# Pollinators, Pesticides, and Biocontrol Basics

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Entomologist
February 2026

# Overview

- Pests and beneficials
- Pesticides, bee poisonings, and resistance
- Biocontrol
- Helpful online resources

All photos, diagrams, and illustrations have been produced by Megan Asche unless credited to another author.

# Pests

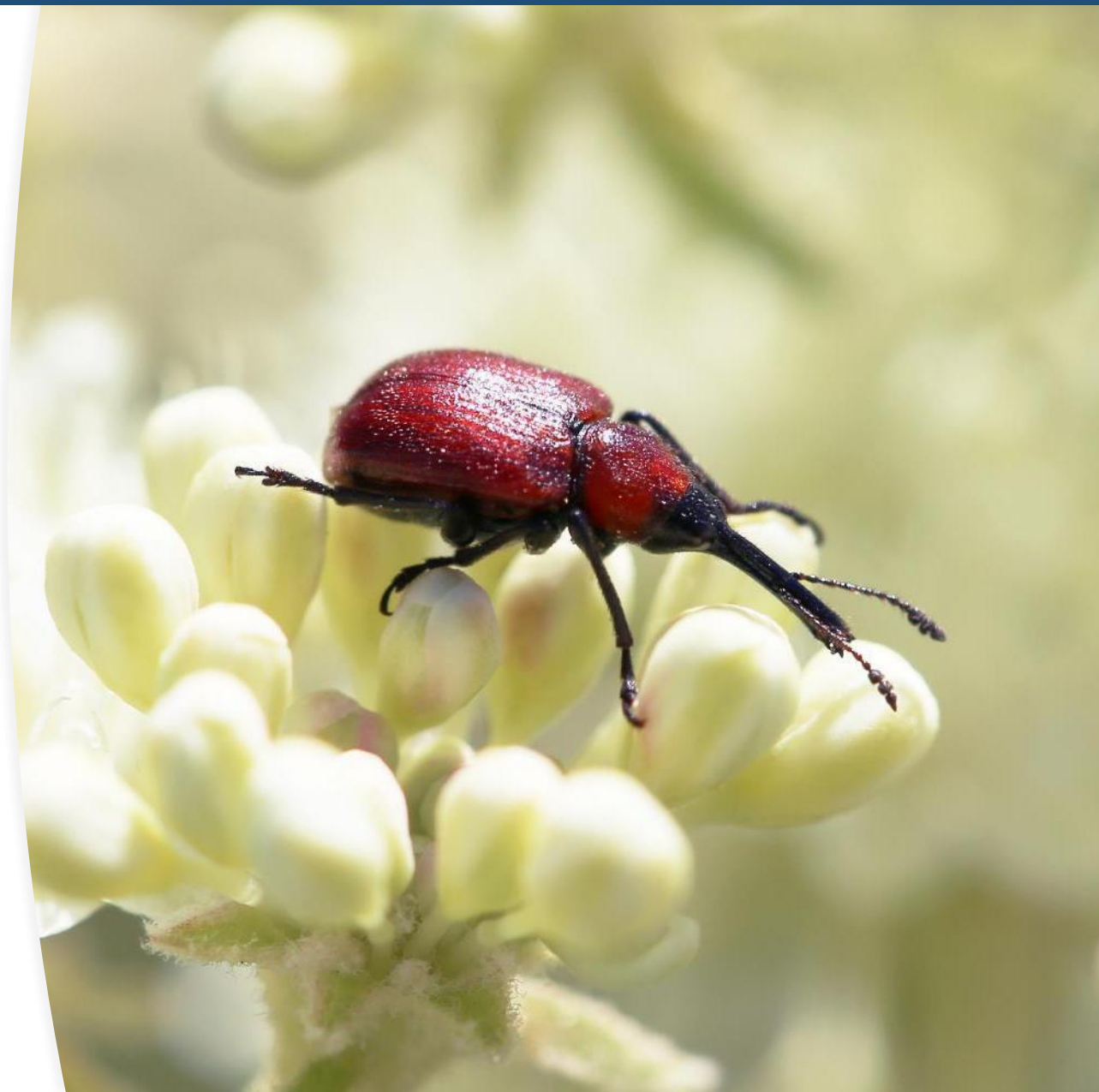
A destructive insect or other animal that attacks crops, food, landscaping, livestock, or anything else people care about.

- Some pests are deadly – like mosquitoes.
- Most are not dangerous.
- Many are just expensive or annoying.

**Are all insects pests?**

No, there are plenty of insects that benefit human beings

- Pollinators and generalist predators used for bio-control
- And most insects don't directly impact us at all



