

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 a 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 varieties in a dual-purpose system versus a grain-only system.

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 is dependent on variety, planting date, seeding and nitrogen rates, and fall temperature and precipitation.

Date of first hollow stem is also an important trait in dual-purpose systems because terminating grazing at the right time is essential to maintain the grain yield potential for subsequent harvest. Grazing past first hollow stem can decrease wheat grain yield in 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. Date of first hollow stem is dependent on temperature and day length.

Grain yield following grazing is another variety-specific trait of importance 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.

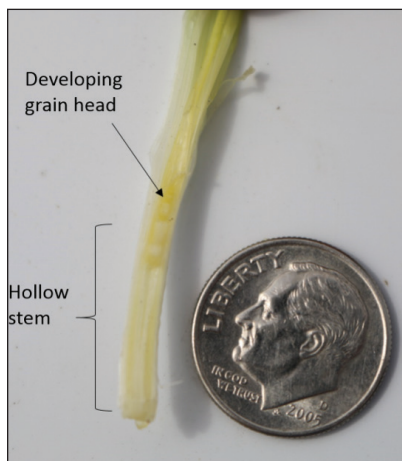


Figure 1. *Wheat plant at the first hollow stem stage. First hollow stem occurs when there is approximately 1.5 centimeters ($\frac{1}{16}$ inch or roughly the diameter of a dime) below the developing wheat head.*

Description of site and methods

Twenty-one 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 early sowing date, increased nitrogen rate, and higher seeding rate; while a third trial was sown using the same varieties under grain-only management (Table 1). All plots received 50 pounds per acre of 18-46-00 in furrow at planting, and nitrogen fertilization was performed for a 65 bushels per acre yield goal. Dual-purpose plots received an additional 100 pounds of nitrogen per acre pre-plant to supplement forage production (Table 2). All trials were sprayed with foliar fungicides at heading (May 12, 2023).

One of the two dual-purpose trials was used for destructive measurements to assess forage yield and date of first hollow stem. Forage yield was measured by hand clipping plants approximately $\frac{1}{2}$ inch above the soil surface at two 1-meter by 1-row samples within each plot. Samples were then placed in a forced-air dryer for approximately 7 days and weighed. First hollow stem was measured eight times during the winter and early spring by splitting 10 primary stems collected from each plot one or two times per week. First hollow stem sampling was terminated when 100% of the measured stems passed $1\frac{1}{2}$ centimeters of hollow stem below the developing wheat head (Figure 1).

Simulated grazing occurred in the dual-purpose trial four times during the spring (Table 1). Plots were grazed to about 1.5 inch height using a commercial grass mower every time regrowth achieved about 2 inches. Simulated grazing was stopped at the average first hollow stem date of the varieties evaluated. Plant height was measured in five plants in each plot. Grain harvest was performed with a small plot combine and grain yield was corrected for 13% moisture content.

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.



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Table 1. Seeding rate, dates of sowing, forage harvest, simulated grazing, and grain harvest for three trials evaluating 18 winter wheat varieties under dual-purpose or grain-only management.

Trial	Seeding rate -- pounds per acre --	Sowing Date	Forage Harvest	Simulate	Grain Harvest
				Grazing	date
Dual Purpose - First Hollow Stem	120	9/22/22	12/16/22	-	-
Dual Purpose - Grain Haverst	120	9/22/22	-	3/6/23 3/13/23 3/20/23 3/27/23	7/1/23
Grain Only	75	10/19/22	-	-	7/1/23

Table 2. Initial soil fertility and soil texture on the study site collected at sowing. Abbreviations: O.M., organic matter; NO₃-N, nitrate nitrogen; NH₄-N, ammonium nitrogen; CEC, cation exchange capacity.

Soil depth	O.M.	pH	NO ₃ -N	NH ₄ -N	P	K	S	Ca	Mg	CEC	Sand	Silt	Clay
inches	%		ppm						Meq/100g	%			
0-6	2.7	7.9	24.4	2.8	10	221	3.5	5,473	86	28.7	25	49	26
6-24	2.1	8.2	16.1	2.3	5	195	3.9	5,823	100	30.5	24	46	30

Weather conditions

The fall of 2022 had 3.5 inches of precipitation at the station where the plots were located. Still, below-average temperatures resulted in modest forage production in December (Table 3). The winter and early spring were colder than average and extremely dry, with only 2.0 inches of cumulative precipitation between January 1 and March 30. A total of 10.0 inches of precipitation accumulated between April 1 and harvest (Figure 2), helping the crop recover some of drought stress experienced during the dry winter.

