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2015

Flax Variety Trial

Heather Darby
University of Vermont, heather.darby@uvm.edu

Abha Gupta
University of Vermont

Lily Calderwood
University of Vermont

Erica Cummings
University of Vermont

Julian Post
University of Vermont

See next page for additional authors

Authors
Heather Darby, Abha Gupta, Lily Calderwood, Erica Cummings, Julian Post, and Sara Ziegler

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Dr. Heather Darby, UVM Extension Agronomist
Abha Gupta, Lily Calderwood, Erica Cummings, Julian Post, and Sara Ziegler
UVM Extension Crops and Soils Technicians
802-524-6501

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2015 FLAX VARIETY TRIAL

Dr. Heather Darby, University of Vermont Extension
heather.darby[at]uvm.edu

Flax *(Linum usitatissimum* L.*)* is a multi-purpose crop grown for its fiber, oil (linseed oil), and meal. The importance of flax as a major crop in the United States dropped drastically in the 1980's when latex paints replaced linseed oil based paint. Recently there has been renewed interest in flax, both for human consumption and for animal feed, for its high levels of heart-healthy omega-3 fatty acids. This variety trial was established to determine what flax varieties can grow and thrive in Vermont's climatic conditions.

MATERIALS AND METHODS

Ten flax varieties were planted at Borderview Research Farm in Alburgh, VT on 19-Apr 2015. General plot management is listed in Table 1. The experimental design was a randomized complete block replicated 4 times. Plot size was 5' x 20'. The previous crop was sunflowers. The field was disked and spike tooth harrowed prior to planting. Plots were seeded with a Kincaid Cone Seeder at a seeding rate of 800 live seeds per square meter.

Vigor was measured on 6-May by doing a visual assessment of each plot and using a 1=low through 5=high scale. Populations were measured on 28-May and determined by taking two 1 foot counts per plot. On 6-Aug plant heights were measured and lodging was noted as not at all significant. Flax plots were harvested with an Almaco SP50 small plot combine on 10-Aug and swathed a few days prior. 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 2016 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). The varieties of flax grown are listed in Table 2. Results were analyzed with an analysis of variance or a Tukey-Kramer test of significance 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	Sunflowers
Planting date	19-Apr
Harvest date	10-Aug
Seeding rate	800 live seeds m^2
Tillage methods	Disk and spike tooth harrow

Table 2. Flax varieties, origin, year released and seed color, 2015.

Variety	Origin	Year released	Seed color
Carter	North Dakota	2004	Yellow
Cathay	North Dakota	1998	Brown
Gold ND	North Dakota	2014	Yellow
Neche	North Dakota	1988	Brown
Nekoma	North Dakota	2002	Brown
Omega	North Dakota	1989	Yellow
Pembina	North Dakota	1998	Brown
Rahab	South Dakota	1994	Brown
Webster	South Dakota	1998	Brown
York	North Dakota	2002	Brown

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 3. 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 GDD to reach maturity.

Table 3. 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.

Flax yields and plot characteristics are listed in Table 4. All varieties fell within the range of average flax heights (12-36 inches). Plant populations showed significant differences between flax varieties with Pembina having the highest population of 619 plants m^2. However those differences did not relate to yield differences when the plots were harvested on 10-Aug. Flax yields ranged from 383 to 811 lbs ac^{-1} (Table 4 and Figure 2), with no significant difference between varieties. Yields were much lower than typical yields from the mountain West, where flax is normally grown. Yields from variety trials in North Dakota range from 1200-2100 lbs ac^{-1}. 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 of the crop and weeds before harvest, can reduce yield losses through the combine. The plots in this experiment were swathed to allow the crop to dry prior to harvest. Unfortunately, a predicted rain event forced a harvest before the crop was completely dry. This likely led to significant yield losses.

Figure 1. Flax plots swathed on7-Aug, Alburgh, VT.

Table 4. Plot characteristics and yield of 10 flax varieties, Alburgh, VT, 2015.

