2012

Sunflower Variety Trial

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UNIVERSITY OF VERMONT EXTENSION

CULTIVATING HEALTHY COMMUNITIES

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2012 SUNFLOWER VARIETY TRIAL

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Oilseed sunflower is a relatively new crop for Vermont and the Northeast in general. Because of regional differences in soil conditions, length of growing season, and weather patterns, it is important to select varieties that will perform well under Vermont's specific conditions. Sunflower varieties that will perform well here will generally be early to medium in maturity and have good disease resistance. In addition, varietal differences in plant stand characteristics (such as height and head diameter) may confer ability to resist pest pressures and increase yields and overall quality. The goal of this study is to evaluate pest pressure as well as seed and oil yields of varieties that will most likely mature during a northeast growing season.

MATERIALS AND METHODS

In 2012, UVM Extension's Northwest Crops and Soils Program initiated their sixth consecutive sunflower variety trial at Borderview Research Farm in Alburgh, VT. The experimental design was a randomized complete block with split plots replicated four times. Seventeen sunflower varieties were trialed and evaluated for stand characteristics, seed yield, insect damage and oil content. Relative maturities (RM), traits and seed treatments are listed in Table 1.

Table 1. Seventeen sunflower varieties evaluated in 2012, Alburgh, VT.

Variety	Company	RM	Traits	Seed treatment
306	Croplan	88	DMR, NS	CruiserMaxx™
369	Croplan	97	DMR, NS	CruiserMaxx™
378	Croplan	97	DMR, NS	CruiserMaxx™
460	Croplan	93	NS, ExpressSun	CruiserMaxx™
555	Croplan	94	CL, DMR, NS	CruiserMaxx™
2930	Syngenta	92	NS, DMR	CruiserMaxx™
3433	Syngenta	94	NS, DMR	CruiserMaxx™
3480	Syngenta	94	NS, CL, DMR	CruiserMaxx™
3495	Syngenta	95	NS, CL, DMR	CruiserMaxx™
3733	Syngenta	97	NS, DMR	CruiserMaxx™
7120	Syngenta	94	HO, DMR	CruiserMaxx™
Defender Plus	Seeds 2000	Early	NS	CruiserMaxx™
Durango	Seeds 2000	Med-Full	NS	*Untreated*
Falcon	Seeds 2000	Medium	NS, ExpressSun	CruiserMaxx™
Sierra	Blue River Hybrid	Med-Late	Organic	*Untreated*
Teton	Seeds 2000	Med-Early	HO	Cruiser® 5FS, Maxim® 4FS, Apron XL® LS
Torino	Seeds 2000	Med-Full	CL, NS	CruiserMaxx™

Traits: DMR = Downy Mildew Resistant; NS = NuSun (55-75% oleic acid); ExpressSun® (Express® herbicide tolerance); CL = Clearfield® (Beyond® herbicide tolerance); HO = High Oleic (>80% oleic acid)
Seed treatments: CruiserMaxx™ = thiamethoxam, azoxystrobin, fludioxonil, mefenoxam; Cruiser® 5FS = thiamethoxam; Maxim® 4FS = fludioxonil; Apron XL® LS = metalaxyl-M and S-isomer

The soil was a Benson rocky silt loam, previously a hayfield, and plots were prepared with fall chisel plow and disk, and finished with a spike-tooth harrow (Table 2). A John Deere 1750 corn planter, equipped with sunflower finger pickups, was used to plant sunflower in two-row plots, with 30" between

rows. Sunflowers were seeded at 36,480 viable seeds per acre on 31-May. No starter fertilizer was applied, nor was additional fertility added during the season. To control weeds, the pre-emergent selective herbicide Trust® (trifluralin) was applied on 14-May at 1.5 pints per acre, and Select Max® (clethodim) was sprayed on 30-Jun at a rate of 32 ounces per acre. Plots were cultivated on 21-Jun with a Brillion four-row cultivator with an S-shank, and mini-rototillers were used to weed between rows on 3-Jul.

Table 2. Agronomic practices for the 2012 sunflower variety trial at Borderview Research Farm.

