

Enhancing Farm Landscapes for Native Bees and Improved Crop Pollination



Rufus Isaacs
&
Julianna Tuell

Department of Entomology
Michigan State University



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Michigan Natural Landscapes

Provide

- Biodiversity
- Pest suppression
- **Pollination**



Prairie



Oak savanna



Pollination

- The transfer of pollen from the stamen to the stigma and subsequent fertilization of the ovary.

Self pollination



Cross pollination



Michigan Agricultural Landscapes

Provide

- Biodiversity
- Pest suppression
- **Pollination**



Annual crops



Orchards



Most fruits and vegetables are dependent on bees for pollination

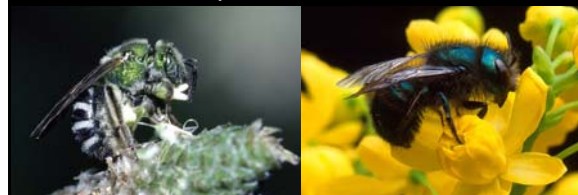
87 of the leading global foods are pollinated by insects

35% of human food is insect pollinated


This includes.... apple, sweet cherry, tart cherry, pear, peach, blueberry, cranberry, raspberry, strawberry, melon, squash, sunflower, tomato, clover, cucumber, etc.



Over 20,000 species of bees in the world



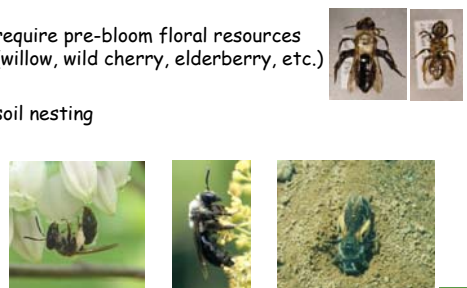
Honey Bee



- Main commercial pollinator
- In US, annual value of honey bee pollination = \$14.6 billion

Digger (*Andrena*) Bees

- emerge in early spring
- require pre-bloom floral resources (willow, wild cherry, elderberry, etc.)
- soil nesting



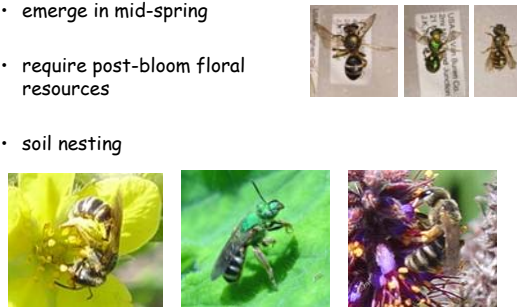
Bumble bees

2nd most important, globally



Sweat Bees (*Halictids*)

- emerge in mid-spring
- require post-bloom floral resources
- soil nesting




Why even consider native bees?



- Some native bees are efficient crop pollinators.
- Native bees are adapted to local spring weather.
- Some native bees emerge in synchrony with specific crops to pollinate them exclusively.
- Long term sustainability of pollination.
- May be considered 'pollination insurance'.
- Most of them are free!

Bumble Bees

- collect pollen by buzz-pollination
- queens emerge in early spring
- workers emerge later in the spring
- require flowers through the season
- nest in insulated cavities in the ground
- colonies can be purchased to increase bumblebee numbers during bloom



Mason (*Osmia*) Bees

- emerge in early spring
- require early season flowers
- use mud to divide nests built in stem and beetle-galleries
- some are managed commercially (apple and cherry production)
- ongoing NW Michigan tests of *Osmia cornifrons* in Balaton cherry



Native Bees on Blueberry Flowers

Family	Species or Group	No. of bees sampled	% bees carrying <i>Vaccinium</i> pollen	% pollen load from <i>Vaccinium</i>
Andrenidae	<i>Andrena carolina</i>	54	85%	95%
Andrenidae	<i>Andrena carlini</i>	28	61%	47%
Andrenidae	other <i>Andrena</i> spp.	22	9%	39%
Halictidae	<i>Halictine</i> spp.	13	69%	56%
Colletidae	<i>Colletes</i> spp.	6	83%	67%



