NORTHWEST CROPS & SOILS PROGRAM

2015 Sunflower Variety Trial

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

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Although sunflowers are a relatively new crop in the Northeast they have potential to add value to diversified operations providing 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 region of the U.S. is the northern Great Plains, so most of the available production and agronomic management guidelines are from this region. Identifying varieties and management practices of sunflower that are suited to the local climate is essential to viable crop production and expansion of the sunflower acreage in the Northeast. With this in mind, UVM Extension's Northwest Crop and Soil Program has been evaluating performance of sunflower varieties in our microclimate.

MATERIALS AND METHODS

A trial was initiated at Borderview Research Farm in Alburgh, VT in 2015 to assess yield and quality of sixteen sunflower varieties of varying relative maturity (RM) (Table 1). The experimental design was a randomized complete block with four replications and sixteen varieties as treatments.

Table 1. Characteristics of 16 sunflower varieties, sunflower variety trial, Alburgh, VT, 2015.

Variety	Company	RM	Traits	Seed Treatments	Seed size
306	Cropland	88	NuSun®, DMR	Untreated	3
3080	Cropland	90	NuSun®, DMR	Untreated	2
3495	Syngenta	93	Clearfield®, NuSun®	CDM	4
3732	Syngenta	97	NuSun®	CMB, Bion 500 FS®, Unistand™	3
3733	Syngenta	97	NuSun®	CDM	4
7111	Syngenta	89	Clearfield®	CMB, Bion 500 FS®, Unistand™	4
432 E	Cropland	89	ExpressSun™, DMR	CDM	4
460 E	Cropland	93	ExpressSun™	Untreated	2
559 CL	Cropland	95	Clearfield®, DMR	Untreated	2
Badger	NuSeed	Medium	Clearfield®, DMR	Untreated	3
Camaro II	NuSeed	Medium	Clearfield®, DMR	Cruiser®	3
Cobalt II	NuSeed	Early	Clearfield®, DMR	Untreated	4
Durango	NuSeed	Medium-Full	ExpressSun™	Untreated	4
Hornet	NuSeed	Medium	Clearfield®, DMR	Cruiser®	4
Talon	NuSeed	Early	ExpressSun™	Cruiser®	3
Torino	NuSeed	Medium-Full	Clearfield®	Cruiser®	4

Traits: Clearfield® = tolerant of Beyond® ammonium salt of imazamox herbicide; ExpressSun® = tolerant of Express® tribenuron methyl herbicide; NuSun® = 55-75% oleic acid; DMR = Downy Mildew Resistant. **Treatments:** Bion 500 FS® = acibenzolar-S-methyl; Cruiser® = thiamethoxam; Unistand™ = pelleted seed coating for uniform size 3 seed; Cruiser® DM Pak (CDM) = thiamethoxam, azoxystrobin, metalaxyl-M and S-isomer, fludioxonil; CruiserMaxx® Bean (CMB) = thiamethoxam, mefenoxam, fludioxonil.

Trial management details are in Table 2. The soil was a Benson rocky silt loam. The previous crop was corn grown conventionally with a winter 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 17-May at a rate of 1.5 pints per acre. Sunflowers were planted on 5-Jun 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 14-Jun and were cultivated on 17-Jun and 7-Jul. Sunflowers were thinned to a population of 32,000 plants per acre on 8-Jul. Plots were covered with grape netting to minimize losses due to birds on 1-Sep.

Table 2. Agronomic field management of a sunflower variety trial, Alburgh, VT, 2015.

Location	Borderview Research Farm – Alburgh, VT
Soil type	Benson rocky silt loam, 8-15% slope
Previous crop	Corn with winter rye cover crop
Varieties	16
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
Thinned (date; plants ac^{-1})	8-Jul; 32,000
Weed control	Cultivated 17-Jun and 7-Jul
Sunflower planting date	5-Jun
Starter fertilizer (at planting)	10-20-20 250 lbs. ac^{-1}
Covered with netting	1-Sep
Sunflower harvest date	19-Sep
Pressing date	17-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 random plants in each plot and noting white mold infection on the 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 19-Sep 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. Due to excessive moisture and stalk debris, harvest moistures could not be measured accurately. Therefore, seed yields presented here are "as is" at harvest moisture. Oil from a known volume of each seed sample was extruded on 17-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. ac^{-1} and gallons ac^{-1}) is reported at 10% moisture**.**

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 ($p<0.10$).

