Issue 1014

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eUpdate

08/01/2024

These e-Updates are a regular weekly item from K-State Extension Agronomy and Kathy Gehl, Agronomy eUpdate Editor. All of the Research and Extension faculty in Agronomy will be involved as sources from time to time. If you have any questions or suggestions for topics you'd like to have us address in this weekly update, contact Kathy Gehl, 785-532-3354 kgehl@ksu.edu, or Dalas Peterson, Extension Agronomy State Leader and Weed Management Specialist 785-532-0405 dpeterso@ksu.edu.

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1. Nitrate toxicity in drought-stressed forages

Drought-stressed crops tend to accumulate high nitrate levels in the lower leaves and stalk of the plant (Figure 1). Crops such as forage and grain sorghum, sudangrass, hybrid sorghum-sudan, and pearl millet are notorious nitrate accumulators. Corn and other cereal grains can also accumulate potentially toxic levels of nitrate. Nitrates accumulate in the lower portion of these plants when stresses reduce crop yields to less than expected, based on the supplied nitrogen fertility level. Nitrate toxicity in livestock is caused by its absorption into the bloodstream and binding to hemoglobin, rendering it unable to carry oxygen throughout the body. The result is eventual asphyxiation and death.

Figure 1. Drought-stressed corn plants (top photo) and forage sorghum (bottom photo). Photos by Dorivar Ruiz Diaz and John Holman, K-State Research and Extension.

Animals under physiological stress (sick, hungry, lactating, or pregnant) are more susceptible to nitrate toxicity than healthy animals. Toxicity is related to the total amount of forage consumed and how quickly it is eaten. Generally, forages containing more than 6,000 ppm nitrate should be considered potentially toxic (Table 1). Symptoms of nitrate toxicity may appear within a few hours after eating or not for several days. Signs of toxicity include reduced appetite, weight loss, diarrhea, and runny eyes. However, these are nonspecific symptoms of numerous disorders and are not a reliable diagnosis of nitrate poisoning. Lower nitrate levels can cause abortion without any other noticeable symptoms.

Forage testing

It is wise for producers to test their drought-stricken forage prior to harvest. Levels of nitrates can increase in drought-stressed plants after rain, and delaying harvest may be beneficial. Nitrate testing can be done through several labs, including the K-State Soil Testing Laboratory. Not all labs use the same testing procedure so be sure to use the scale provided by the testing lab. Harvesting the forage 6-to-12 inches above the ground to avoid the highest concentrations of nitrate in the plant is a good practice. Producers should collect a good representative forage sample above this cutting height to get an accurate determination of the nitrate concentration. It's important to consider factors like actual nitrate concentration, storing and feeding methods, and forage availability, as these can significantly impact the safety of your livestock. Ensiling forage will reduce nitrates levels ~50%, but ensiled forage should be tested for nitrate levels prior to feeding. Toxicity is related to the total amount of nitrate in the diet (including water) and how quickly it is eaten. Generally, if forages contain more than 6,000 ppm nitrate, they should be considered potentially toxic (Table 1).

Table 1. Level of forage nitrate (dry matter basis) and the potential effect on animals.

ppm Nitrate (NO_3)	Effect on Animals
0-3,000	Virtually safe
3,000-6,000	Moderately safe in most situations; limit use for stressed animals to 50% of total ration.
6,000-9,000	Potentially toxic to cattle depending on the situation; should not be the only source of feed.
9,000 and above	Dangerous to cattle and often will cause death.

Management options

Depending on the planned feeding method, a producer may wish to test different parts of the plant. If wrapping the forage into a bale and feeding it directly to livestock, a producer may want to test the lowest part of the stalk to determine the greatest risk of nitrate forage that the animal could ingest. If this value is high, further testing may be needed. If a producer was planning on grinding the bale, a whole?plant sample above what will be left in the field may be a more accurate representation of what will be eaten. If a harvested forage is high in nitrate, grinding and mixing the feed with a low nitrate forage, such as prairie hay, brome, or forage sorghum, will dilute the total nitrates in the animal's diet and could potentially reduce the risk of poisoning. However, be aware that bunk sorting could occur if the forage mix is feed free choice.

If parts of the field show more stress and potentially differ in nitrate concentration, baled forage from those areas can be segregated. Mark bales and retain their identity in storage. Resample and test for nitrates and forage quality in each field and subgroup separately to determine safe and cost-effective feeding options. While the nitrate concentration does not change after hay harvest, the variability of nitrates across a field and the challenge of collecting a truly representative sample pre-harvest make a thorough post-harvest sample imperative.

High-nitrate forages chopped for silage and properly ensiled are a safer option for livestock feeding. During the ensiling process, potentially 50 percent of the nitrates in the forage will be metabolized by the microbes and can vastly reduce the risk of poisoning. It is still not a bad idea to leave 6 inches of stubble in the field. That is the portion of the stem with the highest concentration of nitrates, and leaving residue will help reduce soil erosion and capture snow over winter.

Grazing high nitrate forages can be a dangerous practice. This option requires very careful management. Grazing pressure should be limited so that animals do not consume the parts of the plant forage testing has shown to be dangerous. Although animals tend to consume the leaves and the top portions of the plant, which contain less nitrates, the risk of consuming a high-nitrate portion of the plant still exists. In addition, the longer the animal is left on a field and the more that animal is forced to eat the remaining forage at the lower portions of the plant, the greater the risk of nitrate poisoning.

For more information, see K-State Research and Extension publication MF3029, "Nitrate Toxicity", at your local county Extension office or at https://bookstore.ksre.ksu.edu/pubs/MF3029.pdf

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2. Pre-emergence herbicides in wheat

Pre-emergence herbicides with residual activity are an important component of high-yielding cropping systems. They are not emphasized as much in wheat production compared to other cropping systems in Kansas, but residual herbicides applied prior to wheat emergence can be part of a good weed management system in wheat. Selected products for this use are described in Table 1.

Most residual herbicides labeled for pre-emergence application in wheat are Group 2 (ALS-inhibiting) herbicides, which are associated with herbicide-resistant populations of kochia, marestail (horseweed), bushy wallflower, flixweed, henbit, and brome species in Kansas. Products in Groups 14 (the PPO-inhibiting herbicides) and 15 (the long-chain fatty acid-inhibiting herbicides) are also labeled; however, they are generally more dependent on rainfall for activation than the Group 2 herbicides.

Herbicides to control emerged weeds may be applied with or without residual herbicides in the weeks prior to planting wheat. Older products include the Group 2 herbicides Amber, Olympus, and Pre-Pare, as well as Group 4 (plant growth regulating) herbicides like 2,4-D, dicamba, or fluroxypyr. It is especially important to know planting interval restrictions for Group 4 herbicides, which range from 10 to 45 days.

When selecting pre-emergence herbicides for use in wheat production, keep in mind that many of these products are also labeled for use in emerged wheat. Unless using a planned split application, avoid repeated use of products from the same herbicide group to slow the development of herbicide-resistant weed populations in your fields.

Table 1. Select herbicides for pre-emergence or pre-plant applications in winter wheat.

