

Wheat Research Progress Report

Project #: 3019 3569

Title: Improving Spring Wheat Varieties for the Pacific Northwest

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Progress Report Year: 2008

Accomplishments

A total of 299 crosses were made in 2008, and 26,027 breeding lines were evaluated in field trials at 1 to 16 locations throughout Washington State (Table 1). Grain samples from 833 advanced breeding lines with superior agronomic performance were sent to the USDA-ARS Western Wheat Quality Laboratory for end-use quality assessment (Table 2). Over 1,500 F₄ lines (885 SWS, 278 HRS, 240 HWS and 124 spring clubs) were selected from the field based on plant type, stripe rust resistance and heading date (Table 2). Early generation, end-use quality assessment tools will be used to evaluate these selections to identify superior genotypes for advancement in 2009 field trials.

Table 1: Number of spring wheat breeding lines and/or named varieties evaluated or advanced per generation in 2008.

Generation	Market Class ^a				Total
	SWS	HRS	HWS	Club	
F ₁	106	154	26	13	299
F ₂	106	211	34	13	364 ^b
F ₃	103	98	46	36	283 ^b
F ₄	14,600	2,560	4,800	1,360	23,320 ^b
F ₅	656	410	197	156	1,419 ^b
F ₆	78	33	27	30	168 ^{b,c}
F ₇	36	12	12	9	69 ^b
F ₈	19	16	11	5	51 ^b
F ₉ or >	17	21	12	4	54 ^b
Total:	15,721	3,515	5,165	1,626	26,027

^aSWS: soft white spring; HRS: hard red spring; HWS: hard white spring; Club: spring club

^bIncludes specialty crosses for stripe rust resistance, Hessian fly resistance, drought tolerance and Rhizoctonia tolerance.

^cIncludes breeding lines donated to our program from the Sunderman family.

Table 2: Number of advanced experimental breeding lines submitted to the Western Wheat Quality Laboratory for milling and baking evaluations in 2008.

Generation	Nursery	Market Class				Total
		SWS	HRS	HWS	Club	
F ₄	Headrows	885	278	240	124	1,527
F ₅	Single Plot	307	201	99	94	701
F ₆	Preliminary	31	0	11	15	57
F ₇	State	33	0	8	6	47
F ₈	Tri-State	11	10	5	2	28
Total:		1,267	489	363	241	2,360

Includes specialty crosses for stripe rust resistance, Hessian fly resistance, drought tolerance and Rhizoctonia tolerance.

Project Highlights

1. Soft White: Louise was officially released from our program in 2005, and in 2008, it was grown on more than 155,000 acres, representing 52% of the total soft white common spring wheat acreage. This variety is beginning to displace a significant portion of Alpowa and Nick, a WestBred, variety acreage in intermediate and high rainfall zones. Louise has superior high-temperature, adult-plant (HTAP) resistance to stripe rust compared to Alpowa, is partially resistant (65%) to the Hessian fly (HF), and has better emergence than Alpowa. The grain yields of Louise equaled or exceeded those of Alpowa and Nick in a majority of the non-irrigated field trial evaluations conducted from 2001 to 2008. The end-use quality of Louise is superior to Zak, and Louise is a dramatic end-use quality improvement compared to Alpowa.

Whit (formerly WA8008) was officially released in July of 2008, and this variety is targeted for production in the high rainfall regions in Whitman and Latah counties. Whit has excellent yield potential in the high rainfall zone that equals or exceeds that of Louise, but Whit matures earlier and is shorter in plant height than Louise. Whit is HF resistant, has moderate levels of HTAP resistance, and has excellent milling and baking qualities. We anticipate that Whit will replace significant portions of the Louise, Nick and Alpowa acreages in targeted production regions.

One soft white spring wheat experimental breeding line, WA8039, was approved for preliminary release in 2008. WA8039 has excellent grain yield potential, high test weight, excellent end-use quality and high levels of HTAP resistance to stripe rust. WA8039 is intended as a replacement for Alpowa in the low to intermediate rainfall zones based on its improved emergence and higher levels of HTAP resistance.

A new soft white preliminary release candidate, WA8090, was identified in 2008. WA8090 has outstanding grain yield potential across a broad range of production conditions, and has excellent milling and baking qualities. WA8090 is currently undergoing screening for HF and HTAP resistances; if results are favorable, this line will be proposed for pre-release in 2009.

