Issue 906

K-STATE Research and Extension

Extension Agronomy

eUpdate

05/12/2022

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. Checking Wheat Heads for Pollination Problems

Many environmental conditions can cause pollination problems in wheat, such as freeze damage, drought, or heat stress. This year, the most concerning factor as it relates to a potential for unsuccessful pollination is heat stress, in particular that experienced during May 9-12 (for more details, please see accompanying eUpdate article).

About 4 to 5 days after flowering, producers can begin checking their fields to see if their wheat successfully pollinated.

To check for successful pollination, producers can collect some heads from the field, pull the flower parts back and look to see if there is a small developing wheat kernel in the ovary (Figure 1). If there is, fertilization was successful.

Because different tillers go through development in slightly different timings, and kernels in the middle section of the head initiate pollination before those at the top and bottom of the head, heat stress is context-specific. It may damage kernel fertility in various tillers or spikelets within a head differently depending on the susceptibility of the particular stage of pollination during the heat event. Thus, growers are encouraged to check for kernel development in as many tillers and portions of the head within a tiller as possible.

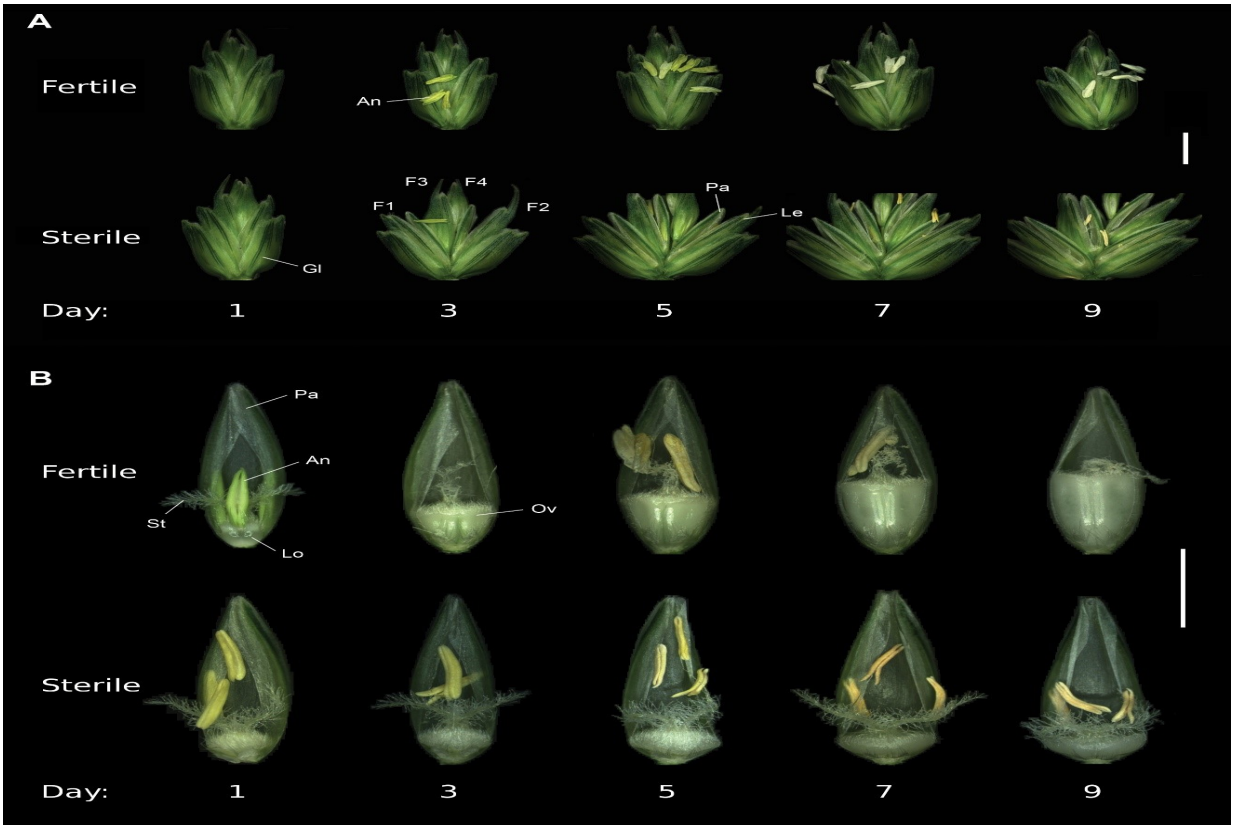

Figure 1. Floret images of male-fertile (upper row) and male-sterile (lower row) plants during flowering time and early seed development with days counted from full heading. Abbreviations: An, anther; Lo, lodicule; Pa, palea; Ov, ovary; St, stigma. Scale bar is 2 mm. Photo adapted from Okada et al (2017), available at: https://academic.oup.com/jxb/article/69/3/399/4676045

If normal self-fertilization was unsuccessful, the florets will flare open. These flowers can still be cross-pollinated by nearby wheat plants with viable pollen, but the odds of that occurring are low.

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2. Effects of High Temperatures on Wheat

Both daytime high and nighttime low temperatures have been extremely high across parts of Kansas during the four-day period May 9-12 (Figure 1). Extreme heat in early- to mid-May occasionally happens, but usually just for a single day. To have four consecutive days of days with highs in the low- to mid-90s °F at a time when much of the state's wheat crop is either in the heading or flowering stage is concerning. Unfortunately, that is the situation this year (Figure 2).

