WEED SCIENCE

RESEARCH & EXTENSION

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6. TITLE: Organic Weed Management for Wild Blueberry Growers

OBJECTIVES

- Explore mechanical and cultural weed management strategies; tine weeding and cover cropping.
- Monitor wild blueberry and weed ground cover changes in response to mechanical and cultural weed management strategies.

LOCATIONS: UMaine Blueberry Hill Farm Experiment Station, Jonesboro ME
PROJECT TIMEFRAME: 2019 – 2022

INTRODUCTION

Due to the low prices of conventional frozen wild blueberries (2014-2018 mean = $0.40/lb) and increasing demand for organic wild blueberries, there are now 52 certified organic wild blueberry farms in Maine. While this group only accounts for 11% of all Maine wild blueberry farms, they are able to sell frozen berries at a higher price ($5.00 - $19.80/lb). Finding cultural and mechanical methods of weed management is important for all wild blueberry growers whether they are considered small, large, organic or conventional. Small organic growers are stuck with low blueberry yields because they do not have effective OMRI approved herbicides. Large organic-transition and conventional farms are in search of transition methods and low residue practices due to market demand.

To date, the University of Maine has found that removing weeds from a wild blueberry field can double yield in the conventional system (Yarborough 1997). Applying sulfur to reduce soil pH to 4.0 in the wild blueberry system is a very effective way of culturally reducing grass species (Saunders 2016 and Yarborough 1997). Soil pH reduction is a slow process which takes 2-3 years and one that does not reduce woody weeds as well as grasses. Removing woody weeds three times per season via mowing, weed whacking, and/or hand pulling is the most effective method of mechanical weed management to date (Drummond et al. 2012).

This four-year study will explore tine weeding and winter-kill cover crops as mechanical and cultural weed management tools for the wild blueberry system. A flex-tine weeder is a tractor attachment with metal fingers called “tines” that drag through the top one inch of

soil dislodging weed seedlings (Figure 1). Tine weeding is used on vegetable and small grain farms in early spring just as the first winter annual weed seedlings emerge. The stiffness of tines allows them to break through the soil crust and the vibration of tines uproots weed seedlings (Bowman 1997). Flex-tine weeders are designed to dislodge white thread stage weeds when the machine is run at a "fast" speed.

Cover cropping is defined as the planting of another plant species among or alternating with the cash crop. There are numerous benefits of cover cropping, a few of which include weed suppression, erosion management, soil organic matter builds up, increased soil water holding capacity, and habitat for natural enemy and pollinating insects. Several species of cover crop have been explored to meet the needs of different cropping systems. In wild blueberry production, planting a cover crop that would then become a weed would not be wise. Therefore, we are interested in "winter-kill" cover crop species that are planted in the late summer and die over the winter such as common oat (*Avena sativa*) or sorghum-sudan grass (*Sorghum* × *drummondii*). As the cover crop species grows in late summer through early fall, organic matter is created. After the plant dies, it falls to the ground creating a vegetative mat with the potential to suppress weeds (Clark 2007).

Figure 1. Williams flex-tine weeder at Blueberry Hill Farm, May 2019.

METHODS

In April 2019, the site location for this study was selected at Blueberry Hill Farm in Jonesboro, ME. This ongoing trial is a randomized complete block design replicated six times with 6' by 30' plots and 3' wide buffers between plots. The trial is located on one acre that is now managed organically although it is not an organically certified piece of land. One soil sample was taken of the site location before the project began.

Treatments are listed in Table 1. Two controls were employed; no weeding and hand weeding on one date. On May 13th and June 12th prune year tine weeding treatments were completed. Tines on a Williams flex-tine weeder were set to have the greatest down pressure (setting 8). The tractor was run slower than recommended at 1 mph due to the bumpy field. The hand weeded treatment was completed on June 12th.

Table 1. Weed management treatments used in the 2019 prune-cycle as well as future weed management treatments to be implemented in the 2020-2021 crop and prune cycles.