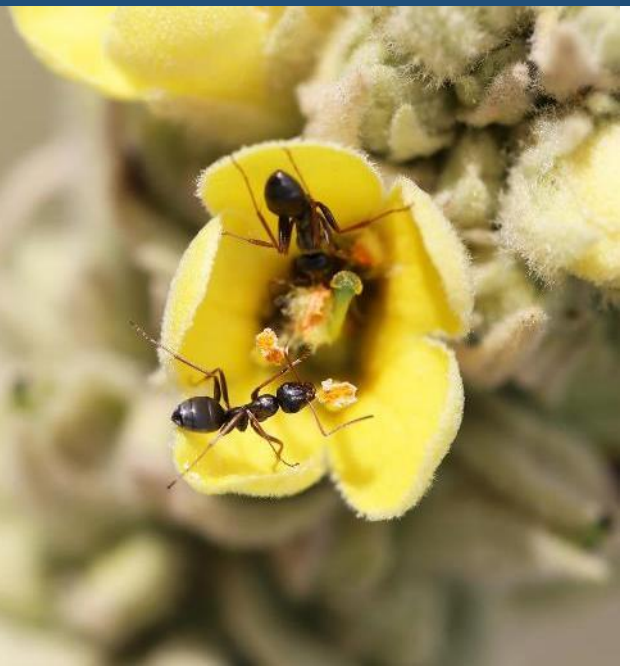
# Beneficial insects

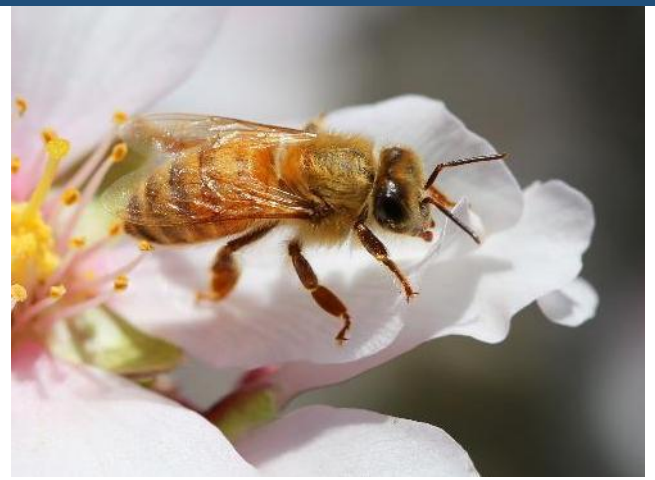
Many insect species are vital to the success of growing crops and decorative plants.

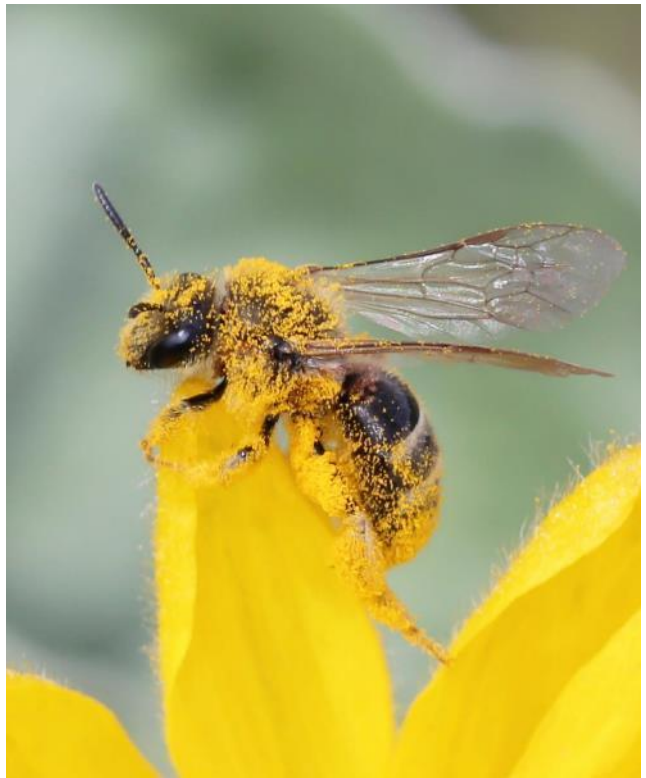
Beneficial insects include:

- **Pollinators**: move pollen from the male anther to the female stigma of a flower.
- **Predators**: hunt and consume pest insects.
- **Parasitoids**: develop inside the eggs, larvae, or pupae of pest insects, killing them in the process.









## Hymenoptera

Hymenoptera is the most beneficial insect order – ***to humans.***

It contains many parasitoids and predators which help control insect pests.

It also contains the major pollinators of agricultural crops.

**Hymenoptera:**

- Sawflies
- Solitary wasps
- Ants and other social wasps
- **Solitary bees**
- **Honey bees and other social bees**

## Why are bees the best pollinators?

Bees are functionally separated from wasps because they collect pollen to feed their young.

They have feathered hairs that trap pollen to their bodies. Many bees also have pollen-collection devices, such as “pollen baskets.”

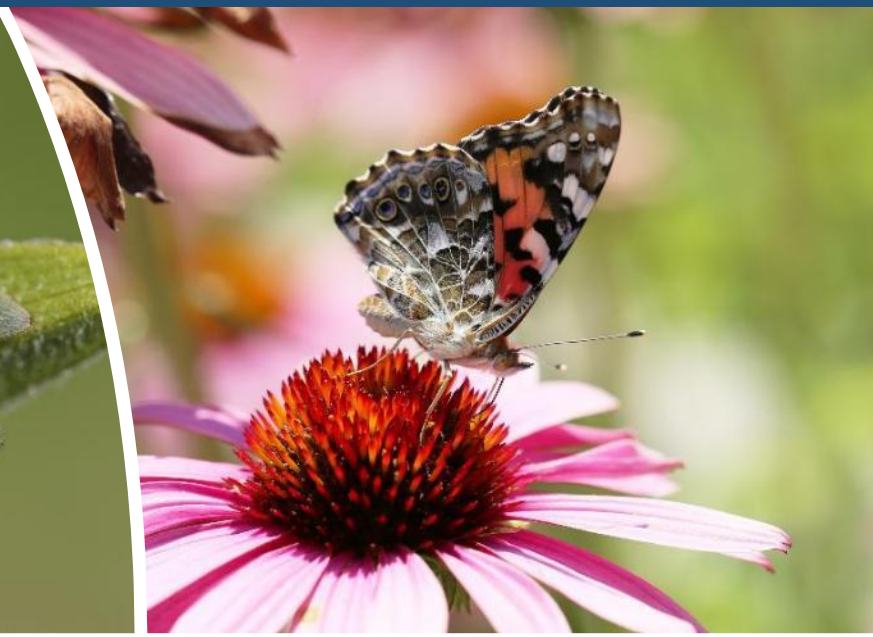
In addition, bees are often more robust and hairy than wasps.

