

**Washington Grain Commission
Wheat and Barley Research Annual Progress Reports and Final Reports**

PROJECT #: 30109-3157

Progress report year: 1 of 3

Title: Evaluation and Selection for Cold Tolerance in Wheat

Cooperators: K. Garland Campbell, K. Sanguinet, A.H. Carter

Executive summary:

We used the artificial screening system in the greenhouse to evaluate the Washington Extension Soft and Hard Winter Wheat Trials. We have screened these extension trials every year since 2001. The survival results for the top varieties grown according to the Washington Grain Commission Variety Survey are below.

In 2019 we rated 936 breeding lines from public regional winter wheat breeding programs for survival. All breeding programs had lines that varied in winter tolerance. Breeders have used this information for selection of new experimental lines.

We are analyzing the data from two mapping experiments. The first is a large genome wide association study of soft wheat from the WSU winter wheat and ARS winter wheat programs. The second is a doubled haploid population of Cara/Xerpha. These two populations will give us the information about markers associated with freeze tolerance in our adapted wheat populations.

Impact

- The data from these cold tolerance trials was published in the seed buyers guide so that farmers can select winter wheat that is less sensitive to winter kill.
- Our results from screening the regional nurseries, and screening breeding lines has been used by winter wheat breeders to select for resistance to winter injury.
- Varieties released from the WSU winter wheat breeding program have consistently excellent cold tolerance and this tolerance has been maintained because of testing using the procedures developed by this project.
- Because of the high correlation between our artificial screening trial and winter survival in the field, we are able to incorporate better cold tolerance into our early generation breeding lines.
- We have identified molecular markers that are being used by breeders to select for winter survival.

Freeze Survival of Top Acreage Winter Wheat Varieties Based on 2019 Washington Wheat Variety Survey

		Percent Survival	95% LCL*	95% UCL*		Percent Survival	95% LCL	95% UCL	
Soft White Wheat					Club Wheat				
1	UI Magic CL+	10%	0	27	1	ARS Crescent	63%	46	81
2	Otto	55%	41	69	2	Bruehl	53%	35	70
3	Curiosity CL+	80%	63	97	3	Pritchett	54%	37	72
4	Norwest Duet	52%	35	70					
5	Norwest Tandem	56%	35	77					
6	Mela Cl+	68%	51	86	Hard Winter Wheat				
7	LCS Art Deco	23%	5	40	1	LCS Jet	34%	17	52
8	M-Press	33%	12	54	2	Keldin	63%	45	81
9	Puma	40%	23	58	3	SY Clearstone CL2	66%	48	83
10	Sy Ovation	14%	0	32	4	WB 4303	85%	64	107
11	Wb 1604	41%	24	59	5	LCS Fusion AX	Not tested		
12	Resilience CL+	47%	29	64	6	SY Touchstone	47%	26	69
13	LCS Drive	14%	0	35					
14	ORCF 102	23%	5	40	Checks				
15	Jasper	28%	10	45					
16	SY Assure	22%	1	43		Norstar	87%	76	98
17	SY Dayton	16%	0	33		Stephens	31%	20	42
18	SY Raptor	5%	0	34					
19	Eltan	73%	62	84					
20	UI Castle CL+	11%	0	28					
21	Madsen	26%	9	43					
22	Bobtail	26%	8	43					
23	WB 1783	55%	34	76					

* LCL and UCL are the lower and upper confidence limits for the percent survival.

Data provided by K. Garland-Campbell and E. Klarquist based on artificial freezing tests conducted at the WSU wheat plant growth facility 2016-2019. Funding from the Washington Grains Commission, project 6600. Additional data for cultivars and breeding lines included in the 2019 WSU variety testing nurseries but not on this list provided by request: kim.garland-campbell@usda.gov

WGC project number: 3019-3157
WGC project title: Evaluation And Selection For Cold Tolerance In Wheat
Project PI(s): Kimberly Garland-Campbell, Karen Sanguinet and Arron Carter.
Project initiation date: 7/1/19
Project year: Year 1

Objective	Deliverable	Progress	Timeline	Communication
1. Evaluate Washington winter wheat variety trials and the hard spring wheat trials.	Ratings for freezing tolerance for commonly grown and new winter wheat cultivars and hard spring cultivars and breeding lines.	2019 Washington winter wheat trials were evaluated in the artificial freezing trials.	June 2019 - June 2022.	Presentation at grower meetings, Wheat commission meetings, field days, plot tours, Wheat Life and Research Review. Published on WSU small grains Website
2. Evaluate cold tolerance of new breeding lines in US regional nurseries in order to identify germplasm to use in crossing for better winter survival.	Ratings for freezing tolerance for advanced wheat germplasm from the US that can be used as new sources of cold tolerance for the PNW.	New breeding lines from the WSU winter wheat breeding project and the USDA-ARS winter wheat breeding project for 2019 were evaluated. These data were used for selection.	June 2019 - June 2022.	Presentation at grower meetings, Wheat commission meetings, Wheat Life and Research Review. Email results to regional nursery cooperators and publish on regional nursery web sites.
3. Evaluate cold tolerance of advanced breeding lines contributed by regional winter wheat breeding programs, including the WSU and USDA-ARS wheat breeding programs.	Ratings for breeding lines contributed by regional wheat breeders that will facilitate their selection decisions.	The Western Regional Soft Winter wheat and the Western Regional Hard Winter Wheat trials were evaluated. Data were sent to cooperators.	June 2019 - June 2022.	Peer reviewed publications. Direct communication with wheat breeders.
4. Evaluate cold tolerance of F3-F5 (early generation) wheat populations that are segregating for cold tolerance and select resistant progeny.	Selections made for cold tolerance in early populations.	The methods were worked out to conduct these trials and the first set of lines has undergone freezing.	June 2019 - June 2022.	Direct communication with wheat breeders.
5. Identify genes controlling cold hardiness in winter wheat.	New molecular markers and genomic selection indices for cold tolerance in PNW winter wheat and Hard red spring wheat.	RNA seq was conducted on Norstar wheat expressing different levels of cold tolerance due to epigenetic gene action. These data are being analyzed.	June 2019 - June 2022.	Direct communication with wheat breeders. Peer reviewed publications.