2. Hard Red: Since 2006, more than 54,000 acres of Tara 2002, a 2000 variety release, were produced in Washington State. Tara 2002 was originally targeted to the intermediate to high rainfall zones as a replacement for WestBred 926. Tara 2002 is early maturing, is

moderately resistant to stripe rust and the HF, and has outstanding end-use quality. The unique quality attributes of Tara 2002 resulted in the development of an identity preserved market for this variety. Tara 2002 is used in a flour blend called The Shepherd's Grain, which is sold by Columbia Plateau Producers to local and regional clientele including WSU Dining Services.

Hollis, a 2003 WSU release, was grown on more than 35,000 acres in 2008, representing 12 percent of the hard red spring acreage in Washington State. Hollis acreage has nearly tripled since 2006, and all of these acres are in the Central and East Central growing regions of the state.

Kelse (formerly WA7954) was approved for variety release in July of 2008. Kelse is the first hard red spring wheat variety developed by our program with excellent race-specific all-stage resistance and high-temperature, adult-plant (HTAP) resistance to stripe rust. Kelse is well adapted to the high rainfall zone, and has exceptionally high grain protein content compared to other hard red spring wheat varieties currently in commercial production. It also is 100% resistant to the Hessian fly (HF). Kelse is targeted for production in the intermediate to high rainfall zones as a potential replacement for WestBred 926, Hank and Tara 2002.

Scarlet, a 1998 WSU release, has been one of the primary HRS varieties in commercial production in Washington State for the last several years. Although Scarlet has performed well in the semi-arid region, it has relatively low test weight when stressed and it is not an excessively tall variety. It also is susceptible to new races of stripe rust in the region, and it is susceptible to the HF.

A new hard red spring line with variety release potential was developed using marker-assisted selection (MAS; see progress report for Project No. 3572 for details). Two seedling resistance genes for stripe rust, *Yr5* and *Yr15*, were introgressed into Scarlet using MAS. WA8034 is a backcross derivative of Scarlet that contains *Yr5* and *Yr15*. The agronomic performance of WA8034 is very similar to Scarlet, with improved end-use quality and stripe rust resistance. WA8034 is targeted to the semi-arid and intermediate production regions of Washington State, and was proposed for preliminary release in February 2008, but was denied due to concerns about its test weight. A sister line, WA8033, also derived through MAS, with improved test weight will be considered as a preliminary release candidate in 2009.

- 3. Hard White:** Only 12,000 acres of hard white spring wheat were grown in Washington State in 2008, representing 2% of the total spring wheat acreage across all spring wheat market classes. Over 44% of the 2008 hard white acreage was sown with Blanca Grande, a General Mills variety. General Mills proactively marketed Blanca Grande, and created an outlet for producers to sell the grain. To date, a marketing plan has not been created for WSU hard white varieties, and as a result, adoption of the two hard white spring wheat varieties that have been released by this program to date has been limited or non-existent. Although the hard white component of this program has been reduced in magnitude due to market demand, two new hard white experimental breeding lines, WA8078 and WA8079, with excellent agronomic and end-use quality attributes have been identified and are being considered for preliminary release in 2009.

4. Spring Club: Eden, a 2002 release, was grown on approximately 7,500 acres in 2008, representing 100% of the spring club acreage in Washington State. Eden is an intermediate height spring club, with outstanding grain yield potential that has equaled or exceeded yields of the best soft white common entries in variety testing trials across locations for the last 8 crop years.

Although Eden has outstanding grain yield potential, it lacks HTAP resistance to stripe rust, which greatly increases the risk of producing this variety in the high rainfall zone. We have identified a broadly adapted, high yielding spring club line, WA8047, with high levels of resistance to stripe rust that was approved for preliminary release in 2008. WA8047 is taller than Eden with similar yield potential and superior end-use quality. If the high level of stripe rust resistance in WA8047 is confirmed, this variety will be proposed for full release in February 2009.

