2014

Sunflower Variety Trial

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

Sara Ziegler
University of Vermont

Erica Cummings
University of Vermont

Susan Monahan
University of Vermont

Julian Post
University of Vermont

NORTHWEST CROPS & SOILS PROGRAM

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Dr. Heather Darby, UVM Extension Agronomist
Sara Ziegler, Erica Cummings, Susan Monahan, and Julian Post
UVM Extension Crops and Soils Technicians
(802) 524-6501

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2014 SUNFLOWER VARIETY TRIAL

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

Sunflowers are being grown in the Northeast for their potential to add value to diversified operations as fuel, feed, fertilizer, and an important rotational crop. Some sunflower varieties have also been gaining popularity for their potential to produce high quality edible oil. The major sunflower production areas are in the northern Great Plains, so seed production and agronomic management guidelines generally come from this region. Identifying varieties of sunflower that will perform well in Vermont's climate is essential to viable crop production. With this in mind, UVM Extension's Northwest Crop and Soil Program has been evaluating sunflower varieties for performance in our microclimate.

MATERIALS AND METHODS

A trial was initiated at Borderview Research Farm in Alburgh, VT in 2014 to assess the yield and quality of twenty-one commercially-available sunflower varieties of varying relative maturity (RM) (Table 1). The experimental design was a randomized complete block with four replications and with twenty-one varieties as treatments.

Table 1. Characteristics of 21 sunflower varieties, sunflower variety trial, Alburgh, VT, 2014.

Variety	Company	RM	Traits	Treatment	Seed Size
306	Croplan	88	NuSun	CruiserMaxx	3
3080	Croplan	90	NuSun	CruiserMaxx	2
3433	Syngenta	92	NuSun	CruiserMaxx	3
3733	Syngenta	97	NuSun	CruiserMaxx	4
3845	Syngenta	96		CruiserMaxx, Bion® 500FS	3
7111	Syngenta	89	Clearfield	CruiserMaxx	3
7120	Syngenta	92		CruiserMaxx	3
432E	Croplan	89	DuPont ExpressSun	CruiserMaxx	4
548CL	Croplan	93	Clearfield	CruiserMaxx	3
559CL	Croplan	95	Clearfield	CruiserMaxx, Bion®	2
8H288CLDM	Mycogen	92	Clearfield	Maxim 4FS, Apron XL, Dynasty 100FS, Cruiser 5FS	2
8N270CLDM	Mycogen	90	NuSun, Clearfield	Maxim 4FS, Apron XL, Dynasty 100FS, Cruiser 5FS	4
8N358CLDM	Mycogen	94	NuSun, Clearfield	Maxim 4FS, Apron XL, Dynasty 100FS, Cruiser 5FS	2
Badger	NuSeed	Medium to Medium-late	Clearfield	CruiserMaxx, Bion® 500FS	4
Camaro II	NuSeed	Medium	NuSun, Clearfield	CruiserMaxx	4
Cobalt II	NuSeed	Early	Clearfield	CruiserMaxx, Bion® 500FS	4
Daytona	Blue River Hybrids	Medium	Organic	UNTREATED	4
Durango	NuSeed	Medium-full to Full	NuSun, ExpressSun		4
Hornet	NuSeed	Medium	Clearfield	CruiserMaxx, Bion® 500FS	4
Talon	NuSeed	Medium	NuSun, ExpressSun	CruiserMaxx	4
Torino	NuSeed	Medium-Full	NuSun, Clearfield	CruiserMaxx	4

Traits: Clearfield® = tolerant of Beyond® ammonium salt of imazamox herbicideExpressSun® = tolerant of Express® tribenuron methyl herbicide; NuSun® = 55-75% oleic acid.

Treatments: Apron XL® = metalaxyl-M and S-isomer; Cruiser Maxx® = thiamethoxam, azoxystrobin, fludioxonil, mefnoxam; Cruiser 5FS = thiamethoxam; Dynasty100FS® = azoxystrobin; Maxim 4FS® = fludioxonil; Bion® and Bion 500FS® = acibenzolar-s-methyl.

Trial management details are in Table 2. The soil was a Benson rocky silt loam. The previous crop was corn grown conventionally with a rye cover crop. Each plot was 5' wide (2 rows of sunflowers on 30" rows) and 30' long. The seedbed was prepared with a spring disc, harrow, and spike tooth harrow to finish. The pre-plant herbicide Trust® (trifluralin) was applied on 16-May at a rate of 1.5 pints per acre. Sunflowers were planted on 31-May with a John Deere 1750 MaxEmerge corn planter fitted with sunflower finger pickups. Seeding rate was 35,000 seeds per acre. At planting, a 10-20-20 starter fertilizer was applied at a rate of 250 lbs. per acre. Sunflowers emerged by 9-Jun and were cultivated on 23-Jun and 3-Jul. Sunflowers were thinned to a population of 30,000 plants per acre on 21-Jul.

