



## Extension Agronomy

# eUpdate

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*06/16/2017*

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. Effects of recent high temperatures on wheat

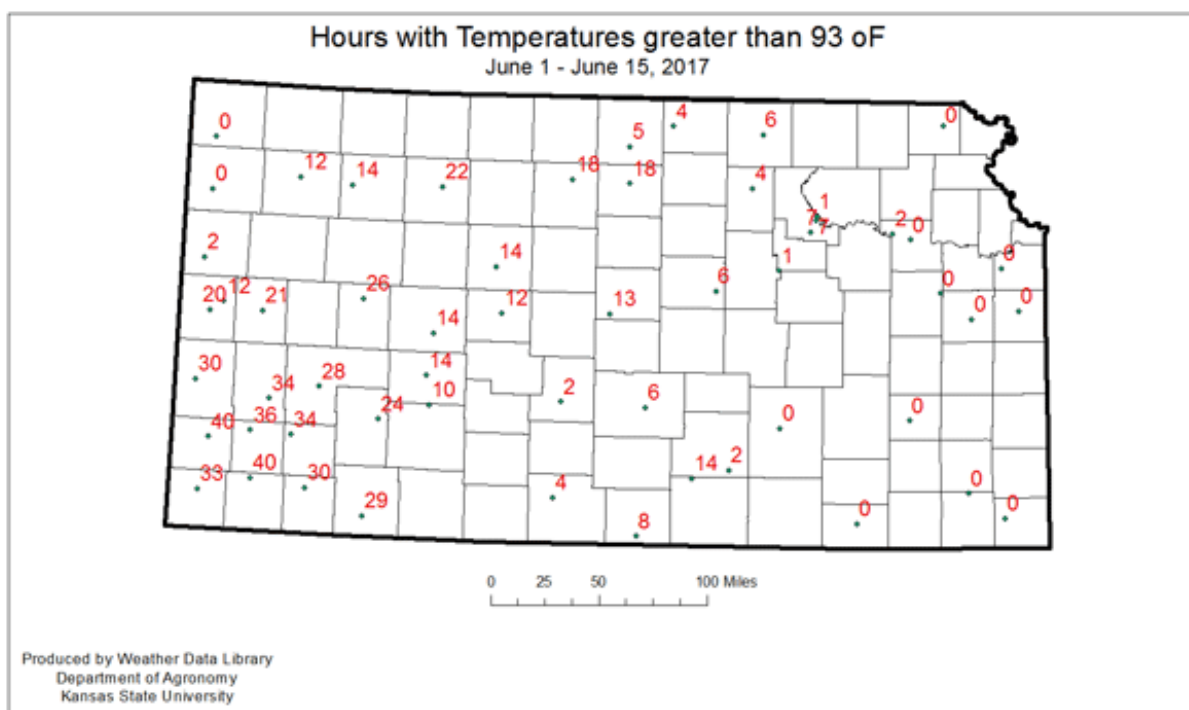
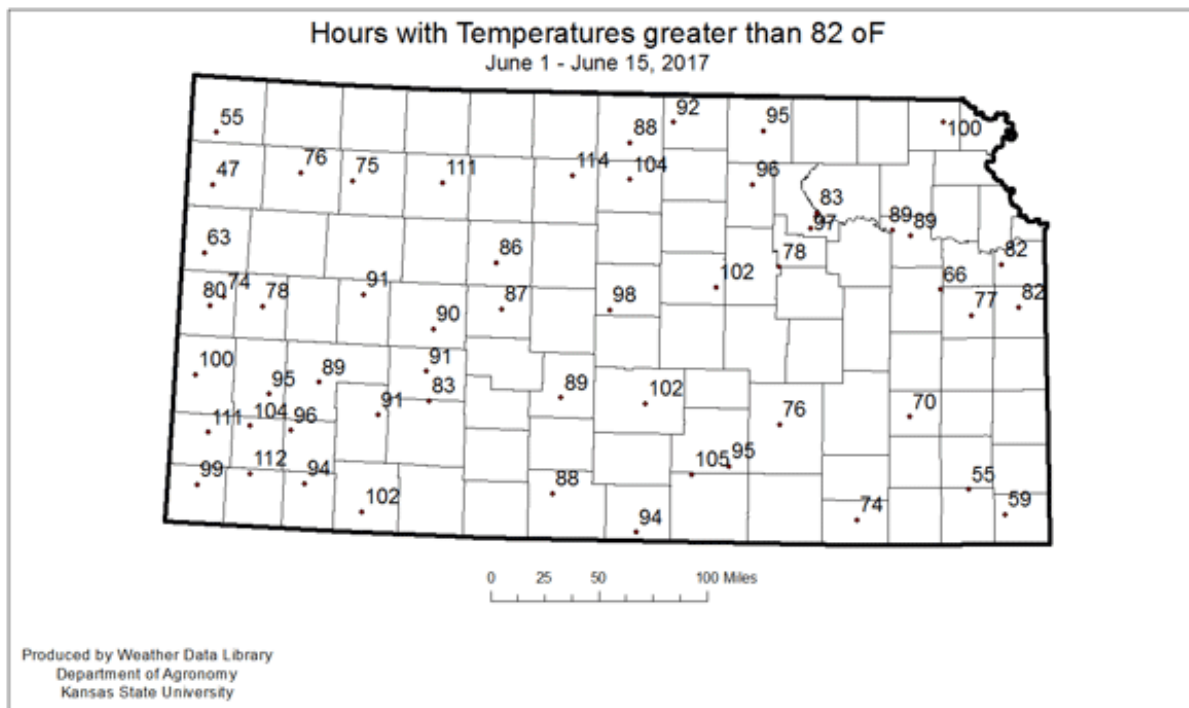
There have been some extremely high temperatures the last few weeks in Kansas. While this is not unusual for this time of year, the high temperatures have caught some of the wheat during early to mid-grain fill. Wheat in northwest, north central, and west central Kansas will likely be most affected by the heat stress this year since much of the crop in those regions was behind in development (mid-berry to late milk stage) and it is likely the hot temperatures matched more sensitive phases of the grain filling period there. In southeast and south central Kansas, the wheat is mostly mature and already being harvested, and should not suffer the consequences of heat stress.

### **What effect will these temperatures have on the wheat crop?**

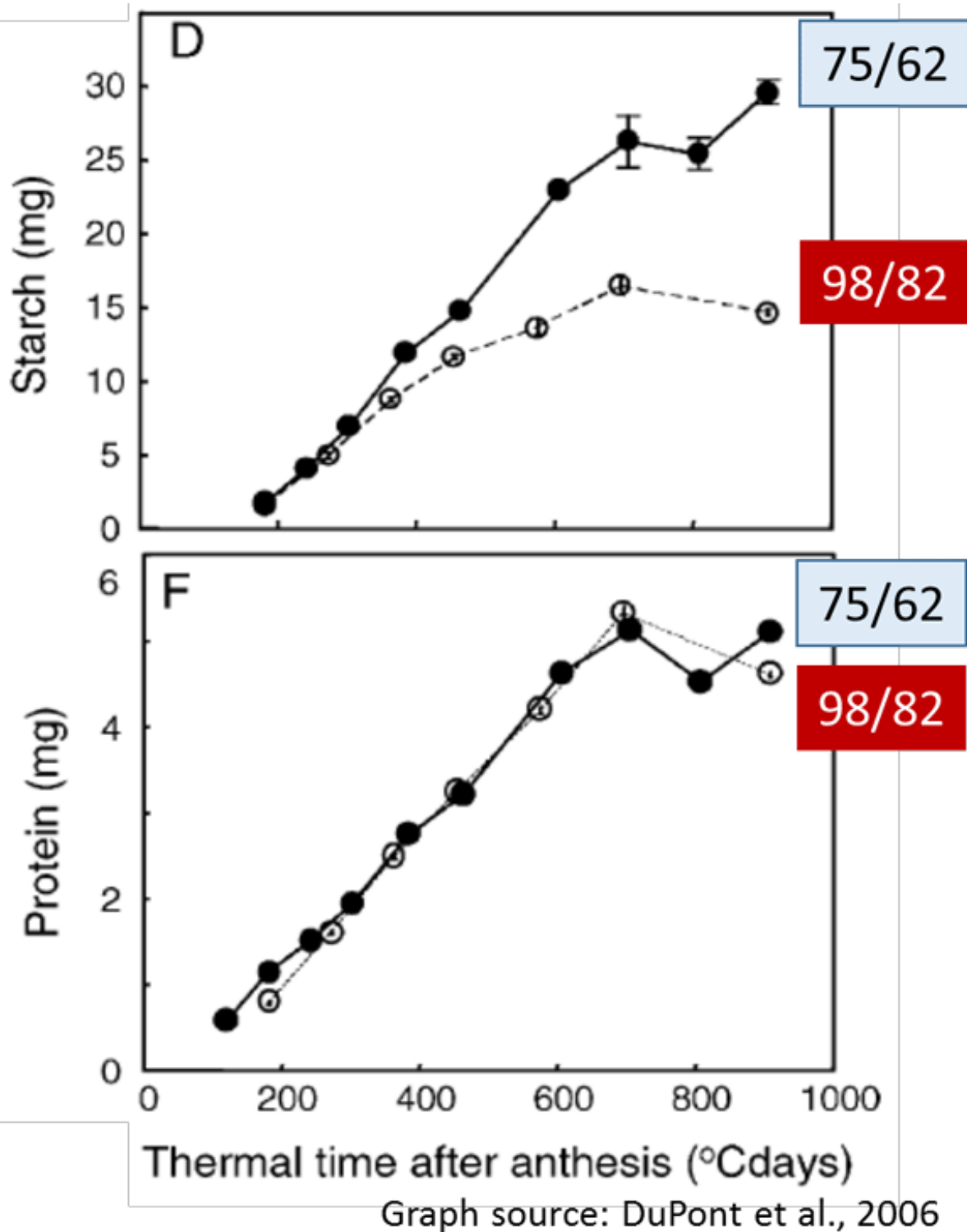
The effects of hot temperatures on wheat grain development and yield depend on the stage of development of the wheat, the moisture condition of the soil, and how long the extreme heat lasts.

Wheat begins to suffer when temperatures get above about 82 degrees F. At these temperatures, photosynthesis slows and stops but the rate of respiration continues to increase. Basically, the plants begin to use more sugars than they can produce by photosynthesis. We observed as much as 114 hours of temperatures above 82 F in the June 1 – 15 period (Figure 1), and 87 hours in the June 9-15 period, hours in which grain yield was likely not increased.

At about 93 degrees key enzymes begin to break down and stop functioning. As a result, the plant does not accumulate sugar (starch) in the grain during heat stress (Figure 2), which results in decreased wheat yield. Protein accumulation, on the other hand, seems to be unaffected by high temperatures and occurs normally under heat stress conditions (Figure 2). Due to a decrease in sugar accumulation coupled with normal rates of protein accumulation, wheat under heat stress tends to have a greater percent protein content. We observed as much as 40 hours of temperatures above 93 F in the June 1 – 15 period (Figure 1), and most of those hours were in the June 9-15 period, hours in which grain yield may be reduced.

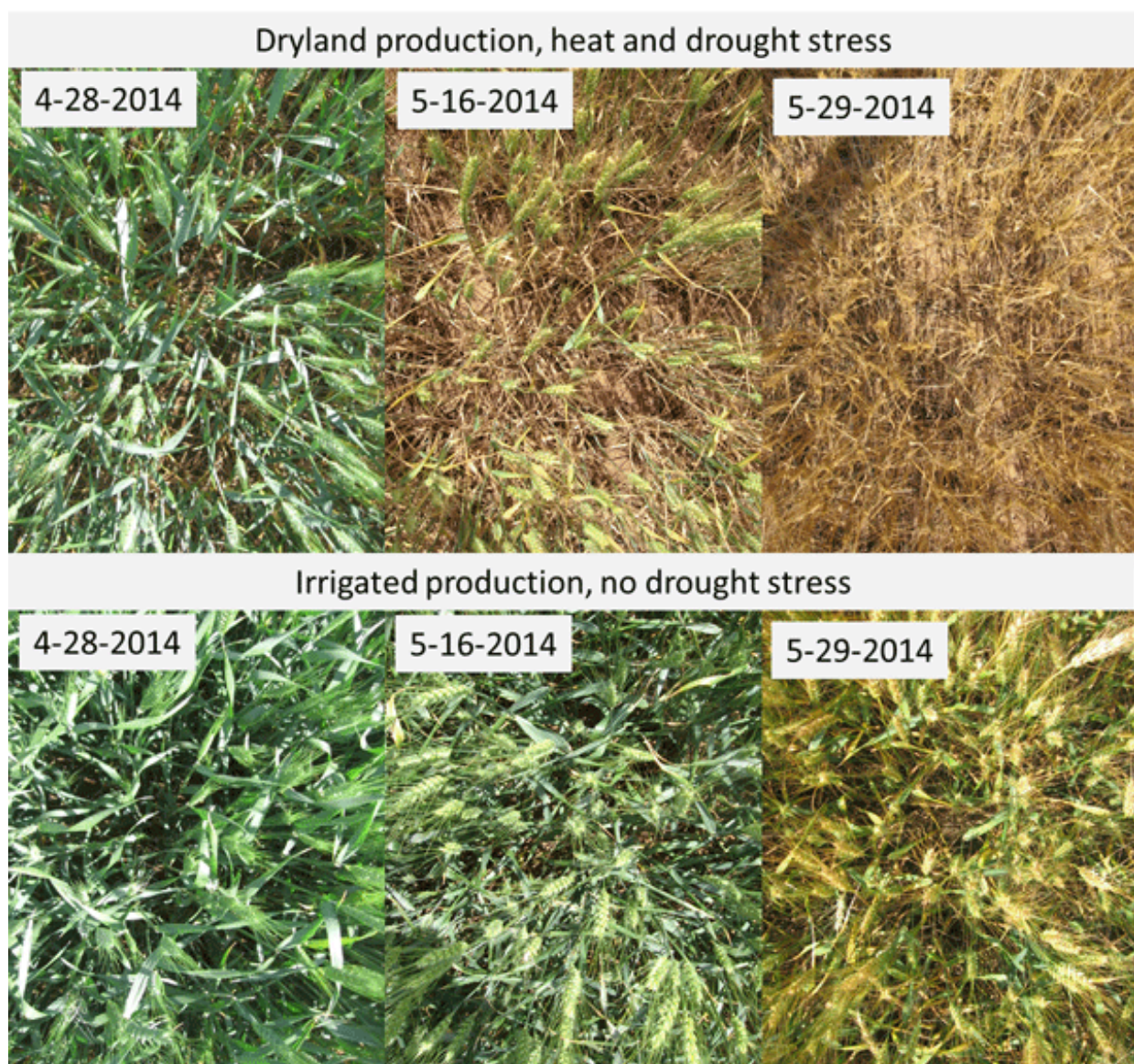


**Figure 1. Number of hours when temperatures were above 82 degrees Fahrenheit during the June 1 - 15 period (upper panel), and number of hours when temperatures were above 93 degrees Fahrenheit during the June 1 - 15 period (lower panel).**