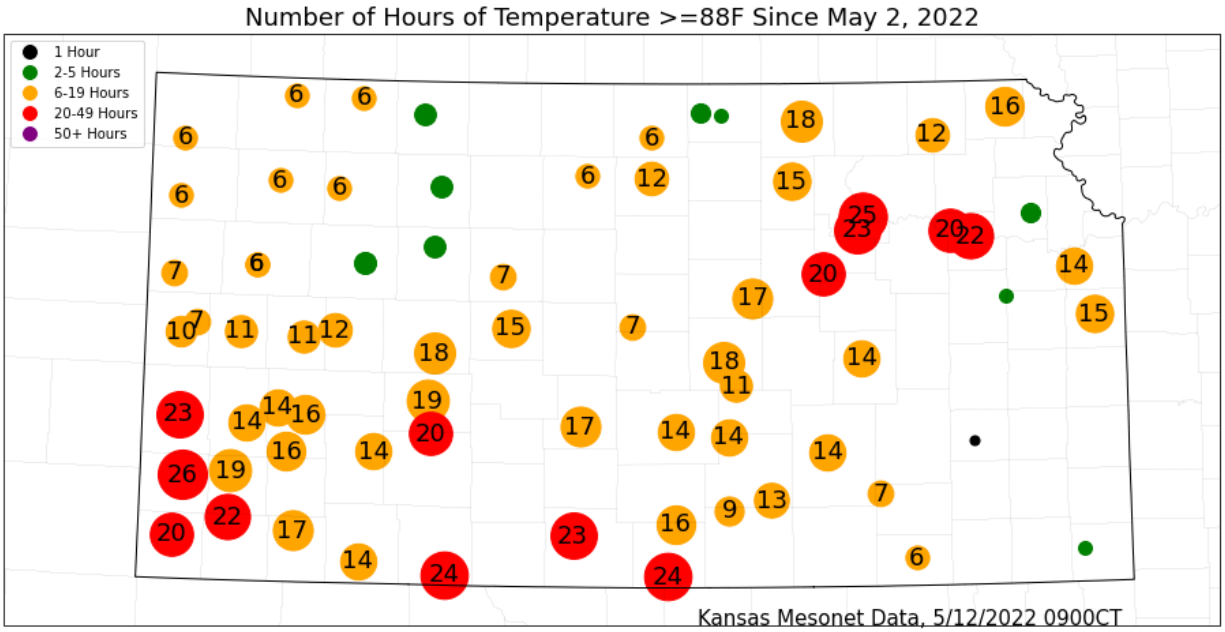
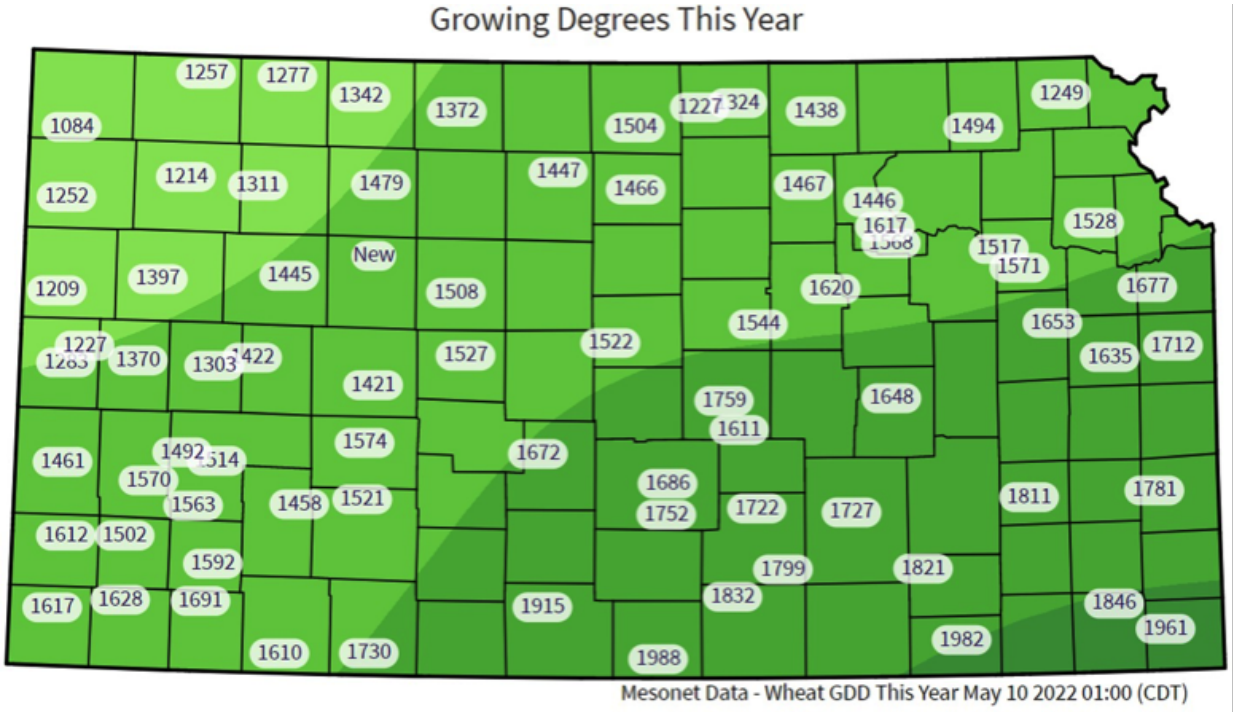


Figure 1. The number of hours of temperatures greater than 88 degrees F since May 2, 2022. Source: Chip Redmond, Kansas Mesonet Manager.



Color	GDD °F	Estimated Wheat Growth Stage
	1200 to 1400	Flag leaf emergence or boot
	1400 to 1600	Boot or heading
	1600 to 1800	Heading to flowering
	1800 to 2000	Heading or flowering

Figure 2. Upper panel shows the number of hours accumulated above 88 degrees F at the onset of the heat wave, May 9-10. Lower panel shows the estimated wheat growth stage.

Wheat is generally sensitive to unusually high temperatures at nearly every stage of growth, being more sensitive in the reproductive stages than in the vegetative stages, and becoming less sensitive as it progresses from flowering to late grain fill (after soft dough stage of development) and physiological maturity.

One of wheat's most sensitive stages to heat is anthesis (flowering). The optimum temperature for wheat from flowering to grain fill is about 54 to 72 degrees F. The longer the period of high temperatures and the higher the temperatures during reproductive stages, the more serious the potential yield loss. Temperatures above 88 degrees F immediately prior to anthesis can greatly reduce pollen viability, thus reducing grain number and consequently grain yield.

One bit of good news is that air temperatures do not necessarily correspond to temperatures within

the wheat canopy. Plants can cool themselves by about 2 to 3°F when soils are moist. On the other hand, heat stress is often worsened by drought stress (Figure 3). We might expect the impact of the heat stress will be worse in areas where there is little or no soil moisture.

