

Annual Flowering Herbs for Pollinators Variety Trial

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- Rick Hartmann - Minburn
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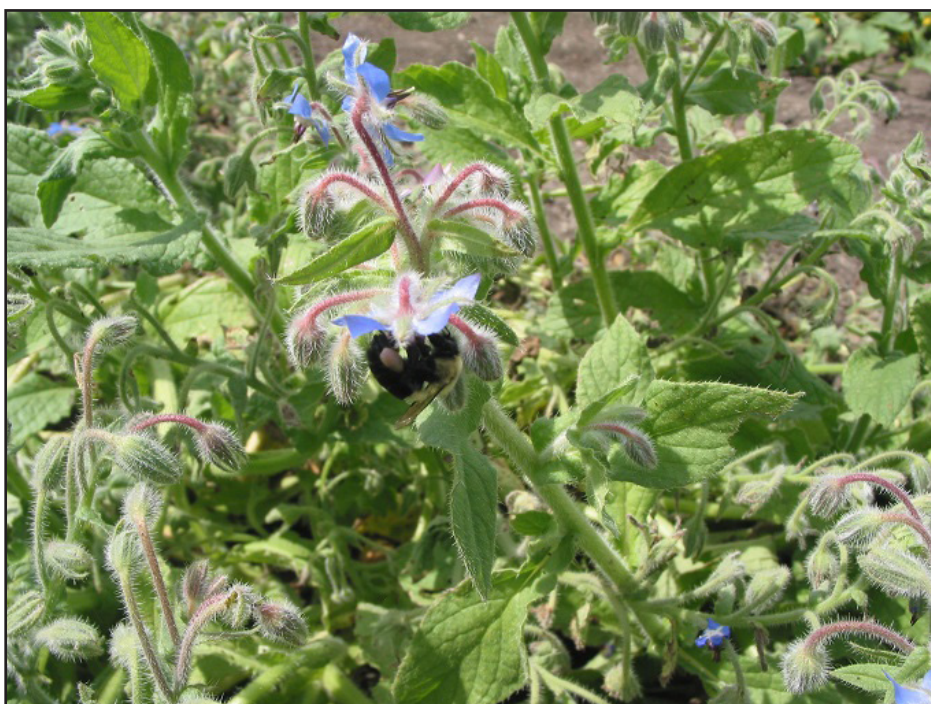
In a Nutshell

- Two farmers planted strips of flowering herbs – anise hyssop, borage, and lemon basil – with cash crops on their farms. Pollinators in prairie strips were also observed.
- Farmers evaluated characteristics of the herbs and assessed pollinator use of the herbs by doing transect counts of pollinators during bloom.

Key Findings

- Neither farm had successful direct seedings of anise hyssop (McGary had success with transplanting).
- Borage filled out and flowered earliest though it became top-heavy, fell over, and had late-season weed management issues.
- Lemon basil (and anise hyssop, at McGary's) had healthy, upright habits but required more early-season weeding at Hartmann's.
- Small native bees had the most individuals counted among all pollinator groups observed on both farms.
- Hartmann's lemon basil had the most pollinators; at McGary's, borage had the highest average count.

Project Timeline:
April 2016 – Oct. 2016



A bee visiting a borage flower.

level diversity increases abundance and richness of native pollinators, and studied increases in fruit set are best achieved with native pollinators, while managed honey bees have been found to be only supplementary (Garibaldi et al., 2013; Kennedy et al., 2013). Most research uses perennial flowering habitat, including 2013 research by Practical Farmers of Iowa farmer-researchers on baseline bee populations (Kolbe et al., 2014).

The practice of increasing perennial habitat and floral resources for pollinators and beneficial insects around field margins and in patches is gaining popularity among farmers. For this project, however, farmers were interested in providing floral resources for pollinators within their production beds using annual flowering herbs. Rob

Faux, who completed a separate pollinator project on flowering strips with Practical Farmers in 2016 said, "We are convinced that annual flowering plants are important for the diversity in our vegetable production and want to support increased use of flowering plants in other horticulture operations. We see this project as a step in that direction." Rick Hartmann, who participated in this project, echoed this sentiment, saying, "I would like to incorporate more non-crop plants within my production fields. I hope we can identify suitable herbs to use, how to manage them and an idea of how beneficial they are."