Table 2. Agronomic field management of a sunflower variety trial, Alburgh, VT, 2014.

Location	Borderview Research Farm – Alburgh, VT
Soil type	Benson rocky silt loam, 8-15% slope
Previous crop	Corn with rye cover crop
Varieties	21
Replications	4
Plot size (ft)	5 x 30
Planting equipment	John Deere 1750 MaxEmerge planter
Sunflower planting rate (seeds ac^{-1})	35,000 seeds per acre
Row width (in.)	30
Weed control	Cultivated 23-Jun and 3-Jul
Sunflower planting date	31-May
Starter fertilizer (at planting)	250 lbs. ac^{-1}, 10-20-20
Sunflower harvest date	14-Oct
Pressing dates	30-Dec

Plant stand characteristics including plant population, lodging, disease incidence, bird damage, height, and head width were measured just prior to harvest. Bird damage was visually estimated with a standard protocol from the National Sunflower Association. Disease incidence was measured by scouting ten consecutive plants in each plot and noting white mold at specific locations on the plant, including head, stalk and base. Issues with white mold (*Sclerotinia sclerotiorum*), a fungus which can overwinter in the ground and spread quickly, especially in wet seasons, have proven problematic in the Northeast in the past. Plots were harvested on 14-Oct with an Almaco SPC50 plot combine with a 5' head and specialized sunflower pans made to collect sunflower heads. At harvest, test weight and seed moisture were determined for each plot with a Berckes Test Weight Scale and a Dickey-john M20P moisture meter. Seed yields were adjusted to 13% moisture before reporting. Oil from a known volume of each seed sample was extruded on 30-Dec with a Kern Kraft Oil Press KK40 (at 120°F and 40 RPM), and the oil quantity was measured to calculate oil content. Oil yield (in lbs. per acre and gallons per acre) was adjusted to 10% pressing moisture and reported**.**

Data were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within the trial were treated as random effects and hybrids were treated as fixed. Mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was

considered significant ($p<0.10$). Where data were missing, a pair-wise comparison (Tukey-Kramer) was used to determine significant differences between treatments ($p<0.10$).

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 treatments (i.e. 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 (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. In the following example, 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 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 treatments were significantly different from one another. The asterisk indicates that treatment B was not significantly lower than the top yielding treatment C, indicated in bold.

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

RESULTS AND DISCUSSION

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 2014 growing season (Table 3). Historical weather data are from 1981-2010 at cooperative observation stations in Burlington, VT, approximately 45 miles from Alburgh, VT.

Table 3. Consolidated weather data and GDDs for sunflower, Alburgh, VT, 2014.

Alburgh, VT	June	July	August	September	October
Average temperature (°F)	66.9	69.7	67.6	60.6	55.0
Departure from normal	1.1	-0.9	-1.2	0.0	6.8
Precipitation (inches)	6.09	5.15	3.98	1.33	2.00
Departure from normal	2.40	1.00	0.07	-2.31	-1.60
Growing Degree Days (base 44°F)	681	799	736	501	142
Departure from normal	27	-27	-31	3	12

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, it was slightly cooler and wetter than average in the spring of 2014. In June 2014, there were 2.40 more inches of precipitation than normal. After June, however, the summer was slightly drier than normal, with an average of 2.84 fewer inches of rainfall between July and October. Growing degree days