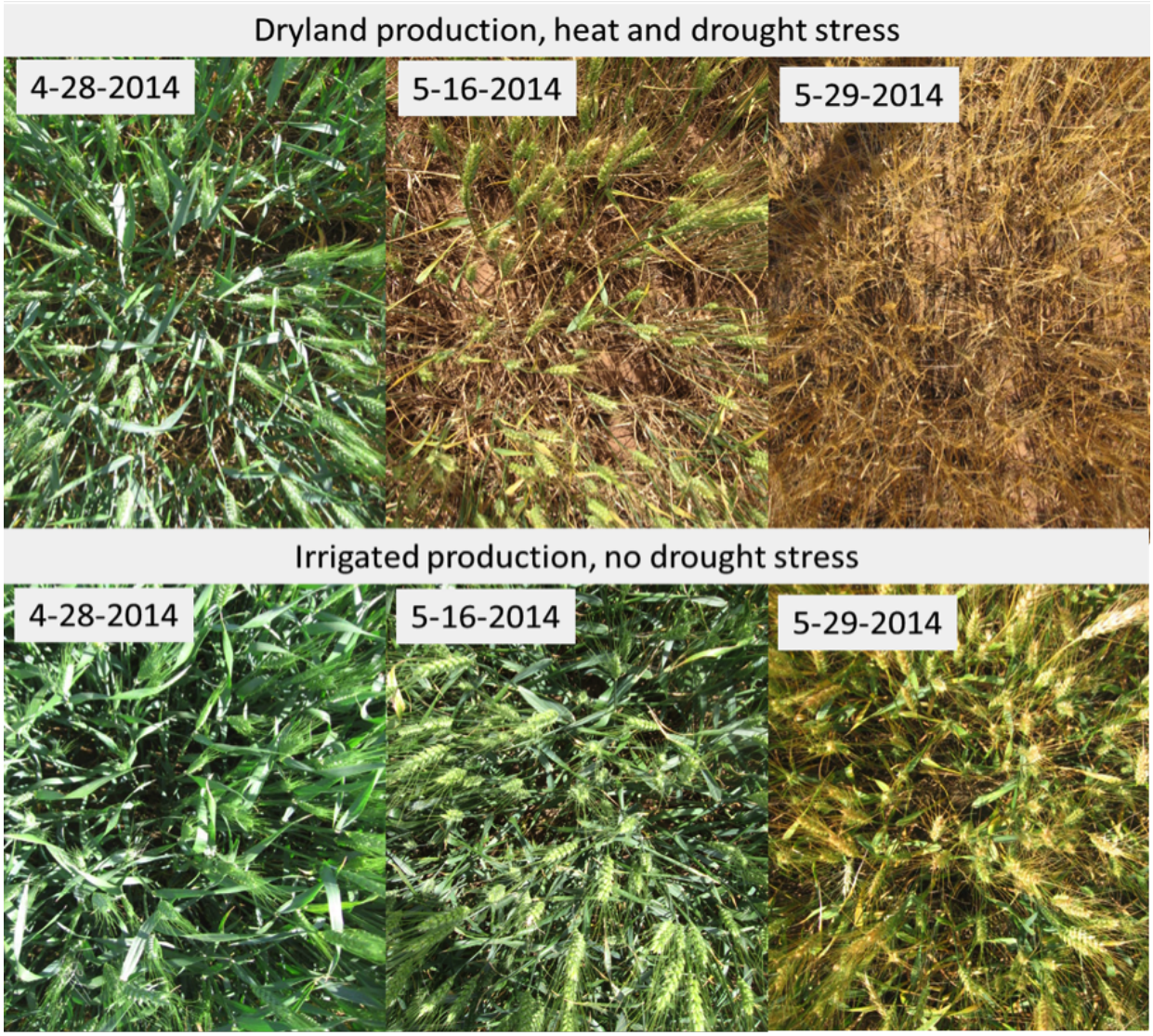


Figure 3. Interaction of heat and drought stress on wheat canopy coverage and leaf area progression between late April and late May (heading through grain filling and maturity stages). Photos were taken from neighboring fields conducted under the exact same management except that the field in the upper row was dryland and the field in the lower row was irrigated. Photos by Romulo Lollato, Extension Wheat and Forage Specialist, K-State.

Heat stress during pollen formation

Pollen forms in the developing head about 5 to 7 days before flowering. It's during this period, in addition to the period of about 3 days following flowering, that the wheat is the most sensitive to heat stress. If temperatures in the canopy get above about 88 degree F during pollen formation, there can be significant pollination problems.

If the wheat is actively pollinating during the time of extreme heat, this can reduce fertilization, cause kernel abortion and a reduction in the number of seeds per spike, and ultimately reduce grain yield.

In general, the more advanced the wheat stage of growth when this period of extreme heat began, the less severe the potential damage might be.

Where wheat development is the furthest along, such as where wheat flowered somewhere around May 4 to 6 or earlier when temperatures were cooler, the current period of high heat should have no effect on the development of viable pollen and little effect on pollination success. There's a good chance this wheat had already successfully pollinated before the period of extreme heat began. But that's not to say the wheat in this stage of development would not be affected at all by the heat since. That wheat would probably have been at the kernel elongation stage during the period of maximum heat stress. Short-but-early heat stress during grain filling can reduce grain growth, sometimes to a greater extent than longer periods of moderately high temperatures.

Where wheat had just headed or began flowering during the period of May 9-12, there may be pollen sterility and/or problems with normal self-fertilization processes. Either way, seed set may be reduced, possibly severely in the worst-case scenarios.

Where wheat was still in the flag leaf or early boot stage of growth, heat stress could still reduce grain yield mostly due to a reduction in the length of what we call the "critical period." The critical period for yield determination is the period most related to grain number determination, and in wheat it starts about 20 days prior to flowering and ends around 10 days after flowering under normal temperature conditions. Because crop development is driven by temperature accumulation, this period can be as long as 45-50 days in a cool and moist year, to as short as 15-20 days in a hot and dry year. By accelerating crop development, heat stress shortens the duration of this period and negatively impacts yield.

Summary

It is hard to put a number of the potential yield damage due to heat stress, as it depends on many factors such as stage of crop development during heat stress (different tillers and different kernels

within a head will be at different stages of development), actual temperatures within the wheat canopy, and especially on grain filling conditions following this heat wave.

If the period of high heat damaged pollen viability, disrupted pollination, or caused kernel abortion, the effect on grain yields can be significant and irreversible, especially if grain fill conditions continue warm. Cool temperatures, especially nighttime temperatures, for the upcoming 3 to 4 weeks would normally help the crop compensate through lengthening the grain fill period, kernel weight, and the number of kernels per spikelet – if the heads were successfully pollinated. If the extreme heat occurred prior to pollen formation, pollen viability should be unaffected but shortening of the critical period could reduce yield. If the wheat had already successfully been fertilized at the time of the heat stress, grain yield could be reduced by reduced grain growth, but the actual effect on grain yield will depend greatly on whether the remainder of the spring is cool and moist.

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3. Jumping Straight to Summer

This year started off with statewide below-normal temperatures through April. With the dry conditions experienced through this period, the cool temperatures helped mitigate drought expansion and water demands. However, May has brought a turn to much-warmer-than-normal temperatures for Kansas thus far. With our lack of previous warmth, our bodies haven't had an opportunity to adjust and it has brought on numerous additional stressors.

Climatology of May heat

The average first 90°F reading across the state varies by location. However, most of the state has a 50% chance of breaking that benchmark in May. Typically the first region to reach 90°F is the southwest as noted by Greensburg in Figure 1. Western Kansas, Tribune, is usually the second area to achieve this mark by mid-May. Western Kansas has a much drier climate and therefore can have a large swing of temperatures. In a wetter climate such as Chanute, there is more moisture in the atmosphere with a higher specific heat. Therefore, it takes more energy to warm in the afternoon and thus, the average first 90F occurs later in the year. In addition, the southwest is more likely to incur warm/dry downslope winds from the Rocky Mountain. The southeast observes a more southerly flow which results in persistent Gulf of Mexico moisture and humidity. These respective stations have measured their first 90F as early as March and as late as June.

