Issue 902

K·STATE
Research and Extension

Extension Agronomy

eUpdate

04/14/2022

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. 2022 Kansas Wheat: Crop Conditions and Risk of Freeze Injury

Crop conditions

The 2021-22 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 timings for western (mid-September) and central (October) Kansas, but these predominantly matched good planting timings for these regions. Consequently, more than 60% of the winter wheat crop was rated as good or excellent by the USDA-NASS during the fall (Fig. 1).

The crop also had above-average temperature conditions during the fall (Fig. 2), which led to good biomass production where water was available from earlier rainfalls (Fig. 3). However, this large biomass production also increased the water consumption by the crop. During the winter and spring, temperatures were below average (Fig. 2), leading to a slowdown of crop growth development. Currently the crop growth stages range from upright tillers in northwest Kansas to the jointing in south-central and southeast Kansas (Fig. 3). The increased water demand led by greater fall biomass production was, unfortunately, met with below average precipitation during the remainder of the fall and during winter – especially in western Kansas (see section below), leading the crop to experience early signs of drought stress in that portion of the state. While the crop in central Kansas is still mostly not undergoing severe drought stress, the recent increase in biomass as the crop goes into reproductive development will be accompanied by an increase in crop water demand; thus, more precipitation will be needed shortly to avoid yield losses due to drought. Consequently, crop conditions deteriorated considerably during the last few months, and the latest USDA-NASS report suggests that only around 30% of the Kansas wheat crop is in good or excellent conditions.

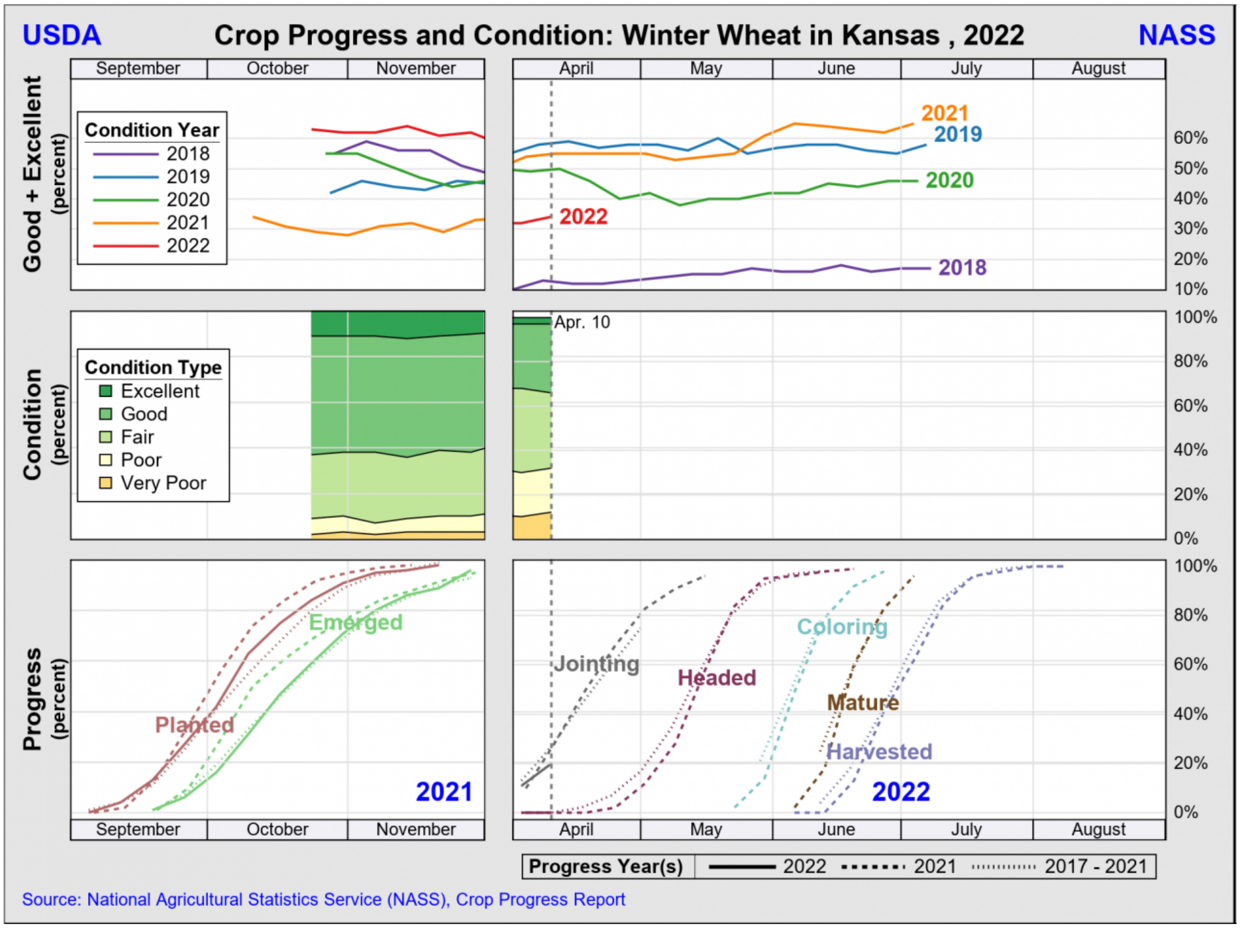


Figure 1. Crop progress report for the 2021-22 winter wheat crop in Kansas.
Source:
https://www.nass.usda.gov/Charts_and_Maps/Crop_Progress_&_Condition/2022/KS_2022.pdf

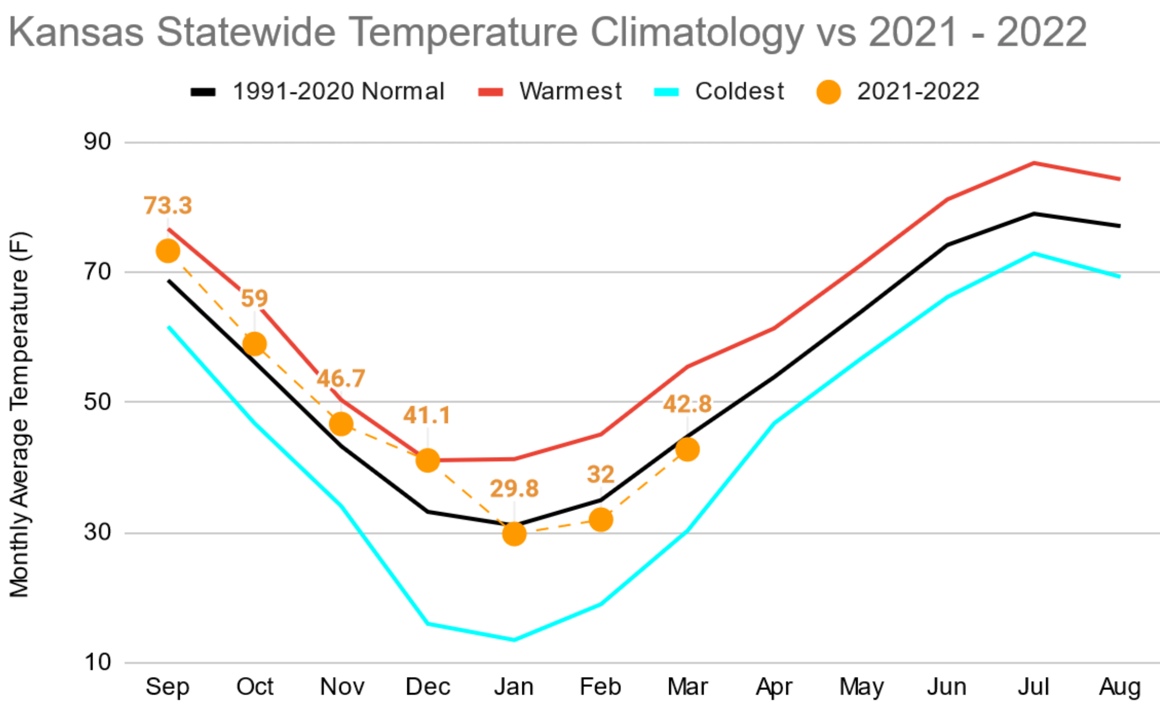


Figure 2. Mean monthly average temperatures for Kansas reflecting the wheat season for 2021-22 (orange dots), normal (black line), minimum (blue line) and maximum (red line).

