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2012 Organic Spring Wheat Planting Date Trial Report

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2012 ORGANIC SPRING WHEAT PLANTING DATE TRIAL REPORT

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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 been developing best agronomic practices for wheat production. 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 wheat varieties may respond better to earlier or later planting dates. At this time, there is no data to document optimum spring wheat planting dates for the Northeast. The objective of this project was to determine the effect of planting date and variety on organic spring wheat yield and quality.

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 four replications. Main plots were planting date and subplots were varieties. Planting dates started on 6-Apr and continued approximately every week for 7 weeks (Table 2). Four hard red spring wheat varieties were selected to represent varieties of varying heights (Table 1).

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

Variety	Type	Seed source
Ladoga	Hard red spring wheat	USDA-ARS
McKenzie	Hard red spring wheat	Semican, Canada
RB07	Hard red spring wheat	Minnesota Foundation Seed, MN
Superb	Hard red spring wheat	Oliver Seed Co., VT

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

Planting date	Plant emergence	Harvest date
6-Apr	19-Apr	30-Jul
12-Apr	24-Apr	30-Jul
19-Apr	3-May	30-Jul
26-Apr	6-May	30-Jul
3-May	10-May	8-Aug
17-May	22-May	Partial harvest
25-May	1-Jun	Not harvestable

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-toothed harrow. All plots were managed with practices similar to those used by producers in the surrounding areas (Table 3). The previous crop was sunflowers. Plots were seeded at 125 lbs ac^{-1} in 6" rows with a Kincaid Cone Seeder.

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

Trial information	Borderview Research Farm Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Sunflowers
Row spacing (in)	6
Seeding rate (lbs ac^{-1})	125
Replicates	4
Harvest area (ft)	5 x 20
Tillage operations	Fall plow, spring disk, & spike-toothed harrow

Populations on the first five planting dates were measured on 16-May by taking two, 0.3 meter plant counts per plot.

The first four planting dates were harvested on 30-Jul and the fifth planting date was harvested on 8-Aug (Table 2). Due to excessive weed pressure, the sixth and seventh planting dates could not be harvested. The plots were harvested with an Almaco SPC50 small plot combine. At the time of harvest, plant heights were measured excluding the awns. A visual estimate of what percent a plot was lodged and the severity of lodging was recorded based on a visual rating with a 0 – 5 scale, where 0 indicates no lodging and 5 indicates severe lodging and a complete crop loss. In addition, grain moisture, test weight and yield were determined.

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, falling number and mycotoxin levels. 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. Deoxynivalenol (DON) analysis 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 planting date and variety data were analyzed using the PROC MIXED procedure in SAS using the Tukey-Kramer adjustment, which means that each variety and planting date was analyzed with a pairwise comparison (i.e. ‘Superb’ statistically outperformed ‘Ladoga’, or ‘planting date one’ statistically outperformed ‘planting date two’, etc.) In all tables, the top performing variety can be found in bold.

RESULTS

Seasonal precipitation and temperatures were recorded using a Davis Instruments Vantage Pro2 weather station at Borderview Research Farm in Alburgh, VT, and weather data was summarized for the 2012 growing season (Table 4). Though May was wetter than normal (based on 1981-2010 data), April, June, July and August all had less precipitation than average. All months during the growing season had higher than average temperatures (based on 1981-2010 data). There were an accumulated 4758 Growing Degree Days (GDDs) at a base temperature of 32°F. This was 267 more than the historical 30-year average for April-August. Ideal spring conditions led to early planting of spring wheat.

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

Alburgh, VT	April	May	June	July	August
Average Temperature (F)	44.9	60.5	67.0	71.4	71.1
Departure from Normal	0.10	4.10	1.20	0.80	2.30
Precipitation (inches) *	2.64	3.90	3.22	3.78	2.92
Departure from Normal	-0.18	0.45	-0.47	-0.37	-0.99
Growing Degree Days (base 32)	396	884	1046	1221	1211
Departure from Normal	12.0	128	32.0	23.0	72.0

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.

