



Extension Agronomy

eUpdate

10/27/2017

These e-Updates are a regular weekly item from K-State Extension Agronomy and Kathy Gehl, 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 Kathy Gehl, 785-532-3354 kgehl@ksu.edu, or Curtis Thompson, Extension Agronomy State Leader and Weed Management Specialist 785-532-3444 cthompso@ksu.edu.

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1. As temperatures fall, what factors influence the survival of winter canola?

Until beneficial rains fell in mid- to late-September, canola planting in Kansas was delayed due to inadequate soil moisture conditions. Thus, canola plants may be smaller than normal going into the winter acclimation period. How could this, and other factors, affect the winter survival of canola?

Effect of canola size on winter survival

Canola overwinters -- and is the most tolerant to cold temperatures -- in the rosette growth stage (Figure 1). At this stage, the crown develops at the soil surface with larger, older leaves at the base and smaller, newer leaves at the center. The stem thickens but its length remains unchanged. For optimum winter survival, a winter canola plant needs 5 to 8 true leaves, 6 to 12 inches of fall growth, a root collar diameter of $\frac{1}{4}$ to $\frac{1}{2}$ inch, and an extensive root system. Hardened winter canola can withstand temperatures below 0 degrees Fahrenheit for short periods of time.



Figure 1. Winter canola near Concordia at the appropriate size for overwintering. Photo by Mike Stamm, K-State Research and Extension.

On the other hand, canola that has too much top growth (typically 20 inches or more) can succumb

to winterkill for a number of reasons, including overuse of available soil water and nutrients, stem elongation above the soil surface, and physical damage to the unprotected crown as winter temperatures arrive.

Causes of excessive fall stem elongation

Stem elongation in the fall -- not to be confused with bolting, i.e. stem elongation with visible flowering structures -- may occur because:

- The crop was planted too early (Figure 2)
- The crop was seeded at higher-than-optimal plant populations (Figure 3)
- Excessive soil fertility is present (particularly nitrogen)
- An unusually warm fall persists
- Selection of a poorly adapted cultivar
- A combination of any of these factors

For example, closely spaced and crowded canola plants increase early plant-to-plant competition for light. This “reaching” for light may lead to an extension of the growing point above the soil surface. Any time the growing point (rosette) is elevated, the chances for winterkill are increased because overwintering plant parts are in an unprotected position above the soil surface.



Figure 2. Winter canola plot in mid-October. Early planting and warm temperatures resulted in

more than 20 inches of fall growth and an increased risk of winterkill. Photo by Mike Stamm, K-State Research and Extension.



Figure 3. High plant populations in a winter canola plot in mid-October. Competition for light places the growing point well above the soil surface, increasing the risk of winterkill. Photo by Ignacio A. Ciampitti, K-State Research and Extension.

Another factor in stem elongation and winter survival is the amount of surface residue present in the seed row. K-State research has shown that residue removal from the seed row is important for keeping the rosette, or crown, close to the soil surface, especially in no-till cropping systems. Appropriate residue management (any method to remove residue from the seed row) greatly benefits winter survival.

Figure 4 (upper and lower panels) shows what can occur when residue blows back into the seed row following planting into heavy corn residue. Because of residue in the seed row, the canola hypocotyl in this case is etiolated, or overextended, and thus vulnerable to freezing temperatures and other biotic stresses. Etiolation is when a plant develops in partial or complete absence of light. Under these conditions, plants will have long, weak stems and a pale color. In the situation shown below, the canola hypocotyls grew upward through the corn residue, stopping when they reached sunlight above the soil surface. That is where the rosettes were established. As a result, the crop easily succumbed to cold temperatures, and the field in this specific example was lost because of poor residue management.



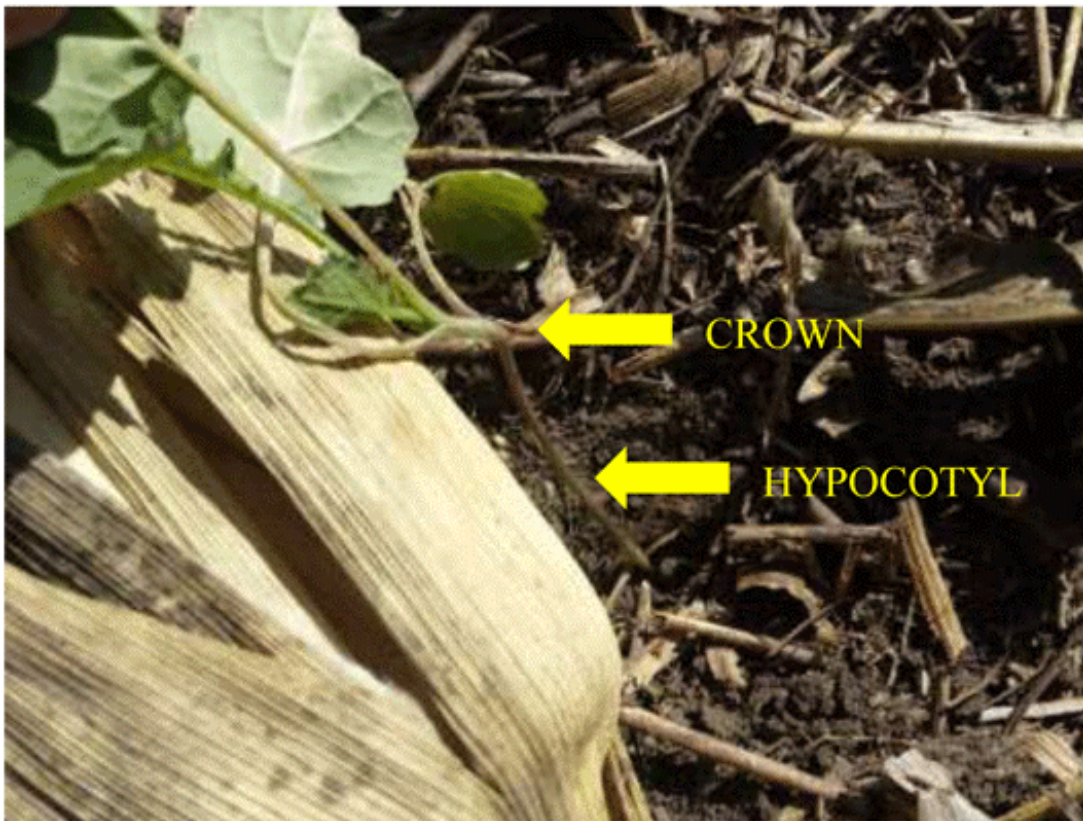


Figure 4. Inadequate residue management causes etiolation of the hypocotyl to an exposed position above the soil surface. Photos by Mike Stamm, K-State Research and Extension.

Planting dates in 2017

Soil moisture conditions dictated planting dates for winter canola in 2017. In many parts of Kansas, dry soils delayed planting until beneficial rains fell in mid- to late-September. Compared to 2016 when soil moisture was adequate and allowed for earlier planting, planting dates in 2017 were, in some cases, delayed beyond the optimum. Because canola needs adequate fall growth to overwinter, it is important for the crop to be planted into adequate soil moisture. This will help guarantee rapid emergence and establishment in the fall.

Similar to fall 2016, the warm temperatures in early October have benefited canola growth and development (Figure 5). However, the first hard freeze of the season is expected overnight on October 27. This could be a concern as some canola will not have attained the 5 to 8 true leaf stage that is optimal for winter survival. Late-October is typically when canola begins to acclimate to winter conditions, so these temperatures are not out of the ordinary. Low temperatures at or below 30 degrees F are essential for winter hardening.

Will the fields with small canola succumb to winterkill?

It is hard to say because there are a number of factors that can affect winter survival. Good winter survival begins with selecting a winter hardy cultivar. Management of the crop, including selecting an optimum planting date, fertilization and seeding rate, also can affect overwintering. The environment has probably the biggest influence and individual canola fields may see different effects from the cold. The ultimate low temperature and the duration of below-freezing temperatures are things to keep in mind when weighing what might happen. In addition, better survival is often seen when temperatures gradually drop versus rapidly drop. In the long run, an interaction of all these factors will determine how the crop will overwinter.



Figure 5. Late-planted (September 30) winter canola near Manhattan benefited from the above-normal fall temperatures in 2016. The top picture was taken on Nov. 2 and the bottom picture was taken on Oct. 19 of the same year. Similar effects from warm October temperatures

have been observed in 2017. Photo by Mike Stamm, K-State Research and Extension.

Cultivar differences in overwintering potential

Cultivar differences exist for fall vigor, the ability to avoid fall stem elongation, and winter survival, so it is important to consider these traits when considering what cultivar to grow. Hybrid cultivars tend to have quick establishment in the fall because of hybrid vigor. This is an important trait because it results in rapid plant development for overwintering. However, there can be a tradeoff between good fall vigor and too much fall growth, and this usually has to be managed by agronomic practices such as planting date and seeding rate. Planting later to take advantage of vigor may present some challenges in terms of winter survival if weather conditions are not favorable for fall growth.

