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eUpdate

07/14/2022

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. Managing the prussic acid hazard in sorghum

Forage sorghum, sorghum-sudangrass, and sudangrass are important forage crops throughout the United States. While sorghum is a valuable forage crop, sorghum species can produce prussic acid, which can be toxic to livestock. Prussic acid, also known as hydrogen cyanide (HCN), can cause acute toxicity and death. Potential of HCN toxicity (HCN potential) is directly related to dhurrin content, which is the precursor to HCN. Dhurrin is broken down through cell disruption, such as chewing or freezing, which causes rapid HCN release.

Characteristics Affecting Dhurrin Content and HCN Potential

Species/Varieties. Dhurrin content in sudangrass is about 40 percent less than in most other sorghums. As a group, the sorghum-sudangrass hybrids have more HCN potential than sudangrass and forage sorghum has more HCN potential than sorghum-sudangrass and sudangrass. Johnsongrass, shattercane and sorghum have high HCN potential, and may be hazardous when found in pastures and fence rows.

Plant Age. Sorghum age has a significant effect on dhurrin content. Plants have larger amounts of dhurrin in the early growth stages or early regrowth. Older plants, however, can increase HCN potential as a result of environmental factors, as described below. Delay grazing until the plants have reached a height of 18 to 24 inches to avoid HCN toxicity under good growing conditions.

Tissue Type. The vegetative portion of all sorghums can contain dhurrin. HCN potential varies within a single sorghum plant depending on the plant tissue. Tillers, commonly called shoots, can contain a large amount of dhurrin, too. Examine fields for the presence of young tillers on more mature sorghum plants.

Drought. In the western and southern United States, ingestion of sorghum species during drought can cause cyanide toxicity in livestock (Figure 3).. Nitrate levels also can be high in drought-stressed plants.

Figure 1. Sorghum undergoing drought stress. Photo credit: K-State Research and Extension.

Frost. Sorghum can become stressed in frost conditions leading to an increase in dhurrin. It is important to remove livestock from sorghum when a frost is predicted. After a frost, keep livestock off frosted sorghum plants for at least one week. This recommendation is a rolling suggestion, meaning that every time another frost occurs, livestock should be removed from the frosted plants for another week, until the plants have been completely killed with a hard frost. After a non-killing frost, sorghum should be scouted for regrowth because it can contain a large amount of HCN. If regrowth is apparent, you should wait 10 to 14 days or until the regrowth has reached 24 inches tall before grazing or chopping.

Nitrogen Application. Overfertilization with nitrogen can cause the crop to be toxic by two different mechanisms, HCN potential and nitrate concentration.

Feeding Options

Pasture. Grazing sorghum is considered to be the most dangerous option when HCN potential is a concern; however, proper management can reduce risk. Figure 6 shows a calf grazing sorghum-sudangrass that is more than 18 inches tall and shows no stress from frost or extreme drought, both conditions that could increase HCN potential. Residues from grain sorghum can be safely grazed after grain harvest, if the remaining plant is totally dead after a frost, or a week has passed since the frost occurred. Grain sorghum can have small tillers that can be high in HCN until after a killing frost.

