Issue 1064

K-STATE Research and Extension

Extension Agronomy

eUpdate

07/31/2025

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. Liming soils for optimum wheat production

Problems of low soil pH are common throughout central and south-central Kansas. Even well-drained, productive soils under good management often become acidic over time due to high crop yields. This problem typically starts in sandier soils and is exacerbated by high rates of nitrogen (N) fertilizer. As a result, long-term continuous wheat production in these areas is particularly vulnerable. However, long-term application of N can cause acidic soils in other regions of the state with different soil types.

How acidic soils impact wheat production

Strongly acidic soils may present several problems for wheat production, including aluminum (Al) toxicity and, in some cases, manganese toxicity. Deficiencies in phosphorus, calcium, magnesium, and molybdenum can also develop. These problems are often difficult to distinguish and largely stem from root damage caused by Al toxicity (Figure 1).

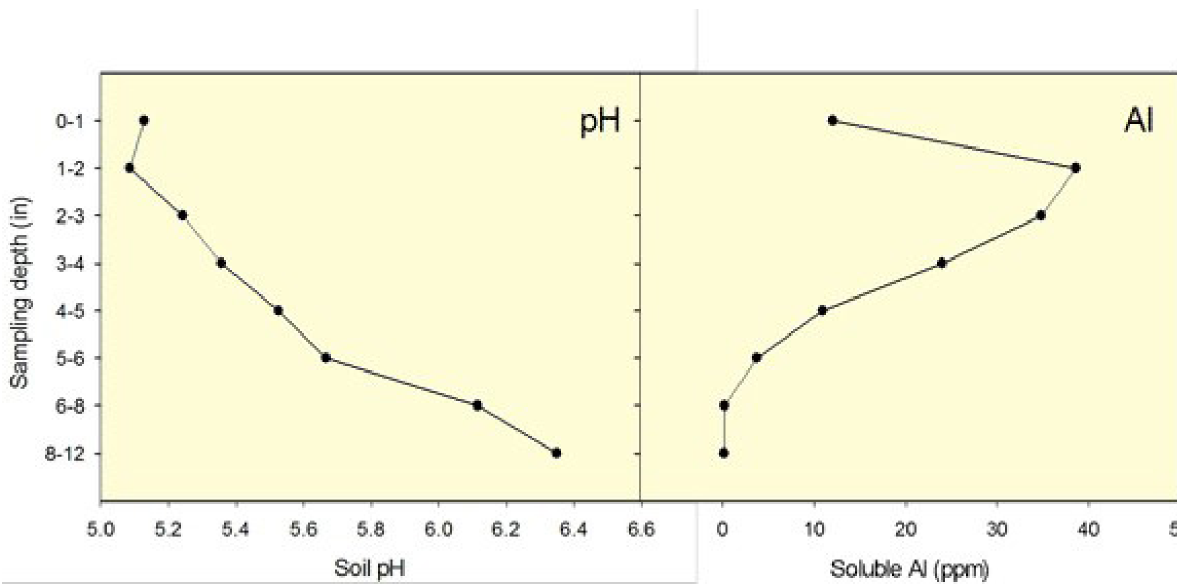

Figure 1. Soil pH stratification after long-term surface nitrogen application. Aluminum concentration in solution increases with a decrease in soil pH. Data from Dorivar Ruiz Diaz, K-State Research and Extension.

Typical symptoms of Al toxicity include thin stands, poor plant vigor, and purpling (Figure 2). High Al levels reduce root development, resulting in short, stubby, and often brown-colored roots.

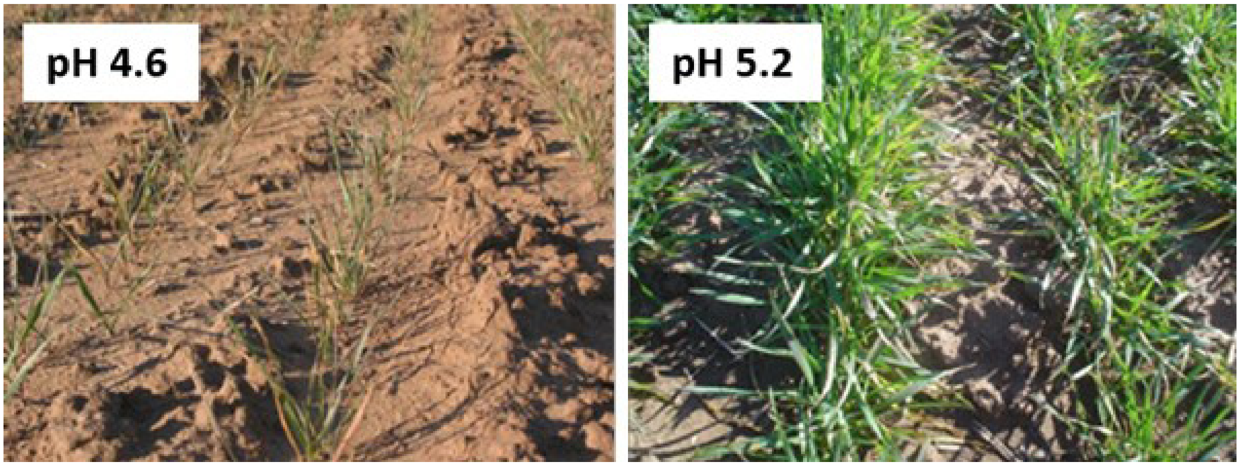

Figure 2. Wheat growing on very acidic soils, such as this soil in Harper County with a pH of 4.6, is often spindly and has poor vigor. Photos by K-State Research and Extension.