Treatment		Crop Cycle	Timing	Cover Crop*	
				Species	Seeding Rate
Control	C	Crop + Prune			
Control, Hand Weed	HW	Crop + Prune	6/12/19		
Tine	T1Dp	1x Prune	5/13/19		
Tine	T2Dp	2x Prune	5/13/19, 6/12/19		
Tine	T1Dc	1x Crop	TBD		
Tine	T2Dc	2x Crop	TBD		
Cover Crop	CCOL	Crop to Prune	TBD	Oat	Low
Cover Crop	CCOH	Crop to Prune	TBD	Oat	High
Cover Crop	CCSSL	Crop to Prune	TBD	Sudan Grass	Low
Cover Crop	CCSSH	Crop to Prune	TBD	Sudan Grass	High
Cover Crop & Tine	CCLT	1x Prune	TBD	Cover Crop	Low
Cover Crop & Tine	CCHT	1x Prune	TBD	Cover Crop	Low

** All Cover Crop treatments will be planted in the fall of 2020*

Data Collection

Measures of weed and blueberry crop growth were collected using two 0.5m x 0.5m quadrats per plot. Two quadrats were placed per plot and flagged for repeated measurements in the same locations throughout the study.

Weed control efficacy was evaluated within each quadrat by ranking overall weed cover using the Daubenmire scale from 0-6 (Table 2). Weeds were identified into two groups; grass and broadleaf, each of which were also given a severity rating on the same 0-6 scale. In 2019, weed evaluations were completed one time before tine weeding on May 13th, 2019 and two times after tine weeding in control, hand weeded, and prune tine weeded plots on June 27th and August 28th, 2019.

Blueberry plant cover was collected by counting the total number of ramets per quadrat (Figure 2). Eight stems per quadrat were measured for height (cm) and bud number on September 26th, 2019. In the upcoming years of this experiment, cover crops will be planted, and repeat measurements will be taken in the tine, control and cover crop treatments to be compared to this initial baseline year.

Table 2. Daubenmire ranks.

	Percent Coverage	
Rank	**Range**	**Midpoint**
1	0-5%	2.5%
2	5-25%	15.0%
3	25-50%	37.5%
4	50-75%	62.5%
5	75-95%	85.0%
6	95-100%	97.5%

Figure 2. Diagram of a wild blueberry ramet, defined as an independent root shoot of the larger plant.

Data Analysis

Blueberry health and recovery after tine weeding were evaluated using blueberry stem height, bud counts (per stem), blueberry plant cover and number (ramets/m^2). The continuous data (stem height, plant and bud number) were evaluated using a one-way ANOVA with a Tukey's Pairwise comparison in JMP (JMP®, Version 14.3) across all weed management treatments ($\alpha = 0.05$). Ranked (ordinal) data for blueberry plant cover and weed severity by type (broadleaf and grass) were compared using Chi-Squared test in JMP across all treatments ($\alpha = 0.05$).

RESULTS

Impact of Tine Weeding

Observationally, we saw that two tine weed passes were more effective than one pass per date at uprooting white thread stage weed seedlings. The first pass loosened up the soil required to then dislodge weeds in the second pass. Preliminarily, Canada mayflower, horse weed, and red sorrel were uprooted (Figure 3). Loose and dead wild blueberry ramets were pulled up in some cases (Figure 4). The most damage to wild blueberry occurred from driving over the field on the second tine weed date, June 12th (Figure 5). On the first tine weed date, May 13th, wild blueberry leaves were not out yet and therefore less damage to wild blueberry from tractor tracks was observed.

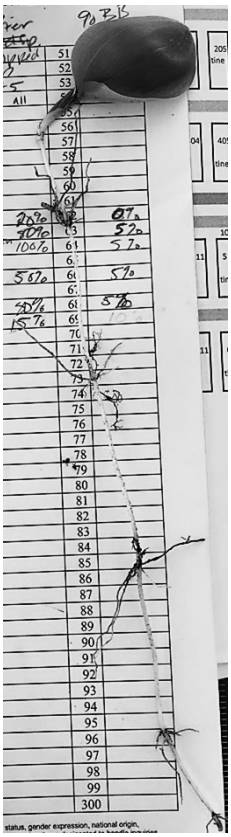

Figure 3. Canada mayflower uprooted from tine weeding on May 13th, 2019.

