



Extension Agronomy

eUpdate

04/05/2019

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. Soil and plant considerations for late applications of anhydrous ammonia

Many producers could not apply N fertilizer in the fall due to the persistent saturated soil conditions, with wet conditions continuing for many soils this spring. Corn planting has already begun in south eastern Kansas. As planting time for the rest of the state rapidly approaches, producers may have questions related to the potential effect of ammonia (NH_3) to corn seedlings, as well as soil considerations for anhydrous ammonia applications under suboptimal conditions.



Figure 1. Field application of anhydrous ammonia. Photo by Stu Duncan, K-State Research and Extension.

Soil factors related with anhydrous ammonia application

- **Chemical** – Ammonia (NH_3) needs to react with water shortly after application in order to convert into ammonium (NH_4^+), which is the molecule that can adhere to clay particles and organic matter in the soil. Ammonia is very soluble in water. After it is placed in the soil, NH_3 reacts with water in the soil to form ammonium-N (NH_4^+), which is retained on the soil cation exchange sites. This process takes a little time – it does not occur immediately upon contact with the soil. The main controlling factors in the conversion of NH_3 to NH_4^+ are soil temperature, soil moisture, and soil pH. The higher the soil temperature and the wetter the soil, the more rapid the conversion occurs. Also, equilibrium between NH_3 and NH_4^+ is affected by soil pH. More NH_3 will remain unconverted in the soil longer at higher application rates and at higher soil pH levels.
- **Physical** – Wet soils might not seal properly above the injection slot. This can allow the gas to

physically escape into the air before it has a chance to be converted into NH_4^+ . Other issues related to soil compaction can cause significant damage, ultimately reducing the yield potential of the corn crop.

Anhydrous ammonia injury to corn seedlings

Free ammonia (NH_3) is toxic to the corn seedling and root system. Visual symptoms typically include root necrosis (death) and plant growth reduction after germination. This potential for injury from spring applications is higher when corn is planted shortly after anhydrous application.

The greatest concentration of ammonia is within the first 1-2 inches of the injection point, and with a typically radius of about 3-4 inches for the overall retention zone for a fine-to-medium textured soil. The size of this zone can vary greatly depending on the N application rate, knife spacing, soil texture, organic matter, soil structure, and moisture. Good soil moisture will help with the conversion to NH_4^+ , potentially reducing the risk of injury to the corn seedling. However, under ideal conditions, waiting 10 to 14 days after ammonia application will allow for adequate time for the conversion process. Other alternatives to reduce the risk of injury include managing factors such as the planting distance from the anhydrous injection point, planting at an angle to the anhydrous application, and reducing the application rates, particularly on sandy soils (Figure 2).



Figure 2. Corn planted at an angle to the anhydrous ammonia application. Photo by Stu

Duncan, K-State Research and Extension.

If corn planting can be done at an adequate distance from the anhydrous injection point, the risk of injury will be reduced, and planting can be done sooner after anhydrous application. Producers can also consider a split application of N. This which will allow for a lower N rate applied with anhydrous this spring, with the balance of N applied as side-dress during the growing season. Furthermore, if starter fertilizer will be applied at planting, using either a 2x2 or surface dribble placement, can allow for safe applications of N at planting time (see accompanying eUpdate article in this issue, "Placement and rate considerations for nitrogen application with starter fertilizer").

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2. Placement and rate considerations for nitrogen application with starter fertilizer

Starter fertilizer is typically considered as the placement of a small rate of fertilizer, usually nitrogen (N) and phosphorus (P), near the seed at planting time. The idea is this fertilizer "jump starts" growth in the spring, and it is not unusual for a producer to see an early-season growth response to starter fertilizer application. But some producers might also consider using this opportunity apply higher rates of fertilizer that can supply most of the N and P needs for the corn crop. Wet soil conditions in many areas of Kansas during the fall and winter months continue to limit N applications for corn. Under these conditions, N application at planting time can provide a good alternative for some producers.

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

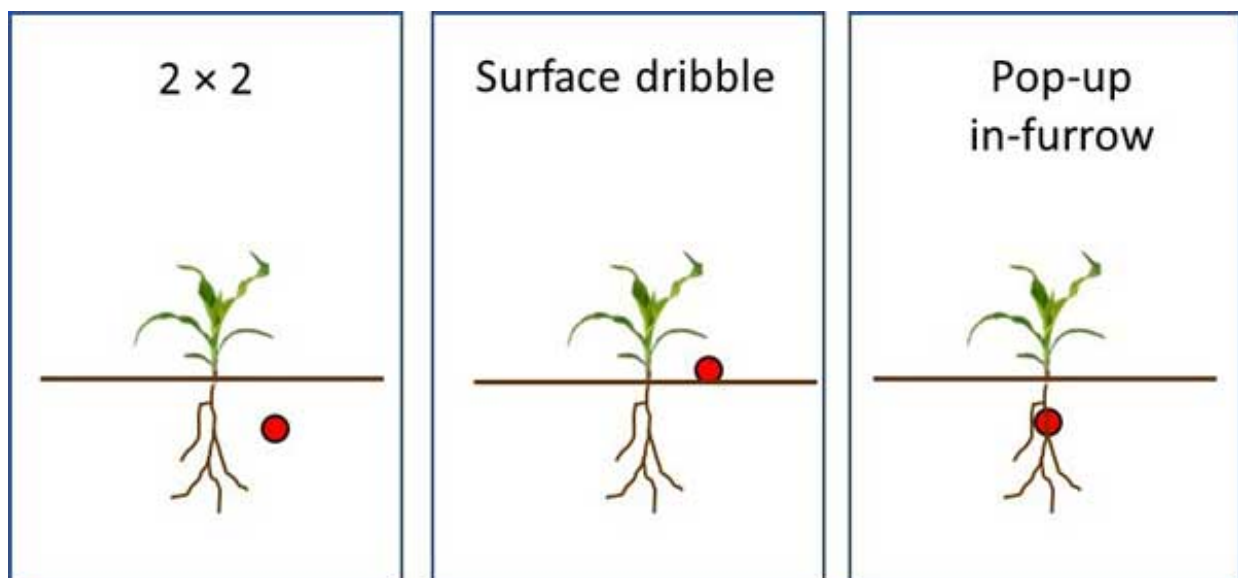


Figure 1. Example illustrations of starter fertilizer placement with respect to the corn plant. Graphic by Dorivar Ruiz Diaz, K-State Research and Extension.

What are the risks with “pop-up” placement?

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

What is a “salt”?

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



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

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

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

N rates with 2x2 placement or “surface dribble”

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

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

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3. Soil temperature and moisture update for early April 2019

Selection of the optimal planting date is one of the most critical factors in the decision-making process for producers. In making this decision, producers should consider soil temperatures rather than just calendar dates. After a very warm start to March, air temperatures across Kansas declined this past week.

For the week of March 30 to April 5, average weekly soil temperatures at 2 inches among crop reporting districts overall ranged from 45 to 53 degrees F (Figure 1). For example, in the northeast region, soil temperatures ranged from 45 to 47 degrees F; while in the southwest region, soil temperatures varied from 53 to 47 degrees F (Figure 1). Soil temperatures were around 44-47 degrees F for the northwest region.

