Issue 843

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eUpdate

03/11/2021

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. Pay attention to growth stage for spring herbicide decisions on wheat

Producers should pay close attention to the growth stage of their wheat before making spring herbicide applications. Some herbicides must be applied after tillering, several must be applied before jointing, and others can be applied through boot stage. Remember that weeds are most susceptible at early growth stages and coverage becomes difficult as the wheat canopy develops, so the earliest practical and labelled applications generally result in the best weed control.

Applications permitted prior to jointing

Dicamba can be applied to wheat between the 2-leaf and jointing stages of wheat. Application of dicamba after wheat reaches the jointing stage of growth causes severe prostrate growth of wheat and significant risk of yield loss. Dicamba is effective for control of kochia, Russian thistle, and wild buckwheat, but is not good for control of mustard species. Kochia, Russian thistle, and wild buckwheat are summer annual weeds that may emerge before or after wheat starts to joint, so timing of dicamba for control of these weeds can sometimes be difficult. Fortunately, dicamba provides some residual control of these weeds following application.

Products labeled only for use on herbicide-resistant wheat must also be applied prior to jointing. Beyond should be applied to 1 gene ClearField wheats after tiller initiation and prior to jointing, but can be applied to 2-gene ClearField wheats until the second node is detected at the soil surface. Aggressor should be applied to CoAXium wheat varieties after 4-leaf growth stage and before jointing. Beyond should only be applied to ClearField wheat varieties and Aggressor should only be applied to CoAXium wheat varieties.

Other herbicides that must be applied prior to jointing include Agility SG, Olympus, Outrider, PowerFlex HL, Pulsar, and Rave.

Applications permitted through boot

Herbicides that can be applied later in the spring – prior to boot stage – include Ally + 2,4-D, Amber, Finesse, Glean, Starane Flex, and Starane NXT. Starane is a better choice than dicamba products for control of kochia after wheat moves into the jointing stage of growth

2,4-D is labeled for application to wheat from the full-tiller stage until prior to the boot stage of growth, Application of 2,4-D prior hinders the tillering process and can result in significant yield loss if applied too early. Wheat will sometimes exhibit prostrate growth from 2,4-D applications applied in the jointing stage of growth, but yields generally are not significantly affected if applied before the boot stage of growth.

In general, MCPA is safer on wheat than 2,4-D, especially when applied prior to tillering. MCPA can be applied after the wheat is in the three-leaf stage (may vary by product label) until it reaches the boot stage of growth. Neither herbicide should be applied once the wheat is near or reaches the boot stage of growth, as application at that time can result in malformed heads, sterility, and significant yield loss (Figure 2).

Both 2,4-D and MCPA are available in ester or amine formulations. Ester formulations generally provide a little better weed control than amine formulations at the same application rates, but also are more susceptible to vapor drift. However, the potential for vapor drift damage in early spring is minimal. Ester formulations generally are compatible for use with fertilizer carriers, while amine formulations often have physical compatibility problems when mixed with liquid fertilizer.

Applications permitted through flag leaf

Many herbicides used in the spring on wheat can be applied up to the time the flag leaf is visible, or later. One newer product that can be applied from 2-leaf and flag leaf is called Pixxaro EC. It is labeled for control of flixweed, horseweed, kochia, wild buckwheat, and other troublesome weeds.

Other herbicides that can be applied through flag leaf include Affinity BroadSpec, Affinity TankMix, Ally Extra SG, Express, Harmony, Harmony Extra, Huskie, Quelex, Sentrallas, Supremacy, Talinor Weld, and WideMatch must be applied before the flag leaf is visible.

Figure 1. Stunting from an application of 2,4-D to wheat prior to tillering. Photo by Dallas Peterson, K-State Research and Extension.

Figure 2. Malformed heads from an application of 2,4-D at boot stage. Photo by Dallas Peterson, K-State Research and Extension.

For more detailed information, see the "2021 Chemical Weed Control for Field Crops, Pastures, and Noncropland" guide available online at https://bookstore.ksre.ksu.edu/pubs/SRP1162.pdf or check with your local K-State Research and Extension office for a paper copy.

The use of trade names is for clarity to readers and does not imply endorsement of a particular product, nor does exclusion imply non-approval. Always consult the herbicide label for the most current use requirements.

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2. Be aware of fire weather conditions during prescribed burning season

The prescribed burning season in Kansas has started. Be careful - the outlook for potential wildland fire in Kansas is above normal for parts of Kansas (Figure 1). Dry moisture conditions in Kansas, along with adequate fuel, increases the chances of wildfire when coupled with warm temperatures, high winds, and low humidity. Counties have issued burn bans already this year. The National Weather Service (NWS) is also issuing Red Flag Warnings. Criteria for a Red Flag Warning can vary somewhat depending on the location, but usually indicate conditions where control of fire will be difficult. For instance, winds gusting to over 25 miles per hour, along with warm air temperatures, and relative humidity less than 25% will often result in a Red Flag Warning this time of the year. The Wichita NWS uses a Grassland Fire Danger Index to communicate fire-weather conditions.

