

**2010**  
**Organic Spring Wheat**  
**Variety Trial Results**



photo by Will Brinton

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# 2010 MAINE ORGANIC SPRING WHEAT VARIETY TRIAL RESULTS

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In 2010, the University of Maine, in collaboration with the University of Vermont, began an extensive trial evaluating varieties of hard red spring wheat to identify those that perform well in northern New England under organic production. In Maine, this trial was established at two locations, the University of Maine Smith Farm Research Facility in Old Town and Rainbow Valley Farm, a private farm in Sidney (see cover photo). The trial was also conducted at two sites in Vermont, results for which are reported in a separate bulletin. This collaborative work was funded by a grant from the USDA Organic Agriculture and Extension Research Initiative (OREI) to improve bread wheat production in our region.

## TRIAL DESIGN AND VARIETIES

The experimental design was a randomized complete block with four replications, which means that each variety was planted in four separate plots at each location. All of the spring wheat varieties that were evaluated are hard red types (Table 1). Hard types of wheat are preferred for bread flour.

**Table 1. Hard red spring wheat varieties planted in Old Town and Sidney, ME.**

Hard Red Spring Wheat Variety	Origin and Year of Release†	Seed Source
AC Barrie-1	Ag Canada‡, 1994	Meadowbrook Farms, Canada
AC Barrie-2	Ag Canada, 1994	Farm-saved seed
AC Walton	Ag Canada	McCardle Brothers, Canada
Ada	MAES, 2006	Univ. of Minnesota
Batiscan	Semican	Semican, Canada
Cabernet	Resource Seed, PNW, 2001	Tri-State Seeds, WA
Faller	North Dakota State Univ., 2007	Albert Lea Seed House, MN
FBC Dylan	NPSAS/FBC, 2006	North Dakota State Univ.
Glenn	North Dakota State Univ., 2005	Albert Lea Seed House, MN
Howard	North Dakota State Univ., 2006	North Dakota State Univ.
Kelse	Washington State Univ., 2008	Washington State Univ.
Kingsey	Semican	Semican, Canada
Magog	Semican	Semican, Canada
Malbec	Agripro Syngenta, PNW	Tri-State Seeds, WA
Oklee	MAES, 2003	Univ. of Minnesota
RB07	MAES, 2007	Univ. of Minnesota
Red Fife	Heritage var. from Canada, 1860	Butterworks Farm, VT
Roblin	Ag Canada, 1996	Wood Prairie Farm, ME
Sabin	MAES, 2009	Univ. of Minnesota
Steele-ND	North Dakota State Univ., 2004	Albert Lea Seed House, MN
Superb	Ag Canada, 2001	Oliver Seed Co., VT
Tom	MAES, 2008	Univ. of Minnesota
Ulen	MAES, 2005	Univ. of Minnesota

† Year of release was not always available.

‡ Abbreviations: Ag Canada = Agriculture and Agri-Food Canada, MAES = Minnesota Agricultural Research Station, PNW = Pacific Northwest, NPSAS/FBC = Northern Plains Sustainable Agriculture Society/ Farm Breeding Club

## WEATHER DATA

Seasonal precipitation and temperature recorded at the Rogers Farm Forage and Crop Research Facility are shown in Table 2. Weather data closer to Sidney than Old Town was not available. Weather in 2010 was ideal for growing wheat. Due to a warm dry spring, wheat planting occurred about two weeks earlier than typical. Except for the month of June, this pattern continued through the growing season with above average temperatures and below average rainfall. From planting to harvest in Old Town, there was an accumulation of 3020 Growing Degree Days (GDD).

**Table 2. Temperature and precipitation summary for Old Town, ME, 2010.<sup>†</sup>**

Old Town	April	May	June	July	August	Total
Average Temperature (°F)	46.3	56.1	62.0 <sup>‡</sup>	70.5	67.3	---
Departure from Normal	4.3	2.2	- 0.7	2.1	1.2	---
Total Precipitation (inches)	2.3	1.9	4.0 <sup>‡</sup>	2.2	1.1	11.5
Departure from Normal	- 0.9	- 1.5	0.4	- 1.2	- 2.1	- 5.3
Growing Degree Days (base 32°F)	426	726	857 <sup>‡</sup>	1182	1077	3020

<sup>†</sup>Based on National Weather Service data from cooperative observer stations in close proximity to field trials. Historical averages are for 30 years (1971-2000). <http://cdo.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl>

<sup>‡</sup>Values are incomplete due to missing or flagged data.

## CULTURAL PRACTICES

Plots were managed following practices similar to those used by farmers in Maine (see Table 3).

Smith Farm - Old Town, ME - The field used in the trial in Old Town was previously cropped to soybeans, which were not harvested due to crop failure. The field was moldboard plowed in September of 2009. On April 21, solid dairy manure was applied at 21 tons/acre (target 70 lbs N/acre) and incorporated using a seed-bed conditioner. Prior to planting, the field was Perfecta harrowed to prepare the seedbed. Plots were seeded with a Almaco Cone Seeder on April 26, 2010. A Lely spring-tine harrow was used for weed control at the 3 to 4 leaf stage (May 26). Plots were harvested with an Almaco SPC20 plot combine on August 6, 2010.

