

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.

In dryland environments typical of western Kansas and eastern Colorado, wheat is often sown into dry soil and relies on deeper subsoil moisture that accumulated during summer rainfall events. This strategy requires deeper planting depths 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-planted 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 variety, this reduction in coleoptile length due to high temperatures may be as much as 60%. For example, a variety that has a 2 $\frac{7}{8}$ -inch (75 mm) coleoptile at 60 degrees Fahrenheit could have a 1 $\frac{5}{8}$ -inch (40 mm) coleoptile when soil temperature is 80 degrees Fahrenheit. 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.

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

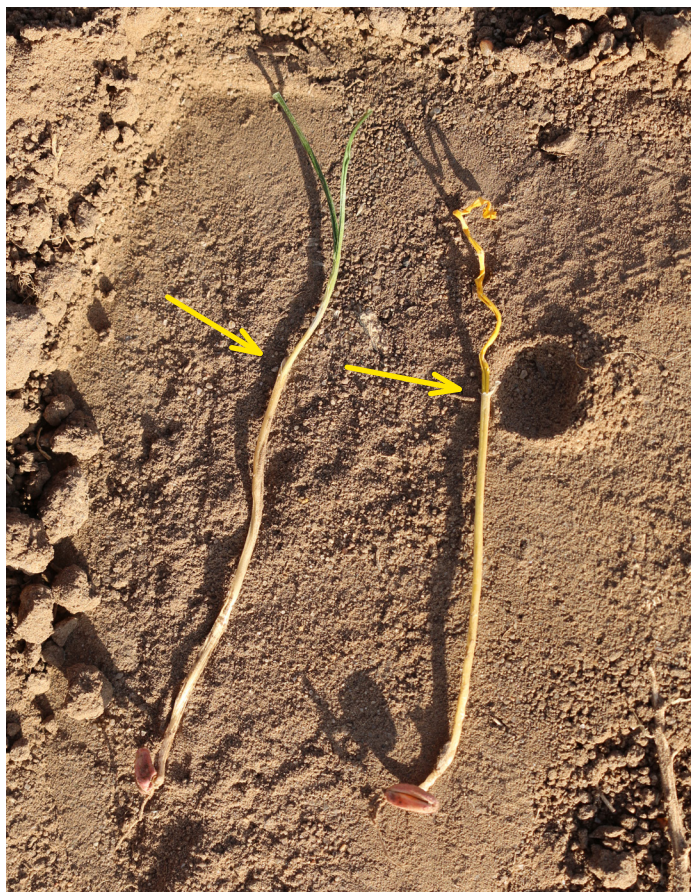


Figure 1. Deep-sown wheat demonstrating the potential for coleoptile elongation (yellow arrows point to the end of the coleoptile). In the left, the coleoptile was able to reach the soil surface and the first true leaf emerged above ground, therefore showing normal early development. In the right, the 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.

Kansas Wheat Rx is a prescription for economical and sustainable production of high-quality winter wheat in Kansas.

Wheat Rx is 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.



kswheat.com/kansas-wheat-rx

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 2022-23 Kansas State University winter wheat variety performance tests, as well as from other seed sources used for agronomic studies during the same crop year. Varieties may have been treated with different seed treatment products, which can influence the reported results. Sixty seeds of each variety were tested (Figure 2). 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. Temperature during the experiment was stable, ranging from 69 to 72 degrees Fahrenheit.

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 3¾ inches (72 to 87 mm) and included Kivari AX, AG Icon, Bob Dole, KS Providence, and DoubleStop CL Plus. Some of these varieties were also in

the longest coleoptile group in the 2022 report (i.e., Kivari AX, KS Providence, Bob Dole, and DoubleStop CL Plus), reinforcing the argument for their long coleoptile. Varieties may have changed group between their ratings in the last report as compared to this report. This is possible due to differences in seed treatment used between years, and also due to different season-specific conditions under which the varieties were cultivated.

Several variety options were also included in the second and third longest coleoptile groups (namely “Long” and “Medium-long” in Table 1) and could potentially be good options for deep sowing in western environments, as their coleoptile length ranged from 2¾ to 2¾ inches. Alternatively, many varieties had relatively short coleoptiles, falling in the two lowest groups (less than 2½ inches (55 mm)). These varieties included: Larry, AM 525, KS DH0010-17, Becks 732 LCS 19DH-152-6, Bakers Ann, AP Roadrunner, Bentley, Duster, AM 535, and WB4792. Use caution when sowing these varieties in deeper than average conditions; and note that seed purity and vigor can influence coleoptile length. Wheat seeds were submitted for testing in the official wheat variety testing program at Kansas State University, there was no effort to ensure all seeds met minimum purity or vigor requirements.

