Published online September 14, 2017
JOURNAL OF PLANT REGISTRATIONS

CULTIVAR

Registration of 'UI Sparrow' Wheat

J. Chen,* J. Wheeler, W. Zhao, N. Klassen, K. O'Brien, J. M. Marshall, C. Jackson, K. Schroeder, R. Higginbotham, and X. Chen

Abstract

'UI Sparrow' (Reg. No. CV-1134, PI 680612) soft white winter wheat (*Triticum aestivum* L.) was developed and released by the Idaho Agricultural Experiment Station in August 2016. Soft white winter wheat is an important wheat class grown in Idaho and the rest of Pacific Northwest. Resistance to stripe rust is critical for winter and spring wheat cultivars grown in the Pacific Northwest. Resistances to dwarf bunt and snow mold are also important traits for winter wheat cultivars produced in the dryland areas of the Pacific Northwest. UI Sparrow, tested under the experimental designations IDO1108DH, is a semidwarf cultivar with strong straw, brown chaff, and long awns. It has excellent resistance to dwarf bunt, all-stage resistance to all tested predominant races of *Puccinia striiformis* f. sp. *tritici* except for PSTv-40, moderate to high levels of high-temperature adult-plant resistance to stripe rust, and high level resistance to snow mold. UI Sparrow was released as an alternative to 'Eltan', 'Otto', and 'Xerpha' in the low-rainfall regions (<300 mm) and to 'Bobtail', 'SY Ovation', and 'UI-WSU Huffman' in the intermediate- (300–500 mm) and high-rainfall regions (>500 mm) of Idaho and Washington.

Journal of Plant Registrations
doi:10.3198/jpr2017.04.0021crc
Received 10 Apr. 2017.
Accepted 6 July 2017.
Registration by CSSA.
5585 Guilford Rd., Madison, WI 53711 USA
*Corresponding author (jchen@uidaho.edu)

Soft white winter wheat (*Triticum aestivum* L.) is an important wheat class grown in Idaho and the Pacific Northwest for domestic use and for export to Asian countries for making pastry and noodles. Few soft white winter wheat cultivars are adapted to diverse rainfall areas and also have high level resistance to stripe rust (caused by *Puccinia striiformis* Westend. f. sp. *tritici* Erikss.), dwarf bunt (caused by *Tilletia controversa* J. G. Kühn), and snow mold [caused by *Microdochium nivale* (Fr.:Fr.) Samuels & I. C. Hallett and *Typhula ishikariensis* var. *idahoensis* Imai]. The objectives of the present study were to develop a soft white winter wheat cultivar that has high level and durable resistance to major diseases and has improved yield compared with current cultivars grown in the states of Idaho and Washington. 'UI Sparrow' (Reg. No. CV-1134, PI 680612) soft white winter wheat (*Triticum aestivum* L.) was developed and released by the Idaho Agricultural Experiment Station in August 2016.

UI Sparrow was selected for high yield, resistance to fungal diseases, and cold tolerance using the wheat-by-maize dihaploid breeding method. Grain yields of UI Sparrow were comparable to check cultivars ('SY Ovation' and 'UI-WSU Huffman') under irrigation and better than dryland cultivars 'Eltan' (Peterson et al., 1991) and 'Otto' (Carter et al., 2012) in Idaho and Washington environments. Height and heading date of UI Sparrow were similar to Eltan, but lodging resistance was much better than Eltan. End-use quality of UI Sparrow was comparable to Bruneau and Eltan. UI Sparrow is adapted to most areas of Idaho and Washington, both irrigated and dryland. UI Sparrow has excellent resistance to dwarf bunt, which is a critical trait required for organic wheat production. UI Sparrow has all-stage resistance to all tested predominant races of *P. striiformis* f. sp. *tritici* except for PSTv-40 and also has a moderate to high level of high-temperature adult-plant resistance to stripe rust. Its resistance reaction was similar to Otto but better than Eltan. UI Sparrow has very good winterhardiness and moderate resistance to snow mold (5.0 on a 0-to-9 scale, where 9 is the best), comparable to Eltan (4.5) and Otto (4.0). Resistance of UI Sparrow

J. Chen, J. Wheeler, W. Zhao, N. Klassen, K. O'Brien, J.M. Marshall, and C. Jackson, Univ. of Idaho Aberdeen Research and Extension Center, 1693 S 2700 W, Aberdeen, ID 83210; K. Schroeder, Dep. of Plant Sciences, Univ. of Idaho, 875 Perimeter Drive, Moscow, ID 83844; R. Higginbotham, Dep. of Crop and Soil Sciences, Washington State Univ., Pullman, WA 99164; X. Chen, USDA-ARS, 361 Johnson Hall, Washington State Univ., Pullman, WA 99164.

