



Extension Agronomy

eUpdate

03/15/2019

These e-Updates are a regular weekly item from K-State Extension Agronomy and Kathy Gehl, Agronomy eUpdate 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 Dalas Peterson, Extension Agronomy State Leader and Weed Management Specialist 785-532-0405 dpeterso@ksu.edu.

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1. Optimal time to remove cattle from wheat pastures: First hollow stem

What is the first hollow stem (FHS) stage of wheat development?

Before the wheat leaf sheaths become erect after spring green-up, the developing growing point, which is below the soil surface, will soon begin to form a tiny head. Although the head is quite small at this point, it has already established some important yield components. At this stage, the maximum potential number of spikelets is determined. Sufficient nitrogen (N) should already be available in the root zone at this growth stage to maximize the potential number of seeds per head.

Once the embryo head has developed, the first internode will begin to elongate, pushing the head up through the leaf sheaths. This first internode will be hollow. This will be visible before you can actually feel the first node (joint, located just above the first internode).

FHS is the point at which a 1.5 cm (about half-inch) length of hollow stem can first be identified below the developing head (Figure 1). This length is roughly equivalent to the diameter of a dime, which makes its identification in the field easier. FHS occurs when the developing head is still below the soil surface. This means that producers have to dig plants out of the ground to measure it.

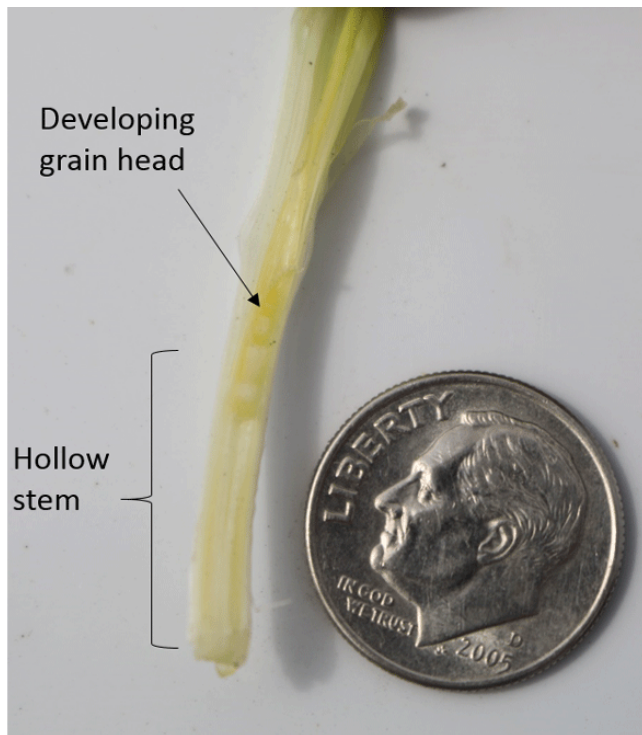


Figure 1. Wheat plant reaching the first hollow stem stage of growth, characterized by approximately 1.5 cm (or roughly the diameter of a dime) of hollow stem underneath the developing grain head. Photo by Romulo Lollato, K-State Research and Extension.

How to look for first hollow stem

To look for FHS, start by digging up some plants from fields or areas that have not been grazed, such

as field corners or just outside the fence. Date of FHS is variety- and field-specific, so it is important to sample each individual field. Select the largest tillers to examine, and slice the stem open from the crown area up. Look for the developing head, which will be very small. Next, see if you can find any hollow stem between the developing head and the crown area. If there is any separation between the growing point and crown, the hollow stem is elongating. If that separation is 1.5 cm, the wheat plant is at FHS. FHS occurs between a few days to a week or more prior to jointing, depending on temperatures.

Yield losses from grazing past first hollow stem

If the wheat has reached FHS, cattle should be removed to prevent grain yield loss. Yield losses from grazing after FHS can range from 1 to 5% per day, depending on grazing intensity and the weather following cattle removal (Figure 2). If cattle removal is followed by cool, moist weather, yield losses will often average about 1% per day grazed after FHS; if weather is hot, dry, and harsh, yield losses of 5% per day or more can be expected. In fact, as much as 1.25 bushels per day yield decrease can occur according to data from Oklahoma State University. It is easy for producers to be late by a few days in removing livestock as they wait for obvious nodes and hollow stems to appear, and even the first few days can be significant.

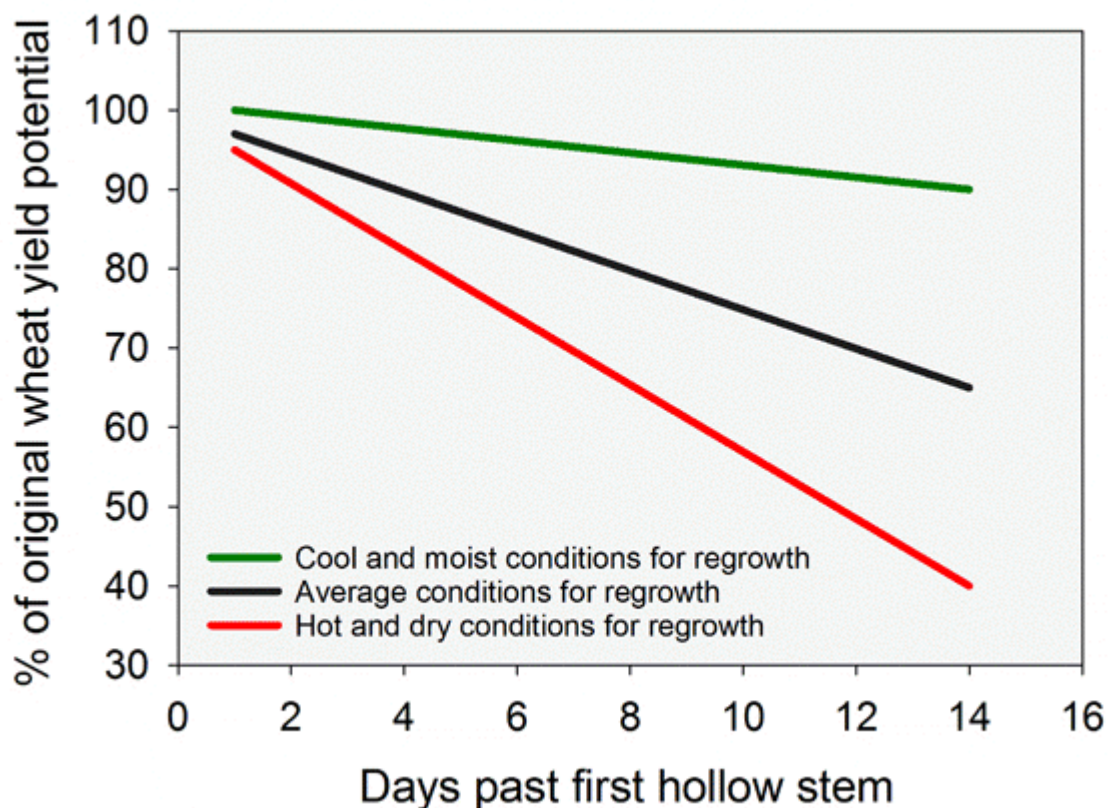
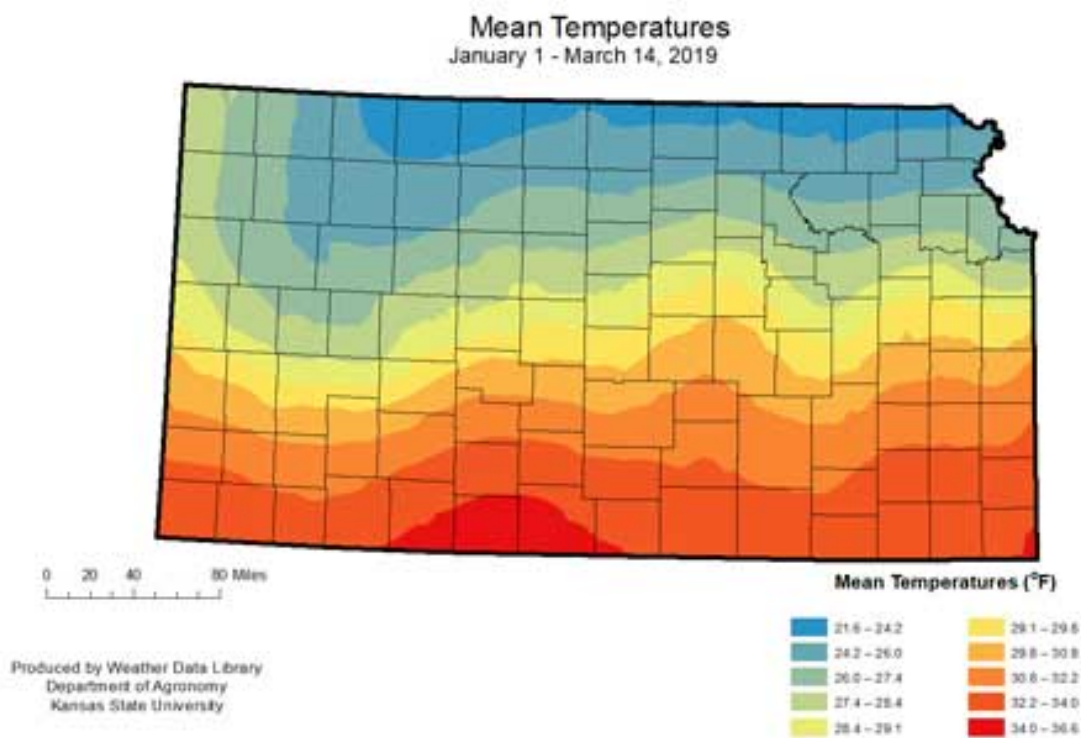


