Demonstrating creation of habitat for beneficial insects - Year 3 (2020)

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Funding Sources

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- New York State Department of Agriculture and Markets
- The Towards Sustainability Foundation

Project Location

The demonstration plots are located in Ontario County. However, the results could be applicable throughout New York State.

Abstract

Many people are interested in protecting pollinators by creating good habitat for them. The same habitat (flowers and grasses of varied shapes and sizes that provide blooms throughout the growing season) is also good for other beneficial arthropods (including both insects and arachnids, like spiders and predatory mites) that are natural enemies of pests. There are many different ways to establish these plants and manage weeds during the establishment process. In this project, we demonstrate some of these options, while also collecting data on how effective (both in terms of plant establishment success and attracting beneficial insects) and costly each method is. In this third year of the project, we continued to maintain the plots established in 2018 and collected data on the time and costs required and weed control achieved using each method, and visually documented the growth of the habitat plants. Over three years, all transplanted treatments required similar amounts of time to establish. The mulched treatment required more time for the initial installation, but less time to weed in subsequent years. It also has the best establishment of habitat plants and least weed cover. The fall seeded treatments are establishing better than the spring seeded treatment, although the decision to stop mowing the spring seeded treatment in 2020 may be impacting establishment. Additional wildflower species bloomed in the seeded treatments in 2020. Whether plants were established by transplanting or seeding, something was blooming from mid- to late May until mid-October (when data collection ceased).

Background and Justification

From farmers to backyard gardeners to 4-H clubs to golf course managers, there continues to be strong interest in protecting pollinators. Providing perennial plants that produce pollen and nectar or offer shelter is one popular way to support pollinators. In and around agricultural fields, this same habitat can also shelter and feed other beneficial insects like natural enemies of pests (e.g., Grab et al. 2018, McCabe et al. 2017). It could also harbor pest insects. In backyard gardens, attracting natural enemies to a small vegetable plot is likely to be much more cost effective than releasing natural enemies.

There are many ways to establish perennial habitat for beneficial insects, and these methods typically involve some combination of the following three choices:

- Transplant small seedlings or direct seed
- Plant in the spring or in the fall
- Type of weed management

All three choices involve very different labor and supply costs, and are also expected to contribute to the speed and success of establishment. People who want to protect pollinators or attract natural enemies want to know which method is best, and facing a broad array of choices without advice or guidance can be daunting. Choosing an inexpensive but slow establishment method could also lead to frustration and abandonment of a pollinator habitat project when planting seeds in the spring does not produce a beautiful weed-free meadow of flowers by August.

This project provides data to help stakeholders select a beneficial insect habitat establishment method that fits their budget, timeline, and goals. It is also creating a demonstration field site where stakeholders and educators can view and learn about habitat establishment. Finally, it will enable us to collect additional data on the benefits of this habitat (which beneficial arthropod species are attracted, impacts on pests in an adjacent Christmas tree planting) and potential drawbacks (whether pest species are also attracted, and how many).

Objectives

1. Establish habitat (perennial wildflowers and grasses) using different methods and timing for planting and weed control in a research field at Cornell AgriTech in Geneva, NY.
2. Record the costs of materials and the amount of time required for plant establishment using each method.
3. Document the success and speed of establishment with each method (including weed control) during the first several years after establishment.
4. Quantify the insects present (pollinators, natural enemies, and pests) in the habitat plots established by different methods and compare them to arthropods present in nearby mowed grass. This objective was omitted in 2020, due to COVID-19 restrictions.
5. Quantify the impact of these habitat plots on pest populations in the adjacent Christmas tree planting. This objective will be completed in a later year.

Procedures

Plot maintenance (Objective 1)

Establishment of the beneficial insect habitat plots began in 2018 (see previous reports from Year 1 and Year 2 of this project) and treatments are summarized in Table 1. Maintenance of all treatments continued in 2020 (Table 2), similar to previous years, except that we stopped mowing Treatment C (seeded in spring 2018). It is generally recommended to mow perennial wildflowers aggressively for two growing seasons and to cut back on mowing in the third season (Lee-Mäder et al. 2013). This was the third growing season for Treatment C. A walk-behind mower was used to mow all plots except for treatment H (tractor-pulled mower used for tree row middles). Although an annual weed, ragweed was pulled by hand because it was blooming at a time of year when mowing was not required due to dry weather and slow growth of plants.

