2014

Heirloom Winter Wheat Variety Trial

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NORTHWEST CROPS & SOILS PROGRAM

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2014 HEIRLOOM WINTER WHEAT VARIETY TRIAL

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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. Production of heirloom wheat may also provide a farmer with a value added market with increased returns. This variety trial was established to determine heirloom winter wheat varieties that are suitable for production in Vermont's growing conditions. This was the third year that this trial was conducted in Vermont.

MATERIALS AND METHODS

In the fall of 2013, an heirloom winter wheat variety 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 oats and barley. The field was disked and spike tooth harrowed prior to planting. Plots were seeded with a Great Plains Cone Seeder on 20-Sep 2013 at a seeding rate of 125 lbs acre^{-1}.

Plots were harvested with an Almaco SPC50 small plot combine on 30-Jul 2014. The harvest area was 5' x 20'. 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 vomitoxin, 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, and their market class, year, and origin, 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	Alburgh, VT Borderview Research Farm
Soil type	Benson rocky silt loam
Previous crop	Oats and barley
Seeding Rates (lbs ac^{-1})	125 lbs acre^{-1}
Row spacing (in)	6
Replicates	4
Planting date	20-Sep 2013
Harvest date	30-Jul 2014
Harvest area (ft)	5 x 20
Tillage operations	Fall plow, spring disk & spike tooth harrow

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

Variety	Market Class	Year	Origin
Bacska	HRWW		Hungary
Blackhull	HRWW	1917	Kansas
Bluejacket	HRWW	1946	Kansas
Clark's Cream	HWWW	1972	Kansas
Columbia	HRWW	1955	Oregon
Coppei	SRWW	1911	Washington
Federation	SWWW	1914	Australia
Florence	HWWW	1914	Australia
Forward	SRWW	1920	New York
Genesee Giant	SWWW	1893	New York
Goldcoin	SWWW	1890	New York
Gold Drop	HRWW	1843	England
Honor	SWWW	1920	New York
Hybrid 63	SWWW	1907	Washington
Kanred	HRWW	1917	Kansas
Karkov MC22	HRWW	1923	Quebec, Canada
Lennox	HRWW	1975	Ontario
Michikof	HRWW	1920	Indiana
Minard	HRWW	1915	Minnesota
Minturki	HRWW	1919	Minnesota
Oro	HRWW	1927	Oregon
Pesterboden	HRWW	1892	Hungary
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
Russian	HRWW	1917	Virginia
Sonora	SWWW	1770	Mexico
Triplet	SRWW	1918	Washington
Turkey Red	HRWW	1873	United States
Ukrainka	HRWW	1926	Kiev, Ukraine
Wasatch	HRWW	1944	Utah

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

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. Temperatures were below average in September and November of 2013, and March, April, and July of 2014. In September and October of 2013, and March of 2014, Alburgh received less rain than the 30 year average. However, in November of 2013, and April, May, and June of 2014, Alburgh received more rain than average. From March to July of 2014, there was an accumulation of 3356 Growing Degree Days (GDDs) which is 4 GDDs higher than the 30-year average. Many of the heirlooms in the trial were developed in environments much different than New England. Hence, it is important to evaluate the varieties for tolerance to our climate. All varieties were able to survive the winter.

Table 3. Seasonal weather data collected in Alburgh, VT, 2013 and 2014.

Alburgh, VT	Sep -13	Oct-13	Nov -13	Mar -14	Apr -14	May -14	Jun-14	Jul-14
Average temperature (°F)	59.3	51.1	35.1	22.2	43	57.4	66.9	69.7
Departure from normal	-1.3	2.9	-3.1	-8.9	-1.8	1	1.1	-0.9
Precipitation (inches)	2.2	2.2	3.2	1.7	4.3	4.9	6.1	5.2
Departure from normal	-1.4	-1.4	0.0	-0.5	1.5	1.5	2.4	1.0
Growing Degree Days (base 32°F)	825	600	176	25	330	789	1041	1171
Departure from normal	-33	98	-8	25	-54	33	27	-27

Based on weather data from a Davis Instruments Vantage pro2 with WeatherLink data logger. Historical averages are for 30 years of NOAA data (1981-2010) from Burlington, VT.

During the 2014 growing season, many observations and measurements were recorded on heirloom winter wheat development. The flowering date was recorded when at least 50% of the plot was in bloom for each of the varieties (Table 4). Eighteen of the 33 heirloom winter wheat varieties were flowering by 14-Jun and all varieties were flowering by 17-Jun at the latest.

Table 4. The flowering dates of 33 heirloom winter wheat varieties in Alburgh, VT, 2014.

