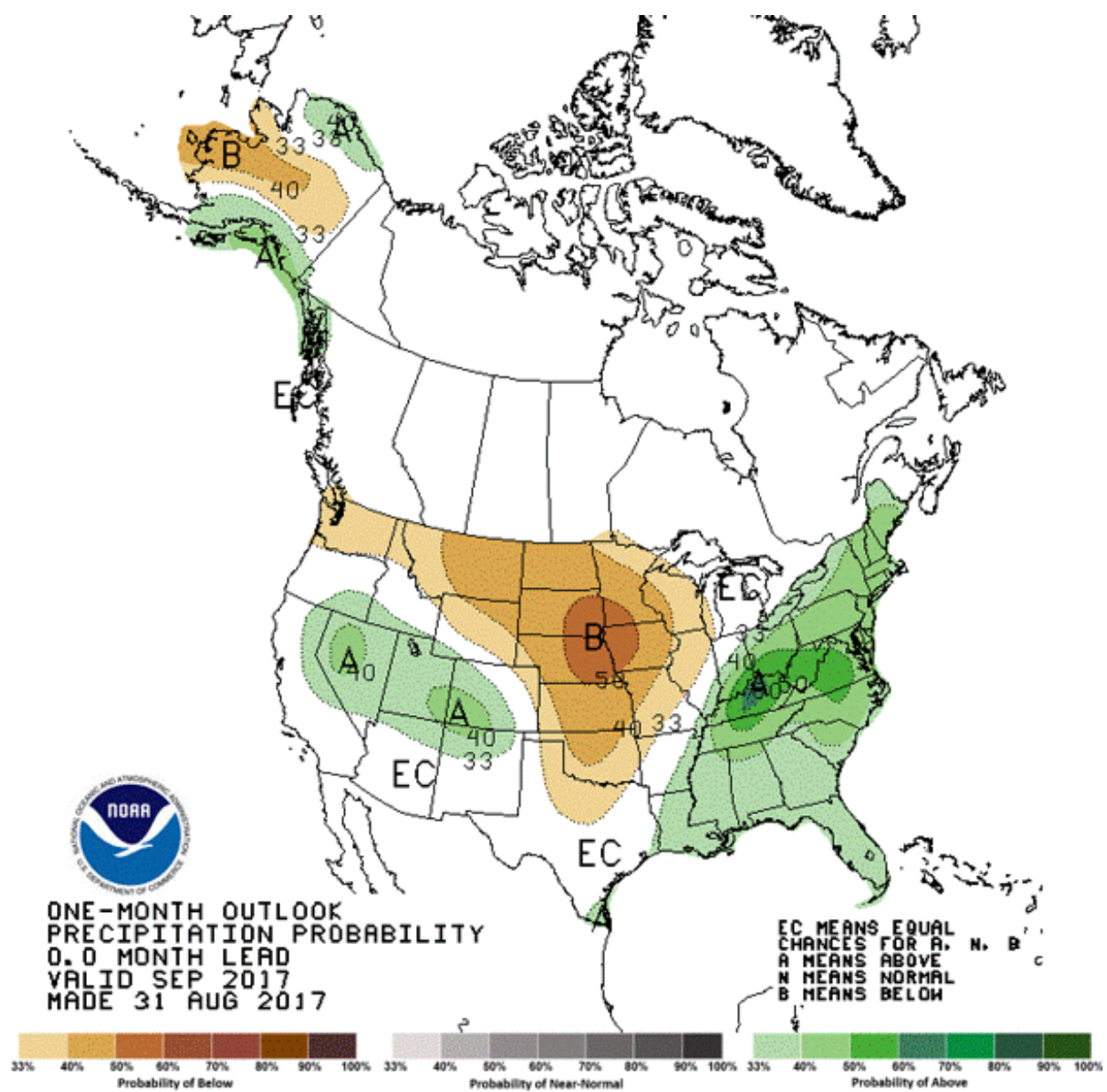
## Drought Conditions (Percent Area)

|   | None   | D0    | D1    | D2    | D3   | D4   |
|---|--------|-------|-------|-------|------|------|
| <b>Current</b>                              | 62.50  | 17.60 | 19.90 | 0.00  | 0.00 | 0.00 |
| <b>Last Week</b><br>08-22-2017              | 63.49  | 18.00 | 18.52 | 0.00  | 0.00 | 0.00 |
| <b>3 Months Ago</b><br>05-30-2017           | 100.00 | 0.00  | 0.00  | 0.00  | 0.00 | 0.00 |
| <b>Start of Calendar Year</b><br>01-03-2017 | 17.31  | 51.98 | 17.13 | 13.58 | 0.00 | 0.00 |
| <b>Start of Water Year</b><br>09-27-2016    | 100.00 | 0.00  | 0.00  | 0.00  | 0.00 | 0.00 |
| <b>One Year Ago</b><br>08-30-2016           | 94.79  | 4.24  | 0.97  | 0.00  | 0.00 | 0.00 |