Location	Borderview Research Farm – Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Hay
Tillage operations	Fall chisel plow, disk and spring-toothed harrow
Seeding rate (viable seeds ac^{-1})	36,480
Planting equipment	John Deere 1750 corn planter with sunflower cups
Row width (in.)	30
Plot size (ft)	5 x 30
Planting date	31-May
Varieties	17
Herbicide	Pre-emergent: 1.5 pt ac^{-1} Trust on 14-May Post-emergent: 32 oz ac^{-1} Select Max® on 30-Jun
Mechanical cultivation	Brillion 4-row S-shank on 21-Jun; mini-tiller between rows on 3-Jul
Bird control	Netting secured on 20-Sep
Harvest date	18-Oct
Oil pressing dates	27-Nov and 29-Nov

To protect against bird damage, on 20-Sep the sunflower trial was covered with grape and tobacco netting, which was staked at each corner to discourage birds from eating seed below the covering. Seed loss due to bird damage seemed to be minimal over the course of the season. Plant stand characteristics such as population, height, head width, disease and lodging were measured prior to harvest on 16-Oct, after bird netting was removed. 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. White mold (*Sclerotinia sclerotiorum*), which can overwinter in the ground and spread quickly, especially in wet seasons, has proven to be a problem in the Northeast in the past.

Plots were harvested on 18-Oct with an Almaco SPC50 plot combine with a 5' head and specialized sunflower pans. 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. After seeds were cleaned with a Clipper fanning mill to remove debris and plant material, seed samples from each plot were evaluated for insect damage. Banded sunflower moth larvae damage the seed and create distinguishable exit holes in harvested seed samples. Oil from a known volume of each seed sample was extruded on 27-Nov and 29-Nov with a Kern Kraft Oil Press KK40, 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.
All data was analyzed using a mixed model analysis where replicates were considered random effects. The LSD procedure was used to separate means when the F-test was 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 is real or whether it might have occurred due to other variations in the field. All data was analyzed using a mixed model analysis where replicates were considered random effects. At the bottom of each table a Least Significant Difference (LSD) value is presented for each variable (e.g. yield). LSDs at the 10% level (0.10) 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 at right, treatment A is significantly different from treatment C but not from treatment B. The difference between A and B is equal to 200, which is less than the LSD value of 300. This means that these treatments did not differ in yield. The difference between A and C is equal to 400, which is greater than the LSD value of 300. This means that the yields of these two treatments were significantly different from one another. The treatment in bold had the top observed performance, while treatments with an asterisk did not differ significantly from the top performer.

Planting date	Yield
A	**2100***
B	1900*
C	1700
LSD (0.10)	300

RESULTS

Using data from an on-site Davis Instruments Vantage Pro2 Weather Station at Borderview Research Farm in Alburgh, VT, weather data are summarized for the 2012 sunflower growing season (Table 3). In general, 2012 was warmer and drier than average. Monthly temperatures averaged above normal for every month (May-Oct). In addition, precipitation was below average with the exception of Sep and Oct. For sunflower, Growing Degree Days (GGDs) are calculated with a base temperature of 44°F. There were 3726 accumulated GDDs for the 2012 growing season, 392 more than the 30-year average (1981-2010).

Table 3. Summarized weather data for 2012 – Alburgh, VT.

Alburgh, VT	May	Jun	Jul	Aug	Sep	Oct
Average temperature (°F)	60.5	67.0	71.4	71.1	60.8	52.4
Departure from normal	4.1	1.2	0.8	2.3	0.2	4.2
Precipitation (inches)*	3.90	3.22	3.78	2.92	5.36	4.13
Departure from normal	0.45	-0.47	-0.37	-0.99	1.72	0.53
Growing Degree Days (base 44°F)	526	686	849	839	517	309
Departure from normal	142	32	23	72	19	104

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).

* Precipitation data from Jun-Sep 2012 are based on Northeast Regional Climate Center data from an observation station in Burlington, VT.

Though all sunflower plots were seeded at the same rate, there was a significant difference in early summer population by variety (Table 4). The variety 'Torino' (Seeds 2000) had the greatest population on 29-Jun (41,527 plants per acre), significantly higher than all other varieties. Torino also had the highest

population on 16-Oct, just prior to harvesting (36,953 plants per acre). In all varieties, with the exception of '369' (Croplan), there was a decrease in plant population between Jun and Oct (Figure 1).

Table 4. Plant stand characteristics of seventeen sunflower varieties, 2012.

