NW CROPS & SOILS PROGRAM

UNIVERSITY OF VERMONT EXTENSION

CULTIVATING HEALTHY COMMUNITIES

2010
Sunflower Variety Trial Report

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The UNIVERSITY of VERMONT EXTENSION

WEATHER DATA

The 2010 growing season was warmer and slightly wetter than normal through the majority of the spring. The month of May was considerably drier than normal, though June's rainfall exceeded 30-year averages. No effect was apparent on germination rates. Accumulated growing degree days (GDDs) for the sunflower season totaled 3,120 from the beginning of June through the middle of October, when the sunflowers were harvested, which was 264 GDD above the 30 year averages (table 1). These data were recorded at weather stations in close proximity to the research site.

Table 1. Summarized weather data for the 2010 growing season.

South Hero (Alburgh)	Feb.	March	April	May	June	July	August	Sept.	Oct.
Avg. Temperature (F)	26.2	37.8	49.3	59.6	66.0	74.1	70.4	64.0	50.6
Departure from Normal	5.9	7	5.8	3.0	0.2	3.0	1.4	3.6	1.8
Precipitation (inches)	1.85	2.79	2.76	0.92	4.61	4.30	5.48	4.32	*
Departure from Normal	0.44	0.73	0.25	-2.01	1.40	0.89	1.63	0.86	
GDDs (base 44)	0.0	43.4	231.0	482.1	658.5	933.1	820.0	598.5	221.7
Departure from Normal	0.0	43.4	100.5	91.5	4.5	94.6	45.0	106.5	26.4

Based on National Weather Service (NWS) data from South Hero, VT. Historical averages are for 30 years of data (1971-2000).
* Data not available from NWS

ANALYSIS

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 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 (e.g. 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 values. 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, treatment A is significantly different from treatment C but not from treatment B. The difference between A and B is equal to 400, which is less than the LSD value of 2.0. This means that these treatments 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 treatments were significantly different from one another.

Treatment	Yield
A	**2100***
B	1900*
C	1700
LSD	300.0

Sunflower Variety Trial

Variety selection is one of the most important agronomic decisions that sunflower growers make about their crop each season, especially in Vermont where the relatively short growing season limits available choices. Sticking with a tried and true variety is often difficult because new varieties are released every year while familiar ones are discontinued, and seed companies release new traits that may or may not influence yield. To help area farmers make the best decisions, UVM Extension conducted replicated variety trials at Borderview Reseach Farm in Alburgh, VT during the 2010-growing season. The trial evaluated fourteen varieties with varying maturity dates, seed sizes, and trait information, as listed in table 2. All varieties are non-GMO hybrids. The varieties Croplan 306 and Croplan 3080 were not treated with a seed fungicide or insecticide. All others were treated with the CruiserMaxx treatment package,

which contains Thiamethoxam (broad-spectrum insecticide), Azoxystrobin (fungicide), Fludioxonil (fungicide), and Mefenoxam (fungicide).

Table 2. Relevant agronomic information for trialed varieties.

Variety	Company	Seed Size (1=large, 5 = small)	Relative Maturity	Traits
306	Croplan	4	87 days	NS, DMR
521	Syngenta	4	95 days	NS
555	Croplan	4	94 days	NS, DMR, CL
2930	Syngenta	4	92 days	NS, DMR
3080	Croplan	4	90 days	NS, DMR
3480	Syngenta	4	95 days	NS, DMR, CL
3875	Dekalb	3	102 days	NS
3980	Syngenta	3	97 days	NS, CL
7120	Syngenta	4	95 days	HO, DMR
Cobra	Seeds 2000	2	Medium-early	NS, ExpressSun
Defender Plus	Seeds 2000	3	Early	NS, DMR
S655	Triumph	3A	94 days	NS
Teton	Seeds 2000	3	Early	DMR
Viper	Seeds 2000	3	Medium	NS, CL

NS = NuSun trait (55-75% oleic acid); **HO** = high oleic (>80% oleic acid); **DMR** = Downy Mildew Resistant; **CL** = Clearfield® trait (Beyond tolerance), **ExpressSun** = Express® tolerance

CULTURAL PRACTICES

The seedbed was prepared using conventional tillage methods, and the plots managed in similar fashion to producers in the area (Table 3). The plots were planted on May 26 2010 at a rate of 29,000 seeds per acre with a John Deere 1750 corn planter equipped with sunflower fingers.