## Intensity:

D0 Abnormally Dry
  D1 Moderate Drought
  D2 Severe Drought
  D3 Extreme Drought
  D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.





| Aug-17   |                        |                   |          |                     |                   |          |                  |                   |                  |     |
|--|------------------------|-------------------|----------|---------------------|-------------------|----------|------------------|-------------------|------------------|-----|
| Kansas Climate Division Summary  |                        |                   |          |                     |                   |          |                  |                   |                  |     |
|  | Precipitation (inches) |                   |          |                     |                   |          | Temperature (°F) |                   |                  |     |
|  | Aug-17                 |                   |          | 2017 through August |                   |          |                  |                   | Monthly Extremes |     |
| Division   | Total                  | Dep. <sup>1</sup> | % Normal | Total               | Dep. <sup>1</sup> | % Normal | Ave              | Dep. <sup>1</sup> | Max              | Min |
| Northwest  | 2.04                   | -0.69             | 74       | 16.71               | 16.89             | 98       | 71.1             | -3.6              | 101              | 43  |
| West Central   | 1.56                   | -1.05             | 60       | 18.62               | 16.29             | 115      | 71.9             | -3.7              | 101              | 47  |
| Southwest  | 2.50                   | -0.21             | 92       | 20.72               | 15.44             | 135      | 73.1             | -4.2              | 100              | 49  |
| North Central  | 2.54                   | -0.75             | 77       | 21.09               | 21.31             | 98       | 72.5             | -4.5              | 101              | 47  |
| Central  | 2.15                   | -1.42             | 60       | 21.16               | 22.48             | 94       | 73.5             | -4.6              | 102              | 49  |
| South Central  | 3.54                   | 0.10              | 103      | 25.55               | 23.47             | 109      | 74.4             | -4.8              | 104              | 50  |
| Northeast  | 3.93                   | 0.03              | 100      | 24.58               | 25.66             | 95       | 71.5             | -4.8              | 95               | 49  |
| East Central   | 5.56                   | 1.47              | 136      | 27.57               | 27.61             | 99       | 72.1             | -5.0              | 96               | 51  |
| Southeast  | 6.88                   | 3.14              | 188      | 34.30               | 29.41             | 116      | 74.0             | -4.6              | 99               | 53  |
| STATE  | 3.46                   | 0.13              | 104      | 23.61               | 22.00             | 108      | 72.7             | -4.4              | 102              | 43  |
| 1. Departure from 1981-2010 normal value   |                        |                   |          |                     |                   |          |                  |                   |                  |     |
| 2. State Highest temperature: 104 °F at Larned #2, Pawnee County, on the 21st.   |                        |                   |          |                     |                   |          |                  |                   |                  |     |
| 3. State Lowest temperature: 43 °F at Brewster 4W, Thomas County, on the 28th.   |                        |                   |          |                     |                   |          |                  |                   |                  |     |
| 4. Greatest 24hr: 8.85 inches at Hillsdale Lake, Miami County, on the 22nd (NWS); 8.30 inches at Wellsville 3.6 NNW, Douglas County, on the 22nd (CoCoRaHS). |                        |                   |          |                     |                   |          |                  |                   |                  |     |
| Source: KSU Weather Data Library   |                        |                   |          |                     |                   |          |                  |                   |                  |     |

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## 8. Comparative Vegetation Condition Report: August 29 - September 4, 2017

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 28-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, and his pioneering work in this area is gratefully acknowledged.