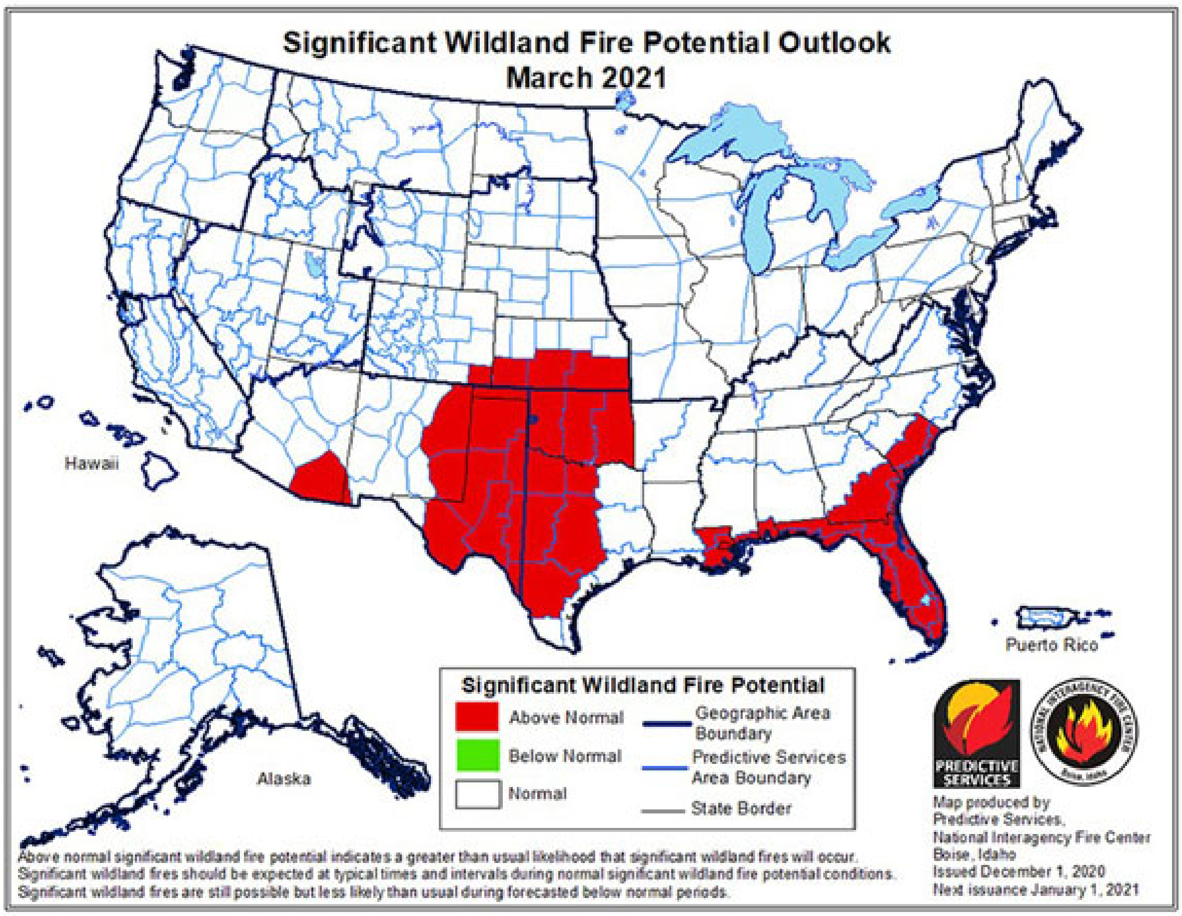

Figure 1. Potential wildland fire outlook for March 2021.

If you are planning to burn this spring, be sure to know your local regulations. Kansas regulations require the person conducting the burn to:

1. notify the local fire authority,
2. not create a traffic safety hazard,
3. not create an airport safety hazard, and
4. insure that the burning is supervised until the fire is extinguished.

Your county may require a burn permit. Always check with local authorities to ensure burning is allowed before staring a prescribed burn.

Weather forecasts and smoke model

Weather forecasts can be obtained from the NWS offices in Topeka, Wichita, Dodge City, Goodland, Hastings, NE, Kansas City/Pleasant Hill MO, and Springfield, MO. Online, simply type weather.gov/ and the name of your NWS office.

Weather conditions for conducting a safe prescribed burn are:

- wind speeds 5-15 mph,
- 40-70% relative humidity, and
- air temperatures of 50-80^{o}F.

The amount of cloud cover and mixing height will influence smoke dispersal. Check under the hourly forecast to see what is expected. That hourly forecast is also helpful to see when wind shifts might occur.

A smoke model located at ksfire.org predicts the direction smoke from a fire will travel based on current weather conditions, location, date, amount of fuel, and size of area to be burned. Another site providing useful information relative to conducting a prescribed burn is the Kansas Mesonet. You can see current humidity and wind directly at mesonet.ksu.edu/fire/rh at 70+ locations across the state.

Make sure prescribed fires are completely extinguished

With recent dry weather, mopping up your prescribed fire is critical. Numerous rekindles have been responsible for wildfires throughout eastern Kansas in the last week. Be sure to know the weather forecast for the next days after the burn. The best burning conditions often occur in advance to days with strong winds and low humidity. These unfavorable conditions can cause a flare-up to occur from smoldering objects such as dead wood that can burn for a long time.

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3. Topdressing wheat with sulfur

Traditionally, sulfur (S) deficiency is most common on high-yielding crops grown on irrigated sandy soils that are low in organic matter and subject to leaching. However, due to reduced S additions from the atmosphere (there is less S in the air now) and continued crop removal, an increasing number of finer-textured soils have shown S deficiency.

In recent years, sulfur deficiency in wheat has become common in many areas of Kansas, particularly in no-till wheat where cooler soil temperatures can slow S mineralization in the soil. Classic S deficiency symptoms, confirmed by soil and plant analysis, have been observed in many no-till wheat fields during periods of rapid growth in the spring. These observed deficiencies generally occur during periods of rapid growth prior to jointing or during stem elongation.

The photos below are a good representation of the problem. Generally, the S-deficient wheat is yellow and stunted (Figure 1-top photo), and the problem is found in patches in the field (Figure 1-bottom photo), especially in areas where there has been previous soil erosion or soil movement. Sulfur deficiency in growing crops is often mistaken for nitrogen (N) deficiency. However, unlike N deficiency where the older leaves show firing and yellowing, with S deficiency, the pale yellow symptoms of S deficiency often appear first on the younger or uppermost leaves. Wheat plants with S deficiency often eventually become uniformly chlorotic. The patchy S-deficient areas of the field are often found on hilltops or sideslopes where erosion has occurred and soil organic matter is reduced, or where leaching is more pronounced. In terraced or leveled fields, wheat in areas where topsoil was removed or significant cuts were made, also commonly shows symptoms.

Figure 1. Sulfur deficiency in wheat. Photos by Dorivar Ruiz Diaz, K-State Research and Extension.

The majority of S in soil is present in organic forms (requires mineralization to become plant available) in surface soils and as sulfate (SO_4^{2-}), an inorganic form and plant available. Sulfate is relatively soluble, so it tends to leach down from the surface soil into the subsoil. In many of our Kansas soils it will accumulate in the B horizon (subsoil) in two forms:

- Some sulfate will be sorbed to clay surfaces and coatings similar to the processes whereby phosphates are sorbed, though sulfate will not be sorbed as strongly.

- Sulfate will also be present in the subsoil of many Kansas soils as gypsum.

A soil test for available sulfate in the soil profile is available. For proper interpretation of this test, soil organic matter, soil texture, the crop to be grown, and the expected yield level all need to be considered. Since sulfate is mobile, sampling to a 24-inch depth is important. Accurate estimates of S needs cannot be made from a surface sample alone. However, due to the relatively high demand for S during the rapid vegetative growth phase of wheat and relatively shallow rooting by the wheat crop at this time, the S measured in the deeper subsoil by the test may not be available to wheat in the early spring, especially where soils are still cold.

Sulfur deficiency in wheat has been showing up early in the spring, shortly after green-up, before organic S is mineralized from soil organic matter, and before wheat roots can grow into the subsoil to utilize sulfate accumulated there. Deficiencies of S are often difficult to identify because the paling in crop color is not always obvious. Wheat plants lacking S also may be stunted, thin-stemmed, and spindly. In the case of wheat and other cereal grains, maturity is delayed. Due to the slower growth and lack of good tillering, winter annual weed competition is also enhanced.

Many fields in north central and northeast Kansas now have an established history of S deficiency for wheat. In this situation, rather than waiting for symptoms to appear in the spring, farmers may want to consider a winter topdress application of S as a preventive measure.

