Issue 709

K-STATE Research and Extension

Extension Agronomy

eUpdate

09/07/2018

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. Early planting of wheat can lead to several problems

The general target date for planting wheat for optimum grain yields in Kansas is within a week of the best pest management planting date, or BPMP (formerly known as the "Hessian fly-free") date (Figure 1). If forage production is the primary goal, earlier planting (mid-September) can increase forage yield. However, if grain yield is the primary goal, then waiting until the BPMP date to start planting is the best approach (Figure 2). Planting in mid-September is ideal for dual-purpose wheat systems where forage yields need to be maximized while reducing the effects of early planting on reduced grain yields.

Optimum wheat planting dates in Kansas depend on location within the state. Suggested planting dates by zone are as follows:

Zone 1: September 10-30

Zone 2: September 15 – October 20

Zone 3: September 25 – October 20

Zone 4: October 5 - 25

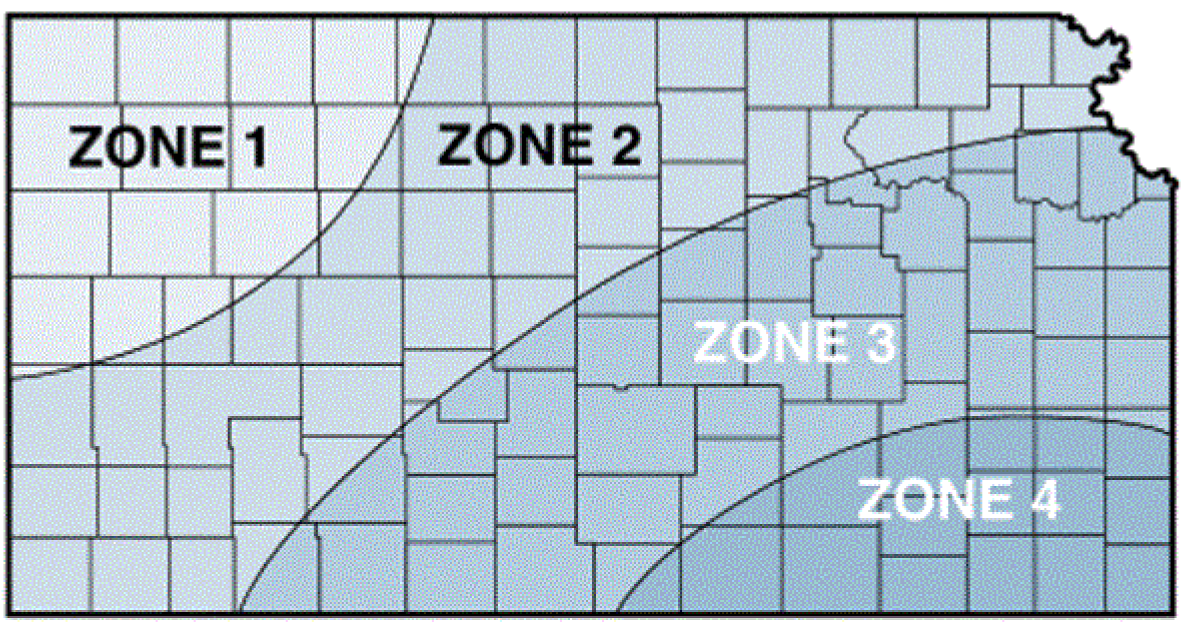

Figure 1. Optimum wheat planting dates by zone in Kansas.

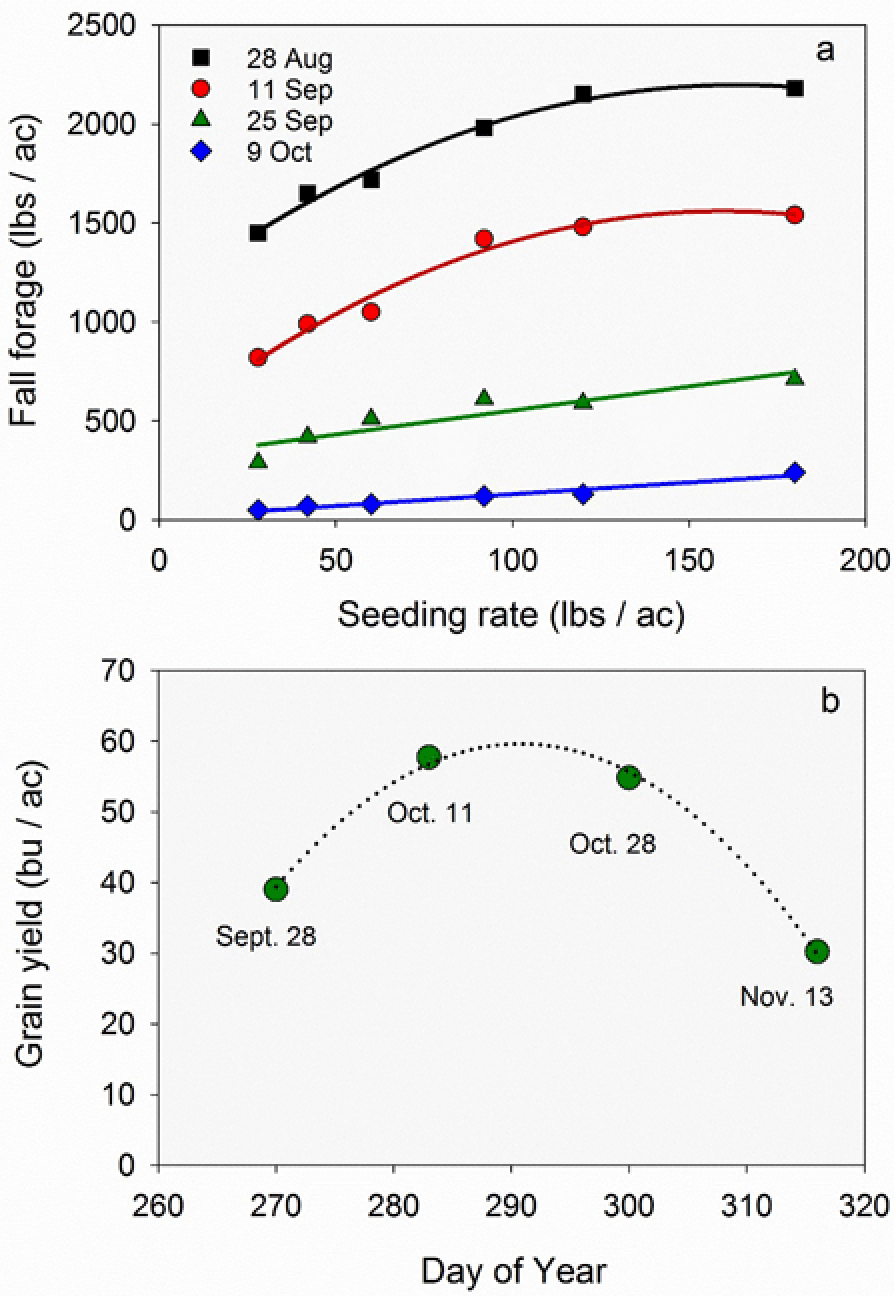

Figure 2. Effect of planting date and seeding rate on wheat fall forage yield in Lahoma, north-central Oklahoma (a) and effect of planting date on wheat grain yield near Hutchinson, south-central Kansas (b). Figure adapted from KSRE numbered publication MF3375.

While the effects of planting date on wheat yield shown above will hold true for most years, they will largely depend on environmental conditions and disease pressure during the growing season. In some years, earlier-planted wheat does best and some years the later-planted wheat does best. For instance, early-planted fields during 2016-17 had a better final stand as compared to later-planted ones in western Kansas, mostly due to lack of moisture for later planted fields. If fields become too wet to plant by mid-October and stay that way through the remainder of the fall, then producers end up planting much later than the optimum planting date, and this is an incentive to start planting earlier than the fly-free date if soil conditions are good.

Ideally, producers should not start planting much earlier than the BPMP date, which can seem quite late to some especially in south central Kansas. Several problems can arise from planting too early:

- Increased risk of **wheat streak mosaic** and related diseases. Wheat curl mites that spread these diseases survive the summer on volunteer wheat and certain other grasses. As those plants die off, the wheat curl mites leave in search of new plants to feed on. Early-planted wheat is likely to become infested, and thus become infected with wheat streak mosaic virus, high plains virus, and Triticum mosaic virus. The wheat curl mites can about a mile or more through the air before dying, so if wheat is planted early, make sure all volunteer wheat within a mile is completely dead at least two weeks before planting.
- Increased risk of **Hessian fly**. Over the summer, Hessian fly pupae live in the old crowns of wheat residue. After the first good soaking rain in late summer or early fall, these pupae (or "flaxseed") will hatch out as adult Hessian flies and start looking for live wheat plants to lay eggs on. They are most likely to find either volunteer wheat or early-planted wheat at that time. After the BPMP date, many of the adult Hessian fly in a given area will have laid their eggs, so there is generally less risk of Hessian fly infestation for wheat planted after that date. Hessian fly adult activity has been noted through November or even early December in Kansas.
- Increased risk of **barley yellow dwarf**. Many types of aphids can spread barley yellow dwarf. In Kansas, greenbugs and bird cherry-oat aphids are the primary vectors of this viral disease. These insects are more likely to infest wheat during warm weather early in the fall than during cooler weather. Planting wheat after the BPMD reduces the risk of problems with aphids and barley yellow dwarf.
- Increased risk of **excessive fall growth and excessive fall tillering**. For optimum grain yields and winter survival, the goal is for wheat plants to head into winter with established crown roots and 3-5 tillers. Wheat that is planted early can grow much more than this, especially if moisture and nitrogen levels are good. If wheat gets too lush in the fall, it can use up too much soil moisture in unproductive vegetative growth and become more susceptible to drought stress in the spring if conditions are dry.
- Increased risk of **take-all, dryland foot rot, and common root rot**. Take-all is usually worse on early-planted wheat than on later-planted wheat. In addition, one of the ways to avoid dryland foot rot (*Fusarium graminearum* and other *Fusarium* species) is to avoid early seeding. This practice promotes large plants that more often become water stressed in the fall predisposing them to invasion by the fungi. Early planting of wheat also favors common root rot because this gives the root rot fungi more time to invade and colonize root and crown tissue.
- **Grassy weed infestations** become more expensive to control. If cheatgrass, downy brome, Japanese brome, or annual rye come up before the wheat is planted, they can be controlled with glyphosate or tillage. If wheat is planted early and these grassy weeds come up after the wheat has emerged, producers will have to use an appropriate grass herbicide to control them.
- Germination problems due to **high soil temperatures**. Early planted wheat is sown in hotter

soils, which may become problematic as some wheat varieties have high-temperature germination sensitivity. In other words, some varieties will not germinate when soil temperatures are greater than 85°F. If planting early, it is important to select varieties that do not have high-temperature germination sensitivity and sow sensitive varieties later in the fall, when soil temperatures have cooled down.

- Emergence problems due to **shortened coleoptile length**. Hotter soils tend to decrease the coleoptile length of the germinating wheat. Therefore, deeply planted wheat may not have a long-enough coleoptile to break through the soil surface and may result in decreased emergence and poor stand establishment. When soil temperatures, it is often better plant wheat at a shallower depth (3/4 to 1 inch deep) even if moisture is absent in the top layers of soil. Planting wheat deep (>2 inches) increases the risk of poor emergence and unacceptable stands.

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2. Control seed-borne diseases in wheat with fungicide seed treatments

Fungicide seed treatments are becoming an important part of wheat production in Kansas. Seed treatments may help with wheat stand establishment in certain situations, and greatly reduce the risk of problems with seed-borne diseases such as common bunt, loose smut or flag smut.