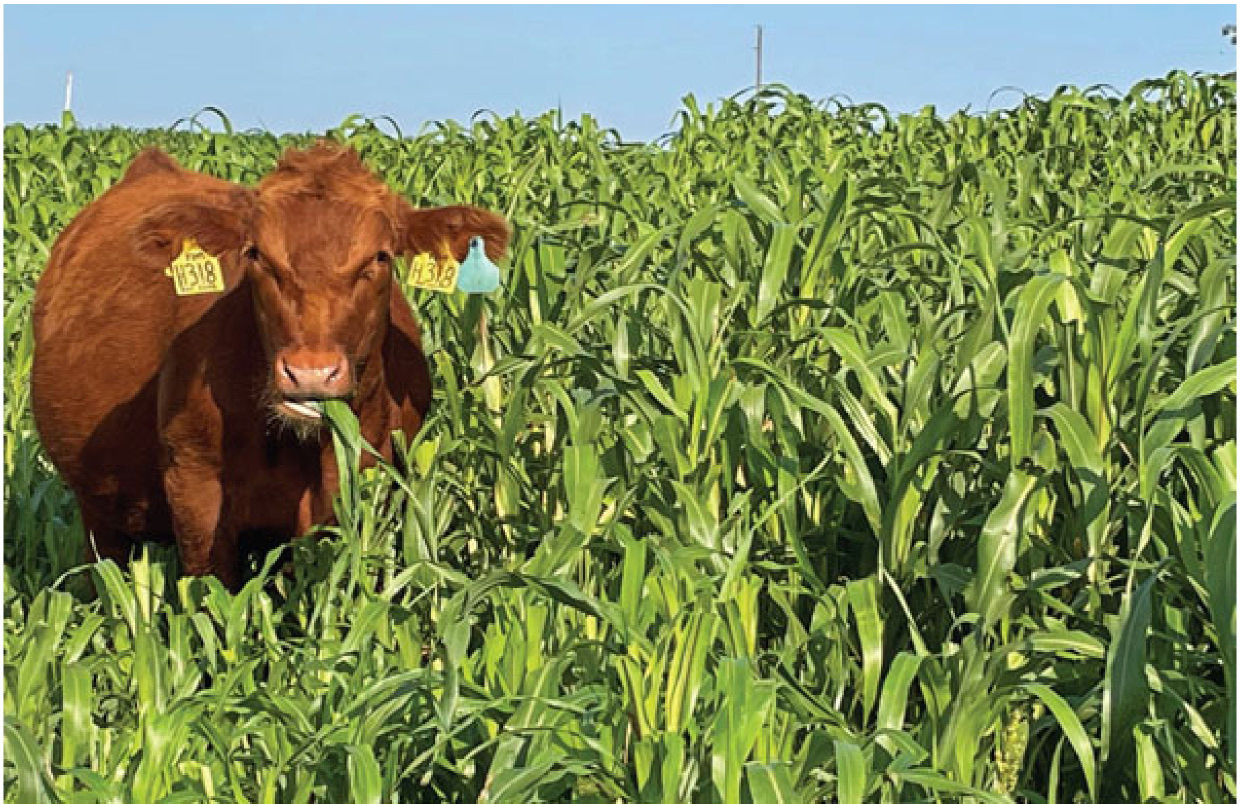

Figure 2. Calf grazing on sorghum-sudangrass pasture without concern of HCH poisoning. Photo credit: K-State Research and Extension.

Hay. It is recommended to use forage sorghum as hay when HCN potential is not a concern; plants are greater than 18 to 24 inches tall, and not drought or cold stressed. Drying does not eliminate risk. If in doubt about the degree of stress that might lead to elevated dhurrin in hay, collect a representative sample and test for HCN potential.

Silage. Silage is considered one of the safest options when feeding sorghum forage.

Green Chop. Use of green chop reduces HCN potential as compared to grazing but is not considered as safe as feeding silage.

If HCN is a concern, several steps can be taken to reduce the potential of cyanide toxicity. These steps include:

- use the sorghum before a frost occurs,
- submit sorghum sample(s) to a qualified lab to be tested for HCN,
- wait to graze 7 to 10 days after a killing freeze,
- do not apply more than 50 pounds of nitrogen (soil plus fertilizer) per cutting, and
- dilute the sorghum feed with another feed source.

If you suspect HCN poisoning in even one animal, call your local veterinarian immediately and remove the rest of the livestock from the feed. Accurate diagnosis of clinical signs and removal from feed is important in these cases. Your veterinarian may collect samples of forage, rumen contents, or blood to help confirm a diagnosis.

Overall, sorghum has many beneficial properties. If proper management occurs, sorghum can be a safe and beneficial forage crop. Soon, a new hybrid will be on the market that is dhurrin-free. This hybrid will not release HCN because there is no accumulation of dhurrin. This new hybrid will be a great option for removing the fear of cyanide toxicity.

Kansas testing information

Check with your local county extension agent or office for the closest option. https://www.ksre.k-state.edu/about/statewide-locations.html

Editor's Note: This article summarizes key points from a recently released publication from researchers at Kansas State University and Purdue University. The entire publication, "Managing the Prussic Acid Hazard in Sorghum", can be viewed at https://bookstore.ksre.ksu.edu/pubs/MF3607.pdf

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2. Kansas weather history: Looking back at two record-setting summers

Mid-July is the midpoint of meteorological summer. On average, this is the hottest time of year in Kansas. As with any year, the focus of heat varies in time and place with most years featuring a hot spell of some kind. However, there are two summers in the Kansas climate record that were brutally hot and extremely dry, which still hold significant records over 80 years later. Even more noteworthy, these two summers occurred only two years apart during the Dust Bowl era, in 1934 and 1936.

The period June 1 through August 31, termed "meteorological summer", normally averages 11.4 inches of statewide precipitation. In the summer of 1934, Kansas only averaged 5.25 inches of moisture statewide. This was the second driest summer on record at the time (records began in 1895), behind only 1913 (4.18"). Then 1936 came along with only 3.25" of summer precipitation. That year still stands as the driest summer on record. As for temperatures, the summer of 1934 was hotter (average of 83.2°, 6.4° above normal) than 1936 (82.0°), but they both still rank first and second on the list of hottest summers.