Table 1. Summary of plant-establishment treatments.

Treatment	Plant establishment	Time of establishment	Weed management
A	Transplant	Spring 2018	No-till; hand weeding
B	Transplant	Spring 2018	Mulch; hand weeding
C	Seed	Spring 2018	Mow; hand weed perennials
D	Transplant	Fall 2018	Buckwheat cover crop prior to planting; hand weeding
E - control	None	-	Mow
F	Seed	Fall 2018	Solarize prior to planting; mow; hand weed perennials
G	Seed	Fall 2018	Herbicide/tillage prior to planting; mow; hand weed perennials
H	grass mix	Spring 2018	Mow

Table 2. Summary of the methods used to establish habitat for beneficial arthropods in 2020.

Treatment	Spring 2020	Summer 2020	Fall 2020
A	-	Hand weed 2x	-
B	-	Hand weed 2x	-
C	-	Hand weed 1x	-
D	-	Hand weed 2x	-
E - control	-	Hand weed 1x	-
F	Mow 1x	Mow 1x; hand weed 1x	-
G	Mow 1x	Mow 1x; hand weed 1x	-
H - control	Mow as needed	Mow as needed	Mow as needed

We kept a record of supplies purchased and time spent maintaining each plot (mowing and hand weeding) throughout the season. A full description of the procedures used to establish each treatment in Year 1 of this project can be found online. Details of the perennial wildflower and grass species used in the plots are in the Year 1 report for this project.

Plant bloom, Insect sampling, Weed cover

From May through September, we took pictures of each plot and kept a list of which species were blooming (including weeds that were not planted) weekly. Insect sampling had to be canceled in 2020 due to COVID-related restrictions. Percent of plot area covered by weeds was assessed by Bryan Brown in spring and fall 2020.

Christmas trees

These beneficial arthropod habitats are being established at the edges of a 1-acre field planted with Christmas trees. The trees were planted in Spring 2018, and maintenance continues, including weed management and fertilization, as needed. Once the trees are larger, we will use them to address Objective 5, as well as to test and demonstrate other Christmas tree IPM strategies. In 2020, we collected data on tree survival (spring and fall), budbreak (spring), and tree height (fall; five trees measured per row per variety).

Results and Discussion

Plots where wildflowers were transplanted in spring 2018 without mulch (Treatment A) and fall 2018 following a cover crop (Treatment D) continue to require more effort to control weeds by hand pulling compared to the plots where mulch was applied after transplanting in spring 2018 (B; Fig. 1). This means that while applying mulch required a larger initial investment of time, these three transplanted treatments seem to require similar amounts of time when you compare them over the first few years of establishment. Few additional costs were incurred in 2020 to manage these plots, limited to gas for the mower. The transplanted and mulched treatment (B) continues to be the most expensive (Fig. 2).

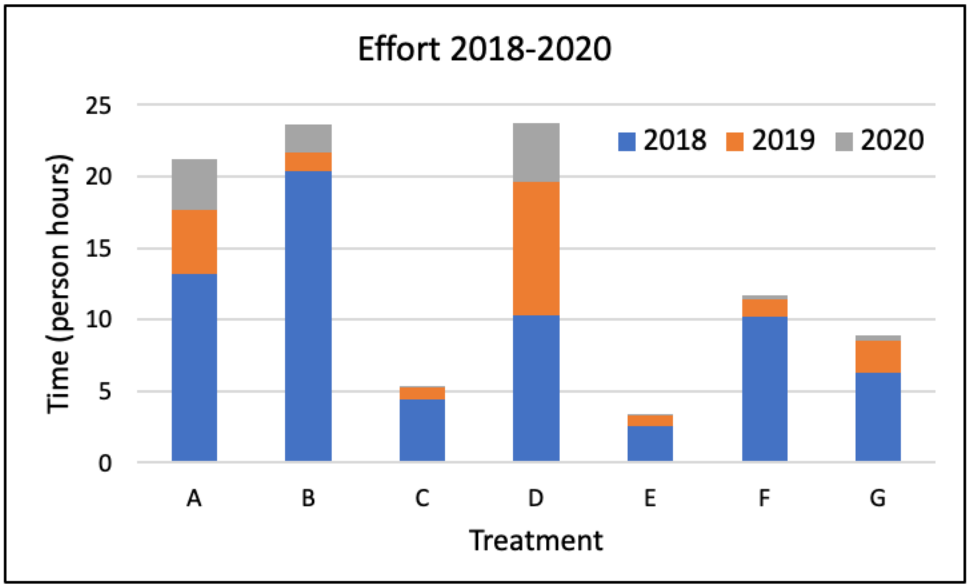

Figure 1. Amount of time spent establishing and maintaining beneficial arthropod habitat plots in Years 1-3 (2018-2020) of this project. Total time spent on all four replicate plots (460 ft^2 or 0.01 A) is shown for each treatment.

