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Wheat Variety Date of First Hollow Stem and Grain Yield 2018-2019

MF3312

To be successful in dual-purpose systems, wheat varieties often require traits sometimes overlooked in grain-only systems. These include fall forage yield potential, date of first hollow stem, recovery potential from grazing, resistance to viral diseases more commonly transmitted under early sowing, high temperature germination sensitivity, long coleoptile, and tolerance to low soil pH and aluminum toxicity. This publication evaluates the fall forage yield, date of first hollow stem, plant height, and grain yield 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 can be produced for every 1,000 pounds of wheat forage produced in an acre. Forage production is dependent on variety selection, planting date, seeding and nitrogen rates, and fall temperatures and precipitation.

Date of first hollow stem is an important trait in dual-purpose systems. Terminating grazing at the right time is essential to maintaining grain yield potential. Grazing past first hollow stem can decrease wheat grain yield in as much as 1 to 5 percent per day.

Varieties with a shorter vernalization requirement might reach first hollow stem up 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 in photoperiod-sensitive varieties.

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

Description of site and methods

Thirty-six 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 a third trial was sown to the same varieties under grain-only management (Table 1). A randomized complete block design with four replications was used at the three trials. All plots received 50 pounds per acre of

Table 1. *Seeding rate, dates of sowing, forage harvest, simulated grazing, and grain harvest for three trials evaluating 36 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	09/19/2018	12/15/2018	—	—
Dual-purpose — Grain harvest	120	09/19/2018	—	2/1/2019	6/26/2019
			—	2/27/2019	
			—	3/18/2019 3/25/2019	
Grain-only	60	10/22/2018	—	—	6/26/2019

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	2.3	7.2	21.3	50.8	205	3,516	164	13	5.8	19.5
6 - 24	2.0	7.8	20.5	9.8	168	4,983	191	21	5.2	27.0

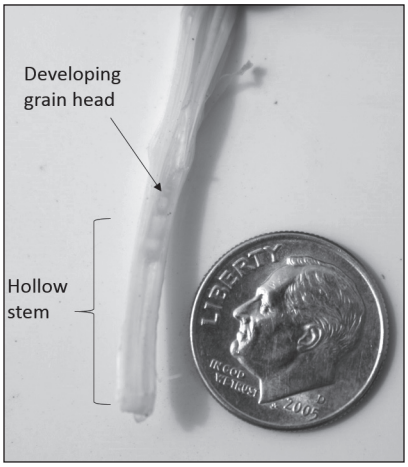

Figure 1. *Wheat plant at the first hollow stem stage. First hollow stem occurs when there is approximately 1.5 centimeters (9/16 inch or roughly the diameter of a dime) below the developing wheat head.*

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). Trials were not sprayed with foliar fungicides; thus, the high incidence of leaf and stripe rust during the 2018-19 season needs to be considered when evaluating the results from these experiments.

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 during the winter and early spring by splitting 10 primary stems collected from each plot on a weekly basis during the spring. First hollow stem sampling was terminated when 100% of the measured stems had passed 1.5 centimeters (9/16 inch) 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.

The remaining two trials, one managed as grain-only and another as dual-purpose, were harvested for grain yield to differentiate how commercial varieties recovered from simulated grazing. Simulated grazing occurred in the dual-purpose trial during the fall and spring seasons (Table 1). Plots were grazed to a height of about 1.5 inch using a commercial grass mower every time regrowth achieved about 2 inches. Simulated grazing was terminated at first hollow stem. Grain harvest was performed with a small plot combine and grain yield was corrected for 13% moisture content.

Weather conditions

The fall of 2018 had 17.2 inches of precipitation at the station where the plots were located, and was characterized by an early onset of cold temperatures (November 8, 2019; Figure 1). Winter and early spring were cool and moist, with 3.3 inches cumulative precipitation between January 1 and March 15. Temperatures remained below average and precipitation above average through the end of the growing season, totaling another 18.8 inches accumulated between April 1 and June 30 (Figure 1). The early onset of cold temperatures in the fall combined with the excessive growing season precipitation (39.3 inches) favored yield in the dual-purpose trial when compared to the grain only trial.