Rainbow Valley Farm - Sidney, ME - The field used in the trial in Sidney was previously cropped to silage corn. Liquid dairy manure was applied at a rate of 5333 gallons/acre (target 70 lbs N/acre) on April 15 and incorporated on the same day using a disc harrow in two passes over the field and a cultivator packer. Seed-bed preparation was completed on April 15 with two passes of a C-shank chisel harrow. The plots were seeded on the same day with an Almaco Cone Seeder. A Lely spring tine harrow was used for weed control at the 2 to 3 leaf stage (May 5). Plots were harvested with an Almaco SPC20 plot combine on July 30, 2010.

## MEASUREMENTS AND METHODS

Flowering date was recorded for each variety where possible. Once the wheat reached physiological maturity, plant height, number of tillers, and wheat and weed above-ground biomass were measured. Only tillers with filled grain heads (spikes) were counted. The biomass was cut one inch above the soil surface. Prior to harvest, the incidence and severity of lodging was noted for each plot.

All varieties were harvested on the same day at each site once the latest maturing variety threshed free in hand tests and weather and logistics allowed. Following harvest, the grain from both locations was cleaned

with a small Clipper cleaner. Measurements taken include grain yield, moisture, test weight, crude protein, falling number, and DON. Harvest moisture and test weights were determined using a Seedburro GMA 128 grain moisture meter. Subsamples were ground into flour using a Perten LM3100 Laboratory Mill. Flour was then analyzed for crude protein, falling number, and mycotoxin levels. Protein content was determined using a Perten Inframatic 8600 Flour Analyzer. Most commercial mills want a minimum of 12% grain protein for bread wheat, and preferably 13% for hard red spring wheat. Falling number was determined on a Perten FN 1500 Falling Number Machine. The falling number is related to the level of sprout damage that has occurred in the grain due to enzymatic activity. It is measured by the time it takes, in seconds, for a plunger to fall through a slurry of flour and water to the bottom of the tube. Falling numbers greater than 250 seconds indicate low enzymatic activity and sound quality wheat. Falling numbers lower than 200 indicates high enzymatic activity and poor quality wheat. Concentrations of deoxynivalenol (DON), a mycotoxin produced by the fungus that causes *Fusarium* head blight, was determined using Veratox DON 2/3 Quantitative test from the NEOGEN Corp. This test has a detection range of 0.5 to 5 ppm. Samples with DON values greater than 1 ppm are considered unsuitable for human consumption. Cleaning done by mills can reduce this value to some extent.

Data were analyzed using mixed model Analysis of Variance in which replicates were considered random effects. The LSD procedure was used to separate variety averages when the ANOVA F-test was significant ( $P < 0.05$ ). There were significant differences between the two locations for most measures so results from

**Table 3. General plot management of the spring wheat variety trials.**

Trial Information	Spring wheat variety trial	
Location	Smith Farm Research Facility Old Town, ME	Rainbow Valley Farm Sidney, ME
Soil type	Suffield very fine sandy loam	Buxton silt loam
Previous crop	Soybeans	Corn silage
Fertility source	Solid dairy manure	Liquid dairy manure
Target nitrogen rate (lbs/ac)	70	70
Row spacing (in)	6.5	6.5
Seeding rate (seedlings/ac)	30	30
Replicates	4	4
Planting date	4-26-10	4-15-10
Harvest date	8-6-10	7-30-10
Harvest area (ft <sup>2</sup> )	4' x 34'	4' x 34'
Tillage operations	Moldboard plow, seedbed conditioner	Disc harrow, C-shank chisel harrow



A Lely spring-tine harrow was used to control weeds at both locations. The Old Town trial is pictured here.

## WHAT IS A SIGNIFICANT DIFFERENCE?

Variations in yield and quality can occur not only due to genetics but also due to variability in soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference between two varieties is real or whether it might have occurred due to other variability in the field. The Least Significant Difference (LSD) is the minimum difference needed between two averages to consider them statistically different. LSDs at the 5% level of probability are presented at the bottom of each table for each measure. Where the difference between two varieties within a column is equal to or greater than the LSD value, you can be sure in 19 out of 20 chances that there is a real difference between the two varieties.

In the example below, variety A is significantly different from variety C because the difference between their yields (1454) is greater than the LSD value (889). Variety A is not significantly different from variety B because the difference between their yields (725) is less than the LSD value (889).

Throughout this bulletin, the greatest value at each site for each measure is indicated with an underline and bold type. Varieties that are not significantly different from the greatest value are also in bold type. Using the example below, variety C had the highest measured yield (underlined and bolded) but it was not significantly different than the yield of variety B (bolded).