	June population	Harvest population	Lodging	Sclerotinia head rot	Bird damage	Plant height	Head diameter	Harvest moisture
	plants ac^{-1}	plants ac^{-1}	%	%	%	inches	inches	%
306	32888	27443	10.0*	**0.00**	6.7	62.1*	4.74	10.3
369	21417	21417	5.0*	**0.00**	5.9	62.2*	6.32*	12.1
378	33323	28241	20.0	2.50	6.7	66.0*	5.87	10.4
460	33977	30347	10.0*	**0.00**	22.9	62.5*	5.57	10.1
555	33033	27443	10.0*	2.50	10.2	64.5*	4.78	8.8
2930	22361	18586	7.5*	5.00	4.0	60.4	5.79	10.2
3433	27588	22143	5.0*	2.50	18.2	59.6	5.31	9.4
3480	25918	22869	5.0*	2.50	12.8	59.2	5.53	12.0
3495	29185	25918	12.5*	2.50	17.4	66.1*	5.31	9.2
3733	24248	15101	37.5	**0.00**	14.3	60.0	5.37	12.3
7120	31871	24684	7.5*	**0.00**	18.1	60.6	5.30	10.0
Defender Plus	33251	26572	17.5*	2.50	4.3	56.1	5.36	9.6
Durango	11180	10745	**0.0***	**0.00**	**2.1**	46.5	**6.79***	**15.1***
Falcon	32089	16698	42.5	**0.00**	14.2	59.7	4.88	11.5
Sierra	26572	23014	10.0*	5.00	7.2	60.2	5.83	10.5
Teton	30710	22070	15.0*	**0.00**	**2.1**	58.2	5.49	9.7
Torino	**41527***	**36953***	10.0*	**0.00**	8.6	**66.1***	5.20	13.3*
LSD (0.10)	5201	6242	18.7	NS	NS	4.2	0.89	1.8
Trial mean	28891	23544	13.2	1.47	10.3	60.6	5.50	10.8

Treatments indicated in **bold** had the top observed performance.
* Treatments indicated with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
NS – No significant difference was determined between treatments.

Lodging was impacted by variety, with the lowest level (0.00% lodging) in the variety Durango (Seeds 2000), though this was not statistically lower than lodging in 13 other varieties. The greatest incidence of lodging was in the variety Falcon (Seeds 2000) (42.5%). In this trial, no sclerotinia infection was found in the form of stalk or base rot. Sclerotinia head rot was present in eight of the 17 varieties, though there was no significant impact of variety on head rot susceptibility. There was, likewise, no significant difference in bird damage by variety, though the average level of damage to sunflower heads was 10.3%.

Plant height averaged 60.6 inches for the trial and was significantly different by variety (Figure 2). The tallest variety was Torino (66.1 inches), though Torino was not significantly taller than 3495 (Syngenta), 378 (Croplan), 555 (Croplan), 460 (Croplan), 369, or 306 (Croplan). Head width varied significantly by variety, and was greatest in Durango (6.79 inches), though not statistically greater than the variety 369 (6.32 inches). The smallest head width was in the variety 306, though the diameter was not statistically lesser than 11 other varieties. Harvest moisture was greatest in Durango, though not statistically greater than the harvest moisture of Torino. The trial average for harvest moisture was 10.8%.