Abbreviations: IT, infection type.

to eyespot (caused by *Tapesia yallundae* Wallwork & Spooner) (disease index = 41) was similar to Madsen (35) but better than Eltan (67). Resistance of UI Sparrow to cephalosporium stripe (caused by *Cephalosporium gramineum* Y. Nisik. & Ikata) (disease index = 63) was similar to Madsen (66) but worse than Eltan (33). UI Sparrow has the *SrTmp* gene conferring resistance to stem rust (caused by *Puccinia graminis* Pers.:Pers. f. sp. *tritici* Erikss. & E. Henn.), including the UG99 race group.

Methods

Pedigree and Breeding History

UI Sparrow is an F_1–derived dihaploid line from the cross 'UI Silver' (PI 658467) × 'Simon' (PI 636132) using the wheat-by-maize dihaploid method (Laurie and Bennett, 1986). UI Silver is a hard white winter wheat cultivar derived from the backcross IDO498*2/UT944157, which was released by the Idaho Agricultural Experiment Station in 2010. IDO498 is a hard red winter wheat breeding line derived from the pedigree Turcikum 57/3*Manning. Manning (CItr 17846) is a hard red winter wheat derived from the pedigree Delmar/PI 178383//Columbia/4/Delmar/3/UT 175-53//Norin 10/Brevor (Dewey, 1981). UT944157 is a hard white winter wheat breeding line that is a sib-selection to 'Golden Spike' (Hole et al., 2002). Golden Spike is a hard white winter wheat derived from the pedigree Arbon/Hansel/4/Hansel/3/CItr 14106/Columbia//McCall. Simon is a soft white winter wheat cultivar derived from 'Haven'/'Lambert'//'Madsen' (Zemetra et al., n.d.). Haven is a soft red biscuit wheat from Nickerson Seed Inc. (formerly PBI). Lambert is a soft white common winter wheat released jointly by the Idaho Agricultural Experiment Station, the Oregon Agricultural Experiment Station, and Washington Agricultural Experiment Station (Zemetra et al., 1995). Madsen is a soft white common winter wheat developed by the USDA-ARS, Pullman, WA (Allan et al., 1989), and carries the *Pchl* gene for resistance to eyespot.

The cross was made and F_1 seeds were obtained in the field in 2007 and assigned as A0711W. The dihaploid production was conducted in a greenhouse in spring 2008. A total of 51 dihaploid (A0711W08DH-1 to A0711W08DH-51) plants were obtained and replanted for a seed increase in the spring of 2009. The 51 dihaploid lines were planted in single headrow plots in the fall 2009, and all were harvested in summer 2010. All dihaploid lines were planted in nonreplicated trials in Aberdeen and Moscow, ID, in fall 2010 and evaluated for yield and baking quality in summer 2011. One line, A0711W08DH-30, that showed good agronomic performance and milling and baking quality was selected and named as IDO1108DH in 2011, with the DH indicating a dihaploid.

Line Selection Evaluation

UI Sparrow, under the experimental designation IDO1108DH, was tested in replicated preliminary yield trials in Aberdeen and Rockland, ID, in 2012; in Western Regional Soft Winter Wheat Trials in 2013; and in replicated elite yield trials in Aberdeen, Rockland, Arbon Valley, and Kimberly, ID, from 2013 to 2016. UI Sparrow was extensively tested in the Extension State Variety Trials in rainfed and irrigated conditions in Idaho, Washington, and Oregon in 2013 to 2016. Details for plot size and trial location characteristics can be found on the respective web pages for each of the variety trials (Washington State University Extension Cereal Variety Testing Program, 2017;, University of Idaho Extension, 2017; Oregon State University, 2017). Grain yield, volume weight, days to heading (50% of heads in the plot completely visible), and plant height (distance from ground to top of spike excluding awns) were measured in most locations, whereas lodging (0-to-9 scale, where 0 = no lodging, 9 = 100% plants lodged) was recorded only when significant lodging was present in the field.

