Hard Red Winter Wheat Variety—KS Bill Snyder

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Summary

KS Bill Snyder, a hard red winter wheat variety, was developed by the wheat breeding program at the Agricultural Research Center-Hays, Kansas State University and released by the Kansas Agricultural Experiment Station in 2023. KS Bill Snyder was selected from a single cross of KS11HW15/KS060476-M-6 using a modified bulk breeding method. KS Bill Snyder is an F_4-derived line and has been tested in yield trials from 2018 to 2023 in Kansas before its release. It has performed well in both dryland and irrigated yield trials in western Kansas and surrounding regions. KS Bill Snyder has a medium maturity and medium-short stature. It has good grain shattering tolerance, and very good straw strength and winter hardiness. KS Bill Snyder also has a good disease-resistant package including resistance to stripe rust and soilborne mosaic virus; moderate resistance to wheat streak mosaic virus, leaf rust, and powdery mildew; and intermediate resistance to stem rust, *Triticum* mosaic virus, and barley yellow dwarf virus. Its test weight, milling qualities, and baking qualities are all above average.

Procedures

The cross (KS11HW15/KS060476-M-6) that derived KS Bill Snyder was made in the fall 2013 in the greenhouse at Hays, KS. Parental line KS11HW15 is a hard white wheat line developed by the wheat breeding program at Hays. Parental line KS060476-M-6 is a hard red wheat line developed by the wheat breeding program at Manhattan. KS Bill Snyder was developed using a modified bulk breeding method. In brief, F_1 and F_2 were bulk harvested. Then, individual heads were selected from the F_3 generation and planted as head rows at the F_4 generation. Visually selected head rows were advanced to yield trials.

KS Bill Snyder was evaluated in the first unreplicated preliminary yield nursery (PYN1) at Hays in 2018, the second unreplicated preliminary yield nursery (PYN2) at Hays, Colby, and Garden City in 2019, the replicated advanced yield nursery (AYN) in three locations (Hays, Colby, Garden City) in western Kansas and three locations in central Kansas in 2020, the Kansas intrastate nursery (KIN) in 2021, 2022, and 2023, the southern regional performance nursery (SRPN) in 2022, and Oklahoma Elite Test in 2023. KS Bill Snyder was approved for release by the Kansas Agricultural Experiment Station in 2023 and it was named after legendary K-State football coach Bill Snyder. Certified seed will be available in fall 2024.

Results and Discussion

Agronomic Characteristics

KS Bill Snyder is an awned, white-glumed, hard red-seeded winter wheat. It has a medium maturity with a heading date similar to KS Hamilton (Zhang et al. 2021c) and KS Territory (Table 1). KS Bill Snyder is medium-short, and it was 3 cm shorter than KS Hamilton and KS Territory (Table 1). Its coleoptile length is about average. Freeze damage occurred in the trials in 2020 and 2023; however, no significant damage was observed on KS Bill Snyder, indicating its good winter hardiness. KS Bill Snyder also has very good straw strength and lodging rarely occurred in its testing plots. No visible grain shattering was noticed on KS Bill Snyder, indicating its good grain-shattering resistance.

KS Bill Snyder has a good disease-resistance package (Table 1). It carries *Wsm2* and has the moderate resistance to wheat streak mosaic virus at 18°C. It also has resistance to stripe rust and soilborne mosaic virus; moderate resistance to leaf rust and powdery mildew; and intermediate resistance to stem rust, *Triticum* mosaic virus, and barley yellow dwarf virus. It is susceptible to Hessian fly and scab, and moderately susceptible to acid soil.