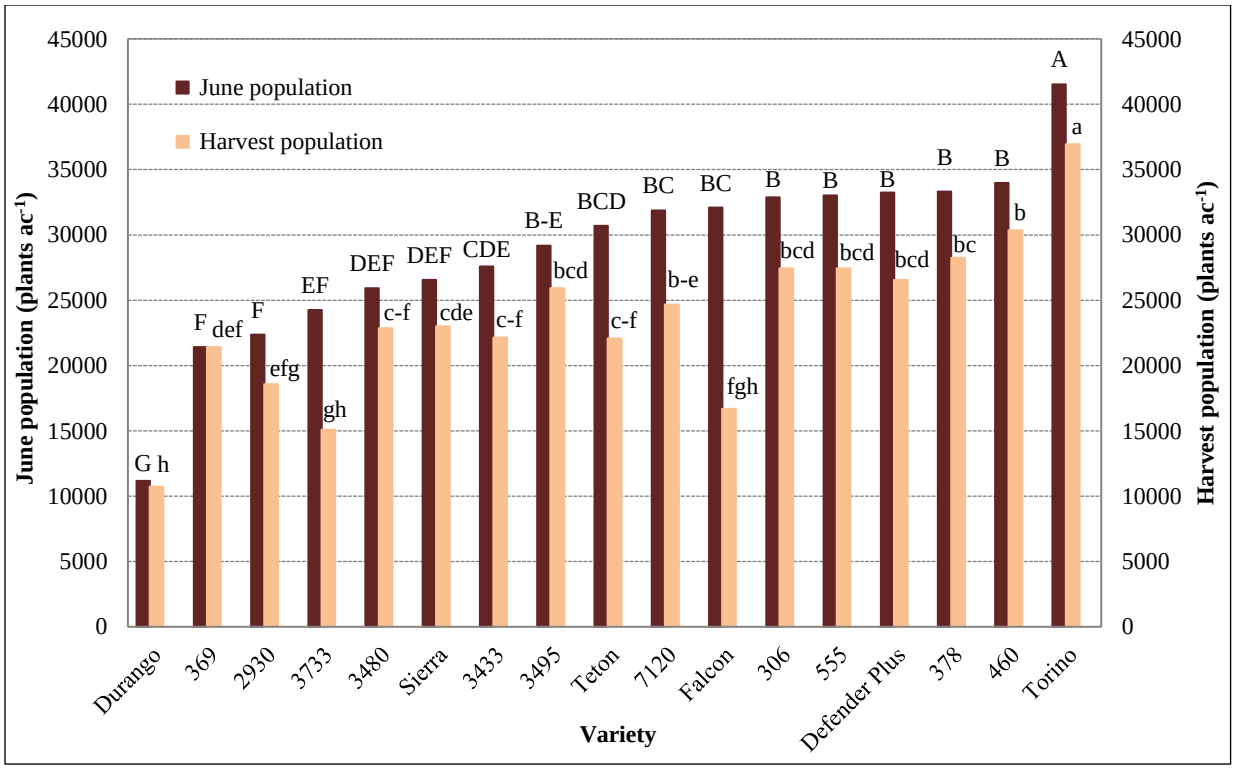

Figure 1. June population and harvest population by variety. Varieties that share a letter were not significantly different from one another (p=0.10; compare capital letters for June population and lower-case letters for harvest population).

