

New York State Pollinator Protection Plan

Precision Pollinator Management: Strategies for supporting pollinators on your crop





\$240,355,000



\$144,207,000



\$52,137,000



\$31,371,000



\$2,800,000

New York crops dependent on pollination

Values from: New York State Agricultural Overview. 2014, USDA



\$3,042,000



\$20,493,000



\$12,640,000



\$10,091,000



\$7,520,000



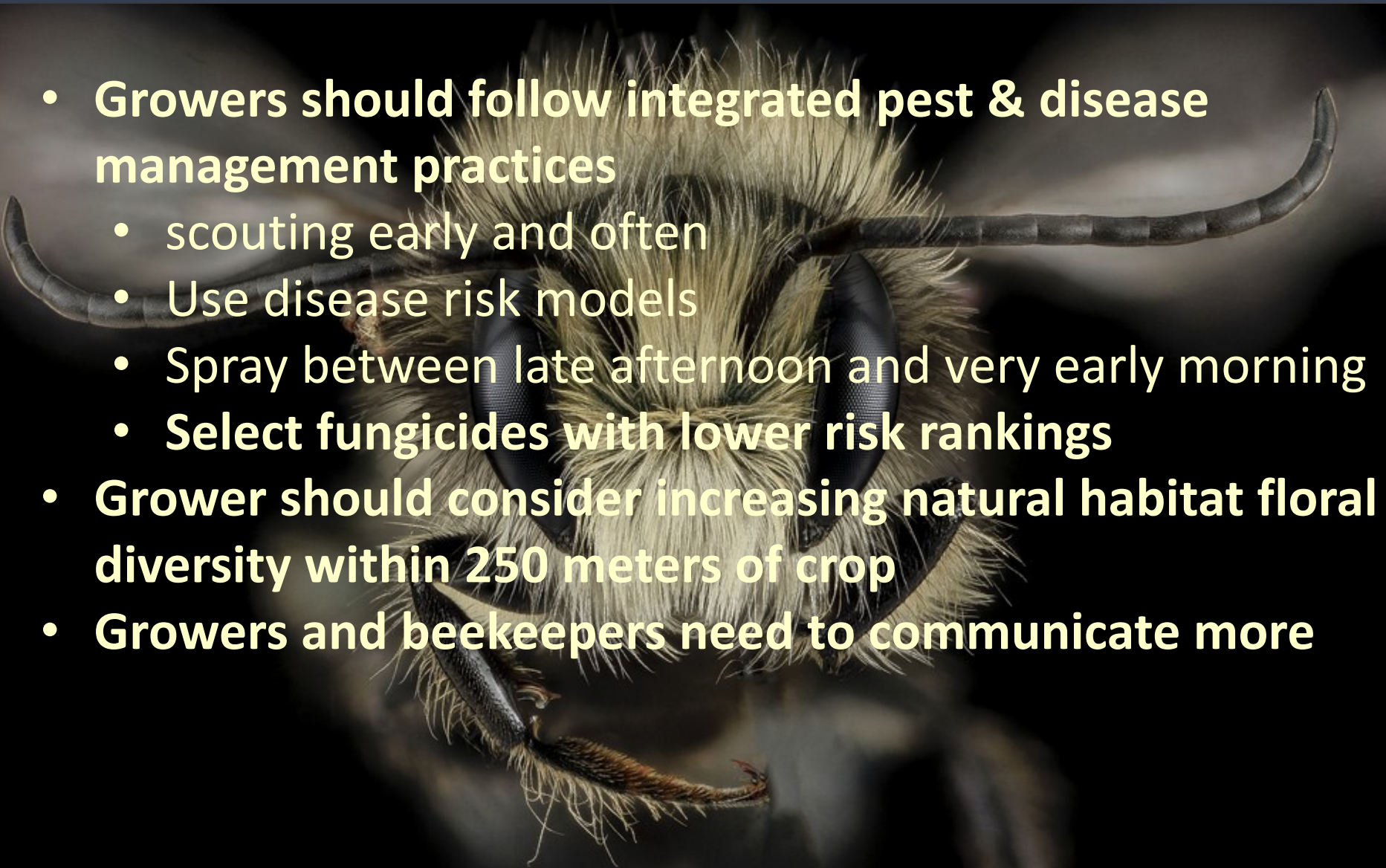
\$3,472,000

Both wild native bees and honey bees are crucial to agricultural production

□ Wild bee ■ Honey bee



Pesticide Management

- **Growers should follow integrated pest & disease management practices**
 - scouting early and often
 - Use disease risk models
 - Spray between late afternoon and very early morning
 - **Select fungicides with lower risk rankings**
 - **Grower should consider increasing natural habitat floral diversity within 250 meters of crop**
 - **Growers and beekeepers need to communicate more**
- 

Make an effort to meet local beekeepers

- **Make pollination contracts**
- **Grower communicates with beekeeper when intending to spray**
- **Beekeeper lets growers know when they put their hives nearby (1-2 miles radius).**
- **Beekeeper educates grower**
- **Grower educates beekeeper**