There are many S-containing fertilizer materials. Several dry materials are available that can be blended with dry phosphorus or nitrogen fertilizers for winter/spring topdressing. Some of these products are best used in preplant applications, however.

- **Elemental S** (typically 90-95 percent S) is a dry material marketed by several manufacturers. Before it becomes available for plant uptake, elemental S must first be oxidized by soil microorganisms to sulfate-S and this can be a slow process when surface-applied. As a result, this material is well suited for preplant applications only. Elemental S is not suited for corrective applications to S-deficient wheat in the spring.

- **Ammonium sulfate**, (21-0-0-24S) is a dry material that is a good source of both N and available S. It has high acid-forming potential, however, and soil pH should be monitored. Ammonium sulfate is a good source to consider for both preplant or topdressing to correct existing sulfur deficiencies.

- **Gypsum** (analysis varies) is calcium sulfate, and is commonly available in a hydrated form containing 18.6 percent S. This material is commonly available in a granulated form that can be blended with other materials. Since it is a sulfate source, it would be immediately available, and is another good source for spring topdressing.

- **New N-P-S products,** such as Microessentials, 40-Rock, and others, are ammonium phosphate materials formulated with sulfur, and in some cases micronutrients such as zinc. In most of these products the sulfur is present as a combination of elemental-S and sulfate-S.

There are also liquid sources of sulfur fertilizers available.

- **Ammonium thiosulfate**, (12-0-0-26S) is the most popular S-containing product used in the fluid fertilizer industry, as it is compatible with N solutions and other complete liquid products.
- **Potassium thiosulfate**, (0-0-25-17S) is a clear liquid product that can be mixed with other liquid fertilizers.

Liquid and dry fertilizer sources can be applied in combination with N at topdressing this spring. However, is important to consider the potential plant availability of each S fertilizer source for this wheat growing season.

For more information see K-State publication MF 2264 "*Sulfur in Kansas*" at
http://www.ksre.ksu.edu/bookstore/pubs/MF2264.pdf

For estimations of required application rates of S see K-State publication MF-2586 "*Soil Test*

Interpretation and Fertilizer Recommendations" at
http://www.ksre.ksu.edu/bookstore/pubs/mf2586.pdf

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4. Chloride as a topdressing nutrient for wheat

Chloride (Cl) is a highly mobile nutrient in soils and topdressing is typically a good time for application, especially in regions with sufficient precipitation or with coarse-textured soils are prone to leaching.

One of the main benefits from good Cl nutrition is the improvement in overall disease resistance in wheat. Wheat response to Cl is usually expressed in improved color, suppression of fungal diseases, and increased yield. It is difficult to predict whether Cl would significantly increase wheat yields unless there has been a recent soil test analysis for this nutrient. Chloride fertilization based on soil testing is becoming more common in Kansas.

As with nitrate and sulfate, Cl soil testing is recommended using a 0-24 inch profile sample. Based on current data, the probability of a response to Cl in dryland wheat production in northeast and central Kansas seems higher than in western Kansas.

The interpretation of the Cl test and corresponding fertilizer recommendations for wheat are given in the table below. Chloride fertilizer is recommended when the soil test is below 6 ppm, or 45 pounds soil chloride in the 24-inch sample depth. Dry or liquid fertilizer sources are all plant available immediately. Potassium chloride (potash) and ammonium chloride are commonly available and widely used fertilizer products, though other products such as calcium, magnesium, and sodium chloride can also be used and are equal in terms of plant availability.

Table 1. Soil test chloride interpretations for wheat in Kansas

	Soil Chloride in a 0-24 inch sample		**Chloride Recommended**
Category	(lbs/acre)	(ppm)	(lbs Cl/acre)
Low	<30	<4	20
Medium	30-45	4-6	10
High	>45	>6	0

Chloride deficiency symptoms appear as leaf spotting and are referred to as physiological leaf spot.

Figure 1. Upper and lower photos both depict chloride deficiency symptoms (physiological leaf spotting) in wheat. Photos by Dorivar Ruiz Diaz, K-State Research and Extension.

K-State has done considerable research on Cl applications to wheat since the early 1980's, mostly in the eastern half of the state. Results have been varied, but there have been economic yield responses in almost all cases where soil test Cl levels have been less than 30 lbs per acre (Figure 2).

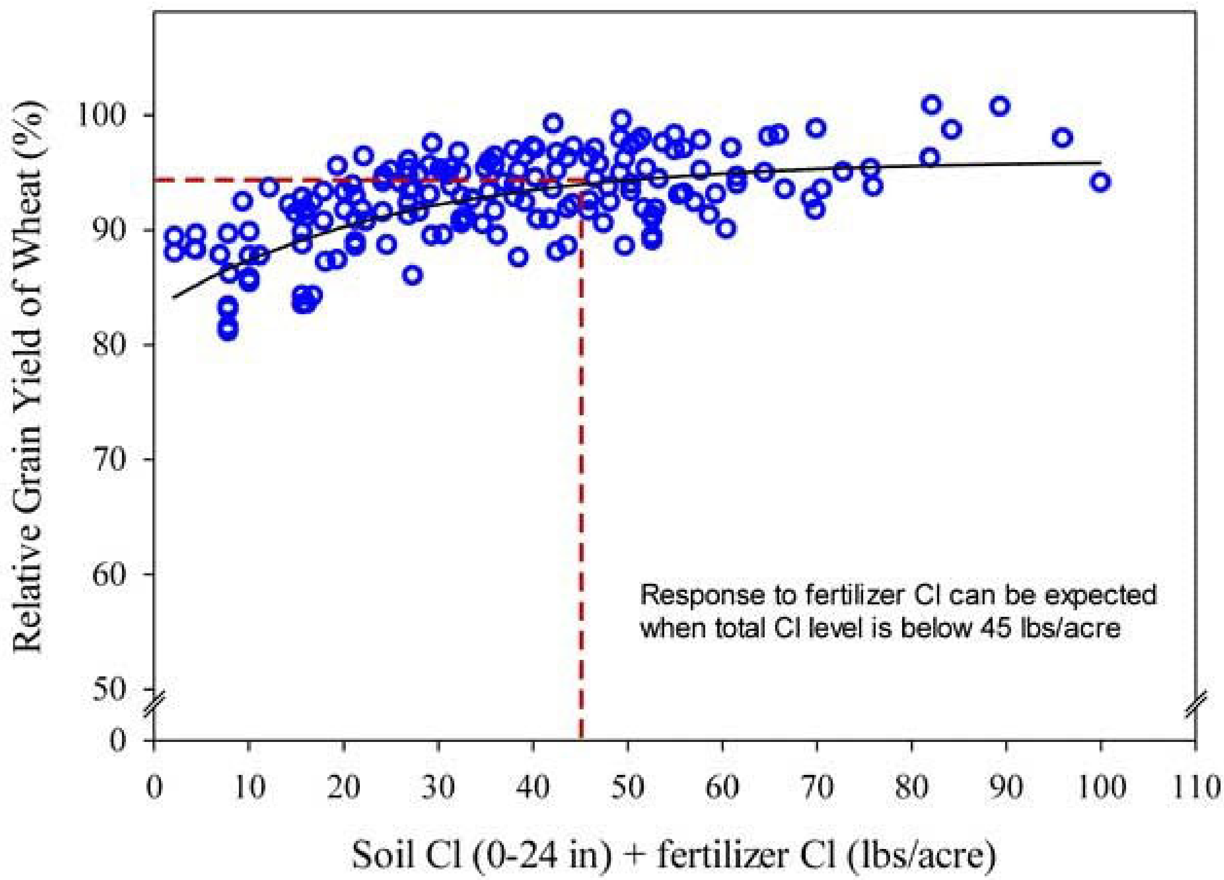

Figure 2. Relative wheat grain yield as affected by total chloride supply (soil + fertilizer) in Kansas.

