PREVENTING DISEASE WHILE MINIMIZING HARM TO POLLINATORS DURING BLOOM
BALANCING PEST MANAGEMENT AND POLLINATOR HEALTH

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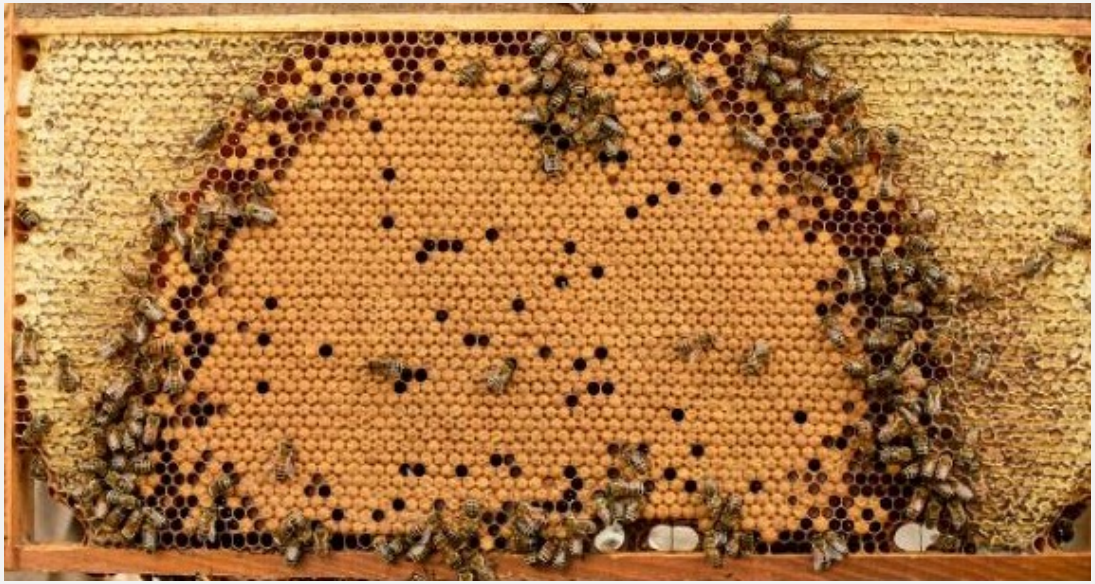
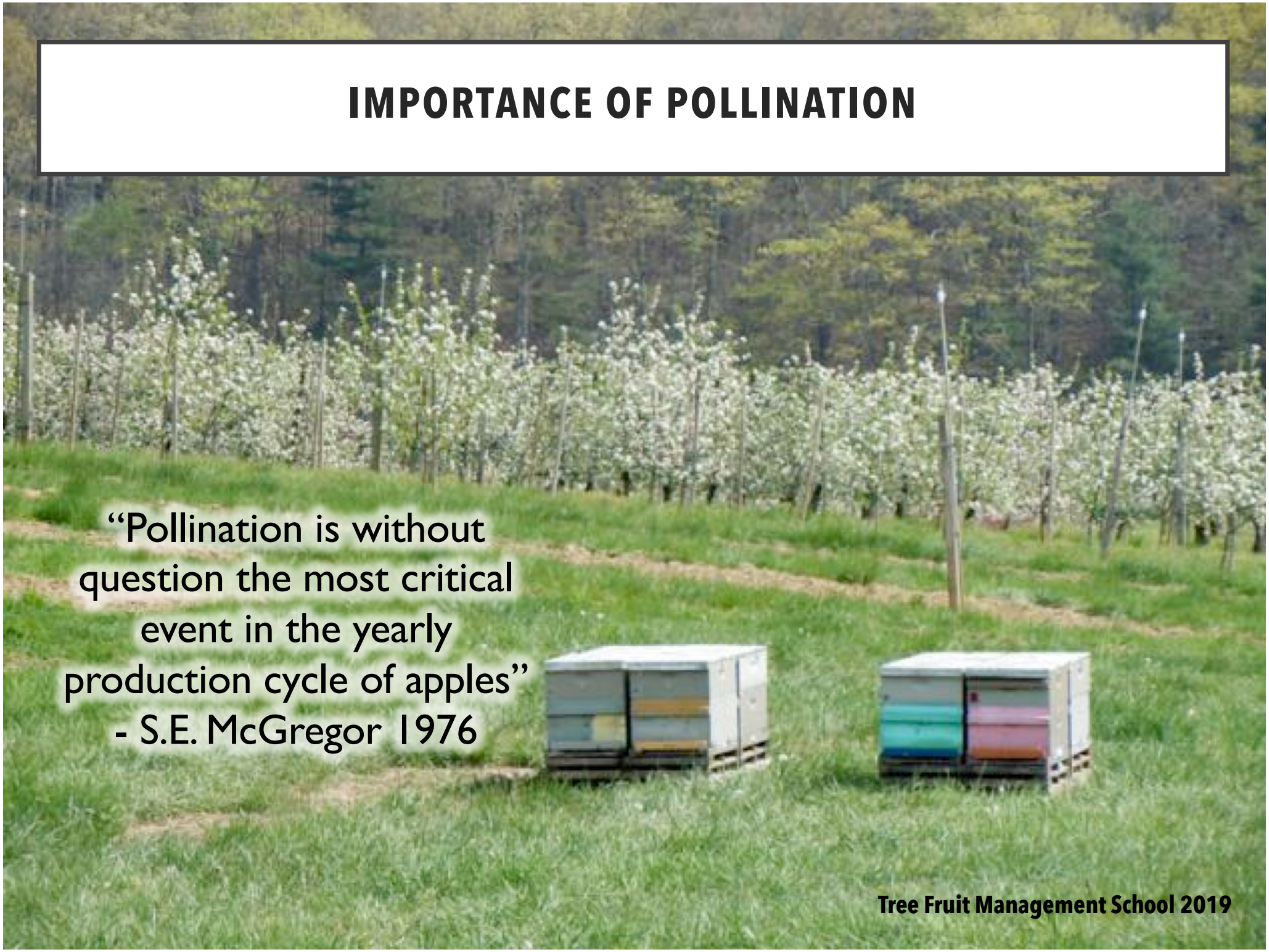
OUTLINE