Table 3. Agronomic and trial information for the sunflower variety trial.

Borderview Farm, Alburgh, VT	
Soil Type	Silt loam
Previous Crop	Rye
Tillage Methods	Plow and disk
Planting Date	5/26/2010
Row Width	30 inches
Fertilizer application (side-dress)	70 lbs N / acre
Herbicide application	Trust @ 2qts. / acre (05/11/2010)
Harvest Date	10/13/2010

In previous years we have had consistent problems with goldfinches, house finches, and mourning doves eating large proportions of our sunflower crops, which has made data collection impossible. In an effort to save as much of our crop as possible, we utilized several methods of bird deterrents. The first deterrents we used were squawk boxes (Bird Gard PRO Bird Repeller) and scare eye balloons (Scare-Eye balloons, Gemplars, Madison WI). The finches quickly became accustomed to the deterrents, and several times we observed birds sitting on the squawk boxes or very close to them with no reaction to the sound. We then placed grape and tobacco netting over the trial plots, staking them down on the corners to keep the birds from getting to the sunflowers from underneath. This proved to be the most effective solution, and very quickly the number of birds in the immediate area declined dramatically and no further loss occurred. The netting did cause some lodging, especially in windy situations, but the loss to lodging was negligible in comparison with what would have been lost to birds.

Just prior to harvest in mid-October, plant height head width, population, lodging and severity of white mold (Sclerotinia head rot and stalk rots), were determined in each plot. White mold incidence is heaviest in wet summers, though it is most likely present in all years. Although sunflowers are susceptible to a wide variety of molds and fungal diseases, white molds can be particularly devastating because they can be contagious (in the case of Sclerotinia wilt, image 1), can cause high lodging rates in infected plants (Sclerotinia mid-stalk rot and wilt), or can envelop the entire head and ruin the seed (head rot). There are currently no varieties that demonstrate genetic resistance to the white molds; however, some varieties may be less susceptible based on other factors such as growth stage at critical times of the mold lifecycle. Our aim was to document these differences if possible. For the purposes of this trial, we counted Sclerotinia wilt and Sclerotinia mid-stalk rot together, because we expect similar effects on lodging rates and yield.

Image 1. Sclerotinia wilt infection. Note the black sclerotia on the left side of the stalk.

At harvest, seed yield, test weight (Berckes Test Weight Scale), and seed moisture (Dickey-john M20P) were determined for each plot. Samples were then pressed using a Kern Kraft KK40, and the meal and oil were weighed to give oil content of the seed, and to calculate the yield of oil in gallons.

RESULTS

This growing season proved to be favorable for sunflowers. Planting was well-timed with the rain to give good stand establishment. The average population for all of the varieties was just above 22,500 (Table 4). Only a few varieties had below trial average harvest populations. Syngenta 7120 had the highest population in the trial, with a population of over 26,000 plants per acre, which translates to a stand establishment rate of nearly 90% – the maximum germination rate. The average establishment rate was 77.7%. This rate reflects several factors that reduce plant numbers between planting and harvest, including actual (versus maximum) germination rates, pre-harvest plant death from a variety of causes, loss to cultivation, and lodging. Poor stand establishment could be related to planting equipment and seed size. The planter was calibrated for size 4 seed so larger seed many have resulted in less seeds per acre. In considering a yield and population goals for a field-scale crop such as sunflowers, these losses are important to consider.

In this trial, there was no clear relationship between plant population and heights or head width, which indicates that instead the differences we measured were attributable to a varieties genetic potential. Syngenta 3980 and Dekalb 3875 were the tallest varieties with an average height of 162 cm. There were few statistical height differences among varieties. Not surprisingly, s655 was the shortest. It is the only variety we tested which was considered "short-stature" (Image 2). A short stature variety was included in the trial because high lodging rates have been observed with standard varieties in previous years. Teton was the top performer for head width at 19.3 cm. Syngenta 3980 was the only similar variety (Figure 2).