Some studies have compared pollinator activity in annual flower mixes to perennial flower mixes. They found the annual mixes, especially when containing borage (*Borago*

Background

Pollination by wild insects is essential to fruit and vegetable farmers in Iowa and around the world. Studies have shown that providing flowering resources within or adjacent to agricultural fields can increase the fruit set of cash crops (Blaauw and Isaacs, 2014). In addition, farm- and landscape-

officinalis), were favored by shorter-tongued bumblebees and honeybees, while long-tongued bumblebees preferred some species in the perennial mix (Carvell et al., 2006). Though annual flowering herbs will not provide overwintering habitat and should be planted in succession to provide continuous blooms, the literature shows they do attract pollinators and can boost yields of pollinator-dependent crops.

For this study, farmers selected three annual flowering herbs to plant in strips on their farms, among their vegetable crops. They evaluated the herbs based on anthesis, plant height, and ease of management. Farmers also evaluated the attractiveness of each herb species to pollinators by doing walking pollinator counts twice during the flowering period.

Methods

This project was conducted at two Iowa farms: Rick Hartmann (Small Potatoes Farm in Minburn) and Alice McGary (Mustard Seed Community Farm in Ames).

Each farmer planted three species of flowering herbs – anise hyssop, borage and lemon basil – in strips among their vegetable production. Hartmann planted all plots in a single field, McGary planted replications of each herb in three different fields – with brassicas, with potatoes, and with melons.

All herbs were selected for the trial based on past farmer experience with the species and their flowers, their observation of their flowers as pollinator attractors, ease of establishment and management. Organic seed for borage and lemon basil was donated by Johnny's Seeds; anise hyssop was purchased from High Mowing Seed Company. Planting method and management of annual flowering herbs were determined by each farm, and are summarized in **Tables 2** and **3**.

The method for pollinator counts was based on "Streamline Bee Monitoring Protocol for Assessing Pollinator Habitat" from The Xerces Society (Ward et al., 2014). Twice during the bloom period of each flower species, farmers performed transect counts of bees walking at a pace of 10 ft per minute. Observed bees were categorized as honey bees, or large or small native bees. Moths and butterflies were also counted. McGary did additional pollinator counts in established prairie strips on her farm for additional comparisons.

Month	Hartmann				McGary			
	Precip. (in.)		GDD		Precip. (in.)		GDD	
	2016	Avg.	2016	Avg.	2016	Avg.	2016	Avg.
April	3.5	3.4	208	189	4.1	3.3	221	196
May	5.7	4.5	377	388	4.3	4.4	405	394
June	3.0	4.9	702	592	1.3	4.8	666	590
July	5.3	4.1	720	714	7.9	3.7	684	716
Aug.	3.1	4.2	699	652	4.1	4.0	670	661
Sep.	5.5	4.2	551	445	7.4	3.6	518	459

^a Precipitation and growing degree day data accessed from the weather station nearest farm locations (Iowa Environmental Mesonet, 2016) Hartmann: PERRY; McGary: AMES-8-WSW.

Results and Discussion

At both farms, growing degree days in 2016 were higher than the monthly average by more than one standard deviation in June and September, which are highlighted in bold in **Table 1**. Rainfall was low in June, and above average in July and September. Months with rainfall varying 1.5 in. from the average are shown in bold (**Table 1**).

Flower Character

Hartmann (Minburn)

Hartmann direct seeded each herb species using an Earthway Seeder on May 21. Plates used in the seeder and seed spacing are given in **Table 2**. The anise hyssop did not emerge at Hartmann, but the borage and lemon basil emerged in eight days. Borage reached full canopy and flowering sooner than the lemon basil, and had a longer anthesis period (68 days vs. 45 days for lemon basil).