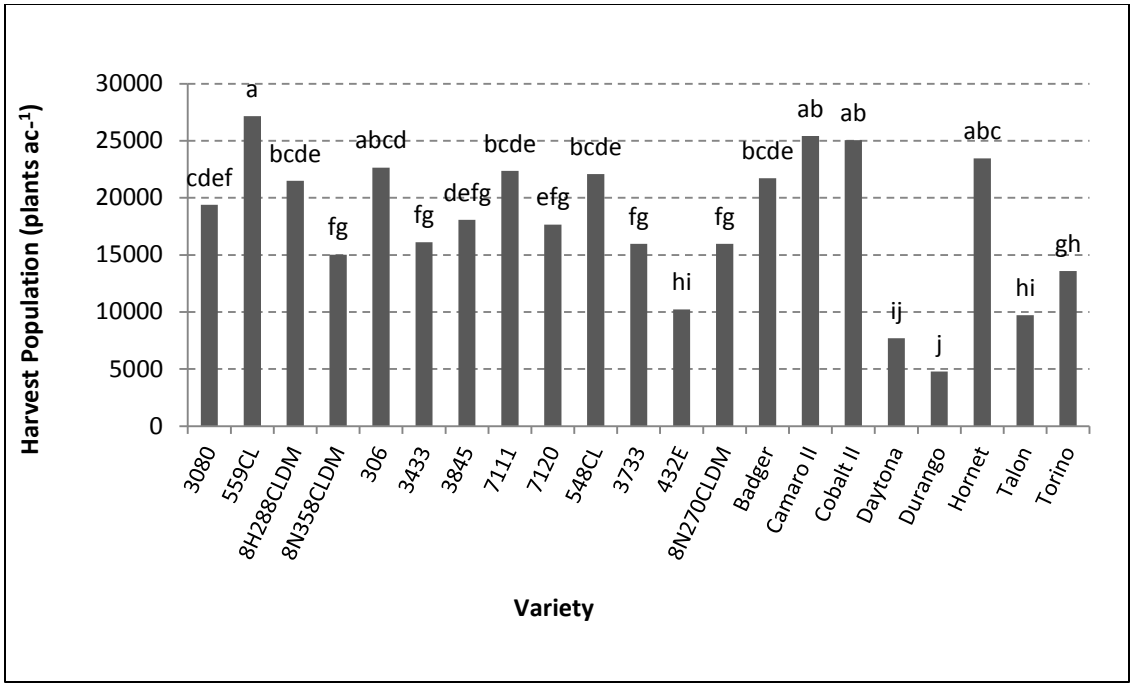
are calculated at a base temperature of 44°F for sunflowers. Between the months of planting and harvesting, there were an accumulated 2859 GDDs for sunflowers, 17 fewer than the 30-year average.
Bloom dates of the sunflower varieties were monitored and the average bloom date recorded. Bloom dates ranged from 4-Aug (65 days after planting) to 14-Aug (75 days after planting) (Table 4). The bloom dates were similar to last year's which ranged from 6-Aug (67 days after planting) to 13-Aug (74 days after planting).

Table 4. Average bloom dates by variety
Alburgh, VT, 2014

Variety	Average bloom date	Days after planting
306	5-Aug	66
3080	6-Aug	67
3433	8-Aug	69
3733	8-Aug	69
3845	8-Aug	69
7111	4-Aug	65
7120	7-Aug	68
432E	5-Aug	66
548CL	8-Aug	69
559CL	7-Aug	68
8H288CLDM	5-Aug	66
8N270CLDM	4-Aug	65
8N358CLDM	6-Aug	67
Badger	5-Aug	66
Camaro II	7-Aug	68
Cobalt II	6-Aug	67
Daytona	8-Aug	69
Durango	14-Aug	75
Hornet	10-Aug	71
Talon	5-Aug	66
Torino	10-Aug	71

The twenty-one varieties evaluated in the 2014 sunflower variety trial were statistically different from one another in yield and quality indicators (Table 5). Plant populations varied widely and were well below the target population of 28 to 30,000 plants per acre (Figure 1). Plant stands could have been reduced by excessive rain in June or damaged by successive cultivation. Extremely low populations for the variety Durango may have been related to a planter malfunction.

Figure 1. Harvest population of 21 sunflower varieties, Alburgh, VT 2014



Treatments that share a letter are not statistically different (p=0.10).

Table 5. Plant stand characteristics and pest damage on 21 sunflower varieties, Alburgh, VT, 2014.

