K-STATE Research and Extension

Coleoptile Length of Winter Wheat Varieties 2022

Wheat Rx Series

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.

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 variety, this reduction in coleoptile length due to high temperatures may be as much as 60%. For example, a variety that has a 2⅞-inch (75 mm) coleoptile at 60 degrees Fahrenheit could have a 1⅝-inch (40 mm) coleoptile at 80 degrees Fahrenheit 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.

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.

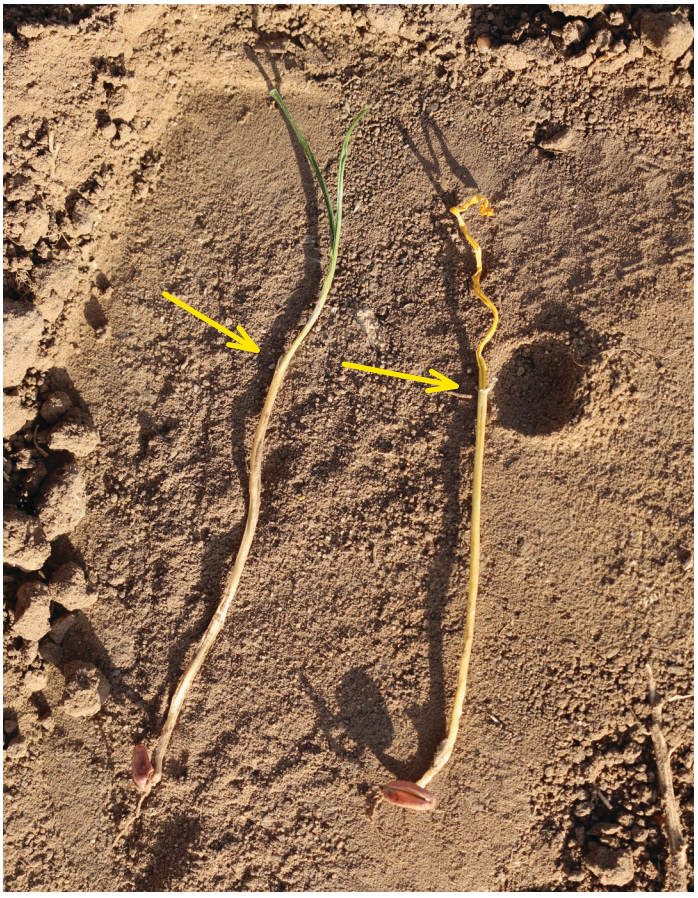

Figure 1. *Deep-sown wheat demonstrating the potential for coleoptile elongation (yellow arrows point to the end of the coleoptile). In the left, the coleoptile was able to reach the soil surface and the first true leaf emerged above ground, therefore showing normal early development. In the right, the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

KANSAS WHEAT Rx

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 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 (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.

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 3¼ inches (72 to 84 mm) and included LCS Steel AX, TAM 204, Kivari AX, Skydance, KS Dallas, KS Providence, Strad CL Plus, Bob Dole, and DoubleStop CL Plus.

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 2⅜ to 2¾ inches. Alternatively, many varieties had relatively short coleoptiles, falling in the two lowest groups (less than 2⅛ inches (55 mm)). These varieties included: AM492, Big Country, TAM 114, AM Cartwright, LCS Link, Tatanka, Kanmark, Gallagher, Duster, MS Maverick, AM 513, AP RoadRunner, KS Hatchett, WB4699, AM514, KS Territory, and LCS Valiant. 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.

