2012

Sunflower Planting Date Trial

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2012 SUNFLOWER PLANTING DATE TRIAL

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Sunflower is a relatively new crop for the Northeast, and producers are interested in growing this crop for both the oil and seed meal. These products can be used for fuel, feed and food. Sunflower can yield well here in Vermont, but pest pressures often compromise strong yields. Altering planting dates may help to mitigate some of these pest pressures by getting the plants through a vulnerable growth stage before or after the most active periods in a pest's lifecycle. In addition, certain varieties may be impacted differently by alterations in planting date. Because Vermont has a short growing season, there is only so much flexibility when shifting planting dates and still expecting a viable harvest, so the maturity of a sunflower variety becomes a crucial factor. Two sunflower varieties with different maturities were assessed in this study evaluating the impacts of five varying planting dates on stand characteristics, pest damage, and seed and oil yield.

MATERIALS AND METHODS

To evaluate the impact of planting date on sunflower plant characteristics and quality, a research trial was conducted at Borderview Research Farm in Alburgh, VT (Table 1). The soil was a Benson rocky silt loam and plots were prepared with fall chisel plow and disk, and finished in the spring with a spike-toothed harrow. The experimental design was a randomized complete block with split plots replicated three times. The main plots were five planting dates, each spaced one week apart (18-May, 25-May, 1-Jun, 8-Jun and 15-Jun). The subplots were two varieties, Croplan '306' and Syngenta '7120.' The variety 306 has a maturity of 88 days; the variety 7120 has a maturity of 94 days. Both are considered early maturing varieties. Both varieties had downy mildew resistance. The plot size for this trial was 5'x30,' and a 10-20-20 starter fertilizer was applied at a rate of 200 lbs per acre at the time of planting. Plots were planted at a rate of 36,000 viable seeds per acre with a John Deere 1750 corn planter fitted with sunflower fingers.

Table 1. Agronomic practices for the 2012 sunflower planting date trial at Borderview Research Farm.

Location	Borderview Research Farm – Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Organic corn
Tillage operations	Fall chisel plow, disk and spike-toothed harrow
Seeding rate (viable seeds ac^{-1})	36,000
Planting equipment	John Deere 1750 corn planter
Row width (in.)	30
Plot size (ft)	5' x 30'
Planting dates	18-May, 25-May, 1-Jun, 8-Jun, 15-Jun
Varieties	Croplan 306 (RM 88) and Syngenta 7120 (RM 94)
Starter fertilizer (at planting)	200 lbs ac^{-1} 10-20-20
Weed control	1.5 pt ac^{-1} Trust on 14-May, tineweeded on 31-May, disked 15-Jun prior to planting, hand-weeded 3-Jul
Harvest date	18-Oct
Pressing date	27-Nov

To control weeds chemically, the pre-emergent selective herbicide Trust® (trifluralin) was applied on 14-May at 1.5 pints per acre. A tineweeder was used on 31-May to reduce weeds. All plots were hand-weeded on 3-Jul.

Plots were assessed on 16-Jul to determine growth stage, and scouted at the R3/R4 stage for banded sunflower moth (BSM) eggs. Three plants from each 2-row plot were scouted, with five bracts per head assessed with magnifying lenses. BSM eggs are small, opaque and spherical in shape (Figure 1). The research trial was not protected from birds with netting or other strategies, in order to more accurately estimate the impact of bird pressure on seed yields and quality. Plant stand characteristics such as population, height, head width, disease incidence and lodging were measured 10 days before harvest (8-Oct). 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.

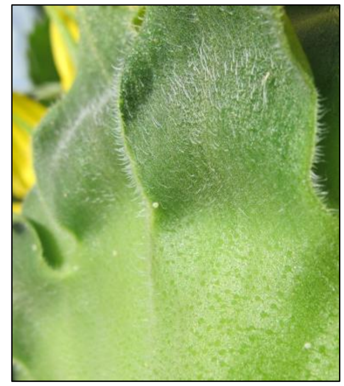

Figure 1. BSM eggs are small (0.4 mm), spherical, and off-white in color.

