Issue 539

K-STATE Research and Extension

Extension Agronomy

# eUpdate

*12/04/2015*

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, Jim Shroyer, Crop Production Specialist 785-532-0397 jshroyer@ksu.edu, or Curtis Thompson, Extension Agronomy State Leader and Weed Management Specialist 785-532-3444 cthompso@ksu.edu.

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## 1. Can excessive wheat fall growth and development be a problem in some areas this year?

The wheat crop is off to a good start in many parts of Kansas. The dry conditions common during most of September, which resulted in uneven stands in many fields across the state, have dissipated. Most of Kansas now seems to have enough moisture for good fall wheat development. In some cases, almost too much moisture (Figure 1).

**Figure 1. Water logging in a wheat field near McPherson following a nearly 3-inch precipitation event. Photo taken December 3, 2015 by Romulo Lollato, K-State Research and Extension.**

With the available moisture in addition to the mild fall temperatures in most of the state, some of the wheat may be showing more fall growth and development than desirable, especially if planted earlier than the optimal planting date (Figure 2). There are reports of wheat in western Kansas in which leaves are as much as a foot long. While the crop may look great, this amount of topgrowth may in fact be more than what we would like to see at this point in the growing season.

It is important that each wheat plant produce sufficient but not excessive tillers. Wheat plants need a minimum of 1-2 tillers and 4-5 leaves to increase the likelihood of surviving the winter. An excessive number of fall tillers and lush fall development may lead to tiller competition for available resources, increased disease incidence, and other detrimental effects.

**Figure 2. Lush vegetative growth of early planted wheat in Saline County. Photo taken November 18, 2015 by Rafael Maeoka, visiting scientist at K-State.**

**Figure 3. Wheat crop planted in early- to mid-September near Garden City. Photo by Anserd J. Foster, K-State Research and Extension.**

**Consequences of excessive fall growth and development**

Gradually falling temperatures guide the wheat plant toward developing cold hardiness to protect against cold injury and help survive the winter. Winter wheat is most tolerant to cold temperatures during tillering stages. Excessive fall development with the crop already showing erect leaves may increase the probability of cold temperature damage during the winter and early spring. In this situation, there is good likelihood that winter injury will occur to large primary tillers and they may not survive the winter. If the growing point has emerged from below ground and is not insulated during the winter, chances are that those plants or tillers will not make it through the winter.

Depending on winter and spring weather conditions, the loss of the large primary tillers may not be all bad. The development of secondary tillers may offset the loss of the large tillers as long as the growing point and buds of main stem and tillers survive the winter. Successful development of secondary tillers will depend on moisture, nutrient, and temperature conditions during the winter and spring, and can compensate for the loss of primary tillers to a certain extent. On the other hand, if the larger tillers survive the winter, they will probably be more advanced and thus more susceptible to spring freeze damage to the developing head, which could reduce yield. Spring freezes generally occur late enough that the plants cannot compensate by forming additional tillers.

In some situations, few plants in a field may have jointed or even headed during the fall, the result of partial vernalization. For full article on partial vernalization, please see: https://webapp.agron.ksu.edu/agr_social/eu_article.throck?article_id=92/

Another serious detrimental effect of excessive fall growth is increased soil water depletion due to increased crop biomass. Plant transpiration is directly related to plant biomass. A crop with lush growth requires more maintenance moisture than a thinner canopy. Depleting soil water early during the growing season can induce late-season drought stress if the weather turns dry and the soil profile is not replenished. A wheat crop with good, but not excessive fall development, may result in more soil water being available later in the growing season; while a wheat crop with lush excessive fall growth has a greater probability for yield loss due to drought stress.

One alternative to hold the wheat back and reduce some of the lush growth is to have cattle graze the crop. Grazing will remove some of the aboveground biomass and excessive fall growth. It is important to be aware of soil moisture conditions prior to releasing cattle on the crop, though, especially following last week's precipitation events. Releasing cattle on the wheat crop when soils are wet can cause compaction and trampling of wheat plants, ultimately decreasing stands.

A mild fall may also result in increased pest incidence, such as greenbugs, wheat curl mite, aphids, and Hessian fly; and consequently an increase in diseases vectored by some of these pests, such as wheat streak mosaic and barley yellow dwarf virus.

**Final comments**

While this article addresses the issue of excessive fall growth and development observed in some fields across Kansas, it is important to emphasize that overall, wheat is off to a great start in Kansas.

The mild temperatures should have ensured that wheat planted during the optimum planting time, as well as some of the later-planted wheat, have just enough above- and below-ground development to survive the winter. Additionally, the available moisture from the October and November precipitation events can not only promote appropriate fall growth, but also help insulate the crown from low winter temperatures.

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## 2. Mustard species in Kansas

**Tansy mustard and flixweed**

Tansy mustard and flixweed are two similar mustard species common in central and western Kansas. These weeds emerge in the fall and grow as a rosette with finely lobed compound leaves. Tansy mustard and flixweed bolt in the spring. Small orange seeds are produced in long, narrow seed pods. Seed pods of tansy mustard are usually about 1/2 inch long and thicker than flixweed seed pods, which are generally 1 to 1 1/2 inches long.

Tansy mustard **(***Descurania pinnata*) is a native winter annual. The plant is covered with fine hairs. The stem is erect, branched and 4 - 30" high. The flowers are small, pale yellow, and occur in small clusters. Tansy mustard spreads by seed from early to late summer.

Figure 1. Tansy mustard. All photos by Dallas Peterson, K-State Research and Extension.

Flixweed (*Descurainlia sophia*) is very similar to tansy mustard, and often confused with it. It is an introduced annual or winter annual species from Eurasia which reproduces by seed. Stems are erect, branched, and 4 - 40" high. Flixweed often grows taller than wheat, while tansy mustard generally does not. Leaves have a lacy appearance. The stem and leaves are covered with fine hairs. Flowers are small, pale yellow, and grow in small clusters. Although tansy mustard is native to the area and flixweed is introduced, flixweed is probably the more common weed problem in wheat fields.

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Figure 2. Flixweed.

**Bushy wallflower (treacle mustard)**

Bushy wallflower, or treacle mustard, (*Erysimum repandum*) is a common weed in central and eastern Kansas. It is native to Eurasia. It usually emerges in the fall and forms rosettes with long narrow leaves

and irregular leaf margins. Most vegetative growth occurs during the spring. Bushy wallflower rosettes bolt in the spring and bear bright yellow flowers at the top of the plant, which only grows to about 12 – 18" tall. Seeds are produced in long, narrow seed pods.

Figure 3. Bushy wallflower, or treacle mustard.

**Field pennycress**

Field pennycress (*Thlaspi arvense*) is native to Eurasia. The seedling develops as a compact, vegetative rosette. If it emerges in the fall, it overwinters either as seedlings or vegetative rosettes. It can also emerge from seed in the spring. It bolts in the spring and bears white flowers at the top of the plant, which may grow from 1 to 2 feet tall. Field pennycress has a flat, broadly winged seed capsule that looks something like a penny. Field pennycress reproduces solely by seed. It is often found in grain fields, roadsides and other disturbed areas. Once this weed is established in a field, the soil will soon become contaminated with its seeds. It is an aggressive competitor with crops, and can cause significant yield reductions. Field pennycress may produce from 1,600 to 15,000 seeds/plant.

