Issue 952

K-STATE
Research and Extension

Extension Agronomy

eUpdate

04/20/2023

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.

Subscribe to the eUpdate mailing list: https://listserv.ksu.edu/cgi-bin?SUBED1=EUPDATE&A=1

eUpdate Table of Contents | 04/20/2023 | Issue 952

1. Adjusting seeding rates for soybeans

Seed cost is a critical economic factor, and selecting the proper seeding rate is a key management practice. This article reviews key factors in determining optimal soybean seeding rates.

Key terminology: seeding rate, survival rate, plant density

There are three important terms: (1) "Seeding rate" refers to the target number of planted seeds per acre. (2) "Plant population" or "plant density" refer to the effective number of plants growing in a field. (3) "Survival rate" refers to the percent of sown seeds that germinate and emerge. Normally, we may expect about 80% percent of the seeds planted to survive to become part of the final plant population. Thus, for calculation purposes, it's best to start by knowing the desired final plant density, then using the expected survival rate to calculate back to the number of seeds per acre you'll need to plant. Below is an example:

$$Seeding\ rate\ \left(\frac{seeds}{acre}\right) = \frac{Plant\ density\ target\ \left(\frac{plants}{acre}\right)}{Survival\ rate\ \left(\frac{plants}{seeds}\right)}$$

Example of seeding rate calculation with a plant density target of 100,000 plants/acre, and expected survival rate of 80% (0.8 plants/seed):

$$\frac{100{,}000\ \cancel{plants}/acre}{0.8\ \cancel{plants}/seed} = 125{,}000\ \frac{seeds}{acre}$$

Note: The seed survival rate varies depending on specific environmental conditions and the quality of the planting practice. Thus, before deciding the seeding rates, it is necessary to consider potential soil and weather conditions that could affect the success of the final stand establishment, to achieve the proper plant density required.

Adjusting by yield environment

Identifying yield potential for each environment in your field is a good practice when refining the soybean seeding rate decision. A recent study by Carciochi, Ciampitti, and collaborators published in Agronomy Journal evaluated soybean yield performance in a database of hundreds of experiments across the Midwest. Seeding rates ranged from 69,000 to 271,000 seeds/a, and final plant density and seed yield data were considered for the analysis. The data was classified by yield environments as follows: **Low** (<60 bu/a), **Medium** (60-64 bu/a), and **High** (>64 bu/a).

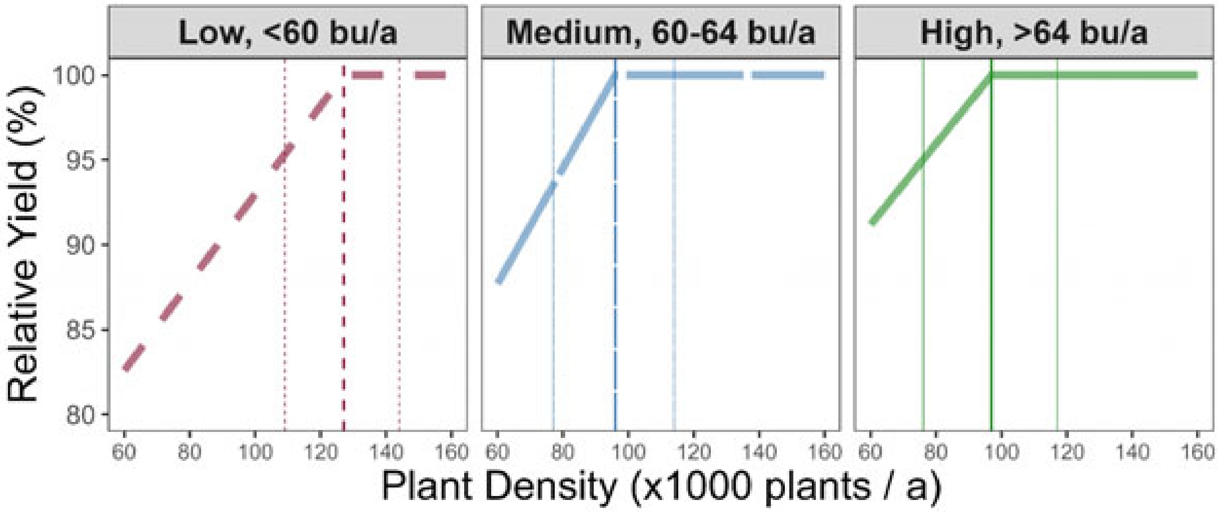

Figure 1. Expected soybean relative yield (%) with respect to the optimal plant density by yield environment. Vertical lines indicate expected optimal plant densities (Low: 127,000 plants/a; Medium: 96,000 plants/a; High: 97,000 plants/a) and their corresponding uncertainty (95% intervals). Adapted from Carciochi et al. (2018). (We'll need to put this citation at the end of the article.)

The main outcomes of this study were:

- **Most probable values**. On average, optimum plant densities were:
  - Low-yield environments: 127,000 plants/a,
  - Medium-yield environments: 96,000 plants/a
  - High-yield environment: 97,000 plants/a.