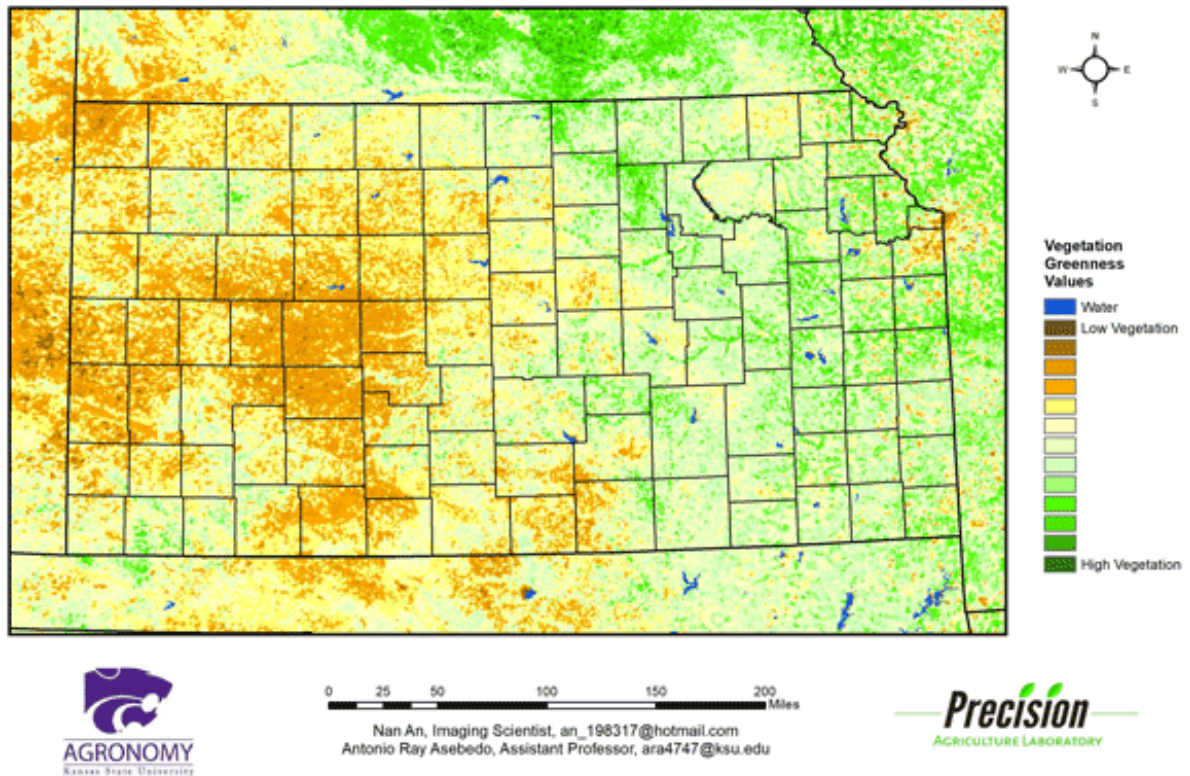
The maps have recently been revised, using newer technology and enhanced sources of data. Dr. Nan An, Imaging Scientist, collaborated with Dr. Antonio Ray Asebedo, assistant professor and lab director of the Precision Agriculture Lab in the Department of Agronomy at Kansas State University, on the new 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:

