2015

Flax Planting Date Trial

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NORTHWEST CROPS & SOILS PROGRAM

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CULTIVATING HEALTHY COMMUNITIES

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INTRODUCTION

Early seeding of flax generally produces the best yields and quality. Moderate temperatures and sufficient soil moisture during flowering and seed development are important for high yield and quality, and these conditions are more likely to occur with early seeding. There is little risk of frost damage with flax. Newly emerged flax can withstand temperatures down to 27^{o} F, while plants past the two leaf stage can withstand temperatures as low as 18^{o} F. Flax has small leaves and is relatively short, which naturally makes it less competitive against weeds. Early planted flax will establish before the majority of summer weed species. This could potentially help reduce weed competition. This trial was initiated to determine optimum flax planting dates to maximize yields in the Northeast.

MATERIALS AND METHODS

One variety of flax, Rahab 94, was planted on four planting dates every week from 19-Apr to 11-May. This trial was conducted at Borderview Research Farm in Alburgh, VT. The experimental design was a randomized complete block with four replications. Main plots were the weekly planting dates from 19-Apr to 11-May. Plot size was 5' x 20'. General plot management is listed in Table 1. The previous crop was barley. The field was disked and spike tooth harrowed prior to planting. Plots were seeded at a seeding rate of 800 live seeds per square meter.

Populations were determined on 28-May by counting plants in two one-foot sections and vigor was measured. Vigor was measured by doing a visual assessment of each plot and using a 1=low through 5=high scale. Weed cover was determined on 10-Jun as a percent of total plant cover using the web based IMAGING crop response analyzer. Digital images were taken with a compact digital camera, Canon PowerShot G12 (Melville, NY) (10.4 Megapixels). One picture covering approximately 1/2 m^2 was taken in each plot before weeding and one picture was taken after weeding. Digital images were analyzed with the automated imaging software, which was programmed in MATLAB (MathWorks, Inc., Natick, MA) and later converted into a free web-based software (www.imaging-crop.dk). The outcome of the analysis is a leaf cover index, which is the proportion of pixels in the images determined to be green. Total plant cover (1st picture) – flax cover (second picture)/ total plant cover = weed cover (%). Plant heights were measured on 6-Aug.

Flax plots were harvested with an Almaco SPC50 small plot combine on 10-Aug and 23-Aug 2015 and swathed a few days prior to harvest. The harvest area was 5' x 20'. Seed was cleaned with a small Clipper M2B cleaner (A.T. Ferrell, Bluffton, IN). Oil from a known volume of each seed sample was extruded on 2-Jan with a Kern Kraft Oil Press KK40 (at 120°F and 40 RPM), and the oil quantity was measured to calculate oil content. A subsample of flax meal from each plot was sent to Cumberland Valley Analytics in Hagerstown, MD for wet chemistry analysis of crude protein (as a percentage of dry matter content) and fat (as a percentage of dry matter content, calculated with ether extraction). The oil was also analyzed with an FOSS NIRS (Near Infrared Reflectance Spectroscopy) DS2500 Feed and Forage analyzer (Eden Prairie, MN) at the University of Vermont Cereal Testing Lab (Burlington, VT). Results were analyzed with an analysis of variance in SAS (Cary, NC). The Least Significant Difference (LSD) procedure was used to separate cultivar means when the F-test was significant ($p<0.10$).

Table 1. General plot management, 2015.

Trial Information	Borderview Research Farm Alburgh, VT
Soil Type	Benson rocky silt loam 8-15% slope
Previous crop	Barley
Varieties	Rahab 94
Planting dates	19-Apr, 28-Apr, 4-May, 11-May
Harvest date	10-Aug and 23-Aug
Seeding rate	800 live seeds m^2
Tillage methods	Disk and spike tooth harrow

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 (i.e. yield). Least Significant differences (LSD's) at the 10% level of probability 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 in 9 out of 10 chances that there is a real difference between the two varieties. Treatments that were not significantly lower in performance than the highest value in a particular column are indicated with an asterisk. In the example below, A is significantly different from C but not from B. The difference between A and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these varieties did not differ in yield. The difference between A and C is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yields of these varieties were significantly different from one another. The asterisk indicates that B was not significantly lower than the top yielding variety.

