Best Management Practices for Pollinators in Orchards

2017 Tree Fruit IPM School

February 3, 2017

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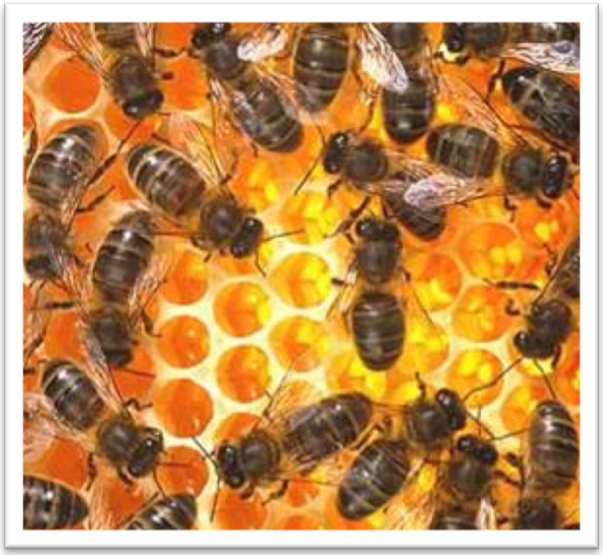
1. Good horticultural practices
2. Preventing diseases
3. Managing insect and mite pests

4. Adequate pollination

Honey bees



- Rented for pollination services
- Perennial – active as long as the weather is favorable
- Pollinate many crops
- Portable colonies

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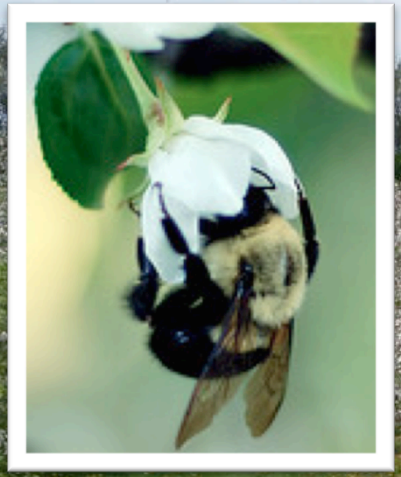
Managed bumble bees

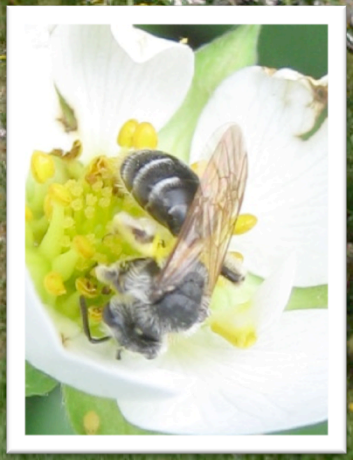
- Purchased colonies
- Out of synch with natural colonies
- Pollinators of many crops
- 6-8 weeks of activity
- Portable for the lifespan of colony

Managed orchard mason (*Osmia*) bees

- Solitary bees (as opposed to colony forming) requiring management via temperature and sanitation of nesting materials
- Particularly suited to orchard pollination
- Active for ~4 weeks
- Portable after nesting is completed