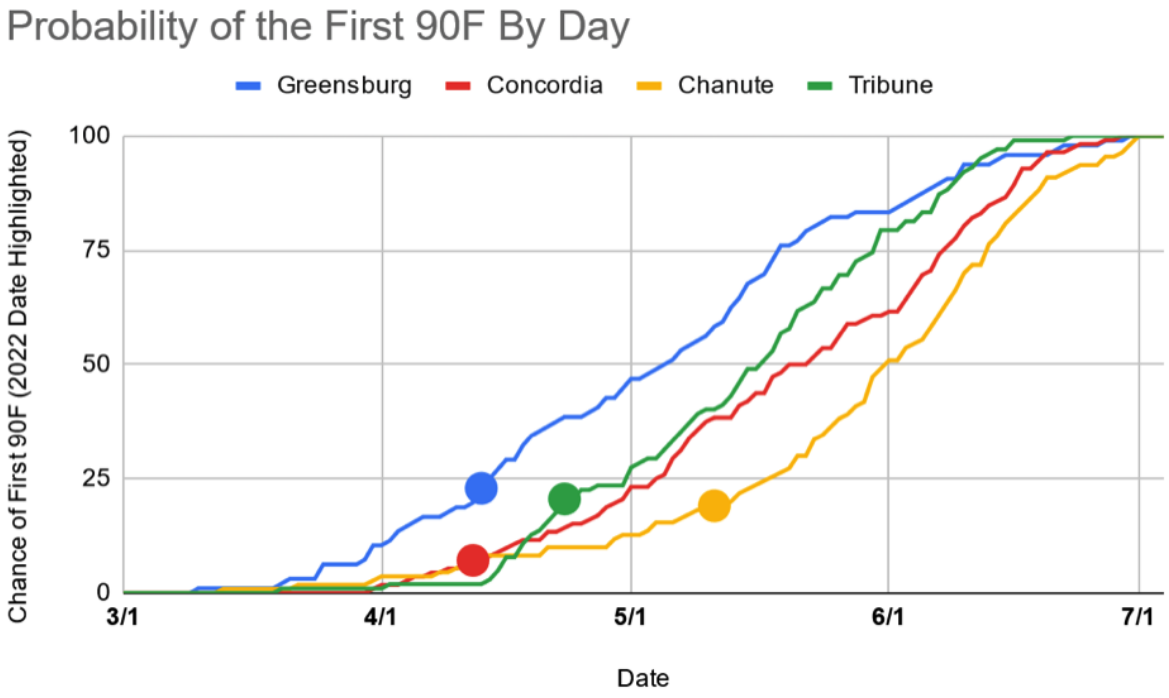

Figure 1. Probability of Greensburg, Concordia, Chanute, and Tribune to observe their first 90°F reading of the year by various dates. Data from NWS Cooperative Observer Program (Source: NWS COOP).

This year, the first 90°F reading occurred much earlier at all locations, falling within the 25% chance of probability. Concordia, Tribune, and Greensburg all observed 90°F in April (12, 23, 13th respectively). Chanute, though occurring almost a month later, still observed a very early first 90°F on the 11th.

The northern latitude of Concordia makes its first 90°F reading very interesting. Over the 112 years of data, there was only a 7% chance of it occurring on/before April 12th. This was likely the result of drought conditions that extended from the southwest northward into north-central Kansas (Figure 2) at that time. During the period of April 10 - May 9th, 38 daily maximum high temperatures have been broken (NCEI).

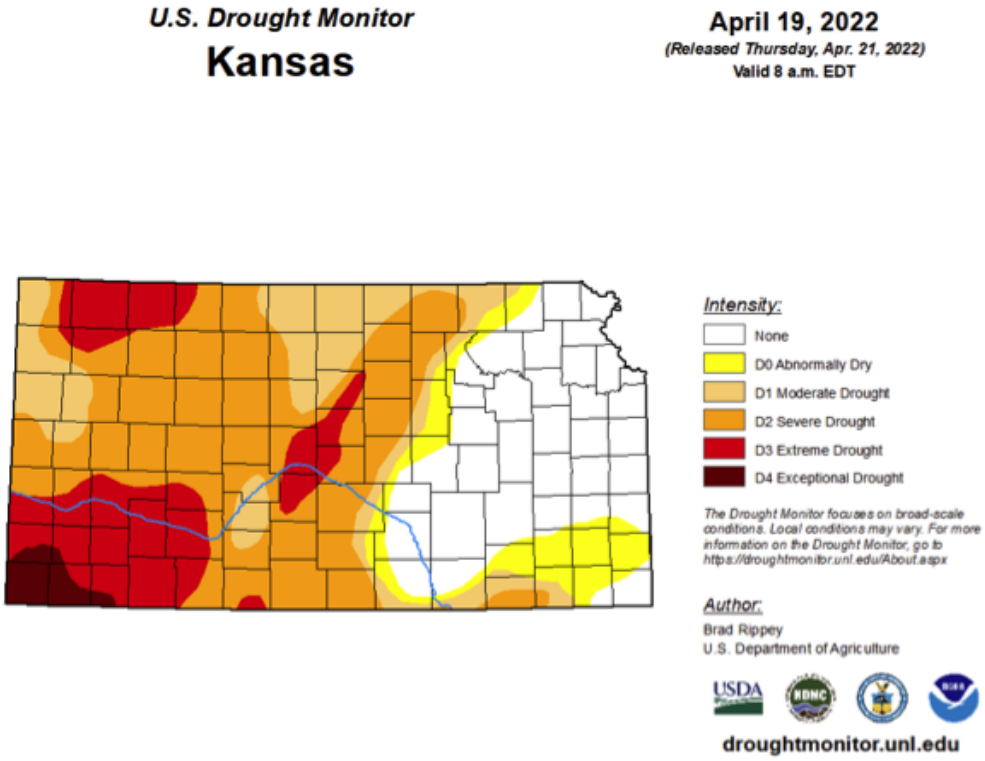

Figure 2. Drought monitor in mid-April which captured the very early first 90°F recorded at many locations in Kansas. (Source: Droughtmonitor.unl.edu)

Duration of Heat

With the early onset of warmer-than-normal temperatures in the state and continuing drought, May's early heat wave shouldn't come as a surprise. The region observed a very progressive and

active weather pattern over the first few months of the year. This was accompanied by frequent cold fronts and resulting cooler temperatures. However, over the last week, the weather pattern has become "bogged up" in what meteorologists call a rex block or blocking pattern (Figure 3). This has created a stagnant pattern with persistent south/southwest surface flow for Kansas. While the origins and flows have different moisture quantities, they both contribute to warmer temperatures.

