Wheat and Barley Variety Screening in the Klamath Basin, 2008

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Introduction

Grain is produced on about 100,000 acres in the Klamath Basin and 60,000 acres within the Klamath Reclamation Project. Susceptibility to late spring frosts has historically limited winter cereal production and spring cereals have accounted for the majority of production. Starting in 2003, a significant shift to production of hard red winter wheat was observed. With few late spring frosts and frost-free summers, most of the winter wheat crops produced reasonably good yield and quality in the past few years.

Klamath Basin Research & Extension Center (KBREC) cereal variety evaluation efforts have focused on spring cereal varieties in the past, but with the increased acreage

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of commercial winter wheat, and grower requests for more winter wheat information, we also began seeding winter wheat trials at the station in the fall of 2004. While the first year (2004-05) included only the Oregon State University (OSU) Oregon Winter Elite Yield Trial (OWEYT), in 2005-06 and 2006-07 we also planted the Western Regional Soft Winter Wheat and Hard Winter Wheat Nurseries on the KBREC site mineral soil. However, in 2008, we planted only the OWEYT trial at KBREC due to decreased funding and lack of staff in the fall of 2007.

In 2008, small grain variety trials were conducted on-site at KBREC on a mineral soil, and at a Lower Klamath Lake (LKL) site on a silty clay loam muck (high organic matter) soil. The OWEYT and OSU Oregon Spring Elite Yield Trial (OSEYT) trials were only grown at the KBREC site. The Western Regional Spring Barley Nursery, and the Western Regional Soft and Hard Spring Wheat Nurseries were only grown at the LKL site.

The two trials planted at the KBREC site resulted in failures. The OSEYT trial had a late flush of weeds that went uncontrolled. Yields were reduced considerably and were not reflective of the varieties' performance under normal conditions. The OWEYT trial was decimated by geese predation in the early spring. Foraging geese are typical in the Klamath Basin in late winter, but in 2008 the density of geese and lack of other nearby forage resulted in nearly complete annihilation of the wheat plants. We maintained both trials through until harvest for observational purposes, but there was no meaningful data, so they won't be discussed further.

Procedures

LKL Site

The spring grain variety trials at the LKL site were conducted on Algoma silt loam soil in a continuous grain rotation. The field was flooded during the winter to replenish moisture to the entire soil profile. All three trials were arranged in a randomized complete block design. The Western Regional Spring Barley Nursery had three replications, while the Western Regional Soft and Hard Spring Wheat Nurseries each had four replications. Seed was planted one inch deep at 30 seeds/ft^2 with a Kincaid (Kincaid Equipment Mfg.) plot drill on May 15, 2008. The plots were 20.0 by 4.5 ft, (9 rows at 6-inch spacing), with a harvested area of 13.0 by 4.5 ft.

All plots were fertilized with 50 lb/ac N as anhydrous ammonia shanked in during seedbed preparation tillage, followed by 100 lb/ac N, 125 lb/ac P_2O_5, no K_2O, and 94 lb/ac S banded at seeding (applying 625 lb/ac of 16-20-0-15 fertilizer). The plots were irrigated by the grower during the season with the overhead linear move system used for the entire field (several hundred acres), based on his judgment of water need. Plots were harvested using a Hege (Hans-Ulrich Hege) plot combine with a 4.5-ft-wide header on September 18.

Grain yield, test weight, lodging percentage, plant height, and maturity (date of 50 percent heading) were measured for all trials. For the spring barley trial, percent plumps (percent above 6/64 and 5.5/64 sieves) and thins (pan) were also measured.

All measured parameters were analyzed statistically using SAS® for Windows, Release 9.1 (SAS Institute, Inc.) software. Treatment significance was based on the F test at the P=0.05 level. If this analysis indicated significant treatment effects, least significant difference (LSD) values were calculated based on the student's *t* test at the 5 percent level.