## Other pollinators

Any animal that feeds, lands on, or just touches a flower could be a potential pollinator.

While bees are the most efficient insect pollinator, it is important to remember many animals contribute to this process.

Applying pesticides responsibly helps protect the entire ecosystem.



# What are pesticides?

Any chemical used to harm living things harmful to man (aka pests).

Insecticides (insects)

Nematicides (nematode worms)

Fungicides (fungi)

Algicides (algae)

Miticides (mites)

Rodenticides (rodents)

Avicides (birds)

Ovicides (eggs)

Select the chemical based on the **pest you are targeting.**

While pesticides are helpful tools, they can cause problems.

Problems typically occur when pesticides are applied:

- **At the wrong place**
- **At the wrong time**
- **In the wrong manner**

This can result in:

- **Killing non-target organisms**
- **Pesticide resistance**

Target = aphids

Non-target = bees

## Bee poisonings

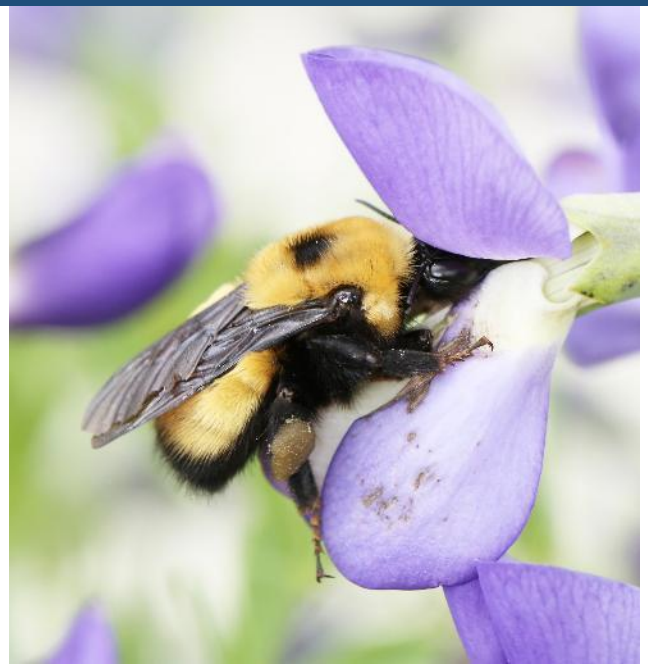
The accidental exposure of bees to pesticides, leading to lethal and sub lethal effects.

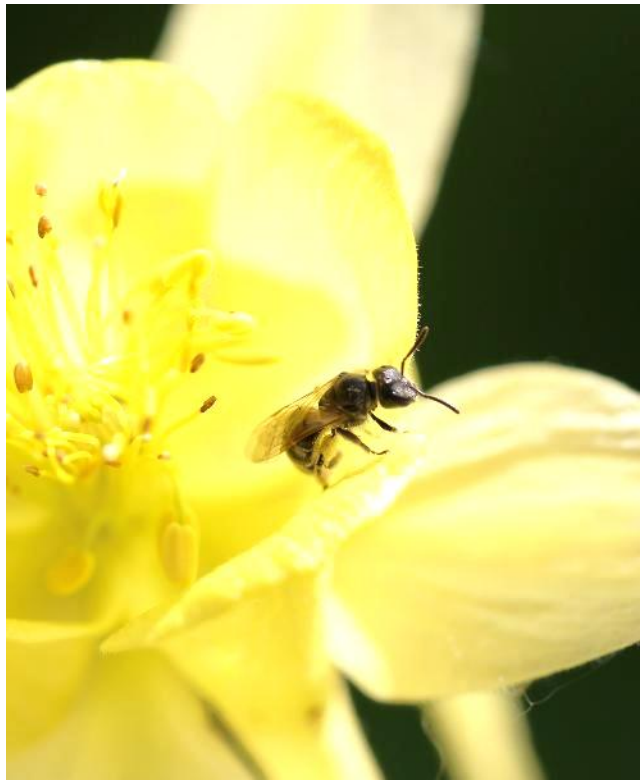
## Exposure and impact

Bee poisonings are often related to contaminated pollen, which is used for larval feedings by bees.

Exposure to pesticides may have lethal effects – killing many bees in a short period of time.

Sub lethal effects can include a decrease in queen fertility and reduced longevity, immune function, orientation, and social behavior of the whole colony.