### Example

Variety	Yield
A	3161
B	<b>3886</b>
C	<b><u>4615</u></b>
<i>LSD</i>	889

## RESULTS

### Wheat Growth and Development

Varieties flowered 5 to 7 days earlier in Sidney than in Old Town reflecting an earlier seeding date (Table 4). Most varieties flowered within a few days of one another, with the exception of AC Walton, Kingsey and Red Fife, which flowered 5 to 8 days after the earliest variety.

Batiscan, Kingsey, and Red Fife were the tallest varieties. It is thought that taller varieties may be more competitive with weeds and therefore better suited for organic production than shorter varieties. We did not see evidence of this in our trial. Shorter varieties, such as Faller and Sabin, had equally low weed biomass as these taller varieties. However, we did observe that varieties with higher wheat plant biomass (Table 5) tended to have lower weed biomass providing evidence that bigger, but not necessarily taller, plants were more competitive with weeds. In general, weed pressure was moderate at both locations due to the early planting dates.



*Fusarium* head blight on spring wheat grown in the Old Town trial.

## Wheat Yield

A typical yield for organic hard red spring wheat grown in Maine is estimated to be about 2,000 lbs/acre (personal communication, Matt Williams, 2011). Yields in these trials were well above this level in almost all cases, averaging 2690 lbs/acre in Old Town and 2591 lbs/acre in Sidney (Table 5; Figs. 1 and 2). Faller, Oklee, and Tom were in the top yielding group at both sites. Kingsey, Ulen, Sabin, and Superb also yielded well at both sites. Varieties that were among the lowest yielding at both sites were AC Barrie-1 (certified seed), AC Barrie-2 (farm-raised seed), Ada, Batiscan, and Red Fife.

**Table 4. Wheat growth and development measures and weed biomass for spring wheat grown in Old Town and Sidney, ME.**

Variety	Estimated Flowering Date		Plant Height		No. of Tillers		Weed Biomass	
	Old Town	Sidney	Old Town	Sidney	Old Town	Sidney	Old Town	Sidney
			inches	inches	no./ft <sup>2</sup>	no./ft <sup>2</sup>	lbs/ac	lbs/ac
AC Barrie-1	27-June	---	39	---	53	---	617	--
AC Barrie-2	26-June	20-June	36	33	51	42	758	567
AC Walton	28-June	---	37	---	41	---	712	--
Ada	25-June	18-June	28	27	<b>69</b>	43	<b>451</b>	592
Batiscan	26-June	21-June	40	36	48	34	<b>400</b>	567
Cabernet	25-June	19-June	24	21	58	39	526	493
Faller	25-June	20-June	31	31	<b>62</b>	<b>47</b>	<b>252</b>	335
FBC Dylan	23-June	19-June	33	29	55	38	559	358
Glenn	22-June	18-June	33	32	57	44	556	458
Howard	24-June	19-June	31	31	<b>66</b>	45	611	458
Kelse	26-June	19-June	29	28	41	34	706	436
Kingsey	28-June	23-June	40	<b>37</b>	53	41	<b>218</b>	703
Magog	27-June	20-June	38	33	54	37	596	372
Malbec	24-June	19-June	26	22	51	43	<b>340</b>	448
Oklee	23-June	18-June	30	31	52	45	<b>399</b>	494
RB07	22-June	18-June	28	29	<b>68</b>	<b>53</b>	660	614
Red Fife	30-June	23-June	<b>42</b> †	<b>40</b>	50	<b>46</b>	<b>497</b>	455
Roblin	22-June	18-June	32	30	54	39	646	665
Sabin	24-June	20-June	31	30	<b>61</b>	<b>46</b>	<b>354</b>	436
Steele-ND	24-June	19-June	35	32	<b>62</b>	<b>46</b>	<b>550</b>	441
Superb	23-June	18-June	34	30	<b>69</b>	45	<b>402</b>	497
Tom	23-June	19-June	30	30	<b>61</b>	<b>48</b>	<b>313</b>	312
Ulen	23-June	19-June	30	31	49	41	<b>478</b>	517
<i>Trial Mean</i>	---	---	33	31	56	43	502	487
<i>LSD (0.05)</i>	---	---	2	4	9	8	302	NS ‡

† For all measures, bolded values are not significantly different from the highest value, which is indicated with underline. For weed biomass, the lowest values are indicated.

‡ No significant difference among varieties.

In general, test weights were good at both sites. Exceptions were AC Walton, Cabernet, and Malbec grown at the Old Town site. Wheat plant biomass is reported here as an indicator of potential straw yield. It was measured as the weight of entire wheat plant (stem, leave, and grain) cut one inch above the soil surface and dried. Subtracting grain yield from wheat plant biomass gives a very rough and likely over-estimate of potential straw yield, but one that could be useful for comparing varieties. For example, at the Old Town site, Faller and Oklee had similar yields yet the potential straw yield for Faller was 5874 lbs/acre (9449 – 3575 lbs/acre) compared with 4939 lbs/acre for Oklee (8292 – 3353 lbs/acre).