Deficiencies were most likely to be found on fields with no history of potash (KCl) applications. Recent studies showed that there are variety differences in response to Cl and are likely associated with the tolerance of that variety to fungal diseases.

For more information, please refer to the KSRE publication *Chloride in Kansas: Plant, Soil, and Fertilizer Considerations*, MF2570: www.ksre.ksu.edu/bookstore/pubs/MF2570.pdf

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5. Be patient as spring planting approaches: Soil temperature and moisture update

Selection of the optimal planting date is one of the most critical factors in the decision-making process for farmers. In making this decision, producers should consider soil temperatures rather than just calendar dates. After a very mild start to March, air temperatures across Kansas are forecasted to cool down in the coming days.

For the week of March 4-10, average weekly soil temperatures at 2 inches among crop reporting districts ranged from 39°F to 51°F (Figure 1). Differences can be quite large, based on soil moisture, residue, and soil types. For instance, the weekly average at Oberlin is 51°F (red arrow, Fig. 1), while it is 39°F at Colby (black arrow, Fig. 1).

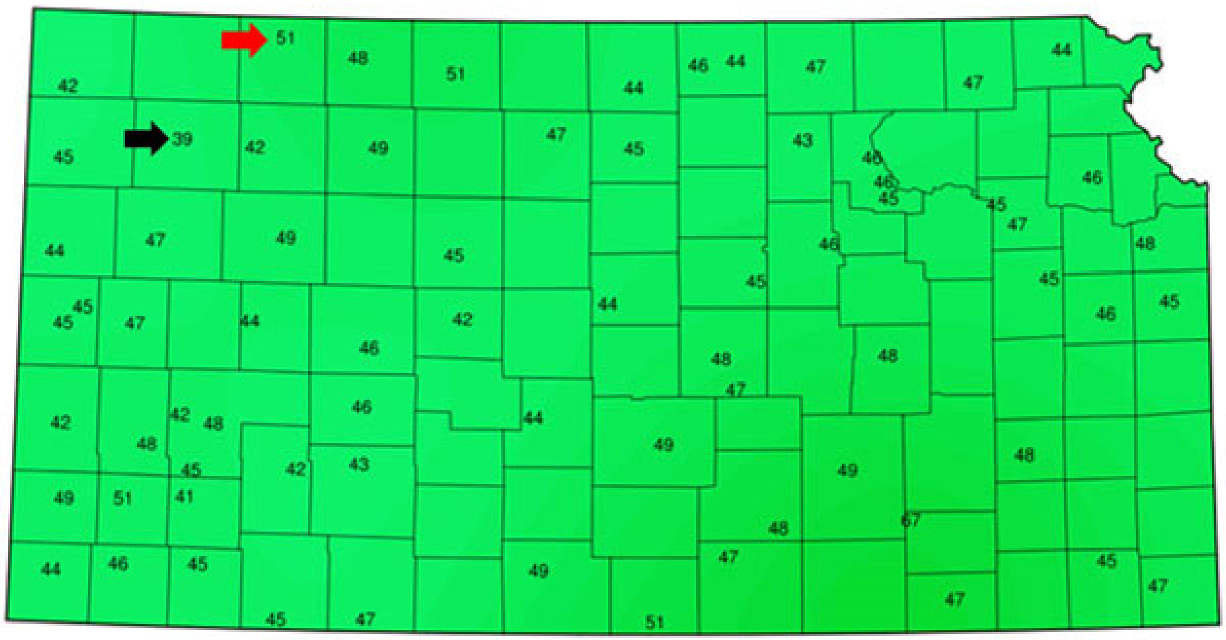

Figure 1. Average soil temperatures at 2-inch soil depth for the week of March 4 to 10, 2021. The red and black arrows highlight a large difference in soil temperature in neighboring counties in NW Kansas ([http://mesonet.k-state.edu/)](http://mesonet.k-state.edu/).

Air temperatures ranged from 55°F to 43°F, with the coolest temperatures in the west and the warmest in the east (Figure 2).

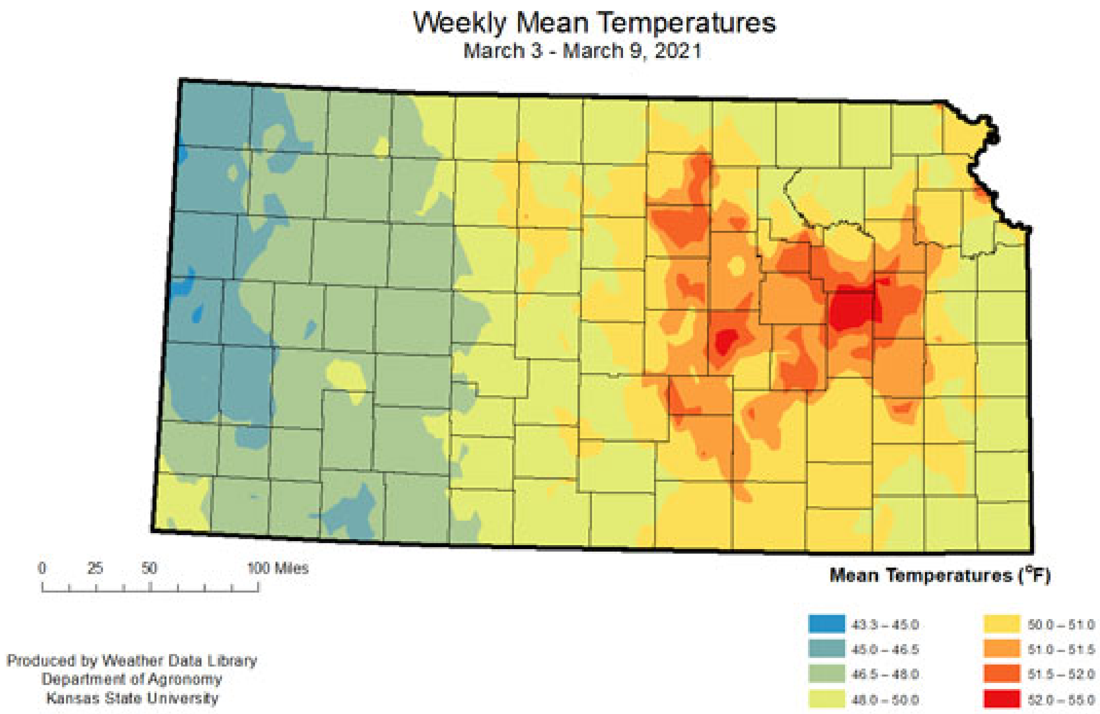

Figure 2. Weekly mean air temperatures for the week of March 3 - 9, 2021.

