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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2014 WINTER CANOLA SOIL PREPARATION X FERTILITY TIMING TRIAL

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Although winter canola is a relatively new crop to the Northeast, it has the potential to be utilized in rotations to break pest and disease cycles or as an oilseed crop for high quality culinary oils or on-farm fuel production. Winter canola is planted in late summer as it overwinters and is harvested for seed the following year in early summer. Due to the very small size of the seed, it is also important to establish good seed-soil contact when planting to ensure proper germination. If planted too deep or with minimal soil contact, germination will be low resulting in poor stand and higher weed pressure potentially reducing yields. In addition, knowing when to apply fertilizer can be difficult as the crop's lifecycle spans both fall and spring when manure and other fertilizers are typically added to fields. To help address these issues the UVM Extension Northwest Crop and Soil Program conducted a winter canola soil preparation and fertility timing trial in 2013-2014.

MATERIALS AND METHODS

A trial was conducted in 2013-2014 at Borderview Research Farm in Alburgh, VT. The experimental design was a randomized complete block with split plots replicated three times. Plots were 10'x 25' and were seeded with a Great Plains grain drill at a rate of 6.4 lbs viable seed per acre (Table 1). The main plots were four soil preparation methods (drill, drill + pack, pack + drill, and pack + drill + pack). The subplots were two nitrogen (N) fertilization times. Plots were fertilized with ammonium sulfate (21-0-0) at 70 lbs N per acre in the spring (21-Apr 2014) or a split application of 35 lbs N per acre in the fall (27-Sep 2013) and spring (21-Apr 2014). Plots that included packing in the soil preparation treatment were packed with a Cultipacker. The soil type was a Benson rocky silt loam and the previous crop was spring wheat.

Table 1. Agronomic field management of winter canola trial in Alburgh, VT 2013-2014.

Location	Borderview Research Farm – Alburgh, VT
Soil type	Benson rocky silt loam, 3-8% slope
Previous crop	Spring wheat
Variety	Wichita treated with Helix Xtra
Replications	3
Plot size (ft)	10 x 25
Planting equipment	Great Plains grain drill, packed with Cultipacker
Planting date	16-Aug 2013
Seeding rate (lbs ac^{-1})	6.4
Weed control	Clethodim herbicide 12 oz. ac^{-1}
Fertilizer	70 lbs N ac^{-1} Ammonium sulfate (21-0-0)
Harvest date	25-Jul 2014
Pressing dates	13-Aug 2014

Pictures to determine weed cover and canola establishment in the soil preparation treatments were taken on 27-Sep 2013 and analyzed using a computer imaging program. Canola populations, vigor (1-10 scale, 1 = weak 10 = vigorous), and heights were collected for each plot on 1-Oct 2013. Plots were sprayed with clethodim herbicide on 4-Oct 2013 at a rate of 12 oz. per acre to try and suppress volunteer wheat. The following spring populations and vigor were again measured for each plot on 21-Apr 2014. Biomass samples were collected from the plots on 20-May 2014. The samples were dried to determine biomass yield on a dry matter basis. All plots were at least 75% bloomed on 29-May 2014 and plots were harvested on 25-Jul 2014. The seed was cold-pressed with a KernKraft 40 oilseed press on 13-Aug 2014. Samples of a known weight and moisture were pressed and the oil and meal collected to measure oil content from which oil yield could be calculated.

Data were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within trials were treated as random effects, and soil amendment 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 (LSDs) at the 0.10 level of significance are shown, except where analyzed by pairwise comparison (t-test). 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 top-performing treatment in a particular column are indicated with an asterisk. In the example above, treatment C is significantly different from treatment A but not from treatment 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 treatments did not differ in the evaluated variable. 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 values evaluated variable of these treatments were significantly different from one another. The asterisk indicates that treatment B was not significantly lower than the top performing treatment C, indicated in bold.