Fall forage yield

Fall forage production of the evaluated varieties averaged 2,077 pounds per acre and ranged from 1,397 to 2,700 pounds per acre (Table 3). The greatest forage producing variety was Green Hammer, which was statistically similar to the forage production attained by the varieties SY Achieve CL2, Bentley, Rockstar, Joe, Whistler, Spirit Rider, Doublestop CL Plus, WB4515, Bob Dole, Paradise, Gallagher, Smith's Gold, WB4595, AM Eastwood, and Lonerider. Varieties such as Zenda, Iba, Showdown produced significantly less forage than the ones mentioned above (Table 3).

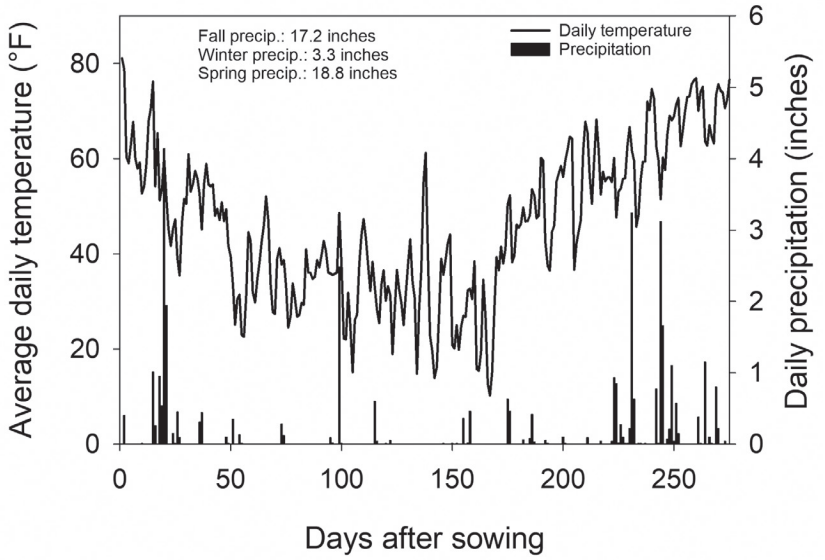

Figure 2. *Observed weather during the 2018-19 growing season in the South Central Experiment Field near Hutchinson, Kansas. Weather data are average daily temperature and cumulative daily precipitation from September 19, 2018 until June 30, 2019.*

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, KS, during the 2018-19 production year. Shaded values belong to the highest testing group and do not differ statistically from each other.*

Variety	Source	Fall dry forage yield (12/15/2018)	First hollow stem	Plant height	
				GO	DP
		--- lbs / a ---	Day of year	----- in -----	
AM Eastwood	AgriMaxx	**2,104**	83	29.5	33.6
Bentley	OGI	**2,557**	90	**34.0**	**43.1**
Bob Dole	Agripro	**2,366**	90	**36.3**	**40.8**
Byrd	Plains Gold	1,831	85	**33.1**	37.3
Doublestop CL Plus	OGI	**2,385**	90	32.9	**42.0**
Gallagher	OGI	**2,143**	90	31.3	35.5
Green Hammer	OGI	**2,700**	85	**33.8**	**40.3**
Iba	OGI	2,038	85	28.8	36.7
Joe	KWA	**2,470**	90	**33.2**	38.5
Langin	Plains Gold	1,397	95	30.6	38.1
Larry	KWA	1,902	85	30.0	**40.3**
LCS Valiant	Limagrain	1,519	92	31.9	37.2
Lonerider	OGI	**2,099**	90	29.4	35.9
Paradise	Polansky	**2,146**	90	30.0	36.8
Rockstar	Polansky	**2,547**	90	31.6	35.1
Ruby Lee	OGI	1,822	85	31.3	**40.5**
Showdown	OGI	2,000	90	31.2	39.7
Smith's Gold	OGI	**2,106**	85	28.2	37.3
Spirit Rider	OGI	**2,399**	83	26.9	34.6
Stardust	OGI	1,775	85	32.4	36.7
SY Achieve CL2	Agripro	**2,615**	83	32.0	35.1
SY Benefit	Agripro	1,838	83	30.3	36.3
SY Grit	Agripro	1,920	85	31.0	36.5
SY Rugged	Agripro	1,653	92	28.4	34.6
SY Wolverine	Agripro	2,035	90	25.1	35.8
TAM 204	Watley Seed	**2,094**	85	30.9	37.0
Tatanka	KWA	1,967	90	30.3	37.3
WB4269	WestBred	1,824	85	28.4	37.0
WB4303	WestBred	1,970	83	29.8	34.9
WB4515	WestBred	**2,369**	90	31.3	**40.3**
WB4595	WestBred	**2,106**	85	32.4	39.5
WB4699	WestBred	1,798	92	28.1	35.8
WB4792	WestBred	1,937	85	32.0	**40.5**
WB-Grainfield	WestBred	1,852	90	**33.7**	38.0
Whistler	Plains Gold	**2,442**	90	**35.3**	39.3
Zenda	KWA	2,054	85	31.2	38.4
Average		2,077	88	31.0	37.7
Minimum		1,397	83	25.1	33.6
Maximum		2,700	95	36.3	43.1
LSD (0.05)*		607		3.2	2.9

