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NW CROPS & SOILS PROGRAM

UNIVERSITY OF VERMONT EXTENSION

CULTIVATING HEALTHY COMMUNITIES

2012 Organic Winter Wheat Planting Date Trial

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The UNIVERSITY of VERMONT EXTENSION

2012 ORGANIC WINTER WHEAT PLANTING DATE TRIAL

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In 2012, the University of Vermont Extension conducted a winter wheat planting date trial for the first time. As the demand for local organic wheat has risen over the last few years, UVM Extension has been trying to determine the best agronomic practices for wheat production in the problematic Northeastern climate. Traditionally, producers have planted winter wheat after the Hessian fly free date, 15-Sep. Producers are interested in knowing how late they can plant their wheat in order to plan rotations and maximize yield.

MATERIALS AND METHODS

The trial was conducted in 2012 at Borderview Research Farm in Alburgh, VT. The experimental design was a randomized complete block split design with three replications. Main plots were planting date and subplots were varieties. Planting dates were initiated on 13-Sep 2011 and continued approximately every week for 5 weeks (Table 1). Three hard red winter wheat varieties were selected to represent varieties of varying heights. The variety 'Harvard' came from Agri-Culver Seeds in New York, while 'AC Morley' and 'Redeemer' were sourced at Bramhill Seeds in Palmerston, Ontario. The soil type at the project site was a Benson rocky silt loam. The seedbed was prepared by fall plow, disk and spike-toothed harrow. All plots were managed with practices similar to those used by producers in the surrounding areas (Table 1).

Table 1. Winter wheat planting date trial specifics in Alburgh, VT, 2012.

Trial information	Borderview Research Farm Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop (PD 1-3)	Spring canola
Previous crop (PD 4-5)	Winter wheat
Row spacing (in)	6
Seeding rate (lbs ac^{-1})	150
Replicates	3
Planting dates	13-Sep, 21-Sep, 28-Sep, 7-Oct, 12-Oct
Fertilizer	4lbs ac^{-1} Pro-Booster & Pro-Gro 5-May 2012
Harvest area (ft)	5 x 20
Tillage operations	Fall plow, disk & spike-toothed harrow

Fall population was assessed on 24-Oct 2011 and vigor was assessed on 11-Apr 2012. Plant height was measured prior to harvest. All plots were harvested on 11-Jul 2012 with an Almaco SPC50 small plot combine. Yields were adjusted to 13.5% moisture before reporting. Following harvest, seed was cleaned with a small Clipper cleaner. A one-pound subsample was collected to determine quality. Quality measurements included standard testing parameters used by commercial mills. Harvest moisture was determined for each plot using a Dickey-john M20P. Test weight was measured using a Berckes Test Weight Scale, which weighs a known volume of grain. Subsamples were ground into flour, using the

Perten LM3100 Laboratory Mill, and were evaluated for crude protein (CP) content, falling number and mycotoxin levels. Grains were analyzed for CP using the Perten Inframatic 8600 Flour Analyzer, and CP is reported at both 12% and 14% flour moisture. Falling number was determined using the AACC Method 56-81B, AACC Intl., 2000 on a Perten FN 1500 Falling Number Machine. Deoxynivalenol (DON) analysis was performed using Veratox DON 5/5 Quantitative test from the NEOGEN Corp. This test has a detection range of 0.5 to 5.0 ppm.

Data was analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications were treated as random effects and treatments were treated as fixed. Mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered 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 to the right, 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

Using data from a Davis Instruments Vantage Pro2 weather station at Borderview Research Farm in Alburgh, VT, weather data was summarized for the 2011-2012 growing season (Table 2). The 2012 growing season was warmer than normal, with less than average precipitation throughout the entire season, except for in September which had above average precipitation. Overall, the season accumulated 5956 GDDs at a base temperature of 32°F. There were 897 more GDDs than the 30-year average (1981-2012). Although the 2011-2012 winter was warmer and less snowy than normal, and GDDs accumulated throughout the year, it is important to note that plant growth does not normally occur when the ground is frozen (Dec-Feb).

Table 2. Temperature, precipitation, and growing degree days (GDDs) data by month for Alburgh, VT, 2012.