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 2015 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, 2015.

Alburgh, VT	June	July	August	September
Average temperature (°F)	63.1	70.0	69.7	65.2
Departure from normal	-2.7	-0.6	0.9	4.6
Precipitation (inches)	6.42	1.45	0.00	0.34
Departure from normal	2.73	-2.70	-3.91	-3.30
Growing Degree Days (base 44°F)	581	815	810	654
Departure from normal	-73	-11	43	156

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 June there were 2.73 more inches of precipitation than normal. After June, however, the summer was drier than normal, with an average of 3.30 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 2860 GDDs for sunflowers, 115 more than the 30-year average.

Bloom dates of the sunflower varieties were monitored and the average bloom date recorded. Bloom dates ranged from 8-Aug (63 days after planting) to 17-Aug (73 days after planting) (Table 4). The bloom dates were similar to last year's which ranged from 4-Aug (65 days after planting) to 14-Aug (75 days after planting). The average bloom date for the trial this year was 13-Aug, an average of 69 days after planting.

Table 4. Average bloom dates by variety
Alburgh, VT, 2015

Variety	Days after planting	Bloom date
306	68	12-Aug
3080	69	12-Aug
3495	72	16-Aug
3732	71	15-Aug
3733	67*	11-Aug*
7111	68	12-Aug
432E	66*	10-Aug*
460E	70	14-Aug
559CL	71	14-Aug
Badger	**65**	**8-Aug**
Camaro II	68	12-Aug
Cobalt II	69	12-Aug
Durango	72	15-Aug
Hornet	71	14-Aug
Talon	69	12-Aug
Torino	73	17-Aug
LSD (*p*=0.10)	3.05	
Trial Mean	69	13-Aug

The variety 'Badger' had the earliest average bloom date of 8-Aug or 65 days after planting. The varieties '432 E' or '3733' which bloomed on 10-Aug and 11-Aug were not statistically different than 'Badger'. It is interesting that the varieties that are rated early maturing, 'Cobalt II' and 'Talon' flowered an average of four days later than 'Badger' which is a medium maturing variety. In addition, the variety '3733' has a relative maturity of 97 days but it was one of the first varieties to bloom. These trends suggest that perhaps differences in relative maturity may appear later in the sunflower season such as during seed development or dry down.

The 16 varieties evaluated in the 2015 sunflower variety trial were statistically different from one another in stand characteristics (Table 5). Plant populations varied, but much less widely than in 2014. However, there were still a few varieties that were below the target population of 28-30,000 plants ac^{-1}. Plant stands

could have been reduced by excessive rain in June or damaged by successive cultivation. The variety 'Durango' had very low plant populations in 2015 and 2014 trials.

Table 5. Plant stand characteristics and pest damage on 16 sunflower varieties, Alburgh, VT, 2015.

Variety	Population (plants ac^{-1})	Height (cm)	Head width (cm)	Lodging (%)	Bird damage (%)
306	29185*	160.0	13.2	15.3*	0.7
3080	**31508**	172.7	12.0	43.8	7.3
3495	31145*	177.8*	12.5	12.5*	3.6
3732	28096*	165.5	13.3	20.5*	2.3
3733	27515*	165.4	14.5	28.8	0.9
7111	29113*	145.8	13.7	2.8*	**0.7**
432 E	28677*	166.6	13.6	**2.3**	2.3
460 E	30782*	180.6*	13.3	29.3	5.7
559 CL	28750*	**193.1**	11.7	33.8	6.1
Badger	26426	168.5	13.2	46.3	6.8
Camaro II	26136	175.2	14.0	22.3*	6.6
Cobalt II	23522	145.2	14.3	2.8*	5.3
Durango	17351	136.7	15.0	4.3*	6.5
Hornet	28967*	168.2	**19.5**	22.5*	1.4
Talon	23595	159.4	13.2	56.3	15.4
Torino	30056*	173.6	12.1	11.0*	6.0
LSD (p=0.10)	4151	16.2	NS	25.7	NS
Trial Mean	27552	166	13.7	22.1	4.8

Treatments in **bold** were top performers for the given variable.
Treatments with an asterisk* did not statistically differ from the top performer (p=0.10).
NS – No significant difference was determined.

