


Research Report: Using Insectary Plants to Attract Hoverflies in NH, 2017 and 2018

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INTRODUCTION and BACKGROUND

Aphids are an economically damaging pest for several crops. This study aimed to explore the practicality of using insectary plants to attract predatory hoverflies to help manage aphids. Sweet alyssum (*Lobularia maritima*) has been successfully used as an insectary crop to help manage aphids on broccoli and lettuce crops in California, however, this practice is untested in the Northeast.

Before we recommend using insectary plantings for biological control of aphids, we need to know:

- Which insectary plants are most attractive to hoverflies?
- Do the insectary plants attract other, less desirable insects?

Hoverflies (Diptera: Syrphidae), also known as flower flies or syrphid flies, are a diverse family with 6,000 described species. Many hoverfly adults are brightly colored, striped, and may sometimes be mistaken for bees (Figure 1). Characteristics that distinguish hoverflies from bees are their large eyes that constitute most of their head, their stubby antennae, their two wings, and their aptitude for hovering like a hummingbird.

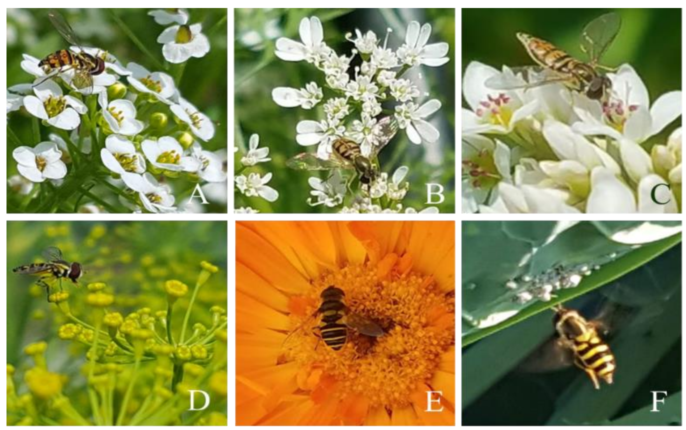

Figure 1. Hoverflies foraging on various insectary plants and locating aphids on a cash crop. ***(A)*** *Toxomerus geminatus on alyssum;* ***(B)*** *Toxomerus marginatus on cilantro;* ***(C)*** *Toxomerus marginatus on buckwheat;* ***(D)*** *Toxomerus marginatus on dill;* ***(E)*** *Unidentified hoverfly on calendula;* ***(F)*** *Unidentified hoverfly locating a cabbage aphid colony on a Brussels sprout leaf.*

Hoverfly adults feed from flowers for important nutrients needed for reproduction and energy. Subsequently, these adult insects fly to the neighboring cash crop plants and lay eggs that hatch into larvae that prey on aphids. See the life cycle below (Figure 2).

Several studies have shown that insectary plantings encourage adult hoverflies to stay in the field longer, increasing aphid predation rates and reducing crop damage. Since there are many hoverfly species, and not all hoverfly species have predatory larvae, it is important to identify the species of hoverflies present in this region to understand their potential as biological control agents of aphids.