In general, wheat grain yield potential starts to decline when soil pH drops below 5.5 and KCl-extractable (free aluminum) levels are greater than 25 parts per million (ppm). If Al 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 limiting wheat production, applying lime to raise soil pH to optimum levels can provide significant improvement to plant growth and yield.

Common questions about lime applications for wheat

If I apply a half-rate of lime now, or in late August, will it benefit wheat planted in early to mid-October?

Lime applications 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.

Is incorporation needed to be effective in the above situation?

If the lime is incorporated, the effect in the upper soil profile will be relatively quick. With a lower application rate to the surface in no-till systems, 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 I expect?

Several studies in Kansas have shown significant increases in yield and test weights when liming acid soils (Figure 3 and Table 1). In some cases, yields can easily double depending on the severity of the problem.

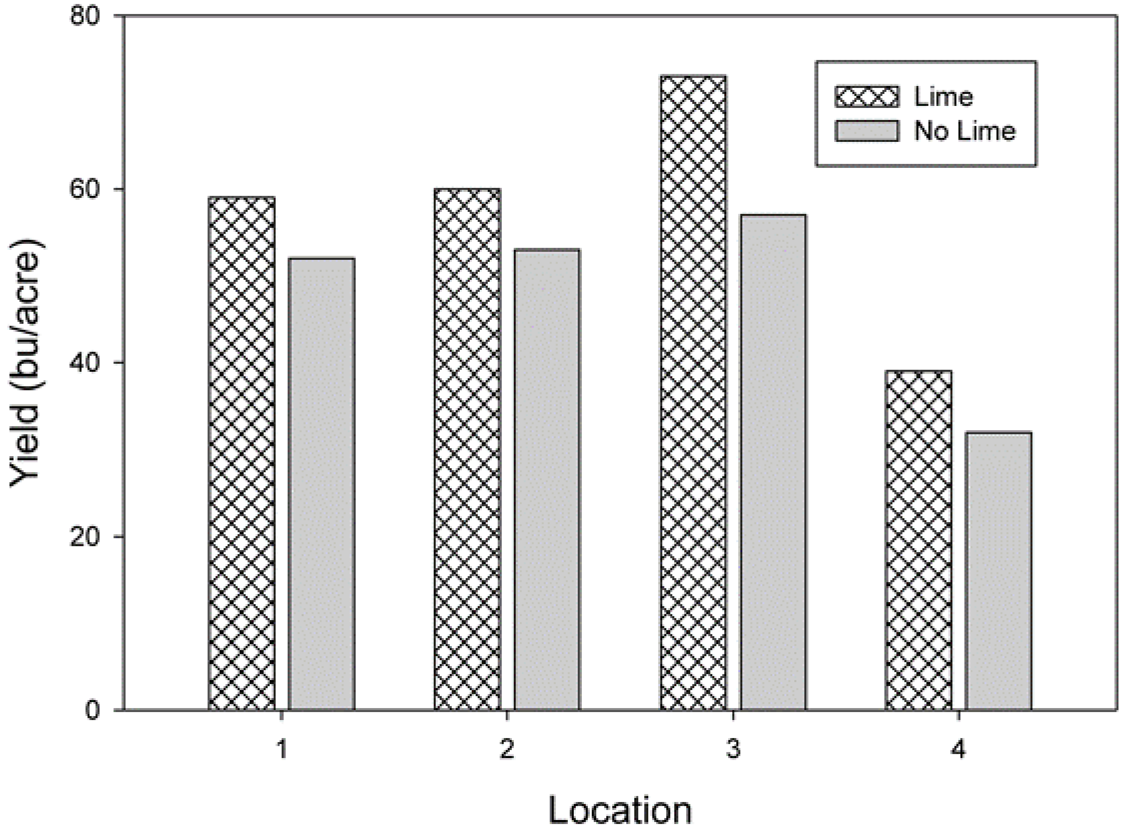

Figure 3. Effect of lime on wheat yields at four locations in Reno and Rice Counties. Yields averaged over two varieties – one susceptible and one tolerant to acid soils. Initial soil pH varied from 4.8 to 5.1, and lime application rates varied from 5,000 to 11,000 lbs/acre ECC. Source: Olsen, C.J. et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

Should I apply less lime than the K-State Soil Testing Laboratory recommendation?

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. These crops 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.

Lower rates can provide near-equivalent yield boosts but require more frequent application. With current crop prices, using tools like variable-rate technology allows producers to target lime more cost-effectively, especially since soil pH can vary widely within a single field.

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.

Choosing the right lime source

The Effective Calcium Carbonate (ECC) content of the lime depends on both its purity (relative to pure calcium carbonate) and its fineness. Lime can be from various sources and with different qualities, but all materials must guarantee their ECC content and are subject to inspection by the Kansas Department of Agriculture. 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. However, since all lime sources have very limited solubility, they must be incorporated and given time to react in the soil to raise the pH.

When selecting a lime source, the cost per pound of ECC should be a primary factor in source selection. Also consider the rate of reaction, uniformity of spreading, and availability, but the total ECC applied ultimately determines the final pH change.

Final thoughts

Other strategies to increase yields in acidic soils include using 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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2. Plan ahead: Allow time for lime applications for alfalfa production

Correcting acidic soil conditions with lime application 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 as it tends to be more pH sensitive compared to other legumes like soybeans.

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.