Plots were harvested on 18-Oct with an Almaco SP50 plot combine with a 5' head and 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 with a Kern Kraft Oil Press KK40, and oil quantity was measured to calculate oil content. Oil yield (in lbs per acre and gallons per acre) was adjusted to standard 10% pressing moisture and reported.

All data were 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 below, 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 2). 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 2. Summarized weather data for sunflower growing season, 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.

Planting Date by Variety Interactions

A significant interaction between planting date and variety was observed for insect damage in sunflower (Figure 2). Banded sunflower moth damage was assessed after harvesting and cleaning by measuring the incidence of larvae-damaged seeds. Among three out of five planting dates, insect damage was greater in the variety ‘306’ (Croplan). In the first planting date (18-May) and the fourth (8-Jun), however, insect damage was greater in ‘7120’ (Syngenta). The fact that this was the only statistically significant interaction between the two treatments indicates that both varieties were impacted similarly by alterations in planting date.

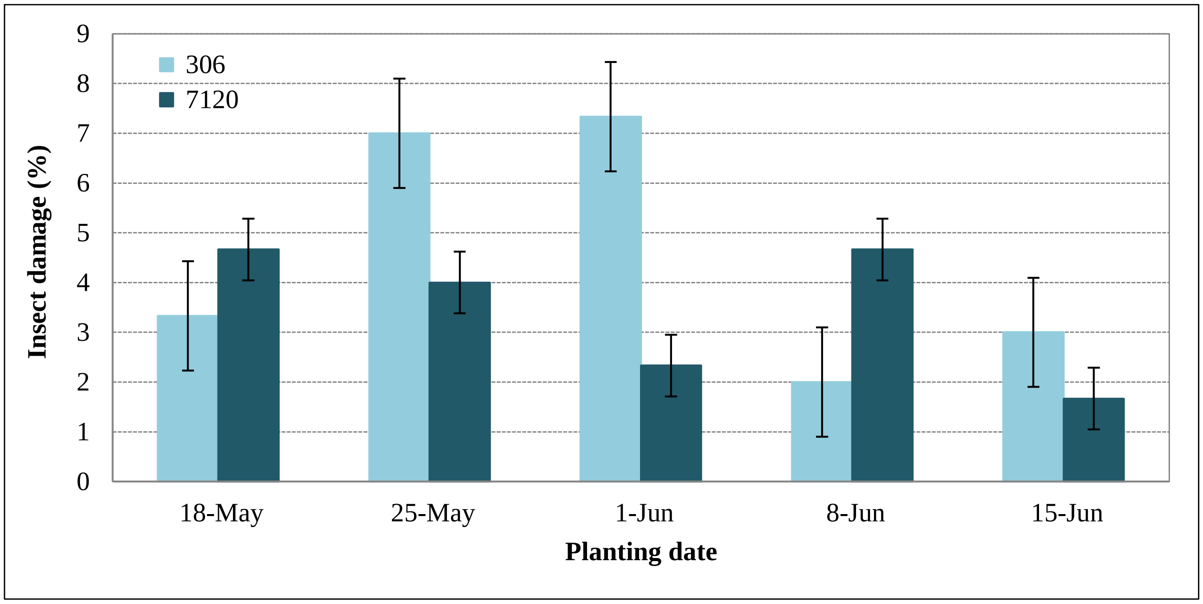

Figure 2. Impact of planting date on insect damage in two sunflower varieties, Croplan 306 and Syngenta 7120. ***Vertical bars represent +/- one standard deviation.***

Impact of Planting Date

Though plant stand characteristics were not statistically different by planting date, pest damage was significantly impacted by planting date (Table 3). There was no significant difference in sunflower population when the trial was assessed on 29-Jun. Population just prior to harvest was likewise not statistically significant by planting date. The average harvest population was 13,696 plants per acre which was almost a third of the actual seeding rate of 36,000 seeds per acre.