Andrena carolina



Bees with pollen in a pan trap



Blueberry pollen

Other Native Bees

- Carpenter bees



Photo: Jeff Evans

- Cellophane bee



How you manage your farm will affect the ability of native bees to prosper

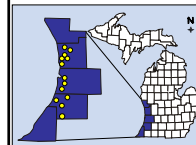
In a survey of 15 Michigan blueberry farms, the following management factors affected native bee abundance:

Increased by:

- unmown ditches around fields
- meadows near fields

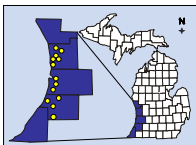
Decreased by:

- more frequent insecticide application
- intense field perimeter management

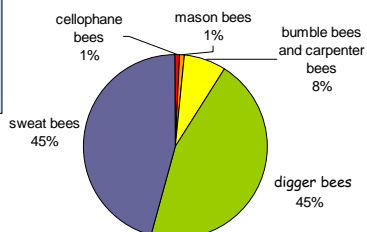


Tuell & Isaacs, unpublished data

What Native Bees are Present During Blueberry Bloom?



Pan trapping 2x during bloom at 15 farms in 2004, 2005, 2006

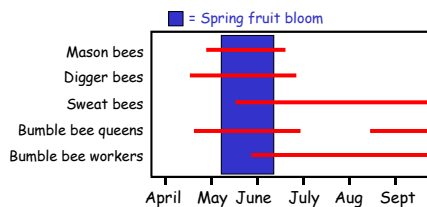


What Do Native Bees Need?

- Food resources
 - Nectar and pollen resources before and after crop bloom
- Nesting resources
 - Patches of semi-bare ground
 - Undisturbed vegetation/thatch
 - Nesting boxes or straws
 - Access to mud or plant material
- Habitat free of bee-toxic pesticides

Why are extra food resources needed?

- Crop bloom period may be short, depending on the number of crops/cultivars on a particular farm.
- Many native bee life cycles extend beyond crop bloom.



Exotic plants

Benefits

- Reliable seed or plant sources
- Large agronomic database
- Prolific/sustained floral display
- Previous success in other locales

Disadvantages

- Do not enhance native biodiversity
- Potentially invasive



Pre-bloom food resources

- Woody plants found in adjacent habitat:
 - field edges
 - ditches
 - treelines.



Native plants

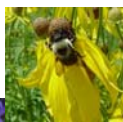
Benefits

- Enhance native biodiversity
- Re-creation of imperiled habitats
- Less likely to be invasive
- Adapted to local climate
- Provide habitat permanency



Post-bloom food resources

- Herbaceous plants in
 - buffer strips
 - ditches
 - other adjacent habitat.



Bloom Timing of Native Plants Attractive to Beneficial Insects natural enemies and bees

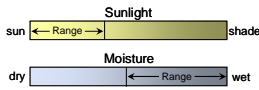
Native plant	Natural enemies	Bees	Bloom Period						
			May	Jun	Jul	Aug	Sep	Oct	
wild strawberry	**	*							
golden Alexanders	***	**							
Canada anemone	***	*							
peristemon	**	**							
angelica	***	*							
cow parsnip	***	*							
sand coreopsis	***	*							
shrubby cinquefoil	***	*							
Indian hemp	***	*							
late figwort	**	**							
swamp milkweed	**	**							
Culver's root	**	***							
yellow coneflower	***	**							
nodding wild onion	*	**							
meadowsweet	***	**							
yellow giant hyssop	**	***							
horsemint	***	**							
Missouri ironweed	**	**							
cup plant	***	***							
pale Indian plantain	**	**							
boneset	***	**							
blue lobelia	***	***							
pale-leaved sunflower	***	*							
Riddell's goldenrod	***	***							
New England aster	***	**							
smooth aster	**	**							

East Lansing, MI, 2004-5

KEY
* good
** better
*** best

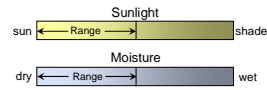
Wild strawberry (*Fragaria virginiana*)

- Natural enemies: ★★☆☆
Chalcid wasps
- Bees: ★☆☆☆
sweat bees, small carpenter bees
- Bloom: mid-late May