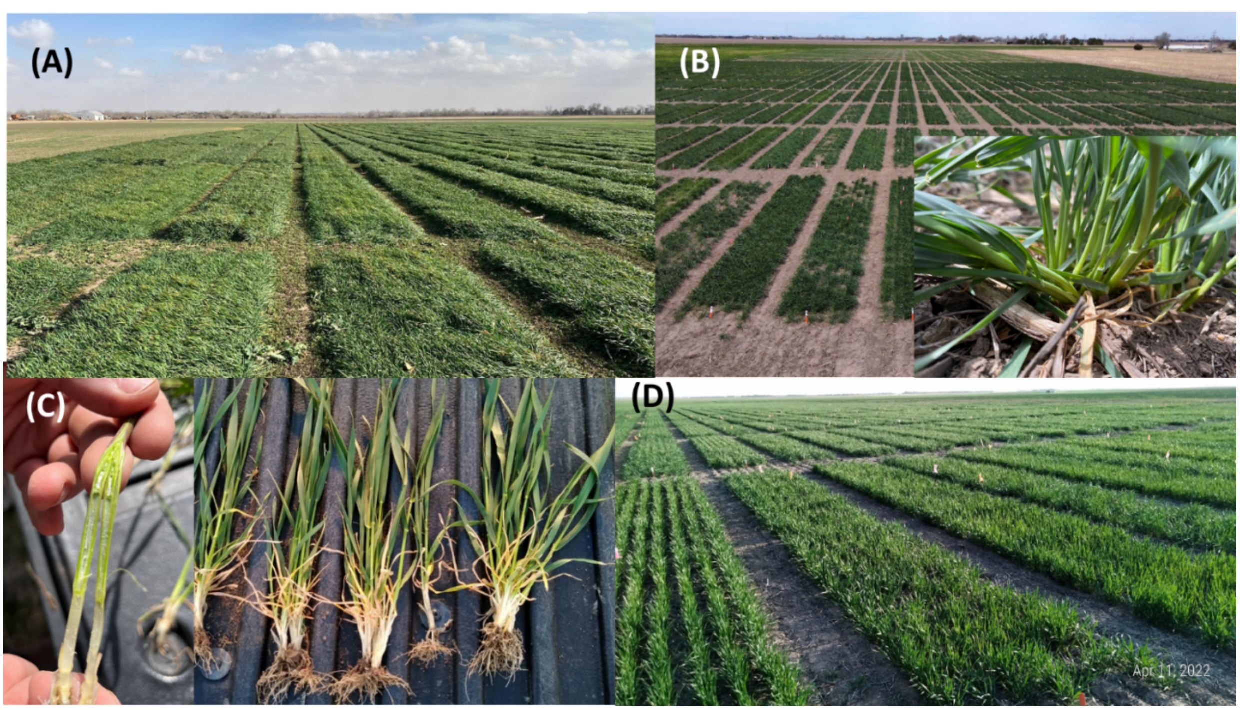


Figure 3. (A) Good biomass production of a September-planted winter wheat field near Hutchinson in a photo taken in mid-December 2021. (B) Winter wheat field experiment planted late after soybeans near Great Bend, reaching the jointing growth stage on 13 April 2022. (C) Winter wheat planted at the optimum time (mid-October) after a previous canola crop, reaching the second node stage of development near Hutchinson on 12 April 2022. (D) Late-October planted winter wheat, no-tilled into soybean stubble, reaching the first node stage of development as of 12 April 2022 near Hutchinson.

Potential for freeze injury during 31 March – 14 April

Cold air temperatures occurred during 31 March – 14 April 2022, which have potential to cause freeze injury to the 2022 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 presence of residue covering the soil surface, might also impact the extent of freeze damage within a field. The challenge is to integrate 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 4). For fields that have not jointed yet, the crop generally withstands temperatures of 15-20 degrees F fairly well, especially if the growing point is still below ground, which might be the case for some late-planted wheat fields in north-central and northwest Kansas. Kansas Mesonet data indicates that temperatures fell below this threshold, reaching as low as about 10 degrees Fahrenheit in parts of northwest Kansas (Fig. 5), 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 degrees 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-degree F threshold in most of central and north-central Kansas; however, they dipped below the threshold for as many as 7 hours in southwest Kansas (Fig. 5), which can cause damage to fields at the first node of development or more advanced stages.

More advanced fields, such as second node to flag leaf emergence (south-central and southeast Kansas), are more vulnerable to freeze injury, as temperatures near the 24-28 degrees F threshold can cause injury. Minimum temperatures dipped around these sensitive thresholds in those parts of the state, but overall they never reached below 24 degrees F and were below 32 degrees F for no more than 2-4 hours (Fig. 5).

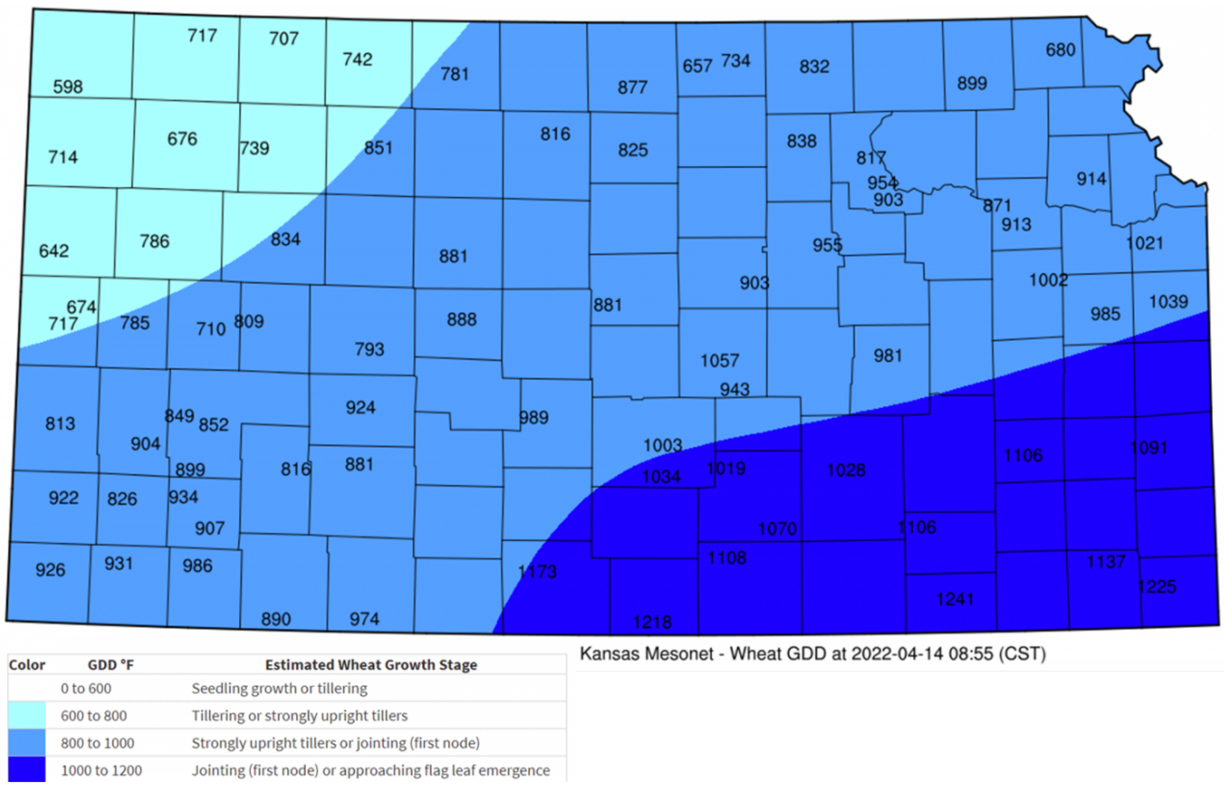
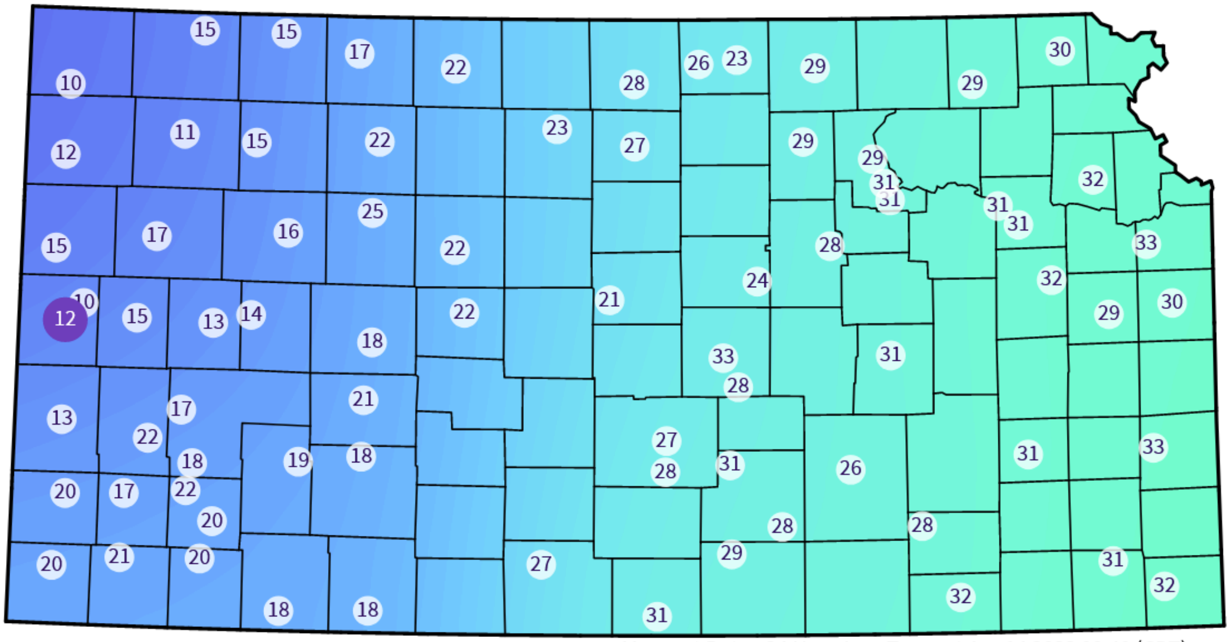