In this trial, no sclerotinia infection was found in the form of base rot. Sclerotinia head rot, averaging only 1.0% in the trial, was lowest in sunflowers planted in June. Sclerotinia stalk rot also varied by planting date, though four of the five planting date treatments experienced 0.0% stalk rot. There was 5.0% stalk rot in the second planting date treatment, 25-May.

Table 3. Impact of planting date on plant stand characteristics across two varieties, Alburgh, VT, 2012.

Planting date	June population	Harvest population	Sclerotinia		Lodging	Bird damage	Plant height	Head width
			Head rot	Stalk rot				
	plants ac^{-1}	plants ac^{-1}	%	%	%	%	in	in
1 - 18-May	**12688**	14366	35.0	**0.00***	23.3*	74.3	50.2	6.64
2 - 25-May	10026	9475	36.7	5.00	51.7	74.0	50.1	6.68
3 - 1-Jun	12377	**17664**	13.3*	**0.00***	**10.0***	29.7*	**57.4**	7.03
4 - 8-Jun	10026	13818	11.7*	**0.00***	21.7*	24.5*	55.0	7.14
5 - 15-Jun	8850	13156	**0.0***	**0.00***	11.7*	**17.0***	56.4	**7.47**
LSD (0.10)	NS	NS	17.2	2.51	19.0	19.5	NS	NS
Trial mean	10793	13696	1.0	0.00	23.7	43.9	53.8	6.99

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 significantly greatest in the second planting date (51.7%). All other planting date treatments outperformed this one, though the lowest lodging incidence was in sunflowers planted on 1-Jun (10.0%). Seed loss due to bird damage seemed average in 2012, compared to other seasons. Bird damage was lowest in the latest planting date, 15-Jun (17.0%). Bird damage decreased as planting dates were delayed (Figure 3).

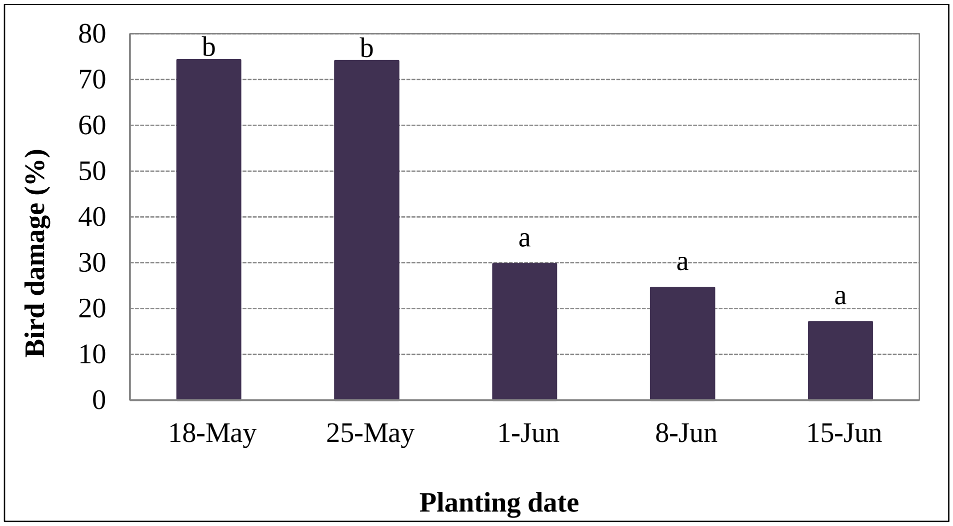

Figure 3. Bird damage severity by planting date. Planting date treatments that share a letter were not significantly different from one another (p=0.10).

Plant height and sunflower head width did not vary statistically by planting date (Table 3). The average plant height was 53.8 inches, with the tallest plants planted on 1-Jun. Average head width was 6.99 inches, ranging from 6.64 (18-May) to 7.47 (15-Jun).