**Table 5. Wheat plant biomass, grain moisture at harvest, test weight, and yield of spring wheat, Old Town and Sidney, ME.**

Variety	Wheat Plant Biomass		Grain Moisture at Harvest†		Test Weight		Yield at 13.5% moisture	
	Old Town	Sidney	Old Town	Sidney	Old Town	Sidney	Old Town	Sidney
	lbs/ac	lbs/ac	%	%	lbs/bu	lbs/bu	lbs/ac	lbs/ac
AC Barrie-1	7733	---	13	---	58	---	2077	1987
AC Barrie-2	7879	8203	14	13	57	59	1759	---
AC Walton	8246	---	14	---	54	---	2699	---
Ada	8121	8107	13	13	57	60	2098	2382
Batiscan	<b>10236</b>	8422	13	13	57	58	2006	2376
Cabernet	7945	8432	13	13	53	56	2790	2441
Faller	<b>9449</b>	9597	13	13	59	59	<b>3575</b>	<b>3260</b>
FBC Dylan	8598	8910	13	13	59	59	2987	2566
Glenn	8203	9066	13	14	<b>60</b>	<b>61</b>	2334	2200
Howard	<b>9216</b>	8954	13	13	59	59	2811	2565
Kelse	7483	9694	13	13	55	59	2138	2710
Kingsey	<b>10434</b>	7701	14	14	<b>59</b>	60	2836	<b>2845</b>
Magog	<b>9199</b>	9727	13	14	56	59	2396	<b>2765</b>
Malbec	7580	8522	13	14	54	58	2954	2480
Oklee	8292	8641	13	14	59	60	<b>3353</b>	<b>2943</b>
RB07	<b>9113</b>	8919	13	13	56	58	2766	2716
Red Fife	8600	9493	13	15	57	57	2036	1993
Roblin	8568	8987	13	12	56	58	2523	2071
Sabin	<b>9424</b>	8855	13	13	57	58	2986	<b>2920</b>
Steele-ND	8619	8816	14	14	59	59	2829	2643
Superb	<b>10337‡</b>	8798	13	13	57	60	3168	<b>2807</b>
Tom	<b>9071</b>	9316	14	14	59	60	<b>3684</b>	<b>3050</b>
Ulen	8351	8852	13	13	57	59	2969	2679
<i>Trial Mean</i>	<i>8731</i>	<i>8858</i>	<i>13</i>	<i>14</i>	<i>57</i>	<i>59</i>	<i>2690</i>	<i>2591</i>
<i>LSD (0.05)</i>	<i>1515</i>	<i>NS §</i>	<i>---</i>	<i>---</i>	<i>1</i>	<i>1</i>	<i>453</i>	<i>515</i>

† All varieties at each site were harvested on the same day.

‡ For all measures, bolded values are not significantly different from the highest value, which is indicated with an underline.