Alburgh, VT	Sep 2011	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012
Average temperature (°F)	62.8	50.1	43.4	29.5	22.2	26.0	39.7	44.9	60.5	67.0	71.4
Departure from normal	2.20	1.90	5.20	3.60	3.40	4.50	8.60	0.10	4.10	1.20	0.80
Precipitation (inches)*	5.6	3.5	1.4	2.2	1.5	0.7	1.5	2.6	3.9	3.2	3.8
Departure from normal	1.9	-0.1	-1.7	-0.1	-0.6	-1.1	-0.8	-0.2	0.5	-0.5	-0.4
Growing Degree Days (base 32°F)	932	578	344	110	55	59	331	396	884	1046	1221
Departure from normal	74	76	142	91	55	59	205	12	128	32	23

Based on weather data from an on-site Davis Instruments Vantage Pro2 weather station with a Weatherlink data logger.
Historical averages are for 30 years of NOAA data from Burlington, VT (1981-2010).
*Precipitation data from Jul-Sep 2012 are based on Northeast Regional Climate Center data from an observation station in Burlington, VT.

Planting Date x Variety Interactions

There was a significant interaction between planting date and variety for winter wheat yield, harvest moisture and plant population. These interactions indicate that winter wheat varieties respond differently across planting dates for plant population, yield and harvest moisture (Figure 1). AC Morley was the highest yielding variety with the exception of the 28-Sep planting date. Both Redeemer and AC Morley had significant yield declines at this date. Interestingly, at this time there was a significant amount of rain and the plots were planted into wet soil. This may have led to compaction and poor early season growth of the wheat. There were no significant interactions between variety and planting date for wheat quality.

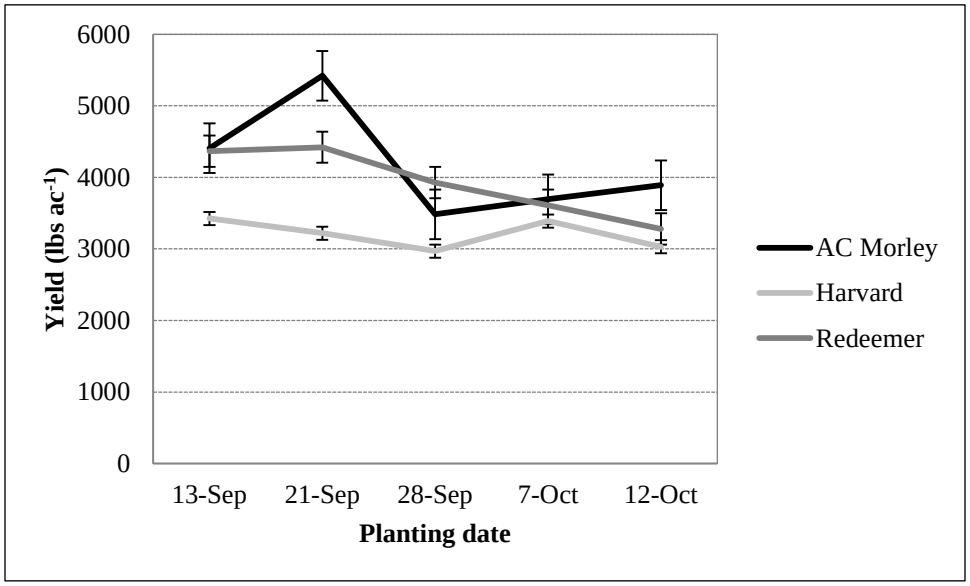

Figure 1. Planting date by variety interaction for winter wheat yield. Vertical bars represent +/- one standard deviation.

Impact of Planting Date

There was no significant difference in fall population by planting date (Table 3). The vigor of the wheat plants was based on a 1-5 scale, with 1 being poor vigor and 5 being very vigorous. The earliest planting date (13-Sep) had the highest vigor (3.44), while the last planting date (12-Oct) had the lowest vigor (2.06). Planting date did not have a significant impact on plant height. The highest yield was found at the 21-Sep planting date (4354 lbs per acre), though this was not significantly different than the 13-Sep planting date (Figure 2). Planting date did not significantly impact test weight of the wheat.

Table 3. Winter wheat plant measurements and harvest data, 2012.