Figure 2. Percent of original wheat yield potential as affected by days of grazing past first hollow stem and weather conditions following grazing termination. Average yield losses by grazing for 14 days past first hollow stem ranged from 10% under favorable conditions to 60% under non-favorable conditions. Research conducted by Oklahoma State University (OSU) and

Two things are observed when wheat is grazed too long: 1) fewer heads per acre because the primary tiller has been removed, and 2) smaller and lighter heads than expected because leaf area has been removed. As cattle continue grazing, the wheat plant is stressed and begins to lose some of the tillers that would produce grain. A little later, if there is not enough photosynthate, the plant begins aborting the lower spikelets in the head or some of the florets on each head. Finally, if there is not enough photosynthate during grain filling, the seed size will be reduced and if the stress is severe enough, some seed will abort.

Air and soil temperatures during 2019

Crop development is mostly a function of available water, nutrients, and temperature. While nutrient availability is field-specific and water has been abundant since the fall for the majority of the wheat growing region of the state, temperatures will be the focus of this discussion. Average temperatures across the entire state of Kansas were cooler-than-normal for the time period between January 1 and March 14 (Figure 3), which will likely delay the arrival of first hollow stem as compared to most years. As temperatures increase and wheat begins growing more rapidly in the spring, producers should start thinking about when to pull cattle off pasture to protect grain yields.



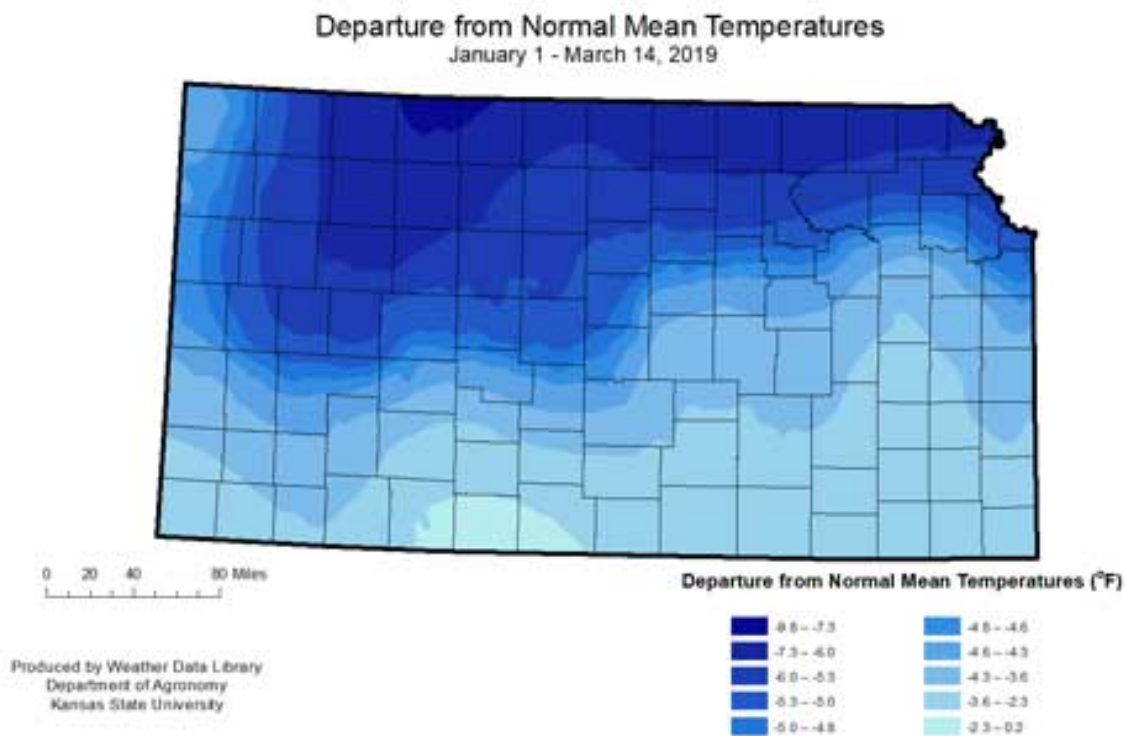


Figure 3. Mean and departure from long-term average temperatures during the period of January 1 to March 14, 2019. Maps generated by the K-State Weather Data Library.