The seed shatters readily. Seed dispersal is chiefly by wind. Seeds can remain viable for as long as 6 to 10 years or more in the soil. This persistent viability of field pennycress seeds in the soil, their capacity to germinate when brought to the surface by cultivation, and the very large reservoir of dormant seeds present in the soil of a heavily infested area are all factors that contribute significantly to the persistence of this troublesome weed. Field pennycress has a strong, foul odor, even causing cows to produce bitter flavored milk after eating it. It is sometimes called stinkweed.

Figure 4. Field pennycress.

**Blue mustard**

Blue mustard (*Chorispora tenella*) is a winter annual that germinates in the late summer and fall, and produces a rosette similar in appearance to a dandelion. The plant overwinters as the rosette. Blue mustard bolts in the spring. With mild February weather the flower stalk may elongate in early March. Cold weather in February results in late March elongation. It bears purple or blue flowers at the top of the plant, which may grow from 12 to 18" tall. Seeds are produced in long, narrow seed pods 1 to 2 inches long. Viable seed can be produced approximately 10 days after bloom. Blue mustard is a problem in winter annual crops, such as winter wheat, throughout Kansas. Blue mustard was introduced into the U.S. from Siberia. Uncontrolled blue mustard can be extremely competitive with wheat, causing as much as 85% yield loss from season-long competition. In 2014 K-State research, we found more than 65% yield loss where blue mustard was not controlled until spring.

Figure 5. Blue mustard.

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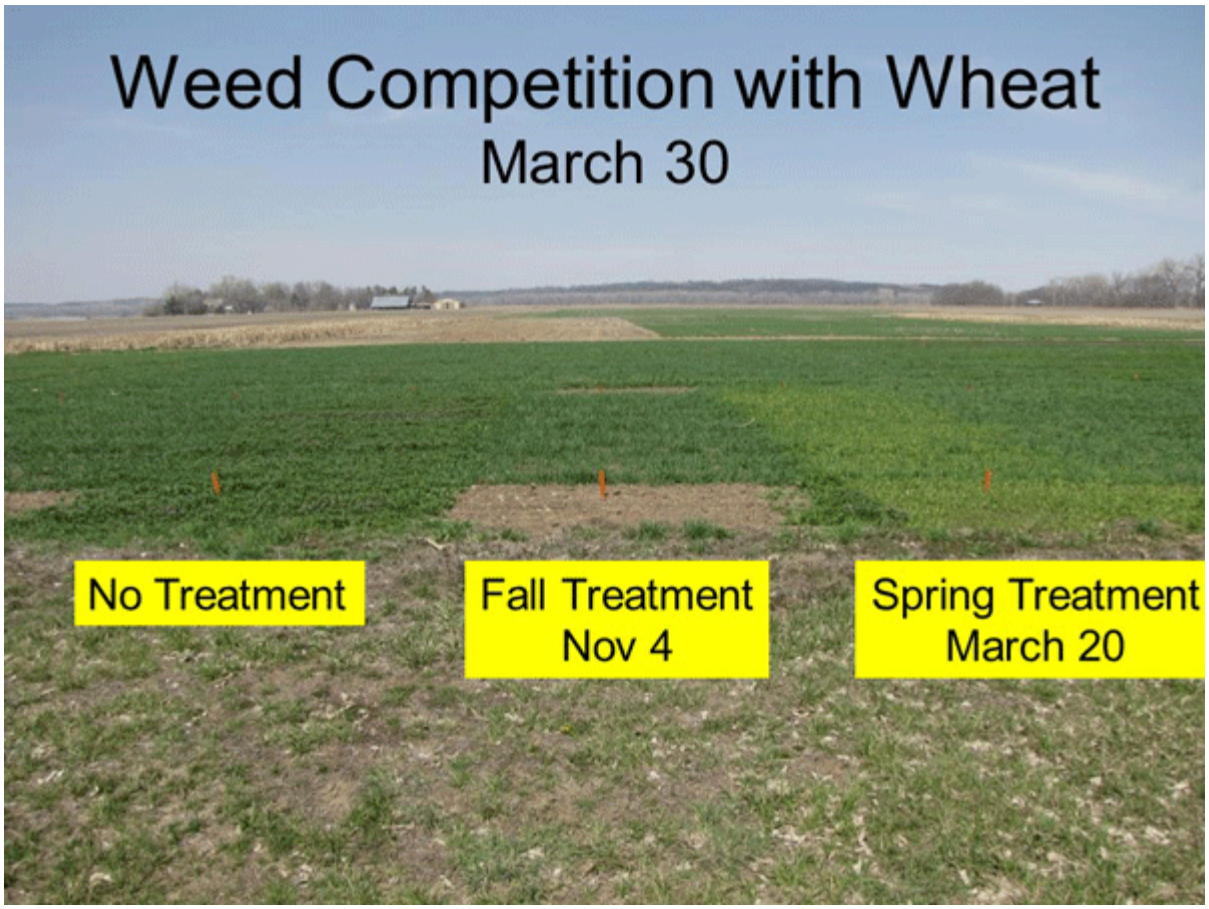
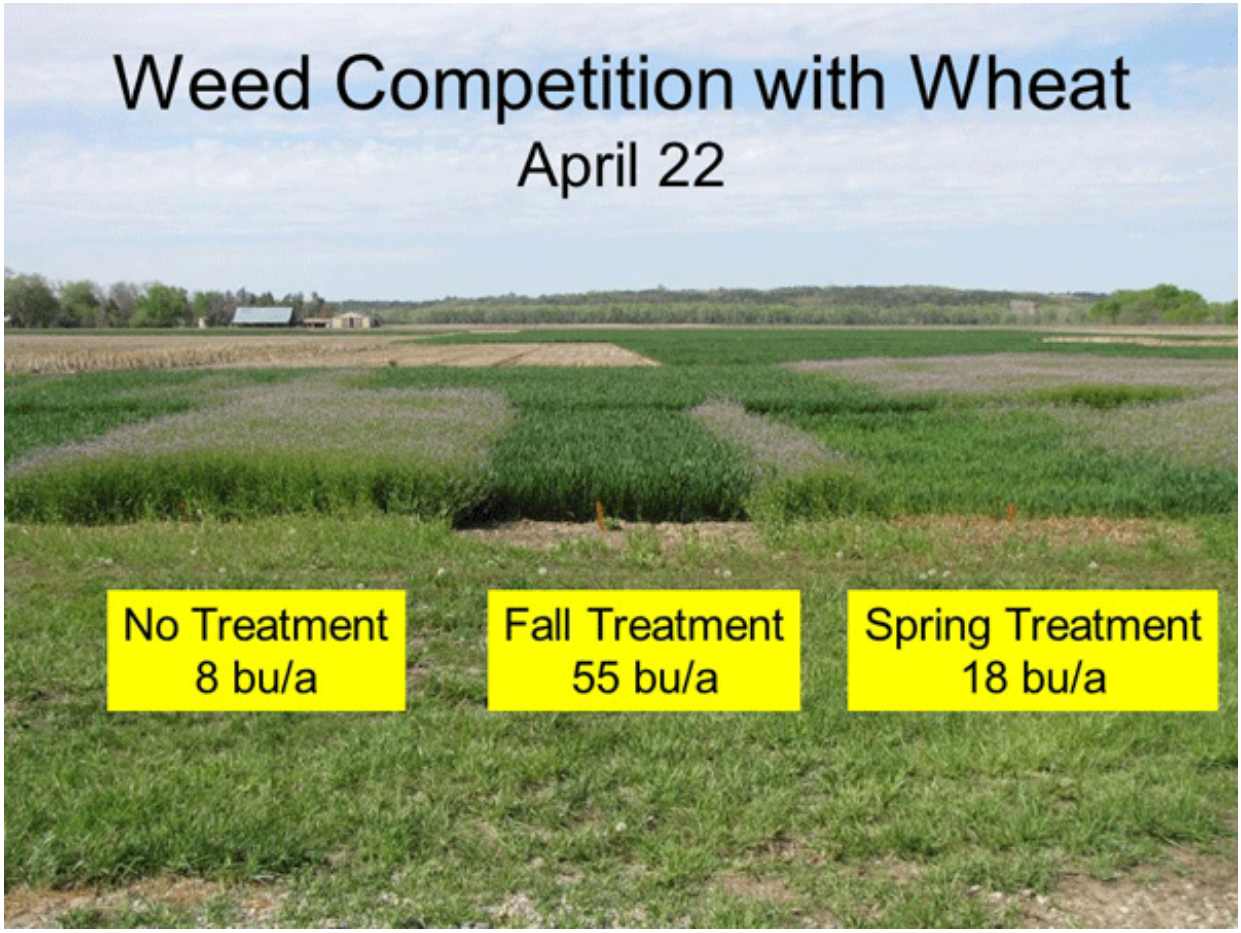
## 3. Control of mustards in wheat

