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Planting Flowers for Bees in Connecticut

Many people are concerned about the future of bees and pollination. Beekeepers report annual losses of about 35% of their hives each winter across the US, which is twice the “normal” winter losses from before 2005 (1). While it is not clear whether total numbers of bumble bees are declining, many studies have shown that some species of bumble bees are in trouble – with reduced numbers and geographical range (2). Several species of bumble bees, including some native to Connecticut, are close to extinction (3).

There is controversy about the causes of these declines, and whether other bee species are also in trouble. However, there is widespread agreement that providing a safe source of pollen and nectar benefits all kinds of bees, including honey bees and a wide diversity of native bees. The best way to do this is to provide a diversity of flowers blooming over a long season that are attractive to bees and that are protected from pesticide spray and drift.

In the words of Dr. Marla Spivak, MacArthur “Genius” award winner: **"There are two things each and every one of us can do to help bee populations. We can plant bee-friendly flowers in our gardens *without pesticides*. Also, we can all campaign to have a wide variety of flowers planted in community gardens and on roadsides, and to have flower borders planted around farms."**(4)

Our research project focused on bees on vegetable farms. While beekeepers often move hives to fruit orchards to provide pollination services during bloom, relatively few vegetable growers rent bees from beekeepers to provide pollination, even though many vegetable crops benefit from bees. All the cucurbits, including pumpkins, squashes, cucumbers, and melons have separate male and female flowers and require insect pollination in order to set fruit (5). Nearly all of that pollination is carried out by bees. Although many other vegetables, including tomatoes and eggplant can self-pollinate, seed set and fruit size are increased by activity of native bees, particularly bumble bees (6). Bumble bees have a unique action of “buzz pollination” that honey bees cannot perform, which releases pollen from tomato and eggplant flowers (7). Vegetable growers often produce some small fruit, such as strawberries, that also need insect pollination – strawberries rely on a mix of bees, including some of the small sweat bees, to get access to all parts of the flowers (8).

In Connecticut, our vegetable growers are typically highly diversified, growing cut flowers and herbs, and they often have areas on their farms with cover crops or with other low-maintenance flowering plants such as clovers, or even weeds, that could provide pollen and nectar to bees. We carried out a project in 2011 and 2012, with a Conservation Innovation Grant from the Connecticut office of the Natural Resources Conservation Service to see

what flowering plants besides vegetables were growing on vegetable farms, and which of those plants on farms are most attractive to bees. With a crew of summer workers, we went to 10 vegetable farms for two summers and measured the bees in two ways:

1. Timed observations – using a stopwatch we counted the numbers of bees seen in either two minutes (for small plantings in rows) or five minutes (for fields of cover crops). Observing bees on the wing, we could count the numbers in certain classes: honey bees, bumble bees, carpenter bees, green bees, tiny bees (such as sweat bees), megachilids (leaf cutter bees), and other bees.
2. Netting bees - Collecting a sample of bees with an insect net, killing them in soapy water, bringing them back to the laboratory, and identifying them to species. Again, these samples were timed, so that we could make a fair comparison between samples on different flowering plants. Although it is unfortunate that we have to kill bees to make an accurate identification, it is important to know which bees and how many species of bees are attracted to different plants.

We found quite a diversity of flowering plants on the 10 farms. Below are tables for each of the groups we studied (herbs, cut flowers and ornamentals, wildflowers and weeds, cover crops and ground covers, and vegetables gone to seed, based on our observation data. For each group of flowering plants, we have given a common name, the scientific name of the genus, the primary category of bee attracted to the flower (honey bees, bumble bees, or a diversity of other bees), whether the plant is a US native or introduced from elsewhere in the world, the plant family, the life span of the plant (annual, biennial, or perennial), and the months in which we caught bees attracted to the flowers of the plant on farms in Connecticut. The flowers are listed in descending order of attractiveness, with the plants that attracted the most bees per minute of observation at the top. As an example, on the herb common motherwort (*Leonurus cardiaca*), we counted 34 bees per minute of observation, predominantly bumble bees. This introduced perennial herb in the mint family (Lamiaceae) bloomed and attracted bees in June and July.