Gasparini et al 2025

## Indicators of bee poisoning

- Large number of dead bees outside the hive entrance
- Increase defensiveness
- Abnormal movements
- Paralysis

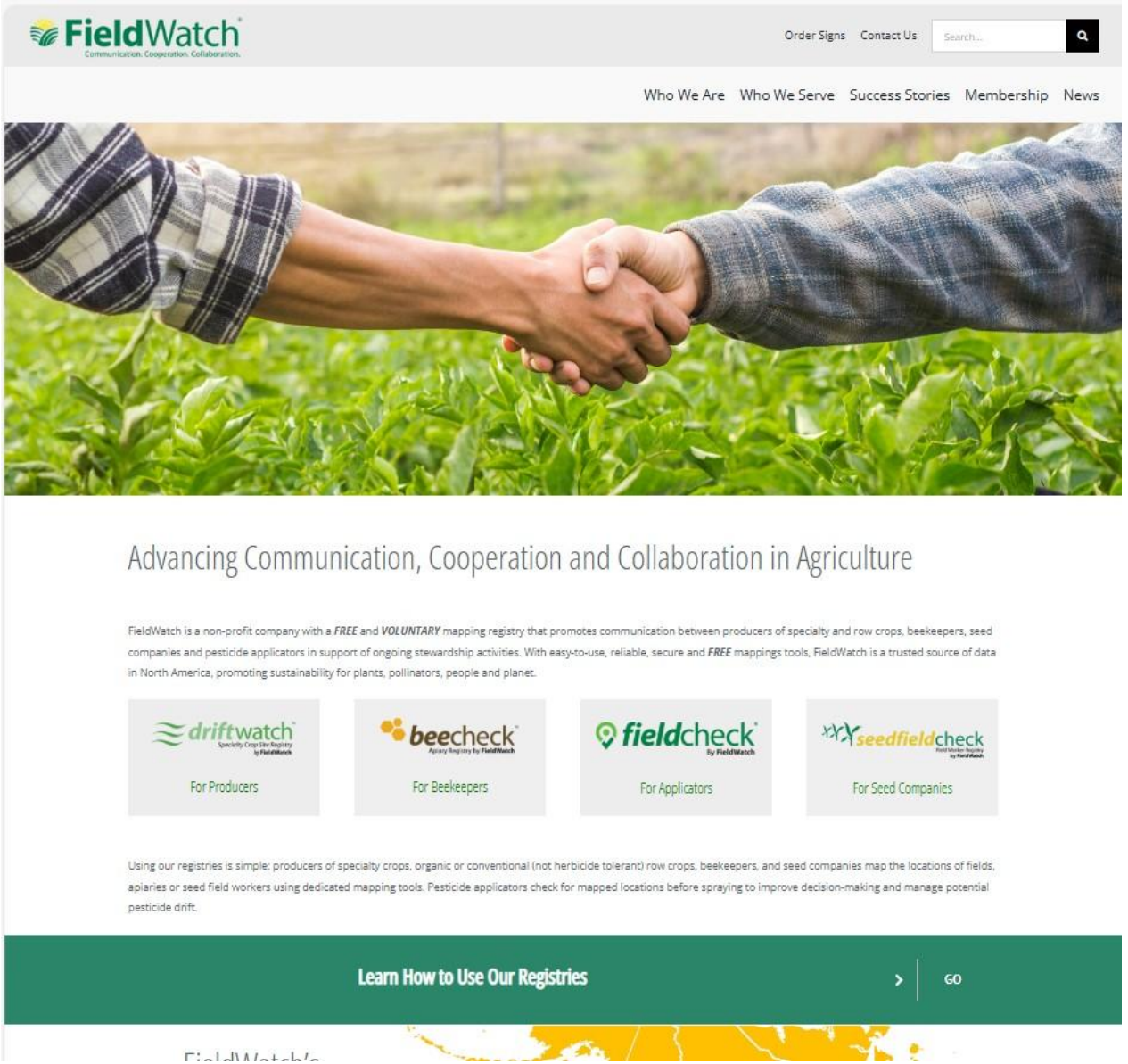
These signs will likely appear 1-3 days after a pesticide application.

https://agr.wa.gov/departments/pesticides-and-fertalizers/pesticides/pesticides-and-pollinators

# FieldWatch

- A free and voluntary mapping registry that promotes communication between farmers, pesticide applicators, and beekeepers.
- You register the location of your apiary and applicators can check for mapped location before spraying.

