Pollinators and pesticides

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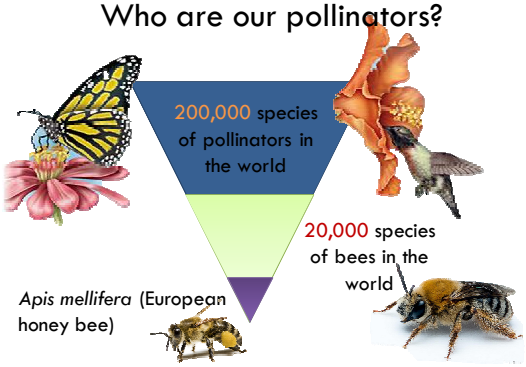
Meghan Milbrath 2018

Who are our pollinators?



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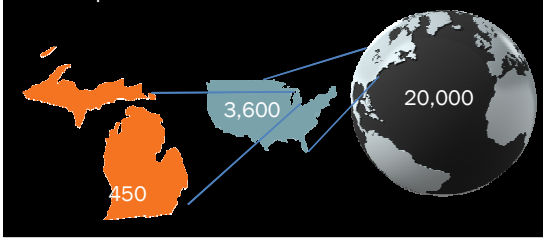
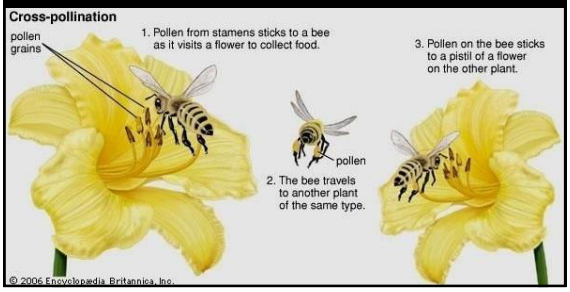
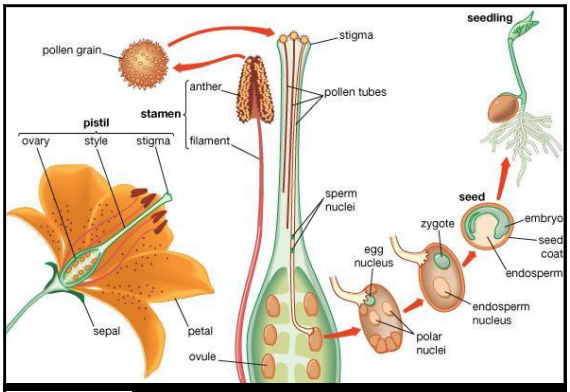
Bees!

There are more than 450 species of bee in Michigan, 4,000 species of bee in the United States, and 20,000 bee species around the world!



Pollination is the process that describes the vital method of sexual reproduction in plants.





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Most of our native plants depend on pollinators for reproduction

We need pollinators for plant diversity and ecosystem function.

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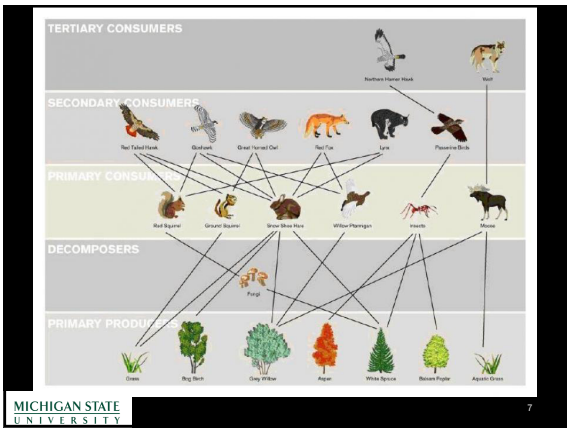
TERTIARY CONSUMERS
SECONDARY CONSUMERS
PRIMARY CONSUMERS
DECOMPOSERS
PRIMARY PRODUCERS
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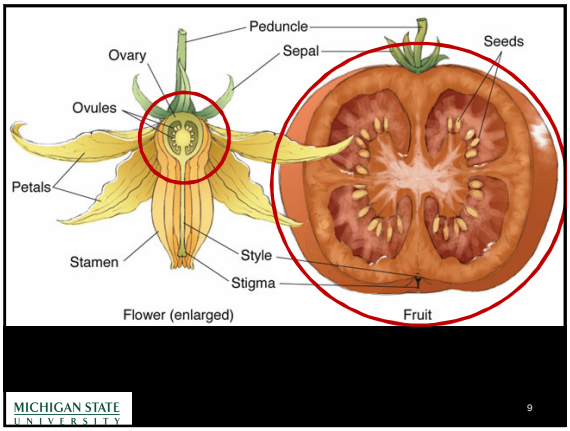
Many crops in the US are dependent on pollinators:
Almonds
Apples
Onions
Avocados
Carrots
Mangos
Lemons
Limes
Honeydew
Cantaloupe
Zucchini
Broccoli
Summer squash
Eggplant
Cucumbers
Celery
Green onions
Cauliflower
Leeks
Bok choy
Kale
Mustard greens
Broccoli rabe
Your produce choices with bees
Your produce choices without bees