Trade name	Common name	Herbicide group	Application timing*	Comments
Amber	Triasulfuron	2	BD, PRE, or POST	Requires tank mix or sequential application of herbicide from different group
Anthem Flex	Pyroxafulfone + carfentrazone	15 + 14	DPRE	Plant wheat 1 – 1.5″ deep
several	Dicamba	4	BD	Apply at least 45 days before planting wheat
Facet	Quinclorac	4	BD	Plant wheat at least 1″ deep
Finesse	Chlorsulfuron + metsulfuron	2 + 2	PRE, POST	Suppression only of cheat, downy brome, and Japanese brome
Kochiavore	Fluroxypyr + bromoxynil	4 + 6	BD	Apply at least 30 days before planting wheat
Olympus	Propoxycarbazone	2	PRE, POST	Mix with glyphosate for BD
Outrider	Sulfosulfuron	2	PRE, POST	Apply after planting but before wheat emergence; If dry, apply POST
Pixxaro	Fluroxypyr + halauxifen	4 + 4	BD, POST	Do not use multiple applications or in successive years at the same site

Pre-Pare	Flucarbazone	2	BD, PRE	Mix with glyphosate for BD; Rainfall necessary for activation to control PRE
Quelex	Halauxifen + florasulam	4 + 2	BD, POST	Broadleaf weed control only
Reviton	Tiafenacil	14	BD	Mix with glyphosate for grass activity
Scorch	Fluroxypyr + dicamba	4 + 4	BD	Apply at least 30 days before planting wheat
Sharpen	Saflufenacil	14	BD, PRE	Rainfall required for activation; Injury may occur to exposed wheat seed
Zidua	Pyroxasulfone	15	DPRE	Rainfall required for activation; Plant wheat 1 – 1.5" deep
several	2,4-D	4	PRE, POST	Apply at least 2 weeks after a 0.5" rainfall before planting wheat

*BD = burndown; PRE = preemergence to wheat and weeds; DPRE = Delayed preemergence application after wheat emergence; POST = postemergence

For additional information, see the "2024 Chemical Weed Control for Field Crops, Pastures, and Noncropland" guide available online at https://bookstore.ksre.ksu.edu/pubs/SRP1183.pdf or check with your local K-State Research and Extension office for a paper copy.

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

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3. Liming soils for optimum wheat production

Problems of low soil pH are common throughout central and south-central Kansas. Well-drained, productive soils under good management usually become acidic over time as a natural result of high crop production. This problem typically starts in sandier soils and is exacerbated by high rates of nitrogen (N) fertilizer application over the years, making long-term continuous wheat production in central and south central Kansas especially vulnerable to this problem. However, long-term application of N also generated acid soils in other regions of the state with different soil types.

Strongly acidic soils may present several problems for wheat production. These include aluminum toxicity and, in some cases, manganese toxicity, as well as deficiencies in phosphorus, calcium, magnesium, and molybdenum. These problems caused by acid soils are difficult to separate from one another and are often related to root damage due to Al toxicity (Figure 1).

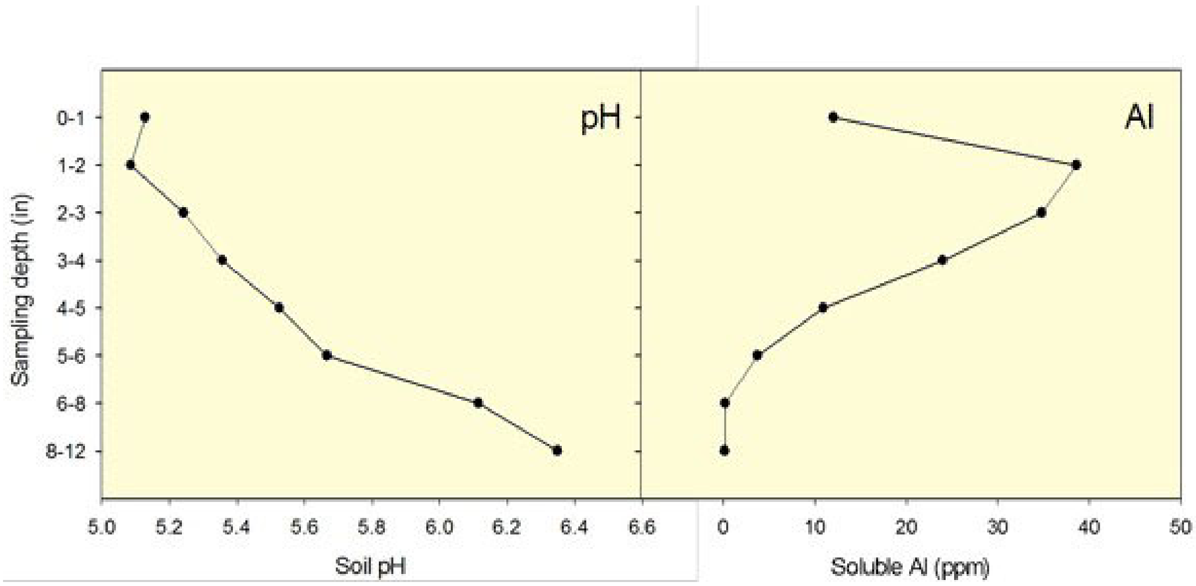

Figure 1. Soil pH stratification after long-term surface nitrogen application. Aluminum concentration in solution increases with a decrease in soil pH. Data from Dorivar Ruiz Diaz, K-State Research and Extension.

Typical symptoms of aluminum toxicity include thin stands, poor plant vigor, and purpling (Figure 2). High concentrations of aluminum will reduce root development, giving them a short stubby appearance. The roots will often have a brownish color.

Figure 2. Wheat growing on very acidic soils, such as this soil in Harper County with a pH of 4.6, is often spindly and has poor vigor. Photos by K-State Research and Extension.

In general terms, aluminum toxicity will reduce the grain yield potential of wheat when soil pH levels are below 5.5 and KCl-extractable (free aluminum) levels are greater than 25 parts per million (ppm). If aluminum levels are not high, pH levels in this range are not as much of a problem for wheat. When soil pH levels are 5.0 or less, yields start dropping off rapidly in most cases. A minimum soil pH of approximately 6.0 is needed to maximize wheat fall forage production for most wheat varieties.

Where acid soils are causing a reduction in wheat production, plant growth, and yield can be significantly improved by liming the soils and raising the pH to an optimum range.

Common questions about lime applications for wheat:

If a half-rate of lime is applied now, or in late August, will that give it enough time to benefit wheat planted in early to mid-October this year?

Is incorporation needed to allow enough time to be effective in that situation?

Lime application may require time to react and increase soil pH. However, most of the change in pH will occur in the first 4-6 weeks after lime application. If the lime is incorporated, the effect in the upper soil profile will be relatively quick. With a lower application rate to the surface (no-till), the effect on pH would be limited to the upper 2-3 inches and would require more time to have a significant effect depending on factors such as soil texture and moisture.

What kind of yield increases can you expect?

Several studies in Kansas have shown a significant increase in yield as well as test weight when liming acid soils (Figure 3 and Table 1). In some cases yield can easily double depending on the severity of the problem.