Mustards are a common broadleaf weed in wheat throughout Kansas. Unfortunately, producers often do not notice these weeds in their fields until they start to bloom in the spring. As a result, producers often don't think about control until that time. Although it is still possible to get some control at that time with herbicides, mustards are much more difficult to control at that stage and often have already reduced wheat yields by then.

To keep yield losses to a minimum, mustards should be controlled by late winter or very early spring, before the plants begin to bolt, or stems elongate. If winter annual broadleaf weeds are present in the fall, they can be controlled with any number of ALS-inhibiting herbicides, including Ally, Amber, Finesse, Affinity, Rave, Olympus, or PowerFlex. Huskie, 2,4-D, and MCPA can also provide good control of most mustards if the weeds are at the right stage of growth and actively growing, and if the wheat is at the correct growth stage. Dicamba and Starane are not very effective for mustard control.

In the later winter or early spring, blue mustard is perhaps the most difficult of the winter annual broadleaf weeds to control because it bolts very early. To be effective on blue mustard, herbicides typically need to be applied to blue mustard in late February or early March. Blue mustard is more difficult to control than tansy mustard with 2,4-D because blue mustard has often already bolted by the time 2,4-D can be safely applied to wheat. Thus, 2,4-D often is applied too late to be effective on blue mustard.






Figures 1a and 1b. Effect of timing of blue mustard control in wheat: K-State research, 2014. Photos by Dallas Peterson, K-State Research and Extension.

Flixweed and tansy mustard should be treated when they are no larger than two to three inches across and two to three inches tall. As these plants become larger the control decreases dramatically. Ester formulations of 2,4-D and MCPA are more effective on tansy mustard and flixweed than amine formulations. Field pennycress is easier to control than tansy mustard or flixweed. Herbicide applications made before the pennycress bolts are usually effective. Wheat should be fully tillered before applying 2,4-D or tillering will be inhibited and wheat yields may be decreased.

Most ALS-inhibiting herbicides control winter annual mustards very well, although there are populations of treacle mustard and flixweed in Kansas now that are ALS-resistant, and cannot be controlled by these products.

Alternative control measures will be needed to control these populations. The best approach is to use other herbicides such as 2,4-D, MCPA, or Huskie as an alternative or in a tank-mix with the ALS herbicides. MCPA can be applied after the wheat is in the 3-leaf stage; but as mentioned above, 2,4-D should not be applied until after wheat is fully tillered -- which often doesn't occur until spring. Huskie can be applied between the 1-leaf and flag leaf stage of growth. None of these herbicides has

much residual control, so the majority of weeds need to be emerged and actively growing at the time of treatment.

Some producers commonly apply ALS herbicides with fertilizer in January or February. Unfortunately, MCPA, 2,4-D, and Huskie are most effective when applied to actively growing weeds, so application when weeds are dormant may not provide good control. As a result, if an ALS-inhibitor tank-mix with one of these herbicides is applied to dormant ALS-resistant mustards in the winter, poor control could occur.

ALS-resistant bushy wallflower seems to be present in a number of fields in central Kansas. ALS-resistant flixweed has only been confirmed in the Saline county area, but may start to show up elsewhere. Producers should watch for cases of poor control, and consider alternative herbicides or herbicide tank-mixes to help prevent or manage ALS-resistant weeds.

Crop rotation with corn, grain sorghum, soybeans, cotton, or sunflowers is a good way of managing mustards as long as they are controlled in the spring prior to producing seed. Crop rotation will usually result in a gradual reduction of mustard populations in the future as the seedbank in the soil gradually decreases.

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## 4. K-State Soybean Schools scheduled for late January


A series of four K-State Soybean Production Schools will be offered in late-January 2016 to provide in-depth training for soybean producers.

The one-day schools will cover issues facing soybean producers: weed control strategies, crop production practices, soil fertility and nutrient management, insect and disease control, and risk management.

The schools will begin at 9 a.m. and adjourn at 2.30 p.m., including a farmer panel at the end of the School. The dates and locations are:

Jan. 25: **Great Bend:** Great Bend Recreation Commission, 1214 Stone Street
- Alicia Boor, Barton County Agricultural Extension Agent, aboor@ksu.edu, 620-793-1910

Jan. 26: **Overbrook:** Grace Community Church, 310 E 8th Street
- Darren Hibdon, Frontier District Crop Production Extension Agent, dhibdon@ksu.edu, 785-229-3520

Jan. 28: **Beloit:** NC Kansas Technical College Auditorium, Highway 24
- Sandra Wick, Post Rock District Crop Production Extension Agent, swick@ksu.edu, 785-282-6823

Jan. 29: **Marysville:** American Legion, 310 N 19th St
- Anastasia Johnson, Marshall County Agricultural Extension Agent, anastasia@ksu.edu, 785-562-3531

Lunch will be provided, courtesy of the sponsors. There is no cost to attend, but participants are asked to pre-register before Jan. 22.

Online registration at K-State Soybean Schools: http://bit.ly/KSBEANSchools

You can also register by emailing or calling the nearest local Research and Extension office for the location you plan to attend.

