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Extension Agronomy

eUpdate

03/28/2024

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. Update - Soil temperature and moisture status in Kansas

The planting date is one of the most critical factors for row crops. Farmers should base this decision on soil temperature and moisture rather than just calendar dates.

Soil temperature

After a cooling trend during the last week of March, air temperatures across Kansas seem to be back to normal again with the forecast continuing at and/or above normal temperatures to persist into April. Therefore, planting decisions should consider the current soil temperatures and the short-term (7-day period) forecast.

For the 7-day period between March 21 and 27, average soil temperatures at 2 inches across Kansas districts ranged from 41°F to 53°F (Figure 1). You can monitor soil temperatures across the state by using the Kansas Mesonet's soil temperature tracking tool at https://mesonet.k-state.edu/agriculture/soiltemp/.

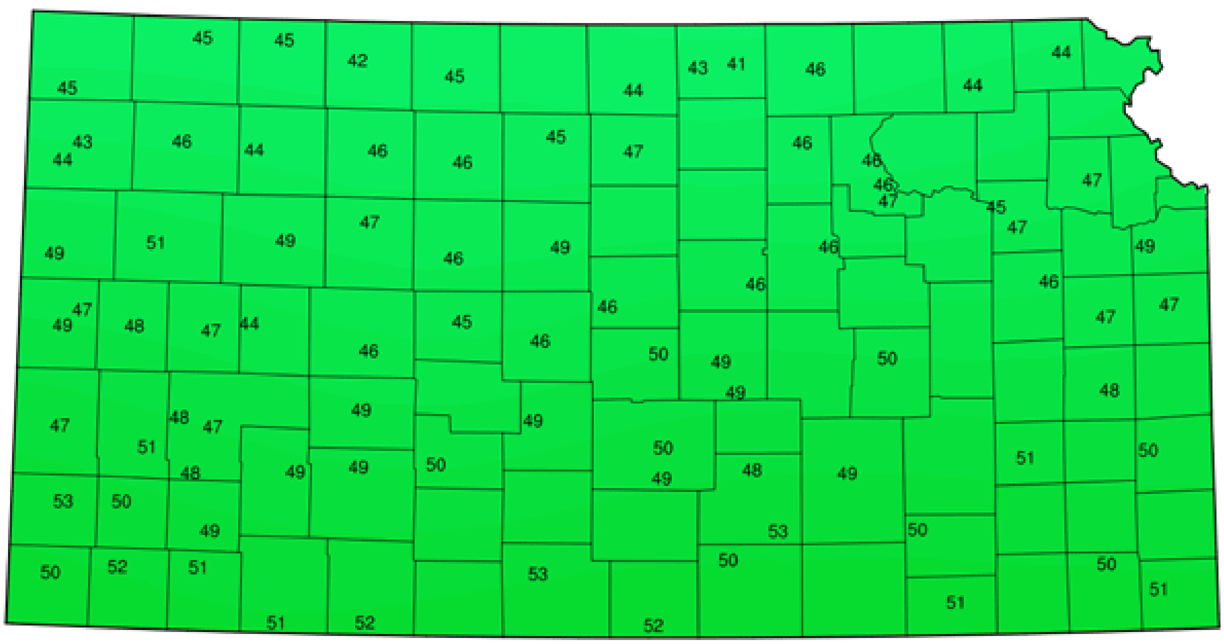

Figure 1. Average soil temperatures at 2-inch soil depth for the week of March 21 to 27, 2024. Source: Kansas Mesonet. (https://mesonet.k-state.edu/agriculture/soiltemp/)

Projections for the next 6-10 days lean toward near-normal temperatures (Figure 2). In parallel, there is a slight favor for below-normal precipitation for most of the state, which should aid in keeping soil temperatures in a slowing warming trend (Figure 3).

It is worth mentioning that topsoil temperature differences could be large depending on multiple factors. Actual changes in any given field will be affected by several factors, including soil type, soil moisture, residue cover, tillage, landscape position, and others. For example, wet soils under a no-tillage system are expected to warm up slower. Dry soils will fluctuate more rapidly, matching air temperatures, particularly if skies are clear.

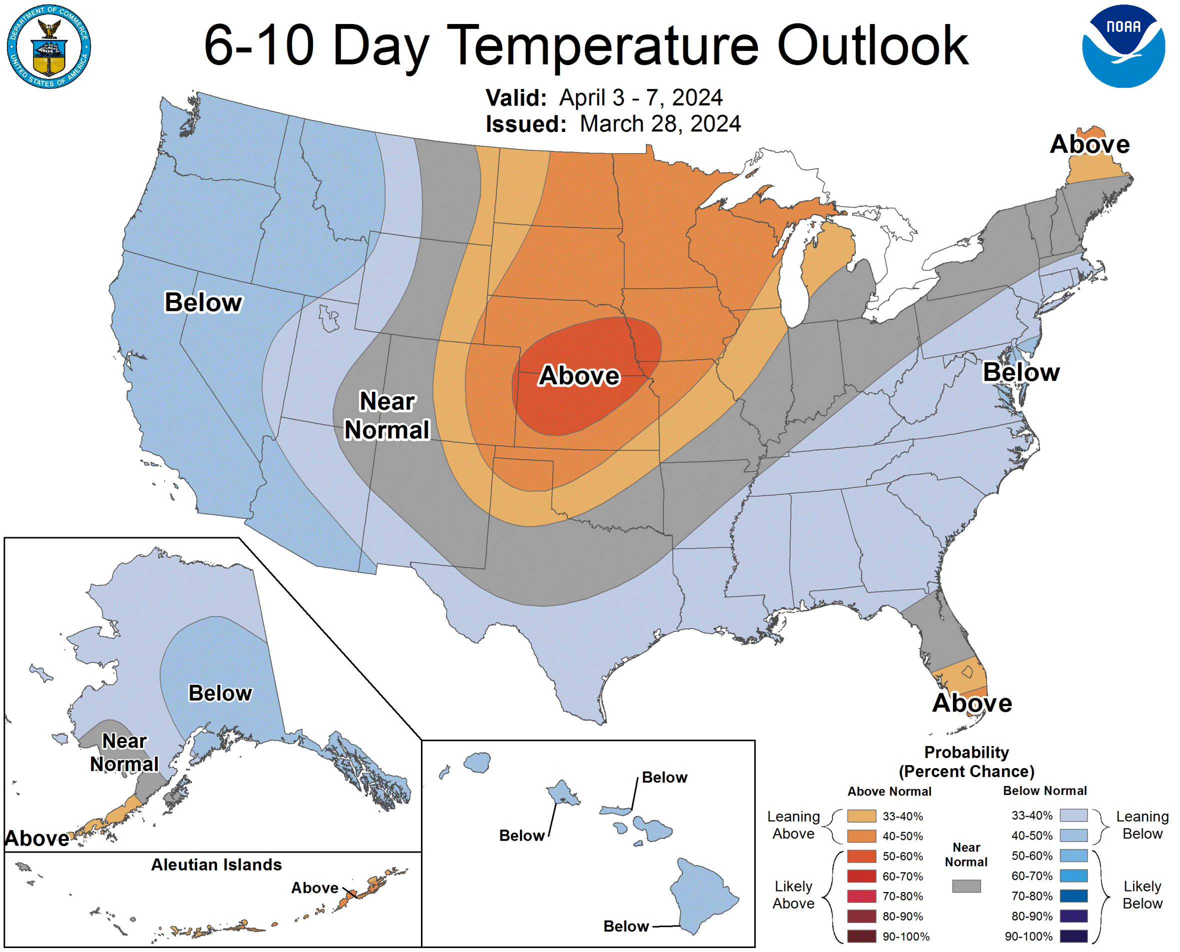

Figure 2. 6 to10-day temperature outlook for April 3-7, 2024. Source: NOAA.

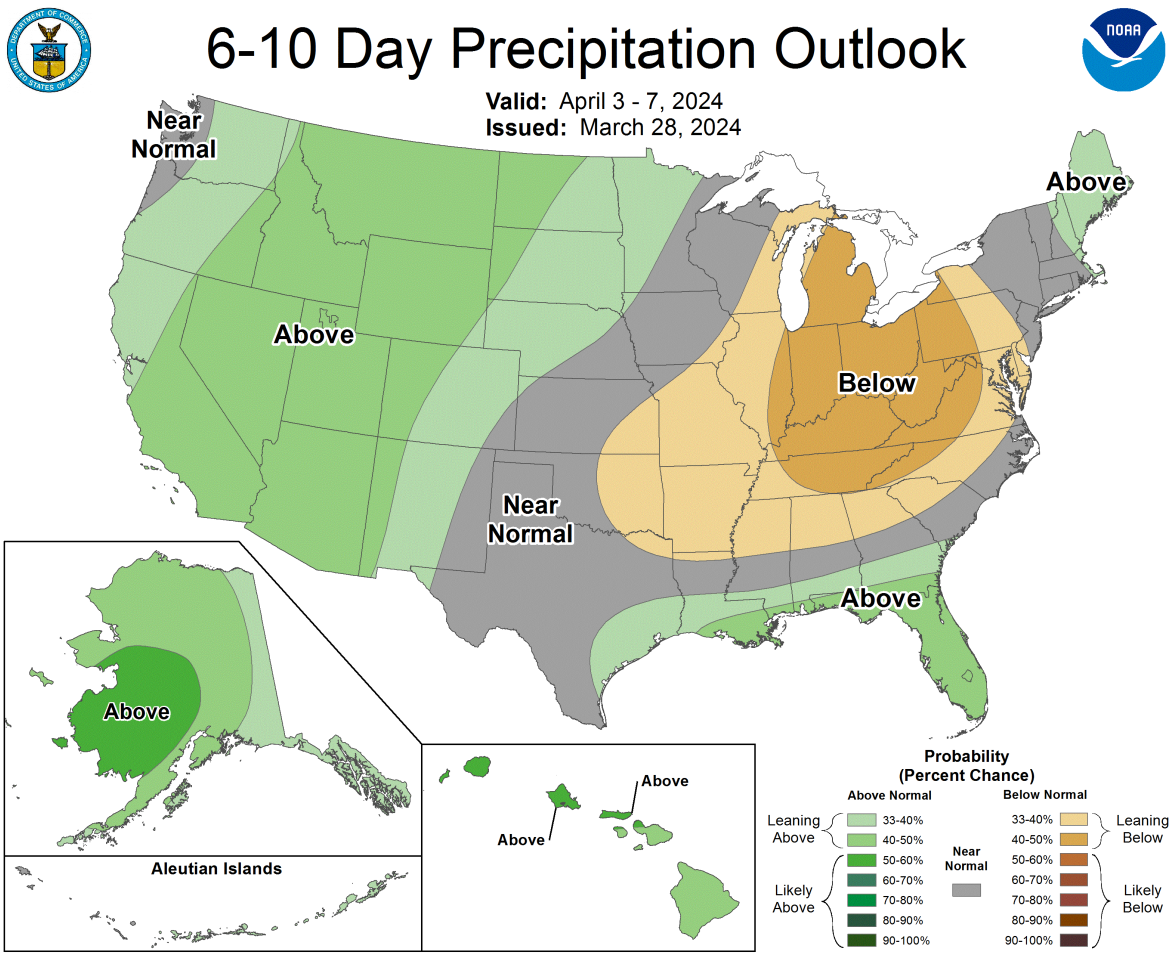

Figure 3. 6 to10-day precipitation outlook for April 3-7,2024. Source: NOAA.