Treatment	Variable
A	6.0
B	7.5*
C	**9.0***
LSD	2.0

RESULTS

Weather data was collected with an onsite Davis Instruments Vantage Pro2 weather station equipped with a WeatherLink data logger. Temperature, precipitation, and accumulation of Growing Degree Days (GDDs) are consolidated for the 2013-2014 growing season (Table 2). Historical weather data are from 1981-2010 at cooperative observation stations in Burlington, VT, approximately 45 miles from Alburgh, VT.

Table 2. Weather data and GDDs for winter canola in Alburgh, VT 2013-2014.

	2013					2014						
Alburgh, VT	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Average temperature (°F)	67.7	59.3	51.1	35.1	20.0	16.8	19.0	22.2	43.0	57.4	66.9	69.7
Departure from normal	-1.1	-1.3	2.9	-3.1	-5.9	-2.0	-2.5	-8.9	-1.8	1.0	1.1	-0.9
Precipitation (inches)	2.41	2.2	1.87	3.16	0.23	0.85	0.65	1.70	4.34	4.90	6.09	5.15
Departure from normal	-1.5	-1.44	-1.73	0.04	-2.14	-1.20	-1.11	-0.51	1.52	1.45	2.4	1.00
Growing Degree Days (base 32°F)	1241	896	652	144	16	31	14	25	330	789	1041	1171
Departure from normal	102	38	150	-40	16	31	14	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.

In general the 2013-2014 season was drier and cooler than normal. We saw particularly low temperatures in December and January with some extended periods with temperatures well below zero. During this time, large amounts of ice accumulated as well. There was also below average precipitation during the fall and winter of 2013 followed by a slightly above average precipitation in the spring and summer of 2014.

Soil Preparation by Fertilization Timing Interactions

No significant interactions between soil preparation method and fertilization timing were observed in any of the investigated parameters for winter canola. This indicates that the soil preparation methods were impacted similarly by fertilization timing.

Impact of Soil Preparation

Fall vigor was the only growth characteristic of winter canola that varied statistically between soil preparation methods (Table 3). The highest dry matter biomass yield, 2241 lbs per acre, was produced in the pack + drill + pack soil preparation treatment, although not statistically different from the other preparation methods. The highest vigor was 7.7 in the drilled plots which only differed statistically from the pack + drill + pack method. Interestingly, fall vigor did not appear to be related to spring survival. The highest survival rate was 43.1% in the pack + drill preparation, however this was not statistically different from other methods. The soil preparation method did not have an impact on canola establishment or weed cover. Overall, soil preparation and planting technique did not impact winter canola stand development or winter survivability.

Table 3. Growth characteristics by soil preparation method, 2013-2014.

Soil preparation	DM yield lbs ac^{-1}	Fall vigor 1-10	Fall height cm	Spring survival %	Canola %	Weeds %
Drill	2033	**7.7***	**19.8**	27.9	82.1	17.9
Drill + Pack	1649	6.3	17.5	42.7	**93.3**	**6.70**
Pack + Drill	2013	6.8	16.9	**43.1**	88.8	11.2
Pack + Drill + Pack	**2241**	5.3	17.7	36.6	93.3	6.70
LSD (.10)	NS	1.5	NS	NS	NS	NS
Trial Mean	1984	6.5	18.0	37.6	89.3	10.5

Treatments indicated in **bold** had the top observed performance.
NS- no significant difference at the .10 level.
* Varieties that did not perform significantly lower than the top performing variety in a particular column are indicated with an asterisk.

Harvest characteristics did not statistically differ between soil preparation methods (Table 4). Yields and corresponding oil yield were relatively low likely due to low survival as no treatment produced a survival rate above 50%.

Table 4. Harvest characteristics by soil preparation method, 2013-2014.