Yield Performance

KS Bill Snyder has been evaluated in various yield trials in Kansas and other regions in the last 6 years (2018-2023). The mean dryland yield (74.6 bu/a) of KS Bill Snyder across 20 trials over the last 6 years in western Kansas was about 4 bu more than check varieties Joe (Zhang et al. 2016) and Langin (Haley et al., 2018) (Table 2). When averaging from 2018 to 2022 (16 trials), KS Bill Snyder yielded over 9 bu more than WB Grainfield, the most grown variety in western Kansas. When averaging from 2021 to 2023 (16 trials), KS Bill Snyder yielded about 3 to 13 bu more than Joe, Langin, KS Territory, KS Hamilton, and SY Monument; but about 4 bu less than KS Big Bow (Zhang et al., 2024), which is a newly released hard white wheat variety. When averaging from 2022 to 2023 (11 trials), KS Bill Snyder yielded 3.7 bu more than SY Wolverine and similar to Canvas. The 2023 crop year was extremely dry and significant rain only came after heading in most locations, which failed most tillers and caused very low yields. It seems like only the late and tall lines were favored in 2023 because of this late rainfall. The mean yield of KS Bill Snyder across 5 trials harvested was 35.6 bu/a, which was similar to or higher than most check varieties, but over 6 bu less than check variety Whisler, which is a tall and late variety. Our multiple-year data clearly show that KS Bill Snyder has very competitive yield in western Kansas dryland trials and it has significant ($P < 0.1$) yield advantage over many check varieties, including Joe, Langin, KS Territory, KS Hamilton, KS Dallas (Zhang et al., 2021b), KS Western Star (Zhang et al., 2021a), WB Grainfield, SY Monument, T158, and TAM114. KS Bill Snyder also had very good test weight, which was very similar to KS Dallas (data not shown).

KS Bill Snyder was tested in irrigated trials in Colby from 2021 to 2023. In 2021, most entries in the trial were forced to finish off prematurely because of the hot dry winds. Therefore, only entries with early maturity made high yields in that year. KS Bill Snyder yielded very well in both 2022 and 2023. In the average of three years, it had a greater yield than any check variety in the trials.

KS Bill Snyder was tested in AYN and KIN in central Kansas from 2020 to 2023. In general, central Kansas was considered drier than normal from 2021 to 2023. KS Bill Snyder did well in these tests with an average of 74 bu/a, which was over 4 to 9 bu more than WB4699 and Zenda.

KS Bill Snyder was also tested in the 2022 SRPN across Great Central Plains states, including TX, OK, KS, CO, NE, and SD (data not shown). The mean yield of KS Bill Snyder was ranked as #1 among 45 entries across the 21 locations harvested. It did well in McGregor (#4), Prosper (#1), College Station (#6), TX; Hutchinson (#3), Salina (#8), Hays (#8), KS; Julesburg (#3), CO; and Lincoln (#3), Sidney (#1), NE. In 2023, KS Bill Snyder was further tested in Oklahoma Elite Trials in eight locations. KS Bill Snyder did very well in all but one location. It was in the top yielding group in six locations and was very close to the top yielding group at Morris. However, it did not do well in a low-yielding location, Alva. In the average of all eight trials, KS Bill Snyder was ranked as #3 among 40 entries.

Milling and Baking Qualities

The milling and baking quality of KS Bill Snyder has been tested by the K-State quality lab since 2020. In general, the milling and baking quality of KS Bill Snyder is good. Its protein content was slightly lower than the check varieties. Its flour yield was similar to KS Territory and higher than SY Monument and WB4699. Its water absorption in Farinograph tests was similar to KS Territory and SY Monument and greater than WB4699. Its mixing stability was significantly greater than KS Territory ($P < 0.1$) and WB 4699 ($P < 0.01$). Its mixing time in Mixograph tests was significantly longer than KS Territory ($P < 0.1$) and WB4699 ($P < 0.05$). Its loaf volume was similar to SY Monument and smaller ($P < 0.1$) than KS Territory.

