



**K-STATE**  
Research and Extension

## Extension Agronomy

# eUpdate

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*10/07/2016*

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. Most likely causes of poor wheat emergence

Getting good stand establishment of wheat is the first step in establishing the yield potential of the crop. A good and uniform stand allows for better use of resources -- such as light, water, and nutrients -- decreasing within-field yield variability and increasing the yield potential of the crop.

Simultaneously, getting good stand establishment is the first hurdle for producers as they begin the new season. If the wheat doesn't emerge, or emerges in a spotty pattern, producers will have to diagnose the problem quickly and decide whether it would be best to wait a little longer or replant the field. Poor emergence or stand establishment can be caused by a number of problems, such as deep planting (Figure 1), a plugged drill, poor seed quality, seedborne or soilborne diseases, seed dormancy, dry soil, soil crusting, false wireworms, and low soil pH. Producers should take time to examine the evidence, looking for field patterns that can be an indication of the possible causes of poor stands.

### **Soil temperature and moisture**

The ideal soil temperature for germination of wheat seed is between 54 and 77 degrees. Planting in soils with temperatures more than 90 degrees can reduce wheat germination in varieties with high-temperature germination sensitivity, although seed of varieties with high-temperature germination sensitivity might eventually germinate once a cool rain brings the soil temperature down. High soil temperatures can also reduce germination by reducing coleoptile length. If the coleoptile is too short, the first true leaf will emerge below the soil surface and will take on an accordion-like appearance (Figure 1).

This year, however, temperatures have been mild for the most part, conducive for good germination if there are no other problems. Topsoil moisture is adequate in most of Kansas, but is too dry for good germination and emergence in some areas of southwest Kansas.

Some fields have been crusted by heavy rains after planting, which can prevent the coleoptile from breaking through the soil surface. If the wheat hasn't emerged in a timely manner and you've had a heavy rain after the wheat was planted, dig up some seed and look for crinkled coleoptiles. If this is the case, you can try to break up the crust with a light tillage or hope for a gentle rain. But if the coleoptile stays underground for more than a week or so and hasn't been able to break through the soil surface, the germinated seed will start losing viability. At that point, the producer will need to consider replanting if final stands are below approximately 50% of the targeted stand, or if the emergence pattern is not uniform.

If soil temperatures are ideal, the topsoil is not unusually dry, and there has been no crusting, the most likely causes of poor stands would be deep planting, a plugged drill, poor seed quality, unusually long seed dormancy, diseases, or insects.

### **Planting depth**

Deep planting (deeper than the coleoptile's ability to elongate) can slow emergence or cause stand establishment problems. Varieties differ in their coleoptile lengths, but for the most part wheat should be planted about 1 to 1.5 inches deep. Most varieties can emerge at slightly deeper depths if

the soil is not too restrictive and temperatures are in the ideal range, but it is possible the wheat cannot emerge if it is planted deeper than 2.5 inches.

Coleoptile length is determined by the variety and soil temperature conditions. Coleoptile length is shorter at both lower and higher temperatures than the ideal range. If the coleoptile grows as long as it can and still hasn't broken through the soil surface, the first true leaf will emerge below ground (Figure 1). Under normal conditions, this first true leaf emerges above ground. If the first true leaf has to start growing in the soil, it is very unlikely to be able to force its way through the soil and emerge. What you'll see when digging up the seed is an intact coleoptile alongside a short first leaf that is scrunched up or crinkled. If this is the case, replanting will likely be necessary.



**Figure 1. Wheat plants that were sown at approximately 4 inches deep near Hutchinson. The wheat plant on the right had its first true leaf emerge below the soil surface. As the first true leaf does not have the strength to push through the soil, it stays trapped underneath the surface and takes on an accordion-like shape. Despite the deep planting, the coleoptile of the plant on the left made it through the soil surface and the first true leaf emerged normally. Photo by Romulo Lollato, K-State Research and Extension.**



## Seed quality

Another possible reason for poor emergence is poor seed quality. As long as the seed was tested for germination by a licensed laboratory and had an acceptable germination rate, seed quality should not be a problem. If germination testing on the seed lot was not done by a laboratory, poor seed quality could be a problem if other potential problems have been ruled out as the cause of poor emergence. At times, wheat doesn't germinate simply because the seed has an unusually long seed dormancy requirement. This is hard to identify in the field, and can cause producers to replant when it's not necessary. There are variety differences in seed dormancy requirement, although this hasn't been tested recently. And even within the same variety, some seed will have longer dormancy than others depending on the conditions in which it was produced. If a seed lot has unusually long seed dormancy but is acceptable in all other qualities, it should eventually germinate and emerge just fine.



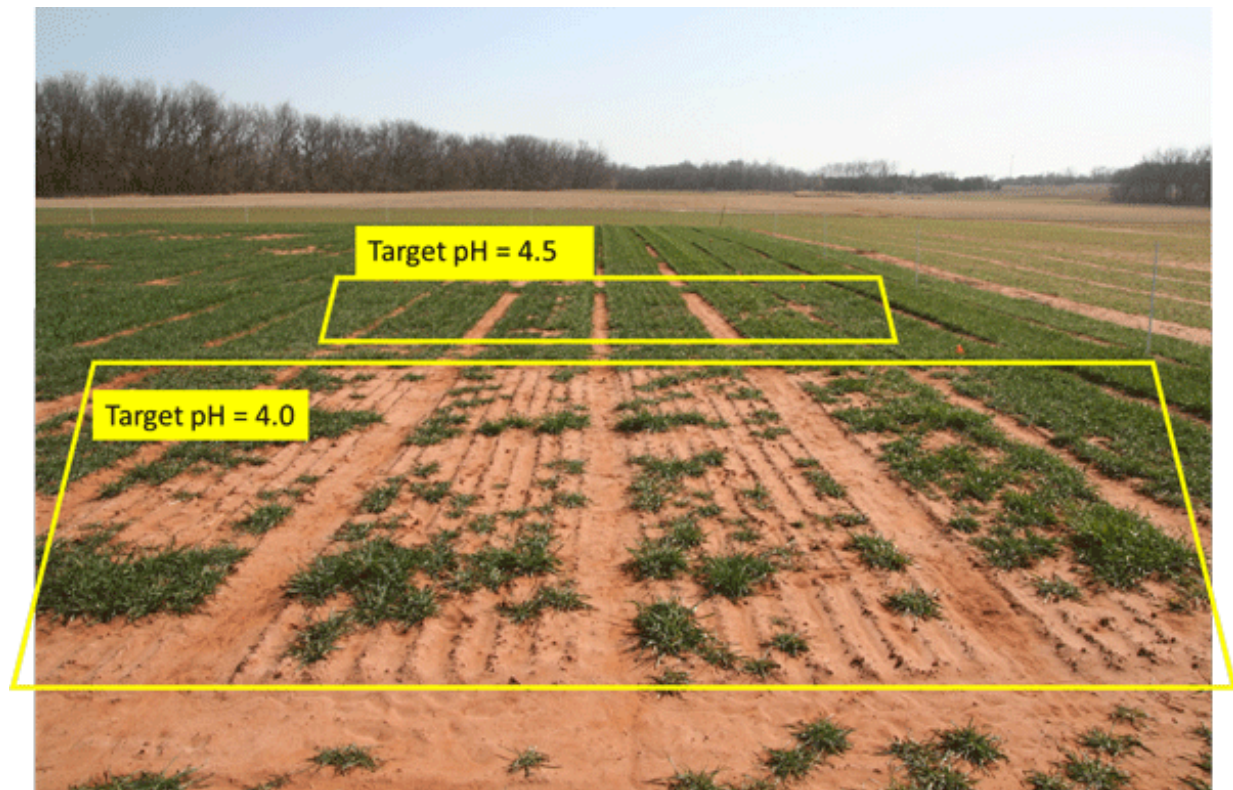
**Figure 2. There are two different varieties in this field. The variety on the right had poor seed quality, and this resulted in poor emergence. Photo by Jim Shroyer, K-State Research and Extension.**

## Insect problems

False wireworms can be the cause of poor emergence. False wireworms are soil-inhabiting, yellowish to orange-colored worms up to 1 ½ inches long. A pair of short antennae is clearly visible on the front of the head and the head region does not appear flattened when viewed from the side. They commonly follow the drill row in dry soils, feeding on the seeds prior to germination. Other insect and disease problems can attack seedlings after emergence.

## Low soil pH

Although low soil pH has been historically known to decrease overall plant growth (root and aboveground biomass), its effects on wheat stand establishment had not been reported until recently. A study in Oklahoma looking at four different varieties and a soil pH gradient ranging from 4 to 7.5 indicated that a minimum soil pH of 4.9 was needed to ensure an acceptable emergence uniformity and stand establishment (Figure 3).



**Figure 3. Low soil pH effects on wheat stand establishment. A soil pH of 4 decreases stand establishment significantly from higher pH levels. Stand establishment was still patchy even at soil pH of 4.5. Photo by Romulo Lollato, K-State Research and Extension.**

Making the decision to replant the crop needs to take into account percent stand establishment as compared to the targeted stand, replanting date, rate, and weed control. See the accompanying article on replanting decisions in this issue of the Agronomy eUpdate.

For more information on emergence problems, see K-State's publication S-84, *Diagnosing Wheat Production Problems* at: <http://www.ksre.ksu.edu/bookstore/pubs/s84.pdf>

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## 2. Replanting decisions for winter wheat

Wheat stands may be thin this year, for a variety of reasons. For example, some regions of southwest Kansas have been without substantial precipitation for more than a month, which may result in uneven wheat emergence and sub-optimal stand establishment (Figure 1). Where stands are too thin, producers will have to decide whether to replant.



**Figure 1. Contrasting wheat emergence near Belleville during the 2015-16 growing season. Photo by Romulo Lollato, K-State Research and Extension.**

The most probable cause for uneven wheat emergence during this fall in southwest Kansas is dry soils. However, poor seed quality may also play a role in poor wheat emergence, especially when



using saved seed, or brown bagged seed, which might be common this growing season due to the low commodity prices. Soil crusting, seedling rot diseases, soil insects, or low soil pH, may also be causes of poor emergence. For more details on these, please read the accompanying article in this issue of the Agronomy eUpdate “Most likely causes of poor wheat emergence.”

If dry soils are the cause of the problem, replanting will not bring many benefits unless the seed has partially germinated and perished before emerging. It is very important to dig into the soil and evaluate the seed to determine the cause of poor emergence. Wheat seeds may still be germinating and emergence may occur in the next few days, depending on temperatures. Thus, if seed are still hard and viable, or if germination started to occur recently and there are very short coleoptile emerging from the seed (Figure 2), the best advice is to leave the field alone.



**Figure 2. Wheat seed with elongating coleoptile visible below ground. This particular field, close to Belleville, got approximately an inch of rain in the week prior to taking this photograph and some seed had just begun germinating. Photo by Romulo Lollato, K-State Research and Extension.**

Considerations when deciding whether to replant wheat fields are i) percent stand compared to the target stand, ii) replanting date, iii) stand uniformity, and iv) weed control.

**i. Percent stand compared to the goal**

In order to check how far actual stands are from the target stand, counting the number of emerged

plants per row foot and comparing to the values on Table 1 should give a good estimate. Table 1 shows the number of target plants per row foot depending on seeding rate, seed size, and row spacing, and considering 80% emergence. If seed size is not known, 14,000 to 16,000 seeds per pound can be used for most wheat varieties in Kansas, except those with rather large or small kernels.