- Pollination and Bees
- Pesticide Exposure
- Sub-Lethal Effects
- Best Management Practices



IMPORTANCE OF POLLINATION



IMPORTANCE OF POLLINATION

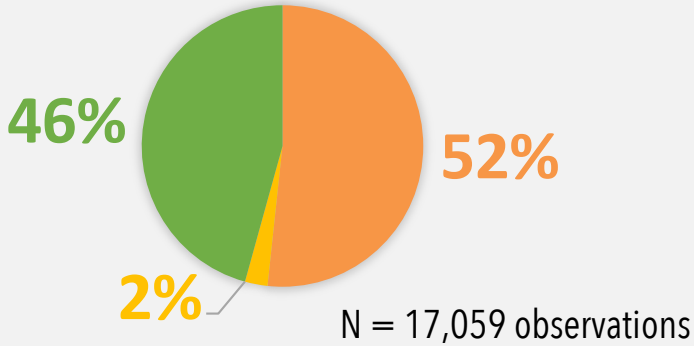
Poor pollination

Good pollination

Not every ovule must be fertilized for fruit to develop, but the more seeds there are, the more likely fruit will remain on the tree until harvest.

WHO ARE THE MAIN POLLINATORS IN TREE FRUIT?

- Managed, non-native **honey bees** (52%)
- Wild, (mostly) native **solitary bees** (46%)
  - Mostly ground-nesting *Andrena*; some halictid/sweat bees
  - Some stem-nesting mason bees (including non-native horn-faced bee)
- Wild, native **bumble bees** (2%)



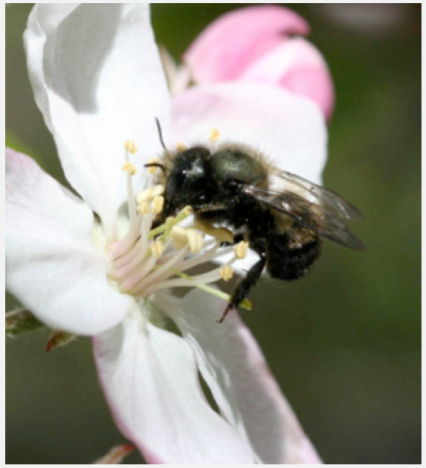
Honey bees

Apis mellifera

Miner bees

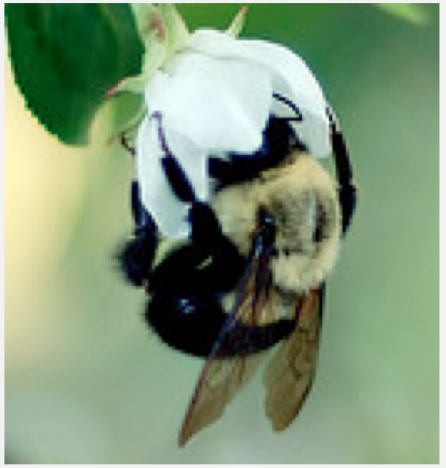
Andrena spp.

Mason bees



Osmia spp.

Bumble bees



Bombus spp.

SPRING-ACTIVE SOLITARY BEES

70+ species active in MI orchards during bloom

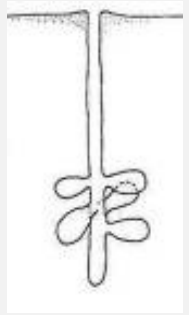
♂ ♀

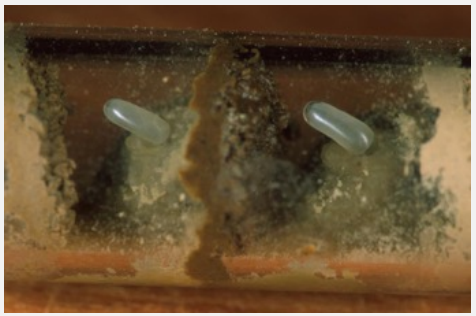
Environmental cues trigger emergence; males emerge first and await the emergence of females to mate

or

Individual females gather nesting materials or dig nests in soil and collect pollen and nectar