Impact of Planting Date x Variety on Spring Wheat Yield and Quality

Planting date x variety interactions were observed for yield, protein, falling number and DON concentrations. This indicates the varieties responded differently across planting dates. The variety Superb was highest yielding at the 6-Apr planting date, but yields dropped as planting dates became later (Figure 1). The other three varieties, RB07, Ladoga and McKenzie, have more gradual yield reductions as the planting dates extended into early May.

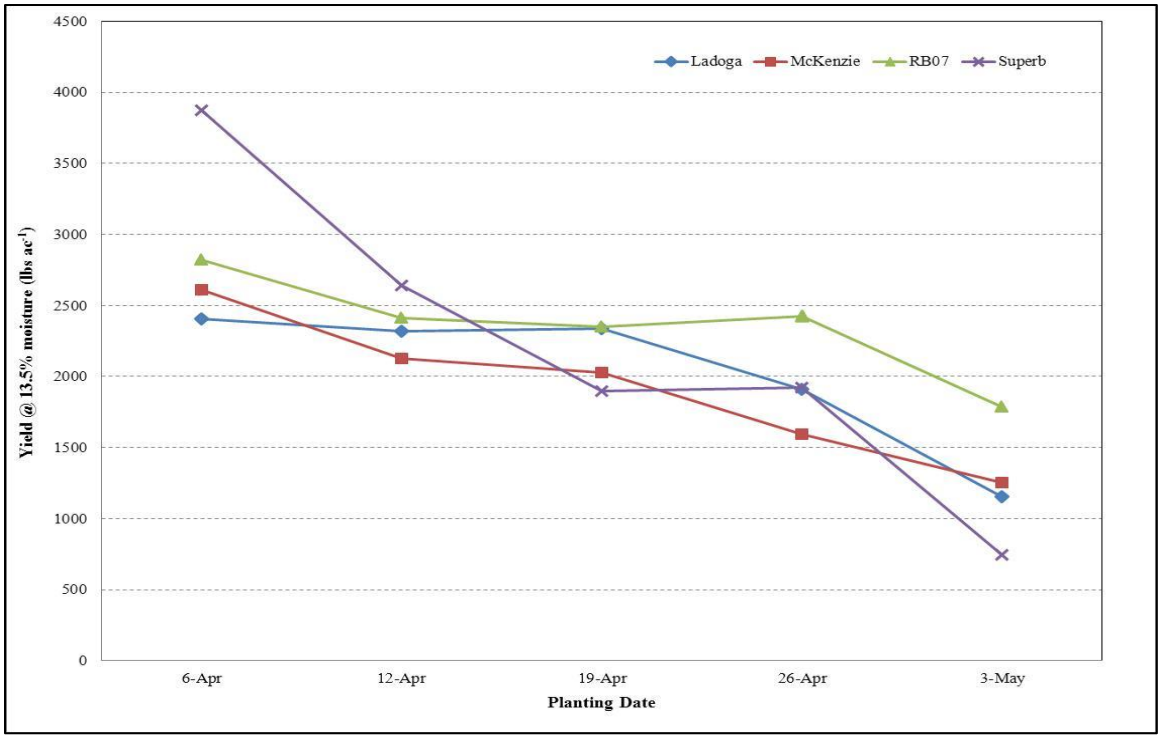

Figure 1. The interaction of planting date and variety on yield, Alburgh, VT.

The protein levels of the four different varieties varied across planting dates (Figure 2). RB07 and Ladoga appear to have consistently increased protein levels as the planning dates extended into early May, whereas Superb and McKenzie had protein levels that fluctuated across planting dates. For the most part, protein concentrations had an inverse relationship with yields.