- **Expected uncertainty**. In 50% of cases, optimum plant densities ranged from:
  - Low-yield environments: 109,000 - 144,000 plants/a
  - Medium-yield environments: 77,000 to 114,000 plants/a, and
  - High-yield environments: 76,000 to 117,000 plants/a

- In low-yield environments, the need for higher optimal plant density was not related to a low plant survival rate, but to a reduced potential growth rate per plant.
- Another reason for the need for higher plant density in low-yield environments is that there is often less precipitation during the reproductive period in these environments, reducing the crop's reproductive ability (reduction in yield contribution from branches).

Site-specific simulator

For site-specific management, the previous information can be used to generate prescriptions for variable rate seeding. In 2022, Kansas State University, in collaboration with the Iowa Soybeans Association, launched a free web-based simulator designed to assist farmers in implementing variable seeding rates (Figure 2).

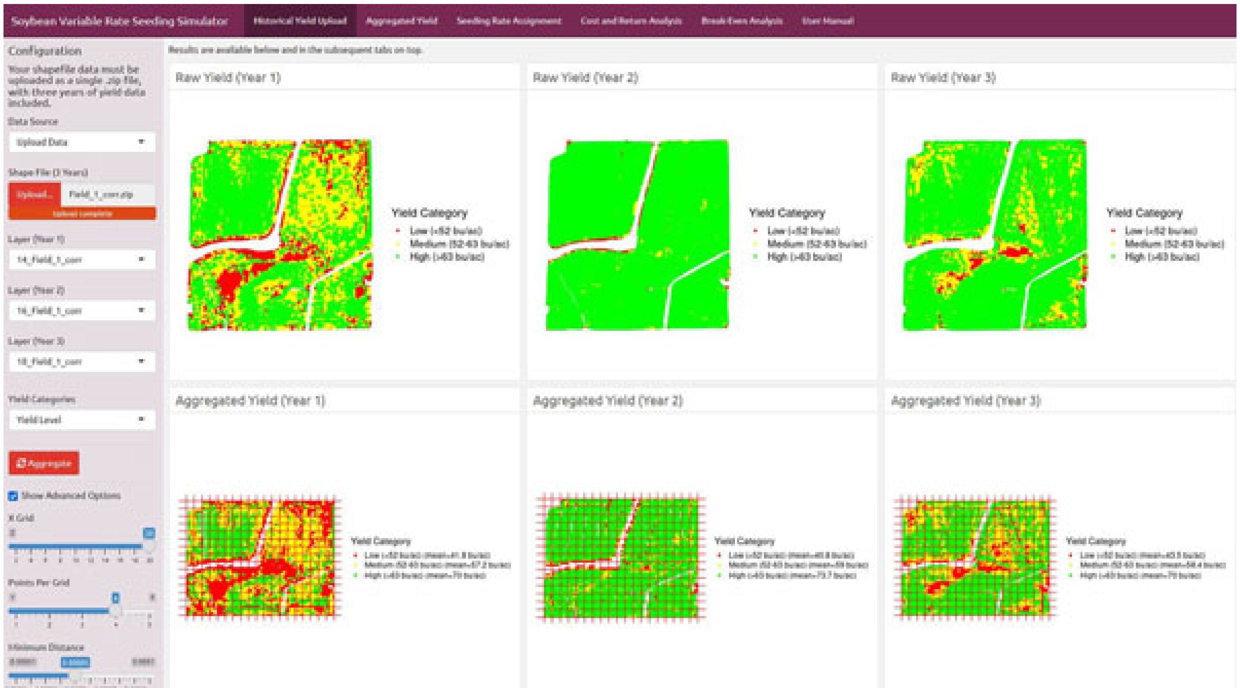

Figure 2. View of the Soybean Variable Seeding Rate Simulator. Link:
https://analytics.iasoybeans.com/cool-apps/SoybeanVRSsimulator/

Maintaining a fixed seeding rate for the whole field can reduce profitability compared to using a variable seeding rate. For example, Figure 3 shows a simulation of potential lost profit ($/a) for not adjusting the seeding rate by yield environment. The simulation comprises different scenarios with yield environments ranging from 40 to 70 bu/a, three survival rates (0.7, 0.8, and 0.9), two soybean grain market prices of ($12 and $16/bu), and three potential costs per bag of 140,000 seeds ($40, $55, $70/bag).

How the profits simulation works

The potential lost profits ($/a) for a given field will increase when using fixed seeding rates for the whole field compared to using the optimal rate for each yield environment zone (vertical lines). Regardless of the environment, conditions that reduce the survival rate will increase the seed costs, as they increase the seeding rate needed to achieve the optimal plant density.

On the one hand, a farmer may be using a fixed seeding rate for the whole field that is "below" the optimal rate for some of the yield environment zones within the field. In that case, adjusting the seeding rate for each zone will reduce the potential lost profit since achieving the extra yield will more than compensate for the additional seed cost. On the other hand, if a farmer is currently using a fixed seeding rate for the whole field that is "above" the optimal rate for some of the yield environment zones within the field, reducing the seeding rate to the optimal for each zone will reduce the potential lost profit due to investing in unnecessary seeds.