Lodging was statistically impacted by variety; overall, an average of 22.1% of sunflower plants lodged. The least lodging was observed by variety '432 E' with 2.3% lodging. This did not statistically differ from the nine varieties '306', '3495', '3732', '7111', 'Camaro II', 'Cobalt II', 'Durango', 'Hornet', and 'Torino'. The highest lodging was observed by variety 'Talon' with 56.3% lodging. Three other varieties, 'Badger', '3080', and '559CL' were statistically similar to 'Talon' with 46.3, 43.8, and 33.8% lodging respectively. Excessive lodging may have been observed as the plants were covered with bird netting to reduce bird damage. High winds may have caused increased damage with the bird netting. In addition, the average height of sunflowers in this trial was 166 cm, 25 cm taller than in 2014 and 29 cm taller than in 2013. Although lodging did not always correlate to taller plants, this may have impacted potential damage from the netting. The tallest variety was '559CL' at a towering 193 cm, over 6 feet. The shortest was 'Durango' at only 137 cm, about 4.5 ft. Half of the varieties trialed grew to over 5.5 feet. Almost no symptoms of sclerotinia white mold at the base, stalk, or head was seen when assessed just prior to harvest. Therefore, disease incidence is not included here.

Bird damage was not significantly different by variety. Overall bird damage was low compared to in the planting date trial and variety trials in previous years; the average and highest bird damage observed in this trial was 4.8% and 15.4% respectively. Both of these are the lowest observed over the 2013-2015 seasons. The variety with the highest bird damage (15.4%) was 'Talon'.

The sunflower varieties trialed also differed statistically in yield and quality (Table 6). Sunflowers were all harvested on the same day (19-Sep) as most varieties were mature and rain was forecasted the following week. This caused many of the stalks and seeds to be high in moisture. Excess moisture in the plant material made it more difficult for the combine and seed cleaner to adequately clean the seed prior to drying. Therefore, an accurate harvest moisture was not attainable with the moisture meter. The seed yields presented in Table 6 are reported at harvest moisture. We estimate that most moistures were above 20%.

Table 6. Yield and quality of 16 sunflower varieties, Alburgh, VT, 2015.