Figure 4. Dead and/or loose wild blueberry ramets were occasionally pulled out of the ground by tine weeding.

Figure 5. The late tine weeding date damaged wild blueberry under tractor tracks and was not as effective at pulling weeds out.

Blueberry Health

Blueberry stem height and the number of buds per stem were not significantly affected by the weed management treatments in the first year of this experiment (Figure 6). It is worth noting, however, that the tine weeded plots in the prune-cycle were slightly taller than the control. Additionally, the number of buds per stem decreased by an average 0.5-1.0 bud per stem in plots that were tine-weeded more than once.

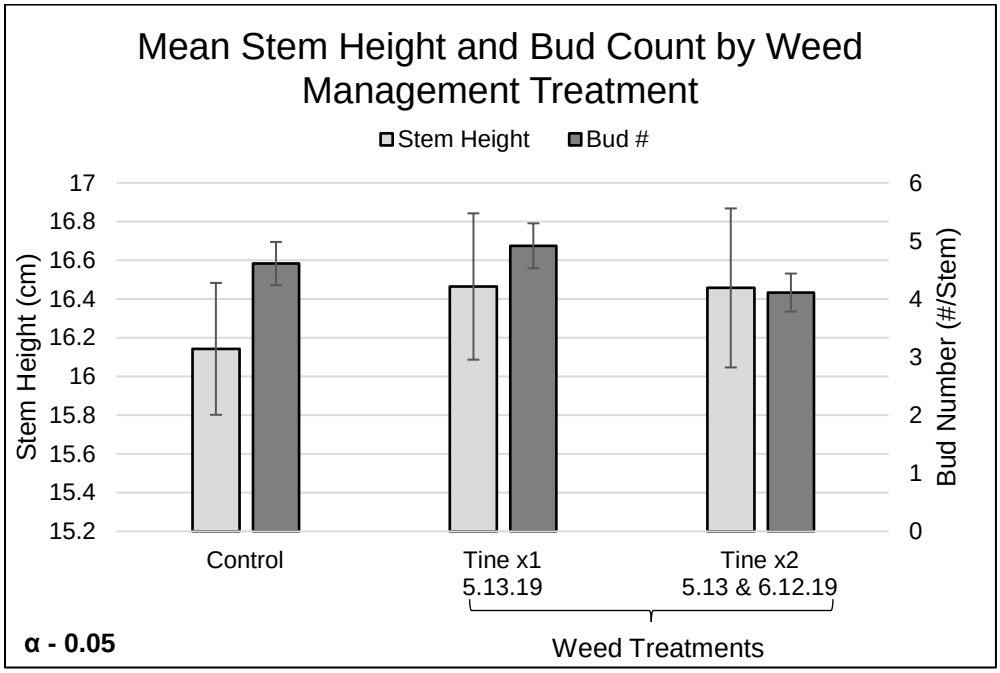

Figure 6. The average stem height (July-Sept.) and number of buds per stem (Sept.) by weed management treatment in an organic wild blueberry field in Jonesboro, Maine. Error bars indicate the standard error of the mean. No significant differences were observed at the 0.05 level of significance.

Similarly, there were no significant differences between blueberry plant cover and weed management treatment. The number of ramets per m^2 was significantly greater in plots that were tine weeded on two dates compared to the control (Figure 7). This 15% increase in the number of ramets observed may represent the tine weeder's capacity to cut or disturb rhizome structure, there by stimulating the plant to produce more shoots.