Unmanaged wild bees in orchards



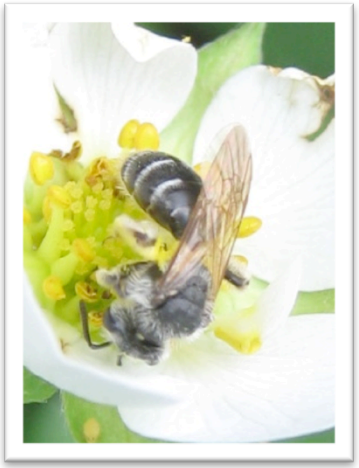


Unmanaged wild bees in orchards

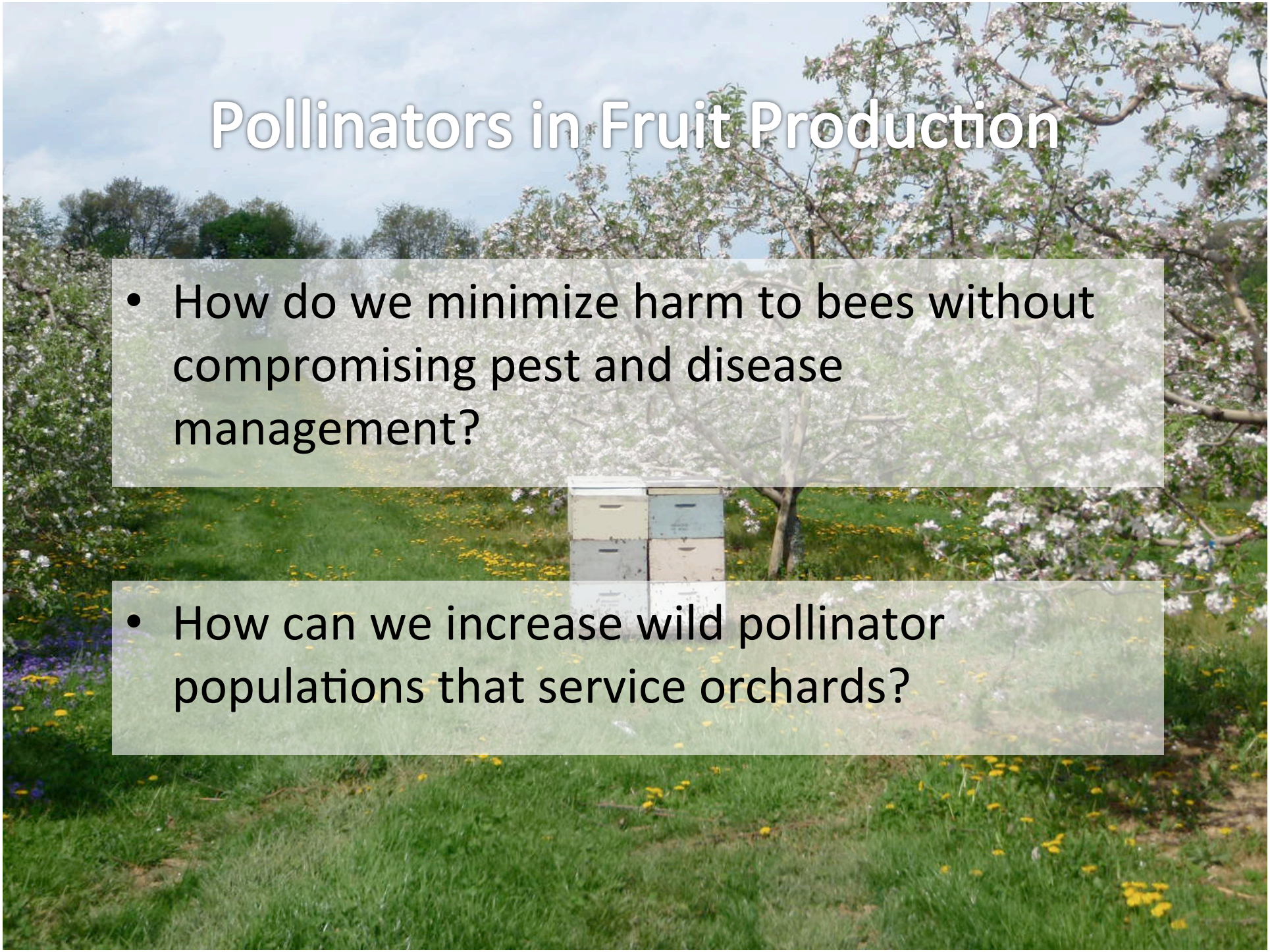
- >80 species active during spring bloom in Michigan
- Most are solitary, often nesting in soil of weed-free strips in orchards
- Limited by flowers that bloom when crop is finished
- Wild bees do not compete with honey bees, but appear to increase their pollination efficiency.