The K-State canola breeding program has been selecting for cultivars that avoid fall stem elongation regardless of the planting date or seeding rate and this often translates into better winter survival. These cultivars have prostrate fall growth which keeps the crown (growing point) more protected at the soil surface. This trait could be especially useful in years when soil moisture conditions are ideal for planting but the calendar indicates it is too early to plant. We hope to broaden the planting window by planting these cultivars earlier while avoiding the risks of fall stem elongation and winterkill.

Another tool under development by private industry and being evaluated by the K-State canola breeding program is the semi-dwarfing trait. The semi-dwarfing trait also helps keep the crown closer to the soil surface regardless of planting date or seeding rate. We have seen enhanced winter survival in the hybrids that possess this trait.

Current research

K-State agronomists are investigating production practices to help manage fall vigor and growth. We have studies evaluating seeding rate by variety (open pollinated vs. hybrid) in narrow and wide row spacing (9-in and 30-in). In the first year of the studies, we did not see consistent differences in winter survival among the cultivar by seeding rate interactions because the winter temperatures were warmer than normal. However, in subsequent years, winter survival was greater with reduced seeding rates, and yield was similar to that achieved with higher seeding rates. Other questions we want to address through these studies include:

- How far can we reduce seeding rates and remain profitable?
- How do varieties respond to different seeding rates?
- What is the optimum seeding rate for a given row spacing by variety interaction?

In collaboration with private industry, we are evaluating different plant growth regulators and their ability to help manage fall growth. Using plant growth regulators to manage fall growth in winter canola is a common practice in the European Union (EU). In addition to the products, we are evaluating at what growth stage and at what rate do we apply these products in the fall.

Having too little or too much fall growth in winter canola depends on an interaction of the variety

chosen, management practices, and the weather. Predicting the weather is challenging enough and this can be stressful on producers. Through breeding and production research at K-State, we hope to find improved ways to manage these risks in winter canola.

For more information about canola growth and development stages, please consult the recently published K-State Canola Growth and Development poster:

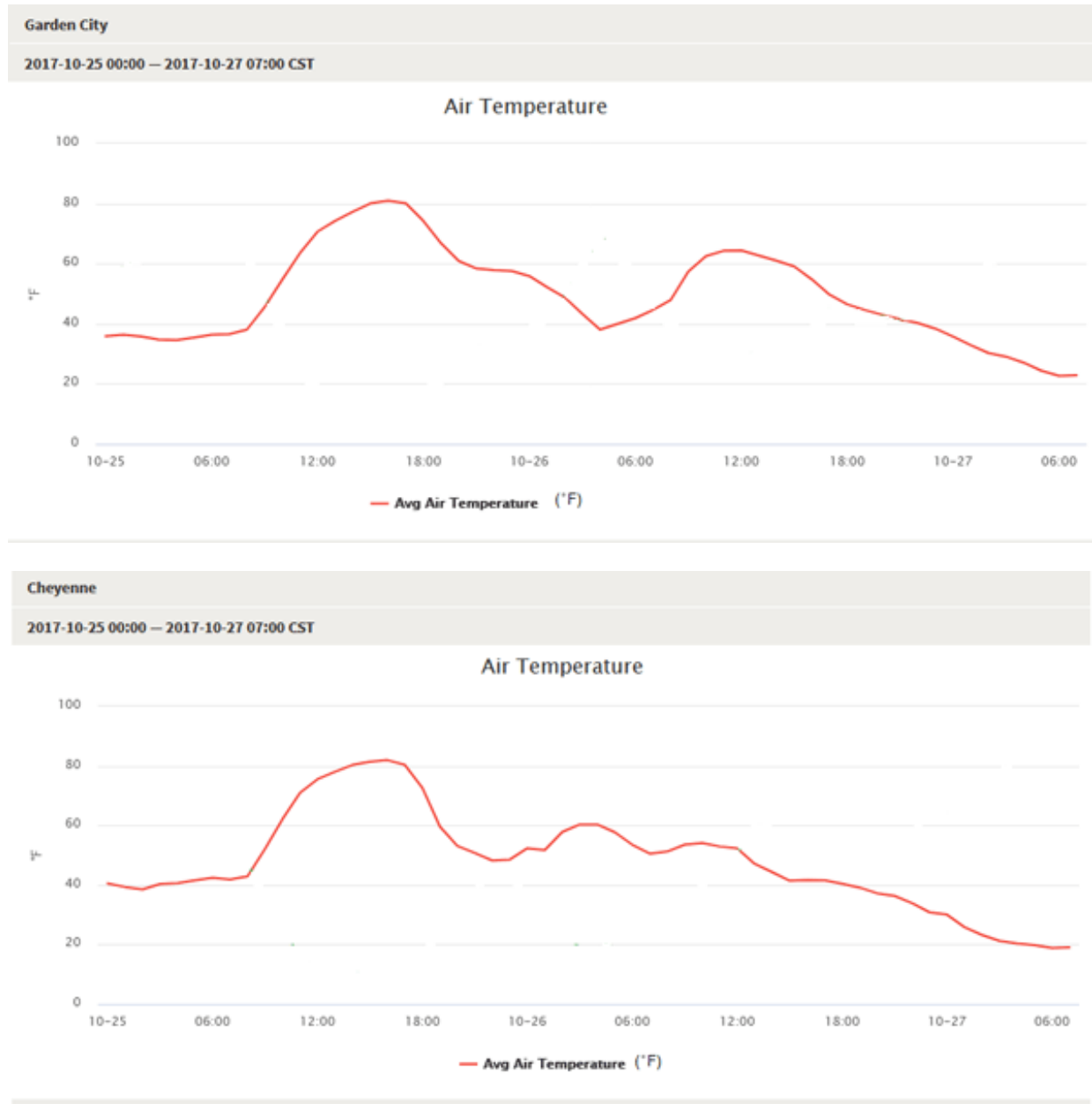
<https://www.bookstore.ksre.ksu.edu/pubs/MF3236.pdf>

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2. Sharp decline in temperatures: Possible impacts on the Kansas wheat crop

The sudden, sharp drop in temperatures across Kansas observed on October 27 could have different consequences, varying from no impact to some injury in particular fields. Temperatures dropped from around 80 degrees F on the afternoon of October 25 to approximately 20 degrees F the morning of October 27, particularly in the western portion of the state (Figure 1).



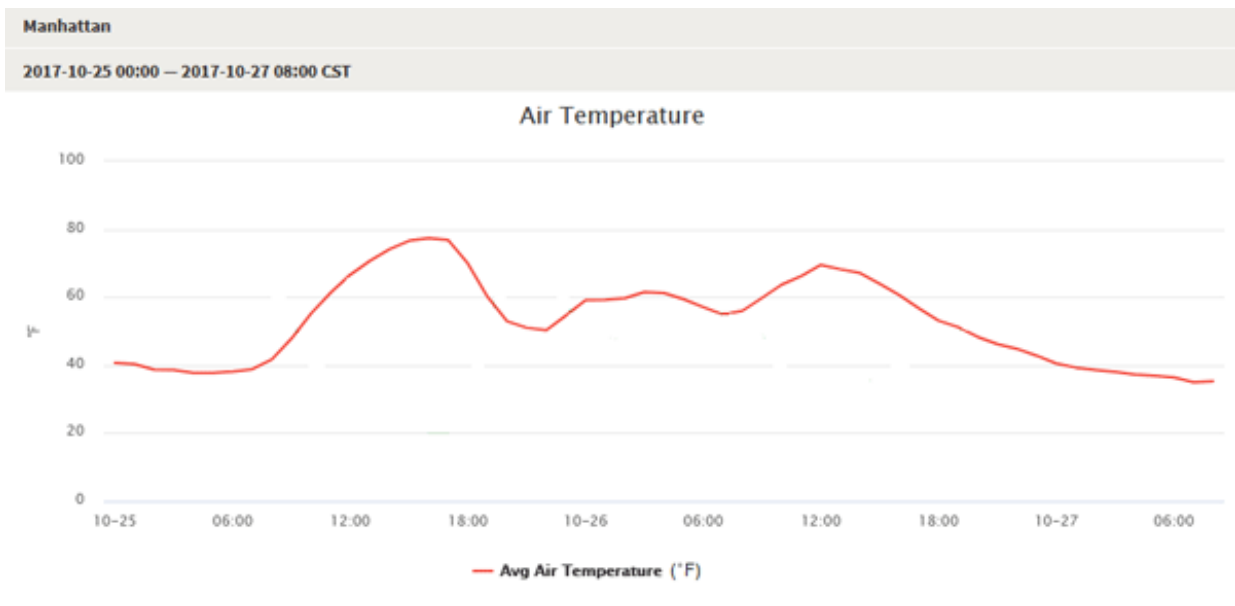


Figure 1. Hourly temperature dynamics from October 25 through October 27 for Garden City (upper panel), Cheyenne (middle panel), and Manhattan (lower panel). Data courtesy of Kansas Mesonet.