♂ ♀



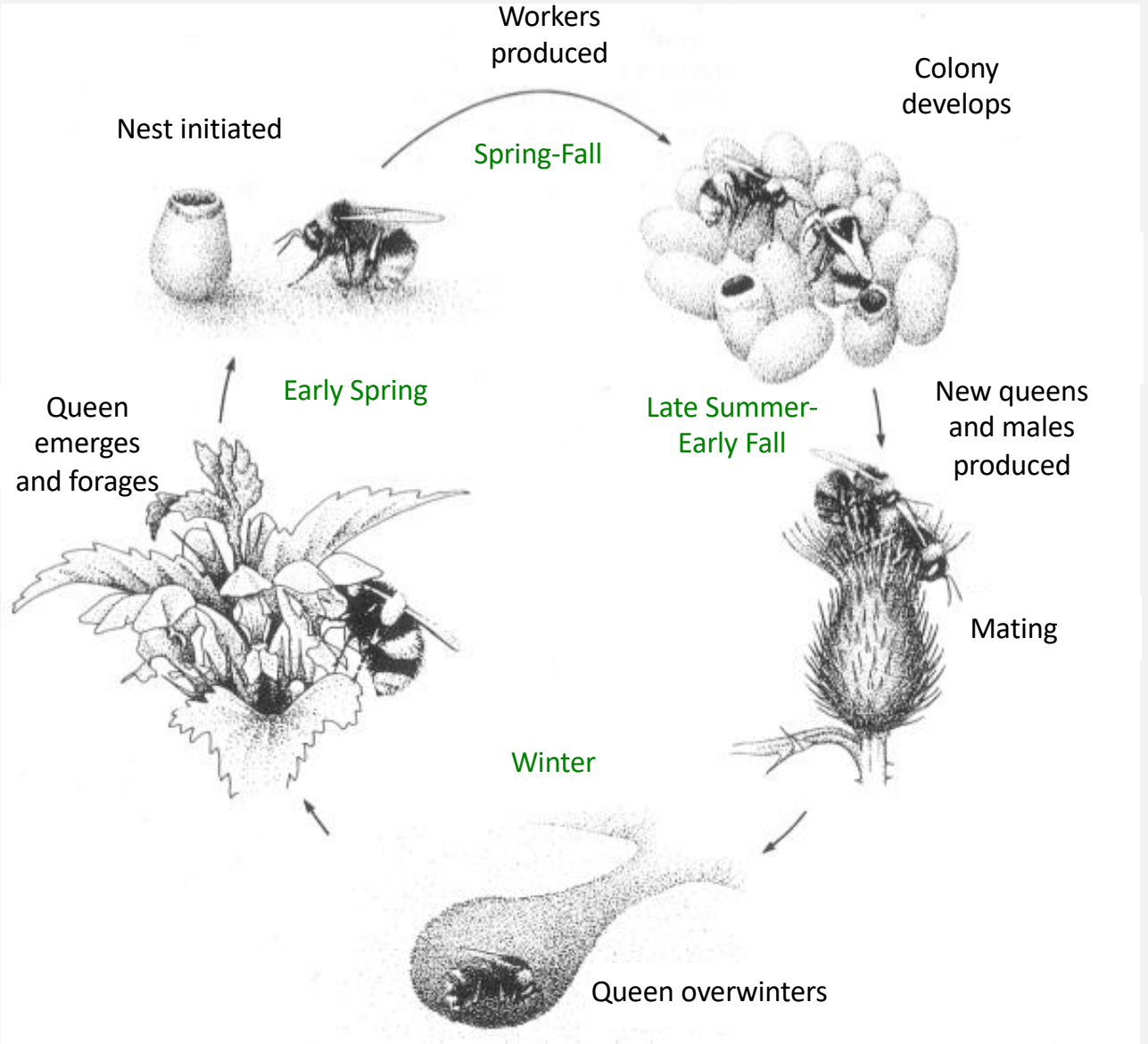


Larvae develop into pupae or pre-adults, that overwinter in the nest cells

Adults are active for about 3 weeks, depending on the particular species.
New species emerge all season long.

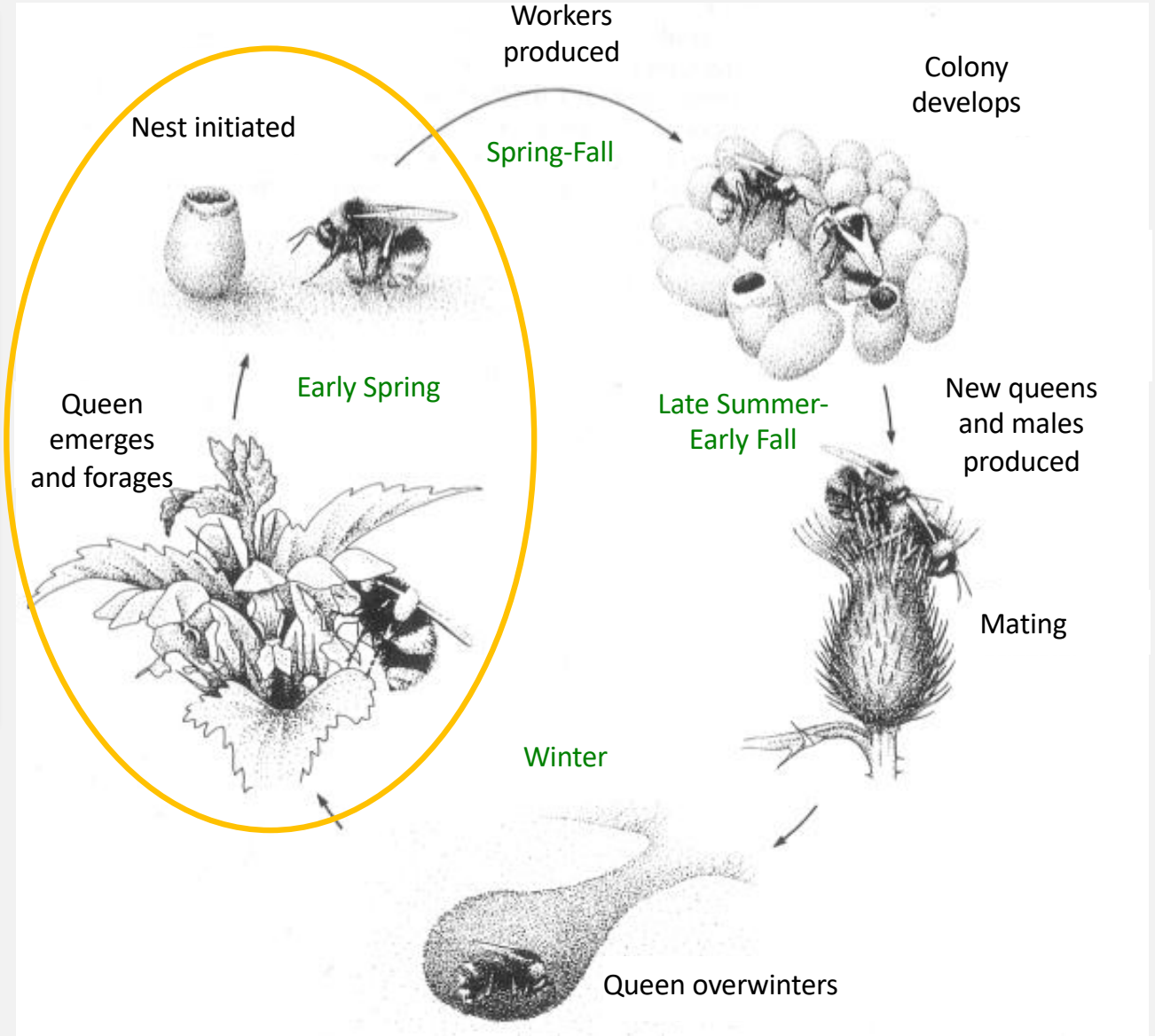
WILD BUMBLE BEES

6 common species



WILD BUMBLE BEES

Only queens are available to forage during orchard bloom



HONEY BEES:
THE WORKHORSE OF CROP POLLINATION

Colonies are portable, contain thousands of foragers.

