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These e-Updates are a regular weekly item from K-State Extension Agronomy and Steve Watson, Agronomy e-Update Editor. All of the Research and Extension faculty in Agronomy will be involved as sources from time to time. If you have any questions or suggestions for topics you'd like to have us address in this weekly update, contact Steve Watson, 785-532-7105 swatson@ksu.edu, or Curtis Thompson, Extension Agronomy State Leader and Weed Management Specialist 785-532-3444 cthompso@ksu.edu.

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1. Harvesting options for winter canola

Most of the winter canola crop in Kansas has finished blooming and is filling seed pods. The cooler and wetter weather recently has benefited pod fill and slowed the maturing process somewhat. A return to warmer temperatures will cause seed to turn color quickly. As the crop matures, it is important to consider the harvesting options available and what suits an individual producer best.



Figure 1. Canola in the ripening growth stage. Photo by Mike Stamm, K-State Research and Extension.

It is critical to have a plan at canola harvest, thus it is helpful to review some general principles.

- Seed moisture loss and color change can occur rapidly, going from too wet to dry in a matter of a couple days or even several hours. Harvesting operations must happen in a timely manner.
- Producers should base the decision to commence harvest operations on seed moisture content and visual observations of seed color change, and not plant or pod color changes.

- Moisture content should be 10% or less. Elevators will not accept canola seed that is greater than 10% moisture content.
- The plant matures from the bottom to the top of the racemes.
- Ripe canola must be harvested as soon as possible to prevent losses from shattering.
- Canola can be harvested overnight and at times when it is too damp to be harvesting wheat.
- Cylinder speeds are typically 450 to 650 rpm. Concave clearance should be 3/4" in the front and 1/8" to 1/4" in the rear. Fan speeds are similar to wheat. Combine speed is slower for canola than wheat.
- Always refer to the combine operators' manual. If there is not a listing for canola, there should be one for rapeseed. Start there and make adjustments according to what is coming into the bin and leaving the back of the combine
- Canola seed can be a little trashy in the bin. If the seed is completely clean, you are probably throwing too much over.
- A producer may want to cut canola before wheat if ready, since canola would be more apt to shatter.



Figure 2. Canola seed color change. Photo courtesy of *Great Plains Canola Production Handbook*.

There are four harvest methods for winter canola:

1. Direct combining
2. Swathing followed by combining
3. Desiccation
4. Pushing followed by combining

The preferred harvest method depends on weather and crop conditions, the ability to harvest quickly, and equipment availability. In all cases, it is important to set the combine properly and monitor operations frequently, adjusting for changing crop and field conditions. The primary concerns when harvesting winter canola are to minimize seed loss and to harvest at moisture levels that allow for proper seed storage and handling.

Direct combining

Winter canola can be direct combined with conventional or rotary combines. A few general rules apply to combine set up and operation:

- Canola is an indeterminate crop and will have some immature pods and seeds when it is ready for direct combining.
- In thinner stands, it is not unusual to have more green pods due to branching. This may cause some unevenness in maturity and dry down.
- Seed is ready to harvest before the entire plant is brown looking as the lower stem will remain green. Use a handheld grain tester to check moisture levels.
- Reel speed should match ground speed. Operating the reel too fast will cause pod shatter.
- Raise the reel above the canola canopy to lightly “pull” the crop into the grain table. The reel should be as far back over the grain table as possible.
- Cut standing canola just below the seedpods, which is about 12” or more aboveground.

There are some advantages to direct combining:

- Works well for uniform, tall, interlaced, and thick stands.
- Generally results in the best overall yield and oil quantity because the crop is allowed to ripen completely.
- Lower harvesting costs because no additional machinery is needed and only one pass through the field is required.

There are also some disadvantages to direct combining:

- Canola must be harvested when the crop is ready as shattering risks increase the longer a ripe crop stands in the field.
- If relying upon custom cutters, communication and dependability are critical to getting the crop out of the field in a timely manner.
- Unless a desiccant is applied, canola that is direct combined will likely be harvested at peak wheat harvest.

- Thin stands can result in uneven plant maturity, slowing the harvesting process and increasing the amount of time the crop needs to dry down.
- Standing canola is more susceptible to seed loss from heavy rain, hail, and high winds.

Swathing

Swathing is the most common harvest method used in the southern Great Plains. The optimum time to swath winter canola is when 40 to 60% of seeds on the main raceme have turned from dark green to a reddish-brown, brown, or black color. Seeds that have a speckling of brown or black are considered turned. At 50% seed color change, seeds in the lower one-third of the main raceme should have completely turned, the majority of the middle one-third should be turned, and the top one-third should be dark green and firm. The decision to swath should always be made based on seed color change and not pod or plant color change. Seed color change occurs rapidly, about 10% change every 2-3 days, but can be as high as 50% in 3 days depending on the weather. The key to minimizing harvest losses with this method is to swath at the appropriate crop stage. Swathing late increases the potential for shattering losses and reduced yields. Swathing too early increases the chances for high green seed count and reduced yield and oil content. Windrows will be harvested using a pickup header.

Here are a few general rules to swathing:

- Start monitoring crop stage about one week after flowering. Continue to monitor for proper stage every 2-3 days following.
- Seed color is the key for determining when to swath, not overall plant or pod color.
- Use a draper, belt-style swather. Do not crimp the windrow.
- Try to avoid swathing during the heat of the day (over 85 degrees F). This prevents accelerated seed curing and reduces the potential for high green seed count.
- Swathing during a heavy dew or a light mist will help to minimize potential shatter losses from the swathing operation.
- Swath parallel to the prevailing wind direction to reduce potential for movement of the windrows.
- Canola should be swathed just below the lowest pods and windrows should be placed on top of standing stubble. This allows for air circulation around the windrow.
- A roller attachment is necessary to push the windrow into the standing stubble, further protecting it from the weather.
- The crop can be in windrows for 7 to 10 days. If conditions are hot, dry, and windy, then it may be closer to 4 days.

There are several advantages to swathing:

- Typically earlier harvest because dry-down is accelerated by cutting off the plant from grain fill.
- Better ability to manage large acreages of canola.
- With earlier harvest, it may increase double-cropping opportunities by a week or more.
- Helps dry up any weeds present in the field that might increase seed moisture content.

- Proper swathing with good, tight windrows can withstand heavy rain and some wind with minimal yield loss.
- Helps control uneven maturities in fields.
- Fewer risks associated with severe weather than with direct combining.

There are also disadvantages to swathing:

- Potential for yield loss and low oil content from cutting off the plant prematurely when swathed prior to the optimum stage.
- Potential for yield loss from shatter when swathed later than the optimum stage.
- Swathing during hot, dry conditions (over 85 degrees F) can result in seed shrinkage.
- More time, investment, and labor involved.
- Tall, tangled, or lodged stands can be difficult to swath.
- If not placed properly into standing stubble, strong winds can move windrows.

Desiccants

Desiccants are now labeled to aid dry down and can be used prior to direct combining. Desiccants should be applied at 75-80% seed color change. There are three products available: Reglone Desiccant (diquat dibromide), Nufarm Diquat SPC 2 L (generic diquat), and Sharpen (saflufenacil).



Figure 3. Canola following desiccation. Photo by Mike Stamm, K-State Research and Extension.

Diquat should be applied at a rate of 1.5 to 2 pt per acre, with a minimum 15 gal per acre spray volume by land and 5 gal per acre by air. A seven day pre-harvest interval exists. Add a nonionic

surfactant containing 75% or greater surface active agent at ½ to 4 pt per 100 gal of spray volume. Diquat is a contact herbicide that is activated by sunlight and will only desiccate the plant materials that it touches, so coverage is important. It may also be applied on cloudy days or in the evening to allow it to spread more evenly over the plant. Diquat is typically the fastest acting desiccant.

Saflufenacil should be applied at a rate of 1.0 to 2.0 fl oz/a with a minimum 10 gal per acre spray volume by land and 5 gal per acre by air. A three day pre-harvest interval exists, but depending on weather conditions, seven days may be required for optimal desiccation. Include a methylated seed oil (1.5 pt/a) plus ammonium sulfate at 8.5 to 17 lb/100 gal of spray solution as additives. Saflufenacil is typically a slower acting herbicide than diquat and desiccation of the crop may not be as complete.

Producers may consider using a desiccant under the following conditions:

- To get the crop out of the field quicker when direct combining.
- Heavy, tall, and dense crop canopies exist.
- Heavy weed infestations caused by thin stands and excessive rainfall prior to harvest.
- Excessive lodging, making it harder to push or swath.
- Uneven crop maturity due to thin stands, low spots, wet holes, sandy knobs, or excessive rainfall making it harder to push or swath.

Pushing

Pushing was developed as an alternative to swathing. It is designed to provide the advantages of direct combining while minimizing some of the risks associated with direct combining or swathing. Pushing is still a new concept in the southern Great Plains, so experience and equipment are limiting factors.

A pusher is a roller hydraulically mounted on the front of a tractor which is driven at high speeds through the field. The pusher force lodges, or “pushes,” the crop over without cutting the plants off from the root system. The concept is to prevent yield losses from weather events by laying the crop over, allowing the crop to mature normally. Vertical sickles are located at both ends of the pusher/roller and directly in front of the tractor tires. These are designed to ensure a clean cut between passes and reduce the amount of canola crushed by the tires. Once the canola is ripe, it can be combined in the opposite direction it was pushed. The header width of the combine should match the width of the pusher.

There are advantages to pushing:

- Reduces susceptibility to shattering from wind and storms.
- Allows the crop to ripen completely.
- Works in fields with high yield potential and tall, heavy, and thick plants.

There also are disadvantages to pushing:

- Shorter, thinner crops do not push well.
- Pushing equipment is scarce in the region.
- Harvesting is typically slower than direct combining and swathing due to the amount of material entering the combine.
- Dry down of the pushed crop is typically slower than direct combining because the crop canopy has been compacted, reducing air flow.

Summary

Canola producers have a several avenues to assist them with canola harvest and getting their crop out of the field. Whatever harvest method is chosen, the keys to success are planning ahead and performing all operations in a timely manner.

For more information on these harvest methods, see the K-State publication MF-3092, *Harvest Management of Canola*. For general information on canola crop growth and seed color staging, see publication MF-2734, *Great Plains Canola Production Handbook*. Both publications can be found at www.bookstore.ksre.ksu.edu.

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2. Effect of delayed planting on corn yield: Planting date by maturity interaction

With soils continuing to be very wet in parts of Kansas and with the 8-14 day outlook projecting wetter-than-average conditions (particularly for eastern Kansas), more questions have been coming in about the effect of delayed planting on corn yield. A series of studies at K-State looking at delayed corn planting was conducted a few years ago.

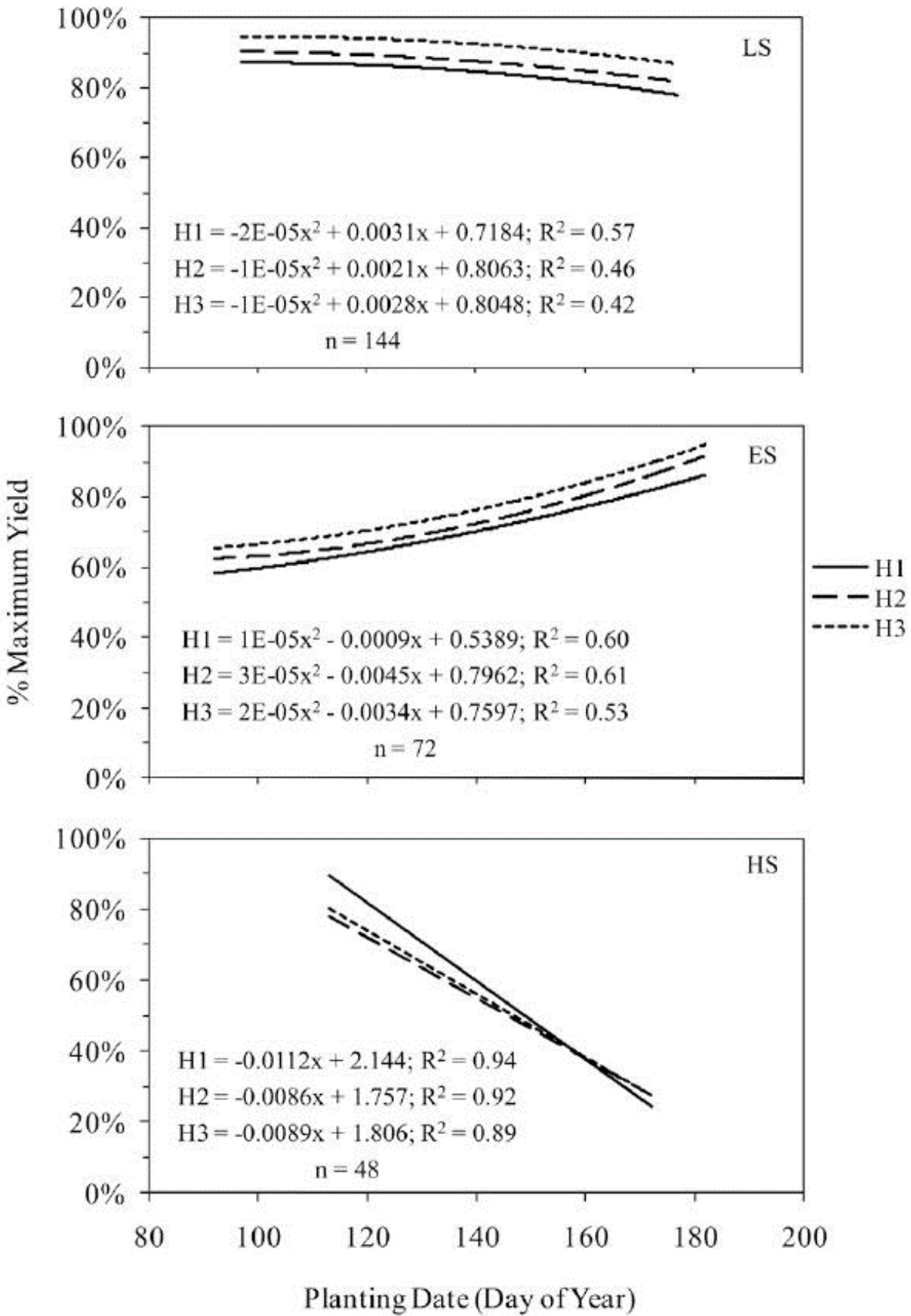
Three hybrid maturities were tested: 100-, 108-, and 112-day. Over the two years and three locations (Belleville, Manhattan, and Hutchinson) of these studies, there were three distinct environments (as related to the environmental stress):

- Low Stress – where rainfall was favorable during the entire growing season
- Early Stress – where cool temperatures and wet conditions limited early corn growth
- High Stress -- where conditions (rainfall and temperatures) were favorable early in the season, but the mid-summer was hot and dry

In the *Low Stress* environments, yields were reduced by less than 20% when planting was as late as mid-June. Yields were not statistically different for any planting date before May 20 (starting from early April). Maximum yield in these non-irrigated environments was 176 bu/acre. The yield responses were similar for hybrids of all maturities.

In the *Early Stress* environments, yields actually increased as planting was delayed until late June. This response was similar for all hybrid maturities. These environments had favorable temperatures and rainfall throughout July and early August. Maximum yield in these environments was 145 bu/acre.

In the *High Stress* environments (hot, dry mid-summer conditions), yields dropped by about 1% per day of planting delay, depending on hybrid maturity. The shorter-season hybrids had the best yields if they were planted before late May (maximum yield = 150 bu/acre), but all hybrids had yield reductions of more than 50% when planting was delayed until early to mid-June.



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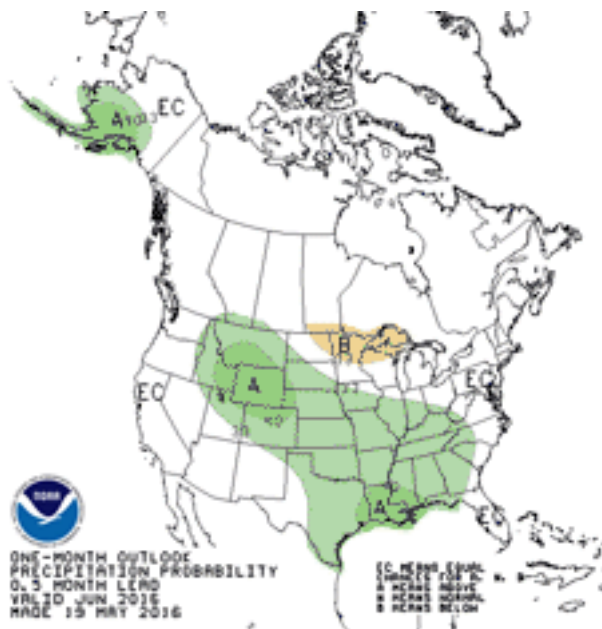
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Figure 1. The top chart (LS, or Low Stress) shows how little corn yields changed as planting dates got later when growing conditions were good through the remainder of the season. The middle chart (ES, or Early Stress) shows that corn yields actually increased with later planting dates when conditions were too cool and wet early, but then became more favorable. The lower chart (HS, or High Stress) shows how dramatically corn yields decreased when conditions were favorable early in the season, but the mid-summer was hot and dry. H1 refers to the 100-day hybrid. H2 refers to the 108-day hybrid. H3 refers to the 112-day hybrid.

In many ways, the current growing season is shaping up like the “Early Stress” scenario above, with cool conditions early in the season. Will this cool spring be followed by favorable temperatures and rainfall, or by hot and dry conditions during the rest of the growing season?

While long-term weather predictions are highly unreliable, the National Weather Service Climate Prediction Center (<http://www.cpc.ncep.noaa.gov/>) one-month (June) and three-month outlook indicates increased chances of wetter-than-normal conditions statewide (Fig. 2).