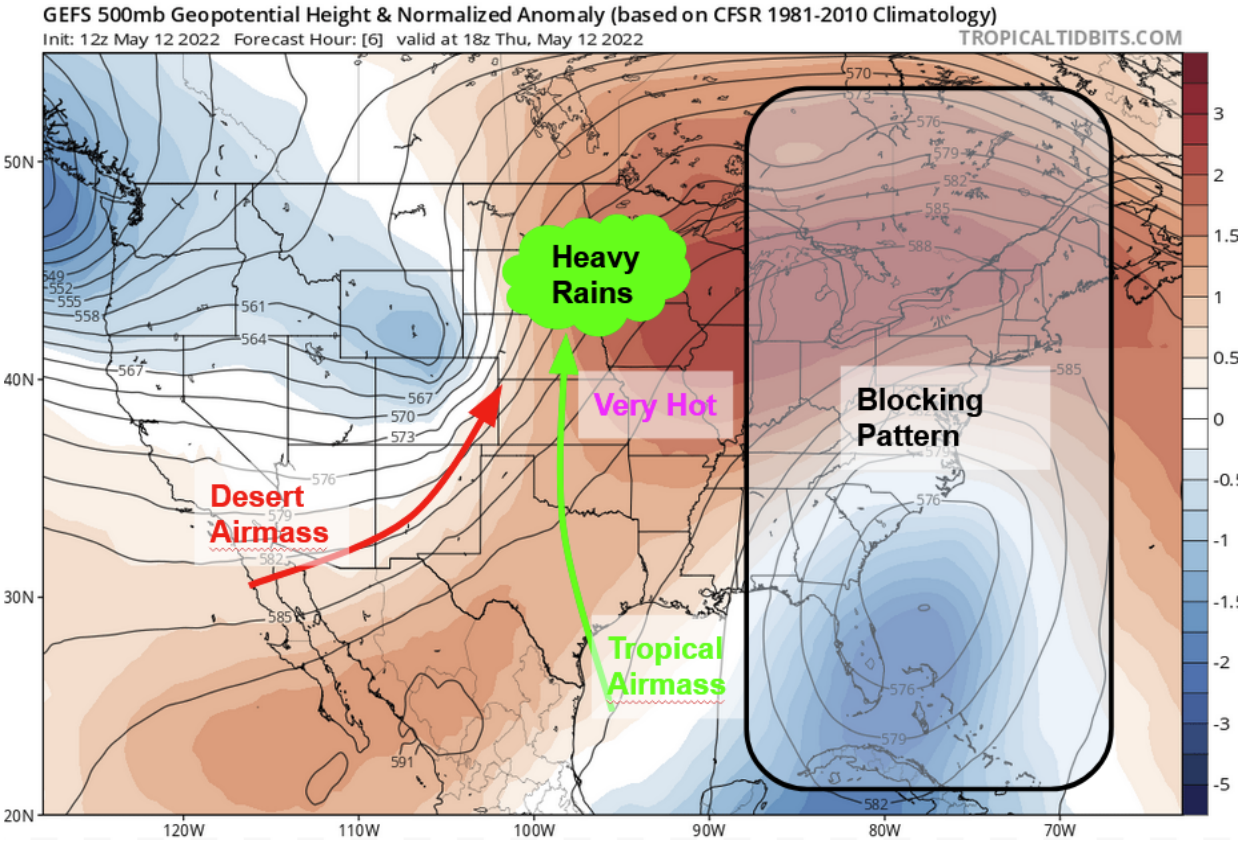

Figure 3. Upper level pattern anomalies with blocking pattern highlighted. Impact descriptions are also included. Tropical moisture has overtaken eastern Kansas, with drier downslope/desert air mass for the west. Both these are leading to very warm conditions in the state. Additionally, this is resulting in heavy rains north of Kansas. (Map Source: Tropicaltidbits.com).

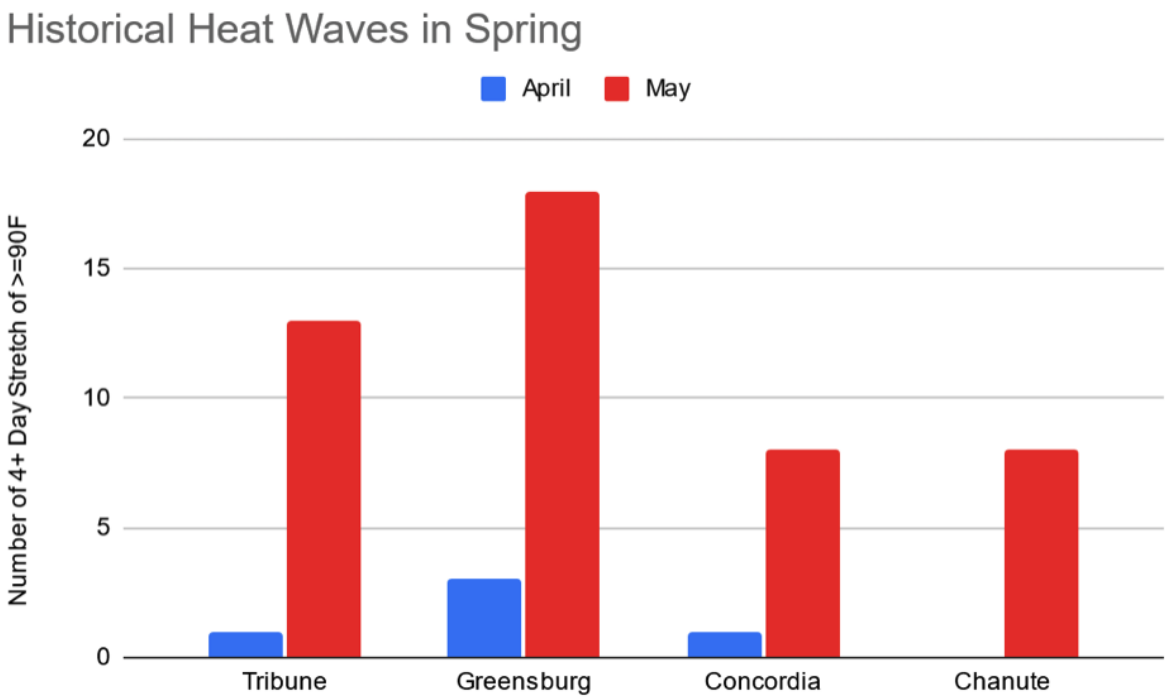

Figure 4. Count of four or more consecutive 90°F days in each station's record in April and May. (Source: NWS COOP).

The result of these warm conditions have been several consecutive days with daily maximum temperatures of at least 90F at many locations. As of this writing (May 12, 2022), there have been three straight days of 90°F+ temperatures with a fourth likely occurring today (May 12).

Historically, this isn't an extreme anomaly. Each location discussed before has observed a stretch of four or more days reaching 90°F consecutively in spring (Figure 4). The southwest and west have the greatest likelihood of observing such a stretch with Greensburg observing 18 and Tribune 13 in May. They have both also observed similar stretches in April as well. Further east, it becomes less frequent. While Concordia has had one stretch in April (seven straight days in 1989), both Chanute and Concordia have observed eight such periods in their historical record.

Indications for the summer

The flip from spring to summer was quite dramatic with the recent cooler conditions. Many are questioning if we jumped straight into summer, and the current weather pattern is quite similar to June/July conditions. The expectation of La Nina to continue into the fall is very concerning. Historically, summers following a La Nina winter trend warmer than normal and drier than normal for much of Kansas (Figure 5). With already persistent drought, these trends are concerning.