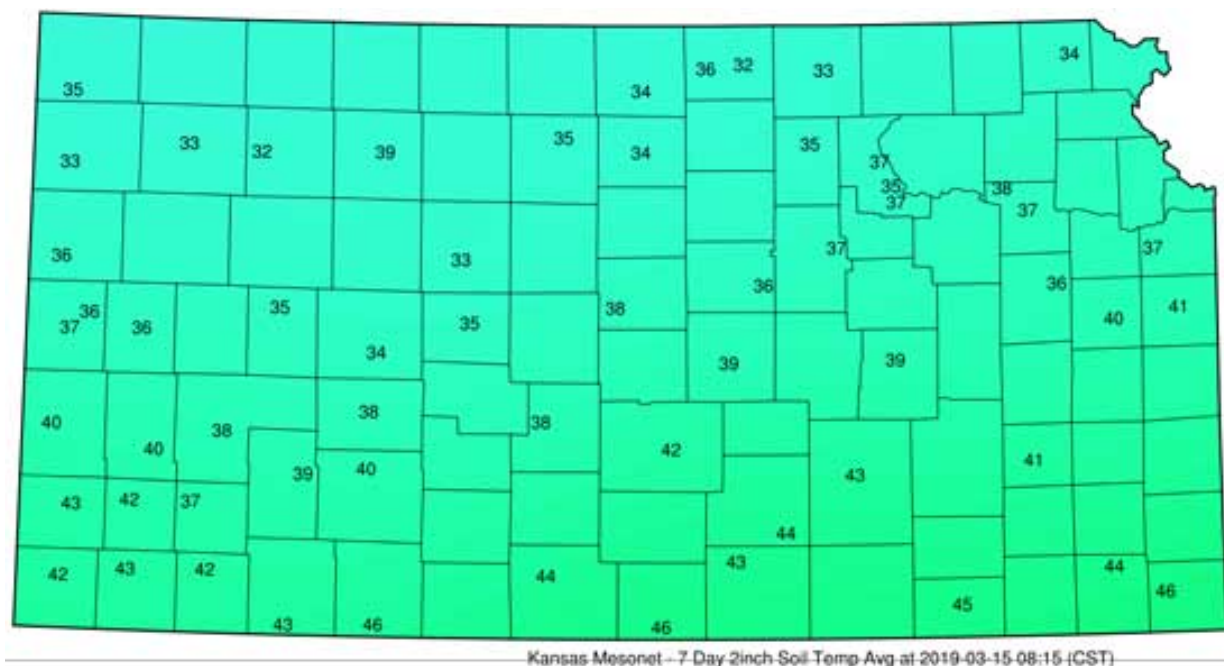


Figure 4. Weekly average soil temperatures at the 2-inch depth during the period March 9 - March 15. Map generated by the K-State Weather Data Library.

Soil temperatures will be slow to warm as much of the state has very saturated soils. As the soils thaw, muddy conditions may also influence the decision to remove cattle.

For more information on managing wheat in dual-purpose systems, check the K-State Research and Extension publication MF3375 [PSS-2178 from Oklahoma State Extension], "Dual-purpose wheat: Management for forage and grain production" at <https://www.bookstore.ksre.k-state.edu/pubs/MF3375.pdf>.

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2. First hollow stem update: March 15, 2019

Cattle should be removed from wheat pastures when the crop reaches first hollow stem (FHS). Grazing past this stage can severely affect wheat yields (for a full explanation, please refer to accompanying eUpdate article “Optimal time to remove cattle from wheat pastures: First hollow stem”).

First hollow stem update

In order to screen for FHS during this important time in the growing season, the K-State Extension Wheat and Forages crew measures FHS on a weekly basis in 36 different commonly grown wheat varieties in Kansas. The varieties are in a September-sown replicated trial at the South Central Experiment Field near Hutchinson.

Ten stems are split open per variety per replication (Figure 1), for a total of 40 stems monitored per variety. The average length of hollow stem is reported for each variety in Table 1. As of March 12, 2019, none of the varieties had yet reached first hollow stem but all varieties had started to show minor stem elongation.



Figure 1. Ten main wheat stems were split open per replication per variety to estimate first hollow stem for this report, for a total of 40 stems split per variety. Photo by Romulo Lollato, K-State Research and Extension.

Table 1. Length of hollow stem measured March 12 of 36 wheat varieties sown mid-September 2018 at the South Central Experiment Field near Hutchinson. The critical FHS length is 1.5 cm (about a half-inch or the diameter of a dime).

| Variety | Hollow stem length (cm) |
|--------------------|--------------------------------|
| | (3/12/2019) |
| TAM 204 | 0.24 |
| AM Eastwood | 0.41 |
| EXP 40-1 | 0.21 |
| SY Achieve CL2 | 0.28 |
| SY Benefit | 0.28 |
| SY Rugged | 0.17 |
| Bob Dole | 0.21 |
| SY Grit | 0.14 |
| NE10478-1 | 0.22 |
| Lonerider | 0.18 |
| Bentley | 0.24 |
| Doublestop CL Plus | 0.20 |
| Gallagher | 0.21 |
| Iba | 0.19 |
| Smith's Gold | 0.18 |
| Stardust | 0.41 |
| Spirit Rider | 0.21 |
| OK12716 | 0.23 |
| OK13209 | 0.32 |
| Ruby Lee | 0.18 |
| Whistler | 0.23 |
| Langin | 0.19 |
| Byrd | 0.23 |
| EXP | 0.33 |
| Paradise | 0.14 |
| WB4515 | 0.23 |
| WB-Grainfield | 0.26 |
| WB4303 | 0.36 |
| WB4269 | 0.29 |
| WB4792 | 0.30 |
| WB4699 | 0.21 |
| WB4595 | 0.23 |
| Zenda | 0.22 |
| Larry | 0.23 |
| Tatanka | 0.29 |
| Joe | 0.14 |

While none of the varieties had yet reached first hollow stem as of March 12, there were statistical differences among the varieties evaluated and these differences tend to increase over time. Thus, we will report first hollow stem during the next few weeks again until all varieties are past this stage. Additionally, first hollow stem is generally achieved within a few days from when the stem starts to elongate, so we advise producers to closely monitor their wheat pastures at this time.

The intention of this report is to provide producers an update on the progress of first hollow stem development in different wheat varieties. Producers should use this information as a guide, but it is extremely important to monitor FHS from an ungrazed portion of each individual wheat pasture to take the decision of removing cattle from wheat pastures.

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3. Soybean plant-back guidelines following Resicore in Kansas

Questions have arisen recently about the rotation guidelines in the [2019 K-State Chemical Weed Control Guide](#) for Resicore. Resicore is an herbicide premix of clopyralid, mesotrione, and acetochlor that is labeled for PRE and POST applications to field corn in Kansas. The statement in the weed guide regarding crop rotation to soybeans when Resicore is applied in combination with atrazine is incomplete and not totally accurate (pages 28 and 35 in the Weed Guide). The K-State Weed Guide indicates that if Resicore is applied with atrazine, soybeans are restricted for 18 months. However, that is not entirely true and there are several statements on the Resicore label that confound the guidelines for rotation to soybeans in Kansas (Figure 1).

A table in the Resicore label indicates the rotation interval to soybean is 10.5 months, but there are several footnotes below the table relative to soybean and the 10.5-month rotational restriction. Some of these footnotes could apply directly to applications in Kansas. Those footnote statements include 4, 5, 6, 7, and 8 (Figure 1).

Footnote 4 states that a 10.5-month rotational restriction is applicable for soils with more than 2% organic matter and 15 inches of rainfall during the 12 months following application. An 18-month restriction should be observed for soils with less than 2% organic matter and 15 inches of precipitation. However, this leaves speculation about soils with less than 2% organic matter and more than 15 inches of rainfall in the previous 12 months following application or soils with more than 2% organic matter and less than 15 inches of rainfall in the 12 months following application. Undoubtedly, these soils exist in our state. Which begs the question: what would be the appropriate rotational restriction in these other combinations of soil organic matter and rainfall?

Rotational Crop Restrictions:

When Resicore is applied as directed on this label, follow the crop rotation intervals in Table 1. If Resicore is tank mixed or used sequentially with other products, follow the most restrictive product's crop rotation interval.