**https://fieldwatch.com/**



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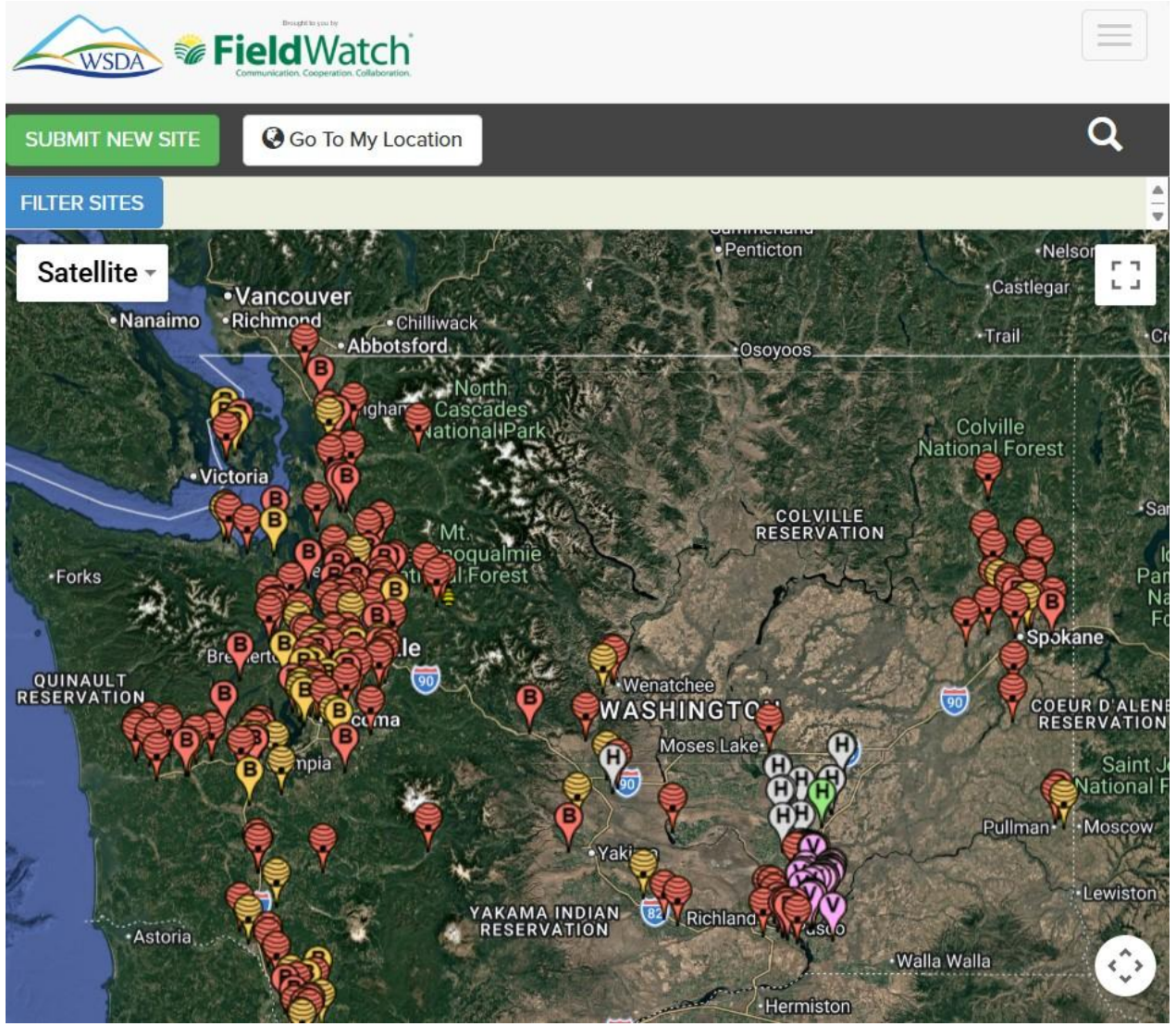
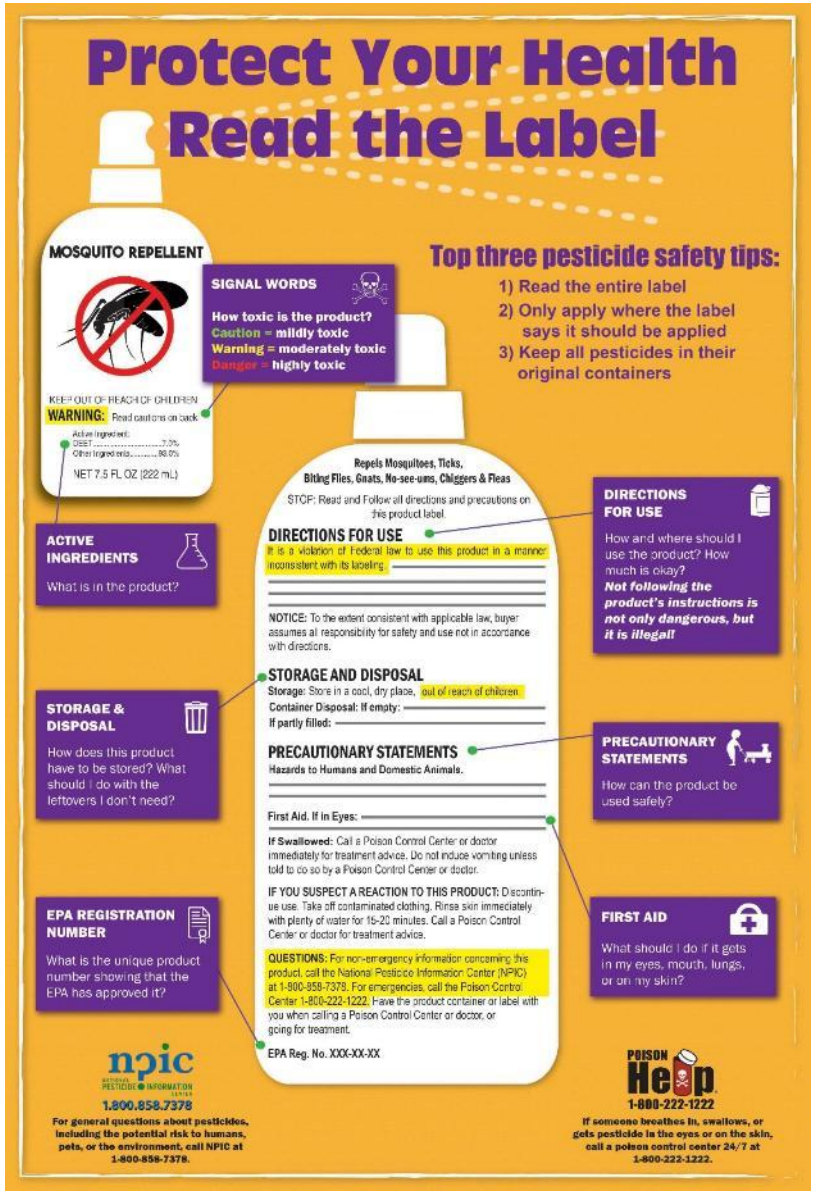