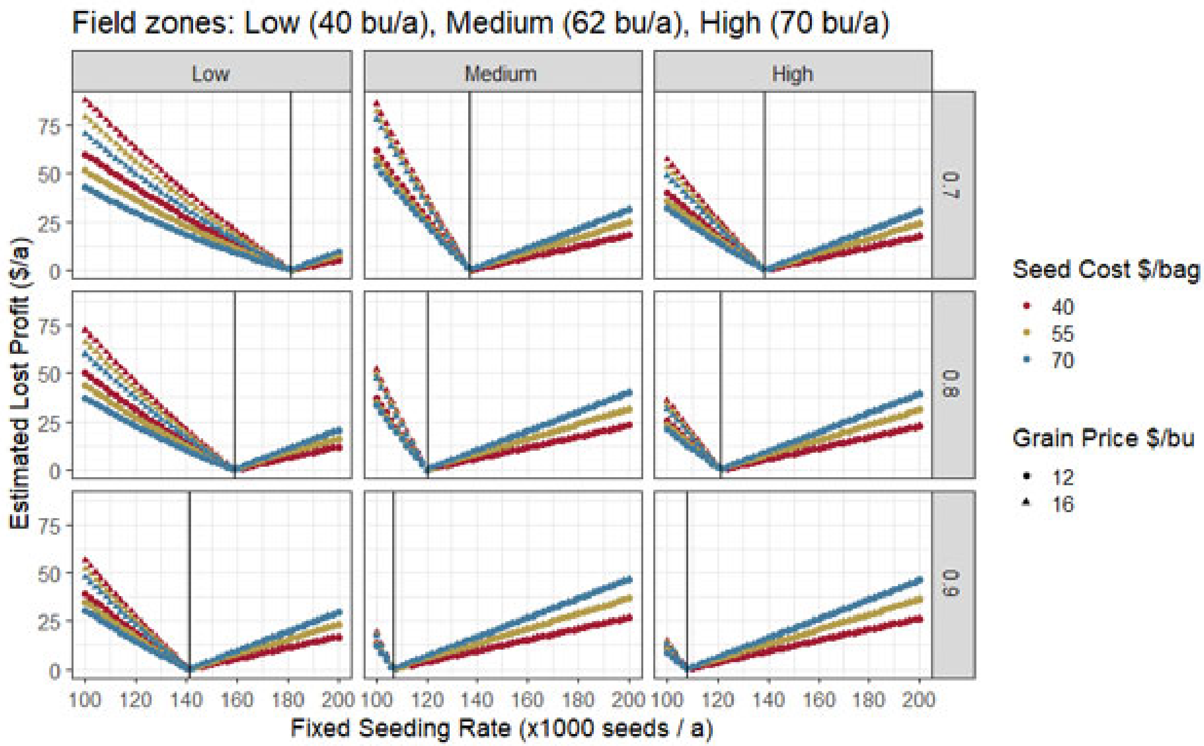

Figure 3. Simulation of lost profit per acre for NOT adjusting seeding rates by yield environment (Low, Medium, High) at three plant survival rates (0.7, 0.8, 0.9) and six combinations of seed cost ($40, 55, 70/bag) and grain price ($12, 16/bu). Hypothetical yield environments range from 40 to 70 bu/a. Hypothetical seed costs are based on 140,000 seeds per bag. The vertical lines indicate the optimal seeding rate for each situation.

Interaction with other practices

The soybean seeding rate is tied to other practices such as row spacing and planting date. The final number of seeds per linear foot of row decreases as row spacing narrows. For example, at a target plant density of 105,000 plants per acre and 85 percent germination, 30-inch rows will have twice the number of seeds per linear foot as 15-inch rows (6 vs. 3 seeds per linear foot). However, the seeding rate per acre would remain the same for both row spacings, as only the number of seeds per linear foot would change, not the seeding rate per acre.

From a planting date standpoint, the seeding rate will need to increase at later planting dates to compensate for the reduction in the length of the growing season and reduced potential for branches to contribute to yield.

For more information about the optimal soybean seeding rates and optimal plant densities, please, consult https://bookstore.ksre.ksu.edu/pubs/MF3460.pdf

Final considerations

In summary, adjusting seeding rates based on plant survival rates, soil conditions, and planting dates can reduce the risk of yield and profit losses due to suboptimal densities in a low-yield environment, while limiting higher seed costs due to supra-optimal densities, especially for medium and high yield environments. Moreover, soybean plant density levels above the optimal plant density increase the risk of lodging and disease development without adding a yield benefit.

If planting early, try to maximize plant survival and reduce threats to emergence by:

- Avoid planting when soil temperatures are below 60°F. If planted into soils cooler than 60°F, seedlings may eventually emerge but will have poor vigor.
- Treating seeds with fungicide and insecticide.
- Selecting varieties with resistance to soybean cyst nematode and sudden death syndrome.

Ignacio Ciampitti, Farming Systems Specialist
ciampitti@ksu.edu

Adrian Correndo, Postdoctoral Fellow
correndo@ksu.edu

2. Soybean seed treatments: Avoiding seedling diseases

As producers start planting soybeans in Kansas, it is important to consider common causes of seedling damping off and potential management strategies. This article addresses some frequently asked questions concerning the use of seed treatments.