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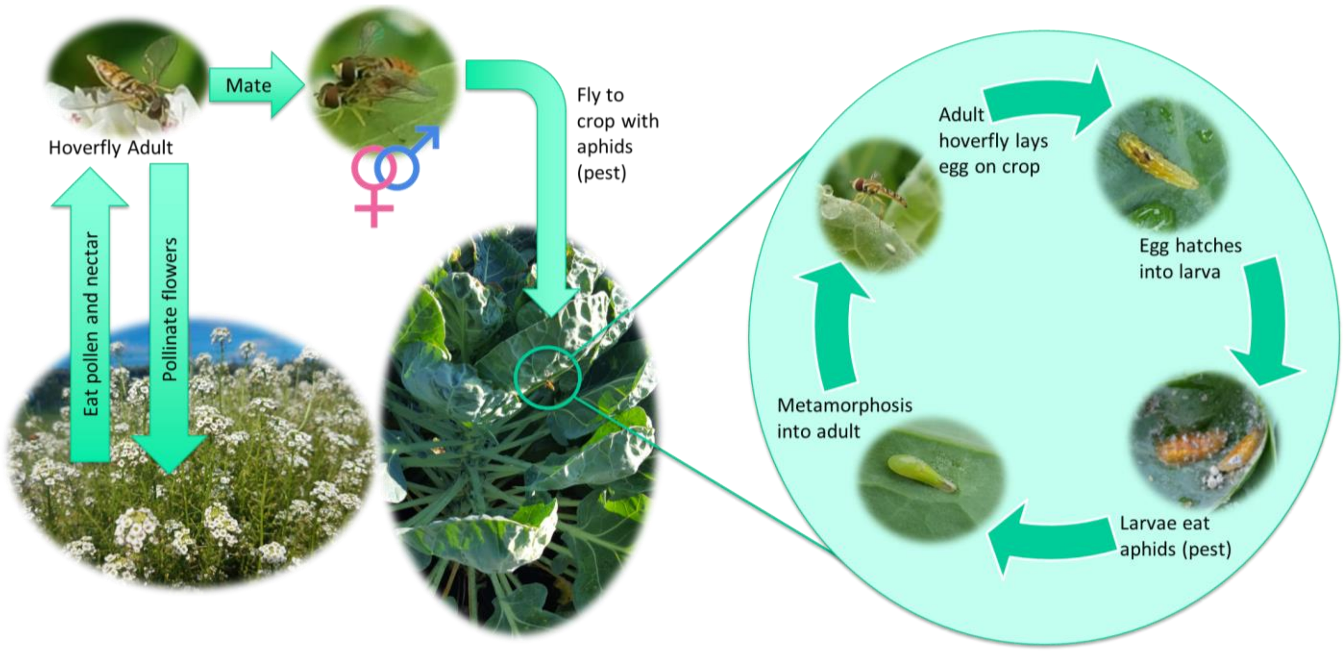

Figure 2. Lifecycle of an aphid-eating hoverfly with a Brussel sprout host plant. The life stage that is responsible for eating aphids is the larvae, which then pupate and go through metamorphosis into adults.

We focused on annual flowering plants that have been studied as insectary plants:

(1) Alyssum (*Lobularia maritima*)
(2) Buckwheat (*Fagopyrum esculentum*)
(3) Cilantro (*Coriander sativum* L.)
(4) Dill (*Anethum graveolens* L.)
(5) Phacelia (*Phacelia tanacetifolia*) – 2017 only
(6) Calendula (*Calendula officinalis* L.) – 2018 only
(7) Fennel (*Foeniculum vulgare*) – 2017 only

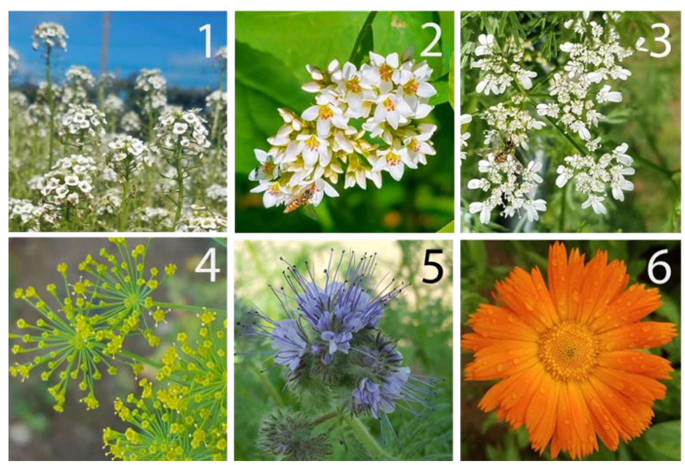

Figure 3. Field photos of flowering insectary plants. Fennel is not included because it did not flower in 2017.

GOALS, OBJECTIVES and HYPOTHESES

Our overall goal was to understand how insectary plants are used by hoverfly species in our region over time, and to determine which hoverfly species are present in the region. Our specific goals were:

(1) Describe the bloom duration for seven insectary plant species from July until frost;
(2) Quantify the number of hoverflies observed on different insectary plant species;
(3) Quantify the number of other insects observed on different insectary plant species;
(4) Identify hoverfly species collected from insectary plants.

WHAT WE DID

Insectary plant seedling production.
All insectary plants (except Buckwheat) were sown into 128-cell trays using Promix BX soilless media and grown in a greenhouse until transplant at Woodman Horticultural Farm in Durham, NH. Buckwheat was direct seeded in the field at a rate of 27 oz of seed per plot. In 2018, phacelia did not germinate and therefore was not included.