Results and Discussion

Weather was unusually warm in 2008 for the first two weeks after seeding, followed by two weeks of cold weather, including several days below freezing (Fig. 1). A delay in irrigation initiation due to repairs to the grower's irrigation system resulted in dry soil conditions during germination. Later in the season there was good availability of irrigation water and relatively few hot days during the season, but the initial stress on germination and seedling growth persisted throughout the season. In addition, weed control was less than ideal, probably due to the lack of any herbicide use (this was a certified organic field). Prior trials in this field had less weed pressure than what was experienced in 2008.

These factors likely all contributed to poor yields in 2008. By comparing yields of check varieties over the years, we observed several trends, including: spring barleys yielded less in 2008 than in 2006 (the last prior year a spring barley trial was grown on organic soil); and the spring wheat entries yielded much less in 2008 than in 2005 (the last prior year a spring wheat trial was grown on organic soil) (Roseberg and Smith, 2005 and 2006). Overall, mean yields for trials at the LKL site in 2008 were lower than any trials on organic soil in recent years. The 2008 spring wheat trial yields were much lower by a considerable margin. Details of the 2008 trials are given below.

Western Regional Spring Barley Nursery

Twenty-seven entries were included in the 2008 trial at the LKL site. This trial included 13 feed entries (varieties or selections), 8 malting entries, and 6 entries that could be used for either feed or malting. Differences in yield were statistically significant at the P=0.05 level. Yields ranged from 1,830 to 5,560 lb/ac with a mean of 3,180 lb/ac (Table 1). The range of yields was wider than those observed the last time this trial was planted on the LKL site (2006), and the overall mean was somewhat lower than the 2006 mean (Roseberg and Smith, 2006).

Test weights were greater than the 48 lb/bu industry standard for all entries, indicating good moisture, fertility, and weather conditions during the seed-filling phase. Only two of the entries had test weights below 50 lb/bu. The overall mean test weight in 2008 (52.8 lb/bu) was greater than in 2006 (51.1 lb/bu). The percent of seed retained on the 6/64 screen (the plumpest seed) was greater in 2008 than 2006, in excess of 97% for all entries.

Western Regional Soft Spring Wheat Nursery

Four standard named varieties and five numbered selections were included in the 2008 trial planted at the LKL site. All were soft white spring types except WA008047, which was a club wheat. Yields ranged from 530 to 2,810lb/ac, with a mean of 1,630 lb/ac (Table 2), and were statistically significant at the P=0.05 level. As in 2005 (the last year this trial was planted on organic soil), Nick was among the lowest yielding entries

(Roseberg and Smith, 2005). Unlike 2005, Louise had the highest yield in 2008, and Alturas and Alpowa were in the middle.

Differences in test weight were statistically significant. Only three entries had test weights above the industry standard of 60 lb/bu. Overall test weights in 2008 were lower than in 2005, with a mean of 59.4 lb/bu. Top entries included IDO599, WA008047, WA008008, and Nick. WA008047 and WA008008 had good combinations of yield and test weight.

Western Regional Hard Spring Wheat Nursery

This trial evaluated five hard white spring (HWS) and twenty hard red spring (HRS) wheat experimental lines and named varieties at the LKL site. Differences in yield were statistically significant at the P=0.05 level. Total yields ranged from 730 to 4,410 lb/ac, with a mean of 2,230 lb/ac (Table 3). HRS and HWS varieties were both represented among the highest- and lowest-yielding entries. Overall yields were much lower than in 2005, and were also much lower than the long-term average for this location (Roseberg and Smith, 2005).

Differences in test weight were statistically significant. The overall mean test weight was 59.4 lb/bu, slightly less than the 60.0 lb/bu industry standard. They were also lower than the overall mean test weight of 61.5 lb/bu observed in 2005. Of the entries planted in 2005 and 2008, only Clearwhite was among the highest in test weight both years (2nd highest in 2005, and number one in 2008).

In this trial, the replication effect was significant for all parameters measured. For example, the mean yield for rep 1 was significantly less than the mean yield of the other three replications. This trial was located nearest the edge of the field, and due to the way the linear irrigation system was operated, the edge of this trial (rep 1) did not receive the full irrigation allotment each cycle, resulting in lower overall irrigation received than for the rest of this trial and the other two spring grain trials grown in this field in 2008. It was thought this moisture stress in rep 1 exacerbated the other stresses in 2008 (described below), resulting in different results for the plots in rep 1. However, any differences in irrigation due to where the linear irrigation system stopped and started for each cycle were uniformly experienced felt by all plots within a rep. So despite this replication effect, the other parameters measured all exhibited significant differences between varieties that can be attributed to varietal differences.