For more information, contact:

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## 5. K-State Sorghum Schools scheduled for early February


A series of four K-State Sorghum Production Schools will be offered in mid-February 2016 to provide in-depth training for sorghum producers. The schools will be sponsored by Kansas Grain Sorghum Commission.

The one-day schools will cover issues facing sorghum producers: weed control strategies, crop production practices, soil fertility and nutrient management, insect control, irrigation, limited irrigation and iron chlorosis (western Kansas), sugarcane aphid, and risk management.

The schools will begin at 9 a.m. and adjourn at 3 p.m., including a farmer panel at the end of the School. The dates and locations are:

Feb. 2: **Scott City:** Wm. Carpenter 4-H Building, 608 N Fairground Rd
- John Beckman, Scott County Extension Agent, jbeckman@ksu.edu, 620-872-2930

Feb. 3: **Phillipsburg:** Phillips County Fair Building, 1481 US-183
- Cody Miller, Phillips-Rooks District Extension Agent, codym@ksu.edu, 785-543-6845

Feb. 4: **Ellsworth:** American Legion Post 174, 645 W 15th St
- Michelle Buchanan, Midway District Extension Agent, mbuchanan@ksu.edu, 785-472-4442

Feb. 5: **Emporia:** Bowyer Community Building, 2650 W US Hwy 50
- Brian Rees, Lyon County Extension Agent, brees@ksu.edu, 620-341-3220

Lunch will be provided, courtesy of the sponsors. There is no cost to attend, but participants are asked to pre-register before Jan. 29.

Online registration at K-State Sorghum Schools: **http://bit.ly/KSSORGHUMSchools**

You can also register by emailing or calling the nearest local Research and Extension office for the location you plan to attend.

For more information, contact:

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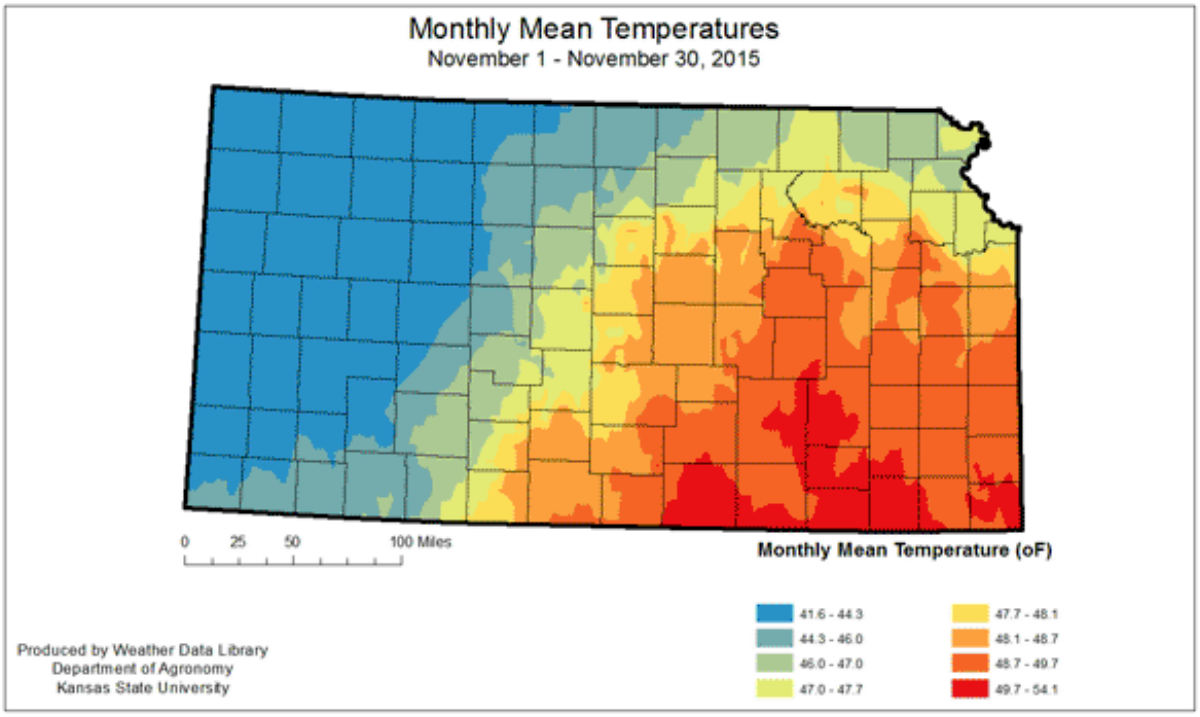
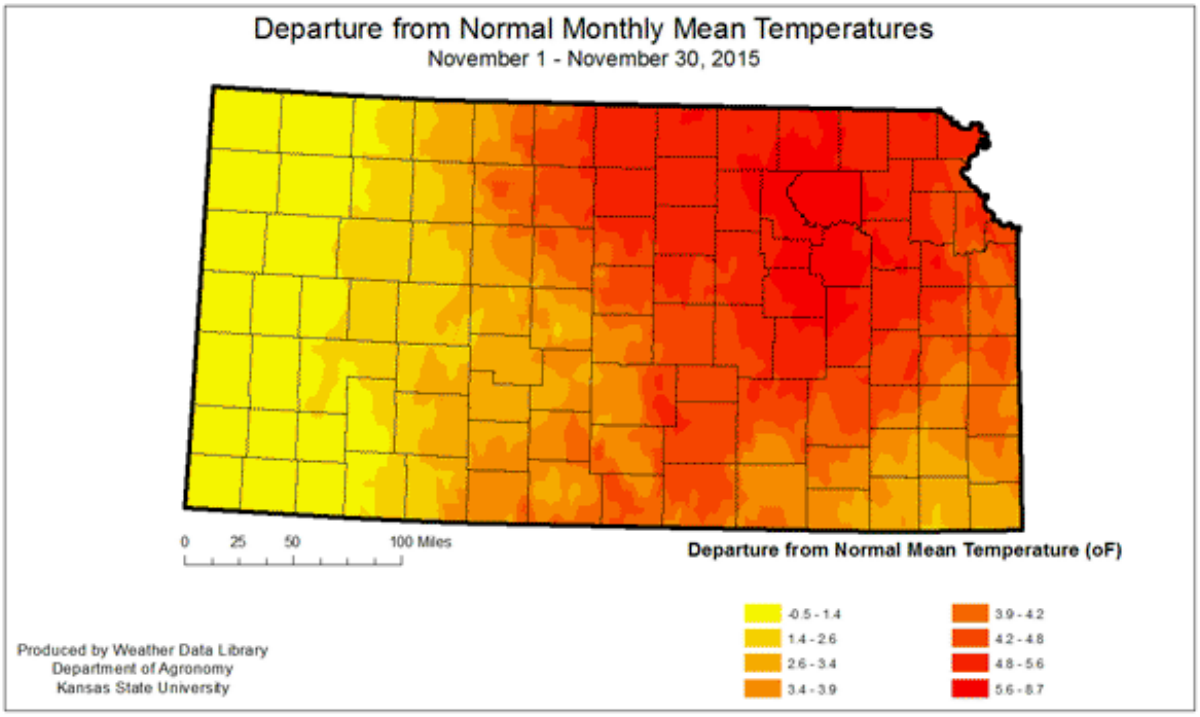
## 6. November weather summary for Kansas: Abrupt changes