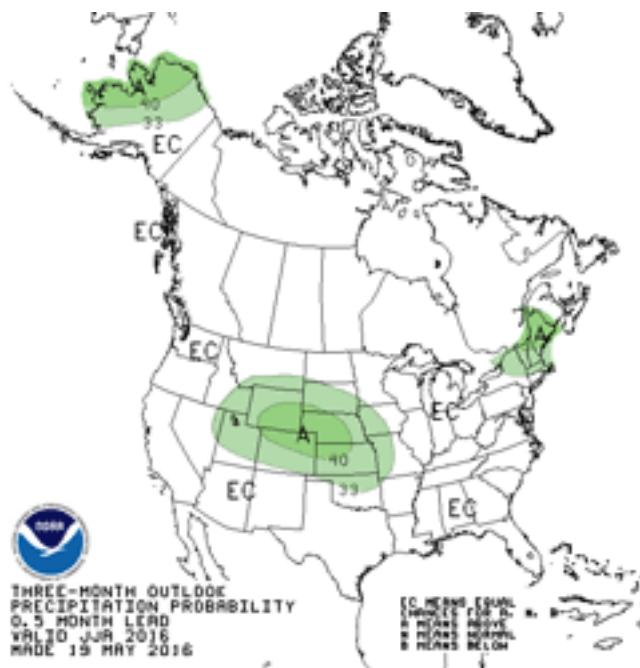


Figure 2. One-month (left-panel) and three-month (right-panel) outlook precipitation probability (from May 19, 2016). Source: NOAA.

Using a Web-Support Decision Tool: “Useful to Usable” (mygeohub.org)

To get an estimate of what may happen in various scenarios, producers may want to try the “Useful to Usable” web-support decision tool at mygeohub.org. As an example, for the Manhattan location, if a 111-comparative relative maturity (CRM) corn hybrid was planted on April 15, it will take 2,666 growing degree days (GDD) from planting to physiological maturity (black layer). That means it will reach black layer around the last week of August or first week of September (latest black layer time, Sept. 10, in the example below). The earliest first freeze experienced at this location was early October (in 1985); thus, mid-April planting does not risk early termination of the crop by fall frost (Fig. 3). Of course, we are well past that date now.

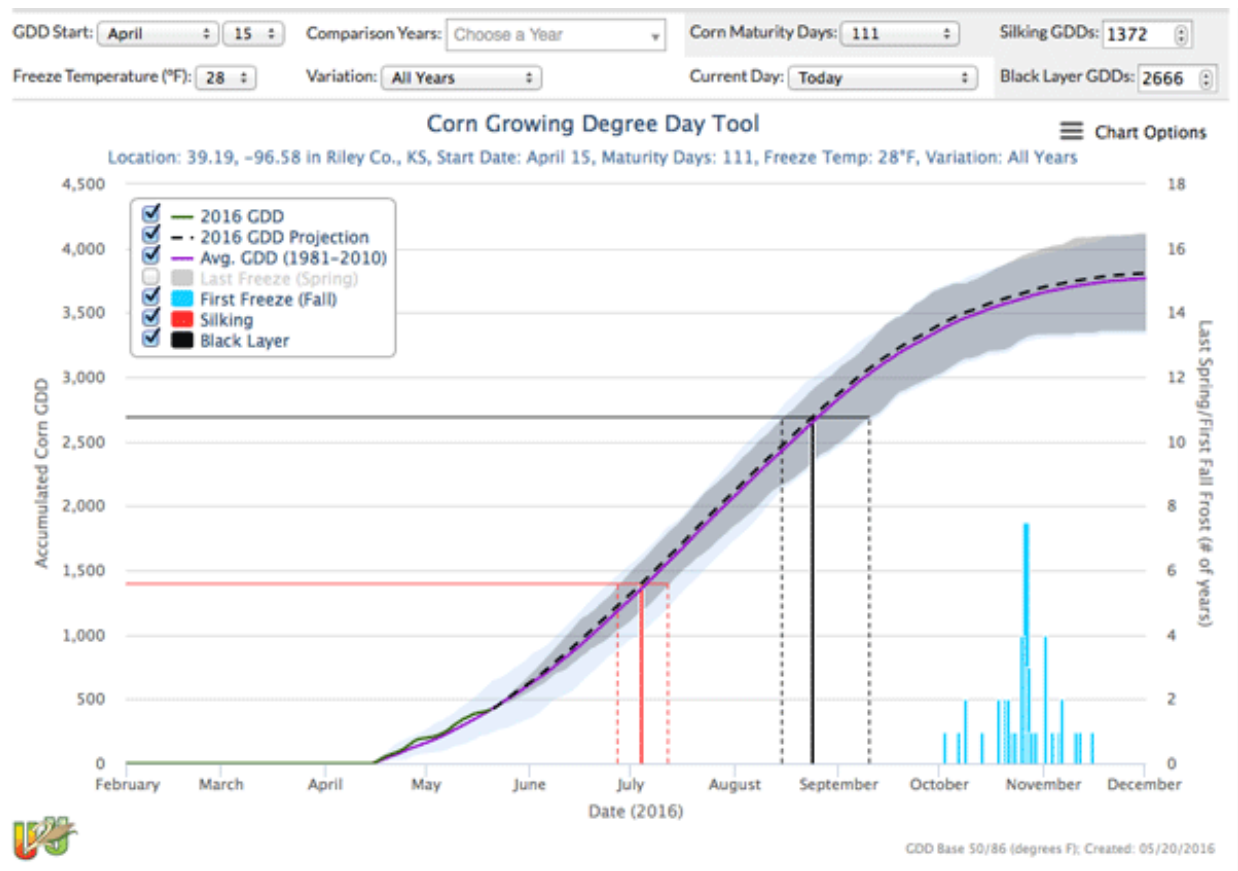


Figure 3. Corn growing degree day tool for a 111-CRM planted April 15, 2015.
 From <https://mygeohub.org/groups/u2u/gdd> (“Usable to Useful” website).

If the planting date is this Friday, May 20, without changing the CRM, the final GDD required is similar -- 2,666. Nonetheless, black layer will be reached sometime from mid-September to first week of October. This situation increases the risk of damage from an early fall freeze, but the impact is predicted to be minimal (Fig. 4). If planting is delayed even until the last day of May (May 31, 2016) without changing the CRM (111 days), then in this case the black layer would be reached sometime during the last week of September to mid-to-late October, which proportionally increases the risk of exposing the crop to the first fall frost (earliest occurring in the first week of October for this location).

= CRM (111-days) but planted at:
May 20 May 31

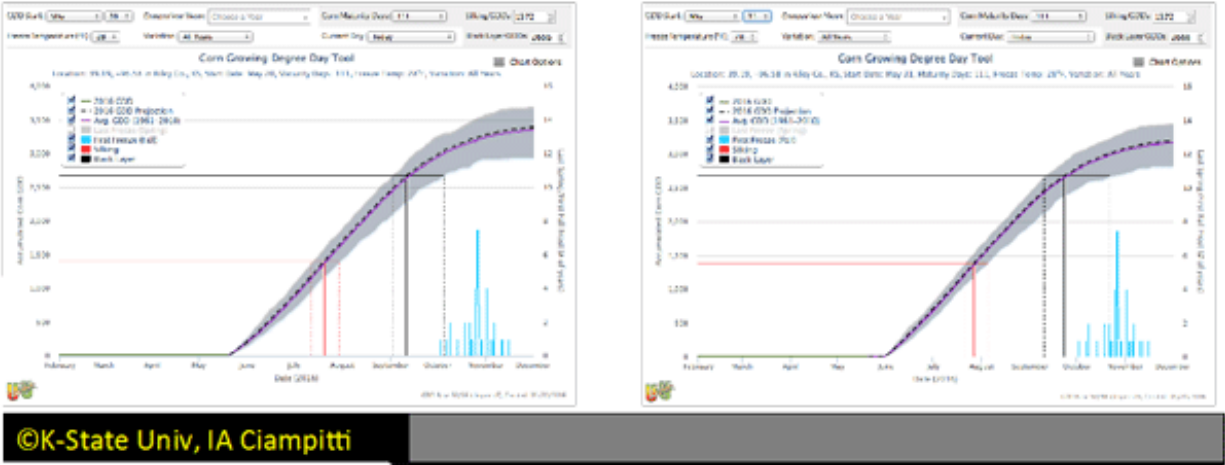


Figure 4. Corn growing degree day tool for a 111-CRM planted May 20 (right panel) and May 31 (left panel). From <https://mygeohub.org/groups/u2u/gdd> (“Usable to Useful” website).

If planting is delayed to June 6, the same CRM corn hybrid will reach maturity sometime from about early October to the beginning of November (Fig. 5 – left panel). This will increase the likelihood of a killing frost (high probability for late-October), which will result in a low-test weight and high moisture content in the grain due to a shortening of the grain filling and drying down period. By keeping the same planting time, but switching to a shorter CRM corn hybrid (e.g. 103 CRM) (Fig. 5 – right panel), the corn would reach black layer just a week after the 111-CRM hybrid planted May 20 (Fig. 4 – left panel). If 103 CRM corn hybrid seed was not easy to find for the farmer, even switching to 105 CRM planted on June 6 will be similar to the outcome obtained for planting the 111 CRM on May 31 (Fig. 4 – right panel). Thus, changing to a shorter CRM will increase the probability of reaching maturity with a small risk of being impacted by an early fall freeze.

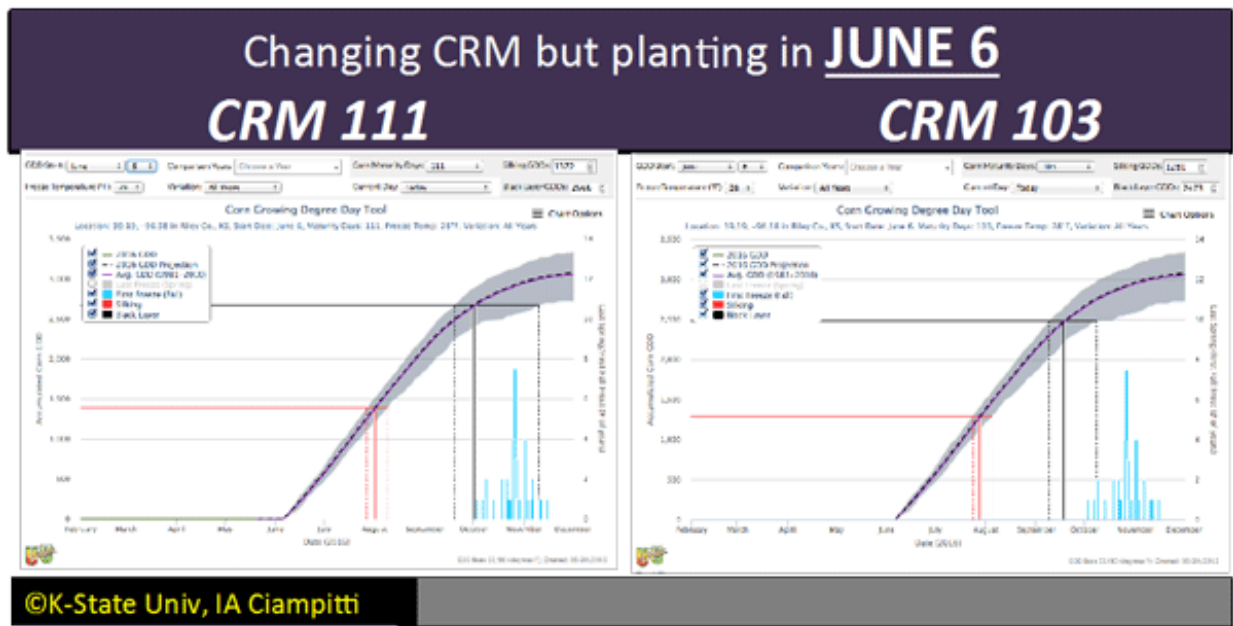


Figure 5. Corn growing degree day tool for a 111-CRM planted June 6 (left panel) and for a 103-CRM (right panel) planted at the same time.

From <https://mygeohub.org/groups/u2u/gdd> (“Usable to Useful” website).

As you move south and east from Manhattan, the risk of early termination from a fall freeze will decrease, but the risk will increase as you move north and west from Manhattan.

So, depending on your location and what you believe will happen during the rest of the growing season, delayed planting may or may not have much of an effect on corn yields. A previous eUpdate (April 26, 2013, No. 400) article on historical yield and planting date relationships confirmed that planting date is not necessarily a strong predictor of corn yield.

When making decisions on delayed planting of corn, crop insurance considerations are often an important factor, as well as agronomic considerations.

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3. Kansas climate basics: Temperatures, precipitation, and extremes 1891-2015

Nearly 70 years ago, Snowden Flora, a meteorologist of U.S. Weather Bureau located in Kansas published a book 'Climate of Kansas' (Flora, 1948). This book did an excellent job of documenting the weather and climate conditions for Kansas based on instrumental observations from late nineteenth century to the 1940s and put them into accurate historical perspective. Following up this work, a few scientists have published educational and/or extension bulletins and/or books detailing aspect of the Climate of Kansas. For example, Bark in 1963 published a bulletin in Kansas Agricultural Experiment Station on precipitation change in Kansas. Later, Feyerherm and Bark (1964) calculated wet and dry days in Kansas, and in the mid-1990s, Goodin et al. (1995) published the Kansas Climate and Weather Atlas.

These publications based on historical climate observations have not only advanced climate science in Kansas but more importantly they successfully helped to assist Kansas stakeholders' in decision making. However these publications are constrained by the use of a limited set of climate stations and/or relatively short periods used for data analysis.

While global scale changes have an influence on the climate of Kansas, other factors help explain the specific conditions across the state. At the local scale, climates are affected by various factors that include topography, elevation, proximity to oceans, water in lakes and rivers, irrigation practices and other land cover changes, and latitude.

The borders of Kansas extend 400 miles from the moderate elevations and abundant precipitation conditions (more than 42 inches of annual precipitation) of the lower Missouri Basin to the High Plains lying along the eastern slope of the Rockies (with less than 20 inches of annual precipitation). The geographic factors contribute to three quite distinct climate zones of Kansas: western third, central third, and eastern third varying widely across seasons (Fig. 1).

We undertook a study to report on the basic changes of temperature and precipitation from 1895 to 2015 as well as the extreme weather records from 1891 to 2015 in Kansas.

Methods: Source of climate data

For our study, daily climate data was obtained from Global Historical Climatology Network (GHCNd) in which the U.S. component of GHCNd is an integrated version of NCEI's (National Centers for Environmental Information) daily surface observations including the U.S. Cooperative Observer Network, the Automated Surface Observing System (ASOS), other observing systems, and thus represents the most complete historical record of daily data for the United States. Thirty long-term climate stations (Fig. 1) were selected across Kansas for January 1, 1891 to December 31, 2015 based on data availability and station continuity.

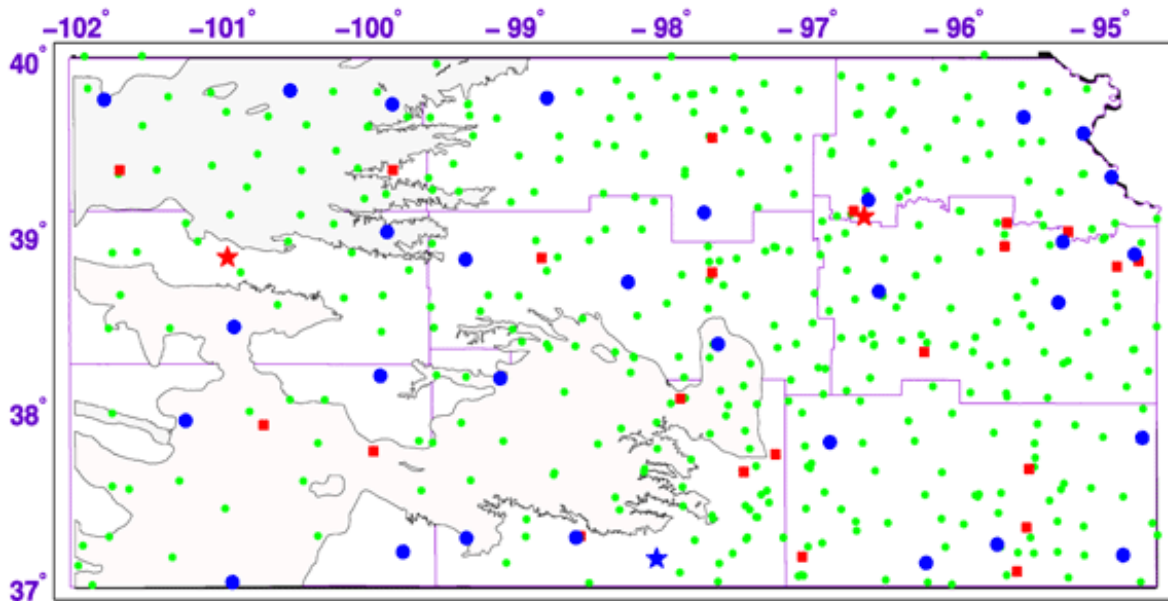


Figure 1. Total 433 active daily climate observing stations (green dots) which include 30 long-term (over 1860s to current) high quality daily stations (blue dots) and 31 long-term monthly stations (blue dots plus one blue star) in Kansas selected by the Global Climatology Network (GHCN). Kansas also has 22 federal ASOS stations (with data from the 1970s to current) and two USCRN stations (red stars, from 2002 to current). Aquifers in western Kansas and the nine crop reporting districts are shown. Each third of Kansas contains at least 9 high-quality stations analyzed in this report.

This daily data set is part of the U.S. historical climatology network program (Menne et al 2012). These daily data sets were subjected to high-quality control but there were still erroneous observations in Kansas stations. We first identified erroneous temperatures by using the 4th standard deviation as a threshold and then visually assessed suspected records by a spatial correlation method. We used daily precipitation observations only to assess the climate extreme records. When analyzing monthly and annual precipitation we used the monthly data sets for Kansas.