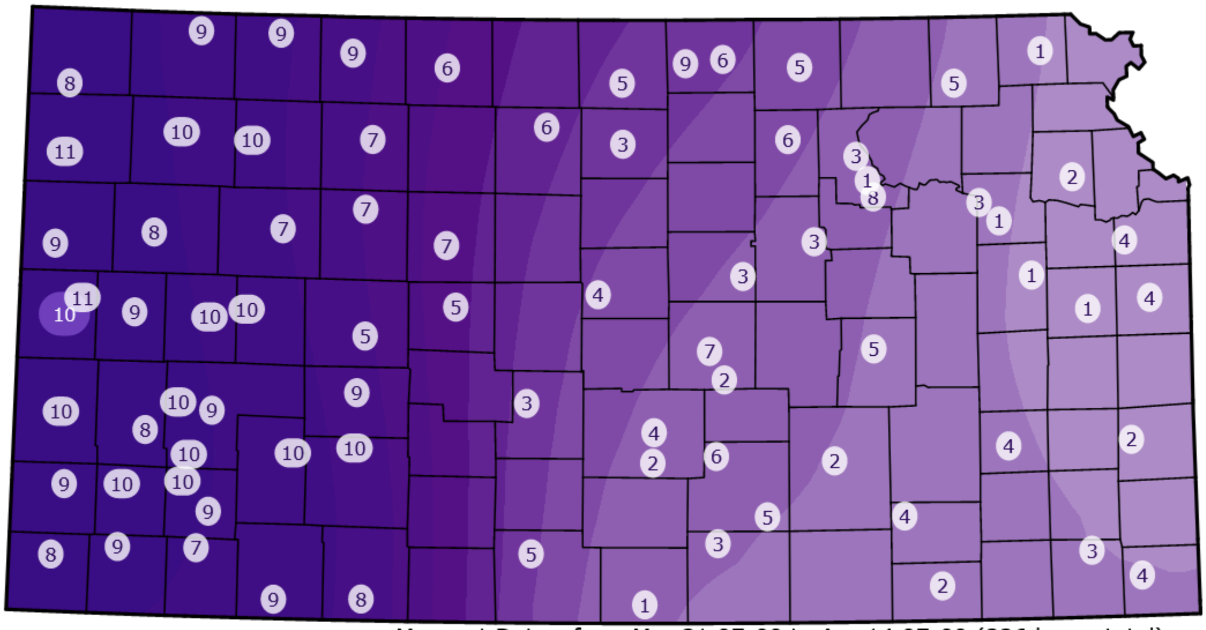
Figure 4. Estimated wheat growth stage as of April 14, 2022. Growth stage is estimated for each county based on temperatures accumulated in the season. Local growth stage may vary with planting date and variety. The KSU Wheat GDD Growth Stage model is available at: https://mesonet.k-state.edu/agriculture/wheat/gdd/

24 Hour Low Temperature



Mesonet Data - 24 Hour Low Temp at Apr 14 2022 08:40 (CDT)

Hours Below 32



Mesonet Data - from Mar 31 07:00 to Apr 14 07:00 (336 hours total)

During most recent cold event, consecutive hours that air temp stayed below threshold

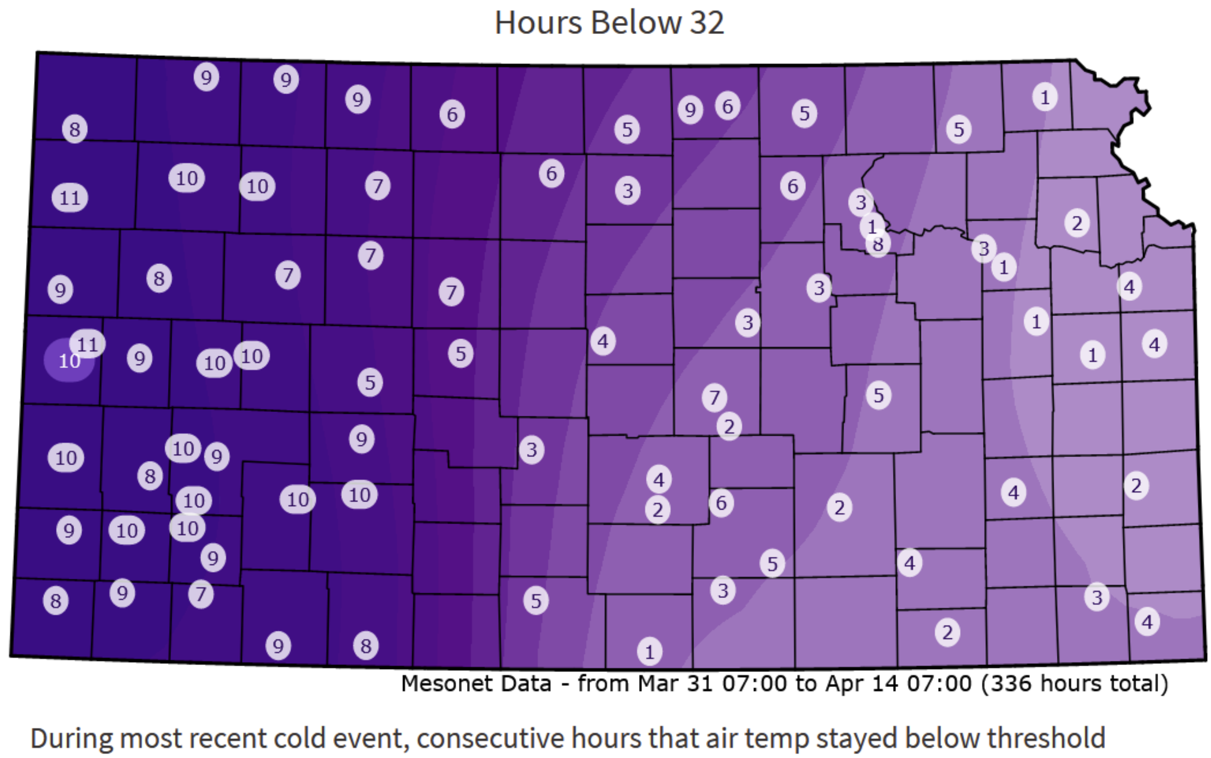


Figure 5. Minimum temperatures observed during the 31 March – 14 April period (upper panel), number of hours below 24 (middle panel) and 32 (lower panel) degrees F observed during the coldest event during the specified period.