**Table 1. Target plants per row foot (80% emergence) based on seeding rate, seed size, and row spacing.**

Seeding rate	Seed size	Row spacing (inches)				
		6	7.5	8	10	12
lb/ac	seeds/lb	Target plants per row foot (80% emergence)				
45	12,000	5	6	7	8	10
	14,000	6	7	8	10	12
	16,000	7	8	9	11	13
	18,000	7	9	10	12	15
60	12,000	7	8	9	11	13
	14,000	8	10	10	13	15
	16,000	9	11	12	15	18
	18,000	10	12	13	17	20
75	12,000	8	10	11	14	17
	14,000	10	12	13	16	19
	16,000	11	14	15	18	22
	18,000	12	15	17	21	25
90	12,000	10	12	13	17	20
	14,000	12	14	15	19	23
	16,000	13	17	18	22	26
	18,000	15	19	20	25	30
120	12,000	13	17	18	22	26
	14,000	15	19	21	26	31
	16,000	18	22	24	29	35
	18,000	20	25	26	33	40

To determine the average number of plants per foot of row, several random plant counts across the field should be taken, given a more or less uniform emergence throughout the field. If the average number of plants is about 50 percent or more of normal and the stand is evenly distributed, the

recommendation is to keep the stand. Wheat's tillering ability can greatly compensate for poor stand provided soil fertility is adequate and the weather is favorable. With less than 40 percent of normal stand, the recommendation is to replant the field. If possible, replanting should be done at a 45 degree angle to the original stand to minimize damage to the existing stand.

#### **i. Replanting date and seeding rate**

As of early October, there is still time to hit the optimum planting date window for most of Kansas with the exception of some areas in the northwest portion of the state. If there are signs that the field will not achieve about 50% stand, it will not emerge evenly, or that the seedlings have perished after planting, producers still have time to take the decision of replanting until the middle to end of October without compromising the yield potential. Producers can cross-drill at the rate of 30-40 pounds per acre in western Kansas and 40-60 pounds per acre in central and eastern Kansas, using a double-disc opener drill if at all possible to minimize damage to the existing stand. If the replanting is done in November or later, increase the seeding rates to 60-75 pounds per acre in western Kansas and 75-90 pounds per acre in central Kansas. If stands are less than 30 percent of normal, increase these seeding rates by 20-30 pounds per acre.

#### **i. Weed control**

A thin wheat stand can increase the potential for weed and grass infestations. If these concerns become severe, the wheat stand should probably be replanted or thickened. Uneven wheat stands can also influence herbicide timing due to different staging of the crop within the same field. Figures 1 and 2 exemplify a field where parts of the field will begin tillering at the same time other parts are still emerging. Herbicides such as 2,4-D and dicamba have very specific application guidelines, and attention must be paid to the herbicide label to avoid injury to the wheat crop.

Paying attention to wheat leaf staging when controlling weeds can help minimize the consequences of applying these herbicides outside the labeled recommendations. Potential problems due to improper application timing include trapped heads, missing florets, or twisted awns. More developed plants during the fall often hold the best yield potential; thus, this factor might be considered if a decision needs to be taken between risking some herbicide injury to more developed plants versus those that emerged late in uneven wheat fields.

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### 3. Fall armyworms, armyworms, and army cutworms in wheat

Where wheat has emerged, fields need to be checked for fall armyworms, armyworms, and army cutworms. If you see worms on your wheat this fall, the first thing to do is to determine which worm is present. Proper identification is important because they have different feeding and overwintering patterns.

We have been hearing about and seeing a mixture of both armyworms and fall armyworms on wheat and other host plants this fall. These small worms start by causing small “windowpanes” in wheat (Figure 1) or alfalfa. No army cutworm infestations have been verified yet on wheat.



**Figure 1. “Windowpane” feeding damage on wheat leaf. [Photo](#) by Holly Schwarting, K-State Research and Extension.**

Flocks of birds in wheat or alfalfa fields in fall or early spring are often indicative of a “worm” infestation as the birds are feeding on the larvae. Fields with 25-30% of the plants showing “windowpane” feeding need to be monitored frequently as these larvae consume more as they get larger. Treatment should be applied before stands become threatened.

For treatment options, please refer to the latest K-State Wheat Insect Management guide at: <http://www.bookstore.ksre.ksu.edu/pubs/mf745.pdf>



## Fall armyworms

When scouting fields for fall armyworm damage, look for “windowpane” injury caused by tiny larvae chewing on seedling leaves. Each individual field should be scouted in several locations, including the field margins and the interior. The larvae themselves are usually too small to be easily observed after they first hatch, and hide in or around the base of seedlings. Within a few days of hatching, the larvae become large enough to destroy entire leaves.

The suggested treatment threshold is 2-3 actively feeding larvae per linear foot of row in wheat. Fields with 25 to 30 percent of plants with windowpane injury should be re-examined daily and treated immediately if stand establishment appears threatened. Larvae increase in size at an exponential rate, and so do their food requirements. Later instars do the most damage, sometimes destroying entire stands, and are the least susceptible to insecticides. Without treatment, problems can continue until larvae reach maturity or until a killing frost. Thin stands of wheat are especially at risk.



**Figure 2. Fall armyworm larva. Photo by Holly Schwarting, K-State Research and Extension.**

Fall armyworms will feed until the temperatures cool into the mid-20's or they pupate, whichever comes first. If a killing frost does not occur soon after the treatment threshold is reached, fields may require chemical treatment.

## Armyworms

Armyworm larvae are green to black with stripes of various colors. The head capsule is medium brown with dark markings. Most damage to wheat in Kansas occurs in southern and eastern areas of the state during warm, moist periods from late April to early June rather than in the fall. Like fall armyworms, armyworms will feed until the temperatures cool in the mid-20's or they pupate, whichever comes first.



Figure 3. Armyworm larva. Photo by Holly Schwarting, K-State Research and Extension.

In the spring, each larva, feeding mostly at night, can consume 43 linear inches of wheat leaf, or the equivalent of three whole plants, in the course of its development. However, 80 percent of this damage occurs during the last three to five days of larval feeding. When leaf feeding is observed, look for larvae curled up on the ground under litter, especially in patches of lodged plants. Treatment is usually not necessary below levels of four or five larvae per foot, but is probably justified at infestations of five to eight per foot depending upon larval maturity in relation to crop maturity.

Wheat is likely to suffer yield loss if the flag leaf is destroyed before the soft dough stage is completed. Consequently, the stage of plant development is a factor to consider when making treatment decisions. As wheat plants mature and the leaves dry out, armyworms may feed on beards and clip heads to complete their food requirements.

### **Army cutworm**



The army cutworm is a late fall to early spring pest in Kansas. Leaf damage by early stage army cutworm larvae will look very similar to that of fall armyworms. However, army cutworm larvae are typically very small in the early fall – smaller than fall armyworms or armyworms. If the worms causing defoliation in wheat in the fall are relatively large, ½ inch or more, they are probably armyworms and/or fall armyworms.

Adult moths lay eggs in soil in the fall. The brown, faintly striped larvae hatch during the fall and early winter. They will feed throughout the winter (unlike fall armyworm larvae), burrowing in the soil to escape frost and emerging again to feed during spells of warmer weather.



Figure 4. Army cutworm larva. Photo by Holly Schwarting, K-State Research and Extension.

Unlike other cutworms, only above ground plant parts are consumed, giving plants the appearance of being grazed by cattle.

Infestations in well-established stands will probably not require insecticide applications while wheat is dormant, but some fields never green up in the spring because of cutworm feeding. Along with fall scouting, frequent inspections during warm periods in February, March, and early April are strongly encouraged, particularly when preceded by a dry fall.

Moisture availability, crop condition, and regrowth potential are all factors influencing potential

losses to this pest. Late-planted fields under dry conditions with poor tillering may suffer economic damage with as few as one or two larvae per square foot.

In most fields, treatment will not be necessary until populations average four to five worms per square foot. Vigorous, well-tillered fields under optimal growing conditions can tolerate even higher populations, as many as nine or 10 larvae per square foot, without measurable yield loss. Infestations in later stages of crop development are less damaging than early ones because established plants can compensate for considerable defoliation and larvae normally finish feeding before wheat enters reproductive stages.

### **Mixed populations**

Mostly the same insecticides are registered for control of these species of worms, but higher rates are recommended for fall armyworm. Any fields with mixed populations should be treated with the fall armyworm rate.

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#### 4. Sorghum development and potential freeze injury

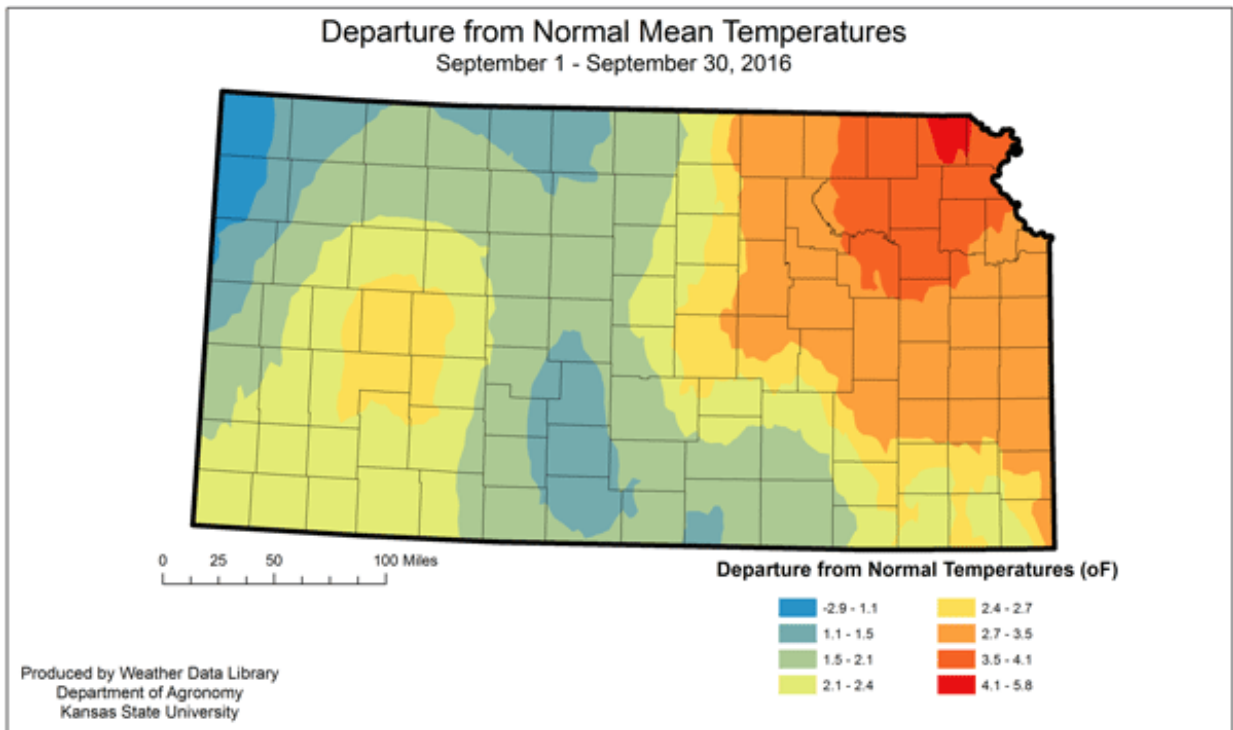
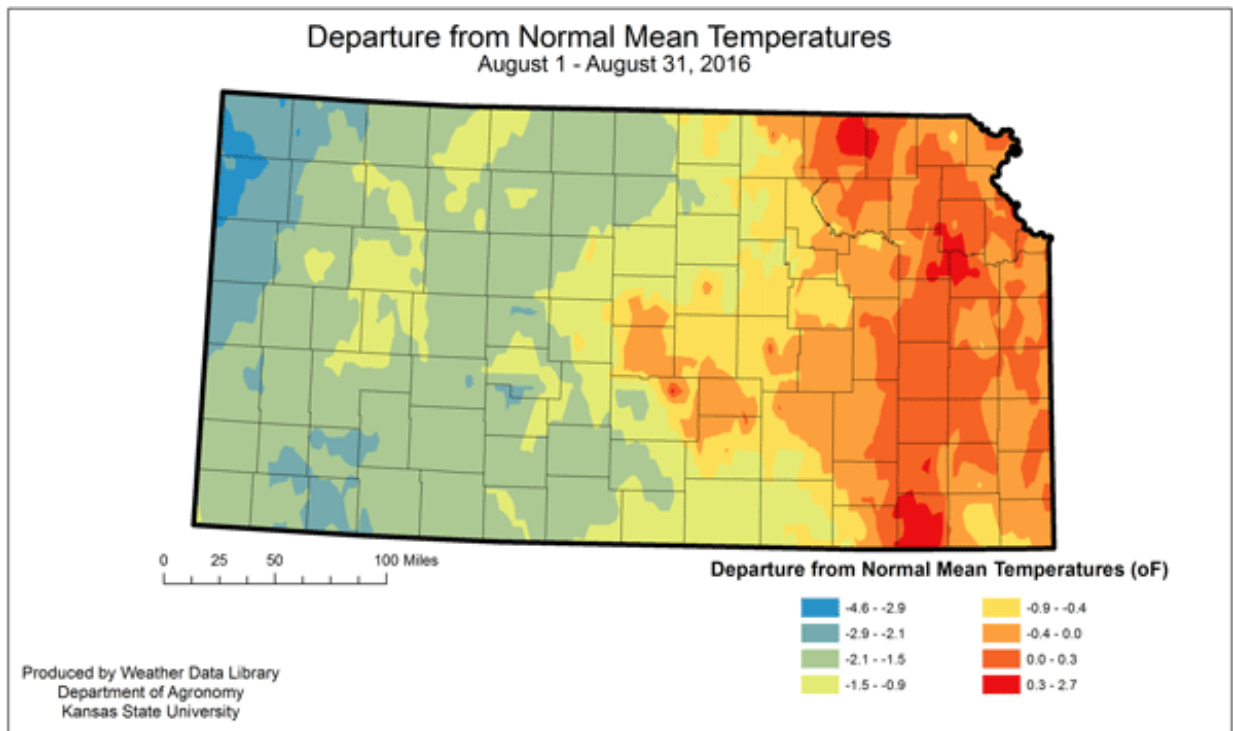
The latest “Crop Progress and Condition” report from Kansas Agricultural Statistics, on October 3, stated that grain sorghum maturity and harvest are ahead of normal overall this season. Still, this is not the case across all different crop reporting districts.