Unfortunately, forecast models also suggest warmer and drier than normal through the entire summer. The Climate Prediction Center's main summer outlook (June, July, August) currently favor higher probability of above-normal temperatures and below-normal moisture (Figure 6). This wave of heat could very much be the start of a very impactful summer. Hopefully other, more short-term global oscillations can break these expectations and prove these expectations wrong.

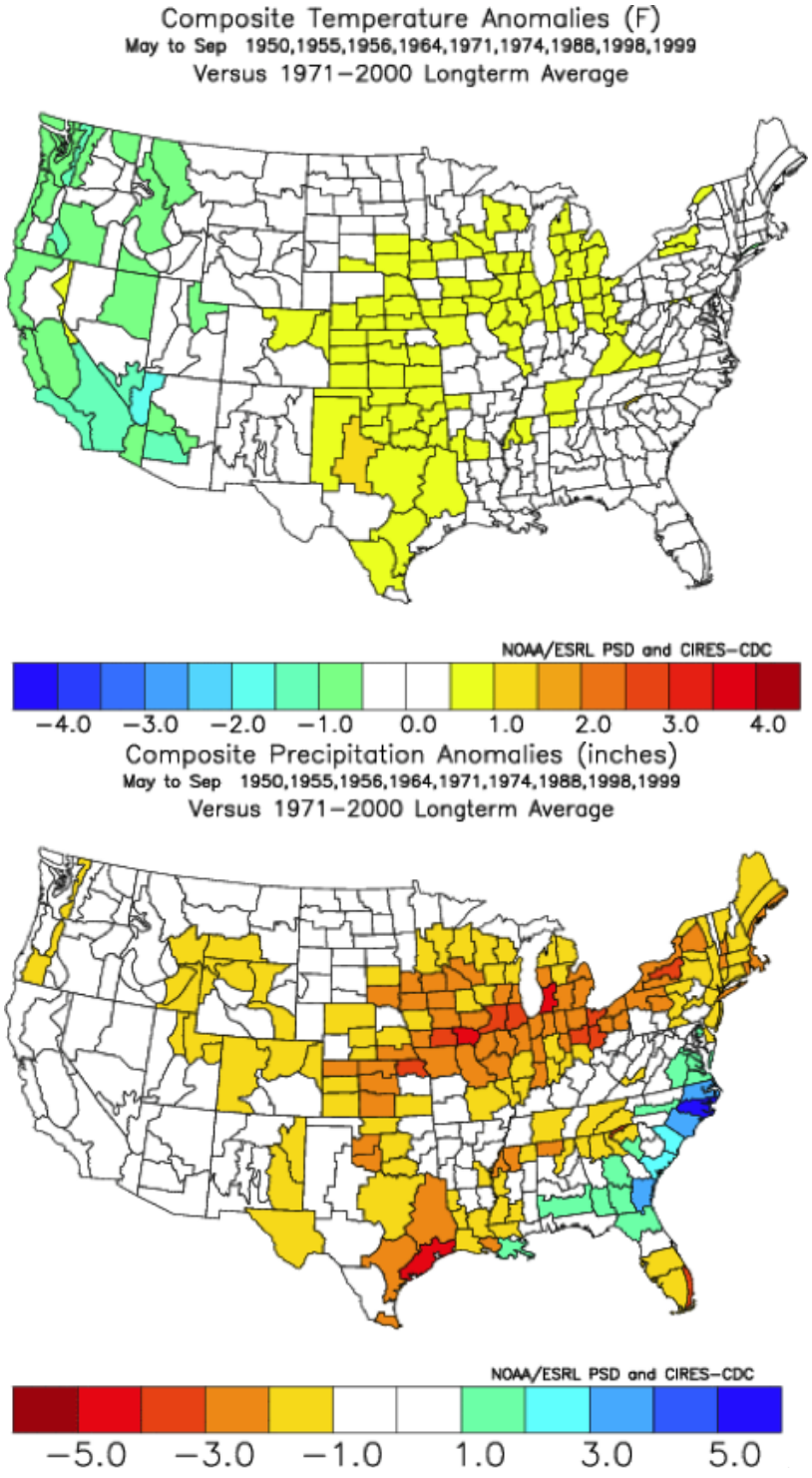

Figure 5. Summer temperature (left) and precipitation (right) anomalies following La Nina winters compared to normal. (Source: NOAA Physical Sciences Laboratory).

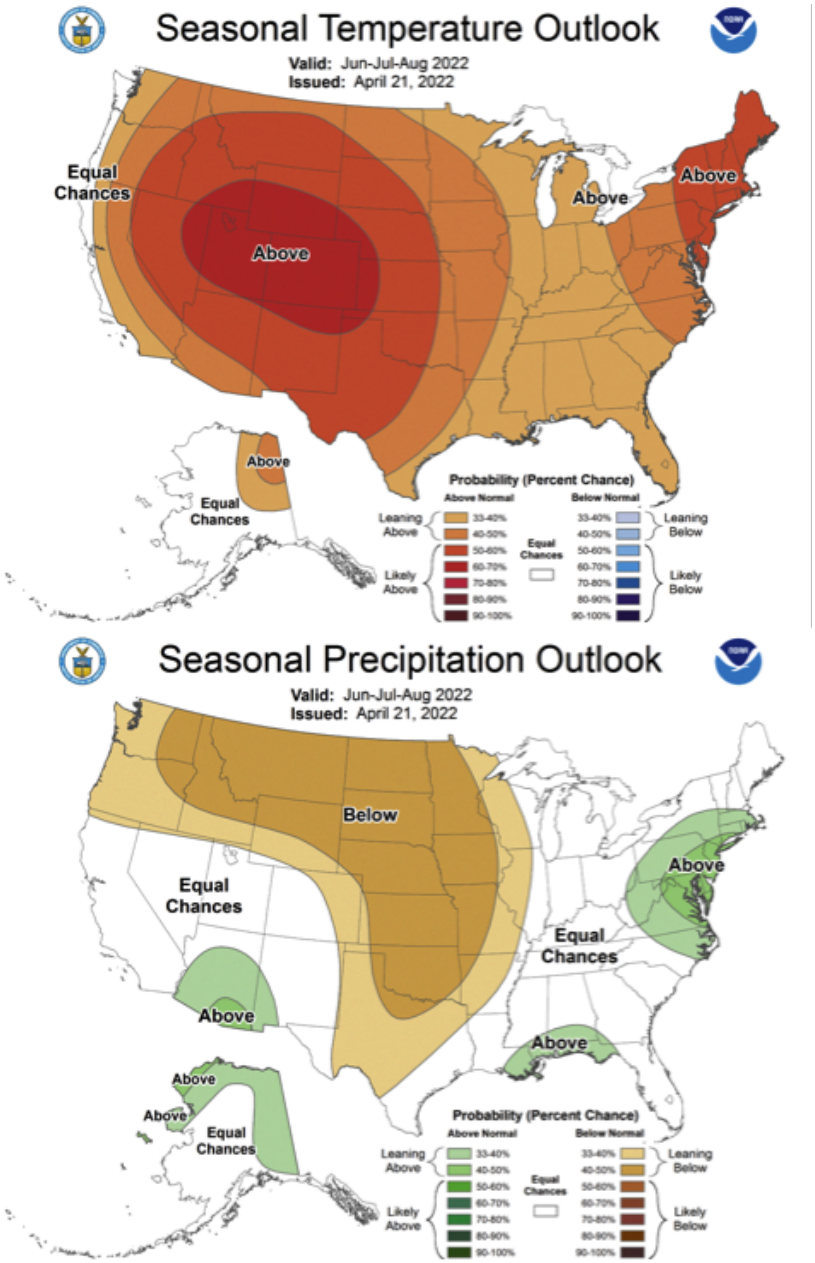

Figure 6. Climate Prediction Center temperature (left) and precipitation (right) forecast outlook for May through July.