## Kansas Vegetation Condition

Period 36: 08/29/2017 - 09/04/2017



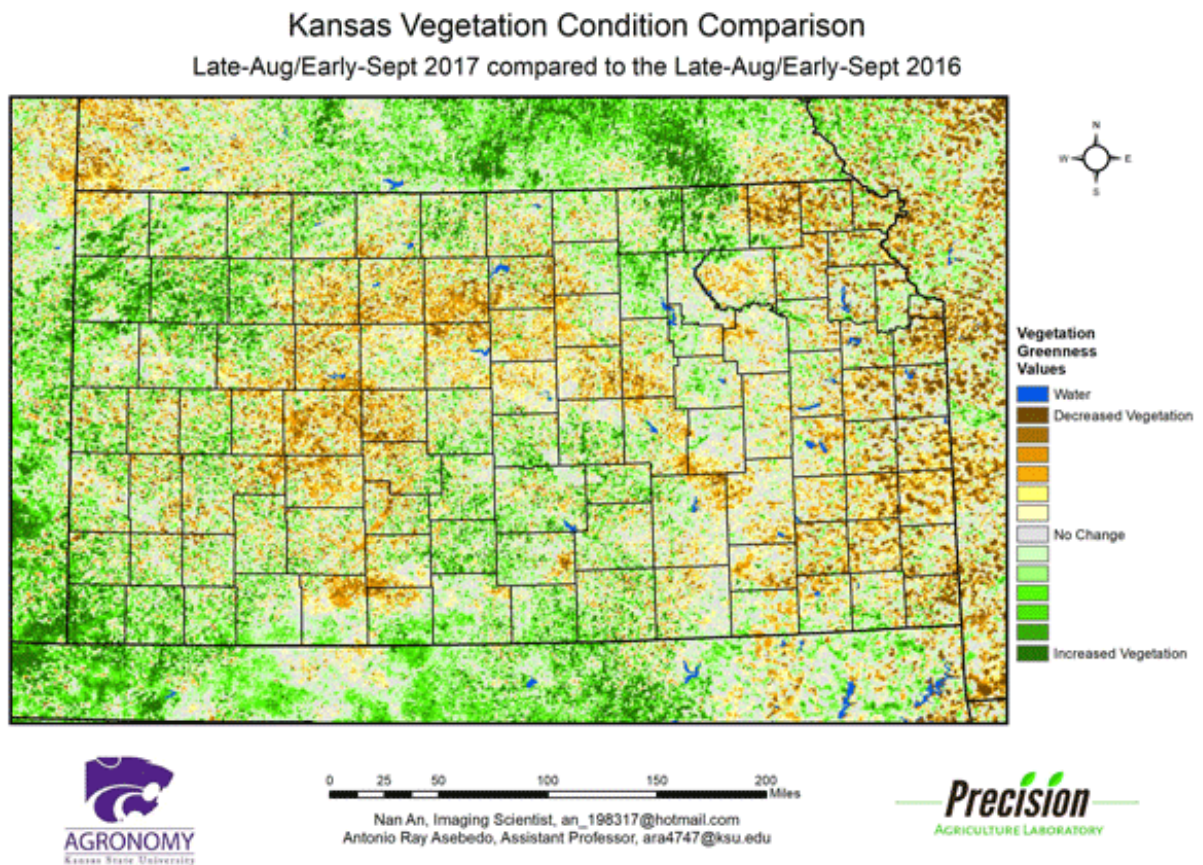
**Figure 1. The Vegetation Condition Report for Kansas for August 29 – September 4, 2017 from K-State’s Precision Agriculture Laboratory continues to show a split in vegetative activity. The greatest vegetative activity continues in eastern Kansas, particularly in extreme Northeastern Kansas. Impact from the recent rains continue to be visible, and the flooded areas of Wyandotte and Johnson counties show reduced photosynthetic activity. Parts of western Kansas with higher rainfall show increased activity compared to the areas that missed the storms.**

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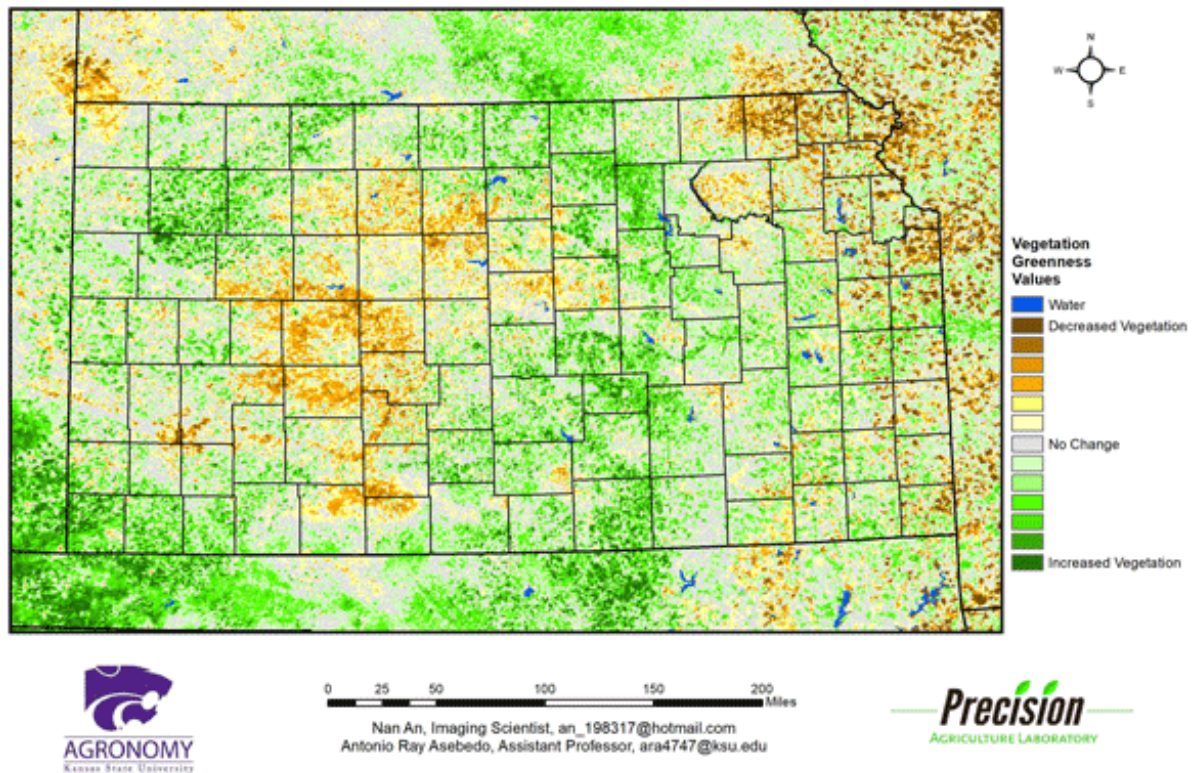