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 north central and northwest Kansas where soil temperatures were above 38 degrees during the entire week and the crop is around the first node stage of development. However, the more advanced crop in south central and southeast Kansas, with the growing point further above the soil surface, likely did not benefit as much from the soil temperature buffering capacity.

Integrated risk of freeze injury to Kansas wheat

Based on the factors above, we estimate that parts of southwest Kansas would be more exposed to potential of freeze damage, given that the crop is relatively advanced and was met with many hours of air temperatures below 24 degrees F. This area of high risk corresponds to (i) areas with more hours below threshold for the predominant crop growth stage, and (ii) a 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.

Symptoms of freeze injury on foliage should occur over the next few days across the entire state. In most cases, however, leaf burn injury by itself should not result in any long-term damage to the crop, especially if there is available moisture 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 as it emerges from the whorl (which would indicate a dead tiller) and wheat heads that are trapped within the boot and thus emerge from the side of the culm.

Romulo Lollato, Wheat and Forage Specialist

lollato@ksu.edu

Chip Redmond, Kansas Mesonet Manager

christopherredmond@ksu.edu

Erick DeWolf, Wheat Pathologist

dewolf1@ksu.edu

Kelsey Andersen Onofre, Extension Wheat Pathologist

andersenk@ksu.edu

2. Injury symptoms from freeze damage to wheat: what to look for?

The recent cold temperatures experienced during 31 March – 14 April 2022 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 a 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 fields where they sample for freeze damage symptoms depending on conditions that were more likely to result in freeze damage. Below, we make comments about these individual conditions that might help growers prioritize fields to be sampled; as well as 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. If temperatures get too low, however, the cold will go through the ice.

Residue. No-till fields can many times sustain more freeze damage because the residue acts as a blanket and doesn't allow the heat from the soil to radiate 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 take any immediate decision 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 (Fig. 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, and give 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 (Fig. 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, wheat and forage specialist, K-State Research and Extension.

The best thing producers can do for the first few days is simply walk the fields to observe lodging, crimped stems, and damaged leaves. Producers should not take any immediate actions as a result of the freeze, such as destroying the field for re-cropping. It will take several days of warm weather to accurately evaluate the extent of damage. 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 (Fig. 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.

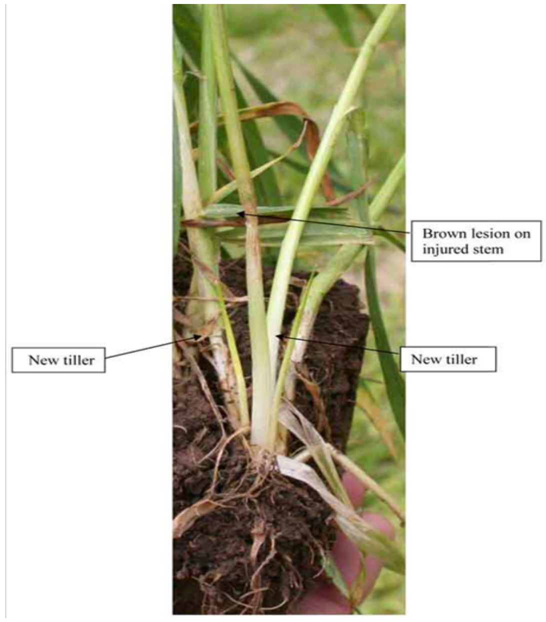


Figure 3. Left: A stem that was split open by having ice form within the stem. This stem has died and a new tiller has begun to grow at the base. Right: Some of the tillers on this plant had freeze damage to the lower stems. These stems are dying, but the symptoms may not be immediately evident. The 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 south central Kansas and southeast Kansas might have been at 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 this occurs repeatedly and if it is windy at night. To detect injury, producers should wait several days then split open some stems and look at the developing head. If the head is green or light greenish in color and seems firm, it is most likely going to be fine. If the head is yellowish and mushy, that's a sign of freeze injury.

Freeze injury at the boot stage causes a number of 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

Romulo Lollato, Wheat and Forages Specialist
lollato@ksu.edu

3. Brown Wheat Mite Outbreaks in Western Kansas

Reports of brown wheat mite outbreaks have come in from southwest and northwest Kansas in the last two weeks and the climate outlook for the region is likely to favor continued issues with this pest.

Brown wheat mite (Figure 1) is a sporadic pest of wheat in western Kansas but can also become problematic in eastern Kansas during dry years. Typically, continuous wheat faces a higher risk of damage from this pest and injury can be confused with drought stress. Mites damage individual cells in the leaf causing stippling while concentrated feeding at leaf tips causes plant tissue to dry out and die. Plants take on a scorched appearance and eventually wither (Figures 2 and 3).

Figure 1. Brown wheat mite

Figure 2. Appearance of a field infested with brown wheat mites

Figure 3. Stippling caused by brown wheat mite feeding.

Brown wheat mites present in fields right now are from eggs that hatched last fall. They can easily survive cold temperatures and can produce multiple generations during the winter and an additional two to three generations in the spring. These mites are active during the day, with peak activity during the afternoon on warm days. They do not produce webbing like spider mites and can easily be observed moving rapidly on leaf surfaces when scouting a field. Their rapid movement and tendency to drop to the ground when disturbed can make assessing the level of infestation difficult.

The economic threshold is estimated to be several hundred mites per foot of row in early spring. Stressed plants are most likely to succumb to damage. A solid rainfall is typically all that is needed to knock brown wheat mite populations below damaging levels, but that does not look to be in the forecast any time soon. Fields with noticeable populations of mites should be scouted for their eggs. Brown wheat mites lay two different types of eggs on soil clods and debris; red “winter” eggs and white “summer” eggs (Figure 4). The white eggs will remain dormant through the rest of the growing season and hatch in the fall. Red eggs will continue to hatch this spring and add to the current population. By late April, adults begin to lay the white, diapausing eggs. Once there are more white eggs in the field than red eggs, the population is naturally declining and treatment is not likely warranted.