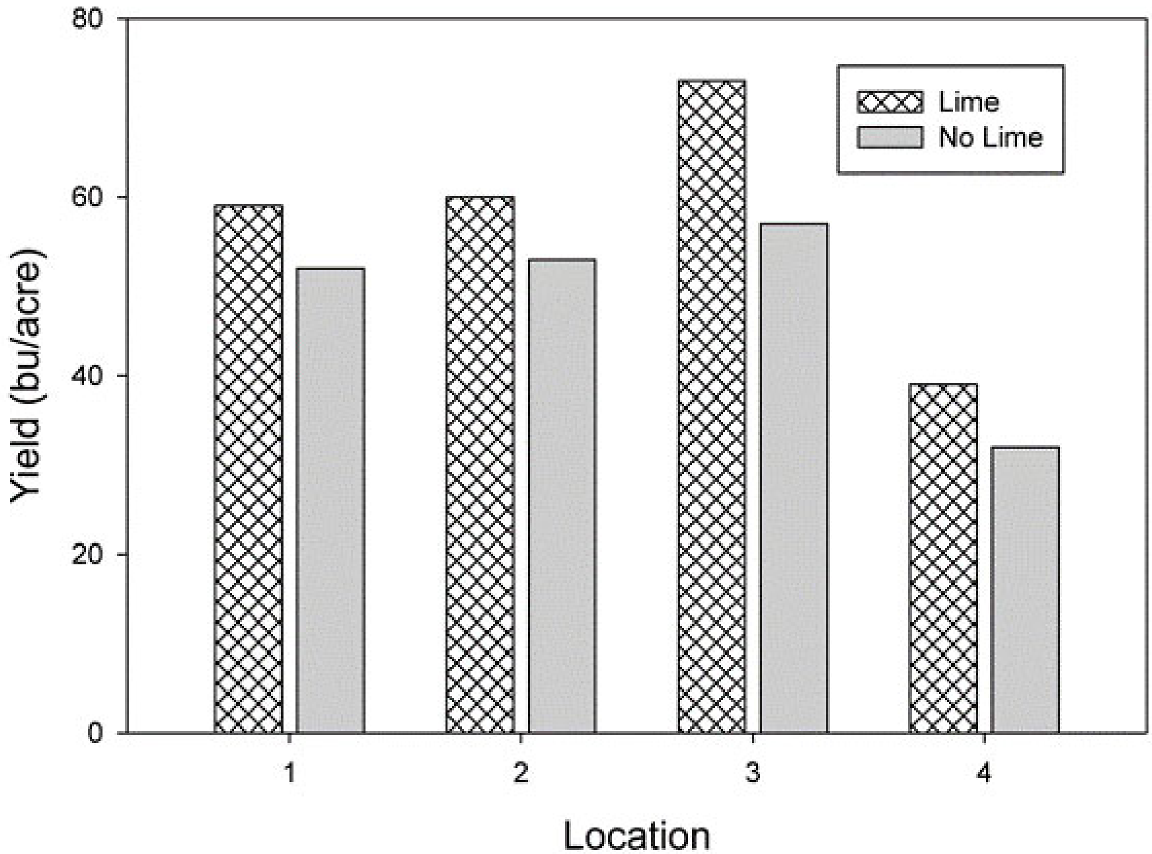

Figure 3. Effect of lime on wheat yields at four locations in Reno and Rice Counties. Yields averaged over two varieties – one susceptible and one tolerant to acid soils. Initial soil pH varied from 4.8 to 5.1 and lime application rates varied from 5,000 to 11,000 lbs/acre ECC. Source: Olsen, C.J. et al. Kansas Fertilizer Research 1999, SRP847.

Should producers consider applying a lower rate of lime than what is recommended by the K-State soil testing laboratory?

It can be expensive to apply the full recommended rate of lime to soils. The yield increases from an application of the full rate of lime are likely to hold up for up to 8 years or more. But the initial cost can be quite high. Lime is a long-term investment that many producers are reluctant to make for several reasons.

If the cropping system consists of some combination of wheat, grain sorghum, corn, or sunflowers, without a legume in the rotation, then it's not critical to use the full recommended rate of lime, particularly during years of lower grain prices. With these crops, which can tolerate somewhat lower pH levels than soybeans and alfalfa, producers may realize some benefit by applying less-than-recommended rates of lime as long as they are willing to make more frequent applications. If soybeans or alfalfa will be grown on the field in question, and if the pH level is less than 6.0, then the full rate of lime should be applied.

Table 1 below shows the effect of a lower-than-recommended rate on wheat yield and test weight. The half-rate increased yield and test weight nearly as much as the full rate in this case. However, producers should be aware that if they use lower-than-recommended rates of lime, they will need to make more frequent applications. The current crop prices require efficient and cost-effective lime application which can be achieved with the use of technology such as variable application. Soil pH can vary significantly in the field, making lime one of the inputs with the highest return to variable rate application.

Table 1. Effect of lime rate on wheat yield and test weight, Sedgwick County.

Lime rate (lb ECC/acre)	Yield (bu/acre)	Test weight (lb/bu)
0	23	46
3750 (half rate)	42	60
7500 (full rate)	46	61

Variety: Karl (susceptible to acid soils). Initial soil pH: 4.7. Lime recommendation: 7500 lb ECC/acre (full rate). Source: Suderman, A.J., et al. Kansas Fertilizer Research 1994, SRP719.

What type of lime is best to apply?

All lime materials must guarantee their ECC content and are subject to inspection by the Kansas Department of Agriculture. The purity of the lime material relative to pure calcium carbonate and the fineness of crushing are the two factors used in the determination of the Effective Calcium Carbonate (ECC) content. Lime can be from various sources and with different qualities. To ensure a standardized unit of soil-acidity neutralizing potential, we use units of ECC.

Research has clearly shown that a pound of ECC from ag lime, pelletized lime, water treatment plant sludge, fluid lime, or other sources is equal in neutralizing soil acidity. All lime sources have very limited solubility and must be incorporated and given time to react with the acidity in the soil to effect neutralization.

Therefore, when selecting a lime source the cost per pound of ECC should be a primary factor in source selection. Such factors as rate of reaction, uniformity of spreading, and availability should be considered, but the final pH change will hinge on the amount of ECC applied.

Other recommendations to increase yields in acid soils include the use of aluminum-tolerant wheat varieties and applying phosphate fertilizer with the seed to tie up aluminum and reduce toxicity. These management practices can certainly help to maintain yields and may be the best alternatives for some producers. However, there is only one long-term solution to low soil pH levels: liming.

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4. Allow time for lime applications when planting alfalfa this fall

Correcting acidic soil conditions by applying lime can significantly impact crop yields, especially for alfalfa. Acidic soils can significantly reduce nodule establishment and activity in alfalfa, affecting nitrogen status and overall nutrient and water uptake (Figure 1). Since seeding alfalfa is expensive and a stand is expected to last for several years, getting lime applied and acidity corrected before seeding is critical. Liming is one of the most essential but often overlooked management decisions a producer can make for alfalfa production.

Unfortunately, lime is not always available in close proximity to where it may be needed. In many cases, trucking and spreading costs may be more than the cost of the lime itself. Lime quality can also vary widely, and no one wants to apply more than necessary. Knowing how lime recommendations are made can help make the best decisions on how much and what kind of lime to apply.

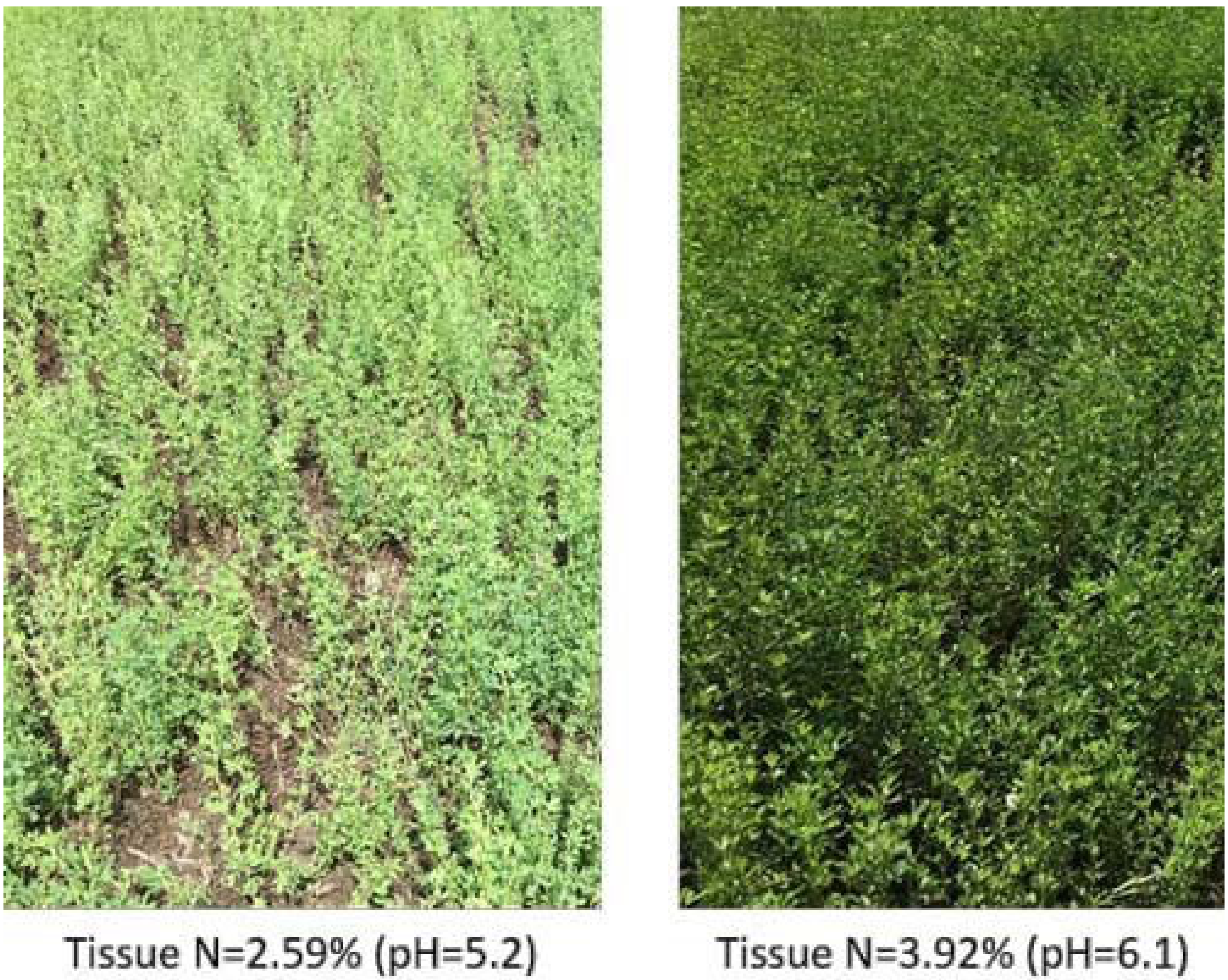

Figure 1. Soil pH affects nodule formation and activity for N fixation in alfalfa, in addition to nutrient availability and uptake. Photo by Dorivar Ruiz Diaz, K-State Research and Extension.