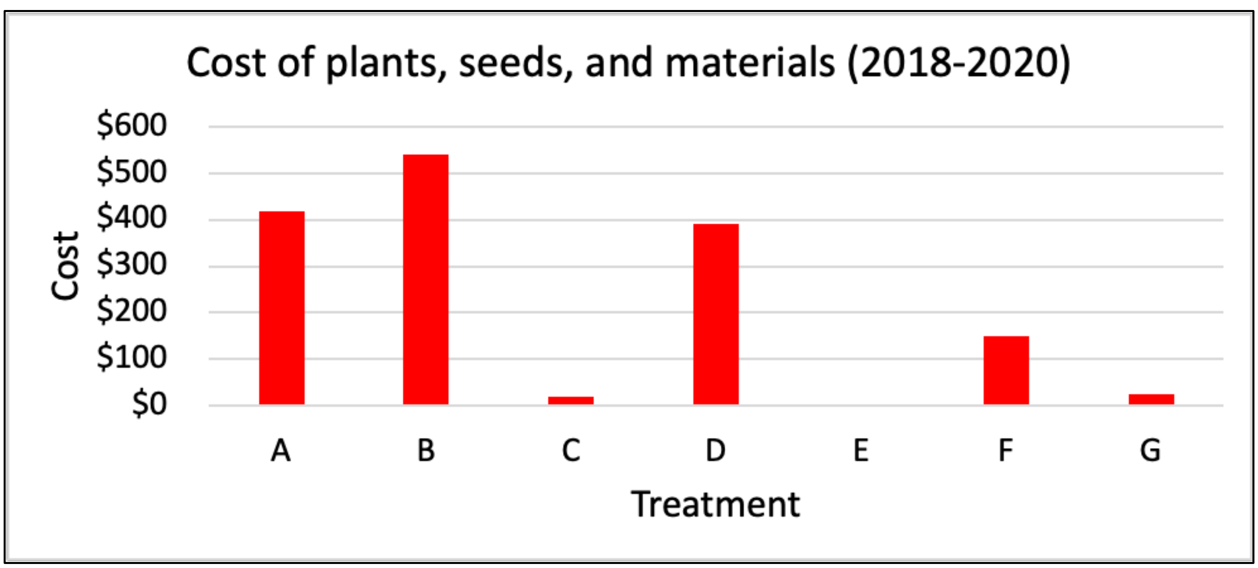

Figure 2. Total cost of plants, seeds, and materials for establishing and maintaining beneficial arthropod habitat plots in Years 1-3 (2018-2020) of this project. Total cost for all four replicate plots (460 ft^2 or 0.01 A) is shown for each treatment.

Very little mowing was done in 2020 because of dry weather. The decision to stop mowing plots seeded in spring 2018 resulted in plots that were largely over-run by grasses (may or may not have been part of the original seed mix) and aster weeds (not species included in the mix). Some species that were seeded (e.g., blackeyed susans, coreopsis, echinacea, butterfly milkweed) did bloom, but not very many (Fig. 3). It could be that the wildflower establishment was poor. Spring is not the recommended time for planting perennial wildflower seeds. Or it could be that these plots needed to be mowed at least once in 2020. Since 2021 will be the third year for the fall-seeded plots, perhaps less-frequent (rather than no) mowing in these plots would be a better strategy. In contrast, even if they did not bloom, many seedlings of wildflowers from the seed mix were observed in the plots seeded in fall 2018, include echinacea, butterfly milkweed, four different aster species, bergamot, blackeyed susans, and goldenrod (Fig. 4).

Figure 3. One of the plots in treatment C seeded in spring 2018 and not mowed in 2020. Picture was taken on 14 July.

Figure 4. One of the plots seeded in fall 2018 and mowed during 2020. Picture was taken on 1 September.