Peduncle
Ovary
Sepal
Seeds
Ovules
Petals
Stamen
Style
Stigma
Flower (enlarged)
Fruit
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Of the more than 300 crops grown in Michigan, about 100 are pollinated by bees.
Pollinators Present
Pollinators Absent
[6]


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Honey bees contributed $15 billion in value to agriculture through increased yield and superior harvest.
Photo credit: Sarah B Scott


1. Good horticultural practices
2. Preventing diseases
3. Managing pests
4. Adequate pollination
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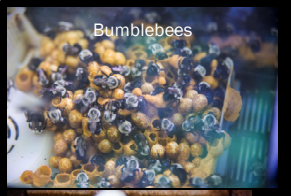
Managed Bees



December 1942

"Wherever a proper balance exists between plants and pollinating insects, both flourish. Agricultural development, however, has seriously interfered with this balance. It has demanded the growing of certain plants in enormous acreages and has unwittingly destroyed native pollinating insects as well as their nesting places. As a result the burden of pollination has been increased to such an extent that wild bees are no longer adequate or dependable, particularly where agriculture is highly developed. In many places the depletion of wild pollinators is so acute that honeybees have to be brought in especially for pollination, and so in practically all agricultural areas honeybees are now the most numerous of the flower-visiting insects."

United States Department of Agriculture Agricultural Research Administration Bureau of Entomology and Plant Quarantine THE DEPENDENCE OF AGRICULTURE ON THE BEEKEEPING INDUSTRY—A REVIEW

California's Central Valley has 800,000 acres of almond trees

Pollination requires ~ 2 million hives

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http://eberthoney.com/honeybeeblog/blog4.php/2009/05/24/may-and-apple-pollination-pictures

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http://eberthoney.com/honeybeeblog/blog4.php/2009/05/24/may-and-apple-pollination-pictures

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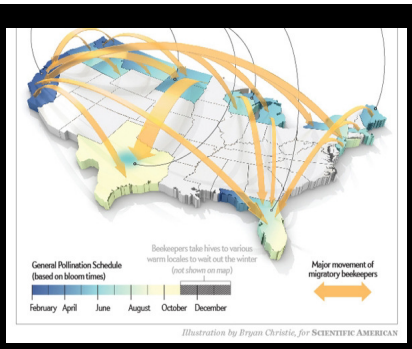
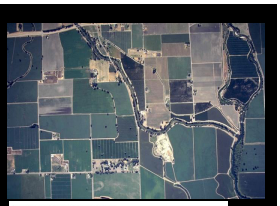
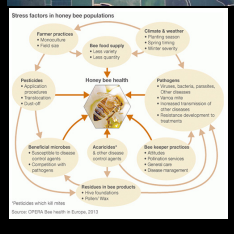
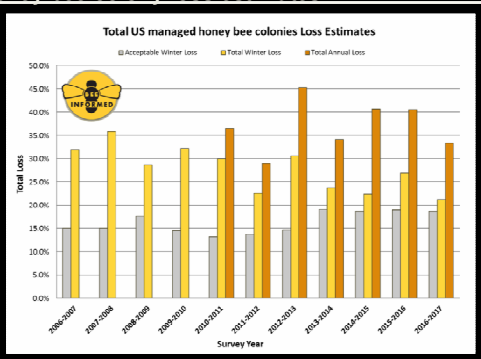