Andrena spp.
digger bees

Augochlorella spp.
green bees



Lasioglossum spp.
sweat bees


Pollinators in Fruit Production
• How do we minimize harm to bees without compromising pest and disease management?
• How can we increase wild pollinator populations that service orchards?

Pollinators in Fruit Production

- Points to consider:
  - Most farms grow a variety of different cultivars that bloom at different times – pre-bloom and "petal fall" may be different in adjacent blocks.
  - Fungicides are critical during bloom to manage disease.
  - Insecticide residual activity, timing of applications, and potential drift are important.

Fungicides & Early Spring Diseases

Cherry Leaf Spot **causes severe defoliation and tree decline**

Apple scab **infections will cause foliar and fruit damage**

- Fungicides by themselves previously considered safe around bees based on lab-based toxicology (LD_{50}) studies.
- New research identifying sub-lethal effects of fungicides on colony health:
  - Increased toxicity of pyrethroids when applied in combination (Pilling & Jepson 1993)
  - Increased toxicity of miticides used in the hive (Johnson et al. 2013)
  - Interference with detoxification (Mao et al. 2013)
  - Interference with Nosema immunity (Pettis et al. 2013)
  - Increased larval mortality (Johnson 2015)
  - Gut microbe interference (Kakumanu et al. 2016)

Potential pesticide effects on bees throughout the growing season

- **Insecticides:**
  - Vary in their toxicity to bees, most studies have been conducted on honey bees with effects on wild bees unknown.
  - Most insecticides are restricted from use during crop bloom, but drift onto non-crop flowers can occur at other times if care is not taken.

THE NEW EPA BEE ADVISORY BOX

On EPA's new and strengthened pesticide label to protect pollinators

PROTECTION OF POLLINATORS

APPLICATION RESTRICTIONS EXIST FOR THIS PRODUCT BECAUSE OF RISK TO BEES AND OTHER INSECT POLLINATORS. FOLLOW APPLICATION RESTRICTIONS FOUND IN THE DIRECTIONS FOR USE TO PROTECT POLLINATORS.

Look for the bee hazard icon in the Directions for Use for each application site for specific use restrictions and instructions to protect bees and other insect pollinators.

This product can kill bees and other insect pollinators.

Bees and other insect pollinators will forage on plants when they flower, shed pollen, or produce nectar.

Bees and other insect pollinators can be exposed to this pesticide from:

- Direct contact during foliar applications, or contact with residues on plant surfaces after foliar applications
- Ingestion of residues in nectar and pollen when the pesticide is applied as a seed treatment, soil, tree injection, as well as foliar applications.

When Using This Product Take Steps To:

- Minimize exposure of this product to bees and other insect pollinators when they are foraging on pollinator attractive plants around the application site.
- Minimize drift of this product on to beehives or to off-site pollinator attractive habitat. Drift of this product onto beehives can result in bee kills.

Information on protecting bees and other insect pollinators may be found at the Pesticide Environmental Stewardship website at:
http://pesticidestewardship.org/pollinatorprotection/Pages/default.aspx

Pesticide incidents (for example, bee kills) should immediately be reported to the state/tribal lead agency. For contact information for your state/tribe, go to: www.aapco.org. Pesticide incidents can also be reported to the National Pesticide Information Center at: www.npic.orst.edu or directly to EPA at: beekill@epa.gov

Alerts users to separate restrictions on the label. These prohibit certain pesticide use when bees are present.

The new bee icon helps signal the pesticide's potential hazard to bees.

Makes clear that pesticide products can kill bees and pollinators.

Bees are often present and foraging when plants and trees flower. EPA's new label makes it clear that pesticides cannot be applied until all petals have fallen.