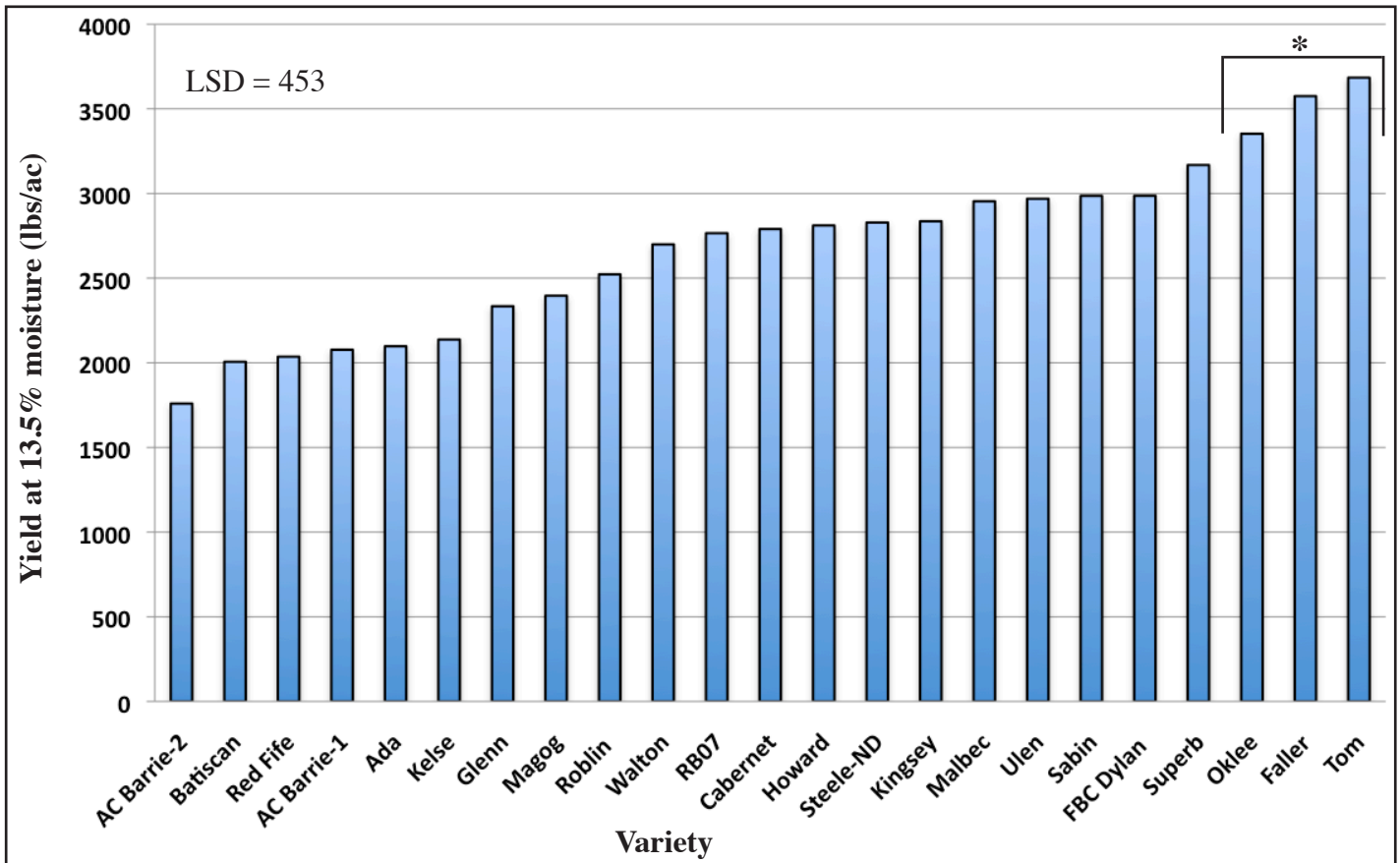


Figure 1. Yield of 23 spring wheat varieties, Old Town, ME.