Said Hartmann, "I concluded borage was superior in strength of emergence and canopy to the basil (and hyssop, which did not emerge). Borage was much less work to take care of, in terms of time to manage and weed. However, borage could not be managed for weeds toward the end of the cucurbit season, because it had fallen over and was sprawled in a manner that weeding was nearly impossible with a tool. Lemon basil was easier to manage at the end of the year because of this. Basil could be thinned and serially marketed, providing some income, while there was no known market for borage."

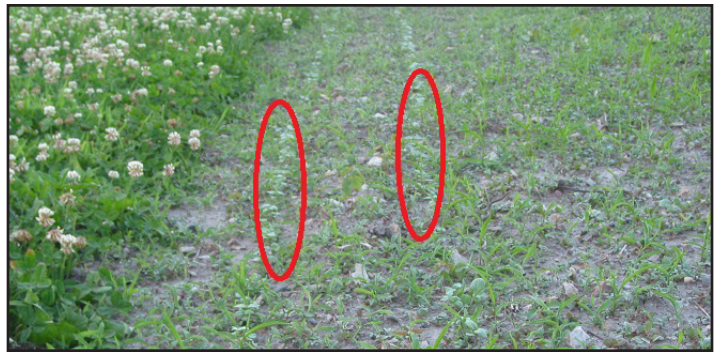
Table 2

Trial Design and Flower Character at Hartmann

Farm	Hartmann		
Herb	Anise Hyssop	Borage	Lemon Basil
Direct Seed/ Transplant Date	DS: May 21		
Seeding Rate	14 seeds/ft	42 seeds/ ft	6 seeds/ft
Seeding Method	Plate 1	Plate 16	Plate 3
Plot ft ² and Dimensions	5.5 ft x 170 ft (single row)	5.5 ft x 170 ft (single row)	5.5 ft x 170 ft (double row)
Days to Emergence	DNE ^a	8 days (May 29)	8 days (May 29)
Days to Full Canopy	-	35 days (June 25)	48 days (July 8)
Days to Flowering	-	40 days (June 30)	57 days (July 17)
Anthesis Period	-	68 days (June 30- Sept. 6) ^b	45 days (July 17-Aug. 31)
Height at Maturity	-	45 in.	26 in.

^a Seeds did not emerge

^b Still in flower, borage was terminated on Sept. 6 to prepare field for fall cover crop.



Hartmann Farm: Lemon basil (above) and borage (below) on June 15, 17 days after emergence.



Hartmann: Trial field on June 6: cucurbits under row covers with un-weeded pollinator plots are between.



Hartmann: Lemon basil after first hoeing on June 18, beginning to hand weed between plants.



Hartmann: Borage after first hoeing on June 18, with no hand weeding.



Hartmann: After hoeing, extensive hand-weeding was needed between lemon basil plants on June 24. Summer squash in the background.

McGary (Ames)

McGary direct seeded all plots on May 14 (Table 3). When the anise hyssop did not emerge from the direct seeding, McGary transplanted a single row of anise hyssop seedlings that had been started in March. Said McGary, "The single row of [transplanted] anise hyssop did very well and could have done much better if we had either had better germination or started more seedlings indoors; we could have had denser stand. I think we should have planted it much earlier; perhaps in April."

For all of the plots, McGary and her crew did one round of hoeing with a quick hand-weeding. After that the plants held their own and flowered until the frost. McGary noted the lemon basil seemed to have the least number of flowers at some times. She periodically harvested from one of the three rows by removing the top third of the branches. "I think this partial harvest was helpful in renewing and staggering the plants' efforts to flower and continue blooming. We should have done this more frequently and systematically for better blooms. The borage and anise hyssop continued to flower with no management," said McGary.

McGary noted that the lemon basil were "extremely healthy, robust, upright plants, with a much more familiar and easily marketable product. They competed very well with weeds, though they seemed to provide less pollinator forage. The anise hyssop also had a very healthy and upright habit throughout the season, and though it is not well-known to people, they are familiar with the licorice flavor."