What causes poor soybean stand establishment?

Although a few diseases may cause poor stand establishment, it is important to also consider other factors that may be causing it, including herbicide damage, soil compaction, high residue, flooding, cold stress, drought, planting depth, and seed quality. Proper identification of the cause of poor stand establishment will be crucial for current and future management decisions.

What are the main soybean seedling diseases in Kansas and what seed treatments are effective?

The most common pathogens causing seedling diseases in Kansas are: *Phytophthora, Pythium, Fusarium,* and *Rhizoctonia*. Although they have different names, the symptoms can be similar. Each of these may result in post-emergence damping off (Figure 1). Although there are seed treatments that are effective against each of these diseases, it is important to remember that these species often require different fungicide products. It is important to carefully check the label of seed treatments and to select a seed treatment product with multiple active ingredients that have efficacy against these common pathogens.

For example, if *Phytophthora* and *Pythium* have been a problem in the past, products should be selected with the active ingredients mefenoxam, metalaxyl, or ethoboxam. For Rhizoctonia, the active ingredient sedaxane has shown excellent efficacy. Strobilurin active ingredients such as azoxystrobin, trifloxystrobin, or pyraclostrobin are effective against other fungal pathogens.

Figure 1. Characteristic symptoms of Pythium damping off. Photo from Kiersten Wise, University of Kentucky.

Seed treatments are not the only tool in the toolbox for managing seedling diseases. Variety selection, crop rotation, high seed quality, proper drainage, and seed treatments all make up the best management practices for seedling diseases in Kansas. A combination of these factors will help ensure a high-quality soybean stand.

What conditions favor seedling diseases?

Each disease has slightly different environmental requirements, but seedling diseases are generally favored by planting in cool soil with poor drainage. Spotty occurrences of infected plants may be most pronounced in low or poorly drained portions of the field. When soil temperatures are cool, soybeans planted early should always consider a seed treatment to avoid early-season losses.

Are there any other diseases to consider when using seed treatments?

Seed treatments are not only effective against the pathogens that cause early-season emergence problems. Two products on the market, ILEVO®, and SALTRO™, also provide protection against sudden death syndrome (Figure 2) and soybean cyst nematode. These products should be considered for fields with a previous history of either of these diseases.

To know if soybean cyst nematode is a problem in your field, take advantage of the soybean cyst nematode testing program offered by K-State Research and Extension. Contact your local extension agent for more sample submission information.

Figure 2. Classic soybean sudden death syndrome foliar symptoms development. Infection typically occurs early in the season, but foliar leaf scorch symptoms are most visible at reproductive growth stages. Photos by Rodrigo Borba Onofre, K-State Research and Extension.

Rodrigo Onofre, Row Crop Plant Pathologist
onofre@ksu.edu

3. Control of late-emerging kochia in wheat or wheat stubble

Getting kochia under control in any cropping system that includes wheat begins with the wheat crop during the spring, and shortly after wheat harvest. This is not always easy, even if early spring herbicide applications for kochia control were made.

Figure 1. Kochia in wheat stubble. Photo by Dallas Peterson, retired K-State Research and Extension.

Late-emerging kochia in wheat

While a majority of kochia emerges early in the spring, emergence can extend over a period of weeks or months. A herbicide applied early in the spring will need to have some residual activity to be effective on later-emerging kochia. Group 2 herbicides that contain thifensulfuron (Harmony, others) or tribenuron (Express, others) have good residual activity on kochia but are ineffective on ALS-resistant kochia. Most kochia populations in Kansas are now ALS-resistant.

Similarly, some kochia populations are resistant to Group 4 herbicides, specifically dicamba and fluroxypyr (Starane, others). If sensitive populations are targeted for control, dicamba must be applied before the jointing stage of wheat and fluroxypyr can be applied through flag leaf emergence. Pixxaro (halauxifen + fluroxypyr) is a combination of two Group 4 herbicides and can be applied up to flag leaf emergence. No kochia populations resistant to halauxifen (Elevore) have been reported in Kansas, however, halauxifen is generally less effective on kochia than fluroxypyr.

Huskie is a combination of a Group 27 herbicide (pyrasfulotole) with a Group 6 herbicide (bromoxynil). It is effective on emerged kochia and can be applied up to flag leaf emergence in wheat. Talinor (bicyclopyrone + bromoxynil) is a similar product that can be used to control kochia. Both of these products should be applied with adjuvants as directed on the labels.

If kochia needs to be controlled later in the season, there are a few herbicide options available as harvest aids. Ally (metsulfuron) and glyphosate are labeled but it is likely that kochia will be resistant to these herbicides. If populations are not resistant, dicamba may be applied after wheat has lost green at the nodes but at least 7 days before harvest. In addition, seed wheat must have a germination test before it can be used. One final option is Sharpen (saflufenacil). Sharpen is a PPO-inhibiting (Group 14) herbicide that can be applied after grain reaches 30% moisture, but at least 3 days before harvest. Be sure to check herbicide labels for adjuvants and application timings for any products you may consider using as a harvest aid.