Projections for the coming weeks call for cooler-than-normal temperatures statewide (Figure 3). In addition, significant moisture is expected, which will slow soil warming (Figure 4).

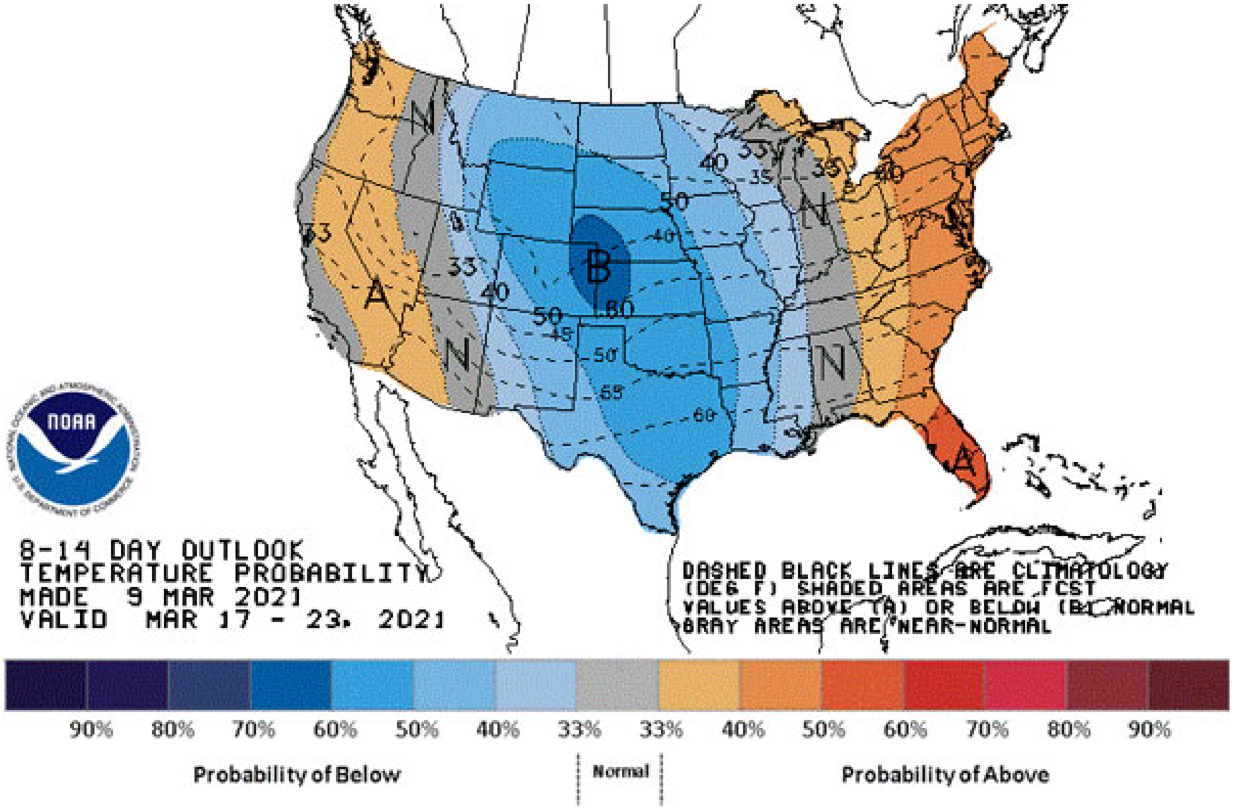

Figure 3. 8 to 14-day outlook temperature probability for March 17 – 23, 2021. (NOAA)