# Tips for applying pesticides:

- Follow the label
  - Trade name – Commercial name
  - Active ingredient and amount
  - EPA registration number
  - EPA signal word(s)
  - Health and safety statements
  - Use rates – how much to use
  - “Keep out of reach of children”



## Tips for applying pesticides:

- Follow the label
- Time of day and the weather
  - Do not apply pesticides when bees are likely to be flying.
  - Bees generally are inactive in the late evening, night, and early morning.
  - Avoid spraying pesticides on windy days to avoid overspray.

| Hazard Level | Time of Day |
|---|---|
| **Safest** | Late evening/night (from when bees cease foraging to midnight) |
| **Intermediate** | Midnight to first light |
| **Dangerous** | Early morning before bees begin foraging |

## Tips for applying pesticides:

- Follow the label
- Time of day and the weather
- Avoid blooming flowers
  - Do not contaminate blooming flowers with insecticides hazardous to bees.
  - Insects do not care if a flower is a crop, a landscaped plant or weed. If it has flowers, spraying it with pesticides may kill non-target pollinators.

# Tips for applying pesticides:

- Follow the label
- Time of day and the weather
- Avoid blooming flowers
- Residue
  - Residue is the amount of insecticide present on a plant after it as been sprayed.
  - The amount of residue and its toxicity decrease with time as the chemical degrades.
  - Be wary of pesticides that with long-lasting residues – that information should be on the pesticide label.

## Tips for applying pesticides:

- Follow the label
- Time of day and the weather
- Avoid blooming flowers
- Residue
- Select lower risk pesticides

## WSU's OPENED – Orchard Pesticide Effects on Natural Enemies Database

https://enhancedbc.tfrec.wsu.edu/opened/

## OSU's Low Risk Pesticide List

https://agsci.oregonstate.edu/oipmc/pesticide-risk-management/pesticide-risk-reduction-low-risk-list

# Are chemical pesticides your only option?

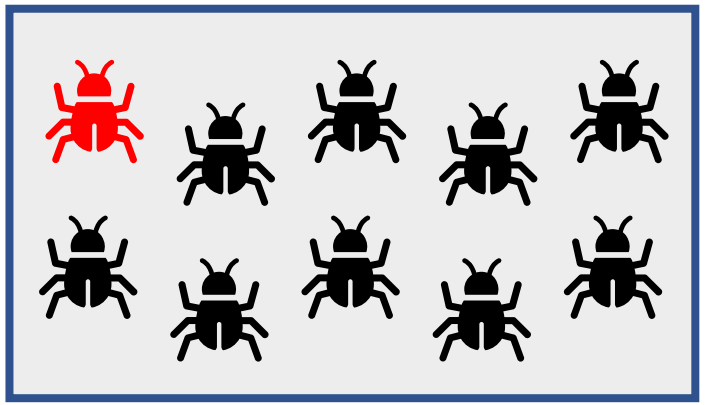
**No.** There are many pest control methods available. Using one is never recommended.

# 2025 NASS Colony Losses Survey

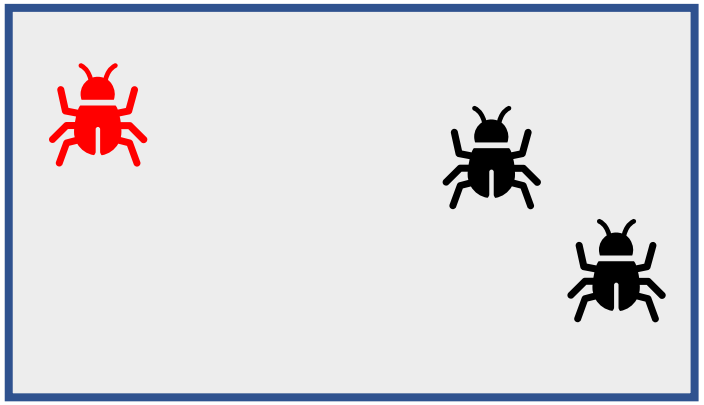
- 110% increase in reported colonies lost with CCD symptoms, compared to 2024
- 62% of commercial honey bee colonies in the US died
- Varroa mites were reported as the #1 stressor
- Nearly all the colonies tested were positive for bee viruses
- Every mite the USDA researchers screened was resistant to amitraz.