For monthly climate data, we used the US Historical Climatology Network (USHCN, version 2.5), which consists of 31 high-quality stations in Kansas. The data quality of monthly average temperatures has been rigorously examined. These 31 USHCN stations have long been commonly selected for use in evaluating climate changes on the global, regional, and state scales and thus these temperatures are considered as a reference base when evaluating climate change over 1895 to 2015.

In daily and monthly data sets we used, all missing data were retained without any filling or replacement by estimation in this study.

Results will appear in next six issues of Agronomy eUpdate

In the next six issues of the Agronomy eUpdate, we will present the results of our study. In each of those articles, we will reference this article that explains the methods we used to conduct the study. The following historical climatic factors in Kansas will be featured in the upcoming issues of this newsletter (in order):

- Temperature trends in general
- Maximum temperature records
- Minimum temperature records
- Precipitation trends in general
- Precipitation and snowfall records
- Top ten hottest, coldest, driest, and wettest years

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4. Soil pH and liming in Kansas: Part 1 -- Basic concepts

Many Kansas soils require periodic applications of ag lime, or other liming materials, for optimum crop production. Liming has several beneficial effects: 1) it reduces harmful or potentially toxic conditions which can develop in acid soils, especially aluminum toxicity; 2) it increases the availability of some nutrients; 3) it replaces the supply of calcium and magnesium essential for plant growth (these nutrients are depleted as soils become acid); 4) it ensures favorable conditions for the activity of certain herbicides such as atrazine; and 5) it provides a suitable environment for microbial activity.

Crops are impacted differently by soil acidity. In Kansas, wheat is one of the most acid-tolerant crops we grow, while alfalfa and sweet clover are two of the least acid tolerant. The measured impact of soil pH and acidity on corn, soybeans and wheat yield is summarized in the table below:

Table 1. Impact of soil acidity on corn, soybean and wheat yields

	Soil pH				
	4.5	5.0	5.5	6.0	6.5
Crop	Percent yield				
Corn	--	89	94	97	100
Soybeans	--	82	90	96	100
Wheat	37	97	97	100	97

The impact of pH on yield is only part of the story though. Weed control, nutrient availability and the health and diversity of the soil microbial community are also important considerations. So with this as a basic introduction, let's take an in-depth look at soil acidity: what it is, how we measure it, factors that cause soils to become acid, and how we can correct the problem.

What is an acid?

By definition, an acid is a proton or hydrogen donor. Soils are considered acidic when the water surrounding the soil particles contains a high concentration of H^+ ions. In soils, the ions or molecules in the soil water, also called soil solution, are in equilibrium with the ions or molecules held on the soil surfaces. That means that when a large portion of the cation exchange capacity (CEC) is satisfied by acids such as hydrogen (H^+) or aluminum (Al^{+3} reacts with water to form $AlOH^{+2}$ which donates H^+ making it an acid), the soil can donate acidity (hydrogen) to the water which surrounds the soil particles, and the soil is acting as an acid. But when the majority of the cations on the CEC are basic cations, the soil solution will have a low H^+ concentration, and the soil will be weakly acidic or neutral.

The main cations, or positively charged ions, found in most Kansas soils are: Hydrogen (H^+); Aluminum (Al^{+3}); Calcium (Ca^{+2}); Magnesium (Mg^{+2}), Potassium (K^+); Sodium (Na^+); and Ammonium (NH_4^+). Hydrogen and aluminum are acidic cations and the others are basic cations.

How do we measure acidity? The pH scale

The concentration of acidity in a solution is commonly expressed using the pH scale, the negative log of the hydrogen ion concentration (activity) in solution. The pH scale runs from 1 (very acid) to 14 (very basic). The midpoint, pH 7 is neutral, with the concentration of acids in solution being equal to the concentration of bases. At pH 7, the acidity, or H⁺ concentration in solution would be 0.0000001M (molar), and the OH⁻, or base concentration would also be 0.0000001M so the solution would be neutral. Since the pH scale is logarithmic, a change of one pH unit is a 10 fold change in the H⁺ concentration, or acidity level, in the soil solution. So as pH drops from 7 to 6, the H⁺ concentration increases from 0.0000001M to 0.000001M. As the pH drops further to 5, the H⁺ concentration increases another 10x to 0.00001M, now 100 times as high as at pH 7.

Measuring the acidity of soil

The relative acidity of a soil is commonly measured by estimating the pH, or hydrogen ion activity/concentration in the soil solution. This is normally done by collecting a soil sample, mixing the soil with a standard volume of water and measuring the pH of the soil:water mixture with a pH meter. The pH value obtained reflects the chemical environment in the soil water where plant roots reside. It also tells us something about the relative concentration of acidic and basic cations present on the cation exchange capacity, or CEC of the soil, and the percent base saturation. More on that in a minute.

In most Midwestern states, soil pH is commonly measured by making a 1:1 mixture by volume of soil and water. This slurry is stirred, allowed to react and settle for 10 to 20 minutes. Then a combination pH and reference electrode is inserted into solution above the soil in the sample container and the pH is measured. This sounds simple, and it is. But the procedure needs to be followed precisely to get an accurate and reproducible value. A good technician using a well-calibrated pH meter can run the procedure multiple times on subsamples taken from the same soil sample and generally get similar results, within +/- 0.1 pH units.

Measuring pH is fairly simple and reliable. The results we get from a soils lab are fairly reproducible, though environmental factors like dry soil conditions, can cause changes in soil pH. So what does measuring soil pH tell us? Measuring water pH in soils will tell us if the soil is acidic, and whether it needs lime. But unfortunately, soil pH is only part of the story. Soil pH alone won't tell us how much lime will be needed to accomplish a desired change in pH.

Soil acidity, pH, and base saturation

Rain water moving through the soil will leach ions in the soil solution -- such as soil acidity -- below the root zone. But this leaching won't change the soil pH much, because the soil will quickly re-establish the equilibrium between the solid soil and the soil solution. This process is buffering, or a resistance to change, and maintains a relatively constant environment for plant roots and other organisms residing in soils. The greater the soil's CEC, the more highly buffered the soil system is. Sandy soils generally have a relatively low CEC, so they are relatively weakly buffered and change pH fairly quickly. Silt loam or silty clay loam soils have higher CEC and are more highly buffered; thus, these soils will change pH more slowly. Soils in a given region will have a general relationship between the relative concentration of acid and basic cations on the CEC (% base saturation) and soil pH. An example of this relationship is shown in Figure 1.

Base Saturation versus pH

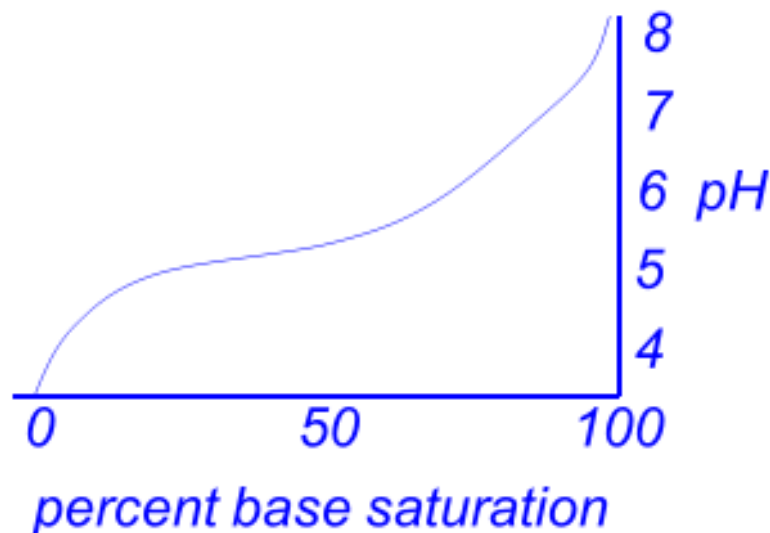


Figure 1. The relationship between percent base saturation and soil pH in a typical Midwestern soil when calcium is the dominant basic cation.

This is the general relationship found when calcium is the dominant basic cation on the exchange sites, as is the case in most Midwestern soils. The actual shape of this curve for a given soil will change depending on the clay and organic matter content, the type of clays present, and the total cation exchange capacity. So the shape isn't all that important. What is important to remember is that as the base saturation approaches 0, the pH in most soils will approach 4. It is very unusual to find soils with pH levels below 4. The most common places that a soil pH below 4 is observed are areas where acid mine drainage accumulates, or drainage across a coal seam surfaces. The free acids present, normally sulfuric acids, can be strong enough to lower the pH below 4 in those cases. Another place one can see pH below 4 is in areas where the soil contains sulfides. This is most common in certain marine sediments, but not found here in Kansas.

In some areas of Kansas, particularly where irrigation with marginal quality water containing sodium has been practiced, sodium has become a significant portion of the exchangeable cations. Only when sodium is present in significant quantities, >15%, will soil pH above 8.5 occur. If soil pH's higher than 8.5 are found in routine soil testing, an exchangeable sodium test should be requested. In a normal calcium dominant system, calcium carbonate forms limiting the upper pH to around 8.2

Why do soils become acid?

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Soil acidification is a natural process, with a number of sources of acidity being added to most soils naturally. Some soils are acidic because of the composition of the parent material from which they were formed. Other soils become acid by a number of natural processes over long periods of time. Crop production with the use of nitrogen fertilizers has accelerated the soil acidification process, making liming a much more common and important part of soil management today. The net result is that hydrogen and aluminum (acidic cations) replace calcium, magnesium, and potassium (basic cations) on the soil cation exchange complex.

Natural sources of soil acidity

Rainfall. Soils will naturally become acidic in humid regions because rainfall is a natural source of acidity. Natural rain, without any pollution from man, has a pH of about 5.4. This is due to the CO₂ content of the atmosphere dissolving in the rain to form a very dilute concentration of carbonic acid, H₂CO₃. As CO₂ levels rise in the atmosphere, the pH of rain water decreases. The actual amount of acidity supplied through rainfall each year is very, very small -- normally less than 1 pound of acidity per acre per year. But over long periods of times, centuries in geologic time, this will cause soils in a humid climate, where rainfall exceeds the amount of water use by plants, to become acidic. Most of the soils in humid parts of the United States, east of the Mississippi are naturally slightly acidic. This includes much of the eastern half of Kansas.

Other sources of acidity. In addition to the acidifying effects of rainfall, organic acids, similar to vinegar, are produced in the soil when plant residues and organic matter decompose. These weak acids react and combine with nutrients such as calcium, magnesium, and potassium and move down through and below the root zone with rainfall. Hydrogen is released from these organic acids and replaces basic cations, causing the soil in the leached zone to become even more acidic. Examples of this process are found where limestone rock is found just a few feet below an acid surface soil. The long-term leaching of these acids has dissolved sufficient limestone and caused a collapse of the surface soil, creating sinkholes.

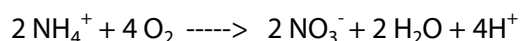
Impacts of cropping on soil acidity

Crop removal. Calcium, magnesium, and potassium are essential nutrients for plant growth. Their uptake by plants, and subsequent removal through harvest, can have an acidifying effect on soils. The amount of these nutrients removed by cropping depends on: a) crop growth, b) the part of crop harvested, and c) stage of growth at harvest. Removal is greater for hay crops than for grain crops, as shown in Table 2.

Crop	Production	Calcium	Magnesium	Potassium
Hay crops	tons/acre	lbs/acre		
Alfalfa	6	180	28	240
Red clover	3	75	22	100
Grass	3	22	10	110
Grain crops	bu/acre			
Corn – grain	150	2	8	25
Soybeans – seed	50	8	8	45
Wheat – grain	50	1	4	13

Source: *Feeds and Feeding*. Frank B. Morrison. 22nd Edition.

Fertilizers. Nitrogen fertilizers have a greater acidifying effect on soils than any other source. Most commonly used nitrogen fertilizers contain ammonium nitrogen (urea is an ammonium forming material). Soil bacteria convert ammonium (NH_4^+) to nitrate (NO_3^-) through a biochemical process called nitrification. Hydrogen (H^+) is released in this process, and the freed hydrogen ions cause an increase in acidity.



Nitrification

Table 3 shows the calculated amount of ag lime needed to offset the acidity potential of several common nitrogen fertilizers. It is evident that applying more nitrogen fertilizer than a crop can take up is not only wasteful and expensive from the nitrogen standpoint but also increases the cost of a liming program and can be a pollution hazard.

The second potential acidifying effect from nitrogen comes from nitrate that is not taken up by the growing crop. Nitrates are very soluble and if not taken up by plants, will move downward with soil water and be carried below the root zone. The negatively charged nitrate ions take other positively charged ions, most likely calcium and magnesium since they are normally present in the largest quantities, with them and their removal in this manner has the same acidifying effect on soils as removal by a crop.

Fertilizer	N concentration	Pounds of ECC needed as lime to neutralize the acidity from 1 lb of actual N
Ammonium nitrate	34% N	3.6
Anhydrous ammonia	82% N	3.6
Urea	46% N	3.6
UAN solutions	28-32% N	3.6
Ammonium sulfate	21% N	7.2
Monoammonium phosphate	11-12% N	7.2
Diammonium phosphate	18% N	5.4

Summary

Soil acidity is a natural process which humans have accelerated with modern cropping systems. It has important impacts on soils, and the plants and organisms found there. Part 2 of this 3-part series will discuss how we determine lime needs in different cropping systems.

Dave Mengel, Soil Fertility Specialist
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5. Does corn need additional nitrogen?

Prolonged wet soil conditions in parts of Kansas have resulted in large areas of some fields of corn turning (or remaining) yellow this spring. If the yellow color is due to nitrogen (N) deficiency, sidedressing will be needed.

This raises several questions. How much N will be needed? Should the N rate at sidedressing depend on the growth stage of corn? If urea-based products are applied, will it volatilize under current conditions?

The first question regarding rates is perhaps the most difficult to answer. If a chlorophyll meter or optical crop sensor, along with a reference strip for comparison purposes, are not available for making an estimate of how much N will be needed, producers will have to rely on other methods to estimate sidedressing N rates needed.

Supplemental N needs for individual fields may range from 0 to 100 lbs N/acre, but will vary greatly depending on soil texture, drainage, N source applied and when applied. The keys are what loss mechanisms were involved -- leaching on sands or denitrification on heavier soils -- and how much of the fertilizer applied had been converted to nitrate. Urea and UAN fertilizers convert more rapidly to nitrate under most conditions than ammonia, thus are more rapidly lost. A well-drained silt loam soil which had ammonia applied a week or two prior to planting will likely have much less loss than a similar soil with urea broadcast applied in February or March.

The need for additional N also depends on what the yield potential is. Yield potential can be reduced in many fields by the early-season N deficiency/stunting, especially on early planted corn. Delayed planting has reduced yield potential in other areas. In both situations, N requirements will also be reduced. Potential yield loss is difficult to estimate, but a good starting point might be about one bushel/acre for each day the crop development is delayed by stunting or delayed planting.

Nitrogen applications

If additional N is to be applied, it needs to be applied as soon as possible. Also keep in mind that rainfall will be needed to move surface-applied N into the root zone. But keep in mind also, that there is likely a significant amount of N remaining in most fields, which will carry the plant for a while, which is why many fields are greening up as the soil dries and oxygen returns to the root zone. Much of the N applied now will be to avoid N stress later in the season as the current depleted preplant supplies run out.

It is difficult to say exactly how much, if any, additional N needs to be applied. If additional N is going to be applied, our estimate would be that amounts will vary from 30 to 80 lbs N/acre for many situations this year, with lower amounts on productive, well-drained silt loams which received spring, preplant ammonia. Higher N losses will have occurred on poorly drained soils, such as clay pan soils, or on sands or sandy loams prone to leaching, and higher sidedress N rates will be needed in many of those situations. Fields that received broadcast urea in late winter/early spring will also likely need larger amounts of supplemental N.

There are a number of ways to apply nitrogen after corn planting:

- Ammonia can be sidedressed, beginning as soon as the rows are up and visible, and the

ground is in good enough condition that the application won't damage seedling corn with slabs of soil. Normally ammonia can still be applied with minimal stalk breakage or root pruning damage until the 6-7 leaf stage of corn, approximately 30-35 days after emergence.

- UAN solutions, either 28% or 32%, can be applied as a surface band after emergence. UAN can also be coulter-banded as a sidedress with ground equipment until the 6-7 leaf stage. If that's not possible or desirable, UAN can be applied with high clearance sprayers and drop hoses to the soil surface as a sidedress typically as late as the 16- to 17-leaf stage. New research shows that current corn hybrids can respond to N application as late as silking stage if N deficiencies are observed. This can provide a good window for N application if high-clearance equipment is available. It's important to avoid applying UAN over-the-top directly on the plant and damaging leaf tissue, especially at the 5- to 6-leaf stage and later, when the tassel is developing and when the number of rows of kernels on the ear are being determined. Research has shown that burning a leaf or two at the 2- to 4-leaf stage will have minimal effects on yield.
- Urea can also be broadcast after planting as late as the 5- or 6-leaf stage with minimal damage to plants and good response. In a rescue situation, urea has been successfully broadcast over the top of 10- to 12-leaf corn, or aerially applied even later. Some leaf speckling or flecking will be seen, but good responses can still be obtained. With surface application of urea-containing fertilizers, the risk of volatilization losses increases with warm temperatures. The application of urease inhibitor products can help to reduce N losses, particularly if no rainfall is forecasted for the next 7-10 days.

A final comment: Make sure that the cause of the stunting and off color corn is N deficiency. Odds are that if the corn has turned yellow mostly in the lower lying areas of the fields and the fields have been saturated or extremely wet, it is N deficiency due to denitrification or leaching – or simply the inability to make planned applications of N. But there are other causes of yellowing to consider.