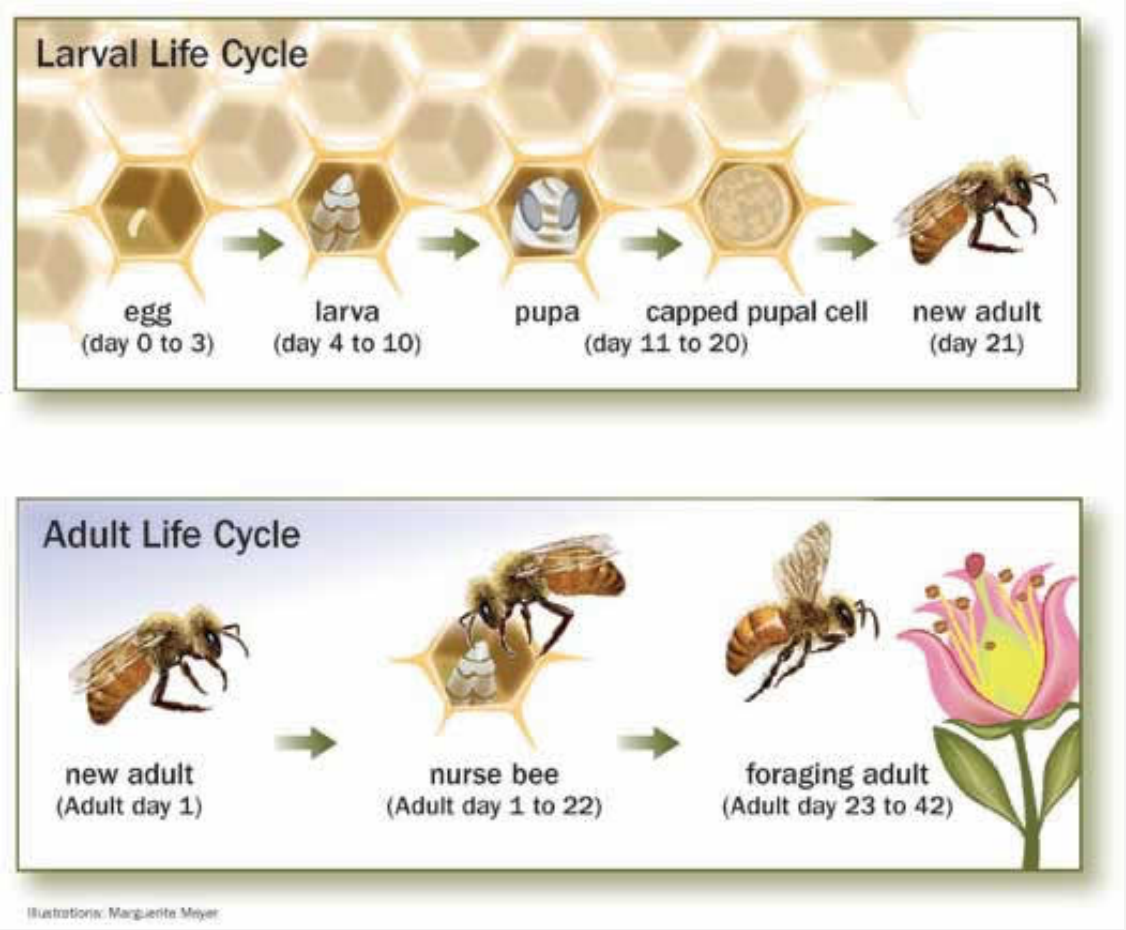
Individual hives collect pollen and nectar from many different cultivated and wild plants.

Individual foragers recruit others to visit particular flower patches through waggle dance.

Individual foragers exhibit floral constancy – enabling pollination.

HONEY BEE LIFE CYCLE

- **Queen** lays eggs; controls whether eggs will be drones, workers, or new queens
- **Drones** (male bees) mate with new queens, then die
- **Workers** (female bees other than queen) take care of brood, provide housekeeping in the hive, forage for food, process nectar into honey and pollen into bee bread



- Three weeks as **Brood** – eggs, larvae, pupae
- Three more weeks until the worker becomes a forager