**Figure 2. Effect of day and night temperatures (day/night) in two temperature scenarios (mild temperatures in the blue box and hot temperatures in the red boxes) on starch (upper panel) and protein (lower panel) accumulation on the wheat kernel. Source: Dupont, F.M., Hurkman, W.J., Vensel, W.H., Tanaka, C., Kothari, K.M., Chung, O.K., and Altenbach, S.B. 2006. Protein accumulation and composition in wheat grains: effects of mineral nutrients and high temperature. *European Journal of Agronomy* 25(2):96-107.**





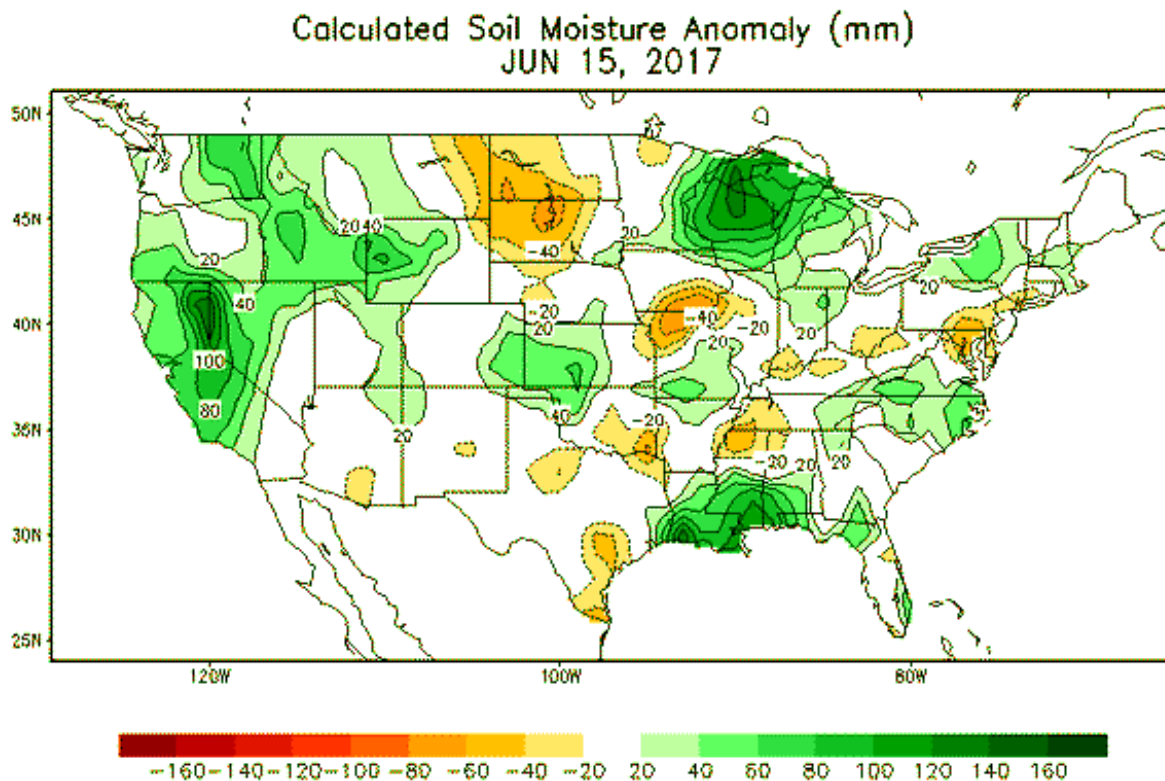
**Figure 3. Canopy cover on two nearby fields planted on the same day to the wheat variety Iba near Perkins, Okla. Upper panels reflect early leaf senescence observed in the dryland system as a consequence of both heat and drought stress, while lower panels reflect the longer period of time with healthy leaves observed in the irrigated system. Photos by Romulo Lollato, K-State Research and Extension.**

A period of high heat will also destroy membranes of chloroplasts and chlorophyll molecules. Once destroyed, these compounds will not be replaced. This will result in permanent browning of the leaves.

Heat stress is often worsened by drought stress. A good example of the effects of heat and drought stresses on wheat leaf persistence is shown in Figure 3, for the wheat variety Iba. In Figure 3, leaves

on wheat in the dryland system senesced prematurely (upper panels) as compared to leaves the irrigated system in which wheat maintained healthy leaves for at least an additional two weeks.

Still, grain fill can usually recover from short periods of heat stress if conditions are otherwise favorable. We might expect the impact of the heat stress will be worse in with prolonged periods of temperature above 82 degrees especially in areas where there is little or no soil moisture. Plants can cool themselves more easily when soils are moist than under dry soil conditions. Soils, either topsoil or subsoil, in the majority of the wheat-growing region in Kansas are moist this season (Figure 4).



**Figure 4. Source: NOAA Climate Prediction Center**

Heat damage may be minimal in fields where the wheat is at the dough stages of development. But where the wheat is still in the milk stages of kernel development, the wheat may experience reductions in test weight and poor grain fill.

Another common effect of both extreme heat and drought is premature death of the heads. This can happen to heat-stressed wheat in which the root systems were unusually shallow due to dry conditions. During this growing season, wheat in some areas (especially western Kansas) was damaged by the April 29 – May 1 snow event and had kinked stems. This wheat is now more vulnerable to heat stress and have started to abort tillers (Figure 3). In this situation, the extreme heat



can cause enough additional stress that the entire head simply dies. When this happens, the heads will turn white – almost overnight in some cases.







**Figure 5. White heads (upper panel) as a result of premature death caused by period of extreme heat coupled with kinked stems from the late spring snowfall (lower panel). Photo by Romulo Lollato, K-State Research and Extension.**

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## 2. Possible causes of yellow soybeans

When soybeans turn yellow at an early stage of growth, there are several possible explanations.

**Nitrogen (N) deficiency.** In fields that have been extremely wet or extremely dry, or under severe early heat stress, rhizobial nodule development can be delayed, resulting in N deficiency. As soil moisture levels return to more normal conditions (if a short-term stress), the nodule-forming bacteria will go to work and the deficiency symptoms will quickly disappear. With N deficiency, it is usually the lower leaves that are chlorotic or pale green. Within the plant, any available N from the soil or from N fixation goes to the new growth first.



Figure 1. Nitrogen deficiency in soybeans. Photo by Dorivar Ruiz Diaz, K-State Research and Extension.

Soybeans doublecropped after wheat can be N deficient for a short period of time shortly after emergence until the beans become well nodulated. As the wheat straw decomposes, some of the soil available N will be immobilized, making it unavailable to the young soybean plants. Applying a small amount of N (no more than 30 lbs acre) at planting time to soybeans planted into wheat residue is the best way to avoid early-season N deficiency.

Hail damage can also cause N deficiency in soybeans at times. If the foliage is damaged enough so

that the plant can't provide enough food for the rhizobia on the roots, the rhizobia will slough off the roots or become temporarily inactive. If this happens, the plants may temporarily become N deficient. Plants normally recover from this as regrowth progresses and photosynthates are translocated to the nodules.

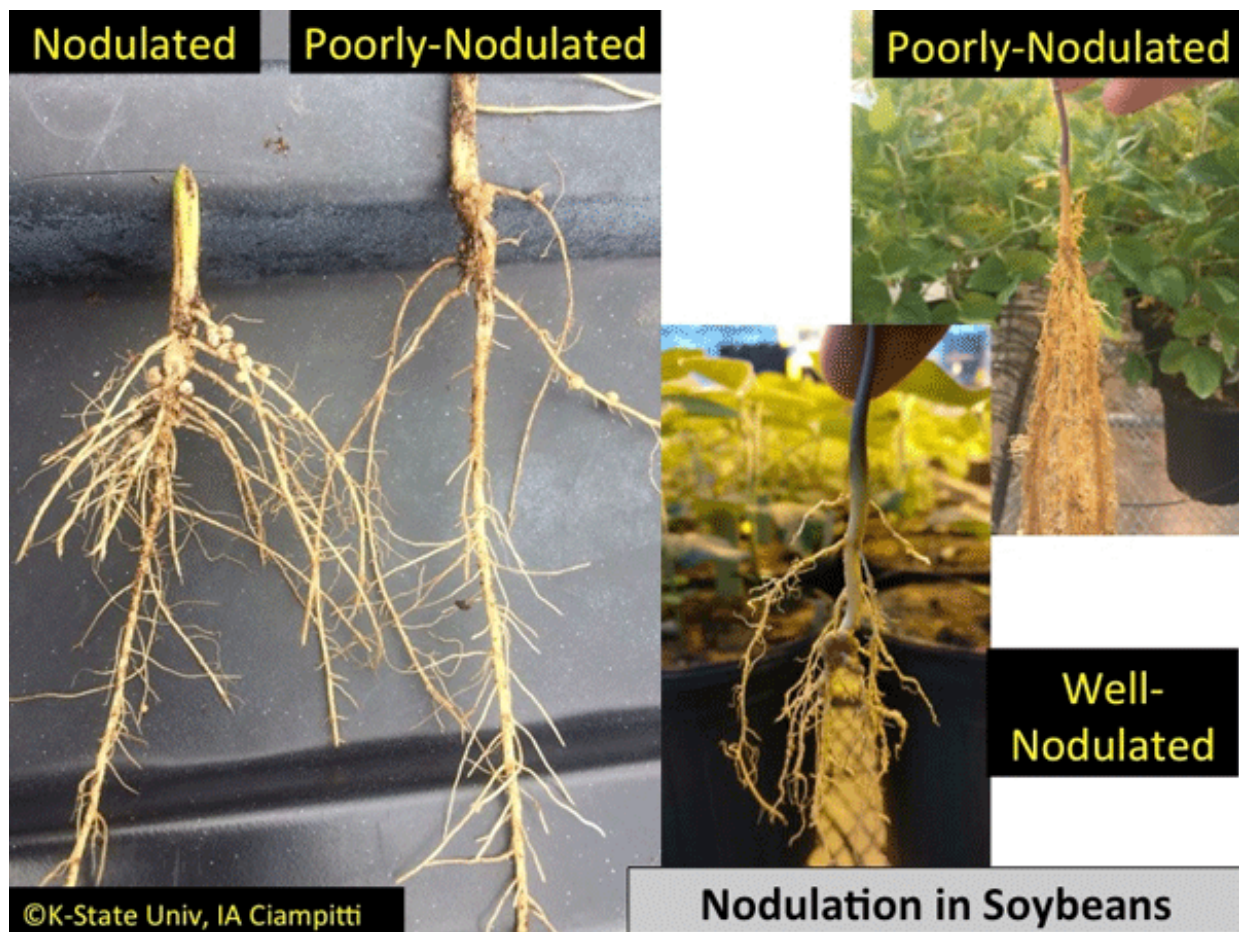


Figure 2. Nodulated and non- or poorly-nodulated soybeans, showing a closeup of the roots and nodules. Photo by Ignacio A. Ciampitti, K-State Research and Extension.

Nitrogen deficiency due to a failure of soybeans to nodulate properly has also been a problem at times where soybeans are planted into new acres with no history of soybean production. In recent years, there have been reports of inoculated soybeans planted on “virgin” fields that have failed to produce nodules, resulting in N deficiency. An examination of the root systems showed very few or no nodules. Previous studies show that a rescue application of 90 to 120 pounds of N per acre gave good returns in these situations. A rescue application should be considered only if N deficiency symptoms are confirmed, and applications should be made as soon as possible to increase N uptake.

**Iron (Fe) chlorosis.** Soils that are too wet can also induce temporary symptoms of Fe chlorosis. With Fe chlorosis, the top most leaves will turn yellow, but the veins remain green. This problem is usually more serious in soils with highly alkaline pH. Additionally, soybean varieties have varying tolerance



to Fe chlorosis so certain varieties may show more of the symptom than others.



Figure 3. Iron chlorosis on soybeans. The upper leaves become chlorotic. Photo by Doug Jardine, K-State Research and Extension.

Excess nitrate in the soil can exacerbate problems of Fe chlorosis in fields with high soil pH and prone to causing Fe chlorosis problems. This can be particularly noticeable during early soybean growth.