Variety	Harvest population	Lodging	Sclerotinia incidence			Bird damage	Plant height	Head width
	plants ac^{-1}	%	Head rot %	Stalk rot %	Base rot %	%	cm	cm
306	22651*	12.5	2.5*	0.0*	0.0*	17.9	151	13.4
3080	19384	7.5*	5.0*	0.0*	0.0*	7.80*	143	13.1
3433	16117	17.5	0.0*	0.0*	0.0*	14.5*	144	16.5*
3733	15972	0.0*	2.5*	0.0*	0.0*	2.10*	142	14.0
3845	18077	**0.0***	0.0*	0.0*	0.0*	5.00*	146	11.8
7111	22361	2.5*	7.5	2.5*	2.5	21.1	126	13.9
7120	17642	5.0*	5.0*	0.0*	0.0*	10.3*	147	12.4
432E	10237	0.0*	0.0*	2.5*	0.0*	31.4	135	**17.9***
548CL	22070	0.0*	0.0*	0.0*	0.0*	22.7	**167***	11.9
559CL	**27152***	15.0	7.5	2.5*	0.0*	19.3	163*	12.4
8H288CLDM	21490	7.5*	2.5*	0.0*	0.0*	22.7	146	12.2
8N270CLDM	15972	5.0*	5.0*	5.0	0.0*	17.9	138	15.5*
8N358CLDM	15028	2.5*	0.0*	0.0*	0.0*	4.30*	136	14.8
Badger	21707	5.0*	5.0*	0.0*	0.0*	22.9	147	13.9
Camaro II	25410*	0.0*	2.5*	0.0*	0.0*	16.6	164*	11.9
Cobalt II	25047*	2.5*	0.0*	0.0*	0.0*	5.00*	148	11.6
Daytona	17696	2.5*	0.0*	2.5*	0.0*	**0.00***	109	16.9*
Durango	4792	0.0*	0.0*	0.0*	0.0*	2.30*	105	17.0*
Hornet	23450*	7.5*	0.0*	0.0*	0.0*	6.50*	142	11.8
Talon	19728	2.5*	7.5	2.5*	0.0*	8.7*	120	14.7
Torino	13576	2.5*	**0.0***	**0.0***	**0.0***	1.7*	139	16.1*
LSD (0.10)	4764	9.1	6.0	3.9	1.3	14.6	13.3	2.5
Trial mean	17884	4.6	2.5	0.8	0.12	12.4	141	14.0

Treatments in **bold** were top performers for the given variable.
*Treatments marked with an asterisk did not perform statistically worse than the top-performing treatment (p=0.10).

Lodging was statistically impacted by variety; overall, an average of 9.1% of sunflower plants lodged. Six varieties (3733, 3845, 432E, 548CL, Camaro II, and Durango) had 0% lodging. Lodging was not always related to plant height. The incidence of sclerotinia white mold was statistically different by variety for head rot, stalk rot, and base rot. However, the sunflowers had low disease incidence in 2014. Ten varieties had 0% sclerotinia head rot. The incidence of stalk rot was 0% for fifteen varieties. Twenty varieties had 0% sclerotinia base rot. The only variety with base rot was 7111.

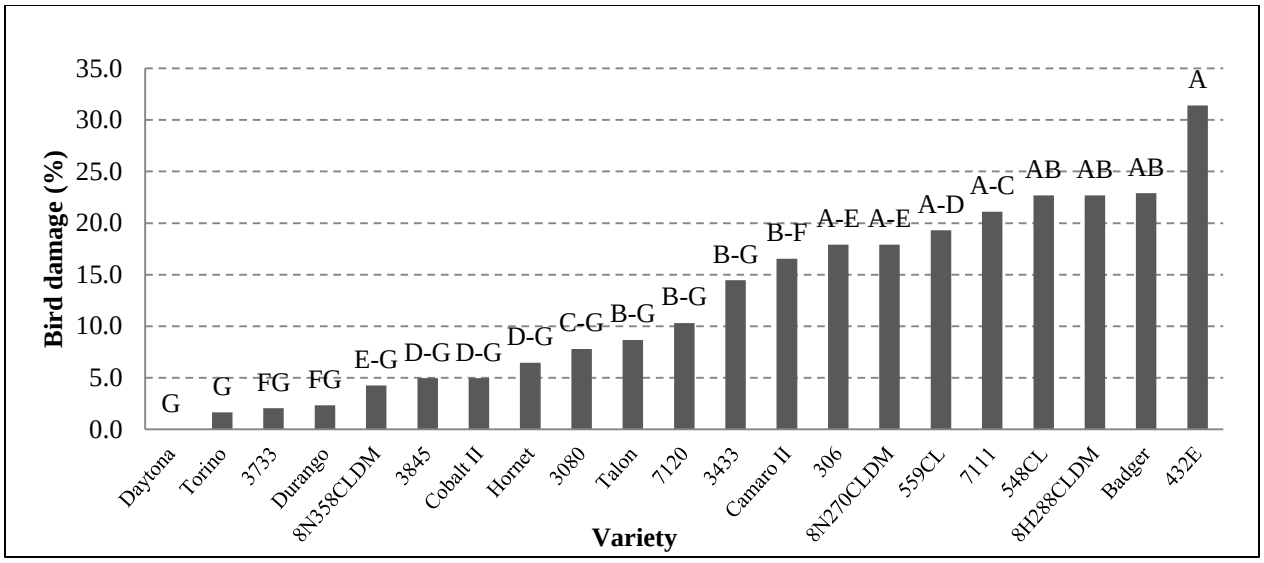


Figure 2. Bird damage by sunflower variety, Alburgh, VT, 2014. Treatments that share a letter were not significantly different from one another (p=0.10).