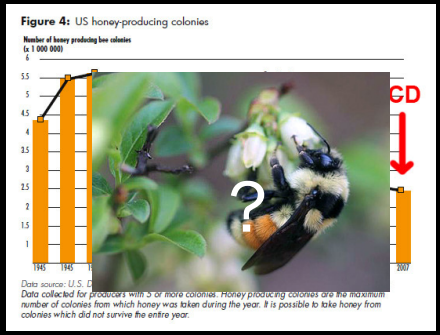
Pollinators in Agricultural Systems are under a lot of stress





Honey bee colony loss estimates

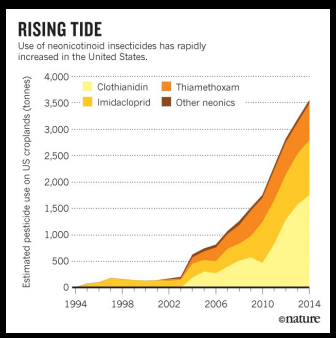




Main Points

1. Widespread use of systemic insecticides

Changing Insecticide Use



Changing Insecticide Use

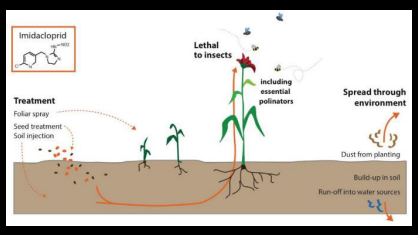
- **Different Pesticides**
  - New compounds
  - Changing pests/resistance
  - Restrictions/concerns on previously used compounds
  - Crop types
- **Changes in application techniques**

Granular/Spray → seed coatings

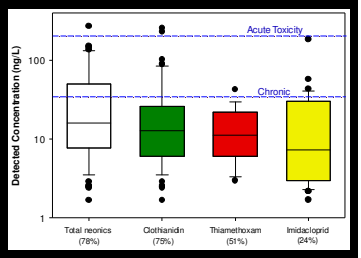
DDT | Organophosphates (Chlorpyrifos, Diazinon) | Pyrethroids (Bifenthrin, Permethrin) | Neonicotinoids (Imidacloprid)

1940 | 1990 | 2000 | 2010

Build-up of insecticides



Midwest Neonic Study



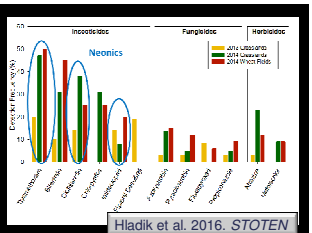
- Neonics detected at all 9 sites (and in multiple samples).
- Multiple neonics detected in 43 of 79 samples (28 of 29 during May-June).

Hladik et al., 2014

Morrissey et al., 2015

USGS

Native pollinators



Hladik et al. 2016. *STOTEN*

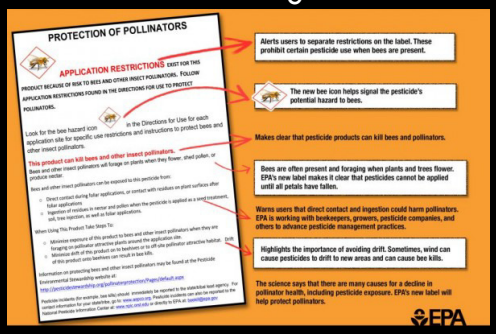
- 19 current-use pesticides and degradates in native bees collected from cultivated agricultural fields and grasslands in Colorado
- Exposure in grasslands = Presence and proximity of agricultural fields

- LD50s for neonics unknown in many native bees species
- Known variability in sensitivities between species
- Sublethal effects include:
  - Skewed sex ratios
  - Reduced immune response
  - Reduced foraging efficiency

Main Points

1. Widespread use of systemic insecticides
2. There is no such thing as 'bee safe'.

Bee Labeling



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LD 50 = the lethal dose for 50% of the animals in the study. (low LD50 = highlty toxic)

When a solitary bee is killed, so Are all of the future offspring

We still see acute bee kills in honey bees, but most of the pesticide damage does not look like this.

Report a Pesticide-Related Bee Kill

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Most chemicals are tested for **acute toxicity** of direct contact in adults

Things that aren't tested:

- Ef
- Ef
- Ch
- Ch
- Ch
- De
- Decreased egg laying
- Behavioral changes
- …

38

Inert Ingredients can be harmful

- Detergents, surfactants, and other inactive ingredients can harm bees.