Yellow corn

There have also been cases in eastern Kansas in recent years where yellowing in corn is due to potassium deficiency, especially in reduced and no-till systems. Nitrogen deficiency symptoms are exhibited on the lower leaves first, with the leaves yellowing from the leaf tips back down the mid-rib in an inverted 'V' pattern.

Potassium deficiency also develops on the lower, older leaves first, but causes the leaf tips and margins to "fire" and die. Both N and K deficiency often do not occur uniformly across the whole field, but in an irregular pattern.

Other possible causes of yellowing may be sulfur or zinc deficiency. With sulfur deficiency, first the upper leaves then the entire plant turns a pale yellow. However, an overall plant chlorosis can also happen when the corn roots are too wet and deprived of oxygen. In that case, the overall yellowing will mask any true nutrient deficiencies until the soil begins to dry out and roots are able to resume growth.

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6. K-State wheat plot tours for May 23-27

The week of May 23 to May 27 is another exciting week for Kansas wheat producers all over the state! Wheat plot tours are up and going and producers willing to learn about the different varieties can choose to attend one (or several) plot tours in their county or agricultural district.

This upcoming week holds 22 wheat plot tours across Kansas. The plot tours generally include a discussion of wheat conditions across the state, as well as tips on what to look for when selecting wheat varieties for one operation. New and upcoming varieties are discussed, as well as older and more established ones and a discussion of how all these varieties are responding to this growing season's conditions.

To find the nearest 2016 K-State wheat plot to you, [click here](#). This list is an ongoing effort, and some details on it might change and plot tours might be added or moved around. Make sure to double check it as the time to your selected tour approaches.

For the week of May 23-27, the schedule plot tour locations include:

Monday, 5/23/2016, 12:00 p.m.

Location: Edwards Co., Kinsley

Contact: Martin Gleason, 620-659-2149, mgleason@ksu.edu

Directions: Fairground Building for lunch, plot 5 miles west of Kinsley

Monday, 5/23/2016, 6:00 p.m.

Location: Pawnee Co., Garfield

Contact: Shannon Rogge, 620-285-6901, luckiksu@ksu.edu

Directions: North of Garfield on H Rd between 210th and 220th

Tuesday, 5/24/2016, 7:30 a.m.

Location: Southeast Kansas Research and Extension Center, Parsons

Contact: Doug Shoup, 620-212-2399, dshoup@ksu.edu

Directions: Just south of HWY 400 on the NW side of Parsons at the SE Research and Extension Center

Tuesday, 5/24/2016, 5:00 p.m.

Location: Reno Co., Hutchinson

Contact: Gary Cramer, 620-662-9021, gcramer@ksu.edu

Directions: South Central Experiment Field, 10702 S. Dean Road, 10 miles SW of Hutchinson

Tuesday, 5/24/2016, 9:00 a.m.

Location: Smith Co., Smith Center

Contact: Sandra Wick, 785-282-6823, swick@ksu.edu

Directions: 4 mi. W of Smith Center on Hwy 36 (N side)

Tuesday, 5/24/2016, 1:00 p.m.

Location: Osborne Co., Osborne

Contact: Sandra Wick, 785-346-2521, swick@ksu.edu

Directions: 1/2 mile west of Osborne, Hwy 24, north side

Tuesday, 5/24/2016, 9:00 a.m.

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Location: Jewell Co., Jewell

Contact: Sandra Wick, 785-378-3174, swick@ksu.edu

Directions: W. on Pearl St. in Jewell. Past water tower and go north to foot bridge.

Tuesday, 5/24/2016, 1:00 p.m.

Location: Lincoln Co., Lincoln

Contact: Sandra Wick, 785-524-4434, swick@ksu.edu

Directions: 8 miles east of Lincoln on Hwy. 18, south side

Tuesday, 5/24/2016, 4:30 p.m.

Location: Mitchell Co., Beloit

Contact: Sandra Wick, 785-738-3597, swick@ksu.edu

Directions: S. of Beloit on Hwy 14 to S Rd. then 7 mi. W., plot on south side

Wednesday, 5/25/2016, 6:00 p.m.

Location: Harvey Co., Newton

Contact: Ryan Flaming, 316-284-6930, flaming@ksu.edu

Directions: The plot is on K-15 between Dutch Ave and NE 96th.

Wednesday, 5/25/2016, 7:30 a.m.

Location: Sedgwick Co., Andale

Contact: Zach Simon, 316-660-0153, zsimon@ksu.edu

Directions: South of Andale 8 miles on 247th then east on 6th St, north side

Wednesday, 5/25/2016, 10:30 a.m.

Location: Sedgwick Co., Clearwater

Contact: Zach Simon, 316-660-0153, zsimon@ksu.edu

Directions: North side of Clearwater at the corner of 135th and 95th.

Thursday, 5/26/2016, 4:00 p.m.

Location: Finney Co., Garden City

Contact: AJ Foster, 620-640-1259, anserdj@ksu.edu

Directions: Southwest Research and Extension Center

Thursday, 5/26/2016, 4:00 p.m.

Location: Barton Co., Great Bend

Contact: Alicia Boor, 620-793-1910, abor@ksu.edu

Directions: 5 miles west of Great Bend on Hwy 56 and 2 1/2 miles south on SW 50 Ave.

Thursday, 5/26/2016, 5:00 p.m.

Location: Barton Co., Galatia

Contact: Alicia Boor, 620-793-1910, abor@ksu.edu

Directions: 1/4 mile to the East of Galatia on NW 190 Rd off of Hwy 281. The exact location is 951-977 NW 190 Rd.

Thursday, 5/26/2016, 6:00 p.m.

Location: Riley Co., Randolph

Contact: Gregory W. McClure, 785-537-6350, gmcclure@ksu.edu

Directions: Randolph/Blue Rapids 5 miles north of Randolph on Hwy 77 to Rose Hill Road, 2 miles

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west on Rose Hill Rd., then ¾ mile north on Halls Ravine Road.

Thursday, 5/26/2016, 9:00 a.m.

Location: Ellis Co., Hays

Contact: Guorong Zhang, 785-625-3425, gzhang@ksu.edu

Directions: KSU Agricultural Research Center in Hays.

Friday, 5/27/2016, 8:30 a.m.

Location: Saline Co., Solomon

Contact: Tom Maxwell, 785-309-5850, tmaxwell@ksu.edu

Directions: Located 3 miles west of Solomon on Old Hwy 40 then 2 ½ miles south on Gypsum Valley Rd

Friday, 5/27/2016, 11:00 a.m.

Location: Saline Co., Mentor

Contact: Tom Maxwell, 785-309-5850, tmaxwell@ksu.edu

Directions: Located ½ mile west of Mentor and just south of Old Hwy 81/Mentor Rd. intersection.

Friday, 5/27/2016, 1:30 p.m.

Location: Saline Co., Gypsum

Contact: Tom Maxwell, 785-309-5850, tmaxwell@ksu.edu

Directions: Located 1 mile west of Gypsum on Hwy K-4 then 5 miles south on Kipp Rd. then 1/4 mile west on Hobbs

Friday, 5/27/2016, 8:30 a.m.

Location: Rooks Co., Stockton

Contact: Cody Miller, 543-6845, codym@ksu.edu

Directions: 7 miles South of Stockton on Hwy 183 to R Rd and 1 mile West to 17 Rd then north about 1/8 Mile (plot is on the west side of the road).

Friday, 5/27/2016, 11:00 a.m.

Location: Phillips Co., Phillipsburg

Contact: Cody Miller, 543-6845, codym@ksu.edu

Directions: 2 miles South of Phillipsburg on Hwy 183 to East Thunder Lane, 1 mile east to E. 200 Rd and about ¼ mile north (plot is on the east side of East 200)

Romulo Lollato, Extension Wheat Specialist
lolato@ksu.edu

Erick DeWolf, Extension Wheat Pathologist
dewolf1@ksu.edu

7. South Central Experiment Field Spring Field Day, May 24

The Spring Field Day at the South Central Experiment Field will be held May 24, starting at 5 p.m. The event will be held at the field headquarters, 10702 S. Dean Road.

The main topics will include:

- Dual-Purpose Wheat Varieties – Romulo Lollato, Wheat and Forages Specialist
- Wheat Breeding Research, Variety Plots – Allan Fritz, K-State Wheat Breeder, Manhattan
- 2016 Wheat Disease Situation and Fungicide Performance – Erick DeWolf, Extension Plant Pathologist
- Wildcat Genetics: The Future of Winter Wheat Development – Daryl Strouts, President, Kansas Wheat Alliance
- Canola Update on Variety Development – Mike Stamm, Canola breeder

In addition, graduate student research will be presented.

- Marshall Hay: Evaluation of Soil-Applied Herbicides for Pigweed Control
- Tyler Gardner: Normalized Difference Vegetation Index (NDVI) Based N Recommendation for Dual-Purpose Wheat Varieties
- Nathan Thompson: Pigweed Control in Double Crop Herbicide-Resistant Soybeans
- Baylee Showalter: Canola Seeding Rate in 30-inch Rows

More information about the field day is available by calling Gary Cramer, agronomist-in-charge, at 620-662-9021, or gcramer@ksu.edu. A meal will follow the field day.

8. Southeast Kansas Spring Crops Field Day May 24 in Parsons

Recent corn and wheat research will be on display at the Southeast Research and Extension Center Spring Crops Field Day and Tour, Tuesday, May 24, in Parsons. It will be hosted at the K-State Southeast Research and Extension Center, 25092 Ness Road (immediately south of U.S. Highway 400 on Ness Road).

Registration and breakfast, compliments of commercial sponsors, starts at 7:30 a.m. The program begins at 8:30 a.m., including:

Tour of wheat (43 varieties) plots – Allan Fritz, K-State wheat breeder; Lonnie Mengarelli, K-State research assistant; and seed company representatives

Wheat disease management – Doug Shoup, K-State southeast area crops and soils specialist

Using NDVI (Normalized Difference Vegetation Index) for nitrogen recommendations – Ray Asebedo, K-State precision agriculture agronomist

Corn management – Gretchen Sassenrath, southeast area crop production agronomist

The program will be hosted rain or shine. More information is available by calling 620-421-4826.

9. Winter canola featured at K-State field days May 24, 25

The latest research and production information on winter canola will be featured at a series of K-State Research and Extension field days on May 24 and 25.

The field days will give producers several opportunities to see winter canola research plots and producer fields. Current research being conducted at the South Central Experiment Field near Hutchinson, as well as canola production fields near Concordia, Haven, and Andale will be on tap. Harvest management will one of the main topics.

With harvest season fast approaching, harvest management is critical for any crop, especially canola. We will talk about how to appropriately stage canola for swathing, desiccating and direct cutting at each location.

The schedule for the field days includes:

May 24. First up is the South Central Kansas Experiment Field spring field day on Tuesday, May 24. The program begins at 5 p.m. at the field headquarters, 10702 S. Dean Road, Hutchinson. Canola topics will include harvest management, a seeding-rate-by-variety-by-row-spacing study and a variety demonstration plot. Ten commercial canola varieties from five different seed suppliers will be on display.

May 25. On Wednesday, May 25, KSRE will partner with Rubisco Seeds to highlight three canola producers in Kansas. "The producers we will visit are growing hybrid canola," Stamm said. "We will be discussing advanced production practices and how those practices have helped make these canola growers successful." Refreshments will be provided by Rubisco Seeds.

The first stop will be at 10 a.m. south of Concordia. From the US-81 and Oat Road junction, drive 4.5 miles east to 200th Road. This field was drilled on 7.5-inch row spacings following double-cropped wheat.

The second stop will be at 2 p.m. east of Hutchinson. From the intersection of US-50 and K61 highways, go 5 miles east on US-50. The field is located at the intersection of US-50 and Kent Road. A second canola field planted after corn and under irrigation will also be included on this stop.

The third stop will be at 5 p.m. in Sedgwick County. From Andale, drive 3 miles west on W 61st St N and 1 ¼ miles south on N 295th St W. In this field, the previous crop residue was burned, then canola was seeded using a no-till planter on 30-inch rows.

For more information, contact Mike Stamm at 785-532-3871 or mjstamm@ksu.edu.

Mike Stamm, Canola Breeder
mjstamm@ksu.edu

10. Kansas Wheat Day, Agricultural Research Center-Hays, May 26

The KSU Ag Research Center will be hosting the Kansas Wheat Day on May 26, 2016.

Registration begins at 8:30 a.m. Coffee, drinks, and donuts will be available, sponsored by the Kansas Wheat Alliance. Opening remarks from Bob Gillen, Western Kansas Agricultural Research Center (WKARC) department head, will be at 9 a.m.

The schedule for the remainder of the morning is:

9:15 Wheat Variety Tour --- Guorong Zhang, WKARC Wheat Breeder

10:15 Weed Management in Wheat-based Cropping Systems---Phillip Stahlman, WKARC Weed Scientist

10:40 Tillage Effects and Nitrogen Application --- Augustine Obour, WKARC Soil Scientist

11:00 Utilizing UAS Imaging Capacity in Wheat Breeding Programs --- Robert Aiken, WKARC Plant Physiologist

11:30 Emerging Issue with Wheat Stem Sawfly --- JP Michaud, KSU Entomologist

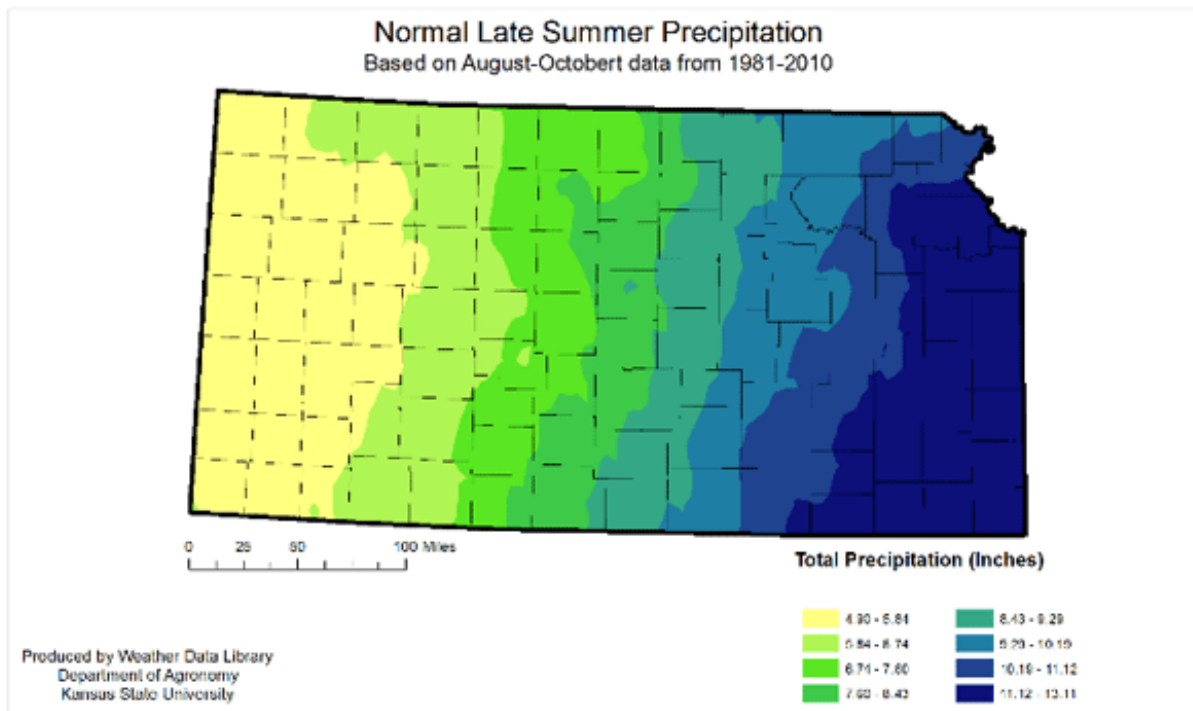
12:00 Lunch --- Sponsored by Kansas Wheat Commission

1:00 Adjourn

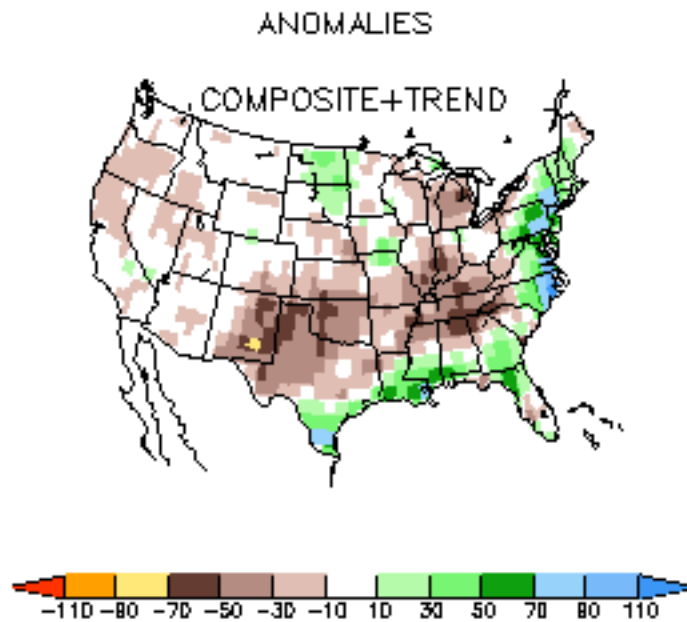
11. Spring Field Day, May 26, Garden City

The current El Niño is fading, and a La Niña watch has been issued. The most recent ONI (Oceanic Niño Index) for the February, March, April (FMA) period is +1.6 degrees Celsius. However, the weekly update from May 11th shows a significant decrease in the anomalies across the equatorial Pacific. The outlook favors a move to neutral conditions during the summer, with a 75 percent chance of a La Niña by autumn.

