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2011 Spring Wheat Planting Date Report

Heather Darby, UVM Extension Agronomic Specialist
Rosalie Madden, Erica Cummings, Hannah Harwood, Amanda Gervais
UVM Extension Crop and Soil Technicians
802-524-6501

www.uvm.edu/extension/cropsoil/

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Dr. Heather Darby, UVM Extension
heather.darby[at]uvm.edu

The localvore movement has revived otherwise historical crops in Vermont, including small-scale grain production. As the demand for local organic wheat has risen over the last few years, University of Vermont Extension has developing best agronomic practices for wheat production in a Northeastern climate. In an organic system, weed management can be one of the biggest challenges. One strategy to manage weeds is to modify planting dates. Early planting dates can establish a crop prior to weed flushes while a late planted crop can help avoid some weed species. Planting date can also have an overall impact on both grain yield and quality. Certain crop varieties may also have characteristics (i.e. height) that can help to compete against weed populations. However, some varieties may respond better to earlier or later planting dates. Another struggle that Northeastern wheat farmers face is disease, most notably, Fusarium Head Blight (FHB), caused predominantly by *Fusarium graminearum*. This disease can cause yield loss, low test weight, low seed germination, and will produce mycotoxins. The primary mycotoxin produced by FHB is a vomitoxin called deoxynivalenol (DON). Spores are usually transmitted by air currents and can infect plants at flowering through grain fill. One of the goals of this project was to evaluate if planting date will have an effect on the susceptible time period of flowering through grain fill, and in turn if it will influence mycotoxin presence and other quality factors in the harvested grain.

At this time there is no data to document optimum spring wheat planting dates for New England. The objective of this project was to determine the effect of planting date and variety on weed biomass, FHB, and spring wheat yield and quality.

MATERIALS AND METHODS

The trial was conducted in 2011at Borderview Farm in Alburgh, VT. The experimental design was a randomized complete block split design with four replications. Main plots were planting date and subplots were varieties. Planting dates started on 19-April and continued approximately every week for 5 weeks (Table 2). Four hard red spring wheat varieties were selected to represent varieties of varying heights. Ladoga, an heirloom variety was selected because of its known tall height (Table 1).

Table 1. Seed varieties and seed sources for planting date trial at Borderview Farm in Alburgh, VT.

Variety	Type	Seed source
AC McKenzie	Hard red spring wheat	Semican
AC Superb	Hard red spring wheat	Seedway
Ladoga	Hard red spring wheat	USDA-ARS
RB07	Hard red spring wheat	University of Minnesota

Table 2. Spring wheat planting and harvest dates at Borderview Farm in Alburgh, VT.

Planting date	Harvest date
19-April	5-August
25-April	5-August
2-May	12-August
10-May	12-August
19-May	17-August

The soil type at the project site was a Benson rocky silt loam. The seedbed was prepared by fall plow, followed by spring disk and spike-tooth harrow. All plots were managed with practices similar to those used by producers in the surrounding areas (Table 3). Two tons/acre of Giroux poultry manure (2-3-2) was fall applied. The previous crop was spring oats and barley. Plots were seeded at 125 lbs acre^{-1} in 6" rows with a Kincaid Cone Seeder.

Table 3. Spring wheat planting date trial specifics in Alburgh, VT.

Trial information	Borderview Farm Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Spring oats and barley
Row spacing	6"
Seeding rate	125 lbs/ac
Replicates	4
Fertilizer	2 tons/ac Giroux poultry manure (2-3-2)
Harvest area	5' x 20'
Tillage operations	Fall plow, spring disk, & spike-toothed harrow

On June 22, 2011, percent cover was evaluated using the IMAGING Crop Response Analyzer a computer analytical program. This strategy was implemented to determine weed biomass of each treatment. From a 0.30 m^2 subplot, a photo was taken of the stand as-is, with both weeds and wheat, and another photo of the exact same location was taken with the weeds removed. Both photos were evaluated for percent cover using the IMAGING Crop Response Analyser (www.imaging-crops.dk) developed by University of Copenhagen. When wheat was in the soft dough stage, spikes in a 1.08 ft^2 were counted. Heights were also recorded for each plot at the soft dough stage. The first two planting dates were harvested on August 5, 2011, the third and fourth planting dates were harvested on August 12, 2011, and the last planting date was harvested on August 17, 2011 (Table 2). All plots were harvested with an Almaco SPC50 small plot combine. At harvest grain moisture, test weight, and yield were determined.