Habitat Management

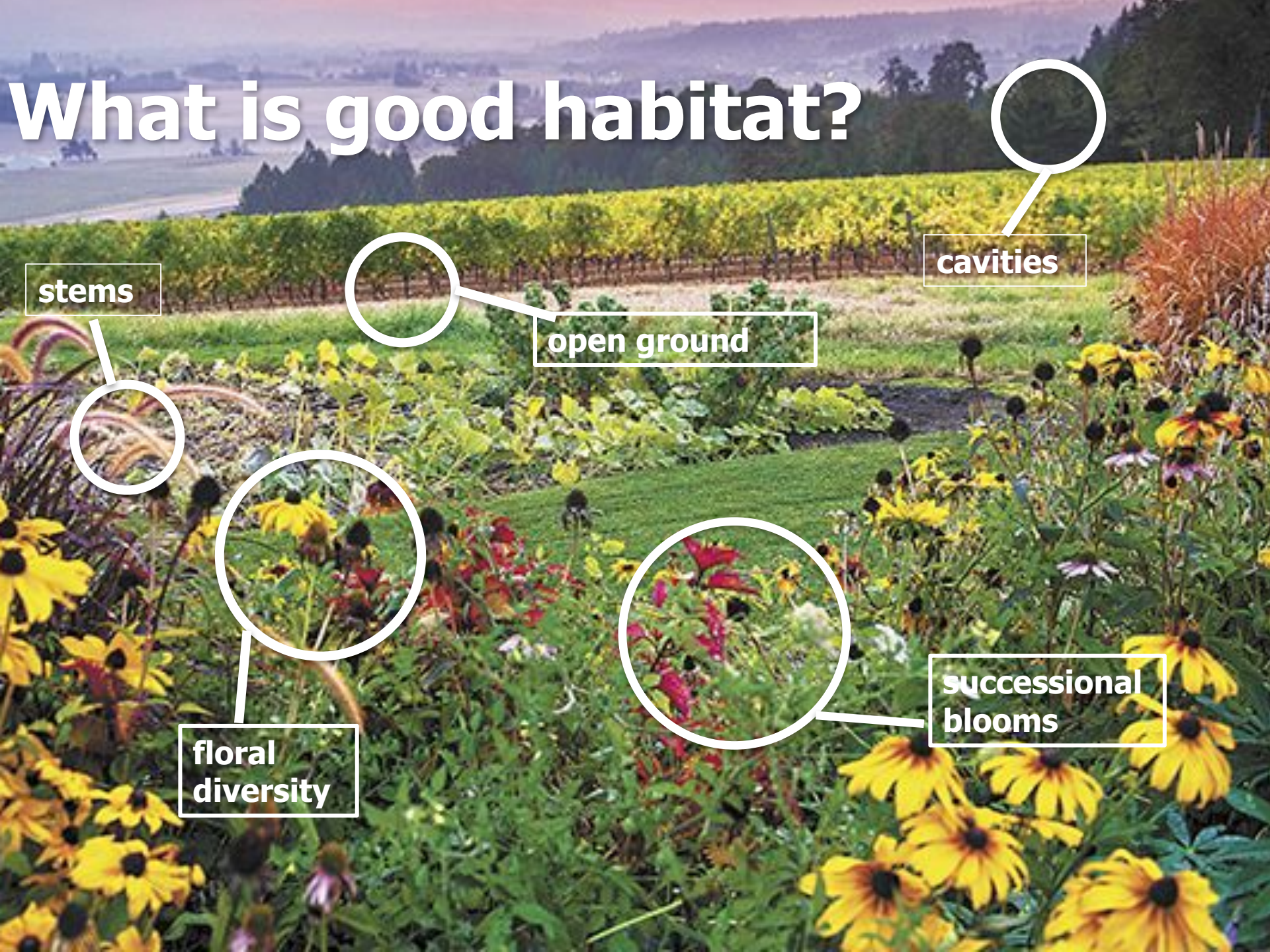
A close-up photograph of a bee's head, showing its large compound eyes, antennae, and the fuzzy texture of its thorax. The bee is positioned centrally, with its head facing forward. The background is dark and out of focus.

- 1. Provide a diversity of wild foraging plants species**
- 2. Push for 3-5 species blooming at all times across season**
 - At least before and after crop bloom
 - At least 30-100 meters from crop margin
- 3. Provide safe nesting sites for native bees 30-100 meters from crop margin (away from drift)**
- 4. Mow small areas on margins to provide bareground for the ground-nesting species – Manage 1/3 area each year.**

What is good habitat?



What is good habitat?



stems

open ground

cavities

floral
diversity

successional
blooms

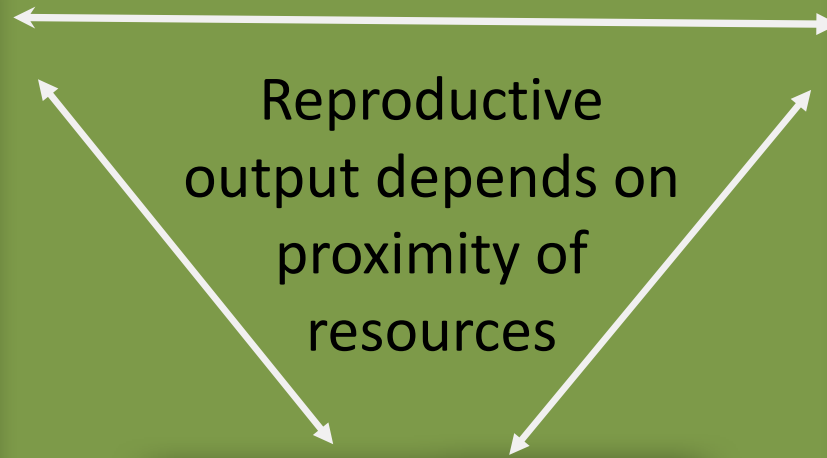
Proximity of Resources



Pollen & nectar



Water



Nests

Good habitat increases bee abundance and diversity

Enhancement	Increases Abundance?	Increases Diversity?	
Hedgerows	Yes	Yes	Hannon and Sisk. 2009. 2154. Morandin and Kremen. 829-839.
Wildflower strips	Yes	Yes	Haaland et al. 2011. In 60-80 Nicholls and Altieri. 20 Development 33(2): 25 Tschumi et al. 2014. IC Klein et al. 2012. Journ
Adjacent fields	Yes	Yes	Steffan-Dewenter. 2003. 1044 Kremen et al. 2004. Ec Williams and Kremen. 2 910-921
Field margins	Yes	Yes	Morandin and Kremen. 829-839.