An interesting phenomenon that occasionally has been observed is that soybean plants in slightly more compacted soil (for example in the wheel tracks associated with the last tillage pass) will be greener and display less yellowing from Fe chlorosis than the rest of the field. Recent studies have shown that soil nitrate concentrations in these wheel tracks are typically lower, so Fe chlorosis symptoms are alleviated compared to the rest of the field. The areas of compacted soil have less oxygen, likely resulting in more denitrification. Areas of higher soybean population in the field can also show greener conditions. Higher plant populations and greater root density can reduce the negative effect of higher soil nitrate concentrations on Fe chlorosis in the volume of soil.



Figure 4. Field of soybeans with iron chlorosis, showing greener areas in the wheel tracks. Photo by Dorivar Ruiz Diaz, K-State Research and Extension.

**Potassium (K) deficiency.** Another cause of yellowing could be K deficiency. Contrary to Fe deficiency, K deficiency is typically more common later in the season. Deficiency symptoms include an irregular yellow mottling around leaflet margins. The yellow areas coalesce to form a more or less continuous, irregular yellow border. Again, as with N, you can see symptoms both in fields that are too wet or too dry. Most of the time, the symptoms will fade with improved soil conditions that allow good root growth, unless the field is truly deficient in K. Potassium deficiency can also be caused by soil compaction, which limits root growth and development.





Figure 5. Yellowing around leaflet margins from potassium deficiency. Photo by Dorivar Ruiz Diaz, K-State Research and Extension.



Figure 6. Chlorosis of the lower leaves from potassium deficiency shows up first on lower leaves.



Photo by Dave Mengel, professor emeritus, K-State Research and Extension.

**Rooting restrictions.** Anything that restricts expansion of the root system (e.g. extremely wet or dry soil, compaction layers, sidewall compaction, root insects and disease etc.) can lead to reduced growth and potential leaf yellowing. With a restricted root system, the growing plant can't access the nutrients it needs to make more leaves. As a result, many of the nutrient deficiencies described above can show up in fields where you might not expect them based on a typical soil test.







Figure 7. Rooting restrictions during early growth for soybeans. Photos by Ignacio Ciampitti, K-State Research and Extension.

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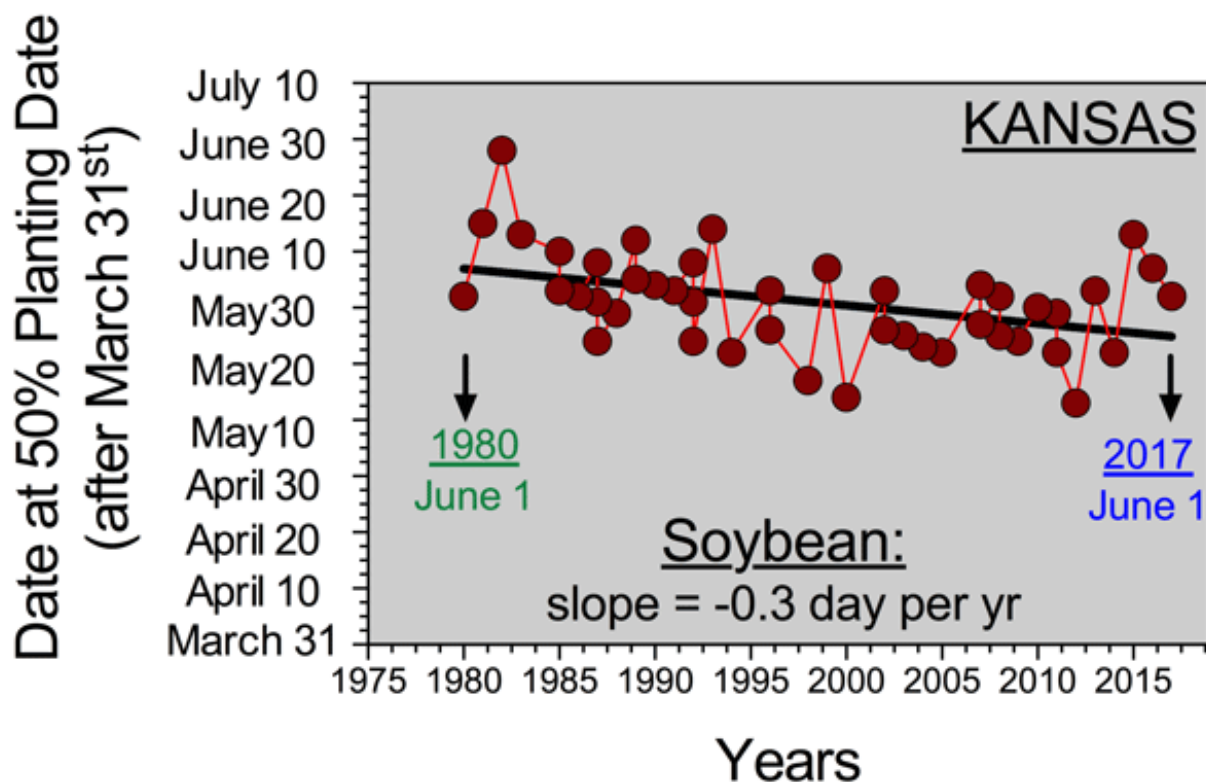
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### 3. Late planting of soybeans: Management considerations

Soybean planting progress in Kansas is ahead of last year's growing season but still there are soybean fields to get planted. In the latest Crop Progress and Condition report from Kansas Agricultural Statistics (June 11, 2017), soybean planting was at 80% complete, ahead of the long-term average of 72%.

To look a little bit to the historical planting dates for our state, in recent decades, Kansas producers have been planting soybeans slightly earlier -- at the rate of about one-third day per year (Fig. 1). In the past three growing seasons (2015-17), however, the "50% planting date" mark was achieved at a similar time (first week of June) statewide. Moreover, the same "50% planting date" mark was attained in 1980 as this current growing season, averaging 50% planting progress by June 1.



**Figure 1. Trend in the date at which 50% of planting progress was achieved for soybean from 1980 to 2016 in Kansas. Source: USDA-NASS.**

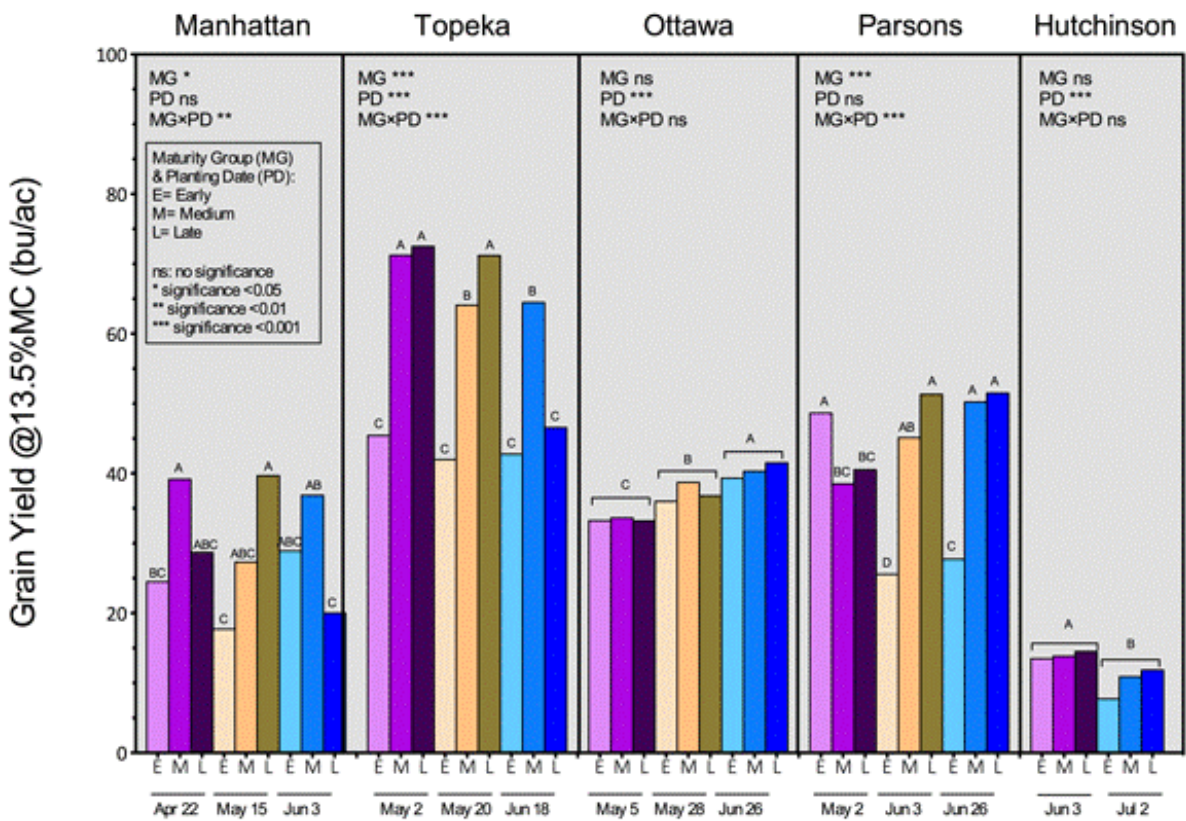
Where soybean planting has been delayed, producers should consider a few key management practices. Planting soybeans in the right soil conditions is essential for establishing an adequate soybean canopy and improving chances to increased yield potential.



**Figure 2. Late-planting soybeans (June 10) into adequate soil conditions. Photo by Ignacio A. Ciampitti, K-State Research and Extension.**

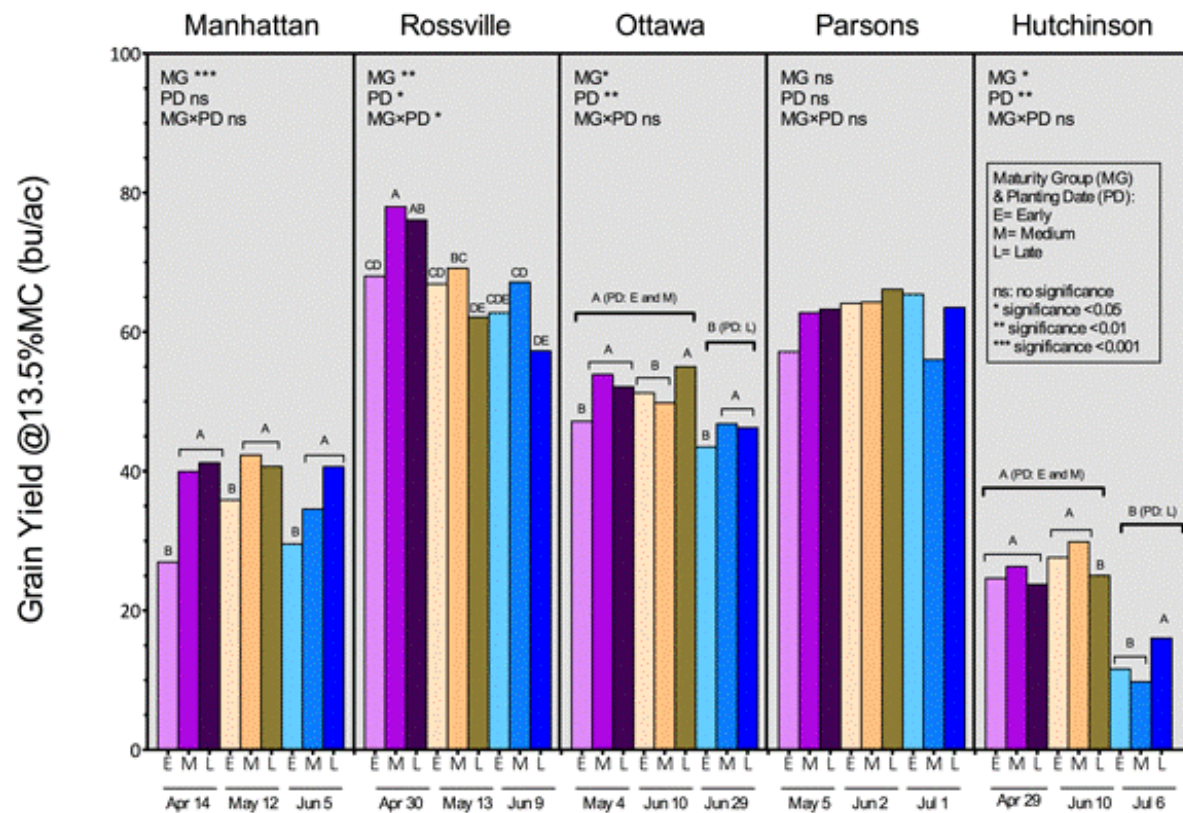
Maturity group factor: From our planting date x maturity group study in 2014, 2015 and 2016, late planting did not clearly result in a yield reduction at the dryland sites, and caused only a minimal yield reduction at the irrigated site. Medium maturity groups (ranging from 3.8 to 4.8) yielded better, depending on the site and growing season evaluated (Figs. 3, 4, and 5). More information related to this study can be found in Agronomy eUpdate issue 626 April 14, 2017 at:

[https://webapp.agron.ksu.edu/agr\\_social/eu\\_article.throck?article\\_id=1335](https://webapp.agron.ksu.edu/agr_social/eu_article.throck?article_id=1335)