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 protein content, falling number, and mycotoxin levels. Grains were analyzed for protein content using the Perten

Inframatic 8600 Flour Analyzer. 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 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 ($p<0.10$).

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 hybrids 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 0.10 level of significance 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 that for 9 out of 10 times, there is a real difference between the two treatments. Treatments that were not significantly lower in performance than the highest hybrid in a particular column are indicated with an asterisk. In the example below, hybrid C is significantly different from hybrid A but not from hybrid B. The difference between C and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these hybrids did not differ in yield. The difference between C and A is equal to 3.0 which is greater than the LSD value of 2.0. This means that the yields of these hybrids were significantly different from one another. The asterisk indicates that hybrid B was not significantly lower than the top yielding hybrid C, indicated in bold.

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

RESULTS

April and May brought excessive rainfall and floods throughout Vermont, saturating many fields and delaying planting on many farms (Table 4). Weather data is based on National Weather Service data from a cooperative observer station in South Hero, VT, which is in close proximity to the trial. Growing degree days (GDDs) are calculated with a base temperature of 32°F. Historical averages are for 30 years of data (1971-2000).

Table 4. Data from a weather station in close proximity to Alburgh, VT.

	April	May	June	July	August
Average Temperature (°F)	46.6	58.7	67.1	74.4	70.4*
Departure from Normal	3.1	2.1	1.3	3.3	1.6
Precipitation (inches)	7.88*	8.67*	3.52*	3.68*	10.23
Departure from Normal	5.00	5.35	0.09	-0.29	6.38
Growing Degree Days	465	826	1088	1314	1121
Departure from Normal	120	63.6	74.1	104	-26.3

*Due to missing data from the South Hero station, precipitation from April to July 2011, and average temperature for August 2011 are taken from an observer station in Burlington, VT.

Table 5. Height and spikes per square foot by hard red spring wheat variety across planting date in Alburgh, VT.

Variety	Height	Spikes
	cm	spikes/ft^2
AC McKenzie	88.4	39.2
AC Superb	80.9	37.1
Ladoga	**107***	38.1
RB07	70.0	40.1
LSD (0.10)	3.4	NS
Means	86.5	38.6

Table 6. Height and spikes per square foot by planting date across all hard red spring wheat varieties in Alburgh, VT.

Planting date	Height	Spikes
	cm	spikes/ft^2
19-Apr-11	**92.1***	39.9
25-Apr-11	88.7*	37.2
2-May-11	87.3	**40.7**
10-May-11	85.5	37.5
19-May-11	78.6	37.9
LSD (0.10)	3.8	NS
Means	86.5	38.6

*Treatments that did not perform significantly lower than the top performing treatment in a particular column is indicated with an asterisk.
NS - None of the varieties were significantly different from one another.

Ladoga was significantly taller than all other varieties and RB07 significantly shorter than all other varieties (Table 5). Earlier planting dates resulted in taller plants than planting dates delayed into the month of May (Table 6). There was no statistical significance determined between planting date or variety and the number of spikes per square foot. The fourth planting date, May 10th, had the lowest percent weed cover, statistically similar to the first and third planting dates, April 19th and May 2nd. The highest weed cover was observed at the last planting date of May 19th. Varieties did not differ in weed cover across all the planting dates (Table 8).

Table 7. The effect of planting date on weed cover in hard red spring wheat in Alburgh, VT.