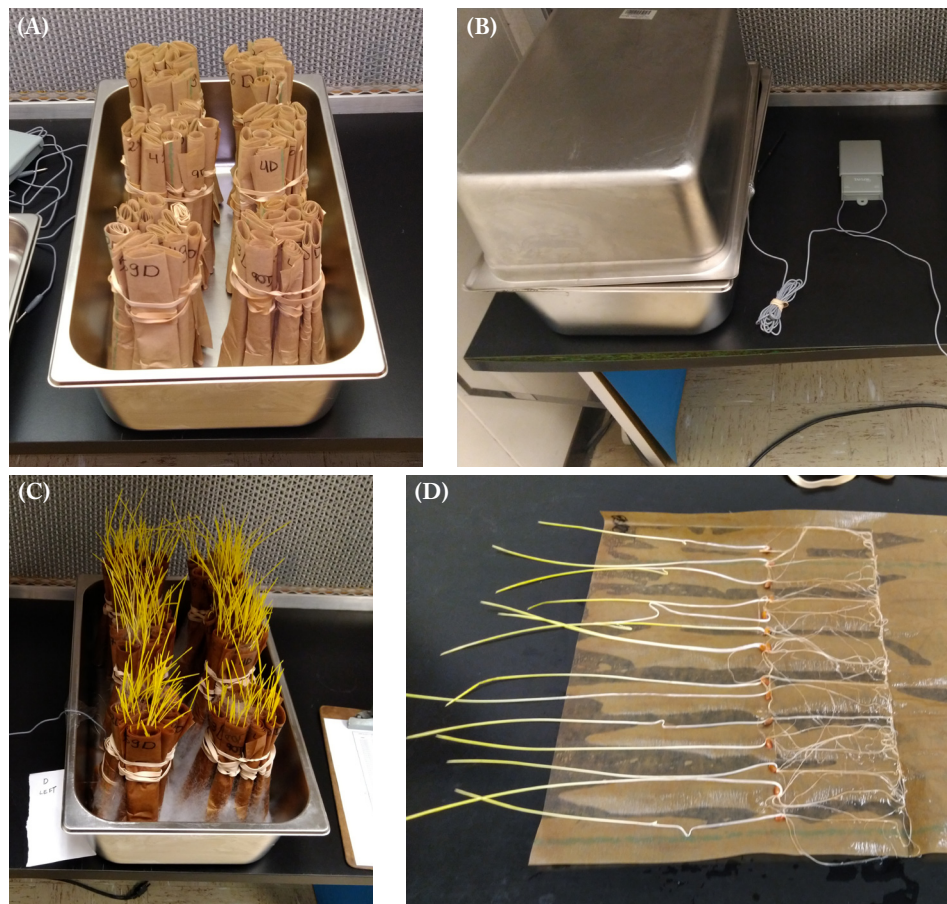


Figure 2. Methodology used for coleoptile length estimation in this study, including (A) adding the rolled up germination papers and water to stainless steel pans, (B) measuring daily temperatures within pans for 12 days, (C) opening the pans at the study termination date, and (D) measuring the coleoptile length of 10 plants within each paper.

Table 1. *Wheat variety grouping based on coleoptile length measured in a controlled environment experiment during the 2023 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 (1¾ – 2½") (46 – 53 mm)	Short (2½ – 2¼") (53 – 55 mm)	Medium short (2¾ – 2¾") (55 – 62 mm)	Medium long (2¾ – 2¾") (62 – 67 mm)	Long (2¾ – 2¾") (67 – 72 mm)	Very long (2¾ – 3¾") (72 – 84 mm)	
Larry	Duster	WB 4523	LCS Atomic AX	AG Golden	WB 4269	Kivari AX
AM 525	AM 535	KS Hatchett	Tatanka	KS 19H10	Canvas	Ag Icon
KS DH0010-17	WB 4792	AM 516	CP 7869	Ag Radical	AP 18 AX	Bob Dole
Becks 732		Gallagher	SY Monument	AP Bigfoot	Green Hammer	KS Providence
LCS 19DH-152-6		Showdown	AP EverRock	LCS Galloway AX	OK 18510	Doublestop CL Plus
Bakers Ann		OK 15MAS Bx7 ARS 8-29	LCS White Lightning	Paradise	ARMOR EXP 6 AX	
Bentley		KS Hamilton	AM 514	LCS Chrome	WB 4401	
		WB 4422	LCS Valiant	LCS Steel AX	SY Rugged	
		Becks 720	WB4303	KS Dallas	KS Silverado	
		KS Big Bow	OK Corral	AM 505	CP 7266 AX	
		Becks 722	CP 7017 AX	CP 7909	AP Prolific	
		Becks 724	Zenda	Whistler	Strad CL Plus	
		Breakthrough	Joe	Langin		
		WB 4699	AM 513	Rock Star		
		High Country	AM Cartwright	SY Wolverine		
		KS Territory	MS Maverick	CP 7050 AX		
		AM 503	LCS Julep	WB 2606		
		Becks 725	KS Ahearn			
		KanMark	LCS Helix AX			
		Smith's Gold	Everest			
		ARMOR EXP 55	WB 4595			
		KS Western Star	WB 4632			
		OK 16103083				

For More Information

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