Seed production fields are a top priority for fungicide seed treatments. These fields have a high value and investments in seed treatments here help prevent the introduction and development of seed borne diseases on your farm. Due to the high value of the seed produced, even small yield increases can justify the use of seed treatments.

Seed treatments can also be very helpful when planting wheat after soybean harvest, even on seed that has high test weight and good germination. Planting wheat late into cool, wet soils often delays emergence, and reduces the tillering capacity of wheat seedlings. This reduced tillering capacity diminishes the plants ability to compensate for stand loss and maintain yield potential.

There are many different seed treatments available for wheat. Although most seed treatment ingredients are fungicides, some will also contain insecticides. Each ingredient targets slightly different spectrum of disease causing fungi or insect pests. Therefore, many commercial formulations include combinations of ingredients that provide a broader spectrum of protection.

As mentioned earlier, the most important use of seed treatments is for the control of seed-borne diseases such as smuts and bunts. Loose smut (Figure 1) control requires a systemic fungicide like tebuconazole or difenoconazole. Common bunt (Figure 2), sometimes called, "stinking smut", can be controlled, very effectively, with most commercial treatments. Some regions of the state have struggled with these diseases in recent years. If you are planning to keep seed that is known to have or been exposed to common bunt, it is critical to use a fungicide seed treatment to avoid problems in the future. Loads of grain contaminated with common bunt are often rejected at the point of delivery.

Figure 1. Loose smut on wheat. Photo by Erick DeWolf, K-State Research and Extension

Figure 2. The brown colored head is mature wheat with symptoms of common bunt. Photo by Erick DeWolf, K-State Research and Extension

Most seed treatments do at least a good job of controlling seed rots and seedling blights. Seed borne Fusarium (scabby kernels) and black point can reduce seed germination and seedling vigor. If a seed lot has either of these diseases, it should be cleaned to remove all light test weight seeds and then tested for germination. If the germination rate is low (less than 90%), a seed treatment could help increase the germination rate.

Some seed treatments also offer limited control or suppression of foliar diseases that occur in the fall. For example, treatments containing tebuconazole and difenoconazole provide some protection against fall infections of powdery mildew, leaf rust, and Stagonospora nodorum leaf blotch. A seed treatment will not prevent the disease from becoming reestablished in the spring, and foliar fungicide applications may still be required to protect yield potential of the crop. Producers must balance the possible benefits against the cost and the possibility of having leftover treated seed. Leftover treated seed can be avoided by using hopper box treatments or other on-farm application equipment. If seed is treated on-farm, pay close attention to thorough coverage of the seed.

Incomplete coverage can reduce the efficacy for the seed treatment.

For more information, see K-State publication MF2955, *Seed Treatment Fungicide Wheat Disease Management 2017* at: http://www.ksre.ksu.edu/bookstore/pubs/MF2955.pdf

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3. Wheat seeding tips for good stand establishment

Regardless of the soil moisture conditions at wheat planting time, there are a few important steps producers can take to improve their chances of getting a good stand of wheat:

- Proper tractor speed. It is best to use a tractor speed of between 5 and 6 miles per hour in most cases when drilling wheat, depending on the amount of down pressure on the openers. If higher speeds are used, the openers can tend to "ride up" in the soil every now and then if down pressure is insufficient.
- Proper, uniform seeding depth. The ideal planting depth for wheat in most cases is about 1.5 inches. When planting early into very warm soils, it is especially important not to plant too deeply since coleoptile lengths are shorter than normal under warm conditions. On the other extreme, producers should also be especially careful not to plant too deeply when planting later than the recommended time into very cool soils. Getting a uniform seeding depth is also important. Where producers are planting into fields with heavy residue, or where there is uneven distribution of chaff from the previous crop, uneven planting depth can be a serious problem. In those situations, it is common to end up with poor stand establishment in areas of the field where the drill opener rode up over the residue or chaff, and was unable to penetrate the soil to the same depth as in other areas of the field.
- Firm seedbed. Planting into loose, fluffy soils can be a problem where soils have been tilled repeatedly during the summer. When seeds are planted into loose soils, rains in the fall will settle the soil and leave the crowns of the seedlings too close to the soil surface. Having a good closing system behind the drill openers, with adequate down pressure, should help.
- Plant during the optimum time. In general, wheat should be planted somewhere around the best pest management planting date (BPMP, former Hessian fly-free date). There may be good reasons to plant some wheat before the BPMP date, such as planting for pasture or time pressures from having considerable acreage to plant. However, stand establishment and ultimate grain yields are usually best when wheat is planted after the BPMP date and before deadlines set by crop insurance. Planting more than three weeks after the BPMP can be risky. Late-planted wheat often does not develop an adequate root system before winter, and forms fewer productive fall tillers. When planting late, seeding rates should be increased by 25 to 50 percent (up to a maximum of 120 lbs/acre) to help ensure an adequate stand and compensate for the lack of tillering.
- Adequate soil fertility. In general, producers should apply at least part of their nitrogen before or at planting time to get the plants off to a strong start. Nitrogen rates of 20-30 lbs can help with fall establishment and tillering. If the soil is low or very low in phosphorus or potassium, these nutrients should be applied at planting time as well so that the plants benefit early in their development. Starter phosphorus with the seed or band-applied close to the seed can also help with fall early growth and establishment, particularly in low-testing soils. Low soil pH can be a concern particularly early in the season when root systems are mostly near the surface, which is often an area of lower pH. Soil tests will determine the need for pH adjustment, and potential for aluminum toxicity. Variety selection and phosphorus application with the seed are potential management strategies for low pH and aluminum toxicity issues if it is too late to apply lime before seeding.
- Make adjustments for planting into row crop stubble. When planting wheat into grain sorghum stubble, producers will need an extra 30 lbs N per acre over their normal N rate. Also, it is important to make sure the sorghum is dead before planting wheat. When planting wheat into soybean stubble, producers should not reduce their N rates since the N credit

from soybeans doesn't take effect until the following spring. If the wheat is being planted no-till after row crop harvest, N rates should be increased by 20 lbs N per acre over the normal N rate. Seeding rates should be increased when planting wheat late after row crop harvest. It's best to use a seeding rate of 90 to 120 lbs per acre in central and eastern Kansas, and 75 to 100 lbs per acre in western Kansas. When planting more than three weeks after the BPMP date, producers should use a seeding rate of 120 lbs per acre.

- Watch out for potential disease issues when planting into corn residue. The risk of some diseases may be higher when wheat is planted into fields with large amounts of corn residue left on the soil surface. Fusarium head blight (scab) of wheat, for example, is caused by a fungus that is known to cause a stalk rot of corn.
- Using a seed treatment. Seed treatments can act as an insurance policy, helping avoid seed-borne and early-season fungal diseases. For more information, see the article "Fungicide seed treatments for wheat" in this issue of the Agronomy eUpdate.

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4. Winter canola planting considerations

Winter canola cultivars exist today that make production possible across much of Kansas. When a winter hardy cultivar is planted at the optimum time into good soil moisture, canola can survive the extremes of Kansas climate.

The planting window for winter canola arrives in Kansas by late August or the first week of September. Now is the time to make decisions to ensure a successful start to the 2018-2019 growing season. Here are some key points to consider as you decide whether winter canola can be a profitable crop for your farm.

Where will winter canola grow in Kansas?

- The most common production areas are central and south central Kansas under dryland, and southwest Kansas under irrigated practices. In recent years, canola production has expanded into north central northwest, and southeast Kansas. Canola commonly follows winter wheat but in some instances has been planted after corn chopped for silage or early corn hybrids.

Is insurance available and what are the plant-by dates?

- Yield and revenue protection are available in the following counties: Barber, Gray (irrigated only), Harper, Kingman, and Sumner.
- Insurance is available for canola in all counties adjacent to and south of I-70.
- Coverage in these counties is available by individual written agreement (yield protection only) if certain criteria are met, including records for at least the three most recent years of

production history for canola or a similar crop (wheat).
- To qualify for full benefits of the coverage, including replant payment if necessary, canola needs to be planted between August 25 and September 25 in southwest Kansas; between September 10 and October 10 in Barber, Harper, and Sumner counties; and between September 1 and September 30 in Kingman County and all other eligible counties.

Variety Selection

- Variety selection should be based on the following traits: winter hardiness, yield, oil content, herbicide tolerance, disease resistance, maturity, lodging susceptibility, and shatter tolerance.
- Producers have the option of selecting either open-pollinated varieties or hybrids.
- The majority of the varieties grown in the southern Great Plains are open pollinated. These varieties have consistent winter survival and yield.
- More hybrids are being grown each year. Hybrids tend to have larger seed size for easier seed metering, vigorous fall and spring growth, and greater yield potential.
- Winter hardiness should be the number one consideration if the crop is being grown in a new area.
- Herbicide resistance options include Roundup Ready and Clearfield.
- Varieties with tolerance to carryover of sulfonylurea (SU) herbicides applied to a previous crop (e.g. Finesse) can be planted in the fall to avoid the long plant-back restrictions these herbicides have for canola.
- Consider selecting two or more varieties with differing relative maturities to spread out harvest and reduce risk.

Site Selection

- Although canola grows over a wide range of soil textures, well-drained, medium-textured soils are best. Soils where water stands for several days or those prone to waterlogging are poor choices.
- The soil pH should be between 5.5 and 7.0. Soil pH correction with lime could be a potential solution for growing canola in soil with low pH (less than 5.5).
- Be mindful when planting canola following crops like sunflower, soybean, alfalfa, or cotton. These crops share similar diseases with canola. Planting canola continuously is not recommended and it is not insurable. Plant canola after grass crops such as wheat or corn because these crops do not share diseases with canola.
- Canola will perform best when adequate time is given after the preceding crop to allow for soil moisture recharge and weed control, and where there is adequate time to get the canola planted early enough to help the plants survive over winter.
- Avoid fields with heavy winter broadleaf weed pressure if possible. If planting where heavy broadleaf weed pressure exists, consider planting a Roundup Ready cultivar.
- Grassy winter annual weeds are easily controlled by using herbicides that are labelled for conventional, Roundup Ready, or Clearfield canola.
- Make sure you are aware of the herbicide history of potential sites. Winter canola cultivars are sensitive to SU and triazine herbicide carryover, and these products have long plant back restrictions (often 18 months or greater).

Seedbed Preparation

- Weeds must be controlled chemically, mechanically, or with a combination of both methods prior to planting because canola seedlings are not competitive with weeds.

- Open-pollinated varieties typically range from 100,000 to 125,000 seeds per pound and hybrids range from 70,000 to 100,000 seeds per pound. Because of its small seed size, a properly prepared seedbed is critical for successful canola establishment.
- A level, firm seedbed with adequate moisture is preferred. A seedbed with many large clumps results in poor seed placement and seed-soil contact. An overworked seedbed may be depleted of moisture and will crust easily, potentially inhibiting emergence. In addition, this could promote deep placement of the seed.
- No-till planting is an option, and some long-term no-till producers have produced canola successfully. With proper settings, no-till planting usually results in very good stands. However, maintaining stands over the winter can be difficult with low disturbance in heavy residue cover. This problem has been overcome by burning surface residue immediately before planting or by using a more aggressive residue manager that removes residue from the seed row. Research in south central Kansas indicates that even with good winter survival, no-till canola yields under heavy residue were lower than where residue was burned or where tillage has been performed.
- No-till producers should ensure that drills and planters are properly set and consider using a setup that creates a more disturbed seed row. Using a high-disturbance opener (such as a coulter, residue manager, or hoe-type opener) in no-till can improve winter survival and result in yields comparable to those obtained in tilled fields.
- If using tillage, perform the most aggressive tillage as early as possible, with each succeeding tillage operation being shallower than the last. Incorporate fertilizer and herbicide with the last tillage operation. Some producers perform one aggressive tillage operation as early as possible and then control newly emerged weeds chemically. Planting into this “stale” seedbed works quite well.