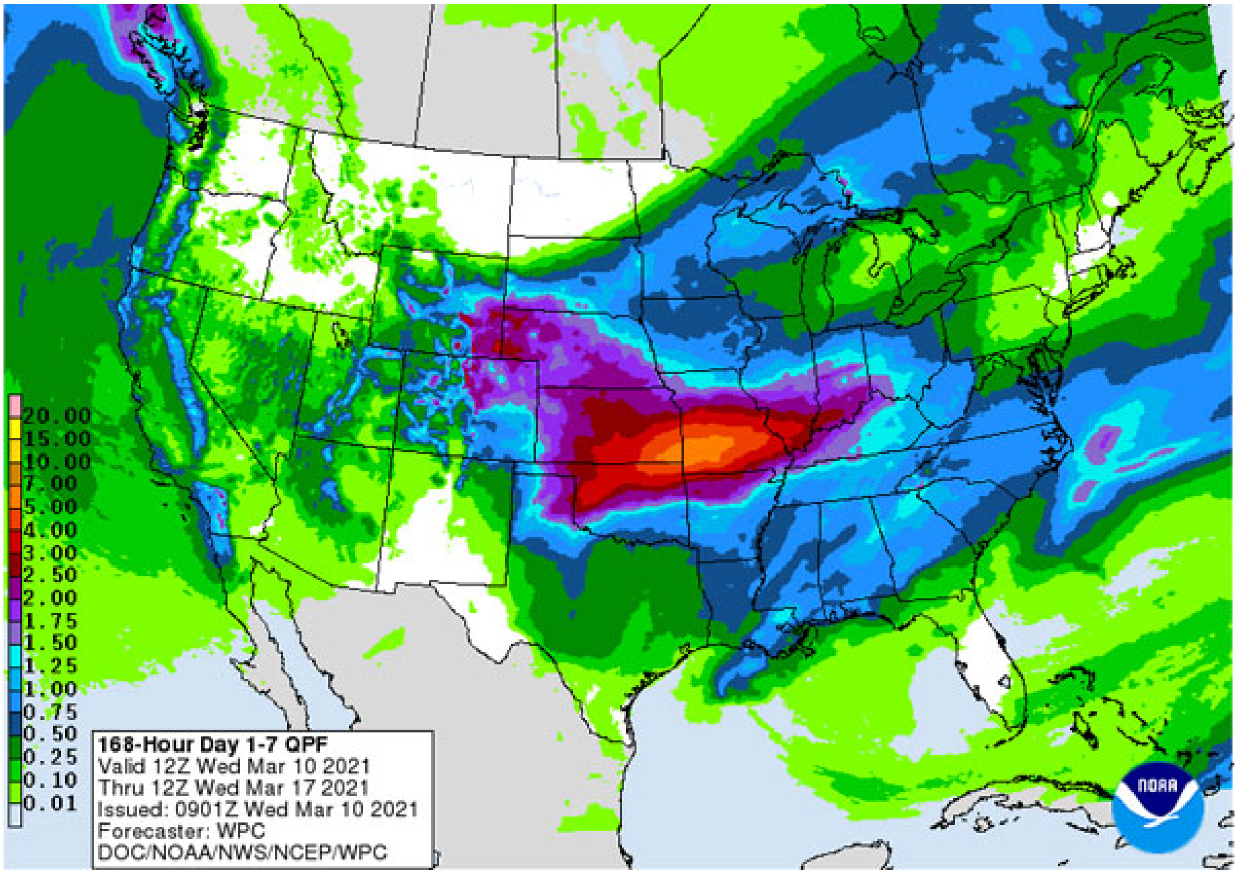

Figure 4. Quantitative Precipitation Forecast for March 10-17, 2021 (WPC)

The actual change in soil temperatures in any given field will be affected by amount of residue cover, soil moisture, and landscape position. Wet soils under a no-tillage system will be slower to warm. Dry soils will fluctuate more rapidly, matching air temperatures, particularly if skies are clear. Current soil moisture status across Kansas is moderate to dry (Figure 5).

The largest weekly departure in precipitation occurred in the southeast corner of Kansas (Figure 6). After the wet upcoming week, projections for the latter part of March call for precipitation to be below-normal for most of Kansas (Figure 7).

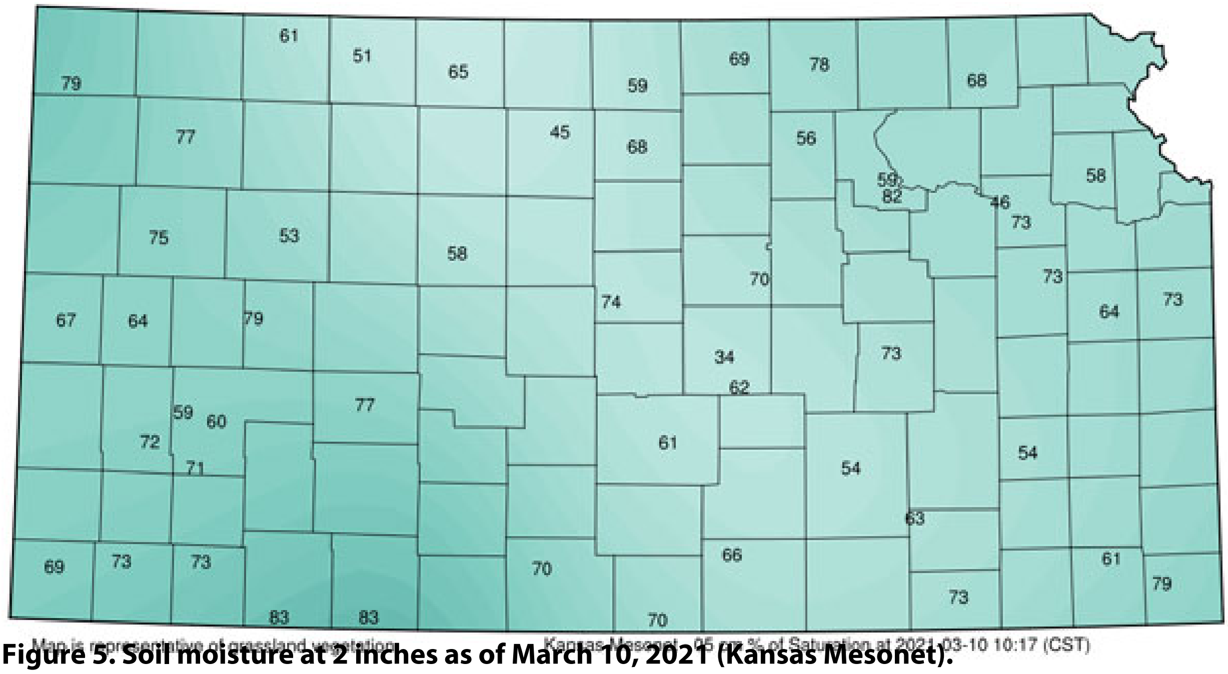

Figure 5. Soil moisture at 2 inches as of March 10, 2021 (Kansas Mesonet).