K-State lime recommendations

A routine soil test measures the soil's pH, which determines whether lime is needed on the field. Generally, east of the Flint Hills, lime is recommended for alfalfa if the pH drops below 6.4, with a target pH for liming of 6.8. In the Flint Hills and west, lime is recommended for alfalfa and all other crops when the pH drops below 5.8, with a target pH of 6.0. The target pH is simply the pH goal once the lime reacts with the soil.

Why is the target pH different for the two areas of Kansas?

The target pH values differ because of the pH of the subsoil. East of the Flint Hills, especially south of the Kansas River, the subsoil tends to be more acidic. A higher target pH is used to ensure adequate pH conditions in the root zone and provide sufficient amounts of calcium and magnesium. Most soils from the Flint Hills and west have high pH (basic) subsoils that can provide calcium and magnesium to meet crop needs.

Determining the soil pH is the first step in determining if lime is needed. However, it does not tell you the amount of lime you need to apply. Soils with more clay and organic matter will have more acidity at a given pH and will require more lime/ECC (effective calcium carbonate) to reach a target soil pH than sandy soil. This is why two soils may have the same pH but different lime requirements.

Calculating lime rates

Lime rates are given in pounds of effective calcium carbonate (ECC) per acre. How does that relate to agricultural lime, and how much lime to apply? Lime materials can vary widely in their neutralizing power. All lime materials sold in Kansas must guarantee their ECC content, and dealers are subject to inspection by the Kansas Department of Agriculture.

The two factors that influence the neutralizing value of aglime are the chemical neutralizing value of the lime material relative to pure calcium carbonate and the fineness of crushing, or particle size, of the product. The finer the lime is ground, the greater the surface area of the product, the faster it will react, and the faster the acid neutralization will occur. These two factors are used in the determination of ECC. Expressing recommendations as pounds of ECC allows fine-tuning rates for variation in lime sources and avoids under or over-applying lime products.

Lime sources

Research has clearly shown that a pound of ECC from agricultural lime, pelletized lime, water treatment plant sludge, fluid lime, or other sources neutralizes soil acidity equally. Therefore, under most circumstances, the cost per pound of ECC applied to your field should be a primary factor in source selection. Other factors such as reaction rate (fineness), spreading uniformity, and availability should be considered. Still, the final pH change and subsequent alfalfa growth will depend on the amount of ECC applied.

Application methods

All lime sources have very limited solubility. When planting alfalfa, the best performance occurs when lime is incorporated and given time to react with and neutralize the acidity in the soil. When surface-applied and not incorporated, as in no-till systems, the reaction of lime is generally limited to only neutralizing the acidity and raising the pH in the top 2 to 3 inches of soil. Surface applications are sufficient in slightly acidic soils, but may not provide as good a soil environment for nodulation and nitrogen fixation in the extremely acid soils.

In no-till or reduced-till systems, where no incorporation of lime is planned, lower rates of lime application are normally recommended to avoid over-liming and raising the pH higher than needed in the surface 2-3 inches of soil. Over-liming can also reduce the availability of micronutrients such as zinc, iron, and manganese and trigger deficiencies in some soils. Current K-State lime recommendations suggest that "traditional" rates designed for incorporation and mixing with the top 6 inches of soil should be reduced by 50 percent when surface-applied in no-till systems or when applied to existing grass or alfalfa stands.

What about the calcium and magnesium contents?

Most agricultural limes found in Kansas contain both calcium and magnesium, with calcium exceeding magnesium. The exact ratio of these two essential plant nutrients will vary widely. Dolomitic lime (magnesium-containing) and calcitic lime (low-magnesium, high-calcium) provide similar benefits for most Kansas soils.

For more information, see the K-State publication *Soil Test Interpretations and Fertilizer Recommendations*, MF-2586: http://www.bookstore.ksre.ksu.edu/pubs/MF2586.pdf

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5. Distinguishing between gray leaf spot and bacterial leaf streak in corn

Bacterial leaf streak was identified as a new corn disease in the U.S. in 2016. For this growing season, bacterial leaf streak disease has been confirmed in several locations across the state, including northeast Kansas.

While yield loss potential for this disease remains unknown, we do know that it can be misidentified as gray leaf spot, resulting in unwarranted fungicide applications. In the early stages of infection, symptoms can appear similar to gray leaf spot. **Fungicides will not have any effect on bacterial leaf streak**.

An easy way to identify the two diseases is to backlight the leaf with the sun (Figure 1). Light passes more easily through the bacterial streak lesion (translucent) causing it to look a brighter yellow-green color. Light does not readily pass through a gray leaf spot lesion (opaque), giving it a much darker appearance. Also, gray leaf spot typically has very sharp edges defined by the leaf veins, whereas bacterial leaf streak lesions will have a wavy edge that can cross the leaf vein (Figure 2).

