Wheat Research Progress Report

Project #: 3019-3192

Title: Field Breeding Hard White and Red Winter Wheat

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Progress Report Year: 2008

Goal:

Development of broadly adapted, high yielding hard red and hard white winter wheat varieties with high yield stability, durable disease resistance, rapid emergence, and improved end-use quality. We seek to improve the sustainability of wheat production in the state through the use of increased genetic diversity, utilization of wild wheat germplasm and through changing the wheat plant itself to function better in more sustainable systems. The current team of scientists and technicians are committed to utilizing all appropriate technology encompassing genetics, molecular biology, gene transfer technology, physiology, pathology, agronomy, and breeding to develop superior winter wheat cultivars and germplasm.

Objectives:

1. Develop hard white and hard red winter wheats with the agronomic traits and disease resistance needed for production in Washington.
2. Develop hard white and hard red winter wheats with quality traits needed for the domestic and export markets.

Accomplishments:

The Washington Agricultural Statistics Service reported for 2007 that Bauermeister, in its second year of commercial production, was once again the top hard red winter (HRW) variety in Washington with 74,700 acres planted. They also reported that the top three varieties produced (Bauermeister, Finley and Buchanan) were out of the WSU Winter Wheat program and accounted for over 55% of the HRW acreage.

WSU Extension Uniform Variety Testing (VT) Program's hard winter wheat trials ranked WA008067 andWA008068 as two of the top 5 yielding HRW varieties with statewide mean yields of 74.3 and 70.6 bu/a, respectively. Bauermeister was ranked #6 with a mean statewide yield of 70.4 bu/ac. All of the WSU HRW varieties met or exceeded minimum protein requirements (11.5%) at every HRW VT location.

MDM, at 71.5bu/a, was the top yielding hard white winter (HWW) wheat statewide with a mean protein level of 11.9%

2007-08 field trials were conducted at the following farms: Lind Experiment Station, Lind, WA; Jim Moore, Kahlotus, WA; USDA Central Ferry Research Station, Pomeroy, WA; Spillman Agronomy Farm, Pullman, WA.; Mark Schoesler, Ritzville, WA; Adelbert and Neil Jacobsen, Waterville, WA and Jason Tanneberg, Mansfield, WA.

Six elite breeding lines were entered into the VT Program's hard winter wheat trials. HRW breeding lines WA008022 andWA008023 were continued, three new HRW breeding lines

(WA008067, WA008068, WA008069) and one new HWW breeding line (WA008070) were evaluated at the 11 V.T. locations in Washington where hard wheats are typically produced.

Sixty-five advanced hard red and hard white breeding lines were evaluated in replicated field trials at multiple sites. One hundred ninety F_5 lines and 178 F_4 HRW and HWW bulk families were advanced at the Lind Experiment Station using bulk breeding techniques. Additionally, 164 F_3 experimental lines developed specifically for emergence from deep planting, 167 F_3 and 987 F_2 experimental lines specific for dryland production were also evaluated for emergence from deep planting (>6.5") and all other agronomic traits at the Lind Experiment Station (Table 1).

Approximately 60 advanced hard wheat breeding lines were delivered to the USDA-ARS Western Wheat Quality Lab, Pullman, WA for full milling and baking quality analysis.

Table 1. 2007-2008 Hard Wheat Breeding lines planted and harvested.

Nursery	Location(s)	Entries	Market Class
Variety Testing Hard	9 VT Hard Wheat	6	HRW, HWW
V.T. (irrigated)	Moses Lake	3	HRW
Advanced 1	Lind, Pullman, CF., St Andrews, Kahlotus, Ritzville, Waterville, Mansfield	25	HRW, HWW
F6	Lind, Pullman	40	HRW, HWW
F5	Lind	190	HRW, HWW
F4	Lind	178	HRW, HWW
HR F3	Lind	167	HRW, HWW
LC F3	Lind	164	HRW, HWW
F2 HR	Lind	987	HRW, HWW
F5 evolutionary bulks	Lind, Kahlotus	8	HRW, HWW
Bulk strips	Kahlotus, Pullman, Lind, Central Ferry	16	HRW, HWW
Hard Increase	Pullman, Central Ferry	65	HRW, HWW

Progress:

The winter wheat breeding trials were planted at the Lind Experiment Station on August 29-31, 2007. Soil moisture was variable which lead to very erratic stand establishment. Emergence notes were taken on over 4,000 plots, but there were no varietal trends in the replicated nurseries. This indicated that emergence was a factor of available moisture at each plot.

The early generation breeding lines at Lind are handled using a bulk-population procedure. The seeds from each line harvested in the F_2 and succeeding generations are bulked and a sub-sample is planted, with selection delayed until an advanced generation, usually the F_5 or F_6, at which time segregation will have essentially ceased. We then select and advance superior plants keeping seed separate from each plant, eventually progressing selected progeny to replicated yield trials, seed increase of a superior line and release of a new cultivar. This year the stands were so variable (as indicated by the high C.V.'s) that no selection was made based on yield. Selection was based on test weight, quality and disease resistance as compared to the check varieties.