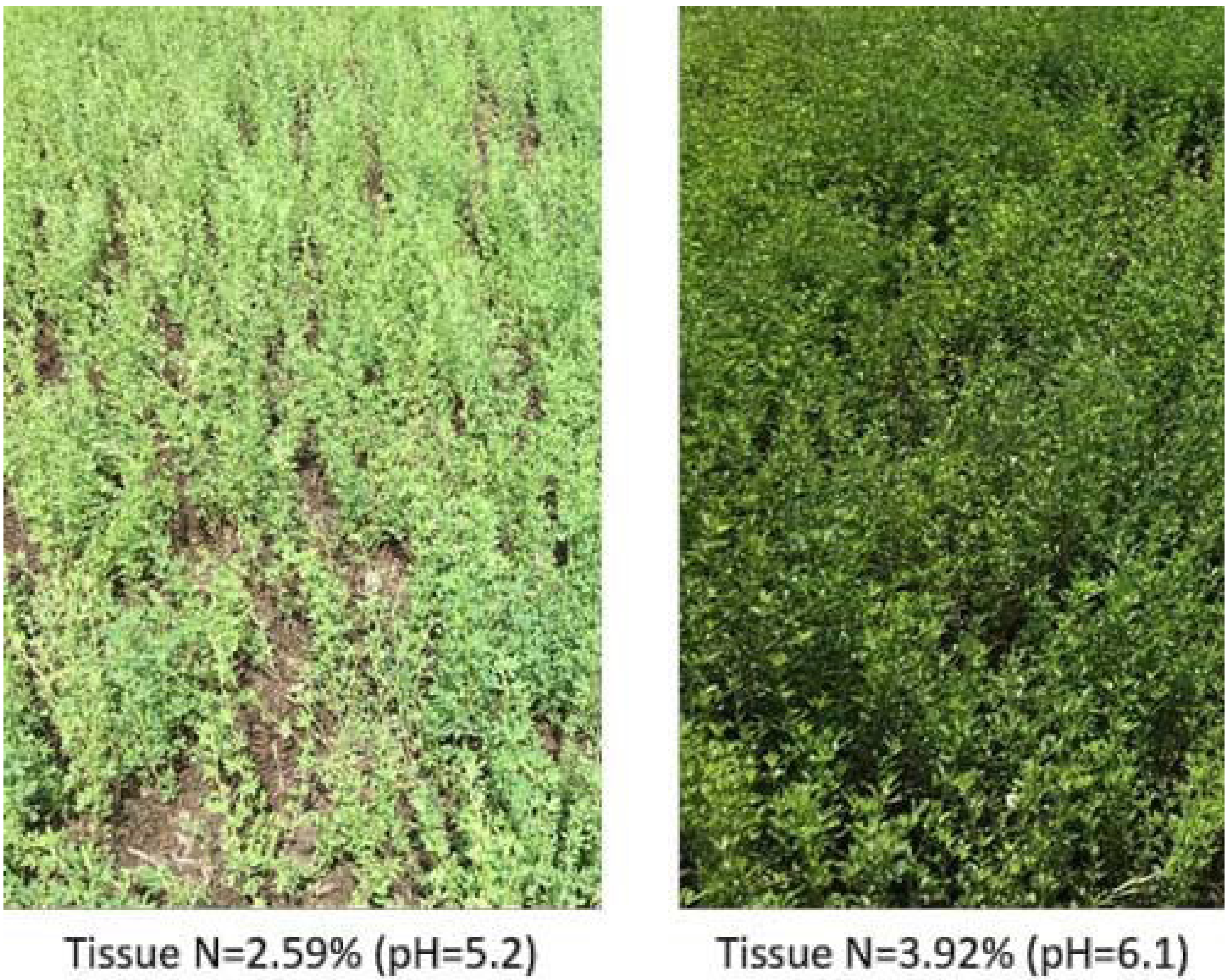

Figure 1. Soil pH affects nodule formation and activity for N fixation in alfalfa, in addition to nutrient availability and uptake. Photo by Dorivar Ruiz Diaz, K-State Research and Extension.

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. Lime materials can vary widely in their neutralizing power (ECC content). All lime materials sold in Kansas must guarantee their ECC content, and dealers are subject to inspection by the Kansas Department of Agriculture.

The ECC content of the lime depends on both its purity (relative to pure calcium carbonate) and its fineness. 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.

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. When selecting a lime source, the cost per pound of ECC should be a primary factor in source selection. Also consider the rate of reaction, uniformity of spreading, and availability, but the total ECC applied ultimately determines the final pH change.

Application methods

All lime sources have very limited solubility. When planting alfalfa, the best performance occurs when lime is incorporated and given time to neutralize the soil acidity (raise the pH). When surface-applied without incorporation, such as in no-till systems, the neutralizing effect is generally limited to the top 2 to 3 inches of soil. This may be adequate for slightly acidic soils, but it’s often not enough to fully correct problems in strongly acidic soils where root development, nodulation, and nitrogen fixation are more severely affected. Alfalfa roots go incredibly deep, thus interacting with more of the soil profile compared to most annual crops.

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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3. Southern rust continues to spread in Kansas this season

Southern corn rust has become active and has been confirmed in at least 21 Kansas counties as of July 31, 2025 (Figure 1). In addition, southern rust has been observed in states to our north (Nebraska and South Dakota). Unlike some other corn diseases, such as tar spot and gray leaf spot, southern rust does not survive in Kansas during winter months and blows in annually from more tropical regions to our south. Severity is dependent on the weather - southern rust is favored by daytime temps in the 90s, warm nights, and high humidity. Now is a good time to be out scouting corn fields in Kansas.

In cooperation with the K-State Plant Pathology Department, the Kansas Corn Commission has launched an online Corn Disease Resource Center (https://kscorn.com/corndisease/) to help corn growers identify what diseases to watch for in their geographic area.