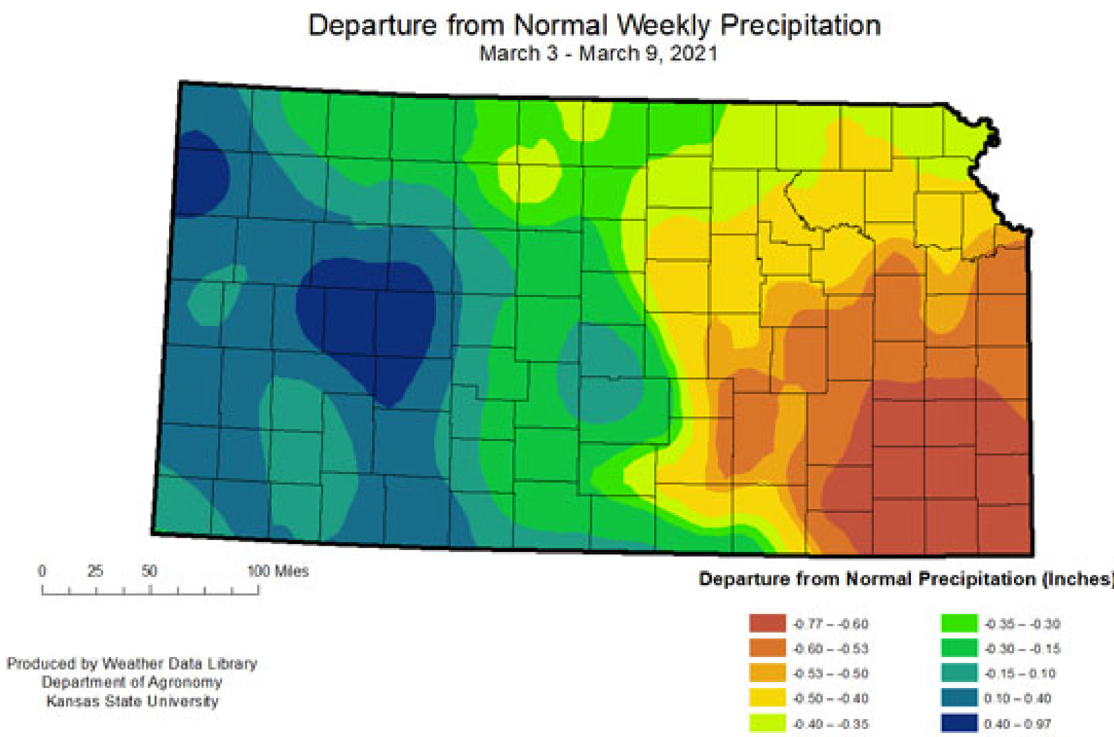

Figure 6. Departure from normal precipitation for the week of March 3-9, 2021

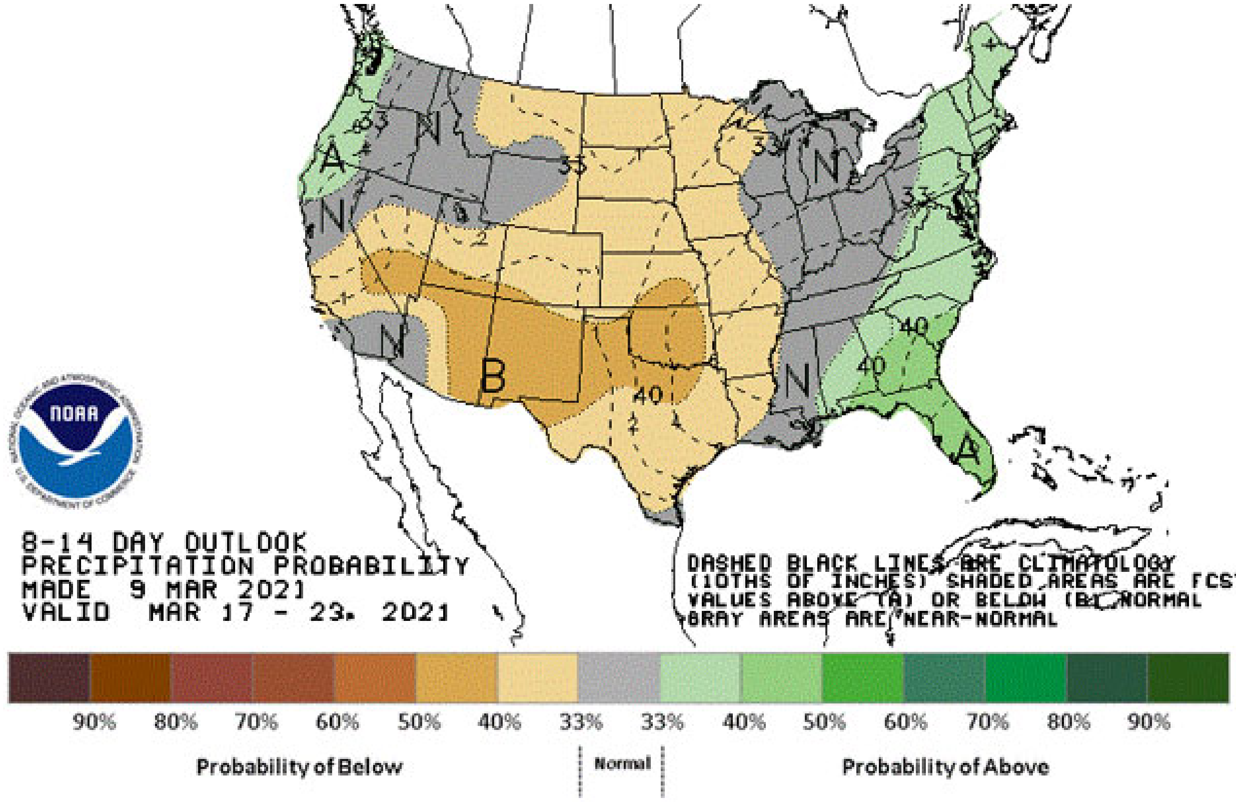

Figure 7. 8 to 14-day outlook precipitation probability for March 17 – to-23, 2021. (NOAA)

Optimal soil temperature for crop emergence

Every summer row crop has an optimal soil temperature for emergence. A minimum for corn is 50°F for germination and early growth. However, uniformity and synchrony in emergence is primarily achieved when soil temperatures are 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. This is particularly true for corn, since it is the earliest summer row crop planted. When soil temperatures remain at or below 50°F after planting, the damage to germinating seed can be particularly severe.

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 and residue distribution, tillage systems, soil type and moisture conditions (more severe under dry conditions), and the growth stage of the plant. Injury is most likely on very young seedlings or on plants beyond the V5-6 growth stage, when the growing point is above the soil surface.

The average day for last spring freeze (32°F) is quite variable around the state (Figure 8). The largest variability is from southeast to northwest Kansas; with the earliest last spring freeze date for the southeast region (April 5-15) and latest for the northwest area (>May 3). Corn planting dates before April 15 in the southeast region would increase the likelihood of the crop suffering from a late spring freeze. Similar conditions can be projected for northwest Kansas if corn is planted before May 3.

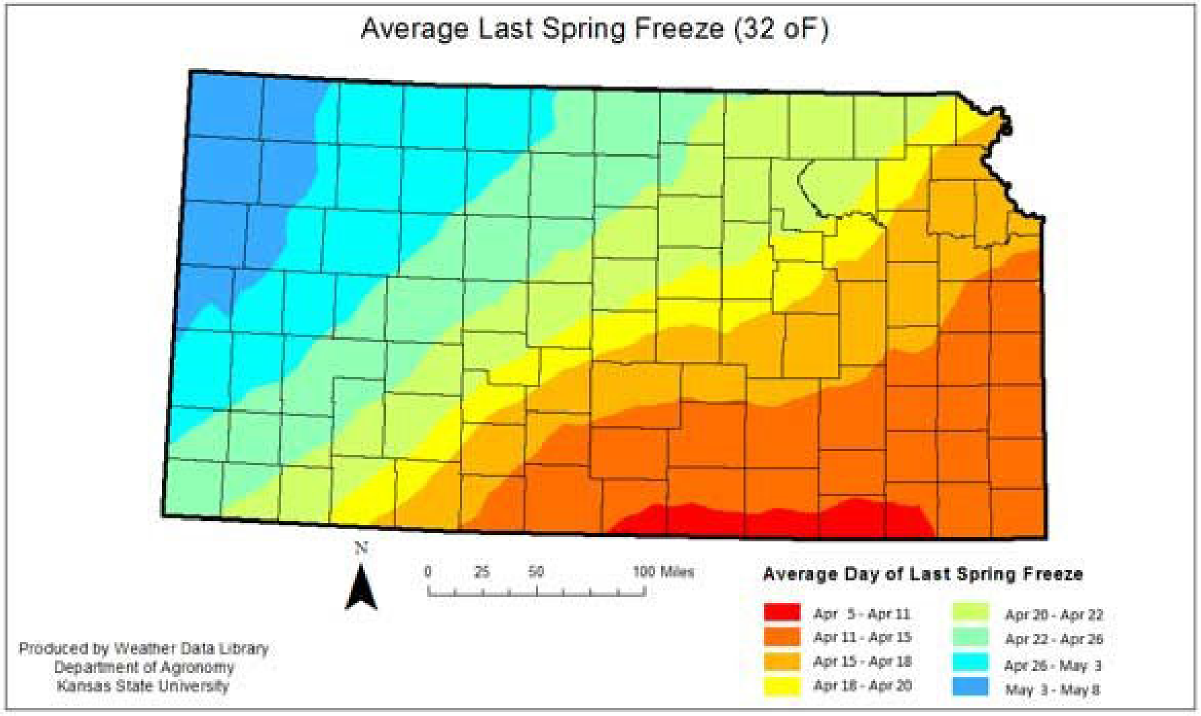

Figure 8. Average last spring freeze (32 degrees F) for Kansas.