Kochia control in wheat stubble after harvest

If kochia has not been completely controlled in the wheat crop, it may be present when wheat is harvested. In most cases, the kochia plants will get "topped" by the combine as the wheat is harvested. If kochia has been topped, producers should wait until some regrowth has occurred before applying herbicides to the wheat stubble to control it.

A combination of glyphosate plus either dicamba or fluroxypyr may be the most effective treatment to control kochia in wheat stubble. Even if kochia populations are resistant to glyphosate, the tank-mix combinations with dicamba or fluroxypyr will probably provide good control, as long as the kochia plants aren't too big, too stressed, or resistant to dicamba and/or fluroxypyr. Some 2,4-D can be added to the mixture to help with the control of other broadleaf weeds, although 2,4-D generally will not help much in controlling kochia. Dicamba or fluroxypyr tanked mixed with a pound of atrazine and 2 oz of saflufenacil (Sharpen) have provided excellent control of kochia following harvest. However, only corn or sorghum may be planted the following spring if atrazine is used.

Paraquat (Gramoxone, others) can also be used to control kochia after wheat harvest. Paraquat activity will be increased if applied with a Group 5 herbicide like atrazine. Metribuzin (Dimetric, others) can be used instead of atrazine if soybeans will be planted the following spring. Wheat can be planted 4 months after a metribuzin application. Paraquat is a contact herbicide that requires thorough coverage, which can be achieved by selecting nozzles to apply medium- to coarse-sized droplets and using spray volumes of 15 to 20 gallons per acre.

To improve kochia control after wheat harvest, apply the postharvest treatments in the morning hours or after the field has received some moisture, not when the kochia plants are under maximum stress. If kochia has been severely drought stressed before treatment, waiting a couple of days following a good rain may increase control.

For more detailed information, see the "2023 Chemical Weed Control for Field Crops, Pastures, and Noncropland" guide available online at https://bookstore.ksre.ksu.edu/pubs/SRP1176.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.

Sarah Lancaster, Extension Weed Science Specialist
slancaster@ksu.edu

4. Update on alfalfa pests in Kansas - Alfalfa weevils and pea aphids

Alfalfa weevils have been hatching throughout the eastern half of Kansas since at least March 20. The larvae have been voraciously feeding on the alfalfa foliage, which for the most part has been moisture-stressed, thus exacerbating the feeding damage. Even after last weekend's rain most of the alfalfa sampled through April 18 had only 2-4-inch stems. Most untreated fields were 100% infested with alfalfa weevils. However, one positive is that about 70% of the weevils sampled were in their final larval instar (Figure 1). Thus, most should be pupating within the week, so their voracious feeding is about finished. Insecticide applications for alfalfa weevils started in the first week of April and seemed to have helped protect some of the foliage (Figure 2).

Figure 1: Alfalfa weevil larvae. Photo by Amie Norton, K-State Research and Extension.

Figure 2: Alfalfa weevil insecticide trial. Treatment was applied on April 6 (top center of photo) versus the untreated plot (center of photo). Photo from Department of Entomology, K-State Research and Extension.

Pea aphids are increasing throughout north central Kansas. However, the surviving beneficials are helping to control most of these aphids (Figure 3).

Figure 3: Lady beetle larva consuming pea aphid. Photo by Amie Norton, K-State Research and Extension.

Jeff Whitworth, Extension Entomology Specialist
jwhitwor@ksu.edu

5. Update on soil conditions and growing degree days this spring

Spring has sprung across Kansas! Temperatures are warming, and so has the soil. Let's take a closer look at where things stand through the first half of April.

The changing of the calendar from March to April coincided with a change in temperatures across the Sunflower State. The average temperature in March across Kansas was 42.2°F or 2.6° below normal. All nine climate divisions averaged below normal last month; departures ranged from -4.9°F in the northwest to -1.5°F in the southeast. The average temperature for the first half of April is 55.7°F or 4.6° above normal. All divisions are above normal, with departures ranging from +3.5° (southeast) to +5.6° (north central). As a result, soil temperatures, which lagged behind seasonal normals for the last three weeks of March, are now well above normal. As of April 16, the 7-day average 2-inch soil temperature across Kansas is 60.0°F, a full six degrees above normal (Figure 1). April 12 and 13 were the warmest days so far this year; the average high and low temperature across the Kansas Mesonet for both days were 86°F and 53°F respectively, well above the normal values for those dates of 66°F and 39°F. Highs in the 90s were common across western Kansas, with widespread 80s across the east. We can thank these warm readings for the recent rapid increase in soil temperatures.