NCEI, National Center for Environmental Information; Data Tools: Daily Weather Records, https://www.ncdc.noaa.gov/cdo-web/datatools/records, accessed on May 12, 2022.

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4. Delayed Preemergence Herbicide Applications in Corn

Farmers in much of the state are planting at a rapid pace following the recent rain. However, the speed of planting coupled with unusually windy conditions can potentially interfere with preemergence herbicide applications (Figure 1). There are several things to consider when the planter 'gets too far ahead' of the sprayer and corn is emerged before preemergence herbicides can be applied to corn.

Figure 1. Because of weather conditions this spring, planting may have gotten ahead of preemergence herbicide applications in corn. Photo by Sarah Lancaster, K-State Research and Extension.

Residual herbicides that prevent weed emergence are the foundation of any weed management program. Fortunately, many of the residual products that might be applied preemergence to corn can also be applied to small corn. These include:

* Atrazine

* Group 15 herbicides such as acetochlor (Harness, Warrant, others), dimethenamid-P (Outlook, others), pyroxasulfone (Zidua, others), and S-metolachlor (Dual, others)

* Group 27 herbicides such as isoxaflutole (Balance Flexx, others) and mesotrione (Callisto, others);

and

* Premixes that contain various combinations of these products, such as Acuron, Anthem, Armezon PRO, Corvus, Lumax or Lexar, Resicore, and SureStart II.

Do **not** apply products that contain flumioxazin (Valor, others) to emerged corn. Table 1 includes key information about some of these products, including the maximum growth stage at which the products can be applied and the amount of rainfall required for activation. Activation requirements could be especially important this year, because of the concerns that drier-than-normal conditions may continue throughout the summer.

Herbicides that control emerged weeds should also be considered. Many corn hybrids are resistant to glyphosate and/or glufosinate (Liberty, others), so these products can remain in the tank mix. Dicamba can also be applied to emerged corn. The rates of dicamba that can be applied to emerged corn depends on the size of the corn. For corn from the spike stage through 8 inches, apply up to the 0.5 lb/acre rate (reduce this to 0.25 lb/ac on coarse-textured soils). Apply up to the 0.25 lb/acre rate until the corn is 36 inches or until 15 days before corn tassels emerge, whichever is earlier.

However, other products that are often included in preemergence applications to control emerged weeds **cannot** be safely applied to emerged corn. These products include paraquat (Gramoxone, others), saflufencail (Sharpen), and tiafenacil (Reviton).

Be sure to include appropriate adjuvants when applying premixed herbicides to emerged weeds. Consider using more 'aggressive' adjuvants, such as COC or MSO, in dry conditions because emerged weeds will likely be more difficult to control. However, be aware that this decision also increases the risk of crop injury. Recommended adjuvants are listed in Table 1. When planning tank mixes, always check the herbicide label to clarify tank mix partners, other crop size restrictions and adjuvants for the tank mix.

Table 1. Key information for selected herbicides that can be applied postemergence to corn

Example Product	Active Ingredient(s)	SOA group(s)	Water for Activation	Growth Stage	Adjuvant
Aatrex 4L	atrazine	5	Sufficient	Up to 12″	(COC)
Status	diflufenzopyr dicamba	19 4	N/A	4″ (V2) to 36″ (V8)	COC or MSO or NIS and AMS or UAN
Harness	acetochlor	15	¼ to ¾″	Up to 11″ to 30″ (only Warrant can be	Not required

				applied up to 30″)	
Outlook	dimethenamid-P	15	Needed	Up to 12″	Not required
Zidua	pyroxasulfone	15	½″	Up to V8	Not required
Dual II Magnum	S-metolachlor	15	½ to 1″	Up to 40″	Not required
Balance Flexx	isoxaflutole	27	Adequate	Up to V2	Not advised
Callisto	mesotrione	27	¼″	Up to 30″ or V8 (whichever is more restrictive	COC or NIS (more consistent control with COC)
Acuron	S-metolachlor atrazine	15 5	½ to 1″	Up to 12″	NIS or COC or AMS
Anthem MXX	mesotrione bicyclopyrone pyroxasulfone fluthiacet-methyl	27 27 15 14	½″	Up to V4	NIS or COC
Armezon PRO	dimethenamid-P topramezone	15 27	Required	V8 or 30″	NIS or MSO
Corvus	thiencarbazone isoxaflutole S-metolachlor	2 27 15	Adequate	Up to V2	Not advised
Lumax	atrazine mesotrione acetochlor	5 27 15	½ to 1″	Up to 12″	NIS or COC
Resicore	mesotrione clopyralid acetochlor	27 4 15	¼″	Up to 11″	NIS or COC
SureStart II	flumetsulam clopyralid	2 4	¼″	Up to 11″	Not required

For more detailed information, see the "2022 Chemical Weed Control for Field Crops, Pastures, and

Noncropland" guide available online at https://www.bookstore.ksre.ksu.edu/pubs/CHEMWEEDGUIDE.pdf or check with your local K-State Research and Extension office for a paper copy. The use of trade names is for clarity to readers and does not imply endorsement of a particular product, nor does exclusion imply non-approval. Always consult the herbicide label for the most current use requirements.

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5. Wheat Tour Schedule 2022

The Department of Agronomy and K-State Research and Extension will host several winter wheat variety plot tours in different regions of the state over the coming weeks. Make plans to attend a plot tour near you to see and learn about the newest available and upcoming wheat varieties, their agronomics, and disease reactions.

A preliminary list of plot tour locations, dates, times, and directions is provided below. Stay tuned to the eUpdate in the coming weeks as this list is updated.