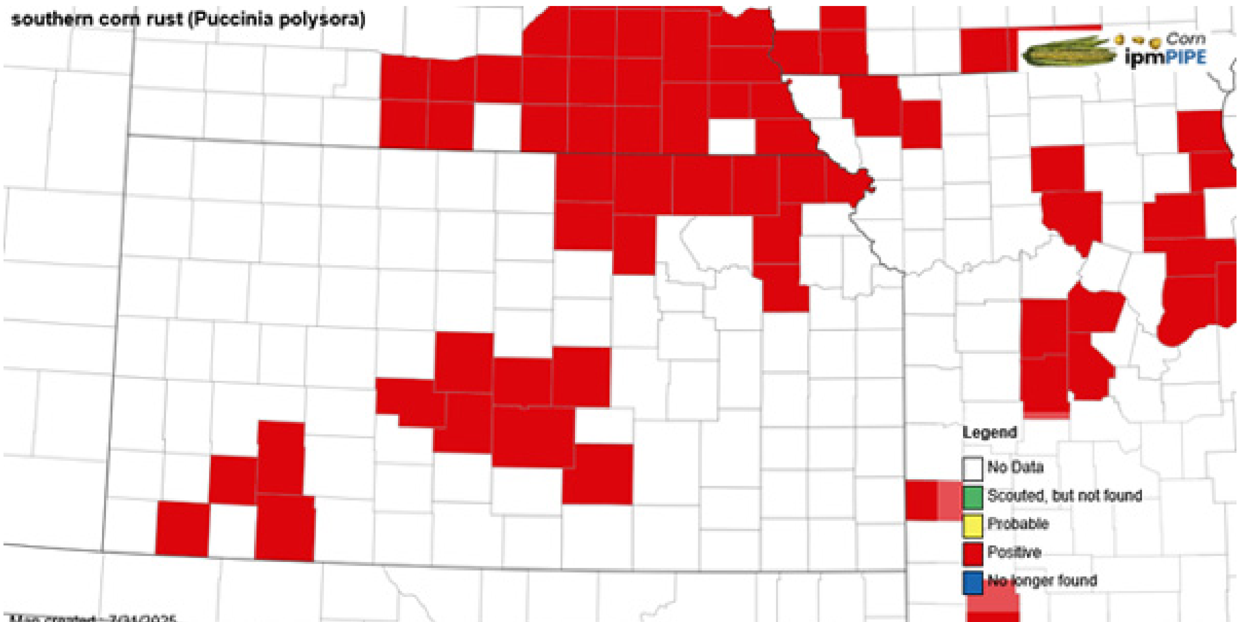

Figure 1. Southern corn rust (Puccinia polyspora**) in Kansas as of July 31, 2025.**
Source: https://kscorn.com/corndisease/

Here are some frequently asked questions related to managing southern rust in Kansas.

Should I apply a fungicide prior to observing southern rust?

Applying a fungicide to control southern rust is not recommended unless the disease has been observed first at low levels in the canopy. Now that southern rust has been reported in Kansas, it is time to scout. Once pustules are observed, the pathogen can reproduce rapidly if temperatures and humidity are high.

What factors should I consider when making the decision to spray for southern rust?

It is important to consider hybrid susceptibility, disease incidence (how many plants are affected), and the crop's growth stage. Infection early in the season on a susceptible hybrid, coupled with conducive weather conditions, poses the highest risk for yield loss.

If I apply a foliar fungicide at tasseling (VT) or silking (R1) to control tar spot and gray leaf spot, will this application have efficacy against southern rust?

Yes. Most fungicides labeled for tar spot and gray leaf spot are also effective for southern rust. Depending on the product, they will have residual activity for approximately three weeks after application. Fields should be carefully monitored for disease development.

What fungicides are best to control southern rust?

Efficacy ratings for corn fungicide management of southern rust have been compiled by a working group of corn researchers and can be found here: Crop Protection Network

How do I know if what I'm seeing is southern rust?

Southern rust produces characteristic orange pustules of spores, primarily on the upper side of the leaf (Figure 2). If you run your finger across the pustules, the orange spores will be visible on your hand. The K-State diagnostic lab can also observe pustules under the microscope to determine if they are southern rust or common rust.

Figure 2. Southern rust on corn. Photo courtesy of Rodrigo Borba Onofre, K-State Plant Pathology.

Please help us track Southern Rust

If you suspect a field has Southern Rust, contact Rodrigo Onofre directly at 785-477-0171 and/or submit a sample to the K-State Plant Disease Diagnostic Lab at https://www.plantpath.k-state.edu/extension/diagnostic-lab/documents/2021_PP_DiseaseLabChecksheet.pdf.pdf. This will help us monitor the situation in the state.

For more information on identifying corn rusts, see K-State Research and Extension Bulletin MF3016, Corn Rust Identification and Management in Kansas.

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4. Corn leafhopper confirmed in additional Kansas counties

Corn leafhopper (CLH; *Dalbulus maidis*), the vector of corn stunt disease complex, was confirmed in Reno County, Kansas, on July 9, 2025 and has more recently been confirmed in Sedgwick (7/30), McPherson (7/29), Stafford (7/31), Barber (7/31), Labette (7/30), and Cherokee (7/18) counties (Figure 1). Corn leafhoppers have been detected in 48 counties in Texas, 7 counties in Oklahoma, and 4 counties in Missouri. Now is the time to intensify scouting efforts.

The early insect onset we're observing this year raises concerns about yield loss. Late-planted corn and/or double-cropped corn are at a higher risk of yield impact than early-planted corn. Corn stunt disease symptoms can take up to 40 days for symptoms to become visible. Due to the efficiency of the corn leafhopper to transmit pathogens associated with corn stunt disease, there is no economic threshold.