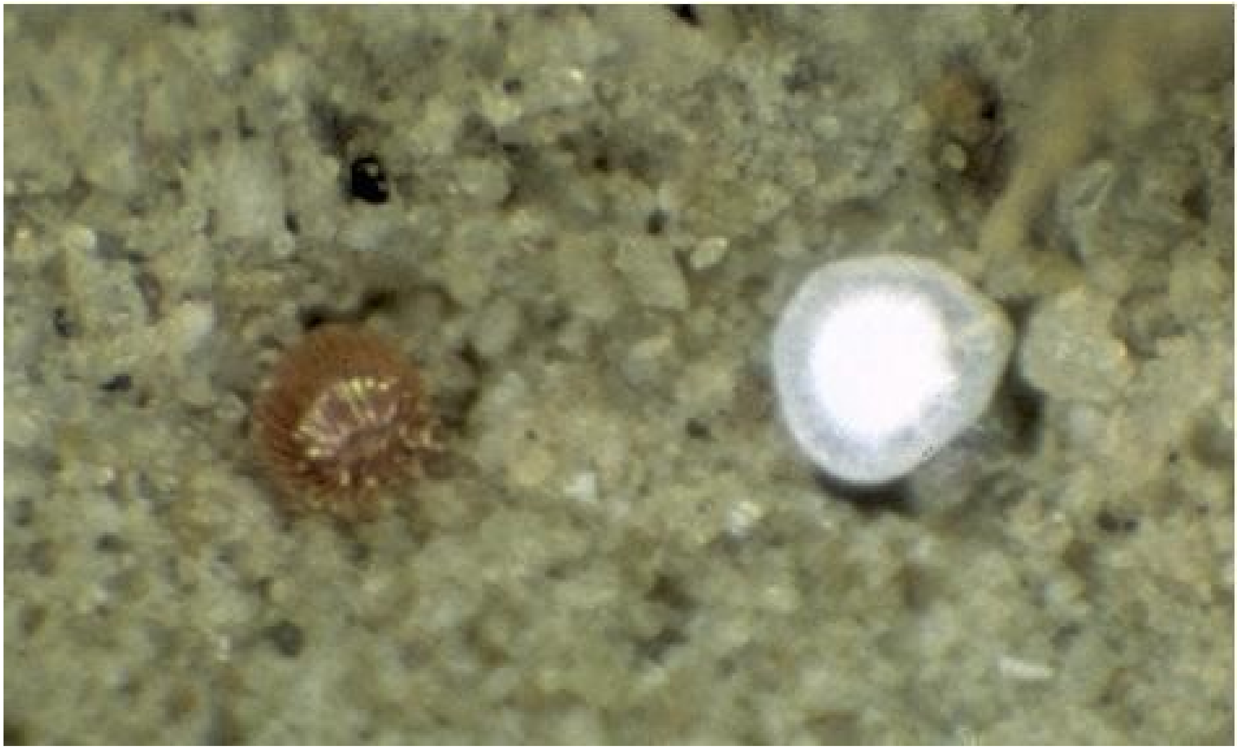


Figure 4. Brown wheat mite eggs. Left: winter eggs that will be hatching now, Right: summer eggs that will be hatching in the fall.

For fields that require treatment, options for control of brown wheat mite are limited as there are no miticides registered for use in wheat and a popular option for control, chlorpyrifos, is no longer available. Dimethoate continues to provide good control of this mite, but there are some products for suppression of brown wheat mite populations if treatment is warranted and dimethoate is not an option (Table 1). As always, be sure to follow all directions on the labels for proper use of any chemical.

Table 1. Products registered in Kansas for control or suppression of brown wheat mite. For more specific information relative to any insecticide, always refer to the actual label on the product.

Trade Name	Chemical Name	Mode of Action Class	Purpose	Rate
Dimethoate	*Dimethoate*	1B	Control	.3-.5 pint/A (.16-.25 lb a.i./A)
Besiege	*Lambda-cyhalothrin and chlorantraniliprole*	3A+28	Suppression	10 fl.oz/A
Proaxis	*Gamma-cyhalothrin*	3A	Suppression	3.84 fl.oz/A (.015 lb a.i./A)
Silencer	*Lambda-cyhalothrin*	3A	Suppression	3.84 fl.oz/A (.03 lb a.i./A)
Warrior II with	*Lambda-*	3A	Suppression	1.92 fl.oz/A (.03 lb

Zeon Technology	*cyhalothrin*			a.i./A)

Anthony Zukoff, Extension Entomology Associate – Garden City
azukoff@ksu.edu

4. Kansas Ag-Climate Update for March 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.

March 2022: Near-normal temperatures statewide with water supply pumped up in the east

Statewide average temperature in March was closer to the normal, with an average temperature of 43°F across the state. This was only about -0.5°F cooler on average than normal (Fig. 1). The temperature ranked as the 77th coldest and 52nd warmest month of March during the past 128 years. However, considering the 5-month window for winter wheat growth, the average recent 5-month (November to March) temperature is ranked as the 14th warmest since 1895.

Climatologically, Kansas March precipitation was about 2 inches. This month was slightly drier in the west but significant wetter across the eastern portion of the state (1.1" above the normal) (Fig. 1). It ranked as the 29th wettest March during the past 128 years. Similarly, considering the 5-month accumulated precipitation for winter wheat growth, it was less than 1.9 inch drier than the 5-month normal with a marked east-west gradient (Fig. 2). This 5-month precipitation was still the driest since 2018, which has the potential to decrease wheat grain yields.

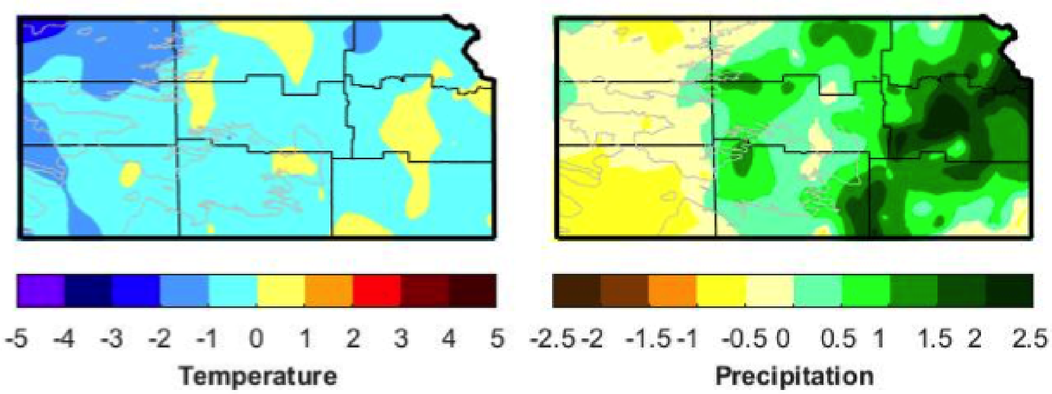


Figure 1. Departures from normal temperature (°F) and precipitation (inches) for March 2022.

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

5. World of Weeds: Poison hemlock and Wild carrot

During the spring, we often receive questions about poison hemlock (*Canium maculatum)*. This plant is in the carrot family and can be confused with related plants, such as wild carrot (*Daucus carota*). However, telling the two species apart is critical. As the name implies, poison hemlock is toxic to both livestock and humans. In fact, poison hemlock is believed to have been the plant used to kill the philosopher Socrates in 399 BC. The toxic effects are caused by chemicals called alkaloids that affect reproductive and nervous systems. If poison hemlock is ingested, symptoms including nervousness, trembling, weakness, poor coordination, pupil dilation, slow and weak heartbeat, coma, and respiratory paralysis develop within two hours. In addition, poison hemlock can cause fetal deformation and the alkaloids can be passed through milk.

Ecology

Poison hemlock and wild carrot are both biennial plants that reproduce by seeds. which can be dispersed by wind or animals.

Poison hemlock was first introduced to the US from Europe during the 1800s. It has successfully invaded most of the United States and is typically found growing in frequently disturbed areas with moist soil, such as pasture and field edges, banks of streams, and in flood plains. It can also invade pastures and alfalfa fields. Livestock may consume poison hemlock in areas where it is the only green foliage or available in large quantities.

Wild carrot is native to Eurasia. It is thought to have been brought to the US by early colonists and is now common in the eastern half of the United States. It can generally be found in pastures, roadsides, and woodland openings and edges. It grows best in full sunlight, as plants growing in heavy shade will act as annual plants. It is rarely found in cultivated or heavily managed fields. The sap of wild carrot can cause skin irritation.

Identification

Poison hemlock grows as a deep-rooted rosette during its first year. Rosette leaves range from 8 to 16 inches in length and can grow up to 4 inches wide. Leaves have a triangular shape, are lobed and fern-like, though not as fine and lacy as wild carrot (Figure 1, left). They are alternately arranged on the stem. Once bolted, stems can be 3 to 10 feet tall and are often branched. The stems are hairless, purple spotted, and hollow except at the nodes where the leaves attach (Figure 1, center). Poison hemlock flowers during May to July. Small, white flowers are arranged in an umbrella-shaped inflorescence that is composed of several bunches of flowers on their own stems that extend from the main stem (Figure 1, right). Poison hemlock also produces a musty odor.