Soil moisture

Current soil moisture is lowest across portions of southwest and south-central Kansas (Figure 4). Recent precipitation has improved moisture in the north and eastern parts of the state over the last week. However, actively growing vegetation has increased demands in these areas as well.

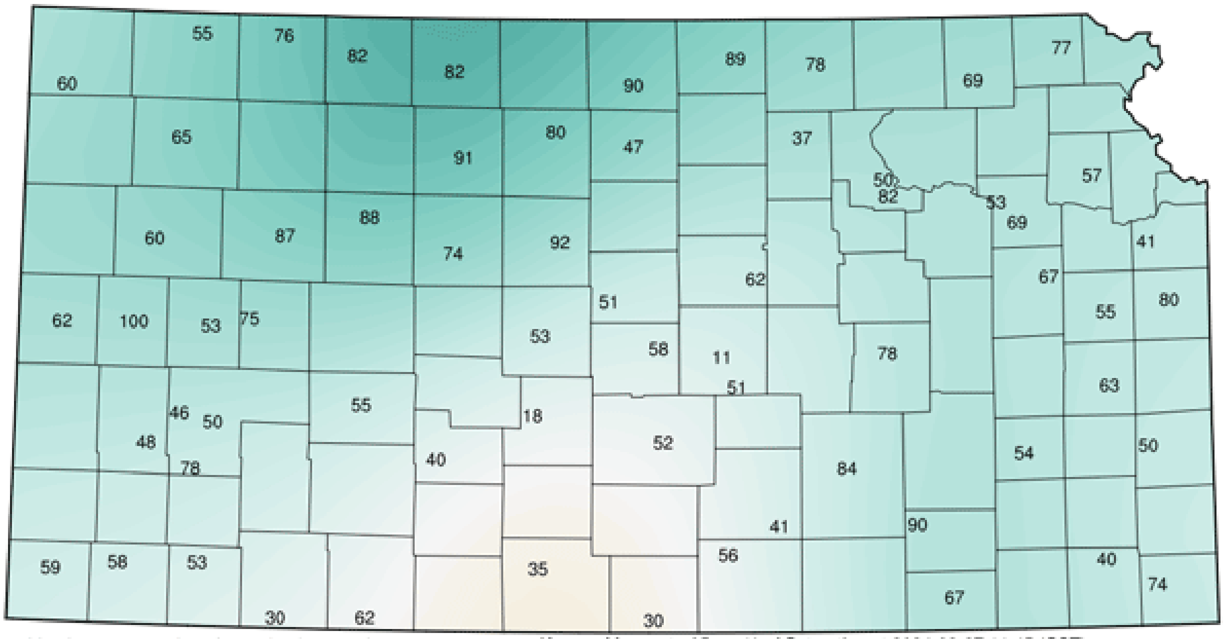

Figure 4. Soil moisture as percent of saturation at 2 inches (5 cm) as of March 27, 2024. Source: Kansas Mesonet https://mesonet.k-state.edu/agriculture/soilmoist/

The largest departure in precipitation occurred in south-central Kansas over the last two weeks (Figure 5). No substantial change in moisture is expected in this region, and March is likely to end on the dry side for much of southwest and south-central Kansas with drought expanding in these areas (Figure 3).

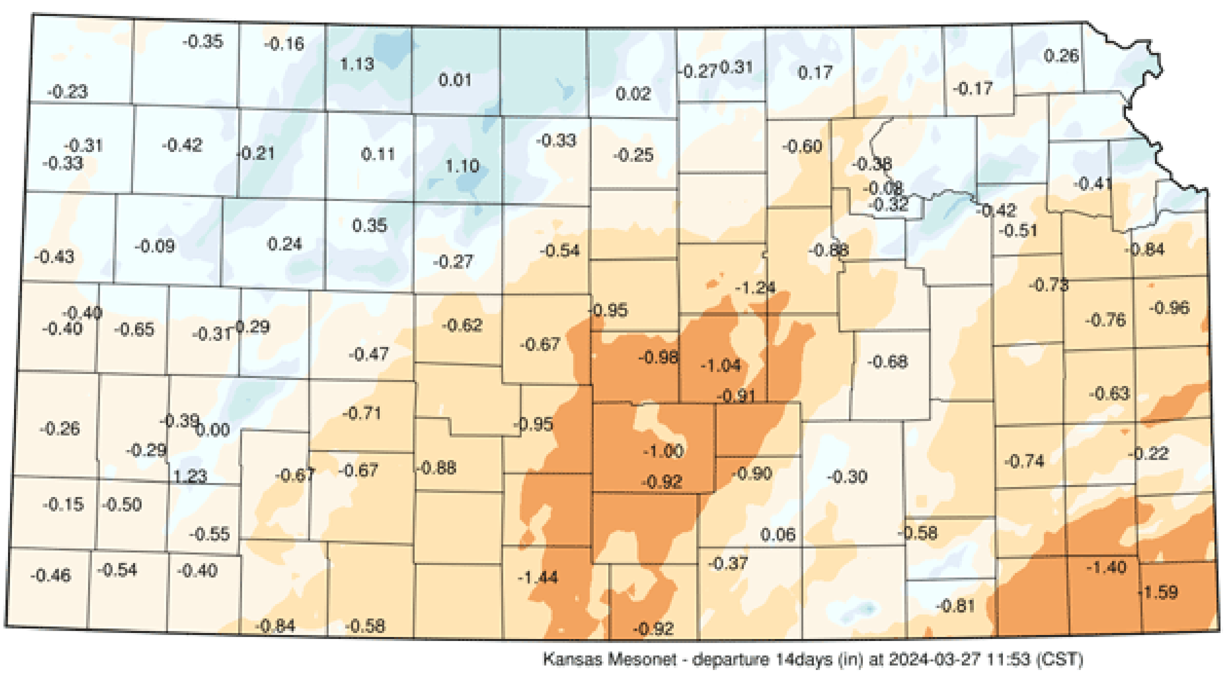

Figure 5. Departure from normal precipitation for the last two weeks ending March 27, 2024. Shades of orange indicate below normal precipitation. Source: [Kansas Mesonet](https://mesonet.k-state.edu/).

Management considerations

Optimal soil temperature for crop emergence

Every summer row crop has an optimal soil temperature for its emergence. Corn's minimum temperature for germination and early growth is 50°F. When soil temperatures remain at or below 50 degrees after planting, the damage to germinating seeds can be particularly severe.

Uniformity and synchrony in emergence are critical and primarily achieved when soil temperatures are consistently above 55°F. Uneven soil temperatures around the seed zone can produce non-uniform crop germination and emergence. Lack of uniformity in emergence can greatly impact corn potential yields. Competition between early-emerged and late-emerged plants, as well as competition from weeds, may negatively impact biomass and grain production. Compensation mechanisms like tillering have limited potential compared to other crops' compensation mechanisms, like branching in soybeans.

Impact of a hard freeze on corn

Corn is also more likely than other summer crops to be affected by a hard freeze after emergence if it is planted too early. The impact of a hard freeze on emerged corn will vary depending on how low the temperature gets, the intensity and duration of the low temperatures, field variability, residue distribution, tillage systems, soil type, moisture conditions (more severe under dry conditions), and the growth stage of the plant. Injury is most likely on young seedlings or plants beyond the V5-6 growth stage when the growing point is above the soil surface.

The average day for the last spring freeze (32°F) varies considerably across the state (Figure 6). From southeast to northwest Kansas, the earliest last spring freeze date is April 1-14, and the latest is May 5-12. Thus, corn planting dates before the second week of April in the southeast or the second week of May in the northwest would represent a high risk of suffering from late spring frost damage.