**"Scientists identify culprit behind biggest ever U.S. honey bee die-off" Thompson 2025**

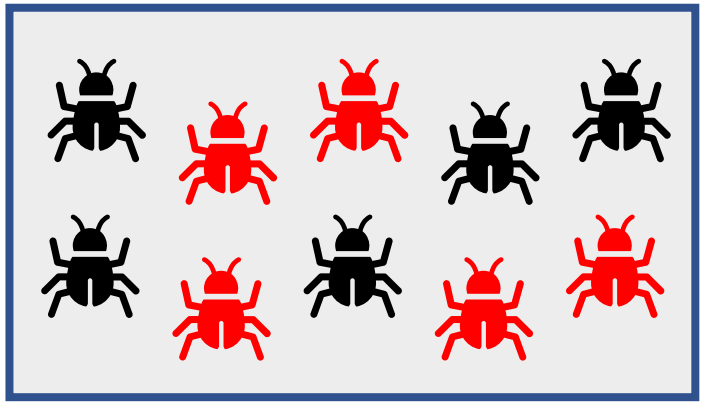
First generation



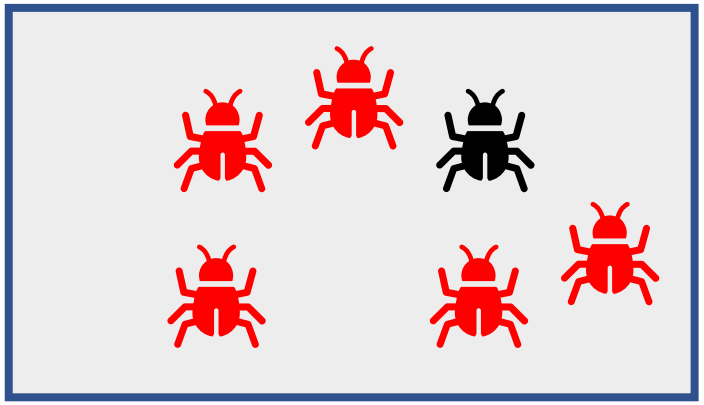
Pesticide



Later generations



Same pesticide



# Project Apis m.'s Advice

- "Take an all-of-the-above approach to controlling varroa mites. These measures included rotating through non-amitraz miticides, sterilizing equipment with alcohol or fire, and isolating ailing colonies to prevent mites from spreading."
- **This recommendation is based on the strategy of "Integrated Pest Management," also know as IPM.**

**https://www.science.org/content/article/scientists-identify-culprit-behind-biggest-ever-u-s-honeybee-die**

**"Scientists identify culprit behind biggest ever U.S. honey bee die-off" Thompson 2025**

# Integrated Pest Management (IPM)

A system that utilizes all suitable techniques and methods to maintain pest populations at levels below economic injury.

**Chemical control**

- Example: pesticides

**Physical-mechanical control**

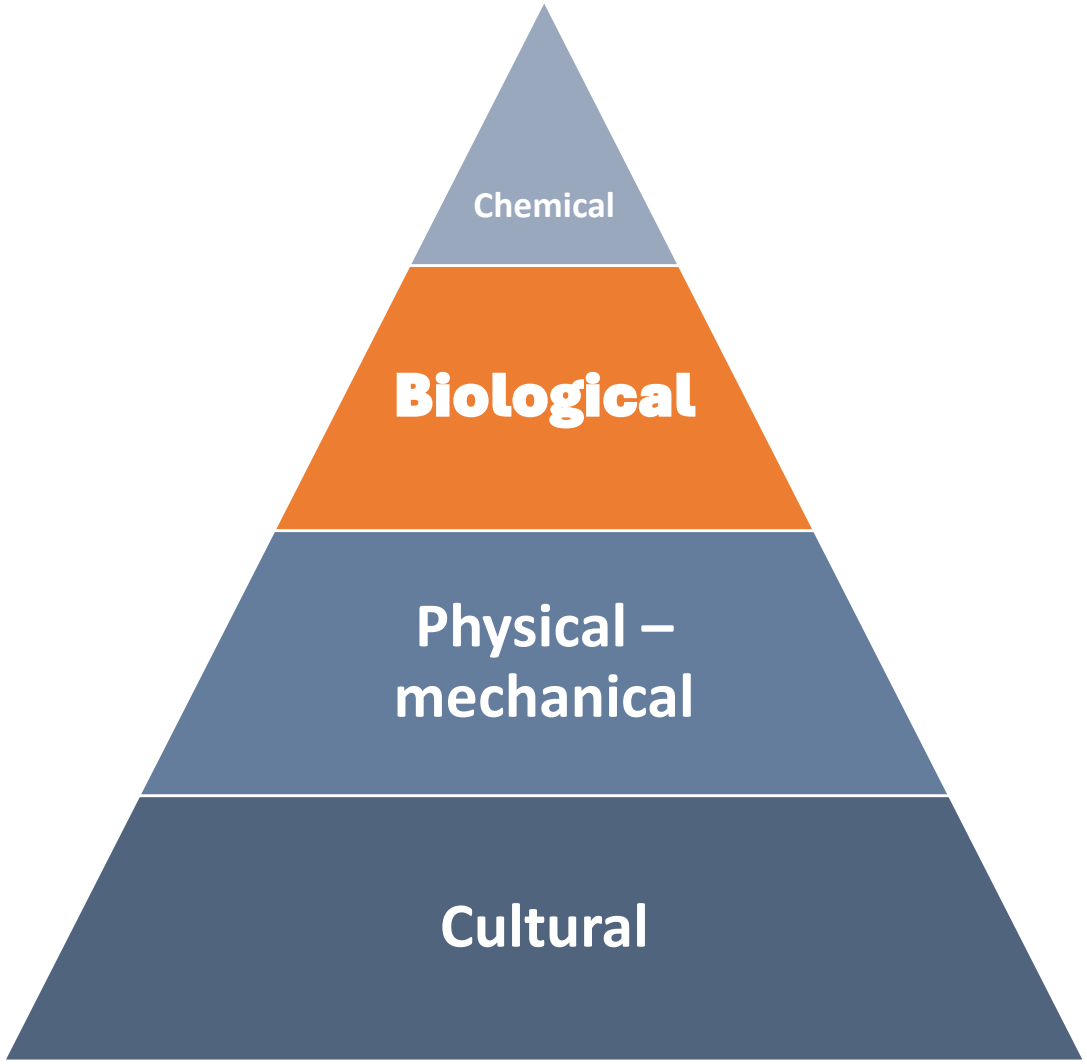
- Example: physical barriers, nest removal