Table 1: Time Interval between Resicore Application and Replanting or Planting of Rotational Crop

| Rotational crop | Rotational Interval |
|---|---------------------|
| Field corn Field seed corn Field silage corn Yellow popcorn | Anytime (1) |
| Wheat | 4 months |
| Alfalfa (2) Barley Millet (pearl and proso) Oats Rice Rye Sorghum (3) Soybean (4, 5, 6) Sunflower (4) Sweet corn | 10.5 months (7, 8) |
| Cotton | 12 months |
| All other rotational crops | 18 months |

- (1) Do not make a second application of Resicore if the original corn crop is lost.
- (2) **Idaho, Nevada, Oregon, Utah, and Washington:** 12 months, areas receiving greater than 18 inches of annual rainfall, excluding irrigation; 18 months, areas receiving less than 18 inches of annual rainfall, excluding irrigation. **All other states:** 10.5 months.
- (3) **Idaho, Nevada, Oregon, Utah, and Washington:** 12 months. **All other states:** 10.5 months.
- (4) **Florida:** 18 months. **Idaho, Nevada, Oregon, Utah, and Washington:** 12 months, areas receiving greater than 18 inches of annual rainfall, excluding irrigation; 18 months, areas receiving less than 18 inches of annual rainfall, excluding irrigation. **All other states:** 10.5 months for soils greater than 2% organic matter AND rainfall more than 15 inches during 12 months following applications; 18 months for soils less than 2% organic matter AND rainfall less than 15 inches during 12 months following applications.
- (5) Injury may occur to soybeans planted the year following application on soils having a calcareous subsurface layer, if products containing atrazine were used at rates above 0.75 lb ai atrazine per acre in tank mixtures and/or sequentially with Resicore.
- (6) In eastern parts of the Dakotas, Kansas, western Minnesota and Nebraska, do not rotate to soybeans for 18 months following application if products containing atrazine were used in tank mixtures and/or sequentially with Resicore and the total atrazine rate applied was more than 2.0 pounds active ingredient per acre, or equivalent band application rate, or soybean injury may occur.
- (7) If Resicore is applied after June 1, rotating to crops other than corn or grain sorghum the next spring may result in crop injury.
- (8) In the High Plains and Intermountain areas of the West, where rainfall is sparse and erratic or where irrigation is required, use Resicore only when corn or sorghum is to follow field corn, or a crop of untreated corn or sorghum is to precede other rotational crops.

Figure 1. Rotational crop restrictions and Table 1 from the 10-23-17 revision of the Resicore herbicide label, page 4. Note the language under footnotes 4,5,6,7, and 8 pertaining to various situations.

The primary fate for each of the active ingredients in Resicore in the soil is aerobic microbial degradation. Several criteria must be met to achieve microbial degradation: 1) warm temperatures, 2) adequate soil moisture, and 3) the herbicide must be available for degradation. For example, persistence would increase in dry and/or cool soils because microbial activity would be reduced; this is where the rainfall discussion of the label arises as areas receiving less rainfall will have reduced microbial activity and longer herbicide persistence.

Beyond soil temperature and moisture, the herbicide must be available to undergo microbial degradation. Soil pH and soil organic matter along with an herbicide's chemical properties govern its availability for degradation. Because acetochlor products are labeled in soybean, the discussion needs to focus on mesotrione and clopyralid in regards to soybean rotation. Weed science literature suggests that soil pH has minimal influence on clopyralid and mesotrione persistence, but rather that soil organic matter governs their availability. Mesotrione has a half-life of 12 days whereas the half-life of clopyralid is 12 to 70 days. Clopyralid is in the same chemical family as picloram (Tordon 22K), and given that soybean is very sensitive to clopyralid (Figure 2), it is rational that increased rotational restrictions should be utilized when Resicore is applied to soils with low organic matter.





Figure 2. Clopyralid carryover can injure soybeans. A) Resicore was applied to corn. The following year soybean was planted, and a reduced stand was observed in boom overlap areas. B) Some soybeans displayed the typical epinasty symptomology observed from growth regulator type herbicide from root uptake of the clopyralid (Photos by Marshall Hay, K-State Research and Extension).

Footnotes 5 and 6 refer to the use of atrazine with Resicore. The Aatrex label indicates that soybean may not be planted until the year following an application of atrazine or no crop other than corn or sorghum may be planted when atrazine is applied after June 10. After review of the Resicore label, it appears that the Resicore label is more restrictive than the Aatrex label in this regard about June 1 vs June 10 applications injuring soybean. It is important to note that atrazine degradation, albeit microbial, occurs independently from mesotrione and clopyralid. While degradation of atrazine is influenced by soil pH as well as soil temperature and moisture, is important to understand that there is no stacking or overloading ramifications in terms of combining clopyralid, mesotrione, and atrazine resulting with increased persistence. Each can cause carry-over problems in soybean, but each would be independent of use rate, etc. of the other herbicides.

Footnote 8 offers additional concern for Resicore applications in the High Plains; however, where do the High Plains start? Based on the Kansas Geological Survey, the High Plains region includes most of the western third of Kansas, but has a highly irregular boundary from north to south. Our interpretation of the label would be that you cannot plant soybeans within 18 months following an application of Resicore in that part of the state, regardless of whether atrazine was applied, soil parameters, or precipitation amounts.

Summary

Perhaps we have proposed more questions about the Resicore label than answers; unfortunately, we do not have the answers to all of these questions. The best we can tell from the label, soybeans can be planted after 10.5 months following applications of Resicore alone or in combination with less than 2 lbs/ac atrazine, so long as soils have greater than 2% organic matter and 15 inches of rainfall during the 12 months following application (which is longer than the 10.5-month interval). The 18-month restriction before planting soybeans is required if you are in the High Plains region; when soil organic matter is less than 2% or less than 15 inches of rainfall occurs; or if more than 2 pounds of atrazine is used with Resicore.

Next year, we will probably indicate that the rotation interval to soybean is 10.5 to 18 months and refer producers to the Resicore label for additional rotation guidelines.

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4. On-farm Research Collaborative Project: Non-biased, research-based, and grower-driven

K-State Extension specialists, area agronomists, and county/district agents are again seeking to collaborate with producers in establishing on-farm and large-scale research plots in 2019. Last year, we had on-farm projects in diverse areas around Kansas, setting up tests involving primarily corn and soybeans, with a few studies on sorghum as well. Funding support from Kansas Corn and Kansas Soybean is helping to increase our on-farm network.

The goal of our on-farm research collaborative project is to establish a network of on-farm research collaborators with the main purpose of providing research results on production practices at the state, regional, or local scale, under a wide set of growing conditions and soil types.

There are no losers in this program. All parties will benefit. Farmers involved in this collaborative research effort will be empowered to solve their own problems and will have greater confidence in making decisions related to their production practices. The standard practice of the program involves producers having a question, then researching the answer on their own farm and soil with a simple strip trial designed with the assistance of K-State researchers. With this information, K-State Extension specialists will be able to check the validity of previous findings conducted with traditional research in small plots and more controlled environments, and to identify and communicate areas for future research.

The on-farm research collaborative project is farmer-run research; thus, information will be produced and used by farmers. Farmer participation is the key component of this project and farmers will be the main beneficiary.

Why should I get involved in this project?

1. The project has a main goal of improving yields and/or minimizing input costs, increasing overall efficiency.
2. The project will help producers learn the best ways to design an on-farm test so they can obtain reliable information on a specific question related to their own farms.
3. The outcomes from this project will empower our producers to make sound decisions with confidence and will aid researchers in identifying and communicating areas for future research.

Who are the key players?

1. Kansas farmers: Farmers are the main players, the ones who will implement the trials, collect the data and utilize the results.
2. Extension Agricultural Agents: The agents are the “gatekeepers” of this project. They will work very closely with farmers and can assist, if needed, with information and/or help on implementing the trials.
3. K-State Extension State and Area Specialists: K-State faculty will assist Extension agents and Kansas farmers in developing the protocols, implementing trials and analyzing the data generated at the on-farm scale.

Research data (small-plots) vs. on-farm data (large-plots): What is the main difference between these

scenarios?

Information produced at research stations has the following features:

- Small plot size = small variability (“controlled conditions”)
- Intensive sampling = usually related to a graduate student project, with many samples taken throughout the growing season
- More complex and more treatments can be evaluated
- Small sample size = measurements may be less representative of “real” farm conditions

On-farm data have the following features:

- Large plot size = higher variability due to uncontrollable variation within each plot
- Less intensive sampling
- Less complex and fewer (two or three) treatments can be evaluated
- Large sample size = measurements may more closely represent “real” farm conditions

Are the on-farm protocols the same for all environments and farmers or should the protocols be farmer- or site-specific?