Figure 1. Poison hemlock leaves (left); stems with purple spots (center); c) umbrella shaped inflorescence (right). Images from John Cardina, Jan Samanek, and Jeff Stachler, Bugwood.org

Wild carrot, also called Queen Anne's lace or bird's nest, is a deep-rooted rosette during its first year. While in the rosette, leaves can range from 2 to 16 inches in length. Leaves are fine, lacy and pinnately lobed. The petiole is generally longer than the leaf blade and has stiff hairs (Figure 2, left). The general shape of wild carrot leaves is more linear, as compared to poison hemlock leaves which are more triangular. Once bolted, the solitary stem can range from 1 to 5 ft tall and can sometimes branch. The stem is hollow and ridged, sometimes with bristly hairs and is often reddish purple. Leaves are directly attached to the stem and are alternately arranged. Wild carrot generally blooms from April to July. Up to 1,000 small flowers can be found in an umbel inflorescence with a flat top (Figure 2, right). The first flower to bloom, in the center of the inflorescence is generally dark purple. When the plant matures the inflorescence turns in on itself and looks like a bird's nest.

Figure 2. Wild carrot leaves with hairs on stem (left) and large umbel inflorescence (right). Photos by Ansel Oommen, bugwood.org and Dallas Peterson, KSRE, retired.

Distinguishing features of poison hemlock and wild carrot are summarized in Table 1.

Table 1. Key features that distinguish poison hemlock from wild carrot.

	Poison hemlock	Wild carrot
Height	3 to 10 ft	1 to 5 ft
Leaves	Triangular	Linear, finely lobed
Petiole	No hairs	Sometimes stiff hairs
Stem	Purple spots	Sometimes hairs, no branching
Flowers	May to July clusters	April to July, center flower purple

Control

Poison hemlock and wild carrot are relatively easy to control. Mechanical control methods such as mowing and cultivation can be effective. However, mowing may need to be repeated several times. Repeated mowing of bolted plants may result in reduce carbohydrate storage, which may stop seed production. In addition, wild carrot can be suppressed by grazing with livestock. Small infestation maybe contained by digging up plants.

Chemical control methods are also effective. Products containing chlorsulfuron and metsulfuron are effective pre- and post-emergent herbicide options, especially for poison hemlock. Spot spraying with 2,4-D or glyphosate is also effective on both species.

Tyler Meyeres, Weed Science Graduate Student

tpmeyeres@ksu.edu

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

6. Starter fertilizer and nitrogen placement and rate considerations for Corn

Starter fertilizer is typically considered as the placement of a small rate of fertilizer, usually nitrogen (N) and phosphorus (P), near the seed at planting time. This fertilizer is intended to "jump start" growth in the spring, and it is not unusual for a producer to see an early-season growth response to starter fertilizer application. But some producers might also consider using this opportunity to apply higher rates of fertilizer that can supply most of the N and P needs for the corn crop.

Producers should be very cautious about applying starter fertilizer that includes high rates of N (and/or K). It is best to have some soil separation between the starter fertilizer and the seed. The safest placement methods for starter fertilizer are either as a deep-band application 2 to 3 inches to the side and 2 to 3 inches below the soil surface (2x2), or as a surface-band application to the side of the seed row at planting time (2x0), especially in conventional tillage or where farmers are using row cleaners or trash movers in no-till (Figure 1).

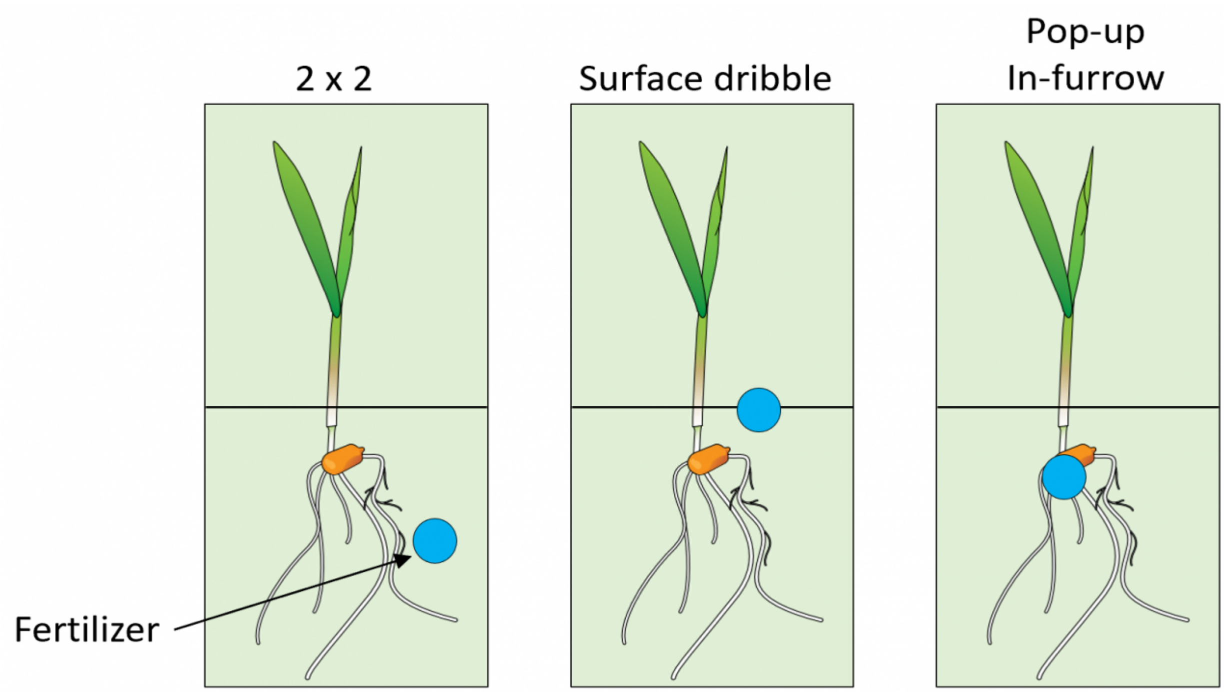


Figure 1. Example illustrations of starter fertilizer placement with respect to the corn plant. Graphic by Dorivar Ruiz Diaz, K-State Research and Extension.

What are the risks with "pop-up" placement?

If producers apply starter fertilizer with the corn seed ("pop-up" in-furrow), they run an increased risk of seed injury when applying more than 6 to 8 pounds per acre of N and K_2O combined in direct seed contact on a 30-inch row spacing (Table 1). Nitrogen fertilizer can result in salt injury. Urea-containing fertilizers can also result in ammonia toxicity. Urea converts to ammonia, which is very toxic to seedlings and can significantly reduce final stands (Figure 2).

What is a "salt"?

"Salts" are ionic compounds that result from the neutralization reaction of an acid and base. Most fertilizers are soluble salts (e.g. KCl from K+ and Cl-). Salt injury can occur when fertilizer addition increases the osmotic pressure in the soil solution (due to an increase in salt concentration) around the germinating seed and roots. This can cause plasmolysis, which is when water moves out of the plant cell, shrinking cell membranes and collapsing the cell. Symptoms of salt damage are short, discolored roots and a reduced corn population.

Figure 2. Symptoms of ammonia toxicity from urea-containing fertilizers placed too close to the seed. Photos by Dorivar Ruiz Diaz, K-State Research and Extension.

Table 1. Suggested maximum rates of fertilizer to be applied directly with corn seed for "pop-up" fertilizer.

	Pounds N + K_2O (No urea or UAN)	
Row Spacing (inches)	**Medium-to-fine textured soil**	**Sandy soil**
40	6	4
30	8	6
20	12	8

N rates with 2x2 placement or "surface dribble"

Starter fertilizer placement, such as 2x2 or surface dribble (2x0), provides enough soil between the fertilizer and the seed and are considered safe alternatives for higher rates of N application. Recent studies in Kansas suggests that the full rate of N can be applied safely using these placement options. One concern from some producers is related to the additional time demands for the application of high rates of fertilizer during planting. However, from an agronomic perspective, this can be an excellent time for N application, minimizing potential N "tie-up", and providing available N to the corn, particularly under no-till systems with heavy residue.