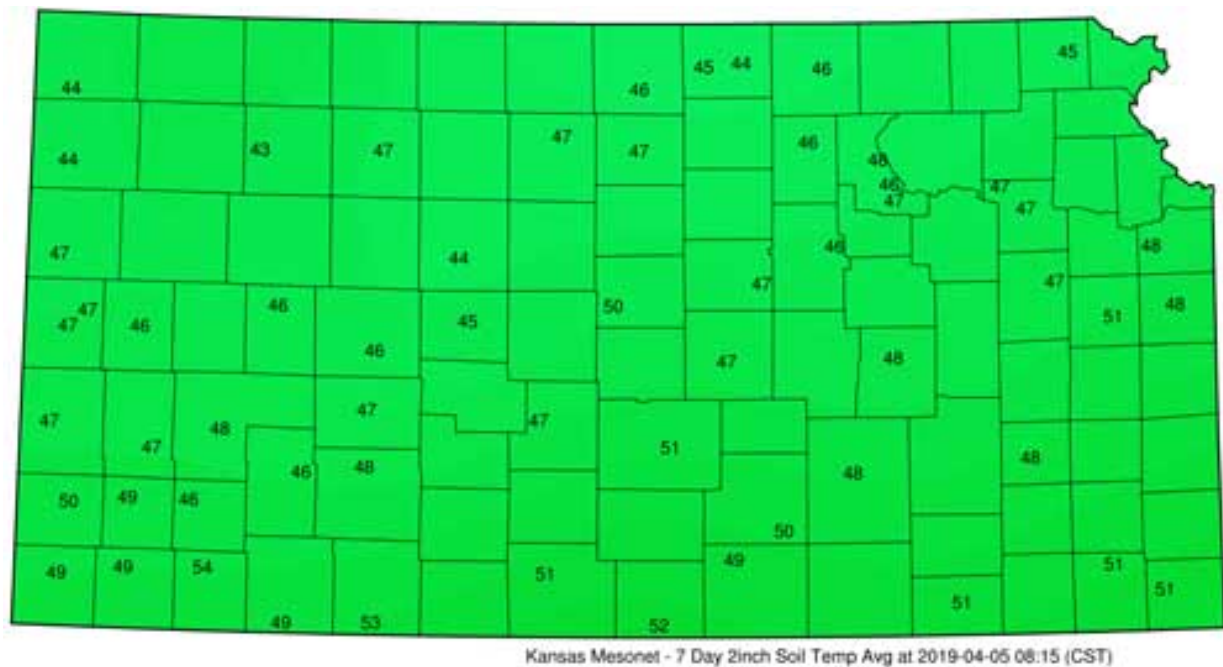


Figure 1. Average soil temperatures at 2-inch depth for the week of March 30 - April 5, 2019.
(<http://mesonet.k-state.edu/>)

Differences in soil temperature were related to the large variations in air temperatures experienced last week, from 38 degrees F in northern portions of the state to 58 degrees F for areas in southern Kansas (Figure 2).

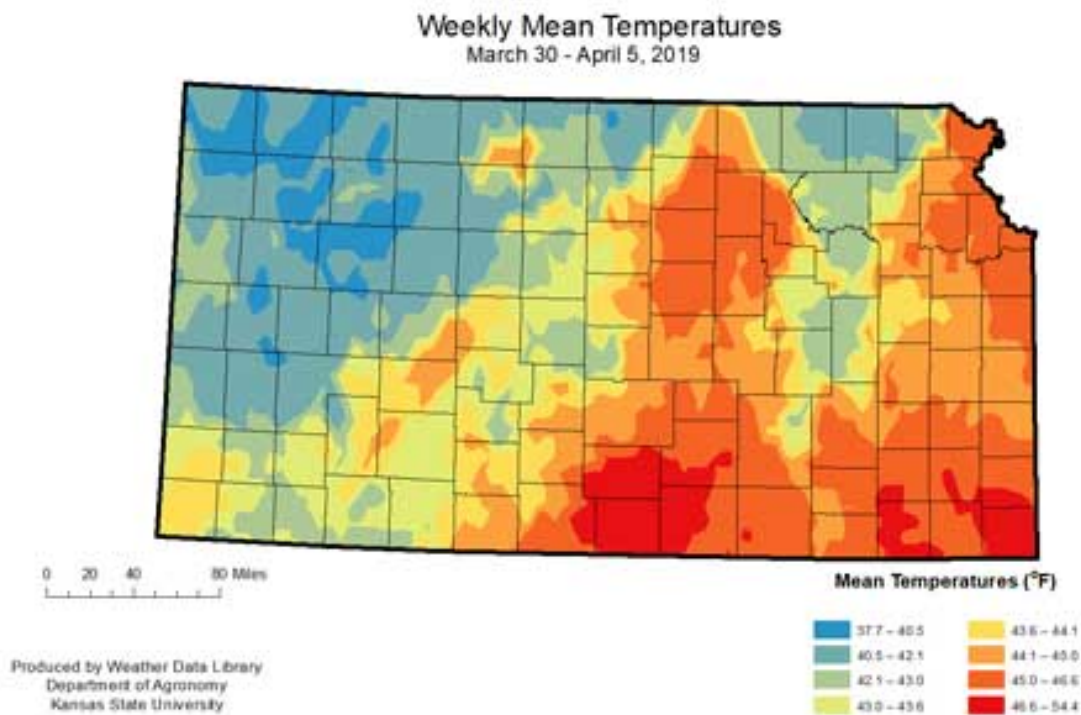


Figure 2. Weekly mean air temperatures for the week of March 30 - April 5, 2019.

Projections for the coming weeks are for increasing air temperatures – but cooler-than-normal state wind, which will slow soil temperature increases (Figure 3).

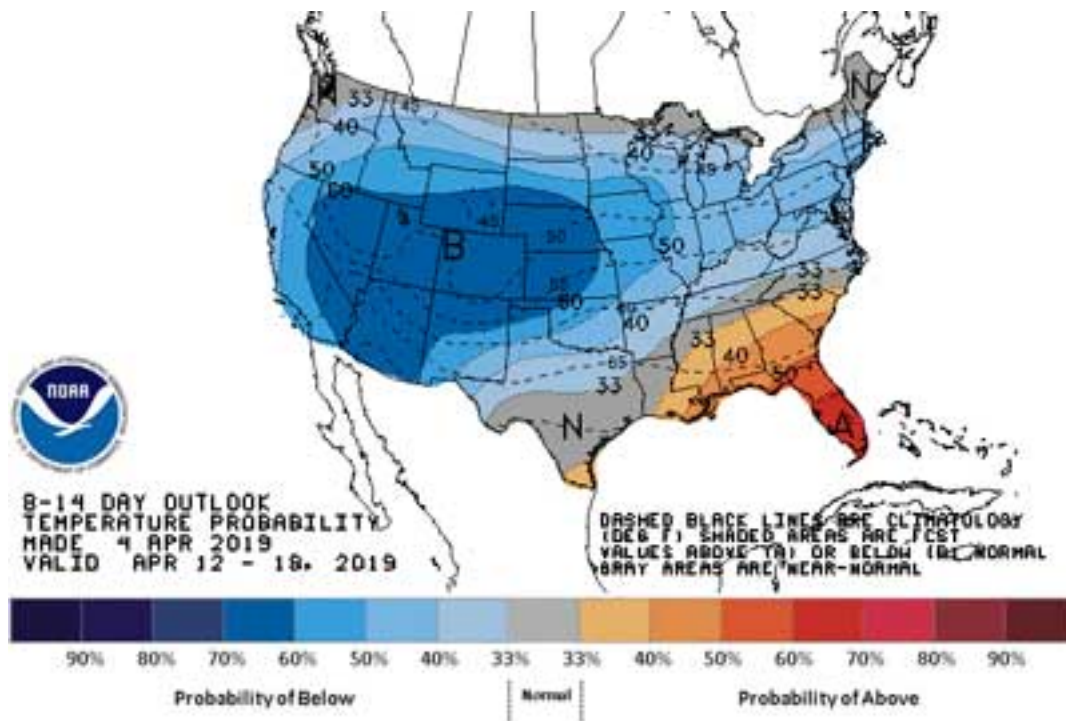


Figure 3. 8 - 14 day outlook temperature probability for April 12-18, 2018 (NOAA).

Current soil moisture status across Kansas is quite wet, despite the relative low precipitation for the week (Figure 4). If saturation is above 50% at the 2-inch soil depth, this reflects wet soil conditions with a low probability for field work. Projections for coming weeks are for precipitation to be above-normal for all of Kansas (Figure 5), which will slow down soil warming and impact potential plans for an early start to planting.