Fall forage yield

Fall forage production of the varieties evaluated ranged from 213 to 679 pounds of dry matter per acre, averaging 354 pounds of dry matter per acre (Table 3). There were significant statistical differences among the varieties, with the highest forage producers being Guardian and KS Ahearn (489 – 679 pounds of dry matter per acre), followed closely by AP Prolific, LCS Atomic AX and LCS Galloway AX (about 450 pounds of dry matter per acre).

First hollow stem

First hollow stem is reported in day of year format (day of the year 80 is March 21). Average occurrence of first hollow stem was day 91 (Table 3), ranging from day of year 85 for early varieties to day of year 92 for late varieties. These dates represent a fairly

late release from winter dormancy, which was due to prolonged cold temperatures and dry winter conditions. The earliest varieties to reach first hollow stem were LCS Atomic AX and KS Hatchett. The latest variety to achieve first hollow stem was Whistler. All varieties reached first hollow stem within a 7-day interval. 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 the interaction with photoperiod.

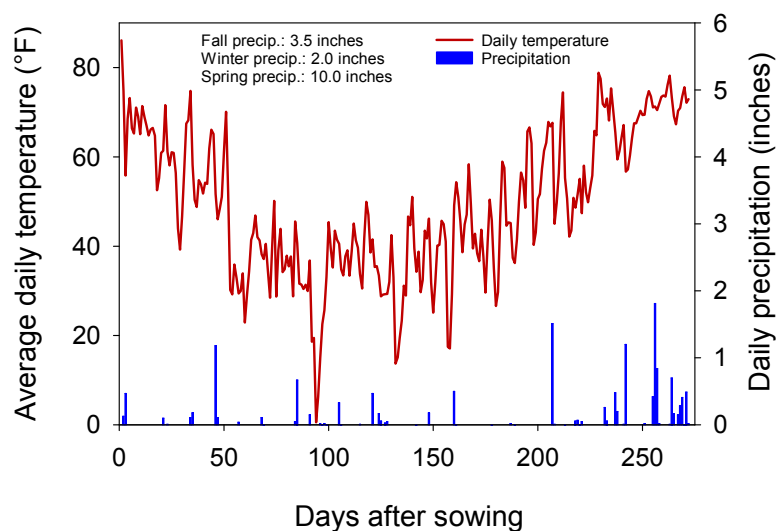


Figure 2. Observed weather during the 2022–23 growing season in the South Central Experiment Field near Hutchinson, Kansas. Weather data are average daily temperature and cumulative daily precipitation from September 20, 2022 until July 1, 2023.

Table 3. Fall dry matter forage yield, date of first hollow stem, and plant height under grain-only (GO) and dual-purpose (DP) systems in Hutchinson, Kansas, during the 2022-23 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 --- pounds per acre ---	First hollow stem Day of year	Plant height		
				GO	DP	diff.
				---- inches ----		
AM Cartwright	AgriMaxx	330	92	22.2	20.4	-1.7
AP EverRock	Agripro	244	89	19.2	19.4	0.2
AP Prolific	Agripro	459	92	21.5	21.6	0.1
AP18 AX	Agripro	304	92	22.8	22.7	-0.1
ARMOR EXP55	Croplan	314	92	22.8	21.9	-1.0
ARMOR EXP6 AX	Croplan	384	89	23.2	22.0	-1.2
CP7017 AX	Croplan	283	89	20.6	21.7	1.1
CP7050 AX	Croplan	351	89	21.6	20.3	-1.3
CP7266 AX	Croplan	335	92	24.1	22.5	-1.6
CP7869	Croplan	403	92	23.9	22.3	-1.6
CP7909	Croplan	304	92	21.8	21.1	-0.7
Guardian	Plains Gold	679	92	24.6	22.3	-2.3
Kivari AX	Plains Gold	375	92	24.2	23.4	-0.8
KS Ahearn	KWA	489	92	21.6	20.8	-0.8
KS Hatchett	KWA	314	85	22.5	20.2	-2.4
KS Providence	KWA	333	92	21.9	21.2	-0.7
LCS Atomic AX	Limagrain	436	85	22.0	21.1	-0.9
LCS Galloway AX	Limagrain	440	89	23.7	22.3	-1.4
LCS Steel AX	Limagrain	286	92	23.3	24.0	0.6
LCS19DH-152-6	Limagrain	234	92	23.4	20.4	-3.0
Whistler	Plains Gold	274	92	28.0	25.9	-2.1
Average		361	91	22.8	21.8	-1.0
Minimum		234	85	19.2	19.4	-3.0
Maximum		679	92	28.0	25.9	1.1

