K-STATE Research and Extension

Department of Agronomy

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Wheat Variety Date of First Hollow Stem, Fall Forage Yield, and Grain Yield for 2020-21

To be successful in dual-purpose systems, wheat varieties often require traits that are sometimes overlooked in grain-only systems. These traits include fall forage yield potential, date of first hollow stem, recovery potential from grazing, resistance to viral diseases more commonly transmitted under early sowing, no high-temperature germination sensitivity, long coleoptile, and 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 dual-purpose versus grain-only systems.

Fall forage yield potential 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 per acre. Forage production is dependent on variety selection, 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 maintaining the grain yield potential. Grazing past first hollow stem can decrease wheat grain yield by as much as 1 to 5% per day.

Varieties with a shorter vernalization requirement might reach first hollow stem up to 20 to 30 days earlier than varieties with a longer vernalization requirement, depending on environmental conditions. An early occurrence of first hollow stem reduces the grazing window into early spring. Date of first hollow stem depends on temperature and day length.

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

Description of site and methods

Thirty-four commonly grown winter wheat varieties 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

Table 1. *Seeding rate, dates of sowing, forage harvest, simulated grazing, and grain harvest for three trials evaluating 34 winter wheat varieties under dual-purpose or grain-only management.*

Trial	Seeding rate	Sowing date	Forage harvest	Simulated grazing	Grain harvest
	--- lbs/acre ---		---------- date ----------		
Dual-purpose — First hollow stem	120	9/17/2020	12/20/2020	—	—
Dual-purpose — Grain harvest	120	9/17/2020	— — —	3/25/2021 3/1/2021 3/5/2021 3/12/2021 3/25/2021 3/30/2021	6/22/2021
Grain only	75	10/08/2020	—	—	6/22/2021

Table 2. *Initial soil fertility on the study site collected at sowing.*

Soil depth	O.M.	pH	NO_3-N	P	K	Ca	Mg	Na	SO_4-S	CEC
inches	%		---------- ppm ----------							meq/100g
0 - 6	3.0	7.3	54.8	27.7	352	4,720	122	11	7.3	25.8
6 - 24	2.6	7.7	36.9	11.8	284	5,405	100	13	6.5	28.7

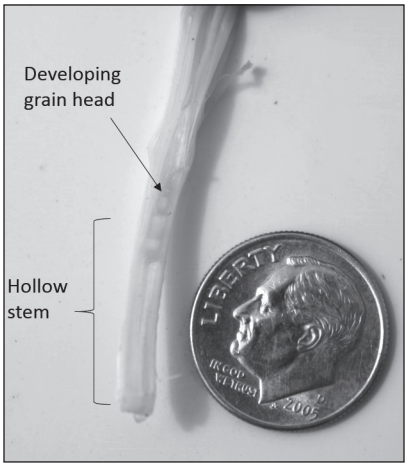

Figure 1. *Wheat plant at the first hollow stem stage. First hollow stem occurs when there is approximately 1.5 centimeters (9/16 inch or roughly the diameter of a dime) below the developing wheat head.*

a third trial was sown to 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 110 pounds of nitrogen per acre pre-plant to supplement forage production (Table 2). All trials were sprayed with foliar fungicides at boot (May 5, 2021).

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 ½ 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 seven times during the winter and early spring by splitting 10 primary stems collected from each plot one or two times per week.