Table 4. Impact of variety on crop stand characteristics in the sunflower variety trial

Variety	Source	Height	Head width	Population	Lodging	White Mold Incidence	
						Head rot	Stalk rot
		cm	cm	plants/acre	%	%	%
306	Croplan	139	17.1	23896*	0.00	2.10	3.30
521	Syngenta	139	16.2	25057*	2.40	2.60	4.90
555	Croplan	150	15.5	21573*	1.30	0.00	14.3*
2930	Syngenta	152	15.1	24228*	0.00	1.50	4.60
3080	Croplan	142	15.3	23066*	5.00*	5.10	5.00
3480	Syngenta	150	15.4	18586	5.20*	23.7*	8.10
3875	Dekalb	157*	15.8	25887*	9.00*	7.00	1.20
3980	Syngenta	**167***	18.5*	25057*	2.10	0.00	7.10
7120	Syngenta	136	16.4	**26053***	2.40	2.90	11.2*
Cobra	Seeds 2000	148	16.7	17258	0.00	7.80	**21.2***
Defender Plus	Seeds 2000	138	16.1	21739*	0.80	3.90	2.30
S655	Triumph	97.8	15.1	18917	0.00	**29.6***	3.50
Teton	Seeds 2000	142	**19.3***	19083	0.00	3.30	1.00
Viper	Seeds 2000	141	14.4	25223*	**9.10***	4.80	5.60
LSD (0.10)		14.9	1.5	4861	5.50	7.60	10.4
Trial Mean		143	16.2	22545	2.70	6.70	6.70

* Treatments that did not perform significantly lower than the top performing treatment in a particular column are indicated with an asterisk.
NS – Treatments were not significantly different from one another.