The actual consequences of this temperature drop should be field specific, dependent on the region within the state, and on several other factors. The moisture level in the topsoil will be important to help buffer possible injuries resulting from cold temperatures. Soil moisture is generally good in most of the state due to early-October rainfall, which will cause the soil to have a better thermal buffer capacity, compared to a dry soil. In fact, soil temperatures at the 2-inch depth did not fall below 44 degrees F at any of the K-State Mesonet (<http://mesonet.k-state.edu/>) weather stations as of October 27 at 7:00 am (Figure 2). These warm soil temperatures could definitely help buffer any negative effects of the sharp temperature drop.

Figure 2. Coldest 2-inch soil temperature as of 27 October 2017, 07:00 am. Minimum soil temperature did not reach values lower than 44°F across the state. Data courtesy of Kansas Mesonet.

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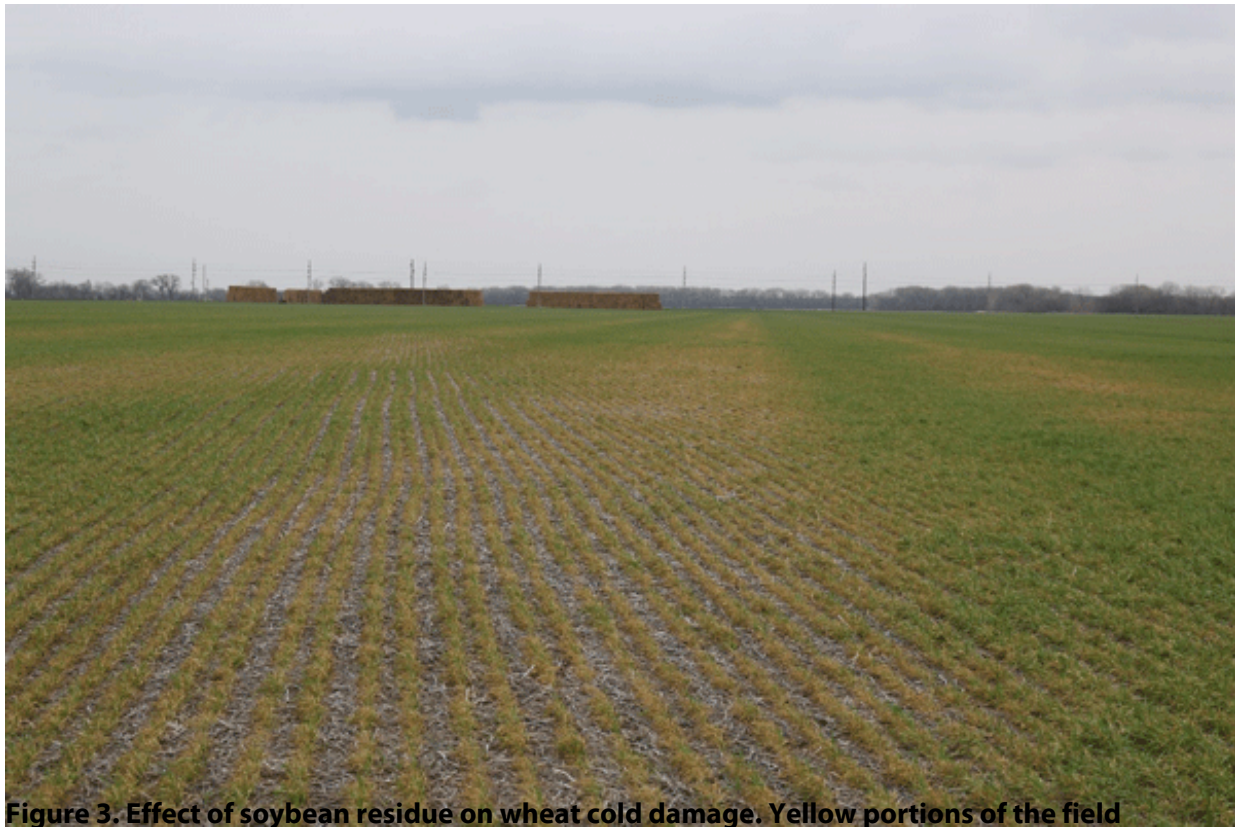


Figure 3. Effect of soybean residue on wheat cold damage. Yellow portions of the field correspond to greater residue left by the combine at soybean harvest, and resulted in poorer seed-soil contact at wheat planting. As a consequence, the plants are more exposed to colder temperatures and potential injury. Photo provided by Romulo Lollato, K-State Research and Extension.

Another factor affecting wheat's response to the cold is whether the wheat had time to become properly cold-hardened. It is important to remember that a large portion of the Kansas wheat crop has been planted recently, after the rainfall events of early- to mid-October; therefore, it is still too early to suggest that the wheat has been cold-hardened. In fact, many fields have not even emerged at this point or are just now starting to emerge.

In fields that have not yet emerged but in which seeds are already sprouted, no significant injury should be expected for two main reasons:

- First, recently sprouted wheat generally handles temperatures above 5-10 degrees F well, and air temperatures never reached those levels (Figure 4).
- Secondly, recently sprouted wheat is still below the soil surface and the warm soil temperatures will likely help buffer the seedling from being damaged by the cold.

In fields where the crop has already emerged, temperatures of around 15 degrees F or less can injure the newly emerged wheat, and these limits decrease as the crop progresses to tillering later in the fall and become more cold-hardy. Thus, some fields in western Kansas where the crop has recently emerged, especially the northwest part of the state, could sustain some level of damage. We likely won't know for sure until temperatures warm up and give us an opportunity to scout.

If fields were affected, the first symptom will be burndown of the wheat from these cold

temperatures as shown in Figure 3. If the wheat was bigger-than-normal, the plants may look “rough” with a lot of brown, dead-looking foliage on the soil surface. That doesn’t mean the plants are dead. The important factor will be whether the crown below the soil surface remains alive. Having a well-developed secondary root system will help the plants survive. As temperatures did not drop as low in the central portion of the state, the concern with possible cold injury is not as great as fields that recently emerged in northwest Kansas.

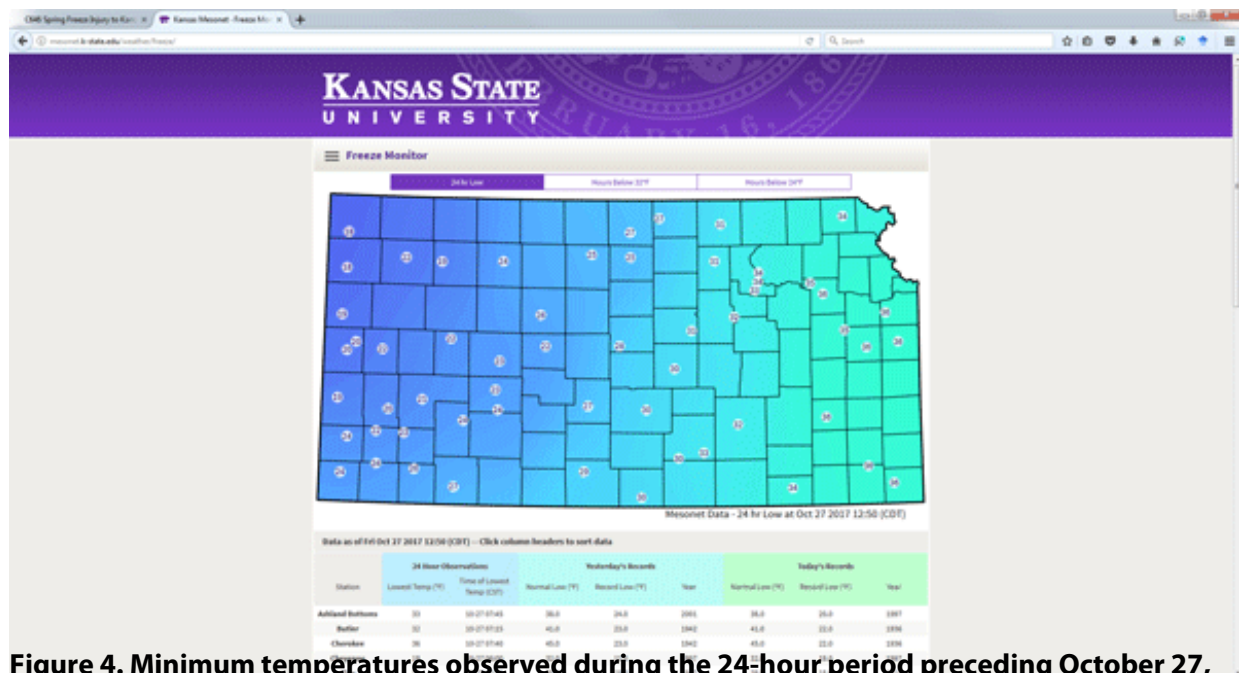


Figure 4. Minimum temperatures observed during the 24-hour period preceding October 27, 2017 at 12:50 PM. Data courtesy of Kansas Mesonet.

