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2012 Heirloom Winter Wheat Trial

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INTRODUCTION

In 2012, UVM Extension conducted a winter heirloom variety trial. Many consumers are interested in heirloom wheat for flavor, perceived health benefits or its history, while many farmers are interested in heirloom wheat because it may have superior genetics better adapted to the challenging growing conditions in the Northeast. This variety trial was established to determine what heirloom winter wheat varieties are viable in Vermont's growing conditions.

METHODS

In the fall of 2011, an heirloom winter wheat trial was initiated at Borderview Research Farm in Alburgh, VT. General plot management is listed in Table 1. Plots were managed with practices similar to those used by producers in the surrounding area. The previous crop was spring wheat and prior to that, the site had been in organic corn. The field was disked and spike-toothed harrowed prior to planting. Plots were seeded with a Kincaid Cone Seeder on 21-Sep 2011 at a seeding rate of 100 lbs acre^{-1}.

Population and vigor were measured on 24-Oct 2011. Populations were determined by taking three, 1/3 meter counts per plot. Vigor was based on a visual rating with a 0–5 scale, where 5 represents excellent stand density and 0 represents no stand. On 11-Apr 2012, winter survival was measured on a 0-5 scale with the same procedure as above. Plots were top-dressed by hand on 3-May 2012 with 500 lbs acre^{-1} each of Pro-Booster and Pro-Gro. Pro-Booster and Pro-Gro are Organic Materials Review Institute (OMRI) approved fertilizers manufactured for North Country Organics in Bradford, VT. They are blended fertilizers composed of vegetable and animal meals and natural nitrate of soda. Pro-Booster has a guaranteed analysis of 10-0-0, and Pro-Gro has a guaranteed analysis of 5-3-4.

Grain plots were harvested with an Almaco SPC50 small plot combine on 19-Jul 2012. The harvest area was 5' x 20'. Just prior to harvest, plant heights were measured, excluding awns, and the severity of lodging was recorded as a percent of plot lodged. Grain moisture, test weight and yield were determined at harvest. Seed was cleaned with a small Clipper M2B cleaner (A.T. Ferrell, Bluffton, IN) and a subsample was collected to determine quality characteristics. Samples were ground using the Perten LM3100 Laboratory Mill. Flour was analyzed for protein content using the Perten Inframatic 8600 Flour Analyzer. Most commercial mills target 12-15% protein content. Falling number was measured (AACC Method 56-81B, AACC Intl., 2000) on the Perten FN 1500 Falling Number Machine. The falling number is related to the level of sprout damage in the grain. It is determined by the time it takes, in seconds, for a stirrer to fall through a slurry of flour and water to the bottom of a test-tube. Falling numbers greater than 350 indicate low enzymatic activity and sound quality wheat. A falling number lower than 200 indicates high enzymatic activity and poor quality wheat. Deoxynivalenol (DON), a vomotoxin, was analyzed using Veratox DON 5/5 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. The varieties of heirloom winter wheat grown are listed in Table 2. Results were analyzed with an analysis of variance in SAS (Cary, NC). The Least Significant Difference (LSD) procedure was used to separate cultivar means when the F-test was significant ($p< 0.10$).

Table 1. General plot management.

Trial Information	Borderview Research Farm Alburgh, VT
Soil Type	Benson rocky silt loam
Previous crop	Spring Wheat
Planting date	21-Sep 2011
Harvest date	19-Jul 2012
Seeding rate	100 lbs $acre^{-1}$
Tillage methods	Mold board plow, disk and spike-toothed harrow
Fertilizer applied	3-May 2012 Pro-Booster and Pro-Gro (1000 lbs $acre^{-1}$)

Table 2. Heirloom winter wheat varieties, market class, year of release and place of origin.

Variety	Market Class	Year	Origin
Blackhull	HRWW	1917	Kansas
Bluejacket	HRWW	1946	Kansas
Clark's Cream	HWWW	1972	Kansas
Columbia	HRWW	1955	Oregon
Coppei	SRWW	1911	Washington
Forward	SRWW	1920	New York
Genesee Giant	SWWW	1893	New York
Goldcoin	SWWW	1890	New York
Honor	SWWW	1920	New York
Kanred	HRWW	1917	Kansas
Oro	HRWW	1927	Oregon
Pride of Genesee	SRWW	1893	New York
Red Chief	SRWW	1901	New York
Red Russian	SRWW	1890	England
Relief	HRWW	1931	Utah
Rio	HRWW	1931	Oregon
Triplet	SRWW	1918	Washington
Wasatch	HRWW	1944	Utah

HRWW-Hard Red Winter Wheat, **HWWW**-Hard White Winter Wheat,
S**RWW**-Soft Red Winter Wheat, **SWWW**-Soft White Winter Wheat.