A La Niña event typically brings warmer and drier-than-normal conditions to the Plains during the late summer and early fall. The first map shows the normal precipitation in Kansas for the August to October period, while the second shows the August to September precipitation anomalies during La Niña events.

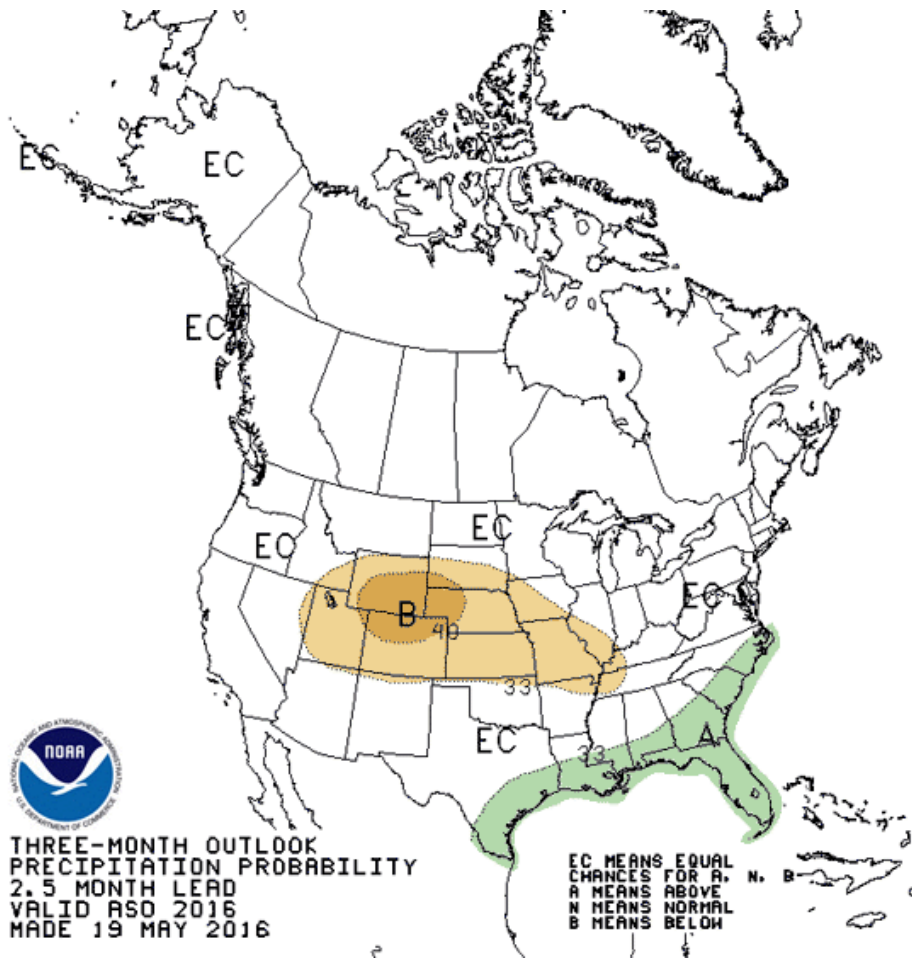


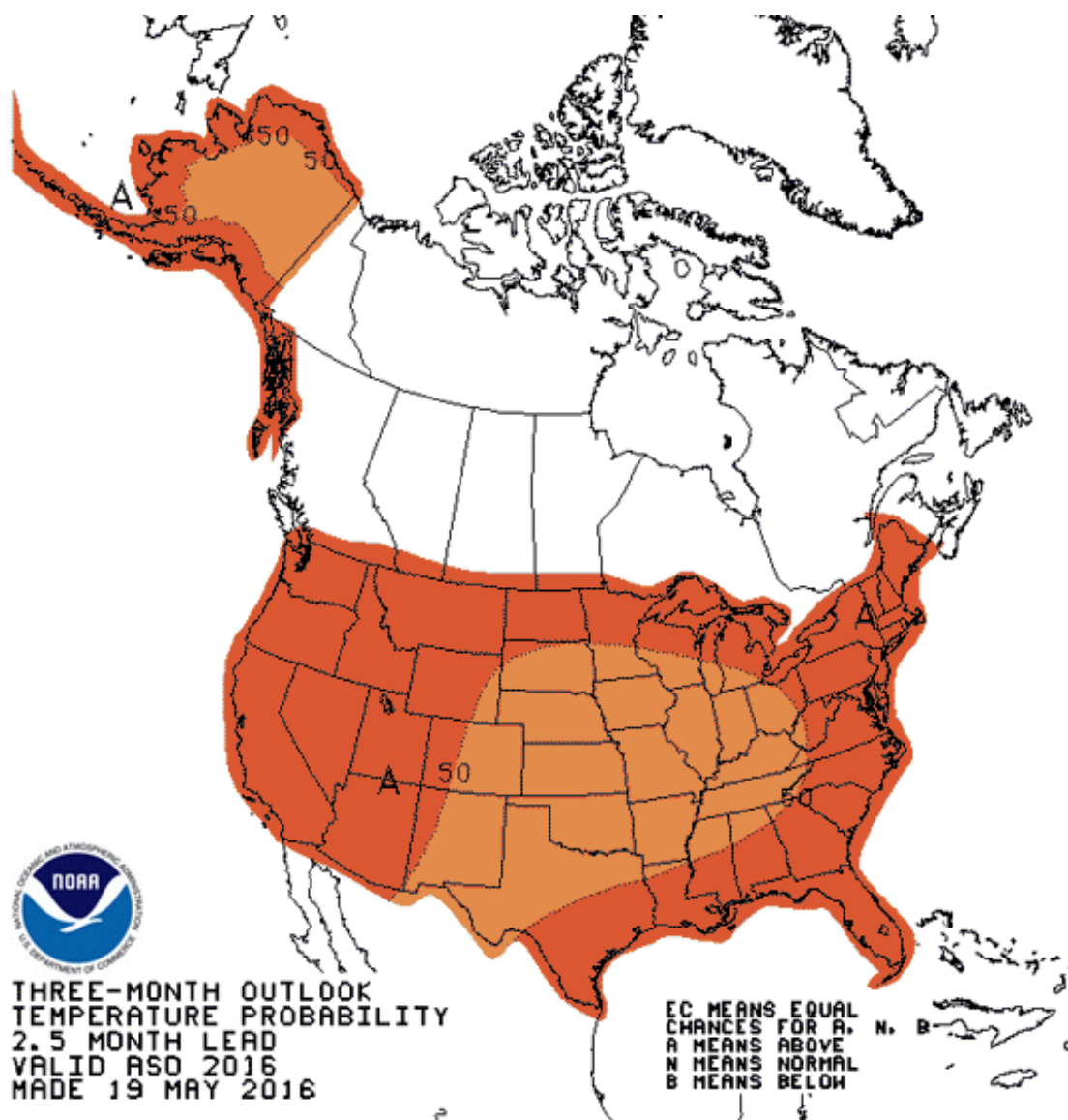
ASO LA NINA PRECIPITATION ANOMALIES (MM) AND FREQUENCY OF OCCURRENCE (%)



(17 CASES: 1954 1955 1956 1964 1970 1971 1973 1975
1983 1985 1988 1995 1998 1999 2000 2007 2010 2011)

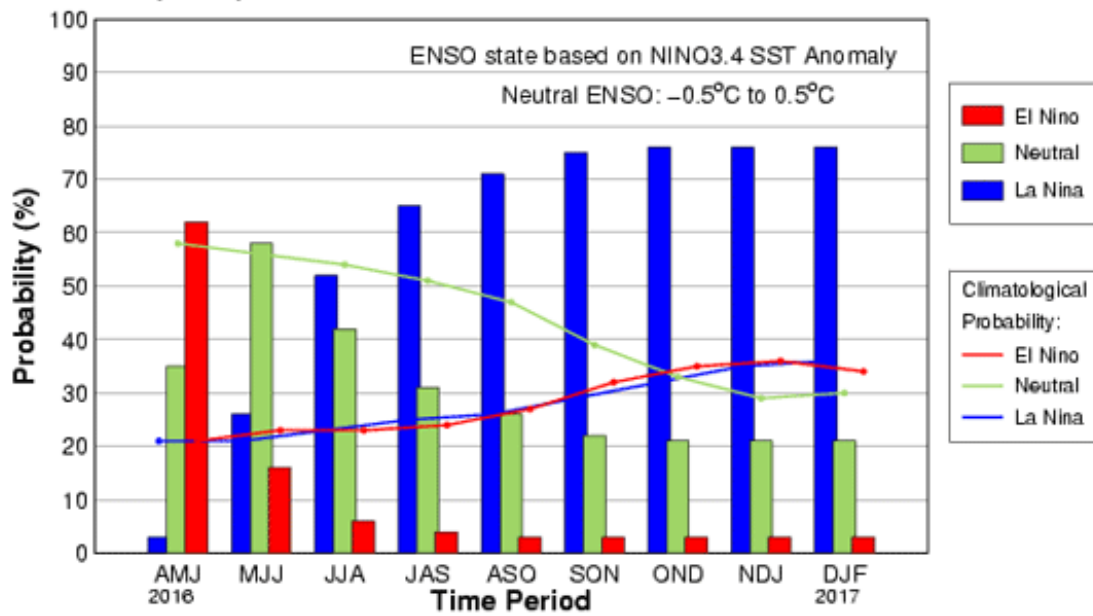
This pattern of a negative anomaly is one of the factors guiding the Climate Prediction Center's outlook for the period, as seen below.





The Climate Prediction Center's long-lead outlooks have the greatest skill when the ENSO is strongly in one phase or another. The outlooks are least reliable when the ENSO is in the neutral phase, as other global circulation features battle for dominance. Historically, summer is a neutral period and serves as the transition between either Nino/Nina or vice versa. However, as summer ends, the probability of a dominant pattern (Nino/Nina) increases as shown below, justifying the CPC's outlooks for this coming late summer and fall.

Early–May CPC/IRI Official Probabilistic ENSO Forecast



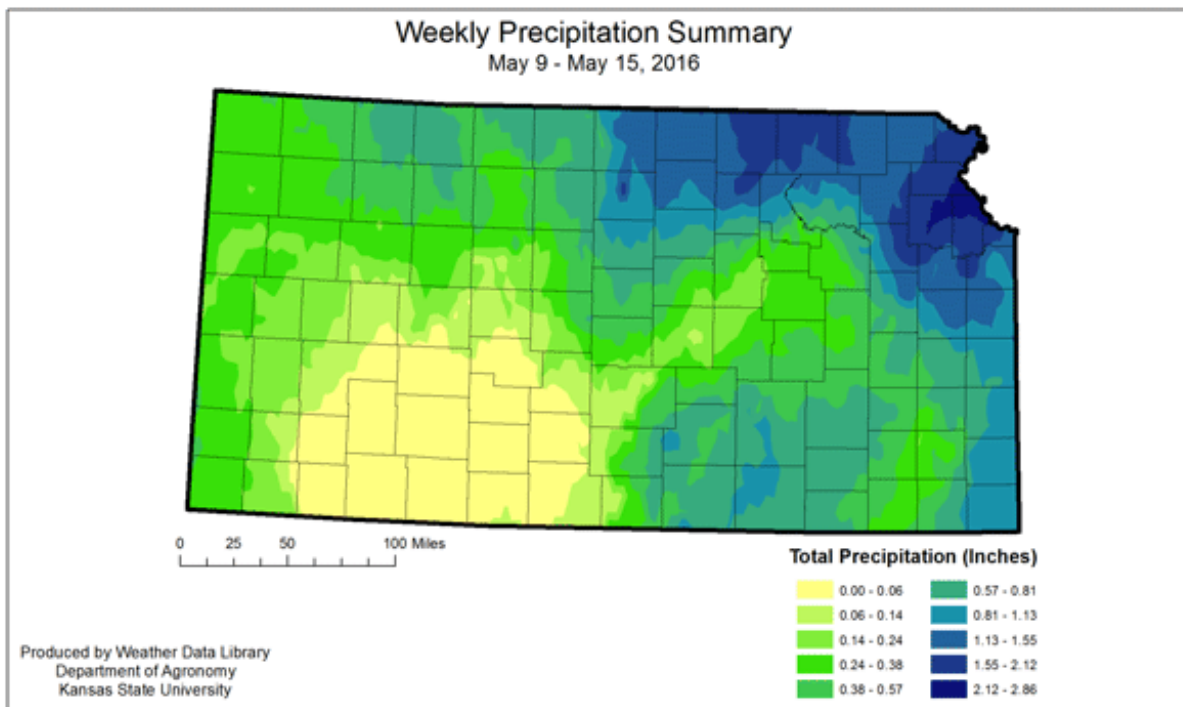
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.ppt

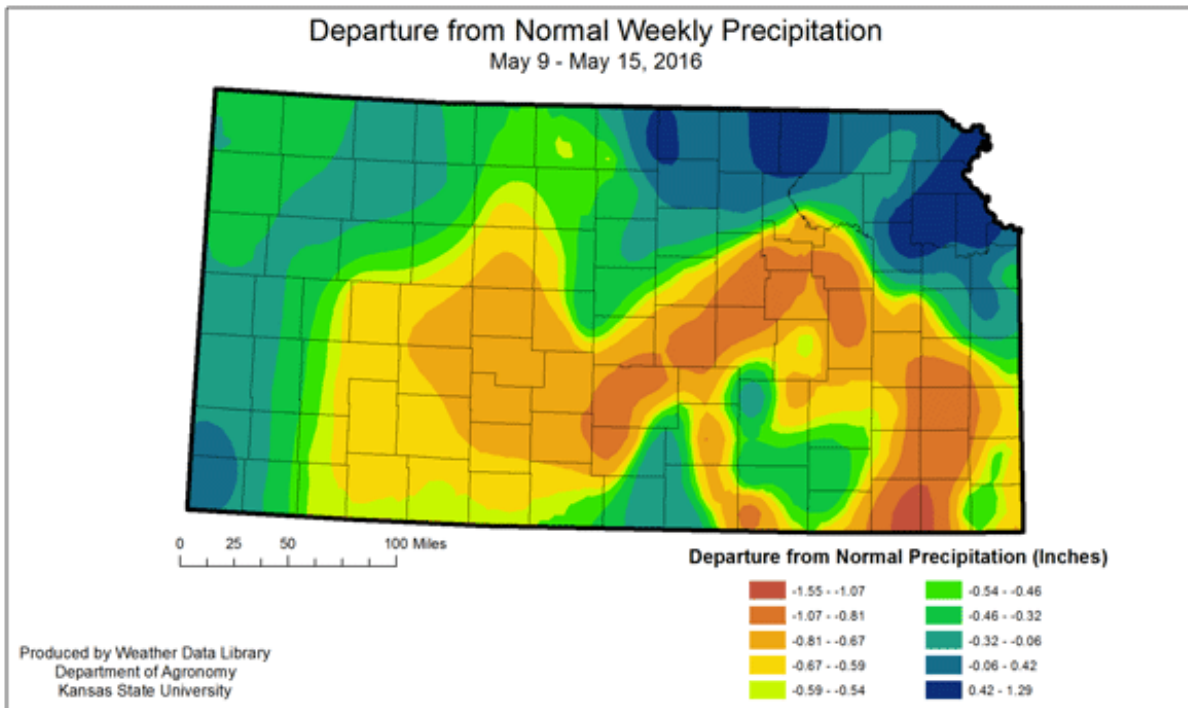
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13. Precipitation in Kansas, May 9-15; and summer outlook

Rainfall was close to normal for the week of May 9-15. The western divisions were on the low end, with between 50 and 58 percent of normal. The Southeast Division had the most, with an average of 2.32 inches, or 175 percent of normal. The statewide average precipitation was 1.06 inches, or 99 percent of the normal for the week. This brings the state average for the year-to-date slightly above normal as well. For the current growing season of April 1 – May 19th, the statewide average is at 7.11 inches, or 144 percent of normal. All divisions are at or above normal, with the southwest at 200 percent of normal. That statewide surplus continues to a slighter degree for the wheat growing season (Sept 1 – May 19th). Only the Southeastern and East Central Divisions have below average precipitation for the period, and they are at 91 percent of normal. Coupled with the wet week, this allowed for the removal of the remaining abnormal dry conditions in the state.