Overall, KS Bill Snyder has high yield potential, good drought tolerance, good disease resistance package, very good straw strength and winter hardiness, good grain shattering tolerance, good test weight, and good milling and baking qualities. The data strongly support that KS Bill Snyder can be used in both dryland and irrigated production in western Kansas. Limited data from central Kansas and other states indicate that KS Bill Snyder might have a broad adaptation and can fit into some other regions than western Kansas. However, regions with issues like acid soil, scab, or Hessian fly are not recommended due to its susceptibility to these diseases.

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Table 1. Agronomy and disease resistance summary for KS Bill Snyder and check varieties

Entry	HD Days	PH (cm)	WSMV	TriMV	Stripe Rust	Leaf Rust	Stem Rust	BYDV	Hessian fly
KS Bill Snyder	132	58	MR	IM	R	MR	IM	IM	S
KS Territory	133	61	R	IM	MR	S	R	IM	R
KS Hamilton	132	61	R	S	IM	IM	R	MR	R
KS Dallas	NA	NA	R	MS	MS	R	R	IM	MS
KS Western Star	NA	NA	S	IM	MR	MR	MR	IM	S
KS Silverado	NA	NA	R	IM	MS	R	MR	MS	R

*HD: heading date, days from Jan. 1; average from 2021 to 2023 at Hays, KS. PH: plant height: average of 2022 and 2023 at Hays, KS. NA: not available.

**Rating scale for disease: R-Resistant, MR-Moderately resistant, IM-Intermidiate, MS-Moderately susceptible, S-Suseptible.

***WSMV: wheat streak mosaic virus, it was tested in inoculated growth chamber trials with race Sid81 at Hays, KS in 2019, 2020, 2021, 2022, and 2023; TriMV: *Triticum* mosaic virus, it was tested in inoculated field trials in 2020, 2021, and 2022 at Hays, KS; Stripe rust was phenotyped in an inoculated field trial (with three races) in Rossville, KS in 2020 and in naturally infected field trials in Hays and Garden City in 2022; Leaf rust was phenotyped in an inoculated field trial (with mixed races) in Manhattan, KS in 2020 and in naturally infected field trial Castroville, TX in 2022; Stem rust was tested in an inoculated field trial in Manhattan, KS in 2020 and 2023 (with race QFCSC), and 2022 (with five mixed races); BYDV: barley yellow dwarf virus, it was tested in naturally infected field trials in Manhattan, KS in 2021, 2022, and 2023; Hessian fly was tested in greenhouse trials (infested with GP biotype) in Manhattan, KS in 2019, 2020, 2021, 2022, and 2023.

Table 2. Paired T-Test for dryland grain Yield (bu/a) between KS Bill Snyder and check varieties in western Kansas

Year	Trial#	KS Bill Snyder Mean	Comparison Variety	Class	Comparison Mean	Yield Difference	*P* value
2018-2023	20	74.6	Joe	HWW	71.1	3.5	0.020
2018-2023	20	74.6	Langin	HRW	70.4	4.2	0.030
2018-2022	16	86.8	WB-Grainfield	HRW	77.4	9.4	0.000
2021-2023	16	73.2	KS Big Bow	HWW	77.4	-4.2	0.048
2021-2023	16	73.2	KS Territory	HRW	70.4	2.8	0.082
2021-2023	16	73.2	KS Hamilton	HRW	68.6	4.6	0.081
2021-2023	16	73.2	SY Monument	HRW	60.2	13.0	0.000
2020-2022	13	88.7	KS Dallas	HRW	78.5	10.2	0.015
2020-2022	13	88.7	KS Western Star	HRW	72.9	15.8	0.006
2022-2023	11	54.0	Canvas	HRW	54.4	-0.4	0.862
2022-2023	11	54.0	SY Woverine	HRW	50.3	3.7	0.218
2018-2020	5	78.9	T158	HRW	67.6	11.3	0.008
2018-2019	3	78.3	Antero	HWW	72.3	6.0	0.198
2018-2019	3	78.3	Danby	HWW	71.8	6.5	0.244
2018-2019	3	78.3	TAM 114	HRW	72.1	6.2	0.019
2018-2019	3	78.3	Tatanka	HRW	66.2	12.1	0.122
2023	5	35.6	Whisler	HRW	41.9	-6.3	0.038
2023	5	35.6	WB4422	HRW	33.7	1.9	0.624
2023	5	35.6	WB4792	HRW	32.0	3.6	0.275

*HWW: Hard White Winter; HRW: Hard Red Winter.