Seed yield ranged widely and was significantly impacted by planting date treatments (Table 4). The greatest seed yield, adjusted to a standard 13% moisture, was in the latest planting date (15-Jun, 1365 lbs per acre), though this was not statistically different from the seed yield of the 1-Jun planting date (Figure 5). The lowest yield was in the earliest planting date (18-May, 490 lbs per acre). Harvest moisture was not statistically different by planting date treatments, and the average moisture at harvest was 16.7%.

Table 4. Impact of planting date on seed yield and post-harvest measurements, Alburgh, VT, 2012.

Planting date	Seed yield	Harvest moisture	Insect damage	Pressing moisture	Oil content	Oil yield	
	lbs ac^{-1}	%	%	%	%	lbs ac^{-1}	gal ac^{-1}
1 - 18-May	490	15.7	4.00	5.58	36.1	193	25.3
2 - 25-May	653	**18.6**	5.50	5.82	35.3	242	31.7
3 - 1-Jun	1103*	15.6	4.83	6.02	34.4	395*	51.8*
4 - 8-Jun	770	17.0	3.33	5.90	**37.9**	312	40.9
5 - 15-Jun	**1365***	16.7	**2.33**	**6.47**	36.5	**517***	**67.7***
LSD (0.10)	332	NS	NS	NS	NS	137	17.9
Trial mean	876	16.7	4.00	5.96	36.0	332	43.5

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.

On 16-Jul, all plots were assessed to determine the current growth stage of the sunflowers (Table 5). Plants were scouted for banded sunflower moth (BSM) eggs at their R3/R4 stage, when oviposition is optimal, by scouting three plants in each plot and tallying the number of BSM eggs on a total of five bracts per sunflower head. Though egg infestation levels were minimal, sunflowers planted earlier tended to have higher incidence of BSM eggs on bracts.

Table 5. Growth stage assessments and BSM scouting data according to planting date, 2012.

Planting date	Growth stage on 16-Jul	BSM eggs at R3/R4 stage
		Eggs plant^{-1}
1 - 18-May	R3/R4	0.20
2 - 25-May	R2/R3	0.00
3 - 1-Jun	R1/R2	0.20
4 - 8-Jun	R1	0.10
5 - 15-Jun	R1	0.00

BSM damage to seed did not differ by planting date treatment. BSM damage, which shows up in the form of exit holes and hollow seeds, was present in an average of 4.00% of harvested seeds. The latest planting date treatment (15-Jun) had the lowest insect damage incidence, though this was not statistically significant (Figure 4).