We continue to deep plant (≥ 6" soil cover) all early generation breeding lines at Lind in order to utilize natural selection for emergence. We are now in the sixth year of implementing this procedure and are seeing positive results in our advanced breeding lines.

All the nurseries emerged erratically, but had minimal disease pressure. A small amount of stripe rust was found on susceptible varieties late in the growing season, appearing too late to affect grain yield. Table 2 is a summary of planting and harvest dates.

Table 2. 2007/08 planting and harvesting dates.

Location	Date planted 2007	Date harvested 2008
Central Ferry	October 23	July 17
Kahlotus	August 27	July 15
Lind	August 29 – 31	July 20-25
Mansfield	August 22	August 5
Pullman	Sept.2 - October 25	August 7 – Sept. 2
Ritzville	August 27	July 24
St Andrews	August 22	August 5
Waterville	August 22	August 5

Table 3. Summary of 2007/08 advanced hard red (AHR) breeding nursery, low precipitation locations.

	Kahlotus		Ritzville		Lind		Dryland Mean	
Variety #	Yield	T wt	Yield	T wt	Yield	T wt	Yield	T wt
WA8023	47.9	58.0	31.3	57.2	27.5	59.2	35.6	58.1
J970054-3	41.9	57.5	28.6	58.1	34.4	59.0	35.0	58.2
J970054-5	44.7	56.8	31.9	57.6	27.4	60.2	34.7	58.2
Bauermeister	45.4	57.8	24.3	58.1	33.7	59.6	34.5	58.5
Finley	45.8	62.8	33.8	61.9	23.8	61.7	34.5	62.1
Farnum	48.4	56.9	29.0	58.6	25.4	59.0	34.3	58.2
WA8067	45.9	59.5	25.9	58.3	29.8	60.4	33.8	59.4
Eltan	39.6	59.1	34.9	59.6	25.0	60.6	33.2	59.7
WA8069	40.4	61.0	30.1	60.1	28.8	60.6	33.1	60.5
Paladin	42.0	62.2	29.4	60.7	26.8	61.8	32.7	61.5
WA8070	39.6	58.4	27.5	60.1	30.9	60.4	32.7	59.6
J030431	43.8	60.6	26.9	59.4	27.0	60.2	32.5	60.0
5J030431	40.1	60.3	24.0	59.4	32.6	60.4	32.2	60.0
7J000048-8	38.1	60.5	28.1	58.2	29.0	60.9	31.7	59.9
7J000048-12	37.7	59.2	26.3	59.0	30.1	60.0	31.4	59.4
WA8068	39.1	61.8	23.1	60.4	29.4	61.5	30.6	61.2
MDM	36.3	57.9	26.1	58.4	28.0	59.6	30.1	58.6
WA8022	42.0	61.0	24.3	59.5	21.6	60.8	29.3	60.4
6J020071-10	25.2	59.6	32.2	58.2	25.8	59.0	27.7	58.9
Eddy	37.3	60.9	20.8	60.8	23.3	61.6	27.1	61.1
	41.1	59.6	27.9	59.2	28.0	60.3	32.3	59.7
	15.2	1.3	18.4	1.5	26.9	1.1	28.7	1.9
	8.8	1.1	7.3	1.3	10.7	0.9	7.5	0.9

Table 4. F6 breeding lines, Lind

Variety	Yield	Test wt.
5J030588-3	26.5	61.3
5J030184-2	25.2	61.0
Bauermiester	24.9	60.6
MDM	23.8	60.5
Xerpha	23.1	60.3
5J030189-3	22.8	31.0
5J030349-6	21.7	59.7
5J030706-1	21.3	59.6
5J030305	21.1	60.1
5J030159-3	21.1	60.5
5J030336-2	20.8	60.5
5J030235-4	20.7	60.8
5J030307-2	20.2	58.9
5J030590-1	20.1	60.0
5J030316-4	19.5	61.3
5J030349-5	18.6	58.2
5J030349-7	18.2	59.6
5J030159-5	18.1	59.9
Bruehl	18.1	60.8
WA007976	17.9	60.0
5J030159-4	17.6	58.7
5J030465-1	17.6	60.4
5J030189-2	17.4	59.3
5J030465-2	16.0	59.5
5J030644-1	16.0	57.9
5J030184-3	16.0	60.9
Masami	14.2	60.1
5J030235-7	13.9	59.2
WA007977	13.2	60.8
5J030519-3	13.2	59.8
5J030727-1	13.0	58.5
5J030189-1	12.6	60.4
5J030184-4	12.1	57.4
5J030588-1	11.0	60.2
5J030465-5	10.2	60.0
5J030159-6	10.1	
5J030349-4	10.0	
5J030588-2	9.8	
5J030696-4	9.7	
5J030307-1	9.4	