Evaluation of End-Use Quality

Milling quality and baking quality of UI Sparrow were assessed by the Idaho Wheat Quality Laboratory at Aberdeen using approved methods of the American Association of Cereal Chemist (AACC, 2000). Composite grain samples of 500 g of each genotype from each location were milled using modifications to AACC method 26-50. Near-infrared analysis was performed with a Perten 8611 (Perten Instruments) according to AACC method 39-10 to determine flour protein concentration, with values calibrated by combustion analysis of total nitrogen content with a LECO Model FP-428 instrument (LECO Corp.) and corrected to 120 g kg^{-1}. Baking quality of the flour samples was measured using the micro sugar-snap cookie method (AACC method 10-52).

Evaluation of Resistance to Stripe Rust and Other Diseases

UI Sparrow was evaluated by X.M. Chen's program in a single-row plot (1.0 m long) for resistance to stripe rust under natural infections in both Pullman and Mt. Vernon, WA, in 2014 and 2016 in either or both of two nurseries: the Southern Idaho Wheat Breeding Nursery and the Western Regional Soft Winter Wheat Nursery. Stripe rust races prevalent at these locations during those years in the Pacific Northwest included PSTv-52, PSTv-37, FSTv-4, PSTv-79, and PSTv-48. Stripe rust resistance was evaluated twice at Feekes growth stages 5–6 and 10.1–10.5 in Mt. Vernon and once at stage 10.1–10.5 in Pullman when the susceptible check 'PS279' had about 30% severity at the early stage and greater than 80% severity at both locations at the late growth stage. Infection type (IT) was recorded using the 0-to-9 scale as described by Line and Qayoum (1992), and severity (SEV) was recorded as percentage of foliage infected. In addition, UI Sparrow was evaluated in the greenhouse together with the other entries in the 2010 Western Regional Soft Winter Wheat Nursery at two temperature profiles. One was the low-temperature profile (diurnal temperature cycle gradually changing from 4°C at 2:00 AM to 20°C at 2:00 PM) with 16 h light using selected races PSTv-4, PSTv-14, PSTv-37, PSTv-40, and PSTv-51 in the seedling stage; the other was the high-temperature profile (diurnal temperature cycle gradually changing from 10°C at 2:00 AM to 30°C at 2:00 PM) with races PSTv-14, PSTv-37, and PSTv-40 in adult-plant stages (boot to flowering stage) (Chen and Line, 1995; Chen, 2005; Chen et al., 2010).

The reaction of UI Sparrow to dwarf bunt compared with the reaction of the susceptible cultivar 'Cheyenne' (CItr 8885; Clark, 1931) was tested in Logan, UT, in two replicate 1.5-m rows in the field in 2015 and 2016. The nursery was artificially

inoculated with a composite of common pathogenic races of *T. controversa*. The percentage of diseased spikes (0% = immune resistance and 100% = susceptible) of Cheyenne and UI Sparrow was determined at plant maturity.

The snow mold resistance of UI Sparrow was assessed in a naturally infected nursery in Tetonia, ID, over 2 yr (2015 and 2016). The snow mold rating is a visual estimate of growth approximately 4 wk after snowmelt that is based on both the percentage of recovery and vigor. The scale ranges from 0 to 9, where 0 = no recovery and 9 = complete recovery.

Statistical Analysis

Data generated from Washington State Cereal Variety Trials were analyzed with the general lattice (ALS) procedure in Agrobase Generation 2, version 38.10.1 (Agronomix Software). Since four major wheat-producing regions with distinct agroclimatic conditions are present in Washington State, data were analyzed across locations within regions instead of over all locations. The final data analysis used only entries common to the trials across all years.

Data generated from the University of Idaho State Variety Trials were analyzed with randomized complete block design using SAS Versions 9.2–9.4 (SAS Institute). Data from rainfed and irrigated trials were analyzed separately. The final data analysis used only entries common to the trials across all years. The LSD test ($\alpha = 0.05$) was used to determine the significance of mean differences among genotypes for the traits evaluated.