Summary

All three trials produced lower yields in 2008 than in previous years. The Western Regional Spring Barley Nursery did not have as drastic of a decrease in yield from previous years as the wheat trials did. Even so, the yields in 2008 were all below the long-term trial average for this location. It is thought that the lower yields in 2008 could be due to the combination of factors, including very warm and dry germination conditions, followed by a period of below-freezing weather, coupled with greater-than-normal weed pressure later in the season.

Crop rotation has some influence on the results of these variety trials and with grain production in the Klamath Basin in general. These trials are typically grown in a field managed in a long-term continuous spring grain rotation, but on some farms spring grains can follow potatoes grown the previous year, benefiting from typical potato management such as high rates of fertilization and common use of fumigants, which also reduce weed seeds. Spring moisture, availability of irrigation water, weed pressure, and weather during germination and early seedling growth can have strong effects on ultimate grain yield.

References

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Table 1. 2008 Western Regional Spring Barley Nursery, seeded in organic soil (ranked by yield). Klamath Basin Research & Extension Center, Klamath Falls, OR.

Entry	Row	Use	Yield (lb/ac)	Test Wt (lb/bu)	6/64 (%)	5.5/64 (%)	Pan (%)	Lodging (%)	Height (inch)	50% Heading (Day of Year)
2ND22182	2 row	malting	5560	56.1	99.1	0.4	0.5	0.0	27.3	197
2B03-3719	2 row	malting	5070	52.6	98.4	0.9	0.7	0.0	27.7	209
Baronesse	2 row	feed	4870	52.3	98.6	0.8	0.6	16.7	26.3	214
BZ503-097	2 row	feed	4580	54.2	98.8	0.7	0.6	0.0	29.0	210
BZ504-093	2 row	feed	3820	53.6	98.3	1.0	0.8	0.0	27.7	216
Harrington	2 row	malting	3770	54.3	98.0	1.1	0.9	0.0	26.0	212
MT020155	2 row	feed/malting	3570	54.0	98.5	0.9	0.5	0.0	25.7	205
BZ505-187	2 row	feed	3510	53.2	98.0	1.1	0.9	0.0	26.7	221
2ND21867	2 row	malting	3380	54.4	98.2	0.9	0.9	0.0	28.0	200
MT030042	2 row	feed/malting	3370	53.3	97.8	1.2	1.0	0.0	27.0	212
UT03B1960-483	6 row	feed	3220	49.6	96.1	2.3	1.5	0.0	28.0	197
MT010160	2 row	feed/malting	3010	53.3	96.6	1.8	1.6	0.0	26.3	217
04WA-122.20	2 row	feed	2960	50.9	97.3	1.5	1.3	0.0	24.7	217
Steptoe	6 row	feed	2890	49.7	98.4	0.9	0.8	0.0	23.0	212
MT040073	2 row	feed/malting	2880	54.8	98.4	0.9	0.7	0.0	25.3	220
UT04B2041-42	6 row	feed	2860	52.3	97.2	1.5	1.3	0.0	26.0	207
2B02-2925	2 row	malting	2840	54.1	98.0	1.1	0.9	0.0	25.3	214
04WA-101.45	2 row	feed	2820	51.4	97.2	1.3	1.5	0.0	27.3	216
MT020204	2 row	feed/malting	2710	52.9	98.1	1.1	0.7	0.0	24.7	210
Stander	6 row	malting	2700	50.7	96.5	1.9	1.6	0.0	28.7	206
02Ab17060	2 row	feed	2550	50.2	97.2	1.4	1.4	0.0	21.3	217
PBI-04-2R-4263	2 row	feed	2470	51.7	96.3	1.8	2.0	0.0	23.7	221
02WA-1095	2 row	feed	2380	51.8	96.8	1.8	1.4	0.0	26.3	223
2ND22927	2 row	malting	2230	55.3	97.2	1.3	1.5	0.0	25.3	204
Morex	6 row	malting	2180	53.7	97.8	1.5	0.7	13.3	31.0	198
MT010158	2 row	feed/malting	1930	53.7	96.7	2.0	1.4	0.0	23.0	219
02WA-7028.9	2 row	feed	1830	51.1	97.1	1.3	1.5	0.0	24.3	222
Mean			3180	52.8	97.7	1.3	1.1	1.1	26.1	212
***P* value**			**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.485**	**0.001**	**<0.001**
LSD (0.05)			680	1.3	1.0	0.6	0.5	NSD	9.2	5
CV (%)			13.0	1.5	0.6	26.7	28.0	628.2	8.5	1.5