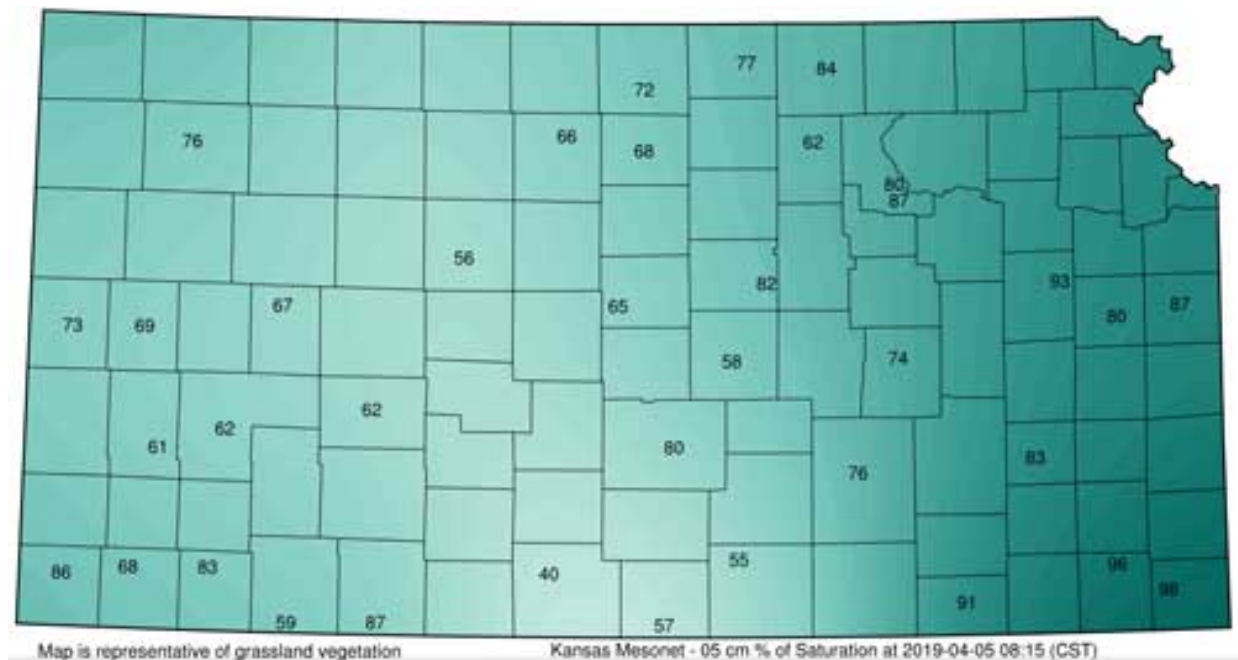


Figure 4. Percent saturation at 2 inches as of April 5-2019 (KS Mesonet).

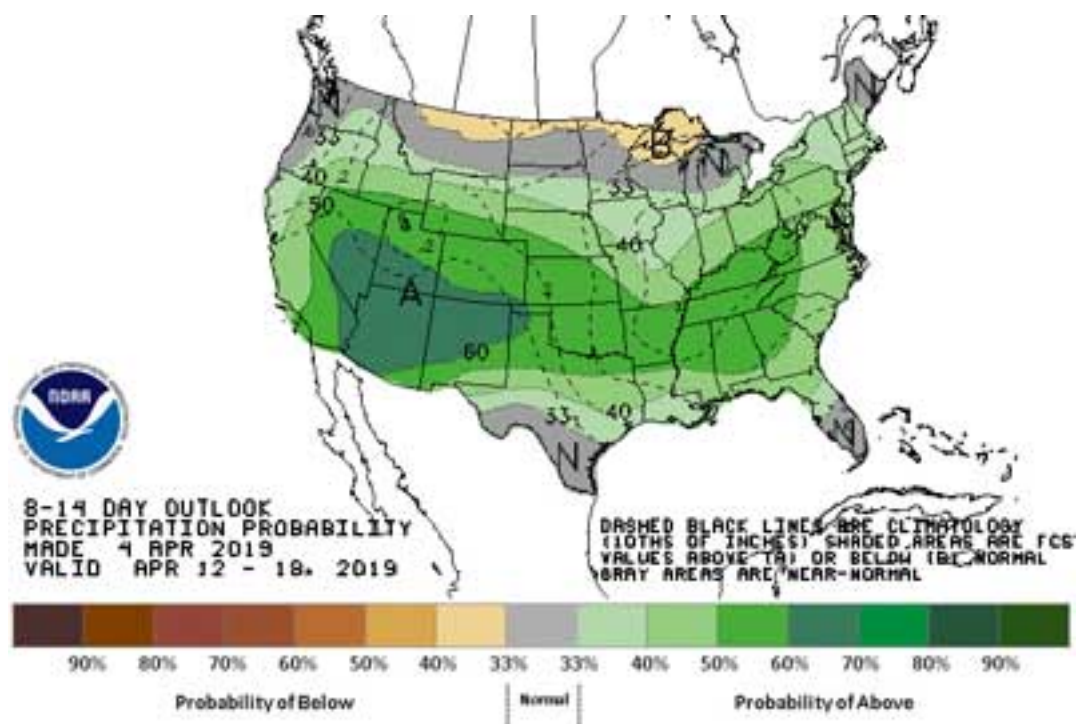


Figure 5. 8-14 Day outlook precipitation probability for April 12 - 18. (NOAA).

Optimal soil temperature for crop emergence

Every summer row crop has an optimal soil temperature for emergence. A minimum for corn is 50 degrees F for germination and early growth. However, uniformity and synchrony in emergence is primarily achieved when soil temperatures are above 55 degrees 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 degrees 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 6). 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.

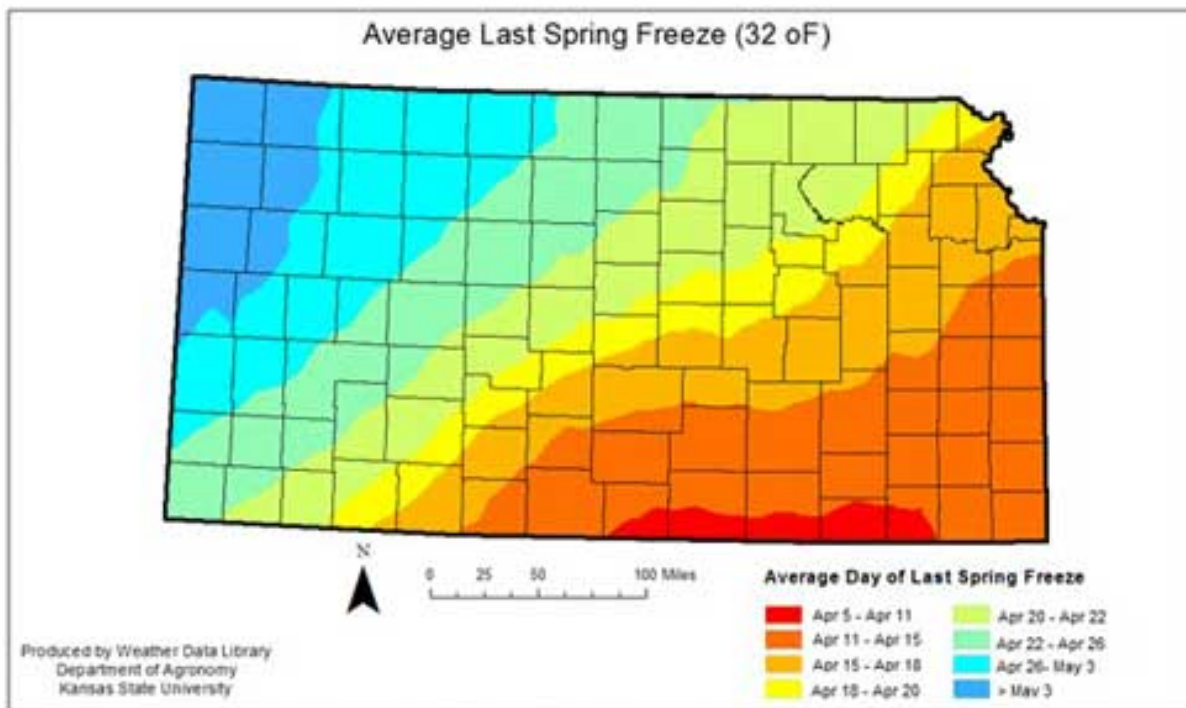


Figure 6. Average last spring freeze (32 degrees F) for Kansas.

Think about 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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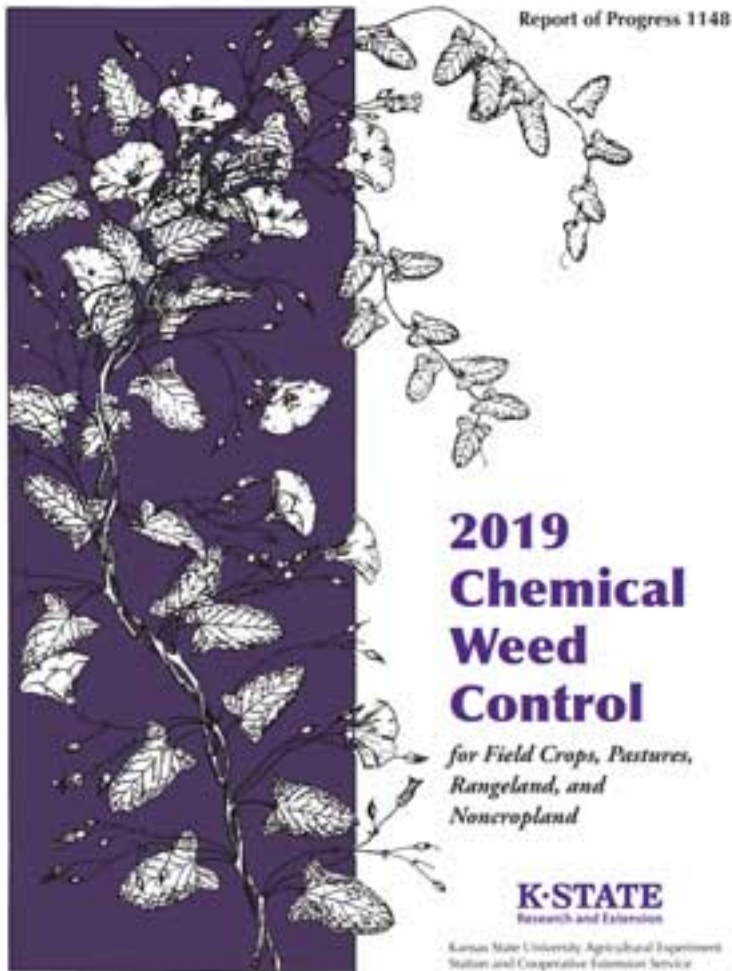
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4. Pre-emergence herbicide programs for corn