If you want to provide flowering resources to bees, here are some suggestions to consider:

First, find out what flowering plants are already present, when they bloom, and whether they are they good resources for bees. For herbaceous plants, you can look at the lists below and see what plants you recognize. We did not sample bees on trees and shrubs because our sampling methods and equipment were not adequate for these larger plants, but trees and shrubs are important resources for bees, especially in the spring. You can get an idea of what trees and shrubs are valuable for honey bees by looking at lists of honey and pollen plants for beekeepers (9,10). When looking at what you already have, consider not only the showy flowers, but also other less conspicuous flowering plants, like clovers, which can be major resources for bees.

Then, to add plants, think about what would fit into your existing yard, farm, or other landscape:

- Are there open fields available annually in a crop rotation that could be seeded to a flowering cover crop? How about seeding clovers into a mowed grassy area or lawn? Or would planting perennials, trees and shrubs produce a longer lasting source of nectar and pollen in a meadow or a more limited area along field edges and hedgerows?
- What plants with other uses might fit into the landscape – herbs, cut flowers, ornamentals, cover crops, vegetables allowed go to seed? Also consider fruit - although we did not sample fruiting trees and shrubs, fruiting bushes and trees can be great bee resources.
- Which plants are relatively inexpensive and easy to grow, and don't require irrigation, fertilizer, other inputs after establishment?
- Which plants do you want to avoid because they are invasive or aggressive and difficult to manage?

- Will you choose native plants for their benefits to wildlife and their adaptation to the local ecosystem, or will you also consider plants that are introduced, but not invasive?

Then, consider your goals for attracting pollinators:

- Which bees do you want to feed - honey bees, bumble bees, or other bees (such as mason bees, which are important in pollinating fruit trees in spring)?
- Do you want high numbers of a particular species, or do you want a diversity of many different bee species?
- Do you want the bees to pollinate a crop?

To support both high bee numbers and diversity, you need a long season of continuous bloom. For bumble bees, it is especially critical to have bloom early in spring, when new queens are establishing nests, and late in fall, when queens are storing up fats for overwintering survival. For both bumble bees and honey bees, plants that continue to bloom during a hot, dry summer are important.

For pollination of a particular crop, such as a fruit orchard, pay special attention to having flowering plants available just before and after the crop flowers. This will help not only the generalist bees with a long season, such as honey bees and bumble bees, it will also help the many species of solitary bees with a short season of activity, such as mason bees and digging bees. These bees may be active for only a few weeks each year, but can make an important contribution to pollination of the crops available during their active period.

Plan to balance massing of flowers and diversity. Clumps at least 3 feet in diameter of a single species are more attractive to pollinators and easier for them to find. But having a diversity of at least 8 or more species of plants also increases abundance and diversity of pollinators (11).

Flowers are not the only limiting resource for bees. Nest sites are also important. Humans provide hives as nesting sites for honey bees, of course, although honey bees can also nest in other available spaces, such as hollow trees. Humans can also provide nesting sites for mason bees, such as the blue orchard bee (12). Most bees choose their own nesting sites, however, and humans can best help them by protecting the nests from physical or chemical damage. Most bee species, about 70%, nest in the ground (11), including bumble bees, and a wide diversity of solitary bees. The other 30% nest in tunnels of various kinds. Carpenter bees make their own tunnels in wood, including in man-made wooden structures, but the other tunnel-nesters generally use existing tunnels created naturally by the plants (hollow stems and twigs) or by other animals (tunnels in wood made by wood-boring beetles and other insects). Be alert for nesting areas with bees traveling frequently to and from a patch of bare ground, a clump of grass, or a pile of twigs or rotting wood. Since small bees can only travel about 500 feet from their nest in order to find pollen and nectar (11), protecting nesting sites will greatly increase the diversity of small bees at your flower plantings.

Finally, protect your pollinators from pesticides. Keep all pesticides away from flowering plants and bee nesting areas, and be aware that many pesticides applied to soil travel through the plant and can contaminate the pollen and nectar that bees rely on for food.

Table 1. Top Herbs Visited by Bees on Vegetable Farms in CT

Listed in order from highest to lowest number of bees per minute of observation. Note that plants with a long season of flowering may have more total bees than those with high numbers per observation over a short season.