**Figure 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for August 29 – September 4, 2017 from K-State’s Precision Agriculture Laboratory shows much of the state has higher vegetative activity, particularly in the west. Rainfall was higher this year and was coupled with cooler temperatures.**



## Kansas Vegetation Condition Comparison

Late-Aug/Early-Sept 2017 compared to the 28-Year Average for Late-Aug/Early-Sept



**Figure 3. Compared to the 28-year average at this time for Kansas, this year's Vegetation Condition Report for August 29 – September 4, 2017 from K-State's Precision Agriculture Laboratory above-average activity in much of the state. The mild, wet weather has particularly favored the southwest corner of the state, while lingering drought has reduced vegetative activity in parts of central Kansas.**

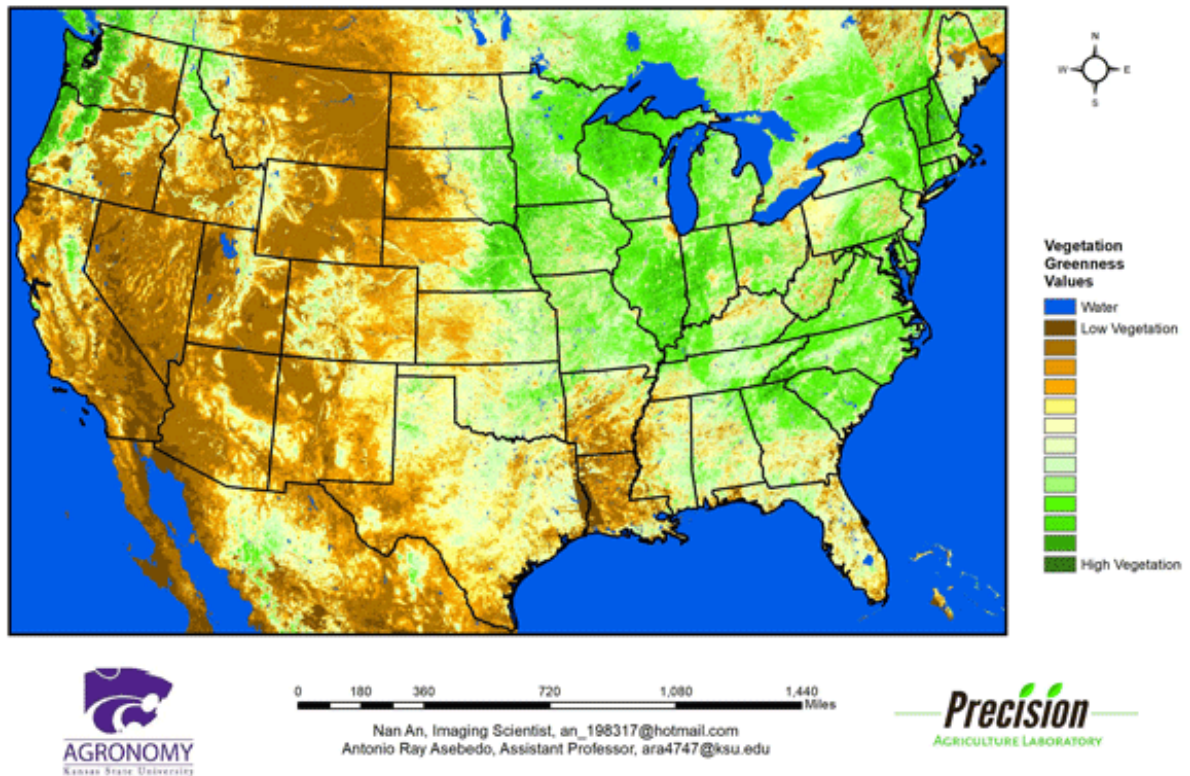
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## Continental U.S. Vegetation Condition