Difficult weeds, especially glyphosate-resistant weeds, are controlled most consistently with soil-applied herbicides which kill germinating seeds/seedlings. Much of the resistance to glyphosate has developed from over-reliance on post-emergence herbicide applications for weed control. Thus it is essential to include one or more of the preplant and pre-emergence residual herbicides available for corn. The specific herbicide you use, although important, is usually less important than just making the decision to use a preplant or pre-emergence herbicide.

It is important to use multiple modes of action when selecting herbicides. To assist growers, we have included in this article a reference number in parentheses that corresponds to the herbicide's site of action. For example, the reference number herbicide mode of action for glyphosate is No. 9, and will be referred to in this article as "glyphosate (9)." There is a key to all herbicide sites of action at the end of this article. When there are two or more numbers in parentheses, it means the active ingredients in a product have different modes of action. If a herbicide is mentioned more than once in a paragraph, we include the reference number only after the first mention of the product in that paragraph.

It is important to change herbicide programs from time to time so that you do not get hooked on any single herbicide program year after year. Weed species shift and develop resistance to herbicide programs that do not change. It's also important to know the strengths and weaknesses of each product in terms of the spectrum of weeds controlled. A table summarizing weed species response to various corn herbicides can be found on pages 24-26 of *2019 Chemical Weed Control for Field Crops, Pastures, Rangeland, and Noncropland* (SRP 1139) at:
<https://www.bookstore.ksre.ksu.edu/pubs/SRP1148.pdf>



For burndown applications in a no-till system on emerged grass and broadleaf weeds, an application of glyphosate (9) and a product containing dicamba (4) or 2,4-D (4) may be critical. The choice between 2,4-D and dicamba will depend on weed species present. Dicamba products will be more effective on kochia and marestail. 2,4-D is more effective on winter annual mustards. The use of pre-emergence herbicides, applied just before or following planting, often provides control of weeds for several weeks. This can greatly improve the effectiveness of a post-emergence herbicide application, and gives the producer more leeway on post application timing.

Categories of soil-applied residual herbicides for corn

Soil-applied residual herbicides for corn can be grouped into several basic categories.

Atrazine (5) is a common component of many preplant and pre-emergence herbicide premixes for corn. Where weed pressure is light, a March application of atrazine with crop-oil concentrate and 2,4-D (4) or dicamba (4) can control winter annual weeds such as mustards and marestail and provide control of most germinating weeds up to planting. If kochia is the key target, 0.5 to 1.0 lb/acre atrazine (5) with a pint of dicamba (4) applied in late February to early March can provide excellent control of germinating kochia. It is essential to add glyphosate (9) to the mix if winter annual grasses

are present. In a premix with other herbicides, atrazine adds burndown control of newly emerged grasses and broadleaf weeds present near planting time, as well as some residual control of small-seeded broadleaf weeds such as pigweeds and kochia (except for triazine-resistant populations). Unless your situation prohibits atrazine use, always apply atrazine (5) with HPPD-inhibitor (27) and acetamide (15) herbicides.

Acetamides (15) and pyrazole (15) /atrazine (5) premixes. The main acetamide (15) products used in corn include acetochlor, S-metolachlor, metolachlor, dimethamid-P, and many premix products containing one of these active ingredients. The pyrazole products include Pyroxasulfone (15) is a pyrazole herbicide, but has the same site of action as the acetamides. In general, these products are very effective in controlling most annual grasses (except shattercane) and small-seeded broadleaf weeds such as pigweeds. They are much less effective in controlling small-seeded kochia or large-seeded broadleaf weeds such as cocklebur, devilsclaw, morningglory, sunflower, and velvetleaf. An exception are those products containing pyroxasulfone – Zidua (15), Anthem (15, 14), and Anthem ATZ (15, 14, 5). These products have activity on kochia and velvetleaf. There have been no cases of weed populations in Kansas developing resistance to the group 15 herbicides to date.

The acetamide and pyrazole products are most effective when applied with atrazine. Several atrazine (5) /acetamide or pyrazole (15) premixes are available and should be used instead of acetamides or pyrazole alone unless atrazine is not allowed. These premixes generally fit into two groups: products with a reduced atrazine rate (1 lb or less / acre) and products with a full atrazine rate (1 to 2 lb/acre). Soil type, soil pH, and organic matter will determine whether the reduced- or full-rate atrazine product is used. In past years, often because of cost, reduced rates of these products were applied to help manage heavy summer annual grass pressure, then followed up with a good post-emergence herbicide program. With the increased occurrence of glyphosate- and other herbicide-resistant weeds, it is essential to use the full rates of these products in conjunction with a POST program.

HPPD-inhibitors (27). Examples of HPPD-inhibitors are isoxaflutole (e.g. Balance Flexx (27), Corvus (27, 2), and Prequel (27, 2)) and mesotrione (e.g. Callisto and many Generic (27), Callisto Xtra (27, 5), Resicore (27, 15, 4), Acuron (27, 15, 5), Lexar EZ (27, 15, 5), Lumax EZ (27, 15, 5), Acuron Flexi (27, 15), Zemax (27, 15). These products either contain atrazine or should be applied with atrazine, and are excellent for control of kochia, pigweeds, velvetleaf, and many other broadleaf weeds.

Acuron (27, 15, 5), Lexar EZ (27, 15, 5), Lumax EZ (27, 15, 5), Resicore (27, 15, 4) and Corvus (17, 2)+atrazine (5) provide excellent control of grass weeds. Corvus will also control shattercane. Balance Flexx has activity on shattercane but is less consistent than Corvus. Prequel has a low rate of Balance mixed with Resolve and will not provide the same level of residual weed control as Acuron, Resicore, Lexar EZ, Lumax EZ, Balance Flexx, or Corvus used at full rates. Keep in mind, products containing Balance should not be applied to coarse-textured soils when the water table is less than 25 feet below the soil surface. Balance Flexx does not provide adequate control of sunflower. Corvus will be much better than Balance Flexx on sunflower, provided the sunflower is not ALS-resistant. Herbicides containing clopyralid (4) such as Hornet (4, 2), Resicore (15, 4, 27), TripleFlex II (15, 4, 2), or Surestart II (15, 4, 2) will also provide very good control of sunflower.

A new herbicide from Syngenta called Acuron contains Lumax EZ (27, 15, 5) + bicyclopyrone (27). Bicyclopyrone is an HPPD-inhibitor herbicide that enhances large-seeded broadleaf weed control and also has grass activity. Acuron (27, 15, 5) provides enhanced control of giant ragweed, common ragweed, common cocklebur, and velvetleaf, along with improved morningglory control compared to Lumax EZ. Acuron Flexi (27, 15) is basically Acuron without atrazine. Acuron Flexi (27, 15) and

Zemax (27, 15) (basically Lumax without atrazine (5)) were developed for areas where atrazine generally isn't used or is prohibited. Resicore will also fit in this scenario and is the most effective of the non-atrazine products in this list. Zemax and Acuron Flexi, without the atrazine (5), may provide less broadleaf weed control.

PPO-inhibitors (14). Examples of PPO-inhibitors include flumioxazin (e.g. Valor (14), and Fierce (14, 15), and saflufenacil (Sharpen (14), and Verdict (14, 15). Valor or Fierce must be applied 7 to 30 days before corn planting in a no-till system. These herbicides provide excellent control of pigweeds; however, they are marginal on kochia. Fierce will provide improved control of velvetleaf and kochia compared to Valor. The addition of atrazine (5) will enhance kochia, pigweed, velvetleaf, and morningglory control, provided the populations are not triazine-resistant. Sharpen and Verdict have excellent activity on pigweeds, kochia, and large-seeded broadleaf weeds. However, the length of residual activity can be shorter than other pre-emergence products when all are compared at full rates. This will depend on the rates of Sharpen and Verdict used. Approximately 7 to 10 days of residual can be expected per 1 oz of Sharpen and 5 oz of Verdict.