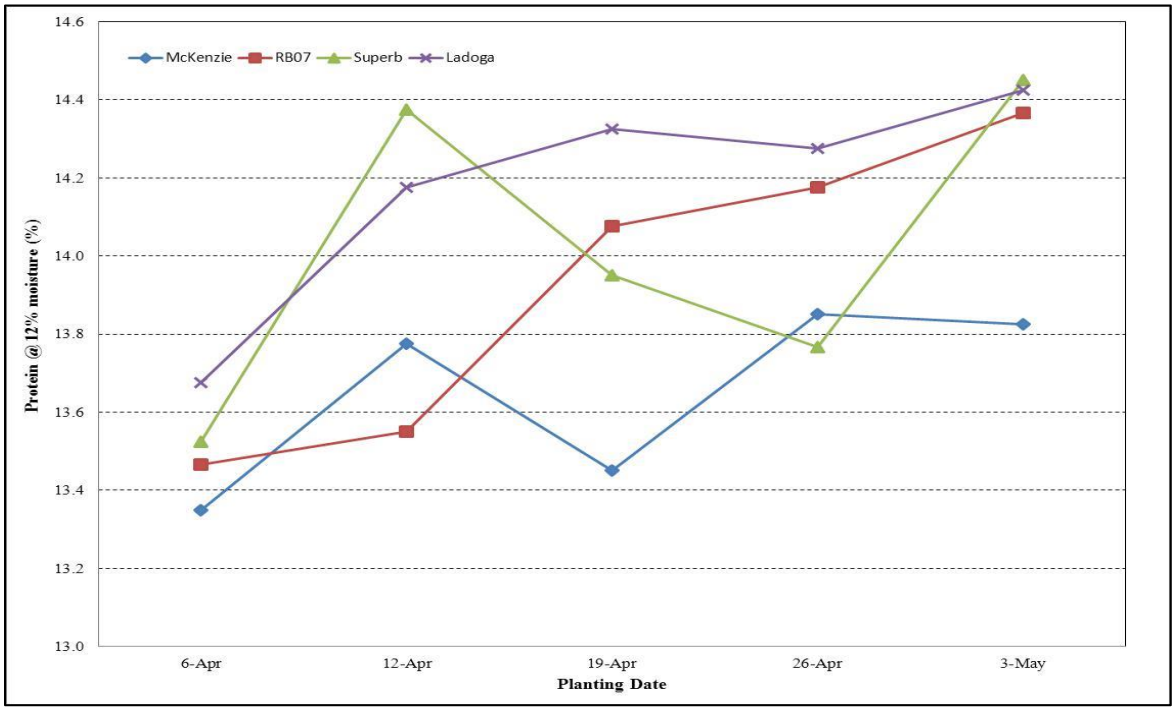

Figure 2. The interaction of planting date and variety on protein concentration, Alburgh, VT.

Impact of Planting Date on Spring Wheat Yield and Quality

The highest yielding planting date was 6-Apr (2929 lbs ac^{-1}) and the lowest yielding planting date was 3-May (1219 lbs ac^{-1}) (Table 5, Figure 3). Overall, the early to mid-April planting dates resulted in the highest spring wheat yields. Test weights for the five planting dates were all within the acceptable range of 56-60 lbs bu^{-1}. Protein levels were highest on the 3-May planting date (14.3%) and lowest (13.5%) on the earliest planting date (6-Apr). A higher protein concentration at the later planting dates may be a result of the lower yield. It's important to note that all of the planting dates met the industry standard of 12-15% protein. All of the falling numbers from the planting dates exceeded industry standards. DON levels were below the FDA 1 ppm threshold at all dates. However, the 3-May planting date was just under the 1 ppm limit (0.98 ppm).

Table 5. Yield and quality characteristics by planting date across all hard red spring wheat varieties in Alburgh, VT.

Planting Date				Quality		
	Yield	Moisture	Test weight	Crude protein @ 12% moisture	Falling number	DON
	lbs ac^{-1}	%	bu ac^{-1}	%	seconds	ppm
6-Apr	**2929a**	10.9a	58.9	13.5c	419	0.28c
12-Apr	2374b	11.1a	58.1	13.9bc	**435**	0.23b
19-Apr	2153b	**10.5a**	58.4	14.0ab	427	**0.19a**
26-Apr	1950b	12.2b	57.8	14.0ab	423	0.55c
3-May	1219c	10.9a	**59.4**	**14.3a**	413	0.98c
p-value (<0.10)	<0.0001	0.0005	0.1157	0.0006	0.2468	<0.0001

Values shown in **bold** are of the highest value or top performing.
Planting dates with the same letter within a column did not differ significantly.