This year, we kept notes not only on what was blooming each week, but on whether flowers had just started to open (E = early bloom), were fully open (P = peak bloom), or were fading (F = fading bloom). Because there were 12 plots across three treatments for each transplanted or direct seeded species, if the plots were evenly split between early and peak (EP) or peak and fading (PF), these two intermediate categories were added. From the third or fourth week in May through the second week in October, something was blooming in at least one plot per treatment. Tables 3 and 4 summarize what was blooming in plots established by transplanting or seeding, respectively. In the seeded plots the following species did not bloom in 2020: yellow false indigo, partridge pea, marsh blazing star, narrowleaf mountain mint, wild senna, Maryland senna, early goldenrod, Ohio spiderwort. A color version of these charts is available here.

Table 3. When transplanted perennial wildflowers bloomed in 2020 by week. E = early bloom; EP = evenly mixed early and peak bloom in different plots; P = peak bloom; PF = evenly mixed peak & fading bloom in different plots; F = fading blooms.

	May				Jun					Jul				Aug				Sep					Oct	
	5	12	21	27	1	9	16	23	30	6	14	21	28	6	12	17	26	1	8	15	22	28	6	14
Golden alexanders		E	P	P	P	F	F																	
Ohio spiderwort					E	E	E	P	P	P	F	F	F	F	F	F	F	F						
Catmint					E	P	P	PF	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Lanceleaf coreopsis						E	P	F	F	F														
Blue false indigo						E	P																	
Tall white beard tongue							E	P	F	F	F	F												
Common milkweed									E	F														
Purple coneflower										E	E	P	P	P	F	F	F	F	F	F	F			
Wild bergamot										E	PF	F	F	F	F	F								
Anise hyssop														E	P	P	F	F	F	F	F			
Boneset														E	P	P	F	F	F	F				
NY ironweed												E	E	E	P	P	P	P	F	F				
Orange coneflower													E	E	P	P	P	P	PF	F	F	F	F	
New England aster																	E	E	E	E	P	P	P	F
Showy goldenrod																			E	P	P	F	F	

Table 4. When direct seeded perennial wildflowers bloomed in 2020 by week. E = early bloom; EP = evenly mixed early and peak bloom in different plots; P = peak bloom; PF = evenly mixed peak & fading bloom in different plots; F = fading blooms.

	May				Jun					Jul				Aug				Sep					Oct	
	5	12	21	27	1	9	16	23	30	6	14	21	28	6	12	17	26	1	8	15	22	28	6	14
Golden alexanders			E	P	PF																			
Hairy beard tongue						E	E																	
Lanceleaf coreopsis							E	PF	F	F	F	F			F	E	P	F	F		F	F	F	F
Tall white beard tongue							E																	
Blackeyed susan									E	E	P	P	P	P	P	P	PF	PF	F	F	F	F	F	F
Purple coneflower											E	E	P	P	P	P	F	F	F	F	F		F	EP
Wild bergamot												E	F	F										
Butterfly milkweed																P	F		E					
Orange coneflower																		E	P	P	PF	F		F
Smooth blue aster																		E		E	P	P	P	P
Gray goldenrod																			E	E	EP	P	F	F
New England aster																				E	E	P	P	P
Zigzag aster																				E	E	P	P	P
Aromatic aster																					EP		EP	P

Weed coverage continued to be high in the seeded treatments (C, F, and G), although coverage of the beneficial habitat plants improved from spring to fall. With weeds controlled by hand weeding, the wildflowers are establishing well, especially in the transplanted and mulched plots (Figs. 5 and 6). Note that the total plot area covered by either weeds or wildflowers sometimes exceeds 100% because weeds were initially assessed by species (and then summed over all species). Also, both weeds and wildflowers may overlap each other in the plots.

