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CULTIVATING HEALTHY COMMUNITIES

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2012 ORGANIC SPRING WHEAT SEEDING RATE TRIAL REPORT

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Throughout Vermont and the Northeast, the demand for local organically grown wheat continues to rise. Due to this demand, there has been a renewed interest by producers to add wheat into their crop rotations. Several producers have asked questions about the best agronomic practices for cultivating organic spring wheat. As a result, University of Vermont Extension has been developing best agronomic practices for wheat production in the Northeast. Seeding rates can influence weed populations as well as overall yield and quality. The purpose of this trial was to determine optimum seeding rates for organic spring wheat in Vermont.

MATERIALS AND METHODS

In April of 2012, an organic spring wheat seeding rate trial was established at the Borderview Research Farm in Alburgh, Vermont. The experimental plot design was a randomized complete block with four replications. The seedbed at the Alburgh location was prepared by conventional tillage methods. All plots were managed with practices similar to those used by producers in the surrounding areas (Table 1). The previous crop planted in the site was sunflowers. In March 2012, the field was disked and spike-toothed harrowed to prepare for planting. The plots were seeded with a Kincaid Cone Seeder on 16-Apr at seeding rates of 50, 75, 100, 125, 150, 175 or 200 lbs ac^{-1} with hard red spring wheat (var. 'Barlow'). Plot size was 6' x 20'.

Table 1. General plot management of the spring wheat seeding rate trial.

Trial information	Alburgh, VT Borderview Research Farm
Soil type	Benson rocky silt loam
Previous crop	No-till Sunflowers
Seeding Rates (lbs ac^{-1})	50, 75, 100, 125, 150, 175 & 200
Row spacing (in)	6
Replicates	4
Planting date	16-Apr
Harvest date	23-Jul
Harvest area (ft)	5 x 20
Tillage operations	Fall plow, spring disk & spike-toothed harrow

Populations were measured on 16-May by taking two, 0.3 meter plant counts per plot.

Grain plots were harvested at the Alburgh site with an Almaco SPC50 plot combine on 23-Jul, the harvest area was 5' x 20'. At the time of harvest, plant heights were measured excluding the awns in inches. A visual estimate of what percent a plot was lodged and the severity of lodging was recorded based on a visual rating with a 1 – 5 scale, where 1 indicates minor plant lodging and wheat could still be combined and 5 indicates severe lodging and a complete crop loss. In addition, grain moisture, test weight and yield were calculated.

Following harvest, seed was cleaned with a small Clipper cleaner (A.T. Ferrell, Bluffton, IN). An approximate one pound subsample was collected to determine quality. Quality measurements included standard testing parameters used by commercial mills. Test weight was measured by the weighing of a known volume of grain. Generally the heavier the wheat is per bushel, the higher baking quality. The acceptable test weight for bread wheat is 56-60 lbs per bushel. Once test weight was determined, the samples were then ground into flour using the Perten LM3100 Laboratory Mill. At this time, flour was evaluated for its protein content and falling number. Grains were analyzed for protein content using the Perten Inframatic 8600 Flour Analyzer. Grain protein affects gluten strength and loaf volume. Most commercial mills target 12-15% protein. Protein was calculated on a 12% moisture and 14% moisture basis. The determination of falling number (AACC Method 56-81B, AACC Intl., 2000) was measured on the Perten FN 1500 Falling Number Machine. The falling number is related to the level of sprout damage that has occurred in the grain. It is measured by the time it takes, in seconds, for a stirrer to fall through a slurry of flour and water to the bottom of the 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.

All data was analyzed using a mixed model analysis where replicates were considered random effects. The LSD procedure was used to separate seeding rate means when the F-test was significant ($P< 0.10$).

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 (e.g. yield). Least Significant Differences at the 10% level of probability are shown. Where the difference between two varieties 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. In the example below, variety A is significantly different from variety C, but not from variety B. The difference between A and B is equal to 725, which is less than the LSD value of 889. This means that these varieties did not differ in yield. The difference between A and C is equal to 1454, which is greater than the LSD value of 889. This means that the yields of these varieties were significantly different from one another. The asterisk indicates that variety B was not significantly lower than the top yielding variety.