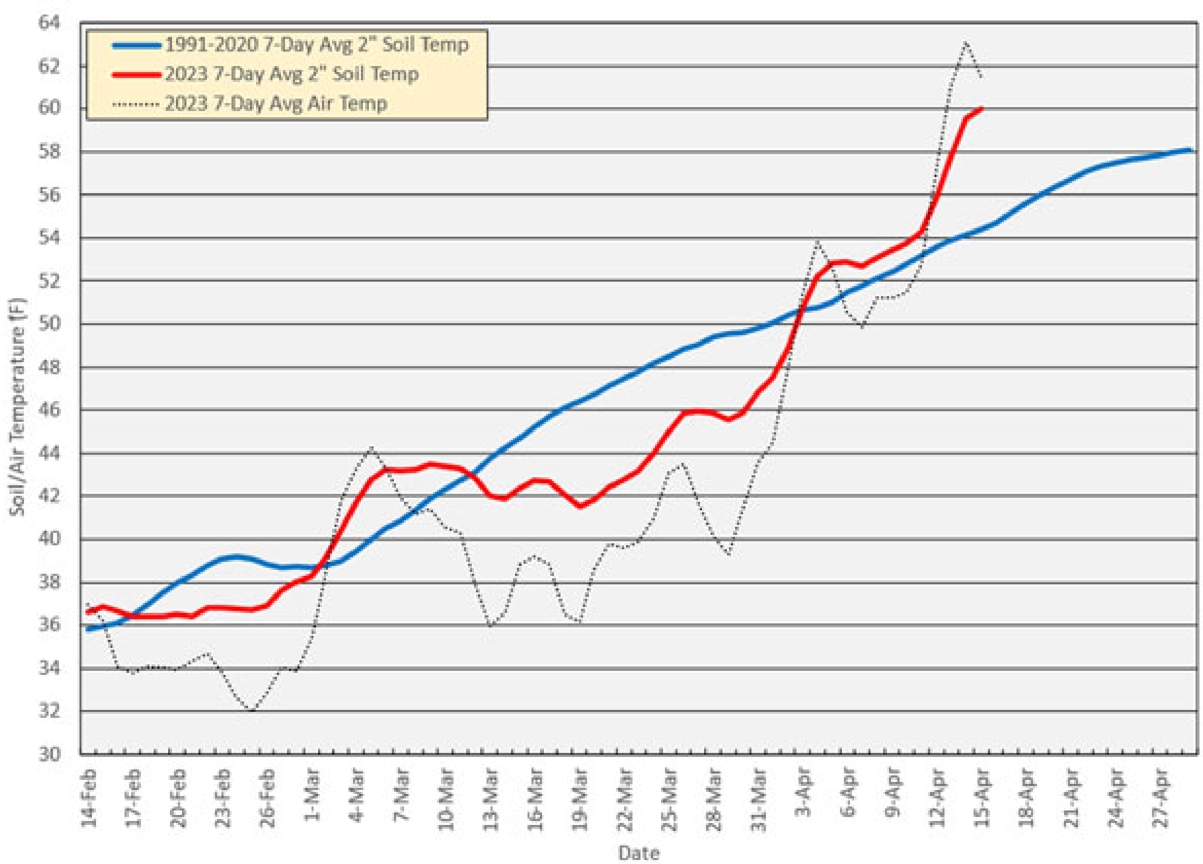

Figure 1. 30-Year average 2-inch soil temperature, 2023 average 2-inch soil temperature, and 2023 average air temperature. Average data plotted are 7-day values. Dates plotted represent the last day of the 7-day average period. Source: Kansas Weather Data Library.

Temperatures this time of year are quite variable though, so 90s in April doesn't mean summer has come early and is here to stay. This past weekend brought a reality check: colder weather. The mornings of April 16 and 17 were chilly, with below-freezing temperatures recorded in many areas. There was even a trace of snow reported in Goodland. This has resulted in cooler soil temperatures, which in turn has halted the increase of the 7-day average. These rapid switches from one extreme to the other are common this time of year. The 30-year average soil temperature line is much smoother than the 2023's line because the warm and cool periods in any given year average out when added to all the other years. We shouldn't expect 2023, or any other year, to mirror the gentle increase of the average line. But now that we're into the second half of April, it's very unlikely that average soil temperatures will tumble back down to below 50°F, which is good news for those who use that threshold to determine when to plant crops.

Growing degree day accumulation

Speaking of thresholds, an additional measure of the ground's readiness for planting is growing degree days (GDDs). Given the switch to warmer weather in April, are the accumulated growing degree days for 2023 above or below normal? Table 1 contains the number of corn GDDs at a few select locations around Kansas. The low and high thresholds for corn GDDs are 50° and 86°F, respectively. The high temperature must reach at least 50°F to accumulate corn GDDs on any given day, and the warmer the average temperature is that day, the more GDDs there are. This year's accumulated corn GDDs are above normal at all locations, even in northwest Kansas where snow was plentiful and temperatures were often the coldest in the state during winter. At four locations, the total GDDs are above 400, historically considered one threshold for the ground's readiness to plant corn. As spring continues and temperatures warm, the average number of GDDs accrued each day increases, so the totals will increase faster in the coming weeks and all locations should be above 400 by month's end.

Table 1. Accumulated corn growing degree days at select Kansas sites through April 15 compared with 1991-2020 normals. 2023 GDDs are taken from the nearest Mesonet site to the listed locations, while 30-year normals are derived from NCEI normal temperatures.