At this time, the exact corn growth stage at which scouting should cease is unknown. Past guidance encouraged scouting through V8, but more studies are needed to verify the validity of this recommendation. Insecticide applications are an option when corn leafhoppers are detected. However, insecticides might not be a bulletproof option to prevent corn stunt disease due to the occurrence of multiple waves of CLH that may occur throughout the early growth stages. Keep in mind that spraying for CLH could increase the chances of spider mite infestations. At present, K-State has no data on insecticide applications to control CLH in Kansas.

In addition, corn stunt disease incidence will not be reduced by insecticide or fungicide applications. If symptomatic corn plants are observed in the field, the plants have already been infected. Remember, the label is the law.

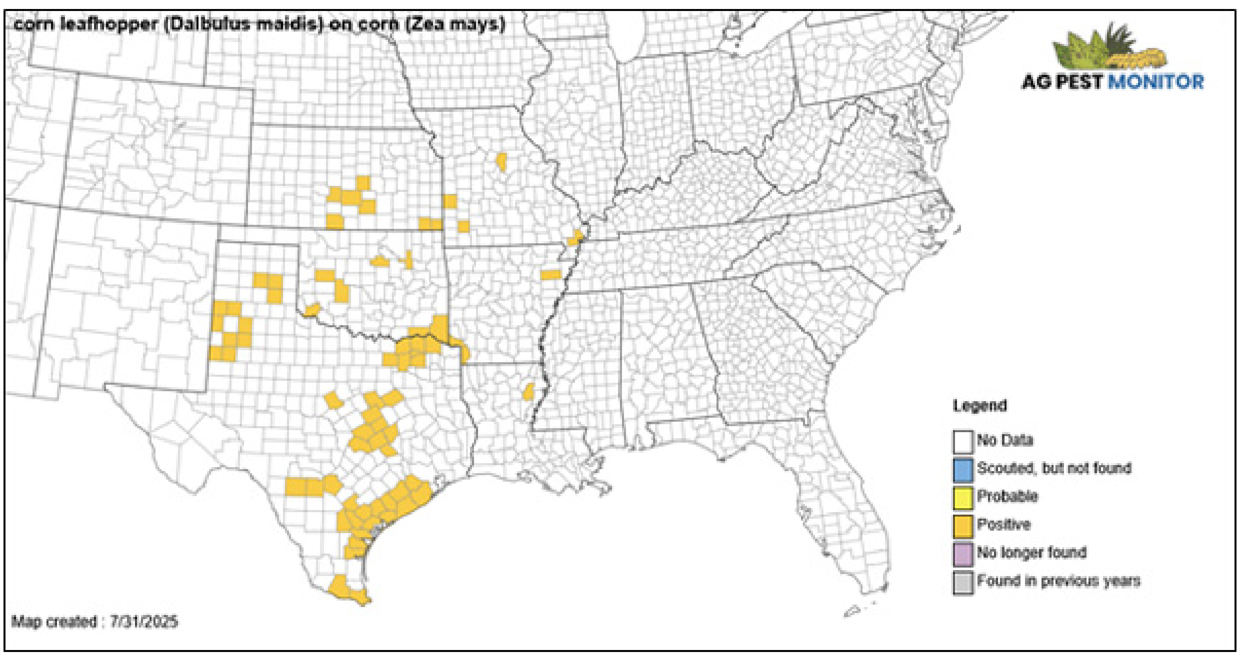

Figure 1. Corn leafhopper (Dalbulus maidis**) in Kansas in 2025. The map can be accessed at https://kscorn.com/corndisease/**

Identification of the corn leafhopper

The corn leafhopper is relatively simple to identify under magnification (Figure 2). These leafhoppers are light tan to yellowish-white in color and approximately 1/8" long. Two distinct dark spots between the antennae and eyes are very characteristic of this species. Nymphs lack wings and can vary in color.

Like most leafhoppers, all stages move quickly when disturbed and hide in shaded areas of corn plants. All stages can be sampled using a sweep net. A video showing how to sample/trap corn leafhoppers in mature corn canopies can be found here: https://youtu.be/QgLuWWSwHWU. It is important to know that not all leafhoppers found in corn fields will be corn leafhoppers. A commonly found species, the aster leafhopper, can be confused with the corn leafhopper (Figure 2, right).

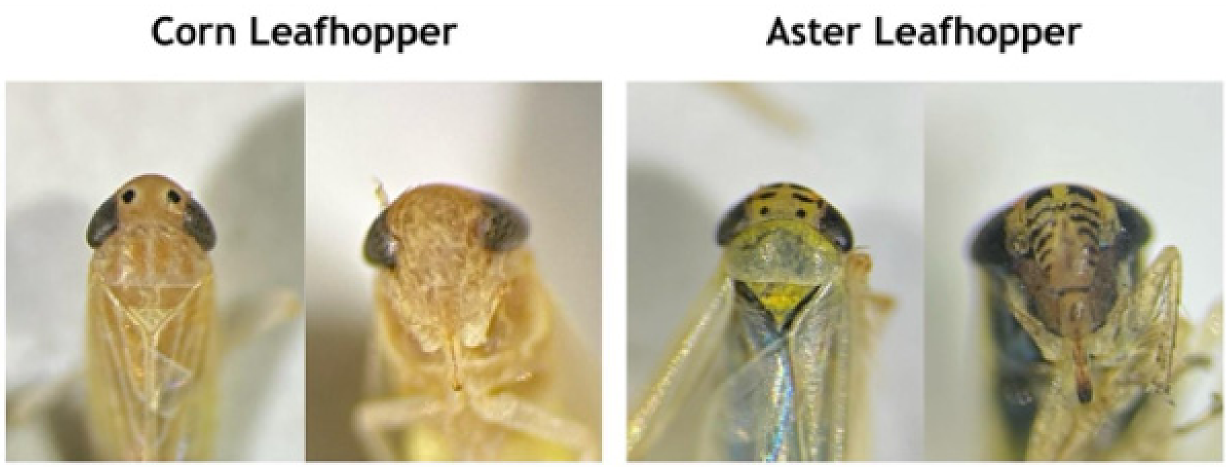

Figure 2. Images of the corn leafhopper (left) and the aster leafhopper (right). Photos courtesy of Rodrigo Onofre, K-State Research and Extension.