Variety	Flowering Date
Bacska	14-Jun
Blackhull	14-Jun
Bluejacket	14-Jun
Clark's Cream	14-Jun
Columbia	14-Jun
Coppei	14-Jun
Federation	17-Jun
Florence	16-Jun
Forward	14-Jun
Genesee Giant	12-Jun
Goldcoin	15-Jun
Gold Drop	14-Jun
Honor	14-Jun
Hybrid 63	17-Jun
Kanred	14-Jun
Karkov MC22	17-Jun
Lennox	14-Jun
Michikof	14-Jun
Minard	15-Jun
Minturki	15-Jun
Oro	17-Jun
Pesterboden	14-Jun
Pride of Genesee	15-Jun
Red Chief	14-Jun
Red Russian	15-Jun
Relief	14-Jun
Rio	14-Jun
Russian	15-Jun
Sonora	17-Jun
Triplet	15-Jun
Turkey Red	15-Jun
Ukrainka	14-Jun
Wasatch	14-Jun

Winter wheat heirloom varieties had an average yield of 2170 lbs acre^{-1}. The highest yielding variety was Forward, which yielded 2849 lbs acre^{-1} (Table 5). Forward was also the highest yielding variety in 2012 and 2013 (data not shown).

Heights and lodging were measured on 30-Jul 2014 before the wheat was harvested. Heights were determined by taking three measurements per plot with a yardstick. In organic systems, taller plants 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 may be prone to lodging depending on many factors such as stalk strength and over-fertilization. Lodging was measured as a percent of plot lodged on 30-Jul 2014. It was measured with a visual rating on a scale of 0-100, where 0 represented no lodging.

Wasatch was the tallest growing heirloom wheat, which grew 48.1 inches (Table 5). Rio was the shortest growing heirloom wheat, which grew 38.8 inches. Even with its height, Wasatch was not significantly different than the top performer for lodging. Rio, even though it was the shortest heirloom wheat grown, had a significantly higher lodging rate than Wasatch.

Test weight is the measure of grain density. It is determined by weighing a known volume of grain. Generally, the heavier the wheat is per bushel, the higher baking quality. Pesterboden and Ukrainka had the highest test weight of 54.5 lbs bushel^{-1} (Table 5). Honor had the lowest test weight of 50.5 lbs bushel^{-1}. None of the varieties reached the ideal industry standard of 56-60 lbs bushel^{-1}.

Table 5. Yield and quality of heirloom winter wheat varieties, Alburgh, VT, 2014.

Variety	Yield lbs acre^{-1}	Moisture %	Test weight lbs bushel^{-1}	Crude protein @ 12% moisture %	Falling number seconds	DON ppm	Height inches	Lodge %
Bacska	2601*	19.0	53.0	10.1	299	0.7	45.0*	40*
Blackhull	2399*	19.4*	53.8*	11.7	281	0.9	43.5	40*
Bluejacket	2531*	19.6*	53.8*	10.2	339	0.6	45.2*	40*
Clark's Cream	1869	19.5*	51.0	9.2	205	1.3	41.7	20*
Columbia	2229*	19.2	52.5	11.4	293	2.3	41.6	23*
Coppei	2266*	19.4*	53.0	9.6	277	1.1	44.6*	63
Federation	2277*	19.5*	53.3*	10.1	294	0.9	44.5*	0*
Florence	1874	18.5	52.2	12.0	314	0.5*	47.6*	0*
Forward	**2849***	18.7	53.5*	8.5	283	0.6*	46.0*	20*
Genesee Giant	2315*	18.8	51.2	9.7	141	1.1	41.2	47
Goldcoin	2692*	19.3	51.3	8.9	187	1.2	43.1	37*
Gold Drop	1717	**19.9***	52.1	10.4	338	0.5*	46.9*	37*
Honor	2142	18.1	50.5	8.8	182	1.4	46.7*	97
Hybrid 63	1345	19.2	51.8	10.7	304	0.4*	41.4	67
Kanred	2037	19.1	53.3*	9.5	313	1.1	46.8*	60
Karkov MC22	1824	18.2	52.5	9.7	281	**0.2***	46.4*	60
Lennox	2635*	19.2	51.2	10.3	335	0.4*	45.8*	30*
Michikof	2246*	19.0	54.2*	10.5	367*	0.5*	46.6*	33*