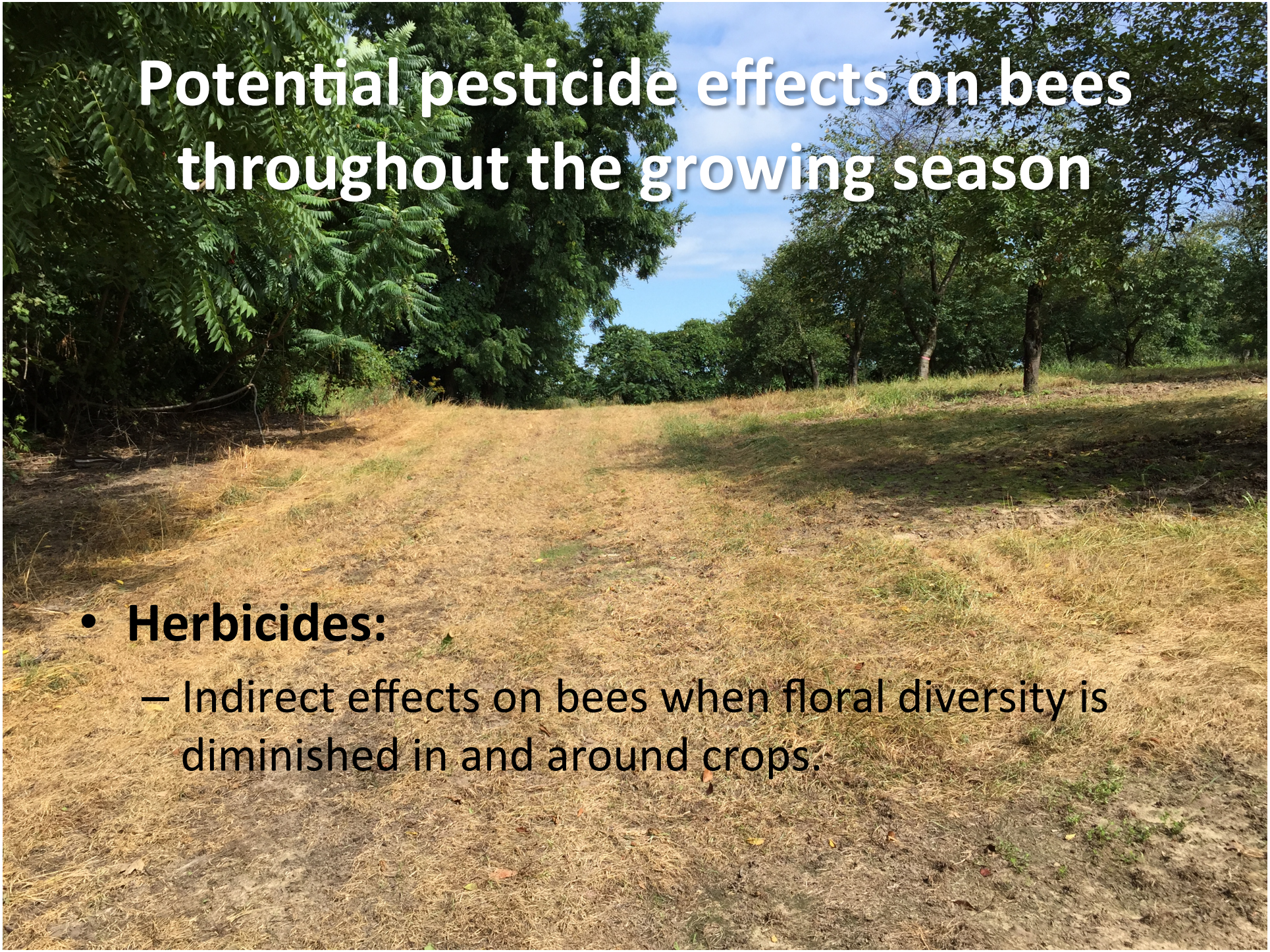
Warns users that direct contact and ingestion could harm pollinators. EPA is working with beekeepers, growers, pesticide companies, and others to advance pesticide management practices.