Planting Date	Weed cover
	%
19-Apr-11	7.00*
25-Apr-11	9.80
2-May-11	7.30*
10-May-11	**3.80***
19-May-11	13.5
LSD (0.10)	3.50
Means	8.30

Table 8. The effect of hard red spring wheat Variety on weed cover in Alburgh, VT.

Variety	Weed cover
	%
AC Superb	8.9
Ladoga	**6.8**
AC McKenzie	8.5
RB07	8.9
LSD (0.10)	NS
Means	8.3

*Treatments that did not perform significantly lower than the top performing treatment in a particular column is indicated with an asterisk.
NS - None of the varieties were significantly different from one another.

April planting dates resulted in the highest spring wheat yields (Table 9; Figure 1). The wheat yields and test weight declined as planting date was delayed into late May. Protein levels were highest in the late May planting date. This may be a reflection of the really low yields. Falling number at all planting dates met the milling standard. There was a decline as planting dates were delayed. DON levels were below the FDA 1ppm threshold at all dates.

Table 9. Yield and quality characteristics by planting date across all hard red spring wheat varieties in Alburgh, VT.

Planting date	Harvest date	Harvest moisture	Yield at 13.5% moisture	Test weight	Crude protein at 12% moisture	Falling number at 14% moisture	DON
		%	lbs/ac	lbs/bu	%	seconds	ppm
19-Apr-11	5-Aug-11	14.5	**1170***	**57.6***	13.8	410*	1.01
25-Apr-11	5-Aug-11	15.3	1070*	56.9	13.6	**416***	0.74
2-May-11	12-Aug-11	13.6	961	56.0	12.8	412*	0.35*
10-May-11	12-Aug-11	14.2	884	56.2	13.5	409*	**0.23***
19-May-11	17-Aug-11	**17.0***	565	51.9	**14.7***	365	0.36
	LSD (0.10)	0.7	194	0.7	0.3	15	0.12
	Means	14.9	929	55.7	13.6	402	0.54

*Treatments that did not perform significantly lower than the top performing treatment in a particular column is indicated with an asterisk.
NS - None of the varieties were significantly different from one another.

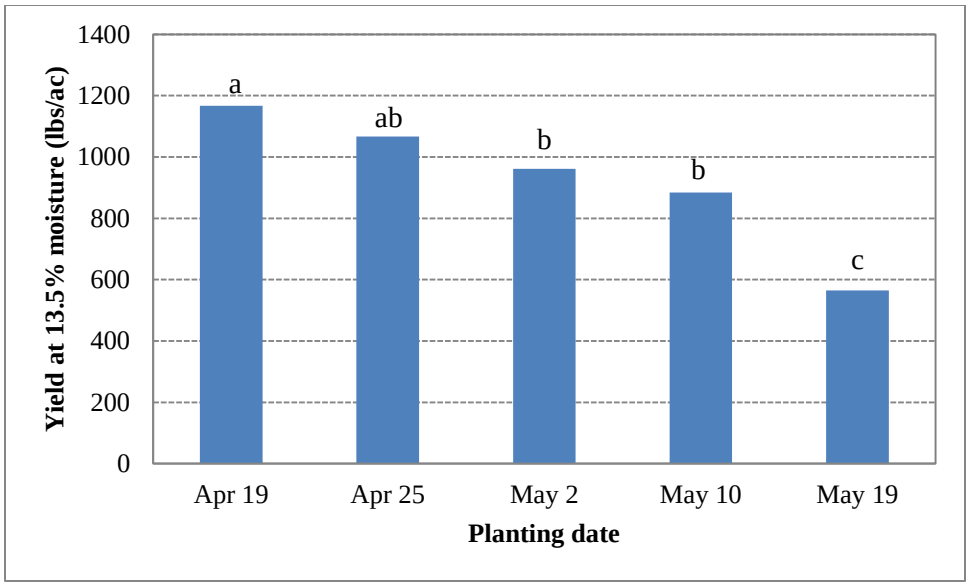

Figure 1. Yield comparison between planting dates in 2011 across hard red spring wheat varieties in Alburgh, VT.