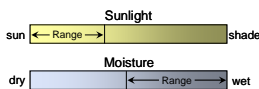
Penstemon (*Penstemon hirsutus*)

- Natural enemies: ★★☆☆
Chalcid wasps, minute pirate bug
- Bees: ★★☆☆
small and large carpenter bees, bumble bees
- Bloom: late May - mid June



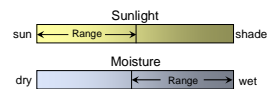
Golden alexanders (*Zizia aurea*)

- Natural enemies: ★★☆☆
Chalcid wasps, dance flies
- Bees: ★★☆☆
yellow-faced bees, Andrenid bees, sweat bees, cuckoo bees
- Bloom: late May - mid June



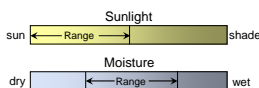
Angelica (*Angelica atropurpurea*)

- Natural enemies: ★★☆☆
Chalcid wasps, dance flies, minute pirate bug
- Bees: ★☆☆☆
sweat bees
- Bloom: early June



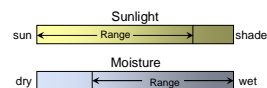
Canada anemone (*Anemone canadensis*)

- Natural enemies: ★★☆☆
minute pirate bug, dance flies, Chalcid wasps
- Bees: ★☆☆☆
sweat bees
- Bloom: throughout June



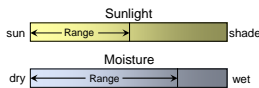
Common cowparsnip (*Heracleum maximum*)

- Natural enemies: ★★☆☆
Chalcid wasps, minute pirate bug
- Bees: ★☆☆☆
yellow-faced bees, sweat bees
- Bloom: mid June



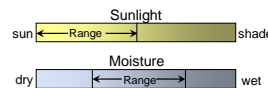
Sand coreopsis (*Coreopsis lanceolata*)

- Natural enemies: ★★★
minute pirate bug, predatory thrips
- Bees: ★☆☆
sweat bees
- Bloom: June - August



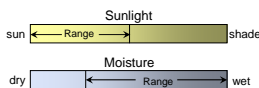
Late figwort (*Scrophularia marilandica*)

- Natural enemies: ★★★
dance flies
- Bees: ★★☆☆
yellow-faced bees, sweat bees, bumble bees
- Bloom: late July – early August



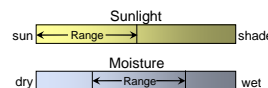
Shrubby cinquefoil (*Potentilla fruticosa*)

- Natural enemies: ★★★
minute pirate bug, Chalcid wasps, spiders, dance flies
- Bees: ★☆☆
yellow-faced bees, sweat bees
- Bloom: July - September



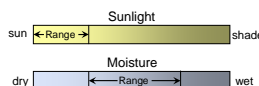
Swamp milkweed (*Asclepias incarnata*)

- Natural enemies: ★★★
Chalcid wasps, dance flies
- Bees: ★★☆☆
yellow-faced bees, sweat bees, large carpenter bees; also highly attractive to honey bees
- Bloom: mid July – mid August



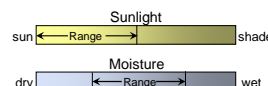
Indian hemp (*Apocynum cannabinum*)

- Natural enemies: ★★★
dance flies, Chalcid wasps, crab spiders, lady beetles
- Bees: ★☆☆
yellow-faced bees, sweat bees
- Bloom: late June - July



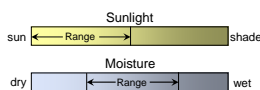
Culver's-Root (*Veronicastrum virginicum*)

- Natural enemies: ★★★
minute pirate bug
- Bees: ★★☆☆
sweat bees, small carpenter bees, bumble bees; also highly attractive to honey bees
- Bloom: late July – early August



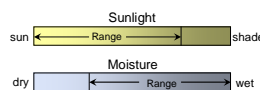
Yellow coneflower (*Ratibida pinnata*)

- Natural enemies:☆☆☆
Chalcid wasps, minute pirate bug, spiders
- Bees:☆☆☆
sweat bees, digger bees, cuckoo bees, small and large carpenter bees, bumble bees
- Bloom: late July - mid August