Corn stunt spiroplasma (CSS, *Spiroplasma kunkelii*) and its associated vector (corn leafhopper, *Dalbulus maidis*) were first confirmed in Kansas during the 2024 corn season. Although most of the positive reports were from field corn, we also confirmed CSS in sweet corn. High levels of disease were found in late-planted and double-cropped corn, leading to potential yield reductions. Corn leafhopper acquires pathogens within minutes of feeding on infected corn plants, but it can take up to 40 days for the leafhopper to be able to infect healthy corn plants during feeding events. The corn leafhopper can also transmit additional pathogens, either singly or in combination with CSS. To date, only the CSS pathogen has been confirmed in Kansas.

Please help us track! K-State is offering FREE TESTING for corn leafhopper identification and corn stunt disease.

Kansas corn farmers have new tools to guard against corn leafhoppers and corn stunt disease. The Kansas Corn Commission is supporting the work of K-State Plant Pathologist Rodrigo Onofre to track leafhoppers and corn stunt disease in Kansas to help growers manage this risk. In addition to the creation of a statewide system to track leafhopper infestations, K-State Plant Pathology is offering **FREE TESTING** to identify corn leaf hoppers (CLH Confirmation and Pathogen Presence) and plant tissue testing for corn stunt disease, thanks to support from the Kansas Corn Commission. Collection and shipping instructions can be found below:

- Collect and ship samples on or before Wednesday to avoid weekend storage
- Collect symptomatic fresh leaf tissue.
- Use a sweep net to collect insects. Empty net into gallon plastic bags.
- Label and use plastic bags; Do not use paper bags, and do not add water.
- Fill out the submission form. Please make sure to add a **"2025 FREE CORN STUNT TESTING"** note to the submission form.
- Ship samples ASAP overnight via UPS or FedEx if possible.

K-State Plant Diagnostic Lab
4032 Throckmorton PSC
1712 Claflin Road
Manhattan, KS 66506

K-Trap Monitoring System

Early detection of corn leafhoppers is a vital component of corn stunt management. To help communicate monitoring results in real-time, a monitoring system and webpage have been created to help growers track corn leaf hopper, corn stunt, and other corn diseases (kscorn.com/corndisease). A collaborative effort between K-State Plant Pathology, Agronomy, and Entomology departments, the Kansas Corn Commission, Kansas Independent Crop Consultants, K-State Research & Extension Ag Agents, and Corteva has been initiated to monitor at least three counties in each crop reporting district for corn leafhoppers (Figure 3).

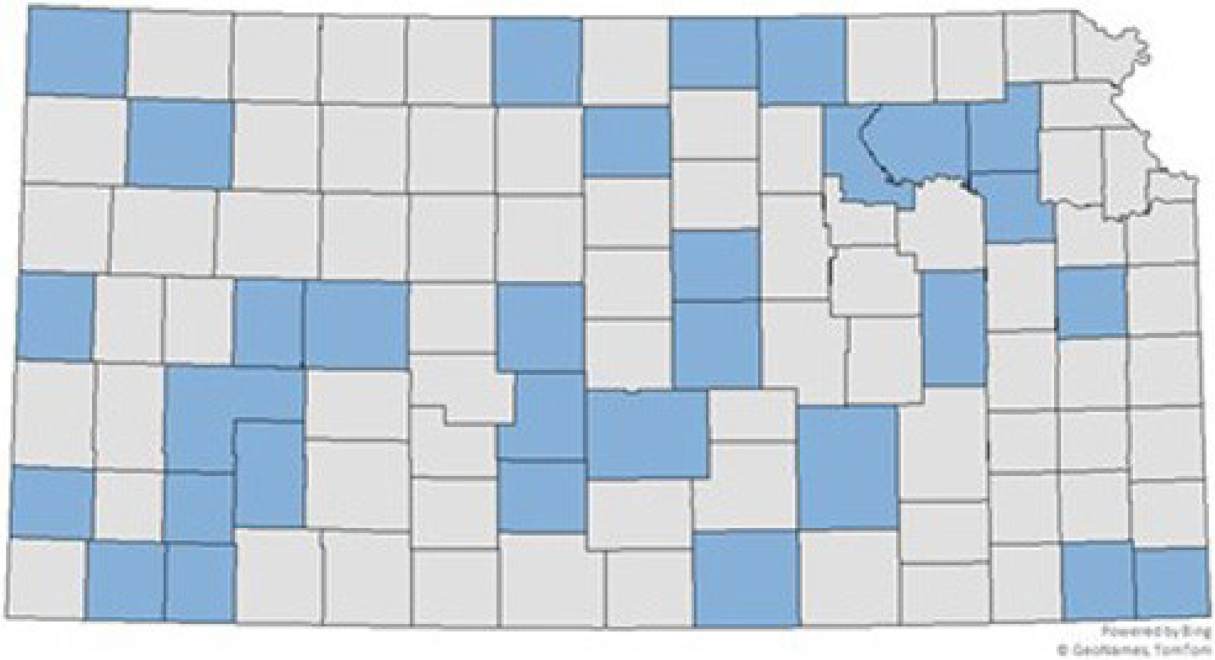

Figure 3. In-season K-Trap monitoring. Counties that are blue have at least one trap for CLH that is monitored weekly during the 2025 corn season.