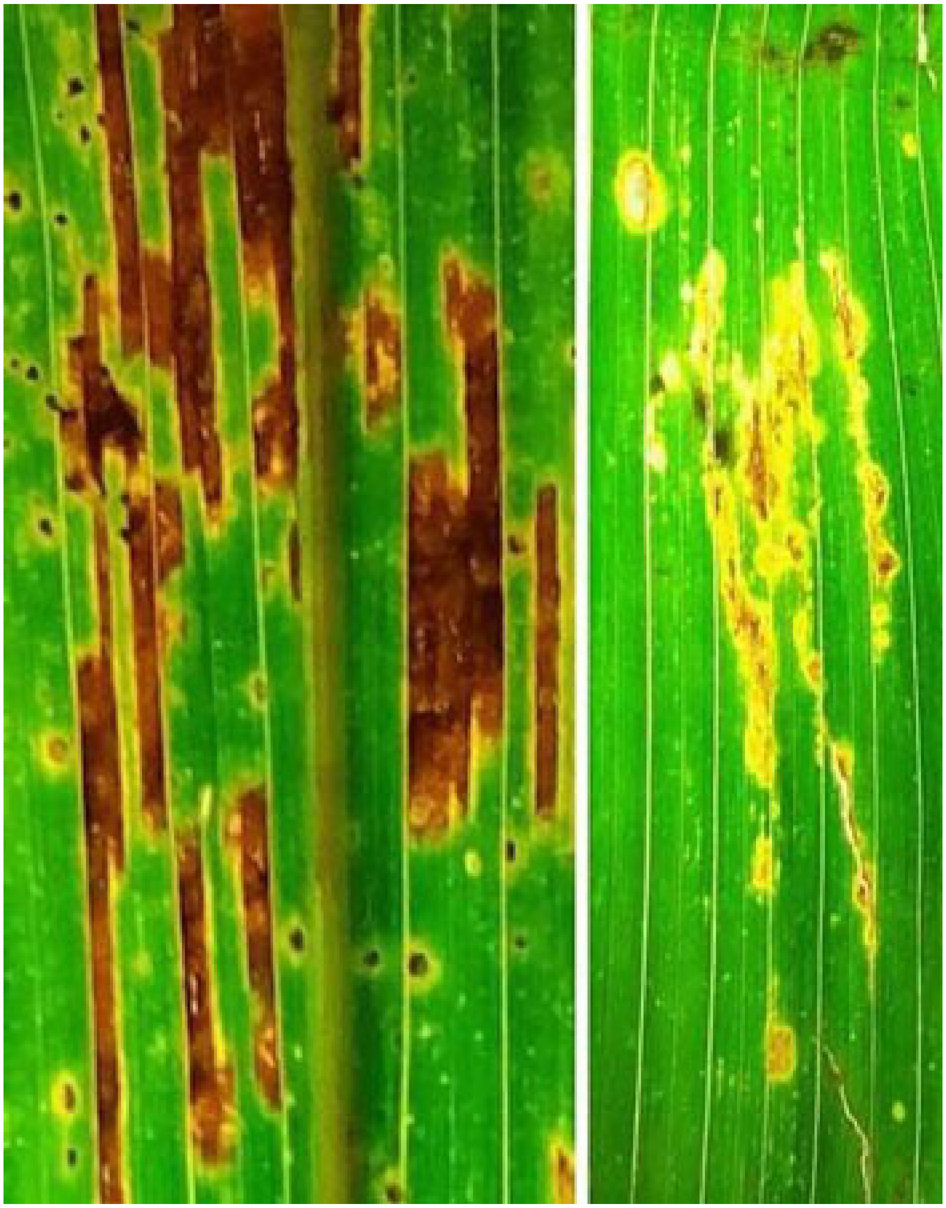

Figure 1. Gray leaf spot lesions (left) have an opaque appearance, while bacterial leaf streak allows light to pass through more easily, giving it a translucent appearance (right). Photo by D. Jardine, K-State Research and Extension.

Figure 2. Sharp-edged gray leaf spot lesions (right) are compared with wavy-edged bacterial streak lesions (left). Photo courtesy of the University of Nebraska.

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6. Dual-purpose wheat variety performance 2024

An updated publication is now available in the Wheat Rx series that examines the performance of several wheat varieties grown for use in a dual-purpose system (grazing and grain). To be successful in dual-purpose systems, wheat varieties require traits sometimes overlooked in grain-only systems. These include fall forage yield, date of first hollow stem, grazing recovery potential, resistance to viral diseases transmitted when the crop is planted early, no high-temperature germination sensitivity, long coleoptile, and greater tolerance to low soil pH and aluminum toxicity. This publication evaluates fall forage yield, date of first hollow stem, plant height, grain yield, and test weight of current varieties in a dual-purpose system versus a grain-only system.

This article summarizes the updated publication. The full publication, *MF3312 Dual-Purpose Wheat Variety Performance*, is available online at: https://bookstore.ksre.ksu.edu/pubs/MF3312.pdf. Wheat Rx is a partnership between Kansas Wheat and K-State Research and Extension to disseminate the latest research recommendations for high-yielding and high-quality wheat to Kansas wheat farmers.

Fall forage yield is an important trait in dual-purpose systems because it sets the potential beef production from wheat grazing in the fall, winter, and early spring. Approximately 100 pounds of beef per acre can be produced for every 1,000 pounds of wheat forage produced in an acre. Forage production depends on variety, planting date, seeding and nitrogen rates, fall temperature, and precipitation.

The date of the first hollow stem is also an important trait in dual-purpose systems because terminating grazing at the right time is essential to maintaining the grain yield potential for subsequent harvest. Grazing past the first hollow stem can decrease wheat grain yield by as much as

1 to 5% per day.

Depending on environmental conditions, varieties with a shorter **vernalization requirement** might reach first hollow stem 15 to 20 days earlier than varieties with a longer vernalization requirement. An earlier occurrence of first hollow stem reduces the grazing window into early spring. The date of first hollow stem is dependent on temperature and day length.

Grain yield following grazing is another variety-specific trait important in dual-purpose systems. Varieties that rely mostly on fall-formed tillers to produce grain yield generally show a greater yield penalty due to grazing than varieties with a good spring tiller potential.

Description of site and methods

Sixteen commonly grown winter wheat varieties, as well as pre-release lines, were sown in three neighboring trials in the South Central Experiment Field near Hutchinson, Kansas. Two trials were sown to simulate dual-purpose management, characterized by an early sowing date, increased nitrogen rate, and higher seeding rate, while a third trial was sown using the same varieties under grain-only management. The publication provides more information on the experiment methods and site characteristics.

Fall forage yield

Fall forage production of the varieties evaluated ranged from 871 to 1,969 pounds of dry matter per acre, averaging 1,457 pounds of dry matter per acre (Table 1). There were significant statistical differences among the varieties, with 11 varieties falling into the highest forage-yielding group (range within the highest yielding group: 1,370 to 1,969 pounds of dry matter per acre).

First hollow stem

The first hollow stem is reported in the day-of-year format. For reference, day of the year 80 is equivalent to March 21. Average occurrence of first hollow stem was day 76 (Table 1), ranging from day of year 72 for early varieties to day of year 83 for late varieties. These dates represent a normal release from winter dormancy; for reference, about 15 days before the dormancy release measured in 2022-23. The earliest varieties to reach first hollow stem were AP24 AX and AR Iron Eagle 22AX. The latest variety to achieve first hollow stem was KS Providence. All studied varieties reached first hollow stem within an 11-day interval. Previous reports of first hollow stem from Oklahoma have shown that early varieties may reach first hollow stem as much as 30 days earlier than later varieties, depending on environmental conditions. Kansas results may differ from Oklahoma results due to cooler winter temperatures holding crop development across varieties, and its interaction with photoperiod as day lengths were already long when temperatures were warm enough to allow for crop development.

Plant height

Varieties and cropping systems also differed significantly in plant height (Table 1). Plant height in the grain-only system averaged 24.9 inches, ranging from 23.6 to 26.9 inches. This average was null to 5.3 inches taller than the heights measured in the dual-purpose system (22.3 inches average height). The range in plant height was narrower in the grain-only system (3.2 inches) versus the dual-purpose system (4.8 inches), with varieties ranging from 19.4 to 25.9 inches.

Table 1. Fall dry matter forage yield, date of first hollow stem, and plant height under grain-only (GO) and dual-purpose (DP) systems in Hutchinson, KS, during the 2023-24 production year. Shaded values refer to the highest testing group. Values pertaining to the highest group are highlighted in bold.

Variety	Source	Fall forage yield	First hollow stem	Plant height GO	Plant height DP	Plant height diff.
		--- pounds per acre ---	Day of year	----- inches -----		
AP Prolific	AgriPro	**1,492**	77	**25.0**	19.8	-5.2
AP Roadrunner	AgriPro	1,246	75	24.1	**22.8**	-1.4
AP Sunbird	AgriPro	**1,370**	77	**26.0**	20.9	-5.1
AP24 AX	AgriPro	**1,646**	72	23.6	20.6	-3.1
AR Iron Eagle 22AX	Armor	**1,473**	72	24.7	22.2	-2.5
CP 7017AX	Croplan	**1,606**	75	24.3	**23.0**	-1.3
CP 7266AX	Croplan	**1,649**	75	**25.3**	**23.5**	-1.7
CP 7869	Croplan	871	79	24.3	**24.3**	0.0
CP 7909	Croplan	**1,665**	75	**24.9**	21.2	-3.7
Golden Hawk	Polansky	875	77	24.4	**23.6**	-0.8
Guardian	Plains Gold	**1,510**	75	**25.1**	**23.6**	-1.5
Kivari AX	Plains Gold	1,082	75	23.8	**23.5**	-0.2
KS Ahearn	KWA	**1,740**	79	**24.8**	21.3	-3.4
KS Providence	KWA	**1,958**	83	24.7	21.0	-3.7
LCH16AC403-158	Limagrain	**1,969**	75	**26.9**	**24.7**	-2.2
WB4347	WestBred	1,154	77	**26.3**	21.0	-5.3
Average		1,457	76	24.9	22.3	-2.6
Minimum		871	72	23.6	19.8	-5.3
Maximum		1,969	83	26.9	24.7	0.0

Grain yield and grain test weight in grain-only or dual-purpose systems

The average grain yield in the grain-only trial was 53.5 bushels per acre, whereas the dual-purpose trial averaged 28.1 bushels per acre (Table 4 in the publication). Varieties that yielded statistically better than their counterparts in the grain-only trial were AP Sunbird and WB4347. The yield penalty from simulated grazing averaged 13.6 bushels per acre and ranged from 6.9 to 19.7 bushels per acre. Varieties included in the highest-yielding group of the dual-purpose trial were AR Iron Eagle 22AX, CP7017AX, Guardian, Golden Hawk, and WB4347. The weather conditions – characterized by enough moisture for forage production followed by drought conditions during the spring – likely worsened the effects of grazing since the larger crop likely used more water early in the season and had no moisture to recover later in the spring.