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If pesticides don't immediately kill the worker, they often bring it home – Less toxic pesticides can be more damaging to a colony

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Photo: Randy Oliver, www.scientificbeekeeping.com

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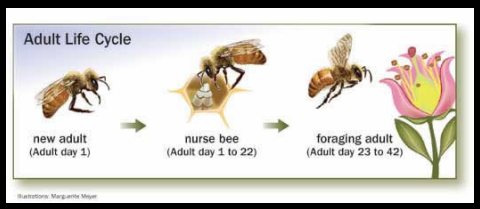
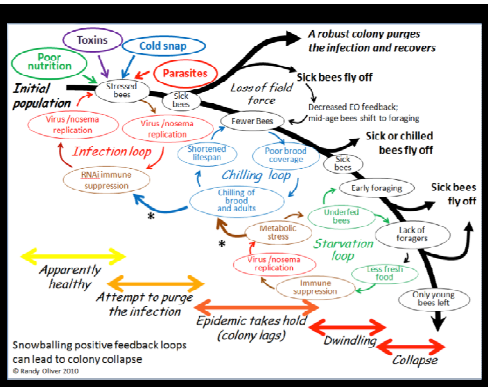
The honey bee colony is a super organism – the concern is the ability of that organism to maintain balanced function.

Common pesticide damage = dwindling death (Slow collapse)

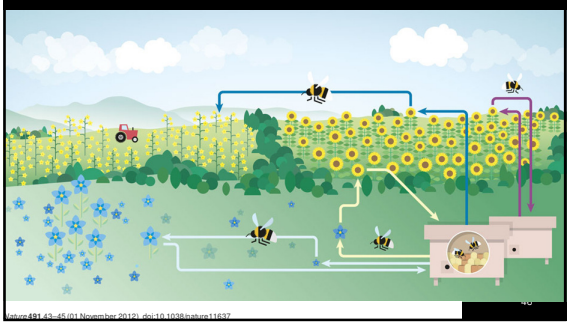




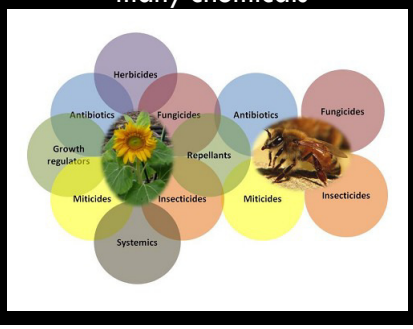
Main Points

1. Widespread use of systemic insecticides
2. There is no such thing as 'bee safe'.
3. Pesticide exposure is complex

Pesticide exposure is complex



Bees are exposed to many stressors in the environment, and are sensitive to many chemicals



Synergistic Effects

Main Points

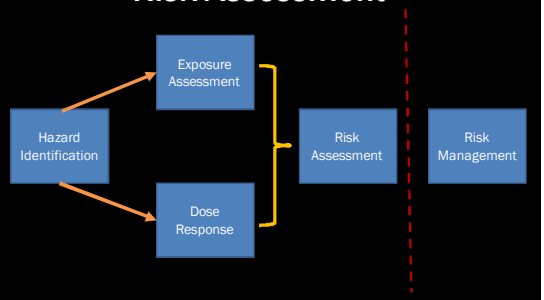
1. Widespread use of systemic insecticides
2. There is no such thing as 'bee safe'.
3. Pesticide exposure is complex
4. True Risk Assessment is technically impossible.

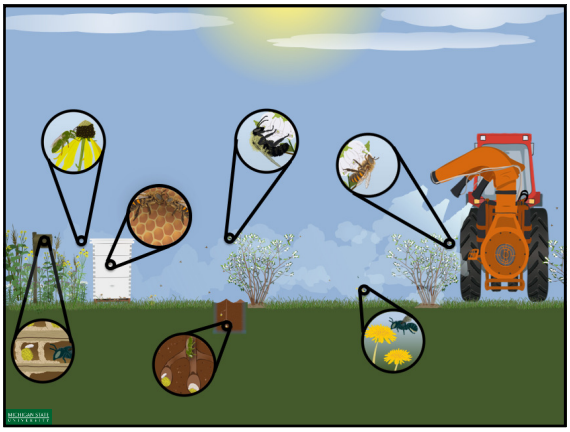
Risk Assessment

The scientific method of assessing the risk of a particular outcome to an organism from an identified hazard.

Combined with economic and social considerations, risk assessments are used to make policy decisions.