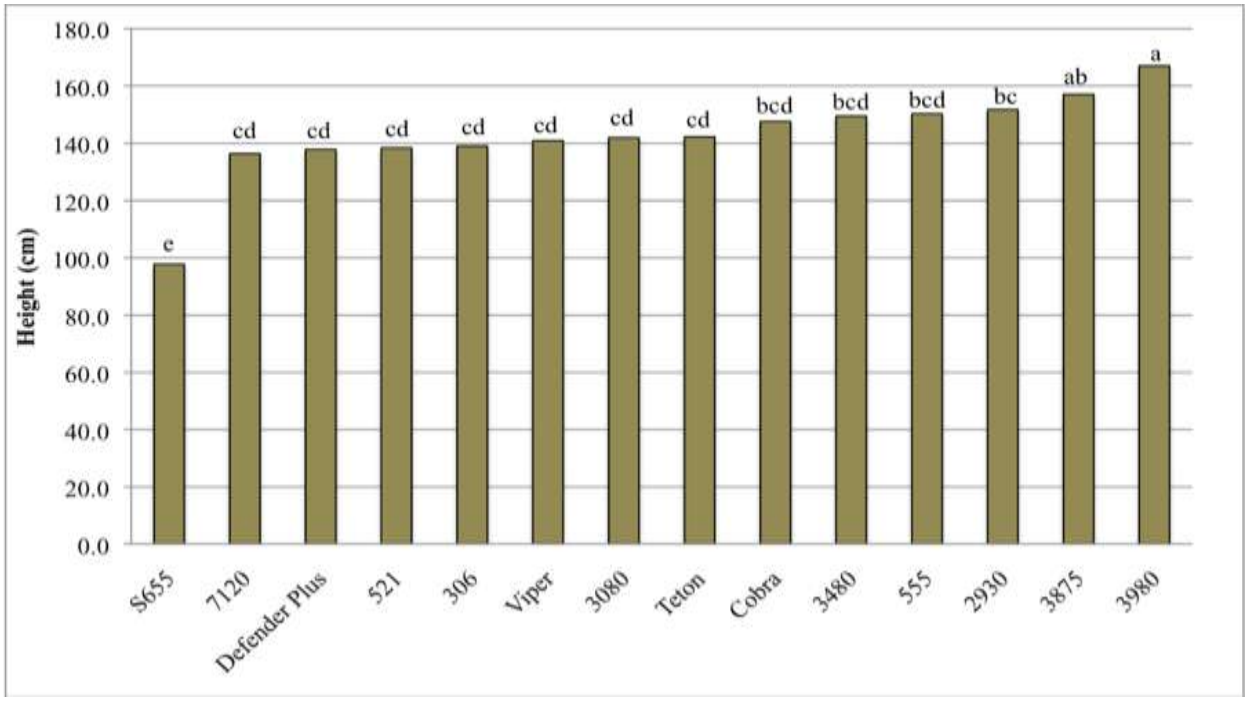

Figure 1. Height of 14 sunflower varieties. Varieties with the same letter did not perform significantly differently (P = 0.10).

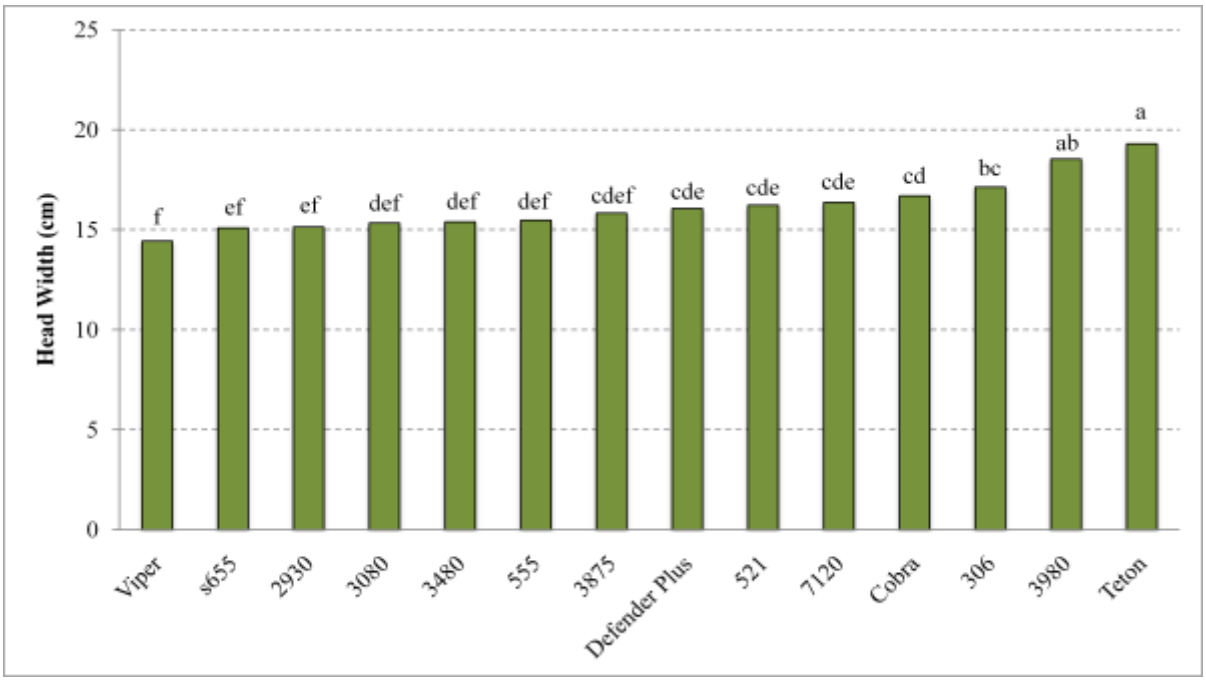

Figure 2. Head width of 14 sunflower varieties. Varieties with the same letter did not perform significantly differently (P = 0.10).