Test weight ranged from 55.1 to 62.7 pounds per bushel in the grain-only system and from 49.5 to 67.1 in the dual-purpose system (Table 4 in the publication). Guardian was the only variety with the highest test weight in both grain-only and dual-purpose systems. The experimental line AP Sunbird was in the highest test weight group under grain-only, and WB4347 was in the highest test group in the dual-purpose system.

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7. Coleoptile length of winter wheat varieties 2024

An updated publication is now available in the Wheat Rx series that examines the coleoptile lengths of many Kansas wheat varieties. Wheat varieties with long coleoptiles are more likely to emerge when planted deep enough to reach soil moisture from past rainfall. This article summarizes information from the publication. The full publication, *MF3612 Coleoptile Length of Winter Wheat Varieties 2024*, is available online at: https://bookstore.ksre.ksu.edu/pubs/MF3612.pdf.

Wheat Rx is a partnership between Kansas Wheat and K-State Research and Extension that disseminates the latest research recommendations for high-yielding, high-quality wheat to Kansas wheat farmers.

Coleoptile Length

Once a wheat seed starts to absorb water, the seminal roots are the first developmental structure to emerge. After the seminal roots, the coleoptile develops. The coleoptile is a rigid protective structure that covers the emerging shoot to aid it in reaching the soil surface (Figure 1). The coleoptile usually continues to elongate until it breaks the soil surface and reaches sunlight. At this point, it stops growing and the first true leaf emerges through it.

If the seed is sown deeper than the coleoptile's length, the coleoptile is not able to emerge through the soil surface, and consequently, the first true leaf emerges below ground. This causes the first true leaf to take on an accordion-like appearance and the wheat plant typically becomes yellow and dies (Figure 1). To avoid this situation, wheat should never be sown deeper than the coleoptile length of the chosen variety.

Figure 1. Deep-sown wheat demonstrating the potential for coleoptile elongation (yellow arrows point to the end of the coleoptile). On the left, the coleoptile was able to reach the soil surface and the first true leaf emerged above ground, therefore showing normal early development. On the right, the coleoptile's maximum length was shorter than the sowing depth, resulting in the emergence of the first true leaf below the ground level. As the first true leaf does not have the strength to continue pushing upwards when it emerges below ground, it takes on an accordion-like shape and becomes yellow, leading to plant death.

In dryland environments typical of western Kansas and eastern Colorado, wheat is often sown on soil moisture accumulated in the last summer rainfall events, which requires growers to sow deep in order to reach moisture. This is less of a concern in central Kansas during most years, where growers can achieve good stands by relying on fall precipitation for good topsoil moisture at sowing time.

To achieve good crop establishment on deep-placed seed, long coleoptile varieties are essential. An additional concern in these regions is that many growers sow their wheat early for grazing, which places sowing time during warmer soil temperatures – which further reduces the coleoptile length.

Depending on the variety, this reduction in coleoptile length due to high temperatures may be as much as 60%. For example, a variety that has a 27/8-inch (75 mm) coleoptile at 60°F could have a 15/8-inch (40 mm) coleoptile at 80°F soil temperature. While different varieties have different sensitivities to warm soil conditions, selecting varieties with longer-than-average coleoptiles could help prevent emergence issues under these conditions.

This publication provides growers with an estimate of the average coleoptile length of different winter wheat varieties common to Kansas and the Great Plains to help guide variety selection for deep sowing.

Description of Procedures

This study was performed under controlled conditions, which differ from field conditions but provide a fair comparison among the different wheat varieties' potential coleoptile lengths.

Seeds were tested from all varieties entered in the 2024 Kansas State University winter wheat variety performance tests, as well as from other seed sources used for agronomic studies during the same crop year. Sixty seeds of each variety were tested. Variety randomization ensured that the experiment was conducted in a randomized complete block design and each variety occurred one time and that the coleoptile length was measured in 40 plants per variety.

Coleoptile Length of Winter Wheat Varieties

Results from this controlled-environment experiment are shown on Table 1. The longest coleoptile varieties ranged from 2¾ to 3 inches (69 to 75 mm) and included KS Providence and Doublestop CL Plus. A number of variety options were also included in the second and third longest coleoptile groups and could potentially be good options for deep sowing in western environments, as their coleoptile length ranged from 21/4 to 2¾ inches (57 to 69 mm). Alternatively, many varieties had relatively short coleoptiles, falling in the three lowest groups of less than 2 inches (51 mm). These varieties included: Breakthrough, WB4523, WB4699, Paradox, LCS Radar, Paradise, P25R76, EXP 2405, KS Bill Snyder, P25R74, WB4347, KS Big Bow, KS Mako, AR Iron Eagle 22AX, WB4792, LSC Runner, WB4422, and P25R65. Caution should be exerted when sowing these varieties in deeper-than-average conditions.

Table 1. Wheat variety grouping based on coleoptile length measured in a controlled environment experiment during the 2023-2024 winter wheat season in Kansas. A total of 40 coleoptiles were measured per variety. Within groups, varieties are ordered from shortest to longest coleoptile.

Coleoptile Length						
Very Short	Short	Medium short		Medium long	Long	Very long
1 – 1¾" (39 – 45 mm)	1¾– 2" (45 – 51 mm)	2 – 2¼" (51 – 57 mm)		2¼– 2½" (57 – 63 mm)	2½– 2¾" (63 – 69 mm)	2¾– 3" (69 – 75 mm)
P25R65	Breakthrough	CP7869	AG Icon	AP Sunbird	CO18D297R	KS Providence
	WB4523	Zenda	AG Golden	LCS Warbird AX	LCS Helix AX	Doublestop CL+
	535	LCS Galloway AX	WB4401	KS Western Star	Strad CL+	
	WB4699	505	CP7017AX	WB2545	LCS Steel AX	
	Paradox	KS Hatchett	Joe	Green Hammer		
	LCS Radar	XP 24-11	KS Ahearn	OK Corral		
	Paradise	CP7266AX	High Country	Canvas		
	P25R76	SY Wolverine	LCS White Lightning	AP24 AX		
	EXP 2405	Smith's Gold	AP Prolific	Crescent AX		
	KS Bill Snyder	Showdown	AP Bigfoot	Guardian		
	P25R74	AG Radical	Uncharted	Langin		
	WB4347	Everest	503	WB2606		
	KS Big Bow	LCS Atomic AX	AP Roadrunner	WB4595		
	KS Mako	KS Territory	CP7909	Rock Star		
	AR Iron Eagle 22AX	KS Hamilton	513	Whistler		
	WB4792			CO18035RA		
	514			LCH16ACC403-158		
	LSC Runner			Kivari AX		
	WB4422			LCS Julep		
				High Cotton		
				WB4445CLP		
				KS Dallas		

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8. Summary of Kansas growing season weather in 2024

Warm and dry for most, wet for a fortunate few

The fourth full month of the growing season concluded on July 31, which for meteorological purposes is considered to have begun on April 1. We have had a few periods of above-normal weather this growing season, but there were also extended periods of below-normal temperatures, particularly in July. Precipitation has varied across the state, as is typical with convective thunderstorms. Where does Kansas stand with respect to normal temperatures and precipitation for the 2024 growing season? In this report, we take a closer look at some summary statistics.