ALS-inhibitors (2). Examples of ALS-inhibitors for use as a soil-applied herbicide for corn include flumetsulam, Python (2); and Hornet (2, 4), a premix of flumetsulam (2) and clopyralid (4). Both herbicides have broadleaf activity only. These products are strong on large-seeded broadleaf weeds such as cocklebur, sunflower, and velvetleaf, or the small-seeded common lambsquarters. Adding Hornet to a full rate of an acetamide (15) /atrazine (5) mix as a pre-emerge treatment will control the annual grasses and add considerably to large-seeded broadleaf weed control. Three-way premixes of acetochlor (15)+clopyralid (4)+flumetsulam (2), include SureStart II (15, 4, 2) and TripleFlex II (15, 4, 2). These products are especially effective for control of sunflower, along with cocklebur and velvetleaf, but less effective for morningglory control. Resicore (15, 4, 27) is a premix of acetochlor (15)+clopyralid (4)+ mesotrione (27). This product contains 3 modes of action as did SureStart II and TripleFlex II, only the ALS-inhibitor (2) has been replaced with an HPPD-inhibitor (27).

Rimsulfuron is another ALS-inhibiting (2) herbicide that is a component of Prequel (2, 27), Instigate (2, 27), Basis (2), and Basis Blend (2). Products with Rimsulfuron will provide short residual control of grass and broadleaf weeds and should be used as a setup herbicide with a good postemergence weed control program. If ALS-resistant broadleaf weeds are present, these ALS-containing herbicides often will be less effective.

Key to herbicide mode of action reference numbers

The Weed Science Society of America has developed a numbered classification system based on the herbicide site of action to assist farmers and applicators in selecting herbicides with different sites of action. Most herbicide labels now prominently display the herbicide classification number at the beginning of the label. Herbicide premixes that contain multiple active ingredients with different sites of action will have all sites of action numbers listed. The Take Action Herbicide Classification chart is an excellent reference that summarizes herbicide active ingredients and sites of action:

https://weedsociety.missouri.edu/publications/2017_Updated_ClassificationPoster.pdf

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5. First hollow stem update: April 3, 2019

Cattle should be removed from wheat pastures when the crop reaches first hollow stem (FHS). Grazing past this stage can severely affect wheat yields (for a full explanation, please refer to the eUpdate article "[Optimal time to remove cattle from wheat pastures: First hollow stem](#)").

First hollow stem update

In order to screen for FHS during this important time in the growing season, the K-State Extension Wheat and Forages crew measures FHS on a weekly basis in 36 different commonly grown wheat varieties in Kansas. The varieties are in a September-sown replicated trial at the South Central Experiment Field near Hutchinson.

Ten stems are split open per variety per replication (Figure 1), for a total of 40 stems monitored per variety. The average length of hollow stem is reported for each variety in Table 1.



Figure 1. Ten main wheat stems were split open per replication per variety to estimate first hollow stem for this report, for a total of 40 stems split per variety. Photo by Romulo Lollato, K-State Research and Extension.

Table 1. Length of hollow stem measured April 3 of 36 wheat varieties sown mid-September 2018 at the South Central Experiment Field near Hutchinson. The critical FHS length is 1.5 cm

(about a half-inch or the diameter of a dime). Varieties that already passed first hollow stem are highlighted.

Variety	12-Mar	18-Mar	25-Mar	27-Mar	1-Apr	3-Apr
	----- cm -----					
AM Eastwood	0.41	0.63	1.62	3.30	--	--
Bentley	0.24	0.25	0.49	0.97	2.22	--
Bob Dole	0.21	0.39	0.80	1.35	2.45	--
Byrd	0.23	0.39	0.90	1.57	--	--
Doublestop CL Plus	0.20	0.28	0.54	1.00	1.56	--
EXP	0.33	0.39	1.07	1.44	2.72	--
EXP 40-1	0.21	0.21	0.67	1.14	1.74	--
Gallagher	0.21	0.44	1.13	1.87	--	--
Green Hammer	0.19	0.35	0.59	1.56	--	--
Iba	0.14	0.29	0.55	1.39	2.77	--
Joe	0.19	0.35	0.48	0.56	0.87	1.30
Langin	0.23	0.29	0.56	1.80	--	--
Larry	0.18	0.37	0.55	0.90	2.02	--
Lonerider	0.22	0.36	0.76	1.03	1.46	3.34
NE10478-1	0.23	0.36	0.61	1.10	2.51	--
Paradise	0.32	0.53	0.99	1.16	2.61	--
Ruby Lee	0.14	0.44	0.89	2.38	--	--
Showdown	0.18	0.39	0.88	1.23	1.82	--
Smith's Gold	0.18	0.37	0.99	1.56	--	--
Spirit Rider	0.21	0.51	1.83	3.28	--	--
Stardust	0.41	0.49	1.00	1.91	--	--
SY Achieve CL2	0.28	0.63	1.55	3.80	--	--
SY Benefit	0.28	0.54	2.12	3.16	--	--
SY Grit	0.14	0.54	1.11	1.65	--	--
SY Rugged	0.17	0.28	0.56	0.83	1.40	1.96
TAM 204	0.24	0.39	1.02	1.54	--	--
Tatanka	0.29	0.48	0.90	1.34	3.93	--
WB4269	0.29	0.30	0.73	1.50	--	--
WB4303	0.36	0.67	2.70	3.25	--	--
WB4515	0.23	0.34	0.67	1.25	2.07	--
WB4595	0.23	0.45	0.97	1.90	--	--
WB4699	0.21	0.39	0.67	0.74	1.48	2.72
WB4792	0.30	0.37	1.17	1.96	--	--
WB-Grainfield	0.26	0.46	0.68	0.84	1.70	--
Whistler	0.23	0.31	0.52	0.94	2.08	--
Zenda	0.22	0.49	1.41	1.47	3.63	--

As of April 3, 2019, all varieties evaluated except for Joe had reached first hollow stem (Table 1). We advise producers to remove cattle from the pastures by this time to avoid potential yield losses.

The intention of this report is to provide producers an update on the progress of first hollow stem

development in different wheat varieties. Producers should use this information as a guide, but it is extremely important to monitor FHS from an ungrazed portion of each individual wheat pasture to take the decision of removing cattle from wheat pastures.

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6. Soybean disease management considerations for 2019

Most plant disease management decisions for soybeans need to be made before the seed hits the furrow. The exceptions are fungicide applications for frogeye leafspot and diseases that affect seed quality such as *Phomopsis* pod and stem blight, purple seed stain, and anthracnose.

Variety selection, crop rotation, and seed-applied chemical choices are the best management practices for the most common soybean diseases in Kansas. The 2018 Soybean Disease Loss Survey has recently been released. The top soybean diseases in 2018 across the U.S. were in order, soybean cyst nematode (SCN), seed quality diseases such as pod and stem blight, frogeye leafspot, sudden death syndrome (SDS), and soilborne seedling diseases. The list for the Kansas 2018 cropping season is similar, except there was less SDS due to the summer-long drought. Kansas producers also had significant late-season *Phytophthora* root rot issues from the excessive rains that began in early August and continued through maturity.

Variety selection is crucial

SCN, SDS, and *Phytophthora* root rot are best managed by variety selection. There is some limited response to rotation, and seed treatment is available for SDS, and to some extent SCN. Currently, all soybean varieties have some basic resistance to SCN, but those varieties available in Kansas derive their resistance from the same parent, PI88788. It has been shown that soybean varieties vary in the number of copies of the resistance gene they contain and that more copies result in better resistance. Since this information is not readily available, it is recommended to never plant the same variety twice in the same field. This will prevent the selection of nematode populations that will thrive on any particular variety. Generally, the most resistant varieties will not respond to the addition of a seed treatment nematicide, since resistance alone will get the job done.

SCN-infested fields are more likely to also have SDS problems, since as the nematode enters the root, it creates a pathway for the SDS fungus to follow. In fields with a history of SDS, it is important to select varieties with good SDS resistance. Remember, SCN resistance and SDS resistance are independent of each other. Since no varieties are immune to SDS, the use of ILeVO fungicide seed treatment is recommended, especially on early-planted fields. ILeVO can also give some protection against the nematode.