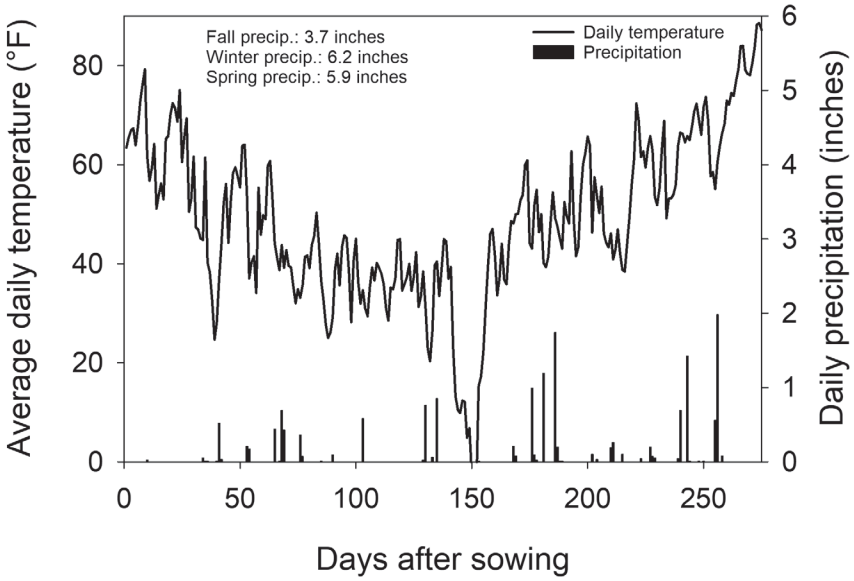

Figure 2. *Observed weather during the 2020-21 growing season in the South Central Experiment Field near Hutchinson, Kansas. Weather data are average daily temperature and cumulative daily precipitation from September 17, 2020, until June 22, 2021.*

First hollow stem sampling was terminated when 100% of the measured stems had passed 1.5 centimeters of hollow stem below the developing wheat head (Figure 1). This trial was not harvested for grain yield due to the excessive amount of destructive measurements.

Simulated grazing occurred in the dual-purpose trial during the fall and spring seasons (Table 1). Plots were mowed to about 1.5 inch height every time regrowth achieved about 2 inches. Simulated grazing was stopped at the average first hollow stem. Plant height was measured in 10 plants in each plot. Grain was harvested and grain yield was corrected for 13% moisture content.

Weather conditions

The fall of 2020 had 3.7 inches of precipitation at the station where the plots were located; however, relatively mild temperatures precluded the wheat crop from producing a large amount of biomass. Winter and early spring were relatively warm and moist, with 6.2 inches of cumulative precipitation between January 1 and March 30, allowing for tiller production during this time. Temperatures remained below average and precipitation above average through the end of the growing season, totaling another 5.9 inches of precipitation accumulated between April 1 and harvest (Figure 2).

Fall forage yield

Fall forage production of the varieties evaluated averaged 737 pounds of dry matter per acre (Table 3), which is similar to that produced in 2019-20 but about half of that produced in 2018-19. The range was from 470 to 1,058 pounds of dry matter per acre. There were no statistical differences among the varieties. The limited forage production during the 2020-21 growing season as compared to previous years was led by mild fall temperatures, which resulted in limited tiller production.

First hollow stem

First hollow stem is reported in day of year format. Day of the year 80 is equivalent to March 21. Average occurrence of first hollow stem was day 89 (Table 3), which is about 13 days later than the 2019-20 growing season. The range in first hollow stem was from day of year 75 for early varieties

Table 3. *Fall dry forage yield, date of first hollow stem, and plant height under grain-only (GO) and dual-purpose (DP) systems in Hutchinson, Kansas, during the 2020–21 production year. The highest testing groups are identified by shading and bold text.*