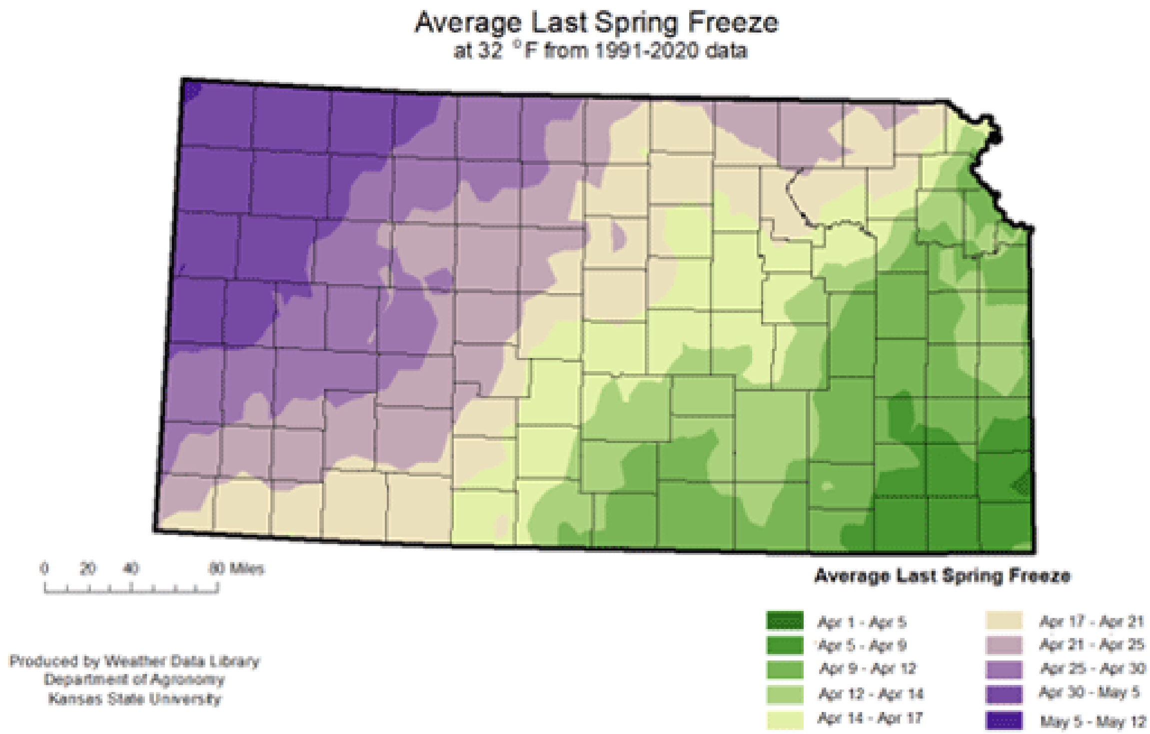

Figure 6. Average last spring freeze (32°F) for Kansas. Source: Kansas Mesonet.

More information about the planting status of summer row crops will be provided in upcoming issues of the Agronomy eUpdate. Stay tuned!

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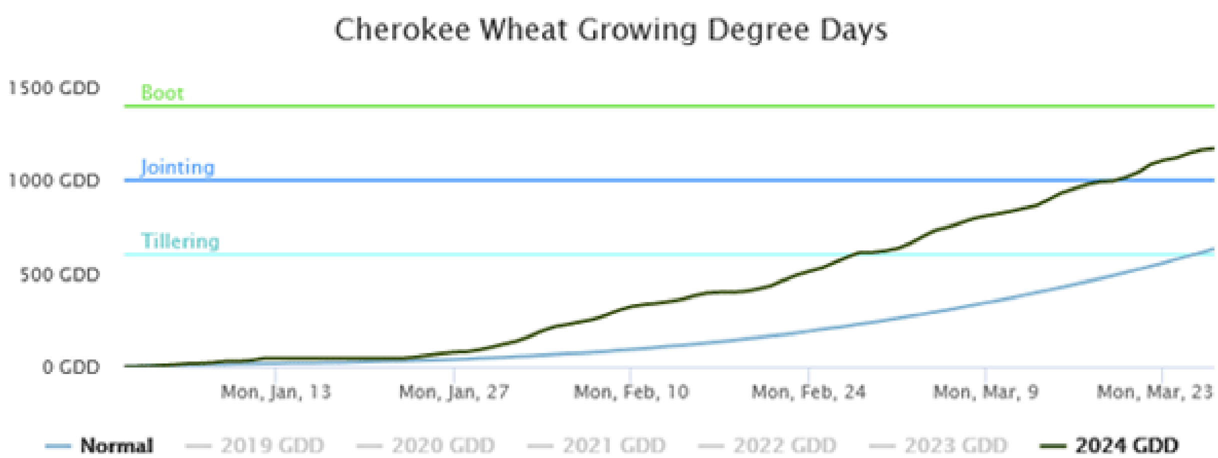
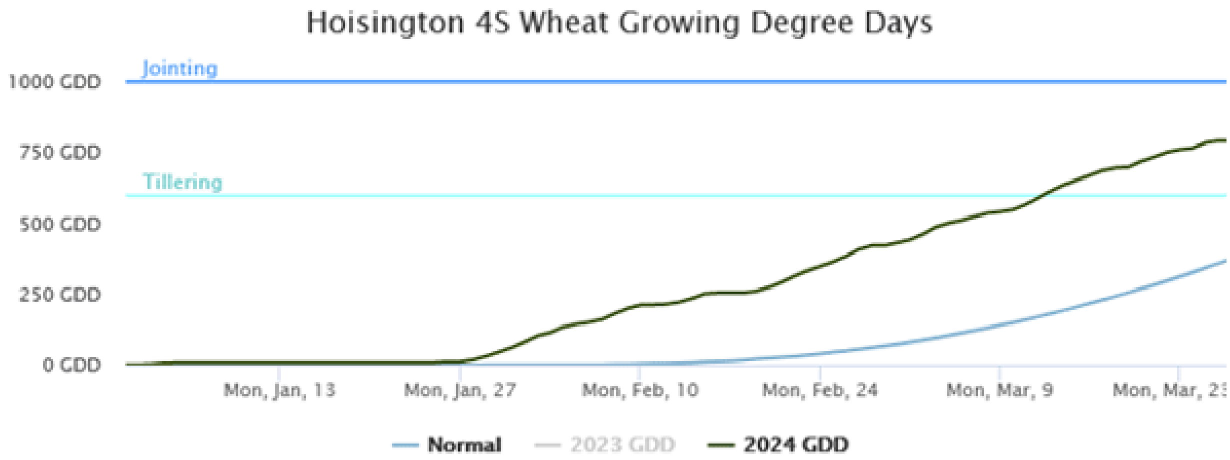
2. 2024 Kansas wheat: Crop conditions and risk of freeze injury

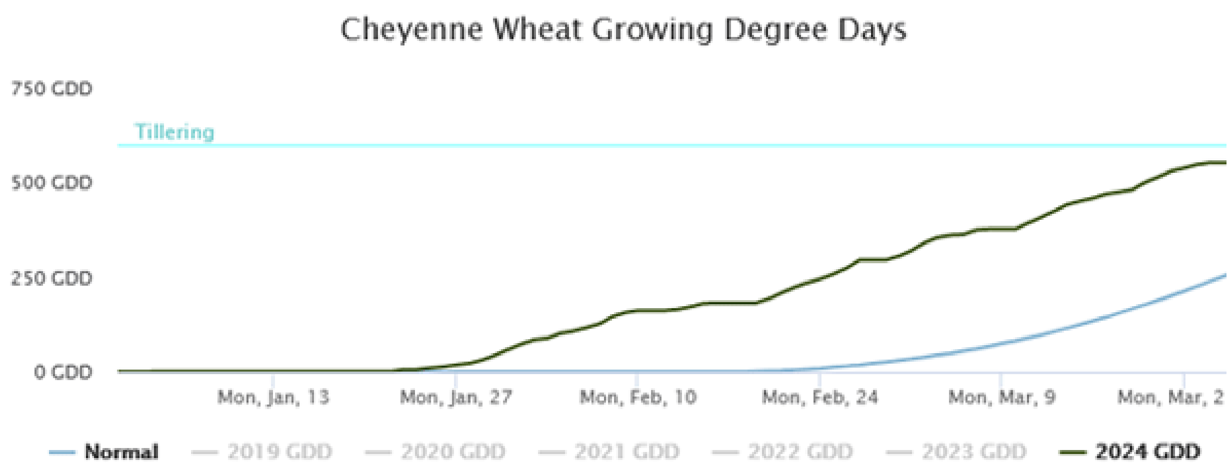
Current crop condition

The 2023-24 winter wheat crop in Kansas was off to a good start in the fall, where even precipitation events across the state resulted in good crop establishment. Precipitation events occurred at different times for western (mid-September) and central (October) Kansas, predominantly matching good planting timings for these regions. This, coupled with winter snowfall and rain, led to over 50% of the winter wheat crop being rated as good or excellent by the USDA-NASS. Perhaps the largest exception was the area starting around Hays and moving north and west, which missed many of the precipitation events and where the crop did not emerge until later in the fall or, at times, in the spring.

The winter was also fairly warm, and more temperature accumulated, leading to a more advanced crop development than historical averages (Figure 1). For example, southeast Kansas has accumulated over 1000 growing degree units since January, more than double the historical average. Consequently, the estimated growth stage of the crop is somewhere during stem elongation, between jointing and boot, when historically the crop should still be just moving from the tillering stage to double ridge or first hollow stem (Figure 2). Likewise, central Kansas has accumulated over 750 GDD temperatures placing the estimated crop growth stage around the beginning of stem elongation (prior to jointing), when normally the crop would still be at the tillering stages. Similarly, the crop in Northwest Kansas, which would typically be nowhere near the end of tillering (~250 GDD), is reaching almost 500 GDD, indicating the end of tillering.