Phytophthora root rot is also best managed by variety selection, although water management can also be important in limiting losses. There are race-specific genes to *Phytophthora*, but since there are well over 50 known races of the fungus, it may be difficult to match resistance genes to the races in a particular field. Therefore, field tolerance scores are usually more important in measuring the variety's response to the disease.

We generally lump soilborne seedling diseases into one category, but in Kansas, there are three separate pathogen groups, *Pythium*, *Rhizoctonia*, and *Fusarium* that can cause stand loss issues and reduced yields depending on soil temperatures and soil moisture (Figure 1). Unfortunately, many of our seed treatment fungicides are specific to only one of the groups. Therefore, it is important to choose a product that has a two-, three-, or even four-way combination of materials with modes of action that will control whatever pathogen group may be in the field.



Figure 1. Pythium seedling blight. Symptoms include rotten, mushy seedlings with poorly-developed roots. Photo courtesy of Gary Munkvold, Iowa State University.

Seed quality issues

The end of 2018 was characterized by seed quality issues due to the extended rains across much of the western soybean growing region. Seed quality testing labs, such as at the Kansas Crop Improvement Association, are reporting significantly reduced germination rates due to the poor-quality seed. When diseases such as Phomopsis, purple seed stain, and anthracnose are present on the seed, they can interfere with germination and cause poor stands (Figure 2). Stands that are too thin may need replanting (if seed is available) or have too few plants to maximize yield. Seed treatments can be useful in controlling these seed-borne diseases. Growers who routinely use fungicide seed treatments should have fewer worries, but if a grower has not invested in fungicides seed treatments in the past, 2019 would be a great time to start.



Figure 2. Purple seed stain. Infected seed varies from pale pink to dark purple discoloration of the seed coat. In most cases, the seed embryo is not affected, but germination of infected seed may be reduced. Photo courtesy of the Crop Protection Network.

Helpful resources

There are several on-line publications available that provide more detailed information on seedling diseases and specific seed treatment fungicides.

“Considerations for Selecting Soybean Varieties”:

<https://cropprotectionnetwork.org/resources/publications/considerations-for-selecting-soybean-varieties>

“Fungicide Efficacy for Control of Soybean Seedling Diseases”:

<https://cropprotectionnetwork.org/resources/publications/fungicide-efficacy-for-control-of-soybean-seedling-diseases>

“Scouting for Soybean Seed Diseases”:

<https://cropprotectionnetwork.org/resources/publications/scouting-for-soybean-seed-diseases>

“Scouting for Soybean Seedling Diseases”:

<https://cropprotectionnetwork.org/resources/publications/scouting-for-soybean-seedling-diseases>

“Seed Treatments: Questions that emerge when plants don’t”:

<https://cropprotectionnetwork.org/resources/publications/seed-treatments-questions-that-emerge-when-plants-dont>.

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7. Review of drought-tolerant corn hybrids: Yield benefits

Drought may not be on the minds of producers across the state given the current soil moisture levels. However, the growing season is long and drought could become a problem later in the season. Based on the soil moisture profile and weather forecast conditions, it would be very unlikely to see drought issues until the late vegetative or reproductive stages for corn this year. Nonetheless, this article emphasizes the importance of understanding your hybrids and hybrid selection for improving yields. One of the main points to highlight for the current growing conditions is that drought tolerant (DT) hybrids have the potential to yield similarly to non-DT hybrids when water is not limiting.

In recent years, drought conditions have raised questions about the utilization of corn as the main crop for maximizing yield production per unit of available water in dryland environments.

Non-transgenic, conventionally bred, “drought-tolerant” (DT) corn hybrids from Pioneer and Syngenta were released to the market with the expectation of increasing corn production in water-limited regions. Monsanto also released biotech transgenic DT hybrids.

Overall, the information from seed companies indicates that DT hybrids could provide from 2 to more than 15 percent yield increase over “competitor hybrids” in non-limiting and water-limiting environments, respectively.

K-State research conducted over the 2012-2015 growing seasons across the state has recently been summarized, and this summary is available in a K-State Research and Extension publication (discussed at the end of this article). The objective of this article is to present an overview of the DT vs. non-DT responses to management practices such as plant population and irrigation.

The information below is intended to provide some guidance to farmers, consultants, and agronomists in making the right decision for selecting corn hybrids. In addition, we hope to develop a better understanding of the kinds of environments in which DT hybrids could be most likely to result in a yield benefit. These hybrids are generally targeted for water-limited environments in the Western Great Plains.

Results

Our research compared DT hybrids from diverse companies with a standard non-DT counterpart of similar maturity. The tests also evaluated the yield response to varying plant population and irrigation levels.

At the plant scale, our analysis did not reveal any change in the plant response to plant population between DT and non-DT hybrids. This indicates no need to change plant population when using DT hybrids.

We also analyzed yields at the plot level for DT vs. comparable non-DT hybrids with similar maturity. The information presented in the figure below (Figure 1) depicts the association of the yields for the DT vs. non-DT corn hybrids: Yellow points = research plots (2012-2013); blue points = on-farm plots; green points = 2014; red points = 2015 growing season plots.

Overall, the analysis found a yield benefit of 3 percent for DT vs. non-DT hybrids under diverse

environments and stress conditions across Kansas during the 2012-2015 seasons. In absolute terms, the yield advantage of using DT hybrids was around 5 bushels per acre compared to the non-DT material. Similar yield trends were observed in research plots and on-farm demonstration plots. A great proportion of DT and non-DT yields were similar -- within a 5% confidence interval as highlighted in Figure 1 -- except in low-yielding and high-yielding environments. In low yielding-environments, DT out-yielded non-DT corn hybrids more often compared to the situation in higher-yield environments.

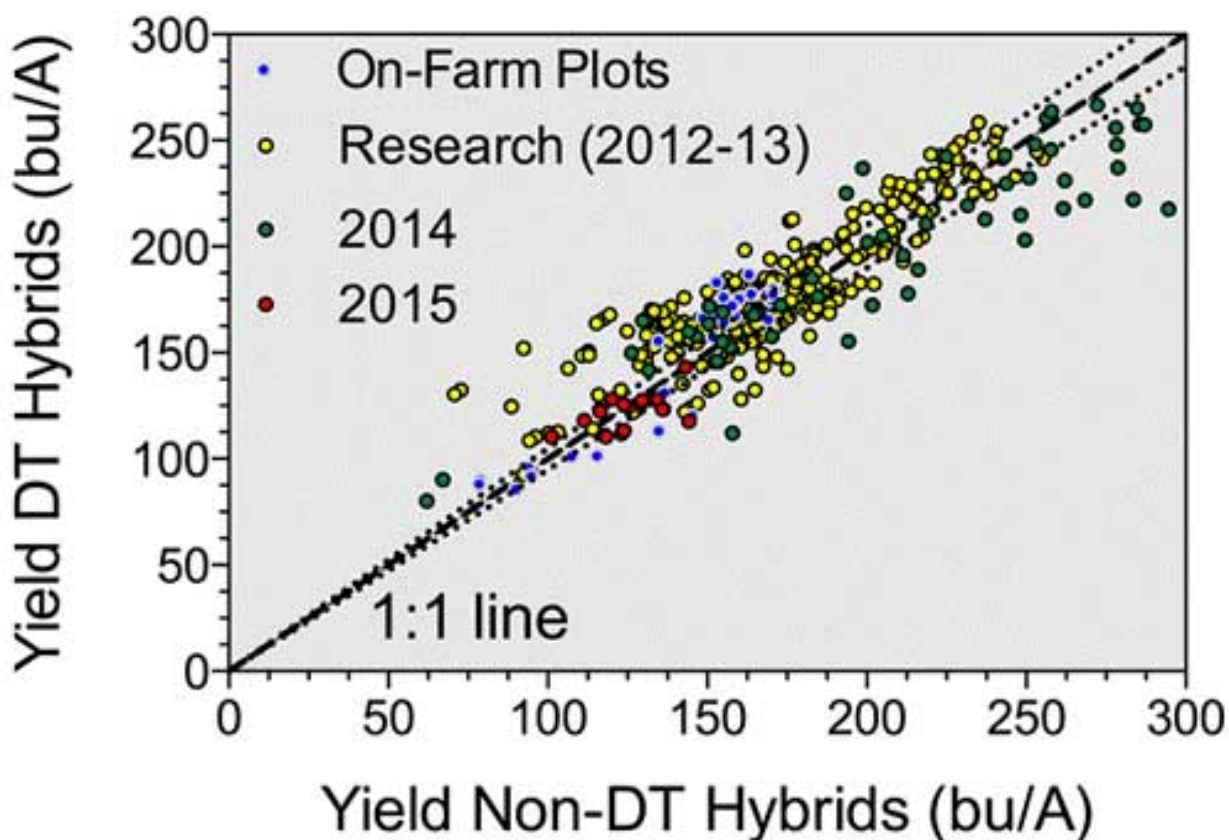


Figure 1. Yield for the DT versus non-DT corn hybrids across site-years for the 2012, 2013, 2014, and 2015 growing seasons.

