2011 Sunflower Tineweeding Trial

Dr. Heather Darby, UVM Extension Agronomist
Hannah Harwood, Rosalie Madden, and Erica Cummings
UVM Extension Crop and Soil Technicians

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

Weed control can be a major issue in the production of oilseed crops such as sunflower, and heavy weed competition can lower yields and affect overall seed and oil quality. Broadleaf weed control can be especially problematic in crops such as sunflower and canola. To address this problem, in 2011, the University of Vermont Extension Crops and Soils Team conducted an evaluation of tineweeding as a weed management strategy in sunflower. Tineweeding is a type of mechanical cultivation that is implemented early in the field season. If cultivated with a tineweeder when weeds are in their young "white thread root" stage, roots can be more completely disrupted, causing desiccation and death. This study also sought to evaluate the timing of tineweeding as it can play a role in the amount of damage caused to weed seedlings.

MATERIALS AND METHODS

This study was conducted in 2011 at Borderview Farm in Alburgh, VT (see Table 1). The soil type at the site was a Benson rocky silt loam. The previous crop was corn. The experimental design was a randomized complete block with three replications. Plots were 10' x 25'. The treatments consisted of one control with no tineweeding, tineweeding at 16 days after planting (DAP), tineweeding at 22 DAP, and tineweeding twice (at both 16 and 22 DAP). The herbicide Treflan (trifluralin) applied preplant on the 24-May at a rate of 2.5 pints per acre. Sunflowers were seeded on May 25 with a John Deere 1750 four-row planter at a rate of 32,000 seeds per acre.

Figure 1. Weed in ideal white thread stage.

Table 1. Agronomic and trial information for the 2011 sunflower tineweeding trial.

Location	Borderview Farm-Alburgh, VT
Soil Type	Benson rocky silt loam
Previous crop	Corn
Tillage operations	Spring disk, harrow, spike-toothed harrow
Herbicide	Trifluralin, pre-plant, 24-May
Plot size (ft.)	
Replicates	10 x 25
Row width (in.)	3
Planting date	30
Variety	25-May
Tineweeding dates	Croplan 555
Harvest date	10-Jun (16 DAP), 16-Jun (21 DAP)
	26-Sept

Figure 2. Evaluating crop and weed populations before tineweeding.

Weed and crop populations were measured before and after tineweeding events, which occurred at 16 and 22 DAP (see Figure 2). Weeds were identified and categorized as either annual or perennial broadleaf and grasses.

At harvest, population, height, head width, disease incidence, bird damage, and lodging were recorded. Bird damage was estimated using percent evaluations provided by North Dakota State University Extension. 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. Plots were harvested with an Almaco SP50 plot combine fitted with specially-designed sunflower pans. Yield was measured by weighing the harvested seeds. At harvest, moisture was measured with a Dickey-John M20P moisture meter. A Berckes test weight scale was used to measure test weight, an indicator of both the density of seed and the amount of debris in the harvest; sunflower test weights should be at least 25 lbs per bushel.

Figure 3. Tineweeding after planting, Alburgh, VT

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 LSD value is presented for each variable (e.g. yield). Least Significant Differences (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 listed in bold had the top performance in a particular column; treatments that did not perform significantly lower than the top performer 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 400, which is less than the LSD value of 500. This means that these treatments did not differ in yield. The difference between A and C is equal to 650, which is greater than the LSD value of 500. This means that the yields of these treatments were significantly different from one another.

Variety	Yield
A	**1600***
B	1200*
C	950
LSD (0.10)	500

RESULTS

Using data from weather stations in close proximity to the trial location, temperature, precipitation, and Growing Degree Day (GDD) information is presented in Table 2. The 2011 growing season proved difficult for sunflower production. The early spring was very wet, causing delays in planting and emergence. July was drier than normal, but August brought heavy rains and tropical storm winds. There were a total of 3,452 GDDs between May and September—302 GDDs above normal.

Table 2. Select weather data for the 2011 sunflower tineweeding trial – Borderview Farm, Alburgh, VT.

South Hero, VT (Alburgh)	May	June	July	August	September
Average temperature (°F) ±	58.7	67.1	74.4	70.4	63.8
Departure from normal	2.1	1.3	3.3	1.6	5.8
Precipitation (inches) *	8.67	3.52	3.68	10.23	5.56
Departure from normal	5.35	0.09	-0.29	6.38	2.1
Growing Degree Days (base 44° F)	454	716	942	749	591
Departure from normal	63.6	62.1	104	-26.3	98.6

± Average temperatures for August and September were taken from Burlington, VT.
Based on National Weather Service data from cooperative observation stations in South Hero. Historical averages are for 30 years (1971-2000).