Table 5. F5 breeding lines, Lind

Variety	Yield	T wt		Variety	Yield	T wt
5J040965	29.7	62.4		5J040952	19.4	60.0
5J040720	28.8	60.8		5J040672	19.2	61.0
Finley	26.5	62.4		5J040597	19.2	60.4
5J040695	26.3	61.8		5J040915	19.2	62.6
5J040583-3	25.9	59.0		Tall Shorty-3	19.1	54.0
5J040617	25.9	61.6		5J040959	19.0	62.4
5J041075	25.5	61.2		5J040928	18.9	62.6
5J040602	25.4	62.4		5J040985	18.5	61.6
5J041077	24.6	58.6		5J040823	18.5	59.2
5J040607	24.5	60.4		5J040736	18.5	60.0
5J040667	24.3	60.2		5J041112	18.3	61.8
5J040578-1	24.1	59.6		5J040895	18.2	61.6
5J040768	24.0	61.8		5J040897	18.2	62.0
5J040717	23.9	60.8		5J041054	18.2	62.4
5J040712	23.7	60.4		5J040583-2	18.1	57.2
5J040722	23.5	61.8		5J040731	18.0	61.0
5J040943	23.5	58.4		5J040755	18.0	60.0
MDM	23.5	60.4		5J040827	17.8	62.4
Finley	23.4	62.0		5J040977	17.8	62.8
5J040704	23.2	62.6		5J040911	17.6	62.0
MDM	23.0	60.6		5J041087	17.5	59.4
5J040948	23.0	59.0		5J041118	17.4	61.8
5J040622	22.9	61.4		5J040652	17.4	60.4
5J040698	22.9	58.4		5J040870	17.2	60.8
5J040932	22.6	61.8		5J040774	17.1	62.0
5J040692	22.6	62.0		5J040842	17.0	61.6
5J040746	22.5	61.6		5J040852	16.9	60.0
5J041069	22.5	60.8		5J040612	16.9	61.0
5J040837	22.4	61.0		5J040682	16.9	59.6
5J041120	22.2	61.6		5J041117	16.8	60.2
5J040569-2	22.1	60.4		5J040751	16.6	60.6
Tall Shorty-1	22.0	53.4		5J041123	16.6	59.6
5J040832	21.9	62.8		5J040758	16.0	60.0
5J041102	21.8	59.4		5J041092	15.9	56.2
5J040971	21.4	62.2		5J040555-2	15.8	60.2
5J040726	21.3	62.0		5J040991	15.8	61.8
5J040763	21.3	61.8		5J040632	15.6	61.0
5J041059	21.1	60.4		**Bauermiester**	15.6	61.6
5J040920	21.0	63.6		5J040440-3	15.5	59.4
5J041073	20.9	59.2		5J040583-1	15.4	57.4
Bauermiester	20.9	60.4		5J040440-1	15.3	59.4
5J040569-3	20.8	61.2		5J040440-2	15.3	61.2
5J040944	20.8	63.6		5J040847	15.2	61.6
Eltan	20.6	61.6		5J040555-1	14.6	60.8
5J040924	20.0	61.2		5J040857	14.5	60.6
5J040662	19.8	60.2		5J040548-1	14.3	59.0
5J040569-4	19.4	60.8		5J040641	14.2	60.0
Tall Shorty-2	19.4	54.4		5J040517-1	14.2	61.0

Significant progress has been made in the following projects within our SWW/HRW breeding programs (see Publications and Presentations, in project # 6194):

- Increasing wheat productivity through diversity. We proved grain yield can be significantly increased by blending just 5% of a taller variety. We are now testing “designer blends” to determine which varieties work best together in specific precipitation zones.

- Reduced/ low inputs. We are studying which varieties are best adapted to perform well under low input systems and which phenotypic traits enhance this ability. Weed suppression ability and harrowing tolerance are examples of two areas we are examining. We are also examining strong gluten wheats to determine if high milling and baking quality attributes can be maintained at lower protein levels.

- Increasing the nutritional value of wheat. We proved many historical varieties have higher mineral nutrient content then our modern ones. Work is being done to recapture this “value-added” component.

- Nitrogen use efficiency (NUE). We are working on making modern wheats more efficient in capturing available nitrogen.

- Developing wheats specifically for emergence from deep planting. We are breeding wheats to eliminate emergence as an issue for growers.

- Designer/participatory wheat. We are working with growers, allowing them to select the plant ideotype they feel will work best for their precise location and then continue to select and advance those lines.

- Nitrogen fixing wheats. Our results indicate that *Azospirillum* inoculation can improve nutrient uptake and increase wheat yield, but this interaction is dependent upon plant genotype and site-specific soil conditions

Publications and Presentations:

See Project # 6194