IT TAKES 2-3 MONTHS TO BUILD UP A STRONG COLONY WITH FORAGERS ENOUGH TO PROVIDE CROP POLLINATION SERVICES

PESTICIDES CAN UPSET THE BALANCE OF THE COLONY

COLONIES OFTEN NEED INCREASED INPUTS TO REBUILD AFTER FULFILLING POLLINATION CONTRACTS

http://stepplerfarms.com/

Beekeepers feeding hives to promote growth/rebuilding

More stress during pollination = More input needed by beekeepers

THE BOTTOM LINE

Weak and/or lost colonies

Increased hive rental fees

Less efficient pollination services

Bad for economy and environment

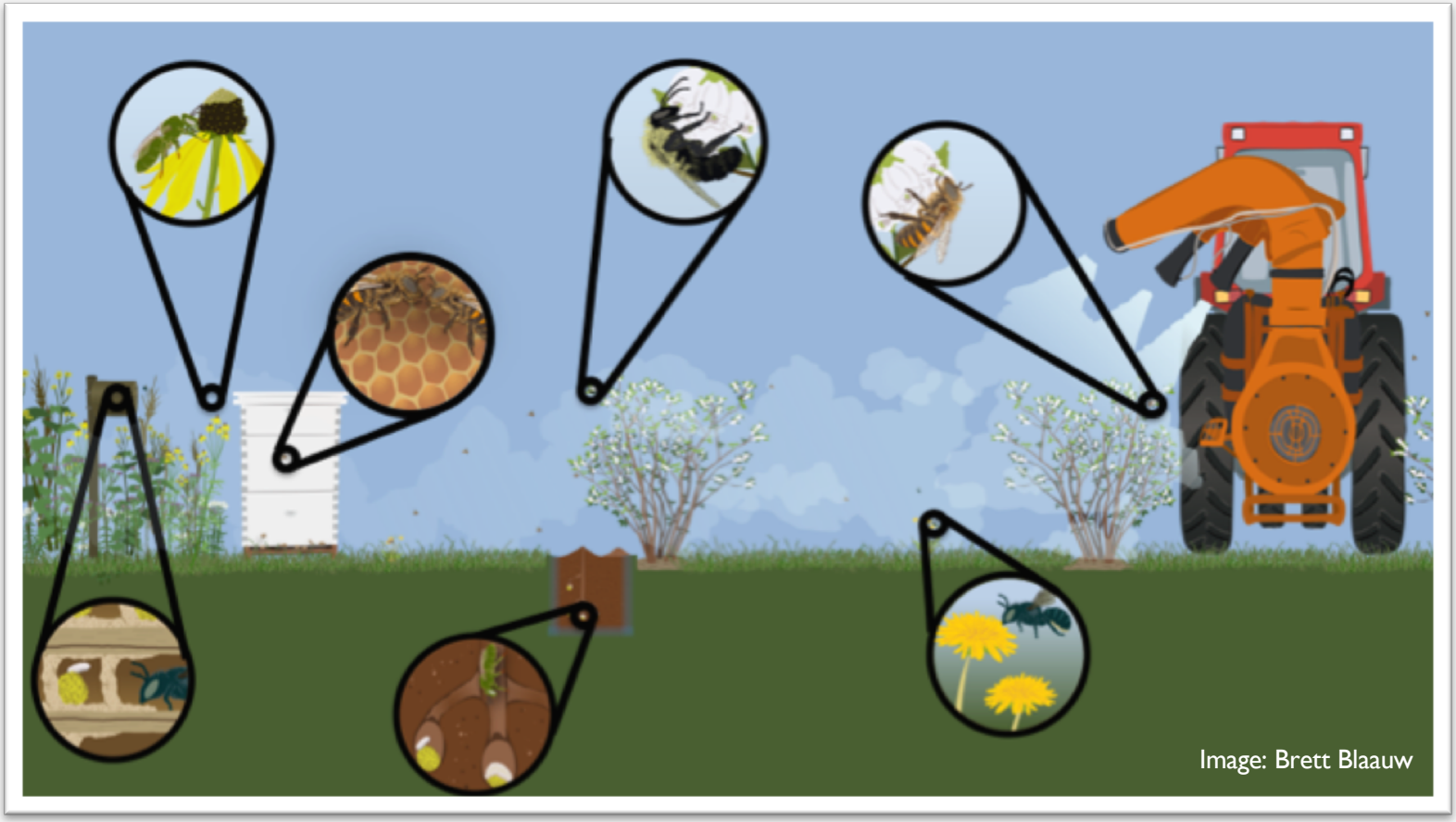
EVERY GROWER OR LAND MANAGER

(EVEN THOSE THAT DON'T DIRECTLY RELY ON POLLINATION)

CAN GREATLY IMPACT BEE HEALTH WHEN MAKING PESTICIDE APPLICATIONS

PESTICIDE EXPOSURE

- Bees can come into contact with pesticides through direct spray, contact with treated crops, drift onto nearby floral resources, and water contamination through runoff.



TOXIC ACUTE DEATH IS RARE, SUB-LETHAL EFFECTS ARE COMMON

Acute vs. Chronic/Sub-lethal

"Sub-lethal" = does not immediately cause death, but disrupts individual bee health and/or the hive's ability to function properly over time