In summary, producers can apply most of the N needs for corn at planting as long as the fertilizer placement provides enough soil separation between the fertilizer and the seed. The best options are the 2x2 placement or surface-dribble, with similar results in terms of crop response. Nitrogen applications with these starter fertilizer options can provide an excellent alternative for producers who might not have the opportunity for anhydrous ammonia applications this spring or are planning to apply additional N as side-dress.

Dorivar Ruiz Diaz, Soil Fertility and Nutrient Management Specialist
ruizdiaz@ksu.edu

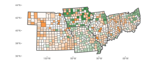
7. Adjust corn plant density for the coming 2022 season

As planting season for corn is around the corner, producers need to determine their corn seeding rates. The plant density necessary to optimize yields (optimal plant density, or OPD) depends on the expected available resources, mainly water and nutrients. In a previous eUpdate article (Optimal corn seeding rate recommendations), we discussed the importance of selecting the right seeding rate under different conditions across Kansas.

Plant density needs to be determined seasonally, depending on the expected growing conditions. In rainy years, a producer may increase the target plant density and obtain an increase in profit provided there is sufficient nitrogen fertilization. Under dry conditions, farmers should consider cutting back on plant density. This applies primarily to dryland corn production.

The upcoming season is expected to be drier and hotter than normal (2022 soil moisture and temperature outlook of spring planting in Kansas) in much of the Corn Belt region, thus yield expectations should be adjusted accordingly. Depending on the combination of current environmental conditions (soil and climate) and forecast, the economic optimum plant density will have to differ from the one used in an average or good growing season.

Based on the weather forecasts released in March, there is a clear signal indicating the need to consider using lower-than-normal plant densities for dryland corn in many areas of Kansas this spring. That is due to the combination of predicted below normal rainfall and high temperatures (Figure 1). Many sections of the state show a potential need to reduce optimal plant density (OPD) for



corn (at least 2,000 plants/acre) to adjust for the current and expected weather conditions.

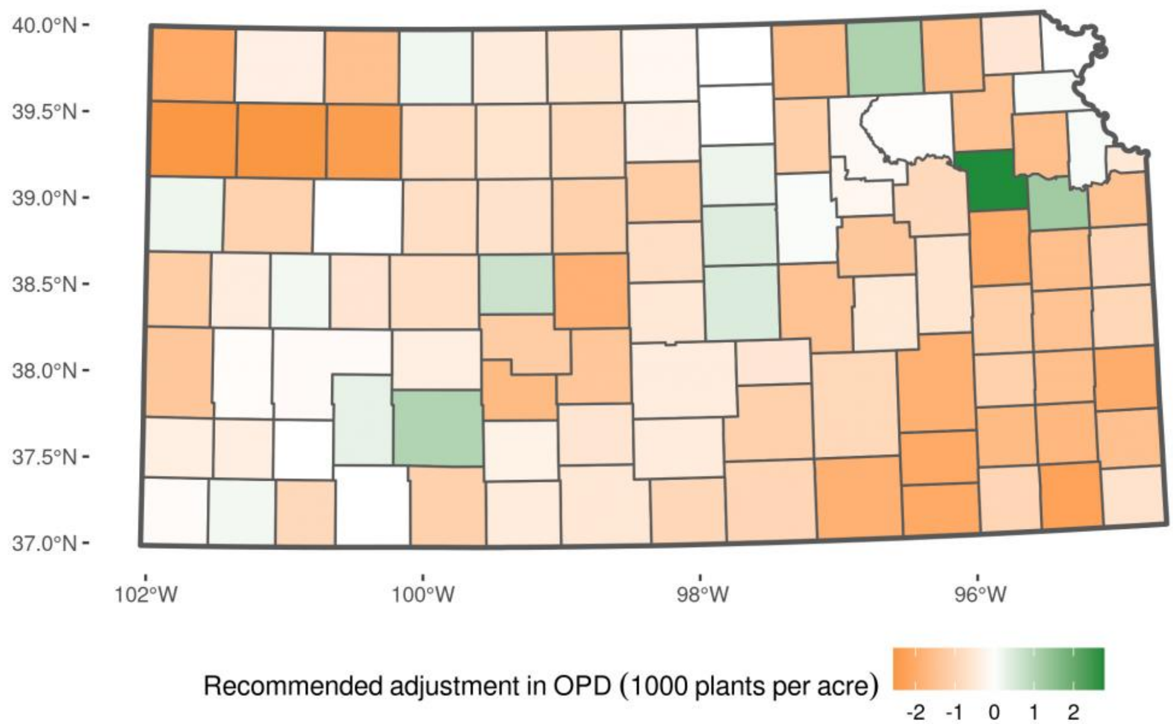


Figure 1. Change in the forecasted optimum plant density (OPD) for the 2022 summer season, relative to the 2018 optimum plant density for corn (wet year) across the region and in Kansas. Colors represent whether the recommended change is to increase (green) or decrease (orange) the target plant density (OPD) from what would be used in a wet year. Upper panel shows the potential changes for the Corn Belt region, and lower panel refers to the changes in plant density for Kansas.

In summary, 2022 is predicted to be a challenging season in much of Kansas, thus farmers should consider reducing their seeding rates for dryland corn. The utilization of probabilistic and dynamic models such as the one presented here, can help producers make real-time decisions to adjust inputs based on current soil moisture conditions and seasonal weather forecasts.

Ignacio Ciampitti, Farming Systems

ciampitti@ksu.edu

Josefina Lacasa, PhD student

lacasa@ksu.edu

8. Soybean planting date and maturity group selection

This 2022 season, soybean acreage projections in Kansas are up. To maximize yields, there are some key practices we cannot overlook. This article presents some tips on selecting the best i) planting date and ii) 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 2021, the "50% planting date" mark was achieved around May 24 statewide – with planting progress moving closer to mid-May if conditions are optimal at that time (USDA-Crop Progress Reports).

Recommended planting dates and maturity groups

Soybeans can be planted over a wide range of dates (Figure 1) with adequate soil moisture conditions, although germination and emergence could be reduced and/or delayed in cool soils (less than 60°F).

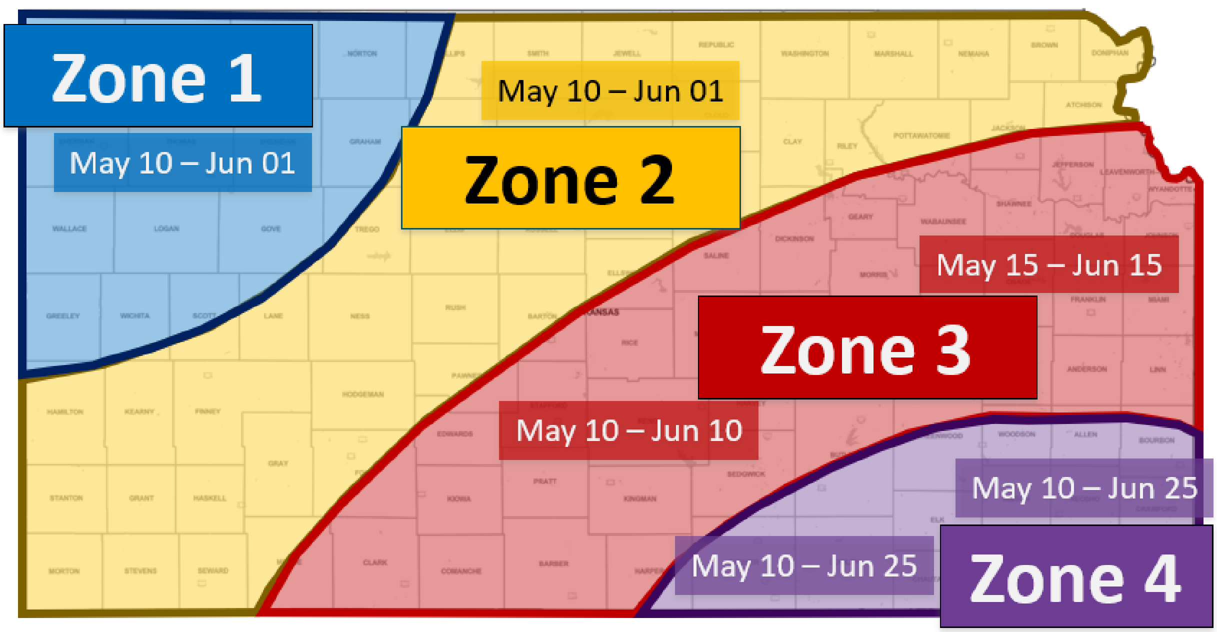


Figure 1. Recommended soybean planting dates. K-State Research and Extension.