Approximately 33 Kansas participants are trapping for the corn leafhopper. Monitoring is ongoing and will continue for 40 weeks. This will help us understand the real-time risk during the growing season. The leafhoppers that are trapped will be tested to see if they carry the pathogens that cause corn stunt disease. Any detections will be added to a map that tracks corn leafhopper detections in Kansas and other states (kscorn.com/corndisease). This page also includes maps for corn stunt pathogens, tar spot, and southern rust, as well as video updates from K-State Research and Extension.

For more information, contact Rodrigo Onofre, Assistant Professor and Extension Specialist, Row Crops Pathologist at the K-State Plant Pathology Department. E-mail: onofre@ksu.edu or at 785-477-0171.

Check out these short videos for answers to some common questions about corn stunt and leafhoppers

Learn the best way to scout your fields for corn leafhopper
www.youtube.com/shorts/_n7RZq0ougY

What next?
www.youtube.com/shorts/-PzNFirAGY0

Does corn stunt carry over in corn residue?

www.youtube.com/shorts/5rUZdi4CG3Q

Purple corn leaves – Is it corn stunt?
www.youtube.com/shorts/Jxkicq8DQfA

What other problems look like corn stunt?
www.youtube.com/shorts/dtjD8Wpip6A

How are sticky traps used to track corn leafhoppers?
www.youtube.com/shorts/DqLKsUI2xcs

Leafhopper project: What, Who, and Why?
www.youtube.com/shorts/XPEnmN05Nfc

For more information, please visit https://kscorn.com/corndisease/.

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5. Dual-purpose wheat variety performance results for 2025

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 information from the 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 for 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 full publication provides more information on the experiment methods and site characteristics.

Fall forage yield

Fall forage production of the varieties evaluated ranged from 826 to 1,970 pounds of dry matter per acre, averaging 1,556 pounds of dry matter per acre (Table 1). There were significant statistical differences among the varieties, with AP Sunbird, KS Ahearn, KS Providence, and KS Territory falling into the highest forage-yielding group (range within the highest-yielding group: 1,803 to 1,970 pounds of dry matter per acre).

First hollow stem

First hollow stem is reported in the day of year format. For reference, day of year 80 is equivalent to March 21. The average occurrence of first hollow stem was day 87 (Table 3), ranging from day of year 82 for early varieties to day of year 89 for late varieties. These dates represent a normal to slightly delayed release from winter dormancy. The range in first hollow stem was narrow, with all studied varieties reaching first hollow stem within a 7-day interval. Four varieties reached it early (AP24 AX, Kivari AX, Sheridan, and AR Turret 25), and all remaining varieties were past this stage at the subsequent measurement.

Previous reports of the 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 their 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 29.5 inches, ranging from 26.8 to 39.3 inches. This average was -1.3 to 7.4 inches taller than the heights measured in the dual-purpose system (27.3 inches average height with a range of 24.0 to 31.9 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 2024-25 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 -----		
AP24 AX	Agripro	1,632	82	28.8	24.0	4.7
AP Sunbird	Agripro	**1,803**	89	26.8	25.1	1.7
CLH10-153.022		1,835	89	**39.3**	**31.9**	7.4
CLH10-1853.014		1,426	89	**33.0**	28.3	4.7
KS Ahearn	KWA	**1,881**	89	27.6	26.2	1.3
KS Bill Snyder	KWA	1,481	89	27.6	28.4	-0.8
KS Mako	KWA	826	89	28.0	29.3	-1.3
KS Providence	KWA	**1,970**	89	29.5	26.9	2.6
KS Territory	KWA	**1,856**	89	29.7	26.3	3.3
KS21H36	KWA	1,682	89	28.7	24.7	4.0
Kivari AX	Plains Gold	1,310	82	30.1	27.3	2.7
Sheridan	Plains Gold	1,511	82	29.0	28.8	0.2
AR Iron Eagle 22 AX	Armor Seed	1,161	89	27.1	26.4	0.7
AR Turret 25	Armor Seed	1,658	82	28.2	27.6	0.6
CP7017AX	Croplan	1,154	89	28.8	27.2	1.6
CP7869	Croplan	1,710	89	29.5	28.1	1.4
Average		1556	87.3	29.5	27.3	2.2
Minimum		826	82.0	26.8	24.0	-1.3
Maximum		1970	89.0	39.3	31.9	7.4

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

The average grain yield in the grain-only trial was 58.0 bushels per acre, whereas the dual-purpose trial averaged 45.6 bushels per acre (Table 2). Varieties that yielded statistically better than their counterparts in the grain-only trial were AP Sunbird, KS Bill Snyder, KS Mako, KS Providence, KS Territory, Sheridan, AR Iron Eagle 22AX, CP7017AX, and CP7869. The yield penalty from simulated grazing averaged 12.4 bushels per acre and ranged from 2.1 to 23.0 bushels per acre. The variety KS Bill Snyder was the highest-yielding variety of the dual-purpose trial. The weather conditions — characterized by cool and moist grain fill weather — benefited some of the later-maturing wheat varieties this season.

Test weights ranged from 54.3 to 61.7 pounds per bushel in the grain-only system and from 51.7 to 60.9 in the dual-purpose system (Table 2). Varieties with the highest test weight at both grain-only and dual-purpose systems were KS Bill Snyder, KS Mako, KS Territory, and Sheridan, whereas the varieties AP Sunbird, AR Iron Eagle 22AX, and CP7017AX were in the highest test weight group under grain-only, and AP24 AX and KS Providence were in the highest test group in the dual-purpose trial.