Variety	Source	Fall forage dry matter (12/22/2020)	First hollow stem	Plant height		
				GO	DP	diff.
		--- lbs/acre ---	Day of year	----- in -----		
10BC329-17-5	AgriPro	714	89	26	21	5.3
AP EverRock	AgriPro	733	83	28	21	6.6
AP Roadrunner	AgriPro	858	89	29	26	3.4
Buckhorn AX	Dyna-Gro	1,058	75	29	23	6.4
Canvas	Plains-Gold	782	89	29	**28**	0.3
Crescent AX	Plains-Gold	704	89	29	**27**	1.7
High Country	Polansky	789	89	27	24	4.0
KS Dallas	KWA	601	89	27	24	3.0
KS Hamilton	KWA	758	94	28	26	1.8
KS Hatchett	KWA	829	89	27	24	3.1
KS Silverado	KWA	664	94	27	25	2.2
KS Western Star	KWA	720	89	**30**	**28**	2.6
KS12DH0156-88	KWA	851	94	27	23	3.4
KS13DH0041-35	KWA	773	89	28	**27**	1.4
LCS Atomic AX	Limagrain	532	89	28	26	2.0
LCS Helix AX	Limagrain	679	89	27	24	3.3
LCS Julep	Limagrain	952	89	27	20	6.4
LCS Photon AX	Limagrain	735	83	27	23	4.7
LCS Revere	Limagrain	833	89	27	21	6.3
Long Branch	Dyna-Gro	723	80	30	24	6.3
MS Maverick	Meridian	729	89	**32**	**29**	3.6
NUSAKA15-3	KSU Exp.	808	89	28	23	4.5
OCW04S717T-6W	OGI	751	89	30	29	1.4
OK Corral	OGI	839	89	28	**27**	1.5
OK12912C-138407-2	OGI	739	94	**32**	**31**	1.6
OK16D101089	OGI	952	89	29	**27**	1.9
Paradise	Polansky	470	89	28	**27**	1.4
Rock Star	Polansky	745	94	28	**27**	0.9
Showdown	OGI	548	89	**31**	**27**	3.6
Smith's Gold	OGI	711	89	28	25	3.4
WB4269	WestBred	654	89	26	23	3.1
WB4401	WestBred	554	89	28	25	3.0
WB4699	WestBred	642	94	25	23	2.1
Zenda	KWA	620	83	27	23	4.4
Average		737	89	28	25	3.3
Min.		470	75	25	20	0.3
Max.		1,058	94	32	31	6.6
HSD*		na	na	1.9	4.0	

* *HSD — Tukey's honest significant difference, or the minimum difference required between two varieties to be statistically different.*

to day of year 94 to late varieties, with the majority of the varieties achieving first hollow stem on day of year 89. This late release from winter dormancy was due to prolonged winter followed by a sharp transition to warm temperatures and moisture availability in the spring. The earliest variety to reach first hollow stem was Buckhorn AX, and the latest varieties were KS Hamilton, KS Silverado, KS12DH0156-88, OK12912C-138407-2, Rock Star, WB4401 and WB4699. All studied varieties reached first hollow stem within a 19-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. Our report may differ from Oklahoma results due to cooler winter temperatures and the interaction with photoperiod.

Plant height

Varieties and cropping systems also differed significantly in plant height (Table 3). Plant height in the grain-only system averaged 28 inches, ranging from 25 to 32 inches. This average was 3 inches taller than the average of all varieties in the dual-purpose system (25 inches). The range in plant height was also wider in the dual-purpose system, with varieties measuring as low as 20 and as tall as 31 inches. The tallest varieties were somewhat consistent regardless of system: KS Western Star, MS Maverick, OK12912C-138407-2, and Showdown were in the tallest group in both systems, while additional varieties in the tallest group in the dual-purpose system also included Canvas, Crescent AX, KS13DH0041-35, OK Corral, OK16D101089, Paradise, and Rock Star.

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

Average grain yield in the grain-only trial was 60.5 bushels per acre, whereas the dual-purpose trial averaged 50.2 bushels per acre (Table 4). Varieties that yielded statistically better their counterparts included in the grain-only trial were 10BC329-17-5, AP EverRock, LCS Revere, Long Branch, NUSAKA15-3, Rock Star, and WB4699. The yield penalty from simulated grazing averaged 10.3 bushels per acre and ranged from less than a positive gain of 7.3 to a loss of 38.9 bushels per acre. A number of varieties were included in the highest yielding group of the dual-purpose trial, with the lowest yielding varieties including 10BC329-17-5, AP EverRock, Buckhorn AX, LCS Helix AX, LCS Julep, LCS Photon AX, OCW04S717T-6W, Smith's Gold, and Zenda. These results demonstrate that the recovery from grazing is variety-specific and should be considered when selecting a wheat variety for dual-purpose systems.

Varieties with the highest test weight at both grain-only (average: 60.5 pounds per bushel) and dual-purpose (average: 61.5 pounds per bushel) systems were 10BC329-17-5, Buckhorn AX, Crescent AX, LCS Photon AX, and LCS Revere. For grain-only, AP EverRock and NUSAKA15-3 were also in the highest test weight group; while for dual-purpose, KS Silverado, LCS Helix AX, and WB4269 were also in the highest test weight group.