Therefore, the main question at this point is: Will remaining sorghum reach maturity before first freeze? The answer is, “it depends.” There are two main factors involved: 1) weather conditions and how they affected the development of sorghum during the season, and 2) crop phenology -- when the crop was planted, hybrid maturity, and the date of half-bloom. Further details on sorghum growth and development can be found at: <https://www.bookstore.ksre.ksu.edu/pubs/MF3234.pdf>

##### **Weather component**

Wet conditions at planting time delayed sorghum planting in some areas of the state, delaying heading. During August, cooler-than-normal temperatures dominated the western half of the state, with the greatest departure in the northwest at 3 to 5 degrees below normal. The warmest conditions were in the eastern divisions with a few pockets at nearly 3 degrees warmer than normal (Fig. 1, upper panel). In contrast, September mean temperatures were above normal across most of the state. Only extreme northwest Kansas had temperatures below normal, with the coolest areas having a departure of almost 3 degrees below normal. In contrast, the eastern divisions had departures ranging from 3.5 to almost 6 degrees warmer than normal (Fig. 1, lower panel).

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. Recent K-State research published by Prasad, Djanaguiraman, Perumal, and Ciampitti found that high temperature stress around flowering time (5-days before and after flowering) could impact sorghum’s final grain number. Also, K-State researcher Vara Prasad and others found that high temperature stress after growing point differentiation (approximately 30 days after emergence) delayed heading and decreased seed set (number and size), affecting final yields.



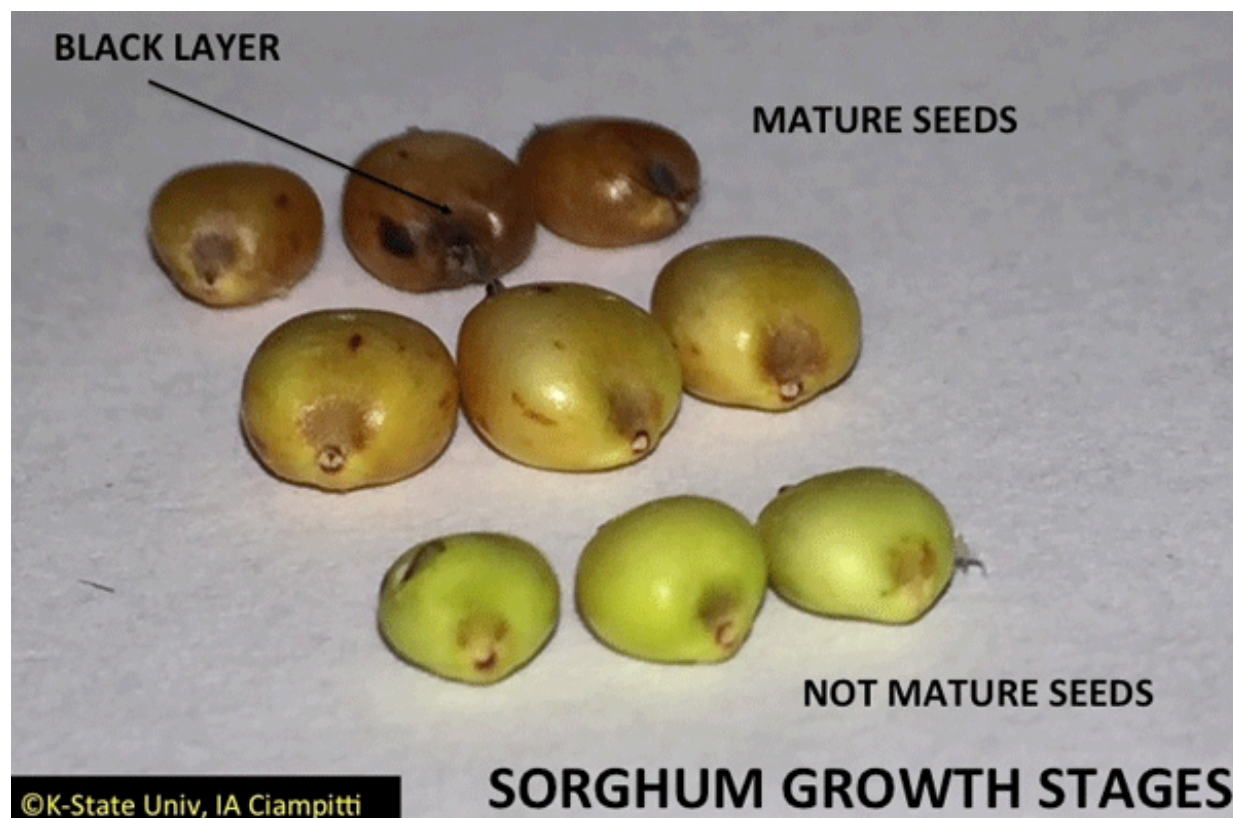
**Figure 1. Departure from monthly mean temperature for the August and September 2016.**

Sorghum is also sensitive to cold temperatures during most of its growth period. Temperatures below 40 degrees F will inhibit sorghum growth. Previous K-State research by Staggenborg and Vanderlip documented the impact on the grain weight early during the grain-filling period when

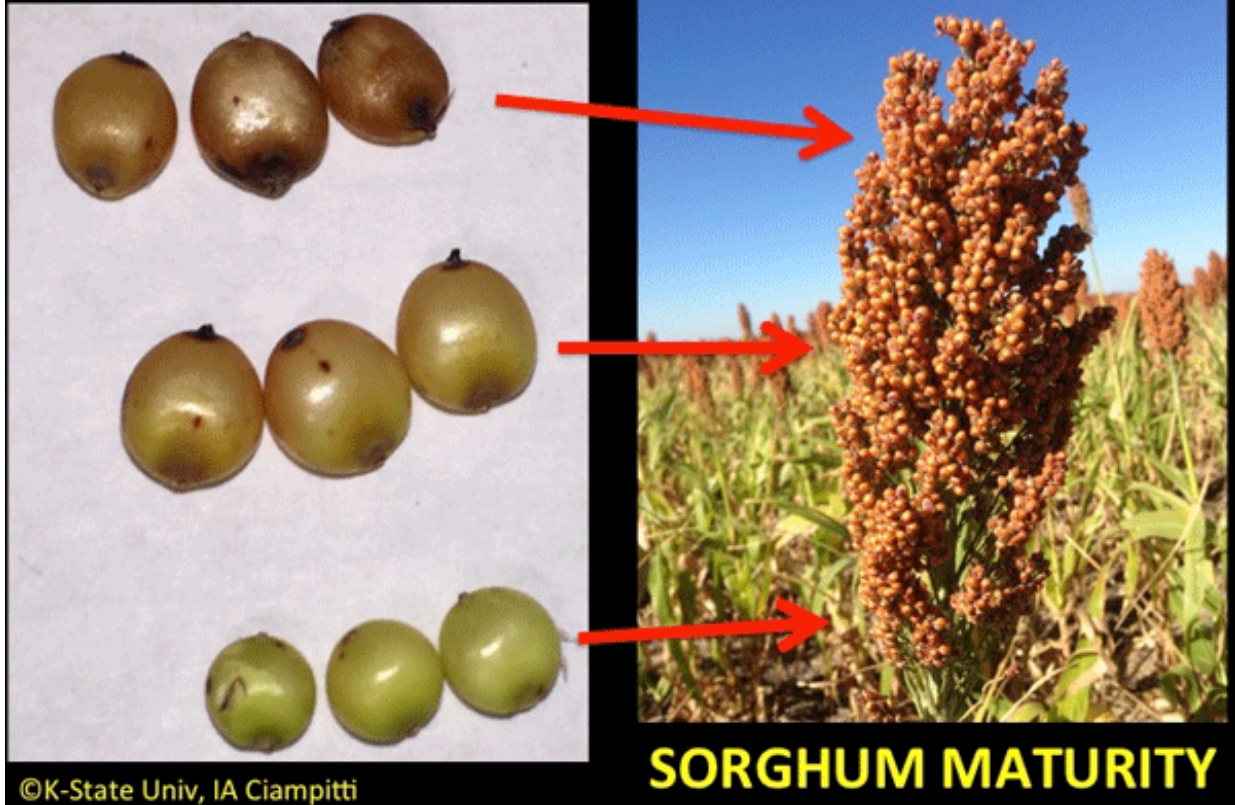
temperatures were below 30 degrees F. The low temperatures at this time caused lower photosynthetic rates and the inability of the plant to translocate carbohydrates to the developing grains. From mid-August until this current week (Oct 6, 2016), the lowest minimum were close to 30 degrees F in a small area of the western section of the state but temperatures below 35 degrees F for the rest of the counties across the state.

### Crop's life cycle progression

The amount of time between emergence and half-bloom will depend on the planting date and the temperatures (cumulative growing degree days) during this period. There are also hybrid differences in the amount of time it takes to go from emergence to flowering. Short-season hybrids have a shorter time from emergence to blooming; while full-season hybrids will need more degree days to reach flowering. The overall cumulative GDD from flowering to maturity (seen as a "black-layer" near the seed base; Fig. 2) is about 800-1200 (based on 50 degrees F as base temperature), with the shortest requirement in GDD for short-season hybrids. From maturity to harvest time, sorghum grain will dry down from about 35 to 20 percent moisture, but the final maximum dry mass accumulation and final nutrient content will have already been attained at maturity.



## MATURITY differences within the HEAD



**Figure 2. Black-layer identification in sorghum. Differences in maturity are related to the position within the head. Photos and infographic by Ignacio Ciampitti, K-State Research and Extension.**

The likelihood of sorghum maturing before a freeze is related to all of these factors. 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.