Seed Purification and Increase

The breeder seed was produced at the Aberdeen Research Station. Four hundred selected heads were individually threshed and planted in 400 headrows in 2013. Based on the uniformity and agronomic performance, 216 headrows were harvested in which 74 headrows were selected for lower grain protein content and higher test weight in 2014. The 74 lines were simultaneously planted in 1.5-m by 3-m plots and evaluated for stripe rust resistance in the USDA stripe rust nursery in Pullman in 2015. Based on the uniformity and stripe rust resistance, approximately 35 plots were harvested and composited, resulting in about 160 kg of breeder seed in summer 2015. Approximately 54 kg of breeder seed was planted (0.5 ha) in fall 2015 for foundation seed production in 2016. Additional breeder seed was produced from 4.5 kg of the 2015 increase, and the remaining breeder seed was used in variety trials in Idaho, Washington, and Oregon in 2016.

Characteristics

General Description

UI Sparrow is a semidwarf, strong straw, medium-late soft white winter wheat cultivar. It has prostrate juvenile plant growth. The plants exhibit a blue-green color with slightly twisted flag leaf. At maturity, heads are semi-erect, long-awned, strap, and brown-chaffed. Anthers are yellow. Stems do not have hair or wax and are purple colored on the bottom stem at boot stage. There are typically three nodes present with hollow internodes. The peduncle is erect, averaging 15 cm in length. At maturity, the heads are brown colored with glumes that are long, narrow, and lacking pubescence. Glume shoulders are oblique. Seed is white in color, soft, with elliptical and angular cheeks, and has a medium brush end. This description was mainly based on the trials conducted in the breeding program in Aberdeen.

Agronomic Performance

Results summarized herein were mainly derived from the Idaho and Washington State Variety Trials. Mean yield of UI Sparrow was 9361.2 kg ha^{-1} in nine irrigated environments of 3 yr (2014–2016) in southeastern Idaho (Table 1), which was not significantly different from Bobtail, Bruneau, and UI-WSU Huffman. However, it was significantly greater than Brundage (Zemetra et al., 1998), Stephens (Kronstad et al., 1978), and Madsen (Allan et al., 1989), while lower than SY Ovation. Grain volume weight of UI Sparrow was 70.0 kg hL^{-1}, which was not significantly different from Bobtail and Stephens

Table 1. Agronomic performance of soft white winter wheat UI Sparrow compared with adapted cultivars in irrigated and rainfed environments in southeast Idaho over 3 yr, 2014–2016.†

Cultivar	Irrigated (16 cultivars)					Rainfed (13 cultivars)		
	Yield	Volume weight	Days to heading	Height	Lodging	Yield	Volume weight	Height
	kg ha^{-1}	kg hL^{-1}	d	cm	%	kg ha^{-1}	kg hL^{-1}	cm
UI Sparrow	9361.2	70.0	151.0	104.1	21	4304.0	69.1	73.7
Bobtail	9643.7	69.6	148.0	94.0	17	4324.2	66.7	63.5
Bruneau	9220.0	71.5	149.0	96.5	21	4061.9	70.3	71.1
SY Ovation	9845.4	72.3	146.0	96.5	12	4404.9	71.6	66.0
UI-WSU Huffman	9011.5	71.0	150.0	99.1	20	3490.3	68.0	66.0
Brundage	8271.8	71.7	143.0	94.0	9	2111.7	71.1	61.0
Stephens	8688.7	70.6	145.0	94.0	16	3685.3	69.0	68.6
Madsen	8540.8	71.3	150.0	99.1	14	3840.0	70.6	68.6
Otto	NA‡	NA	NA	NA	NA	3840.0	70.2	68.6
Eltan	NA	NA	NA	NA	NA	3449.9	69.5	68.6
Site-year	9	9	9	9	9	4	4	4
Average	9172.9	71.3	146.0	94.0	15	3651.7	69.5	66.0
LSD (0.05)	410.2	0.7	0.7	2.5	6	343.0	0.7	2.8

† Data provided by J. Marshall; complete data can be found in Marshall et al. (2017).