Period 36: 08/29/2017 - 09/04/2017



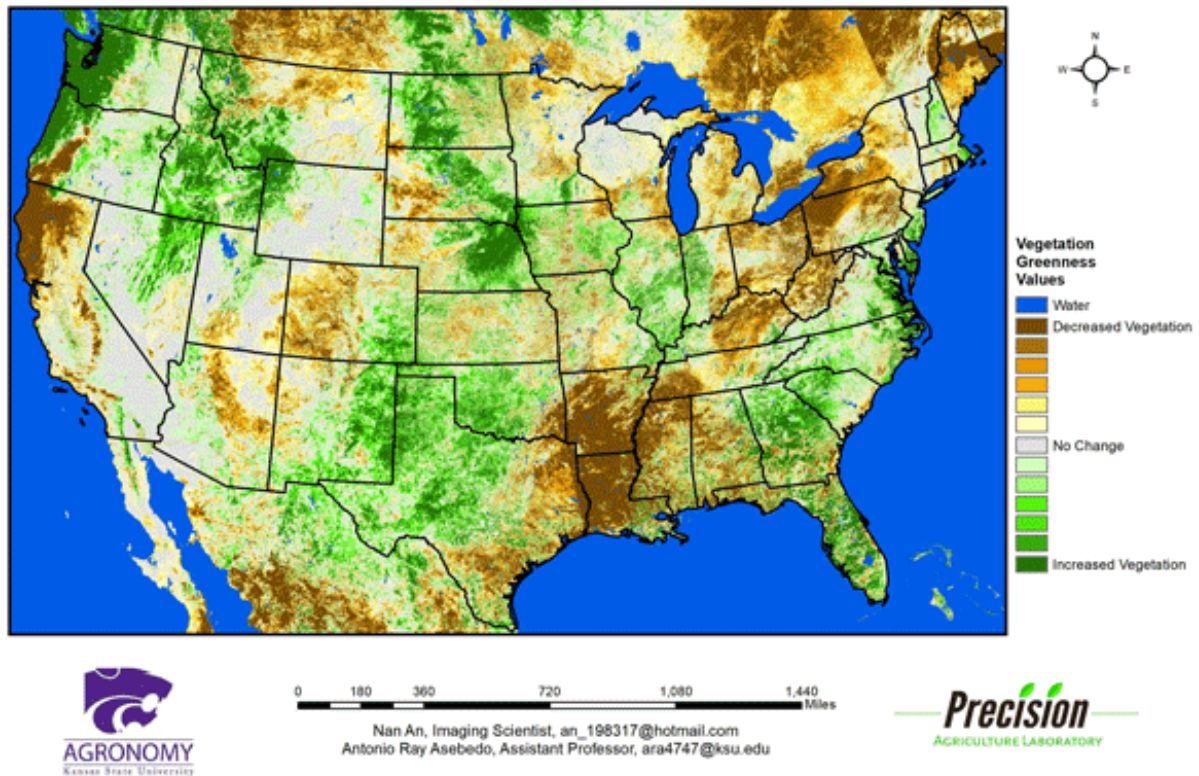
**Figure 4. The Vegetation Condition Report for the U.S for August 29 – September 4, 2017 from K-State’s Precision Agriculture Laboratory shows an area of high NDVI values centered in the Midwest, particularly in eastern Nebraska and western Iowa. A second area of high vegetative activity is also visible along the West Coast, where the recent warm weather has yet to have a visible impact. Extremely low NDVI values continue to highlight the severe drought in eastern Montana and western South Dakota, while the excess rainfall along the Gulf Coast is beginning to show visible impacts, particularly in Louisiana, which experienced the second landfall of Hurricane Harvey.**