Location	2023 YTD	Normal YTD	Difference	Average Daily Corn GDDs		
				Apr 15	May 1	May 15
Ashland	620	437	+183	11	13	17
Belleville	288	237	+51	8	10	14
Garden City	414	358	+56	9	12	15
Goodland	308	272	+36	7	9	13
Hays	360	315	+45	9	11	15
Hutchinson	427	311	+116	9	11	15
Manhattan	362	291	+71	8	11	15
Olathe	389	280	+109	9	12	15
Parsons	446	332	+114	10	12	15

Soil moisture status

One important variable for a successful start to the growing season that is missing from some locations is adequate moisture. Year-to-date precipitation as of April 15 is below normal in all of Kansas' nine climate divisions (Table 2). Statewide, the average precipitation is 3.18 inches or 64% of normal. Northeast Kansas is closest to normal (5.60 inches or 95% of normal), with east central Kansas close behind (6.28 inches or 94% of normal). Southwest Kansas is the driest division (0.99 inches or 32% of normal).

Table 2. Year-to-date precipitation totals and percentages of normal for the state and each of Kansas' nine climate divisions, as of April 15.

	Year-to-date (Jan 1-Apr 15)		
	Average Precip. (inches)	**Departure (inches)**	**% Normal**
Northwest	2.48	-0.75	77%
North Central	2.63	-2.11	55%
Southwest	5.60	-0.28	95%
West Central	2.02	-1.24	62%
Central	2.78	-2.30	55%
East Central	6.28	-0.37	94%
Southwest	0.99	-2.11	32%
South Central	2.36	-3.08	43%
Southeast	4.87	-2.67	65%
STATE	3.18	-1.79	64%

Weather outlooks

Temperatures will continue to warm during the spring, but will undoubtedly vary from week to week. In the short term, another round of cooler air this coming weekend could bring freezing temperatures to parts of Kansas, just as we had this past weekend. The 8 to 14-day temperature forecast issued on April 16 (Figure 2) says there are slightly higher than normal chances for above-normal temperatures for the last week of April, so a freeze this weekend is not currently expected to usher in an extended period of below normal temperatures. The 8 to 14-day precipitation outlook for the same period (Figure 3) has equal chances of above, below, and near-normal precipitation for much of the state. There are slightly elevated chances of above-normal precipitation in the southeast and below-normal precipitation in the far west. At this stage, we need the whole state to be covered in shades of green, indicating above-normal chances for precipitation to erase the growing precipitation deficits in the drought-stricken areas of Kansas. As of now, it doesn't appear that relief in these areas is imminent.