‡ NA, not available.

although it was lighter than the rest of lines tested. Mean height of UI Sparrow was 104 cm under irrigation, which was the tallest cultivar in the trial. Because UI Sparrow has strong straw, its lodging resistance was similar to Bobtail, Bruneau, UI-WSU Huffman, and Stephens. Mean heading date of UI Sparrow was 151 d, which was later than most of lines tested, although the maturity date of UI Sparrow was similar to UI-WSU Huffman and Madsen (data not shown).

Under dryland conditions, mean yield of UI Sparrow was 4304 kg ha^{-1} over four dryland environments of 3 yr in southeastern Idaho (Table 1), which was not significantly different from SY Ovation, Bobtail, and Bruneau but was greater than Madsen, Otto, Stephens, UI-WSU Huffman, Eltan, and Brundage. UI Sparrow had better grain volume weight than Bobtail and UI-WSU Huffman. UI Sparrow headed 1 d earlier than Otto, similar to Eltan, Bruneau, and Madsen, and later than the rest of cultivars. Mean height of UI Sparrow was 73.7 cm, which was not significantly different from Bruneau but taller than the rest of the lines tested (Table 1).

Under dryland production in northern Idaho, the mean yield of UI Sparrow was significantly greater than Stephens, Madsen, and Brundage 96 (Zemetra et al., 2003) while not significantly different from Bobtail, Bruneau, WB Junction, and UI/WSU Huffman (Table 2). Grain volume weight of UI Sparrow was greater than Bobtail but not significantly different from other cultivars. Despite its height, UI Sparrow displayed good resistance to lodging in most trials.

The overall performance of UI Sparrow was exceptional in all precipitation zones in Washington over 3 yr (Table 3). Mean yield of UI Sparrow (8318.8 kg ha^{-1}) was highest in the >500-mm precipitation zones. In the 400- to 500-mm zones, UI Sparrow had similar yield to Xerpha (Jones et al., 2010) and SY Ovation, >400 kg ha^{-1} higher than Madsen and WB Junction, although 229 kg ha^{-1} lower than Bobtail. In the 300- to 400-cm zones, UI Sparrow had higher yield than Eltan, Otto, WB Junction, and Madsen, although lower than Xerpha. In the <300-mm zones, the mean yield of UI Sparrow was similar to Otto, slightly lower than Xerpha, and higher than Eltan, WB Junction, and Madsen.

Flour and Baking Quality

The overall end-use quality of UI Sparrow is similar to Bruneau and Eltan but better than Simon and Stephens (Table 4). Flour protein content of UI Sparrow was less than Simon and

Table 2. Agronomic performance of soft white winter wheat UI Sparrow compared with adapted cultivars in northern Idaho environments over 3 yr, 2014–2016.†

Cultivar	2015 (44 entries)			2016 (40 entries)			2014–2016 (16 entries)		
	Yield	Volume weight	Height	Yield	Volume weight	Height	Yield	Volume weight	Height
	kg ha^{-1}	kg hL^{-1}	cm	kg ha^{-1}	kg hL^{-1}	cm	kg ha^{-1}	kg hL^{-1}	cm
UI Sparrow	6772.1	69.2	98.6	8971.2	73.8	107.4	6940.2	70.8	94.0
Bobtail	6476.2	67.6	86.4	9475.5	73.4	97.3	6980.6	69.0	82.9
Bruneau	7128.5	71.3	98.0	8776.1	76.6	105.9	7041.1	72.6	91.2
WB-Junction	7047.8	72.9	91.2	8527.3	76.6	97.8	6960.4	73.2	85.6
UI/WSU Huffman	6778.8	69.8	94.0	8507.1	76.2	103.1	6819.2	71.8	88.9
Stephens	6496.4	69.8	90.4	8150.7	75.2	97.3	6523.3	71.2	84.8
Madsen	6368.6	70.2	92.2	8076.7	76.2	96.8	6415.7	72.0	86.6
Brundage 96	6698.1	70.0	90.7	8144.0	75.3	93.2	6583.8	71.5	83.6
Site	6	6	6	5	5	5	17	17	17
Mean	6536.7	70.7	89.7	8339.0	76.1	97.3	6745.2	72.1	85.9
LSD (0.05)	282.5	1.1	1.8	309.4	0.6	2.3	181.6	0.5	1.5

† Data provided by Dr. Curtis Schroeder.