Table 4. *Grain yield and grain test weight in grain-only (GO) and dual-purpose (DP) systems in Hutchinson, Kansas, during the 2020–21 production year. The highest testing groups are identified by shading and bold text.*

		Grain yield			Test weight*		
Variety	**Source**	**GO**	**DP**	**diff.**	**GO**	**DP**	**diff.**
		---------- bu/a ----------			------ pounds per bushel ------		
10BC329-17-5	AgriPro	**76.3**	37.4	38.9	**63.4**	**63.3**	0.1
AP EverRock	AgriPro	**80.8**	46.8	34.0	**62.4**	61.2	1.3
AP Roadrunner	AgriPro	62.8	**48.8**	13.9	59.3	59.2	0.1
Buckhorn AX	Dyna-Gro	56.6	35.3	21.4	**62.4**	**64.2**	-1.7
Canvas	PlainsGold	63.2	**54.2**	9.0	60.6	62.0	-1.4
Crescent AX	PlainsGold	57.5	**57.9**	-0.4	**62.8**	**62.9**	-0.1
High Country	Polansky	60.8	**51.9**	8.9	60.3	62.0	-1.6
KS Dallas	KWA	53.4	**51.7**	1.7	57.0	58.5	-1.5
KS Hamilton	KWA	44.5	**51.8**	-7.3	56.9	58.9	-2.0
KS Hatchett	KWA	62.6	**55.9**	6.7	60.7	61.9	-1.2
KS Silverado	KWA	51.7	**49.8**	1.9	60.4	**63.1**	-2.7
KS Western Star	KWA	54.5	**50.1**	4.4	61.5	62.4	-0.9
KS12DH0156-88	KWA	63.2	**50.7**	12.5	59.5	62.1	-2.6
KS13DH0041-35	KWA	54.9	**55.7**	-0.8	58.8	60.5	-1.7
LCS Atomic AX	Limagrain	53.3	**50.7**	2.6	60.5	59.7	0.8
LCS Helix AX	Limagrain	51.7	42.7	9.1	61.7	**63.0**	-1.4
LCS Julep	Limagrain	60.0	39.2	20.9	60.6	62.5	-1.9
LCS Photon AX	Limagrain	54.8	43.5	11.3	**62.7**	**63.5**	-0.9
LCS Revere	Limagrain	**71.2**	**48.0**	23.2	**62.6**	**62.6**	0.0
Long Branch	Dyna-Gro	**69.4**	**53.5**	15.9	59.9	61.4	-1.4
MS Maverick	Meridian	53.4	**59.5**	-6.1	60.6	61.2	-0.6
NUSAKA15-3	KSU Exp.	**73.5**	**59.7**	13.8	**61.9**	61.3	0.6
OCW04S717T-6W	OGI	57.2	45.7	11.5	57.9	58.4	-0.6
OK Corral	OGI	59.2	**54.4**	4.9	56.8	58.5	-1.7
OK12912C-138407-2	OGI	60.0	**48.6**	11.4	60.3	61.3	-1.0
OK16D101089	OGI	56.1	**57.0**	-0.9	58.9	61.2	-2.3
Paradise	Polansky	57.7	**55.1**	2.7	61.5	62.1	-0.6
Rock Star	Polansky	**66.4**	**57.8**	8.6	60.6	60.8	-0.2
Showdown	OGI	61.2	**58.5**	2.7	60.8	61.0	-0.3
Smith's Gold	OGI	63.6	45.9	17.7	60.8	61.5	-0.7
WB4269	WestBred	63.1	**49.2**	13.9	61.6	**62.8**	-1.1
WB4401	WestBred	53.9	**47.2**	6.7	61.2	62.1	-0.9
WB4699	WestBred	**66.4**	**51.9**	14.5	59.8	59.9	-0.2
Zenda	KWA	60.6	45.0	15.7	61.4	62.4	-1.0
Average		60.5	50.3	10.1	60.5	61.5	-0.9
Min.		44.5	35.3	-7.3	56.8	58.4	-2.7
Max.		80.8	59.7	38.9	63.4	64.2	1.3
HSD		14.4	12.5		1.5	1.4	

* *HSD — Tukey's honest significant difference, or the minimum difference required between two varieties to be statistically different.*

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