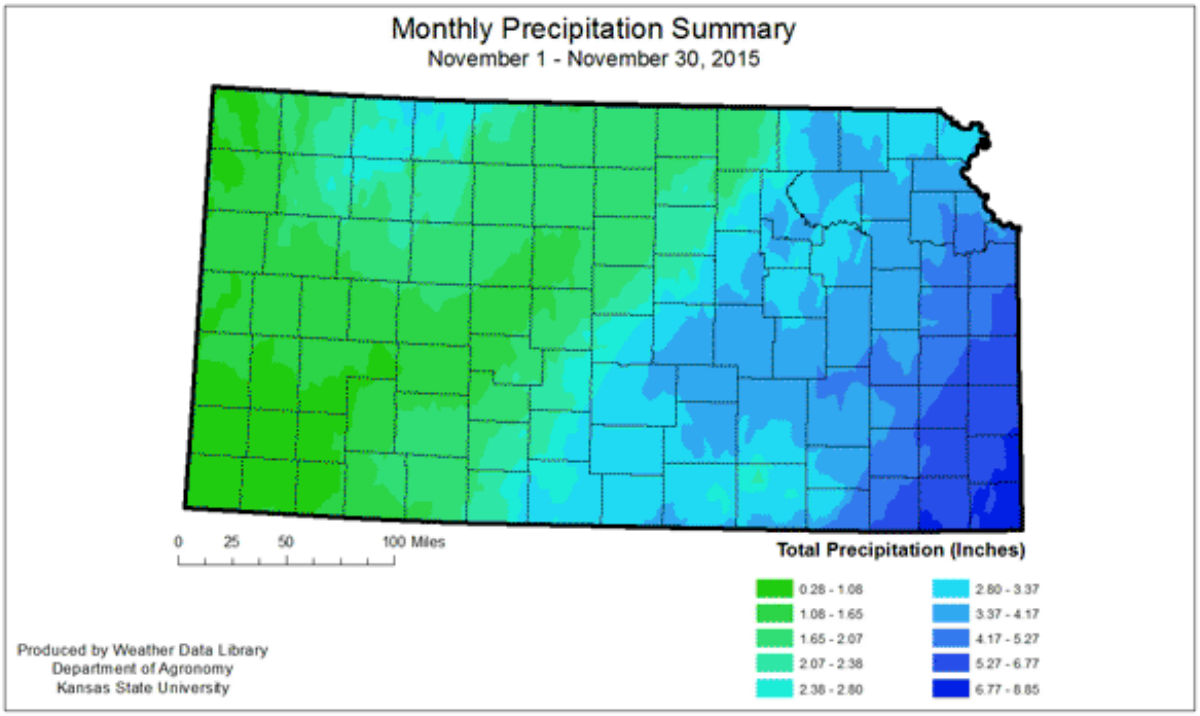
While the weather in Kansas was warmer and wetter than average in November, there were some very abrupt changes. The average statewide temperature was 45.9 degrees F, which was the 17th warmest November on record. The warmest reading for the month was 84 degrees F, reported at Richfield in Stanton County on the 4th. Much of the state averaged 4 to 8 degrees F warmer than normal, although the western third of the state was only at or slightly warmer than normal. Twenty-one new daily record high maximum temperatures were set, although none of those were records for the month. There were also 65 new record warm minimum temperatures recorded during the month. The 60 degrees F reported at the Hutchinson airport on the 4th of November set a new record warm minimum for November at that location. Despite being warmer than average, cold temperatures were still noted. Eight new daily record low maximum temperatures were recorded. Colby serves as an illustration of the temperature swings experienced during the month. On the 16th, the high was 71 degrees F, with a low of 33 degrees F. On the 17th, the high was only 34 degrees F, while the low dropped to 20 degrees F.

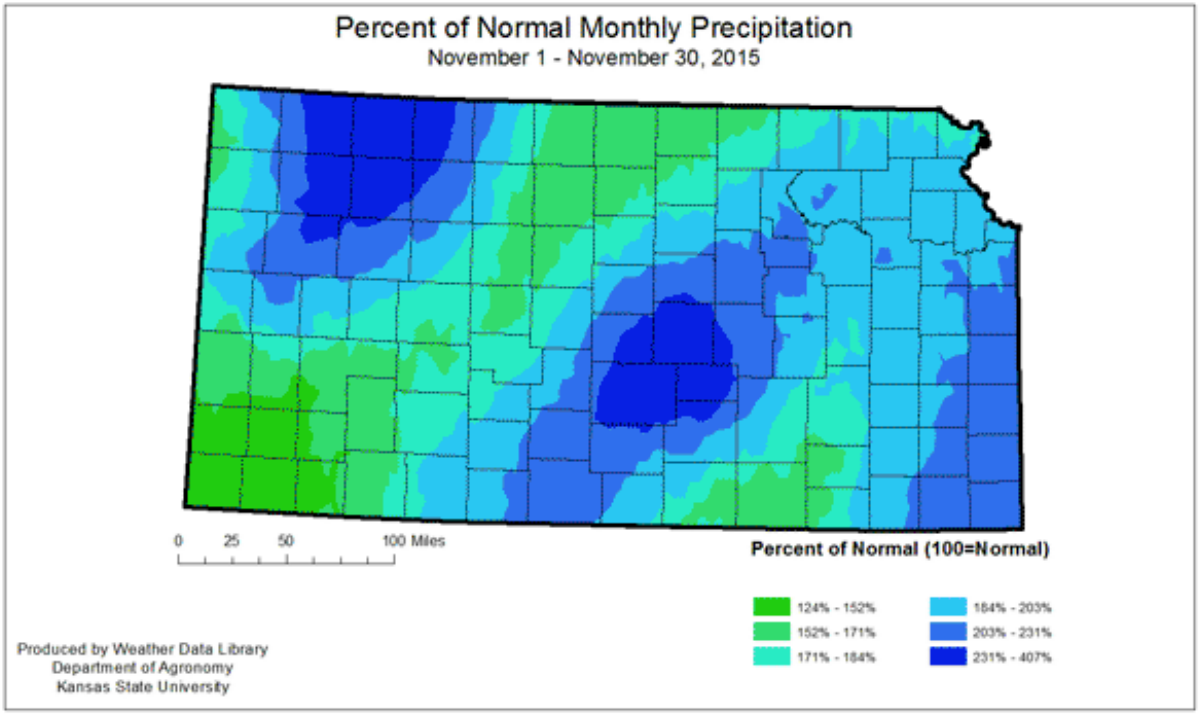





Moisture was plentiful statewide in November, averaging 2.87 inches, or 201 percent of normal for the month. This makes it the 5th wettest November on record. There were major precipitation events during the month. The first event occurred between November 16th and 18th. This brought a severe weather outbreak that included a preliminary total of 23 tornadoes. After the frontal system passed, rapidly falling temperatures resulted in heavy snow in the West Central and Northwestern Divisions. The second was at the end of the month, starting on the 26th and persisting through the 30th. Temperatures during this event fluctuated near freezing, resulting in heavy ice accumulation in the South Central Division with lighter amounts in other parts of the state, along with some minor snow accumulations. Atwood, in Rawlins County, reported the highest daily snow accumulation with 24 inches on the 19th, of which 7 inches was still on the ground at the end of the month. The highest monthly precipitation totals were 8.85 inches at Coffeyville and 8.00 inches at Pittsburg. The greatest daily precipitation totals were 3.85 inches at Atwood on the 19th and 3.31 inches at Pittsburg on the 27th.