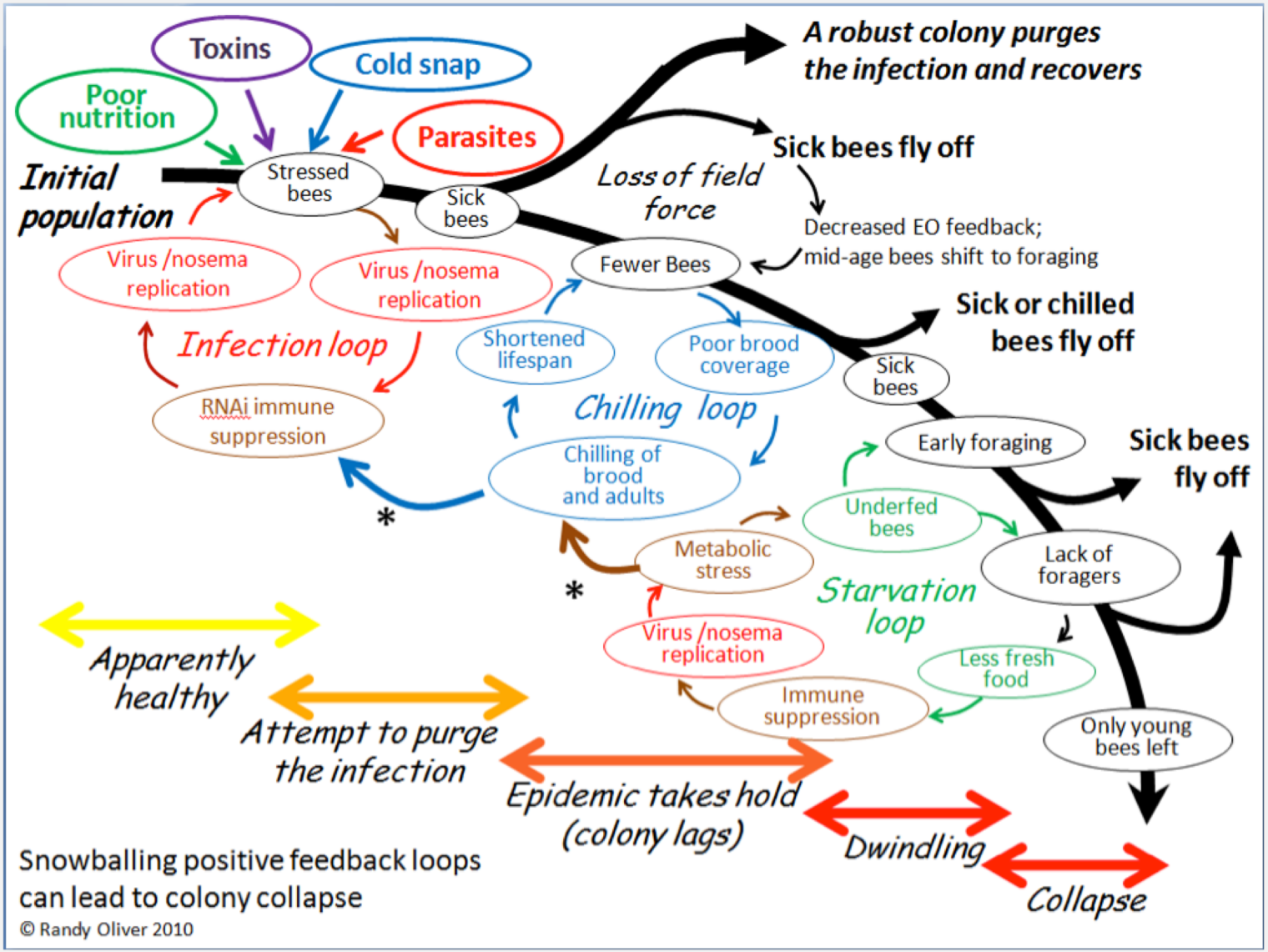
PESTICIDE EXPOSURE

- Foraging bees will carry resources and pesticide residues back to the hive.
- Bees not in immediate contact in the field can still be exposed through stored hive products.

PESTICIDE EXPOSURE

- Stored pesticides can remain in hives for a long period, resulting in chronic exposure.
  - Pesticides are a significant contaminant of bee bread, the main food source for developing bees
  - Bee bread is fermented, and requires active yeasts, fungi, and bacteria
  - Pesticides, especially fungicides can change these important microbial communities

HOW A HONEY BEE COLONY DIES



DO YOU HAVE TO STOP USING PESTICIDES?

NO, however…

Very important to understand the potential risks of using pesticides.

Minimize use as much as possible.

Always follow "Best Management Practices" for reducing exposure.

THERE IS NO LIST OF "BEE SAFE" PRODUCTS

- **Just because products are not labeled as "toxic to pollinators" does not mean the product is safe for bees!**
- Too many knowledge gaps to confidently say that a particular pesticide is completely safe to use around bees
- Focus on using best management practices and avoid particularly harmful substances or tank mixes.

WHY FOCUS ON FUNGICIDES?

- Recent studies have indicated that fungicides have negative health outcomes for bees, despite being largely considered "bee safe".
  - These products with "sub-lethal" effects are often overlooked
- Fungicides are commonly used when bees are present on site (during crop bloom).
- Fungicide residues found in pollen stores and in wax are significantly higher than residues of herbicides or insecticides.

WHAT DO WE KNOW ABOUT FUNGICIDES?

- Impaired ability to find food and recruit other foragers
- Impaired ability to process and digest food

- Increased disease susceptibility
- Impaired cellular function

- Impaired larval development
- Higher larval mortality

These effects may be compounded when fungicides are combined with other pesticides (negative synergistic effects).

BAD COMBINATIONS

Neonicotinoid Insecticides:
acetamiprid,
thiacloprid,
imidacloprid

More toxic when mixed with

Fungicides:
epoxiconazole,
propiconazole,
triadimefon,
triflumizole,
uniconazole-P,
prochloraz,
tebuconazole

Pyrethroid Insecticides:
deltamethrin,
lambda-cyhalothrin,
alphacypermethrin

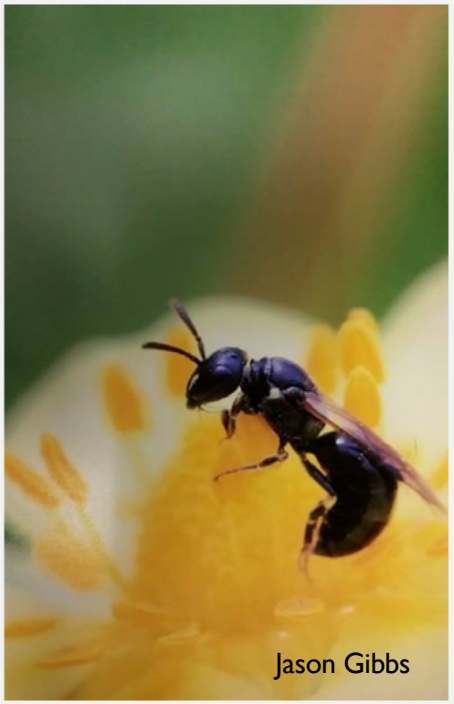
More toxic when mixed with

Fungicides:
difenoconazole,
carbendazim,
prochloraz, flusilazole,
propiconazole,
tebuconazole,
thiophanate-methyl

KNOWLEDGE GAPS

- Sub lethal effects are highly understudied, including effects in developing bees, and the increased toxicity caused by combined exposures.

- Responses of honey bees to pesticides cannot be extrapolated to responses of native bee species.



PESTICIDE RISK ASSESSMENT

- The EPA has just begun to expand the risk assessment process for pollinator health starting with pesticides that are acutely toxic to adult bees through contact.
- The risk assessment process requires lots of research:
  - Different levels/ doses
  - Different exposure routes
  - Different life stages
  - Different health effects
  - Different contexts

We have to make management decisions long before we will have all the answers

KEY POINTS

- **Everyone can impact pollinators when making applications**
  - Pollination is vital to agriculture, economy, and environment
    - Strong healthy colonies needed for pollination

- Pesticides can cause sub-lethal effects which can lead to colony collapse especially in combination with other stressors
  - Pesticides can interact causing synergistic effects
    - Lots of research still needs to be done

WHAT CAN YOU DO TO REDUCE PESTICIDE EXPOSURE?

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TIPS FOR REDUCING EXPOSURE: WORK WITH YOUR BEEKEEPER

Communication

- Develop a pollination contract and bee safety plan with your beekeeper.
- Maintain communication with beekeeper and neighboring farms throughout the season.

