K·STATE Research and Extension

Department of Agronomy

Wheat Variety Date of First Hollow Stem, Fall Forage Yield, and Grain Yield 2016

MF3312

To be successful in dual-purpose systems, wheat varieties often require traits that are overlooked in grain-only systems. These traits include fall forage yield potential, date of first hollow stem, potential for recovery from grazing, resistance to viral diseases common under early planting, high temperature germination sensitivity, coleoptile length, tolerance to low soil pH, and aluminum toxicity. This publication evaluates the fall forage yield, date of first hollow stem, 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 rate, and especially on fall precipitation and temperature.

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

Depending on environmental conditions, varieties with a shorter vernalization requirement might reach first hollow stem up to 30 days earlier than varieties with a longer vernalization requirement. An early occurrence of first hollow stem reduces the grazing window into early spring. In photoperiod-sensitive varieties, date of first hollow stem is dependent on temperature and day length.

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 a good spring tiller potential.

Description of site and methods

Twenty three commonly grown winter wheat varieties were planted in three neighboring trials at the South Central Experiment Field near Hutchinson, Kansas. Two trials were sown to simulate dual-purpose management, characterized by early planting date and higher seeding rate, while a third trial was planted with 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 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 to supplement forage production and harvest (Table 2).

Table 1. *Planting rate, dates of sowing, forage harvest, simulated grazing, and grain harvest for three trials evaluating 23 wheat varieties under dual-purpose versus grain-only management.*

Trial	Planting rate	Sowing	Forage harvest	Simulated grazing	Grain harvest
	---- lbs/acre ----	---- date ----			
Dual purpose 1	120	09/25/2015	01/05/2016	-	-
Dual purpose 2	120	09/25/2015	- - -	12/17/2015 02/04/2016 02/23/2016	6/16/2016
Grain only	60	10/07/2015	-	-	6/16/2016

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

pH (0-6 in)	pH (6-24 in)	NO_3-N (0-24 in)	P (0-6 in)	K (0-6 in)	Ca (0-6 in)	Mg (0-6 in)	Na (0-6 in)	SO4-S (0-6 in)	Cl (0-6 in)	CEC (0-6 in)
		---- ppm ----								meq/100 g
4.9	6.3	15.9	74.7	238	1,379	231	18	8	9	15

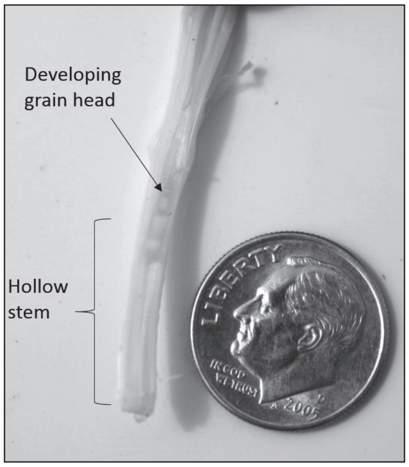

Figure 1. *Wheat plant at the first hollow stem stage. First hollow stem occurs when there is approximately 1.5 centimeters (or roughly the diameter of a dime) below the developing wheat head.*

One of the two dual-purpose trials was used for destructive measurements to assess forage yield and 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 percent 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.

Weather conditions

The warm and moist fall of 2015 favored fall forage development. With a total of 8 inches of fall precipitation and average temperature slightly above 50 degrees Fahrenheit (Figure 2), fall forage production of most varieties were greater than 1,200 pounds per acre despite the relatively late planting for a wheat grown under dual-purpose. Winter and early spring were dry, with less than 2 inches cumulative precipitation between January 1 and April 15. Grain yields following the dry early spring were favored by cool and moist weather during late April and May, with a total of 11 inches of precipitation and 60 degrees Fahrenheit average temperature.

The other two trials, one managed as grain-only and another as dual-purpose, were harvested for grain yield to compare how different commercial varieties recovered from simulated grazing. Simulated grazing occurred in the dual-purpose trial during the fall and spring semesters (Table 1). To represent grazing, plots were mowed to about 1.5 inch every time regrowth reached about 2 inches until first hollow stem.

Fall forage yield

Average fall forage yield across all varieties was 1,550 pounds per acre, ranging from 1,230 to 1,970 pounds per acre (Table 3). The greatest forage producer was the variety WB4303, and statistically similar forage production was attained by the varieties Bentley, TAM 114, WB-Cedar, SY Flint, Duster, WB-Redhawk, Gallagher, and Doublestop CL Plus. Varieties such as KanMark, WB4458, Overley, WB-Grainfield, Everest, and others, produced significantly less forage than the ones mentioned above (Table 3). Fall forage yield may have been restricted across all varieties by the relatively low soil pH in the top 6 inches (Table 2), as pH levels below 6 have shown to decrease wheat forage yield in most varieties.