Snowden ("S. D.") Flora was head of the Topeka office of the U.S. Weather Bureau from 1917 to 1949. He was responsible for writing Kansas' narratives for the monthly Climatological Data publication. Some excerpts from 1934 and 1936:

Summer of 1934

"Record breaking heat and a pronounced shortage of moisture made this one of the most disastrous years for crops ever known in Kansas. It also established a new record for number of deaths due to excessive heat."

"Corn… was practically ruined as far as a yield of grain was concerned, and much of it was so badly damaged it was not fit as fodder for winter feeding… Pastures were dried up and burned brown by the heat... Shortage of rough feed forced great numbers of livestock to market prematurely."

"On July 13 a reading of 119° was recorded at Lincoln which exceeded by 3° any authentic high temperature record ever before made in the state."

Summer of 1936

"(July) was the hottest month ever recorded over Kansas, except July, 1934, and broke all existing high temperature records in most places… the highest reported was 121° on the 18th at Fredonia and on the 24th near Alton which exceeds by 2° any authentic temperature record ever made in the state."

"Corn, which had generally been damaged beyond recovery during July… dried up and was extensively cut for such fodder and silage as it would furnish. In many eastern sections, grasshoppers devoured the leaves before corn could be cut… Water for livestock became very scarce over most of the eastern half of the state… Some wheat was sown in the northwestern counties but grasshoppers ate the crop as fast as it came up."

Comparing 1934 and 1936

Which of these two summers was worse? It's tough to answer this question subjectively, so let's take an objective approach and look at some summary statistics for both years. We can evaluate each summer by its warmest afternoon high temperatures, warmest overnight low temperatures, and total precipitation.

Both 1934 and 1936 were unprecedented with extreme summer conditions. With respect to afternoon high temperatures (Table 1), 1936 generally had the higher extremes, as well as more 100° and 110° days (the shaded cells in Tables 1-3 indicate the more extreme values between the two years at each location). In both 1934 and 1936, roughly half of the 92 days in meteorological summer had highs at or above 100 degrees.

Table 1. Comparative afternoon high temperature data for ten Kansas cities during the summers of 1934 and 1936. Data from NWS COOP.

	June 1-August 31 **1934**			June 1-August 31 **1936**		
	Hottest Temperature	Number of days ≥ 100°	Number of days ≥ 110°	Hottest Temperature	Number of days ≥ 100°	Number of days ≥ 110°
Manhattan	115	61	23	116	53	13
Topeka	112	47	8	114	54	9
Olathe	110	40	2	111	47	2
Chanute	111	41	1	116	49	11
Salina	113	56	17	118	57	18
Wichita	109	39	0	114	47	9
Hays	117	49	9	116	52	11
Goodland	108	35	0	110	39	3
Dodge City	109	42	0	109	36	0
Garden City	113	51	6	107	39	0
AVERAGE		**46**	**7**		**47**	**8**

Overnight low temperatures often get the focus due to significant upward trends in recent decades. They also significantly impact health during heat waves with the human body unable to recover and prepare for the heat the next day. 1934 averaged more days with lows of 70° or above, but at the higher 80° threshold, 1934 and 1936 were nearly the same, with around 9 out of 92 days remaining above 80 degrees at night.

Table 2. Comparative overnight low temperature data for ten Kansas cities during the summers of 1934 and 193. Data from NWS COOP.

	June 1-August 31 **1934**			June 1-August 31 **1936**		
	Warmest Overnight Temperature	Number of days ≥ 70°	Number of days ≥ 80°	Warmest Overnight Temperature	Number of days ≥ 70°	Number of days ≥ 80°
Manhattan	87	55	23	88	40	11

Topeka	85	56	13	85	51	18
Olathe	84	52	5	85	53	10
Chanute	86	58	8	83	56	9
Salina	85	58	19	87	56	12
Wichita	84	68	21	86	62	24
Hays	80	42	2	82	34	3
Goodland	77	15	0	74	9	0
Dodge City	81	54	3	81	43	1
Garden City	79	33	0	78	15	0
AVERAGE		**49**	**9**		**42**	**9**

The low temperatures at night were likely influenced by more precipitation during the summer of 1934. Table 3 evaluates the total summer precipitation of both years, the number of days with beneficial moisture (greater than or equal to a quarter inch) and the number of days without precipitation. The summer of 1936 was drier overall in the totals column, had less days of beneficial rainfall and more days without any rainfall. As a result, the temperatures had a larger daily diurnal swing in 1936, typical of a drier environment. While ending up warmer with afternoon maximum temperatures, the atmosphere cooled off quickly at night with lower dewpoints.