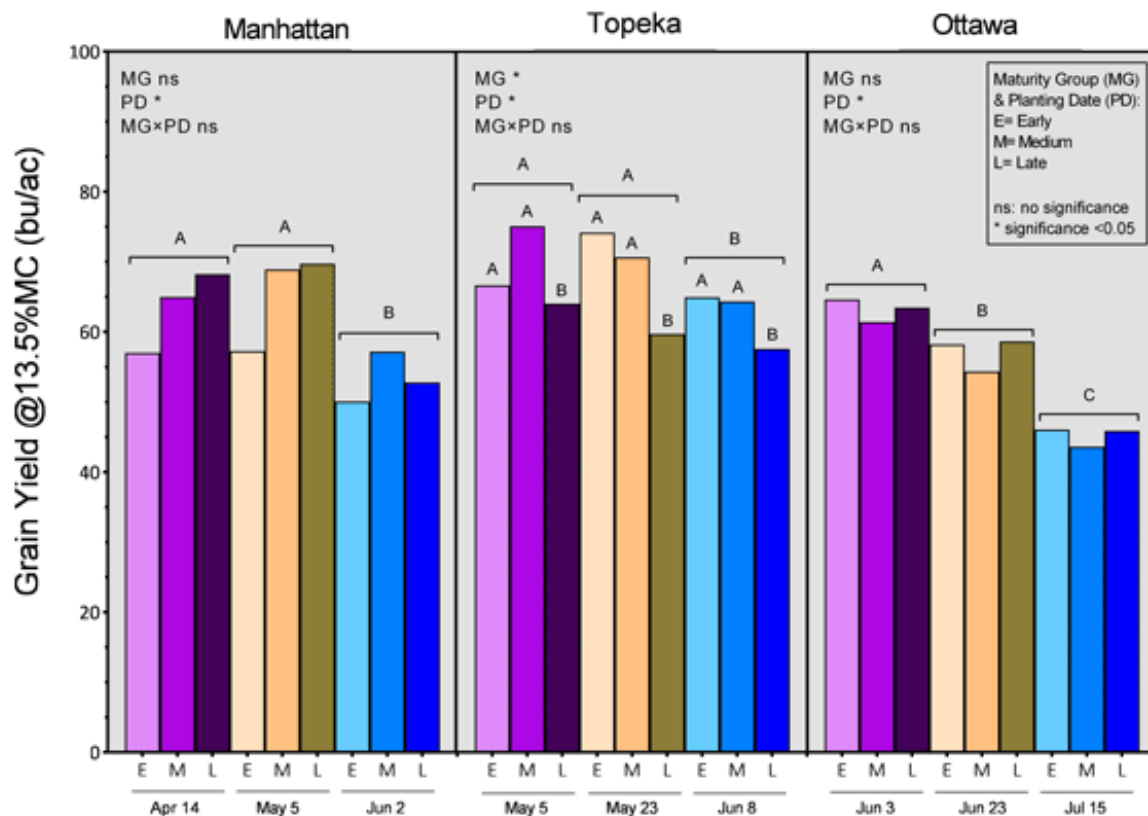


**Figure 3. Soybean yields with different planting dates (early, mid, and late) and maturity groups (E = early, M = medium, L = late maturing groups) at five locations across Kansas for the 2014 growing season.**





**Figure 4. Soybean yields with different planting dates (early, mid, and late) and maturity groups (E = early, M = medium, L = late maturing groups) at five locations across the state of Kansas for 2015 growing season.**



**Figure 5. Soybean yields with different planting dates (early, mid, and late) and maturity groups (E = early, M = medium, L = late maturing groups) at three locations across the state of Kansas for 2016 growing season.**

Seeding rate factor: Increasing the seeding rate of late-planted soybeans by 10-20% as compared to optimal seeding rate can help compensate for the shortened growing conditions. Research information on seeding rate and late planting of soybeans is currently being investigated further, with more updates on this topic in future issues of the Agronomy eUpdate. The same soybean cultivar planted early in the planting window, under normal conditions, will develop nearly 50% more productive nodes than when planted in late June: 19-25 nodes when planted early vs. 13-16 nodes when planted late. For soybean seeding rates and optimum plant populations, see Agronomy eUpdate issue 627 April 21, 2017 at:

[https://webapp.agron.ksu.edu/agr\\_social/eu\\_article.throck?article\\_id=1339](https://webapp.agron.ksu.edu/agr_social/eu_article.throck?article_id=1339)

Row spacing factor: Information on late-planted soybean across multiple row spacings suggests that narrow-rows (e.g. 7" or 15" vs. 30") can hasten canopy closure, increasing season-long light interception, weed suppression, and potentially improving biomass and final yield. In some cases, the likelihood of a positive yield response to narrow rows increases as the planting is delayed later in the season.

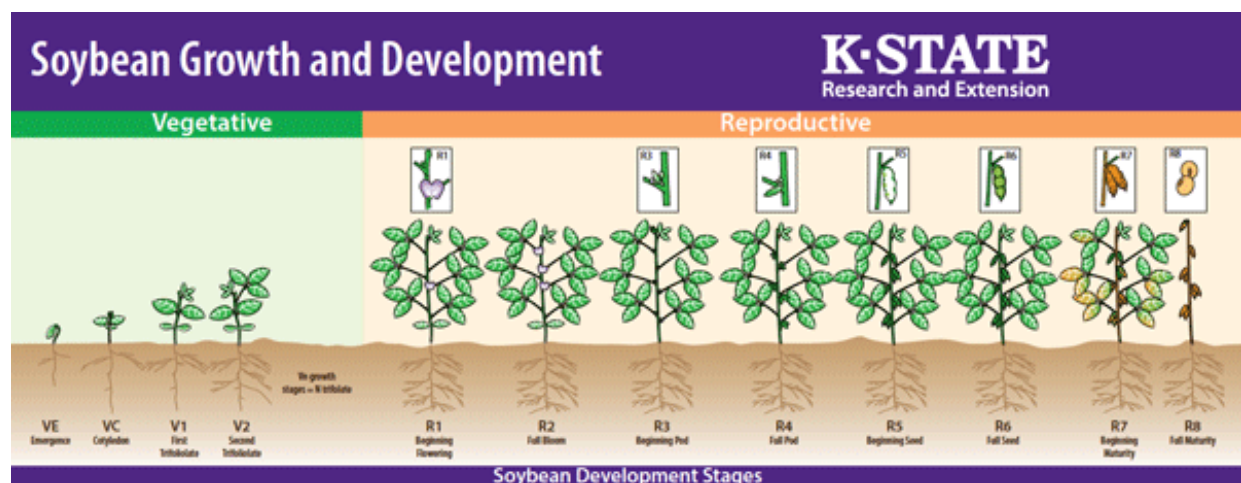
Finally, proper identification of soybean growth stages can make a difference in yield. We have worked with the United Soybean Board and the Kansas Soybean Commission recently to produce a soybean growth and development chart. It can be downloaded at:

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More information about key aspects of each growth stage and management practices can be found in that soybean chart.

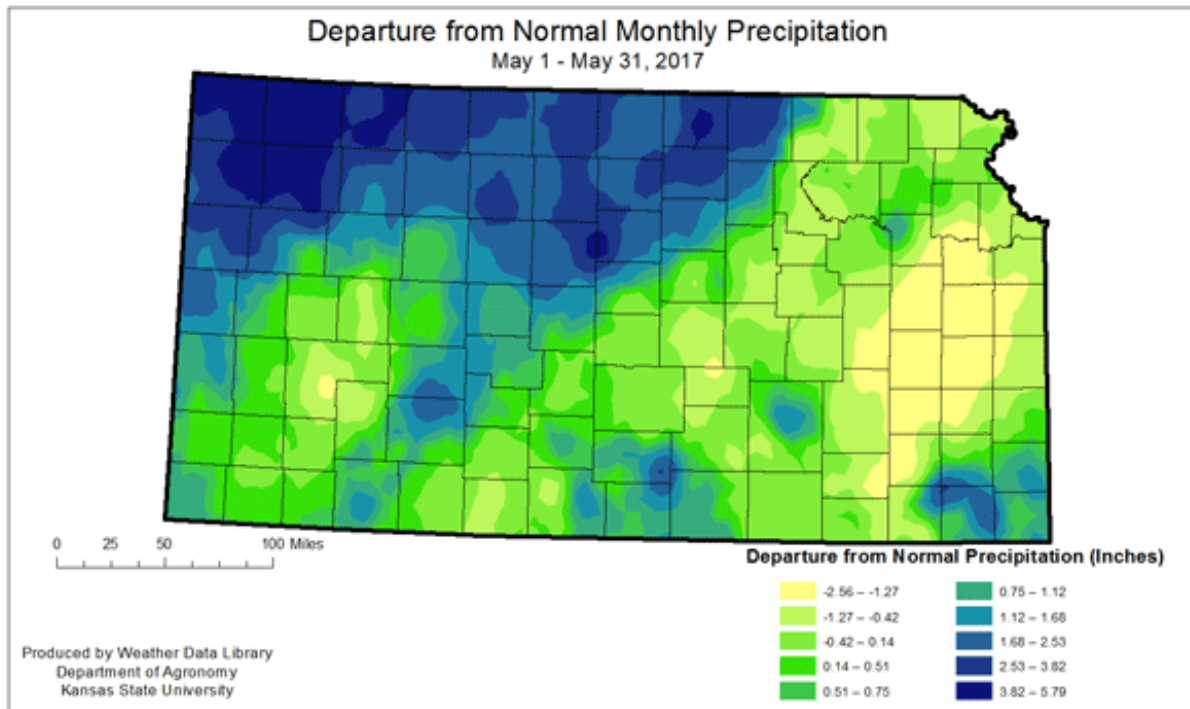
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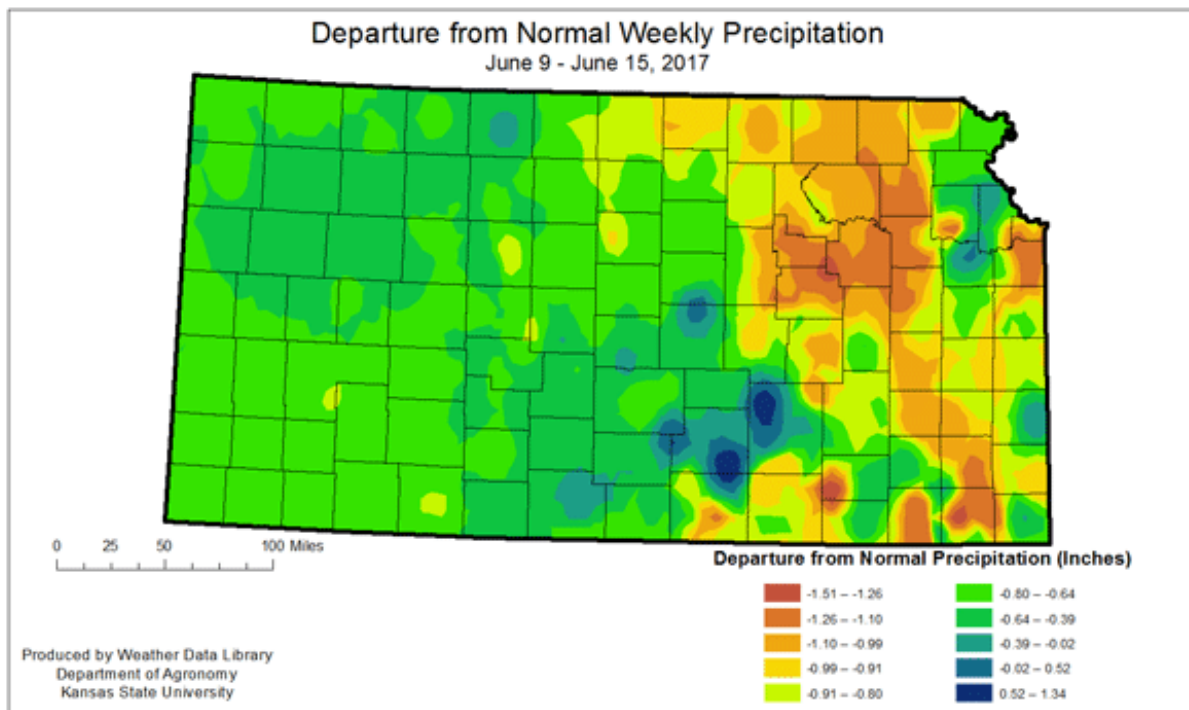
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#### 4. Kansas summer crops: Wet to dry in a hurry

The summer row crop season started with very wet conditions and with very few days for planting row crops. At this point, the very wet start to the season has switched to an extremely dry start to June in much of the state. The maps below show the departure from normal precipitation at the end of May and for the week ending on June 15, 2017:

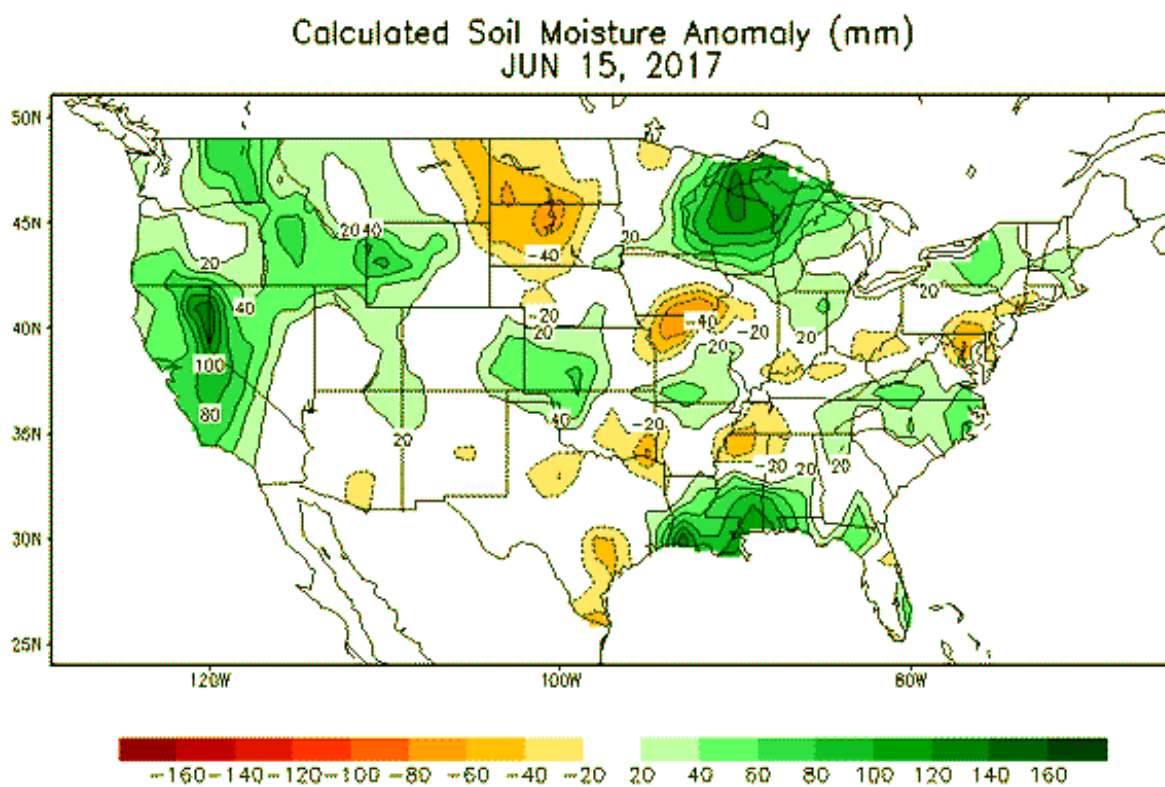






**Figure 1. Precipitation departures for May 2017 and the 7-day period of June 9-15 (lower panel). Source: K-State Weather Data Library**

Despite that deficit, soil moisture values are still above normal across much of the state. However much of the corn was planted into wet ground and root growth has been slow. The rapid switch to warm, dry conditions has increased evapotranspiration demands. Any plants with poor root development are showing signs of stress.