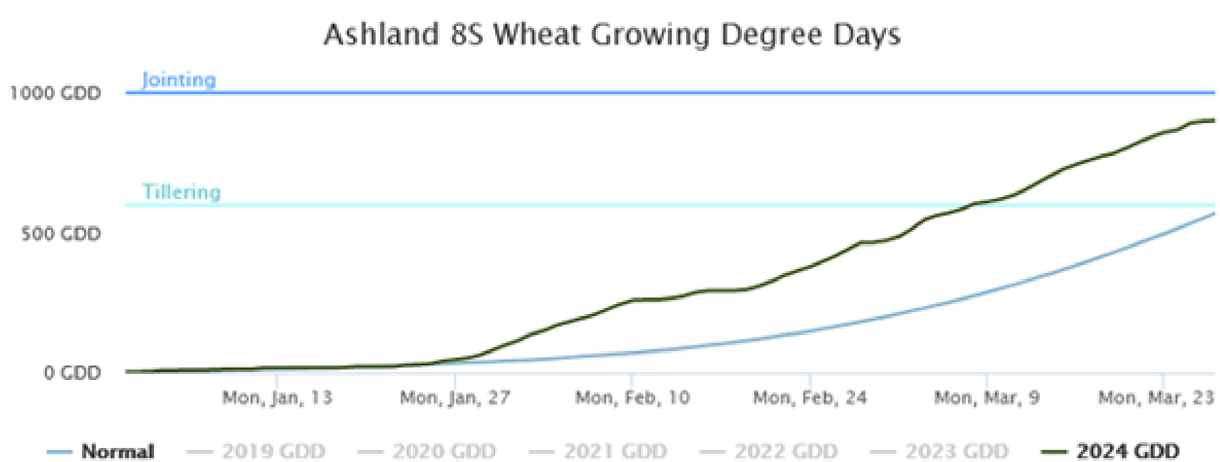


Figure 2. Cumulative growing degree days and simulated crop developmental stage for Cherokee (southeast), Hoisington (central), Cheyenne (northwest), and Ashland (southwest). The blue line denotes the long-term normal, and the green line denotes the current year. Graphs can be created at https://mesonet.ksu.edu/agriculture/wheat/gdd**.**

Potential for freeze injury during March 26-27

Cold air temperatures occurred during March 26-27, which could potentially cause freeze injury to the 2024 Kansas wheat crop. Factors that influence the potential for freeze injury to wheat include primarily:

- Growth stage of the crop
- Air temperatures
- Duration of cold temperatures
- Soil temperatures
- Snow cover

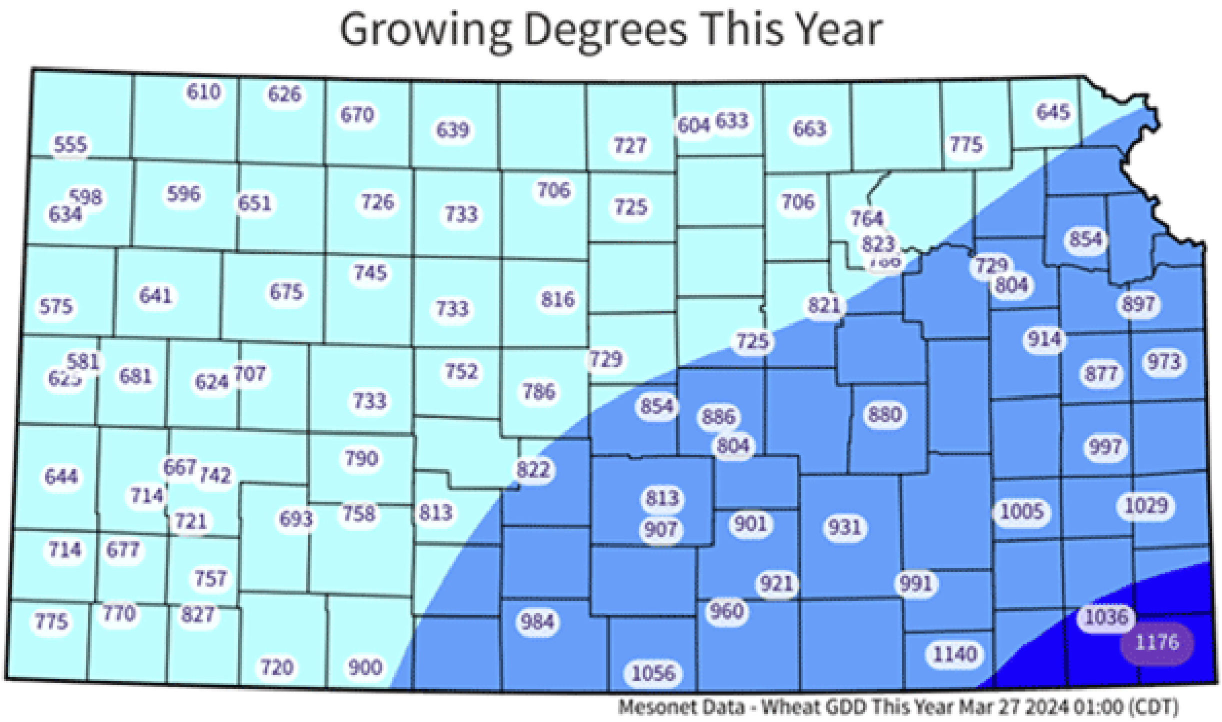
Other factors, such as position in the landscape and the presence of residue covering the soil surface, might also impact the extent of freeze damage within a field. The challenge is integrating all these factors into a reasonable estimate of freeze injury.

Wheat growth stage around Kansas

Based on simple wheat development models, the wheat growth stage around Kansas ranges from upright tillers in the northwest to the early jointing stage in central Kansas to later jointing and reaching flag leaf emergence in south-central and southeast Kansas (Figure 2). For fields that have not jointed yet, the crop can generally withstand temperatures of 15-20°F fairly well, especially if the growing point is still below ground. Kansas Mesonet data indicates that temperatures fell below this threshold, reaching as low as about 10°F in parts of northwest Kansas (Figure 3, top map), suggesting that some injury could be sustained.

If the growing point is already above ground (first joint visible), wheat can sustain temperatures down to about 24 degrees F for a few hours. Minimum temperatures below 24°F for extended periods of time increase the risk of crop injury. Information from the K-State Mesonet indicates that air temperatures were around this 24°F threshold in most of central and north-central Kansas; however, they dipped below the threshold for as many as 17-21 hours in southwest Kansas (Figure 3, bottom map), which can cause damage to fields at the first node of development or more advanced stages.

More advanced fields, such as the second node to flag leaf emergence (southeast Kansas), are more vulnerable to freeze injury, as temperatures near the 24-28°F threshold can cause injury. Minimum temperatures did not seem to fall below these sensitive thresholds in those parts of the state (Figure 3, bottom map).



Color	GDD °F	Estimated Wheat Growth Stage
	0 to 600	Seedling growth or tillering
	600 to 800	Tillering or strongly upright tillers
	800 to 1000	Strongly upright tillers or jointing (first node)
	1000 to 1200	Jointing (first node) or approaching flag leaf emergence

Figure 2. Estimated wheat growth stage as of March 27, 2024. Growth stage is estimated for each county based on temperatures accumulated in the season. Local growth stage may vary with planting date and variety. The KSU Wheat GDD Growth Stage model is available at: https://mesonet.k-state.edu/agriculture/wheat/gdd/

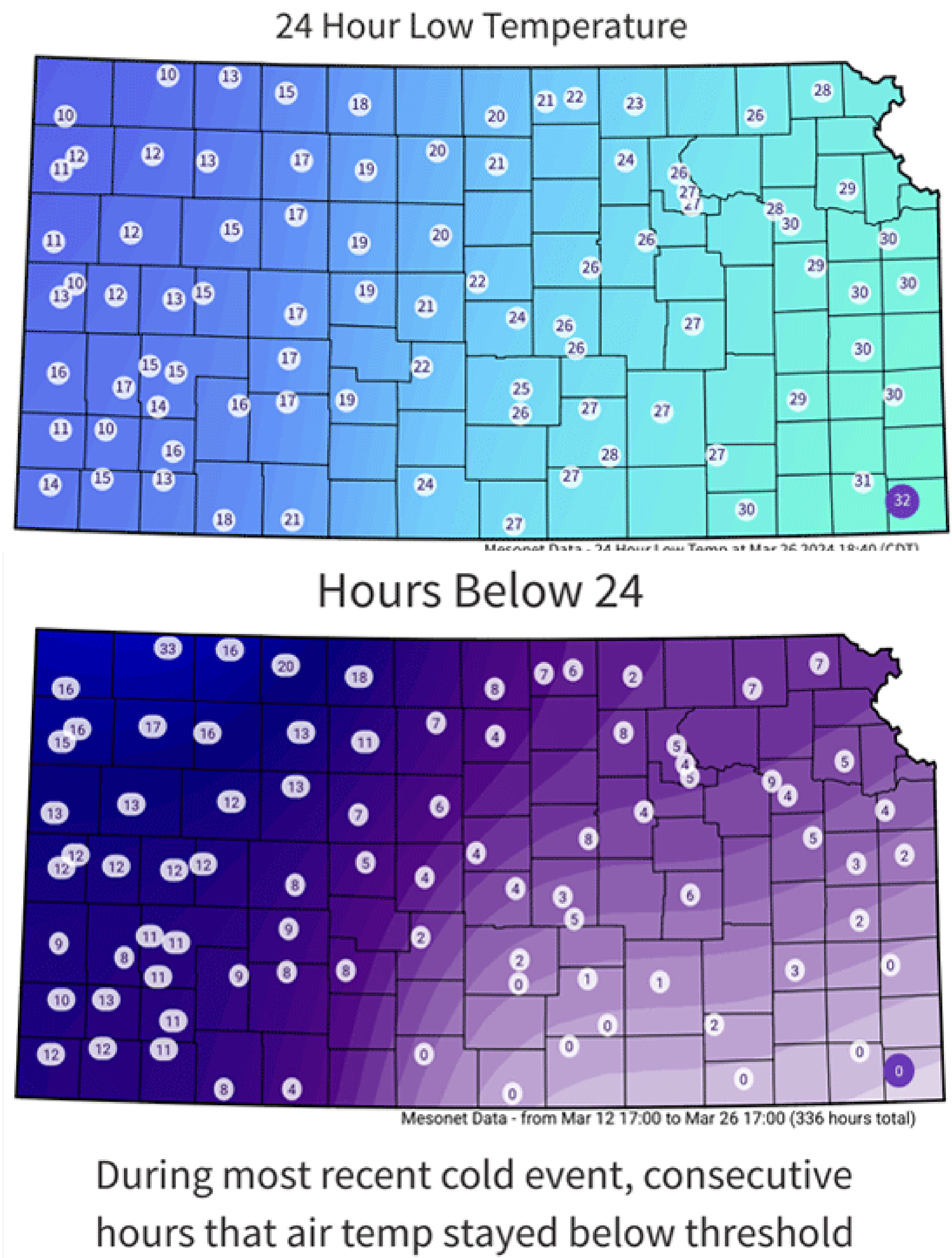


Figure 3. Minimum temperatures observed during the March 26-27 period (upper map) and number of hours below 24°F (lower map) observed during the coldest event during the specified period. Data from https://mesonet.k-state.edu/airtemp/min/hoursbelow/.