Table 3. Irrigated yield (bu/a) summary in Colby, KS

Entry	2021	2022	2023	2021-2023 Avg
KS Bill Snyder	85.3	121.4	112.1	106.2
Joe	74.4	111.7	109.5	98.5
Langin	91.7	102.6	97.7	97.3
KS Big Bow	82.5	112.9	91.7	95.7
SY Monument	78.8	105.7	97.1	93.9
KS Territory	82.7	93.6	97.8	91.3
KS Hamilton	58.9	106.5	95.6	87.0
KS Dallas	68.7	107.8		
KS Western Star	76.7	99.9		
WB-Grainfield	90.0	114.0		
WB4699	93.2	97.6		
SY Woverine		115.4	101.0	
Byrd CL+		107.7	110.0	
Canvas		106.7	92.3	
WB4422			114.1	
WB4792			96.6	
Whisler			82.3	
Mean	80.0	104.6	97.1	93.9
CV (%)	9.5	5.5	9.5	
LSD (0.05)	15.4	11.7	18.6	

*CV: coefficient of variance; LSD: least significant difference.

Table 4. Yield (bu/a) Summary from 2020-2023 in central Kansas

Entry	2020	2021	2022	2023	2021-2023 Avg	2020-2023 Avg
KS Bill Snyder	93.5	71.3	74.5	56.6	67.4	74.0
WB4699	88.4	68.2	69.2	52.3	63.2	69.5
Bob Dole	82.4	72.0	62.1			
Zenda	85.6	68.6	57.4	49.5	58.5	65.3
Showdown		74.4	69.0	56.3	66.6	
SY Wolverine		71.5	67.7	54.9	64.7	
SY Monument		66.3	68.8	53.9	63.0	
Everest		63.2	55.3	40.6	53.0	
KS Silverado	87.3		65.0			
WB4269		65.5				
AP EverRock		69.4	64.7			
AM Cartwright						
LCS Valiant			63.4			
Rock Star			65.3			
WB4401			64.2			
Big Country			62.2			
KS Providence		74.4	69.7	54.5	66.2	
WB4422				57.6		
WB4401				50.8		
AP Prolific				53.3		
Grand Mean	82.4	68.6	64.3	48.8	60.6	66.0
Trial#	1	6	5	4	15	16

*AVG: average.

Table 5. Quality summary for KS Bill Snyder and check varieties in 2021 and 2022

	Grain	Flour			Farinograph			Mixograph		Pub Loaf Baking
Entry	Protein	Flour Yield	Protein	Ash	Absorption	Mix Time	Stability	Absorption	Mix Time	Volume
	---------- % ----------					-------- min --------		%	min	CC
KS Bill Snyder	11.9	63.5	10.8	0.3	61.1	5.9	13.8	61.8	6.3	758.0
KS Territory	12.2	63.8	11.0	0.3	61.3	5.0	9.0*	62.1	4.9*	799.1*
SY Monument	12.7	61.8	11.3	0.3	61.6	7.6	16.7	62.5	8.5***	760.5
WB4699	12.3	62.6	11.0	0.3	58.9	3.5	4.3***	62.1	4.3**	782.5

*, **, *** Significant differences between KS Bill Snyder and check varieties based on student's paired t test at the 0.1, 0.05, 0.01 probability levels.
Grain samples from two locations in 20221 and three locations in 2022 were tested in the Quality Lab at Kansas State University.