Bird damage varied significantly by variety (Table 5; Figure 2). One variety (Daytona) had 0% bird damage, although this did not statistically differ from 11 other varieties. Overall, the average bird damage was 14.6%, with the greatest damage (31.4%) in the variety 432E. Last year, 432E had the greatest bird damage as well. Some of the higher bird damage rates may have been related to the height of the varieties. Plant height varied significantly by variety; the tallest plants (166.5 cm) were of the variety 548CL, but this was not statistically taller than the varieties 559Cl or Camaro II. Head width was also statistically impacted by variety. 432E had the widest head at 17.9 cm, however this was not significantly different than five other varieties (3433, 8N270CLDM, Daytona, Durango, or Torino).

Harvest moisture differed significantly by variety (Table 6). The trial average was 13.7% moisture at the time of harvest (14-Oct). The highest moisture was found in the variety Durango (20.0%), but this was not significantly different than two other varieties (Daytona and Torino). The lowest moisture was found in Badger (10.5%) which did not statistically differ from eight other varieties. Test weight was similar for all varieties except 432E, Badger, and Talon which produced test weights under 27 lbs per bushel the industry standard.

Table 6. Yield and quality of 21 sunflower varieties, Alburgh, VT, 2014.

Variety	Harvest moisture	Test weight	Seed yield at 13% moisture	Pressing moisture	Oil content	Oil yield at 10% moisture	
	%	lbs. bu^{-1}	lbs. ac^{-1}	%	%	lbs. ac^{-1}	gal ac^{-1}
306	14.4	28.8*	2262	5.0*	**34.2***	753*	98.7*
3080	12.0*	28.3*	2304	4.8*	31.1*	697	91.3
3433	11.7*	28.8*	1742	5.3	32.3*	542	71.0
3733	12.5*	27.5*	2658*	5.0*	32.7*	847*	111.0*
3845	12.5*	28.6*	1789	5.0*	28.7	495	64.8
7111	13.2	28.3*	2131	5.1	27.5	566	74.1
7120	12.5*	28.3*	2161	5.1	33.6*	706	92.5
432E	14.7	27.0	1278	5.2	30.6*	379	49.6
548CL	12.5*	28.9*	2111	5.1	33.6*	688	90.1
559CL	13.2	28.1*	2980*	4.9*	31.7*	**940***	**123.1***
8H288CLDM	12.2*	28.1*	2519*	4.9*	28.7	701	91.8
8N270CLDM	13.4	27.8*	1967	5.2	27.5	527	69.1
8N358CLDM	13.7	27.9*	2120	5.0*	24.8	573	75.0
Badger	**10.5***	25.9	2162	**4.7***	29.6	619	81.0
Camaro II	12.9	**29.3***	2913*	5.4	32.2*	912*	119.4*
Cobalt II	12.9	28.3*	2399	5.1	26.2	602	78.8
Daytona	18.1	28.1*	1467	5.4	25.5	371	48.5
Durango	20.0	29.0*	784	5.5	25.9	202	26.5
Hornet	15.4	27.6*	**3088***	5.1	31.0*	924*	121.0*
Talon	10.9*	25.3	1285	5.0*	27.0	336	44.0
Torino	18.4	27.9*	2462*	5.3	30.1*	703	92.1
LSD (0.10)	2.3	2.2	645	0.3	4.5	226	29.6
Trial mean	13.7	28.0	2123	5.1	29.7	623	81.6

Treatments in **bold** were top performers for the given variable.
*Treatments marked with an asterisk did not perform statistically worse than the top performing treatment (p=0.10).

Overall, seed yields were high, averaging over 2000 lbs per acre. Seed yields varied significantly by variety, with the greatest yield from the variety Hornet (3088 lbs per acre). This was not statistically greater than 3733, 559CL, 8H288CLDM, Camaro II, or Torino (Table 6). The lowest yield of 784 lbs per acre was found in the variety Durango which also had the lowest harvest population.