LEAST SIGNIFICANT DIFFERENCE (LSD)

Variations in yield and quality can occur because of variations in genetics, soil, weather and other growing conditions. Statistical analysis makes it possible to determine whether a difference among varieties is real, or whether it might have occurred due to other variations in the field. At the bottom of each table, a LSD value is presented for each variable (i.e. yield). Least Significant differences (LSD's) at the 10% level of probability are shown. Where the difference between two treatments within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure in 9 out of 10 chances that there is a real difference between the two varieties. Treatments that were not significantly lower in performance than the highest value in a particular column are indicated with an asterisk. In the example below, A is significantly different from C but not from B. The difference between A and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these varieties did not differ in yield. The difference between A and C is equal to 3.0, which

is greater than the LSD value of 2.0. This means that the yields of these varieties were significantly different from one another. The asterisk indicates that B was not significantly lower than the top yielding variety.

Variety	Yield
A	6.0
B	7.5*
C	9.0*
LSD	**2.0**

RESULTS AND DISCUSSION

Seasonal precipitation and temperature recorded at a weather station in Alburgh, VT are shown in Table 3. The 2011-2012 winter was extremely mild, with temperatures well above normal each month. Spring green-up occurred in mid March with a week of record warm temperatures and a high of 77.5°F on 21-Mar. The growing season was also warmer and drier than normal. From March to July, there was an accumulation of 3878 Growing Degree Days (GDDs), in Alburgh which is 400 GDDs higher than the 30-year average.

Table 3. Seasonal weather data collected in Alburgh, VT, 2012.

Alburgh, VT	Sept. 2011	Oct. 2011	Nov. 2011	Mar. 2012	Apr. 2012	May 2012	June 2012	July 2012
Average Temperature (F)	62.8	50.1	43.4	39.7	44.9	60.5	67.0	71.4
Departure from Normal	2.20	1.90	5.20	8.60	0.10	4.10	1.20	0.80
Precipitation (inches) *	5.56	3.52	1.41	1.46	2.64	3.90	3.22	3.78
Departure from Normal	1.92	-0.08	-1.71	-0.75	-0.18	0.45	-0.47	-0.37
Growing Degree Days (base 32)	932	578	344	331	396	884	1046	1221
Departure from Normal	74.0	76.0	142	205	12.0	128	32.0	23.0

Based on weather data from Davis Instruments Vantage pro2 with Weatherlink data logger.
Historical averages for 30 years of NOAA data (1981-2010).
* Precipitation data from June-September 2012 is based on Northeast Regional Climate Center data from an observation station in Burlington, VT.

The highest yielding variety was Forward, which yielded almost 2 tons or 3868 lbs acre^{-1} (Table 5). The four highest yielding varieties were soft wheat's developed in New York State. Soft wheat's are generally lower in protein and better suited for pastries and cookies. The highest yielding hard wheat, which is generally desired for bread baking, was Bluejacket, which yielded 2422 lbs acre^{-1}. Bluejacket was developed in Kansas in 1946. Although not an heirloom by the strict definition of being developed before 1950, Clark's Cream was included in this study because it is an older hard white wheat which is of interest to the farming community. Oro had the lowest yields (813 lbs acre^{-1}), which may be due in part to it's low winter survival—32% of the plot had winterkilled when measured on 11-Apr (Table 4).

Of the five tallest varieties, three were developed in New York. Honor grew the tallest at 52.4 inches (Table 4). In organic systems, tall wheat's are generally desired for their ability to shade out competing weeds. All of the varieties grown in this study would be considered tall when compared to many of today's modern cultivars. Tall wheat can be prone to lodging, depending on many factors including stalk strength and over-fertilization. In general, all the varieties stood up well, with the exception of Triplet and Relief, which had 37% and 26% lodging at harvest.