Severe weather included a tornado outbreak on the 16th. This was followed by blizzard conditions on the 18th and 19th. The month ended with a significant icing event from the 27th through the 29th. As of December 1st, Westar Energy reported more than 300 continuing outages, affecting more than 1,000 customers in the Hutchinson area.


Monthly Precipitation Summary
November 1 - November 30, 2015
0 25 50 100 Miles
Total Precipitation (Inches)
0.28 - 1.08
1.08 - 1.65
1.65 - 2.07
2.07 - 2.38
2.38 - 2.80
2.80 - 3.37
3.37 - 4.17
4.17 - 5.27
5.27 - 6.77
6.77 - 8.85
Produced by Weather Data Library
Department of Agronomy
Kansas State University


Percent of Normal Monthly Precipitation
November 1 - November 30, 2015
0 25 50 100 Miles
Percent of Normal (100=Normal)
124% - 152%
152% - 171%
171% - 184%
184% - 203%
203% - 231%
231% - 407%
Produced by Weather Data Library
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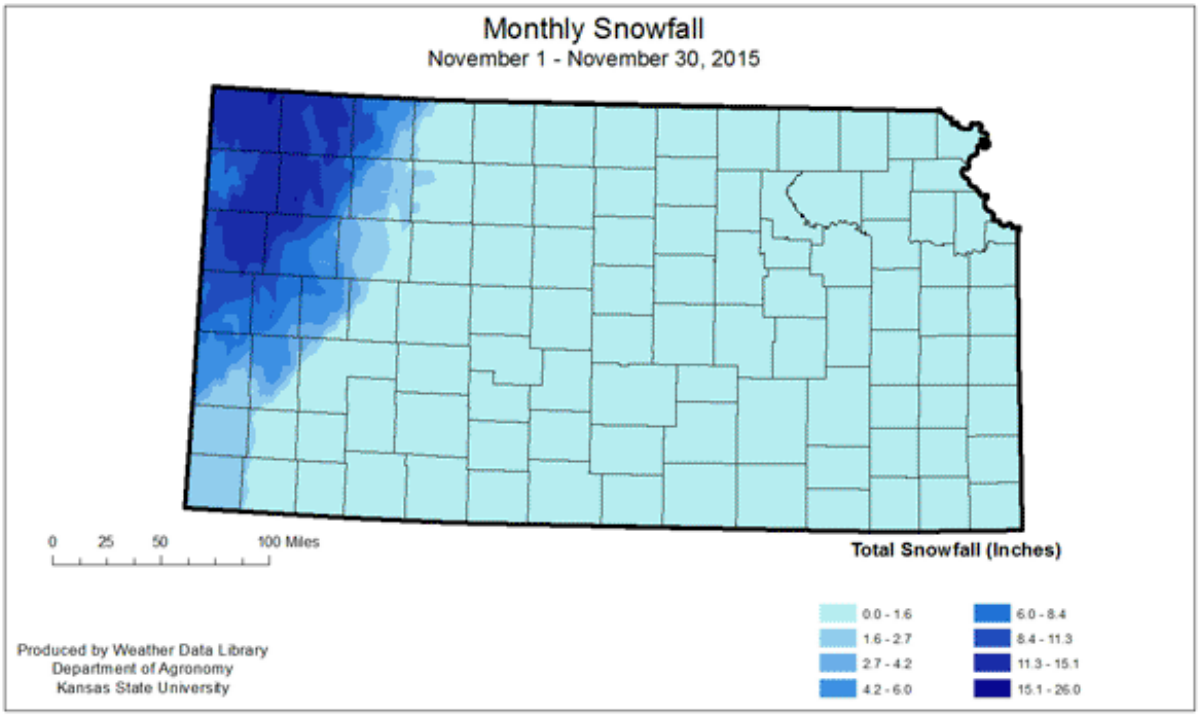
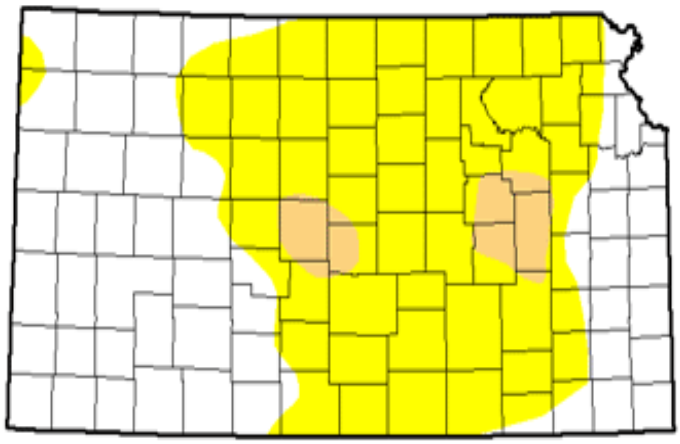



Given the above-normal precipitation, it is not surprising that drought conditions improved. Areas of moderate drought conditions were reduced, as was the area of abnormal dry conditions. Small areas of moderate drought remain in parts of central Kansas, as well as parts of the Flint Hills. Some long-term hydrological deficits are in place affecting some water supplies and reservoirs. The drought outlook is for improving conditions, and the precipitation outlook for December is positive. However, we are in a drier period of the year, so even above-normal precipitation will be slow to erase dry conditions.

# U.S. Drought Monitor
# Kansas



**Author:**
*David Simeral*
*Western Regional Climate Center*

http://droughtmonitor.unl.edu/

## December 1, 2015
*(Released Thursday, Dec. 3, 2015)*
Valid 7 a.m. EST

*Drought Conditions (Percent Area)*

| | None | D0 | D1 | D2 | D3 | D4 |
|---|---|---|---|---|---|---|
| **Current** | 46.33 | 49.16 | 4.51 | 0.00 | 0.00 | 0.00 |
| **Last Week** 11/24/2015 | 45.49 | 41.56 | 12.95 | 0.00 | 0.00 | 0.00 |
| **3 Months Ago** 9/1/2015 | 88.23 | 11.77 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Start of Calendar Year** 12/30/2014 | 19.49 | 43.02 | 19.18 | 16.05 | 2.25 | 0.00 |
| **Start of Water Year** 9/29/2015 | 80.79 | 14.72 | 4.48 | 0.00 | 0.00 | 0.00 |
| **One Year Ago** 12/2/2014 | 18.56 | 42.86 | 19.25 | 17.08 | 2.25 | 0.00 |