Floral Resources



Why are diverse flowers important?

- Specialize on native plant species or families
- The pollen of each plant species presents a certain mix of essential amino-acids that bees need to survive and function optimally.
- Native bees use chemical exudates from natives to line their nest.
- Too little diversity OR reliance on sub-optimal species can weaken a bees immune functions.

Bees need ...

- Abundance and diversity natural to semi-natural habitat surrounding the site.
- Native plants that flower across season (early spring – fall)

Provide resources across whole season

Honey Bees

Bumble Bees

Digger Bees

Blue Mason Bees

Leaf-cutting Bees

Squash Bees



January

February

March

April

May

June

July

August

September

October

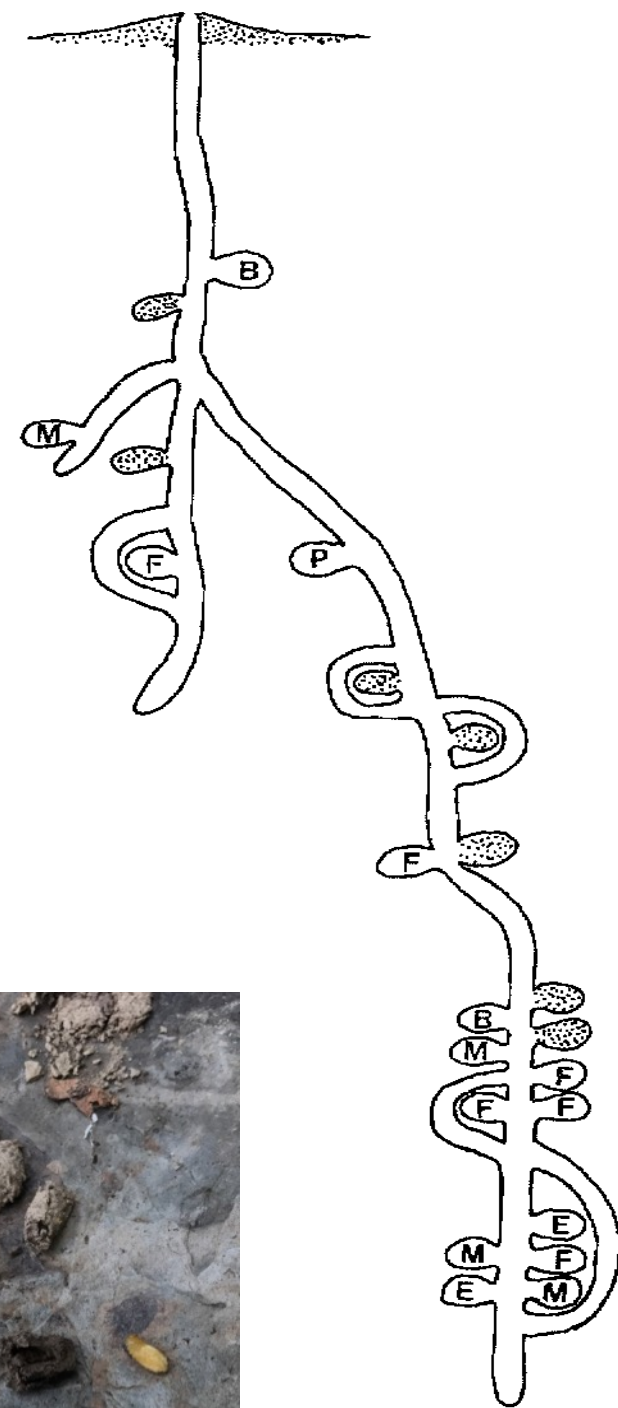
November

December



Nest Resource Considerations

1. Access to safe sites all year round
2. Ease of nest site relocation
3. Stable Temperature and Humidity
 - a) Protect larval provisions and bee
 - Drying out
 - Mold
 - Bacteria
 - b) Emergence cues – day length effect



Get to know the 'wild' bees on the crop



- Count the # of wild bees vs honey bees at early and peak bloom in a 5 minute period.
- Try to identify the wild ones





Observations

4:39 Reset Pause

Please make sure all power savers are turned off and you do not navigate away from the observations screen while the timer is running.

Already have your sample count?
Enter the numbers and hit submit.