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

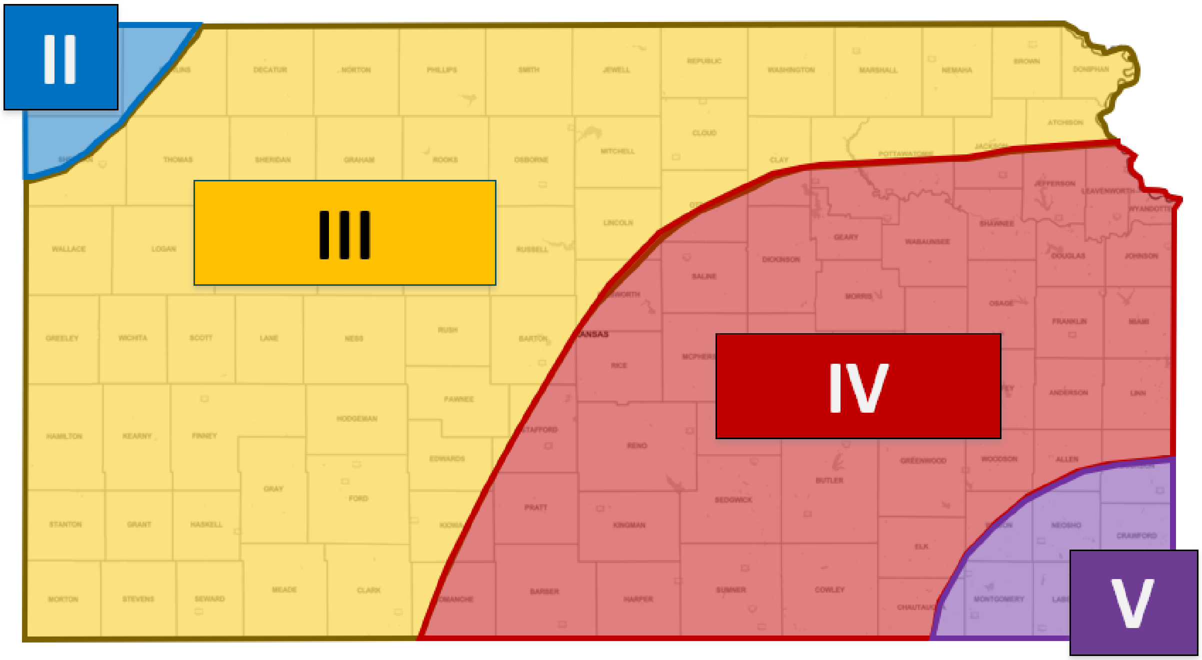


Figure 2. Recommended soybean maturity groups (II to V) across Kansas. K-State Research and Extension.

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). This results highlights the importance of early planting for obtaining maximum yields, and the overall yield penalty associated with delaying planting dates.

It is worth noting, however, that yields are considerably more variable at the earlier planting dates. There is less variability and better yield "stability" for late-planted soybeans (although achieving a lower maximum yield) (Figure 3).

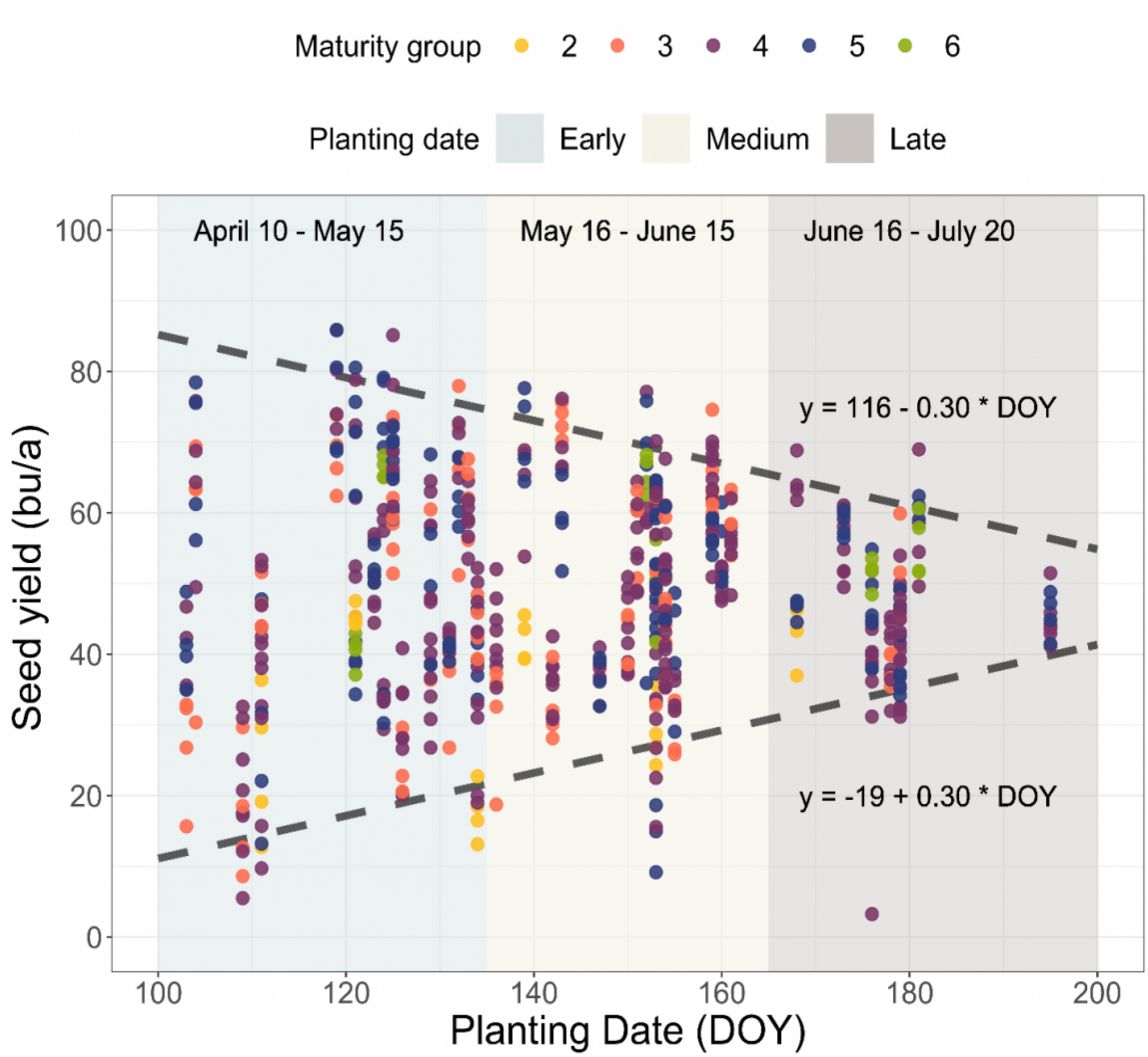


Figure 3. Soybean seed yields as a function of planting date from Early (mid-April to mid-May) to Medium (mid-May to mid-June) to Late (mid-June to mid-July) for a diverse set of maturity groups (from 2 to 6).

This season, 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. 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 (<40-35 bu/a).

Recommendations

- Ultimately, weather patterns dictate soybean yields, especially under dryland conditions. There is no guarantee that any certain planting date will always work out the best when it comes to 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. Selecting varieties with resistance to soybean cyst nematode and sudden death syndrome is advisable. Do not plant into 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 planting soybeans 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.

Ignacio Ciampitti, Farming Systems
ciampitti@ksu.edu

Adrian Correndo, Postdoctoral Fellow

correndo@ksu.edu

Emmanuela van Versendaal, Research Scholar

evanversendaal@ksu.edu