DT vs. non-DT corn hybrids: Yield environment analysis

The analysis of information across diverse yield environments allows us to more clearly understand where there would be a yield advantage from planting DT hybrids. It is clear from Figure 2 that the yield advantage of DT corn hybrids increases as the yield potential of the crop decreases. This graph shows that there is basically no yield difference between DT and non-DT hybrids when yields are around 170 bushels per acre or greater. The yield advantage for DT hybrids gradually increases as the yield of the regular hybrids decreases from 170 bushels per acre.

However, it is important to note that these are generalized relationships and that there are varied responses at each yield level. Some individual points show no difference between DT vs. non-DT hybrids at yields around 100 bushels per acre. Other points show a 30-bushel-per-acre yield advantage for non-DT hybrids at 160 to 170 bushels per acre, and still others show a 60-bushel-per-

acre yield advantage for DT hybrids when non-DT hybrid yields were near 70 bushels per acre. On the opposite side of the yield environments, under high yield environments (>220 bushel-per-acre), individual points show a 30 to 60-bushel-per acre yield advantage for non-DT hybrids when DT hybrid yields were above 220 bushels per acre. How individual hybrids respond to a specific environment is influenced by a number of factors, including the timing and duration of the stress.

One more technical clarification is important to note. The linear response and plateau (LRP) function model fitted in Figure 2 (adjusted to the 2012-2013 data), presented an R^2 of 0.26 units, which can be interpreted to indicate that this model is accounting for only slightly more than one-fourth of the total variation presented in the data. Even when including observations from studies conducted in the last two years (2014-2015), the trend observed in the DT yield advantage versus the non-DT yield values (Figure 2) is not being modified. From all these years of data collection and analysis, we can conclude that there are many management factors involved in the yield results which makes it difficult to separate out the effect of hybrid alone.

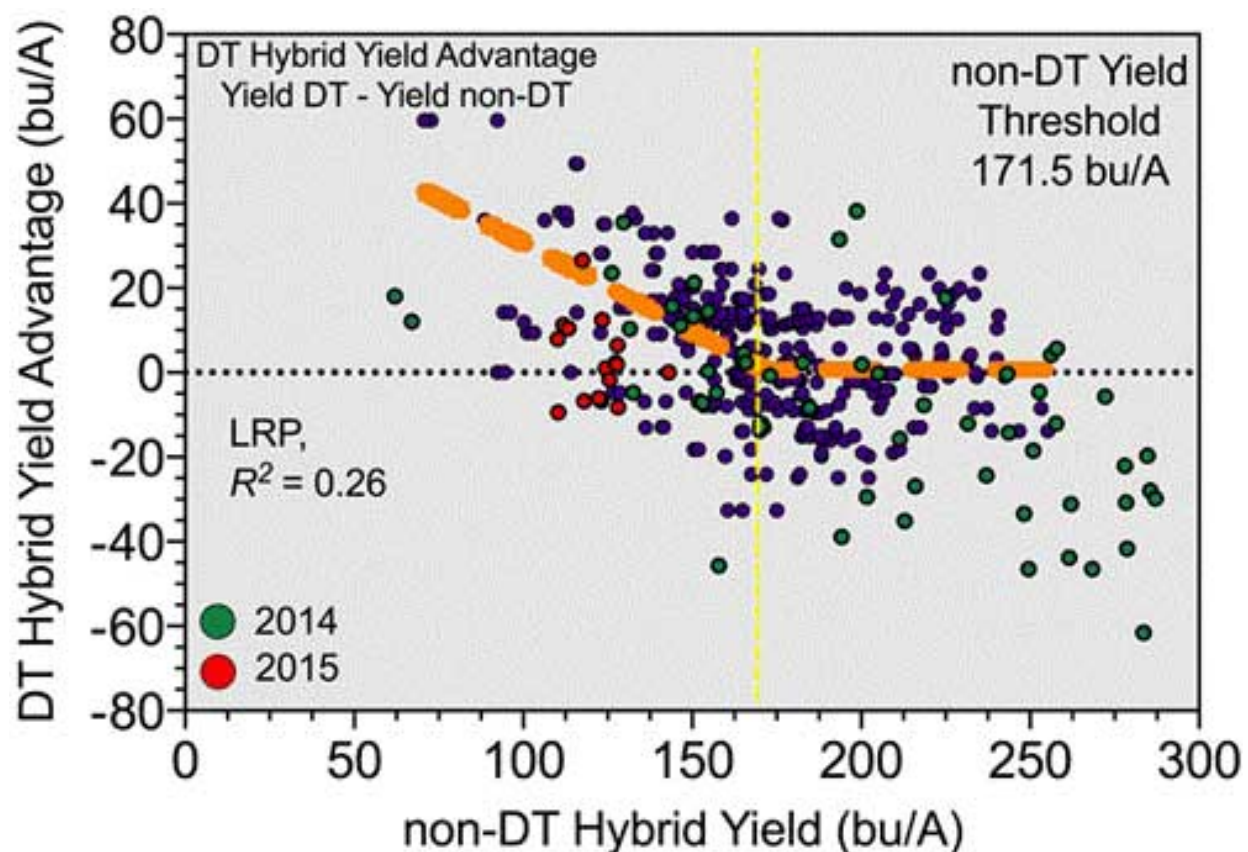


Figure 2. Yield advantage for DT compared to non-DT corn hybrids in the same environment and at the same population, ranging from low-yielding environments to high-yielding environments across site-years for the 2012, 2013, 2014, and 2015 growing seasons.

Still, we need to be cautious using and interpreting this information. More experiments and research data need to be collected, and a deeper understanding is needed to more properly analyze the main causes of the yield differences of DT vs. non-DT corn genotypes. Potential interpretations offered for

the yield advantage for the DT corn hybrids in certain environments are:

- Slower vegetative growth, saving water for reproductive stages (stress avoidance)
- Greater root biomass with superior water uptake
- Differential regulation in the stomata opening, controlling water and CO₂ exchange processes
- Other potential physiological modifications

K-State Research and Extension publication

A publication titled *Drought-tolerant corn hybrids: Yield benefits* was published by K-State Research and Extension in 2017. This publication was supported by Kansas Corn Commission.

This publication presents research information conducted by K-State Research and Extension to evaluate drought-tolerant hybrids in a wide range of production environments. You can view the publication at <https://www.bookstore.ksre.ksu.edu/pubs/MF3338.pdf>

K·STATE
Research and Extension

Corn Fact Sheet Series

Drought-Tolerant Corn Hybrids: Yield Benefits

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Summary

General observations:

- 1) Performance of individual hybrids within DT and non-DT types may vary. Some non-DT hybrids can perform nearly as well as the DT hybrids even in stressful conditions, and DT hybrids have the potential to yield with non-DT hybrids when water isn't limiting.
- 2) The advantage of the DT hybrids became more evident when the water stress increased to the point of leaves rolling most days.

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3) From the information at hand, it is reasonable to expect a DT hybrid to serve as a type of insurance policy to sustain yield potential under water-limited environments. It also appears that there is no yield penalty associated with DT hybrids if water-limiting conditions do not occur.

Lastly, it is critical to understand that these corn genetic materials will not produce yield if the environment is subjected to terminal drought. We cannot expect them to thrive when moisture is severely limited, especially in dryland systems. As properly and explicitly stated by all seed companies, these DT materials have demonstrated the ability maintain yields to a certain degree in water-limited situations, and those yield differences will likely be in the order of 5 to 15 bushels per acre (depending on the environments and crop practices), when compared with a similar maturity non-DT corn hybrid.

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8. Freeze climatology and low temperatures on the Mesonet

As warm weather returns and producers begin to see vegetative growth, interest in freezing temperatures also increase. While we still have some lows dropping to the freezing level, the average date for the last freeze is approaching. The southeast area of the state is the first to see the end of freezing temperatures, while the northwest has an average date of last freeze in May. (Figure 1).