1 HONEY BEES	2 NATIVE BEES
+	+
-	-

NOTES

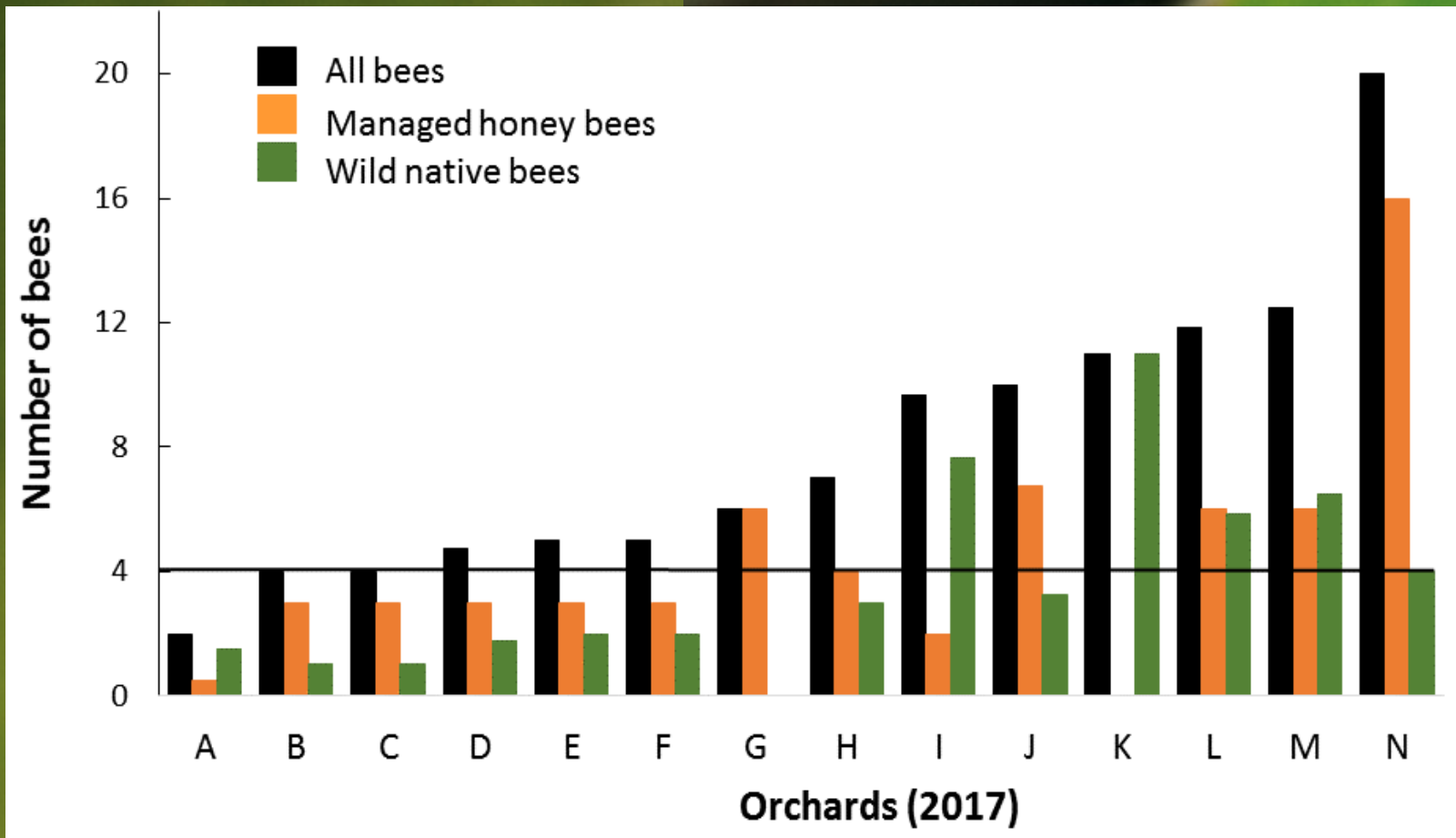
Submit →

Data Collection

- A standardized count of native bees and honey bees.
- Date, Time & Weather
- GPS coordinates
- Pest management
- Bloom stage