Risk Assessment

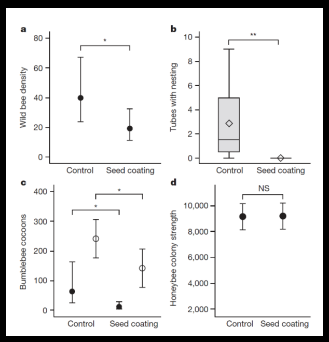




PESTICIDE IMPACTS IN THE FIELD

Wild bees

Bombus terrestris



Osmia bicornis

Apis mellifera

Rundlöf et al (2015) *Nature* 521: 77 – 80

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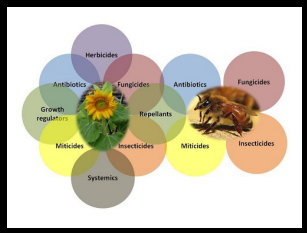

In most cases, we don't know the extent of the harm or risk of the mix of these exposures.

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To know that a pesticide was 'safe' we would have to look at

- Every pesticide
- Every formulation
- Every exposure scenario
- Every possible health outcome

- For every pollinator

The EPA has *just started* performing risk assessments for pollinators.

You cannot go by labeling to determine if a pesticide will have an effect on pollinators.

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Main Points

1. Widespread use of systemic insecticides
2. There is no such thing as 'bee safe'.
3. Pesticide exposure is complex
4. True Risk Assessment is technically impossible.

How do we make smart decisions?

NATIONAL STRATEGY TO PROMOTE THE HEALTH OF HONEY BEES AND OTHER POLLINATORS

1. Reduce honey bee losses to < 15% by 2025.
2. Increase Eastern monarch butterfly populations to 225 million by 2020.
3. Restore or enhance 7 million acres for pollinators by 2020.

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TWO WAYS TO ADDRESS PESTICIDE RISK TO POLLINATORS

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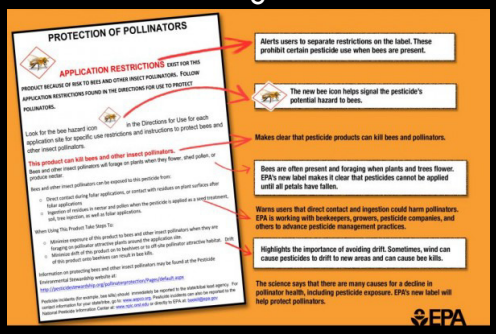
1. Federal Legislation



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The EPA has added new label language to pesticides that are high risk for pollinators

- These labels are the law
- Restrictions during bloom
- Restrictions when honey bees are on contract to pollinate that crop.

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2. State Guidelines

WWW.POLLINATORS.MSU.EDU/PROTECTION-PLAN

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Plans are used to promote communication between beekeepers, and to protect bees whose locations are unknown.

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In Michigan, we do not have a registry, or any way to tell where honey bee colonies are.

Our plan focuses on best management

Individual Education – reduce exposure

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Action 1: Don't use a pesticide unless you have to.

PRACTICE INTEGRATED PEST MANAGEMENT (IPM). ONLY USE A PESTICIDE IF YOU MONITOR AND OBSERVE THAT YOU HAVE A PEST INFESTATION.

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ACTION 2: REDUCE APPLICATIONS WHEN POLLINATORS ARE ACTIVE

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ACTION 3: LOOK FOR HIGH RISK SCENARIOS (BLOOMS)

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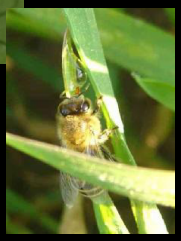

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Action 4: Minimize drift and runoff

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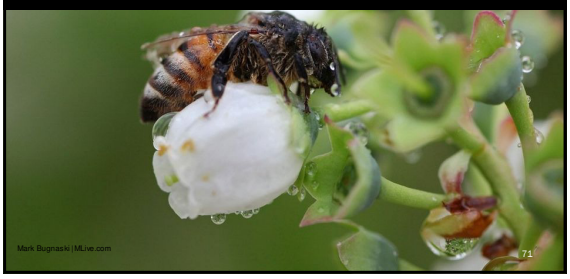
- REMEMBER: JUST BECAUSE A CHEMICAL IS NOT LABELED AS TOXIC, IT IS NOT BEE SAFE.
- USE CARE WITH ALL THAT YOU USE.



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THANK YOU!

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Pollinators.msu.edu

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