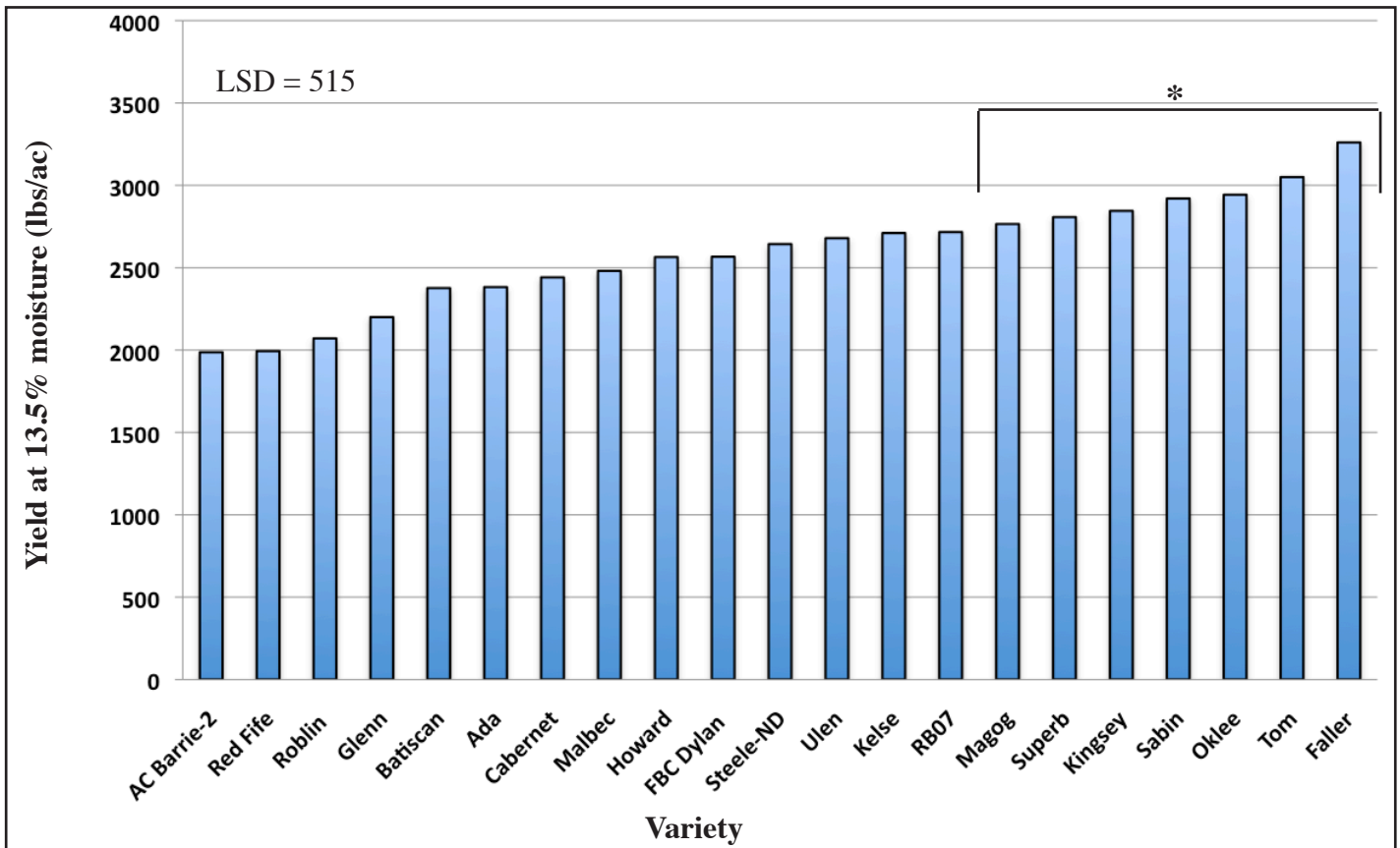


Figure 2. Yield of 21 spring wheat varieties, Sidney, ME.

\* Variety did not perform significantly lower than top performing variety.



## Wheat Grain Quality

Commercial mills use a variety of measurements to determine appropriate wheat quality, but at a minimum they want to know grain protein, falling number, test weight, and mycotoxin (DON) content. While 12% protein is the typical target for bread wheat, some mills expect at least 13% for spring varieties. All varieties were well above this level at the Old Town site, where the average grain protein was 15.8%. In Sidney, grain protein averaged 2.5 percentage points lower (13.3%). Here, 14 of the 21 varieties had protein concentrations above 13% and 2 varieties were below 12%. Higher protein levels in Old Town than in Sidney could be related to greater nitrogen availability at the Old Town site due to a plowed in soybean crop and a higher actual application rate of manure. The target rate for manure nitrogen application was the same for both sites (70 lbs/acre) but was based on prior years' manure analysis. The actual application rate at Sidney turned out to be lower than 70 lbs N/acre. Varieties with high protein concentrations at both sites included AC Barrie-2, Glenn, Kelse, Red Fife, and Roblin.

(Continued on page 10)

**Table 6. Quality of spring wheat, Old Town and Sidney, ME.**

Variety	Crude protein at 12% moisture		Falling number at 14% moisture	DON	
	Old Town	Sidney	Old Town	Old Town	Sidney
	%	%	seconds	ppm	ppm
AC Barrie-1	<b>16.3</b> †	---	464	0.8	---
AC Barrie-2	<b>16.8</b>	<b>14.5</b>	461	2.2	< 0.5
AC Walton	15.6	---	409	2.6	---
Ada	16.0	13.3	<b>532</b>	1.6	0.6
Batiscan	15.7	11.3	332	3.2	0.7
Cabernet	14.7	13.2	376	3.6	2.4
Faller	14.9	12.2	413	1.0	0.6
FBC Dylan	14.8	11.7	<b>502</b>	0.5	< 0.5
Glenn	<b>16.4</b>	<b>15.4</b>	388	< 0.5	< 0.5
Howard	15.9	13.3	423	1.8	0.9
Kelse	<b>16.8</b>	<b>14.3</b>	397	3.3	0.7
Kingsey	15.5	12.5	466	1.1	< 0.5
Magog	15.6	12.6	<b>511</b>	1.2	0.5
Malbec	15.3	13.2	388	2.5	1.2
Oklee	15.7	12.5	478	1.0	< 0.5
RB07	15.8	<b>14.3</b>	408	0.8	0.6
Red Fife	<b>16.4</b>	<b>14.2</b>	392	< 0.5	< 0.5
Roblin	<b>16.6</b>	<b>14.8</b>	403	0.7	< 0.5
Sabin	15.7	12.0	383	< 0.5	< 0.5
Steele-ND	15.8	13.7	414	1.2	0.5
Superb	16.0	13.4	440	1.9	0.7
Tom	14.6	13.2	469	1.2	< 0.5
Ulen	16.0	<b>14.4</b>	367	2.5	0.5
<i>Trial Mean</i>	<i>15.8</i>	<i>13.3</i>	<i>426</i>	<i>---</i>	<i>---</i>
<i>LSD (0.05)</i>	<i>0.8</i>	<i>1.4</i>	<i>34</i>	<i>---</i>	<i>---</i>

† For all measures, bolded values are not significantly different from the highest value, which is indicated with underline.