*Intensity*

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

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

**November 2015**

**Kansas Climate Division Summary**

| | Precipitation (inches) | | | | | | Temperature (°F) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | November 2015 | | | 2015 Jan. through Nov. | | | | | Monthly Extremes | |
| **Division** | **Total** | **Dep.** [1] | **% Normal** | **Total** | **Dep.** [1] | **% Normal** | **Ave** | **Dep.** [1] | **Max** | **Min** |
| **Northwest** | 2.26 | 1.44 | 269 | 20.33 | -0.46 | 97 | 40.1 | 1.1 | 83 | 12 |
| **West Central** | 1.57 | 0.78 | 204 | 20.81 | 0.67 | 103 | 41.3 | 0.8 | 81 | 11 |
| **Southwest** | 1.20 | 0.54 | 177 | 26.99 | 7.76 | 139 | 45.0 | 2.1 | 84 | 16 |
| **North Central** | 2.01 | 0.78 | 160 | 24.74 | -2.39 | 90 | 46.2 | 5.0 | 81 | 17 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Central** | 2.72 | 1.48 | 213 | 25.92 | -2.44 | 90 | 47.4 | 4.5 | 81 | 20 |
| **South Central** | 3.33 | 1.84 | 219 | 32.09 | 1.89 | 106 | 48.4 | 3.8 | 80 | 15 |
| **Northeast** | 3.56 | 1.79 | 201 | 35.30 | 1.52 | 104 | 46.8 | 4.6 | 82 | 13 |
| **East Central** | 4.11 | 1.94 | 189 | 34.47 | -2.05 | 93 | 48.6 | 5.0 | 80 | 21 |
| **Southeast** | 5.19 | 2.60 | 197 | 37.15 | -2.53 | 93 | 49.2 | 3.4 | 81 | 20 |
| **STATE** | 2.87 | 1.45 | 201 | 28.80 | 0.45 | 102 | 45.9 | 3.4 | 84 | 11 |

1. Departure from 1981-2010 normal value

2. State Highest temperature: 84 oF at Richfield 1NE (Stanton County) on the 4th.

3. State Lowest temperature: 11 oF at Tribune 14N (Greeley County) on the 22nd.

4. Greatest 24hr rainfall: 3.85 inches at Atwood, Rawlins County on the 19th (NWS); 3.31 inches at Pittsburg 0.7 WSW, Crawford County on the 27th (CoCoRaHS).

Source: KSU Weather Data Library

Mary Knapp, Weather Data Library
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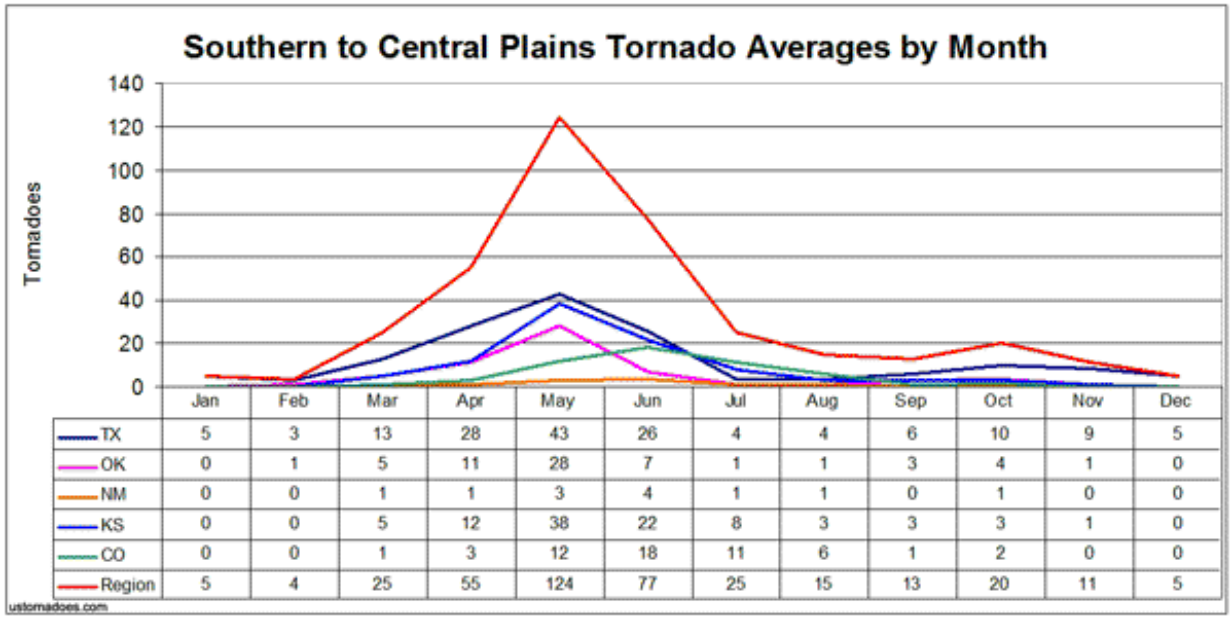
## 7. Fall tornado outbreak: November 16

Kansas is no stranger to tornadoes, ranking second nationally with an annual tornado average of 96 (NCEI). Tornadoes occur typically in spring across the Central Plains, with a peak for Kansas in May. However, there is often a second peak of tornadoes in the fall (usually October) across the Plains. Fall, like spring, is a transitional season in which warm air masses are often clashing with cold, fueling strong storm systems. These gradients provide ample opportunities for thunderstorms. To get tornadoes, however, substantial wind shear is also required, which is more difficult to achieve during the fall. Therefore, tornadoes in November are much rarer in the state, with an average of only one over the 20-year period (Figure 1).




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TX | 5 | 3 | 13 | 28 | 43 | 26 | 4 | 4 | 6 | 10 | 9 | 5 |
| OK | 0 | 1 | 5 | 11 | 28 | 7 | 1 | 1 | 3 | 4 | 1 | 0 |
| NM | 0 | 0 | 1 | 1 | 3 | 4 | 1 | 1 | 0 | 1 | 0 | 0 |
| KS | 0 | 0 | 5 | 12 | 38 | 22 | 8 | 3 | 3 | 3 | 1 | 0 |
| CO | 0 | 0 | 1 | 3 | 12 | 18 | 11 | 6 | 1 | 2 | 0 | 0 |
| Region | 5 | 4 | 25 | 55 | 124 | 77 | 25 | 15 | 13 | 20 | 11 | 5 |

**Figure 1. Average number of tornadoes in Kansas and other states by month (ustornadoes.com).**

November 16, 2015 saw one of those rare storm systems across the United States. As the system moved over the Rockies during the day, an unseasonably warm, moist, air mass pushed northward across the Plains in advance of it. This air mass was overspread by strong upper level winds which provided ample shear for severe thunderstorms. With these ingredients in place, storms developed across the High Plains in the afternoon and drifted north/northeast into the overnight hours. Numerous severe weather reports, including multiple tornadoes, were associated with these violent storms that extended from Nebraska to Texas.