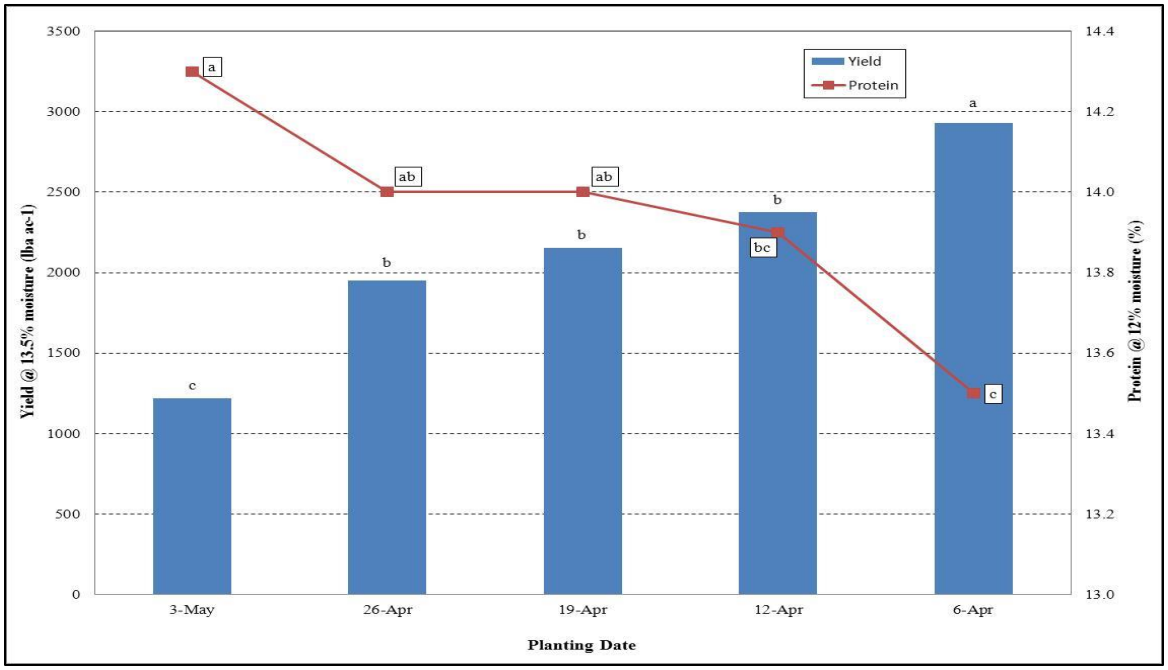

Figure 3. Yield and protein comparison between planting dates in 2012 across hard red spring wheat varieties in Alburgh, VT. Planting dates with the same letter did not differ significantly.

Impact of Variety on Spring Wheat Yield and Quality

RB07 was the highest yielding variety (2349 lbs ac^{-1}) and the lowest yielding variety across planting dates was McKenzie (1921 lbs ac^{-1}) (Table 6, Figure 4). All four varieties had tests weights in the acceptable range of 56-60 lbs bu^{-1}. Ladoga had the highest protein content (14.2%) and McKenzie had the lowest (13.7%). All of the varieties had protein levels that met commercial mill standards of 12-15%. Falling numbers exceeded 400 seconds in all varieties. McKenzie had the lowest level of DON (0.24 ppm), although all four varieties tested below the FDA 1 ppm limit.

Table 6. Yield and quality characteristics by hard red spring wheat variety across all planting dates in Alburgh, VT.