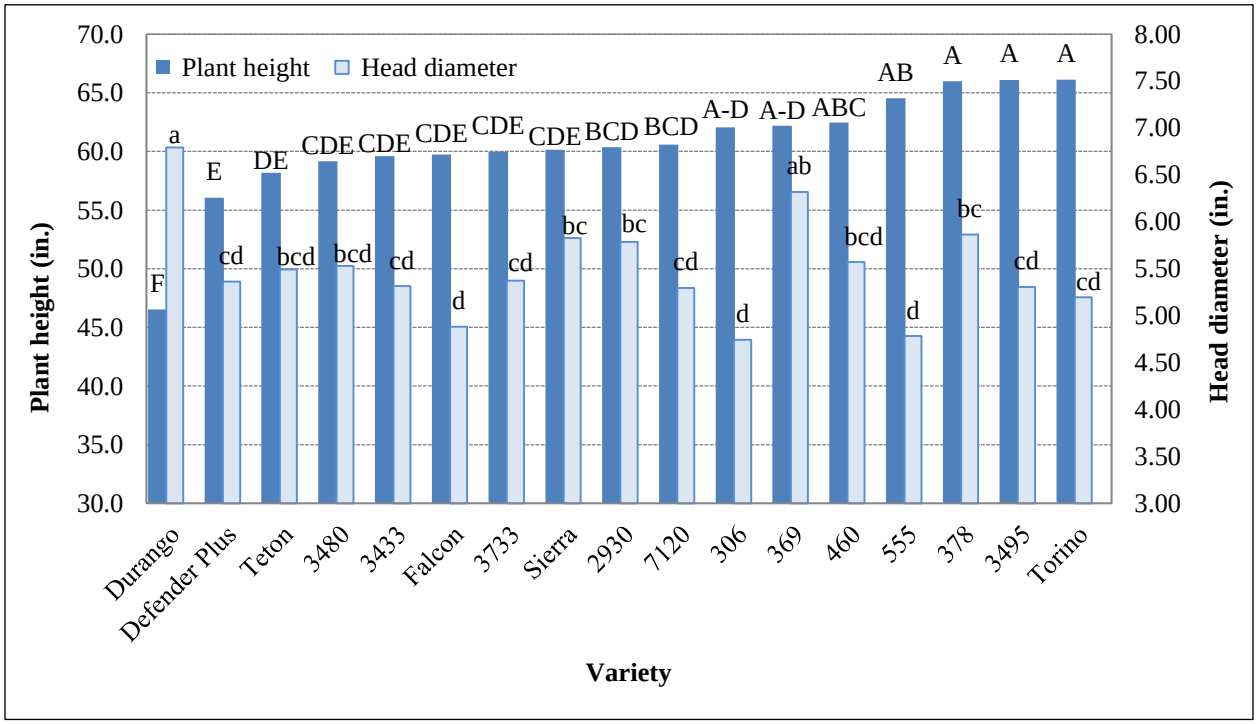

Figure 2. Impact of variety on plant height and head diameter. Varieties that share a letter were not significantly different from one another (p=0.10; compare capital letters for plant height and lower-case letters for head diameter).

Yield and quality were impacted significantly by varietal differences (Table 5). Test weights varied by variety, with the greatest test weight in the variety 3495, though this was not statistically higher than 11 other varieties. The lowest test weight, in the variety Sierra, was 28.5 lbs per bushel, which is still well within an acceptable range for sunflower. The standard bushel weight for sunflower seed is approximately 28 lbs. Seed yield, adjusted to 13% moisture for each test plot, averaged 2174 lbs per acre. There was a significant difference in seed yield by variety, with the greatest yield in Torino (2861 lbs per acre). The varieties 555, 3495, 460, 369, 306, 378, and Teton (Seeds 2000) did not differ significantly from the top performer in seed yield.

Table 5. Yield and quality measurements of trialed sunflower varieties, 2012.

	Test weight	Seed yield at 13% moisture	BSM damage	Pressing moisture	Oil content	Oil yield at 10% moisture	
	lbs bu^{-1}	lbs ac^{-1}	%	%	%	lbs ac^{-1}	gal ac^{-1}
306	31.5*	2365*	2.75	6.25	41.6*	1018*	133*
369	29.5	2375*	4.25	5.75	38.5	954*	125*
378	31.6*	2362*	2.75	6.05	41.1	1016*	133*
460	31.3*	2390*	3.00	6.20	42.0*	1051*	138*
555	31.0*	2818*	4.75	5.98	40.8	**1201***	**157***
2930	32.0*	1748	3.75	6.03	37.9	689	90
3433	31.8*	1673	3.50	5.65	42.3*	991*	130*
3480	30.0	2165	3.50	5.98	**43.3***	976*	128*
3495	**32.8***	2614*	3.50	6.15	39.2	1075*	141*
3733	31.6*	1921	3.75	6.08	42.3*	857	112
7120	32.1*	2196	3.75	5.75	41.4*	959*	126*
Defender Plus	32.0*	1946	**2.25**	6.08	38.5	781	102
Durango	30.4	1654	6.00	**7.05***	33.8	579	76
Falcon	32.0*	1587	5.00	6.08	40.5	670	88
Sierra	28.5	1987	3.50	5.30	38.4	809	106
Teton	30.3	2303*	2.50	5.88	42.7*	1034*	135*
Torino	31.8*	**2861***	5.25	6.30	40.3	1198*	157*
LSD (0.10)	1.9	581	NS	0.62	2.0	259	34
Trial mean	31.2	2174	3.75	6.03	40.3	933	122

Treatments indicated in **bold** had the top observed performance.
* Treatments indicated with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
NS – No significant difference was determined between treatments.

Seeds were examined for signs of banded sunflower moth (BSM) damage after harvesting and cleaning. While there was no significant varietal difference in the incidence of BSM damage, the trial average was 3.75% damage. There was a significant difference in the moisture level of different varieties at the time of pressing; for this reason, all seed moistures were adjusted to a standard 10% moisture when calculating and reporting oil yields. There was a significant difference in oil content by variety, with the highest oil content in the Syngenta variety 3480 (43.3%). The variety Durango had lower oil content than all other varieties (Figure 4). Oil yield was highest in the variety 555 (1201 lbs or 157 gallons per acre). This top performance was not statistically greater than 10 other varieties' oil yield (Figure 3). The lowest oil yields were in the varieties Durango, Falcon, 2930 (Syngenta), Defender Plus (Seeds 2000), and Sierra (Seeds 2000).