First hollow stem

First hollow stem is reported in day of year format. Day of the year 60 is equivalent to March 1. Average occurrence of first hollow stem was day 70, with the earliest varieties reaching first hollow stem on day 65 and latest varieties on day 74 (Table 3). Varieties that reached first hollow stem earlier were WB-Cedar, WB4303, WB-Redhawk, 1863, Gallagher, and Overley, and later varieties included LCS Chrome, DoubleStop CL Plus, LCS Mint, Danby, and Bentley.

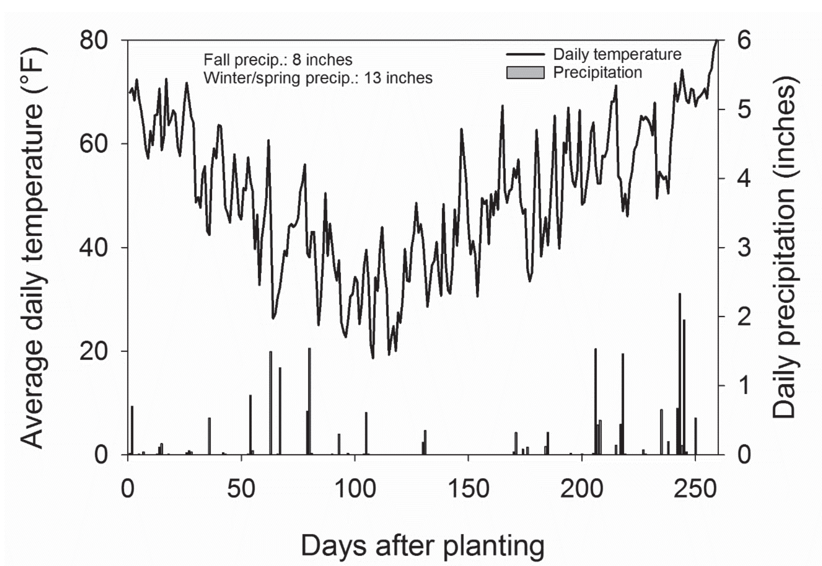

Figure 2. *Observed weather during the 2015-16 growing season in the South Central Experiment Field near Hutchinson, Kansas. Weather data are average daily temperature and daily precipitation from September 25, 2015, until June 14, 2016.*

All studied varieties reached first hollow stem within a 9-day interval, which is most likely a consequence of the above-normal winter temperatures observed during January and February. Above-normal winter temperatures seemed to level the date of first hollow stem across most varieties. 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. These report may differ from results obtained in Oklahoma due to the interaction of varieties with photoperiod.

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

Average grain yield in the grain-only trial was 77 bushels per acre, whereas the dual-purpose trial averaged 74.4 bushels per acre (Table 4). Varieties that yielded statistically better than the others include Bentley, Duster, Gallagher, KanMark, LCS Chrome, LCS Mint, SY Wolf, TAM 114, and WB-Grainfield in the grain-only trial, and the same varieties in the dual-purpose trial with the exception of Duster and Gallagher. The effects of simulated grazing increased and decreased wheat yields by as much as 4.4 and 10.3 bushels per acre, depending on variety (Table 4).

Table 3. *Fall forage yield, date of first hollow stem, plant height, and lodging under grain-only (GO) and dual-purpose (DP) systems in Hutchinson, Kansas, during the 2015-16 production year. Lodging: 1 = excellent straw strength; 9 = poor straw strength.*