The borage was McGary's least favorite. "The borage was very robust, grew quickly, and competed well with weeds early. It continued to produce flowers and was a good insect attractor. Of

Table 3 Trial Design and Flower Character at McGary			
Farm	McGary		
Herb	Anise Hyssop	Borage	Lemon Basil
Direct Seed/ Transplant Date	TP late May ^a	DS: May 14	
Seeding Rate	1-2 seeds/in.		
Seeding Method	hand seeded		
Days to Emergence	-	7-10 days	
Plot ft ² and Dimensions	3 ft x 33 ft (single row)	3 ft x 33 ft (double row)	3 ft x 33 ft (triple row)

^a Direct seeding of a triple-row of anise hyssop did not germinate, so March-started anise hyssop seedlings were used in a single row.

the three, borage is my least favorite herb – looking less lovely and tasting strange. I would need to learn more to market it. As the plants got older and larger, they flopped and tipped, leaving larger areas of open soil for more weed germination."

According to McGary, differences in soil condition existed among the three fields where herb plots were planted. Each field was labeled for this project for their neighboring crops: melon, potato, and brassica. The brassica plots had the best soil (and thus the healthiest stands of plants), followed by potato and last, the melon field.



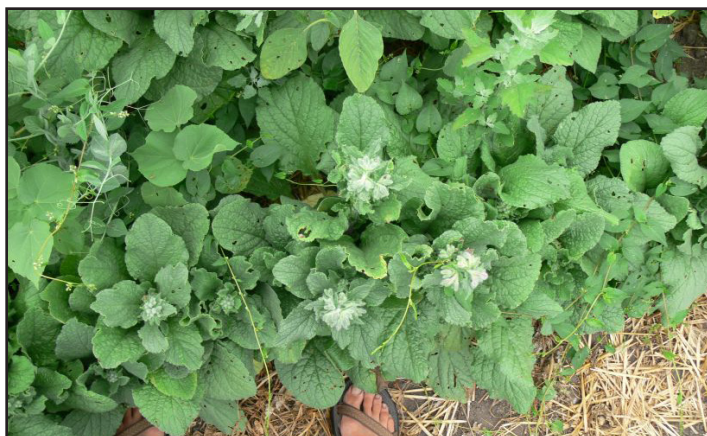
Lemon Basil in three rows after weeding on June 24, next to brassicas at McGary's.



Bed of lemon basil next to potatoes at McGary's on Sept. 1.



Bed of lemon basil next to potatoes on Sept. 2.



Borage next to brassicas at McGary's on June 24.

Pollinator Counts

Hartmann (Minburn)

Hartmann performed three transect walks; two in the borage (July 17 and Aug. 15) and one in the lemon basil (Aug. 15). In the borage, most of the bees observed were small native bees on the two sample dates (79 percent and 82 percent, respectively) (**Figure 1**). Between July and August, there were more big native bees observed in July, and more moths and butterflies observed in August. Hartmann noted there were many flies visiting the borage in July, and some ants. By August, most of the borage had fallen over (see photo), but was still flowering. Hartmann thought bumblebees seemed more attracted to the borage, even as the borage was prone on the ground and the lemon basil was still upright and flowering.

During the lemon basil transect walk, Hartmann counted 340 pollinators, 87 percent of which were small native bees.



Hartmann: Borage on June 24, after hoeing (no hand weeding).



Hartmann: Borage canopy June 24.



Hartmann: Borage in strong bloom on July 17 (anthesis began on June 30).