Highlights the importance of avoiding drift. Sometimes, wind can cause pesticides to drift to new areas and can cause bee kills.

The science says that there are many causes for a decline in pollinator health, including pesticide exposure. EPA's new label will help protect pollinators.

EPA

Read EPA's new and strengthened label requirements: http://go.usa.gov/jHH4



Potential pesticide effects on bees throughout the growing season

- **Herbicides:**
  - Indirect effects on bees when floral diversity is diminished in and around crops.

Recommended Best Practices

Pre-Bloom:

- Clarify expectations with beekeeper - preferably by written contract
  - **Record keeping** by both parties
  - Delivery date and approx. removal date
  - Where hives will be placed
  - Hive strength
    - 6-8 frames with 70-75% capped brood cells per frame is a reasonable expectation
  - Anticipated pre-bloom insecticide sprays and REIs (select a product with short residual, i.e. Lorsban is NOT recommended pre-bloom).

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Recommended Best Practices

When bees are delivered:

- Select location
  - Upwind from potential drift
  - At orchard margins – honey bees are excellent fliers
  - Examine hives delivered, with beekeeper
    - 6-8 frames with 70-75% capped brood cells per frame is a reasonable expectation

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Recommended Best Practices

During Bloom:

- Follow current labels.
- Select least toxic pesticides whenever possible.
  - E-154 contains a toxicity table for bees by pesticide
- Spray when bees are less active.
  - Temp below 55°F, or after sunset
- Turn off sprayer when near hives and avoid pesticide drift onto open flowers in adjacent habitat.
- Avoid using any insecticides during bloom while bees are actively visiting flowers.

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Recommended Best Practices

Post-Bloom:

- Communicate with beekeeper about hive removal.
- Minimize flowers in orchard floor with selective herbicides or by mowing before spraying.
- Avoid pesticide drift onto open flowers in adjacent habitat.
- Plant non-crop flowers outside of orchards
  - Native perennial plants following NRCS Tech Guide 20.
  - Summer blooming cover crops.

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PROJECT
ICP

3 years, 10 sites

n = 2904 bees


PROJECT
ICP

Most important conclusions:

Better communication between growers and beekeepers is key!

Summary

- Orchards need pollinators.
- If renting honey bees**, communication with beekeepers before hives arrive is essential.**
- Place hives in location least likely to be sprayed or in the pathway of drift (upwind).
- Judicious selection of pesticides and how/ when they are applied can minimize risks to bees.
- **Keep good records of pesticide use.**
- Planting non-crop flowering plants outside of orchards will benefit all pollinators.