Though tineweeding did reduce weeds in sunflower plots, there was no significant difference in weed reduction by treatment among any of the three evaluated weed types (Table 3). Overall, the annual grasses and broadleaves were more easily removed as compared to perennial weeds. Annual weeds were reduced on average 50% as compared to only a 15% reduction of perennial grasses. Annual grasses identified included foxtails (*Setaria* spp.), crabgrass (*Digitaria* spp.), barnyardgrass (*Echinochloa crus-galli* (L.) Beauv.), and witchgrass (*Panicum capillary* L.). Annual broadleaf plants identified in the trial included redroot pigweed (*Amaranthus retroflexus* L.), common lambsquarters (*Chenopodium album* L.), and Pennsylvania smartweed (*Polygonum pensylvanicum* L.). Very few perennial broadleaf weeds were identified in this trial; therefore, this weed type was not included in the report.

Table 3. Effects of tineweeding on weed reduction (DAP = days after planting).

Tineweeding	Reduction annual grasses	Reduction annual broadleaves	Reduction perennial grasses
	%	%	%
16 DAP	**100.0**	37.0	0.0
21 DAP	33.3	45.6	**27.6**
16 and 21 DAP	33.3	**68.8**	18.5
LSD (0.10)	NS	NS	NS
Trial Mean	55.6	50.5	15.4

Treatments indicated in **bold** had the top observed performance.
NS – No significant difference was determined between treatments.

There was no significant difference in population at harvest, though the average (11,580) was relatively low. Ideal sunflower populations are closer to 28,000 plants per acre. Likewise, sunflower height and head width were not influenced by tineweeding treatments. Stalk rot caused by white mold fungi was significantly greater in the 21DAP and the combined 21 & 16 DAP treatment. Bird damage was significantly higher in the 21 DAP treatment than other treatments. Seed yield, moisture, and test weight did not vary significantly by treatment.

Table 4. Crop stand and yield data by treatment for the 2011 sunflower tineweeding trial.

Treatment	Harvest population	Plant height	Head width	White mold incidence			Lodging	Bird damage	Seed yield	Moisture	Test weight
	plants / acre	in	in	Head rot %	Stalk rot %	Base rot %	%	%	lbs / acre	%	lbs / bu
Control	**13431**	53.7	4.8	**10.0**	**0.0***	**0.0**	**3.3**	13.8*	723	8.1	26.7
16 DAP	10091	55.4	5.6	23.3	**0.0***	3.3	30.0	18.2*	740	**10.5**	27.3
21 DAP	11035	**58.4**	4.7	46.7	10.0	**0.0**	43.3	29.4	418	10.4	26.7
16 and 21 DAP	11761	57.4	**5.8**	13.3	13.3	**0.0**	6.7	**12.6***	**836**	10.3	**28.7**
LSD (0.10)	NS	NS	NS	NS	7.9	NS	NS	7.9	NS	NS	NS
Trial Mean	11580	56.2	5.2	23.3	5.8	0.8	20.8	18.5	679	9.8	27.3

* 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

In 2011, tineweeding did not have a significant influence yield as compared to the control. Overall tineweeding reduced weed populations up to 50%. The trial indicated that tineweeding was more effective at controlling annual broadleaf and grass weeds compared to perennial grasses. Tineweeding is highly effective when implemented as an early season weed control (between one and two weeks after planting). During this time the weeds are just beginning to sprout and are easily controlled by tineweeding. Once the weeds are germinated and strongly anchored they become more difficult to remove with tineweeding. At this point more aggressive tineweeding is required and most likely will cause a reduction in plant stands. Overall harvest populations were low and most likely resulted in lower than average yields in the trial. Poor early season weather conditions led to reduced emergence and poor stands. Interestingly, higher stalk rot incidence and bird damage was observed in the 21 DAP treatment. A higher weed biomass may have caused a change in the microclimate resulting in higher disease at the base of the plant. A higher weed biomass may have also resulted in taller plants or a delayed maturity resulting in higher bird predation. Final weed biomass was not measured so it is difficult to make conclusions.

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