**Figure 2. Soil Moisture anomaly as of June 15, 2017 (USDA).**

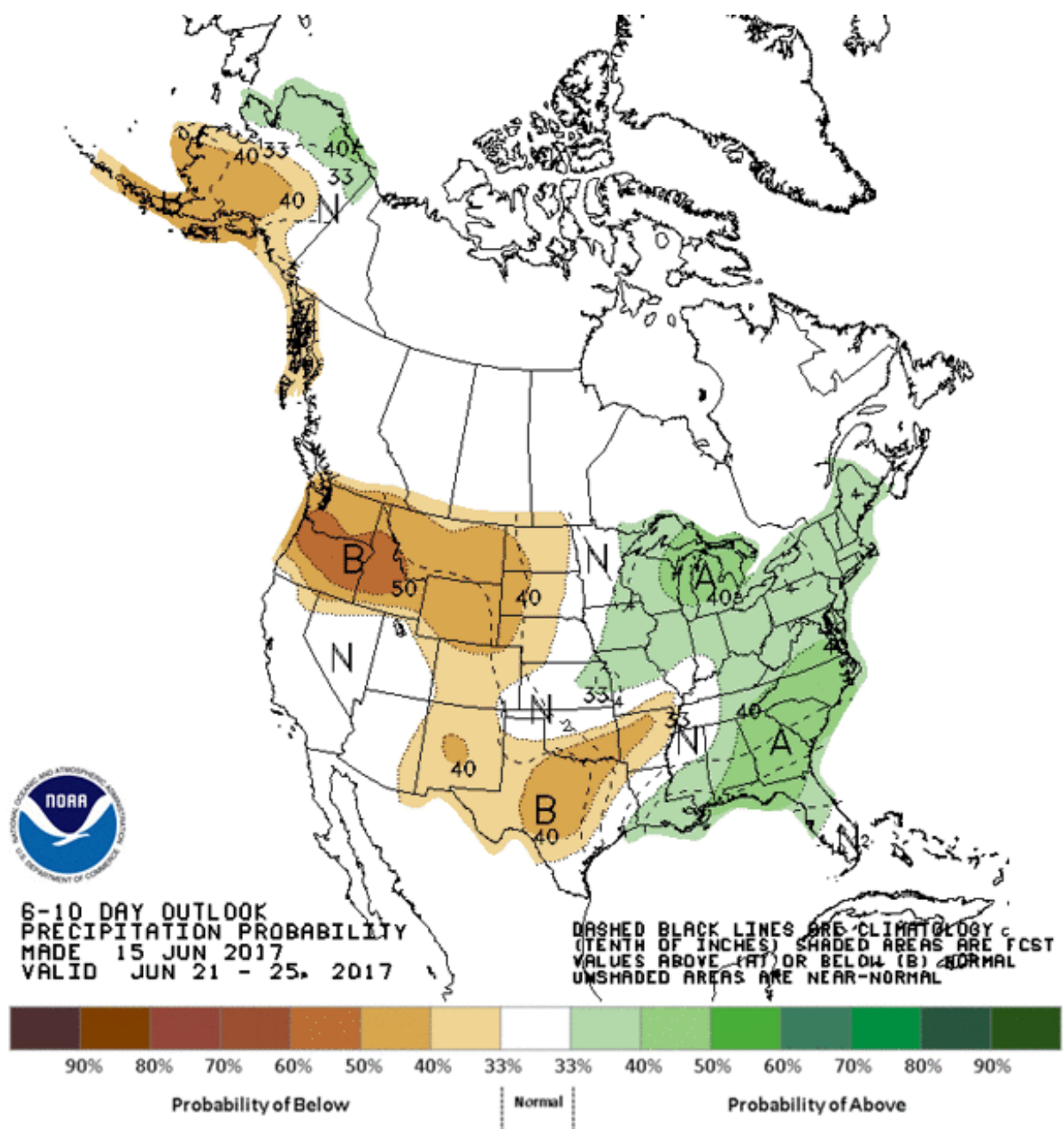




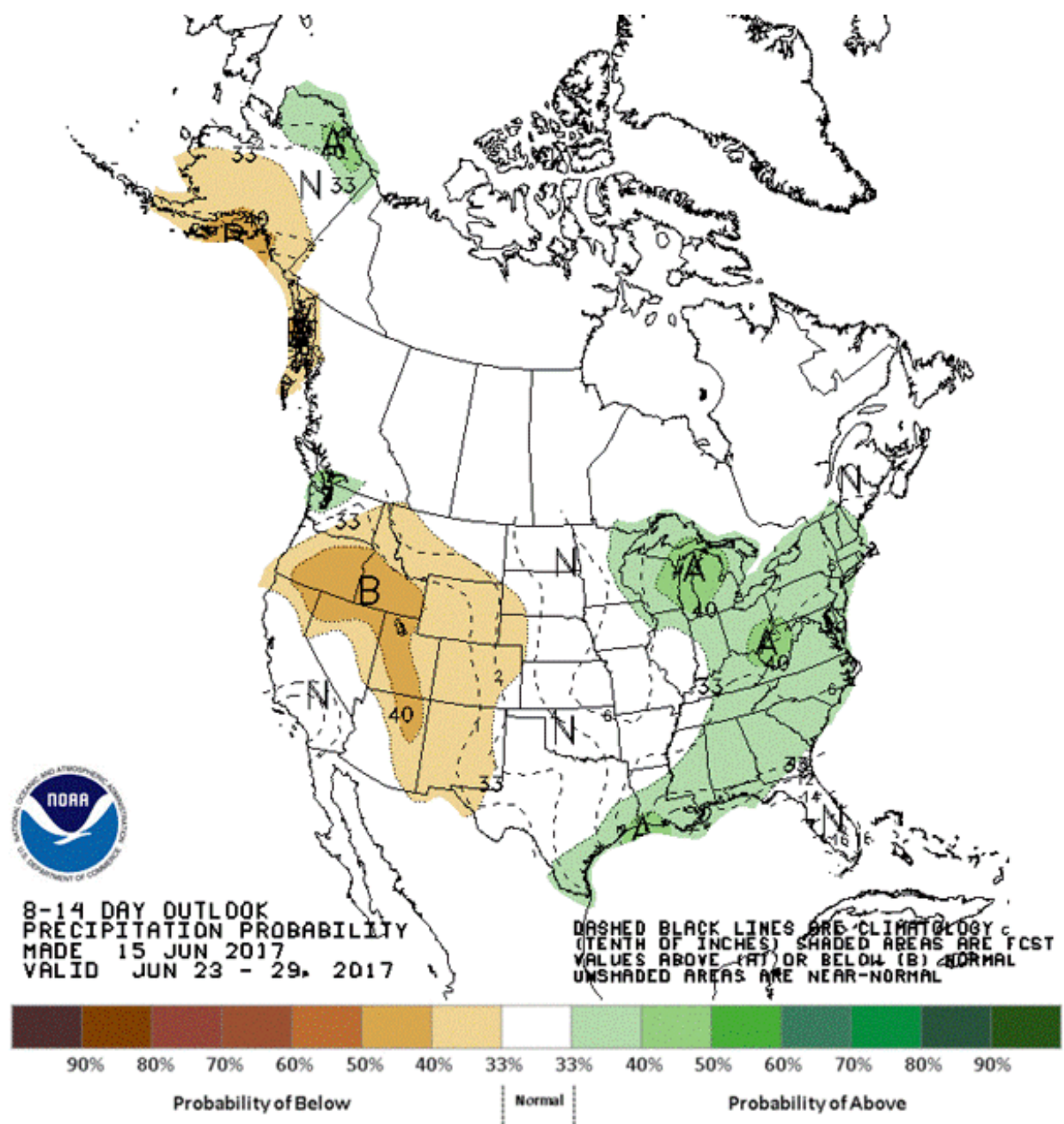
**Figure 3. Corn showing leaf rolling, potential signs of temporary drought effects. Photo by Ignacio A. Ciampitti, K-State Research and Extension.**

### **Short-term weather outlook**

The short-term 6-10 day weather outlook (Fig. 3, upper panel) reflects equal chances for precipitation. The 8-14 day weather outlook also shows a neutral probability of precipitation across the state (Fig. 3, lower panel).

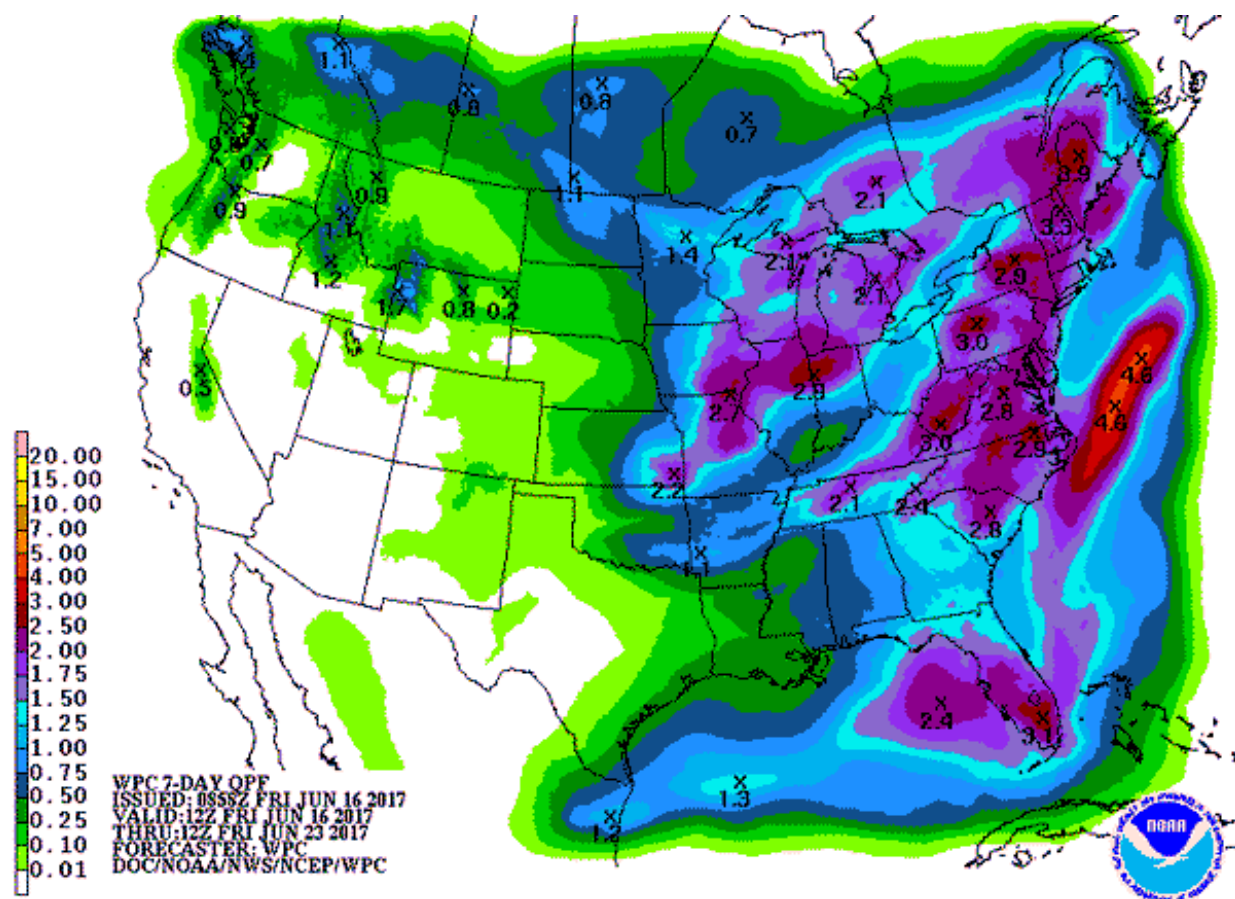






**Figure 3. Weather outlooks, 6-10 day (top panel) and 8-14 day (bottom panel). Source: NOAA.**

The quantitative precipitation forecast for the 7-day total precipitation shows precipitation amounts ranging from 0.5-inch in the SW and SC parts of the state to +1-inch in the eastern side, and close to 2-inches in the SE corner (Fig. 4).