Date	Time	County/District	Location	Direction	Agent
5/16	6:00 pm	Sumner	Viola	922 West 140th Ave. North, Conway Springs	Randy Hein
5/20	10:00 am	McPherson	Marquette	North side of Hwy 4 on Marquette Rd	Shad Martson
5/20	1:00 pm	McPherson	Moundridge	East of the corner of Cherokee and 22nd Ave	Shad Martson
5/20	3:00 pm	McPherson	Inman	Between 5th and 4th Ave on Cheyenne Rd	Shad Martson
5/23	8:30 am	Barton	Great Bend	2.5 miles west of Great Bend on West Barton Co. Rd at the intersection of NW 50th Ave on north side of the highway	Stacy Campbell
5/23	12:00 pm	Harvey	Newton	48th and Hoover	Ryan Fleming
5/23	6:00 pm	Sumner	Belle Plaine	70th N and N Greenwich southwest side	Jeff Seiler / Randy Hein
5/24	8:00 am	Sedgwick	Andale	From Andale, 5 ½ miles south on 247th St W. Plot on east side of road.	Jeff Seiler / Randy Hein

5/24	11:00 am	Sedgwick	Clearwater	From Clearwater, 1 mile north on 135th St W to 95th St S, 1/8 mile west on 95th St, plot on north side of road	Jeff Seiler / Randy Hein
5/24	6:00 pm	Sumner	Caldwell	From Caldwell, 1 ½ mi east of railroad tracks on Hwy 81, north side of road	Jeff Seiler / Randy Hein
5/25	8:00 am	Russell	Russell	East of the high school football field; corner of State St and North Copland St	Craig Dinkel
5/25	11:30 am	Ellsworth	Lorraine	1 mile S of Lorraine on 10th Rd to Ave W, turn west go 2 miles. Plot just west of 8th Rd on Ave W	Craig Dinkel
5/25	6:30 pm	Riley	Riley	From Riley, 3 mi east on Hwy 24, 2 ½ miles south on Anderson Ave, then 1 mile east on North 52nd St. Plot is on the SAVE farm.	Greg McClure
5/26	10:00 am	Post Rock District	Smith Center	West of Smith Center on Hwy 36 to Athol, then S to Trinity Ag LLC, the ½ mile S on the W side of road	Sandra Wick
5/26	10:30 am	Post Rock District	Jewell	North of Jewell on Hwy 14 to K road, then 3 mi	Sandra Wick

				west on the north side of the road	
5/26	1:30 pm	Post Rock District	Osborne	West of Osborne on Hwy 24, south ¼ mi on Sale Barn Road (115th Ave) on the west side	Sandra Wick
5/26	4:30 pm	Post Rock District	Beloit	South of Beloit on Hwy 14 to X Road, then 4.5 miles west on the north side of the road	Sandra Wick
5/27	8:00 am	Chisholm Trail District	Hillsboro	Coop Grain and Supply (directions to come)	Rickey Roberts / Hailey Whitehair
5/27	11:00 am	Central Kansas District	Solomon	Ryan Farm SW of Solomon. 3 mi west of Solomon on Old Hwy 40 and 2.5 mi south on the Gypsum Valley Rd	Jay Weisbe
5/27	2:30 pm	Central Kansas District	Minneapolis	Tim and Ryan Myers, Minneapolis. 1.5 mi west of K-106 Hwy on Justice Rd	Jay Weisbe
5/31	3:00 pm	River Valley District	Clay Center	From K-15/US 24 intersection (Wendy's) in Clay Center, go 4 mi north. Turn west on 22nd Rd. Go 2 ¼ mi. South side of road.	Wade Reh
5/31	5:30 pm	River Valley District	Linn	From Linn, 4 mi south on Osage Rd to 5th Rd. West 1 mi to National Rd.	Wade Reh

				North ½ mile.	
6/1	8:00 am	River Valley District	Belleville (KSU Expt Field)	Take US 36 Hwy 2 mi west of Belleville, north side of road	Wade Reh / Scott Dooley
6/1	11:00 am	River Valley District	Belleville	Polansky Seed (directions to come)	Wade Reh
6/1	6 pm	Ellis	Hays	South of Agricultural Research Center-Hays. On 240 the Ave go 3.3 mi to Munjor Rd, turn west and go 2 mi to 220th Ave, turn south on 220th and go ½ mile.	Stacy Campbell
6/2	9:00 am	Walnut Creek District	LaCrosse	½ mi west of 130 on M, south side or road, or 4 mi north of Alexander to M and 1 ¼ mi east.	Jared Petersille / Lacey Noterman
6/2	11:00 am	Walnut Creek District	Ness City	On 60 Road between M and N, 7 mi south and 5.5 mi west of Ness City	Jared Petersille / Lacey Noterman
6/2	5:00 pm	Walnut Creek District	Dighton	Just east of Ehmke's Farm on north side of the road, east of the scale	Jared Petersille / Lacey Noterman
6/3	8:00 am	Chisholm District	Abilene	(directions to come)	Hayley Whitehair / Rickey Roberts
6/6	1:00 pm	Edwards		(directions to come)	Marty Gleason
6/6	6:00 pm	Pawnee	Rozel	From Rozel, go 3 mi west on 156 Hwy to	Kyle Grant

				310th Ave, then 2 ¾ mi north on the west side of road	

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6. Spring Crops Field Day in Parsons on May 17

K-State Research and Extension will host its Spring Crops Field Day Tuesday, May 17 at the Southeast Research and Extension Center, 25092 Ness Road in Parsons.

Registration is 8:15-8:30 a.m. for the program, which includes:

- Grain Market Update – Dan O'Brien, K-State Agricultural Economist
- Soybean Sudden Death Syndrome – Chris Little, K-State plant pathologist
- Soft Red Winter Wheat Varieties – Jessica Rutkoski, University of Illinois soft wheat breeder

Numerous sponsors will have displays and representatives available to answer questions about products and services. A complimentary sack lunch will be served after the field tours.

In case of rain, the program will be held indoors. More information and advance registration is available by contacting the K-State Southeast Research and Extension Center at 620-421-4826.


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WHEAT ALLIANCE
PIONEER
AGChoice
McCune Farmers Union Coop Association
Beachner GRAIN, INC.
K-STATE Research and Extension
Southeast Kansas
2022 Spring Crop Field Day
May 17th, 8:15 am to noon
Southeast Research and Extension Center
25092 Ness Rd. Parsons, KS
Featuring:
Dan O'Brien: Grain Market Update
K-State Agricultural Economist
Chris Little: Soybean Sudden Death
K-State Plant Pathologist
Jessica Rutkoski: Soft Red Winter Wheat Varieties
Illinois Extension Soft Wheat Breeder
Registration
8:15 - 8:30 am
Presentations & Wheat Plot Tours
8:30 to 11:30 am
Lunch (Free Courtesy of Sponsors)
Register Here
https://bit.ly/cropdayregistration
or call 620-421-4826
KANSAS STATE UNIVERSITY IS COMMITTED TO MAKING ITS SERVICES, ACTIVITIES AND PROGRAMS ACCESSIBLE TO ALL PARTICIPANTS. IF YOU HAVE SPECIAL REQUIREMENTS DUE TO A PHYSICAL, VISION, OR HEARING DISABILITY, CONTACT SOUTHEAST EXTENSION CENTER, 620-421-4826. KANSAS STATE UNIVERSITY, AGRICULTURAL EXPERIMENT STATION AND COOPERATIVE EXTENSION SERVICE, K-STATE RESEARCH AND EXTENSION IS AN EQUAL OPPORTUNITY PROVIDER AND EMPLOYER.