Grain yields shaded in gray are not significantly different from the highest yield in this trial.

Table 2. 2008 Western Regional Soft Spring Wheat Nursery, seeded in organic soil (ranked by yield). Klamath Basin Research & Extension Center, Klamath Falls, OR.

Entry	Type[1]	Yield (lb/ac)	Test Wt (lb/bu)	Height (inch)	50% Heading (Day of Year)
LOUISE	SWS	2810	58.2	28.3	198
WA008008	SWS	2320	60.2	24.8	196
WA008047	Club	2150	60.8	23.5	199
IDO599	SWS	1830	61.1	25.5	196
ALTURAS	SWS	1690	59.3	23.0	200
ALPOWA	SWS	1250	57.5	25.5	202
WA008039	SWS	1180	58.5	24.3	201
OR4041451	SWS	930	58.0	26.8	201
NICK	SWS	530	59.5	17.5	199
Mean		1630	59.4	24.3	199
***P* value**		**<0.001**	**<0.001**	**<0.001**	**<0.001**
LSD (0.05)		730	1.1	2.8	2
CV (%)		30.6	1.1	7.9	0.7

[1]SWS = soft white spring.

Grain yields shaded in gray are not significantly different from the highest yield in this trial.

Table 3. 2008 Western Regional Hard Spring Wheat Nursery, seeded in organic soil (ranked by yield). Klamath Basin Research & Extension Center, Klamath Falls, OR.

Entry	Type[1]	Yield (lb/ac)	Test Wt (lb/bu)	Height (inch)	50% Heading (Day of Year)
IDO706	HRS	4110	60.7	28	196
08010/20	HWS	3500	60.7	25	195
IDO698	HWS	3040	61.1	29	195
08010/4	HRS	3030	57.1	28	201
Hank	HRS	2970	57.9	25	197
08010/6	HRS	2880	59.8	30	200
IDO705	HRS	2700	59.9	24	195
IDO704	HRS	2630	60.2	26	196
WA008034	HRS	2380	56.7	28	198
IDO703	HRS	2350	61.8	23	194
IDO702	HRS	2300	57.5	26	197
IDO700	HRS	2290	60.9	24	195
B02-0081	HRS	2210	61.0	23	196
IDO707	HRS	2150	57.0	24	197
IDO377S	HRS	2080	59.4	26	199
IDO701	HRS	2080	59.3	24	197
Clear White	HWS	1990	62.0	23	198
WA007954	HRS	1850	59.0	24	198
Lassik	HRS	1730	58.4	20	200
OR4031177	HRS	1670	58.0	25	203
IDO697	HWS	1660	57.1	25	196
OR4031111	HRS	1570	57.4	28	202
OR4031138	HRS	1110	61.2	26	196
08010/8	HRS	830	61.5	23	199
08010/18	HWS	730	60.8	23	196
Mean		2230	59.4	25.0	197
***P* (Entry)**		**<0.001**	**<0.001**	**<0.001**	**<0.001**
***P* (Rep)**		**<0.001**	**<0.001**	**<0.001**	**<0.001**
LSD (0.05)		905	0.9	2.2	1
CV (%)		28.7	1.1	6.1	0.5

[1]HRS = hard red spring; HWS = hard white spring.

Grain yields shaded in gray are not significantly different from the highest yield in this trial.

Fig. 1. Grain Daily Max and Min Air Temperatures: 2007 and 2008