Common Name	Genus	Primary bees seen	U.S. Native or Introduced	Plant family	Perennial Annual, or Biennial	May	Jun	Jul	Aug	Sept	Oct
Common motherwort	<i>Leonurus</i>	BB	I	Lamiaceae	P		X	X			
Chives & Garlic											
Chives	<i>Allium</i>	HB	I	Liliaceae	P			X	X	X	
Catnip	<i>Nepeta</i>	BB	I	Lamiaceae	P			X	X	X	
Mint (Peppermint, Spearmint)	<i>Mentha</i>	BB	I	Lamiaceae	P				X	X	
Basil	<i>Ocimum</i>	BB	I	Lamiaceae	A			X	X	X	
Anise Hyssop	<i>Agastache</i>	BB	N	Lamiaceae	P		X	X	X	X	X
Oregano & Marjoram	<i>Origanum</i>	BB	I	Lamiaceae	P		X	X	X		
Lavender	<i>Lavandula</i>	BB	I	Lamiaceae	P		X	X	X		
Thyme	<i>Thymus</i>	BB	I	Lamiaceae	P		X	X	X		
Salvia (sage)	<i>Salvia</i>	BB	I	Lamiaceae	A+P	X	X	X	X	X	X
Calendula	<i>Calendula</i>	Other	I	Asteraceae	P			X	X		
Verbena	<i>Verbena</i>	BB	I	Verbenaceae	A/P			X		X	X
Chamomile	<i>Chamaemelum</i>	Other	I	Asteraceae	P				X		
Feverfew	<i>Tanacetum</i>	Other	I	Asteraceae	P		X	X			
Dill	<i>Anethum</i>	HB	I	Apiaceae	A			X	X		

- HB = honey bee, BB = bumble bee, Other = other species of native bees.
- A = annual, P = perennial, A+P = multiple species in genus with some annual and some perennial, A/P = perennial but usually grown as annual in CT or protected over winter

Table 2. Top Ornamental and Cut Flower Plants Visited by Bees on CT Vegetable Farms

Listed in order from highest to lowest number of bees per minute of observation. Note that plants with a long season of flowering may have more total bees than those with high numbers per observation over a short season.

Common Name	Genus	Primary bees seen	U.S. Native or Introduced	Plant family	Perennial Annual, or Biennial	Apr	May	Jun	Jul	Aug	Sept	Oct
Anise Hyssop	<i>Agastache</i>	BB	N	Lamiaceae	P			X	X	X	X	X
Sunflower (annual, Maxmillian)	<i>Helianthus</i>	BB	N U.S.	Asteraceae	A+P			X	X	X	X	X
Lavender	<i>Lavandula</i>	BB	I	Lamiaceae	P			X	X	X		
Mexican sunflower	<i>Tithonia</i>	BB	I	Asteraceae	A				X	X	X	X
Joe-Pye Weed	<i>Eutrochium</i>	Other	N	Asteraceae	P				X	X		
Salvia (sage)	<i>Salvia</i>	BB	I	Lamiaceae	A+P		X	X	X	X	X	X
Asters (bushy, New England)	<i>Symphotrichum</i>	BB	N	Asteraceae	P						X	X
Purple coneflower	<i>Echinacea</i>	BB	N	Asteraceae	P				X	X		
Pincushion flower	<i>Scabiosa</i>	BB	I	Dipsacaceae	A				X	X		
Cornflower	<i>Centaurea</i>	HB	I	Asteraceae	A				X	X		
Boxwood	<i>Buxus</i>	Other	I	Buxaceae	P	X						
Goldenrod	<i>Solidago</i>	BB	N	Asteraceae	P					X	X	X
Ageratum	<i>Ageratum</i>	BB	I	Asteraceae	A				X	X	X	X
Calendula	<i>Calendula</i>	Other	I	Asteraceae	P				X	X		
Celosia	<i>Celosia</i>	HB	I	Amaranthaceae	A			X	X	X	X	X
Verbena	<i>Verbena</i>	BB	I	Verbenaceae	A/P				X		X	X
Jewelweed	<i>Impatiens</i>	BB	N	Balsaminaceae	A				X	X	X	