Table 2. Winter wheat grain yield and grain test weight in grain-only (GO) and dual-purpose (DP) systems in Hutchinson, KS, during the 2024-25 production year. Shaded values refer to the highest testing group. Values pertaining to the highest group are highlighted in bold.

Variety	Source	Grain yield			Test weight		
		GO	DP	diff.	GO	DP	diff.
		--------- bushels per acre -----------			--------- pounds per bushel ---------		
AP24 AX	Agripro	57.9	40.2	17.7	58.9	**58.6**	0.2
AP Sunbird	Agripro	**61.9**	39.7	22.2	**60.1**	55.7	4.4
CLH10-153.022		30.0	30.7	-0.7	55.2	55.3	-0.1
CLH10-1853.014		36.7	23.1	13.6	54.3	51.7	2.6
KS Ahearn	KWA	59.0	40.6	18.4	59.2	57.6	1.6
KS Bill Snyder	KWA	**64.1**	**66.2**	-2.1	**61.7**	**60.9**	0.8
KS Mako	KWA	**66.0**	56.2	9.8	**61.6**	**60.3**	1.4
KS Providence	KWA	**60.1**	41.3	18.8	59.7	**60.0**	-0.3
KS Territory	KWA	**67.5**	48.4	19.1	**61.0**	**59.7**	1.3
KS21H36	KWA	58.5	49.3	9.1	58.3	58.0	0.4
Kivari AX	Plains Gold	59.1	48.6	10.4	59.4	58.4	1.0
Sheridan	Plains Gold	**60.1**	53.8	6.2	**60.7**	**58.9**	1.8
AR Iron Eagle 22AX	Armor Seed	**66.0**	43.0	23.0	**60.4**	58.4	2.0
AR Turret 25	Armor Seed	54.0	50.7	3.3	59.4	57.9	1.5
CP7017AX	Croplan	**63.3**	56.1	7.3	59.9	57.6	2.2
CP7869	Croplan	**63.8**	41.2	22.6	59.4	57.8	1.6
Average		58.0	45.6	12.4	59.3	57.9	1.4
Minimum		30.0	23.1	-2.1	54.3	51.7	-0.3
Maximum		67.5	66.2	23.0	61.7	60.9	4.4
Maximum		62.4	55.5	-6.9	62.7	61.7	0.1

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6. Coleoptile length of winter wheat varieties 2025

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 2025*, 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 2 7/8-inch (75 mm) coleoptile at 60°F could have a 1 5/8-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 2025 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 in Table 1. The longest coleoptile varieties ranged from 2¾ to 3 1/2 inches (71 to 90 mm) and included Rockstar, AR Iron Eagle 22AX, KS Silverado, KS Dallas, WB4445CLP, Sheridan, Bob Dole, WB2606 Brand, Whistler, High Cotton, LCS Steel AX, KS Providence, LCS Cowie AX, Strad CL Plus, OK198417C, 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 Kansas environments, as their coleoptile length was greater than 21/2 inches (65 mm).

Alternatively, many varieties had relatively short coleoptiles, falling in the three lowest groups. Few varieties had coleoptiles shorter than 2 inches (50 mm), which is an improvement from past years. The only varieties that had 2-inch (50 mm) or shorter coleoptiles were KS Hatchett, KS Mako, and AP Bigfoot, with a few others in the 2 to 21/4 (50-55 mm) range (Larry, AM 553, LCS Atomic AX, and Paradox). 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 2024-2025 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[1]							
1 15/16 – 2 3/16 in (49 - 55 mm)	2 3/16 – 2 1/2 in (55 - 62 mm)		2 1/2 – 2 3/4 in (62 - 69 mm)		2 3/4 – 3 in (69 – 76 mm)	3 - 3 1/4 in (76 – 83 mm)	3 1/4 – 3 1/2 in (83 – 89 mm)
KS Hatchett	PS 1986	WB4422	(W) Joe	KS Homesteader CL+	Kivari AX	KS Providence	OK198417C
KS Mako	KS Territory	AM 514	WB-Grainfield	TAM 204	OK 20056 CF- 10 C24	LCS Cowie AX	Doublestop CL Plus
AP Bigfoot	WB4523	WB4595	KS Bill Snyder	Crescent AX	LCS Julep	Strad CL Plus	
Larry	Breakthrough	AM 513	KS12D03-1 (Durum)	LCS Aries	OK Corral		
AM 553	CO20037R	Zenda	WB4269	LCS Chrome	AP24 AX		
LCS Atomic AX	WB2452	KS Big Bow	Guardian	LCS Galloway AX	Rockstar		
Paradox	Everest	WB4401	AM 545	TAM 112	AR Iron Eagle 22AX		
	AM 555	AP18 AX	AP Prolific	CP7017AX	KS Silverado		
	WB2545	Showdown	High Country	LCS Helix AX	KS Dallas		
	WB4699	CP7869	Canvas	AgriMaxx EXP 2405	WB4445CLP		
	AG Radical	SY Monument	LCS Warbird AX	LCS Runner	Sheridan		
	AM 543	WB4792	CO19DOBR	CO19410R	Bob Dole		
	KS Hamilton	AP Sunbird	Beachners KI202	AG Golden	WB2606 Brand		
	LCS Radar		TAM 115	LCS Valiant	Whistler		
			SY Wolverine	AR Turret 25	High Cotton		
			KS Western Star	KS Ahearn	LCS Steel AX		
			T158	Paradise			

[1] *Varieties are separated based on fixed coleoptile length intervals. Coleoptile length of a variety may change from year to year, so varieties may move between length categories in different seasons. The minimum and maximum values measured are also season-specific, so the exact length range of each category may change slightly.*

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