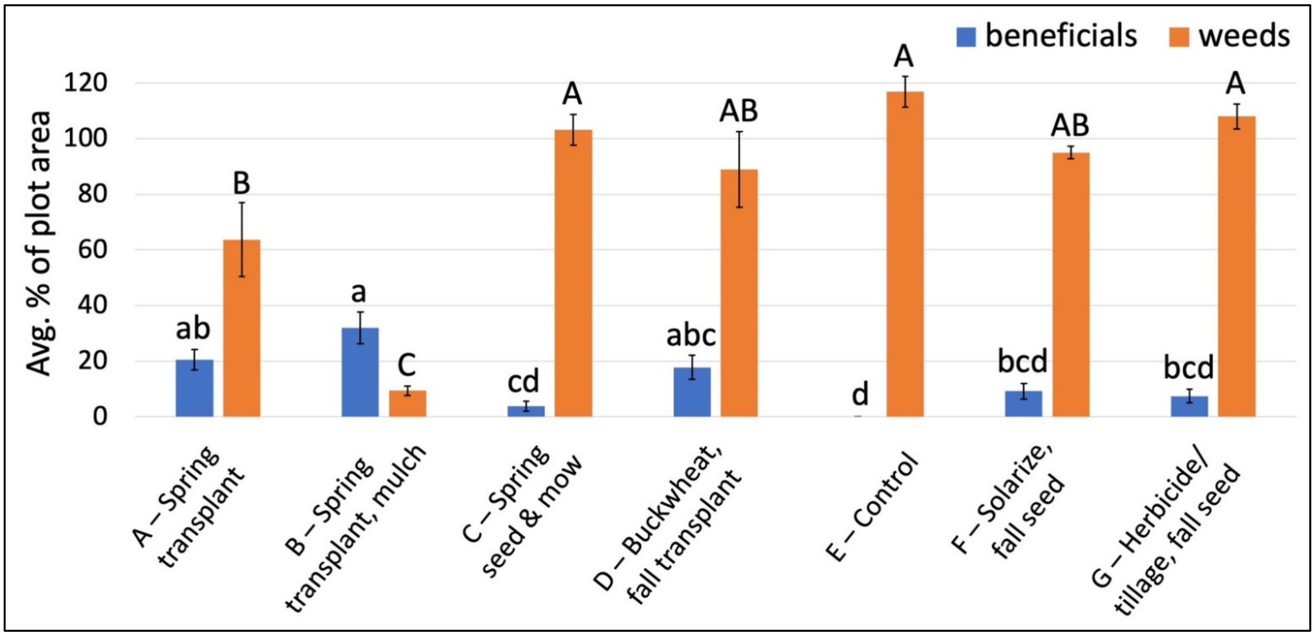

Figure 5. Beneficial habitat plant (blue bars) and weed (orange bars) cover assessed on 19 May 2020. Blue bars labeled with the same lower case letters and orange boars labeled with the same uppercase letters are not statistically different from each other ($P < 0.001$).