Minard	1765	19.3	53.3*	10.6	319	0.6*	43.0	20*
Minturki	1917	19.3	54.3*	11.6	331	0.8	41.5	80
Oro	1837	19.5*	52.7	10.4	251	0.7	41.7	50
Pesterboden	1816	19.0	**54.5***	9.9	328	0.3*	43.5	83
Pride of Genesee	2084	18.4	53.5*	9.9	250	0.9	47.9*	47
Red Chief	2352*	19.0	53.3*	10.0	310	0.5*	46.2*	20*
Red Russian	2087	19.1	52.2	11.2	319	0.7	43.4	37*
Relief	2121	19.9*	53.3*	9.2	**377***	0.7	41.9	67
Rio	2177	19.4*	52.7	8.8	314	0.9	38.8	53
Russian	1554	19.0	53.5*	10.9	314	0.5*	41.1	10*
Sonora	2164	19.6*	52.2	10.1	295	1.0	41.4	**0***
Triplet	2486*	19.2	53.0	9.7	313	0.7	44.0*	27*
Turkey Red	2283*	19.5*	54.0*	10.6	331	0.8	42.8	63
Ukrainka	2670*	18.8	**54.5***	9.6	249	1.5	45.0*	20*
Wasatch	2455*	19.3	53.8*	11.2	351*	0.8	**48.1***	13*
Trial Mean	2170	19.2	52.9	10.2	293	0.8	44.1	39
LSD (0.10)	630	0.6	1.4	NS	34	0.4	4.3	45.0

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

The three varieties with lower crude protein were among the higher yielding varieties (Figure 1). There is often an inverse relationship seen between yield and protein. Falling numbers for most varieties were above 200 seconds and under 350 seconds, indicating sound quality wheat (Table 5). Varieties with low falling number were often soft white winter wheat varieties that are not used for bread baking. Additionally, DON levels for most varieties were under the FDA threshold of 1 ppm which is considered safe for human consumption (Figure 2). Columbia, Ukrainka, and Clarks Cream exceeded the DON 1ppm threshold.