Test weight is the measure of grain density determined by weighing a known volume of grain. Generally, the heavier the wheat is per bushel, the higher baking quality. Red Chief and Bluejacket had test weights over 60 lbs bushel^{-1} and were significantly higher than the other varieties.

Table 4. Growing characteristics of heirloom winter wheat varieties, Alburgh, VT, 2012.

Variety	Population plants m^2	Fall vigor (0-5)	Spring vigor (0-5)	Winterkill %	Height in	Lodging %
Blackhull	223	3.3	3.2*	0.0	43.7	**0.0***
Bluejacket	241	3.2	3.3*	3.3	47.3	**0.0***
Clark's Cream	201	3.5	3.5*	1.7	40.3	6.0*
Colombia	206	2.3	2.7	3.3	42.5	6.7*
Coppei	214	3.5	3.5*	1.7	43.5	1.7*
Forward	234	4.0	3.5*	0.0	46.0	4.3*
Gen. Giant	232	**4.7***	3.7*	0.0	45.6	0.7*
Gold Coin	282*	4.5*	3.8*	5.0	48.5*	4.0*
Honor	**302***	3.8	3.3*	0.0	**52.4***	0.3*
Kanred	210	3.5	3.5*	5.0	39.1	10.0*
Oro	197	2.3	2.5	31.7	46.3	6.0*
Pride of Gen.	221	4.3*	3.8*	0.0	49.3*	1.7*
Red Chief	258*	3.5	3.7*	1.7	43.4	**0.0***
Red Russian	195	3.2	2.7	16.7	50.3*	**0.0***
Relief	221	3.0	3.2*	15.0	42.2	25.7
Rio	214	2.8	3.5*	0.0	43.9	11.7*
Triplet	173	3.0	3.2*	0.0	50.9*	36.7
Wasatch	175	2.7	**3.8***	0.0	47.2	1.7*
Trial mean	222	3.4	3.4	4.7	45.7	6.5
LSD (p<0.1)	44.4	0.58	0.72	NS	4.67	15.7

*Varieties with an asterisk are not significantly different than the top performer in **bold**.
NS – No significant difference amongst varieties.

Table 5. Yield and quality of heirloom winter wheat, Alburgh, VT, 2012.

Variety	Moisture %	Test weight lbs $bushel^{-1}$	DM Yield lbs $acre^{-1}$	Protein @ DM %	Protein @ 14% %	Falling number sec	DON ppm
Blackhull	13.7	58.3	1901	13.0	11.2	433*	0.4
Bluejacket	14.9	60.7*	2422	13.1	11.3	**469***	0.5
Clark's Cream	14.4	58.3	2374	12.4	10.7	435*	0.5
Colombia	11.5*	56.3	1735	11.8	10.2	436*	0.7
Coppei	12.3*	57.0	1947	12.6	10.9	374	0.5
Forward	12.5*	58.3	**3868***	11.0	9.4	378	0.4
Gen. Giant	11.9*	56.0	2611	11.2	9.6	364	0.3
Gold Coin	12.5*	56.7	2862	12.0	10.3	327	0.4
Honor	**11.1***	54.5	2635	11.6	10.0	375	0.5
Kanred	12.8	55.7	1851	12.8	11.0	445*	0.7
Oro	15.3	57.0	813	14.3*	12.3*	421	0.8
Pride of Gen.	11.5*	59.7	2309	11.8	10.1	424	0.5
Red Chief	13.6	**61.8***	1438	13.9*	12.0*	444*	0.2
Red Russian	13.0	55.0	1597	14.1*	12.1*	395	0.6
Relief	15.2	57.7	2229	13.3	11.4	444*	0.6
Rio	12.0*	57.5	2084	12.5	10.8	450*	0.3
Triplet	12.4*	59.2	2073	13.6	11.7	423	0.5
Wasatch	13.5	58.7	2211	**14.6***	**12.5***	443*	0.6
Trial mean	13.0	57.7	2164	12.7	11.0	416	0.5
LSD (p<0.1)	1.55	2.04	498	0.923	0.794	40.1	NS

*Varieties with an asterisk are not significantly different than the top performer in **bold**.
NS – No significant difference amongst varieties.