### **Probability of sorghum maturing before freeze for different flowering dates**

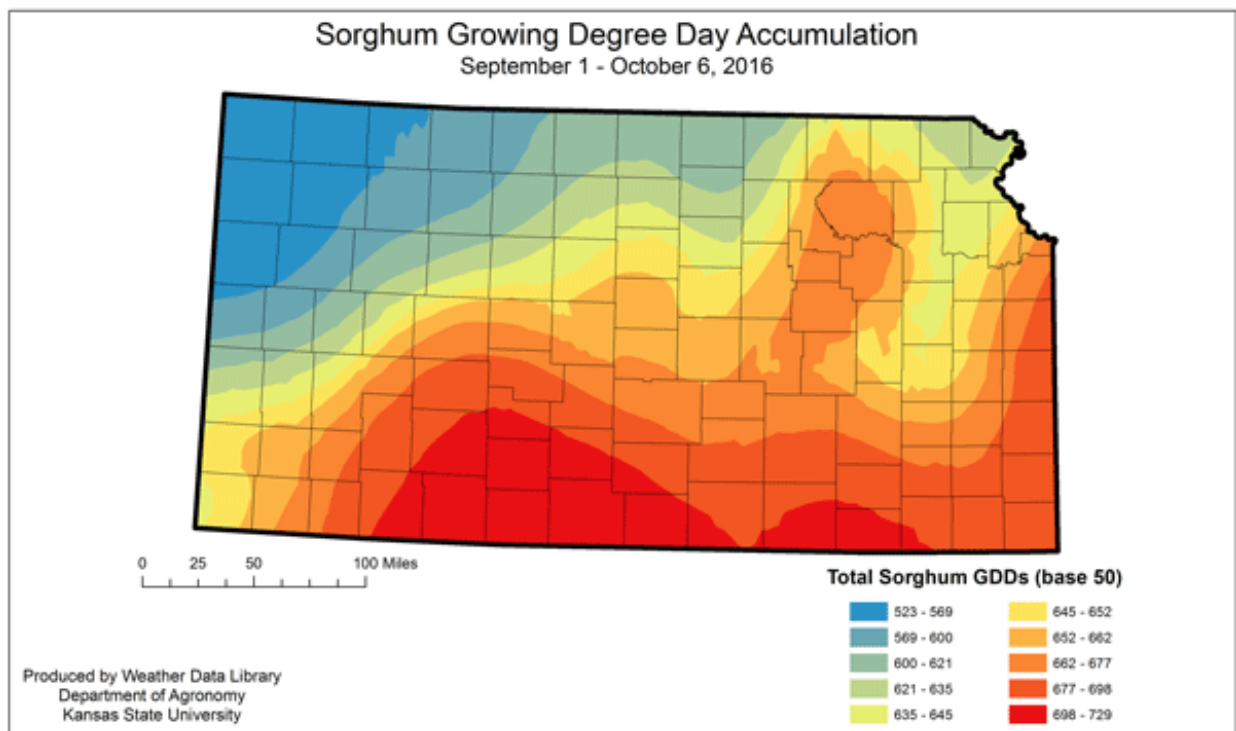
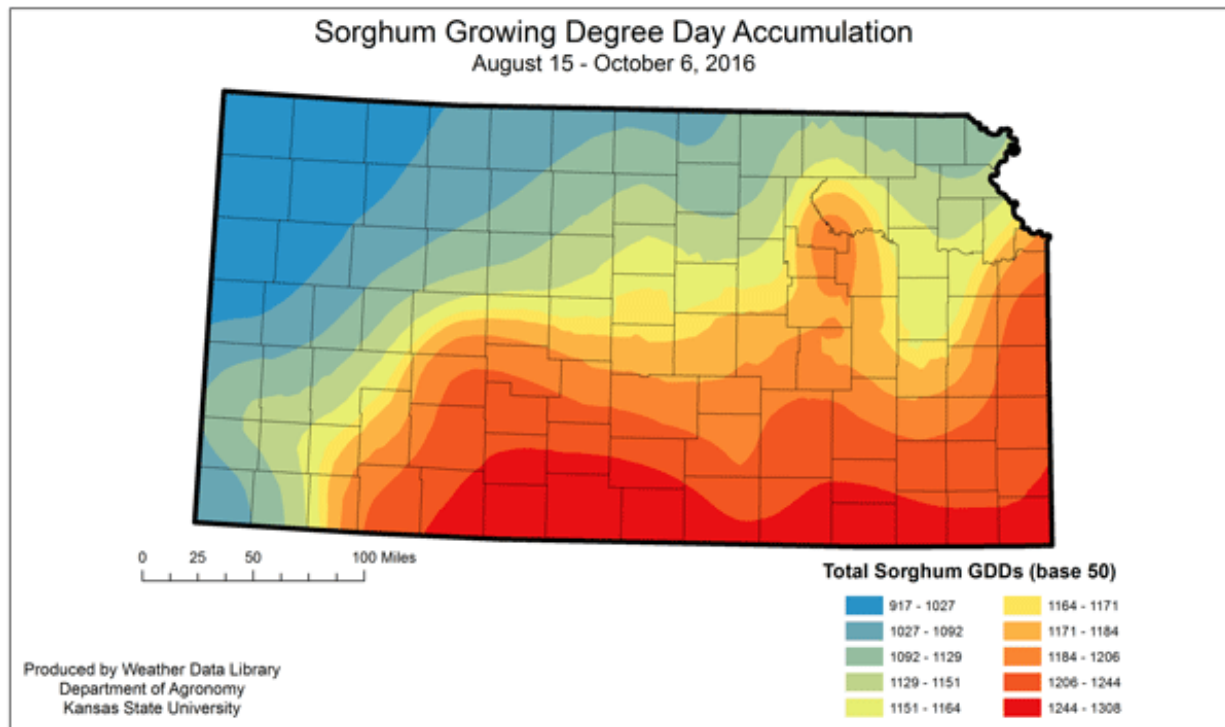
The maps in Figure 3 show accumulated GDDs up to October 6 for the current growing season, starting at two different points: mid-August and early September. Lower GDDs are depicted with blue colors, while higher GDDs are represented in red colors.

If blooming occurred during mid-August the likelihood for maturing before freeze is high in most of the areas of the state that have accumulated 1100 GDDs (Fig. 3). There are some areas of the state where sorghum GDDs accumulation was below 1100 (primarily related to green colors in Fig. 3). Those areas will have a slight lower chance of maturing (having accumulated less than 1200 GDDs) before the first freeze. A worst picture is projected for the extreme northwestern area of the state (blue colors in Fig. 3). In this case, there is a lower probability of maturing before the first freeze (low GDDs, <1000) but it will depend also on the hybrid maturity.

If blooming occurred during early-September the likelihood for sorghum maturing before freeze is



low for the southern part of the state (red color in Fig. 3), presenting a cumulative GDD from early-September to early-October around 700 units; while the probability is extremely reduced once for the sorghum area in direction to the northwestern section of the state, with a cumulative GDD below 650 units.



**Figure 3. Accumulated Growing Degree Days (expressed in degrees F) for August 15-October 6 and September 1- October 6. The maps show that for sorghum that reached half-bloom on**

**September 1, prospects are less certain especially in northwest Kansas. The darker the red, the higher the number of accumulated GDDs.**

### **Management considerations**

From a management perspective, the best way to mitigate this issue is to plan in advance. Recommended practices are just related to improve the use of different hybrid maturity and a different planting date:

- Use early planting dates for full-season hybrids, or
- When planting later, use medium- to short-season hybrids

If the sorghum is killed by a freeze before maturity, producers should first analyze the crop for the test weight and yield potential before deciding whether to graze or harvest the grain sorghum for silage.

For more information on this, see "Harvesting Grain from Freeze-damaged Sorghum," K-State publication MF-1081: <http://www.ksre.ksu.edu/bookstore/pubs/mf1081.pdf>

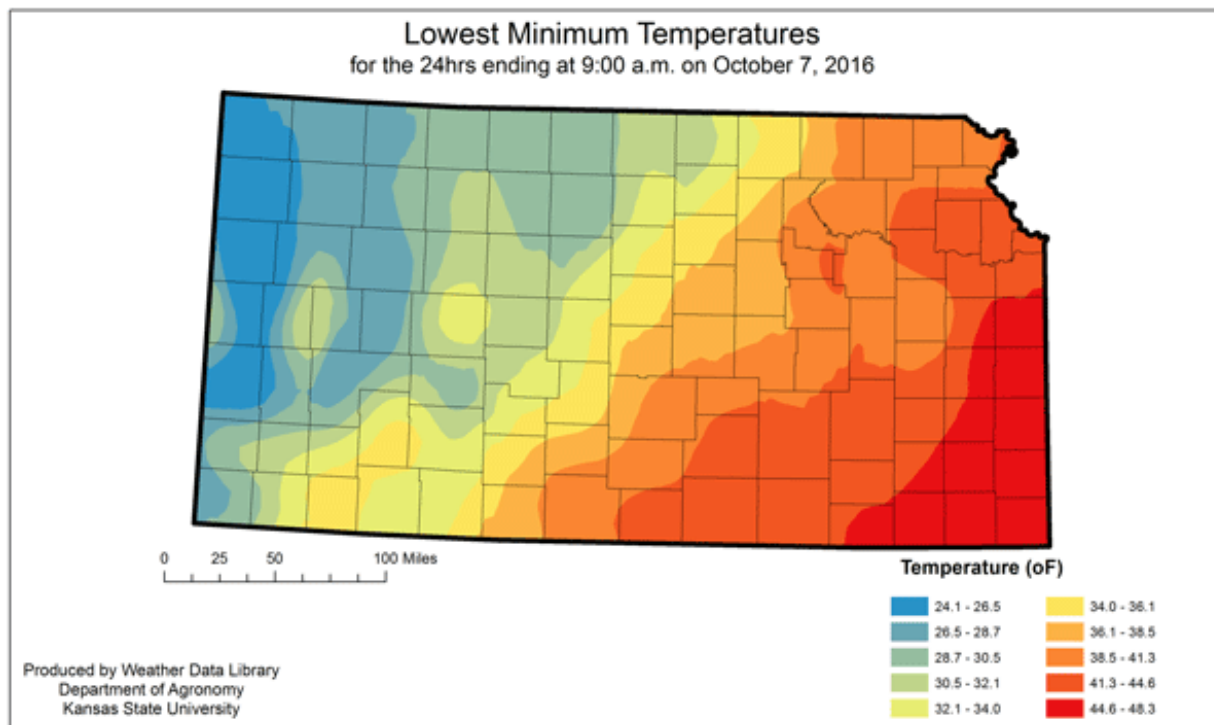
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## 5. Temperatures below freezing: A concern for summer row crops?

Minimum air temperatures for October 7 dropped well below 30 degrees F in the north central and western regions of Kansas, which could pose a problem during the grain filling period of the summer row crops. The eastern and south central parts of the states did not get as cold on that date (Figure 1).