Producers should consider all these factors when deciding on the optimal planting time.

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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6. Understanding herbicide modes of action

Weed scientists at Kansas State University recently updated a comprehensive publication on herbicide mode of action. This publication, C715 - *Herbicide Mode of Action*, provides an in-depth description of how herbicides work to control weeds. Interspersed throughout the publication are helpful illustrations, definitions of herbicide terminology, and full color photos depicting various plant responses to herbicide applications (Figure 1).

The way in which a herbicide kills weeds is called its **mode of action**. Herbicide mode of action is a term that generally describes the plant process (e.g., photosynthesis) or enzyme (e.g., ALS) that is disrupted by the herbicide. Herbicide **site of action** refers to the specific biochemical or biophysical process in the plant that the herbicide disrupts to interfere with plant growth and development processes. This means that one mode of action may be associated with multiple sites of action. The term "herbicide mode of action" is sometimes used interchangeably with "herbicide site of action" or "herbicide mechanism of action." Within a mode of action, herbicides may also be grouped by their chemical structures. Herbicides that share similar structures are said to be in the same chemical family.

The publication is divided into the following topic areas:

- Plant characteristics affecting weed control
- Environmental characteristics affecting weed control
- Application variables affecting weed control
- Categorizing herbicides
- Non-herbicide stresses

Understanding how herbicides work provides insight into how to use the chemicals and helps diagnose causes of poor weed control or crop injury.

Herbicide Mode of Action –C715 is available to download for free at: https://bookstore.ksre.ksu.edu/pubs/C715.pdf.

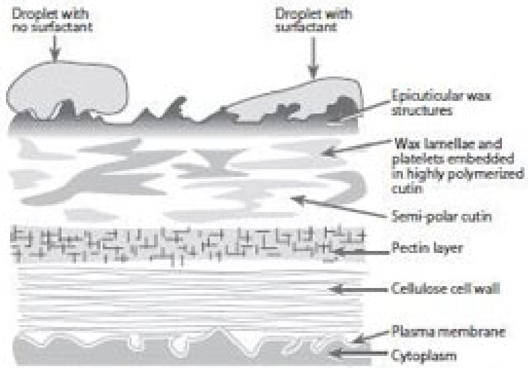

Figure 4. *Leaf surface composition and the influence of surfactants on droplet spread over the leaf surface (adapted from Hull, Davis, and Stolzenberg).*

Categorizing herbicides

Herbicide Selectivity

The potential for a herbicide to kill certain plants without injuring others is called selectivity. **Nonselective herbicides** kill or suppress the growth of most plant species. Their use is limited to situations where control of all plant species is desired, or the herbicide is directed on the target weed and away from desirable plants. Glyphosate, glufosinate (Liberty), and paraquat (Gramoxone) are considered nonselective herbicides; however, glyphosate and glufosinate are used as a selective herbicide in glyphosate- and glufosinate-resistant crops.

Most herbicides used in crop production are selective. Herbicide selectivity is relative and depends on several factors, including plant biology, environment, herbicide application rate, application timing, and application technique. Even a tolerant plant species may be susceptible to a herbicide if the application rate is high enough. Herbicide selectivity may be based on herbicide placement, differential spray retention, absorption, translocation, metabolism, or an insensitive site of action.

Definitions

Contact herbicide: Herbicide that is not translocated throughout the plant and generally kills the tissues they contact, making spray coverage important for effectiveness.

Nonselective herbicide: Herbicide that is toxic to all plant species.

Systemic herbicide: Herbicide that moves throughout the plant, either with sugars or water.

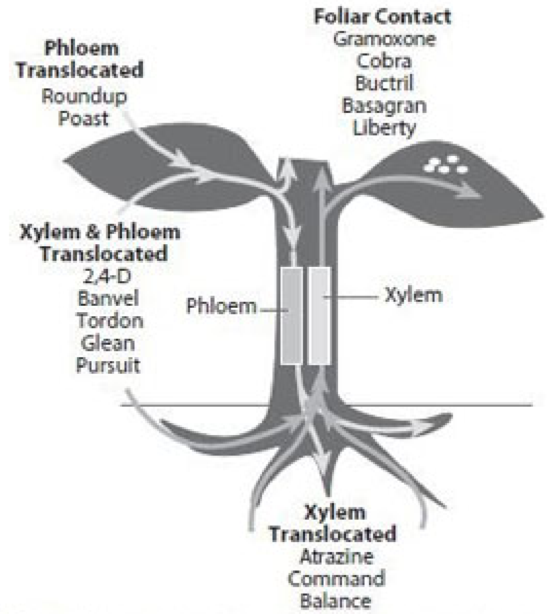

Figure 5. *Herbicide translocation in plants. Brand names are used for example only, similar products may be available under different names.*

Herbicide Translocation

Contact herbicides do not move throughout treated plants. Examples include paraquat, glufosinate (Liberty), and acifluorfen (Ultra Blazer). Thorough spray coverage of a plant is essential with foliar-applied contact herbicides because contact herbicides only damage the plant parts that the spray solution contacts. Underground portions of plants are unaffected and can initiate new growth, therefore, contact herbicides generally are ineffective for long-term perennial weed control. Contact herbicides often are more effective on broadleaves than on grasses. The growing point of young grasses is in the crown region of the plant, which is at or below the soil surface, and thus, difficult to contact with spray. In contrast, the growing point on young broadleaf plants, which is near the top of the plant, is exposed to the spray treatment. Thus, paraquat may not kill all the growing points of a tillered grass plant, and regrowth can occur. In addition, larger broadleaf plants may have regrowth because of sprouting from multiple axillary buds that were not in contact with the herbicide.

Systemic herbicides can be translocated to other parts of the plant either in the xylem or the phloem (Figure 5). Xylem is nonliving tissue through which water and nutrients move from the roots to the shoots and leaves of plants. Translocation in the xylem is only upward and outward in plants from the roots to the

Figure 1. Sample page from the publication, "Herbicide Mode of Action", that discusses herbicide categories. Illustrations and herbicide terminology definitions are helpful resources that complement the text. Source: C715 - Herbicide Mode of Action, K-State Research and Extension.

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