AC Superb was the highest yielding variety (Table 10, Figure 2). AC McKenzie and RB07 had the highest test weight. Ladoga had significantly lower crude protein levels compared to the other three varieties, and the lowest level of DON, although all four varieties tested below the FDA limit. AC Superb and AC McKenzie had the highest falling numbers.

Table 10. Yield and quality characteristics by hard red spring wheat variety across all planting dates in Alburgh, VT.

Variety	Harvest moisture	Yield at 13.5% moisture	Test weight	Crude protein at 12% moisture	Falling number at 14% moisture	DON
	%	lbs/ac	lbs/bu	%	seconds	ppm
AC Superb	**15.7***	**1110***	55.8	**14.0***	**420***	0.93
AC McKenzie	14.3	882	**56.5***	13.8*	416*	0.46
RB07	14.6	873	56.3*	13.8*	377	0.51
Ladoga	15.1	849	54.4	12.9	397	**0.26***
LSD (0.10)	0.6	173	0.6	0.3	14	0.11
Means	14.9	929	55.7	13.6	402	0.54

*Wheat that did not perform significantly lower than the top performing treatment in a particular column is indicated with an asterisk.

NS - None of the varieties were significantly different from one another.

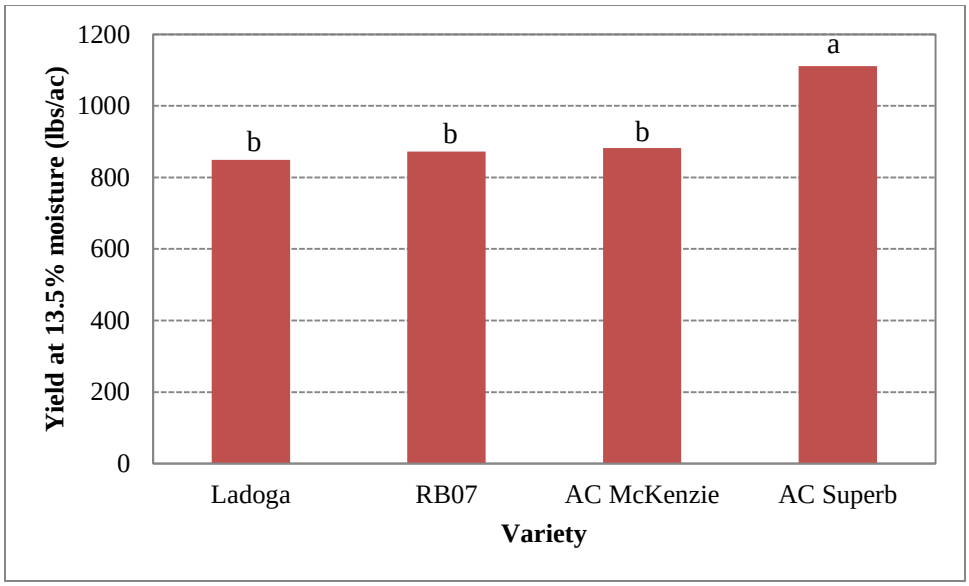

Figure 2. Yield comparison between hard red spring wheat varieties across all planting dates in Alburgh, VT.

DISCUSSION

There were no interactions between planting date and variety indicating that varieties responded similarly across planting dates. Earlier planting dates produced taller wheat across all varieties. The shorter stands of wheat found in the later planted dates could be attributed to plants having a shorter growing period. Similar to other wheat planting date studies, this work indicates that wheat planted in April will result in higher yields. The last planting date, May 19th, had the highest evaluated weed pressure. The May 19th planting date also had the lowest yield and the highest harvest moisture. The high harvest moisture could be attributed to weed biomass hindering wheat dry-down. The last planting date also had the highest crude protein, despite the greatest weed pressure. Oftentimes a lower yield results in higher protein concentration. Higher protein in the latter planting date could also be due to the timing of nitrogen availability of the applied Giroux poultry manure. Overall, planting spring wheat in mid to late April will provide best chances of high yield and quality spring wheat.

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