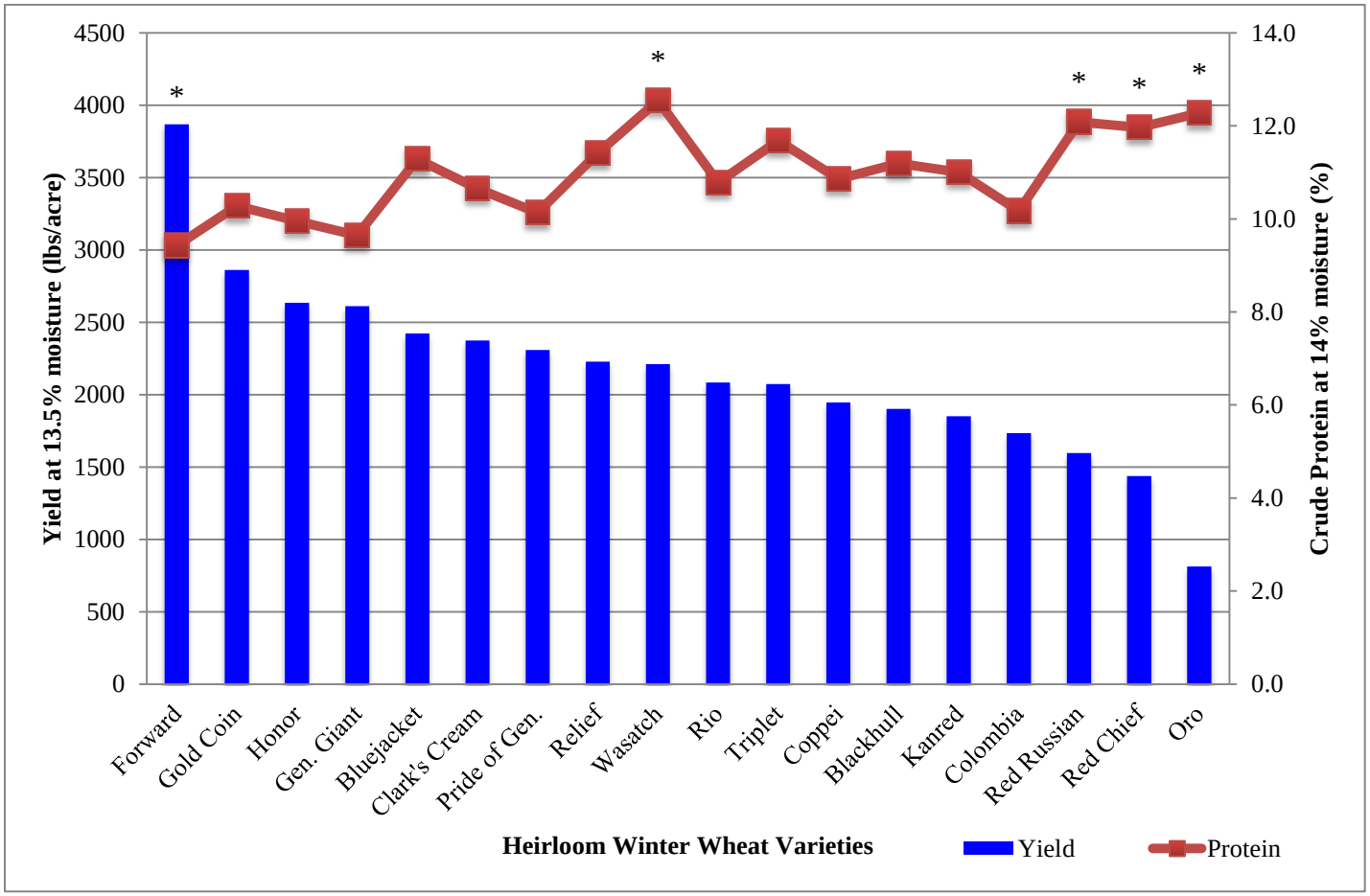

Figure 1. Yield and protein of heirloom winter wheat varieties, Alburgh, VT, 2012. Varieties with an asterisk are the top performer and not significantly different from one another.

Of the four varieties with the highest protein content, three were the lowest yielders (Figure 1). There is often an inverse relationship seen between yield and protein. Wasatch, however, yielded in the middle of the pack, but had the highest protein content, 12.5%. Falling numbers for all varieties were over 350 seconds, indicating low enzymatic activity and sound quality wheat. Additionally, DON levels for all varieties were below the FDA threshold of 1ppm and considered safe for human consumption.

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