**Figure 4. Quantitative precipitation forecast, 7-day total precipitation. Source: NOAA.**

Considering the weather outlook for the coming week, drought stress may be visible in crops with poor root development.

The main concerns from now on are related to the lingering effects of poor root development, and herbicide activation.

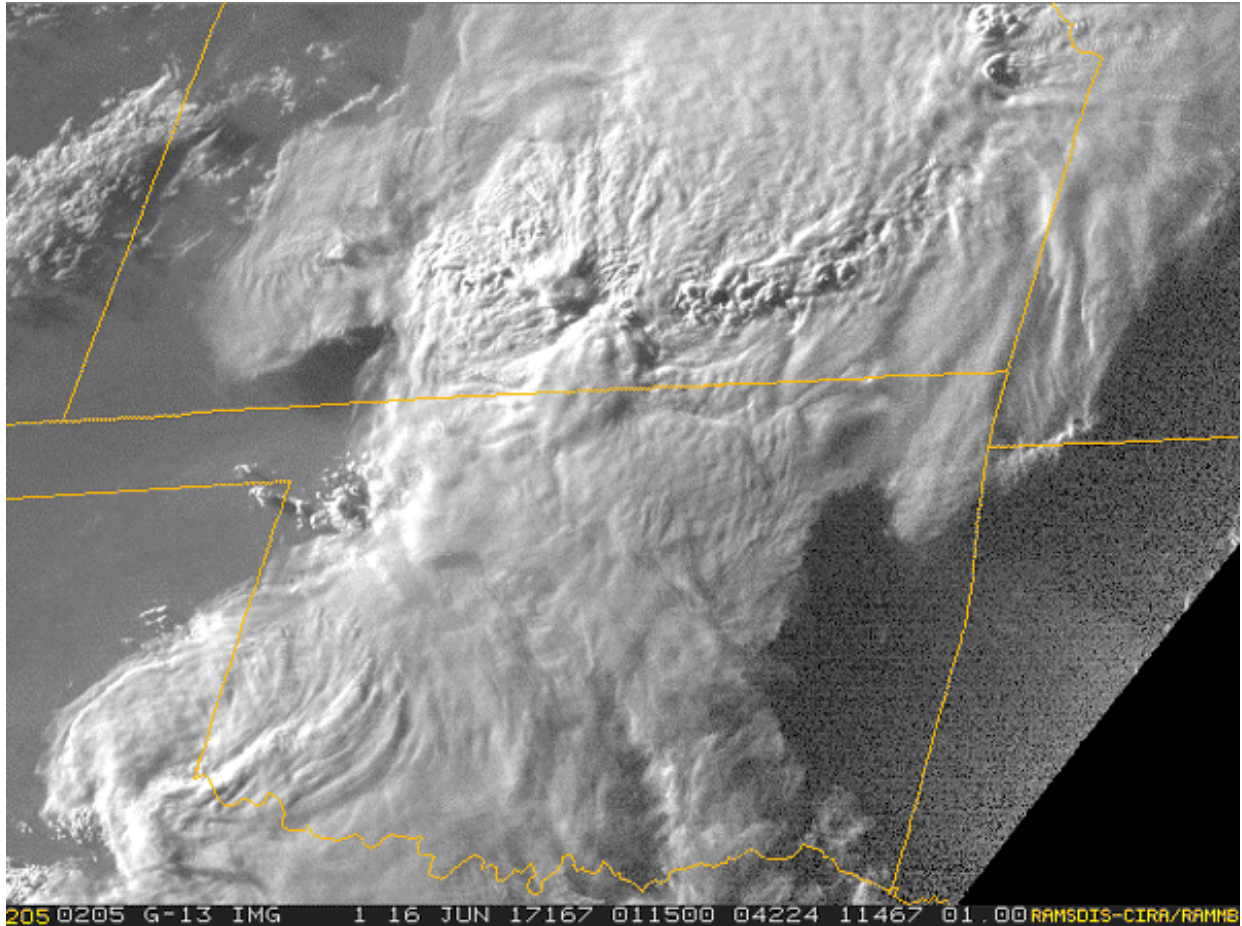
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## 5. Storm summary: June 15, 2017

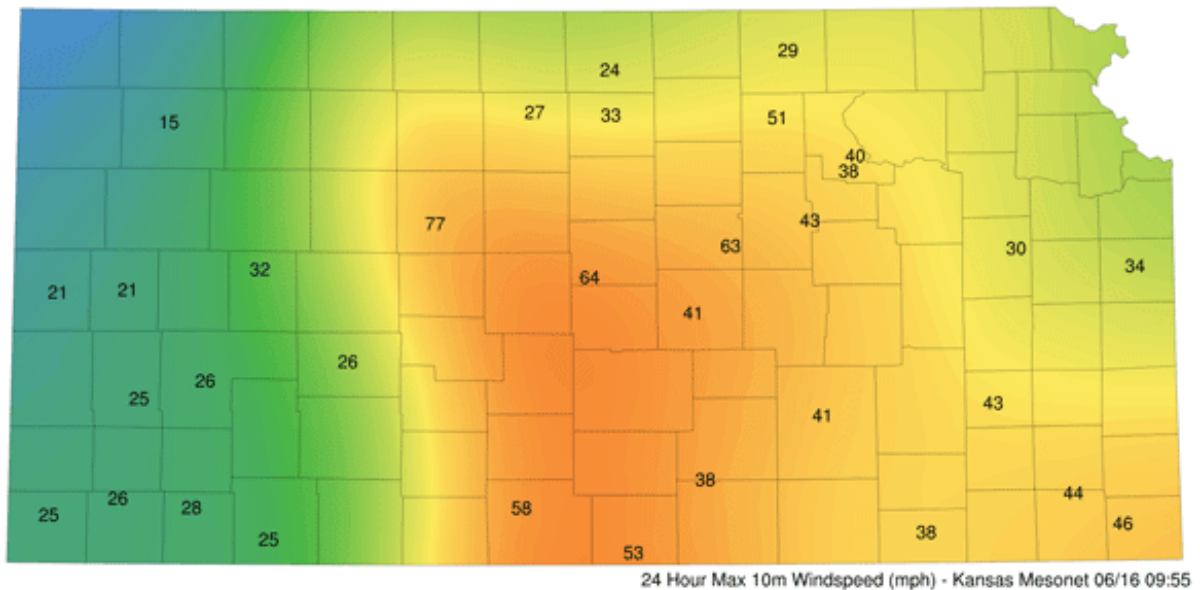
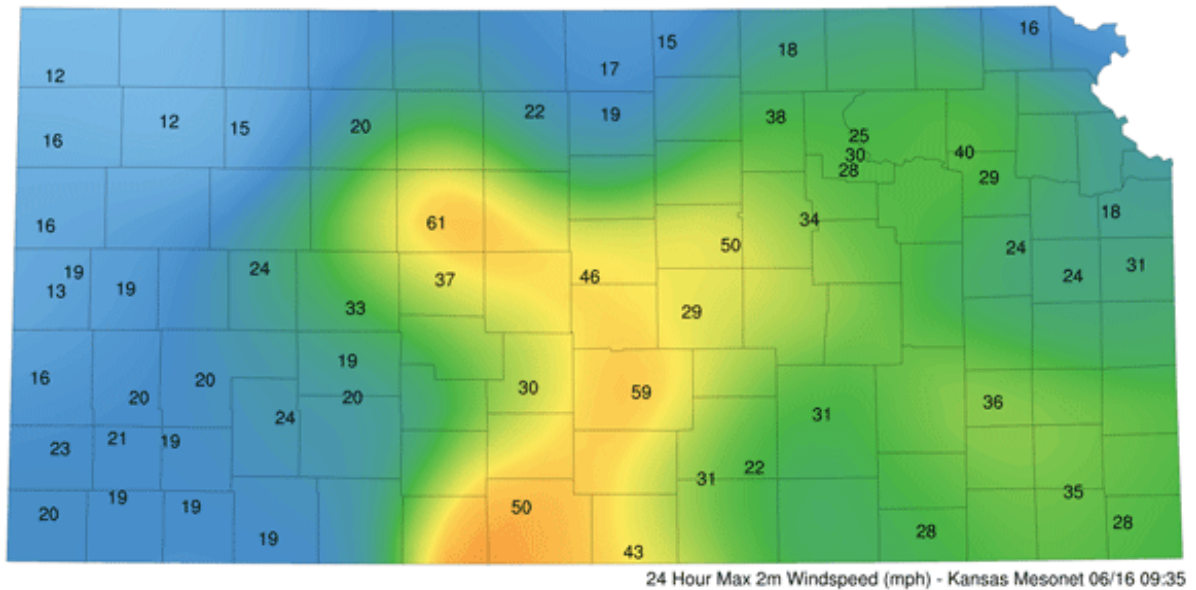
Summer storm season often brings large complexes of severe thunderstorms that overspread large areas. Such was the case on Thursday, June 15th. Thunderstorms developed near Hays and expanded south and east through the afternoon and evening. By early morning the 16th, they had exited the state after creating much chaos, especially in the middle of Kansas. Numerous wind reports in excess of 70 mph, isolated heavy rains, and hail up to the size of softballs were reported.



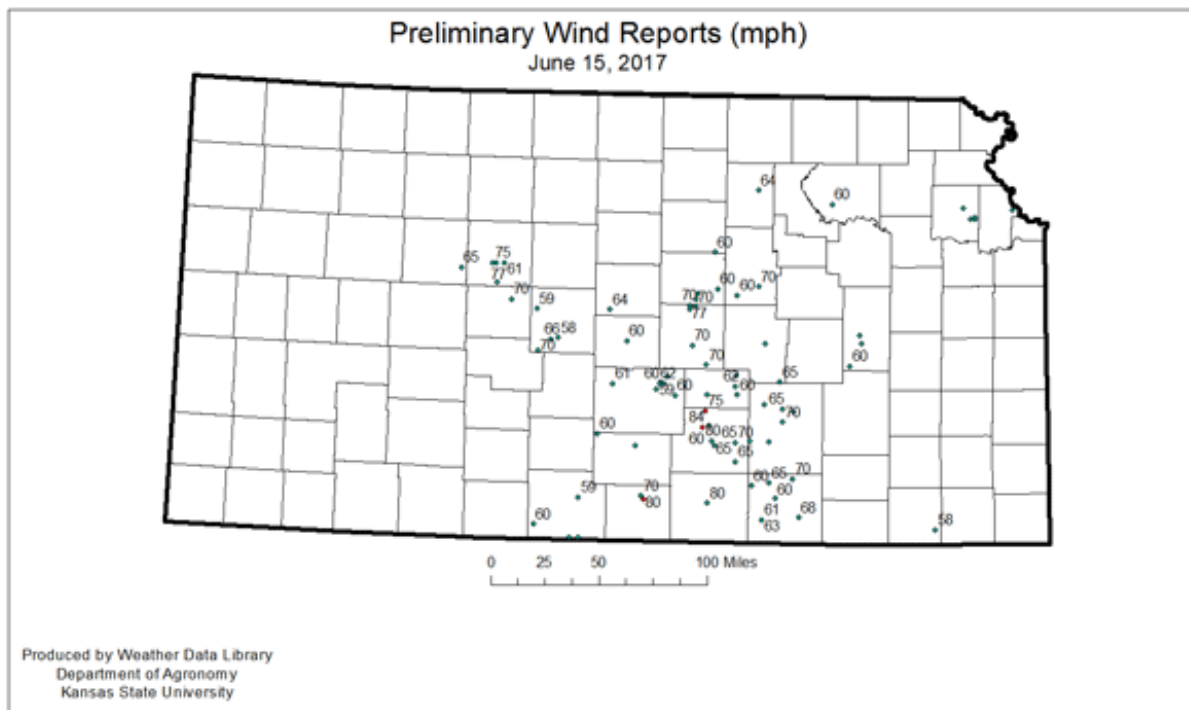
**Figure 1. Visible satellite near sunset on June 15th showed the large complex of thunderstorms across Kansas/Oklahoma.**

The Kansas Mesonet ([mesonet.ksu.edu](http://mesonet.ksu.edu)) provided an ample method of sampling winds associated with this complex. The highest gusts recorded on the network and associated maps:

- Hays: 77.4 mph (1500 CDT)
- Lorraine: 64.1 mph (1745 CDT)
- Gypsum: 63.1 mph (1735 CDT)
- Hutchinson 10SW: 59.3 mph (1900 CDT)
- Lake City: 58.1 mph (1905 CDT)



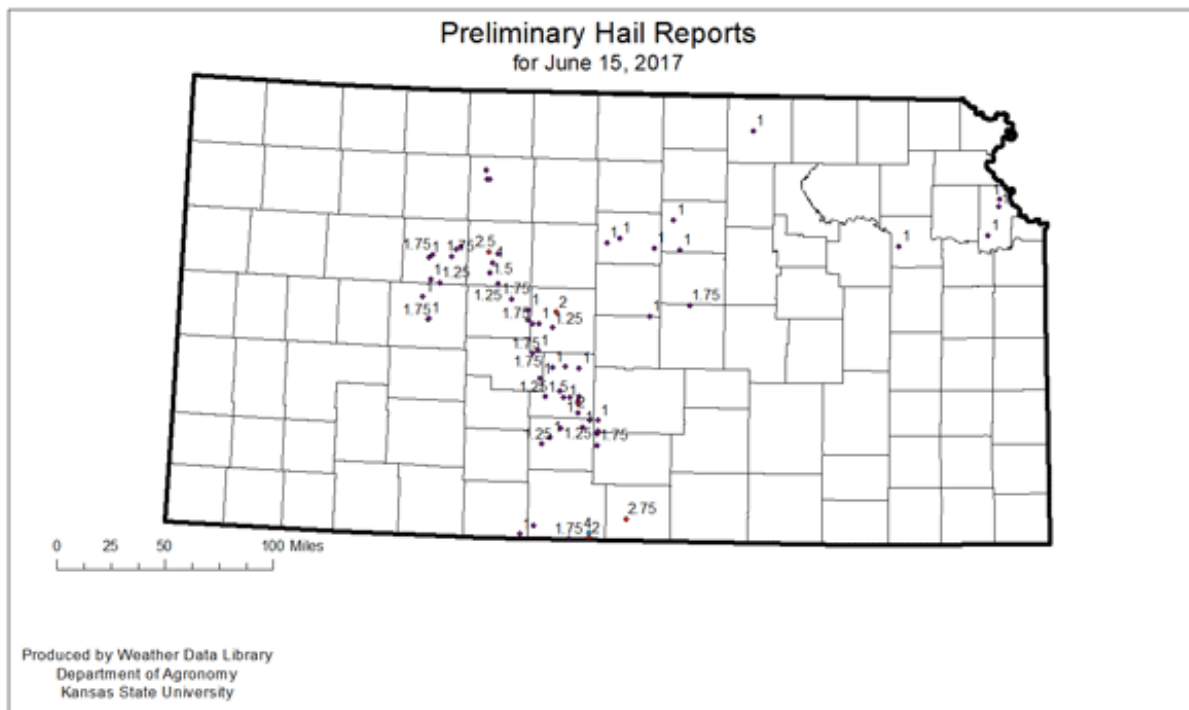
Numerous reports of wind damage were also received by the National Weather Service. Many were downed trees, but some structures were impacted. Some potential impacts to agriculture included windblown crops, damage to pivots, and destroyed storage structures. The most impacted region was central Kansas.