Variety	Height	Population	Vigor	Test weight	Yield
	inches	plants m^2	1 low- 5 high	lbs bu^{-1}	lbs ac^{-1}
Omega	26.5	570	3.0	54.3	**811**
Gold	**30.5***	368	3.5	52.8	798
Neche	28.4*	587	2.5	52.8	781
Carter	26.9*	576	3.0	54.0	713
Rahab	26.6	775	2.8	**53.8**	704
York	27.5*	583	3.0	53.3	651
Pembina	26.5	**619**	2.5	51.9	633
Nekoma	26.4	447	3.3	53.5	578
Webster	26.1	504	2.8	52.8	437
Cathay	27.0*	560	3.3	52.9	383
Trial mean	**27.3**	**559**	**3.0**	**53.2**	**649**
LSD (p<0.1)	**1.5**	**7**	**NS**	**NS**	**NS**

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

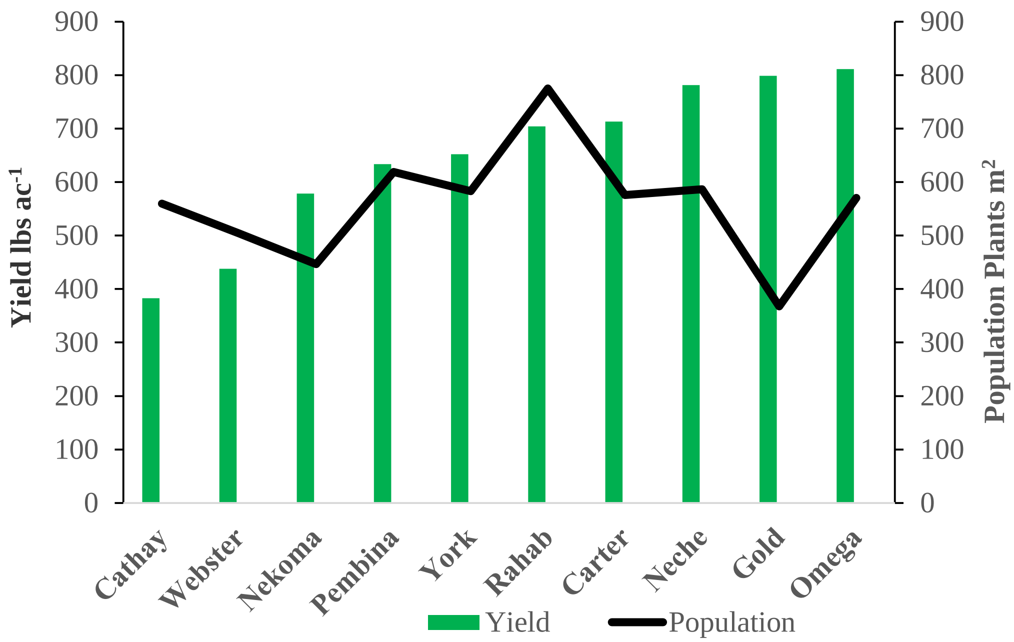

Figure 2. Average yields and plant populations for flax varieties, Alburgh, VT, 2015.

Characteristics of oil extruded from each flax variety are listed in Table 5. 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). Overall, there was no significant difference amongst the varieties for oil content or other characteristics except for iodine values.

Table 5. Flax oil characteristics of 10 varieties, Alburgh, VT, 2015.

Varieties	Oil	Free fatty acids	Insoluble impurities	Iodine value
	%	%	%	%
Gold	**33.7**	7.8	1.7	160
Nekoma	33.7	**8.7**	1.6	164
Cathay	33.5	8.2	1.7	161
Carter	33.2	7.7	1.8	**166***
Rahab	32.8	7.9	1.7	165*
York	32.3	8.1	1.8	164*
Neche	30.6	7.7	1.8	164
Omega	29.7	7.7	1.8	162
Pembina	29.8	8.1	1.7	161
Webster	28.9	8.0	1.8	162
Trial mean	**31.8**	**8.0**	**1.7**	**163**
LSD (p<0.1)	**NS**	**NS**	**NS**	**1.6**

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

There was no significant difference in meal characteristics among the 10 flax varieties (Table 6). All varieties had similar meal characteristics. The average crude protein of the flax meal was 36.3% and the average fat content was 14.8%.

Table 6. Flax meal characteristics of ten varieties grown in Alburgh, VT, 2015.

Variety	Crude protein	Fat
	% DM	% DM
Carter	37.5	14.1
Cathay	36.7	14.3
Gold	36.3	15.4
Neche	36.0	16.0
Nekoma	37.4	12.8
Omega	35.6	14.8
Pembina	35.6	16.5
Rahab	37.4	12.2
Webster	34.7	17.4
York	36.4	14.4
Trial mean	**36.3**	**14.8**
LSD (p<0.1)	**NS**	**NS**

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