Training Materials

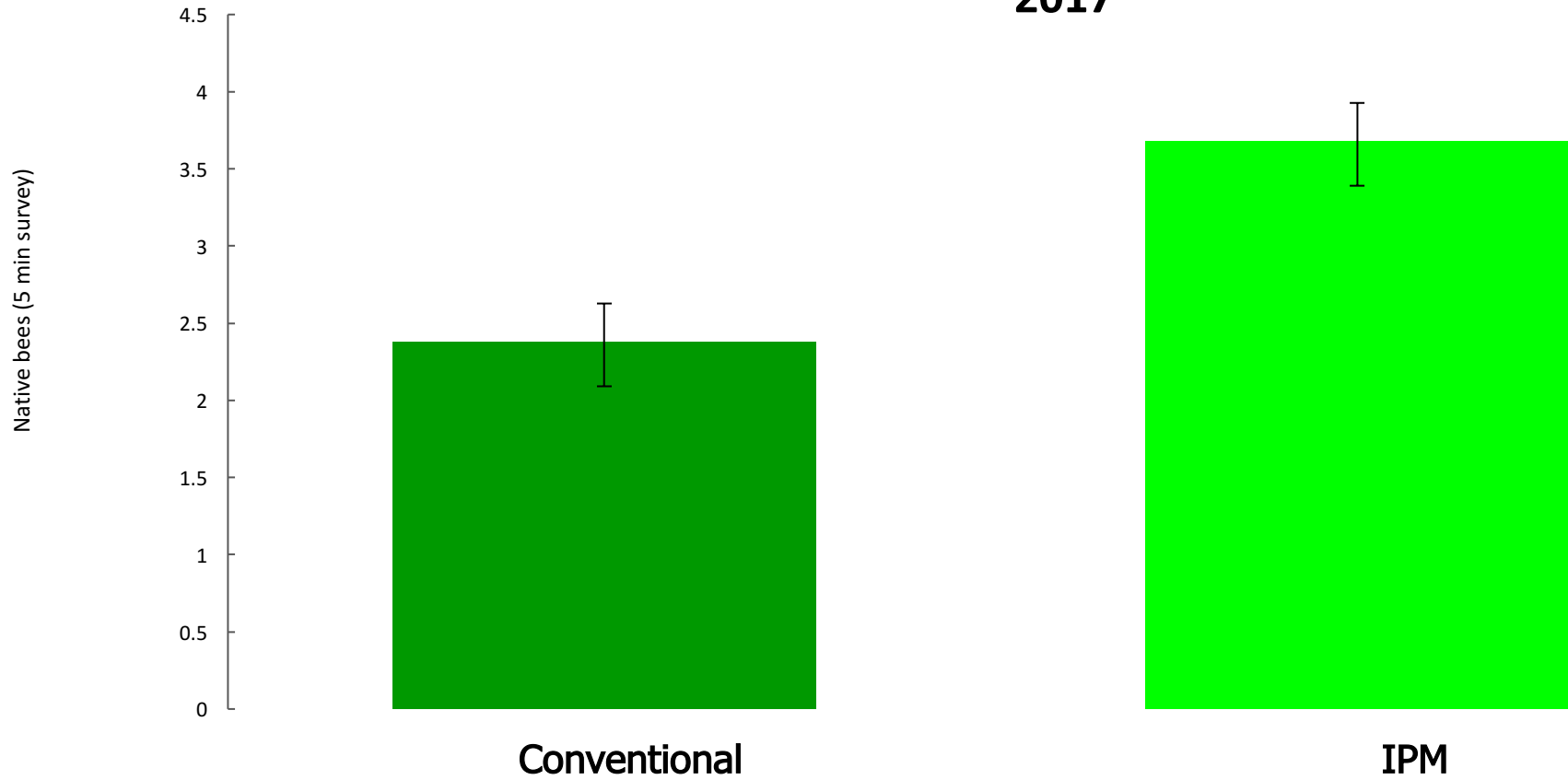
- Video: The protocol and use of survey app
- Bee ID guide & quiz



Average honey bee abundance is enriched by wild native bee abundance helping the orchard reach full bee pollination density in 2017. Black line represents the number of bees needed in an orchard to get full apple blossom pollination.



2016 & 2017



There is great potential in the biodiversity present on our landscapes, **and opportunity to manipulate wild species for pollination in agriculture.**

Pollination Management plan

Decide if you are managing for focal crop bee species or for all species

All bee species

Crop specific bee species

Plant flower species on **borders** of orchards/fields: **across** season (3-5 sp/time)

Plant flower species on **borders** of orchards/fields: **before & after** bloom of crop

Create, protect, manage nesting habitat:

- Mud
- Bare soil - sandy loam soil
- Pebbles
- dead twigs and stems
- fresh clean water

- Scout often
- Spray late PM early AM
- Use low toxicity pesticides
- Call local beekeepers

Flowering times for NY natives preferred by the native bees

Common name	Genus & species	March	April	May	June	July	August	September	October
Tuliptree	<i>Liriodendron tulipifera</i>		■	■					
Wild Plum	<i>Prunus species</i>		■	■					
Serviceberry	<i>Amelanchier laevis</i>		■	■					
Willow	<i>Salix species</i>	■	■	■					
Red Maple/Sugar	<i>Acer rubra</i>		■	■					
Redbud	<i>Cercis canadensis</i>		■	■					
Basswood	<i>Tilia americana</i>		■	■	■				
Golden Ragwort	<i>Senecio aureus</i>	■	■	■	■				
Hawthorn	<i>Crataegus species</i>		■	■	■				
other Maple	<i>Acer species</i>		■	■	■				
Black locust	<i>Robinia pseudoacacia</i>			■	■				
St John's Wort	<i>Hypericum perforatum</i>			■	■	■			
Beardtongue	<i>Penstemon hirsutus</i>			■	■	■			
Black eyed susan	<i>Rudbeckia hirta</i>				■	■	■		
Mountain mint*	<i>Pycnanthemum tenuifolium</i>				■	■	■		
Butterfly milkweed*	<i>Asclepias tuberosa</i>				■	■	■		
Culver's Root	<i>Veronicastrum virginicum</i>					■	■		
Swamp milkweed	<i>Asclepias incarnata</i>				■	■	■		
Beebalm	<i>Monarda species (2)</i>					■	■		
Blue Vervain	<i>Verbena hastata</i>					■	■		
Purple Giant Hyssop*	<i>Agastache scrophulariifolia</i>				■	■	■	■	
Green Headed Coneflower	<i>Rudbeckia laciniata</i>					■	■		
Joe Pye Weed*	<i>Eutrochium maculatum</i>					■	■	■	
Goldenrod	<i>Solidago rugosa</i>					■	■		
New York Ironweed	<i>Vernonia noveboracensis</i>					■	■	■	
Great Blue Lobelia*	<i>Lobelia siphilitica</i>					■	■	■	
New York Aster	<i>Symphyotrichum novi-belgi</i>					■	■	■	■
Stiff Goldenrod*	<i>Oligoneuron rigidum</i>					■	■	■	
Heath Aster	<i>Symphyotrichum pilosum</i>					■	■	■	
New England Aster	<i>Symphyotrichum novae-angliae</i>					■	■	■	■
Flat-top Golden top*	<i>Euthamnia graminifolia</i>					■	■	■	

Questions?