Soil temperatures

Soil temperatures can help buffer freezing air temperatures if the growing point is below ground or near the soil surface. However, its buffering capacity decreases as the crop develops and the growing point moves above the soil surface. Thus, we can expect a positive effect from soil temperatures in the majority of the state since soil temperatures did not reach levels below ~35 degrees F (Fig. 4), with exception of southeast where the crop is further along and the growing point is well into the canopy.

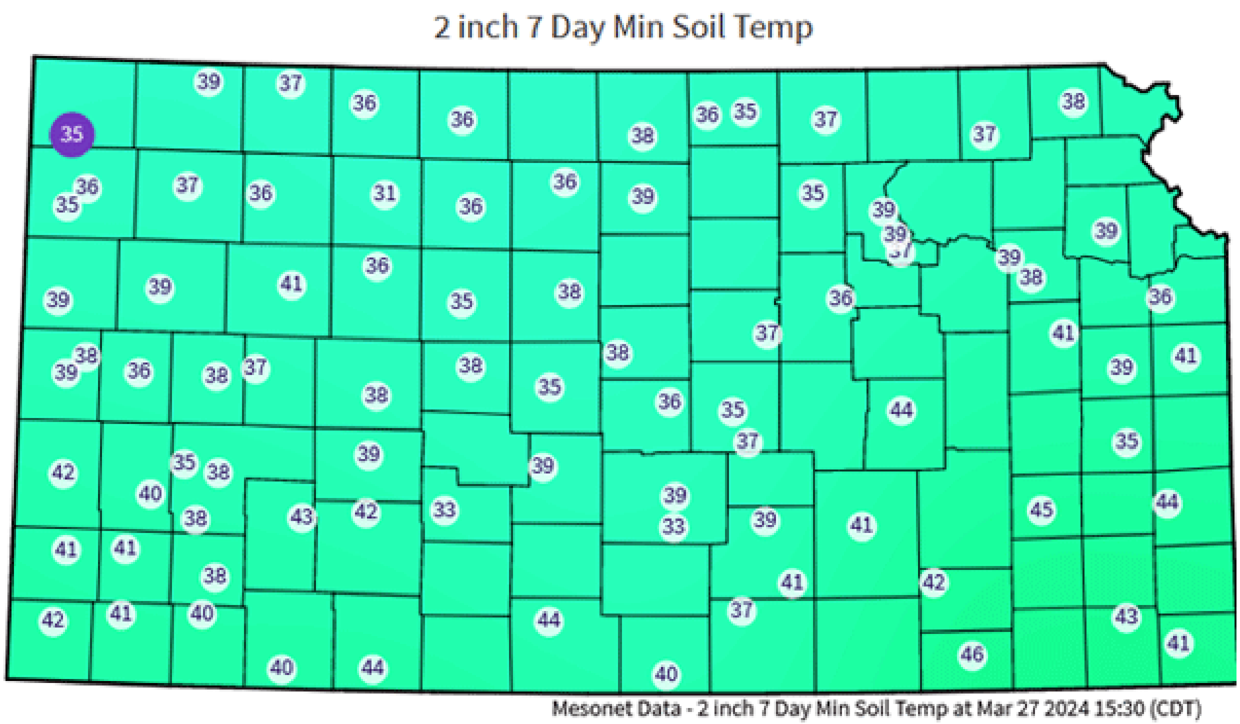


Figure 4. Minimum soil temperatures measured at 2 inch depth observed during the 7 day period preceding March 27. Data from https://mesonet.k-state.edu/agriculture/soiltemp/.

Integrated risk of freeze injury to Kansas wheat

Based on the factors explained above, **we estimate that parts of southwest Kansas would be more exposed to the potential freeze damage**, given that the crop is relatively advanced (at or past jointing) and was met with many hours of air temperatures below 24°F, with lowest temperatures reaching 13°F. This high-risk area corresponds to (1) areas with more hours below the threshold for the predominant crop growth stage and (2) more advanced crop development with temperatures at or below the threshold for freeze damage for the corresponding stage.

In the remainder of the state, temperatures needed to cause damage at the observed crop stages were borderline, and therefore, we expect that only more advanced fields could sustain freeze damage.

Freeze injury symptoms on foliage should occur across the entire state over the next few days. In most cases, however, leaf burn injury alone should not result in any long-term damage to the crop, especially if moisture is available to help the crop recover the lost foliage. Freeze injury symptoms to the developing wheat head, such as a mushy, discolored/brown head, take slightly longer to be visible (10-14 days). Thus, growers with fields at advanced growth stages should check for potential injury to the developing head within this timeframe. For more advanced fields, other symptoms to look for include a yellow flag leaf emerging from the whorl (which would indicate a dead tiller) and wheat heads trapped within the boot and thus emerging from the side of the culm.

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3. Injury symptoms from freeze damage to wheat

The recent cold temperatures experienced during March 26-27, 2024, were enough to cause freeze damage to winter wheat in parts of Kansas. The actual freeze damage will be region-specific depending on crop growth stage and minimum temperatures (some regions had the worst combination of temperatures and crop growth stage) and, within a region, field-specific owing to many individual aspects such as crop density, residue level, etc. While there is nothing that we can do immediately, growers can prioritize the fields where they sample for freeze damage symptoms depending on conditions that are more likely to result in freeze damage. In this article, we discuss the individual conditions that might help growers prioritize fields to be sampled and injury symptoms to look for.

Field conditions that can affect the potential for freeze damage

Density of the stand and condition of the plants. If the stand is thick, that will tend to reduce the extent of freeze damage as the warmth of the soil will radiate up into the canopy. On the other hand, well-fertilized succulent wheat has often sustained more freeze injury than wheat that is not as well-fertilized. Thin stands are at higher risk of injury because the air can penetrate the stand more easily. If the plants were wet before the freeze, this can result in a coat of ice on the plants that may protect the growing point to some extent. However, the cold will go through the ice if temperatures get too low.

Residue. No-till fields can often sustain more freeze damage because the residue acts as a blanket and prevents the heat from the soil from radiating up into the plant canopy.

Soil moisture. There is often less freeze injury at a given temperature when soils are wet than when dry. Wetter soils tend to radiate a little more warmth than dry soils. On the other hand, drought-stressed plants tend to be more hardened against cold injury and their lower leaf water content tends to decrease the severity of the freeze injury.

Wind speed. Windy conditions during the nighttime hours when temperatures reach their lows will reduce the amount of warmth radiating from the soil and increase the chance of injury.

Temperature gradients within the field (position on the landscape). Low spots in the field are almost always the first to have freeze injury. The coldest air tends to settle in the low areas, especially under calm wind conditions.

Wheat variety. Although the sensitivity to freezing temperatures at a given growth stage is very similar across all varieties, varieties can differ in their release from winter dormancy in as much as three weeks. Because of differences in winter-dormancy release, late-release varieties may escape a freeze injury because they are delayed in their development.

Injury symptoms to look for in the coming days

There are many possible scenarios after a freeze, and producers should not make any immediate decisions following a freeze event. Several days of warm temperatures are needed to properly assess freeze damage to the wheat crop.

Greenup

Wheat that hasn't started to joint yet (Feekes 3 through 5) might suffer damage to the existing foliage, but the growing points should mostly be protected by the soil temperatures that were sustained above 38 degrees F across the entire state; thus likely escaping freeze injury. This wheat will have cosmetic damage to the leaves that will show up almost immediately as leaf tip burn (Figure 1).

Figure 1. Leaf burn from freeze damage. By itself, this is cosmetic damage only. Photo by Romulo Lollato, K-State Extension Wheat and Forages Specialist.

Jointing

Where wheat was at the jointing stage, producers should watch their fields closely over the next 7 to 10 days from the freeze event for the following:

- **The color of newly emerging leaves**. If they are nice and green, that probably indicates the tiller is alive. If newly emerging leaves are yellow, that probably indicates the tiller is dead. The color of existing leaves is not terribly important, except for the flag leaf, which should not have emerged at this point in time yet. Existing leaves will almost always turn bluish-black after a hard freeze, giving off a silage odor. Those leaves are burned back and dead, but that in itself is not a problem as long as newly emerging leaves are green.

- **The color of the developing head or growing point** in wheat that has jointed. As long as heads are light green, crisp, and turgid, the head in that tiller is fine. If the head is whitish, flaccid, and mushy, it has died (Figure 2).
- **Ice in the stems**. If there was ice in the stems below the first node the morning of the freeze, those tillers may be damaged (although not always) and may not produce grain. You may see split stems from ice accumulation.
- **Stem integrity**. If the wheat lodged immediately after the freeze, that indicates stem damage. Later tillers may eventually cover the damaged tillers. Even if there is no immediate lodging, look for lesions or crimps anywhere on the stems. If these symptoms are present, it usually means the wheat will lodge at some point during the season. If the stems look undamaged, that's a good sign.

Figure 2. Following an early freeze, crops at jointing might still develop healthy heads (left panel), but depending on minimum temperatures and duration of the freeze event, the developing head might be killed even if still within the stem killed (right panel). The dead head is whitish and flaccid, while the healthy head is light green and turgid. Photos by Romulo Lollato, K-State Research and Extension.

For the first few days, producers should simply walk the fields to observe lodging, crimped stems, and damaged leaves. They should not take any immediate action as a result of the freeze, such as destroying the field for re-cropping. It will take several days of warm weather to evaluate the extent of damage accurately. After several days, producers should split open some stems and check the developing head.

Where stems and/or growing points were killed by the freeze, new tiller growth (coming from the crown area) will occur (Figure 3). In many cases, new tiller growth can be observed even when the stems do not show any symptoms of freeze damage for some time. In those cases, the first sign that the tillers are dead is the sudden growth of new tillers at the base of the plant.

If secondary tillers may begin growing normally and fill out the stand, the wheat may look ragged because the main tillers are absent. Producers should scout for bird cherry oat aphids and other potential insect or disease problems on these late-developing tillers. Enough tillers may survive to produce good yields if spring growing conditions are favorable. If both the main and secondary tillers are injured, the field may eventually have large areas that have a yellowish cast and reduced yield potential.

Figure 3. Left: A stem that was split open by having ice form within the stem. This stem has died and a new tiller has begun to grow at the base. Right: Some of the tillers on this plant had freeze damage to the lower stems. These stems are dying, but the symptoms may not be immediately evident. The growth of new tillers from the base of the plant is a sure sign that the main tillers are dead or dying. Note the brown lesion on the stem with the two new tillers. Photos by Jim Shroyer, professor emeritus, K-State Research and Extension.