Indian hemp	<i>Apocynum</i>	BB	N	Apocynaceae	P		X			
China Aster	<i>Callistephus</i>	BB	I	Asteraceae	A		X	X	X	
Evening Primrose	<i>Oenothera</i>	BB	N	Onagraceae	A			X		
Large bullwort	<i>Ammi</i>	Other	I	Apiaceae	A		X			
Canna	<i>Canna</i>	HB	US	Cannaceae	A/P		X			
Rudbeckia	<i>Rudbeckia</i>	Other	N	Asteraceae	A/P		X	X	X	X
Milkweed	<i>Asclepias</i>	HB	N	Apocynaceae	P		X			
Penstemon	<i>Penstemon</i>	BB	N	Scrophulariaceae	P		X			
Statice	<i>Limonium</i>	BB	I	Plumbaginaceae	A/P			X	X	
Cosmos	<i>Cosmos</i>	BB	I	Asteraceae	A		X	X	X	X
New York Ironweed	<i>Vernonia</i>	Other	N	Asteraceae	P			X		
Phlox	<i>Phlox</i>	HB	N	Polemoniaceae	P		X	X	X	
Nasturtium	<i>Tropaeolum</i>	HB	I	Tropaeolaceae	A		X		X	
Dahlia	<i>Dahlia</i>	BB	I	Asteraceae	A/P		X	X	X	X
Zinnia	<i>Zinnia</i>	BB	I	Asteraceae	A		X	X	X	X
Strawflower	<i>Helichrysum</i>	Other	I	Asteraceae	A			X		
Cleome	<i>Cleomella</i>	BB	I	Cleomaceae	A			X		

- Others sampled, but with low bee numbers: monkey flower, ox-eye and Shasta daisies, love-in-a-mist (*Nigella*), snapdragon, gladiolus, yarrow, lisianthus, marigold, violets, buttercup, sweet william
- HB = honey bee, BB = bumble bee, Other = other species of native bees.
- A = annual, P = perennial, A+,P = multiple species in genus with some annual and some perennial, A/P = perennial but usually grown as annual in CT or protected over winter

Table 3. Top Cover Crop and Legume Species for Bees on CT Vegetable Farms.

Several of these plants are considered weeds in some situations, and crown vetch is listed as an invasive plant in many states.

The plant family Fabaceae used to be called Leguminosae.

Listed in order from highest to lowest number of bees per minute of observation. Plants blooming longer may be visited by more total bees than those with high bees per minute but a short period of bloom.

Common Name	Scientific name	Primary bee category	U.S. Native or Intro- duced	Plant family	Perennial Annual, or Biennial	May	Jun	July	Aug	Sept	Oct
Buckwheat	<i>Fagopyrum esculentum</i>	HB	I	Polygonaceae	A		X	X	X	X	
Alfalfa	<i>Medicago sativa</i>	BB	I	Fabaceae	P			X			
Crimson Clover	<i>Trifolium incarnatum</i>	HB	I	Fabaceae	B	X					
Bird Vetch, Cow Vetch	<i>Vicia cracca</i>	BB	I	Fabaceae	B/P		X				
Alsike Clover	<i>Trifolium hybridum</i>	BB,HB	I	Fabaceae	P	X	X	X	X		
White Clover	<i>Trifolium repens</i>	BB,HB	I	Fabaceae	P	X	X	X	X		
Hairy Vetch	<i>Vicia villosa</i>	BB	I	Fabaceae	B/P	X	X				
Crown Vetch	<i>Securigera varia</i>	BB	I	Fabaceae	P		X	X			
Red Clover	<i>Trifolium pratense</i>	BB	I	Fabaceae	P	X	X	X	X	X	X
Birds Foot Trefoil	<i>Lotus corniculata</i>	BB,HB	I	Fabaceae	P	X	X	X	X		

- Others sampled with low bee numbers: cowpea, yellow sweet clover
- HB = honey bee, BB = bumble bee, Other = other species of native bees. “BB,HB” means roughly equal numbers of bumble bees and honey bees.
- A = annual, P = perennial, B = biennial (or winter annual), B/P = perennial but usually grown as biennial (winter annual) cover crop in CT

Table 4. Wildflowers and Weeds (including invasive plants) visited by bees on 10 Vegetable Farms in CT

Listed in order from highest to lowest number of bees per minute of observation. Note that plants with a long season of flowering may have more total bees than those with high numbers per observation over a short season.