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

RESULTS AND DISCUSSION

Seasonal precipitation and temperature recorded at a weather station in Alburgh, VT are shown in Table 2. From April to September, there was an accumulation of 4582 Growing Degree Days (GDDs) in Alburgh which is 101 GDDs more than the 30-year average. Flax needs 1603 GDDs to reach maturity.

Table 2. Seasonal weather data collected in Alburgh, VT, 2015.

Alburgh, VT	April	May	June	July	August
Average temperature (°F)	43.4	61.9	63.1	70.0	69.7
Departure from normal	-1.4	5.5	-2.7	-0.6	0.9
Precipitation (inches)	0.09	1.94	6.42	1.45	0.00
Departure from normal	-2.73	-1.51	2.73	-2.70	-3.91
Growing Degree Days (base 32°F)	352	930	938	1188	1184
Departure from normal	-32	174	-76	-10	45

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.

Figure 1. Flax seedlings recently emerged, Alburgh, VT, 2015.

Flax plot characteristics and harvest yields are presented by planting date in Table 3. Weeds covered on average 27% of the plots. There was no significant difference in weed pressure as a result of earlier planting dates. It should be noted that all plots were hand weeded once prior to flowering. All varieties fell within the range of average flax heights (12-36 inches). Vigor was significantly higher for the first three planting dates. There were no differences in plant populations between the planting dates. On average, the germination rate was approximately 85%. This indicates that early planting dates had equivalent germination rates as compared to later planting dates.

Yield was significantly higher for the 19-Apr and 28-Apr planting dates (Table 3 and Figure 2). It is important to note that flax yields were far lower than expected. Harvesting flax can be difficult since the seed is very light and easily lost through the back of the combine. Swathing, to allow proper dry down before harvest and minimizing weeds, can help to combine more effectively. The flax was swathed but there was inadequate time to dry the crop prior to combining. An impending rain event led to a less than ideal harvest that led to seed losses. Regardless, the April planting dates led to higher yields and oil quality

Table 3. Plot characteristics and harvest yield of flax planted on four planting dates.

Planting date	Height	Flax population	Vigor	Weed cover	Yield
	inches	plants m^2	1 low-5 high	%	lbs ac^{-1}
19-Apr	27.0	694	3.3*	21	**649***
28-Apr	27.4	603	**3.5***	30	553*
4-May	**29.2**	**718**	3.0*	22	356
11-May	26.5	660	2.1	**34**	358
Trial Mean	**27.5**	**669**	**3.0**	**27**	**479**
LSD (p<0.10)	**NS**	**NS**	**0.8**	**NS**	**126**

*Varieties with an asterisk are not significantly different than the top performer in **bold**.
NS – No significant difference amongst varieties.