Lodging rates also differed between varieties, though there was no clear relationship between lodging rates and stalk rot disease rates. Viper and Dekalb 3875 showed very similar lodging rates (9.1% and 9.0%, respectively), which far surpassed the mean of 2.7% lodging. The short stature variety Triumph s655 and Syngenta 3480 had the highest severity of Sclerotinia head rot with more than 20% of the plants showing signs of disease. High levels of head rot in the short stature variety may have been a result of a humid microclimate created by the other taller varieties surrounding these plots. Sclerotinia stalk rot was most severe in Croplan 555, Sygenta 7120, and Seeds2000 Cobra.

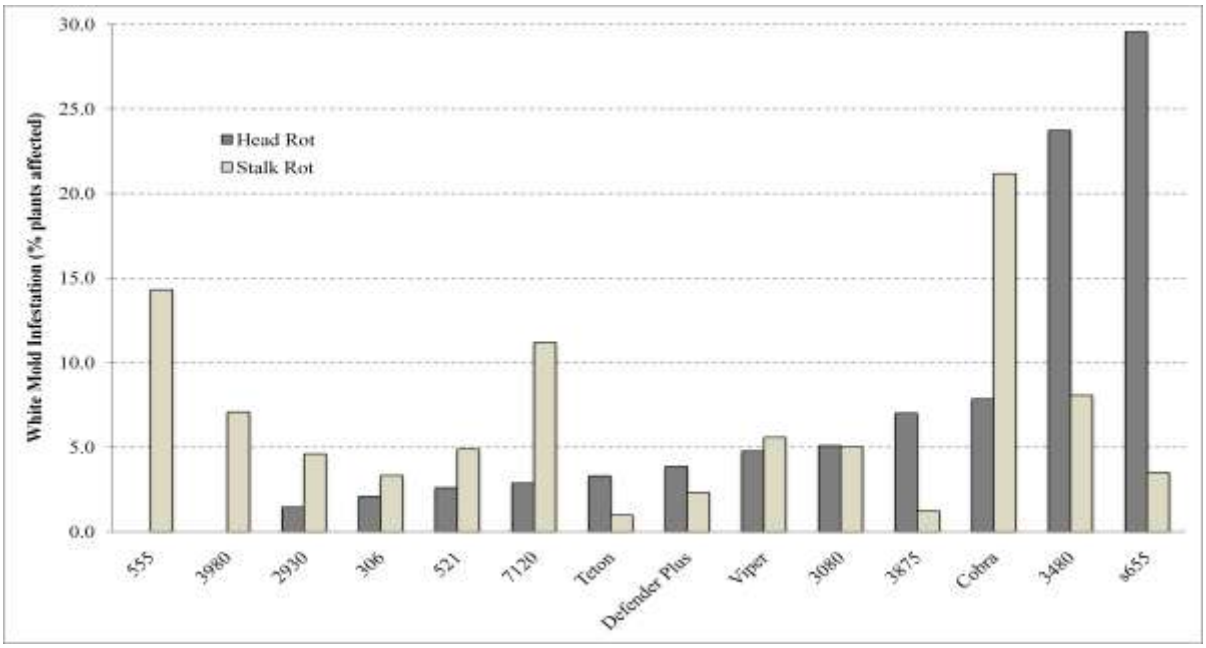

Figure 3. Incidence of white mold head rot and white mold stalk rots of 14 sunflower varieties.

The variety Dekalb 3875 produced the highest seed and oil yield of all the varieties, at 2294 pounds of seed and 110 gallons of oil per acre (Table 5; Fig. 4). The varieties Croplan 555 and Syngenta 3980 produced statistically similar yield to Dekalb 3875.

Table 5. Seed and oil yield parameters of 17 sunflower varieties, Alburgh, VT.