Common Name	Genus	Primary bees seen	U.S. Native or Introduced	Plant family	Perennial Annual, or Biennial	May	Jun	Jul	Aug	Sept	Oct
Purple Loosestrife	<i>Lythrum</i>	BB	I	Lythraceae	P				X		
Joe-Pye Weed	<i>Eutrochium</i>	Other	N	Asteraceae	P			X	X		
Canada Thistle	<i>Cirsium</i>	BB	I	Asteraceae	P		X				
Asters (bushy, New England)	<i>Symphotrichum</i>	BB	N	Asteraceae	P					X	X
Goldenrod	<i>Solidago</i>	BB	N	Asteraceae	P				X	X	X
Jewelweed	<i>Impatiens</i>	BB	N	Balsaminaceae	A			X	X	X	
Bird vetch	<i>Vicia</i>	BB	I	Fabaceae	B/P	X	X				
Indian hemp	<i>Apocynum</i>	BB	N	Apocynaceae	P		X				
Milkweed	<i>Asclepias</i>	HB	N	Apocynaceae	P		X				
Penstemon	<i>Penstemon</i>	BB	N	Scrophulariaceae	P		X				
Pale Smartweed	<i>Polygonum</i>	HB	N	Polygonaceae	A		X			X	
Chicory	<i>Cichorium</i>	BB	I	Asteraceae	P			X		X	X
New York Ironweed	<i>Vernonia</i>	Other	N	Asteraceae	P				X		
Clovers (alsike, crimson, red, white)	<i>Trifolium</i>	BB	I	Fabaceae	B,P	X	X	X	X	X	X
Crown vetch	<i>Securigera</i>	BB	I	Fabaceae	P		X	X			
Field pennycress	<i>Thlapsi</i>	Other	I	Brassicaceae	A,B		X				
Queen Anne's Lace	<i>Daucus</i>	HB	I	Apiaceae	B		X	X	X		
Mallow	<i>Malva</i>	BB	I	Malvaceae	A,B		X				
Yellowcress	<i>Rorippa</i>	HB	N	Brassicaceae	A,B		X				
Yellow Rocket	<i>Barbarea</i>	Other	I	Brassicaceae	B	X	X				
Birds-Foot Trefoil	<i>Lotus</i>	Other	I	Fabaceae	P	X	X	X	X		
Galinsoga	<i>Galinsoga</i>	Other	I	Asteraceae	A			X	X	X	

Others sampled with low bee numbers: Ground ivy, fleabane, ragwort, multiflora rose, wild geranium, catsear, yarrow, dandelion, yellow sweet clover, violets, henbit, deadnettle, chickweed.

Table 5. Top Vegetables Allowed to Flower Visited by Bees on Vegetable Farms in CT

Listed in order from highest to lowest number of bees per minute of observation. Note that plants with a long season of flowering may have more total bees than those with high numbers per observation over a short season.

Common Name	Genus	Primary bees seen	U.S. Native or Introduced	Plant family	Perennial Annual, or Biennial	May	Jun	Jul	Aug	Sept	Oct
Chives & Garlic											
Chives	<i>Allium</i>	HB	I	Liliaceae	P			X	X	X	
Brassicas (collards, kale, Asian greens)											
Brassicas (collards, kale, Asian greens)	<i>Brassica</i>	HB	I	Brassicaceae	B	X	X	X			X
Cilantro/Coriander											
Cilantro/Coriander	<i>Coriandrum</i>	HB	I	Apiaceae	A	X	X	X	X		
Radish (wild, cultivated)											
Radish (wild, cultivated)	<i>Raphanus</i>	BB	I	Brassicaceae	B		X	X		X	
Arugula											
Arugula	<i>Eruca</i>	BB	I	Brassicaceae	A, B		X	X			
Dill											
Dill	<i>Anethum</i>	HB	I	Apiaceae	A			X	X		

- HB = honey bee, BB = bumble bee, Other = other species of native bees.
- A = annual, P = perennial, B = biennial,

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