**Figure 4. National Weather Service wind gust/damage storm reports in Kansas.**

Hail was also an issue. The largest report of hail was 4" (roughly softball sized) near Kiowa in south central Kansas. Numerous other reports were spread across central Kansas. When combined with the strong winds, hail can be increasingly damaging, especially to crops. Here are the hail reports on June 15th:

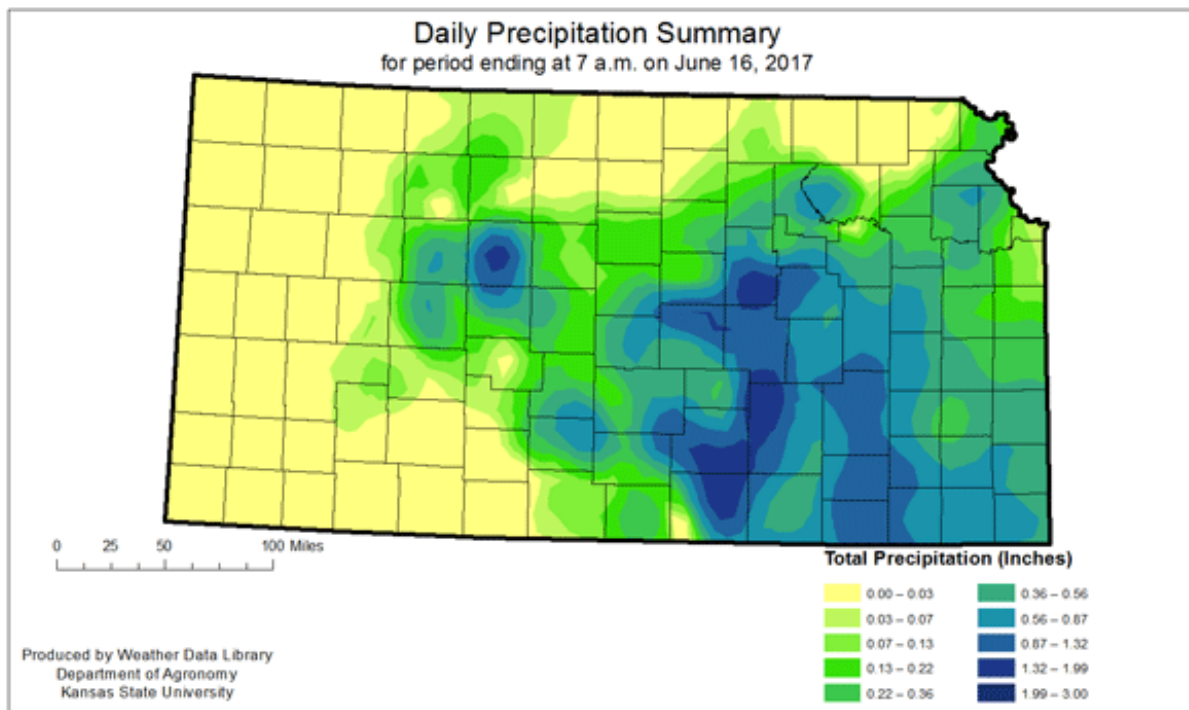




**Figure 5. National Weather Service large hail storm reports in Kansas.**

However, not all the weather was negative. These storms brought much needed moisture to central Kansas. A corridor from Hutchinson northeast to Manhattan were on a 14-20 day streak without receiving 0.1" or more of moisture. With the hot and windy weather during this period, the ground was beginning to quickly dry out. This drying was beginning to not only dry the grasses (several grass fires were reported due to lightning with this event) but also not optimal for crops either.

Heavy rains were hit/miss but a large swath of central to eastern Kansas had very beneficial rains. Cut offs between areas of heavy and light-to-no rain were sharp, especially around Hays and Wichita. Below is the map of the total rain measured ending at 7 a.m. June 16th:



**Figure 6. National Weather Service Cooperative Observer Program, CoCoRaHS, and Kansas Mesonet rainfall reports as of 7am June 16th.**

Lastly, storms also had a pretty side to them! Below is a photo by Jason Keller near Eskridge, Kansas on the night of June 15 in advance of the storm.



**Figure 7. Storm approaches Eskridge, Kansas. Photo by Jason Keller (<https://twitter.com/jasonkellerpt>). Used with permission.**

You can view the latest 24-hour wind gusts (and maximum/minimum temperatures) on the Kansas Mesonet webpage at: [mesonet.ksu.edu/weather/maxmin/](https://mesonet.ksu.edu/weather/maxmin/)

Storm reports can be found at the Storm Prediction Center: [spc.noaa.gov](https://spc.noaa.gov)

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## 6. Comparative Vegetation Condition Report: June 6 - 12

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

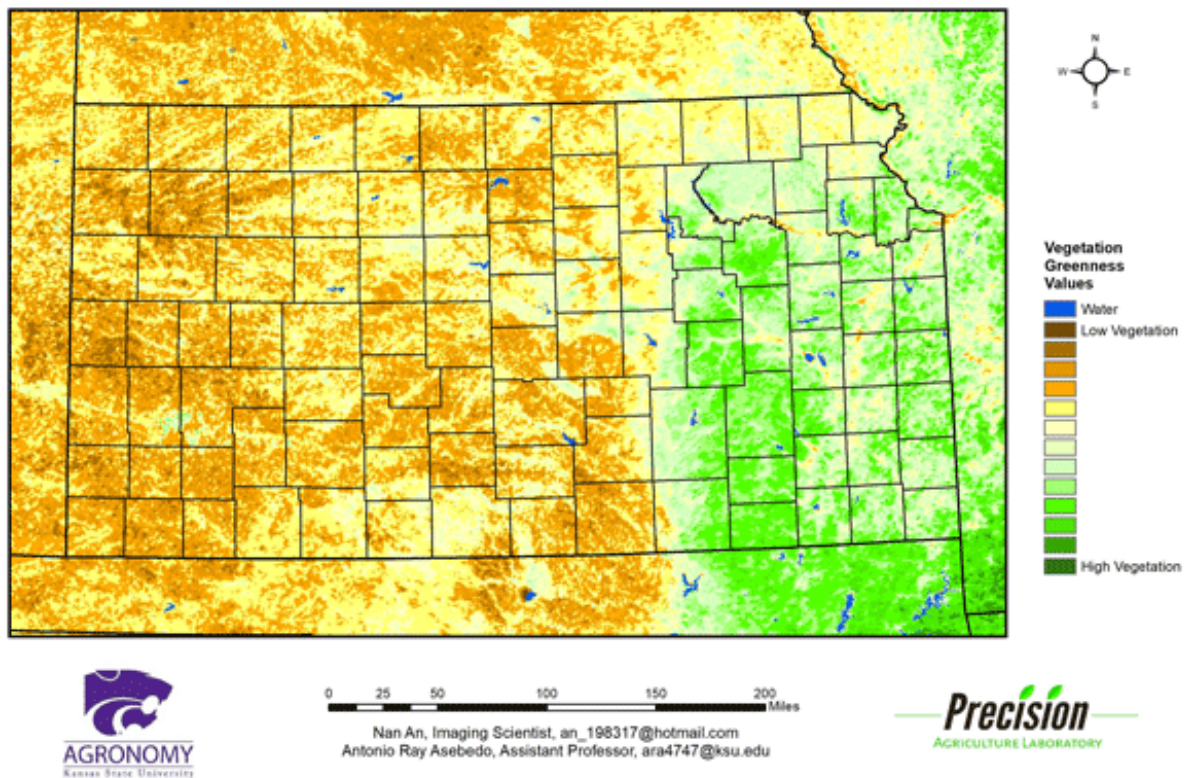
The maps have recently been revised, using newer technology and enhanced sources of data. Dr. Nan An, Imaging Scientist, collaborated with Dr. Antonio Ray Asebedo, assistant professor and lab director of the Precision Agriculture Lab in the Department of Agronomy at Kansas State University, on the new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

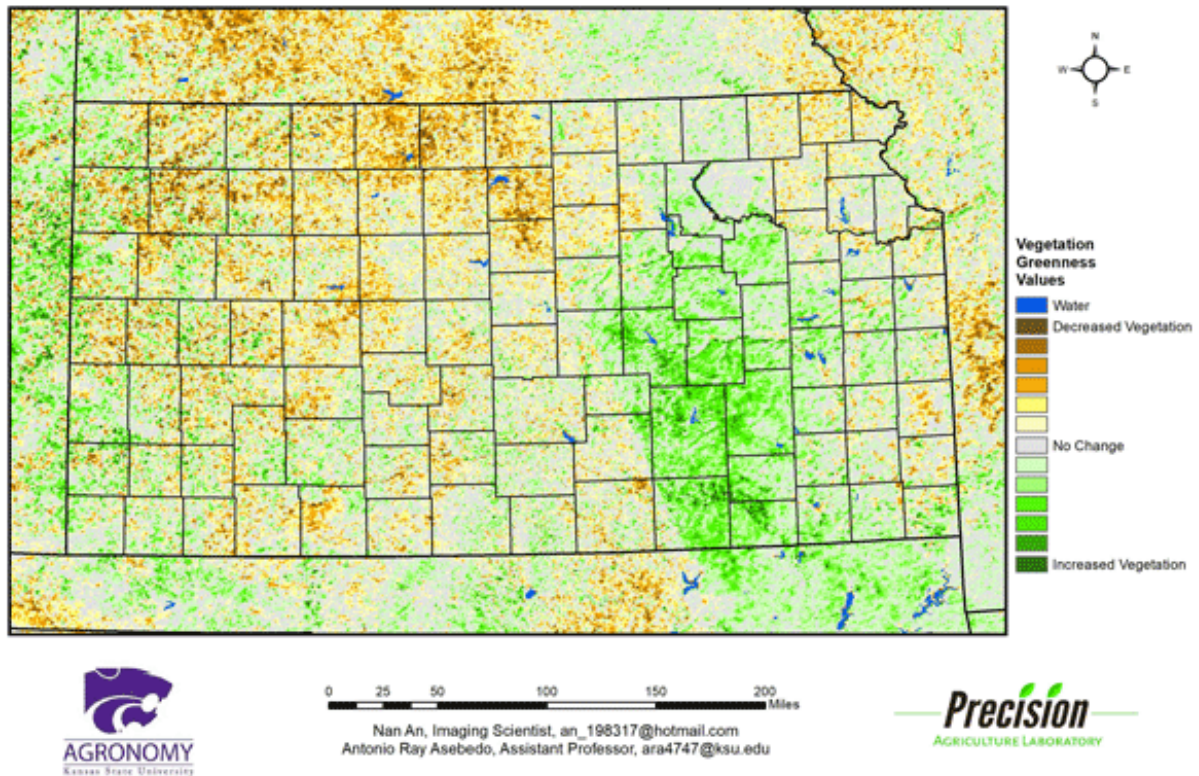
Period 24: 06/06/2017 - 06/12/2017



**Figure 1. The Vegetation Condition Report for Kansas for June 6 – June 12, 2017 from K-State’s Precision Agriculture Laboratory shows increased photosynthetic activity across much of the state. The greatest area of high vegetative activity is in the eastern third of the state, where temperatures have been favorable.**