Figure 1 shows the departure from normal temperature for the growing season to date across Kansas. Almost the entire state is above normal, with a few parts of central and southeast Kansas running over 3 degrees above normal. While the official averages for July have not been released yet, the average temperature for April, May, and June combined ranks in the top 10 warmest in 130 years of records in all nine of Kansas' climate divisions. July is likely to finish a little below normal, despite the month finishing on a very hot note.

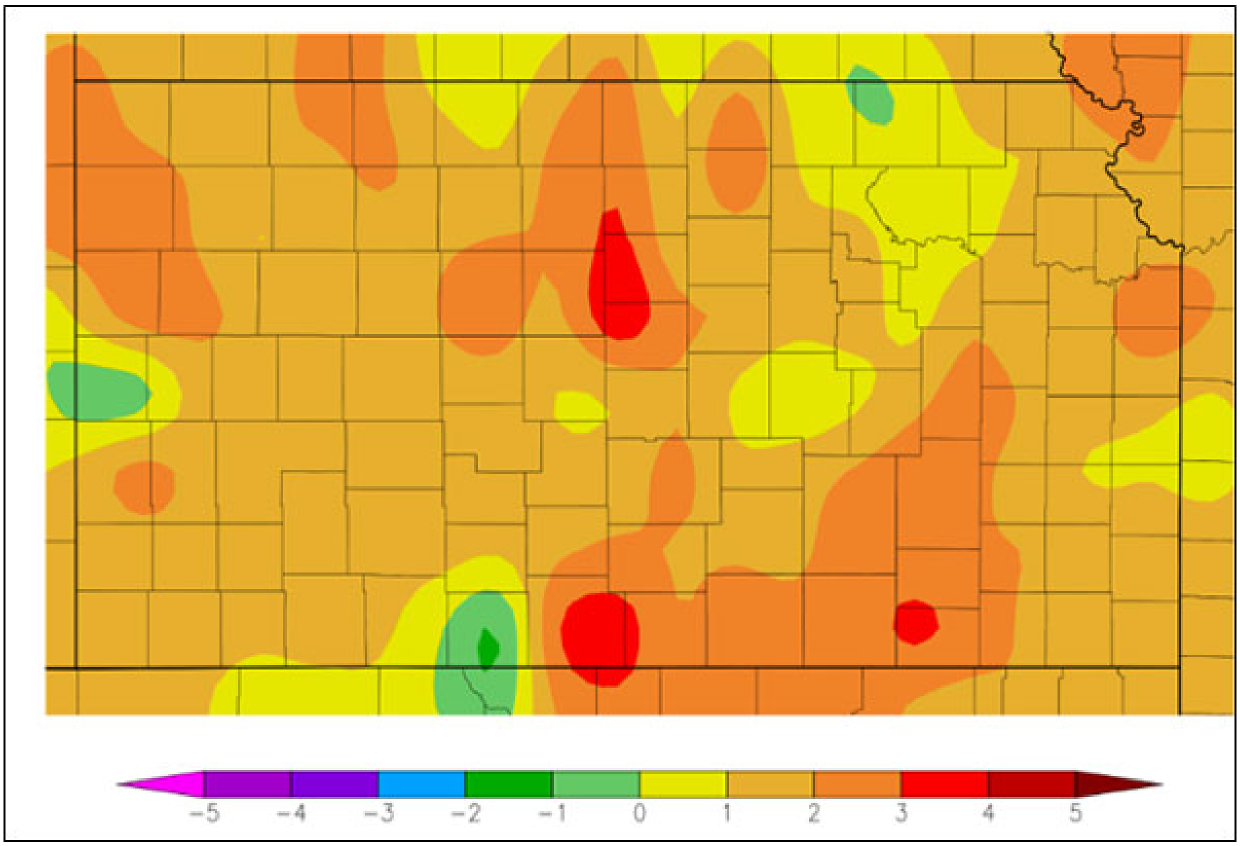

Figure 1. Departure from normal temperature for the growing season to date. Source: HPRCC.

Table 1 contains data for 20 observing sites around the state. Included are the number of days with highs at or above 90 and 100 degrees as well as total precipitation for the period April 1st through July 31st. The average counts for temperatures and departures from normal precipitation are also included for comparison. Despite the near unanimity of the departure from normal temperatures in Figure 1, there are mixed results for the temperature counts at this point in the season. Around half the locations have had more 90 and 100-degree days, while the rest are either below or exactly at normal. In general, counts are close to normal. Still, the northeast Kansas locations are running well behind due in part to this division having received above-normal precipitation combined with below-normal temperatures during what is usually the hottest month of the year. Northeast Kansas received, on average, around two and a half inches above normal precipitation from April 1st through June 30th. It takes more solar energy to warm moist air and wet ground than dry, so places with above-normal precipitation are often a bit cooler in summer. Only seven of the 20 locations in Table 1 are above normal for growing season precipitation, and all of them are running at or below normal on both 90 and 100-degree days. The majority of the sites with below-normal precipitation are running ahead of normal for the counts of very hot days.

Table 1. Counts of 90 and 100-degree days (°F) so far this growing season, and precipitation since April 1. Blue and orange cells indicate below average; pink and green cells indicate above average. Averages and departures from normal are based on 30-year normals for the period 1991-2020, calculated using data from the National Centers for Environmental Information.

Location	**90° Days**		**100° Days**		**Precipitation**	
	2024	Avg	2024	Avg	2024	Dep.
Ashland	45	49	11	13	12.83	+0.91
Chanute	40	27	4	2	19.33	-0.44
Concordia	36	31	8	5	14.02	-0.83
Dodge City	39	42	7	9	15.99	+4.65
Elkhart	40	46	12	9	8.70	-0.68
Emporia	33	25	5	3	12.80	-5.84
Garden City	38	43	8	11	8.12	-2.54
Goodland	38	31	11	5	5.55	-4.99
Hill City	45	36	15	9	8.24	-4.46
Horton	15	26	0	2	22.31	+2.85
Hutchinson	42	37	11	7	9.73	-5.70
Lawrence	35	25	2	2	19.39	-0.26
Manhattan	24	34	1	5	24.18	+5.43
Russell	41	38	13	9	8.08	-5.48
Salina	43	41	12	10	9.46	-5.97
Topeka	29	29	2	3	18.43	+0.54
Tribune	33	38	8	9	10.82	+1.03
Washington	19	32	1	5	18.62	+1.83
Wichita	39	38	8	7	11.09	-6.07
Winfield	38	31	9	4	17.39	-3.07

Figure 2 shows the departure from normal precipitation across Kansas from April 1 to July 31. With respect to normal, more of the state is running behind than ahead for the growing season to date. The largest deficits are in the central third of the state. In parts of central and south central Kansas, the deficits exceed six inches. In Wichita, normal precipitation for this 4-month period averages 17.18". In 2024, they have received only 11.09", resulting in a deficit of 6.07" for the growing season.

Salina has had just 9.46" of precipitation. Compared to the normal amount of 15.43", their deficit is 5.97". In both locations, the 2024 growing season to date is the driest since 2012. Meanwhile, parts of southwest and northeast Kansas are running above normal for the growing season. Dodge City recorded its wettest June on record this year, receiving just over 12 inches of rain. This one-month total is greater than their average precipitation for April to July! As a result, Dodge City is running over 4.5" above normal for the growing season to date. Manhattan is running nearly 5.5" above normal for the growing season, thanks to a very wet May in which a little over 9 inches of rain fell.