5. Donation from the Sunderman Family: Dr. Don Sunderman, former wheat breeder from University of Idaho, opened a private breeding business called SunStar Seed upon retiring from the public sector. Dr. Sunderman continued to develop and release winter and spring wheat varieties adapted to the western region of the U.S. until he passed away. With the intention of ensuring that his work continued to contribute to the advancement of wheat production in the PNW, his family generously donated the breeding material from his private company to WSU. We received Dr. Sunderman's spring material in the fall of 2003, and proceeded to integrate it into our breeding program. In the past 5 crop years we have evaluated and advanced several thousand of these lines. In 2008, 27 advanced lines were evaluated in the field from which 1 hard white and 1 soft white selection were submitted for end-use quality assessment. Lines with acceptable end-use quality will be advanced to 2009 field trials. Although we have yet to identify a variety release candidate among Dr. Sunderman's material, we have incorporated superior traits from his germplasm into our material. We will forever be indebted to Dr. Sunderman for his contributions to our breeding program.

6. Introgression of Marker-Assisted Selection (MAS)-Derived Genotypes into the Breeding Program: We developed genotypes through MAS that carry essential genes of interest through efforts described in our progress report for Precision Breeding (Project No. 3572), which are currently being used as parents in our crossing blocks. Targeted genes include stripe rust seedling resistance genes *Yr5* and *Yr15*, the high protein gene *Gpc-B1*, and Hessian fly resistance genes *H9*, *H13* and *H25*. Of the 255 F₄ families planted in field in 2008, 151 had at least one parent that carried either *Yr5* and/or *Yr15*. Progeny from forward breeding crosses for *Gpc-B1* and HF resistance genes that were made in 2006 will be advanced in field trials in 2009. In addition, a significant amount of advance MAS-derived material has been evaluated in the field since 2006. Several elite lines selected from this material will be advanced into statewide variety testing trials in 2009 (see progress report for Project No. 3572 for details).

Results

1. Over 52% (155,000 A) of the SWS wheat acreage in Washington State was planted to Louise in 2008. Registered and Certified seed of Louise is available for 2009.

2. Approximately 12% (35,500 A) of the HRS wheat acreage in Washington State was planted to Hollis in 2008. Certified seed of Hollis is available for 2009.
3. Over 4% (12,200 A) of the HRS wheat acreage in Washington State was planted to Tara 2002 in 2008. Certified seed of Tara 2002 is available for 2009.
4. 100% (7,500 A) of the spring club acreage in Washington State in 2008 was planted to Eden. Certified seed of Eden is available for 2009.
5. Although seed of our hard white spring wheat varieties Macon and Otis was available, not a single acre of either variety was planted in 2008, which justified the need for a marketing plan for hard white varieties released by WSU. Certified seed of both varieties is available for 2009.
6. Two varieties, Whit (SWS) and Kelse (HRS), were approved for released in 2008. Foundation seed for both varieties will be available in 2009.
7. WA8047 (Spring Club) will be proposed for full release in 2009.
8. In the past 3 years, WSU spring wheat varieties have accounted for 73%, 78%, 0%, and 21% of reported acres for SWS, Spring Club, HWS, and HRS varieties, respectively. This represents nearly 640,000 acres planted to WSU varieties since 2006.

Publications:

Kidwell, K.K., G.B. Shelton, V.L. DeMacon, J. Kuehner, B.K. Baik, D.A. Engle, and N.A. Bosque-Perez, A. Burke, A.H. Carter and X. Chen. 2008. Registration of “Whit” wheat. *Crop Sci* (submitted).

Kidwell, K.K., G.B. Shelton, V.L. DeMacon, X. Chen, J. Kuehner, B. Baik, D.A. Engle, and N.A. Bosque-Perez. 2008. Registration of “Kelse” wheat. *Crop Sci* (submitted).

Abstracts, Presentations and Tours:

Kidwell, K., G. Shelton, V. DeMacon and A. Carter. 2008. Improving spring wheat varieties for the Pacific Northwest. p. 30. *In* Huggins, D., Kok, H., Marsh, D., Rollins, D. (ed), “2008 Field Day Abstracts: Highlights of Research Progress: Bioenergy Cropping Systems Research”. Cooperative Extension, Washington State University, Dept. of Crop and Soil Sciences, Technical Report 08-1.

2008 Field Day Plot Tours: Connell, WA (5 June, 35 attended), Moses Lake, WA (11 June, 15 attended), Lind, WA (19 June, 230 attended).