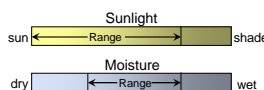
Yellow giant hyssop (*Agastache nepetoides*)

- Natural enemies:☆☆☆
minute pirate bug, predatory plant bug, spiders, dance flies, Chalcid wasps
- Bees:☆☆☆
yellow-faced bees, sweat bees, bumble bees
- Bloom: throughout August



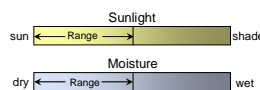
Nodding wild onion (*Allium cernuum*)

- Natural enemies:☆☆☆
minute pirate bug, crab spiders
- Bees:☆☆☆
sweat bees, bumble bees; also highly attractive to honey bees
- Bloom: throughout August



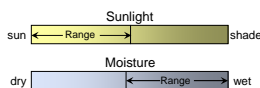
Horsemint (*Monarda punctata*)

- Natural enemies:☆☆☆
soldier beetle, predatory plant bug
- Bees:☆☆☆
large carpenter bees, digger bees, bumble bees
- Bloom: throughout August



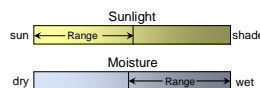
Meadowsweet (*Spiraea alba*)

- Natural enemies:☆☆☆
minute pirate bug, Chalcid wasps
- Bees:☆☆☆
yellow-faced bees, Andrenid bees, sweat bees, bumble bees
- Bloom: throughout August



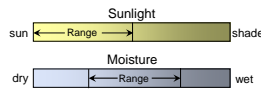
Ironweed (*Vernonia missurica*)

- Natural enemies:☆☆☆
Chalcid wasps
- Bees:☆☆☆
sweat bees, leafcutter bees, cuckoo bees, small carpenter bees, bumble bees
- Bloom: throughout August



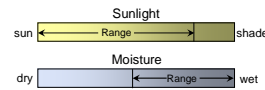
Cup plant (*Silphium perfoliatum*)

- Natural enemies: ★★★
Chalcid wasps, minute pirate bug,
soldier beetle, predatory plant bug
- Bees: ★★★
sweat bees, leafcutter bees, small
carpenter bees, digger bees,
bumble bees
- Bloom: throughout August



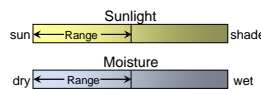
Blue lobelia (*Lobelia siphilitica*)

- Natural enemies: ★★★
minute pirate bug, Chalcid wasps,
soldier beetle, lady beetles,
predatory plant bug
- Bees: ★★★
yellow-faced bees, sweat bees,
small carpenter bees, bumble bees
- Bloom: August – early
September



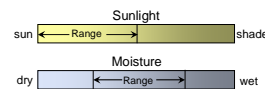
Pale Indian plantain (*Cacalia atriplicifolia*)

- Natural enemies: ★★★
minute pirate bug, Chalcid wasps,
soldier beetle
- Bees: ★★★
sweat bees, digger bees, bumble bees
- Bloom: throughout August



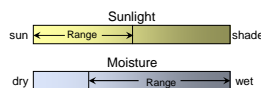
Pale-leaved sunflower (*Helianthus strumosus*)

- Natural enemies: ★★★
Chalcid wasps, soldier beetle,
minute pirate bug, crab spiders
- Bees: ★★★
Andrenid bees, sweat bees,
digger bees, bumble bees
- Bloom: August – early
September



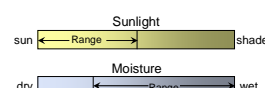
Boneset (*Eupatorium perfoliatum*)

- Natural enemies: ★★★
minute pirate bug, predatory plant
bug, Chalcid wasps, soldier beetle,
spiders
- Bees: ★★★
sweat bees, small carpenter
bees, digger bees, bumble bees
- Bloom: August – early
September



Riddell's goldenrod (*Solidago riddellii*)

- Natural enemies: ★★★
minute pirate bug, Chalcid wasps,
paper wasps, lady beetles
- Bees: ★★★
yellow-faced bees, Andrenid bees,
sweat bees, small and large carpenter
bees, digger bees, bumble bees; also
highly attractive to honey bees
- Bloom: throughout September

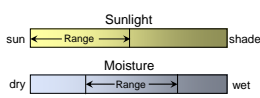





NOTE: Showy goldenrod (*S. speciosa*) was
also tested, and had a similar number of
bees and fewer natural enemies.