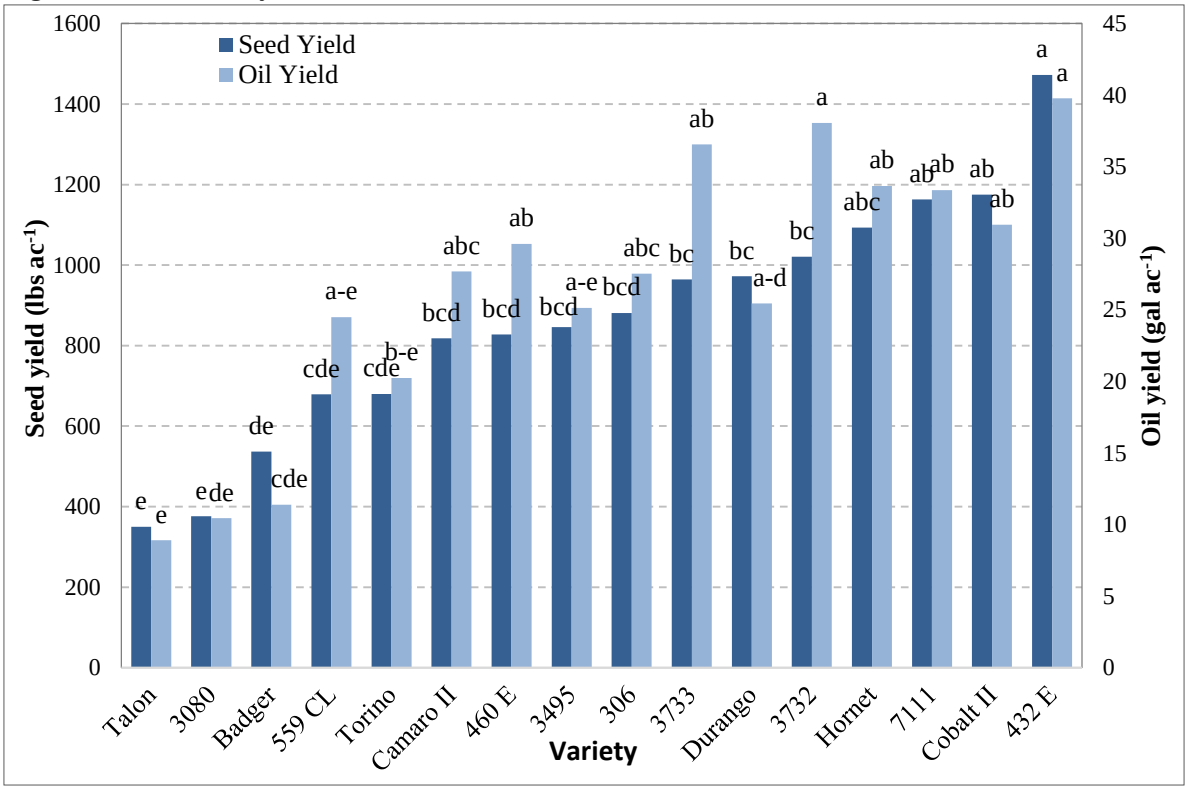
Variety	Seed yield (lbs. ac^{-1})	Test weight (lbs. bu^{-1})	Pressing moisture (%)	Oil content (%)	Oil yield (lbs. ac^{-1})	Oil yield (gal. ac^{-1})
306	881	24.9	4.8	23.1	210*	28*
3080	376	25.3	5.0	21.8	80	10
3495	846	26.5	4.8	23.7	192*	25*
3732	1021	27.1	5.1	28.4*	291*	38*
3733	965	**27.9**	5.2	**28.9**	279*	37*
7111	1164*	25.8	5.3	20.7	255*	33*
432 E	**1472**	23.4	4.6	18.7	**304**	**40**
460 E	828	25.3	5.0	26.5*	226*	30*
559 CL	679	26.3	5.0	26.9*	187*	24*
Badger	536	22.9	4.8	16.0	87	11
Camaro II	818	26.9	**5.4**	25.7*	211*	28*
Cobalt II	1175*	25.9	5.2	20.4	236*	31*
Durango	973	25.9	4.8	20.0	194*	25*
Hornet	1093*	27.1	5.2	25.0*	257*	34*
Talon	350	23.6	4.6	18.0	68	9
Torino	680	26.8	4.9	22.5	155	20
LSD (p=0.10)	417	NS	NS	4.78	125	16.4
Trial Mean	866	25.7	5.0	22.9	202	26.5

Treatments in **bold** were top performers for the given variable.
Treatments with an asterisk* did not statistically differ from the top performer (p=0.10).
NS – No significant difference was determined.

Test weights did not statistically differ by variety. Test weights ranged from 22.9 to 27.9 lbs. bu^{-1} with an average of 25.7 lbs. bu^{-1}. All varieties had lower test weights than the industry standard of 28 lbs. bu^{-1}.
Oil content, averaging 22.9%, was highest in variety 3733 (28.9%). This was not statistically greater than the oil content in five 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 202 lbs., or 26.5 gallons, per acre. Oil yields were highest in 432E, though not

statistically greater than eleven other varieties (Figure 1). Low oil yield may have been influenced not only by the low seed yields and oil contents, but also by the fact that the seed was dried to a below ideal moisture. These low pressing moistures makes the oil extrusion process more difficult and is harder on the press.

Figure 1. Seed and oil yield of 16 sunflower varieties trialed in 2015.



Overall performance of sunflower varieties in this trial was low with most varieties yielding below 1000 lbs. ac^{-1} with only one variety, 432E, producing over 1400 lbs. ac^{-1}. Disease incidence and pest pressure was low, however, high lodging and low test weights contributed to overall low yields. Interestingly the highest yielding variety, 432E, also had the lowest lodging and low bird damage. Lowest yielding varieties including Talon, 3080, Badger, and 559CL had greater than 25% of plants lodged. It was difficult to harvest lodged plants leading to low yields. Oil content was also below what we have seen in previous years. These low seed quality parameters could have been influenced by the fact that there was such low rainfall through the growing season. The overall lower success of this trial compared to other years shows the difficulty in growing sunflower as a viable crop in this region but provided insight into promising varietal selections.

ACKNOWLEDGEMENTS

This project was made possible through an ongoing collaboration with Vermont Sustainable Jobs Fund. A 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 Hillary Emick, Scott Lewins, Lindsey Ruhl and Dan Ushkow for their help with data collection, entry, and processing. 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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