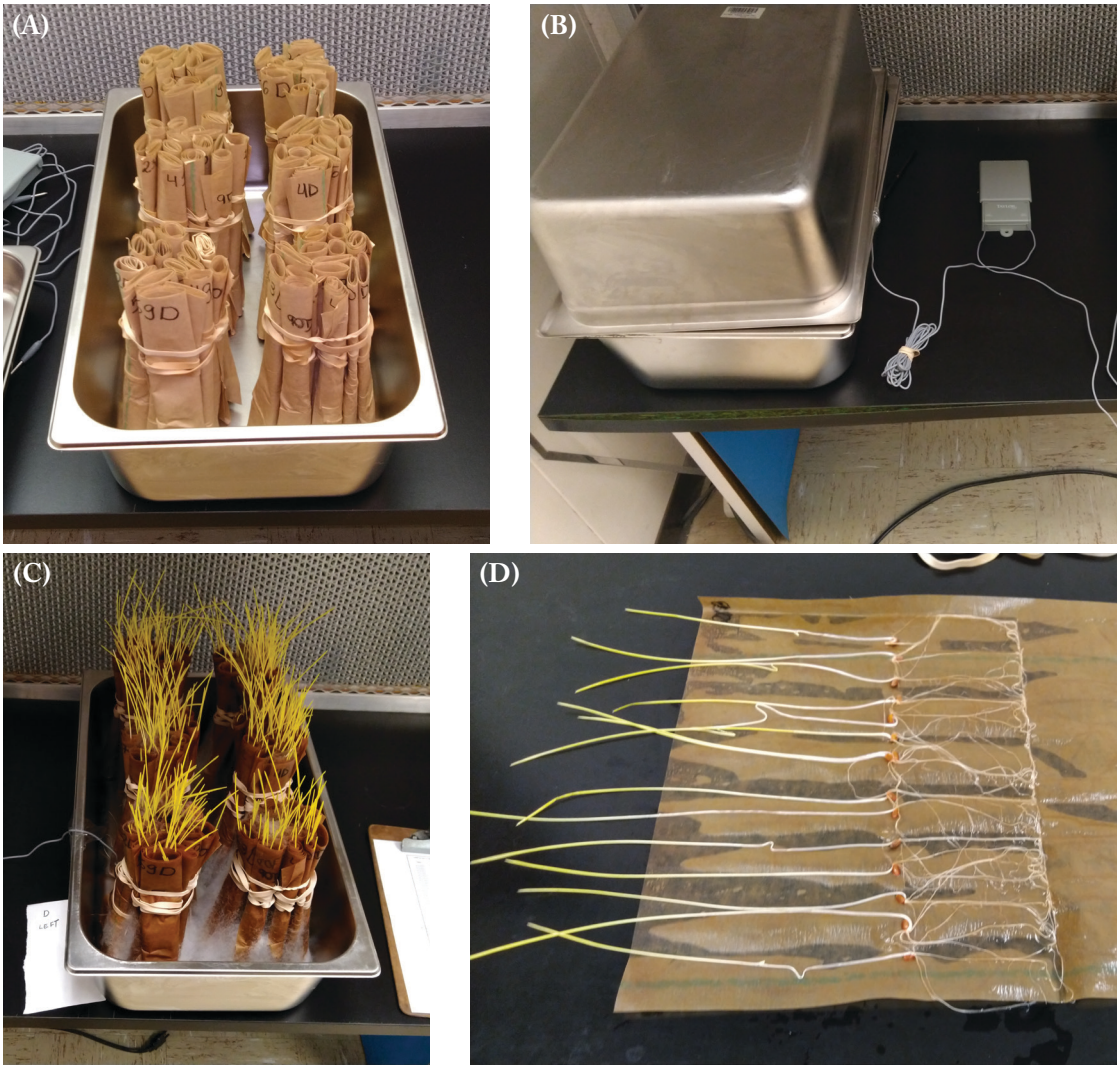

Figure 2. *Methodology used for coleoptile length estimation in this study, including (A) adding the rolled up germination papers and water to stainless steel pans, (B) measuring daily temperatures within pans for 12 days, (C) opening the pans at the study termination date, and (D) measuring the coleoptile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

Table 1. *Wheat variety grouping based on coleoptile length measured in a controlled environment experiment during the 2022 winter wheat season in Kansas. A total of 40 coleoptiles were measured per variety.*

Coleoptile Length					
Very short	**Short**	**Medium short**	**Medium long**	**Long**	**Very long**
(1¾ – 2⅛")	**(2⅛ – 2¼")**	**(2⅜ – 2⅜")**	**(2⅜ – 2⅝")**	**(2⅝ – 2⅞")**	**(2⅞ – 3⅜")**
(46 – 53 mm)	**(53 – 55 mm)**	**(55 – 62 mm)**	**(62 – 67 mm)**	**(67 – 72 mm)**	**(72 – 84mm)**
AM 492	Big Country	Lonerider	WB4595	Guardian	LCS Steel AX
TAM 114	AM Cartwright	Showdown	LCS Runner	AG Icon	TAM 204
LCS Link	Tatanka	Zenda	LCS Revere	WB4401	Kivari AX
Kanmark	Gallagher	LCS Julep	SY Rugged	KS Ahearn	Skydance
Duster	MS Maverick	Joe	WB4303	Whistler	KS Dallas
AM 513	AP Roadrunner	AM 516	Everest	Rock Star	KS Providence
KS Hatchett	WB4699	AM Exp 2105	OK Corral	Canvas	Strad CL Plus
AM 514	KS Territory	Breakthrough	LCS Photon	CP72166AX	Bob Dole
LCS Valiant		AM 530	AG Radical	TAM 115	DoubleStop CL Plus
		SY Wolverine	WB Grainfield	LCS Helix AX	
		WB4422	AP 18AX	Rock Star	
		Langin	Green Hammer		
		AP BigFoot	Uncharted		
		KS Hamilton	KS Western Star		
		Larry	Bakers Ann		
		KS Big Bow	SY Monument		
		AG Golden	WB4792		
		LCS Chrome	KS Silverado		
		AP EverRock	WB4269		
		Paradise	AP Prolific		
		AM 505	Smith's Gold		
		T158			
		CP7017AX			
		High Country			
		CP7907			
		WB4395			

For More Information

Dual-purpose Wheat: Management for Forage and Grain Production. K-State Research and Extension publication MF3375

Factors Affecting Wheat Germination and Stand Establishment in Hot Soils, Oklahoma State University Extension Publication PSS-2256.

Wheat Seedling Emergence from Deep Planting Depths and Its Relationship with Coleoptile Length. PLoS One 2013; 8(9): e73314 doi: 10.1371/journal.pone.0073314

Wheat Grain Yield Response to Seed Cleaning and Seed Treatment as Affected by Seeding Rate During the 2018–2019 Growing Season in Kansas. Kansas Agric. Exp. Stat. Res. Report 6(5). 2020.

Wheat Grain Yield Response to Seed Cleaning and Seed Treatment as Affected by Seeding Rate During the 2019-2020 Growing Season in Kansas. Kansas Agric. Exp. Stat. Res. Report 7(5). 2021.

Wheat Grain Yield Response to Seed Cleaning and Seed Treatment as Affected by Seeding Rate During the 2020-2021 Growing Season in Kansas. Kansas Agric. Exp. Stat. Res. Report 8(4). 2022

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