Osmia lignaria nest
Osmia ribifloris nest





Pear

Wild Plum
 Serviceberry
 Willow
 Red Maple/Sugar
 Redbud
 Verbena
 Zizia
 Veronicastrum
 Golden Ragwort
 Penstemon
 Black Eyed Susan

Bloom: April

Andrena, Bombus, Osmia, Lasioglossum

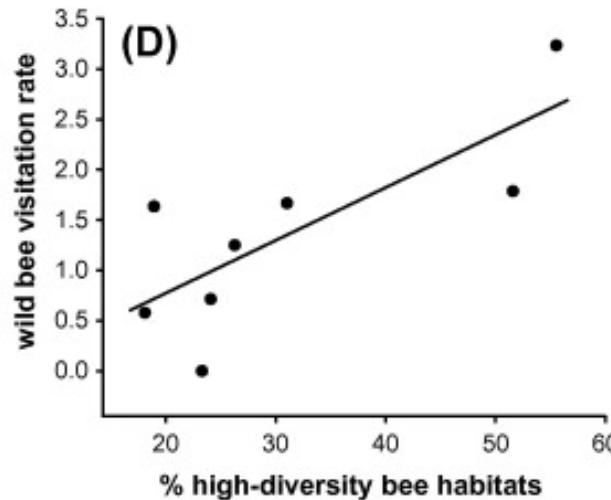
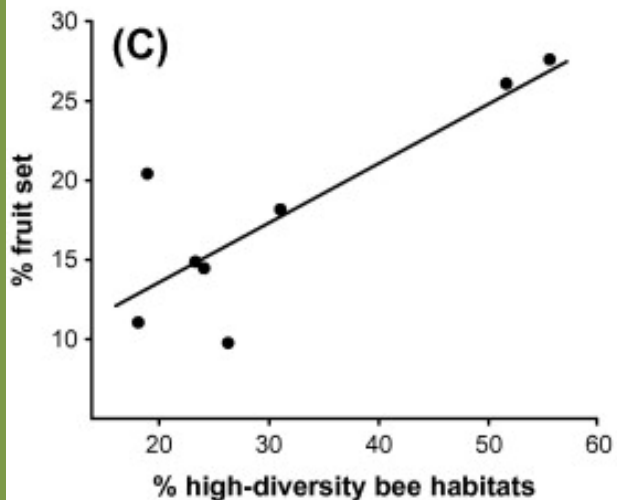
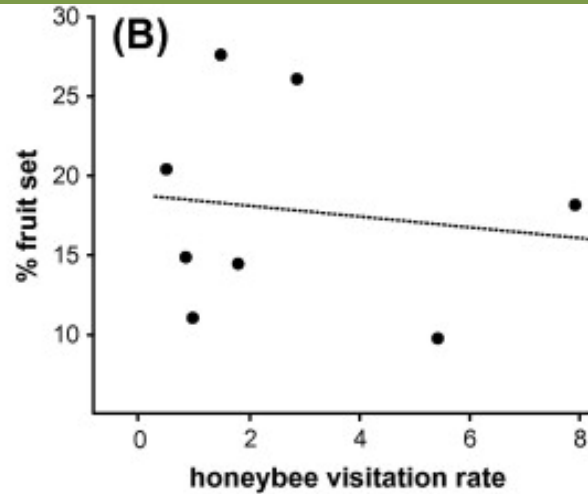
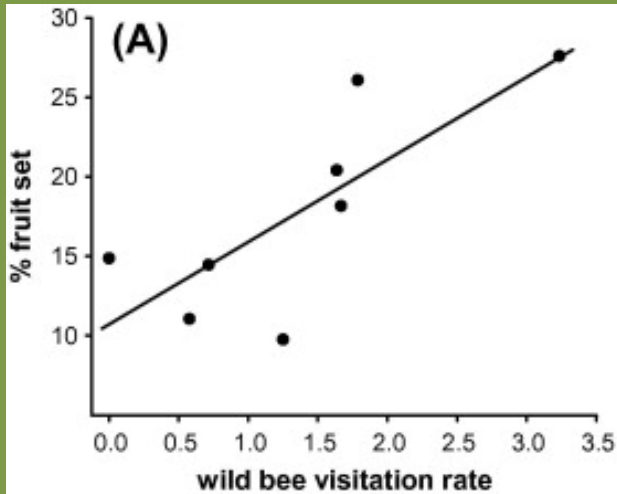
Table I. Visit effectiveness (visits in which at least one stigma was contacted), visitation rates, and number of flowers visited consecutively per tree in *Osmia cornuta* females and *Apis mellifera* workers on “Comice” pear.