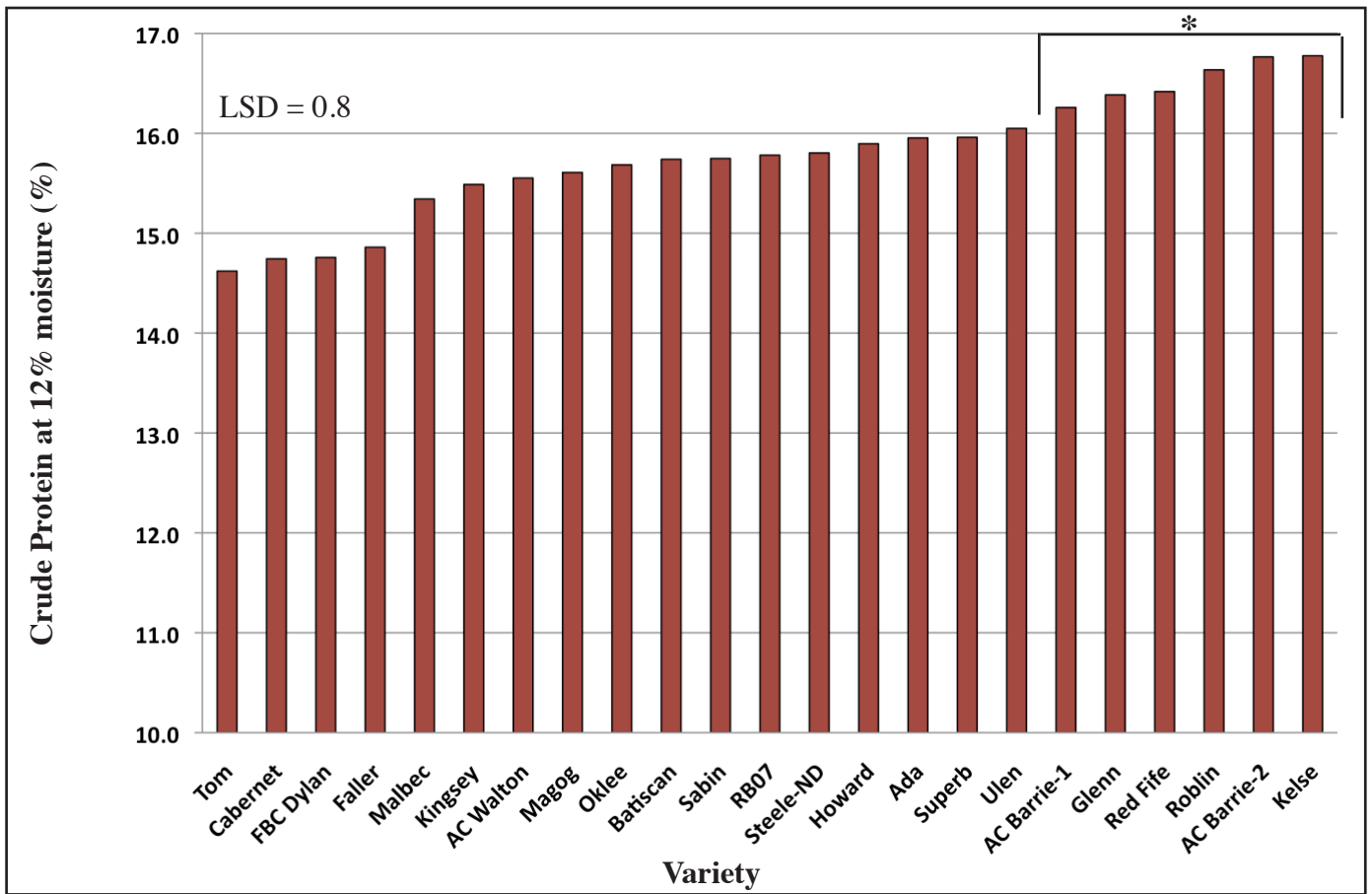


Figure 3. Crude protein levels of 23 winter wheat varieties, Old Town, ME.