New England aster (*Aster novae-angliae*)

- Natural enemies:** ★★☆☆
Chalcid wasps, dance flies
- Bees:** ★★☆☆
Andrenid bees, sweat bees, small carpenter bees, bumble bees
- Bloom:** late May - mid June

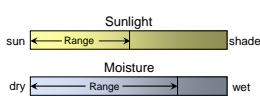



Integrating Native Flowering Plants into Farm Landscapes



- Ditches
- Field margins
- Meadows
- Row middles?

Smooth aster (*Aster laevis*)

- Natural enemies:** ★★☆☆
minute pirate bug, spiders, Chalcid wasps
- Bees:** ★★☆☆
sweat bees, bumble bees
- Bloom:** mid September – early October

What Do Native Bees Need?


- Food resources
 - Nectar and pollen resources before and after blueberry bloom
- Nesting resources
 - Patches of semi-bare ground
 - Undisturbed vegetation/thatch
 - Nesting boxes or straws
 - Access to mud or plant material
- Habitat free of bee-toxic pesticides




Native grasses

Grow in native prairie habitat, where they

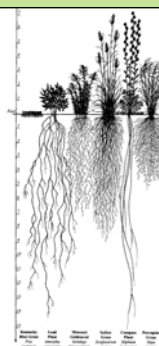
1. Provide structural support for wildflowers
2. Fill in gaps that wildflowers can't in early establishment, decreasing weed pressure
3. Have root systems of different depths that complement wildflowers



Little bluestem (*Andropogon scoparius*)


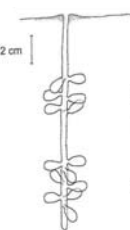





Canada wild rye (*Elymus canadensis*)



Heidi Natura, Conservation Research Institute

Undisturbed semi-bare ground for soil-nesting bees

Undisturbed vegetation/thatch for bumble bees



Bees and Pesticides

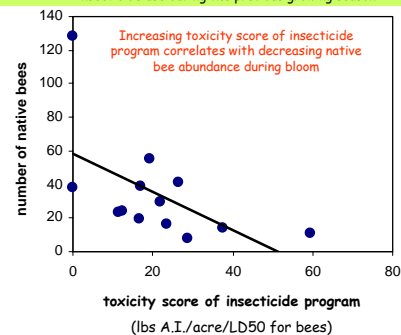
- **Habitat free of bee-toxic pesticides**
 - Provide a clean water source.
 - Avoid spraying (or use bee-safe compounds) during bloom.
 - Use insecticides that are less toxic to bees.
 - Spray pesticides when bees are not active (after dark).
 - Be aware of pesticide drift into adjacent habitat where flowers are in bloom.

Nesting boxes or straws and access to mud for mason bees



Bees and Pesticides

Native bee abundance during bloom in 2004 in relation to insecticide use during the previous growing season



What Do Native Bees Need?

- Food resources
 - Nectar and pollen resources before and after blueberry bloom
- Nesting resources
 - Patches of semi-bare ground
 - Undisturbed vegetation/thatch
 - Nesting boxes or straws
 - Access to mud or plant material
- **Habitat free of bee-toxic pesticides**

Summary

- Native bees are present in all agricultural landscapes.
- Their abundance is dependent on habitat suitability.
- Providing additional food and nesting resources, and reducing use of bee-toxic insecticides can help increase native bee abundance during crop bloom.
- Native Michigan plants can provide a resource bridge through the growing season when crops are not in bloom.

Further Resources

- MSU's Enhancing Beneficial Insects Website
 - www.ipm.msu.edu/plants/home.htm
- Pollinator Conservation Handbook
 - Shepherd et al., The Xerces Society
- How to Manage the Blue Orchard Bee
 - Bosch & Kemp, Sustainable Agriculture Network Series, Book # 5
- Crop Pollination by Bees
 - Delaplane & Mayer, CABI publishing

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