Seeding Date, Rate, Depth and Row Spacing

- The general rule is to plant canola six weeks before the average date of the first killing frost (28 degrees F) in central and south central Kansas, or six to eight weeks for southwest and northern Kansas. This allows adequate time for plant canopy development and root growth to improve winter survival. Planting too late will result in small plants with inadequate reserves to maximize winter survival. Planting too early may result in excessive growth that can deplete soil moisture. Excessive growth may also elevate the growing point or crown, increasing the chance of winterkill. This can be a problem when heavy residue remains in the seed row without management.
- In northern Kansas, winter canola should be planted by September 15 and in central Kansas by September 25. In far south central Kansas (Barber, Harper, and Sumner counties), winter canola should be planted by October 1 and in southwest Kansas by September 15 to avoid problems with winterkill.
- Recent rainfall will likely delay planting in some areas, but soil moisture should be ideal for planting across most of Kansas.
- The most recent 3-month outlook from NOAA projects a slightly increased chance of warmer-than-normal temperatures during September through November. The precipitation outlook is less clear. There are equal chances of above- or below-normal precipitation across the state.
- Winter canola will compensate for a poor plant stand; however, it is important to obtain as uniform a stand as possible to facilitate optimum plant development, winter survival, weed control, and uniform plant maturity. A seeding rate of 3.5 to 5 pounds per acre (approximately 350,000 to 500,000 seeds per acre at a 100,000 seeds per lb seed size) is

recommended for open-pollinated varieties in narrow row spacing. Because of the higher seed costs of hybrids, it is recommended to plant them on a pure live seed basis. The recommended seeding rate is 250,000 to 300,000 pure live seeds per acre in narrow rows.

- More producers are experimenting with canola planted in 30-inch rows. Producers are able to obtain more accurate depth control, precision seed metering, and residue removal from the seed row with row crop planters. Generally, yields may be reduced by 10% going from 15 inches to 30 inches under dryland conditions. However, producers are able to reduce their seeding rate to 1.5 to 3.0 lb per acre (about 135,000 to 270,000 pure live seeds per acre at a 90,000 seed per lb seed weight). Planting an open-pollinated variety or hybrid with prolific branching will also increase the profitability of canola planted in 30-inch rows.
- It is important to check drill calibration. Some drills may require a speed reduction kit to obtain the optimum rate without damaging seed. Some producers planting on 7.5-inch spacing will plug every other row unit and plant on 15-inch spacing so the drill does not have to be slowed as much.
- Seed placement is critical for successful germination, emergence, and stand establishment. Best germination occurs with seed placed ½ to 1 inch deep. Under drier conditions, canola may be planted deeper (not greater than 1.5 inches), but delayed emergence and reduced vigor may occur. Soil crusting following a heavy rain can result in a poor stand. Canola emergence can be greatly reduced when using a deep furrow opener followed by a heavy rain prior to emergence, since soil can fill in the furrow, resulting in a deeper than intended seeding depth.
- To ensure proper seeding depth, producers must plant slower than when planting wheat (preferably 5 mph or slower). Finally, it is important to check seeding depth in each field.
- Rows spaced between 7.5 and 15 inches allow for rapid canopy closure (improved light interception) and weed control. Yields are similar with row spacings in this range.
- Plant-to-plant uniformity at emergence is critical for optimum plant development, overwintering, and weed control.

Plant Nutrition and Soil Fertility

- Soil testing, including a profile sample for nitrogen (N) and sulfur (S), is an important tool in determining fertilizer needs. If you have questions, contact your local Extension office. All nutrient applications should be made based on soil test recommendations. Canola fertility recommendation programs can be found at: http://www.agronomy.ksu.edu/soiltesting/

- Fertility needs are similar to winter wheat; however, canola needs slightly higher levels of N and S.
- Applying high rates of fertilizer in-row at planting is not recommended because canola is sensitive to ammonia and salt damage ("phytotoxic effect"). However, new research by Oklahoma State indicates that a low rate of DAP or MAP (30 to 40 lb/acre of product) is beneficial and not detrimental to yield. The best management practice for banding fertilizer should separate the fertilizer from the seed by two inches to avoid direct contact. Pre-plant broadcast application is also acceptable.
- Lime: Apply lime so that pH is in the range of 5.5-7.0 and early enough so the lime has time to react.
- Phosphorus (P) and Potassium (K): No added P is required if the P soil test is above 30 ppm. Additional K should be applied if soil test levels are less than 125 ppm.
- Sulfur (S): Canola requires more S than wheat because of its high content of sulfur-containing proteins. Sulfur deficiencies are most common on coarse-textured and low-organic-matter

soils. Sulfur can be applied at any time from pre-plant until the canola plant breaks dormancy in late winter. Apply S based on the soil test recommendation. Sulfate-sulfur (SO_4-S) soil tests should be above 10 ppm or fertilizer should be applied. If no soil test is available, an application of 20 lb/acre S is recommended.
- Nitrogen (N): Pre-plant N applications must be carefully balanced, as too little or too much fall-applied N may negatively affect winter survival. One-third to one-half of total N (based on expected yield) should be fall-applied. At least 35 lb/acre but no more than 80 lb/acre of actual N is the general rule for fall applications. Winter survival, plant vigor, and yield potential can decrease without applying fall N.

Weed Management

- A clean seedbed is critical to establishing winter canola. Small canola seedlings compete poorly with established weeds. However, once a good stand and canopy are established, canola suppresses and outcompetes most winter annual weeds.
- No matter what herbicide program you use, the most important thing to remember is to control weeds early in the fall.
- Trifluralin and ethalfluralin are effective at controlling many problem winter annual weeds pre-plant, but each requires mechanical incorporation.
- Grass herbicides such as Select Max, Assure II, and Poast are labeled for cool-season grass control in canola.
- Roundup Ready (glyphosate tolerant) canola varieties are available, providing excellent control of many problem weeds. Glyphosate is not labeled for application once the plant has bolted after dormancy.
- Clearfield canola varieties are available and provide another herbicide resistance option for controlling winter annual grasses.
- Before applying any herbicides, care must be taken to ensure there are no traces of problem herbicides, such as sulfonylurea herbicides, in the sprayer equipment.

Insect Management

- An insecticide seed treatment is highly recommended for control of green peach aphids and turnip aphids through fall and early winter.
- Monitor canola stands for the following fall insect pests: grasshoppers, diamondback moth larvae, flea beetles, aphids, and root maggots. Several products are labeled and provide good to excellent control.

Disease Management

- The best control of canola diseases is achieved through careful rotation. Canola should not be planted on the same field more than once every three years and should never be planted continuously.
- Blackleg (*Leptosphaeria maculans*) is the most serious disease threat to canola. Maintaining proper rotation intervals, planting disease-free seed, and using fungicide seed treatments are important management practices to slow the spread of blackleg.
- Damping-off of young seedlings, which resembles the pinching of the stem at or just below the soil line, is caused by several fungi including *Pythium*, *Fusarium*, and *Rhizoctonia*. A fungicide seed treatment can lessen the effects of these soil-borne diseases.

For further information, see the newly updated *Great Plains Canola Production Handbook*, at your local Extension office, or: https://www.bookstore.ksre.ksu.edu/pubs/mf2734.pdf.

Also see *Canola Growth and Development* poster, available on the web at: https://www.bookstore.ksre.ksu.edu/pubs/MF3236.pdf.

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5. Estimating grain sorghum yield potential

Estimating crop yields before harvest can be erratic, but producers often like to know about the potential yield of their crops. In previous K-State Agronomy eUpdates we discussed the calculation of the potential yield for soybean and corn. These articles are:

- Estimating corn yield potential. https://ksu.ag/2OYWBjG (August 10, 2018 - eUpdate 705)
- Estimating soybean yield potential. https://ksu.ag/2BGZ6EG (August 24, 2018 - eUpdate 707)

This article discusses how to get simple but good estimates of sorghum yield potential. As with soybeans, sorghum can compensate for abiotic or biotic stresses. Sorghum compensates through changes in head sizes (grain number and weight) and number of tillers.

Before going into the procedure to estimate sorghum yields, we need to understand the main plant components of sorghum yield. The main yield-driving factors are:

- Number of plants
- Number of tillers per plant
- Total number of seeds per head
- Seeds per pound

The number of plants and the number of tillers per plant are two of the main components and are determined well before the end of the growing season. The initial plant density, planting date, and the environment, among other factors, influence those two yield components.

Those who want to get right to the formula can skip ahead to the next page, but it will help to know how sorghum yield components develop.

Increasing the number of plants per acre potentially increases competition for resources, which can diminish the plant's capacity to produce tillers. In addition, the interaction of planting date with plant density can have a similar effect. As planting date is delayed, the capacity of the plant to produce tillers will be reduced; thus, plant population needs to be increased to compensate for the reduction in the number of tillers. Previous research at K-State showed sorghum produces more tillers when planted early (mid-to-late May) at lower plant populations as compared with late planting dates (mid-to-late June).

The environment also plays an important role in the final number of heads per unit area. Heat and drought stress will reduce the plant's ability to produce more tillers, and could severely reduce the tiller survival rate. The total number of seeds per head will be determined within the one- or two-week period before flowering until milk to soft dough stages (approximately two to three weeks after flowering). Seed size will be determined close to the end of the season. In the 15 to 25 days after flowering, during the soft dough stage, sorghum grains have already accumulated about 50% of the final dry mass. Thus, the period around flowering is critical for defining not only the final number of grains per head but also the potential maximum kernel size. Final seed weight will be determined when the grains reach physiological maturity (visualized as a "black-layer" near the seed base). From this time until harvest, the grains will dry down from approximately 35% to 20% moisture content.

The interaction among all four components will determine the actual yield, but a wide range of variation can be expected in all these main yield-driving forces (Figure 1).

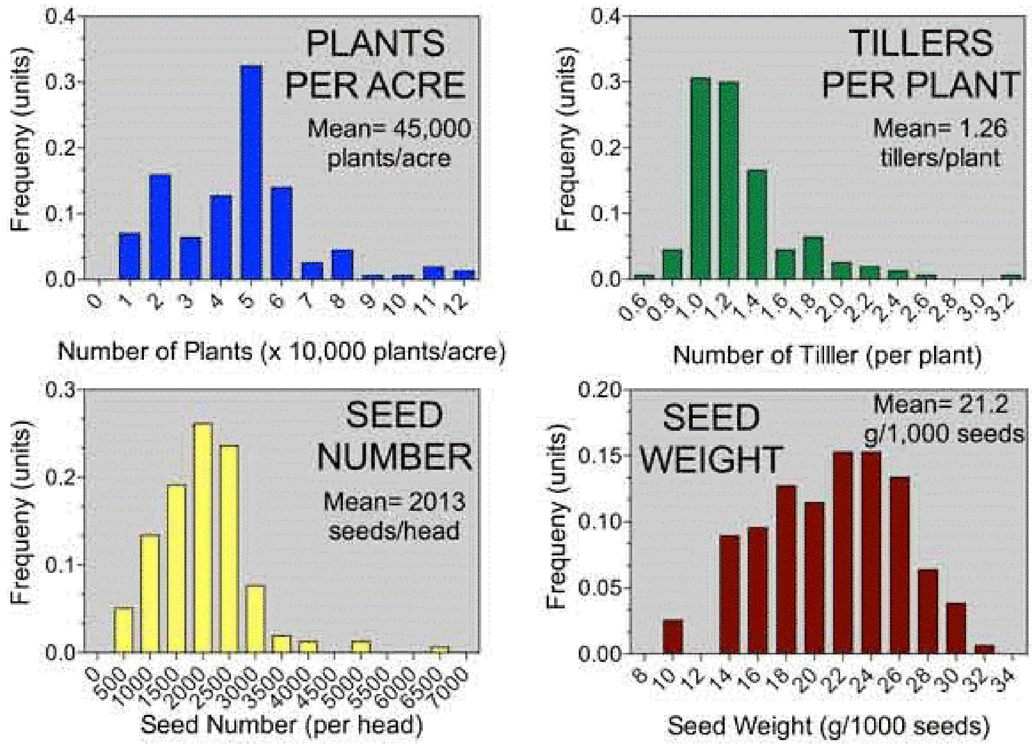

Figure 1. Example of the variation expected to be found in the main sorghum yield components. The number of tillers per plant can also be interpreted as the number of heads per plant, considering that all tillers have one fertile head.