TIPS FOR REDUCING EXPOSURE: WORK WITH YOUR BEEKEEPER

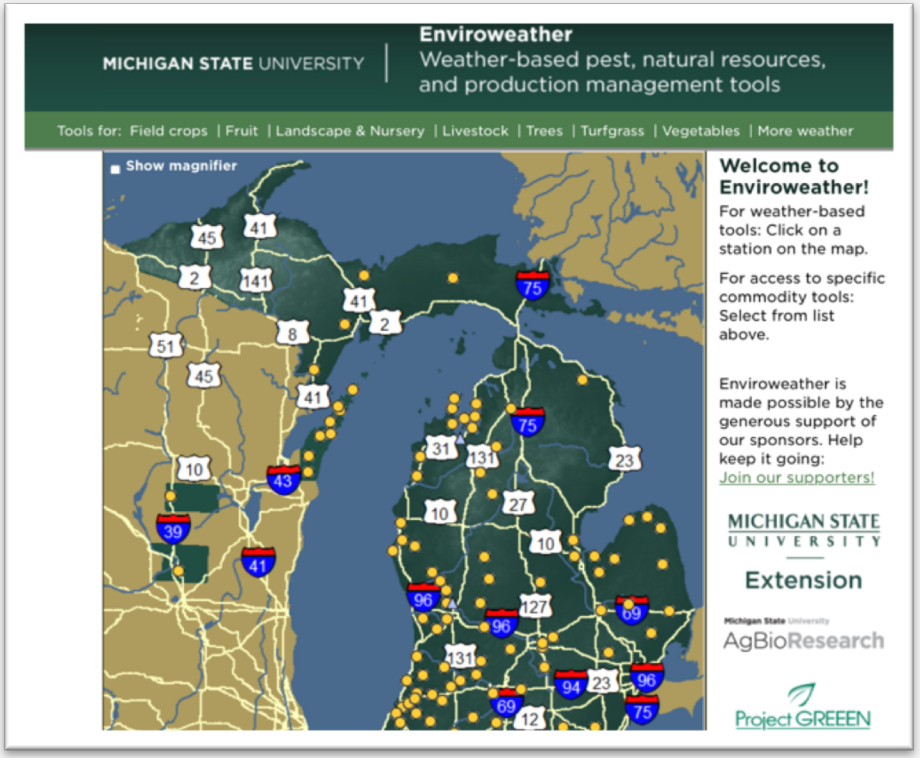
Hive Placement

- Don't allow hives to be placed directly in the orchard.
  - Honey bees are excellent fliers and actively seek out orchards in the spring.
- Provide a sheltered location.
  - Tree lines or hillsides provide natural buffers against chemical exposure and other stressors.
- Place hives in fewer, larger groups.
  - Easier on bees and beekeeper
  - Easier to communicate where they are to farm workers so that they can be avoided

TIPS FOR REDUCING EXPOSURE: IPM

Use All Available Tools

- Correctly identify the problem: scout for and know what pests and diseases to expect during the season.
- Learn what methods and tools can be employed to prevent, suppress, and manage pests and diseases as they arise.
- Use the pest and disease models available on Enviroweather to determine when pesticide applications are predicted to be absolutely necessary.



https://www.enviroweather.msu.edu

TIPS FOR REDUCING EXPOSURE: LABELS

- When a pesticide is the tool to use, always **follow label guidelines and instructions for application**.

Look for this icon on pesticide labels
for bee-specific warnings.

TIPS FOR REDUCING EXPOSURE: PREPARATION

- **Calibrate your sprayer** to be sure that the material being applied is going where it was intended. You will also save money by not spraying more product than you need (consult Sprayer 101 for more info; consider using the free OrchardMax app).

TIPS FOR REDUCING EXPOSURE: PREVENTION

- Always **mow or remove flowering weeds in crop area** before applying plant protectants. While these are great alternate sources of nutrition for bees outside the orchard, they can easily become contaminated in the orchard during the season.

TIPS FOR REDUCING EXPOSURE: PREVENTION

Other ways to reduce or prevent contamination of flowers

- Do not apply systemic products prior to crop bloom.
  - Ex: thiophanate-methyl, propiconazole, myclobutanil, and iprodione
- Avoid applications to all flowering plants when possible.

TIPS FOR REDUCING EXPOSURE: PREVENTION

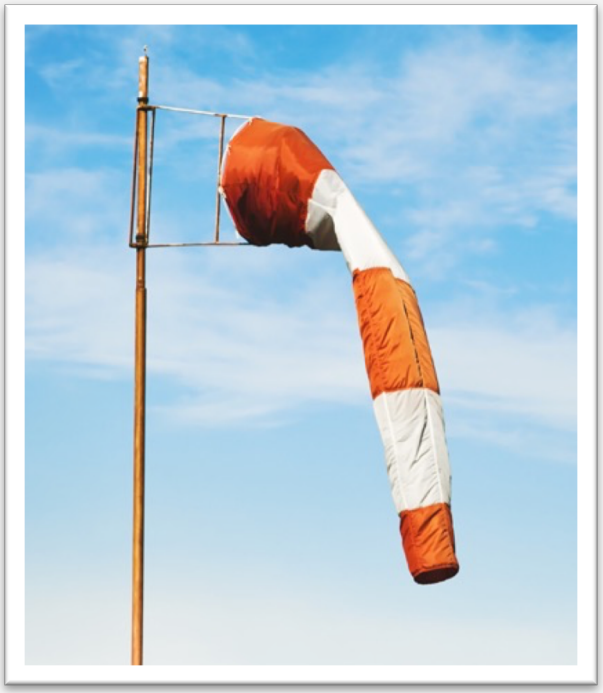
Prevent water contamination

- When filling spray tanks, ensure contaminated puddles are not left behind and that all products are stored properly.

pinterest.com

TIPS FOR REDUCING EXPOSURE: TIMING

- **Spray when bees are less likely to be active**:
  - After sunset or before sunrise, or when the temperature is below 50 F
  - When wind speed is low (<10 MPH).