Farmers have their own interests and specific questions that need to be properly addressed. Protocols will be designed to fit each farmer’s situation. Some of the diverse topics that we have discussed include: corn/soybean/sorghum seeding rates; corn/sorghum hybrids; sorghum/soybean row spacing; corn/soybean/sorghum planting dates; full or limited irrigation; and other topics.

Crops: corn, soybean, grain sorghum, winter canola

Topics:

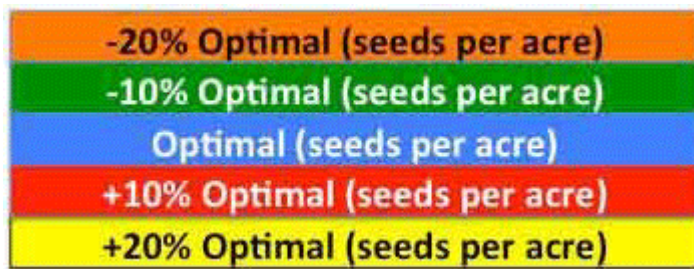
- Seeding rates
- Planting dates
- Row spacing
- Hybrid/variety selection
- tillage
- others

How many factors need to be evaluated?

The idea is to perform “simple” on-farm experiments evaluating one or two factors at a time.

How many levels for each factor?

This will depend on the availability of space in the field, but to properly understand the optimum crop management level, 4 to 5 levels of “treatments” or “variables” are usually needed. For example, if corn seeding rate is being evaluated, five seeding rates will allow the grower to properly identify the optimum seeding rate for each specific farm environment. The diagram below presents an example of 5 test levels for a seeding rate study.

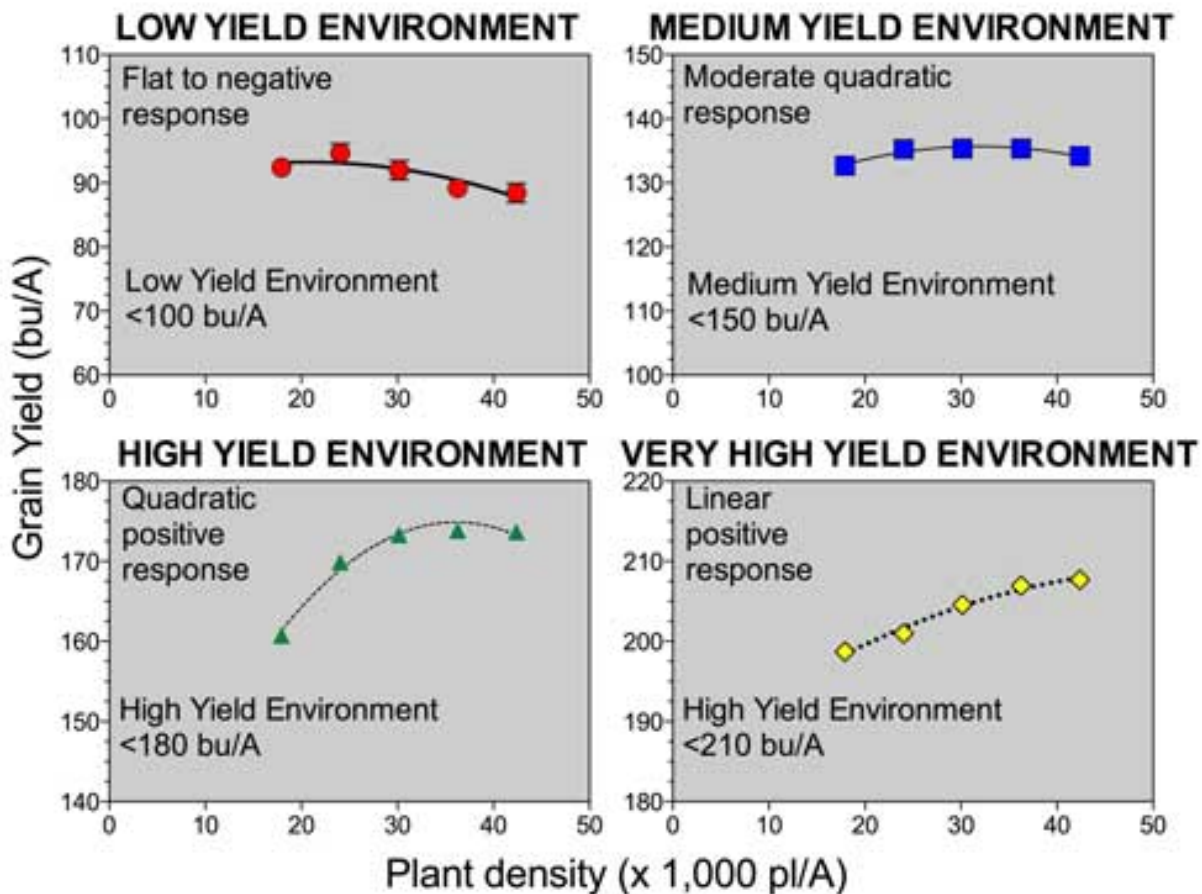


Replications?

To obtain statistically sound and solid recommendations, a minimum of 3 replications are recommended.

Are crop production practices environment-specific?

The example in the graphic below shows how the optimum plant density to maximize corn grain yield will vary according to different environments. For the low yielding environment (<100 bu/acre), the agronomically optimum plant density was about 20,000 plants per acre; while for the very high-yielding site (>200 bu/acre), the agronomically optimum plant density is about 35,000 plants per acre. Therefore, different yield potentials in different environments have different “optimum” crop production practices to maximize net returns.



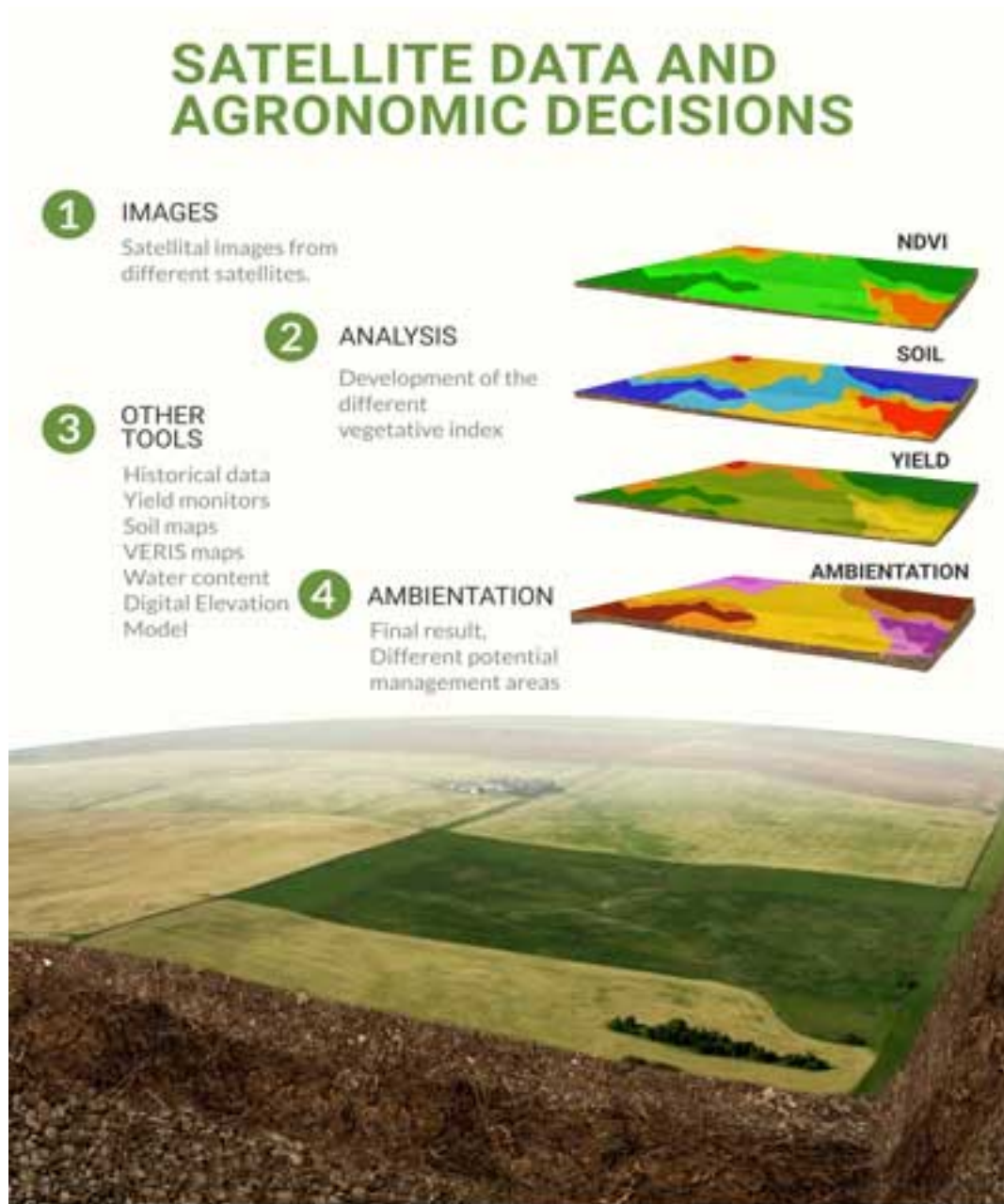
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Precision agriculture technologies