The extent of the unusually large and rapid drop in temperatures from well above-normal to well below-normal is a concern in certain scenarios described above. In fields that were planted earlier, if the wheat did not develop sufficient cold-hardiness, it will be more susceptible to injury from the recent cold snap.

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3. Winter weather outlook for Kansas: December 2017 - February 2018

With cold weather on the horizon, Kansans are interested in what they should expect this winter. Below are the NOAA Climate Prediction Center's outlooks for temperature and precipitation during the winter season -- December through February (Figure 1 and 2).

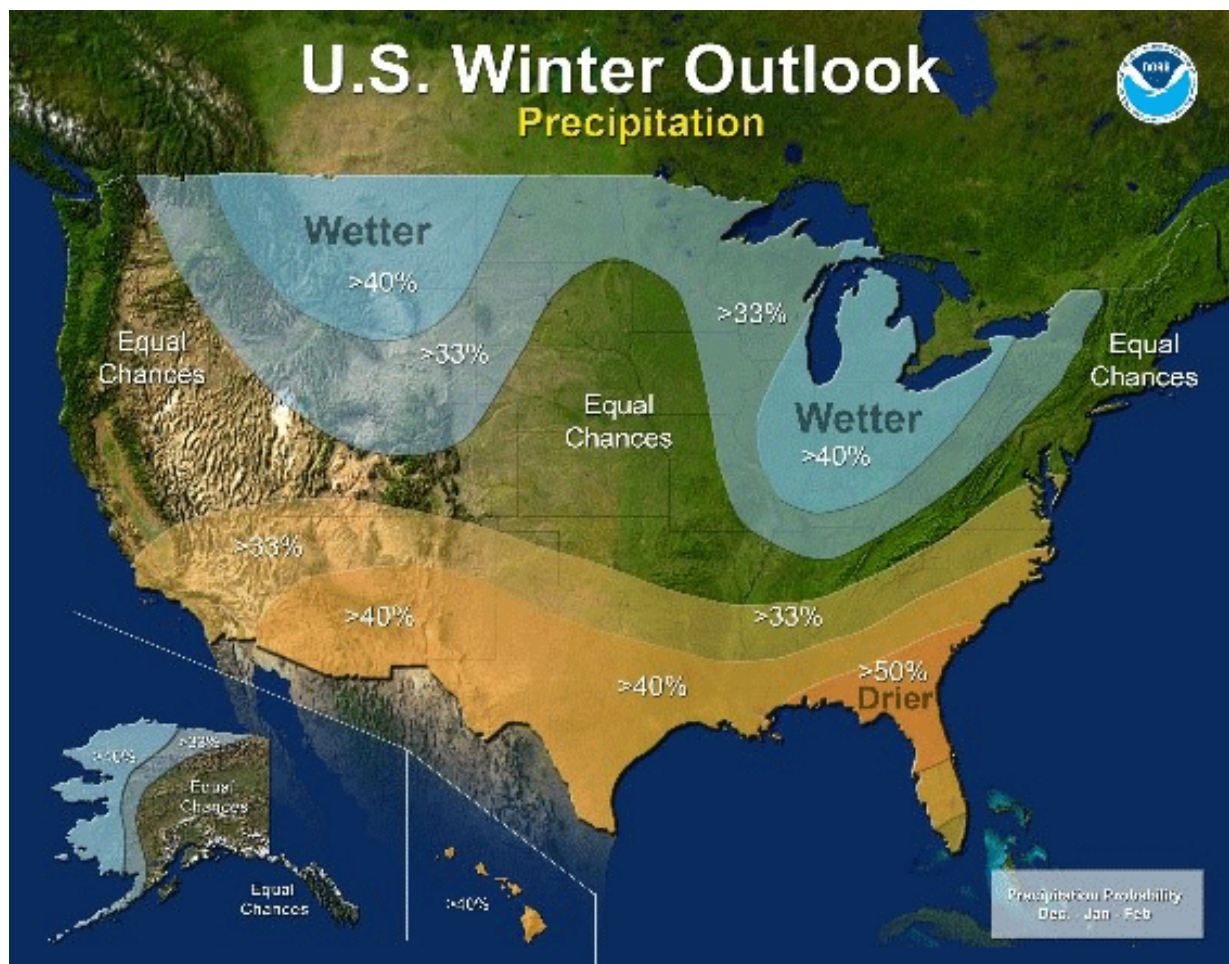


Figure 1. 2017-2018 Winter Outlook map for temperature. Source: NOAA.gov

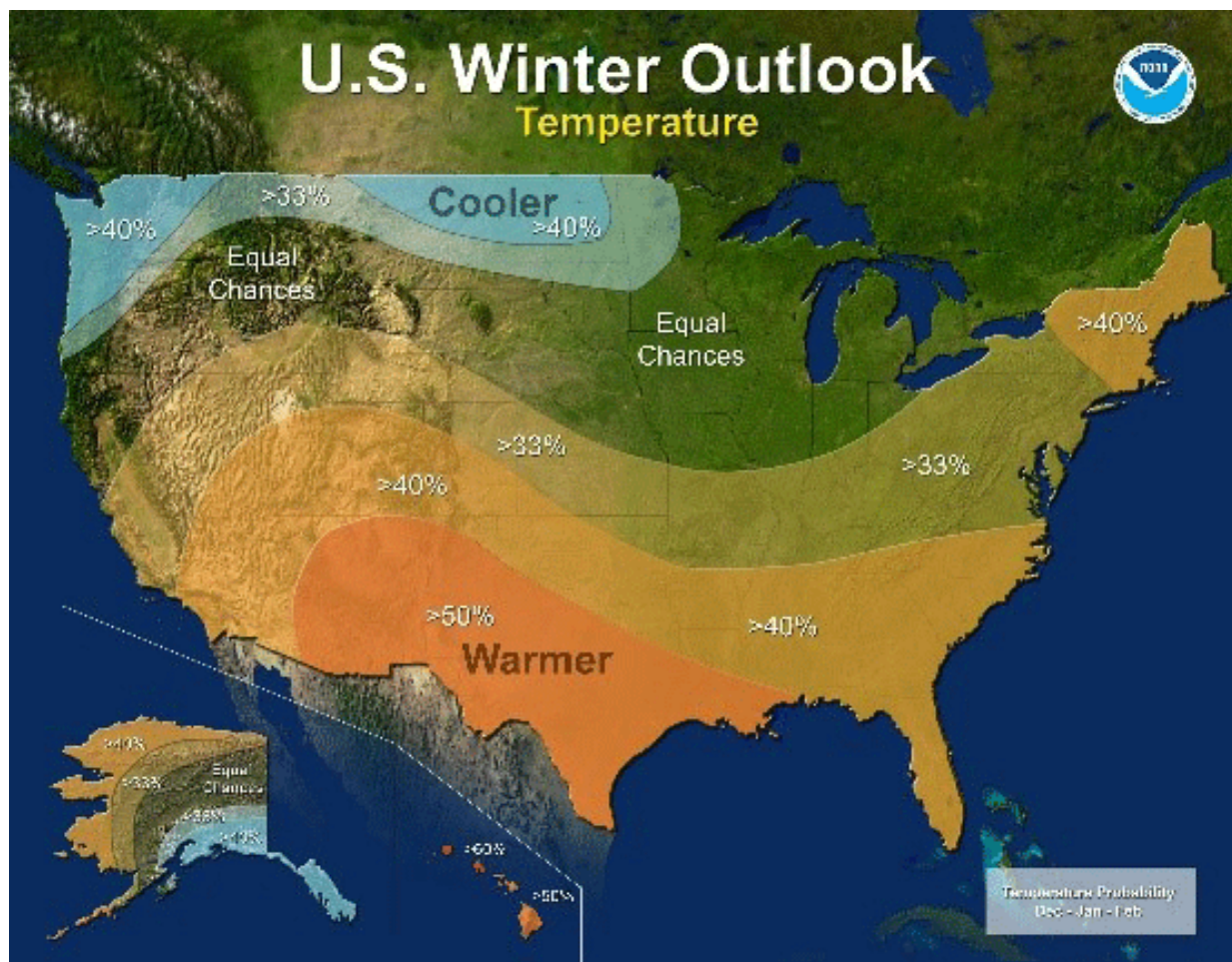


Figure 2. 2017-2018 Winter Outlook map for precipitation. Source: NOAA.gov

The temperature outlook calls for a slight increase in the chance for warmer-than-normal temperatures statewide (Figure 1.). That tendency increases as you move further south and west in the Plains. It is important to remember that this is the 3-month average. There could be significant cold periods and still have an overall warmer-than-normal winter. One difficulty with that pattern is that crops and livestock are not able to develop strong winter hardiness. This makes them more susceptible to severe conditions during the occasional extreme cold snap.

The precipitation outlook is neutral, meaning there is an equal chance to have above-, near-, or below-average precipitation this winter (Figure 2.). Winter is normally the driest time of the year for most of the Plains. Southeast Kansas is an exception, with a more even distribution of precipitation across the year.