Soil preparation	Harvest moisture %	Test weight lbs bu^{-1}	Yield at 8% moisture lbs ac^{-1}	Pressing moisture %	Oil content %	Oil yield lbs ac^{-1}	Oil yield gal ac^{-1}
Drill	13.0	49.5	750	6.6	**35.7**	273	35.8
Drill + Pack	13.7	49.0	**813**	6.9	32.8	269	35.3
Pack + Drill	12.6	**49.8**	669	**6.5**	32.1	232	30.4
Pack + Drill + Pack	**12.4**	49.8	788	6.7	35.0	**281**	**36.7**
LSD (.10)	NS	NS	NS	NS	NS	NS	NS
Trial Mean	12.9	49.5	755	6.7	33.9	263.6	34.5

Treatments indicated in **bold** had the top observed performance.
NS- no significant difference at the .10 level.
* Varieties that did not perform significantly lower than the top performing variety in a particular column are indicated with an asterisk.

Impacts of Fertilization Timing

Vigor, height, and winter survival differed statistically between fertilizer application timing treatments (Table 5). Fall vigor and height were higher in the split application treatment. This makes sense as these plots received some fertilizer during establishment and therefore were able to grow more aggressively in the fall. Despite this, the dry matter biomass yield observed in the spring did not differ by application timing. In addition, winter survival was 14.5% higher in plots which received fertilizer in the spring only.

Table 5. Fall growth characteristics by fertilizer application timing, 2013-2014.

Fertilizer application timing	DM yield lbs ac^{-1}	Fall vigor 1-10	Fall height cm	Spring survival %	Canola %	Weeds %
Split	**2042**	**7.3**	**19.3**	30.3	88.4	11.2
Spring only	1925	5.8	16.6	**44.8**	**90.3**	**9.7**
LSD (.10)	NS	1.1	2.3	13.5	NS	NS
Trial Mean	1984	6.5	18.0	37.6	89.3	10.5

Treatments indicated in **bold** had the top observed performance.
NS- no significant difference at the .10 level.
* Varieties that did not perform significantly lower than the top performing variety in a particular column are indicated with an asterisk.

Although overall survival was still below 50%, these data may suggest that fall applying N fertilizer to winter canola promotes early above ground biomass production but neglects root development and possibly nutrient storage leading to lower winter survival. More research is needed to confirm this suggested relationship.

Harvest characteristics did not vary statistically by fertilizer application timing, indicating that N fertility needs of the canola were met. Oil content and yield were also not statistically different among the N fertility treatments.

Table 6. Harvest characteristics by fertilizer application timing, 2013-2014.

Fertilizer application timing	Harvest moisture %	Test weight lbs bu^{-1}	Yield at 8% moisture lbs ac^{-1}	Pressing moisture %	Oil content %	Oil yield lbs ac^{-1}	Oil yield gal ac^{-1}
Split	13.1	49.3	705	6.7	**34.7**	245	32.5
Spring only	**12.8**	**49.8**	**805**	**6.6**	33.1	**279**	**36.5**
LSD (.10)	NS	NS	NS	NS	NS	NS	NS
Trial Mean	12.9	49.5	755	6.7	33.9	264	34.5

Treatments indicated in **bold** had the top observed performance.
NS- no significant difference at the .10 level.

DISCUSSION

Canola produces a small seed and for best establishment should be planted only ¼ inch deep. This can be difficult to accomplish when soil is worked well and a grain drill is heavy. Broadcasting seed may be an alternative but poor seed to soil contact can result in poor establishment. The goal of this project was to evaluate several soil preparation and seeding methods to determine how to best establish winter canola. Based on this one year of research adequate stands were achieved by just using a grain drill. Cultipacking before or after drilling was not necessary to provide adequate seed to soil contact.

Fall vigor and height were found to be higher in winter canola that was fertilized with a split application method applying half of the total N in the fall and half the following spring. Despite this early vigorous growth achieved with fall N fertilizer, winter survival in split application plots was 14.5% lower than applying all N in the spring. It is possible that fertilizing winter canola in the fall may lead to more biomass production during the fall, but may hinder the plants ability to overwinter. Yield did not differ regardless of N fertility approach indicating that the plants received adequate nutrition. Although more research is needed to further investigate this relationship, it could mean farmers would have more flexibility in timing of fertilizing winter canola, especially in the event of adverse weather or other timing challenges in the fall, without sacrificing yield. In addition, treatment differences may not have been observed due to extremely harsh winter conditions that resulted in significant stand losses.

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