In addition, on-farm studies in 2017-2018 evaluated new technologies and added precision agriculture tools to the evaluation of variability and determination of zone management. Utilization of satellite imagery and precision soil sampling (soil type, altitude, slope), in combination with yield monitor data, allowed us to obtain high-resolution for spatial variability within a field in order to investigate crop production issues and properly address them.



Producers interested in participating in this project can fill out an interest form online at:

<http://bit.ly/KSUONFARMPROJECT>

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5. Prescribed burning resources

The last scheduled Prescribed Burning Workshop will be held March 22, in Reserve, KS. It will be held at the Community Building located at 305 N Main and will begin at 10:00 a.m. Please RSVP to Taylor Hall by Wednesday, March 20 at 785-288-0189 or taylor.hall@sacfoxenviro.org.

Weather is a critical factor that influences fire behavior. Weather forecasts can be obtained from a number of sources, but the national weather service is a preferred source. Go to <http://www.weather.gov> and click on Kansas. Select a site on the map near the location you plan to burn. Find the hourly weather forecast. Good conditions for conducting a prescribed burn and minimizing the impacts of smoke include:

- 45-70 degrees F temperatures
- 40-55% relative humidity
- 5-15 mph winds
- mixing height >1800 feet
- 30-50% cloud cover.

Next, check out the website <http://www.ksfire.org> and use the smoke dispersion model to determine where your smoke will go. Click on the icon titled "Click Here to Access Smoke Model" to access the smoke model (Figure 1).

A color coded map showing the cumulative effects of burning in the Flint Hills area will appear (Figure 2). Green means small impact, yellow medium impact, and red large impact of smoke from burning on major cities. To determine the direction of the smoke, select "Your Fire Impacts", followed by the county, fuel load, size (acres to burn), and date. The model will give a smoke plume over a 48-hour period. The smoke model only predicts where the smoke is likely to travel. It does not mean environmental conditions are safe to burn.



Figure 1. Kansas Flint Hills Smoke Management homepage (www.ksfire.org)

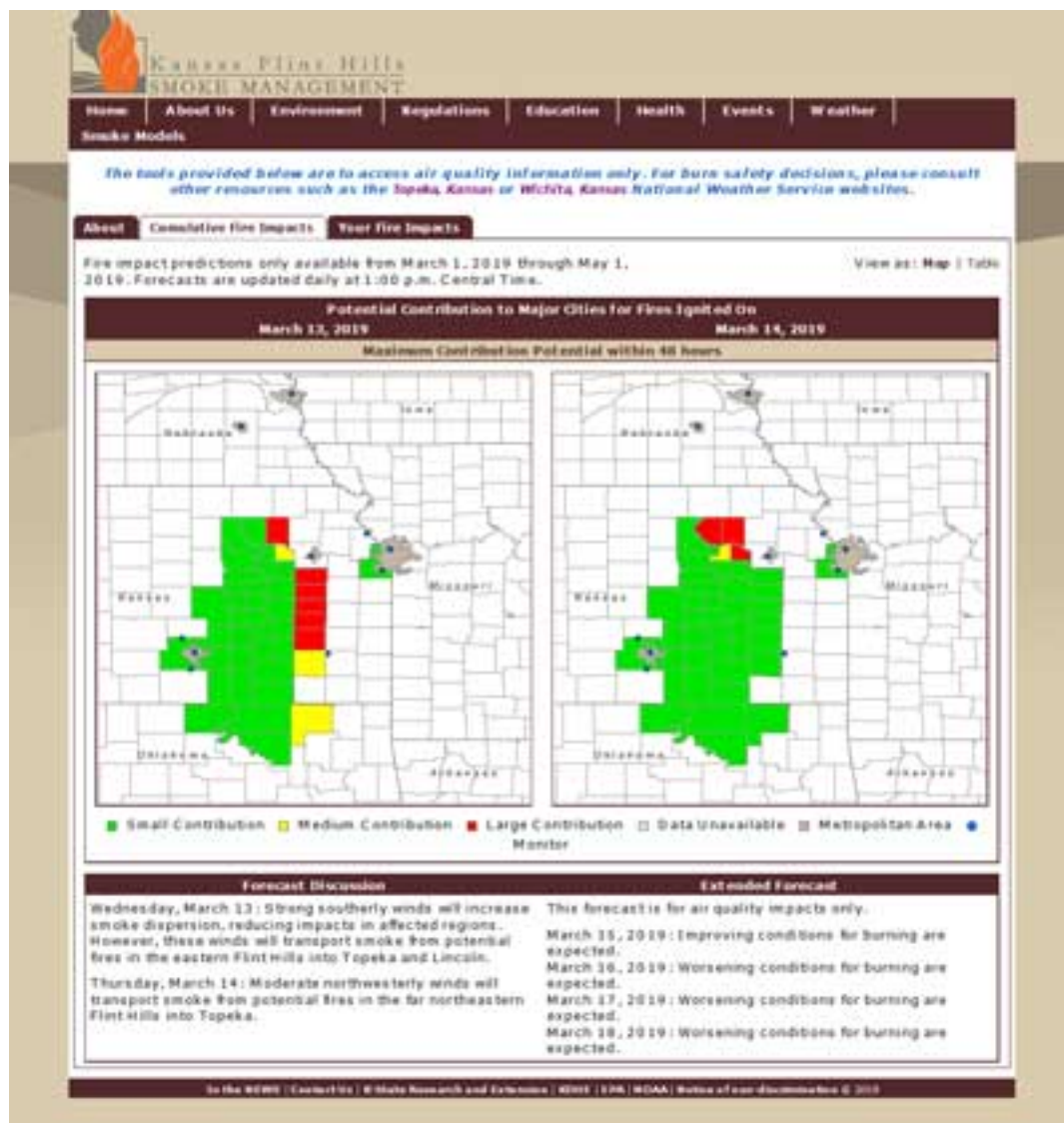


Figure 2. Landing page for the Smoke Model resource.

Temperature inversions, which occur primarily in the late afternoon, at night, and in the early morning can also impact smoke dispersal. Consult the Kansas Mesonet at <http://mesonet.k-state.edu/agriculture/inversion/> to determine the likelihood of a temperature inversion. The site indicates temperatures at 2 and 10 meters as well as wind speed and direction for various reporting stations.