Variety	Yield
A	3161
B	3886*
C	**4615***
LSD	**889**

RESULTS AND DISCUSSION

Seasonal precipitation and temperatures were recorded at a weather station in close proximity to the 2012 trial site (Table 2). The growing season this year was marked by higher than normal temperatures and less than average rainfall, especially in the months of June and July. From April to July there was an accumulation of 3547 Growing Degree Days (GDDs) in Alburgh which is 195 GDDs higher than the 30 year average.

Table 2. Temperature and precipitation summary for Alburgh, VT, 2012.

Alburgh, VT	April	May	June	July
Average Temperature (F)	44.9	60.5	67.0	71.4
Departure from Normal	0.10	4.10	1.20	0.80
Precipitation (inches) *	2.64	3.90	3.22	3.78
Departure from Normal	-0.18	0.45	-0.47	-0.37
Growing Degree Days (base 32)	396	884	1046	1221
Departure from Normal	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.

Plant populations per acre were significantly different between seeding rates (Table 3). The highest plant population was at the seeding rate of 175 lbs ac^{-1} with 2,075,907 plants to the acre. Not surprisingly, 50 lbs ac^{-1} had the lowest plant population with 1,063,477 plants per acre. A low plant population in the 200 lbs ac^{-1} treatment may be a result of high plant density causing smothering of plants. Plant heights and percent lodged were not significantly different among seeding rates.

Table 3. The impact of seeding rate on plant populations, plant height and lodging, Alburgh, VT.

Seeding Rate lbs ac^{-1}	Plant population per acre	Plant height inches	Lodging %	Severity 1-5 scale
50	1063477	32.4	12.5	2.25
75	1157062	34.0	7.50	1.75*
100	1071985	33.0	**2.50**	1.50*
125	1080492	33.4	7.50	**0.50***
150	1590961	34.0	**2.50**	**0.50***
175	**2075907***	**35.2**	17.5	3.00
200	1488867	34.3	16.3	1.25*
LSD (0.1)	323224	NS	NS	1.49
Trial means	1361250	34	9.5	1.5

Values shown in **bold** are of the highest value or top performing.
* Wheat varieties that are not significantly different than the top performing variety in a column are indicated with an asterisk.
NS - None of the varieties were significantly different from one another.

Severity of lodging did differ significantly among seeding rates. The highest incidence and severity of lodging was observed in the 175 and 200 lbs ac^{-1} treatment. Increased lodging in the plots with the highest plant populations could be due to competition for nutrients reducing plant strength. The lowest seeding rate of 50 lbs ac^{-1} also had high lodging, which could be due to too much fertility causing weak plants.

Seeding rate did not significantly impact grain yields, grain moisture and test weights (Table 4). The highest yielding seeding rate was 150 lbs ac^{-1} (2409 lbs ac^{-1}). Interestingly, the lowest yielding seeding rate was 200 lbs ac^{-1} (1870 lbs ac^{-1}). The lowest harvest moisture was the seeding rate of 200 lbs ac^{-1} (16.8%) and the highest was the seeding rate of 50 lbs ac^{-1} (19.2%). All of the seeding rates, except for 50 lbs ac^{-1} (55.8 lbs bu^{-1}) reached the optimal 56 to 60 lb bu^{-1} test weight for wheat. The seeding rates did not significantly impact protein or falling number (Table 4). All of the seeding rates had protein levels that met industry standards of 12-14% . All of the falling numbers were above 250 seconds.

Early planting of wheat allowed all seeding rates to establish prior to significant weed growth. This may have led to all seeding rates having similar yields and quality.

Table 4. The impact of seeding rate on wheat harvest and quality, Alburgh, VT.

Seeding Rate				Quality		
	Yield	Moisture	Test weight	Crude protein @ 12% moisture	Crude protein @ 14% moisture	Falling number
lbs ac^{-1}	lbs ac^{-1}	%	bu ac^{-1}	%	%	seconds
50	1964	19.2	55.8	13.6	13.3	411
75	2146	17.8	57.0	**13.9**	**13.5**	408
100	2277	17.8	57.6	13.7	13.4	412
125	1928	18.6	57.3	13.7	13.4	414
150	**2409**	17.1	58.3	13.5	13.2	**418**
175	2309	17.3	**58.5**	13.8	**13.5**	**418**
200	1870	**16.8**	**58.5**	13.0	12.7	410
LSD (0.1)	NS	NS	NS	NS	NS	NS
Trial means	2129	17.8	57.6	13.6	13.3	413

Values shown in **bold** are of the highest value or top performing.
NS - None of the varieties were significantly different from one another.

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