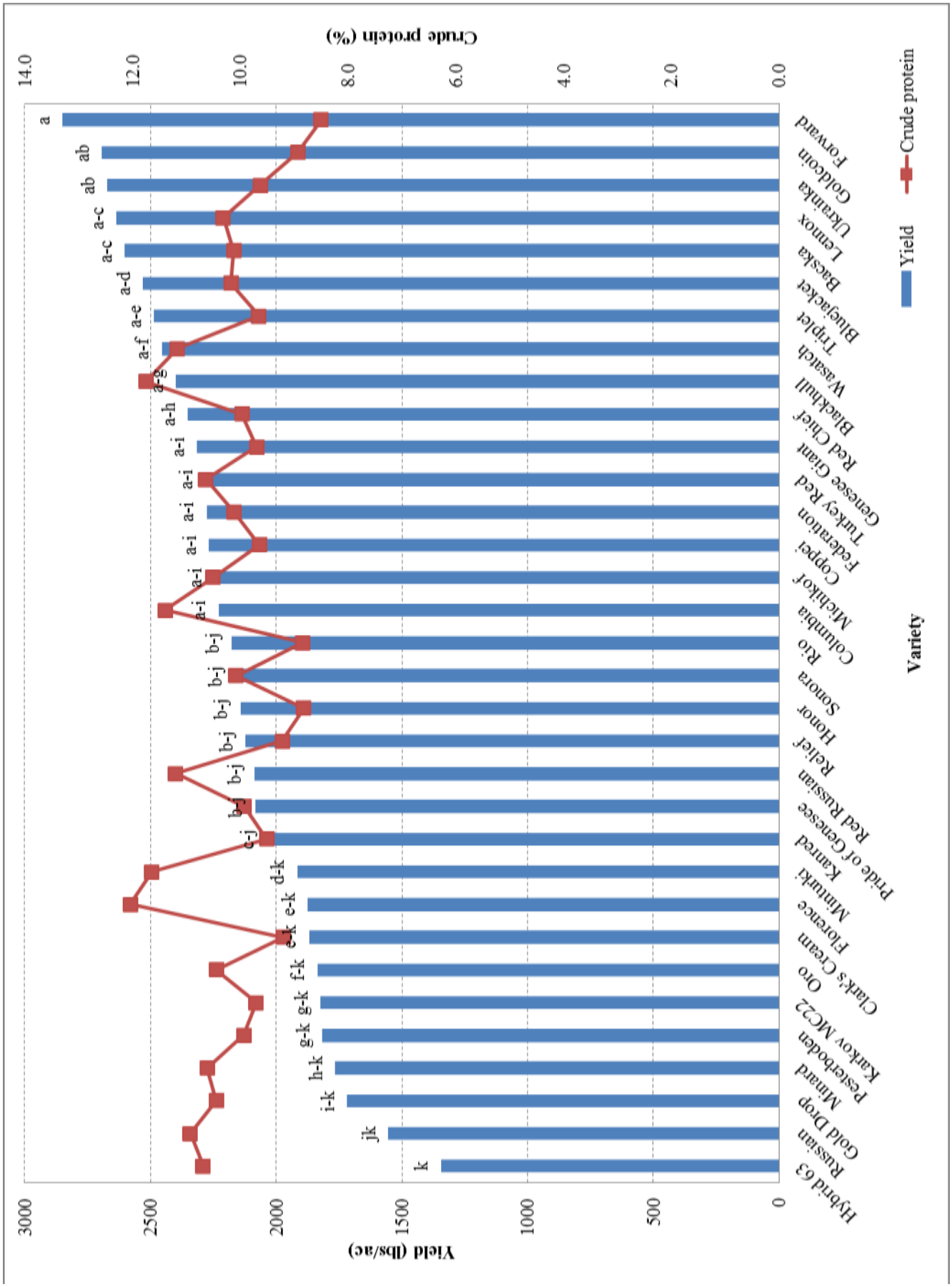

Figure 1. Yield and crude protein of heirloom winter wheat varieties, Alburgh, VT, 2014. For yield, varieties with the same letter are not significantly different from one another.

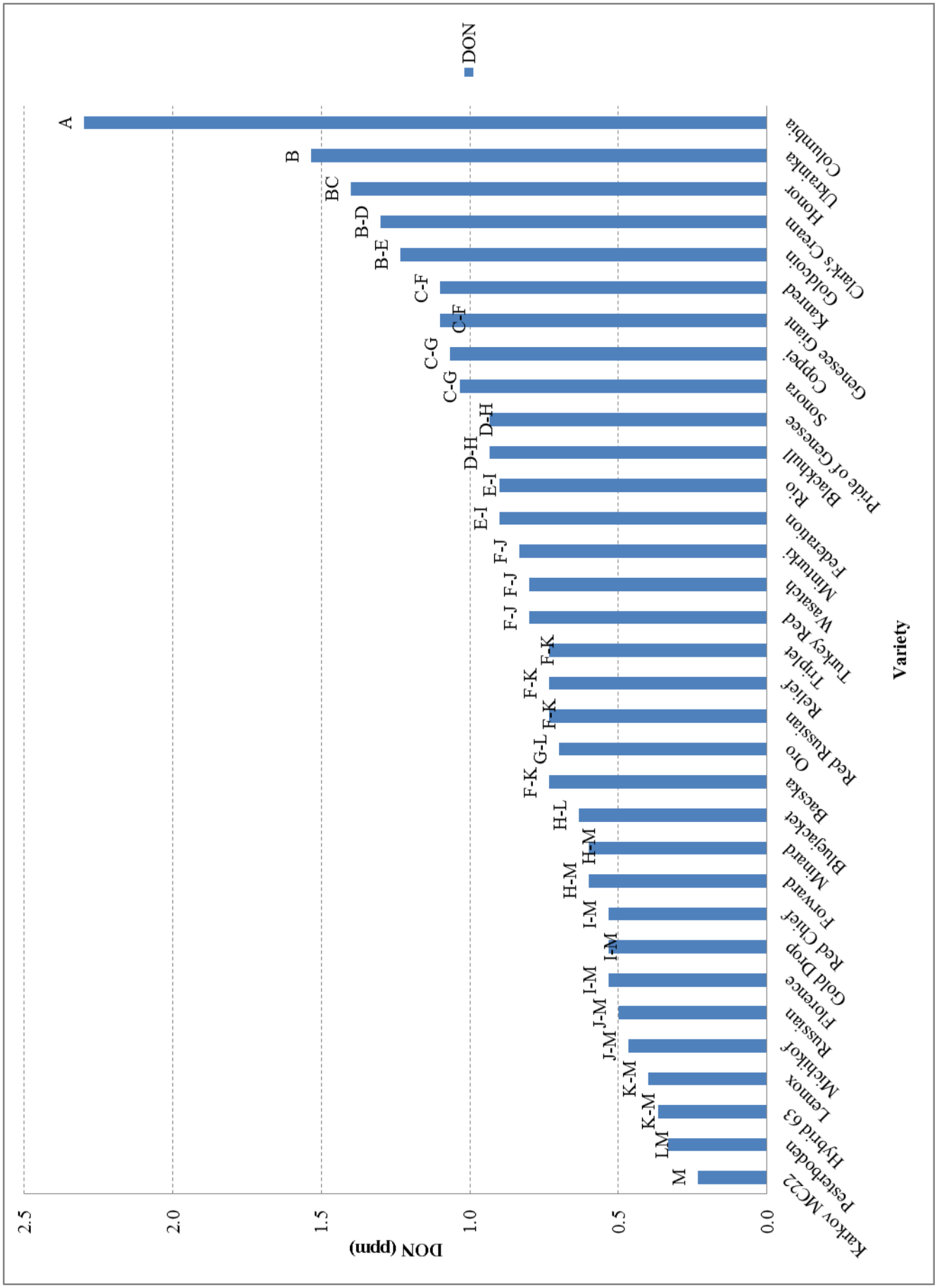

Figure 2. DON levels for heirloom winter wheat varieties in Alburgh, VT, 2014.

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