Planting date (2011)	Plant population	Vigor	Plant height	Harvest moisture	Yield at 13.5% moisture	Test weight
	plant ac^{-1}	1-5 scale	in	%	lbs ac^{-1}	lbs bu^{-1}
13-Sep	839874	**3.44***	**43.9***	15.1	4066*	**61.1***
21-Sep	893484	3.06*	**43.9***	15.8*	**4354***	60.7
28-Sep	991767	2.89	42.1	**16.4***	3460	60.6
7-Oct	**1111085***	2.72	41.6	13.6	3564	60.9
12-Oct	1045376	2.06	41.9	15.0	3400	60.4
LSD (0.10)	NS	0.50	NS	0.9	422	NS
Trial mean	976317	2.83	42.7	15.2	3769	60.7

*Treatments that did not perform significantly lower than the top-performing treatment (in **bold**) in a particular column are indicated with an asterisk.
NS-Treatments were not significantly different from one another.

Planting date did not significantly impact crude protein concentrations (Table 4). Falling number was highest in the October planting dates. The first three planting dates had the lowest DON numbers which is desired.

Table 4. Winter wheat quality data by planting date, 2012.

Planting date (2011)	Crude protein @ 12% moisture	Falling number	DON
	%	seconds	ppm
13-Sep	**13.0***	384	**0.12***
21-Sep	12.8	389	0.22*
28-Sep	**13.0***	373	0.21*
7-Oct	12.7	**415***	0.46
12-Oct	12.8	410*	0.29
LSD (0.10)	NS	25	0.13
Trial mean	12.9	394	0.26

*Treatments that did not perform significantly lower than the top-performing treatment (in **bold**) in a particular column are indicated with an asterisk.
NS-Treatments were not significantly different from one another.

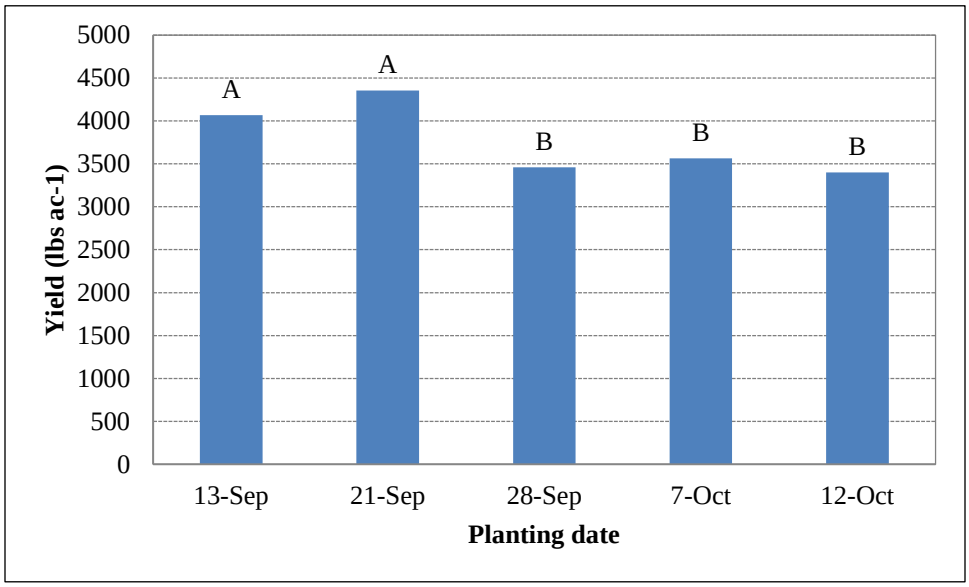

Figure 2. Yield comparison between planting dates across hard red winter wheat varieties in Alburgh, VT, 2012. Treatments that share a letter did not differ significantly by planting date (p=0.10).

Impact of Variety

Variety significantly impacts wheat yield and quality. AC Morley had the highest plant population per acre (1,090,050 plants per acre), though this was not significantly different than the variety Redeemer at 970,504 plants per acre (Table 5). The trial mean for vigor was 2.83, with the highest being Redeemer (3.13), though this was also not significantly different than AC Morley (3.00). AC Morley had the tallest plant height (48.0 inches), while the trial mean was 42.7 inches. Harvard had the highest harvest moisture out of the three varieties (16.2%). The highest-yielding winter wheat variety in this trial was AC Morley (4179 lbs per acre), though this was not significantly different than the second highest yielding wheat variety Redeemer which yielded 3921 lbs per acre (Figure 3). The trial mean for test weight was 60.7 lbs per bushel, with the highest test weight being found in the variety Redeemer (61.8 lbs per bushel).