It is worth noting that neither the temperature nor the precipitation outlook predicts the degree to which conditions will vary. A tenth of a degree (0.1) warmer-than-normal average temperature would validate the outlook to a similar extent as an increase of 10 degrees. A hundredth of an inch (0.01) greater-than-normal average would have a similar result in the precipitation outlook. Significantly wetter-than-normal conditions would be needed to improve the drought conditions in

the Northern Plains. In Kansas, only 1% of the state is in moderate drought with 16% of the state abnormally dry. With the equal opportunity for a wetter/drier than normal winter, near-average conditions are likely. This would likely continue as areas of scattered abnormally dry/moderate drought in the central portions of the state.

The major force responsible for the current winter weather outlook is the ENSO (El Niño-Southern Oscillation) signal. At this time, a weak La Niña pattern (cooler-than-normal waters in the Pacific along the Equator) is expected through the majority of winter. Storm tracks during La Niña winters are typically more zonal across the continental US, with the polar jet steering systems pushed northward across the northern tier of the United States.

Given the uncertainty of the La Niña, other factors may have a stronger influence. Two patterns that deserve attention are the North Atlantic Oscillation (NAO) and the Madden-Julian Oscillation (MJO). The NAO is a comparison of high and low pressure in the Atlantic basins. When the NAO is negative (with a weak gradient between high pressure in the subtropics and low pressure over Iceland), the east coast of the United States tends to have stronger cold outbreaks with more snow (Figure 3). Some of that can clip the eastern Plains region.

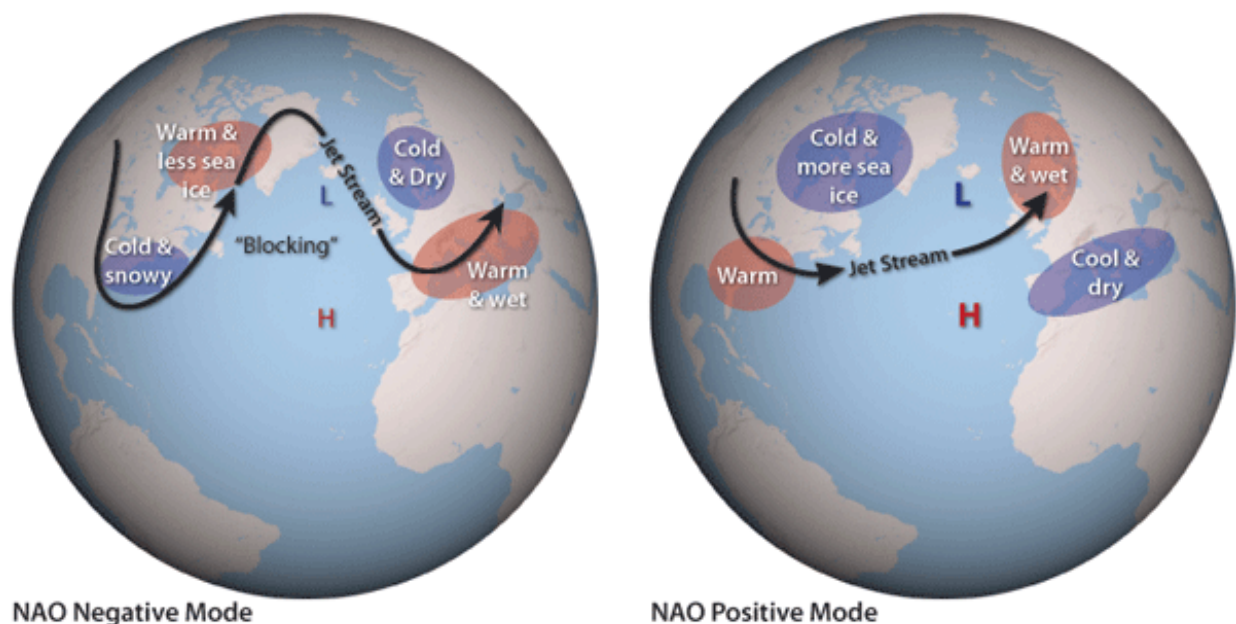


Figure 3. Negative NAO. Source: NOAA.gov

The MJO is an eastward moving 'pulse' of cloud and rainfall near the equator that typically recurs every 30 to 60 days (Figure 4). The position or state of the MJO influences storm generation across the United States. Unfortunately, both the NAO and MJO conditions can change rapidly, and forecasts for these patterns are not as well developed as for the ENSO. That makes it difficult to gauge their impacts on an extended basis.

Madden-Julian Oscillation

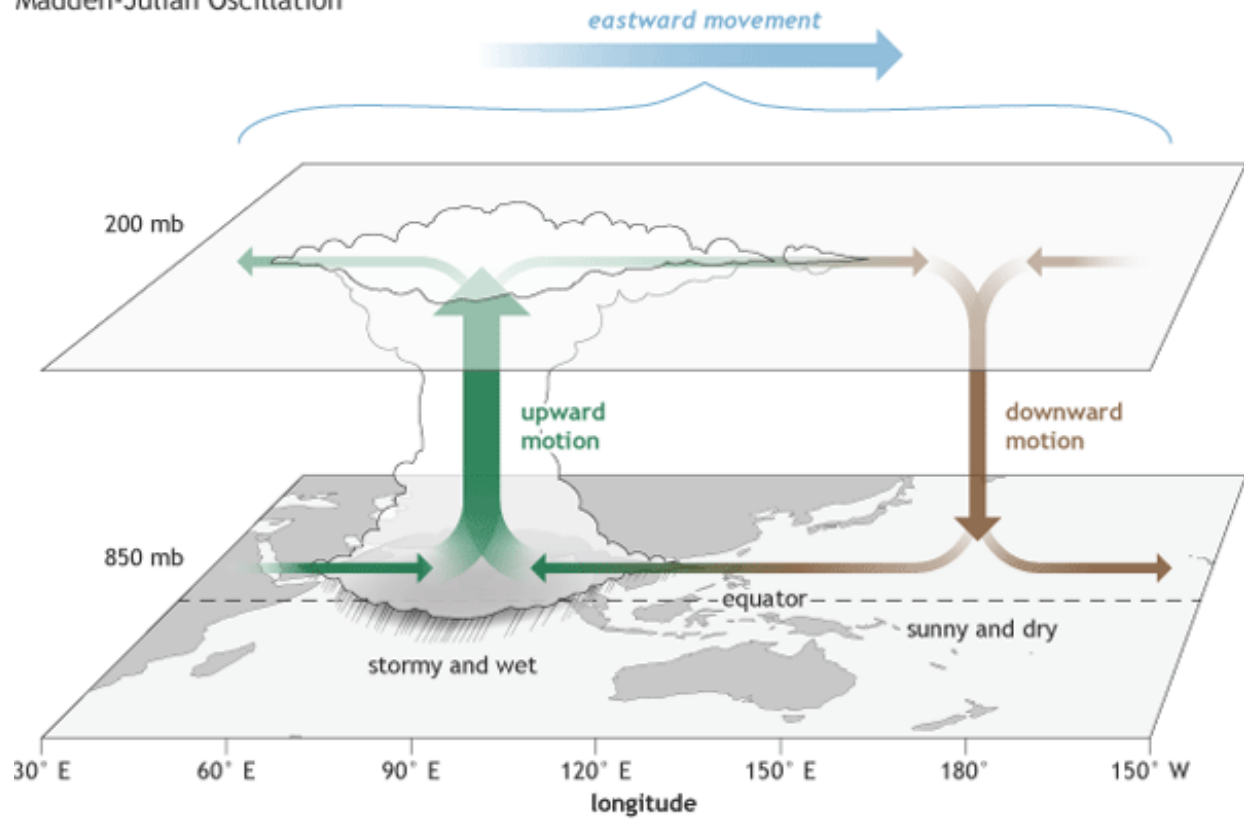


Figure 4. Madden Julian Oscillation. Source: NOAA.gov

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4. Register by Monday, October 30 for the 2017 Agronomy Cover Crop Field Day

Exciting advances in cover crop research will be featured at the 2017 Agronomy Field Day on November 3 at the Ashland Bottoms Research Farm in Manhattan. Topics will focus on understanding the role cover crops play in water quality, weed control, soil quality, and more.

The full list of topics and K-State speakers:

- Using cover crops for weed suppression – Anita Dille, Weed Ecology
- Improving soil quality with cover crops – DeAnn Presley, Soil Management Specialist
- Protecting surface water with healthy soils, cover crops, and fertilizer management – Nathan Nelson, Soil Fertility and Nutrient Management
- Soybean yields and cover crops – Ignacio Ciampitti, Crop Production Specialist and Doug Shoup, South East Area Agronomist.
- Ten years of cover crops in a no-till wheat-sorghum-soybean rotation – Kraig Roozeboom, Cropping Systems Agronomist
- Cover crops and nitrogen management – Peter Tomlinson, Environmental Quality Specialist

The field day will begin with registration at 9 a.m. and wrap up at 1 p.m. Sessions include three concurrent tours in the morning, starting at 9:30, followed by a poster session during and after lunch.