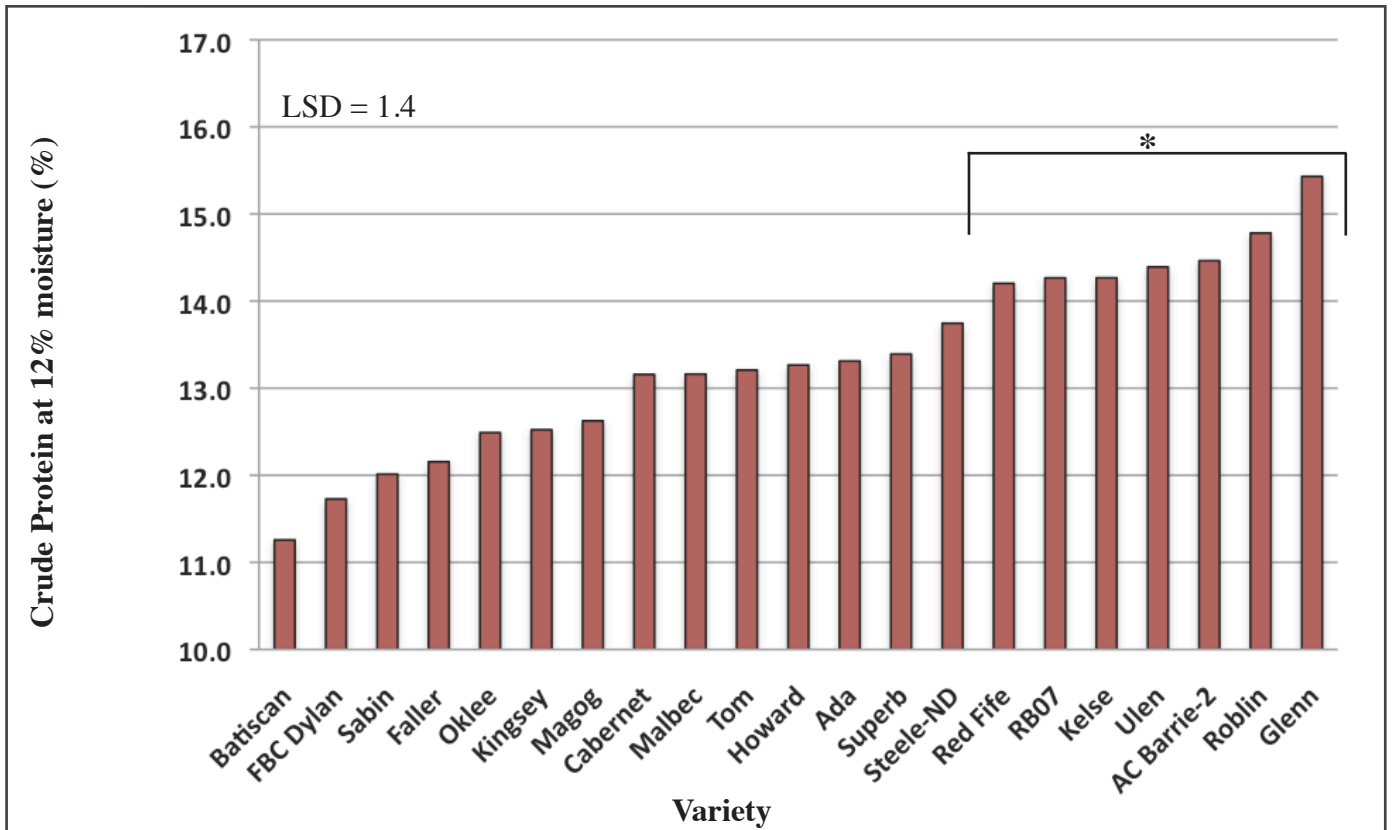


Figure 4. Crude protein levels of 21 winter wheat varieties, Sidney, ME.

\* Variety did not perform significantly lower than top performing variety.

Falling number, measured only for the Old Town trial, was excellent for all the varieties tested (>> 250 seconds), and reflects timely harvest at both sites. In general, sprouting is more of an issue for winter types than spring types of wheat. For DON (the mycotoxin produced by the *Fusarium* head blight fungus), 1 ppm is the maximum level allowed for a finished product for human consumption. Some mills accept higher levels and then clean or blend to reduce the concentration in their product to < 1ppm. In general, DON levels were lower in Sidney than in Old Town. At the Sidney site, only two varieties tested at or above 1 ppm, whereas 16 varieties did at the Old Town site. High DON levels are associated with wet, humid weather just before and during flowering because the fungus that causes *Fusarium* head blight and produces DON infects plants primarily through the flower. Flowering at the Old Town site coincided with rainy weather, whereas in Sidney plants flowered 1 week earlier during weather conditions that were relatively dry. Six varieties tested below 1 ppm at both locations: FBC Dylan, Glenn, RB07, Red Fife, Roblin, and Sabin.

## SUMMARY

It is important to note that the results presented in this report are from just one year of data, and do not necessarily reflect how the varieties would perform in different years. This trial will be repeated in 2011.

Wheat typically receives up to twice the pay price for use as bread flour as for livestock feed, but it must meet high quality standards. Therefore, when choosing which varieties of bread wheat to grow it is important to consider their potential to produce grain with good protein, falling number, and DON levels as well as their yield potential. AC Barrie is currently the most commonly grown organic hard red spring wheat in Maine. It is valued by millers and bakers for its excellent baking characteristics, but it is also known to be a low yielder. Consistent with its reputation, in both our trials AC Barrie had among the highest grain protein concentrations and among the lowest yields of all the varieties tested. It also had moderate to high DON levels at the Old Town site, depending on the seed source.

Because of our humid, wet climate, *Fusarium* head blight is a key issue for growing wheat in Maine. For instance, Aurora Mills and Farm in Linneus, Maine has a rejection rate of nearly 25% due to high DON levels (personal communication, Matt Williams, 2011). While there are currently no known varieties that are completely resistant to this disease, there are several with varying levels of tolerance and resistance. Glenn, bred in North Dakota, is one of the most resistant hard red spring varieties currently available. In our trials, DON levels for Glenn were below 0.5 ppm at both sites. Glenn also performed equally or better than AC Barrie in terms of yield, falling number, and grain protein.

Results from the sites in Vermont are available in a separate publication that can be found at [www.extension.umaine.edu/localwheat](http://www.extension.umaine.edu/localwheat). It may be helpful to compare these results from Maine and Vermont to variety trials from other regions. Ultimately, though, it is important to evaluate data from test sites that are similar to your farm and region when deciding which varieties to grow.



Thomas Molloy staging spring wheat in the Sidney trial.

**Photos** by Ellen Mallory unless otherwise noted.

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