Table 3. Mean grain yield of soft white winter wheat UI Sparrow compared with seven adapted cultivars in different precipitation zones in Washington over 3 yr, 2013, 2014, and 2016.†

Cultivar	Precipitation zone			
	<300 mm	300–400 mm	400–500 mm	>500 mm
	kg ha^{-1}			
UI Sparrow	3443.2	6388.8	7128.5	8318.8
Xerpha	3550.8	6758.6	7047.8	7989.3
Eltan	3315.4	6227.4	NA	NA
Otto	3463.4	5978.5	NA	NA
Bobtail	NA‡	NA	7357.2	7935.5
SY Ovation	NA	NA	7249.6	7532.0
WB-Junction	3039.7	6045.8	6691.4	7431.1
Madsen	2992.6	5891.1	6725.0	7431.1
Site-years	15	17	12	12
Mean	3302.0	6213.9	7034.4	7774.1
LSD	80.7	121.1	161.4	148.0

† Data provided by Washington State University Cereal Variety Testing Program (2017).

‡ NA, not available.

Table 4. Flour quality and cookie diameter of soft white winter wheat UI Sparrow compared with four adapted cultivars in Rockland (dryland [Dry]) and Aberdeen (irrigated [IR]) over 3 yr, 2013–2015.

Cultivar	Flour protein		Flour Yield		Break flour		Cookie diameter	
	Dry	IR	Dry	IR	Dry	IR	Dry	IR
	g kg^{-1}		%		%		cm	
UI Sparrow	120	97	59.6	66.3	40.5	43.0	8.7	8.9
Eltan	122	97	58.7	66.1	45.1	46.3	8.7	9.0
Bruneau	129	96	58.5	67.2	43.7	46.8	8.8	9.0
Simon	130	110	61.6	67.4	36.5	41.9	8.6	8.9
Stephens	112	110	61.3	62.9	38.0	42.3	8.4	8.7
Mean	122	102	59.9	66.0	40.7	44.2	8.6	8.9
LSD (0.05)	9	22	6.2	3.3	6.8	3.6	0.4	0.2

Bruneau but not different from Eltan and Stephens under rainfed conditions. Flour protein of UI Sparrow under irrigation and flour yield under both irrigated and rainfed conditions were not significantly different from the four checks. Break flour yield of UI Sparrow was less than Bruneau but not different from the other three checks under irrigation. Cookie diameter was greater than Stephens but not different from the other three checks under both irrigated and rainfed conditions.

Stripe Rust Resistance

UI Sparrow has all-stage resistance to all tested predominant races of stripe rust except for PSTv-40 and also has moderate to high levels of high-temperature adult-plant resistance to stripe rust (Table 5). The resistance level was similar to Otto but better than Eltan. In the greenhouse seedling tests, UI Sparrow was resistant to races PSTv-4, PSTv-14, and PSTv-37 but susceptible to PSTv-40 and PSTv-51 in 2014; in 2016, UI Sparrow was resistant to PSTv-4, PSTv-14, PSTv-37, and PSTv-51, susceptible only to PSTv-40. In the adult-plant test, UI Sparrow showed a mix of resistant (IT 2) and moderate resistant (IT 5–6) in 2014, but resistant (IT 2–3) in 2016. The field data agreed with the greenhouse data. The highest infection type (5) and severity (30%) were observed at Pullman in the Western Regional Soft Winter Wheat Nursery in 2014, while 2 and 10% were observed in the Washington State Extension Soft Winter Wheat Nursery in 2016.

Other Disease Resistance

UI Sparrow has excellent resistance to dwarf bunt and comparable level of resistance to snow mold (5.0 on a 0-to-9 scale, where 9 is the most resistant) with Eltan (4.5) and Otto (4) in 2015 (Marshall et. al., 2016). In addition, resistance of UI Sparrow to eyespot (disease index = 41) was similar to Madsen (35) but better than Eltan (67); resistance to Cephalosporium stripe (disease index = 63) was similar to Madsen (66) but worse than Eltan (33) based on the mean data of 2 yr (Sexton and Murray, 2015). UI Sparrow has the *SrTmp* gene for resistance to stem rust including the UG99 race group of *P. graminis* f. sp. *tritici* (Jin and Rouse, personal communication, 2014).