Boot

Some crops in southeast Kansas might have reached this stage when the freeze happened. At the boot stage, wheat can be injured if temperatures drop down into the mid to upper 20's for several hours. Injury is more likely if it occurs repeatedly and is windy at night. To detect injury, producers should wait several days, split open some stems, and look at the developing head. If the head is green or light greenish in color and seems firm, it will most likely be fine. If the head is yellowish and mushy, that's a sign of freeze injury.

Freeze injury at the boot stage causes several symptoms when the heads are enclosed in the sheaths of the flag leaves. Freezing may trap the spikes inside the boots so that they cannot emerge normally. When this happens, the spikes will remain in the boots, split out the sides of the boots, or emerge base-first from the boots.

Sometimes heads emerge normally from the boots after freezing but remain yellow or even white instead of their usual green color. When this happens, all or part of the heads have been killed. Frequently, only the male parts (anthers) of the flowers die because they are more sensitive to low temperatures than the female parts. Since wheat is self-pollinated, sterility caused by freeze injury results in poor kernel set and low grain yield.

It's possible for some of the spikelets to be alive and a healthy dark green while other spikelets on the same head are damaged. If a spikelet flowers normally and the kernels on that spikelet develop normally, then the head is at least partially viable and will produce grain (unless it freezes again, of course).

More information on freeze damage to wheat is available in *Spring Freeze Injury to Kansas Wheat*, K-State Research and Extension publication C646, available at: http://www.ksre.ksu.edu/bookstore/pubs/C646.pdf

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4. First hollow stem update - March 27, 2024

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 the eUpdate article "Optimal time to remove cattle from wheat pastures: First hollow stem").

First hollow stem update

To screen for FHS during this important time in the growing season, the K-State Extension Wheat and Forage's crew measure FHS on a weekly basis in 16 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 the hollow stem is reported for each variety in Table 1. As of March 18, 2024, all but three varieties had already reached first hollow stem, with an average length of 2.8 cm between the crown and the developing head. The remaining three varieties (CP7869, KS Ahearn, and KS Providence) reached first hollow stem by March 25, 2024 (Table 1).

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 on 19 and 26 of February and 4, 11, 18, and 25 of March 2024 of 16 wheat varieties sown mid-September 2024 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	**2/19**	**2/26**	**3/4**	**3/11**	**3/18**	**3/25**
AP Prolific	0.0	0.0	0.1	0.1	**2.0**	-
AP24 AX	0.0	0.0	0.4	0.6	**5.5**	-
AR Iron Eagle 22AX	0.0	0.0	0.2	0.7	**4.4**	-
CP 7017AX	0.0	0.0	0.1	0.5	**3.7**	-
CP 7266AX	0.0	0.0	0.1	0.4	**3.1**	-
CP 7869	0.0	0.0	0.1	0.2	0.8	**3.1**
CP 7909	0.0	0.0	0.2	0.6	**3.2**	-
Croplan CP15CW3388#011	0.0	0.0	0.1	0.3	**2.9**	-
Guardian	0.0	0.0	0.2	0.3	**3.2**	-
Kivari AX	0.0	0.0	0.2	0.6	**3.0**	-
KS Ahearn	0.0	0.0	0.1	0.1	0.9	**3.2**
KS Providence	0.0	0.0	0.1	0.2	1.1	**5.7**
Limagrain LCH16AC403-1	0.0	0.0	0.1	0.4	**3.4**	-
Polansky XP24-11	0.0	0.0	0.1	0.3	**2.4**	-
Roadrunner	0.0	0.0	0.3	0.8	**3.1**	-
WB4347	0.0	0.0	0.0	0.1	**2.3**	-
Minimum	0.0	0.0	0.0	0.1	0.8	3.1
Maximum	0.0	0.0	0.4	0.8	5.5	5.7
Average	0.0	0.0	0.1	0.4	2.8	4.0

This report provides producers with an update on the progress of the 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 decide whether to remove cattle from them.

Since all varieties have passed the first hollow stem stage, this is the last report for the 2024 season.

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5. Optimal corn seeding rate recommendations

The optimal corn seeding rate is a management (**M**) variable that depends on the hybrid (genotype, **G**) and the interaction with the environment (**E**). Researchers termed this as the **G x E x M interaction**. To evaluate whether the corn seeding rate they have used was adequate, producers may look back to their corn crop from the previous growing season or wait until the current growing season is nearly complete, which is also known as an *ex-post* approach. It is also worth considering additional M factors that are often overlooked, such as planting date, nitrogen fertilization, row spacing, and crop rotation.

Although specific hybrids can respond differently, the following guidelines may help decide if the selected corn seeding rates need to be adjusted.

1. **Few kernels per ear**: if more than 5% of the plants are barren or most ears have fewer than 250 kernels per ear, the corn seeding rate may be too high.
2. **Too many kernels per ear**: if there are consistently <u>more than 600 kernels per ear</u> or most plants have a <u>second ear</u> contributing significantly to grain yield, the corn seeding rate may be too low. Of course, the growing conditions will also influence ear number and ear size, so it is important to factor in the growing conditions for that season when interpreting these plant responses.
3. **Tipping back**: don't be too concerned if a half-inch or so of the ear tip has no kernels. If kernels have formed to the tip of the ear, there may have been room in the field for more plants, which would have contributed to higher grain yield. Again, this "tipping back" will vary with the G x E x M interaction.
4. **Irrigation**: If fertilizer or irrigation rates are significantly increased or decreased, optimal corn seeding rates may need to be adjusted. For example, research at the Irrigation Experiment Field near Scandia (North Central KS) has shown that corn seeding rates also have to be increased to attain the maximum yield benefit if fertilizer rates are increased.
5. **Nutrient status**: in addition to the growing conditions, nutrient status can also influence the final number of grains per ear. For example, severe nitrogen (N) deficiency will greatly impact the final number of grains, ear size, and ear number.

Keep in mind that the potential ear size and the potential number of kernels (1,000-1,200 per ear) are set before silking (R1), but the actual final number of kernels is not determined until after pollination and early grain fill (R2-R3) due to relative success of fertilization and degree of early abortion.

Always keep long-term weather conditions in mind. In a drought year, almost any corn seeding rate is too high for the available moisture in some areas. Although it's not a good idea to make significant changes to seeding rates based only on recent events, it is worthwhile considering how much moisture is currently in the soil profile and the long-term forecasts for the upcoming growing season.

For this growing season, if you think weather conditions will be more favorable for corn this year than in past years, stay about in the middle to the upper part of the range of seeding rates in the table below. If not, and you expect dry subsoils, you might want to consider going towards the lower end of the range of recommended seeding rates, with the warning that if growing conditions improve, you will have limited your top-end yield potential.

The recommended corn seeding rate and final plant population in the following tables attempt to factor in these types of questions for the typical corn growing environments found in Kansas. Adjust within the recommended ranges depending on the specific conditions you expect to face and the hybrid you plan to use. Of course, do not forget to consult seed company recommendations to determine if seeding rates for specific hybrids should be at the lower or upper end of the recommended ranges for a given environment.

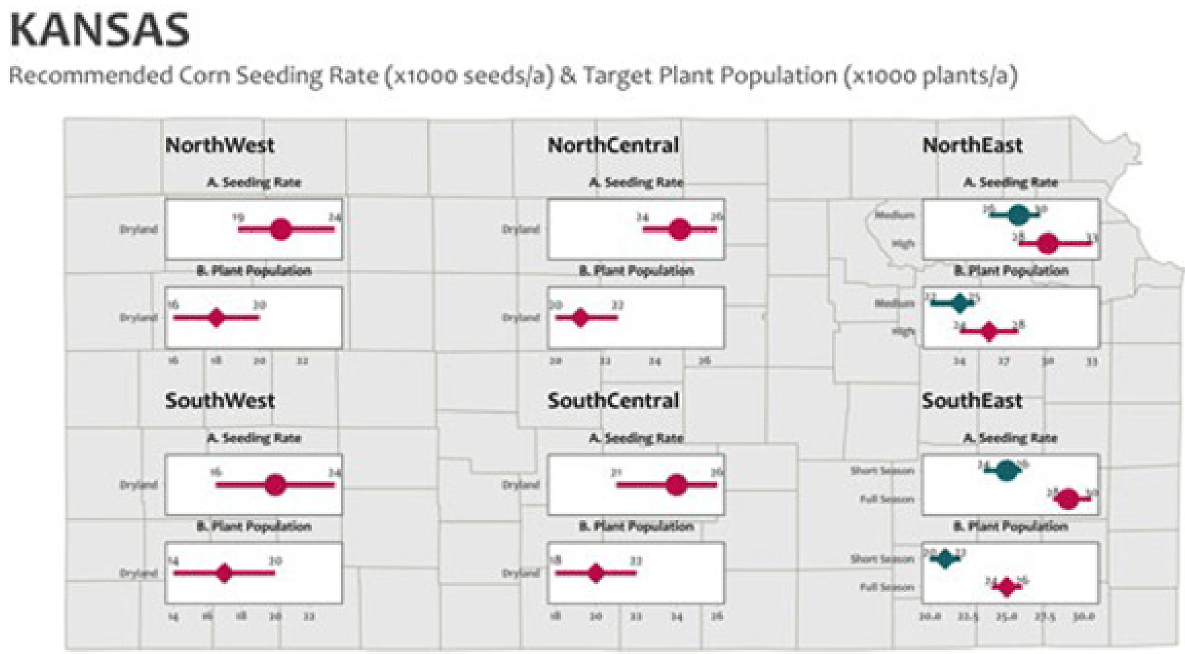

Figure 1. Suggested dryland corn final populations and seeding rates. Map created by A. Correndo, former Post-Doc fellow, Ciampitti Lab, K-State Research and Extension.