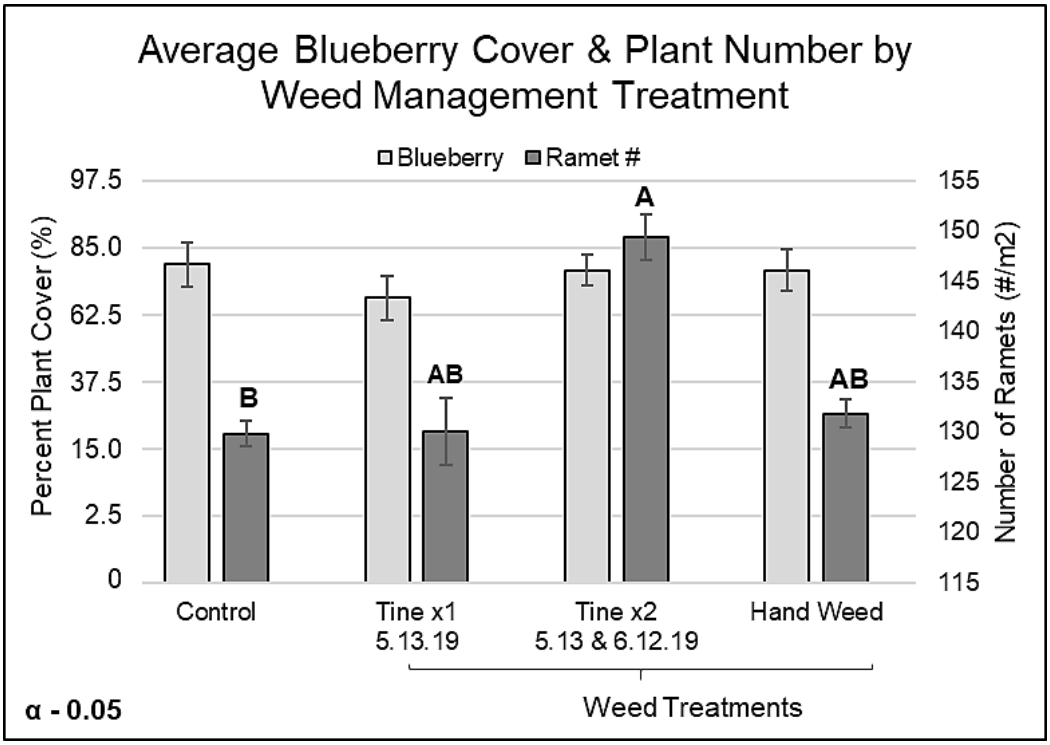

Figure 7. Average blueberry plant cover and average number of ramets/m^2 by weed management treatment in an organic wild blueberry field in Jonesboro, Maine. Error bars indicate the standard error of the mean. Letters indicate significance at the 0.05 level of significance.

Weed Control Efficacy

No significant differences were detected between weed management treatments and the presence of broadleaf or grass weeds in June or August (Figure 8). Hand weeding had the greatest efficacy of all the weed treatments. Interestingly the single tine weed event on May 13th, 2019 resulted in slightly greater weed cover relative to the control. This possible surge in weed cover following a single tine weed treatment may indicate that soil disturbance brings new weed seed to the surface or benefited from tillage in other ways. When the tine-weeding occurred on two dates, weed cover was slightly less than the control. Analysis of the subsequent effects of these weed treatments on weed persistence and wild blueberry yield in the 2020 crop-cycle is required.