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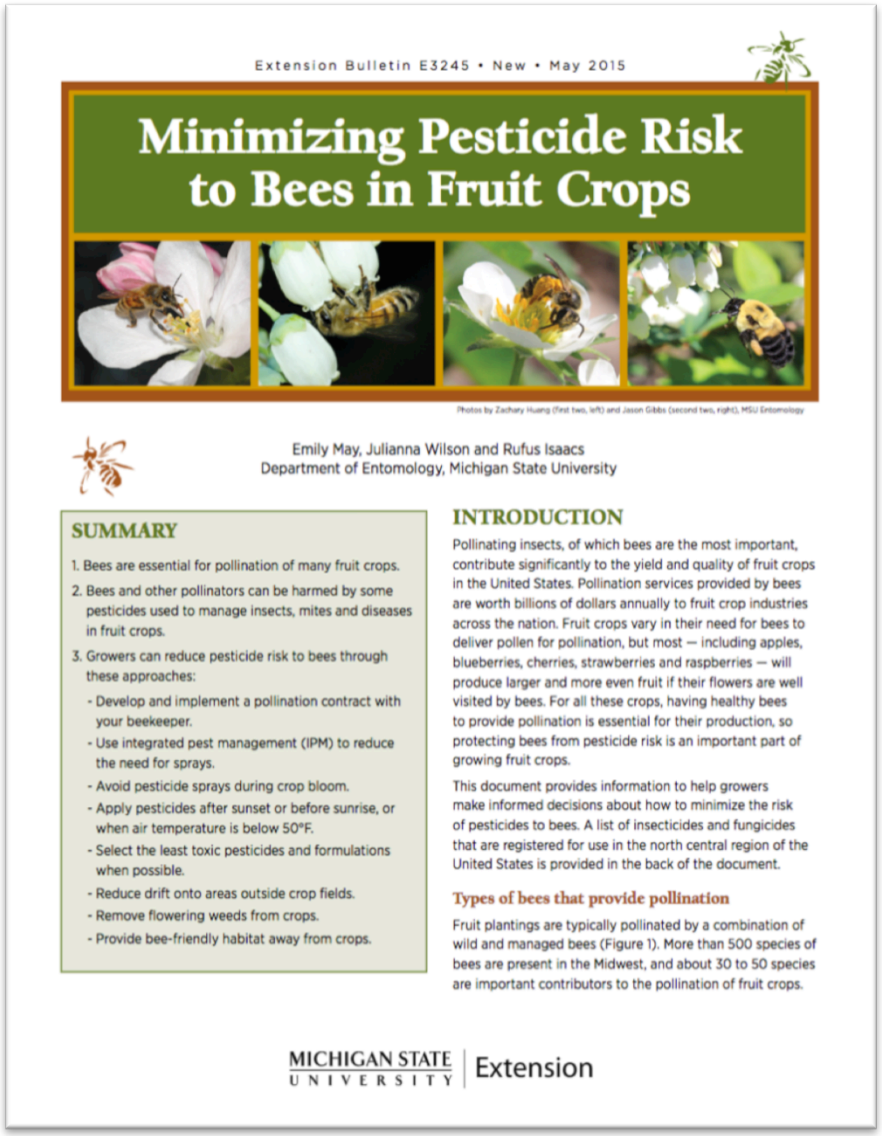
Resources

MSU Bulletin E-3245

www.icpbees.org



Extension Bulletin E3245 • New • May 2015

Minimizing Pesticide Risk to Bees in Fruit Crops

Photos by Zachary Huang (first two, left) and Jason Gibbs (second two, right), MSU Entomology

Emily May, Julianna Wilson and Rufus Isaacs
Department of Entomology, Michigan State University

SUMMARY

1. Bees are essential for pollination of many fruit crops.
2. Bees and other pollinators can be harmed by some pesticides used to manage insects, mites and diseases in fruit crops.
3. Growers can reduce pesticide risk to bees through these approaches:
   - Develop and implement a pollination contract with your beekeeper.
   - Use integrated pest management (IPM) to reduce the need for sprays.
   - Avoid pesticide sprays during crop bloom.
   - Apply pesticides after sunset or before sunrise, or when air temperature is below 50°F.
   - Select the least toxic pesticides and formulations when possible.
   - Reduce drift onto areas outside crop fields.
   - Remove flowering weeds from crops.
   - Provide bee-friendly habitat away from crops.

INTRODUCTION

Pollinating insects, of which bees are the most important, contribute significantly to the yield and quality of fruit crops in the United States. Pollination services provided by bees are worth billions of dollars annually to fruit crop industries across the nation. Fruit crops vary in their need for bees to deliver pollen for pollination, but most — including apples, blueberries, cherries, strawberries and raspberries — will produce larger and more even fruit if their flowers are well visited by bees. For all these crops, having healthy bees to provide pollination is essential for their production, so protecting bees from pesticide risk is an important part of growing fruit crops.