**LSD — Least significant difference, or the minimum difference required between two varieties to be statistically different.*

First hollow stem

First hollow stem is reported in day of the year format. Day of the year 80 is equivalent to March 21. Average occurrence of first hollow stem was day 87, which is 2 to 3 weeks later than the 2015-16 and 2016-17 seasons, but similar to the 2017-18 season. This late occurrence of first hollow stem was mostly due to cool growing season conditions. The earliest varieties (AM Eastwood, Spirit Rider, SY Achieve CL2, SY Benefit, and WB 4303) reached first hollow stem on day 83 and latest variety (Joe) on day 95 (Table 3). All studied varieties reached first hollow stem within a 12-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. The Kansas report may differ from Oklahoma's results due to the interaction with photoperiod.

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

Average grain yield in the grain-only trial was 45.3 bushels per acre, whereas the dual-purpose trial averaged 66.6 bushels per acre (Table 4). Historically, the grain-only trial out yields the dual-purpose trial; however, the different pattern in grain yield observed during the 2018-19 growing season was mainly due to the earlier sowing date and the higher nitrogen rate in the dual-purpose trial.

Colder temperatures occurred November 8, 2018, which was only 20 days after sowing the grain-only trial and about 50 days after sowing the dual-purpose trial. Thus, the earlier-sown trial had more time to develop fall tillers, which contribute more to grain yield than spring-formed tillers. Additionally, the nearly 39 inches of growing season precipitation benefited the dual-purpose trial for two reasons: First, it favored crop recovery from simulated grazing, as there was enough moisture to produce new tillers in the spring. Second, it caused greater nitrogen losses possibly through leaching and denitrification; thus, the additional 110 pounds of nitrogen per acre applied to the dual-purpose trial also contributed to increased grain yield.

Varieties that yielded statistically better their counterparts include Bob Dole in the grain-only trial and DoubleStop CL Plus and WB4792 in the dual-purpose trial (Table 4). Average test weight was 58.2 pounds per bushel in the grain-only trial and 61.1 pounds per bushel in the dual-purpose trial (Table 4). There was significant difference in test weight among varieties, but several varieties were typically included in the highest test-weight group. Some varieties showed extremely low test weight, which was either due to high incidence of leaf and stripe rust, or due to an early and accentuated occurrence of lodging in the dual purpose trial.