When can I start making sorghum yield estimates?

As the sorghum crop gets closer to full maturity, yield estimates will be more accurate because the seed weight will be closer to being set. Nonetheless, we can start taking yield estimations three to four weeks after flowering (from soft to hard dough stages). At these stages, the final seed number can still change. In addition to the seed number, the seed weight will be only partially determined -- approximately 50 to 75% of dry mass accumulation as compared to the final weight.

Variability within the field

Variability between plants needs to be properly accounted for when estimating sorghum yields using the on-farm approach (see next section). Another important factor is the variation between different areas in the field. In general, it is recommended to perform yield estimations in at least 5 to 10 sections of the field to account for field variability.

On-farm approach for estimating sorghum yields

The estimation of sorghum yields should consider the main driving forces:

1. Total number of heads per unit area [number of plants per acre x heads per plant] (**1**)
2. Total number of seeds per head (**2**)
3. Number of seeds per pound (**3**)
4. Pounds per bushel, or test weight, which for sorghum is **56 lbs/bushel** (**4**)

The final equation for estimating sorghum yields:

[(**1**) x (**2**) / (**3**)] / (**4**) = Sorghum yield in bushels/acre

Take the following steps for making sorghum yield estimates:

Step 1. Number of heads per unit area:

For this on-farm approach, start by counting the number of heads from a 17.4 foot length of row when the sorghum is in 30-inch rows. This sample area represents 1/1000th the area of an acre. If the sorghum is in 15-inch rows, then count the number of heads in two rows. For a 7.5-inch spacing, measure four rows. In each of these scenarios, the area counted will be equal to 1/1000th of an acre.

Take head counts in several different areas of the field to properly account for the potential yield variability. If the proportion of smaller heads, less than 3 inches in height, is very low (less than 5%), these heads could be avoided due to the smaller proportion they will represent when determining the final yield.

Step 2. Estimation of the number of seeds per head:

The seed number is, by far, one of the most complicated yield components that needs to be estimated. The total number of seeds per head can vary from 100 to 5,000 seeds per head (Figure 1), but almost ¾ of the seed number distribution is around 1,500 to 2,500 seeds per head. A previous report on sorghum yield estimation (Vogel, 1970), suggested as an alternative to estimate the number of nodes, and branches within nodes, for each sample of sorghum heads, and then to count the number of grains in a subsample of nodes and branches.

This approach is still very tedious. A simpler method of estimating the number grains per head would be very helpful.

Figure 2. To estimate the total number of heads per acre, count the number of heads in a sample area 17.4 feet in length, for 30-inch row spacings. Photo by Ignacio Ciampitti, K-State Research and Extension.

Figure 3. There is no easy shortcut yet for counting the number of seeds per head. Photo by Ignacio Ciampitti, K-State Research and Extension.

Another quick method uses an estimate of seed counts per head based on determinations of general yield environment conditions. From previously published information from K-State (provided by K-State professors Richard Vanderlip, emeritus, and Kraig Roozeboom), we can utilize a very simple association between the yield level, conditions around pollination/grain set time, and the number of grains per heads (Figure 4). In their work, Vanderlip and Roozeboom counted the average number of seeds per head and average seed weight for different yield environments, after harvest.

We can use this relationship to give us a general idea of the kind of seed count per head we can expect based on the general yield environment, using primarily the environmental conditions during the period of the week before flowering to two to three weeks after flowering, when pollination and grain set are being determined. We can then use that estimated seed count per head, and multiply it by the number of heads per acre. The number of seeds per pounds, or seed weight, is also a factor we need to estimate, but the work by Vanderlip and Roozeboom found that to be much less of a factor in yield than seed count per head.

If conditions were very poor during pollination and grain set, around the first week before and two to three weeks after flowering, and the general yield environment is low then the total number of seeds per head will average around 500-1,000 seeds per head (900; Table 1). On the opposite extreme, if the conditions around flowering were very favorable for good pollination and grain set development, and the general yield environment is very high, then the number of seeds per head could be around 1,500 to 3,500 (2,500; Table 1). Intermediate yield environment scenarios can occur if a portion of the three-to-four week period around flowering was favorable and part of it was unfavorable. In that case, the number of seeds per head could range from 1,000-3,500, with an overall average of around 1,745 seeds per head.

This information is provided only for general guidance on estimating sorghum yield potential using the on-farm approach. Different responses between yield and its components might be expected for the complexity of diverse genotypes, crop production practices, and environments.

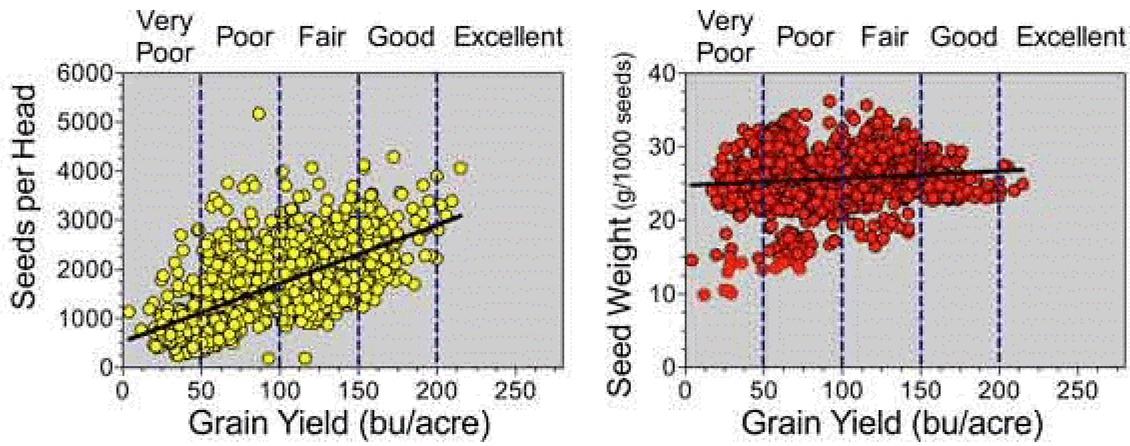

Figure 4. Relationship between grain yield and yield components, seeds per head (yellow points, left panel) and seed weight (red data points, right panel). The number of seeds per head has the most direct relationship with yield.

Table 1. Total number of seeds per head and seed weight components.

Yield Range (bu/acre)	Crop Condition	Average Seeds per Head	Average Seed Weight (g/1,000)	Number of Observations
<50	Very Poor	**900**	**24.5**	**154**
50-100	Poor	**1,500**	**25.5**	**391**
100-150	Fair	**2,000**	**26.2**	**495**
150-200	Good	**2,500**	**25.6**	**129**
>200	Excellent	**3,330**	**25.5**	**5**

Step 3. Estimation of the Seed Weight:

A similar procedure can be followed to estimate the seed weight (Table 1). For the seed weight component, the variation documented in the dataset showed a very narrow seed weight variation as compared with the variability found in the seed number component. In general, it seems that lower seed weight is expected at low yield ranges, but the difference among yield levels is negligible. Table 2 shows the conversion from average seed weight to seeds per pound, and from seeds per pound to the seed size factor employed in the examples below for sorghum yield estimation.

Table 2. Seed weight, seeds per pound.

Yield Range (bu/acre)	Crop Condition	Average Seed Weight (g/1,000)	Seeds Per Pound
<50	Very Poor	**24.5**	**18,520**
50-100	Poor	**25.5**	**17,793**
100-150	Fair	**26.2**	**17,318**
150-200	Good	**25.6**	**17,723**
>200	Excellent	**25.5**	**17,793**

Step 4. Final calculation using "On-Farm" Yield Estimation Approach:

*[(Heads x Seeds per Head)*1,000 ÷ Seeds per Pound] ÷ Pounds per bushel*

Examples:

A. Good Crop Condition:

Irrigated sorghum with adequate plant density (48,000 plants/acre), average number of tillers per plant of 1.3, and good yield environment with adequate flowering and grain filling periods:

(48 plants in 17.4 foot -1/1000th of an acre- x 1.3 fertile tillers per plant) = 62 heads

Yield Estimation = [(62 * 2,500)*1,000 ÷ 17,723] ÷ 56 = **156 bu/acre**

B. Poor to Fair Crop Condition:

Dryland sorghum with adequate plant density (40,000 plants/acre), average number of tillers per plant of 1.3, and poor flowering but fair grain filling period:

Yield Estimation = [(52 * 1,500)*1,000 ÷ 17,723] ÷ 56 = **79 bu/acre**

C. Very Poor Crop Condition:

Dryland sorghum with adequate plant density (40,000 plants/acre), average number of tillers per plant of 1.0, and poor yield environment and growing season (poor flowering and grain filling period):

Yield Estimation = [(40 * 900)*1,000 ÷ 18,520] ÷ 56 = **35 bu/acre**

Summary

Seed number is the main driving force of sorghum yield. On-farm estimations can be roughly based on environmental conditions during the week before and the two- to three-week period after flowering, which is the critical period of pollination and grain set. Actual seed counts per head would make the estimates more accurate, but requires considerable time and effort.

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6. Rate of dry down in corn before harvest

The latest USDA-National Agricultural Statistics Service crop progress and condition report classified more than 40% of the corn crop as 'good' or 'excellent' condition. Overall, 36% of Kansas' corn is mature with only 6% harvested.

The weather conditions experienced from early-August to early-September are critical for corn as related to the grain-filling rate and determining final grain weight. Temperature and precipitation have split across the state, with cooler-than-normal conditions in the northwest and warmer conditions in the northeast (Figure 1a). An area of north central Kansas had excessive moisture; however much of the state had near-normal precipitation for the period (Figure 1b).

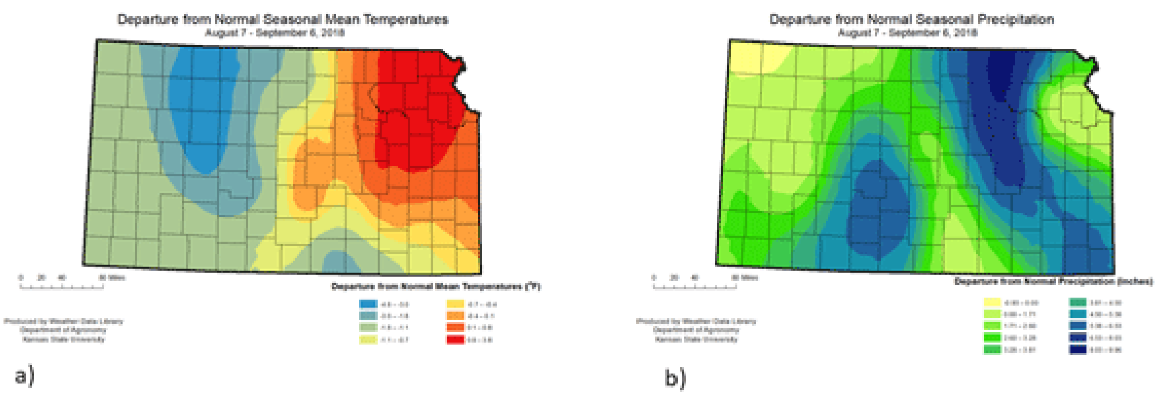

Figure 1. a) Departure from normal temperatures; b) Departure from normal precipitation.