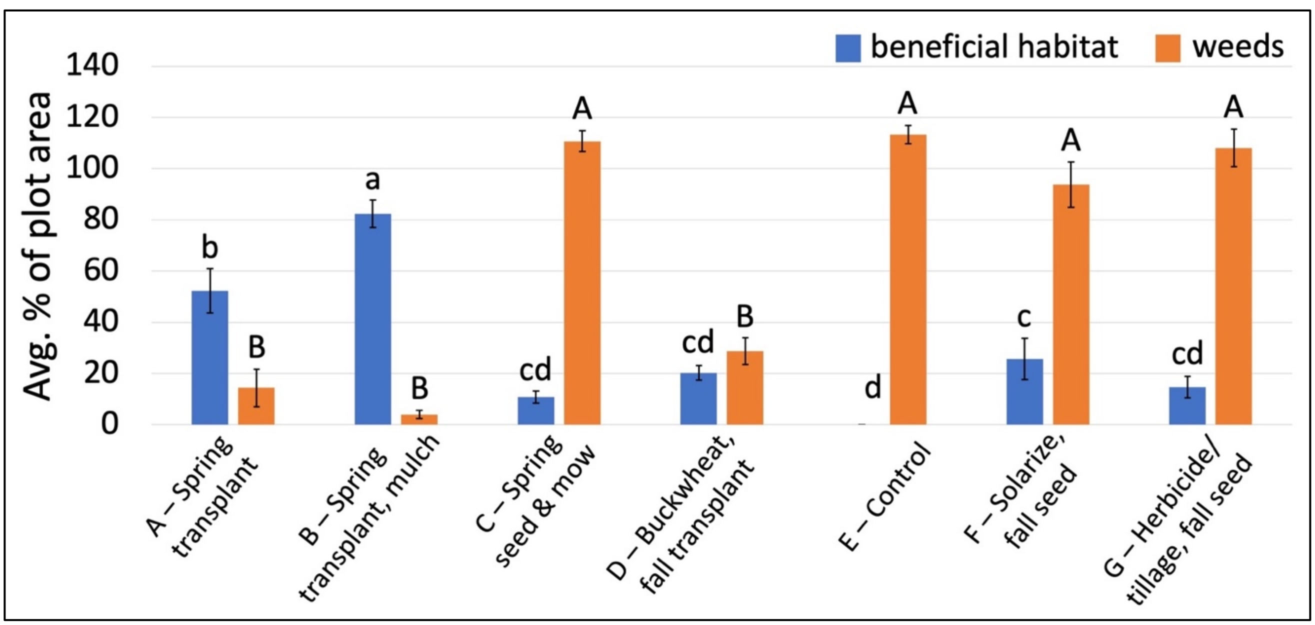

Figure 6. Beneficial habitat plant (blue bars) and weed (orange bars) cover assessed on 25 September 2020. Blue bars labeled with the same lower case letters and orange boars labeled with the same uppercase letters are not statistically different from each other ($P < 0.001$).

Most Christmas tree varieties have survived well, with the exception of the Peterson Frasers and the Turkish firs and few trees were lost during the growing season (Table 5). The first assessment of budbreak was made on 27 May, and several varieties had already exceeded 90% budbreak by that date. Budbreak data collection should start earlier in 2021.

Table. 5 Survival of Christmas trees assessed in May and October 2020, the average height (assessed by measuring five trees per row per variety), and the date when at least 90% of trees in a row had broken bud.

Variety	% surviving May 2020	% surviving Oct 2020	Avg tree height Oct 2020 (in)	≥ 90% budbreak
Balsam Cook's Blue	74%	74%	18.1	6/9
Balsam Sheets Harbor	79%	68%	22.2	5/27
CB Spruce	100%	100%	25.0	5/27
Douglas fir - DEC Lincoln	90%	90%	21.9	5/21
Fralsam	79%	74%	23.6	5/27 - 6/9
Fraser - Peterson	38%	31%	14.3	6/18
Douglas fir - Fort St. James	79%	79%	26.9	5/21
Korean fir	86%	71%	14.2	6/18
Korean x Balsam fir	96%	93%	14.1	6/18
Myer Spruce	100%	100%	16.7	5/27
Nordman - Adagini	100%	100%	15.1	5/27
Nordman Bucraini	90%	70%	12.2	5/27 - 6/1
Turkish fir	25%	0%	-	5/27

Outcomes and Impacts

Because of COVID, some outreach events had to be canceled in 2020. Results from this project were shared with 50 growers at the Christmas Tree Farmers Association of NY Winter Meeting in January, and with 169 attendees at two webinars (including Master Gardener Volunteers, extension staff, growers, and home gardeners). Following these webinars, a Cornell list serv was created to continue disseminating information about establishing habitat for beneficial insects (72 subscribers). Although 73% of respondents at the first webinar (focused on how to establish beneficial habitat) were already creating habitat for pollinators, all respondents reported that they learned something. At the second webinar (focused on sharing results from 2019 insect sampling and recognizing beneficial insects), participants were shown images of different insects at the beginning and end of the presentation. While fewer than 10% of respondents correctly identified the insects that were beneficial at the beginning of the meeting, 54% correctly recognized all beneficial insects by the end of the meeting. When considering survey responses from all Christmas tree outreach meetings held in 2019 and 2020, more growers intend to invest more time in establishing habitat for beneficial insects after the meetings than before the meetings (Fig. 7). Concern for protecting pollinators and the environment and belief that providing habitat for beneficial insects will improve pest control continue to be the most popular reasons why Christmas tree growers are interested in establishing habitat (Fig. 8). Concerns about how much time establishment will take and the need for more information about how to do this on their farms are the most important barriers (Fig. 9). Information about this project, how to establish habitat for beneficial insects, and recognizing beneficial insects was also shared with 104 additional stakeholders, including Master Gardener Volunteers and urban growers through three additional meetings in 2020.