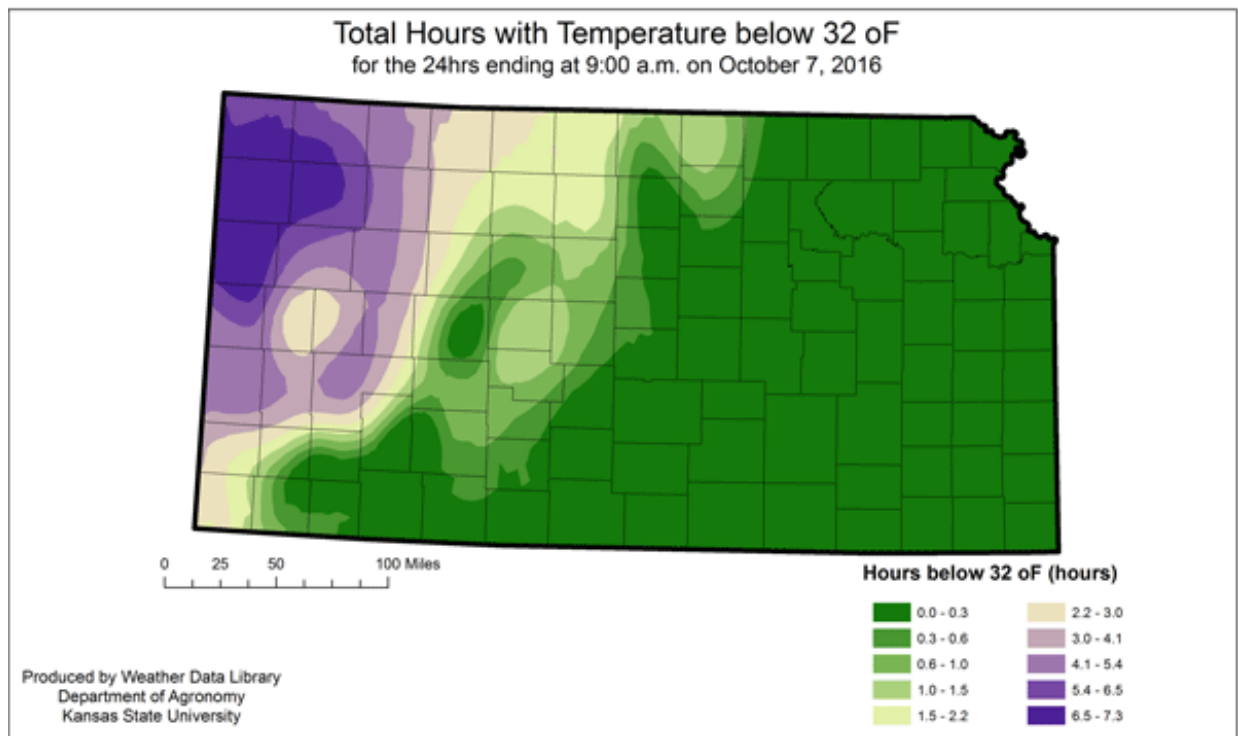
The risk of damage to summer row crops is a function of the current developmental stage of the crop and also related to the minimum temperature and the duration.



**Figure 1. Lowest minimum temperatures measured on October 7.**

### **Duration of damaging temperatures**

The coldest temperatures on October 7 were in the northwest corner of Kansas, where air temperatures were below 32 degrees F for more than 6 hours (Figure 2). The eastern and central parts of the state had temperatures close to 32 degrees F with minimum exposure to temperatures low enough to have a consistent impact on grain filling and final yields. Other areas had temperatures below 32 degrees F, ranging in duration from 2 to more than 6 hours (Figure 2).



**Figure 2. Total hours of air temperatures below 32 degrees F measured on October 7.**

### **Effect on summer row crops**

#### A) Corn:

In most of the state corn is mature (91% based on the most recent USDA Crop Progress and Condition report). Corn can be affected when temperatures are below or at 32 degrees F. The colder below 32 degrees, the less exposure time it takes to damage the corn. However, corn is not affected once the black layer is formed.

#### B) Soybean:

Soybean is now in the final reproductive stages (dropping leaves) in Kansas (56% dropping leaves based on the most recent USDA Crop Progress and Condition report). Temperatures below 32 F can interrupt seed fill and impact yield through lower test weight and seed quality (primarily affecting protein deposition). Necrosis of the leaf canopy is a visible symptom of freeze damage in soybeans. With soybean, absolute temperature is more important than the duration of the cold stress. The most severe injury occurs with temperatures less than 28 F. As the crop approaches maturity, the impact of a freeze event on soybean yields declines.



*C) Sorghum:*

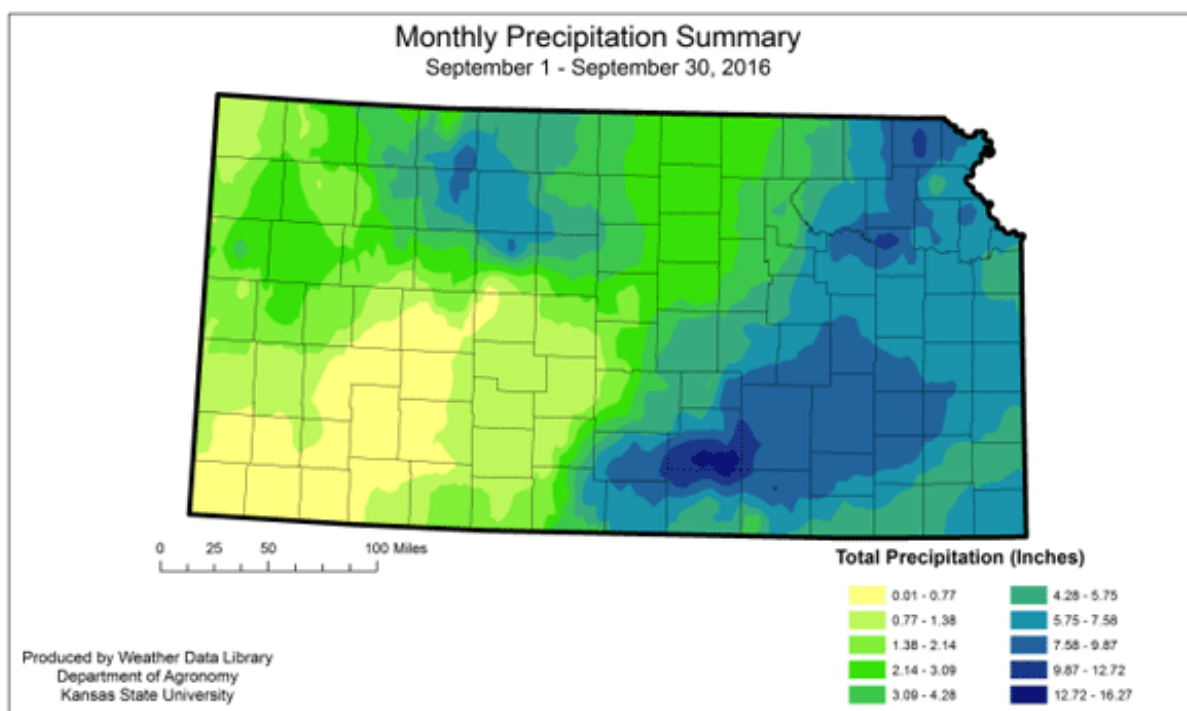
More than half of the sorghum in Kansas has already reach maturity (63% mature based on the most recent USDA Crop Progress and Condition report). The lowest proportion of sorghum mature across the state is in the north central (33% mature) and northwest (58% mature) areas of the state. Low temperatures will reduce seed growth and affect final test weight and seed quality, making the harvest process more difficult. A freeze will kill sorghum if the stalks are frozen, impairing the flow of nutrients to the grain. A freeze at the hard dough stage (before grain matures) will result in lower weight and chaffy seeds.

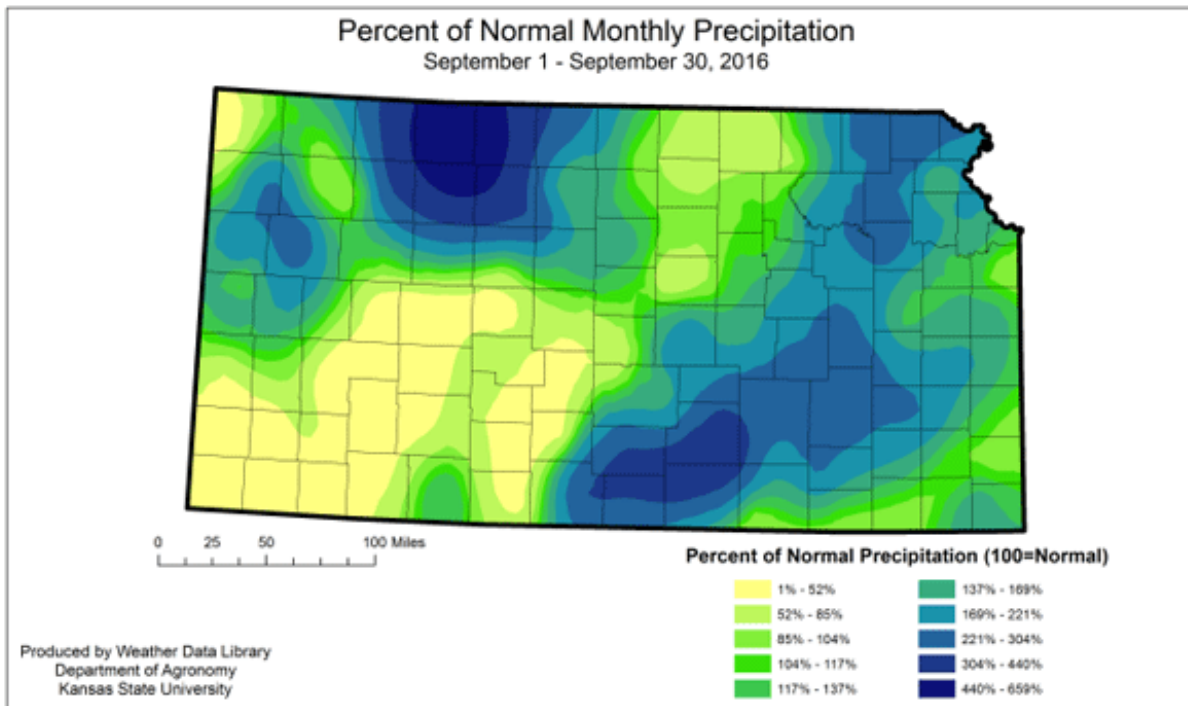
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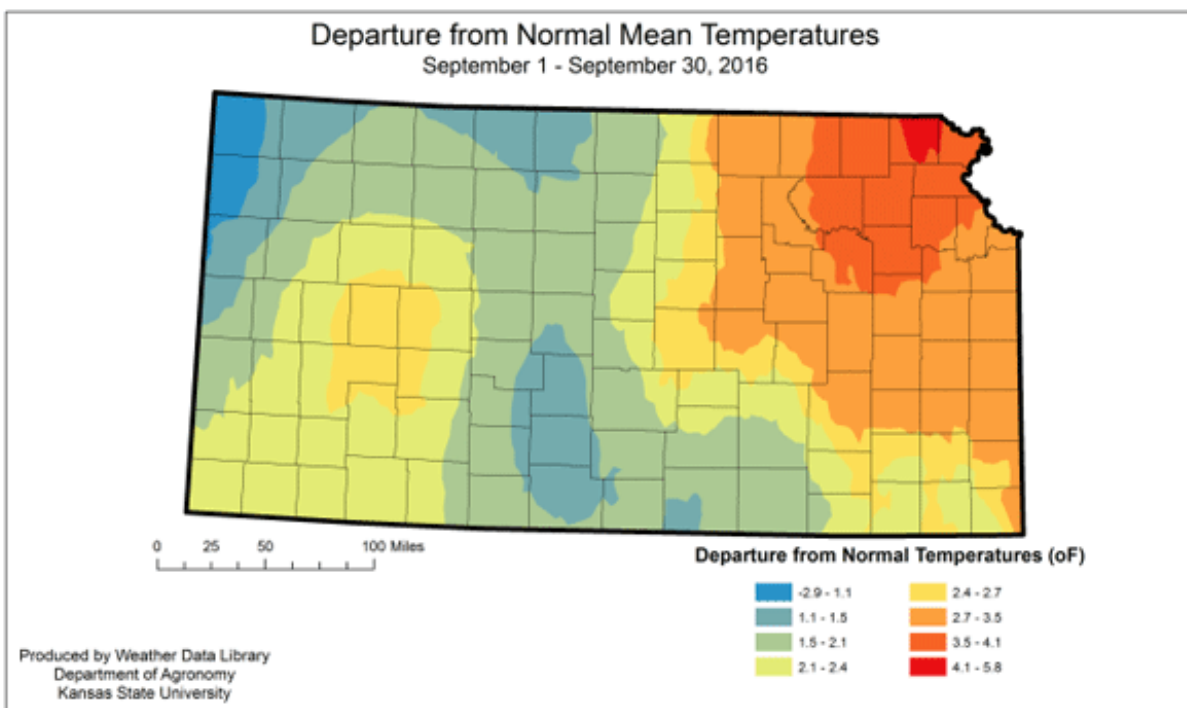
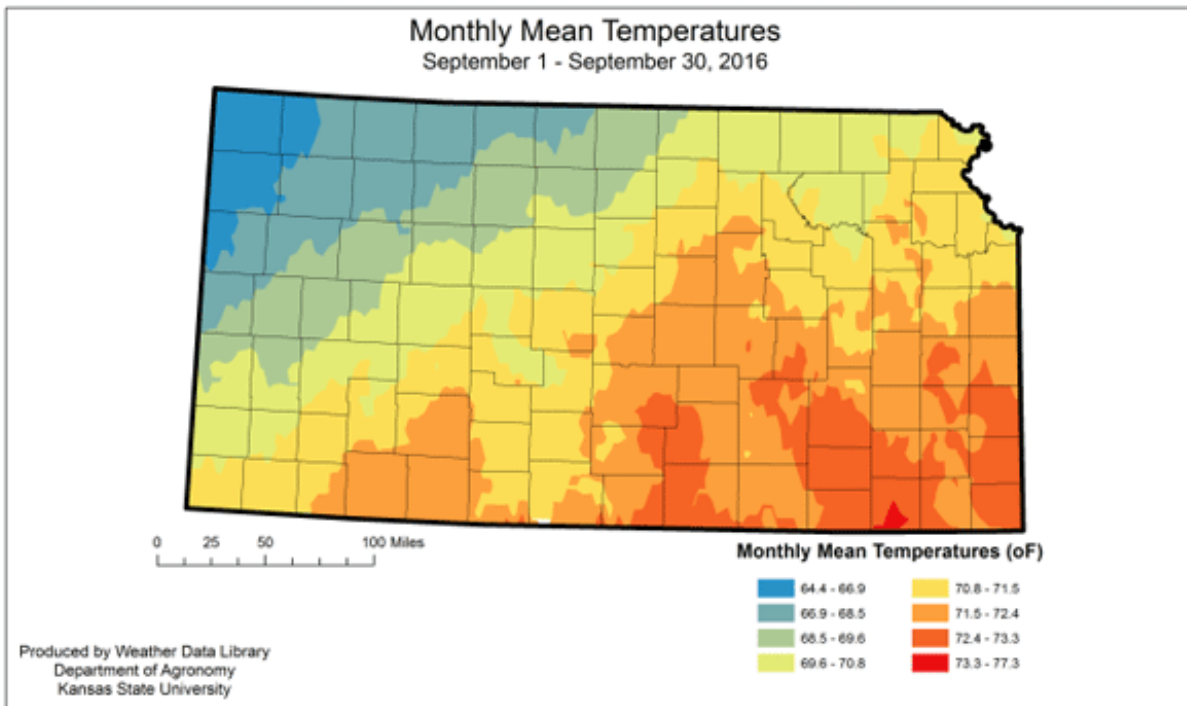
## 6. Kansas weather summary for September 2016: Warm with a wet tilt