	Effective visits		Visitation rates (flowers/minute)		Visits/tree	
	<i>n</i>	%	<i>n</i>	$\bar{x} \pm SE$	<i>n</i>	$\bar{x} \pm SE$
			<i>Osmia cornuta</i>			
	1047	98.7	68	13.8 ± 0.68	76	6.7 ± 0.5
			<i>Apis mellifera</i>			
Nectar foragers	142	19.0	11	7.1 ± 0.02	16	7.1 ± 1.0
Pollen-nectar foragers	336	51.8	26	9.8 ± 0.05	31	7.9 ± 1.2

Cherry

Bloom: Late March - April

Andrena, Bombus, Osmia, Lasioglossum



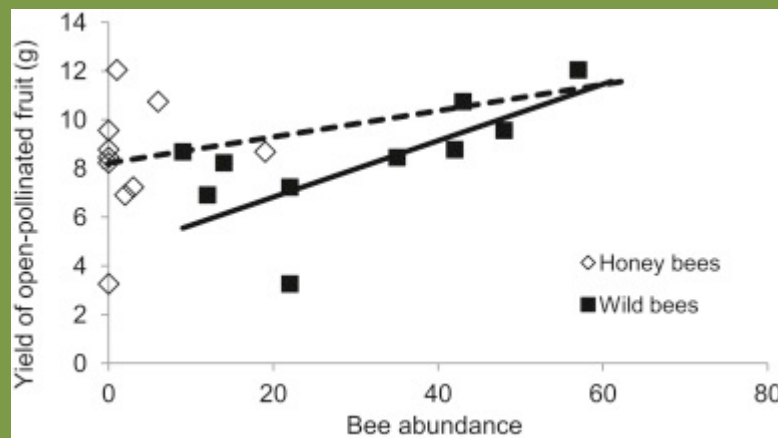
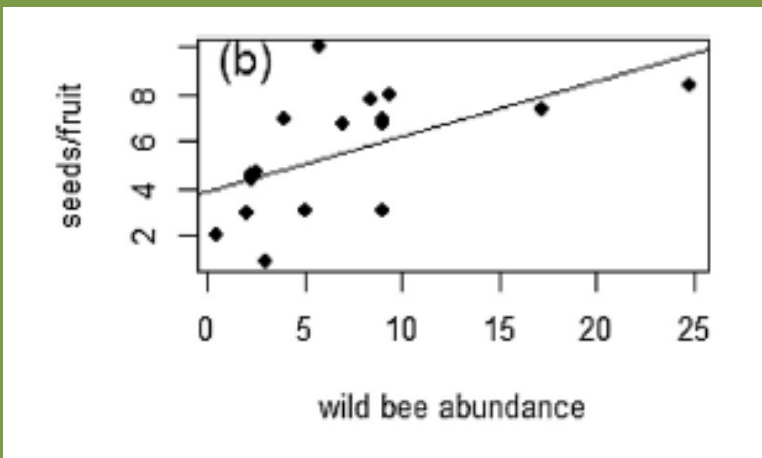
Wild Plum
Serviceberry
Willow
Red Maple/Sugar
Redbud
Verbena
Zizia
Veronicastrum
Golden Ragwort
Penstemon
Black Eyed Susan



Apple & Strawberry

Bloom: early May

Andrena, Bombus, Halictus, Osmia



60% Wild bees
40% honey bees

90% Wild bees
10% honey bees



- Wild Plum
- Serviceberry
- Willow
- Red Maple/Sugar
- Redbud
- Basswood
- Golden Ragwort
- Hawthorn
- other Maple
- Black locust
- St John's Wort
- Penstemon digitalis/hirsutus

Blueberries



Bloom: Late March - April

Bombus sp, *Andrena* sp; honey bees and carpenter bees tend to nectar rob

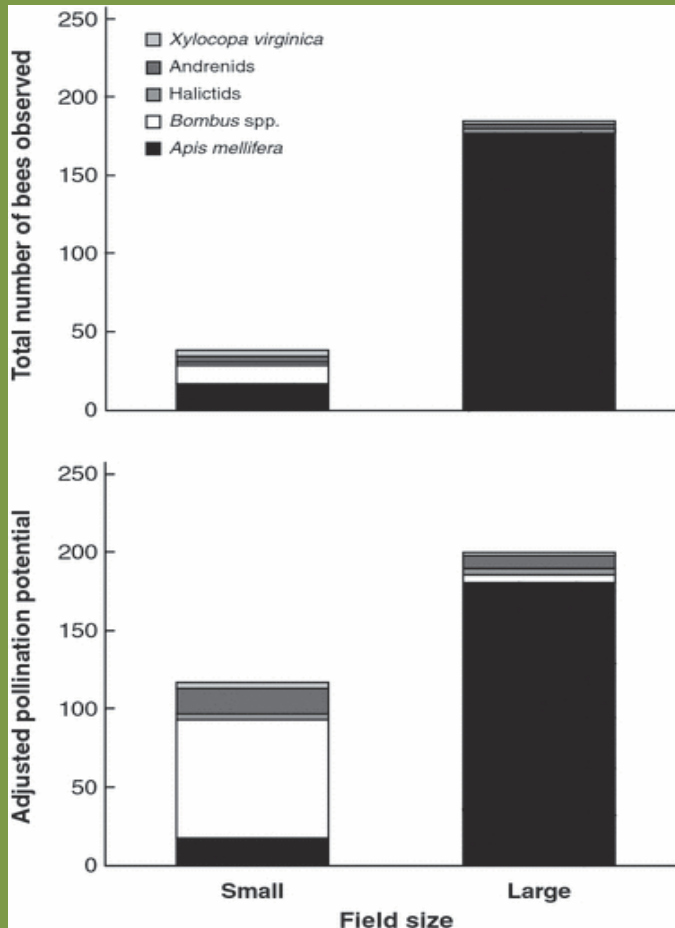


Table 4. Bee abundance (mean \pm SD) per meter square per minute at the study fields in 1999

Site	<i>A. mellifera</i>	<i>B. impatiens</i>	Wild bees
<i>B. impatiens</i> fields	0.31 \pm 0.14	0.51 \pm 0.49	3.1 \pm 1.14
<i>A. mellifera</i> fields	0.08 \pm 0.02	0	0.5 \pm 0.33
Wild native bee field	0.01	0	0.62

Good bumble bee stocking density is 7 hives per acre (\$70-\$100/hive)

- Wild bees contribute 10-20% pollination to conventional blueberry.
- On small farms they contribute 50% of the pollination.