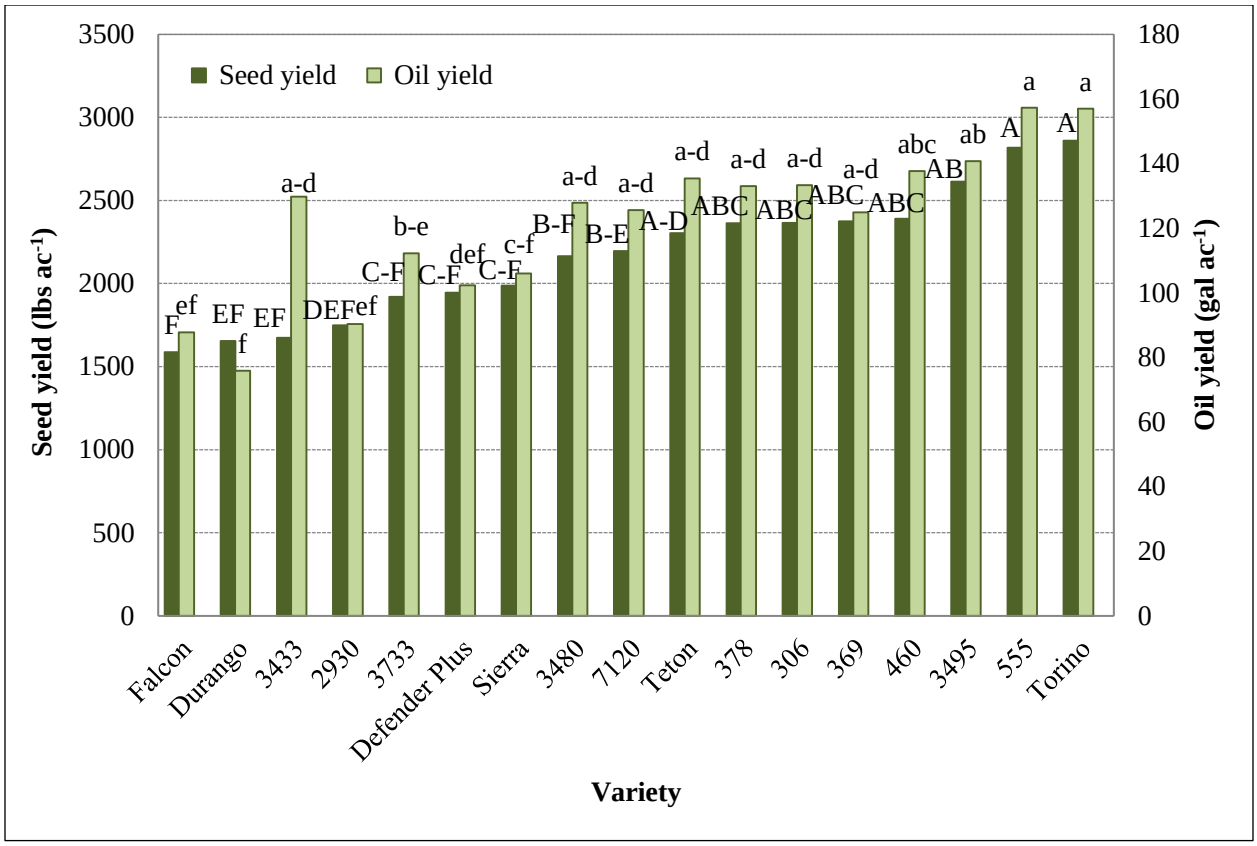

Figure 3. Seed and oil yields for seventeen sunflower varieties. Varieties with the same letter did not differ statistically (p=0.10, compare capital letters for seed yield and lower-case letters for oil yield).