Variety	Source	Seed lbs/ac	Oil gal/ac	Oil Content %	Harvest Moisture %	Test Weight lbs/bu
306	Croplan	1383	60.2	33.3	14.0*	24.8
521	Syngenta	1568	54.6	26.7	**14.7***	24.2
555	Croplan	1727*	78.9	35.0	11.7	23.3
2930	Syngenta	1238	53.9	33.3	11.6	25.2
3080	Croplan	1253	49.1	30.0	13.7*	26.3
3480	Syngenta	1249	59.8	**36.7**	12.1	24.7
3875	Dekalb	**2294***	**110**	**36.7**	10.8	26.2
3980	Syngenta	1931*	75.6	30.0	14.3*	26.8
7120	Syngenta	1354	47.1	26.7	14.5*	25.8
Cobra	Seeds 2000	1510	65.7	33.3	12.0	22.5
Defender Plus	Seeds 2000	919	36.0	30.0	13.6*	24.5
S655	Triumph	730	28.1	29.5	13.9*	26.0
Teton	Seeds 2000	1238	53.9	33.3	14.4*	25.3
Viper	Seeds 2000	1321	63.2	**36.7**	11.5	26.2
LSD (0.10)		678.2	NS	NS	1.5	NS
Trial Mean		1408	59.2	32.2	13.0	25.1

* Treatments that did not perform significantly lower than the top performing treatment in a particular column are indicated with an asterisk.
NS – Treatments were not significantly different from one another.

Image 2. Short stature (Triumph s655) sunflowers as compared with normal sunflowers.

Because there were significant differences between plant populations of some of the varieties in the trial, Figure 5 shows actual yield in pounds of seed per acre (left axis), as well as a population adjusted yield in pounds of seed per 1000 plants. The yield of seed per plant provides a good estimate of the potential yield for a variety. However, actual yields can take into account differences in vigor, germination, standability, disease and pest resistance as well as other factors affecting plant survival. In this trial, relative differences in per plant yield were very similar to the differences in actual yield, indicating that the differences observed were attributable to variety genetic potential instead of plant population. One interesting exception can be seen in the variety Cobra, which had a very high per plant yield, and moderate total yield, likely because of its low population. In fact, this variety also had the lowest stand establishment of

all varieties, at only 59%. Cobra's large seed size of 2 means that it was most likely not seeded at the correct rate.