Table 3. Comparative precipitation data for ten Kansas cities during the summers of 1934 and 1936. Data from NWS COOP.

Precipitation Totals (in.) and Days with Beneficial Moisture and without Precipitation						
	June 1-August 31 **1934**			June 1-August 31 **1936**		
	Total Precipitation	Days with ≥ 0.25″	Days with No Precipitation	Total Precipitation	Days with ≥ 0.25″	Days with No Precipitation
Manhattan	3.54″	5	76	4.72″	4	83
Topeka	7.58″	9	69	2.60″	3	82
Olathe	4.98″	7	73	1.77″	3	81
Chanute	8.29″	7	77	3.43″	4	87
Salina	6.74″	8	73	2.48″	2	76
Wichita	3.93″	6	74	1.29″	2	85
Hays	8.47″	10	66	3.60″	5	79
Goodland	6.17″	10	71	3.71″	2	77
Dodge City	3.01″	4	72	3.39″	3	80
Garden City	2.14″	3	80	3.54″	4	82
AVERAGE	**4.89″**	**7**	**73**	**3.05″**	**3**	**81**

So, which summer was harder to endure and more extreme? The year 1934 was the first occurrence of such an extreme summer, which up to that point had been unprecedented. Increased moisture kept temperatures warmer and night and likely resulted in increased humidity despite cooler afternoons. Meanwhile, 1936 was much drier and despite much warmer temperatures, cooled off more at night with likely more tolerable conditions. Also, with 1934 fresh on the minds of Kansans who had experienced it just two years prior, they likely had developed coping strategies making it more tolerable too.

Will history repeat itself?

The biggest question on many Kansans' minds is, will we see a repeat of the Dust Bowl? Precipitation already received this summer (2022) in Manhattan, Salina, and Wichita will prevent those locations from being the driest on record. However, much of the remainder of the state still has a chance to be record dry. Additionally, while we have had warm temperatures, we are behind on reaching the 100° mark and highest maximums are still lower than previous records. Hopefully timely moisture and moderated temperatures can develop before the end of summer – but for now, it appears likely the heat and dryness is on through July. Let's hope it is nowhere near as extreme as either 1934 or 1936!

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3. EPA proposes changes to address Bt resistance in corn ear pests

Anyone who grows corn is familiar with the variety of pests that attack the crop. One group of pests includes various "worms" that feed on developing corn ears (Figure 1). Corn earworm, fall armyworm, and western bean cutworm all can impact yield by consuming individual kernels. The damaged ears are then exposed to secondary fungal pathogens that can amplify losses. For quite some time, these ear-feeding pests have been well controlled through the use of Bt corn varieties. Unfortunately, in some corn growing regions of the country, these pests have become resistant to a majority of the commercially available Bt traits that have been used to control them. This has resulted in reduced efficacy of these traits and, in some cases, complete control failures. Reasons for the appearance of resistance in these pests have been identified and include:

- The use of the same Bt hybrid year after year; rotation to a new Bt package each season is just as important as rotating modes of action when applying foliar insecticides. The presence of single-trait Bt hybrids in a landscape of pyramided Bt hybrids has also been shown to reduce the durability of the pyramided hybrids if traits are shared between them.
- Poor refuge compliance is also a contributing factor as lack of compliance can increase the likelihood of local resistance development.
- In regions that grow corn and cotton in the same landscape, another scenario driving resistance is the presence of the same Bt traits in two different crops during one growing season. Corn and cotton share several traits that control ear-feeding pests and in some areas these pests are being exposed to the same Bt traits all season long, speeding up the development of resistance.
- Another contributing factor involves the use of seed blends, also known as refuge-in-a-bag (RIB). Cross pollination between Bt plants and non-Bt plants in the same field can result in ears that have weakened expression of Bt toxins, exposing pests to non-lethal doses that eventually fuel the development of resistance.

Figure 1. Corn ear damage. Photo by Anthony Zukoff, K-State Research and Extension.

In light of these challenges and the continued spread of resistance in the country, the US Environmental Protection Agency (EPA) has proposed some new rules regarding the use of Bt targeting these caterpillar pests. Some of the proposed changes, introduced in November 2021, are included below.