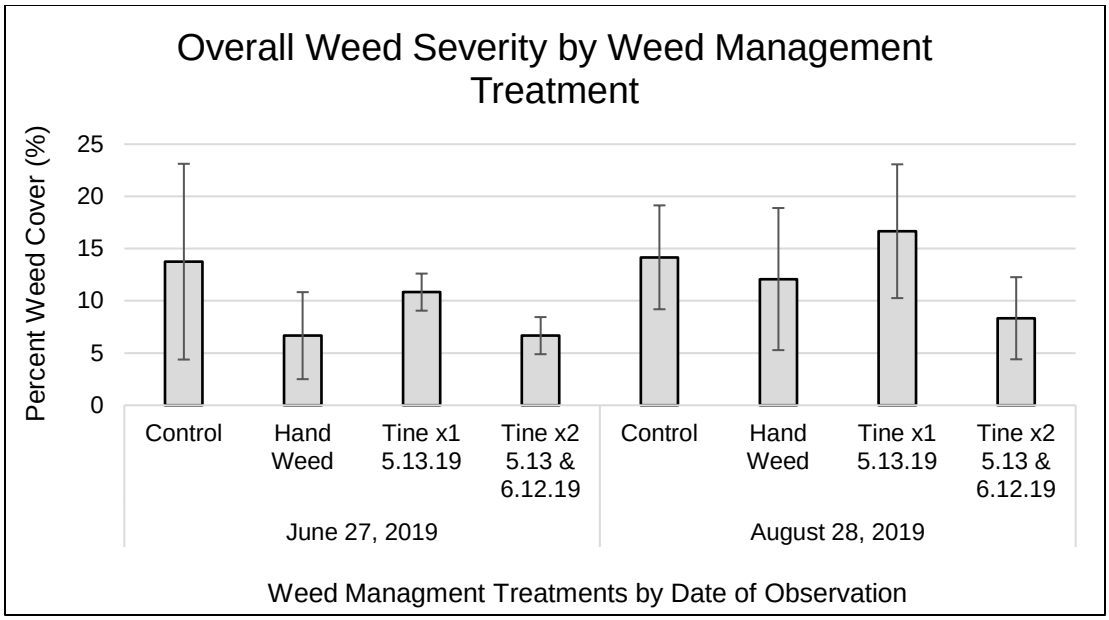

Figure 8. Average weed severity by survey date and weed management treatment in an organic wild blueberry field in Jonesboro, Maine. Error bars indicate the standard error of the mean. No significant differences were observed at the 0.05 level of significance.

DISCUSSION

While this was the first year of tine weeding on any wild blueberry field in Maine, some key observations were made. Preliminarily, tine weeding in early May uprooted annual weeds and two tine weeding dates stimulated wild blueberry growth. The June tine weeding date did not reduce weed pressure and possibly exposed new weed seed. Additionally, driving on wild blueberry in June clearly damaged the crop more than tine weeding, yet tire tracks filled in visually by August.

We know that wild blueberry responds well to mechanical stimulus such as fall pruning, burning, and cutting rhizomes (Libby 2011). There was a 15% increase in the number of ramets observed in plots that were tine weeded on two dates. A combination of crop stimulation and weed removal would be promising for chemical-free weed management.

CURRENT RECOMMENDATIONS

None at this time.

NEXT STEPS

- Carry out cover crop treatments.
- Perform tine weeding on the crop-cycle in the spring.
- Continue to survey wild blueberry health and weed presence
- Harvest to crop yields to compare the effects of weed management on yield.

ACKNOWLEDGEMENTS

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REFERENCES

Clark, A. 2007. Managing Cover Crops Profitably, Third Edition. Sustainable Agriculture Research and Education (SARE) Handbook Series Book 9.

Drummond, F. J. Smagula, D. Yarborough, and S. Annis. 2012. Organic lowbush blueberry research and extension in Maine. International Journal of Fruit Science. 12:216-231.

Libby, B. 2011. University of Maine Master's Thesis. Propagation, nursery container production, and rhizome growth studies of *Vacciumium angustifolium* Ait and *Vaccinium vitis-idaea* L. subsp. Minus (Lodd.) Hulten. University of Maine Master of Science Thesis.

Saunders, O. 2016. Weed control in low-input or organically grown wild lowbush blueberries. ONE 14-222 NE SARE Partnership Grant Final Report. UNH Extension.

Bowman, G. 1997. Steel in the Field; A Farmer's Guide to Weed Management Tools. Sustainable Agriculture Research and Education (SARE) Handbook Series Book 2.

Yarborough, D. E., & Marra, M. C. 1997. Economic thresholds for weeds in wild blueberry fields. *Acta Horticulturae,* 446:293-302. doi:10.17660/ActaHortic.1997.446.44