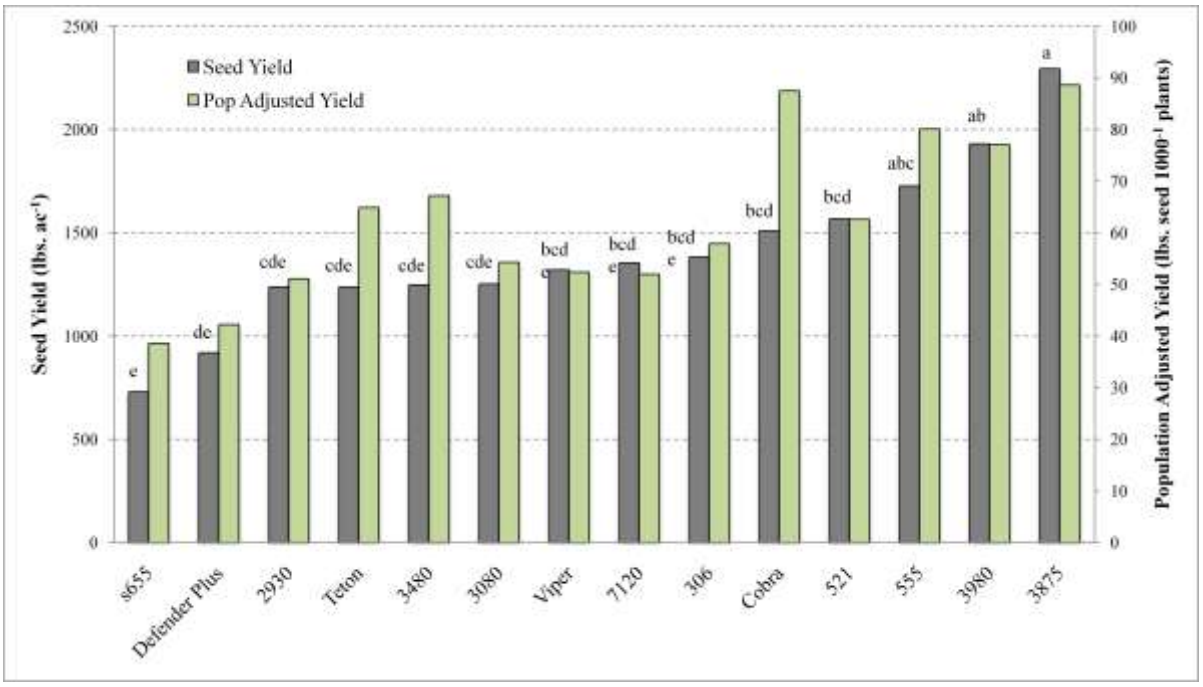

Figure 4. Seed yield per acre and seed yield per 1000 plants of 17 sunflower varieties. Varieties with the same letter did not perform significantly differently (P = 0.10) in terms of yield per acre. No statistical significance was determined for yield per 1000 plants.

Oil content did not differ significantly between most varieties. Results are shown above in table 5 and below in figure 5. Published values for oil content are somewhat higher than observed in this trial, which averages 32%. Dekalb 3875, Syngenta 3480, and Viper all performed highest.

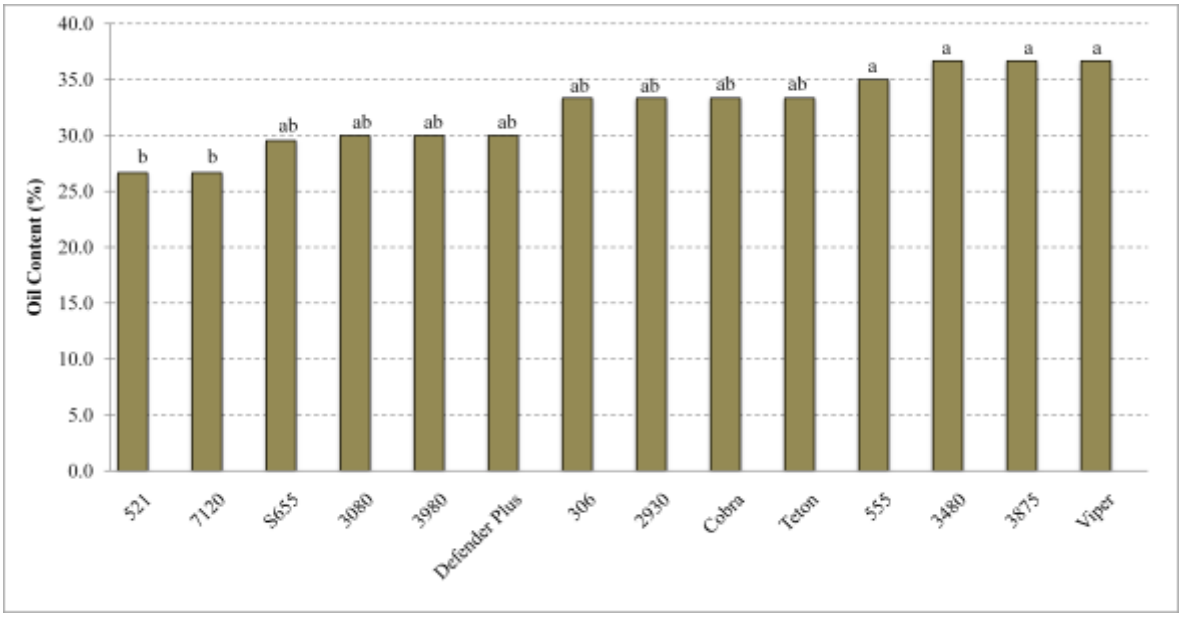

Figure 5. Oil content of 17 sunflower varieties. Varieties with the same letter did not perform significantly differently (P = 0.10). No statistical significance was determined for seed moisture.

In summary, there are several sunflower varieties that performed well in northern Vermont growing conditions. A few varieties such as Dekalb 3875, Syngenta 3980, and Croplan 555 consistently performed among the top in yield per acre, yield per plant, oil content, plant height, and stand establishment. Triumph s655, the short stature variety we selected specifically for its low height, did not perform as well as most of the other varieties, suggesting that the benefit of shorter varieties is not coupled with increased yield.