Table 1. Suggested irrigated corn final populations and seeding rates

Environment	Hybrid Maturity	Final Plant Population (plants per acre)	Seeding Rate* (seeds per acre)
Full irrigation	Full-season	28,000-34,000	33,000-40,000
	Shorter-season	30,000-36,000	35,000-42,500
Limited irrigation	All	24,000-28,000	28,000-33,000

* Assumes high germination and that 85 percent of seeds produce plants. Seeding rates can be reduced if field germination is expected to be more than 85%.

K-State research on corn seeding rates

An intensive review of a large database from Corteva Agriscience (2000-2014 period) was utilized to synthesize yield response to plant population under varying yield environments (<100 bu/acre to >200 bu/acre). Overall, yield response to plant population depended on the final yield environment

(Figure 2). In yield environments below 100 bu/acre, yield response to plant population was slightly negative. Yield response to plant population tended to be flat when the yield environment ranged from 100 to 150 bu/acre, positive and quadratic with the yield environment improving from 150 to 180 bu/acre, and lastly, increasing almost linearly with increasing plant populations when the yield environment was more than 200 bu/acre (Figure 2).

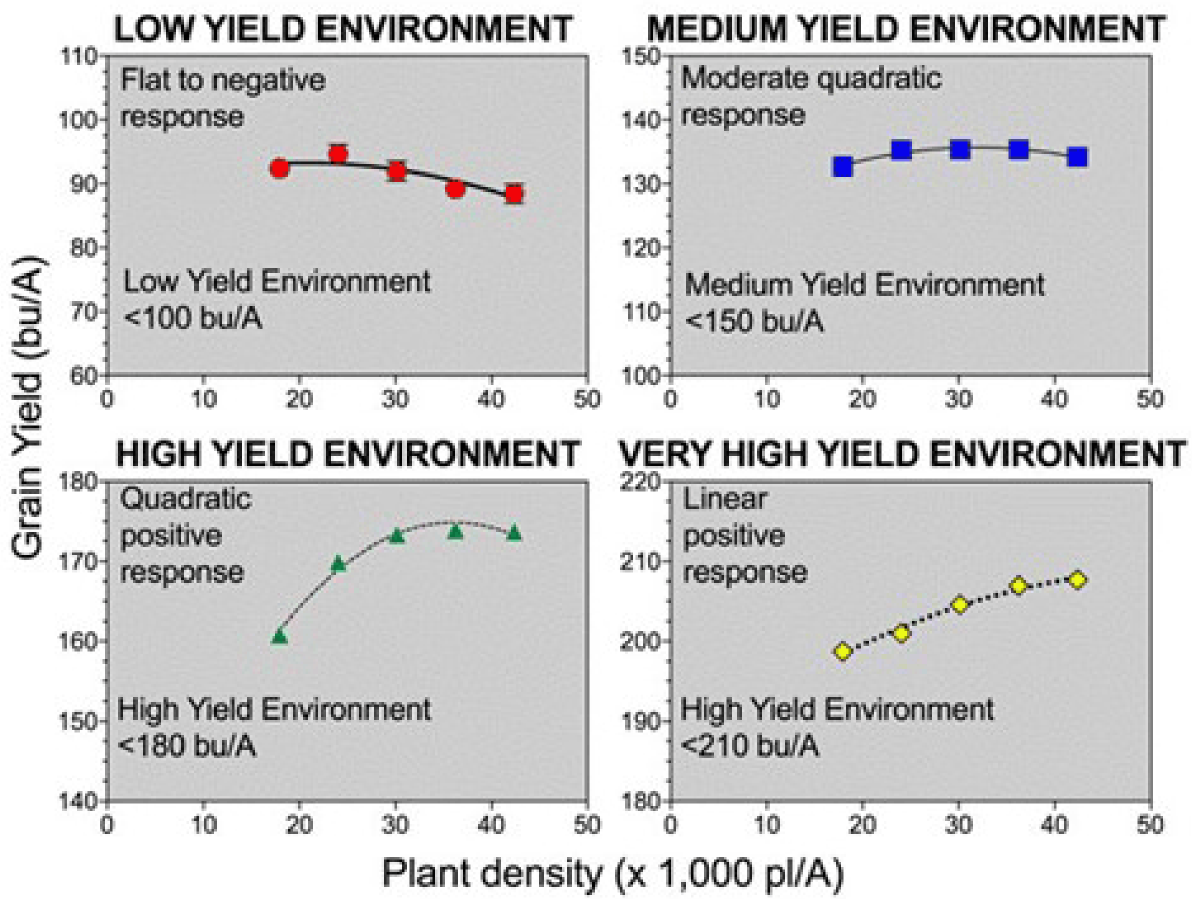

Figure 2. Corn grain yield response to plant density in four yield environments, a) <100; b) 100-150; c) 150-180; and d) > 180-210 bu/acre (Assefa, Ciampitti et al., 2016, Crop Science Journal). Figure created by I.A. Ciampitti, K-State Research and Extension.

As a disclaimer, "agronomically" optimum plant population does not always match with the "economically" optimal plant population. Final seeding rate depends on the genetics (hybrid), the environment, and other production practices (e.g., planting date, crop rotation, tillage). Also keep in mind the corn yield response to plant density curves are merely indicative as they just represent simplified models that carry uncertainty (error).

Stay tuned to future eUpdate articles related to other relevant topics for the coming season.

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6. Soybean planting date and maturity group selection

In the current 2024 season, soybean acreage projections in Kansas are up compared to historical. For maximizing yields, there are key practices we cannot overlook. This article presents tips for selecting the best planting date and maturity group across Kansas.

After considering the effects of genetic yield potential and the environment, planting date is one of the primary management practices under the farmer's control that can highly influence soybean yields. In recent years, Kansas producers have been planting soybeans slightly earlier -- at the rate of about one-third-of-day per year. In 2023, the "50% planting date" mark was achieved around May 21 statewide (ahead of the 42% historical average) – with planting progress moving closer to mid-May if conditions are optimal at that time (USDA-Crop Progress Reports).

Planting dates and maturity group guidelines

Soybeans can be planted over a wide range of dates with adequate soil moisture conditions, although germination and emergence could be reduced and/or delayed in cool soils (less than 60°F). In the last few years, many farmers have anticipated soybean planting dates relative to the ones presented in Figure 1, in many situations, planting soybeans before corn.

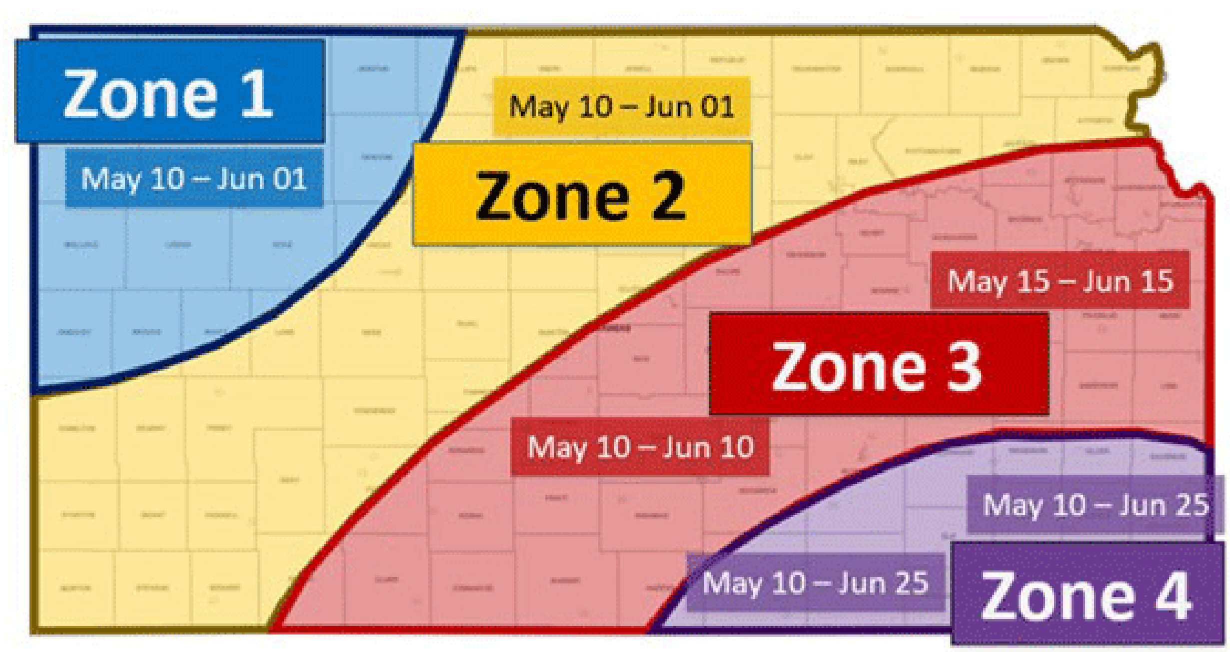

Figure 1. Recommended soybean planting dates under dryland conditions. K-State Research and Extension.

The recommended maturity group varies across Kansas by area (Figure 2).

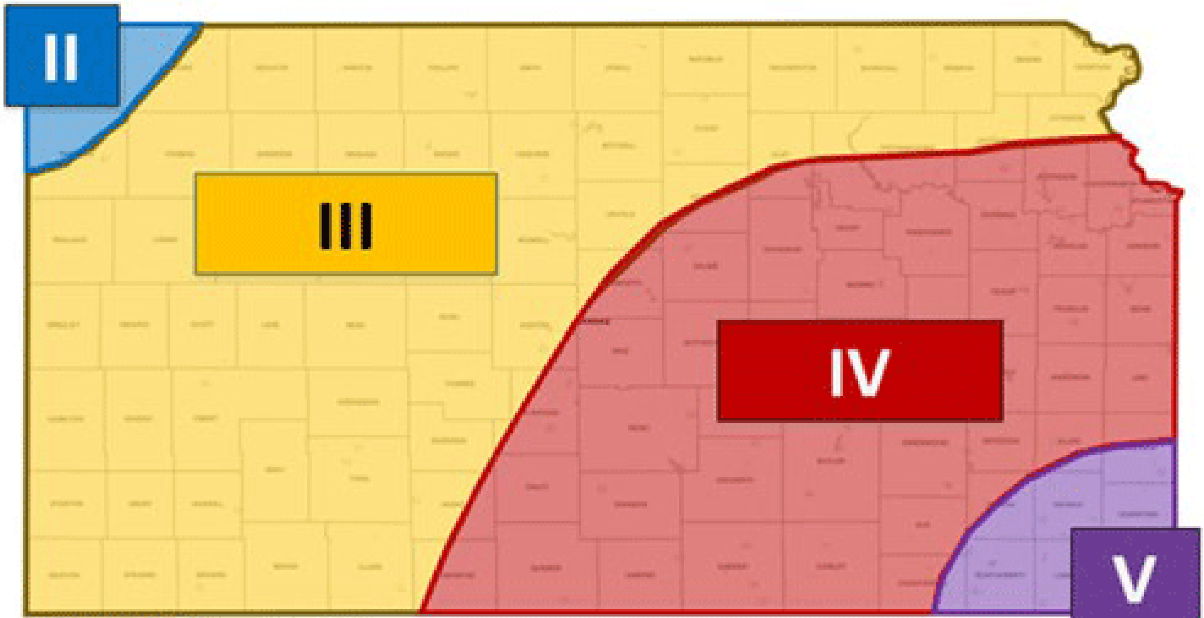

Figure 2. Recommended soybean maturity groups (II to V) across Kansas. K-State Research and Extension.