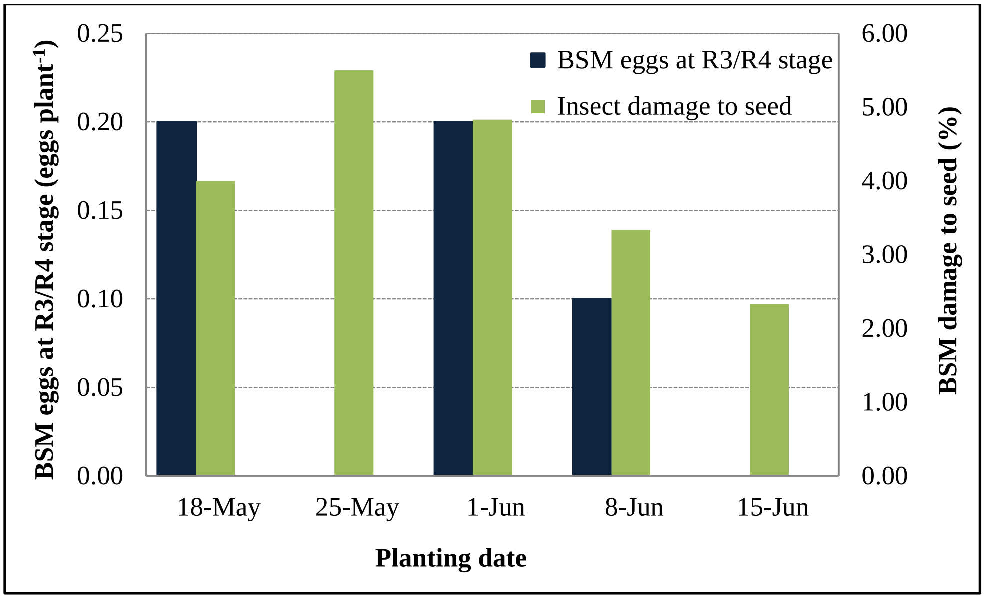

Figure 4. Effect of planting date on banded sunflower moth incidence, in the form of visible eggs at sunflower R3/R4 stage and seed damage assessed after harvesting and cleaning seed. Data on scouted eggs were not statistically analyzed; there was no significant difference in insect damage to seed by planting date (p=0.10).

Oil content averaged 36.0% and was not significantly impacted by planting date. All oil yields were adjusted to a standard 10% pressing moisture (Figure 5). The greatest oil yield was in the latest planting date, 15-Jun (517 lbs or 67.7 gallons per acre). This was not statistically greater than the oil yield of sunflowers planted on 1-Jun (395 lbs or 51.8 gallons per acre). The average oil yield for the trial was 332 lbs or 43.5 gallons per acre.

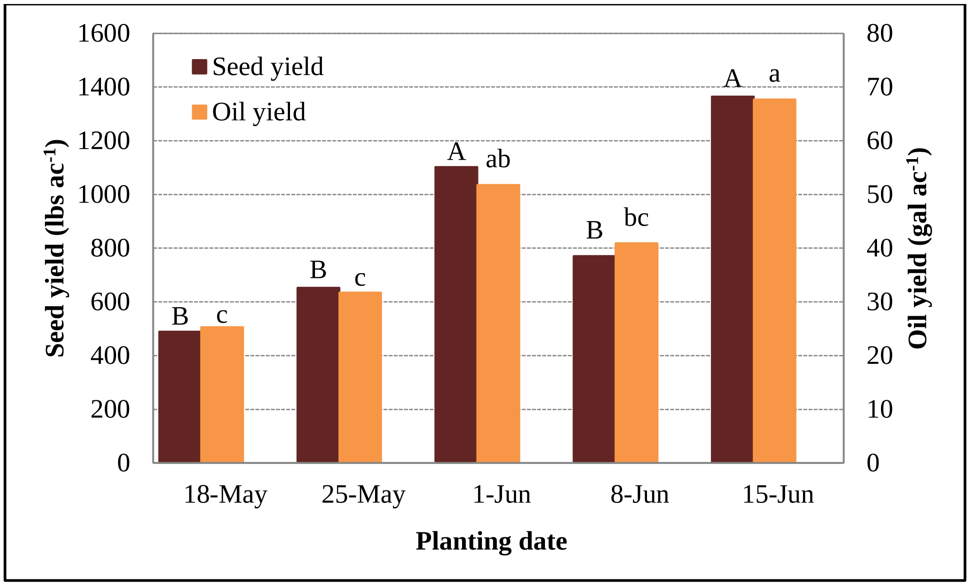

Figure 5. Effect of planting date on sunflower seed and oil yields. Planting date treatments that share a letter were not significantly different from one another (p=0.10; compare capital letters for seed yield and lower-case letters for oil yield).

Impact of Variety

There were no significant differences between varieties in any pre-harvest measurements except sunflower head width (Table 6). The effect of differing varieties, Croplan 306 and Syngenta 7120, was not statistically significant in June population, harvest population, sclerotinia rot, lodging, bird damage or plant height. Head width was significantly greater in the variety 7120 (7.29 inches).

Table 6. Impact of variety on plant stand characteristics across five planting dates, Alburgh, VT, 2012.

Variety	June population	Harvest population	Sclerotinia		Lodging	Bird damage	Plant height	Head width
			Head rot	Stalk rot				
	plants ac^{-1}	plants ac^{-1}	%	%	%	%	in	in
Croplan 306	**11630**	**15442**	**18.7**	1.33	**21.3**	**40.9**	**54.9**	6.69
Syngenta 7120	9957	11950	20.0	**0.67**	26.0	46.9	52.7	**7.29***
LSD (0.10)	NS	NS	NS	NS	NS	NS	NS	0.43
Trial mean	10793	13696	1.0	0.00	23.7	43.9	53.8	6.99

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.