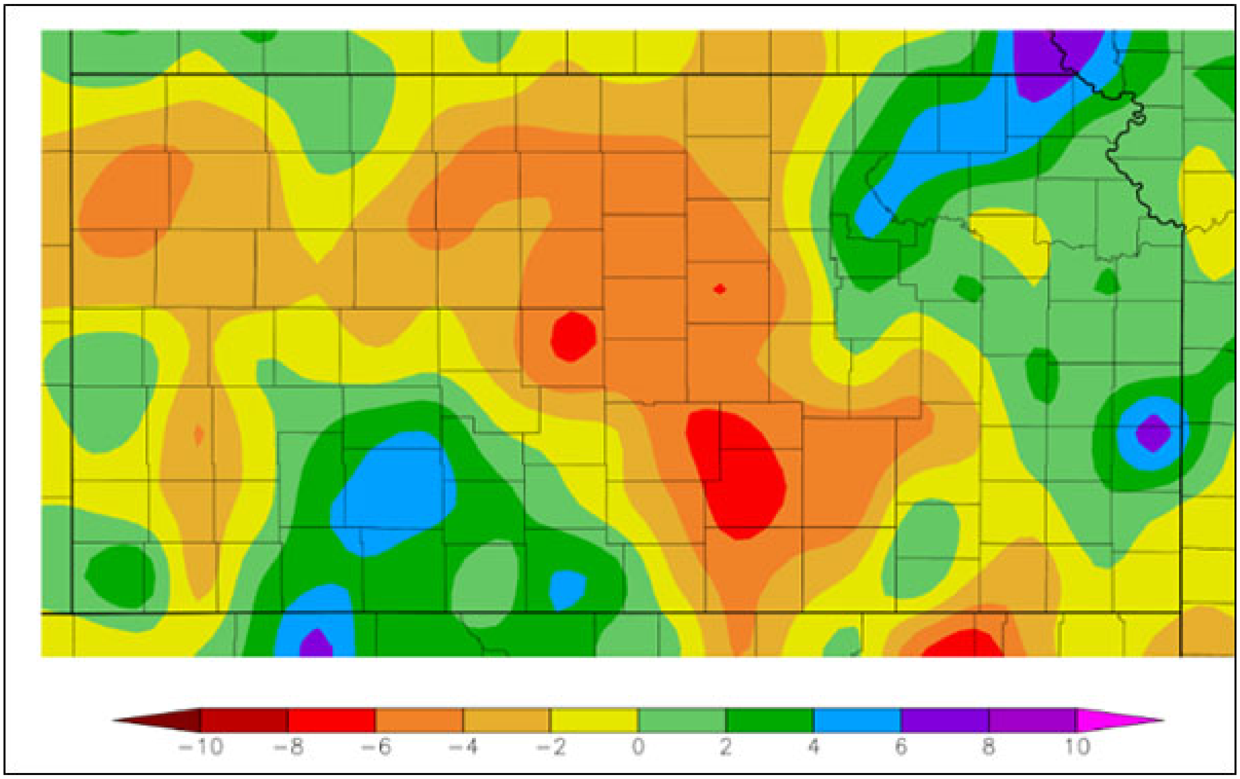

Figure 2. Departure from normal precipitation for the 2024 growing season through July 31. Source: HPRCC.

As August begins, Kansas is in an extended period of summertime heat. A run of below-normal temperatures ended, replaced by above-normal conditions late last month. July 30 was the hottest day this year, with an average high across the Kansas Mesonet of 101 degrees. Hill City reached 111° that afternoon, tying for the hottest reading in the state so far in 2024. In addition, precipitation has been scarce in many areas. In the last two weeks of July, many areas have seen below-normal rainfall. Locations receiving less than one-quarter inch of rain from July 18th through the 31st include Hutchinson (0.04"), Coffeyville (0.06"), Garden City (0.11"), and Winfield (0.16"). The combination of hot temperatures and little precipitation at this point in the growing season is certainly not good news.

The most recent US Drought Monitor update, released on August 1, saw 31% of the state moved from drought-free to D0 status. Just 11% of Kansas is now drought-free, compared to 53% just three weeks ago. The change in the drought category over the past month is shown in Figure 3.

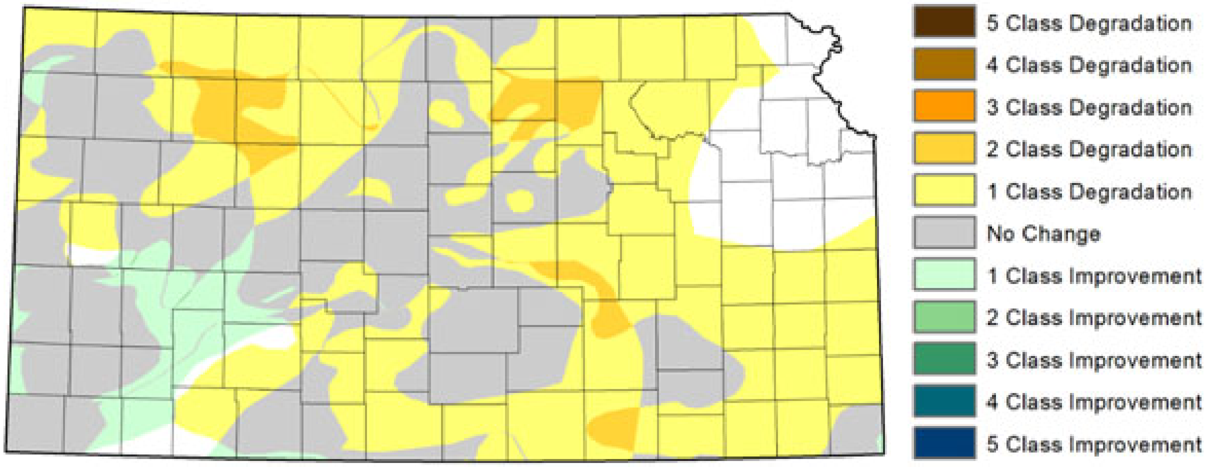

Figure 3. Change in the US Drought Monitor category across Kansas since the start of July 2024.

Looking ahead

How much longer will these conditions persist? The monthly temperature and precipitation outlooks for August were updated by the Climate Prediction Center on July 31(Figure 4). Unfortunately, the forecast maps favor a continuation of the prevailing weather conditions. There are better-than-even chances of above-normal temperatures in all but northeast Kansas. These same areas have elevated chances for below-normal precipitation. Northeast Kansas has equal chances of above and below-normal precipitation. Isolated thunderstorms could bring relief to a few areas, but pinpointing exactly where and when those may occur is impossible far in advance. Shorter lead-time forecasts from the seven local National Weather Service offices that serve Kansas will provide better guidance as to when and where rainfall may occur, as well as identify the magnitude and duration of high temperatures. But should the long-range forecast verify, we may very well see continued worsening of drought conditions across the state.

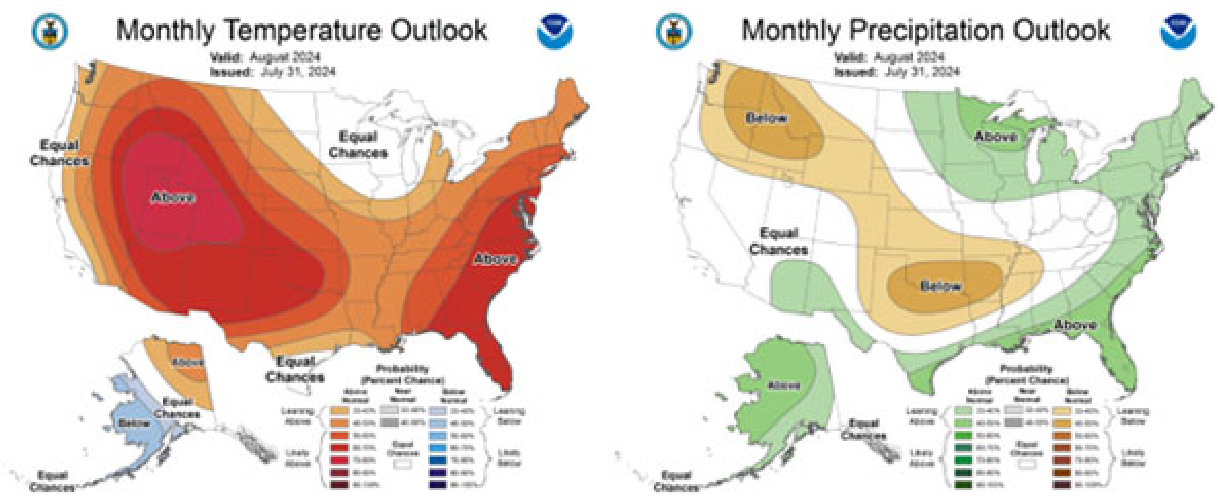

Figure 4. Temperature (left) and precipitation (right) outlooks for August 2024. Source: Climate Prediction Center.

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