Availability

The Idaho Agricultural Experiment Station will maintain breeder and foundation seed of UI Sparrow. Multiplication and distribution rights of other classes of certified seed will be handled by the licensed partners to be identified. Recognized seed classes will include the foundation, registered, and certified seed classes. UI Sparrow has been submitted for US Plant Variety Protection (PVP) under Public Law 91-577 with the Certification Only option. Seed of UI Sparrow has been deposited in the USDA National Plant Germplasm System, where it will be available for distribution on expiration of Plant Variety Protection, 20 yr after the date of publication. Small quantities of seed

Table 5. Stripe rust infection type of soft white winter wheat UI Sparrow compared with check cultivars and susceptible check to selected *Puccinia striiformis* f. sp. *tritici* (PST) races under controlled greenhouse conditions at low temperature for the seedling tests and at high temperature for the adult-plant tests.

Cultivar	Infection type								Field HTAP‡
	Seedling test (4–20°C)					Adult plant test (10–30°C)†			
	PSTv-4	PSTv-14	PSTv-37	PSTv-40	PSTv-51	PSTv-14	PSTv-37	PSTv-40	
	0–9§								
2014 Western Regional Soft Winter Wheat Nursery									
UI Sparrow	2	2	2	8	8	2,2,2	2,2,2	6,6,5	Moderate
PS279 (sus.)¶	8	8	8	8	8	8,8,8	8,8,8	8,8,8	No
2016 Washington State Soft White Winter Wheat Nursery									
Otto	2	8	2	2	2	2,3,2	2,2,2	2,2,2	High
Eltan	8	8	8	8	8	5,5,5	5,5,5	5,5,5	Moderate
UI Sparrow	2	2	2	8	2	2,2,2	2,2,2	2,2,3	High
PS279 (sus.)	8	8	8	8	8	8,8,8	8,8,8	8,8,8	No

† Three numbers indicated three readings in three replications.

‡ HTAP, high-temperature adult-plant resistance.

§ Infection type scale, where 9 = most susceptible.

¶ sus., susceptible check.

for research purposes may be obtained from the corresponding author for at least 5 yr from the date of this publication.

Acknowledgments

UI Sparrow was developed with financial support from the Idaho Wheat Commission; the Idaho Agricultural Experimental Station Hatch Projects; and the National Research Initiative Competitive Grants 2011-68002-30029 and 2017-67007-25939 from the USDA National Institute of Food and Agriculture. The authors are grateful to growers Hans Hayden and Gilbert Hoffmeister for providing technical support and land for trials.

References

Allan, R.E., C.J. Peterson, G.L. Rubenthaler, R.F. Line, and D.E. Roberts. 1989. Registration of 'Madsen' wheat. Crop Sci. 29(6):1575–1576. doi:10.2135/cropsci1989.0011183X002900060068x

American Association of Cereal Chemists (AACC). 2000. Approved methods. 10th ed. AACC, St. Paul, MN.

Carter, A., S.S. Jones, S.R. Lyon, K.A. Balow, G.B. Shelton, R.W. Higginbotham, X.M. Chen, D.A. Engle, B. Baik, S.O. Guy, T.D. Murray, and C.F. Morris. 2012. Registration of 'Otto' wheat. J. Plant Reg. 7(2):195–200. doi:10.3198/jpr2012.07.0013crc

Chen, X.M. 2005. Epidemiology and control of stripe rust on wheat. Can. J. Plant Pathol. 27:314–337. doi:10.1080/07060660509507230

Chen, X.M., and R.F. Line. 1995. Gene action in wheat cultivars for durable high-temperature adult-plant resistance and interactions with race-specific, seedling resistance to stripe rust caused by *Puccinia striiformis*. Phytopathology 85:567–572. doi:10.1094/Phyto-85-567

Chen, X.M., L. Penman, A.M. Wan, and P. Cheng. 2010. Virulence races of *Puccinia striiformis* f. sp. *tritici* in 2006 and 2007 and development of wheat stripe rust and distributions, dynamics, and evolutionary relationships of races from 2000 to 2007 in the United States. Can. J. Plant Pathol. 32:315–333. doi:10.1080/07060661.2010.499271

Clark, J.A. 1931. Registration of improved wheat varieties. J. Am. Soc. Agron. 23:1010–1012. doi:10.2134/agronj1931.00021962002300120007x