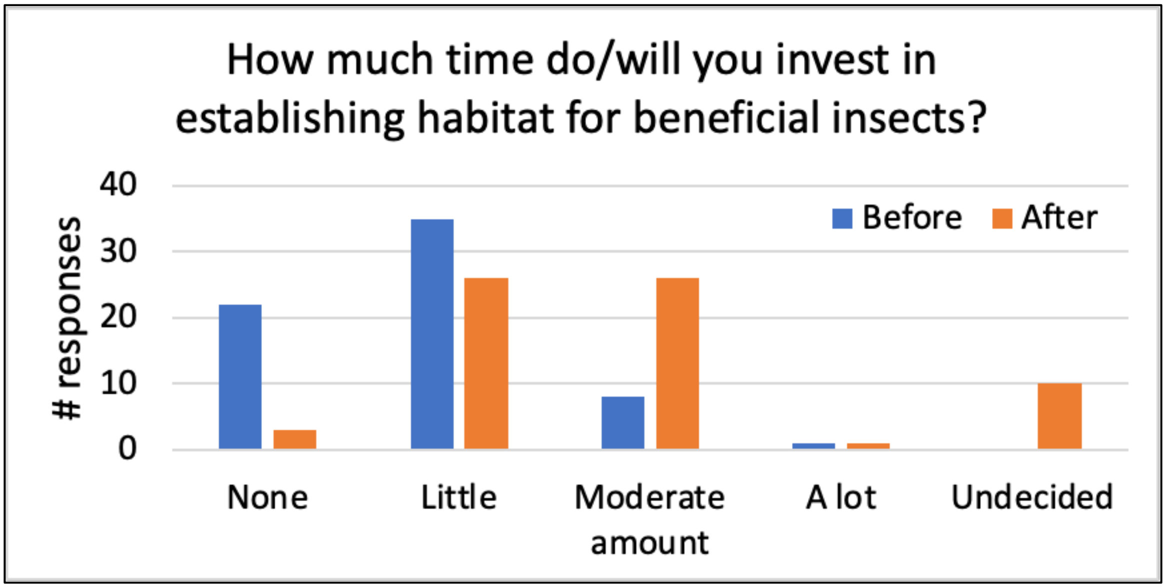

Figure 7. Number of growers reporting how much time they currently spend creating habitat for beneficial insects at the beginning of meetings (blue bars) or after hearing about this project (orange bars). Results are from two meetings held in 2019 and one in 2020, with a total of about 60 survey responses (different numbers of responses before vs. after).