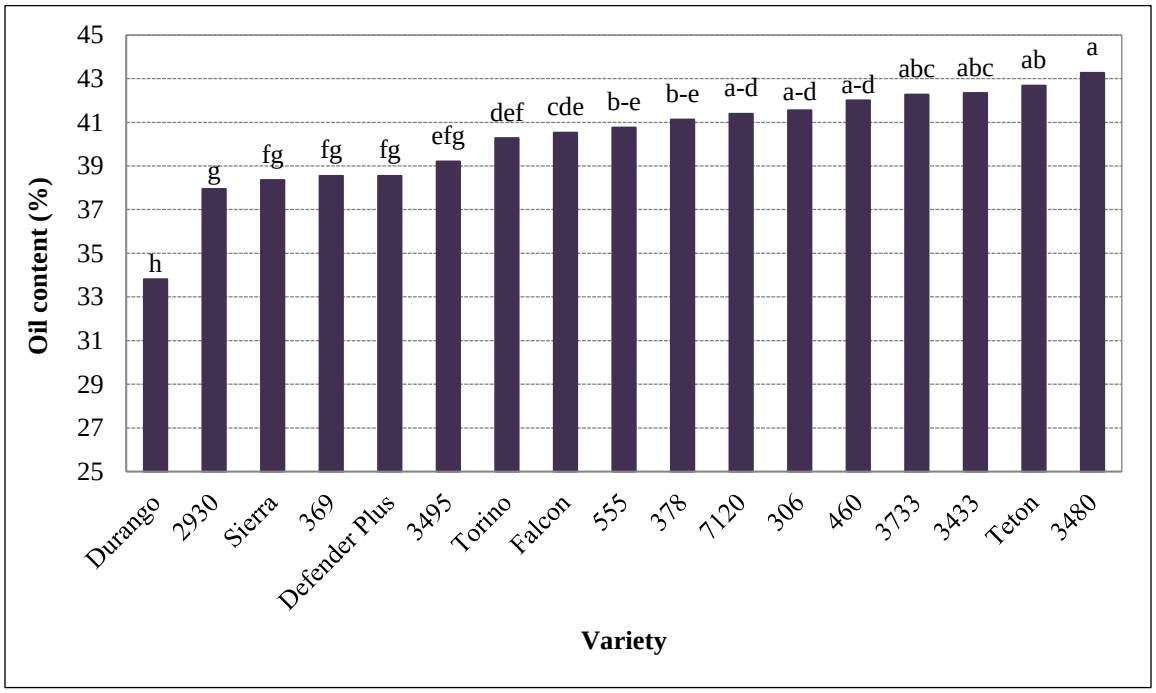

Figure 4. Oil yields by variety. Varieties with the same letter did not differ statistically from one another (p=0.10).

DISCUSSION

Plant population varied significantly by variety, with one notable outlier; Torino had a higher population than all other varieties in early summer (29-Jun) and just prior to harvest (16-Oct). The trial average population was 28,891 plants per acre on 29-Jun and 23,544 plants per acre on 16-Oct, a difference of 5,347 plants per acre, or 18.5% loss during the season. In contrast, Torino, with a significantly greater population than all other varieties, experienced only an 11.0% decrease in population from Jun to Oct. Because the sunflowers were planted in May at a rate of 36,480 viable seeds per acre, the emergence rate was, on average, 79.2%, much higher than the emergence rate in 2011 (57%). A decline in plant populations from June to October could be caused by cultivation. Durango had an exceptionally low population, which may be the result of a larger seed size at planting. Many of the patterns in sunflower plant stand characteristics that have been noted in years past held true in 2012. For example, head width, which usually decreases as height increases, was greatest in the shortest variety, Durango. In addition, the harvest moisture was greatest in the variety Durango (15.1%), perhaps due to the variety's notably wide heads.

Overall, seed yields were relatively high in 2012, averaging over a ton. The top performer in seed yield was the variety Torino (2861 lbs per acre), though this was statistically similar to the next seven varieties in seed yield. Interestingly, Torino also had highest seed yield in 2011. Oil content was high in 2012, averaging 40.3% for the study. Test weight, an indication of overall seed quality and the amount of debris in the harvested yield, was above average for sunflower. Test weights of 28 lbs per bushel or greater generally indicate sunflower seed yields with acceptable quality; the trial average for this study was 31.2 lbs per bushel. Some of the lower test weights were among the varieties with the highest incidence of the burrowing banded sunflower moth (BSM) damage, though damage levels were not statistically significant by variety.

Seed and oil yields vary by variety, and oil yields are linked to varietal differences in oil content as well. Varieties should be selected based on the goals of the grower, and it should be recognized that these results are only from one location and one season. Growers should consider varietal performances from multiple seasons and locations before making decisions about which varieties will work for them.

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