Table 5. Winter wheat plant measurements and harvest data by variety, 2012.

Variety	Plant population	Vigor	Plant height	Harvest moisture	Yield at 13.5% moisture	Test weight
		1-5	in	%	lbs ac^{-1}	lbs bu^{-1}
AC Morley	**1090050***	3.00*	**48.0***	15.4	**4179***	60.6
Harvard	868398	2.37	38.6	**16.2***	3207	59.8
Redeemer	970504*	**3.13***	41.4	14.0	3921*	**61.8***
LSD (0.10)	144778	0.39	1.8	0.7	327	1.0
Trial mean	976317	2.83	42.7	15.2	3769	60.7

*Treatments that did not perform significantly lower than the top performing treatment (in **bold**) in a particular column are indicated with an asterisk.

Redeemer had the highest crude protein concentrations (Table 6). The average falling number for the three varieties was 394 seconds, with Redeemer being the highest (426 seconds). All three of the varieties had DON levels lower than the 1.0 ppm standard for human consumption.

Table 6. Winter wheat quality data by variety, 2012.

Variety	Crude protein @ 12% moisture	Falling number	DON
	%	Sec	ppm
AC Morley	12.3	404	0.28
Harvard	12.8	352	0.29
Redeemer	**13.5***	**426***	**0.20***
LSD (0.10)	0.3	19	NS
Trial mean	12.9	394	0.26

*Treatments that did not perform significantly lower than the top-performing treatment (in **bold**) in a particular column are indicated with an asterisk.
NS-Treatments were not significantly different from one another.

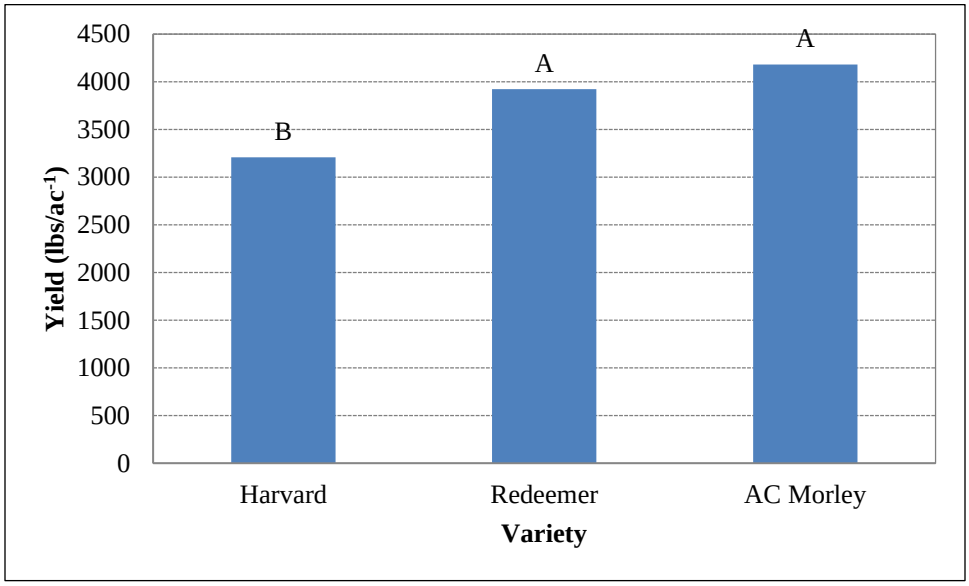

Figure 3. Yield comparison between hard red winter wheat varieties across all planting dates in Alburgh, VT, 2012. Treatments that share a letter did not differ significantly by variety (p=0.10).

DISCUSSION

Although only one year of data, this study indicates that wheat planted during mid-September will result in the best yields. Earlier planting dates produced taller wheat across all varieties and may play a role in suppressing weeds during the growing season. The last planting date (12-Oct) had the lowest yield, the lowest test weight, the shortest height and the lowest vigor. This indicates that planting wheat in October

will produce a crop, but earlier planting would be a more economically viable option. Quality did not seem to be greatly impacted by planting date and was more greatly influenced by variety. Overall, planting winter wheat early allowing for six to eight weeks of growth before the soil freezes, will provide the best chances of high yield and quality winter wheat.

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