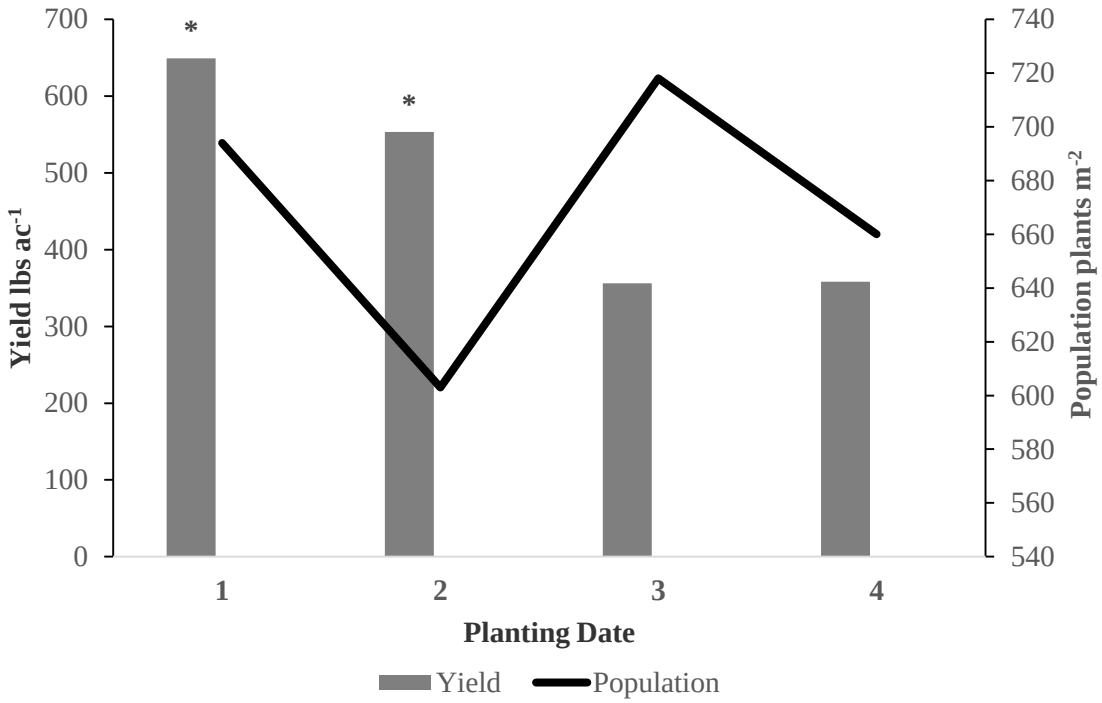

Figure 2. Flax yield by planting date, Alburgh, VT, 2015. Yields with an asterisk* did not perform significantly lower than the top performer.

Characteristics of oil extruded from flax grown on each planting date are listed in Table 4. Free fatty acids and insoluble impurities were not impacted by planting date. Free fatty acids form when oil breaks down, and represents a measure of the potential for oil to go rancid and develop an odor. Insoluble impurities are a measure of sediment. The iodine value reflects the degree of unsaturation of an oil. The higher the number, the more unsaturated the oil is (the more double bonds). Earlier planting dates had higher iodine values when compared to the May planting dates. The percent oil content was significantly higher for the 19-Apr and 28-Apr planting dates.

Table 4. Flax oil characteristics from four planting dates grown in Alburgh, VT, 2015.

Planting date	Oil	Free fatty acids	Insoluble impurities	Iodine value
	%	%	%	%
19-Apr	35.1*	8.1	1.7	160*
28-Apr	**35.8***	7.6	**1.8**	**161***
4-May	31.6	**9.1**	1.6	154
11-May	29.7	8.9	1.6	155
Trial mean	**33.0**	**8.4**	**1.7**	**158**
LSD (p<0.1)	**0.03**	**NS**	**NS**	**4.1**

*Varieties with an asterisk are not significantly different than the top performer in **bold**.
NS – No significant difference amongst varieties.

The meal from the 4-May and 11-May planting dates were significantly higher in fat (Table 5). This may indicate that the moisture content of later planting dates was higher leading to lower levels of oil extrusion. All varieties had similar crude protein proportions. The average crude protein of the flax meal was 35.2% and the average fat content was 12.4%.

Table 5. Flax meal characteristics from four planting dates grown in Alburgh, VT, 2015.

Planting date	Crude protein	Fat
	% dry matter	% dry matter
19-Apr	35.9	11.7
28-Apr	34.9	12.0
4-May	34.7	12.8*
11-May	35.4	**13.0***
Trial mean	**35.2**	**12.4**
LSD (p<0.1)	**NS**	**0.8**

*Varieties with an asterisk are not significantly different than the top performer in **bold**.
NS – No significant difference amongst varieties.

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