Statewide average rainfall for September was well above normal. The statewide average was 4.15 inches, or 148 percent of normal. However, the distribution was skewed to the Northeast and South Central Divisions. The Southwest Division missed out on most of the rainfall. The Southwest Divisional average was just 0.62 inches, or 37 percent of normal. The West Central Division was also below normal, although less dramatically. The average for the West Central Division was 1.57 inches, or 97 percent of normal. In contrast, the South Central Division averaged 5.87 inches, or 206 percent of normal. However, this excess moisture was concentrated heavily in the southern Sedgwick County area, where the Haysville and Clearwater areas had the heaviest totals for the month. This September ranks as the 20<sup>th</sup> wettest in the 122 years of record. The wettest September on record occurred in 1973, when the statewide average total was 8.32 inches. With the overall wet pattern, it is no surprise that there were 138 new record daily rainfall totals. Of those, 11 reports set new monthly records and seven set new all-time records as well. The greatest 24-hour total was at CoCoRaHS station: 9.32 inches at Clearwater 3.9 NNE, Sedgwick County, on the 9th. Highest monthly totals: 15.56 inches at Haysville 3SE, Sedgwick County (NWS) and 16.27 inches at Clearwater 7.0 N, Sedgwick County (CoCoRaHS).





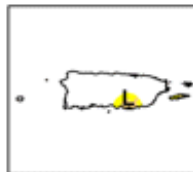
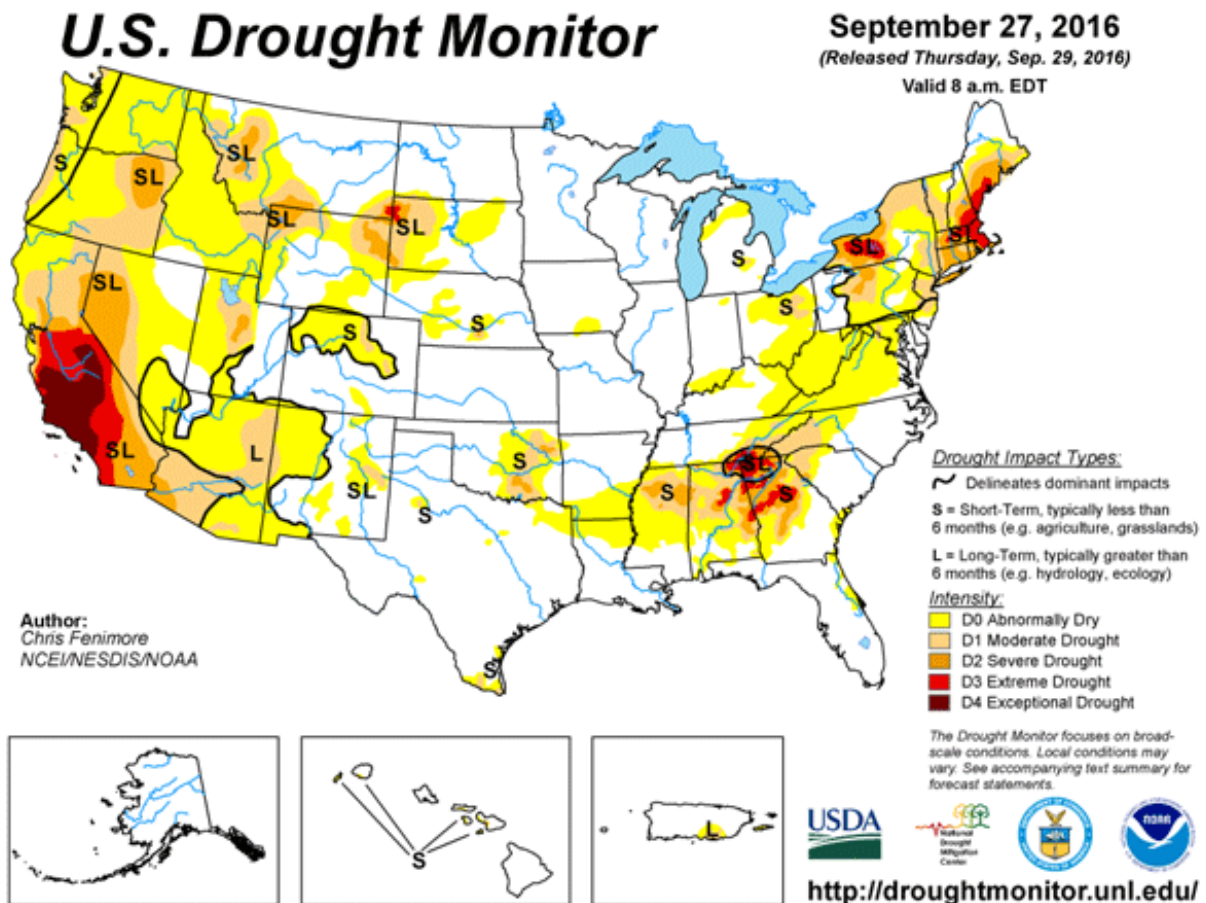
Temperatures were warmer-than-normal across the state in September. The statewide average temperature was 70.7 degrees F, or 3.0 degrees warmer than normal. This was the 32<sup>nd</sup> warmest since 1896, which places it on the warm side of the distribution range. The Northwest Division was closest to normal for the month. Its average was 67.1 degrees F, or 2.3 degrees warmer than normal. The warmest division was the Northeast Division where average temperature was 71.5 degrees F, or 4.5 degrees warmer than normal. There were 2 events that tied the daily record high temperature, when Girard and Pomona Lake reached 90 degrees F on the 20<sup>th</sup>, breaking their previous records of 89 degrees F set in 1998 and 1986 respectively. In contrast, there were no new record low maximum temperatures or minimum temperatures set. There were 27 new record warm minimum temperatures set. Of those, one set a monthly record. That was the 72 degrees F reported for the low temperature at the Garden City Experiment Station on September 6<sup>th</sup>. The previous record was 71 degrees F set on September 1, 1964. The highest temperature recorded was 100 degrees F reported at Hudson, Stafford County, on the 19<sup>th</sup>. The coldest temperature recorded for the month was reported as 31 degrees F at Brewster 4W, Thomas County, on the 27<sup>th</sup>.

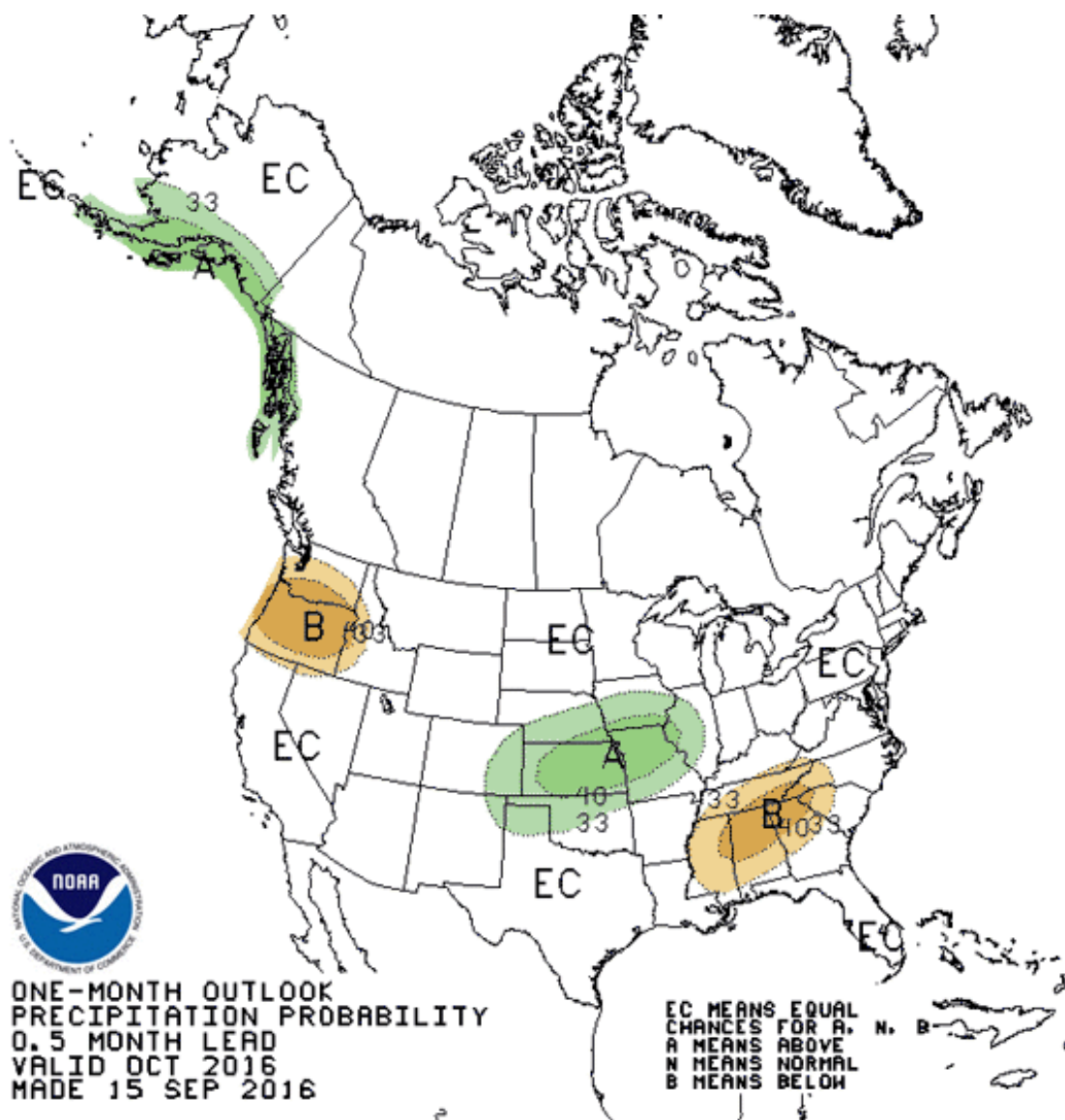


Severe weather was also a factor, although not to the degree that was seen in August. There were a total of 38 hail reports and 29 damaging wind reports in the month. There were 81 flood/flash flood reports, including several swift water rescues.