Prescribed burning is an essential tool for maintaining the integrity of our prairies in Kansas. Plan well, burn safely, and remember smoke from your fire can have negative impacts downwind.

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6. Kansas weather - A storm for the record books

What started out as a week with a spring-like feel in Kansas turned aggressive with a return to winter by mid-week. All of these changes were due to a strong storm system, one of which will be remembered for years to come. Various impacts extended across the central Plains Wednesday, Thursday, and into Friday, including a blizzard for the High Plains, heavy rains and flooding for Kansas/Nebraska, and very strong winds across the entire region. Satellite imagery displayed the extent of the massive impacts felt by this storm (Figure 1).

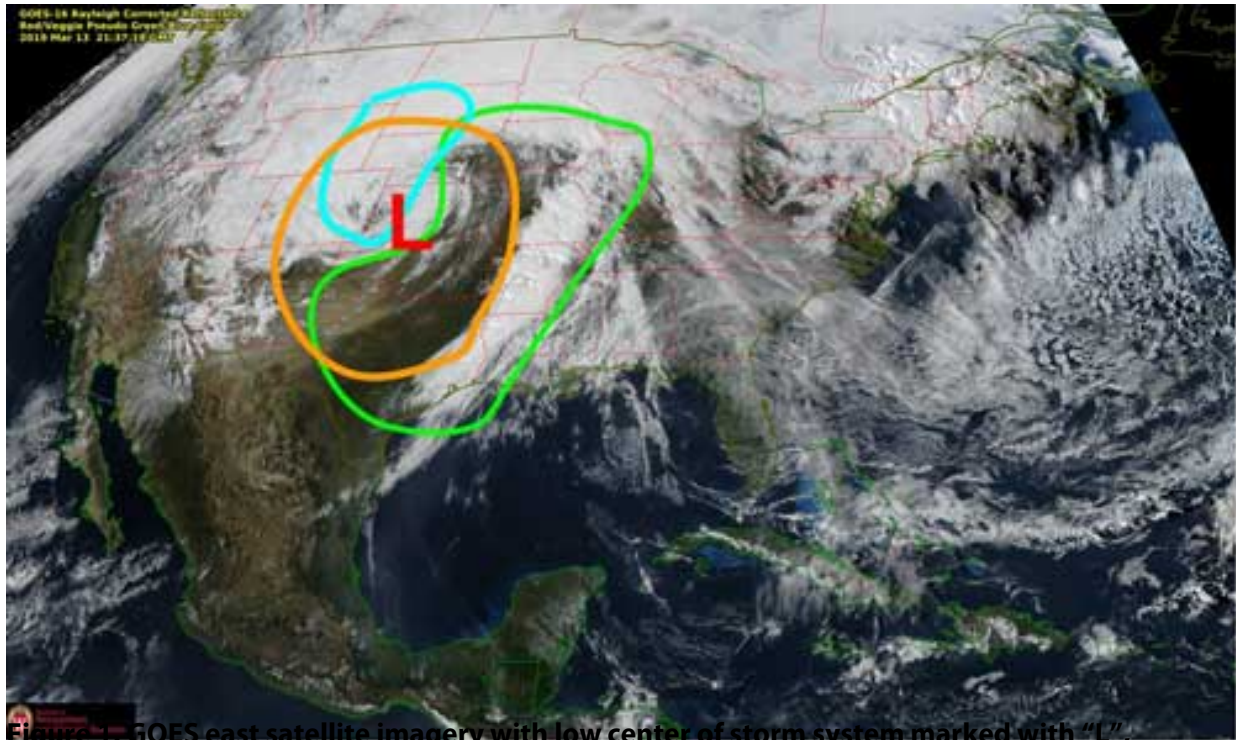


Figure 1. GOES east satellite imagery with low center of storm system marked with “L”, blizzard impacts outlined in blue, heavy rain impacts in green, and wind impacts in orange. (Source: www.ssec.wisc.edu)

Impact: Heavy rain

Warmer temperatures helped turn the frozen ground surface into a muddy mess. Several rounds of heavy rain in advance of the storm on Monday through Wednesday didn't ease the mud. In fact, with persisting frozen sub-surface coupled with no vegetation growth and saturated soils, most of the rain ran off. This created flooding issues along streams and rivers in the region. Heaviest rainfall in Kansas through the period focused on south central to east-central Kansas (Table 1). This event alone provided over half the March monthly normal precipitation for many locations (Figure 2).

Table 1. . Locations of heaviest rain observed on the Kansas Mesonet and the NWS Coop network (Source: mesonet.ksu.edu, Weather Data Library).

| Kansas Mesonet Station | Recorded Rain March 11-14 | National Weather Service COOP sites | Recorded Rain March 11-14 |
|-------------------------------|----------------------------------|--|----------------------------------|
| Butler | 2.64" | Arkansas City | 2.80" |
| Woodson | 2.14" | Cambridge | 2.69" |
| Sedan | 2.01" | Iola 1W | 2.68" |
| Haysville | 1.95" | El Dorado | 2.48" |
| Parsons | 1.80" | Rosalia 1NW | 2.26" |
| Hiawatha | 1.75" | Thrall 1W | 2..20" |
| Viola | 1.54" | Augusta | 2.11" |
| Lake City | 1.48" | Madison | 2.11" |
| Colby, Ottawa | 1.33" | Yates Center | 2.10" |

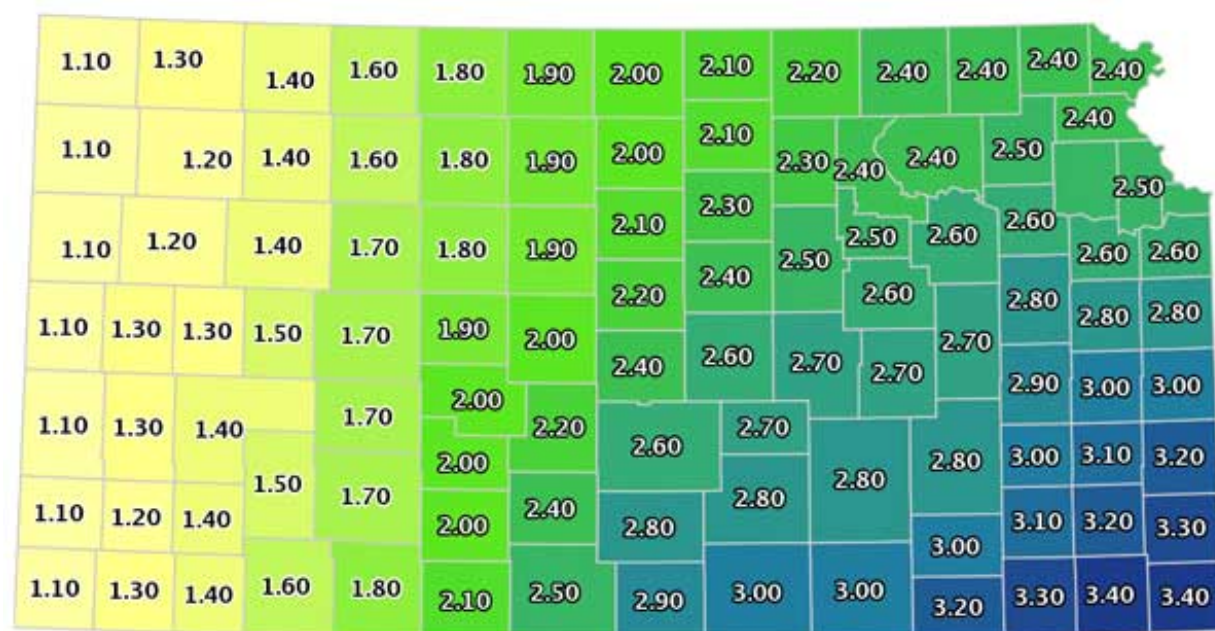


Figure 2. March average precipitation by county. (Source: climate.ksu.edu)

Impact: High winds

Winds increased dramatically late morning across western Kansas as the storm system strengthened in eastern Colorado. As the low shifted eastward into Kansas, the wind field expanded across the state. Strong winds continued through the duration of Wednesday and even strengthened into Thursday morning. Damage was reported to buildings, trees down across the state, and trucks were flipped as a result. Table 2 provides Kansas Mesonet maximum wind gusts across the state.