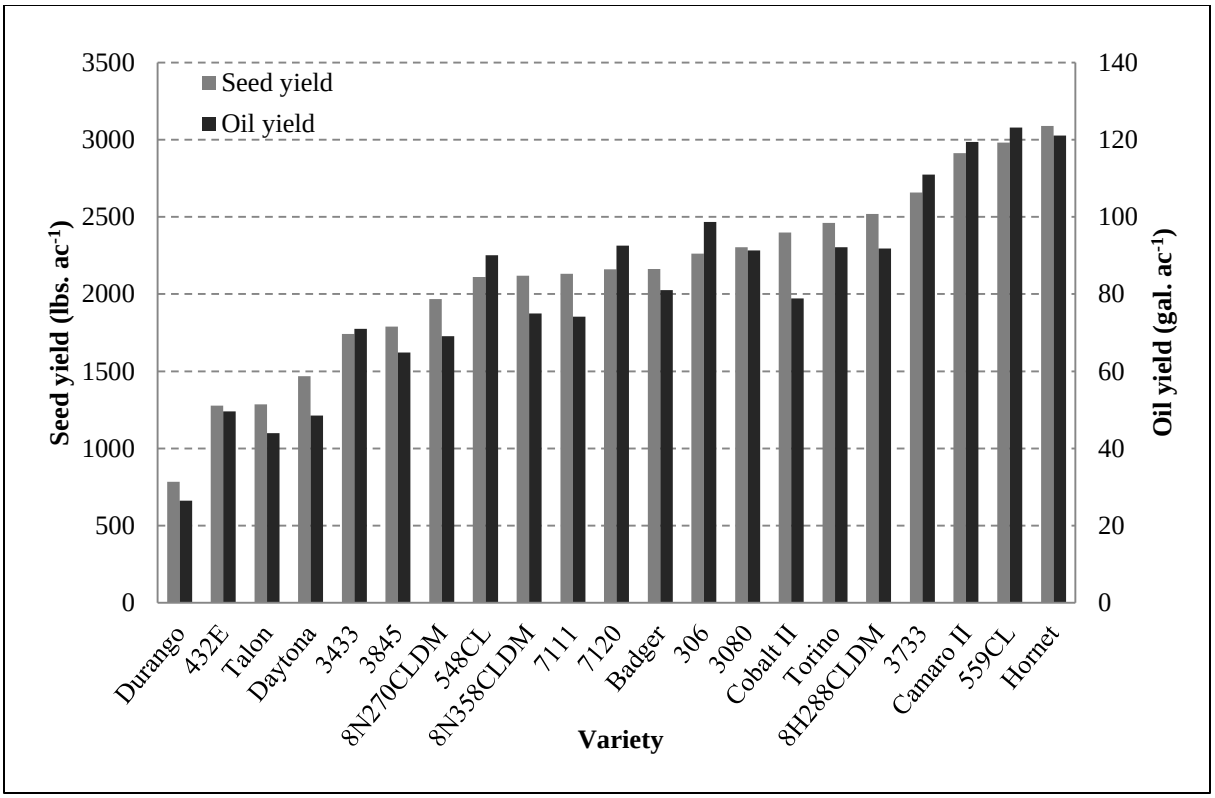


Figure 3. Seed and oil yields of 21 commercially-available sunflower varieties, Alburgh, VT, 2014.

Oil content, averaging 29.7%, was highest in variety 306 (34.2%). This was not statistically greater than the oil content in ten other varieties. This is lower than the average oil content for sunflower oil which is 35-40%. Oil yield, a calculation based on both seed yields and oil content, was statistically significant by variety. Oil yield averaged 623 lbs, or 81.6 gallons, per acre. Oil yields were highest in 559CL, though not statistically greater than the varieties 306, 3733, Camaro II, or Hornet (Figure 3).

Overall performance of sunflower varieties in this trial was high with most varieties yielding over 1800 lbs per acre. In addition, there was low disease incidence, lodging, and bird damage for most varieties and this obviously translated into high seed yields. The overall success of this trial suggests strong potential for sunflower as a viable crop in this region and has provided insight into promising varietal selections.

ACKNOWLEDGEMENTS

This project was made possible through an ongoing collaboration with Vermont Sustainable Jobs Fund. Special thanks goes to Roger Rainville and the staff at Borderview Research Farm for their generous help with this research. We would also like to acknowledge Connor Burke, Lily Calderwood, Julija Cubins, Hannah Harwood, Ben Leduc, Laura Madden, and Dana Vesty for their assistance with data collection and entry. This information is presented with the understanding that no product discrimination is intended and neither endorsement of any product mentioned, nor criticism of unnamed products, is implied.

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