Dewey, W.G. 1981. Registration of Manning wheat. Crop Sci. 21:636. doi:10.2135/cropsci1981.0011183X002100040053x

Hole, D., S. Clawson, S. Young, and D. Roche. 2002. Registration of 'Golden Spike' wheat. Crop Sci. 42:1376–1377. doi:10.2135/cropsci2002.1376

Jones, S.S., S.R. Lyon, K.A. Balow, M.A. Gollnick, K.M. Murphy, J.S. Kuehner, T.D. Murray, X.M. Chen, D.A. Engle, and K.G. Campbell. 2010. Registration of 'Xerpha' wheat. J. Plant Reg. 4(2):137–140. doi:10.3198/jpr2009.06.0306crc

Kronstad, W.E., C.R. Rohde, M.F. Kolding, and R.J. Metzger. 1978. Registration of 'Stephens' wheat. Crop Sci. 18(6):1097. doi:10.2135/cropsci1978.0011183X001800060060x

Laurie, D.A., and M.D. Bennett. 1986. Wheat x maize hybridization. Can. J. Genet. Cytol. 28:313–316. doi:10.1139/g86-046

Line, R.F., and A. Qayoum. 1992. Virulence, aggressiveness, evolution, and distribution of races of *Puccinia striiformis* (the cause of stripe rust of wheat) in North America, 1968–87. Tech. Bull. 1788. USDA, Washington, DC.

Marshall, J.M., C.A. Jackson, T. Shelman, L. Jones, S. Arcibal, and K. O'Brien. 2017. 2016 small grains report. Southcentral and Southeast Idaho Cereals Research and Extension Program, Idaho Agricultural Experiment Station. UI Research Bull. 191. http://www.cals.uidaho.edu/edComm/pdf/RES/RES191.pdf.

Marshall, J.M., C.A. Jackson, T. Shelman, L. Jones, and K. O'Brien. 2016. 2015 small grains report. Southcentral and Southeast Idaho Cereals Research and Extension Program, Idaho Agricultural Experiment Station. UI Research Bull. 188. http://www.cals.uidaho.edu/edComm/pdf/RES/RES188.pdf.

Oregon State University. 2017. Wheat variety trial data. Oregon State University College of Agricultural Sciences. http://agsci.oregonstate.edu/wheat-research/wheat-variety-trial-data.

Peterson, C.J., R.E. Allen, G.L. Rubenthaler, and R.F. Line. 1991. Registration of 'Eltan' wheat. Crop Sci. 31(6):1704.

Sexton, Z.F., and T.D. Murray. 2015. Reaction of winter wheat cultivars and breeding lines to eyespot. Plant Dis. Manage. Rep. 10:CF048. https://www.plantmanagementnetwork.org/pub/trial/pdmr/volume10/abstracts/cf048.asp.

University of Idaho Extension. 2017. South central and southeast Idaho cereals. https://www.uidaho.edu/extension/cereals/scseidaho.

Washington State University Extension Cereal Variety Testing Program. 2017. Variety selection and testing. http://smallgrains.wsu.edu/variety/.

Zemetra, R.S., T. Koehler, J. Hansen, S.O. Guy, K. O'Brien, L. Robertson, B. Brown, and T. Murray. n.d. ID91-343-02A soft white winter wheat: Proposed name 'Simon'. http://washingtoncrop.com/documents/Wheat/Winter/Soft%20White/Simon.pdf.

Zemetra, R.S., M.L. Lauver, K. O'Brien, T. Koehler, E.J. Souza, S.O. Guy, L. Robertson, and B. Brown. 2003. Registration of 'Brundage 96' wheat. Crop Sci. 43(5):1884. doi:10.2135/cropsci2003.1884

Zemetra, R., C. Lui, W. Kronstad, M. Lauver, and N. Haugerud. 1995. Registration of 'Lambert' wheat. Crop Sci. 35:1222.

Zemetra, R.S., E.J. Souza, M. Lauver, J. Windes, S.O. Guy, B. Brown, L. Robertson, and M. Kruk. 1998. Registration of 'Brundage' wheat. Crop Sci. 38:1404. doi:10.2135/cropsci1998.0011183X003800050056x