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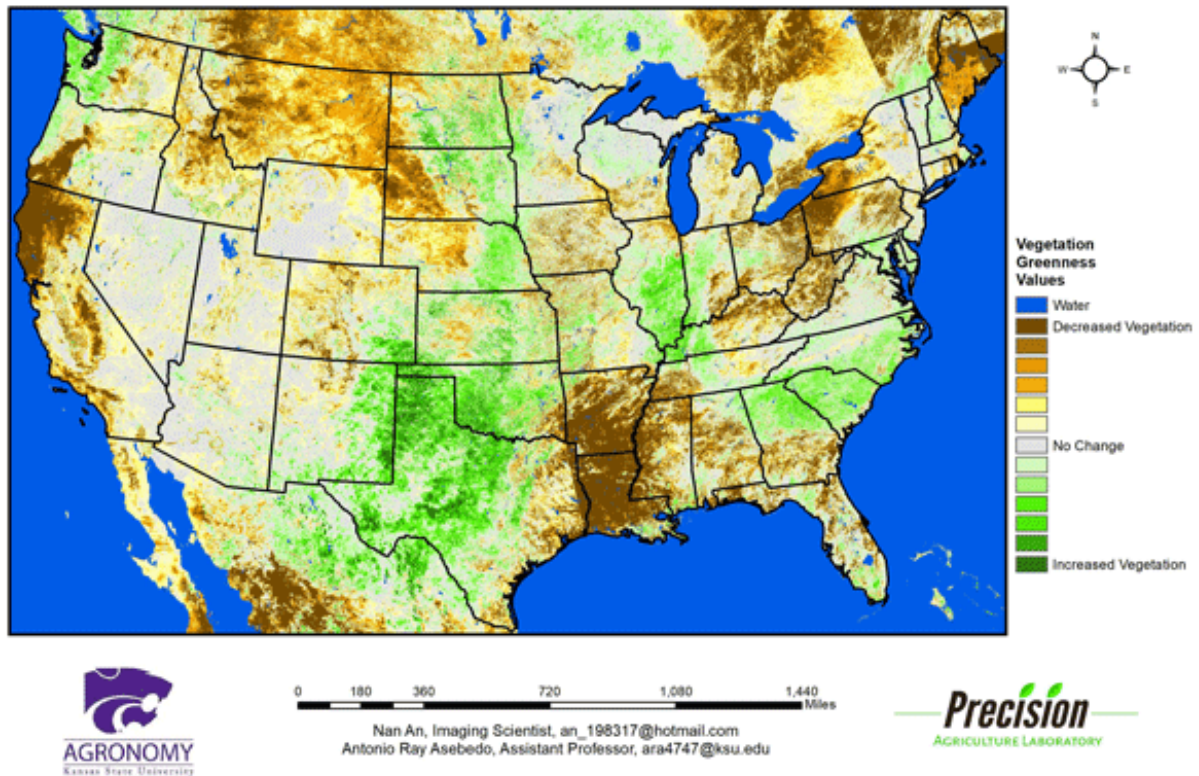
Continental U.S. Vegetation Condition Comparison  
Late-Aug/Early-Sept 2017 Compared to Late-Aug/Early-Sept 2016



**Figure 5. The U.S. comparison to last year at this time for August 29 – September 4, 2017 from K-State’s Precision Agriculture Laboratory again shows the impact that split in moisture has caused this year. Much lower NDVI values are visible in Louisiana, with slightly lower values in the Plains. In contrast, the desert Southwest has much higher NDVI values than last year at this time. Parts of Texas, Louisiana, and into the Ohio River Valley are showing the impacts of the excessive moisture from Hurricane Harvey.**



Continental U.S. Vegetation Condition Comparison  
Late-Aug/Early-Sept 2017 Compared to 28-year Average for Late-Aug/Early-Sept



**Figure 6. The U.S. comparison to the 28-year average for the period of August 29 – September 4, 2017 from K-State’s Precision Agriculture Laboratory shows the drought impacts in the Northern Plains are visible as below-average NDVI values. In Louisiana and the Ohio River Valley, the below-average NDVI values are associated with cloud cover and rain from Hurricane Harvey. Higher-than-average vegetative activity is most visible in west Texas and eastern New Mexico where rainfall and temperatures have been favorable.**

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