Table 2. Maximum measured wind gusts on the Kansas Mesonet on March 13-14, 2019.

(Source: <http://mesonet.ksu.edu/weather/maxmin>)

| Kansas Mesonet Station | Max measured 30 foot wind (mph) |
|---------------------------|---------------------------------|
| Garden City | 71 |
| Leoti | 62 |
| Viola | 61 |
| Richfield, Lane, Lakin | 57 |
| Meade | 56 |
| Hays, Satanta | 55 |
| Wallace | 53 (six foot measurement) |
| Jewell, Colby, Ashland 8S | 52 |
| Osborne, Hodgeman | 51 |
| Tribune, Hutchinson 10SW | 50 |

Atmospheric Pressure: why all the fuss?

Very low pressure at the storm's center created a substantial pressure gradient across the region. With an increased pressure gradient, air movement towards the low becomes enhanced, converging and rising at the center. This rapid air movement develops the strong winds mentioned previously.

This system was so strong, it broke the state low pressure record in Colorado and came extremely close in Kansas as well. Standard air pressure in a benign atmosphere is around 1013 millibars (mb). At the peak intensity/lowest pressure of the storm, nearby weather stations in far southeast Colorado dropped to 970.2mb. This shattered the previous Colorado state record (976.3mb on February 9, 1960). The low weakened as it crossed the state line into Kansas, causing a slight rise in pressure (Figure 3). The Kansas state record low pressure is believed to be 971.2 mb set on March 13, 1973 at Goodland. Wednesday's storm came within 0.6 mb of breaking the record with 971.87 mb measured at Stanton (Table 3). Mesonet data from this day has also been integrated into NOAA's Weather Prediction Center lowest surface pressure archive to be used for future storms (Figure 4).

Table 3. Minimum recorded pressure at Kansas Mesonet stations. (Source: mesonet.ksu.edu)

| Kansas Mesonet Station | Lowest Recorded Pressure - mb (time CDT) |
|------------------------|--|
| Stanton | 971.87 (13:06) |
| Hamilton | 971.93 (13:41) |
| Lakin | 972.45 (14:05) |
| Leoti | 972.77 (15:29) |
| Lane | 972.42 (15:58) |
| Grant | 973.03 (13:34) |
| Tribune | 973.31 (14:10) |

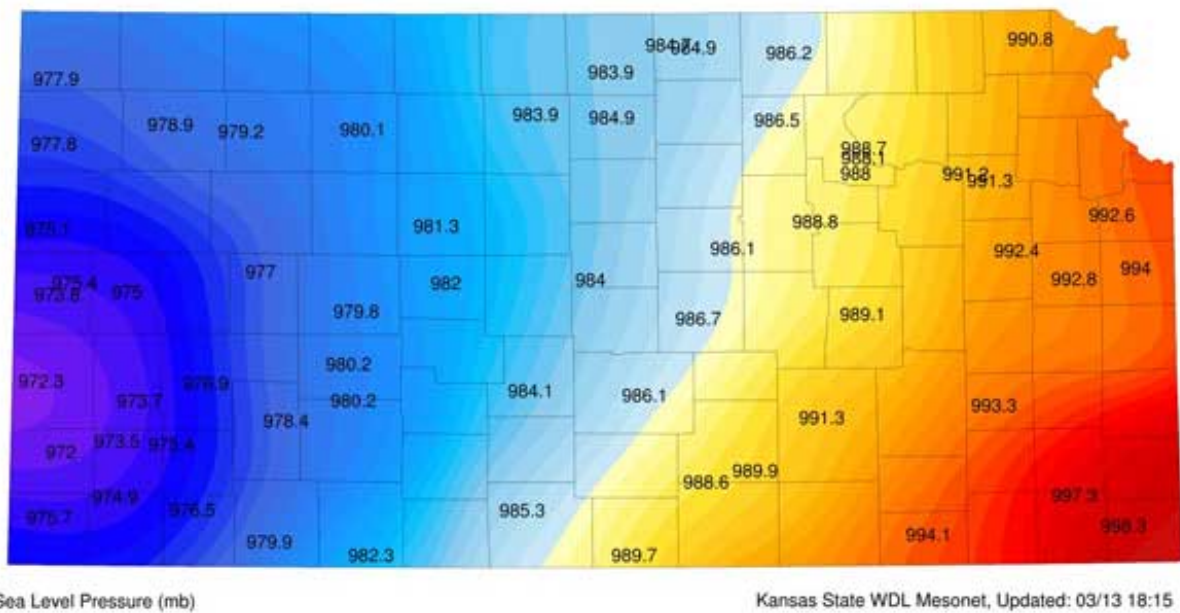


Figure 3. Map of low pressures observed at 1:15pm on March 13, 2019 (18:15 Zulu) on the Kansas Mesonet. (Source: mesonet.ksu.edu)

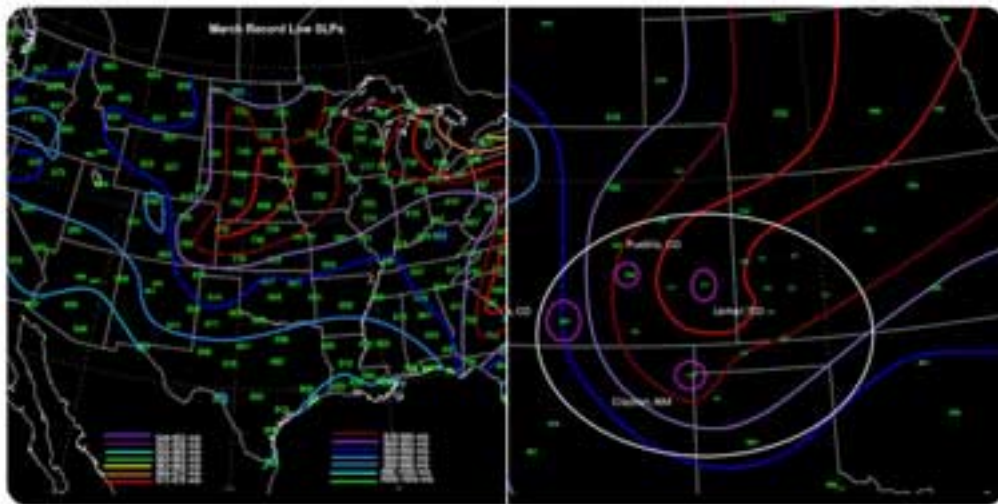


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Follow

The 1st image shows the March low pressure records prior to the 13th. The 2nd image shows the March records set yesterday within the large oval, with the circles indicating the all time low pressure records set. @NWSPueblo, @okmesonet & @ksmesonet contributed several obs.



4:11 PM - 14 Mar 2019

Figure 4. Tweet screenshot from the Weather Prediction Center's lowest pressure maps used to diagnose strongest storm systems across the U.S. (Source: www.twitter.com)

Spring Arrives...Finally

Despite the brief return of winter on Thursday in the wake of the storm, warmer and drier weather is on the horizon for the weekend and into next week. This will help bring soil temperatures closer to normal and hopefully aid in drying out surface soil. Unfortunately, it appears the drier weather will not persist beyond next week as another stretch of cooler, wetter conditions are anticipated to close out the month.

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