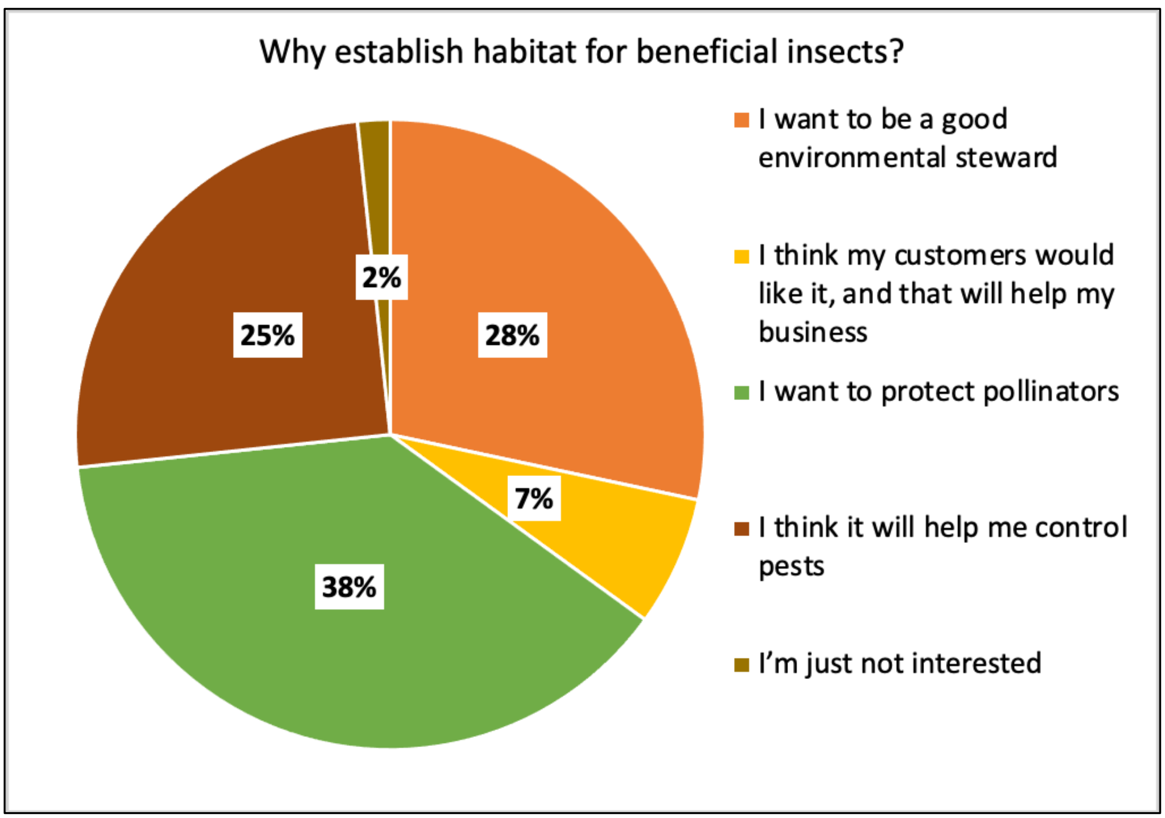

Figure 8. Reasons why Christmas tree growers are interested in establishing habitat for beneficial insects. Data shown are percent of growers responding to surveys at two meetings in 2019 and one meeting in 2020, with a total of about 60 survey responses (different numbers of responses before vs. after).

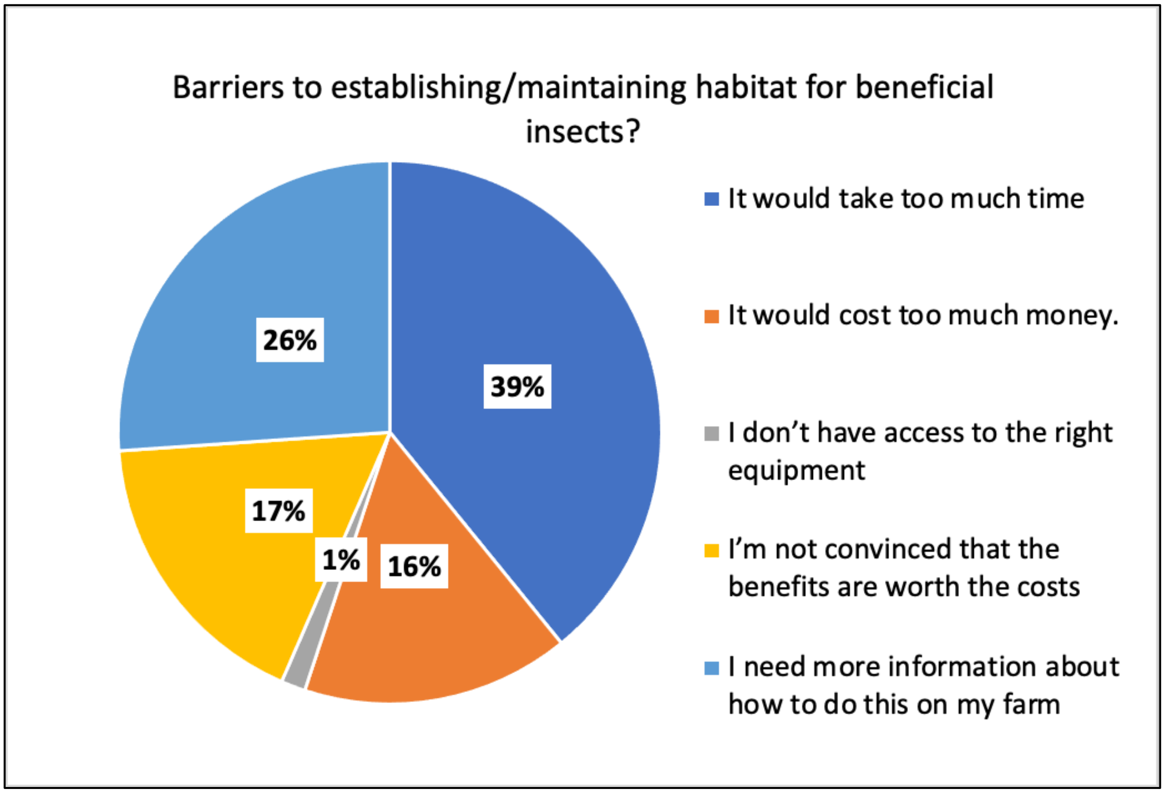

Figure 9. Reasons why Christmas tree growers are hesitant to establish habitat for beneficial insects. Data shown are percent of growers responding to surveys at two meetings in 2019 and one meeting in 2020, with a total of about 60 survey responses (different numbers of responses before vs. after).

Publications

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Grants Funded

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