There is no charge to attend, and a complimentary lunch will be available. Preregistration is requested by October 30th so that a lunch count can be made. To preregister online, see: <https://agron-field-day-2017.eventbrite.com>. You can also preregister by calling Troy Lynn Eckart at 785-532-5776. On-site registration will also be available.

Directions to the Ashland Bottoms Research Farm are given in the infographic below. The address for the farm is 2801 W. 40th Ave, Manhattan, KS 66502.

For more information, interested persons can contact Dorivar Ruiz Diaz at 785-532-6183 or ruizdiaz@ksu.edu

Cover Crops Field Day

Ashland Bottoms Research Farm

November 3, 2017

Topics and K-State speakers:

Using cover crops for weed suppression

Anita Dille

Improving soil quality with cover crops

DeAnn Presley

Protecting surface water with healthy soils, cover crops, and fertilizer management

Nathan Nelson

Soybean yields and cover crops

Ignacio Ciampitti and Doug Shoup

Ten years of cover crops in a no-till wheat-sorghum-soybean rotation

Kraig Roozeboom

Cover crops and nitrogen management

Peter Tomlinson

Schedule:

Registration at 9 a.m. (lunch included)

Sessions include two concurrent one-hour tours in the morning

Poster session during and after lunch.

Registration:

Please register online by October 30 at:

agron-field-day-2017.eventbrite.com

or by phone: 785-532-5776

For more information contact:

Dorivar Ruiz Diaz

785-532-6183 | ruizdiaz@ksu.edu

Directions to Ashland Bottoms Research Farm:

- From K-177 Highway (south of the Kansas River Bridge): turn west on McDowell Creek Road and follow it 7.4 miles, turn right (north) on W. 40th Ave. and travel 1.2 miles
- From Interstate 70, take Exit 307 and follow McDowell Creek Road 3.6 miles north before turning left (north) on W. 40th Ave and follow it 1.2 miles north.

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

Kansas State University Department of Agronomy

2004 Throckmorton Plant Sciences Center | Manhattan, KS 66506

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5. Soil health and grazing field day in Coffey County, KS: November 14

What cover crops can do for you – connecting farm experience with research! This is the theme of a Soil Health and Grazing Field Day hosted by Coffee County Extension and a non-profit organization, Kansas Alliance for Wetlands and Streams (KAWS), on November 14 from 10:30 am – 3:30 pm.

This free field day aims to promote farmer discussion on a variety of topics including:

- Cover crop choices and management
- Cover crop grazing management
- Livestock water and fencing
- Soil and wildlife
- Soil water dynamics
- Yield influences – CIG research update

Featured speakers include:

- Dr. DeAnn Presley, KSU Agronomy
- Dr. Doug Shoup, KSU Agronomy
- Dr. Jaymelynn Farney, KSU Animal Science
- Jeff Davidson and Herschel George, KSU Watershed Specialists

Please RSVP by November 3 to Coffee County Extension at 620-364-5313. Lunch will be provided.

The field day will begin at Black Bear Bosin Shelter House. (½ mile south of WCNOE Eisenhower Learning Center, 1675 Milo Lane, Burlington, KS)

Sponsors include:

K-State Research and Extension – Coffey County
Coffey County Conservation District
Kansas Alliance of Wetlands and Streams (through a USDA-NRCS Conservation Innovation Grant)
Citizens State Bank
Natural Ag Solutions
Wolf Creek Nuclear Operating Corporation



Free Field Day!

Promoting farmer discussion on:

- Cover crop choices and management
- Cover crop grazing management
- Livestock water and fencing
- Soil and wildlife
- Soil water dynamics
- Yield influences- CIG research update

Where: Starting at Black Bear Bosin Shelter House
(¼ mile south of WCNOE Eisenhower Learning
Center, 1675 Milo Lane, Burlington, KS)

When: November 14, 2017

10:30am– 3:30pm

RSVP: By November 3rd to Coffey County

Extension at [620-364-5313](tel:620-364-5313)

Lunch will be provided!

Facilitated by:

Darl Henson, Agriculture Agent,
KSRE– Coffey County
Bob Culbertson & Dan Haines, KAWS

Featured Speakers:

Dr. Deann Presley, KSU
Dr. Doug Shoup, KSU
Dr. Jaymelynn Farney, KSU
Jeff Davidson & Herschel George, KSU
Watershed Specialists

Sponsored by:

K-State Research and Extension– Coffey County
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6. Liquid application technology workshop, November 17

The Biological and Agricultural Engineering department at K-State is hosting a Liquid Application Technology Workshop on November 17, 2017, from 8:30 am to 3:00 pm.

Topics include:

- ExactApply and PWM liquid application technology implementation
- Nozzle selection
- Drift and environment – managing application to reduce off-target error
- 3Rive 3D insecticide system
- Precision sprayer technology

The registration deadline is November 13 and is free for KARTA members and K-State Extension Agents. The registration fee for other attendees is \$25 and includes refreshments and lunch.

The workshop is being conducted at the Stanley Stout Center, 2200 Denison Avenue, Manhattan. There is ample free parking available (see map below).

For questions, please contact:

Arlene Jacobson, ajacobso@ksu.edu, 785-532-2926 or
Ajay Sharda, Assistant Professor, asharda@ksu.edu



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Liquid Application Technology WorkShop

November 17th, 2017

Biological and Agricultural Engineering
8:30 AM – 3:00 PM

Topics Include:

ExactApply and PWM liquid application Technology implementation, nozzle selection, drift and environment – managing application to reduce off-target error, 3Rive 3D insecticide system, and precision sprayer technology.

Agenda coming soon!

Registration: Free for KARTA Members and K-State Extension Agents and \$25 for everyone else.

Registration Deadline Nov 13th, 2017

Includes: Lunch, and refreshment

For Questions Contact:

Arlene Jacobson, ajacobso@ksu.edu; 785-532-2926

Ajay Sharda, Assistant Professor, asharda@ksu.edu



7. Comparative Vegetation Condition Report: October 17, 2017 - October 23, 2017

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

The objective of these reports is to provide users with a means of assessing the relative condition of crops and grassland. The maps can be used to assess current plant growth rates, as well as comparisons to the previous year and relative to the 28-year average. The report is used by individual farmers and ranchers, the commodities market, and political leaders for assessing factors such as production potential and drought impact across their state.

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

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

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

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

Kansas Vegetation Condition

Period 43: 10/17/2017 - 10/23/2017

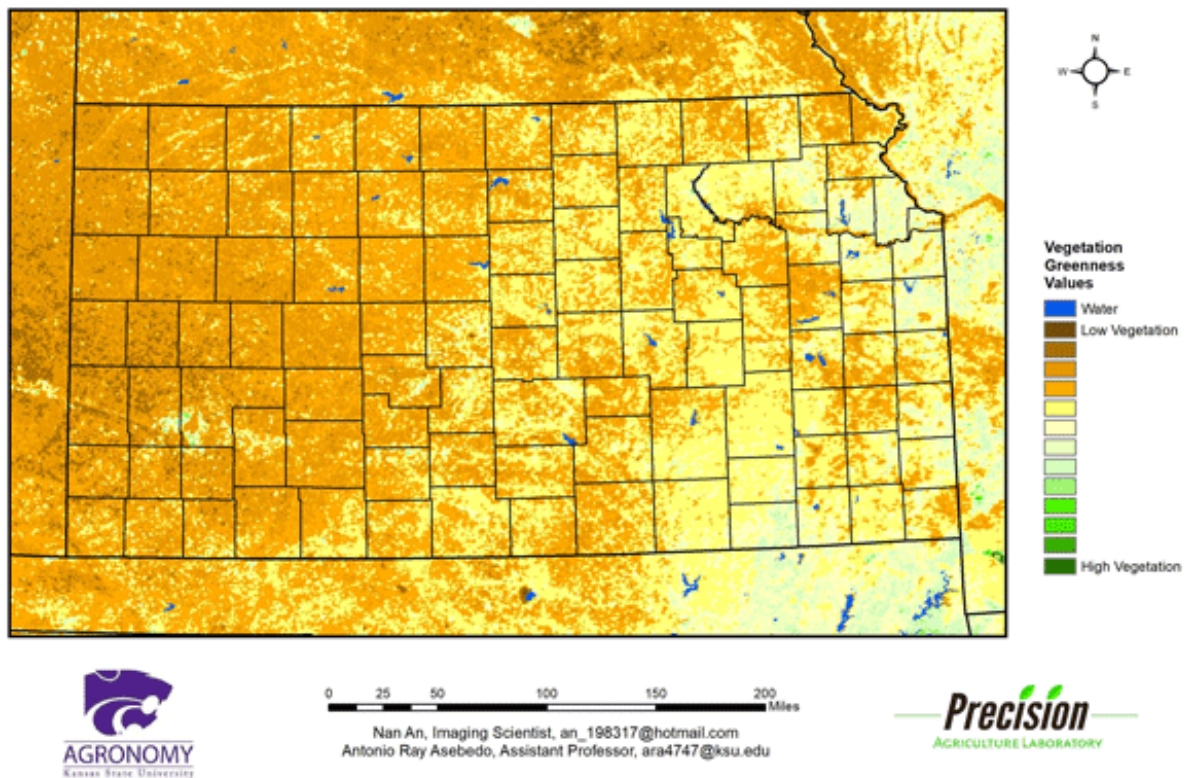


Figure 1. The Vegetation Condition Report for Kansas October 17 – October 23, 2017 from K-State’s Precision Agriculture Laboratory shows very little vegetative activity this week. The greatest areas of photosynthetic activity are in eastern Kansas, with a small pocket along the Arkansas River along the Kearney/Finney county border. The switch to winter dormancy is the major factor in declining vegetative activity.