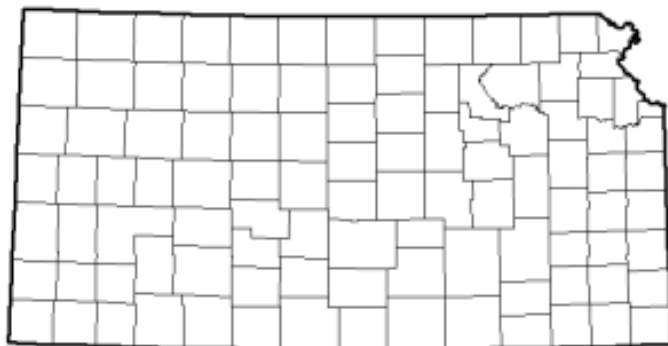




U.S. Drought Monitor Kansas

May 17, 2016

(Released Thursday, May 19, 2016)
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0	D1	D2	D3	D4
Current	100.00	0.00	0.00	0.00	0.00	0.00
Last Week 5/8/2016	98.79	1.21	0.00	0.00	0.00	0.00
3 Months Ago 2/16/2016	98.32	1.68	0.00	0.00	0.00	0.00
Start of Calendar Year 1/20/2015	97.84	2.16	0.00	0.00	0.00	0.00
Start of Winter Year 8/29/2015	90.79	14.72	4.48	0.00	0.00	0.00
One Year Ago 5/18/2015	39.71	27.89	24.85	7.55	0.00	0.00

Author:
David Simera
Western Regional Climate Center



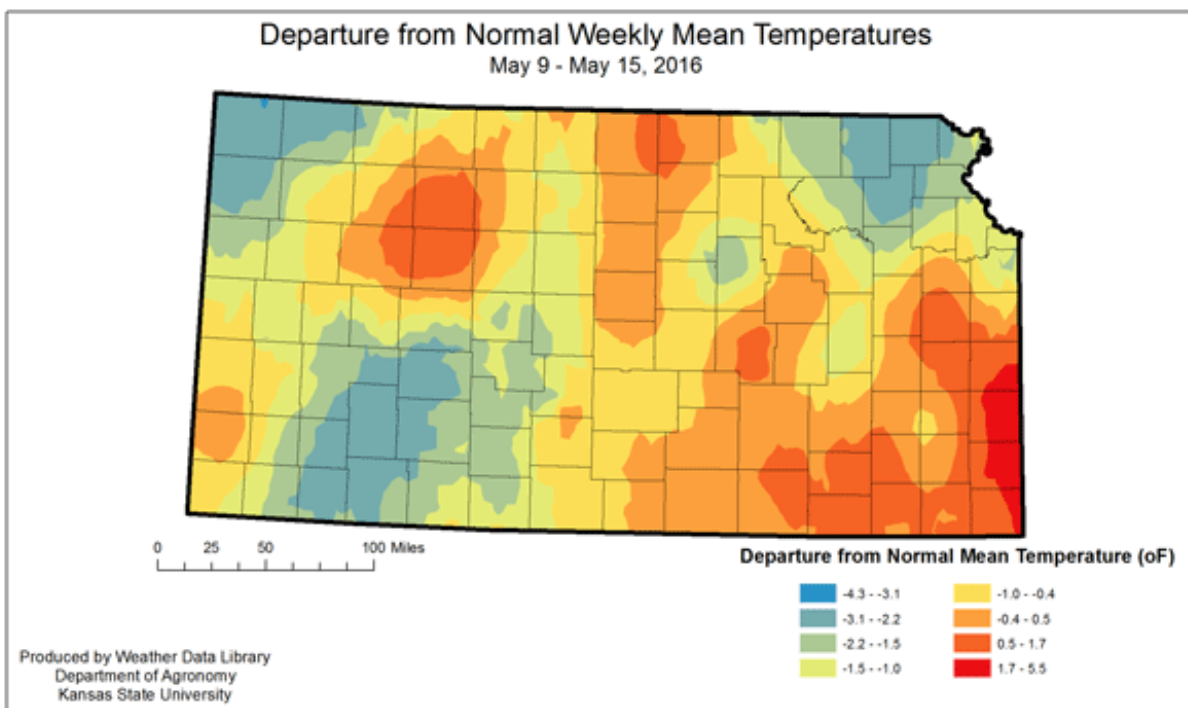
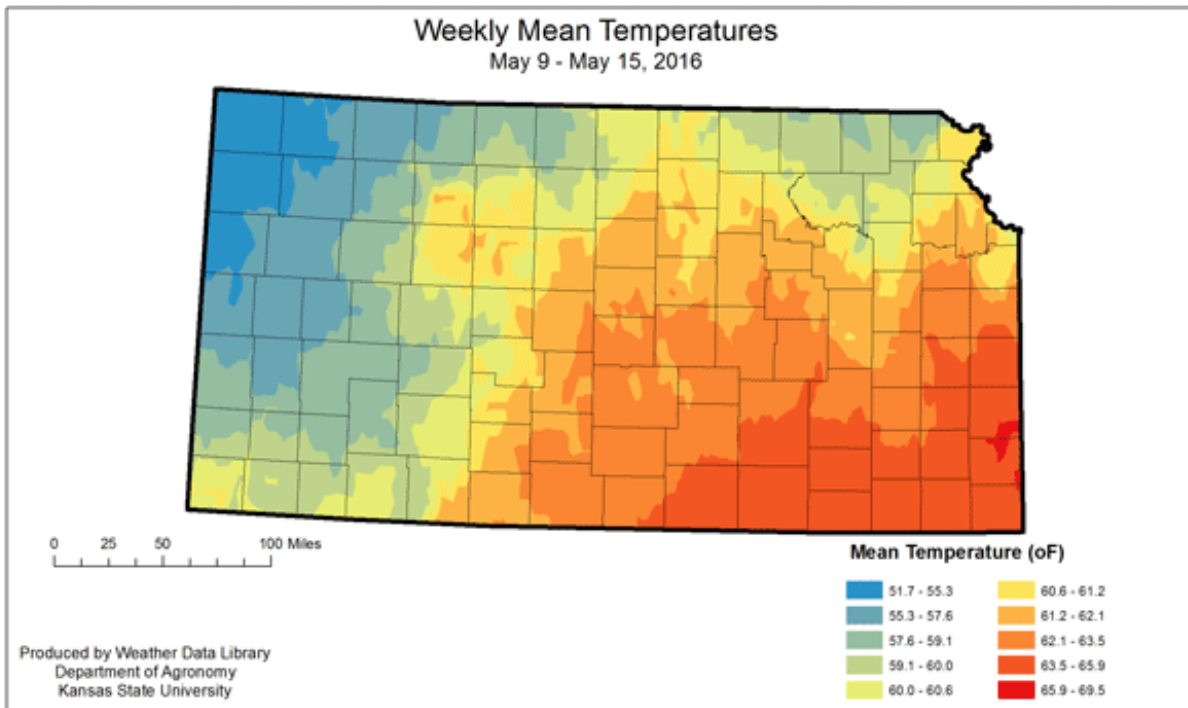
<http://droughtmonitor.unl.edu/>

Intensity:

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

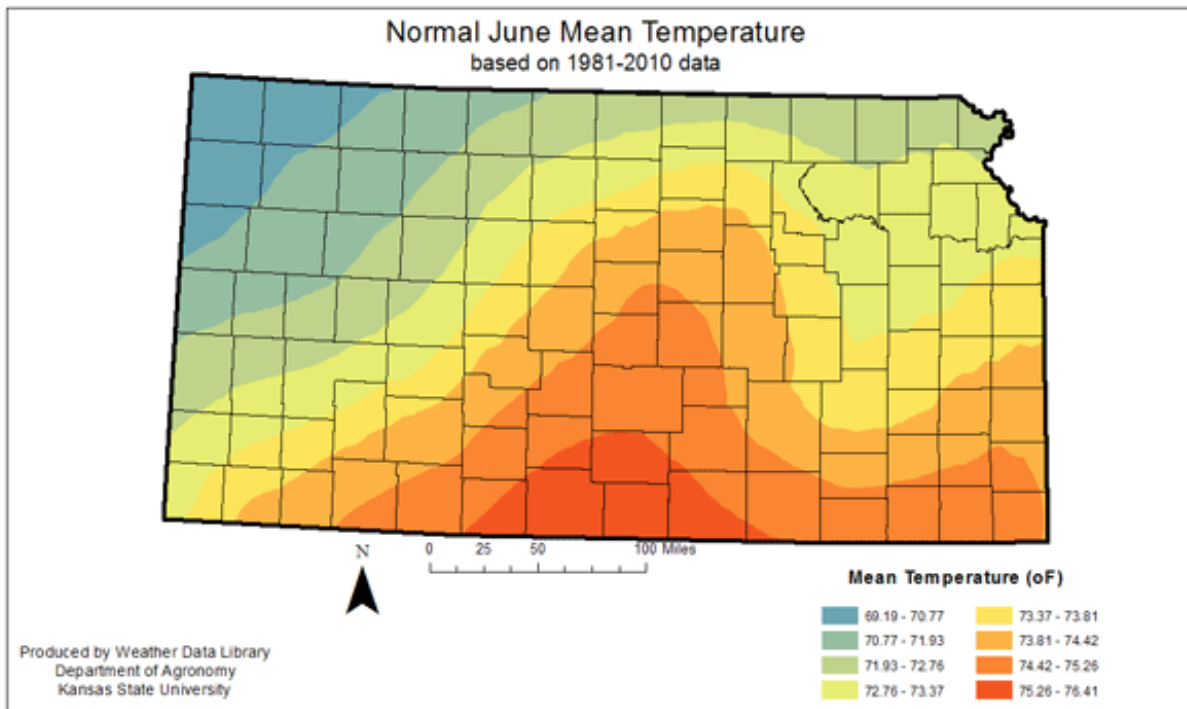
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

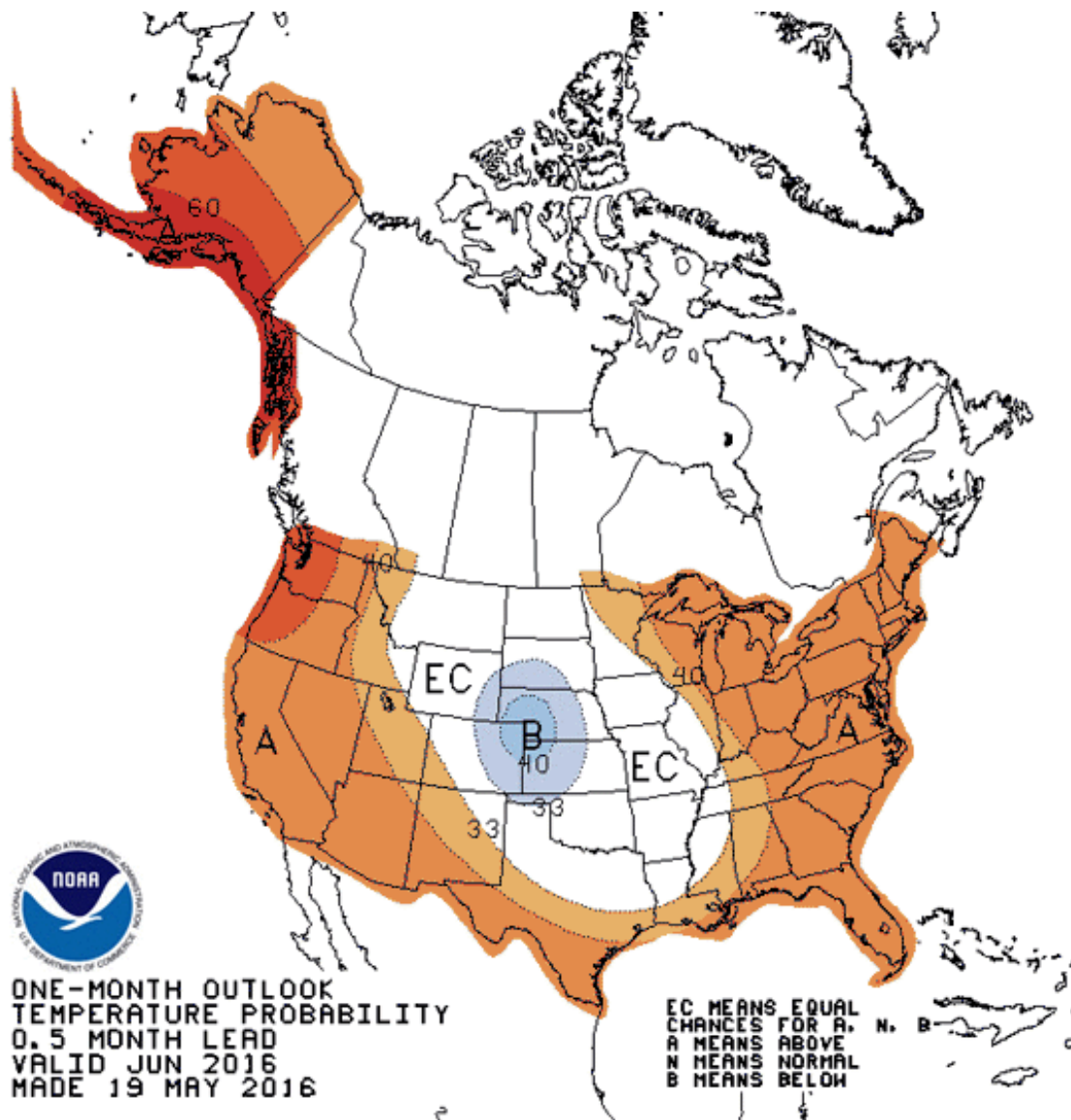
The temperatures were mixed to start the week, but ended well below average for the period. The warmest temperature reported for the week was 88 degrees F on the 14th of May in southwest Kansas. The coldest temperature reported for the week was 31 degrees F in the East Central Division on the 15th of May.

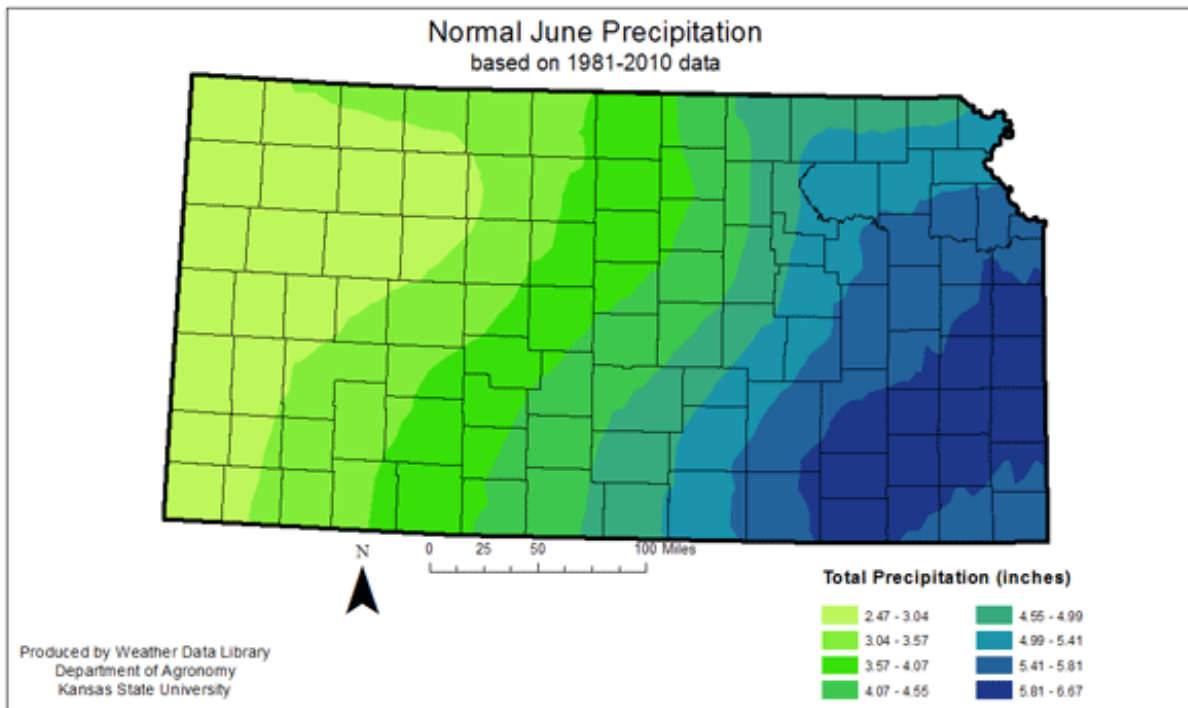


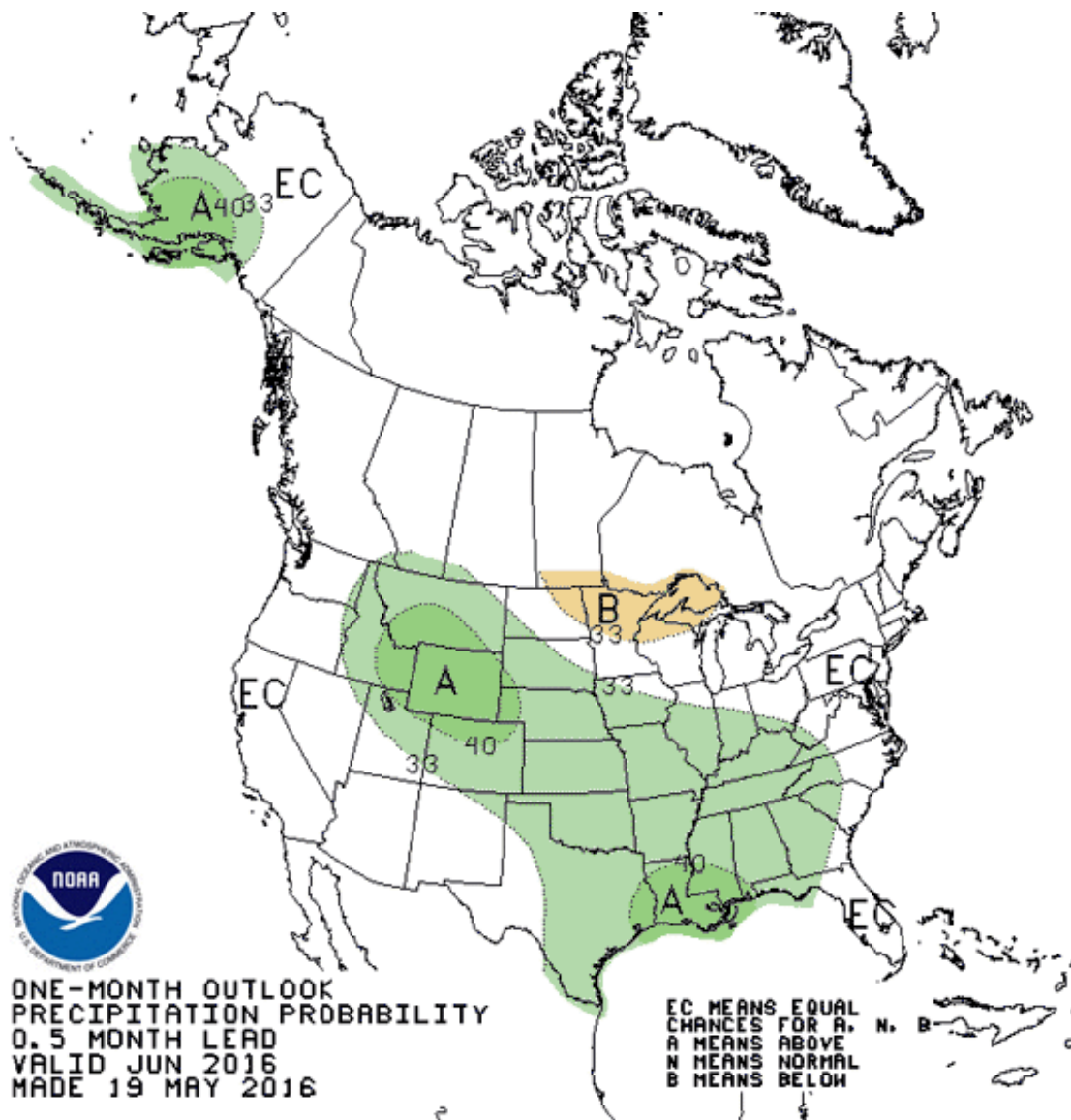
The 8- to 14-day outlook suggests a continuation of wetter-than-average conditions, particularly in the eastern part of the state. In the west, much cooler-than-normal conditions are expected at the start of the week. Temperatures are equally likely to be warmer or cooler than average for the rest of the outlook period. The June outlook favors increased chances of wetter-than-normal conditions