Table 4. *Grain yield and test weight in grain-only (GO) and dual-purpose (DP) systems in Hutchinson, Kansas, during the 2018-19 production year. Shaded values belong to the highest testing group and do not differ statistically from each other..*

		Grain yield			Test weight		
Variety	**Source**	**GO**	**DP**	**diff.**	**GO**	**DP**	**diff.**
		---------- bu/a ----------			---------- lbs/bu ----------		
AM Eastwood	AgriMaxx	39.5	57.8	-18.4	58.5	**59.9**	-1.4
Bentley	OGI	51.8	67.4	-15.6	**59.6**	**59.9**	-0.3
Bob Dole	Agripro	**64.3**	75.0	-10.8	**61.4**	**64.8**	-3.4
Byrd	Plains Gold	41.2	57.6	-16.3	54.5	**61.2**	-6.7
Doublestop CL Plus	OGI	55.3	**77.9**	-22.6	**63.1**	**66.7**	-3.6
Gallagher	OGI	47.2	71.6	-24.4	57.9	**64.1**	-6.2
Green Hammer	OGI	55.1	71.5	-16.4	**63.9**	**65.3**	-1.4
Iba	OGI	40.0	60.1	-20.0	**60.5**	**62.5**	-2.0
Joe	KWA	48.1	69.3	-21.2	57.0	**62.0**	-5.0
Langin	Plains Gold	42.5	63.5	-21.0	**59.8**	**61.0**	-1.2
Larry	KWA	38.7	62.8	-24.1	51.7	**60.5**	-8.8
LCS Valiant	Limagrain	44.8	70.8	-26.1	**59.9**	**60.4**	-0.5
Lonerider	OGI	39.7	60.9	-21.2	**60.2**	**63.8**	-3.6
Paradise	Polansky	43.8	71.6	-27.8	56.9	**62.4**	-5.5
Rockstar	Polansky	49.0	74.6	-25.6	57.9	**63.7**	-5.8
Ruby Lee	OGI	37.1	67.3	-30.2	**59.9**	**62.0**	-2.1
Showdown	OGI	45.7	60.2	-14.5	**59.8**	57.9	1.8
Smith's Gold	OGI	43.1	74.1	-31.0	58.6	**64.8**	-6.2
Spirit Rider	OGI	48.2	73.7	-25.5	**60.4**	**60.8**	-0.4
Stardust	OGI	42.1	62.7	-20.6	57.3	**61.6**	-4.3
SY Achieve CL2	Agripro	48.1	67.1	-18.9	**63.5**	**64.0**	-0.5
SY Benefit	Agripro	47.3	54.3	-7.1	**62.1**	57.0	5.1
SY Grit	Agripro	31.2	63.2	-32.0	52.5	59.4	-6.9
SY Rugged	Agripro	44.6	70.6	-26.0	57.2	**60.0**	-2.8
SY Wolverine	Agripro	42.2	75.8	-33.6	**63.1**	**63.0**	0.1
TAM 204	Watley Seed	35.7	58.8	-23.1	51.4	52.3	-0.9
Tatanka	KWA	46.9	42.6	4.3	57.7	42.7	15.0
WB4269	WestBred	49.1	72.1	-23.0	**62.6**	**64.8**	-2.2
WB4303	WestBred	45.0	66.2	-21.2	54.5	58.1	-3.6
WB4515	WestBred	47.7	66.8	-19.1	**61.9**	**62.6**	-0.7
WB4595	WestBred	52.6	71.2	-18.6	57.9	**63.7**	-5.7
WB4699	WestBred	44.5	74.1	-29.6	55.3	**61.7**	-6.5
WB4792	WestBred	50.7	**86.1**	-35.5	50.8	**62.3**	-11.5
WB-Grainfield	WestBred	43.5	62.3	-18.7	57.9	**61.7**	-3.8
Whistler	Plains Gold	38.8	44.4	-5.6	50.0	56.2	-6.2
Zenda	KWA	47.2	69.8	-22.6	**59.7**	**64.2**	-4.5
Mean		45.3	66.6	-21.2	58.2	61.1	-2.8
Minimum		31.2	42.6	-35.5	50.0	42.7	-11.5
Maximum		64.3	86.1	4.3	63.9	66.7	15.0
LSD (0.05)*		6.3	8.2		5.3	7.3	

**LSD — Least significant difference, or the minimum difference required between two varieties to be statistically different.*

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