Above-normal precipitation coupled with near-normal temperatures allowed for removal of the abnormally dry conditions across the state. On the other hand, the continued below-normal rainfall in the western divisions coupled with warmer than normal temperatures increase the likelihood that abnormally dry conditions will return, particularly in the Southwestern Division.





Sep 2016

**Kansas Climate Division Summary**

	Precipitation (inches)			Temperature (°F)				Monthly Extremes		
	Sep 2016	2016 Jan. through Sept.		Ave	Dep. <sup>1</sup>	Max	Min			
Division Total	Dep. <sup>1</sup>	% Normal	Total	Dep. <sup>1</sup>	% Normal					
<b>Northwest</b>	3.25	1.74	205	19.15	0.69	103	67.1	2.3	97	31
<b>West</b>	1.54	-0.05	97	18.48	0.54	102	69.0	3.0	99	35
<b>Central</b>										
<b>Southwest</b>	0.62	-0.99	37	19.79	2.68	115	71.5	3.3	99	37

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<b>North Central</b>	3.79	1.18	167	28.73	4.73	120	70.0	2.5	96	38
<b>Central</b>	2.94	0.44	113	28.73	3.65	114	71.2	2.6	98	38
<b>South Central</b>	5.87	3.27	209	32.69	6.53	123	72.3	2.5	100	38
<b>Northeast</b>	6.52	2.92	182	32.39	3.01	109	71.5	4.5	95	44
<b>East Central</b>	6.23	2.58	168	33.01	1.63	104	71.3	3.4	93	44
<b>Southeast</b>	7.18	3.17	185	37.20	3.65	111	72.0	2.7	95	43
<b>STATE</b>	4.15	1.54	148	27.88	3.18	111	70.7	3.0	99	31

1. Departure from 1981-2010 normal value
2. State Highest temperature: 100 oF at Hudson, Stafford County, on the 19th.
3. State Lowest temperature: 31 oF at Brewster 4W, Thomas County, on the 27th.
4. Greatest 24hr rainfall: 8.31 inches at Hiawatha 9SE, Brown County, on the 14th (NWS); 9.32 inches at Clearwater 3.9 NNE, Sedgwick County, on the 9th (CoCoRaHS).

Source: KSU Weather Data Library

Mary Knapp, Weather Data Library  
[mknapp@ksu.edu](mailto:mknapp@ksu.edu)

## 7. Comparative Vegetation Condition Report: September 27 - October 3

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.

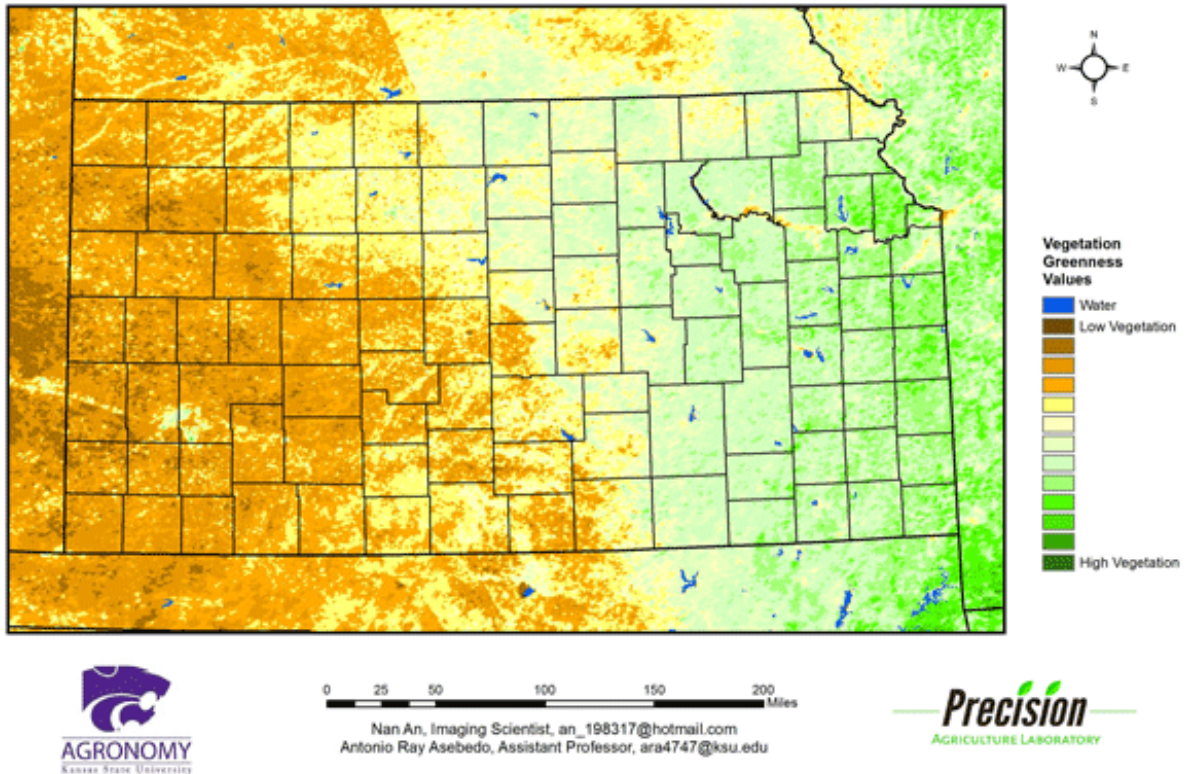
These improvements increase sensitivity for capturing more variability in plant biomass and photosynthetic capacity. However, the same format as the previous versions of the VCR maps was retained, thus allowing the transition to be as seamless as possible for the end user. For this spring, it was decided 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:



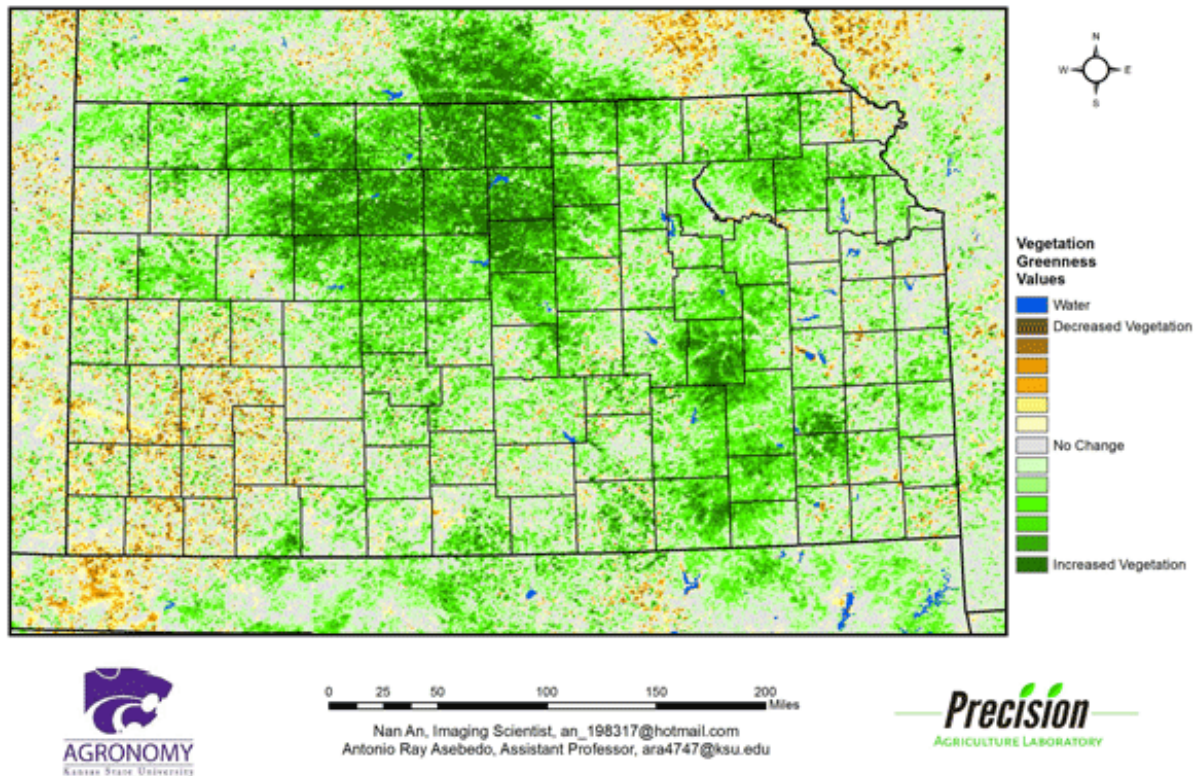
## Kansas Vegetation Condition

Period 40: 09/27/2016 - 10/03/2016



**Figure 1. The Vegetation Condition Report for Kansas for September 27 – October 3, 2016 from K-State’s Precision Agriculture Laboratory shows a continued decrease in the areas with highest NDVI values. Moderate NDVI values continue in the eastern portions of the state, with some lower levels in the river valleys. High streamflow levels have impacted vegetation in those areas. Vegetation continues to move into dormancy in the western areas of the state.**

Kansas Vegetation Condition Comparison  
Late-Sept/Early-Oct 2016 compared to the Late-Sept/Early-Oct 2015

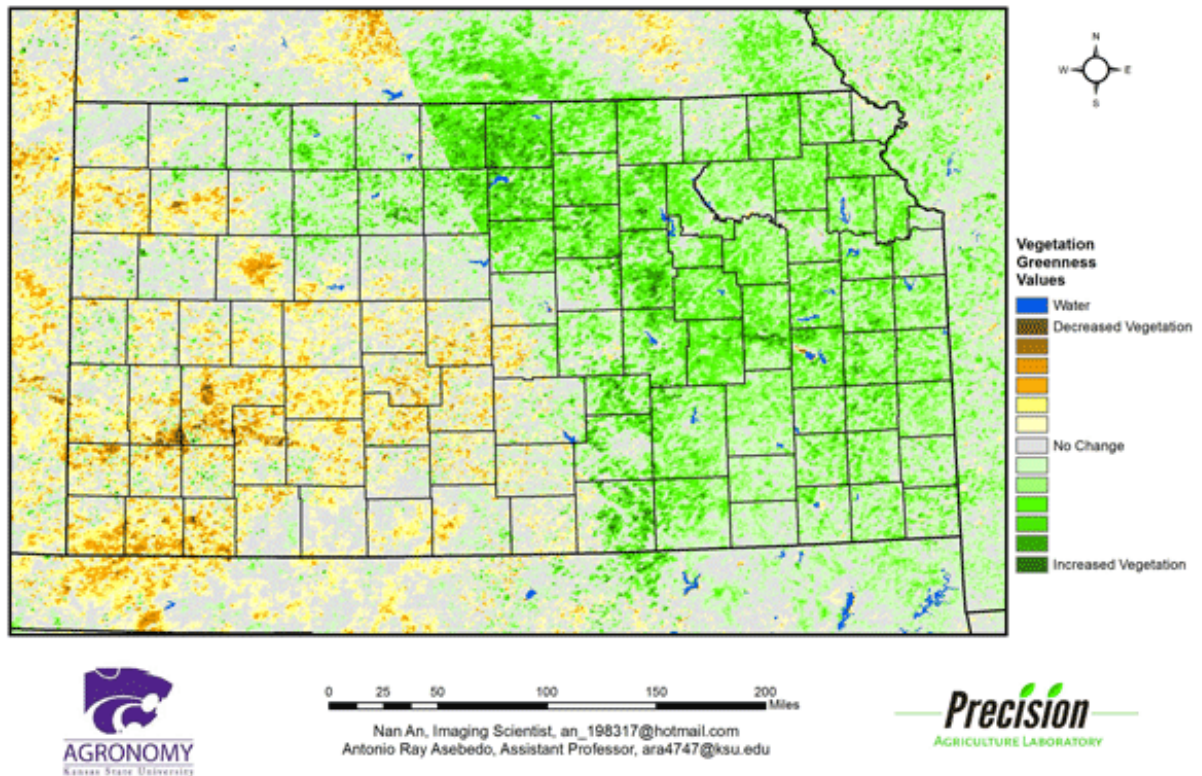


**Figure 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for September 27 – October 3, 2016 from K-State’s Precision Agriculture Laboratory shows the largest area of increased vegetative production is in north central Kansas. This area has been favored with adequate moisture, not the excessive precipitation that has occurred to the east and the lower amounts to the southwest. The pockets of decreased photosynthetic activity are most visible in the Southwest Division where dry surface conditions have created problems for winter wheat.**