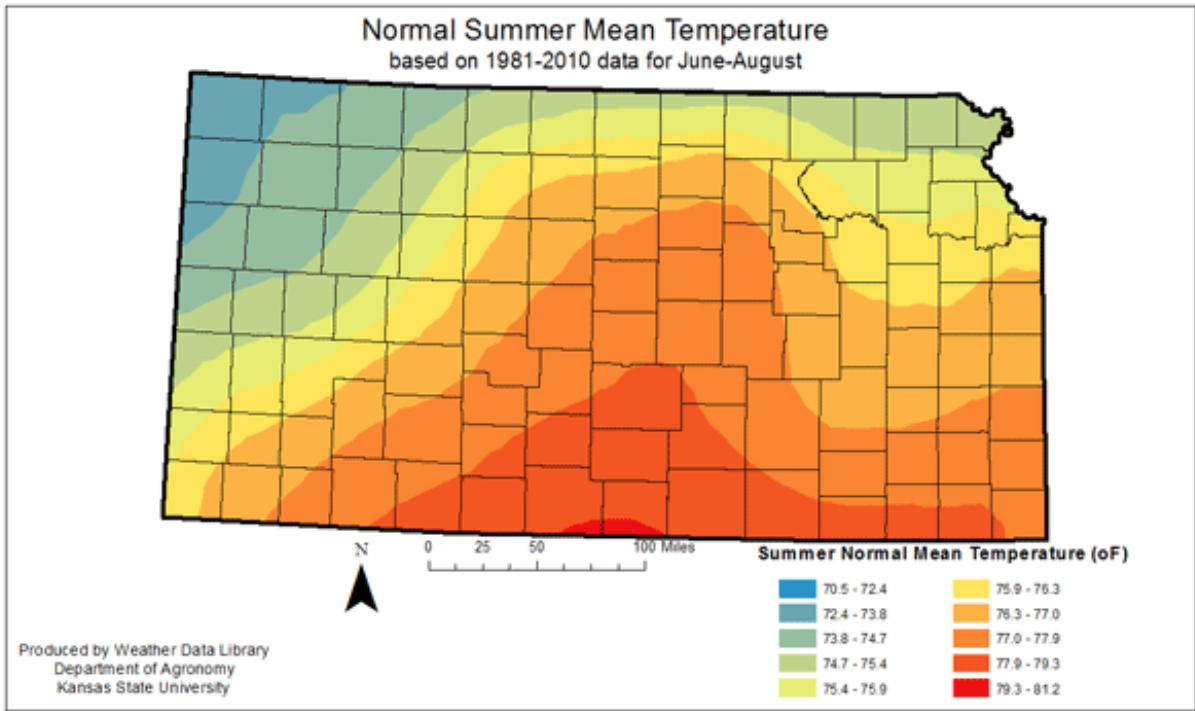
statewide. The temperature outlook is neutral in the central and eastern parts of the state, with a slight chance of cooler-than-normal temperatures in the west.

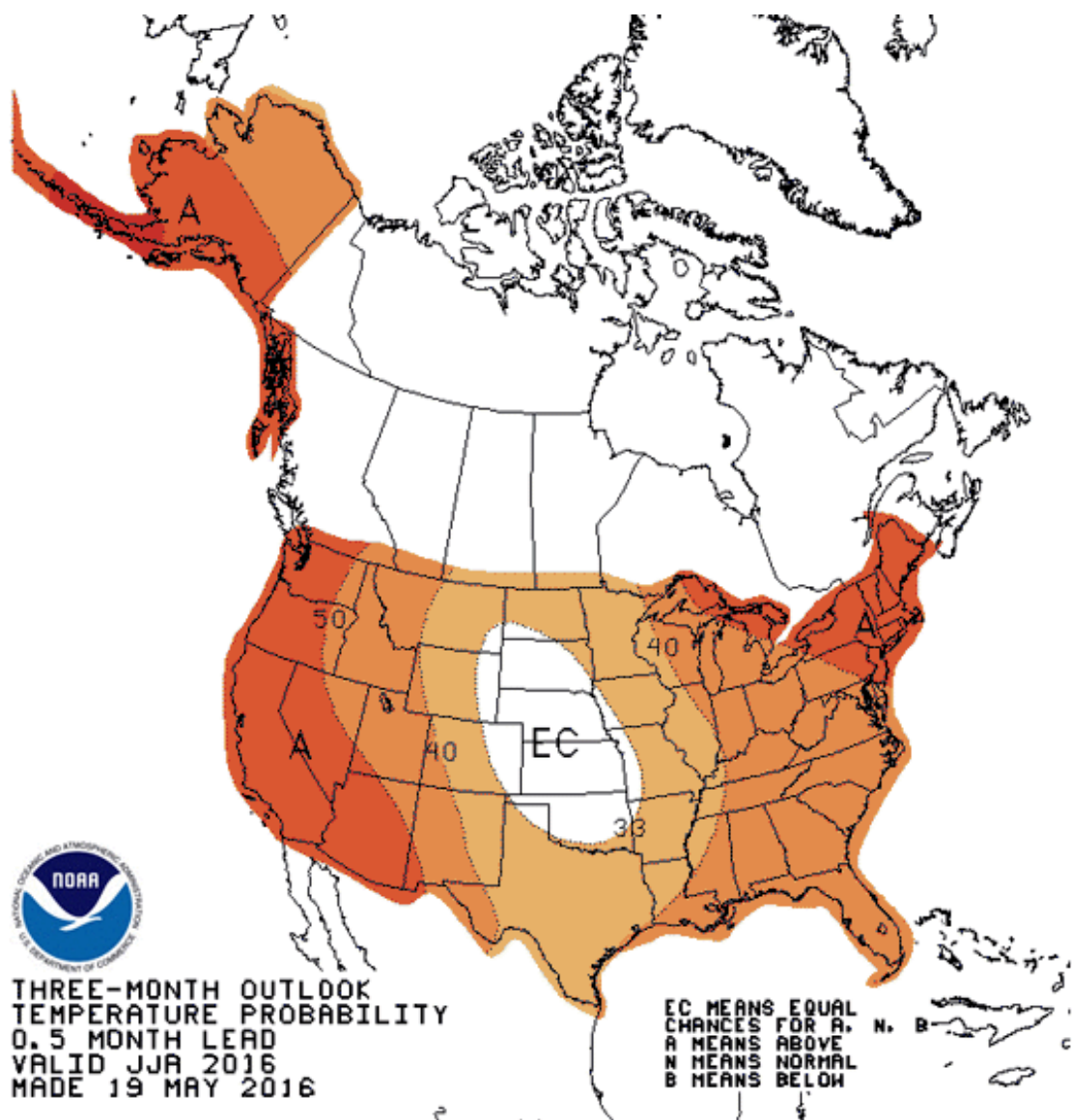


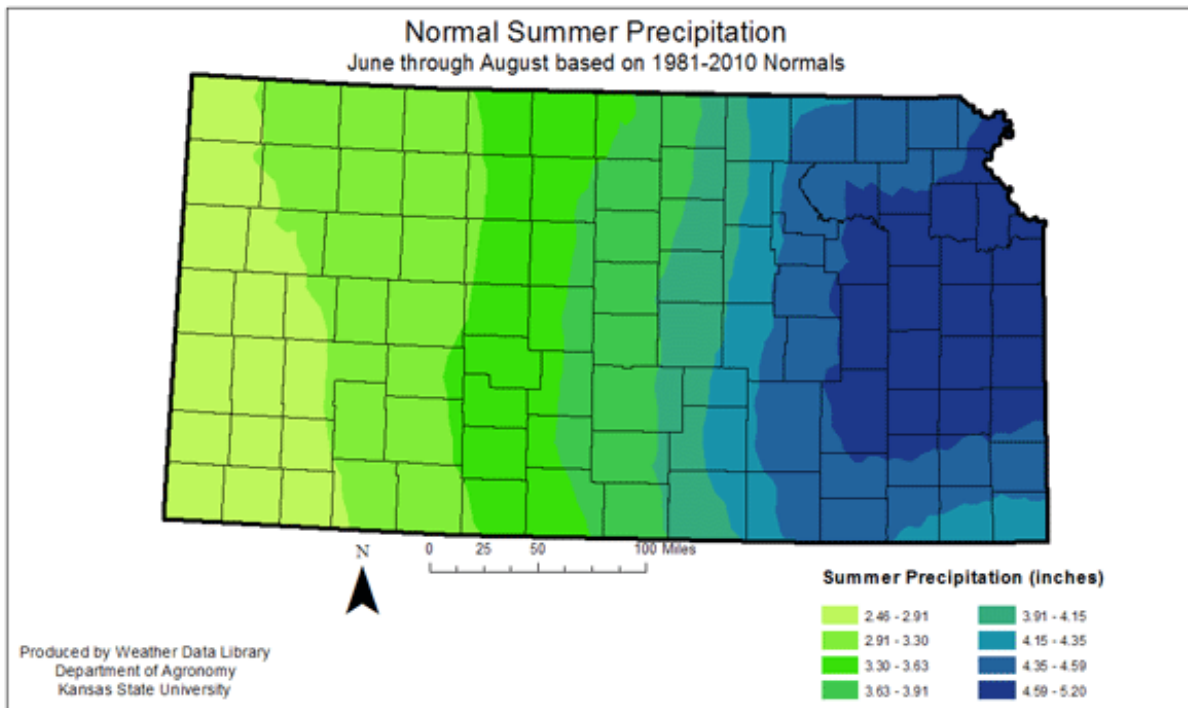


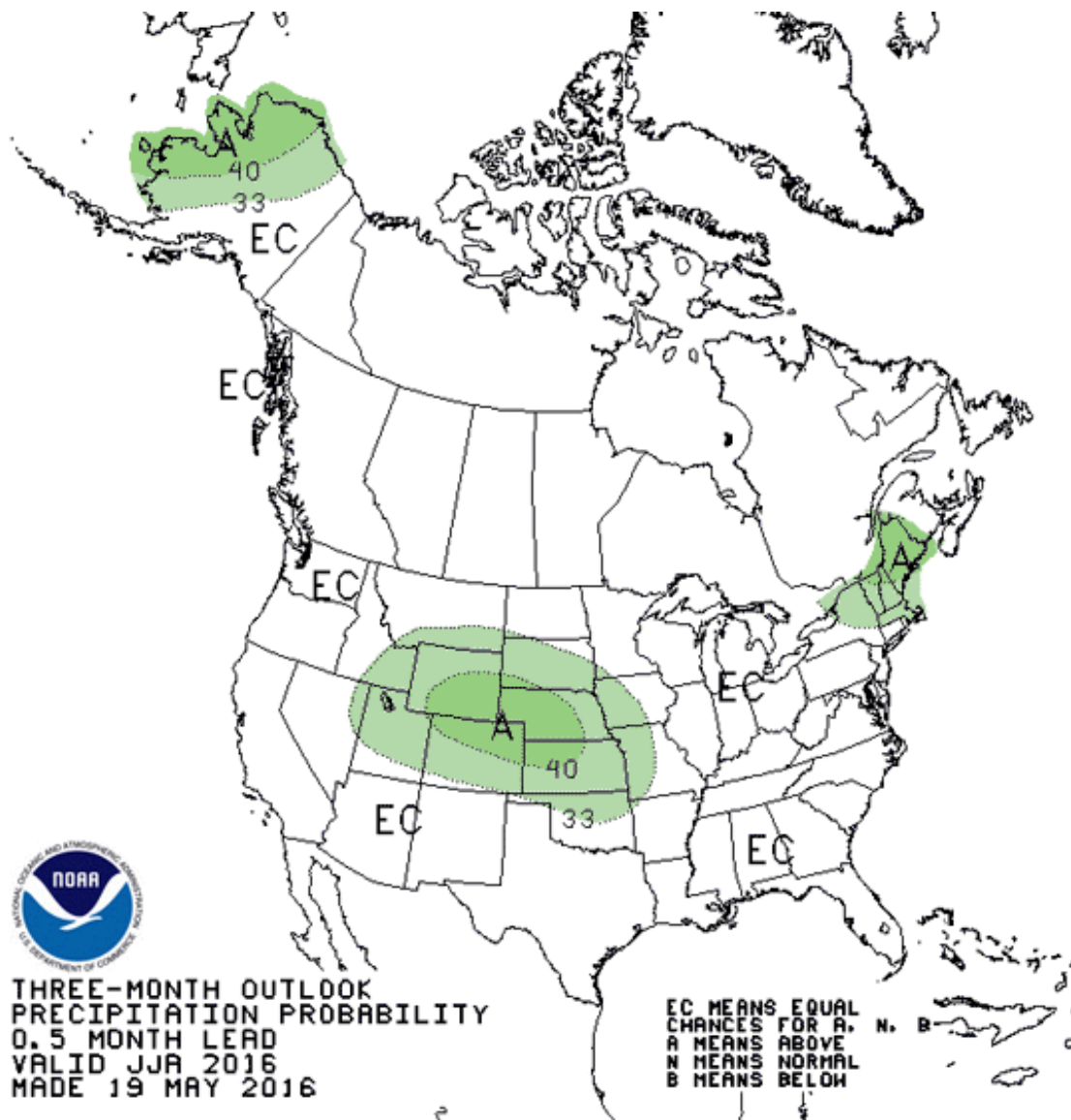












Additional information can be found on the Kansas Climate web site under weekly maps
<http://climate.k-state.edu/maps/weekly/2016/may/>

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14. Comparative Vegetation Condition Report: May 10 - 16

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 20: 05/10/2016 - 05/16/2016

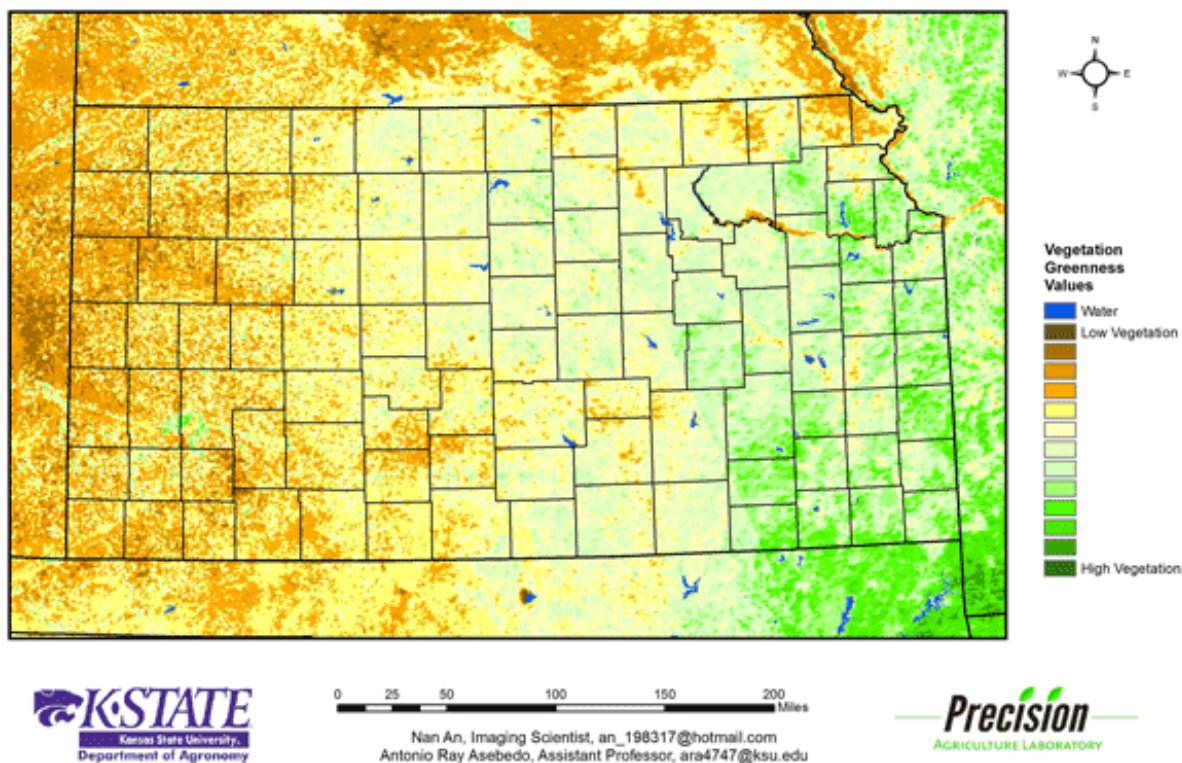


Figure 1. The Vegetation Condition Report for Kansas for May 10 - 16 from K-State's Precision Agriculture Laboratory continues to show widespread low NDVI values in the western third of the state. This is due largely to the cool pattern of the previous week that delayed vegetative activity. Moderate photosynthetic activity is visible in the South Central and Southeastern Divisions. The Flint Hills continue to show relatively low photosynthetic activity where cool temperatures and cloudy conditions have limited green up.