Variety	Source	Fall dry forage yield	First hollow stem	Plant height GO	Plant height DP	Lodging GO	Lodging DP
		lbs/acre	day of year	------ inches ------			
1863	KWA	1,531	69	36.2	34.7	2	6
Bentley	OGI	1,854	72	38.7	37.6	1	2
Danby	KWA	1,467	73	36.5	33.8	2	2
Doublestop CL Plus	OGI	1,609	73	40.9	36.7	1	2
Duster	OGI	1,662	71	36.1	32.7	1	4
Everest	KWA	1,401	70	31.5	29.8	1	2
Gallagher	OGI	1,611	69	34.7	32.6	2	4
KanMark	KWA	1,226	70	31.5	31.5	1	1
LCS Chrome	LCS	1,503	74	36.0	36.0	1	1
LCS Mint	LCS	1,504	73	38.6	38.8	2	3
LCS Pistol	LCS	1,544	69	34.7	34.3	2	3
LCS Wizard	LCS	1,583	70	35.0	34.0	1	1
Overley	KWA	1,287	69	33.7	33.8	1	2
Ruby Lee	OGI	1,419	69	37.4	36.1	1	2
SY Flint	Syngenta	1,762	70	32.8	30.4	1	2
SY Wolf	Syngenta	1,419	71	36.6	34.7	1	2
T158	LCS	1,586	72	31.5	32.2	1	2
TAM 114	TAMU	1,822	70	36.1	34.5	2	2
WB4303	WestBred	1,970	65	31.5	29.4	1	2
WB4458	WestBred	1,250	69	31.1	32.0	1	2
WB-Cedar	WestBred	1,783	65	30.5	30.8	1	1
WB-Grainfield	WestBred	1,327	70	34.4	35.3	2	3
WB-Redhawk	WestBred	1,628	67	33.8	35.1	2	2
Mean		1,554	70	34.8	33.8	1	2
Minimum		1,226	65	30.5	29.4	1	1
Maximum		1,970	74	40.9	38.8	2	6
LSD (0.05)*		375	-	2.7	3.4	1	1

**LSD — Least significant difference, or the minimum difference required between two varieties to be statistically different. Shading indicates varieties with the highest forage yield, tallest plant height, or better straw strength. Shaded varieties in the same column do not differ statistically.*

Table 4. *Grain yield and test weight in grain-only (GO) and dual-purpose (DP) systems in Hutchinson, KS, during the 2015-16 production year.*

Variety	Source	Grain yield			Test weight		
		GO	DP	difference	GO	DP	difference
		------------- bu/a -------------			------------- lbs/bu -------------		
1863	KWA	77.9	77.6	-0.4	59.8	59.3	-0.5
Bentley	OGI	82.4	84.6	2.2	59.8	59.5	-0.3
Danby	KWA	70.8	72.3	1.5	58.9	60.9	2.0
Doublestop CL Plus	OGI	75.1	68.7	-6.4	60.9	58.6	-2.4
Duster	OGI	83.9	74.4	-9.5	59.7	57.1	-2.5
Everest	KWA	77.8	72.4	-5.4	60.5	59.2	-1.3
Gallagher	OGI	84.1	73.8	-10.3	59.7	57.4	-2.3
KanMark	KWA	82.8	81.6	-1.1	61.6	59.3	-2.3
LCS Chrome	LCS	84.2	81.0	-3.2	60.6	59.0	-1.6
LCS Mint	LCS	85.3	85.8	0.5	60.9	60.7	-0.2
LCS Pistol	LCS	74.0	64.1	-9.8	58.2	54.5	-3.7
LCS Wizard	LCS	68.7	64.0	-4.7	58.7	58.5	-0.3
Overley	KWA	65.2	66.8	1.6	59.3	58.3	-0.9
Ruby Lee	OGI	76.4	71.2	-5.1	59.3	56.1	-3.1
SY Flint	Syngenta	75.7	74.2	-1.4	59.3	59.0	-0.3
SY Wolf	Syngenta	83.9	81.1	-2.8	60.3	58.8	-1.6
T158	LCS	79.3	73.1	-6.2	60.8	58.0	-2.8
TAM 114	TAMU	81.2	79.0	-2.2	59.0	58.1	-0.9
WB4303	WestBred	69.0	71.1	2.1	56.5	56.8	0.3
WB4458	WestBred	68.9	70.4	1.5	60.2	57.8	-2.4
WB-Cedar	WestBred	67.1	71.5	4.4	60.5	58.1	-2.4
WB-Grainfield	WestBred	88.4	88.8	0.4	61.8	59.1	-2.7
WB-Redhawk	WestBred	68.0	64.0	-4.0	60.5	57.4	-3.1
Mean		77.0	74.4	-2.5	59.9	58.3	-1.5
Minimum		65.2	64.0	-10.3	56.5	54.5	-3.7
Maximum		88.4	88.8	4.4	61.8	60.9	2.0
LSD (0.05)*		10.5	12.5		ns	ns	

**LSD — Least significant difference, or the minimum difference required between two varieties to be statistically different.*
*** ns — Not significantly different.*
Shading indicates varieties with the highest grain yield. Shaded varieties do not differ statistically.

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