## Kansas Vegetation Condition Comparison

Late-Sept/Early-Oct 2016 compared to the 27-Year Average for Late-Sept/Early-Oct



**Figure 3. Compared to the 27-year average at this time for Kansas, this year's Vegetation Condition Report for September 27 – October 6, 2016 from K-State's Precision Agriculture Laboratory shows below-average vegetative activity concentrated in the western half of the state, with above-average NDVI values to the east. This matches the rainfall distribution for September, where the wetter-than-normal conditions were most widespread in the east.**

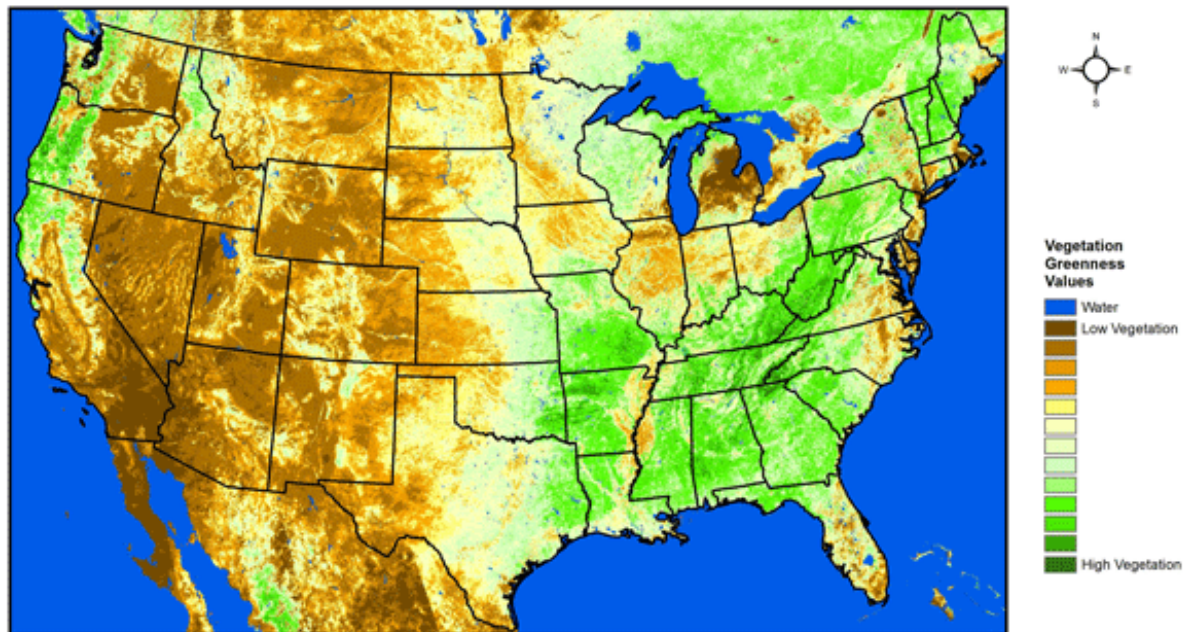
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## Continental U.S. Vegetation Condition

Period 40: 09/27/2016 - 10/03/2016



0 180 360 720 1,080 1,440 Miles

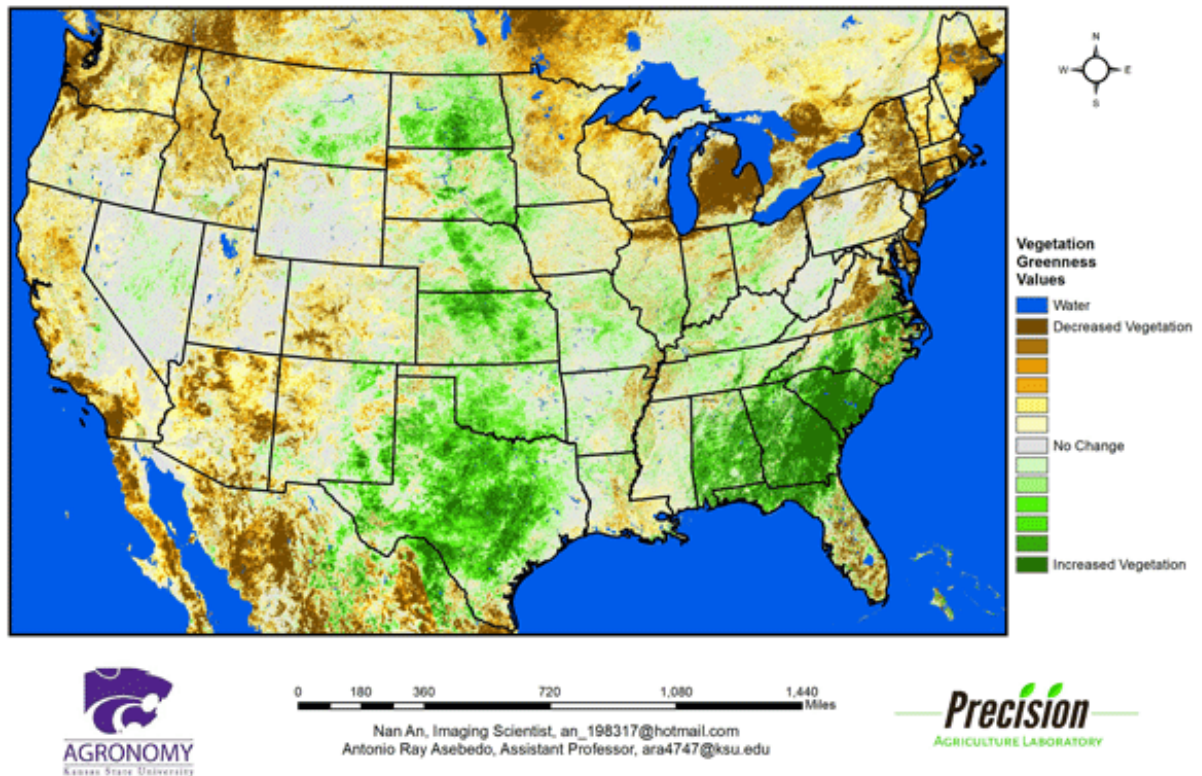
Nan An, Imaging Scientist, an\_198317@hotmail.com  
Antonio Ray Asebedo, Assistant Professor, ara4747@ksu.edu



**Figure 4. The Vegetation Condition Report for the U.S for September 27 – October 3, 2016 from K-State’s Precision Agriculture Laboratory shows the highest NDVI values are in New England, where mild temperatures have extended the growing season. Low NDVI values continue in Wisconsin where saturated soils remain a problem.**

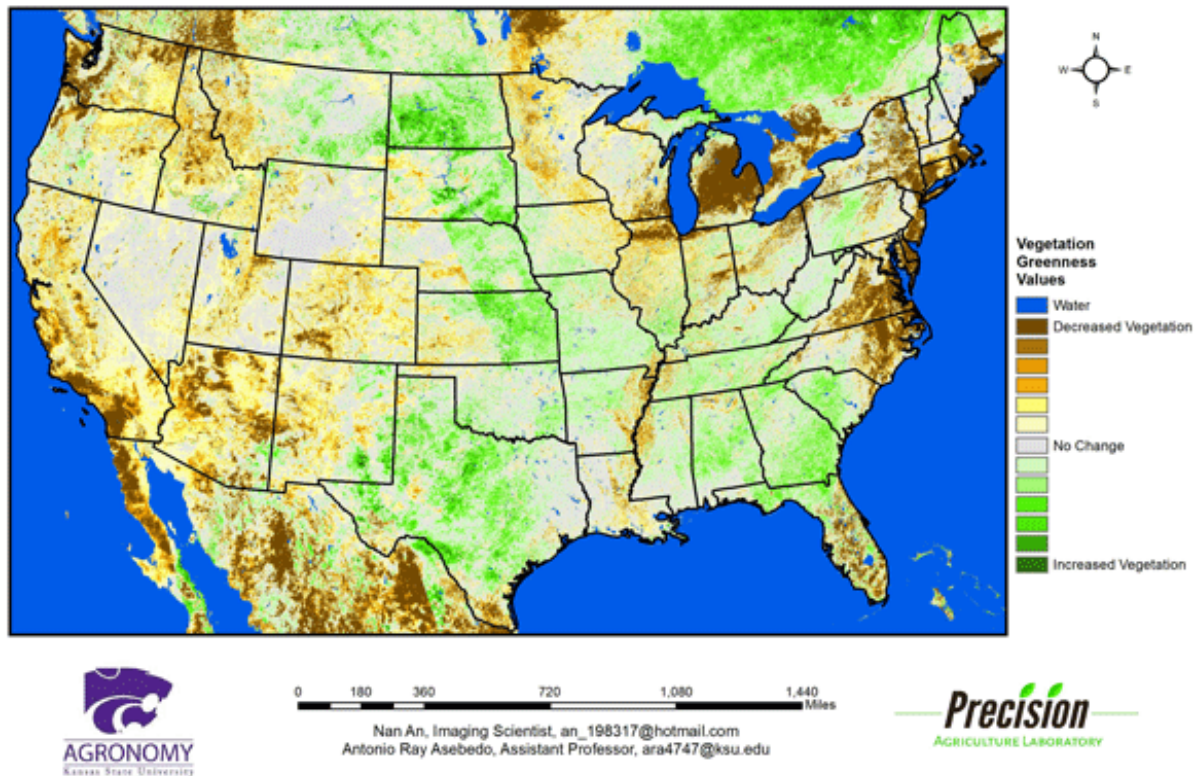


Continental U.S. Vegetation Condition Comparison  
Late-Sept/Early-Oct 2016 Compared to Late-Sept/Early-Oct 2015



**Figure 5. The U.S. comparison to last year at this time for September 27 – October 6, 2016 from K-State’s Precision Agriculture Laboratory shows that lower NDVI values are prevalent in the upper Midwest, particularly in Minnesota and Wisconsin. Persistent rain and cloud cover continues to mask vegetative activity in these areas. In contrast, the Plains and the Southeast have higher NDVI due to more favorable temperatures and moisture this year.**

Continental U.S. Vegetation Condition Comparison  
Late-Sept/Early-Oct 2016 Compared to 27-year Average for Late-Sept/Early-Oct



**Figure 6. The U.S. comparison to the 27-year average for the period September 27 – October 3, 2016 from K-State’s Precision Agriculture Laboratory shows below-average photosynthetic activity in the Upper Midwest. Heavy rains and saturated soils have limited photosynthetic activity in the region, particularly as the growing season comes to a close.**

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