Kansas Vegetation Condition Comparison
Mid-October 2017 compared to the Mid-October 2016

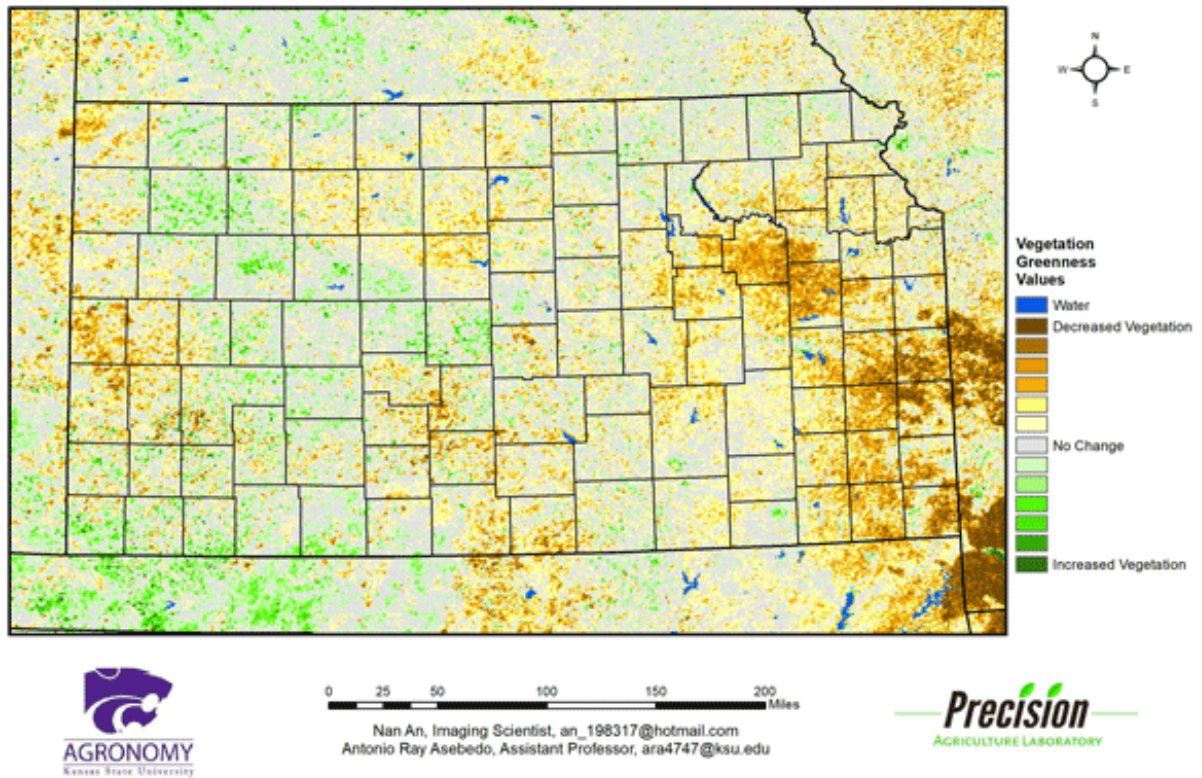


Figure 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for October 17 – October 23, 2017 from K-State’s Precision Agriculture Laboratory shows a decrease in vegetative activity. This is particularly true in the eastern third of the state.

Kansas Vegetation Condition Comparison

Mid-October 2017 compared to the 28-Year Average for Mid-October

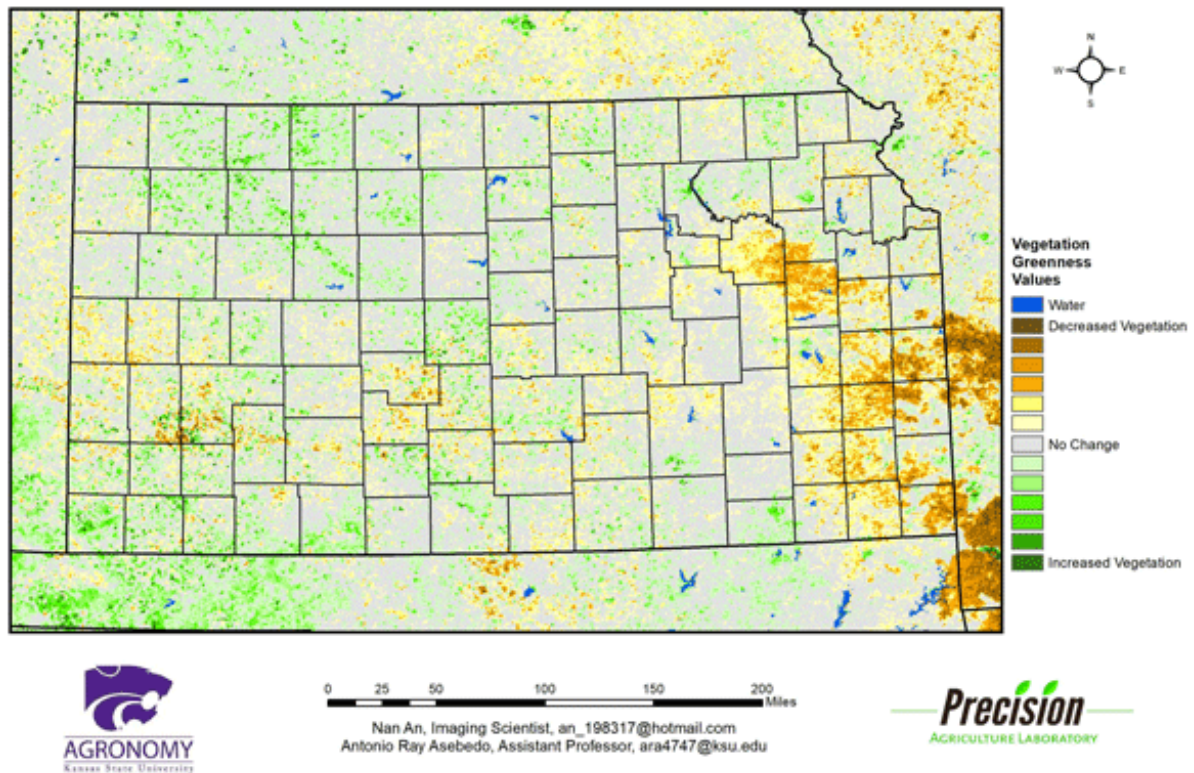


Figure 3. Compared to the 28-year average at this time for Kansas, this year's Vegetation Condition Report for October 17 – October 23, 2017 from K-State's Precision Agriculture Laboratory close to average conditions across the state. Below-average NDVI values are visible in eastern Kansas. These values correspond to areas of the state that had heavy rain last week.