In recent years, a common question from producers relates to the dry down rate for corn when approaching the end of the season. Based on previous information, the average dry down rate depends on the weather, primarily temperature and moisture conditions – but it might range from 1% in late August to less than 0.5% per day in October.

The weather outlook for September calls for an increased chance of warmer-than-normal temperatures with chances for above-normal precipitation. Much of this rainfall may have fallen already, which would favor a faster dry down rate than average.

Grain water loss occurs at different rates but with two distinct phases: 1) before "black layer" or maturity (Figure 2), and 2) after black layer. For the first phase, Table 1 contains information on changes in grain moisture from dent until maturity of the corn.

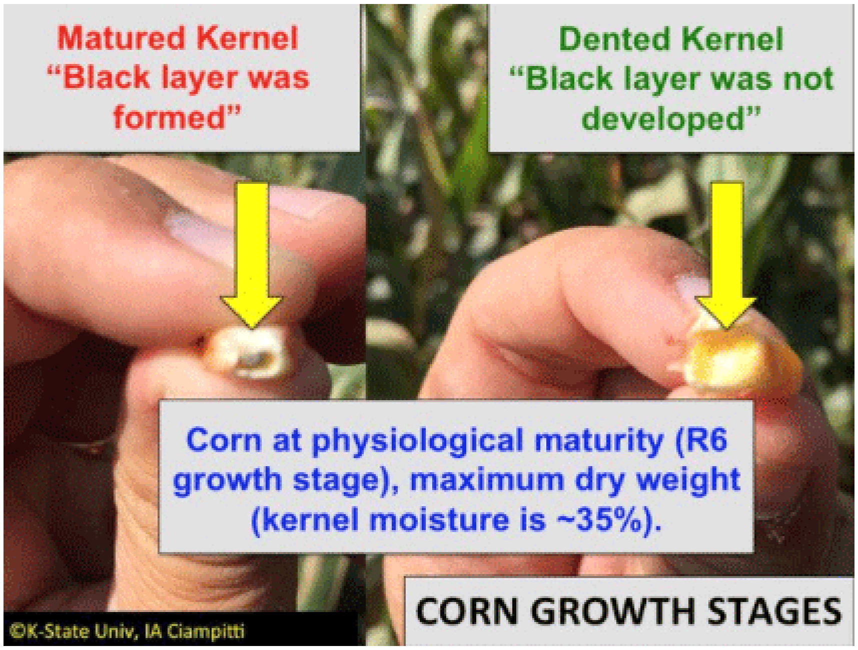

Figure 2. Corn at dent stage and at black layer growth stages. Photo and infographic prepared by Ignacio Ciampitti, K-State Research and Extension.

Table 1. Growth stages, moisture content, and total dry matter progression for corn from late to physiological maturity. Extracted from K-State Research and Extension publication MF3305 (Ciampitti, Elmore, Lauer, 2016).

			Average per Substage	
R Stage	Moisture %	Dry Matter (% of Total Dry Weight)	Growing Degree Days, °F	Days
5.0	60	45	75	3
5.25 (¼ milk line)	52	65	120	6
5.5 (½ milk line)	40	90	175	10
5.75 (¾ milk line)	37	97	205	14
6.0 (Physiological maturity)	35	100		

[1]Abendroth, L.J., R.W. Elmore, M.J. Boyer, and S. K. Marlay. 2011. *Corn Growth and Development*. PMR 1009. Iowa State Univ. Extension. Ames Iowa.

To properly address questions from many producers on the rate of dry down, a study is underway to investigate the grain dry down rate from the moment of "black layer" until commercial harvest grain moisture was reached. For the conditions experienced in 2017 (from late August until mid-September), the overall dry down rate was around 1% per day (from 35% to 13% grain moisture) – taking an overall period of 23 days (Figure 3).

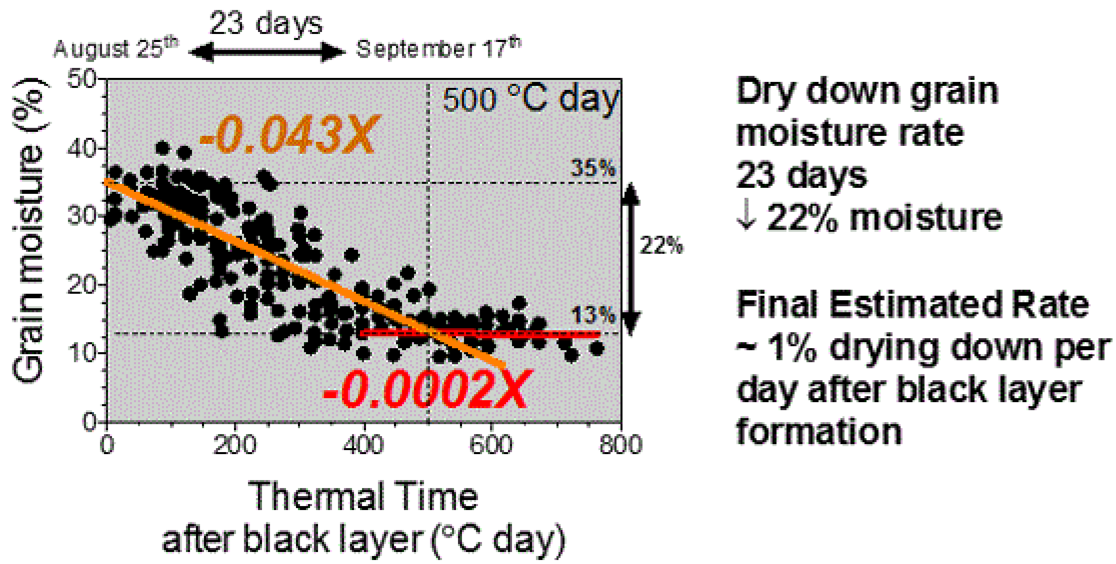

Figure 3. Grain moisture dry down (orange line) across three hybrids and different N rates near Manhattan, KS. Horizontal dashed lines marked the 35% grain moisture at black layer formation and 13% grain moisture around harvest time*. Graph prepared by Ignacio Ciampitti, K-State Research and Extension.

*Note: It is desired to reach harvest with 15.5% grain moisture to maximize the final grain volume to be sold, thus the importance of timing harvest with the right grain moisture content.

This dry down process can be delayed by:

- Low temperatures
- High humidity
- High grain moisture content at black layer (38-40%)

It is expected that the dry down rate will decrease to <0.5% per day for late-planted corn entering reproductive stages later in the growing season. Expect a similar decrease for corn that was exposed to late-season stress conditions (e.g., drought, heat). Under these conditions, maturity may be reached with high grain water content and the last stages after black layer formation could face lower temperatures and higher humidity. These main factors should be considered when the time comes to schedule corn harvest. You can track temperature and humidity levels on the Kansas Mesonet web site at http://mesonet.k-state.edu/weather/historical/ by selecting the station and time period of interest.

This project is expected to be expanded in the coming years to include additional corn producing regions and to consider other factors such as planting date, hybrid maturity, and diverse weather environments across the state. If you are interested in participating, please contact the researchers listed below.

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7. The Labor Day Storm: September 3, 2018

Heavy rain fell in north central Kansas over Labor Day weekend. High rainfall amounts over a very short time period caused flash flooding, particular in Manhattan, on Monday, September 3. Many businesses, homes, and roads were inundated with high water from this event.

Meteorological factors influencing the heavy rain

An outflow boundary from thunderstorms in Nebraska pushed southward Sunday evening. This boundary forces air upward, making it condense into showers and thunderstorms along and north of it. As it moved southeast, it encountered southeast flow with very moist, warm air. This air originated from the Gulf, enhanced by a tropical disturbance in southern Texas, and was two to three standard deviations higher than normal, a near record for Topeka.

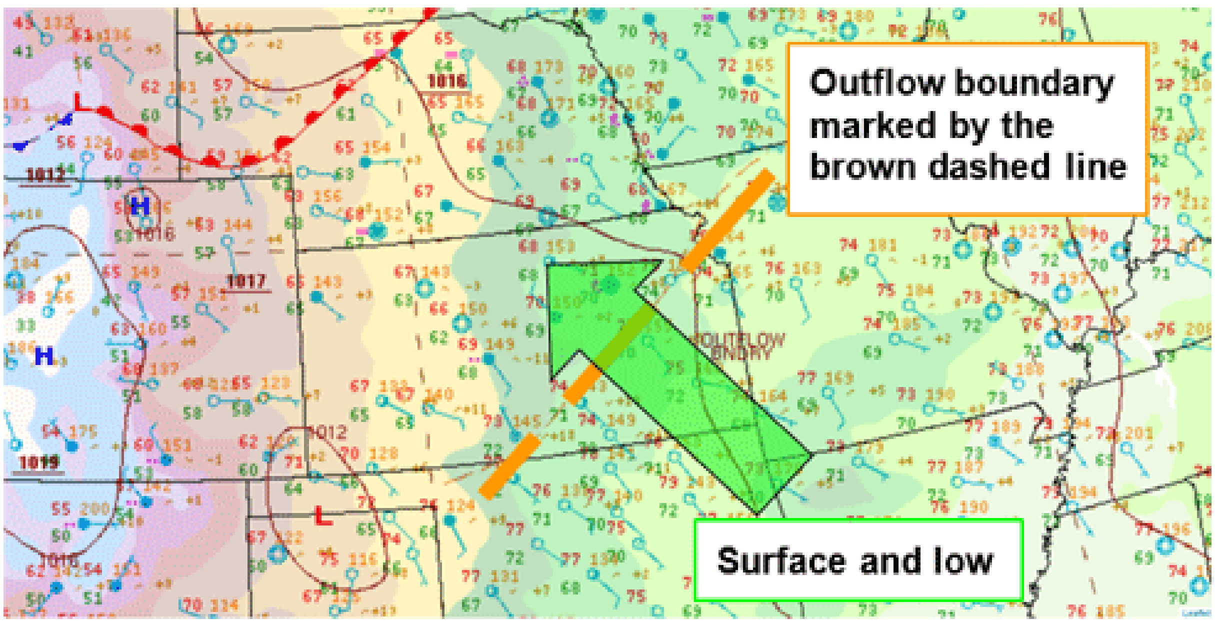

Figure 1. Surface pattern at 1:00 a.m. Monday, September 3, 2018. Background graphic via NOAA.

Air was pushed northward due to a high pressure east of the Central Plains. This air mass was enhanced by surface convergence due to a jet stream spreading out/diverging over the Central Plains. When this happens, thunderstorm activity is enhanced underneath the jet stream. Also, the stream was oriented from southwest to northeast. This provided shear to help thunderstorms sustain themselves, as well as venting the debris clouds (often called anvil clouds) to the north and east. This allowed thunderstorms to continue to develop to the south and east without any containment from previous rainfall, outflows, etc.