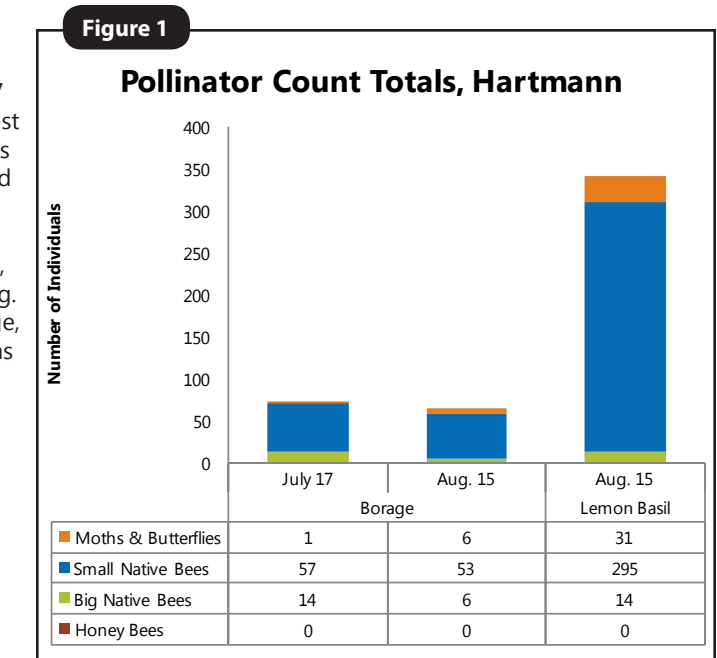


Figure 1. Pollinator Counts at Hartman's Farm. Individual pollinators were tallied during a 10-minute walking transect along the flowering strip.



Hartmann: Lemon basil just beginning to flower on July 17. The canopy closed on July 8.



Hartmann: Aug. 31: borage is still flowering, has begun to re-seed itself and lay prostrate over the ground (lemon basil upright but finished flowering).

McGary (Ames)

McGary performed transect walks for each herb species four to five times during anthesis, and did additional transect walks in their nearby prairie strips for additional comparison. In pollinator counts in the three annual herb species, small native bees were counted in highest numbers, typically followed by honey bees. Prairie had the highest counts of moths and butterflies. Location of the strips (noted by their adjacent crop: melon, potato, brassica) did not seem to overtly impact pollinator count.

Looking at McGary's pollinator counts in **Figure 2**, borage and prairie were tied for the highest average number of individual pollinators counted during transect counts (18.8 individuals), followed by anise hyssop (16 individuals) and lemon basil (14.6 individuals). McGary noted that the lemon basil seemed to have less flowers at some times during the season. Looking at the count data, one transect walk out-performed all others: Aug. 5 in the lemon basil. This transect was taken in the plot next to the potatoes.