Field site preparation. Field experiments were conducted at the NH Agriculture Experiment Station's Woodman Horticultural Farm in Durham. Before transplanting, 150lbs/acre of nitrogen (N) as 27-0-0 was incorporated in the spring based on soil test recommendations. Raised beds (6' between centers) with one line of drip tape were covered with 0.6 mil Organix A.G. Film biodegradable black mulch. Three slits were cut into the mulch in each plot to seed or transplant insectary plants. Seedlings (except calendula and buckwheat) were transplanted 20 days after seeding (DAS) on 11 July 2017 and 20 June 2018. Calendula seedlings were transplanted at 30 DAS on 11 Aug 2017 and Buckwheat was direct seeded in the field on 21 Jul 2017 and 21 June 2018. Density for all transplants was 45 plants per plot (3 rows per bed) except for calendula, which had 30 plants per plot.

Irrigation. Irrigation was determined by regular evaluation of the root zone. On average, the drip irrigation ran about 1.5 hours weekly in 2017, whereas in 2018 drip irrigation was only run twice due to regular rainfall.

Experimental design. The insectary plants were placed in a randomized complete block design with 4 replications (Figure 4). Each plot was a 3-foot-wide raised bed by 5 feet long. There were 2 feet of unplanted bed between each plot.

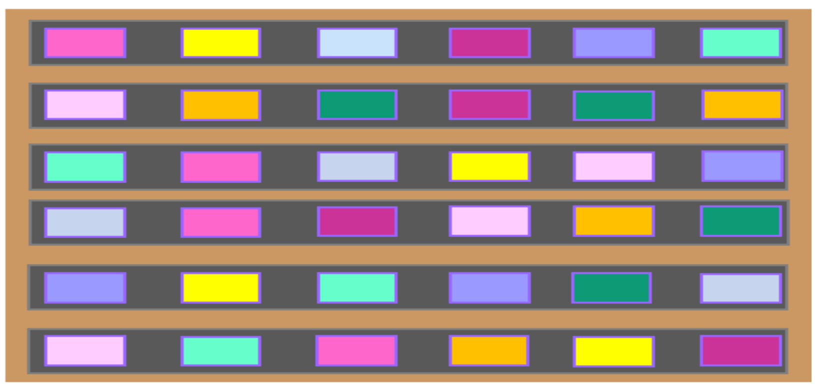

Figure 4. Randomized complete block design of insectary plants with two feet of black plastic mulch between each plot.

DATA COLLECTED

Duration of Bloom. Plots were observed weekly to collect first and last bloom date for each insectary plant treatment (Figure 5).

Figure 5. Photo of field in 2018.

DATA COLLECTED (continued)

Hoverfly and other insect density.
In 2017 we counted the densities of hoverflies, other flies (from the order Diptera, not including Syrphidae), honeybees, bumble bees, other bees, lady beetles, ants, flea beetles, and spiders.

In 2018 we counted hoverflies, honeybees, bees, bumble bees and lady beetles. Additionally, we counted observations of imported cabbageworm adult moths (*Pieris rapae*), a common *Brassica* pest.

Insects were counted from July through October, with eight sample dates in 2017 and 11 sample dates in 2018. Observations were taken before noon on days that were not raining with less than five miles an hour of wind. Insects were counted on insectary plants only if all four replicates had open flowers.

Insect density was measured by placing a 20-inch diameter (314 in^2) plastic ring over a flowering plot (Figure 6). Each plot was observed for two minutes with the naked eye. The ring was then moved within the same plot to a different location and was observed again for two minutes. Thus, insect density is described as the number of insects per 314 in^2 per 4 min. Insects were counted if they flew through the ring during the given time frame; they did not need to land or feed to be counted. Insects that left the ring and re-entered again were counted as an additional insect observed.

Figure 6. Flowering alyssum with 20-inch diameter (314 in^2) black plastic ring for timed insect observations. The ring was placed on a plot and insects were observed for two minutes. The ring was then moved to another location in the same plot and observed for another two minutes. This process was replicated four times for each insectary plant species.

Figure 7. Example of a sweepnet lightly grazing the top of a young alyssum planting. Collected insect specimens were stored in containers with ethanol.

Hoverfly adult identification. We collected insect specimens for identification over 10 dates (July through October) using a standard 15-inch mesh insect sweepnet. Two passes were made with the sweepnet, lightly grazing the top of the flowers (Figure 7). Hoverfly specimens were then dried, pinned, labeled, and sent to the Canadian National Collection of Insects in Ottowa, Ontario for official identification by Michelle Locke.