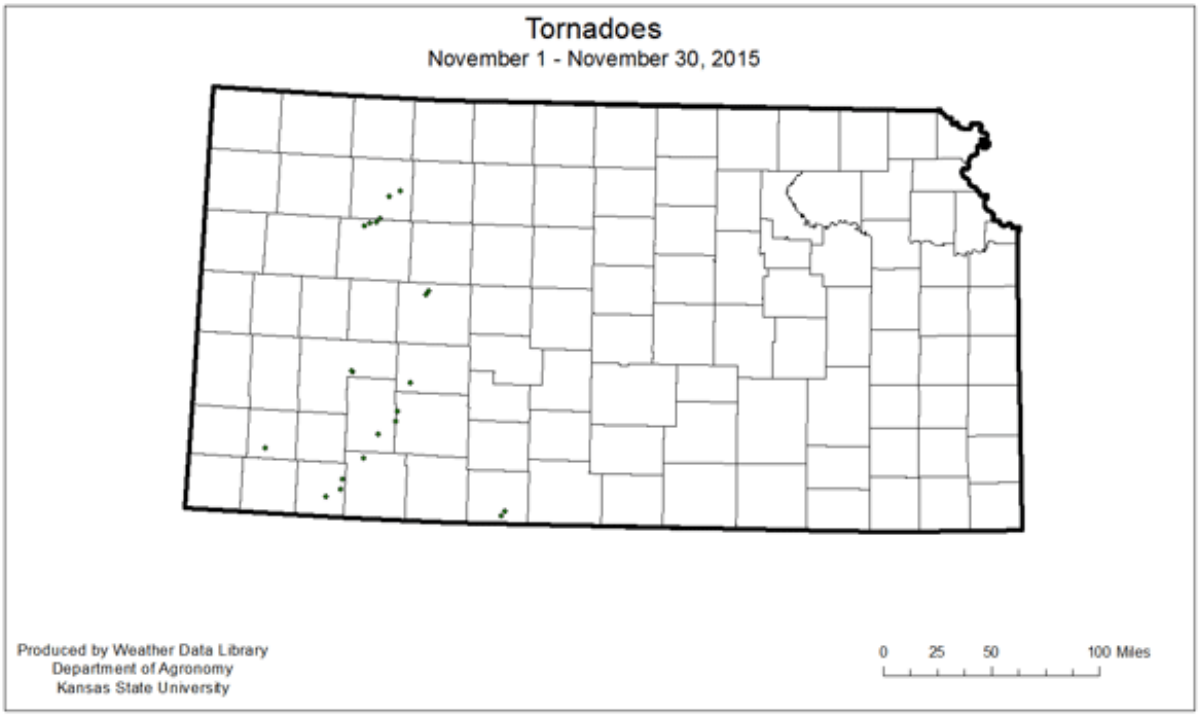



**Figure 2. Preliminary tornado reports in Kansas on November 16, 2015.**

What made this system especially unique was the duration of many of the storms as well as the intensity of the tornadoes. In Kansas, 16 tornadoes were reported from Seward County to Sheridan County (Figure 2). Of the confirmed tornadoes (10 as of 12/4/15), there were 3 EF3's, 5 EF1's, 1 EF2, and 1 EF3. One of these (Kismet-Haggard EF3) had a track of over 50 miles, width of 2000 yards, estimated winds of 155mph, and was on the ground for roughly 70 minutes (Figure 3). This unprecedented tornado was only the second EF3 ever recorded in Kansas in November. It eclipsed the previous F3 tornado (November 27, 1960 in Cloud County) for the strongest, as well as the longest and widest tornado ever confirmed in November (Tornado History Project). Previously, between 1950-2014, only 17 days in November have had recorded tornadoes. Of these 17 days, there were 65 confirmed tornadoes, the most on a single day being the November 27, 2005 with 19. The last recorded tornado in November was an EF0 in Stanton County on the 10$^{th}$ in 2008.

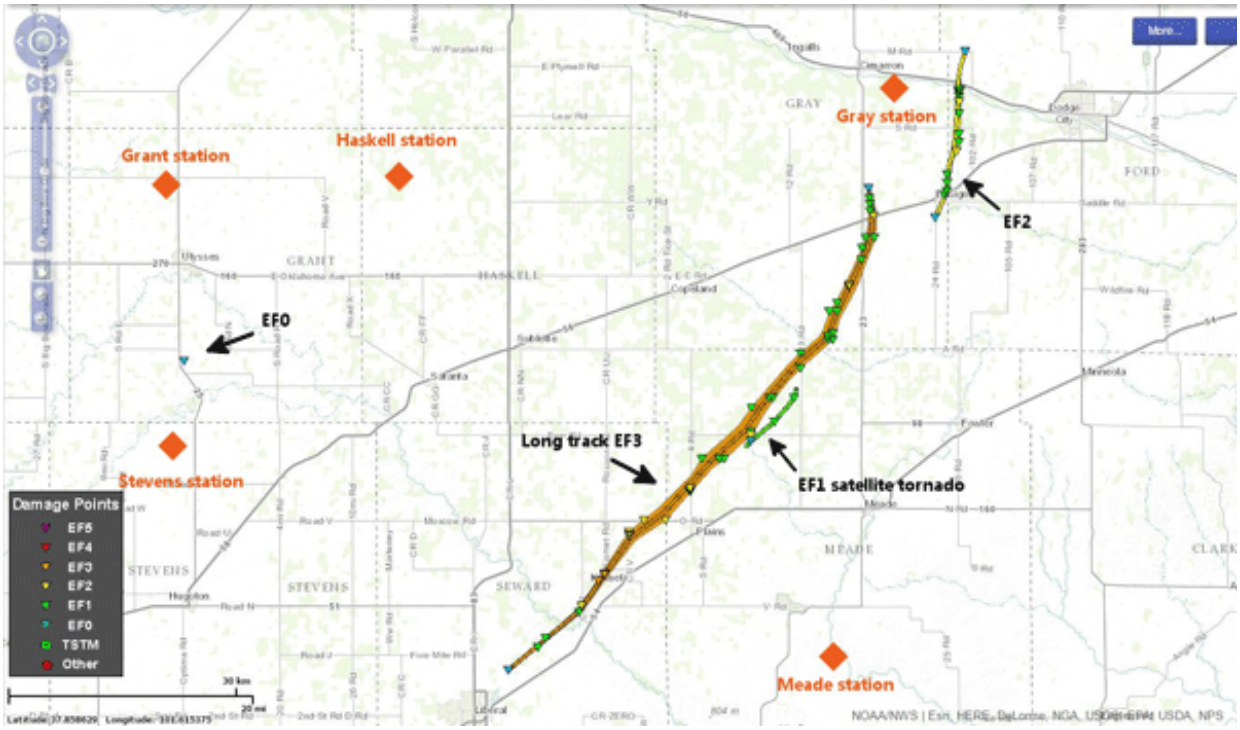



**Figure 3. Zoomed view of the Kismet-Haggard EF3 and nearby tornadoes on November 16, 2015 (National Damage Assessment Toolkit). Orange diamonds represent nearby Kansas Mesonet stations (mesonet.ksu.edu).**

Luckily, no one was hurt nor killed during this tornado outbreak. This event proves that despite typical expectations of severe weather in the spring, it can happen whenever the elements come together – regardless of the month. What set this system apart was the strength of the tornadoes, the widespread area of impact, and their location in the High Plains. It pays to be prepared regardless of the season. Always have multiple ways of receiving warnings and heed them!

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