This document provides information to help growers make informed decisions about how to minimize the risk of pesticides to bees. A list of insecticides and fungicides that are registered for use in the north central region of the United States is provided in the back of the document.

Types of bees that provide pollination

Fruit plantings are typically pollinated by a combination of wild and managed bees (Figure 1). More than 500 species of bees are present in the Midwest, and about 30 to 50 species are important contributors to the pollination of fruit crops.

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The Integrated Crop Pollination Project

A Coordinated Agricultural Project Funded by the USDA Specialty Crop Research Initiative

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Michigan Apple Pollination

Apples Need Pollinatio

Apples require cross-pollination between differe
only 2-5% of all apple blossoms are needed to
are hand- or chemically thinned – **full pollinat**
large, well-formed fruit. Blooming Michigan
over 40 species of wild bees. All of these differer
and nectar to feed their young and in the proces

Integrated Crop Pollination:
combining strategies to

Wild bees can be abundant and active pollinators in many MI orchards, especially those located near woodlots and fencerows that have flowering trees, shrubs, and other wild flowering plants. These natural areas help support wild bees by providing food when the crop is not in bloom. They also provide safe nesting opportunities for wild bees by providing a refuge outside of the cropping area.

Many Michigan apple growers rent managed honey bees to supplement wild bee pollination. Apple growers that rent honey bees benefit from having wild bees in the orchard too; **orchards visited by many different kinds of bees have higher fruit set than those visited by one kind of bee.** Different species of bees tend to visit flowers at different times of the day and may be active at different times through bloom.

Cool, rainy, and wind
number of wild bees
the honey bee and a
conditions than honey
your orchard can ens
the end of crop bloo

Left: A mining bee (for le
Michigan. Photo: Emily Ma

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Emily May[1], Katharina Ullmann[1], and
[1]The Xerces Society for Invertebrate Conservation, [2]Department

Michigan Cherry Pollination

Cherries Need Pollination

Tart cherries require bee pollination to set a large marketable crop of cherries. Bee pollination directly impacts cherry yield: more flowers that are pollinated = more salable cherries. Montmorency tart cherries are self-fertile, meaning flowers can be pollinated with pollen from the same cultivar and do not require pollinizer varieties to be planted within orchard blocks. **Managed honeybees are used to pollinate cherries, but flowers are also visited by over 80 other species of wild bees.** All of these bee species visit cherry flowers to collect pollen and nectar to feed their young.

Integrated Crop Pollination:
combining strategies to improve pollination

Most Michigan cherry growers rent honey bees to supplement wild bee pollination. Some growers also manage small populations of tunnel-nesting mason bees to supplement pollination. Based on recent data, researchers have found **wild bees are abundant and active pollinators in most MI cherry orchards.** Woodlots and fencerows located near orchards have trees, shrubs, and other flowering plants that can help support wild bees by providing food and shelter.

Cherry growers benefit from wild bees in the orchard, even when honey bees are rented for pollination. Different bee species visit flowers at different times of the day and are active at different times during the bloom season. **A diverse set of pollinators that are active in the orchard at bloom can help ensure consistent pollination.**

Most Michigan tart cherry growers rent honey bees for pollination during bloom. Photo: Katharina Ullmann.

Cool, rainy, and windy spring weather conditions often lead to poor pollination and lower yields. However, many wild bees are active at temperatures 5-10 F lower than honey bees. Large-bodied bees such as bumble bees, are able to pollinate flowers under cool and windy conditions, as are wild mining bees and managed mason bees.

Left: A bumblebee visiting cherry flowers in northern Michigan. Large-bodied bees like bumblebees can pollinate cherries in cooler weather than honey bees. Photo: Emily May.

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XERCES SOCIETY for Invertebrate Conservation

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USDA Specialty Crop Research Initiative, Coordinated Agricultural Project
Developing Sustainable Pollination Strategies for U.S. Specialty Crops
(Award 2012-51181-20105)