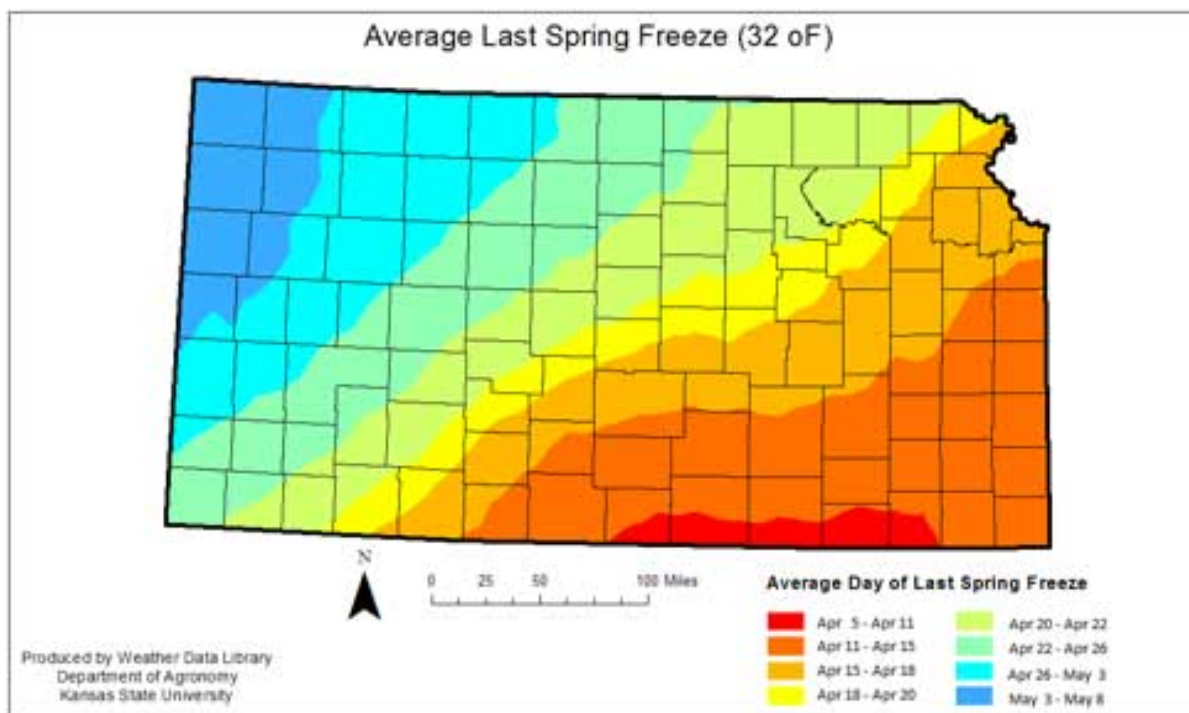


Figure 1. Average spring freeze dates (Weather Data Library).

Historically, almost all parts of the state have recorded freezing temperatures as late as May, but sometimes winter can end early. The earliest last freeze on record in Kansas is March 10, 2012 when many stations last dropped below freezing.

Kansas Mesonet Freeze Monitor

The Kansas Mesonet's Freeze Monitor (<http://mesonet.k-state.edu/weather/freeze/>) is now available for the 2019 spring frost/freeze season. This tool displays the coldest temperatures observed across Kansas during the previous 24 hours. It answers the frequent question: *How cold did it get last night?* Data updates every twenty minutes on both the map and the table (Figure 2).

Another tool important for producers and gardeners is the duration below freezing, as some crops and commodities have lower thresholds for damage. This feature allows users to select options to view maps/data of the duration below freezing (32 degrees F) and the number of hours below 24

degrees F. While both are of interest, the lower threshold is of great importance to wheat growers once jointing occurs and the wheat moves into its reproductive phase. When you view the number of hours, the last spring freeze date for each station is shown with comparison to local climatology.

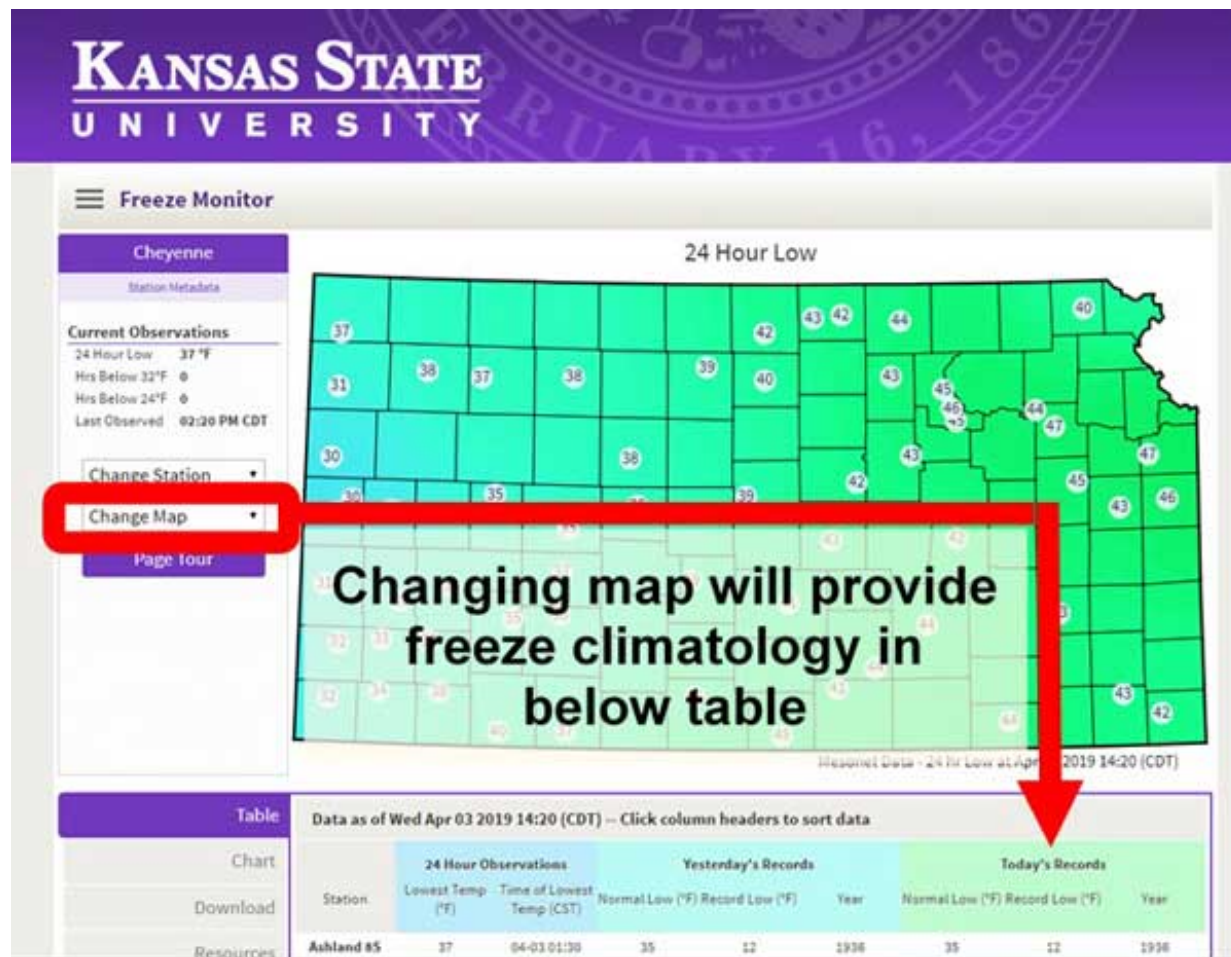


Figure 2. View of the Freeze Monitor webpage: mesonet.ksu.edu/weather/freeze

Users should be aware that the data displayed in the tables below the maps can be sorted. Clicking on the header of a particular column will sort the table by that column. This makes it much easier to see what area was the coldest in the state, as well as latest freeze and earliest climatological freeze data. There are a number of download options, including table and chart data, and images of the maps (Figure 3).



Figure 3. Download options on the Freeze Monitor website.

The Freeze Monitor is updated in the fall, as the growing season comes to an end, to show the fall freeze climatology.

The Freeze Monitor is available at: <http://mesonet.k-state.edu/weather/freeze/>

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Cover Crops and Coffee

April 25 / Geary County, KS

8:00 / Registration starts (coffee and cinnamon rolls served)

8:30 / Welcome, Peter Tomlinson & Chuck Otte

8:45 / Cover crop updates

- Soil health / Laura Starr
- Water quality / Elliott Carver
- Corn and Soybean yields and economics / Nathan Nelson

9:45 / Questions and wrap-up

The **field day location** is at the intersection of Howard Rd and Clarks Creek Rd southeast of Junction City. Use the following link to open directions in Google Maps.

<https://bit.ly/2JYevEZ>



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