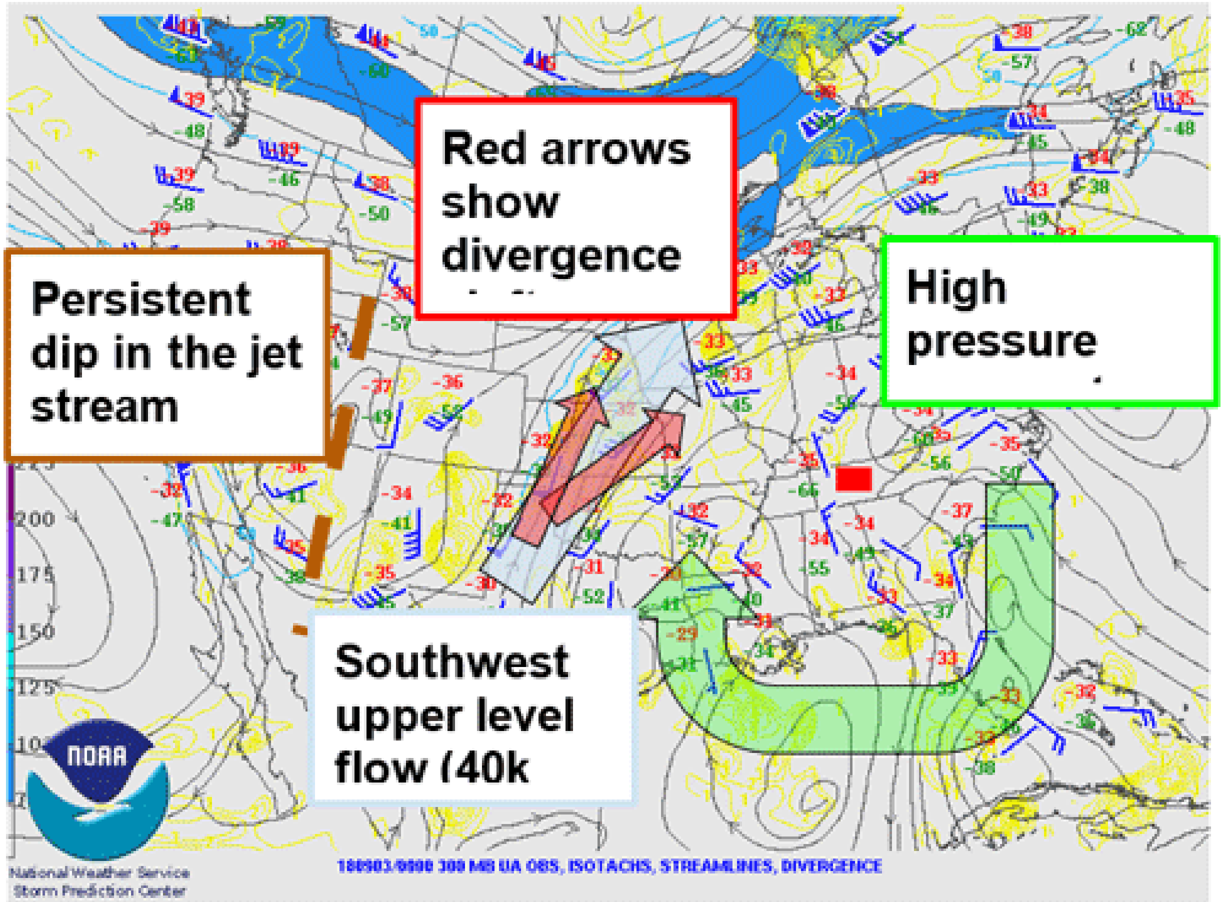

Figure 2. Upper level enhancements leading to the heavy rain event on September 3, 2018. Background graphic via NOAA.

In summary, it takes four ingredients to develop thunderstorms:

1. Moisture - near record amounts from the Gulf
2. Instability - provided by the moist air mass and weak cold air advection in mid-levels
3. Lift - an outflow boundary and upper level divergence/surface convergence
4. Shear - changing of wind direction with height not cutting off surface Gulf air inflow.

This indeed was a perfect storm of ingredients with all four ingredients present. What made this event stand out was the incredible amount of moisture present and the duration of the event stationary over one location.

Rainfall totals and rates

North central Kansas, and Manhattan in particular, saw the heaviest rains over the Labor Day weekend. The largest amounts occurred overnight from September 2-3. Rainfall amounts, as reported by 9:00 a.m. on the September 3rd, can be seen in the table below (Figure 3).

NWS COOP reports for 9/3/2018:		
Name	**StationType**	**Total Pcp**
MANHATTAN ASOS	WBAN	2.01
MANHATTAN	COOP	4.61
MANHATTAN 6 SSW	WBAN	3.61
CoCoRaHS reports for 9/3/2018:		
Station ID	**Station Name**	**Total Pcp**
KS-RL-20	Manhattan 9.8 NW	11*
KS-RL-27	Manhattan 3.7 N	9.16
KS-RL-45	Manhattan 4.9 NNW	8.15
KS-RL-36	Manhattan 5.1 NNW	7.90
KS-RL-43	Manhattan 1.4 NNW	5.76
KS-RL-6	Manhattan 1.9 NW	5.52
KS-RL-39	Manhattan 2.7 NW	5.45
KS-RL-4	Manhattan 1.4 SW	5.02
KS-RL-46	Leonardville 3.5 E	5.00
KS-RL-30	Manhattan 2.4 WNW	4.80
KS-RL-1	Manhattan 0.5 NE	4.61
KS-RL-28	Manhattan 1.7 SW	4.59
KS-RL-48	Manhattan 3.0 W	4.50
KS-RL-8	Manhattan 2.4 WNW	4.25
KS-RL-49	Randolph 4.4 NNW	3.80
KS-RL-37	Manhattan 2.4 SW	2.88
*Gauge over topped; total likely higher.		

Figure 3. Rainfall reports in Riley County, Kansas. Data compiled by the Weather Data Library.

Flooding is influenced by more than simply total amount of rainfall. The rainfall accumulation rate also contributes to the intensity of flooding. The highest 1 hour (Figure 4) and 6 hour (Figure 5) rainfall totals from the Kansas Mesonet stations are shown below.

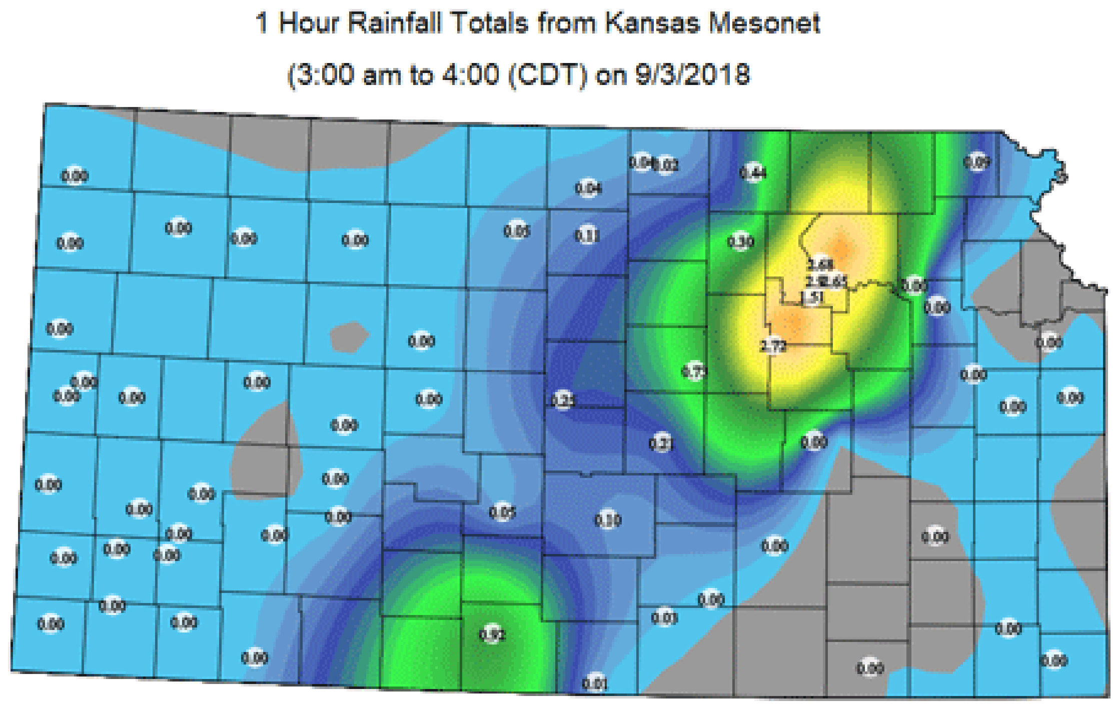

Figure 4. Highest 1-hour rainfall totals (Kansas Mesonet).

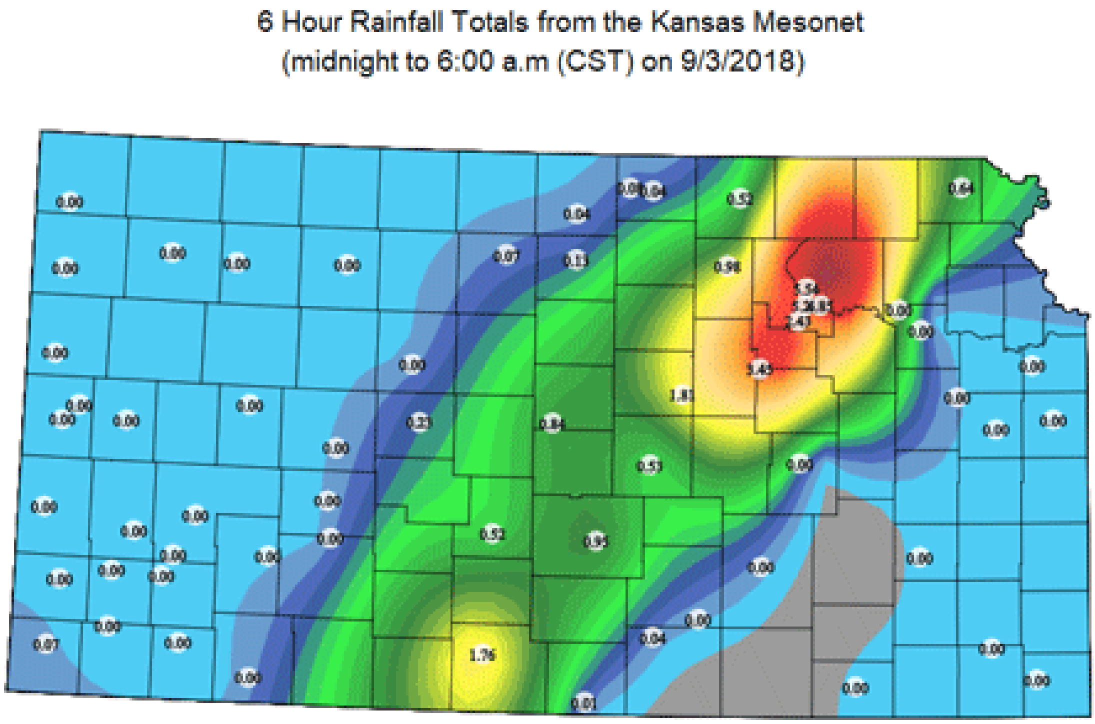

Figure 5. Highest 6-hour rainfall totals (Kansas Mesonet).

How often do these heavy rainfall events occur?

The Hydrometeorological Design Studies Center, a branch of the National Oceanic and Atmospheric Administration (NOAA), has produced a document that answers that question. NOAA Atlas 14 addresses the frequency of rainfall events on time-scales ranging from 5 minutes to 60 days. Other parameters, such as the probable maximum precipitation, are also available.

The 24-hour total of 11.00 inches reported from the Manhattan 9.8NW station falls in the 1000-year return rates, while the 1-hour total of 2.17 inches has a 10-year return frequency.