RESULTS

Duration of bloom. In 2017, the bloom period began with buckwheat at the end of July and ended after hard frosts in November with alyssum (Table 1). The bloom period for buckwheat lasted only 5 weeks. In contrast, alyssum flowered for 16 weeks, into November. Phacelia and dill bloomed for 11 weeks, from the end of August until frost; and cilantro bloomed for 10 weeks, from mid-August until the end of October. In 2018, bloom periods were mostly consistent with 2017. The bloom period started in late July with buckwheat and ended at the frost in November with alyssum and calendula still flowering (Table 1). Similar to alyssum, calendula continued to flower until hard frost, despite the mature seed heads not being removed.

Hoverflies throughout the season. Hoverflies were observed at all sample dates throughout both years, from late July through October. On some dates, far more hoverflies were observed on some flowers than others. For example, buckwheat had more hoverflies than alyssum in late July 2017, whereas exactly the opposite was true in early September 2018 – the reasons for this are not clear.

Table 1. Duration of insectary plant bloom, displayed in weeks of the month. Colored cells indicate that plants were blooming. Numbers indicate the density of hoverflies per 314 in^2 per 4 min. Numbers are in bold when the hoverfly density was significantly greater than or equal to the density on other plants blooming that week.

2017																
Flowering Plant	Jul		Aug				Sept				Oct				Nov	
	Week number															
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Alyssum		1	4	10	**5**				**24**	6				2		
Buckwheat		**16**	18	18	**8**											
Cilantro					0				8	**16**				2		
Dill									7	6				0		
Phacelia									1	1				1		
2018																
Flowering Plant	Jul		Aug				Sept				Oct				Nov	
	Week number															
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Alyssum		**10**		13	**13**	**17**		**17**	**3**	**8**	**6**					
Buckwheat		**6**		12	**14**	**9**		4								
Cilantro				4	**26**	**15**		6	**1**	**2**						
Dill		2		4	**15**	13		3								
Calendula		0		3	2	8		6	0	0	0					

Season-long hoverfly abundance. In 2017, there were significantly more hoverflies on alyssum and buckwheat than on cilantro, dill and phacelia. In 2018, there were significantly more hoverflies on alyssum than on buckwheat, calendula, cilantro, and dill. Phacelia and calendula had the fewest hoverflies in 2017 and 2018, respectively (Figure 7).