- Faster detection of potential resistance issues will be achieved through monitoring for unexpected injury (UXI) that exceeds pre-determined levels. Sentinel plots will be established in high risk areas of the country and monitored for UXI. If detected, various mitigation steps will be triggered.
- Refuge-in-a-bag (RIB) will be increased from 5% to 10% in pyramided Bt products nationwide.
- Single trait Bt products will be phased down over 3 years in the corn belt, 2 years in the cotton belt.
- Pyramided Bt corn products will not be phased down. Pyramids containing the Vip3A trait will maintain a 5-year registration time, while pyramids without Vip3A will have a shortened 3-year registration time.

- Enhanced refuge compliance monitoring will be implemented in the cotton belt.

These proposed changes are the product of several years of feedback from growers, industry, and university scientists from multiple states. The proposal is currently in negotiation with the seed industry and nothing has yet to be implemented.

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4. Kansas Ag-Climate Update for June 2022

The Kansas Ag-Climate Update is a joint effort between our climate and extension specialists. Every month the update includes a brief summary of that month, agronomic impacts, relevant maps and graphs, 1-month temperature and precipitation outlooks, monthly extremes, and notable highlights.

June 2022: Heat wave in western areas under drought condition

The statewide average temperature in June was 74°, or 1.6°F above normal (Fig. 1). Western Kansas had the highest magnitudes above normal, which made drought conditions worse in this area. From a climate perspective, the three-month average temperature (April to June) was slightly warmer (1.4°F above the normal), ranking as 36th warmest of the past 128 years. A short-term heat-wave event was observed in southwestern Kansas, where cattle deaths were reported between June 11 and June 13. The weather conditions likely led to cattle respiration rates that were above the danger threshold (110 breaths per minute) during middays in this period.

Precipitation was relatively evenly distributed across the state, but averaged around 0.5” below normal which made drought conditions worse, particularly in the western part of the state.

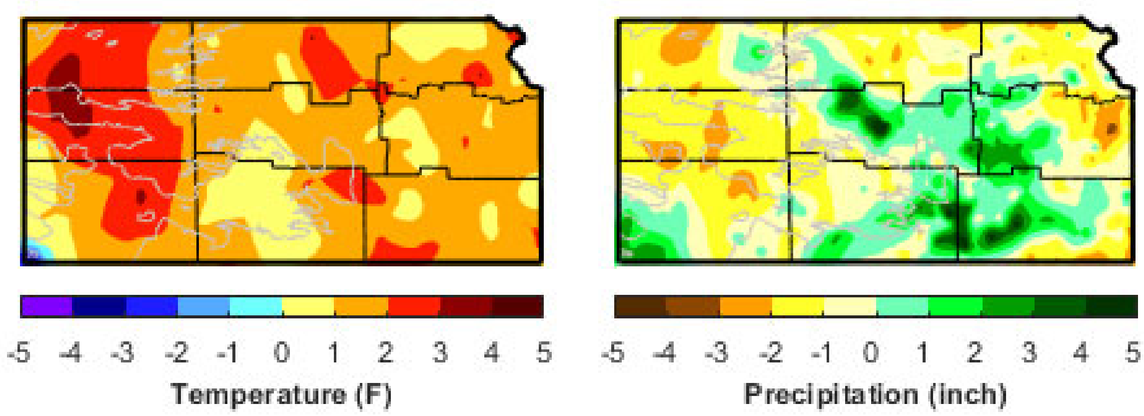

Figure 1. Departures from normal temperature (°F) and precipitation (inches) for June 2022.

View the entire June 2022 Ag-Climate Update, including the accompanying maps and graphics (not shown in this short summary), at http://climate.k-state.edu/ag/updates/

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5. Irrigation technology field day set for July 22

Kansas State University will host a field day on July 22 to help farmers in the Rattlesnake Creek watershed use new irrigation technologies to manage how they apply water more effectively and improve crop yields.

The Irrigation Innovation Technology Field Day will be held near Dillwyn, located in south-central Kansas between Wichita and Dodge City, on the farm of Patrick Doran. Jeff Davidson, a watershed specialist for K-State Research and Extension, said the farm is located on NW 60th Avenue, north of U.S. Highway 50 (1 mile south and 1 mile east of Dillwyn).

The field day is free. Cinnamon rolls and coffee will be available beginning at 7 a.m.

The field day agenda includes:

- Overview of the Rattlesnake Creek Watershed project.
- An update on issues in Groundwater Management District 5.
- Irrigating more efficiently: The Rattlecreek Snake Approach.
- Soil management for water conservation.
- Producers talking about their experiences with irrigation technology.

Participants will also be able to see new technologies in use. Davidson said technology partners will be on hand to display their equipment. The agenda is expected to be finished by 9:40 a.m.

Interested persons are encouraged to pre-register by contacting Davidson by email, jdavidso@ksu.edu.