## Kansas Vegetation Condition Comparison

Early-June 2017 compared to the Early-June 2016

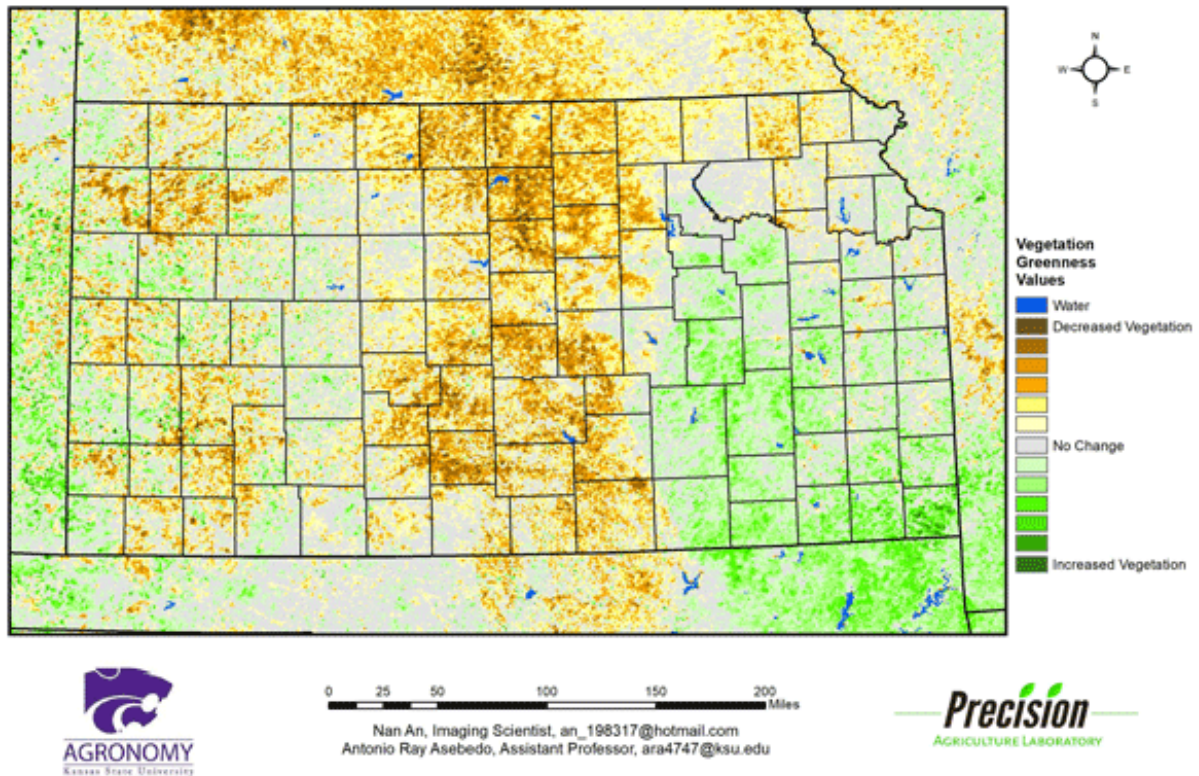


**Figure 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for June 6 – June 12, 2017 from K-State’s Precision Agriculture Laboratory shows a mix of conditions. In parts of northwest and west central Kansas, much lower NDVI values are visible. Saturated soils delayed spring planting/emergence in much of this area. Higher NDVI values in the southeast reflect the more favorable moisture and warmer temperatures that have prevailed this year.**



# Kansas Vegetation Condition Comparison

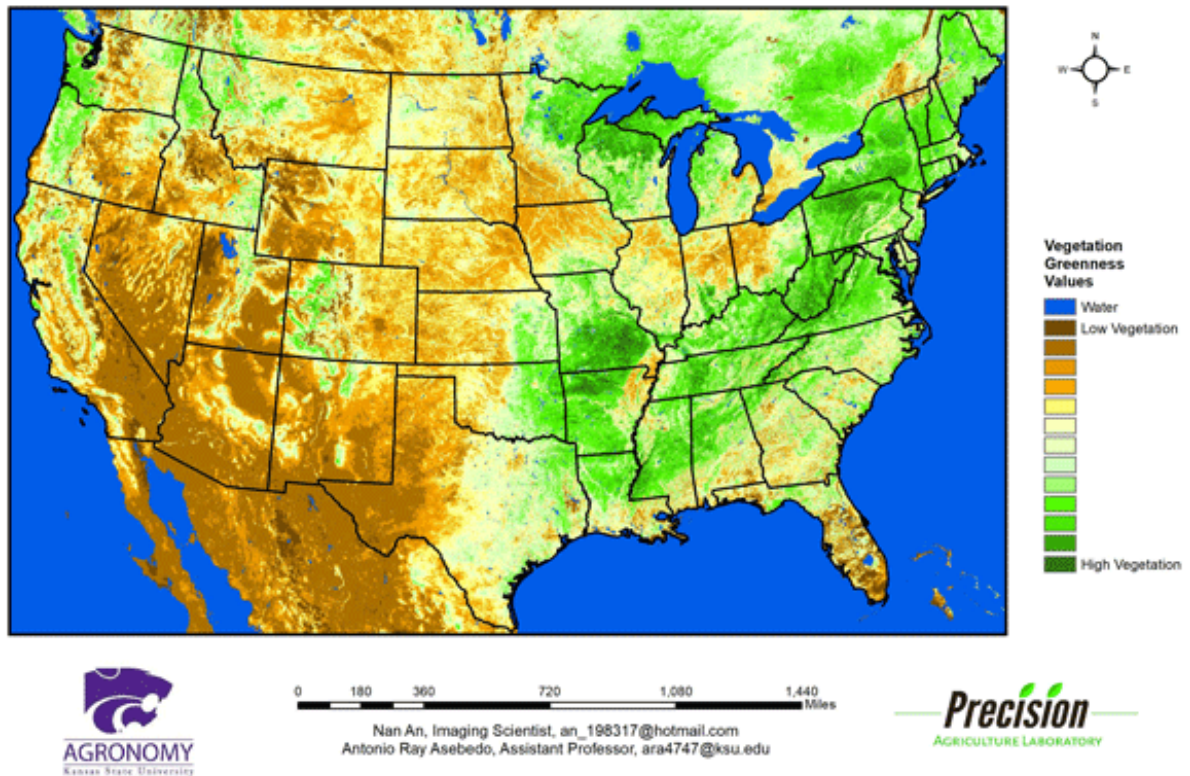
Early-June 2017 compared to the 28-Year Average for Early-June



**Figure 3. Compared to the 27-year average at this time for Kansas, this year's Vegetation Condition Report for June 6 – June 12, 2017 from K-State's Precision Agriculture Laboratory there is near normal activity across eastern parts of the state. Wetter-than-normal conditions have slowed spring planting in the northern parts of the state, and excessive moisture has dampened vegetative activity.**

## Continental U.S. Vegetation Condition

Period 24: 06/06/2017 - 06/12/2017



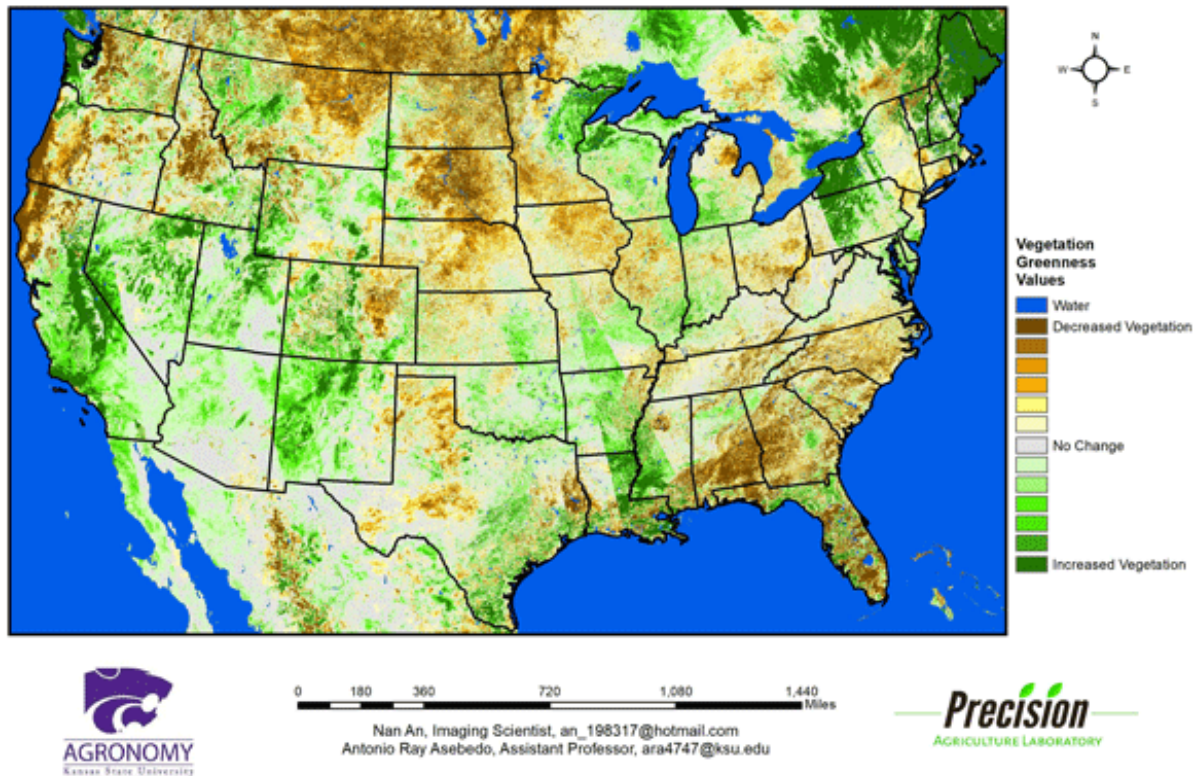
**Figure 4. The Vegetation Condition Report for the U.S for June 6 – June 12, 2017 from K-State's Precision Agriculture Laboratory shows the area of highest NDVI is confined to the South, particularly in east Texas and Louisiana northward into Arkansas and Missouri. A second area of high vegetative activity is also visible along the West Coast, where the wet conditions continue. Low NDVI values are visible along the central Mississippi River Valley, where flooding continues to be an issue, and in the Ohio River Valley, where planting was delayed and flash drought conditions are developing.**

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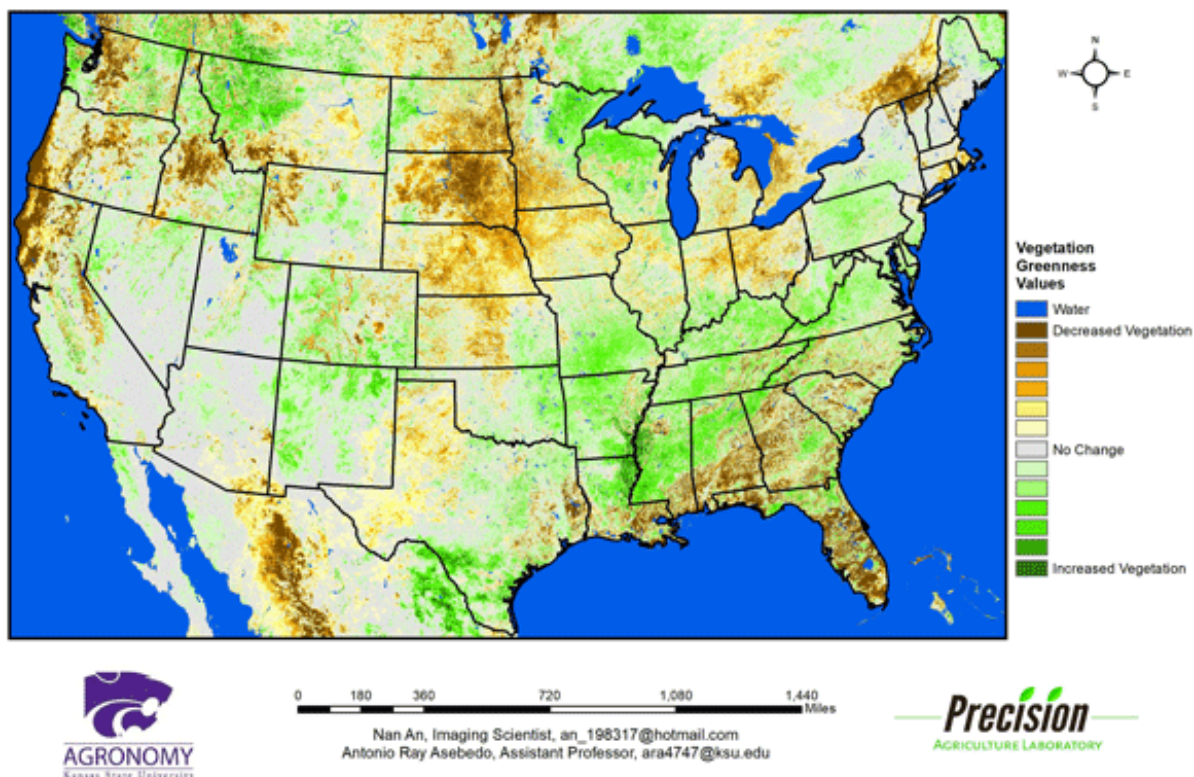
Continental U.S. Vegetation Condition Comparison  
Early-June 2017 Compared to Early-June 2016



**Figure 5. The U.S. comparison to last year at this time for June 6 – June 12, 2017 from K-State's Precision Agriculture Laboratory shows the increasing drought in eastern Montana and the Dakotas. Warm, windy conditions have further stressed range that never emerged from winter dormancy.**



# Continental U.S. Vegetation Condition Comparison Early-June 2017 Compared to 28-year Average for Early-June



**Figure 6. The U.S. comparison to the 27-year average for the period of June 6 – June 12, 2017 from K-State’s Precision Agriculture Laboratory shows below-average photosynthetic activity moving eastward and concentrated in the Northern Plains. Areas from Montana through southwestern Minnesota are showing much below-average NDVI values due mainly to persistent dry conditions. Rainfall from late this week has not yet had an impact on the vegetation. Below-average vegetative activity in western Wyoming, central Idaho, and the mountains of the Pacific Northwest is due to persistent snow pack.**

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