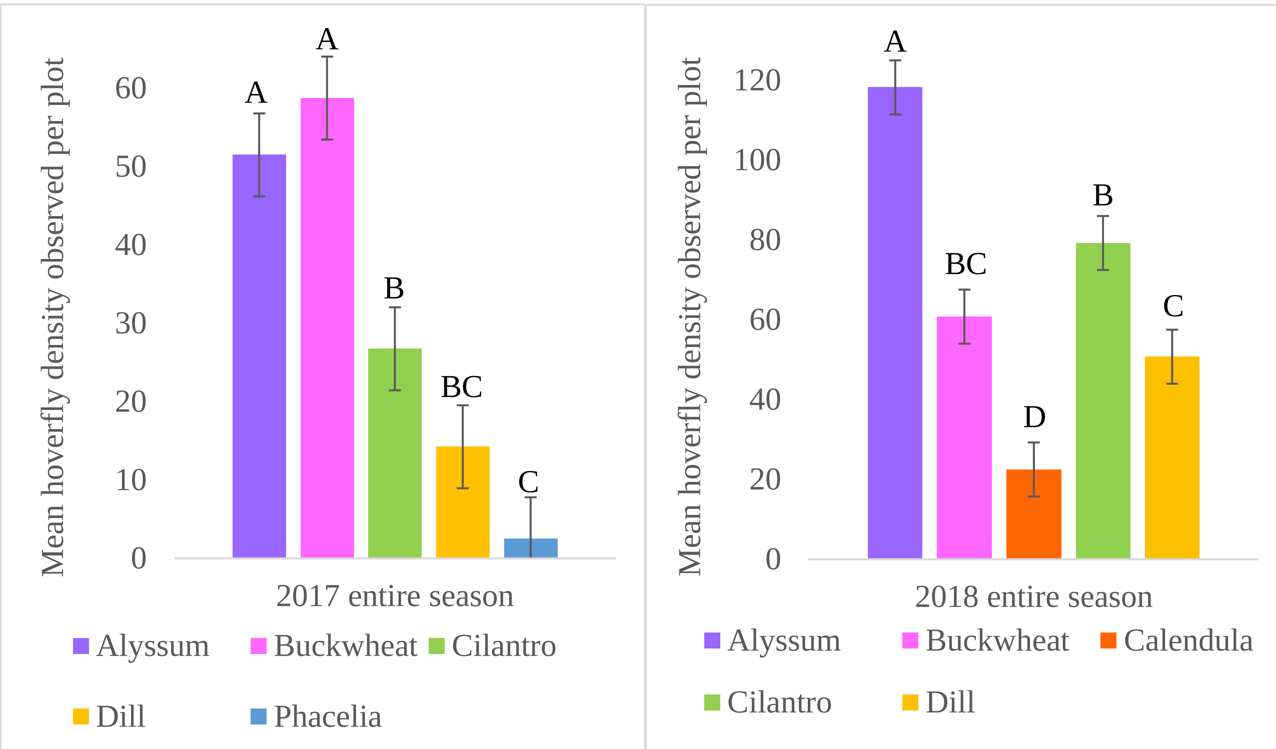

Figure 7. Cumulative mean hoverfly density over entire season per plot, 2017 and 2018. Treatment means followed by the same letter are not significantly different.

Hoverfly Adult Identification. Of 222 captured and identified hoverfly specimens in 2018, the most abundant hoverfly was ***Toxomerus marginatus*** (84.2% of all specimens). ***Syritta pipiens*** and ***Toxomerus politus*** each represented 3.6% of specimens. The remaining 5% included ***Toxomerus geminatus, Syrphus ribesii, Syrphus vitripennis, Sphaerophoria philanthus, Sphaerophoria contigua, Eupeodes americanus, Melanstoma mellinum, Eristalis transversa*** and ***Eristalis tenax.***

This is consistent with results from elsewhere. ***T. marginatus*** is the most prevalent hoverfly species found in vegetable crops in California, and ***T. marginatus*** and ***S. contigua*** have been reported to be the two most prevalent aphid-eating hoverflies in central Illinois over 33 years of data collection.

Other Insects. For each, prevalence on insectary plant species is sorted from most to least:

	2017		
Honeybees.	Buckwheat	≥ Alyssum, Cilantro, Phacelia	≥ Dill
Bumble bees.	Phacelia	≥ Cilantro	≥ Alyssum, Buckwheat, Dill
Other bees.	Buckwheat	> all others species tested	
Lady beetles.	Dill	> all others species tested	
Flea beetles.	Alyssum	> all others species tested	
	2018		
Honeybees.	Buckwheat, Cilantro	≥ Alyssum, Calendula	≥ Dill
Bumble bees.	Calendula	≥ Buckwheat, Cilantro	≥ Alyssum, Dill
Other bees.	Calendula	≥ Buckwheat, Cilantro	≥ Alyssum, Dill
Lady beetles.	Observed on all species, but no significant differences between species.		
Imported cabbageworm (Pieris rapae).	Calendula > all others.		

Overall. Some noteworthy observations include:

- **Alyssum** – had **more flea beetles** than other species
- **Buckwheat** – had **more honeybees** than other species
- **Dill** - had **fewer bees** than other species, and in 2017, had **more lady beetles** than other species.
- **Calendula** – had **fewer hoverflies**, and **more imported cabbageworm moths, bumblebees,** and **other bees** than several other species.

OVERALL CONCLUSIONS

- **Alyssum, buckwheat, cilantro, and dill had more hoverflies** throughout the season than calendula, phacelia, and fennel.
- **Alyssum** was a low maintenance plant that continuously flowered and attracted the hoverfly *Toxomerus marginatus* from July until frost.
- Some of the insectary plants did host important brassica pests, such as **flea beetle (alyssum)** and **imported cabbageworm (calendula).**
- **Additional work is needed to determine whether hoverflies present on insectary plants make meaningful contributions to biological control of aphid (or other) crop pests.**

ACKNOWLEDGEMENTS

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Alina's M.S. Defense Seminar that includes this insectary plant research was recorded with more information and can be viewed:
https://media.unh.edu/media/ANFS+SeminarA+Alina+Harris+M.S.+Thesis+Defense%2C+18+July+2019/1_bo0x2kpn/111160261

Alina's Full Written M.S. Thesis is available with open access, which includes succession plantings of the same insectary plant species in hoverfly density comparisons by date:
https://pqdtopen.proquest.com/doc/2307785575.html?FMT=ABS

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