ACKNOWLEDGEMENTS

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NATIONAL SUNFLOWER SURVEY RESULTS

In the 2010 growing season, Vermont participated for the first time in the National Sunflower Survey, a project funded by the National Sunflower Association and coordinated by North Dakota State University. This year, participants in the survey visited over 200 sunflower fields nationwide, 10 of which were in Vermont, and compiled data on a wide range of field characteristics. In each field we sampled two locations; at each location we calculated population, head size, average seed size, seed set, lodging rate, bird damage, rated weed pressure by species, evaluated disease severity for ten common diseases, and estimated infestation rates for five common insect pests. Seed samples from each sampling location were also sent to the USDA Agricultural Research Station in North Dakota to evaluate the extent of damage to the seed from three common insect seed predators.

Table 6. Vermont results from the National Sunflower Survey

Field ID	Population plants / acre	Est. Yield lbs. / acre	Bird Damage %	Banded Sunflower Moth Damage % Incidence	% Seed Damage	Previous Crop
1	18643	1331	1.0	10.0	0.0	Corn
2	13590	1493	1.0	35.0	2.0	Corn
3	11325	445	9.0	10.0	3.0	Sunflowers
4	10280	632	5.8	60.0	3.0	Sunflowers
5	25090	1713	10.0	0.0	5.0	Corn
6	21431	2171	0.0	0.0	0.0	Corn
7	10455	1529	5.0	50.0	1.0	Sunflowers
8	12023	538	24.8	95.0	2.0	Sunflowers
9	27000	2511	7.3	0.0	0.0	Brassicas
10	15000	758	0.0	100.0	20.0	Sunflowers
Avg.	16483.7	1312.1	6.4	36.0	3.6	n/a

Some results from the survey are presented in Table 6. All of the data are highly variable field to field, and this is most true of yield. The lowest estimated yield was just less than 500 lbs of seed per acre, while the highest was more than five times that at 2500 lbs per acre. Populations were just as variable and are the most likely culprit for the variation in yield. Sunflower seeds are notorious for behaving poorly in grain drills, air seeders, and corn planters alike when no modifications are made to accommodate the odd shape of sunflower seeds. For corn planters with finger pickup and vacuum plate systems, sunflower-specific modifications are available commercially, and can provide vast improvements in seed spacing and eliminating skips and doubles. But even with changes in parts, each planter often requires a little tweaking to get more precise seed spacing.

One significant result showed that those fields where sunflowers were the previous crop statistically underperformed those that had rotated out of another crop (Figure 6, $p < 0.01$). The average population in fields that had two consecutive years of sunflowers was 780 lbs. of seed per acre, while the yield from fields with other preceding crops was 1800 lbs. per acre. The populations were also significantly different – 11800 plants per acre for continuous sunflower and 21150 for rotated fields. Low populations are most likely the cause of low yields, but the relationship between the low yields and rotation is significant, and deserves further attention and discussion.

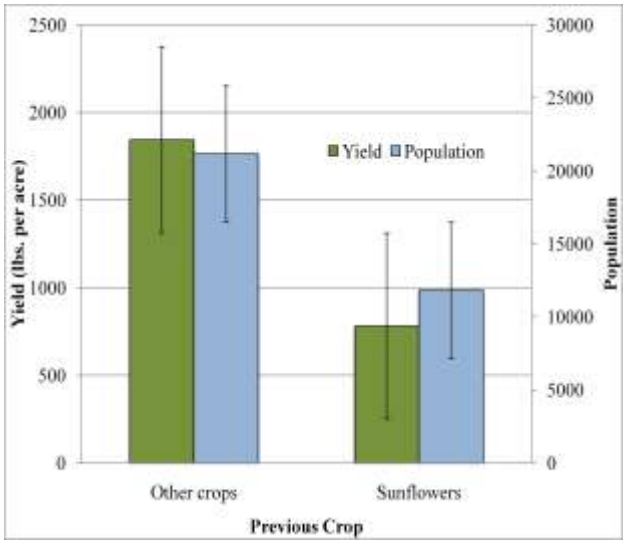

Figure 6. Yield and population from rotated versus continuous sunflowers. Standard error bars are shown ($p<0.01$)