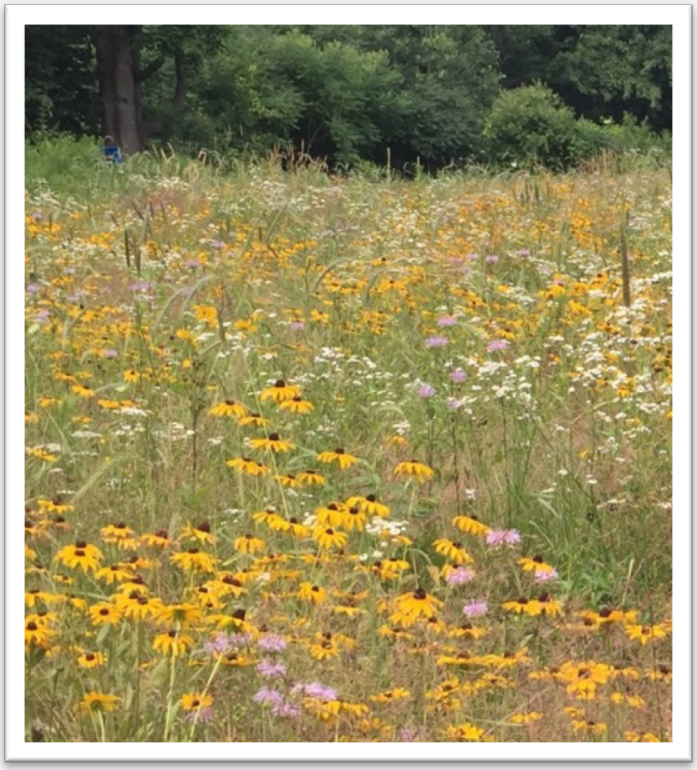
TIPS FOR REDUCING EXPOSURE: TIMING

At bloom time, avoid tank mixes

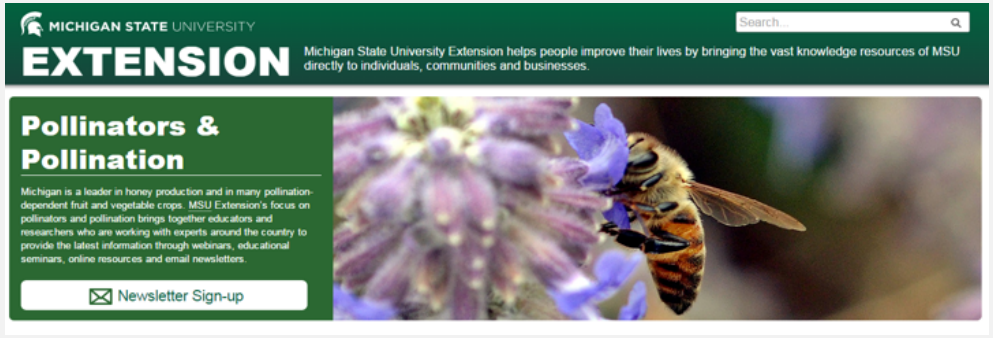
- Fungicides mixed with other pesticides can be more toxic than on their own.
  - Avoid using fungicides with pyrethroid and neonicotinoid insecticides.
- Space treatments of different materials out as much as possible.

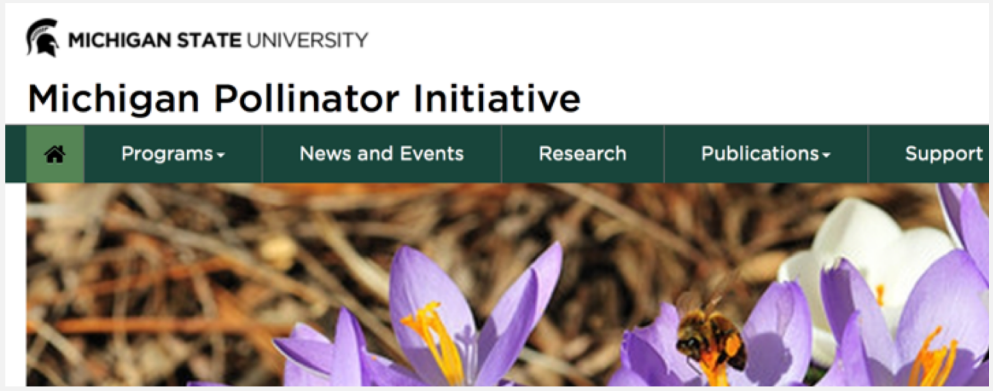
TIPS FOR REDUCING EXPOSURE: PROVIDE HABITAT

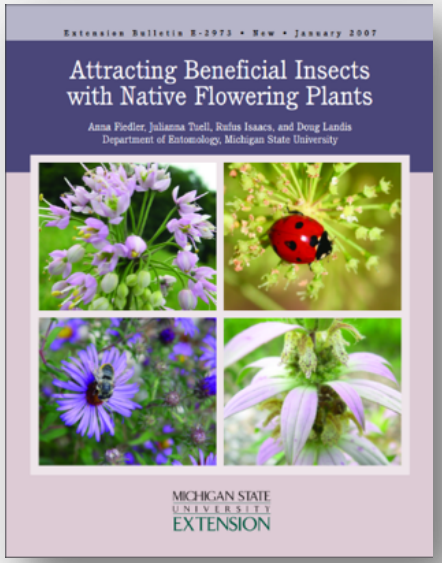
- **Protect and establish bee-friendly habitat** away from crops.
  - Flowering woody trees and shrubs in adjacent habitat provide additional sources of nectar and pollen for spring-active bees; flowering meadows are a good resource for bumble bees.
  - A diverse diet is better for bee health: better reproduction, disease resistance, ability to detoxify chemicals, and longer life expectancy.

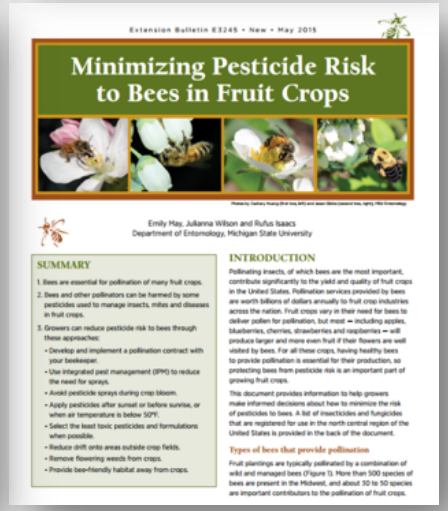


MSU RESOURCES









- Sign up for Extension newsletter
- Mailing list for Michigan Pollinator Initiative (MP3)

WWW.POLLINATORS.MSU.EDU

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