Data for Manhattan, KS										
PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
60-min	**1.36**(1.09-1.74)	**1.59**(1.27-2.03)	**2.00**(1.59-2.56)	**2.36**(1.86-3.03)	**2.89**(2.22-3.84)	**3.33**(2.49-4.46)	**3.80**(2.74-5.17)	**4.29**(2.96-5.97)	**4.99**(3.31-7.08)	**5.54**(3.57-7.91)
2-hr	**1.68**(1.35-2.12)	**1.96**(1.58-2.47)	**2.47**(1.98-3.11)	**2.92**(2.32-3.69)	**3.59**(2.79-4.72)	**4.15**(3.14-5.51)	**4.75**(3.46-6.42)	**5.40**(3.77-7.44)	**6.31**(4.23-8.87)	**7.04**(4.58-9.96)
3-hr	**1.88**(1.52-2.35)	**2.19**(1.77-2.74)	**2.76**(2.22-3.45)	**3.27**(2.62-4.11)	**4.04**(3.16-5.29)	**4.69**(3.57-6.18)	**5.38**(3.95-7.23)	**6.14**(4.31-8.41)	**7.21**(4.86-10.1)	**8.07**(5.27-11.3)
6-hr	**2.21**(1.81-2.73)	**2.59**(2.12-3.20)	**3.27**(2.66-4.04)	**3.88**(3.14-4.82)	**4.80**(3.79-6.20)	**5.57**(4.27-7.24)	**6.39**(4.73-8.47)	**7.27**(5.15-9.86)	**8.52**(5.80-11.8)	**9.53**(6.29-13.3)
12-hr	**2.54**(2.10-3.09)	**3.00**(2.48-3.65)	**3.78**(3.11-4.62)	**4.48**(3.66-5.49)	**5.49**(4.36-6.98)	**6.32**(4.89-8.10)	**7.19**(5.37-9.41)	**8.12**(5.80-10.9)	**9.41**(6.45-12.9)	**10.4**(6.95-14.4)
24-hr	**2.93**(2.45-3.52)	**3.40**(2.84-4.09)	**4.22**(3.51-5.09)	**4.94**(4.08-5.97)	**5.98**(4.80-7.50)	**6.84**(5.34-8.65)	**7.73**(5.83-9.98)	**8.68**(6.26-11.5)	**9.99**(6.92-13.5)	**11.0**(7.42-15.1)
2-day	**3.39**(2.86-4.02)	**3.84**(3.24-4.55)	**4.62**(3.89-5.49)	**5.33**(4.46-6.36)	**6.39**(5.20-7.92)	**7.27**(5.76-9.11)	**8.21**(6.27-10.5)	**9.22**(6.73-12.1)	**10.7**(7.46-14.3)	**11.8**(8.01-15.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked

Please refer to NOAA Atlas 14 document for more information.

Figure 6. Rainfall return rates for Manhattan, KS (NOAA).

The full precipitation atlas, with access to other locations, can be found online at http://www.nws.noaa.gov/oh/hdsc/index.html

Rainfall data from the Kansas Mesonet is available at: http://mesonet.k-state.edu

Additional precipitation maps for Kansas can be found on the Kansas Climate website at: http://climate.k-state.edu/

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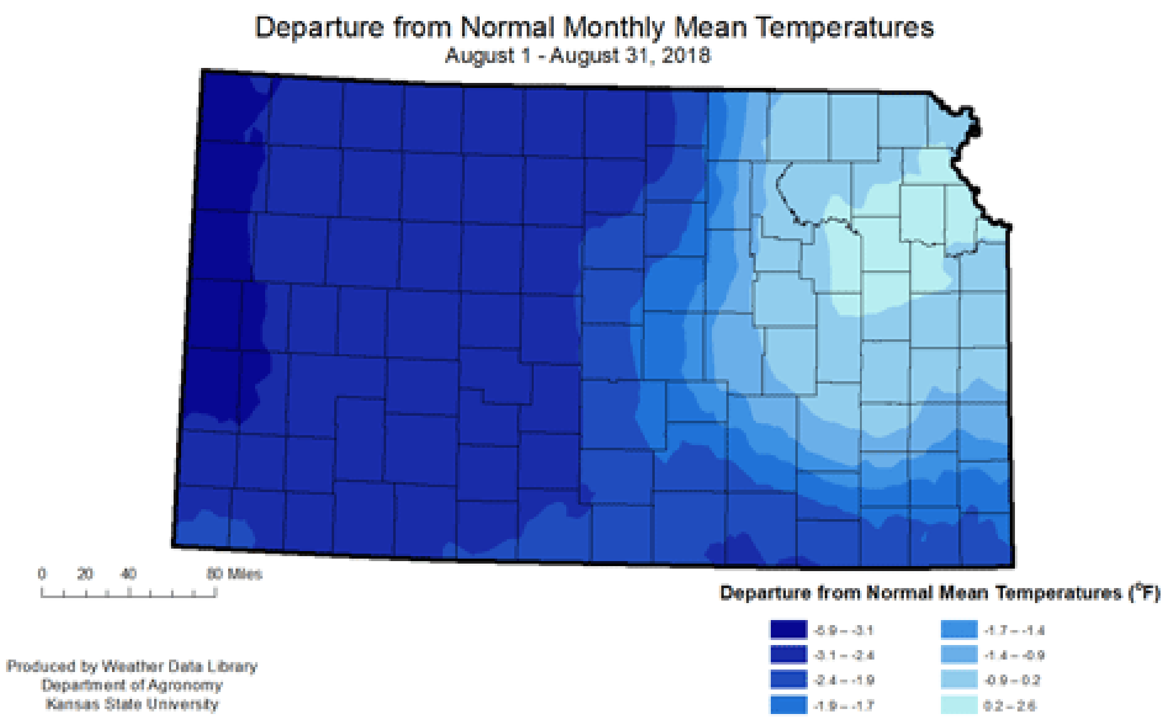
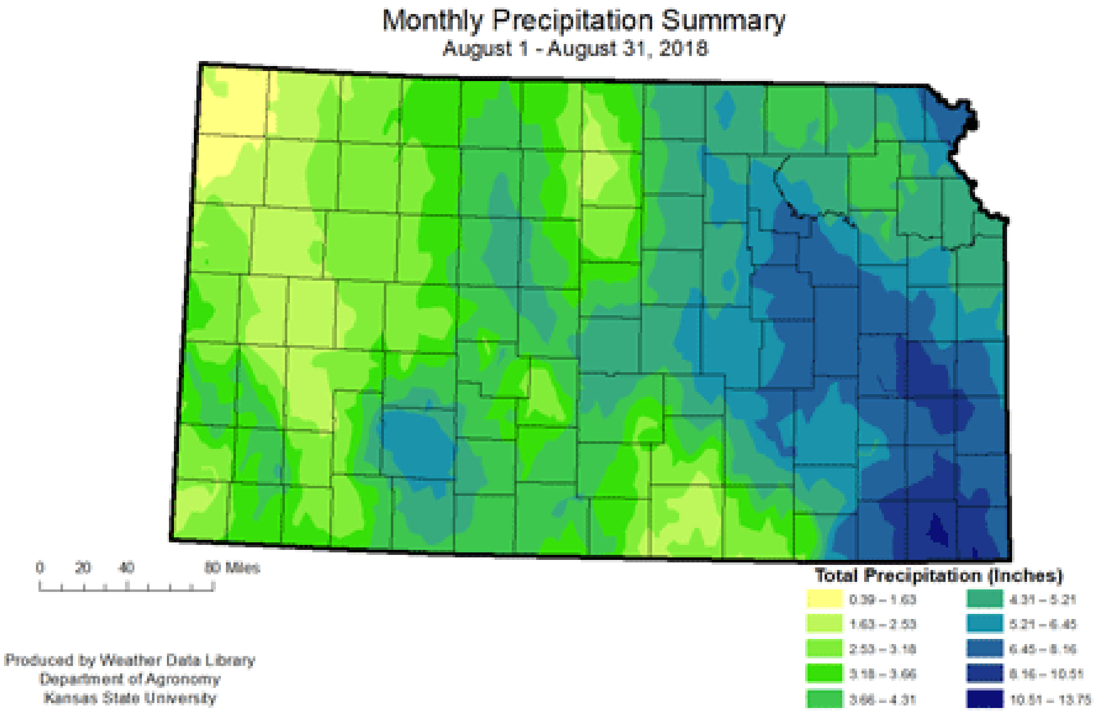
8. August 2018 weather summary for Kansas - Change in patterns

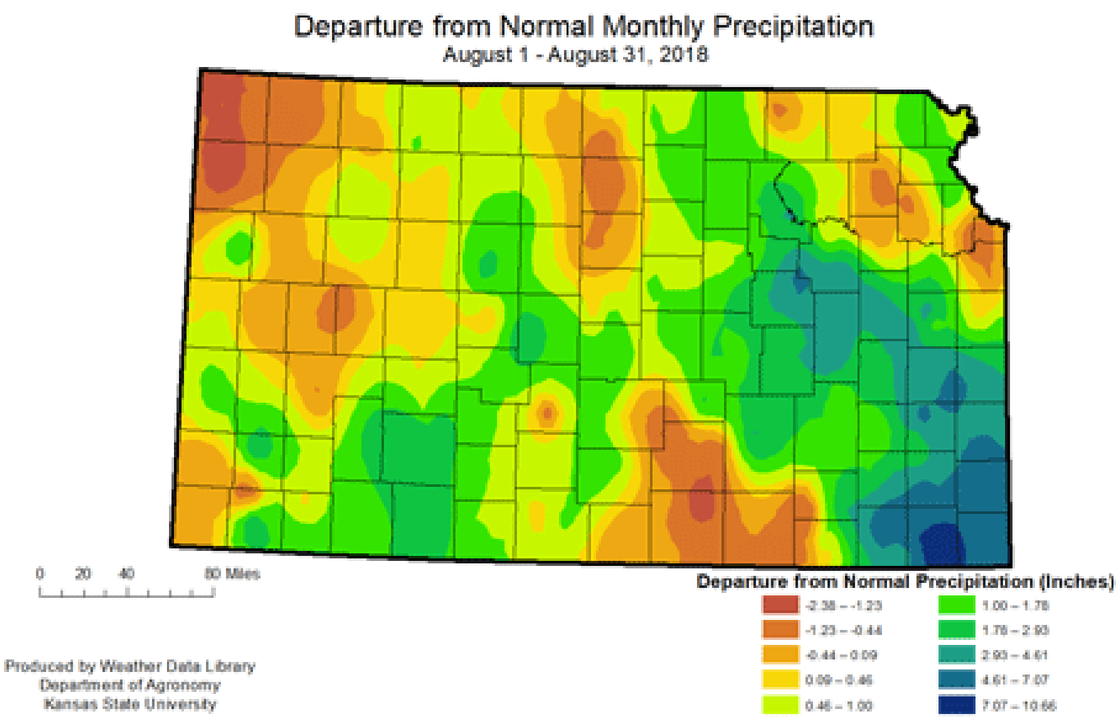
After a very warm start to the summer, August brought a cooler note. Statewide average temperature for August was 76.5 degrees F. This is 1.5 degrees cooler-than-normal, and ranks as the 37th coolest since 1895. The Northeast Division had the largest warm signal, an average of 76.8 degrees F, which was 0.5 degrees warmer-than-normal. The Northwest Division was the coldest with an average of 76.2 degrees, 2.5 degrees below the average.

There were no new record daily warm maximum temperatures. Minimum temperatures were warmer-than-normal with 34 new daily record warm minimum temperatures. None of the daily records set new monthly temperature records for August. There were 41 new record coldest maximums and 6 record coldest minimum temperatures. The warmest temperature reported during the month was 103 degrees F at Marysville, Marshall County, on August 6. The coldest temperature reported during August was 41 degrees F, reported at Brewster 4W, Sherman County, on the August 1.