Figure 2

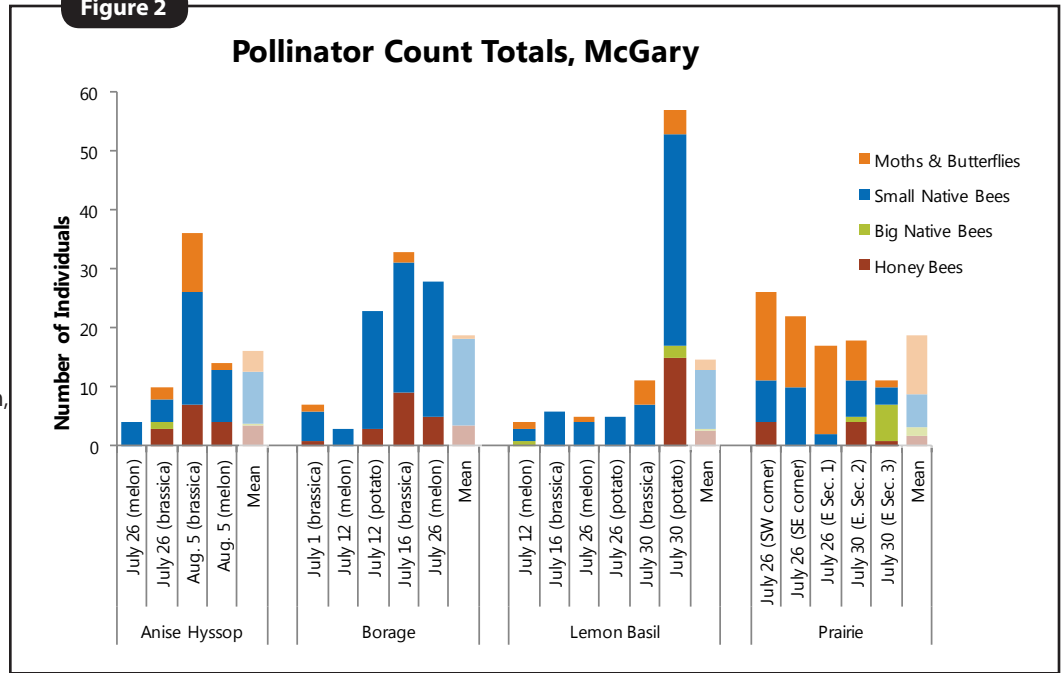


Figure 2. Pollinator Counts at McGary's Farm. Individual pollinators were tallied during a 10-minute walking transect along the flowering strip. Light-colored columns represent the average of all counts by herb species (or prairie). On the horizontal axis, the date indicates when the transect count was taken. The descriptions in parentheses indicate the location of the flowering strip surveyed. For example, melon is the flowering strip adjacent to the melon field.



Borage next to potatoes on June 24 at McGary's.



Borage next to potatoes, flopping over on Sept. 1.



Anise hyssop in poorest soil, after weeding on July 1 at McGary's.



Anise hyssop plot in poorest soil on Sept. 1 at McGary's.

Conclusions and Next Steps

The objective of this project was to evaluate three species of annual flowering herbs for their usefulness as pollinator resources in annual vegetable cropping systems. Annual strips, instead of perennials, allows farmers more flexibility in their field planning, helps with crops rotation, provides within-field barriers between crops, and can be selectively harvested and marketed efficiently.

Two farms planted strips of anise hyssop, borage, and lemon basil, and one of the farms made additional comparisons with established prairie on their farm. Among the three species, borage flowered the earliest (and longest) and was the easiest to establish at both farms. Hartmann thought the borage seemed especially attractive to bumblebees. At McGary's, the borage, on average, had the highest pollinator counts of the three annual herb species (tied with prairie). The borage grew tall and fell over, but continued flowering and attracting pollinators at both farms.

Lemon basil required more weeding earlier in the season, but once established remained upright and tidy, not interfering with neighboring crops. At Hartmann's the lemon basil pollinator counts were higher than the borage pollinator counts. McGary's pollinator counts in lemon basil trended lower, except one count on Aug. 5, which was the highest of any plot at her farm. The anise hyssop did not establish from a direct seeding, but did well when transplanted at McGary's. It had an upright habit, flowered consistently until frost, and was enjoyed by customers and pollinators.

References

- Blaauw, B.R., and R. Isaacs. 2014. Flower plantings increase wild bee abundance and the pollination services provided to a pollination-dependent crop. *Journal of Applied Ecology* 51(4): 890–898.
- Carvell, C., P. Westrich, W.R. Meek, R.F. Pywell, and M. Nowakowski. 2006. Assessing the value of annual and perennial forage mixtures for bumblebees by direct observation and pollen analysis. *Apidologie* 37(3): 326–340.
- Garibaldi, L.A., et al. 2013. Wild Pollinators Enhance Fruit Set of Crops Regardless of Honey Bee Abundance. *Science* 339(6127): 1608–1611.
- Iowa Environmental Mesonet. 2016. Climodat Reports. Iowa State University, Ames, IA. <http://mesonet.agron.iastate.edu/climodat/> (accessed Nov. 16, 2016)
- Kennedy, C.M., E. Lonsdorf, et al. 2013. A global quantitative synthesis of local and landscape effects on wild bee pollinators in agroecosystems. *Ecology Letters* 16(5): 584–599.
- Kolbe, L., S. Skeenhan, J. Beebout, and W. Osterholz. 2014. Bee Baseline Data Collection at Two Farms. Practical Farmers of Iowa Cooperators' Program, Ames, IA. http://bit.ly/pfi_horticulture (accessed June 1, 2016).
- Ward, K., D. Cariveau, et al. 2014. Streamlined Bee Monitoring Protocol for Assessing Pollinator Habitat. <http://www.xerces.org/streamlined-bee-monitoring-protocol/> (accessed June 1, 2016).

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