For Kansas, maximum soybean yield is reduced by 0.3 bu/a per day as planting dates get later in the season, with yield levels closer to 80-90 bu/a when planting in mid-April compared to 50 bu/a for planting in mid-July (Figure 3). These results highlight the importance of early planting for obtaining maximum yields and the yield penalty associated with delaying planting dates.

It is worth noting, however, that yields used to be considerably noisier (more variability) at the earlier planting dates. There is less variability and better yield “stability” for late-planted soybeans, although at lower potential yields (Figure 3).

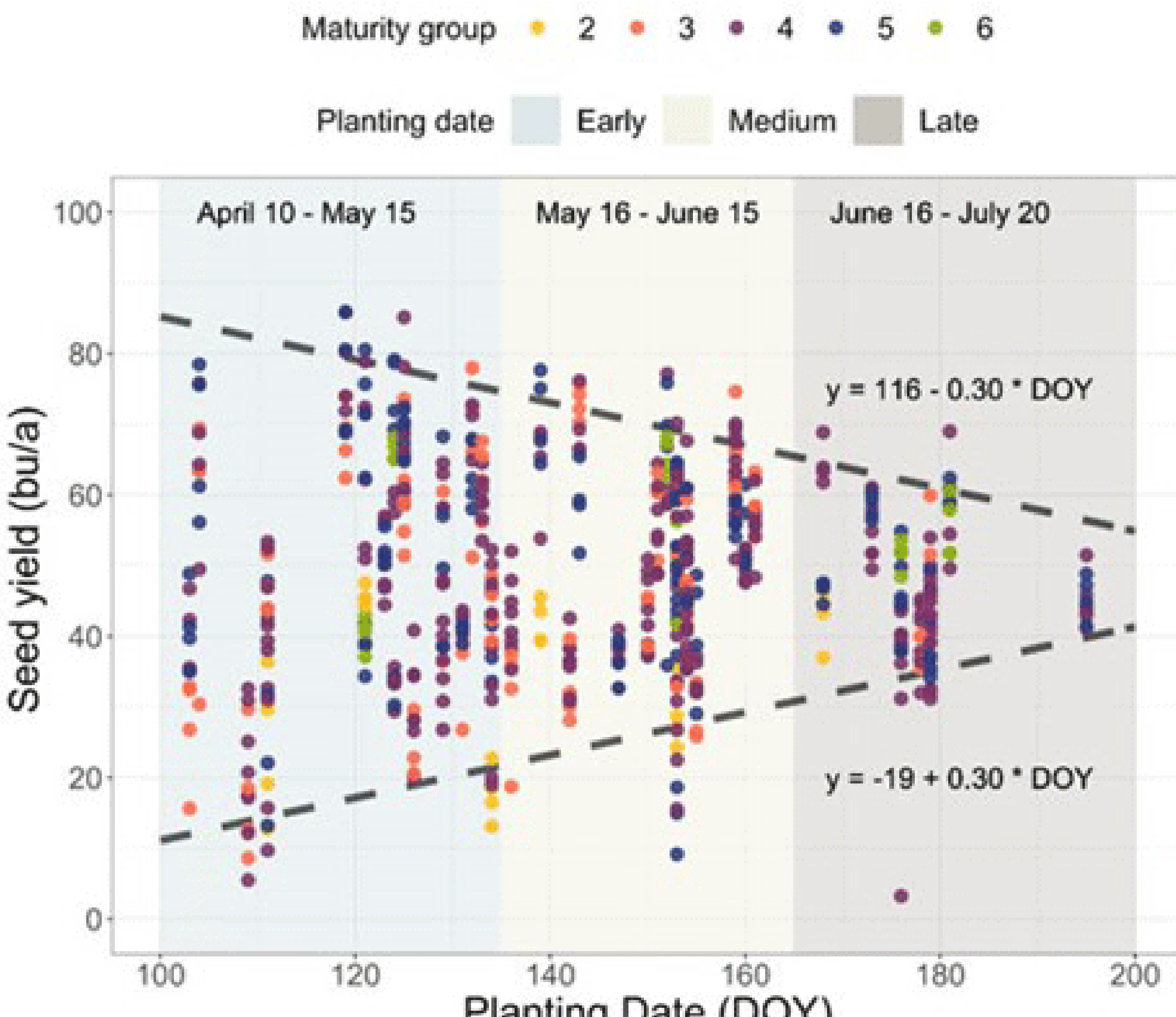

Figure 3. Soybean seed yields as a function of planting date from Early (mid-April to mid-May) to Medium (mid-May to mid-June) to Late (mid-June to mid-July) for a diverse set of maturity groups (from 2 to 6). Data from Ciampitti Lab, K-State Research and Extension.

This season, similar to 2022 and 2023, farmers are planting soybeans earlier than usual, but a note of caution is that lower soil temperatures will reduce the speed of emergence and could compromise uniformity for soybeans. In addition, dry conditions in many areas of the state can further delay overall emergence and early season uniformity. A recent study completed by our research team showed that early-season plant-to-plant uniformity could compromise yields in soybeans, especially in low-yield environments (<35 bu/a). Similarly, at higher yield environments (where plants can express growth plasticity) such as in the east region of Kansas, a recent experiment from our previous growing seasons (2022 and 2023) demonstrates that both early (May) and late planting (June) produced very similar average yield and variability (Figure 4).

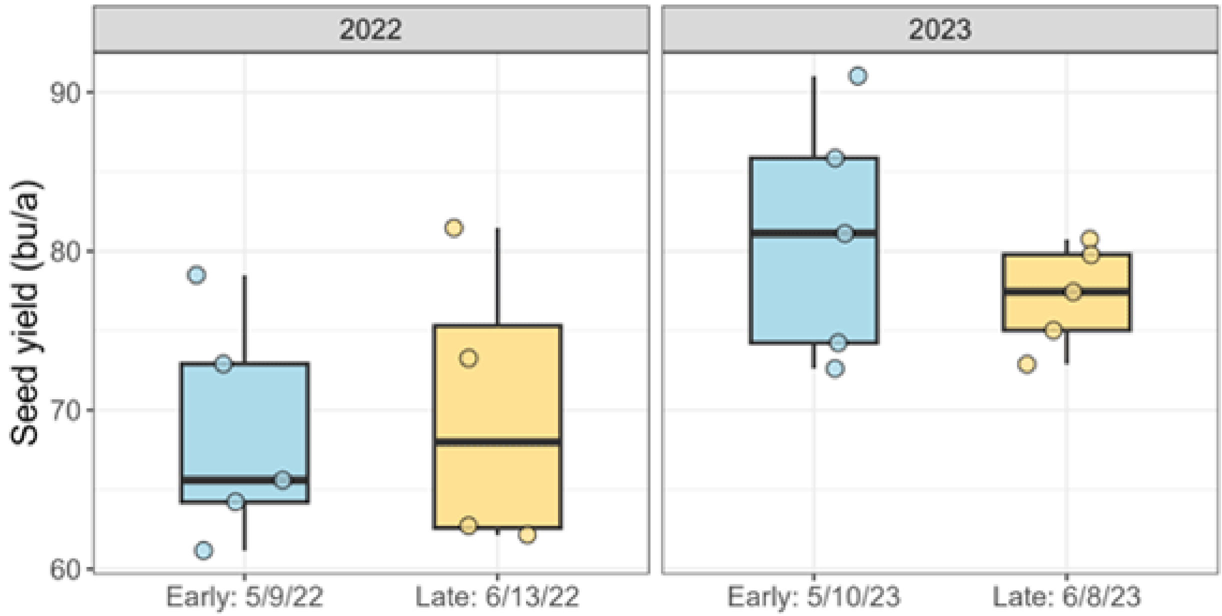

Figure 4. Soybean seed yield (bu/ac) comparing early (May) and late (June) at the Kansas River Valley Research Station, Topeka, KS. 2022 and 2023 cropping season. Graph from Ciampitti Lab, K-State Research and Extension.

Final considerations

- Ultimately, weather patterns dictate soybean yields, especially under dryland conditions. There is no guarantee that any certain planting date will always work out best for soybean yields in Kansas. In fact, the distribution and amount of rainfall and the day/night temperature variations around flowering and during the grain-filling periods have large impacts on soybean yields. Thus, when the risk of drought stress during the growing season is high, diversifying planting dates may be a good approach to consider.
- When planting early (many farmers are trying to plant soybeans before corn), seed should be treated with a fungicide and insecticide. It is advisable to select varieties with resistance to soybean cyst nematode and sudden death syndrome. Do not plant in soils that are too wet. Also, do not plant until soil temperatures are close to 60°F. If planted into soils cooler than 60°F, seedlings may eventually emerge but will have poor vigor.
- In drier areas of Kansas and on shallow soils, yields have been most consistent when soybeans are planted in late May to early June. By planting during that window, soybeans will bloom and fill seed in August and early September, when nights are cooler, and the worst of heat and drought stress is usually over.

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