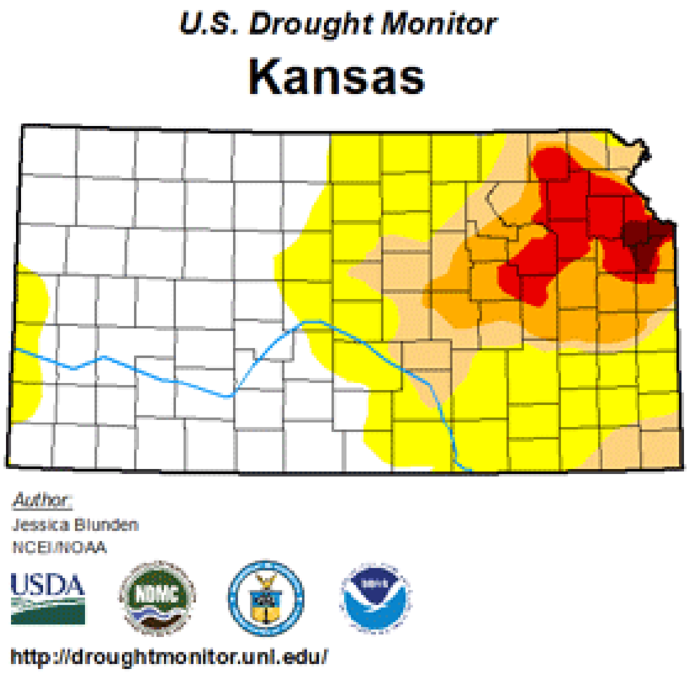
August precipitation showed a more even distribution than earlier in the summer and brought some drought relief. The statewide average precipitation was 4.17 inches, which was 125 percent of normal. The division with the largest surplus was the Southeast Division, with an average of 7.02 inches, or 188 percent of normal. The Northwest Division had the greatest shortfall, with an average of 2.00 inches, creating a deficit of 0.73 inches (73 percent of normal). Due to the cooler temperatures and favorable rainfall distribution, the impacts of that deficit were minimal. The greatest monthly total for a National Weather Service Cooperative station was at Bartlett 1 WSW, Labette County, with 13.75 inches. The Community Collaborative Rain, Hail and Snow (CoCoRaHS) network station with the greatest monthly precipitation was Iola 2.7 SSE, Allen County, with 12.98 inches. Among the Kansas Mesonet stations, the Cherokee station near Columbus had the greatest monthly total at 8.85 inches.





With the resurgence of rainfall, severe weather reports during the month also increased. Tornado numbers continued on the low side with only four tornado reported. Unfortunately, wind and hail caused significant damage in Sherman, Cheyenne, and Rooks counties. Complete damage estimates are not yet available. Total storm reports: 4 tornadoes, 32 hail events, and 45 reports of damaging wind.

The below-normal temperatures in the west lessened the impacts of below-normal precipitation. Only a small sliver of abnormally dry conditions persists in that area. Exceptional drought continues, and extreme drought has shifted into central and east central Kansas. Currently, 46 percent of the state is drought-free, while just under 1 percent is in exceptional drought conditions.



August 28, 2018
(Released Thursday, Aug. 30, 2018)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0	D1	D2	D3	D4
Current	45.57	28.84	10.81	8.54	5.50	0.75
Last Week 08-21-2018	37.66	17.18	24.01	13.42	6.98	0.75
3 Months Ago 05-29-2018	15.19	15.41	23.44	30.11	14.38	1.47
Start of Calendar Year 01-02-2018	0.00	67.30	23.95	8.75	0.00	0.00
Start of Water Year 09-26-2017	59.89	30.03	8.73	1.35	0.00	0.00
One Year Ago 08-29-2017	62.50	17.60	19.90	0.00	0.00	0.00

Intensity:
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

The September outlook has increased chances for above-normal precipitation across a wide swath of the state. However, a more even distribution of rainfall is needed to continue improvement of drought conditions across Kansas. The temperature outlook is for warmer-than-normal temperatures statewide.

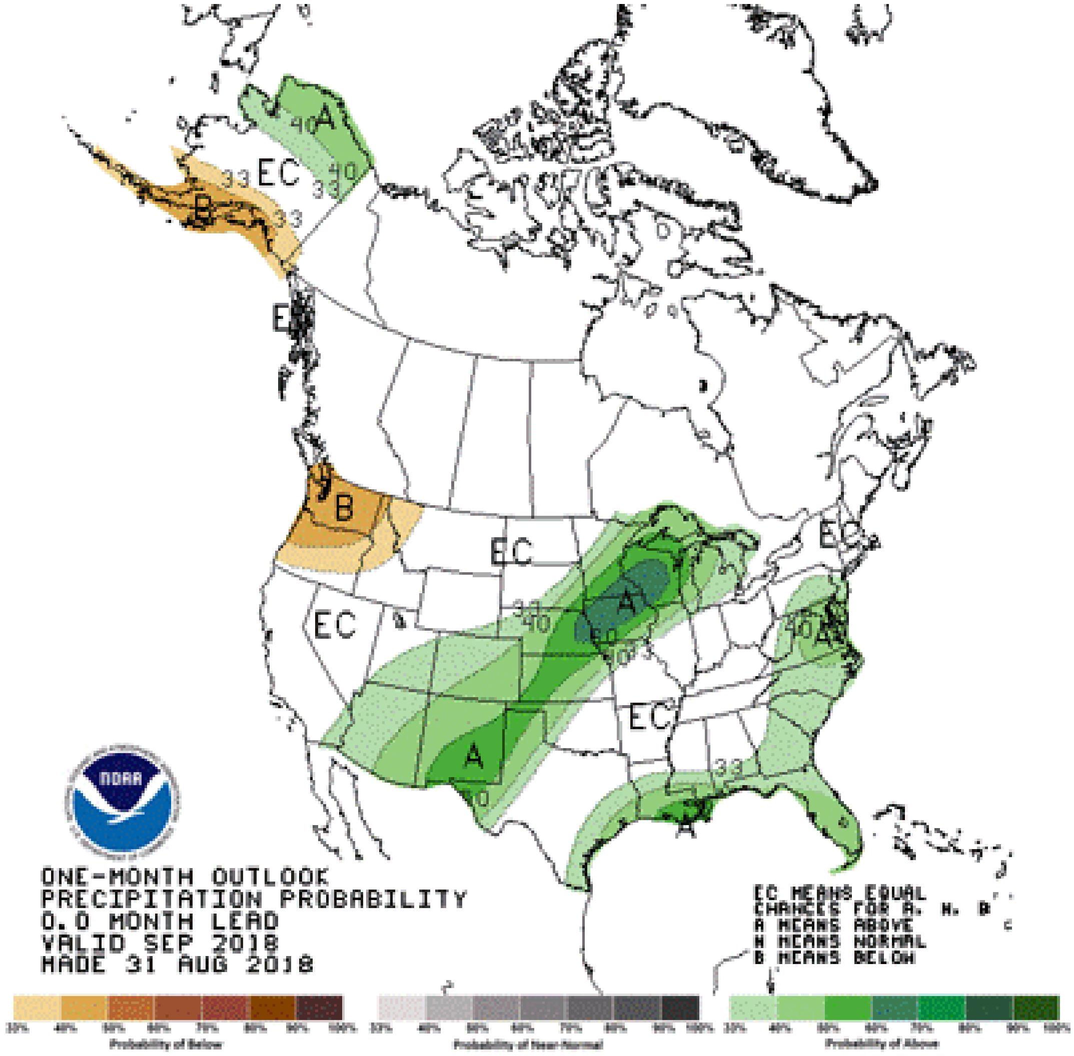

ONE-MONTH OUTLOOK
PRECIPITATION PROBABILITY
0.0 MONTH LEAD
VALID SEP 2018
MADE 31 AUG 2018
EC MEANS EQUAL CHANCES FOR A, N, B
A MEANS ABOVE
N MEANS NORMAL
B MEANS BELOW
NOAA
Probability of Below
Probability of Near-Normal
Probability of Above

Table 1. Kansas Climate Division Summary										
August 2018										
	Precipitation (inches)						Temperature (°F)			
	August 2018			2018 through August					Monthly Extremes	
Division	Total	Dep. 1	% Normal	Total	Dep. 1	% Normal	Ave	Dep. 1	Max	Min
Northwest	2.00	-0.73	73	13.88	-3.01	82	72.2	-2.5	100	41
West Central	2.45	-0.16	94	16.15	-0.14	99	73.3	-2.2	101	48
Southwest	3.96	1.25	146	17.98	2.54	116	75.1	-2.2	101	50
North Central	3.47	0.18	105	18.89	-2.42	89	74.9	-2.1	99	48
Central	4.39	0.82	123	18.91	-3.57	84	76.4	-1.8	101	52
South Central	3.34	-0.10	97	21.79	-1.68	93	77.2	-2.0	101	44
Northeast	3.71	-0.19	95	17.80	-7.86	69	76.8	0.5	101	56
East Central	6.45	2.36	158	19.97	-7.64	72	77.0	-0.2	101	57
Southeast	7.02	3.28	188	26.30	-3.11	89	77.2	-1.3	101	59
STATE	4.17	0.84	125	19.38	-2.62	88	75.6	-1.5	101	41
1. Departure from 1981-2010 normal value										
2. State Highest temperature: 103 oF at Marysville, Marshall County, on the 6th.										
3. State Lowest temperature: 41 oF at Brewster 1W, Sherman County, on the 1st.										
4. Greatest 24hr: 8.75 inches at Independence, Montgomery County, on the 15th (NWS); 8.25 inches at Independence 1.0 SSW, Montgomery County, on the 15th (CoCoRaHS).										
Source: KSU Weather Data Library										

Mary Knapp, Weather Data Library
mknapp@ksu.edu

9. Dryland corn and sorghum field days to be held in central and western Kansas

A series of field days will be held covering dryland corn and sorghum production this week. Several of the locations feature a corn hybrid x planting date study that involves short, mid, and long season hybrids from multiple companies planted at four planting dates.

Speakers will address current production topics for dryland corn and sorghum production. Speakers will include Lucas Haag, Northwest Area Agronomist, and Ignacio Ciampitti, Crop Production Specialist at all locations and Sarah Zukoff, Southwest Area Entomologist, at the Lane County location.

September 13 – Smith County, Corn Hybrid Maturity x Planting Date Study

- 8:00 am - Breakfast, 8:30 am - Field tour at the plots
- Breakfast at Nutrien Ag Solutions, 15092 190th Road (2 miles south of Smith Center on US 281)
- Plot located 1 mile south of Smith Center, intersection of US 281 and 180 Road.
- Dryland Corn Hybrid Maturities x Planting Date Study (9 hybrids in 3 maturity groups planted on four different dates)
- RSVP is requested by **Monday, September 10**. Register online at www.postrock.ksu.edu or at any Post Rock Extension District Office in Beloit, Lincoln, Mankato, Osborne, or Smith Center, or by contacting Sandra L. Wick (swick@ksu.edu) 785-282-6823

September 13 – Barton County, Dryland Sorghum Hybrid Demonstration Plots and Dryland Corn Hybrid Maturity x Planting Date Study

- 12:00 Noon - Lunch in the field at sorghum hybrid demonstration plots
- Plots located at NE 30th Ave, between NE 140 and 150th Road
- 2:00 pm, Dryland Corn Hybrid Maturities x Planting Date Study (9 hybrids in 3 maturity groups planted on four different dates)
- Plots located just north of the K-96 and NW 80 Ave (Olmitz Road) intersection
- RSVP is requested by **Tuesday, September 11**. Call the Cottonwood Extension District Great Bend office at 620-793-1910 or email Brenda (bwalton@ksu.edu)

September 14 – Lane County, Dryland Corn and Sorghum Hybrid Demonstration Plots

- 10:00 am - Meet in the field for dryland corn and sorghum hybrid demonstration plots
- 12:00 pm - Lunch and indoor presentation on dryland corn and sorghum production
- From Dighton: 2 miles east, 2 ¾ miles south, plot is at the intersection of Mustang and CR 120.
- Meal to follow at Pete's Place, 100 East Plum Dighton.
- RSVP by **Thursday, September 13**. Contact Chris Long, Walnut Creek Extension District, to RSVP or for more information, 620-397-2806 or clong@ksu.edu

Meals and refreshments supported by local sponsors. Corn hybrid maturity x planting date studies are supported by the Cover Your Acres Winter Conference and seed donations from Pioneer, LG Seeds, and Dekalb/Channel.