Spring Wheat Variety				Quality		
	Yield	Moisture	Test weight	Crude protein @ 12% moisture	Falling number	DON
	lbs ac^{-1}	%	bu ac^{-1}	%	seconds	ppm
Ladoga	2025ab	**11.0**	57.9	**14.2a**	420ab	0.44bc
McKenzie	1921b	**11.0**	**59.1**	13.7c	**436a**	**0.24a**
RB07	**2349a**	11.1	58.6	13.8bc	408b	0.32b
Superb	2206ab	11.4	58.5	14.0ab	429ab	0.79c
p-value (<0.10)	0.0566	0.5662	0.2235	0.0032	0.0184	<0.0001

Values shown in **bold** are of the highest value or top performing.
Varieties with the same letter within a column did not differ significantly.

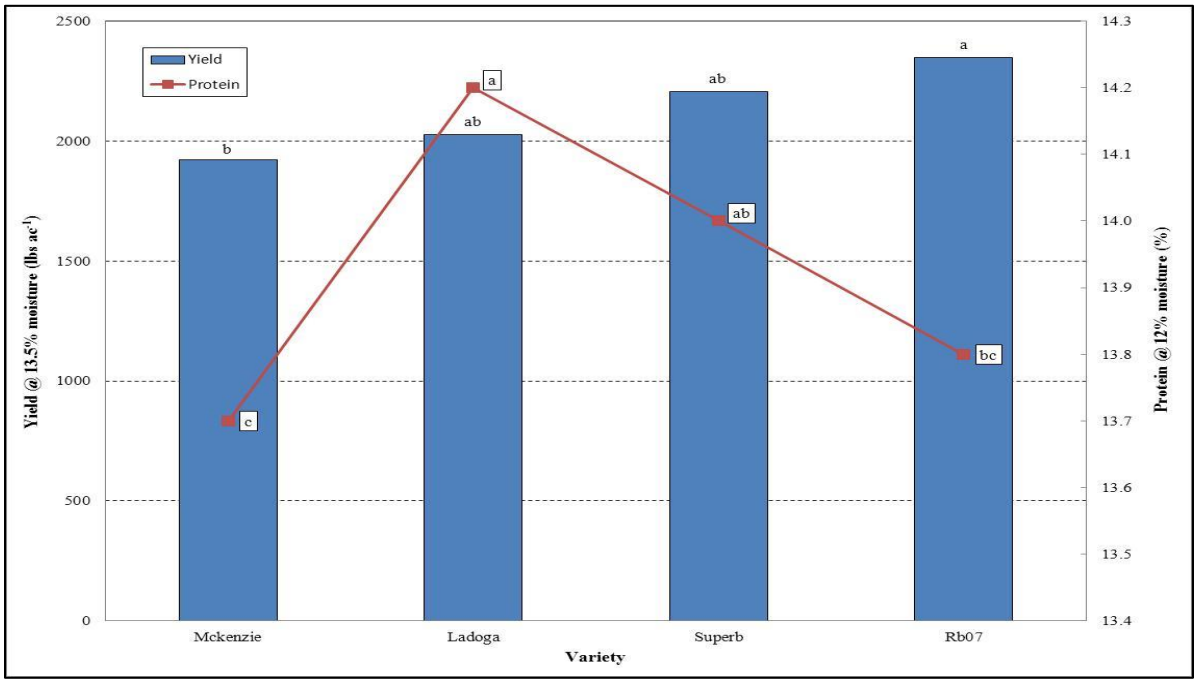

Figure 4. Yield and protein comparison between hard red spring wheat varieties across all 2012 planting dates in Alburgh, VT. Varieties with the same letter did not differ significantly.

DISCUSSION

The warm temperatures in March dried the field out allowing plowing, seedbed prep and planting to occur two weeks earlier than in 2011. The earlier planting dates were observed to have less weed issues, which could be partially attributed to planting the first week in April resulting in wheat establishment prior to weed growth. The later planting dates had higher weed pressure and lower yields. The weed pressure was so severe in the sixth and seventh planting dates that the majority of plots were not harvestable. The later planting dates may have had lower yields, but also had the highest crude protein. The higher protein in the later planting dates was most likely due to the lower yields observed at these dates. Even though the later planting dates had the highest protein content, all of the planting dates met industry standards for baking, 12-15%. Overall, planting spring wheat in early to mid-April will provide best chances of high yield and quality. It is important to remember that the results only represent one year of data.

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