Soybeans

Coreopsis lanceolate
Veronicastrum sp
Agastache nepetoides

- Typically flowers end of at June
- Soybean visited by honey bees and wild bees made pods with proportionately more seeds per pod.
- Only 10% of the pollination is from wild bees
- 20 different bee species in Iowa (Matt O'Neill

Megachile sp., Anthidium manicatum

Table 2 Total pod production and number of pods with 1, 2 or 3 seeds in a soybean (*Glycine max* (L.) Merrill) cv. BRS Carnaúba plantation, under three pollination treatments in NE Brazil (s.e.m = standard error of mean)

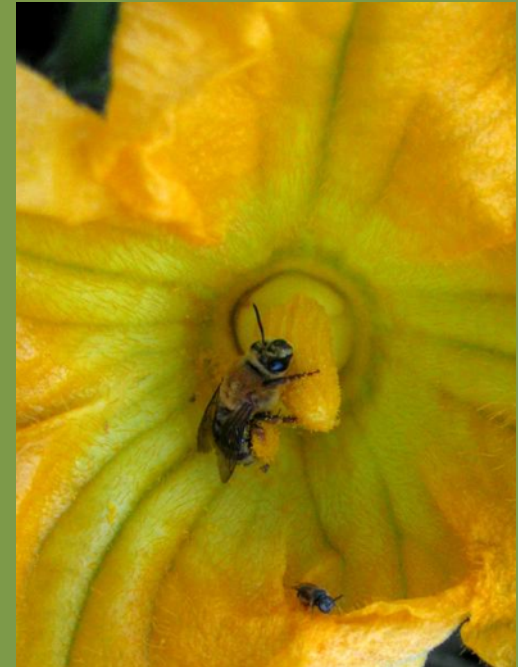
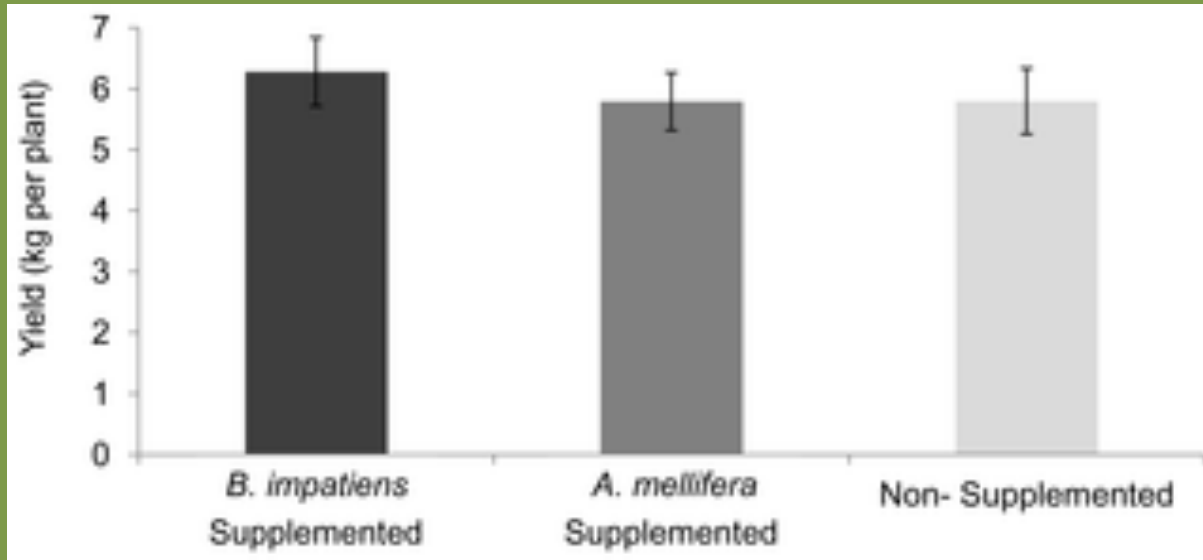
Treatments	# Of plants	Total pods	Pods with 1 seed		Pods with 2 seeds		Pods with 3 seeds		% Total
		X ± s.e.m.	X ± s.e.m.	(%)	X ± s.e.m.	(%)	X ± s.e.m.	(%)	
Honeybee + wild pollinators	50	59.6 ± 2.71a	5.92 ± 0.51aC	9.93	39.54 ± 1.95aA	66.34	14.14 ± 1.10aB	23.72	100.00
Wild pollinators	50	57.16 ± 1.87ab	4.54 ± 0.47abC	7.94	40.94 ± 1.54aA	71.62	11.68 ± 0.85bB	20.43	100.00
Pollinator restricted	50	49.64 ± 2.64b	3.86 ± 0.40bC	7.78	36.52 ± 2.29aA	73.57	9.26 ± 0.51bB	18.65	100.00

Means followed by different lower case letters in columns and upper case letters in rows differ at $p < 0.05$

Squash and Pumpkin

Bloom: August

Peponapis pruinosa, *Bombus sp* and honey bee



- No till to protect the squash bee that nests below the plants
- Provide resources all season to keep *Bombus* nearby

Wild native bees increase the effectiveness of honey bee pollination