Continental U.S. Vegetation Condition

Period 43: 10/17/2017 - 10/23/2017

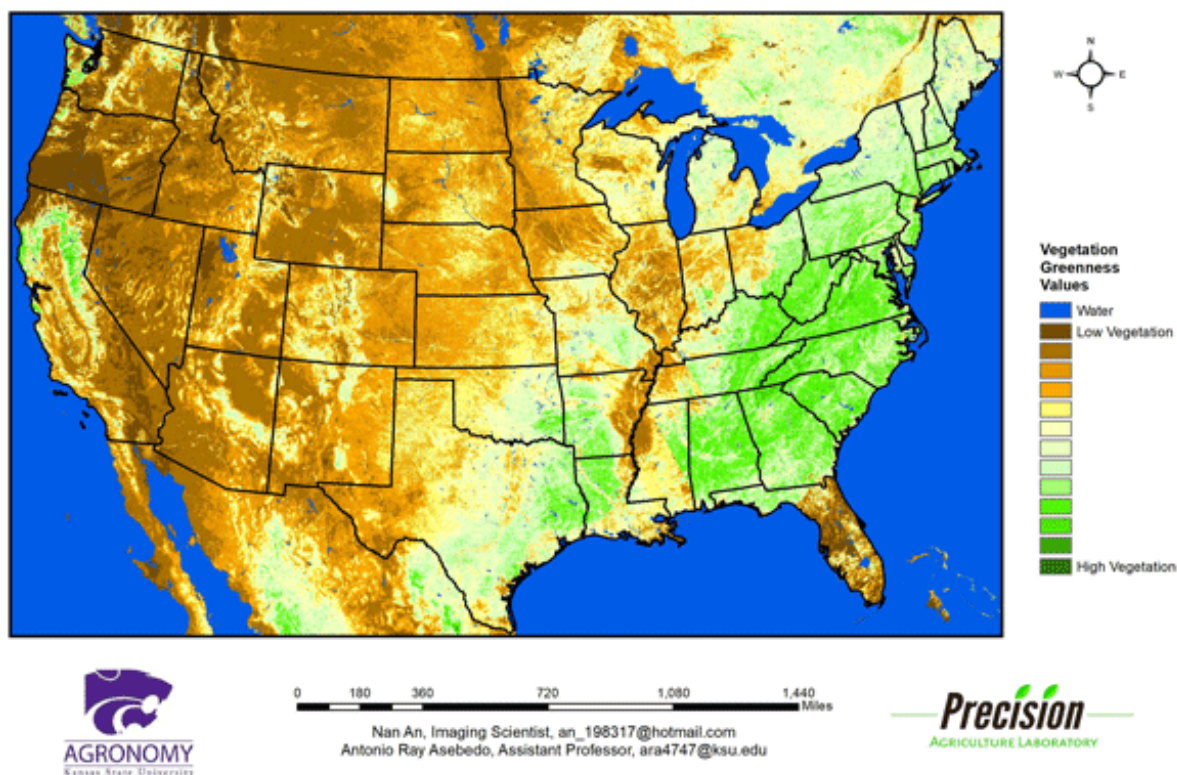


Figure 4. The Vegetation Condition Report for the U.S for October 17 – October 23, 2017 from K-State's Precision Agriculture Laboratory shows the highest NDVI values centered along and east of the Appalachians, where rainfall has reduced drought stress. Low NDVI values are visible across much of Florida as the vegetation recovers from the heavy rains of the hurricanes.

Continental U.S. Vegetation Condition Comparison Mid-October 2017 Compared to Mid-October 2016

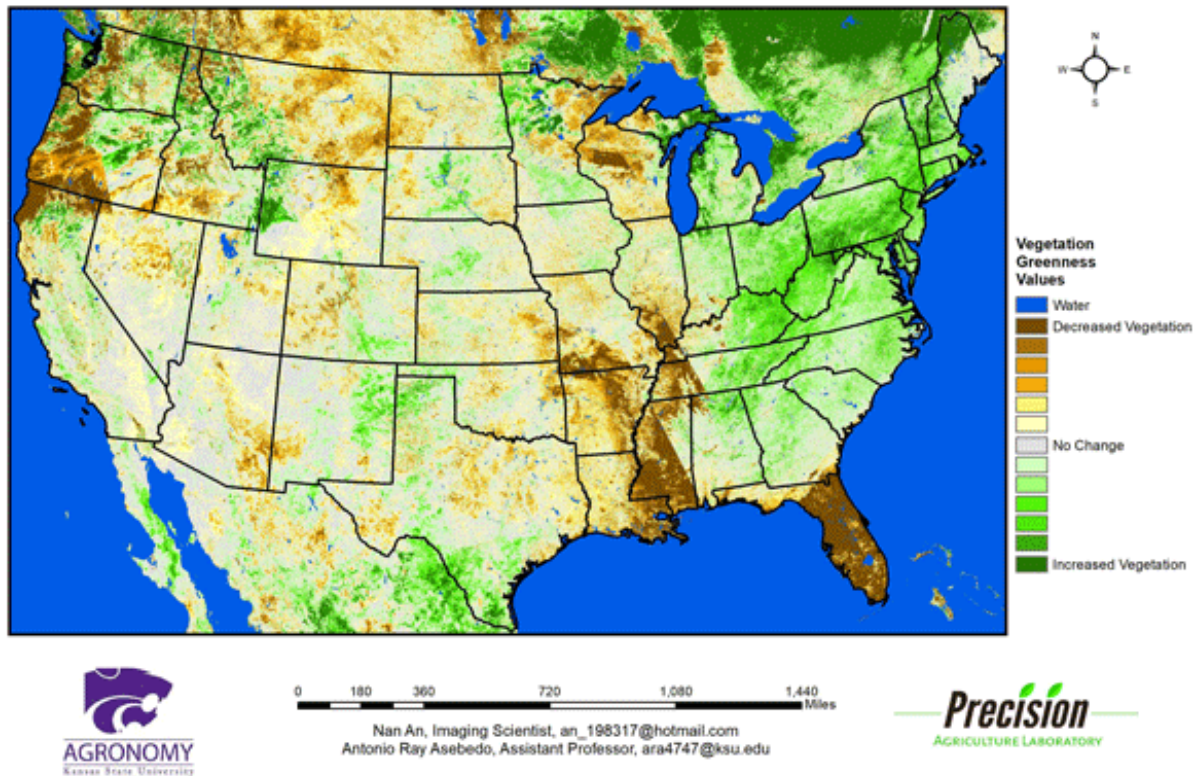


Figure 5. The U.S. comparison to last year at this time October 17 – October 23, 2017 from K-State’s Precision Agriculture Laboratory again shows the impact that a split in moisture has caused this year. Much higher NDVI values are visible across the southern states. Last October, Montana and the Dakotas were moving into a dry pattern that became the start of the intense drought the dominated this year. Recent rains have resulted in some recovery in the area, particularly in South Dakota and western Montana.

Continental U.S. Vegetation Condition Comparison
Mid-October 2017 Compared to 28-year Average for Mid-October

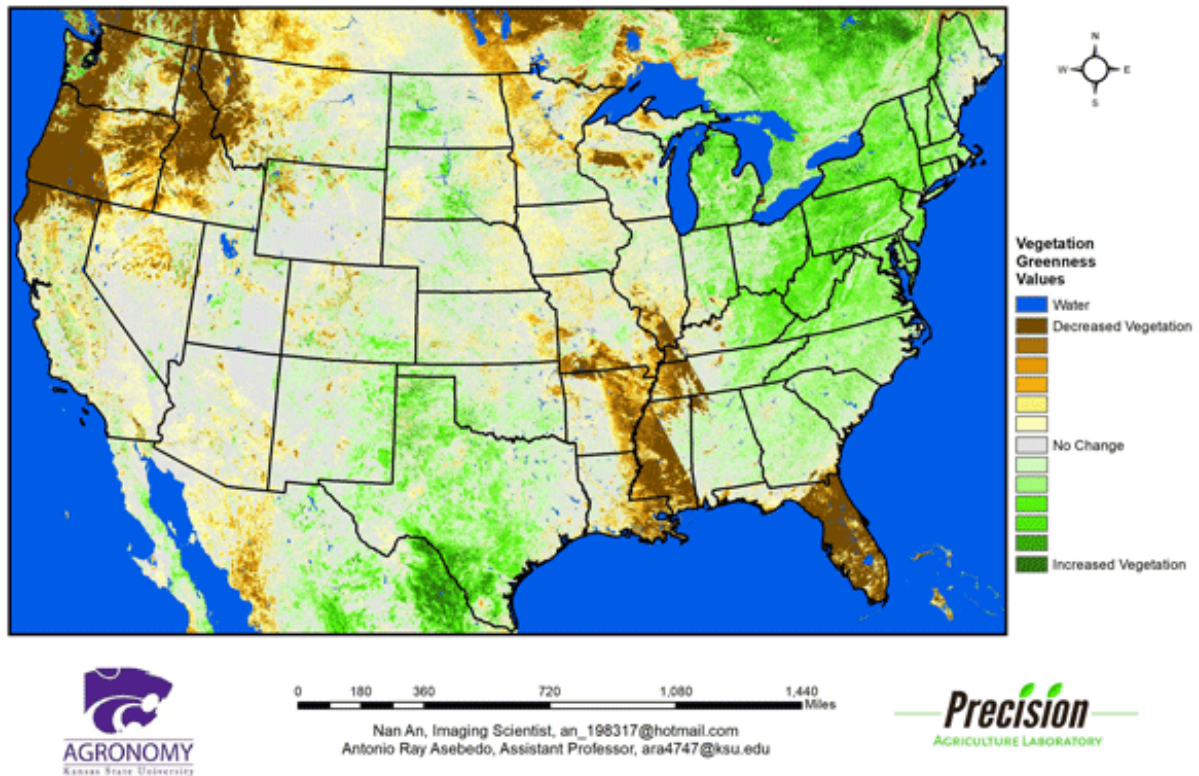


Figure 6. The U.S. comparison to the 28-year average for the period of October 17 – October 23, 2017 from K-State’s Precision Agriculture Laboratory shows a slight improvement in the drought conditions in the Northern Plains. Below-average NDVI values in Idaho, western Montana, and into the Cascades are the result of recent snow and rain in the region. A decrease in average NDVI values in parts of Missouri, portions of Louisiana, and Florida are the result of clouds.

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