There were no statistical differences between varieties in post-harvest measurements (Table 7). Seed yield was not impacted by variety, and the trial average was 876 lbs per acre. Harvest moisture and pressing moisture were unaffected by variety, as well as insect damage to seed. Oil content average was 36.0% and did not differ statistically between the two trialed varieties. Oil yield was also not statistically different by variety.

Table 7. Impact of variety on seed and oil yields, moisture levels and insect damage, Alburgh, VT, 2012.

Variety	Seed yield	Harvest moisture	Insect damage	Pressing moisture	Oil content	Oil yield	
	lbs ac^{-1}	%	%	%	%	lbs ac^{-1}	gal ac^{-1}
Croplan 306	**966**	16.5	4.53	**5.94**	**36.4**	**368**	**48.2**
Syngenta 7120	787	**16.9**	**3.47**	5.97	35.7	296	38.8
LSD (0.10)	NS	NS	NS	NS	NS	NS	NS
Trial mean	876	16.7	4.00	5.96	36.0	332	43.5

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.

DISCUSSION

Overall, the trial's harvest population (13,696 plants per acre) was considerably lower than recommended. Though the study was seeded at a target rate of 36,000 viable seeds per acre, there was a great amount of loss (61.9%) during the season due to possible planting errors, wet soil conditions early in the season, weed competition and mid-summer drought. Interestingly, though the early-season populations were greatest in the first planting date and lowest in the last planting date, seed yields were significantly greatest in the last planting date (1365 lbs per acre) and lowest in the first (490 lbs per acre). Though oil content was not statistically different according to planting date treatments, because of the variance in seed yields, oil yield did differ by planting date. Oil yield was greatest in sunflowers planted latest (15-Jun; 67.7 gallons per acre), though not significantly greater than those planted on 1-Jun (51.8 gallons per acre).

Bird damage was significantly lower in later-planted sunflowers. The last planting date treatment (15-Jun) experienced the least bird damage (17.0%). In late Jul-early Aug, plants were scouted for BSM eggs; all scouted plants were below the economic threshold level guideline for North Dakota (2-3 eggs per 6 bracts). Sunflowers in later planting date treatments tended to have fewer BSM eggs. Insect damage to seed, though not significantly impacted by planting date, also followed the trend of later planting dates having lower incidence of pest damage. Because the assessments of insect damage to seed were made after cleaning the seed, it can be assumed that the insect damage was in fact greater than 4.00% in the total harvest.

There were minimal impacts of the two trialed varieties on plant stand characteristics, pest damage, and seed and oil yields. This suggests that both varieties responded similarly to alterations in planting date.

This study suggests that delaying sunflower planting dates into early or mid-June may help to mitigate pest pressures and increase seed and oil yields. However, due to the shortness of season and variable weather conditions in the Northeast, growers should be careful to select varieties with maturities that will meet the constraints of their climate. Above average temperatures for these season resulted in 392 additional GDDs than the 30 year average. The exceptionally warm season likely influenced the planting date and variety performance. Hence, all planting dates and varieties were able to meet their yield potential because of the additional GDDs. In a normal year, later season varieties planted in mid-June may not reach physiological maturity prior to a killing frost. Therefore, additional years of data across varying environmental conditions needs to be collected to define optimum planting dates for this region.

ACKNOWLEDGEMENTS

UVM Extension would like to thank Roger Rainville and the staff at Borderview Research Farm for their generous help with this research trial, as well as the Vermont Sustainable Jobs Fund and USDA Northeast SARE (LNE09-282) for funding this research. We would also like to thank Katie Blair, Conner Burke, Chantel Cline, and Savanna Kittell-Mitchell for their assistance with data collection. This information is presented with the understanding that no product discrimination is intended and no endorsement of any product mentioned, nor criticism of unnamed products, is implied.

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