Plant height

Varieties and cropping systems also differed significantly in plant height (Table 3). Plant height in the grain only system averaged 22.9 inches, ranging from 19.2 to 28.0 inches. This average was only an inch taller than the average of all varieties in the dual-purpose system (21.9 inches). The range in plant height was narrower in the dual purpose system, with varieties ranging from 19.4 to 25.9 inches. The tallest variety was Whistler at both management systems.

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

Average grain yield in the grain-only trial was 51.0 bushels per acre, whereas the dual-purpose trial averaged 48.9 bushels per acre (Table 4). The weather conditions — characterized by severe drought across

the season with cool and moist conditions after May 15 – were beneficial to late-maturing varieties across both systems. Varieties that yielded statistically better than counterparts in the grain-only trial were LCS Steel AX and Whistler. The yield penalty from simulated grazing averaged 2.1 bushels per acre and ranged from a positive gain of 3.6 bushels per acre to a loss of 7.5 bushels per acre. Varieties included in the highest yielding group of the dual-purpose trial were CP7869, LCS Steel AX, and Whistler.

The only variety with the highest test weight at both grain-only (average: 60.8 pounds per bushel) and dual-purpose (average: 60.8 pounds per bushel) systems was Guardian, whereas the varieties CP7050 AX, CP7869, and LCS Atomic AX were in the highest test weight group under dual-purpose (Table 4).

Table 4. Winter wheat grain yield and grain test weight in grain-only (GO) and dual-purpose (DP) systems in Hutchinson, Kansas, during the 2022–23 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 -----		
AM Cartwright	AgriMaxx	48.2	45.1	-3.1	59.3	60.0	0.7
AP EverRock	Agripro	47.6	42.0	-5.6	59.4	60.1	0.7
AP Prolific	Agripro	51.7	44.3	-7.5	61.6	61.5	-0.1
AP18 AX	Agripro	49.4	44.1	-5.3	60.0	60.6	0.5
ARMOR EXP55	Croplan	52.3	54.6	2.2	61.7	61.3	-0.3
ARMOR EXP6 AX	Croplan	50.1	48.6	-1.5	61.1	60.2	-0.9
CP7017 AX	Croplan	50.8	50.4	-0.4	60.8	61.3	0.4
CP7050 AX	Croplan	43.4	39.6	-3.8	61.8	62.1	0.3
CP7266 AX	Croplan	48.7	46.1	-2.6	61.1	60.3	-0.9
CP7869	Croplan	53.2	55.3	2.0	61.9	61.7	-0.3
CP7909	Croplan	52.9	46.5	-6.5	60.8	61.4	0.6
Guardian	Plains Gold	53.8	54.9	1.1	63.3	62.6	-0.7
Kivari AX	Plains Gold	53.7	53.0	-0.7	61.3	61.3	-0.1
KS Ahearn	KWA	50.8	50.2	-0.5	58.9	59.9	0.9
KS Hatchett	KWA	46.1	45.5	-0.6	60.5	60.5	0.0
KS Providence	KWA	48.7	47.1	-1.6	59.9	60.5	0.6
LCS Atomic AX	Limagrain	47.2	43.6	-3.6	62.1	61.8	-0.4
LCS Galloway AX	Limagrain	53.4	46.7	-6.8	61.0	61.3	0.3
LCS Steel AX	Limagrain	58.6	58.4	-0.2	59.6	59.9	0.4
LCS19DH-152-6	Limagrain	48.4	52.0	3.6	60.1	59.6	-0.5
Whistler	Plains Gold	62.0	59.3	-2.7	60.0	60.0	-0.1
Average		51.0	48.9	-2.1	60.8	60.8	0.1
Minimum		43.4	39.6	-7.5	58.9	59.6	-0.9
Maximum		62.0	59.3	3.6	63.3	62.6	0.9

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MF3312 | July 2023