Kansas State University Department of Agronomy

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www.agronomy.ksu.edu | www.facebook.com/KState.Agron | www.twitter.com/KStateAgron

Kansas Vegetation Condition Comparison Mid-May 2016 compared to the Mid-May 2015

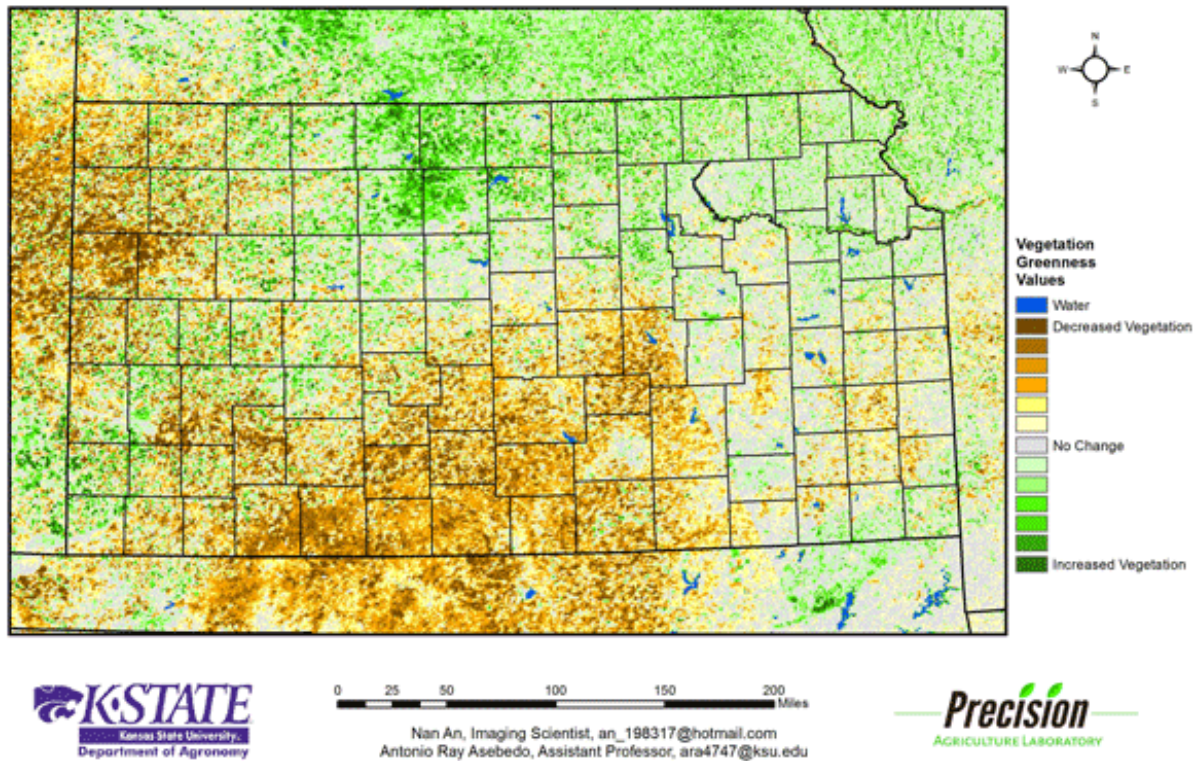


Figure 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for May 10 – 16 from K-State’s Precision Agriculture Laboratory shows vegetative production much lower across the western and southern areas of the state. Much of this is due to excessive rainfall this year, as compared to last. In extreme northwest Kansas, cool temperatures and a late-season snow have delayed vegetative activity this year.

Kansas Vegetation Condition Comparison Mid-May 2016 compared to the 27-Year Average for Mid-May

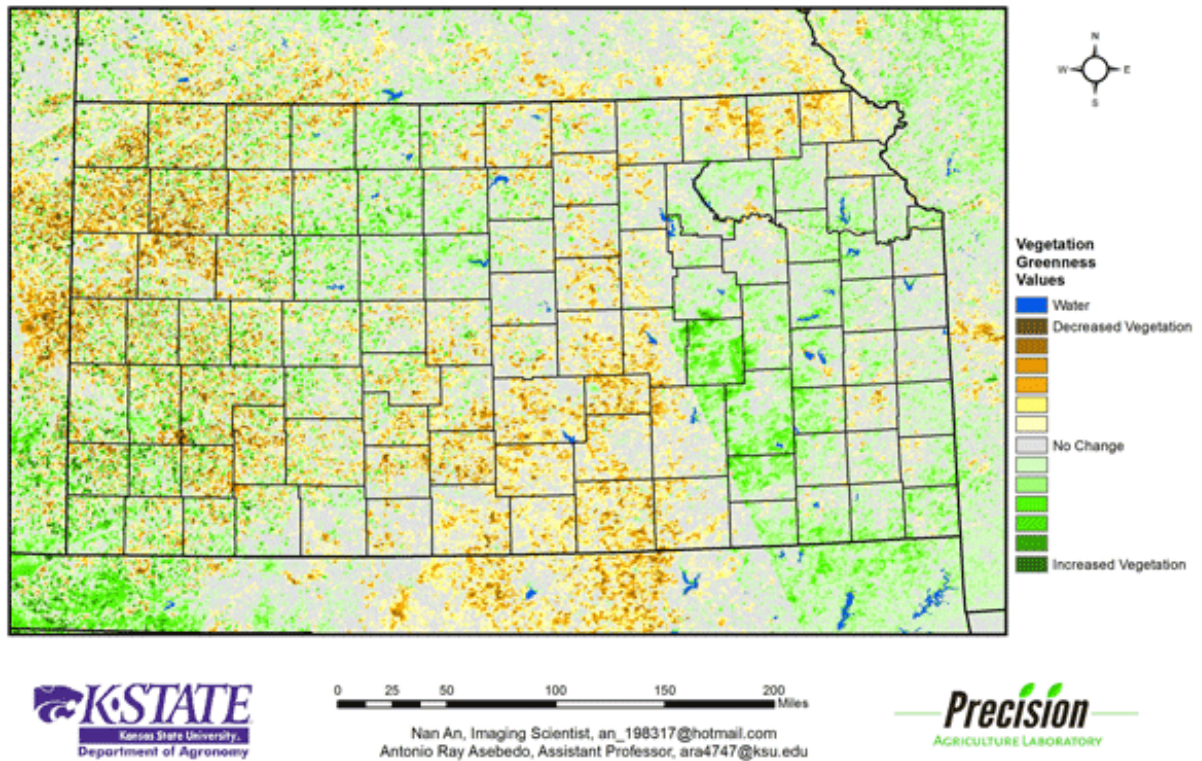


Figure 3. Compared to the 27-year average at this time for Kansas, this year's Vegetation Condition Report for May 10 – 16 from K-State's Precision Agriculture Laboratory shows below-average vegetative activity continues in the extreme northeastern areas of the state, where rain lingered. Increased photosynthetic activity is most visible in the Southwest and Central Divisions. Warmer temperatures in these regions have allowed vegetation to capitalize on the wetter-than-average April.

Continental U.S. Vegetation Condition

Period 20: 05/10/2016 - 05/16/2016

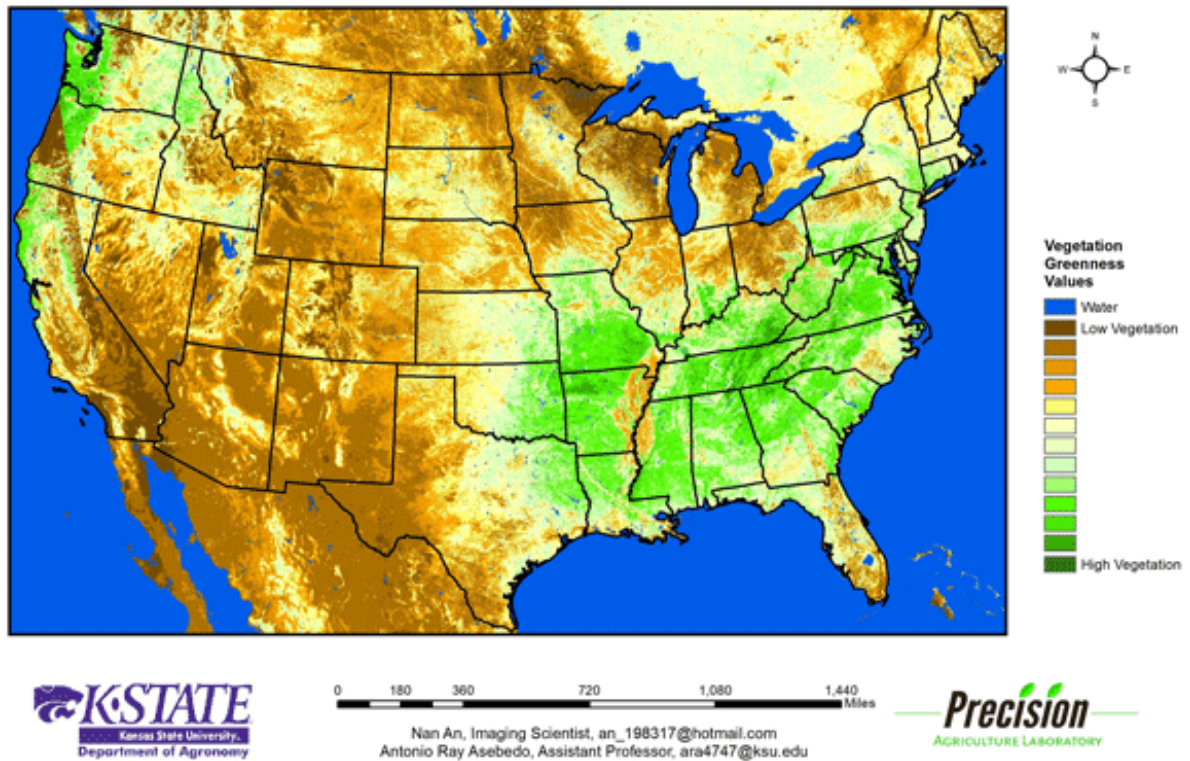


Figure 4. The Vegetation Condition Report for the U.S for May 10 – 16 from K-State’s Precision Agriculture Laboratory shows high NDVI values along much of the West Coast, and in northern Idaho. Favorable moisture continues to drive active photosynthesis in these areas. A pocket of lower photosynthetic activity continues to be visible along the lower Mississippi River, where flooding is an issue. Low photosynthetic activity from the Central Plains through the Ohio River Valley is due to heavy rainfall and lingering cloud cover. The band of lower NDVI values from Oregon through eastern California is due to cloud contamination of the satellite imagery.

Continental U.S. Vegetation Condition Comparison
Mid-May 2016 Compared to Mid-May 2015

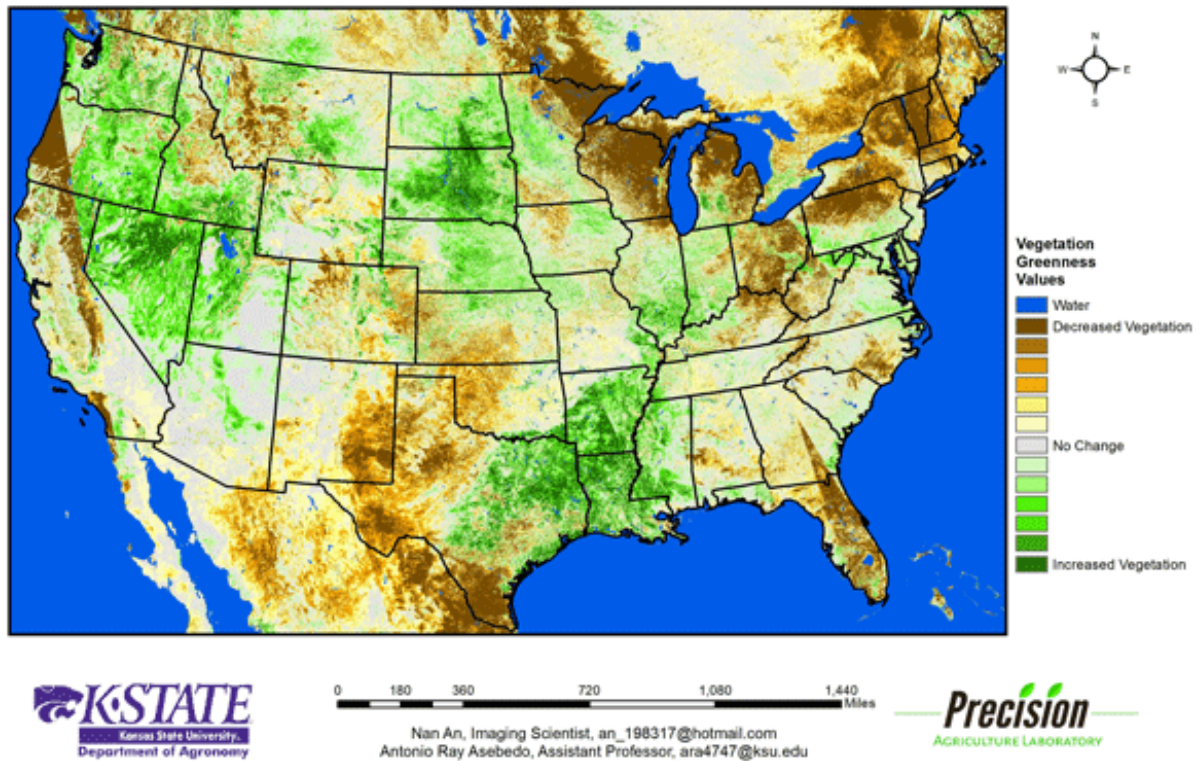


Figure 5. The U.S. comparison to last year at this time for the period May10 - 16 from K-State's Precision Agriculture Laboratory shows that lower NDVI values are most evident in the Eastern U.S. Drier-than-average conditions have delayed vegetation compared to last year. In contrast, the lower NDVI values in northern California are due to a much larger snow pack in the region this year. South Dakota stands out in the Plains with much higher photosynthetic activity, as the vegetation broke dormancy early and is taking advantage of favorable soil moisture. West Texas has seen less favorable growing conditions this year, and thus has lower NDVI values.

Continental U.S. Vegetation Condition Comparison
Mid-May 2016 Compared to 27-year Average for Mid-May

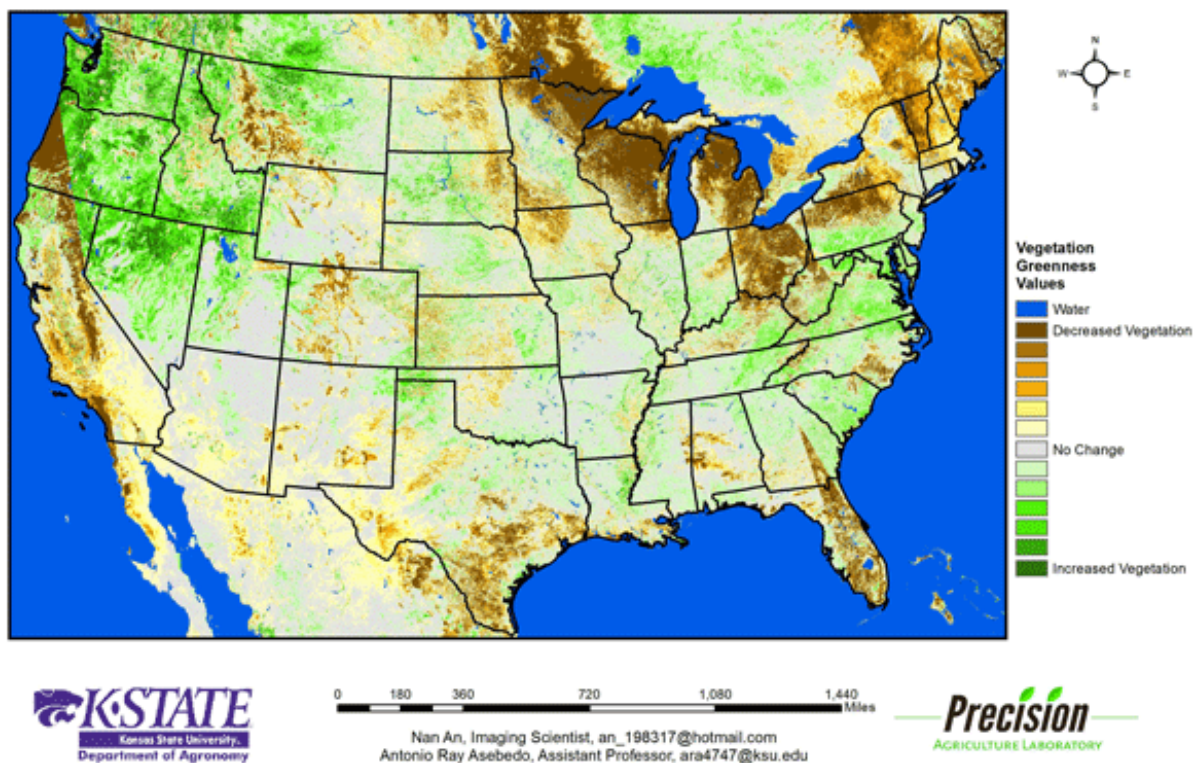


Figure 6. The U.S. comparison to the 27-year average for the period May 10 - 16 from K-State's Precision Agriculture Laboratory shows above-average photosynthetic activity across the Pacific Northwest, where winter moisture has reduced drought impacts. Snow pack from the late-season storms in the central Rockies has reduced photosynthetic activity in these areas. The heavy rains from last week moved east, and the resulting cloud cover has reduced NDVI readings in those areas. Vegetative activity has rebounded in east Texas as the floods of April recede, but is still below average.

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