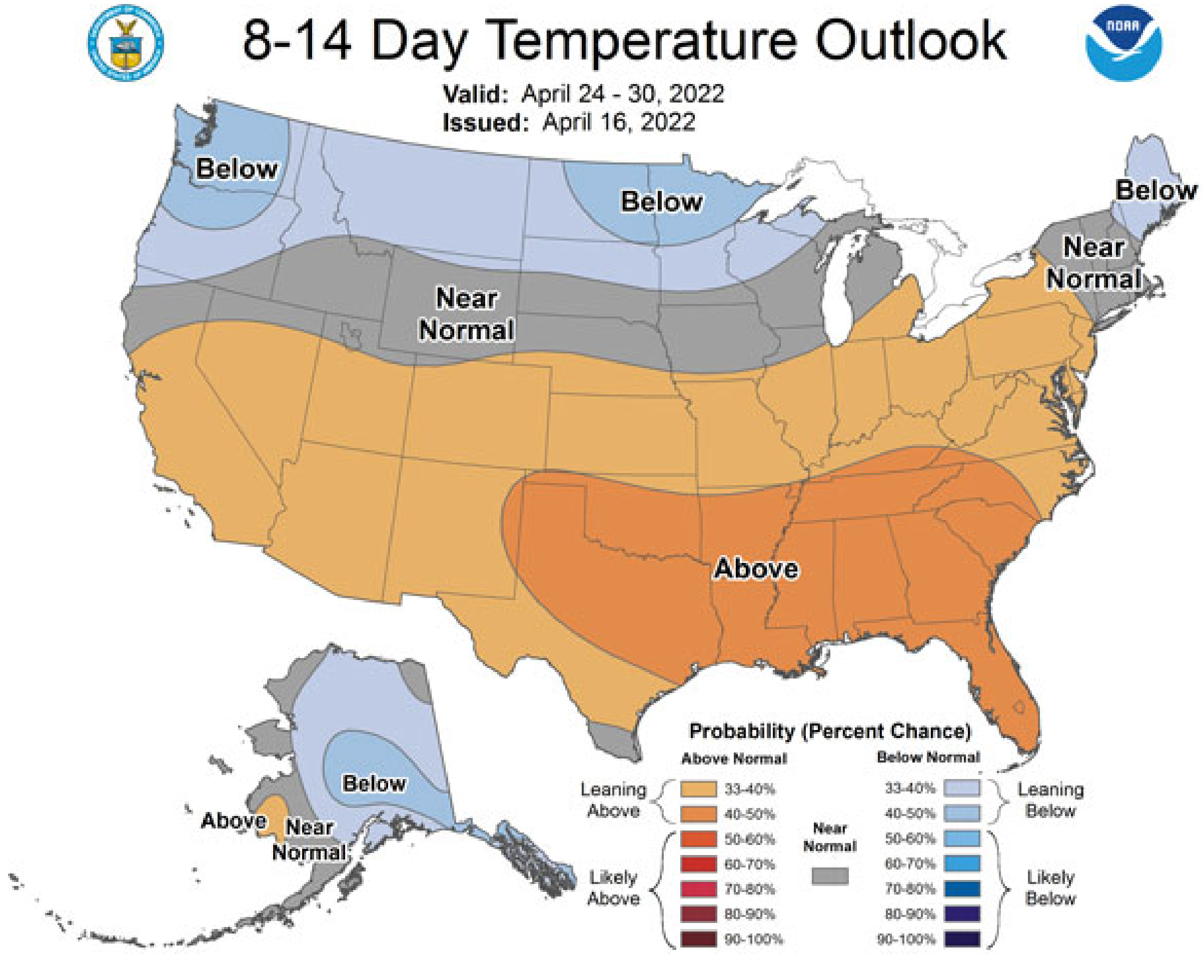

Figure 2. Climate Prediction Center's 8 to 14-day temperature outlook.

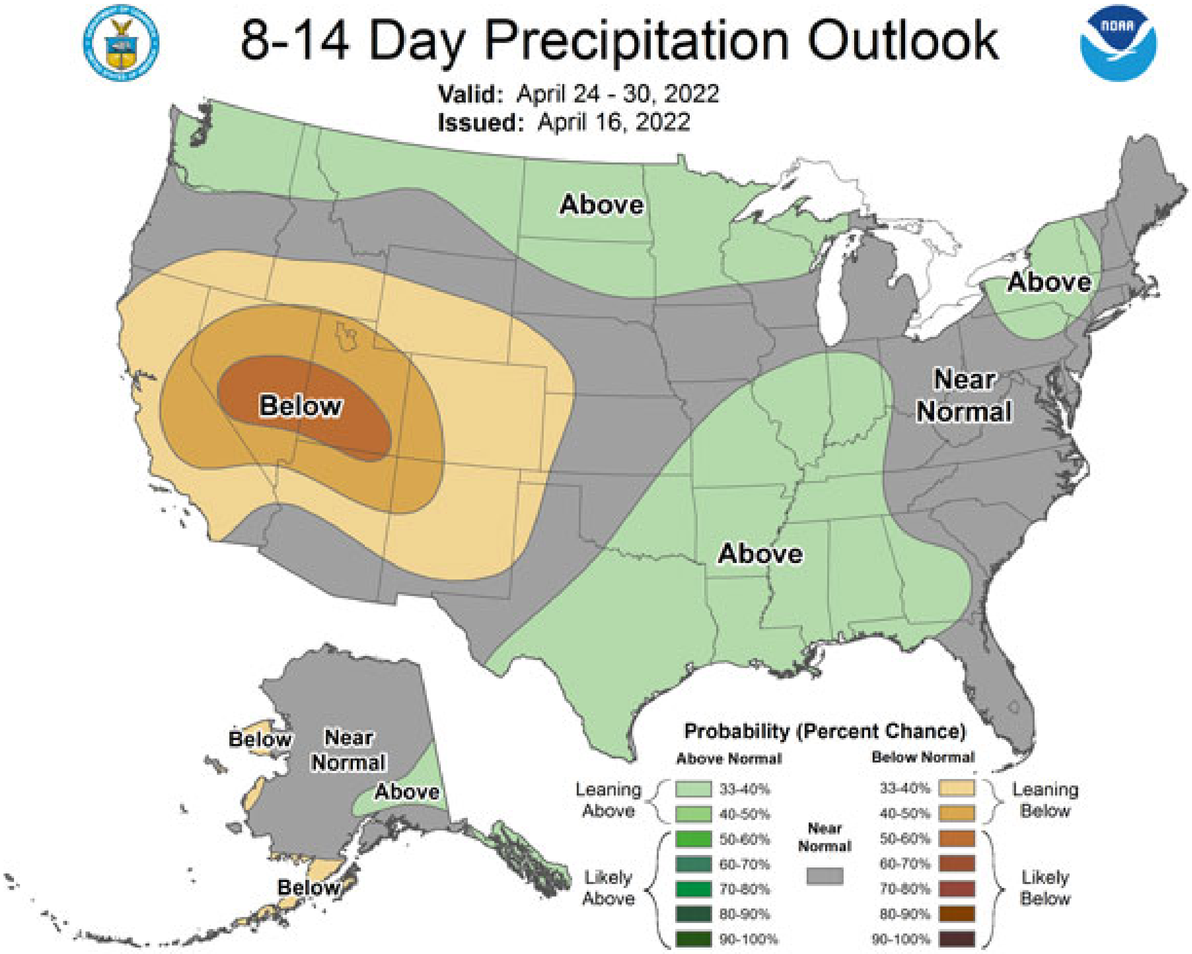

Figure 3. Climate Prediction Center's 8 to 14-day precipitation outlook.

Matthew Sittel, Assistant State Climatologist
msittel@ksu.edu