**Cultural control**

- Example: sanitation practices, timing of harvest

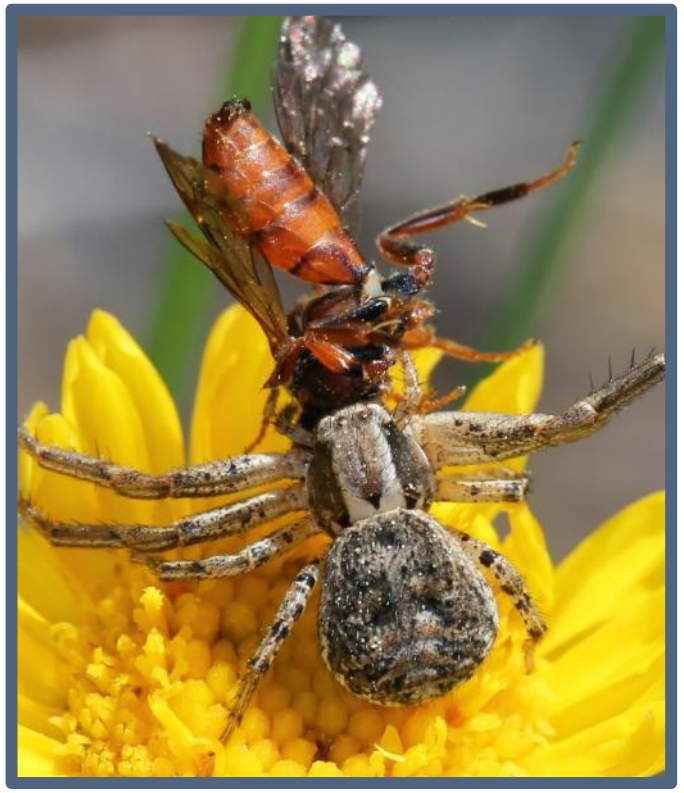
**Biological control**

- Example: natural predators and parasitoids, and maintaining their habitat



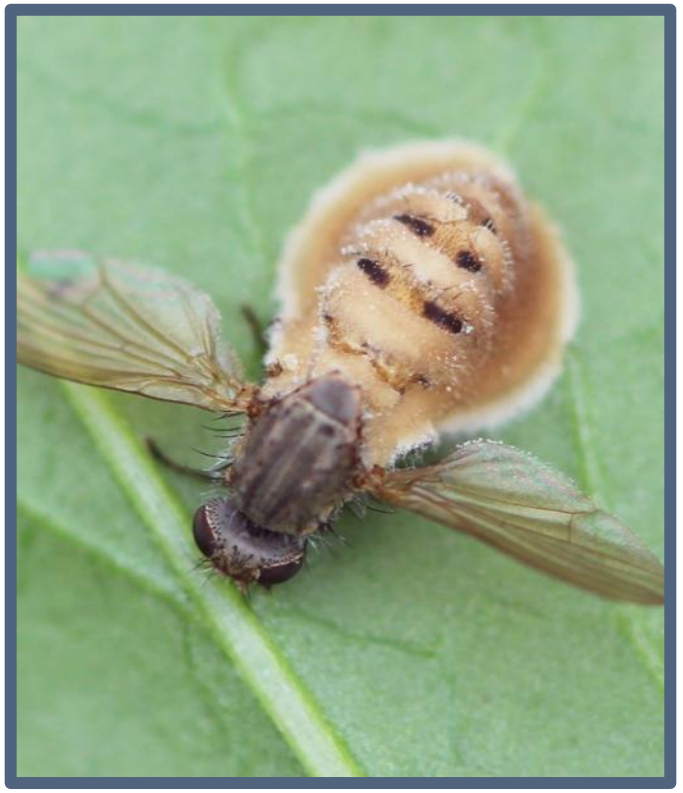

Dent 1991; Phan et al 2024

# 3 Types of Biological Control Organisms



**Predators**

**Parasitoids**



**Pathogens**

# Predators

- An organism that attacks and feeds on other animals – usually smaller and less powerful than themselves.
- They consume more than one animal in their lifetime.
- Most arthropod predators are generalists.
- These arthropods may be predatory in one or more life stages.

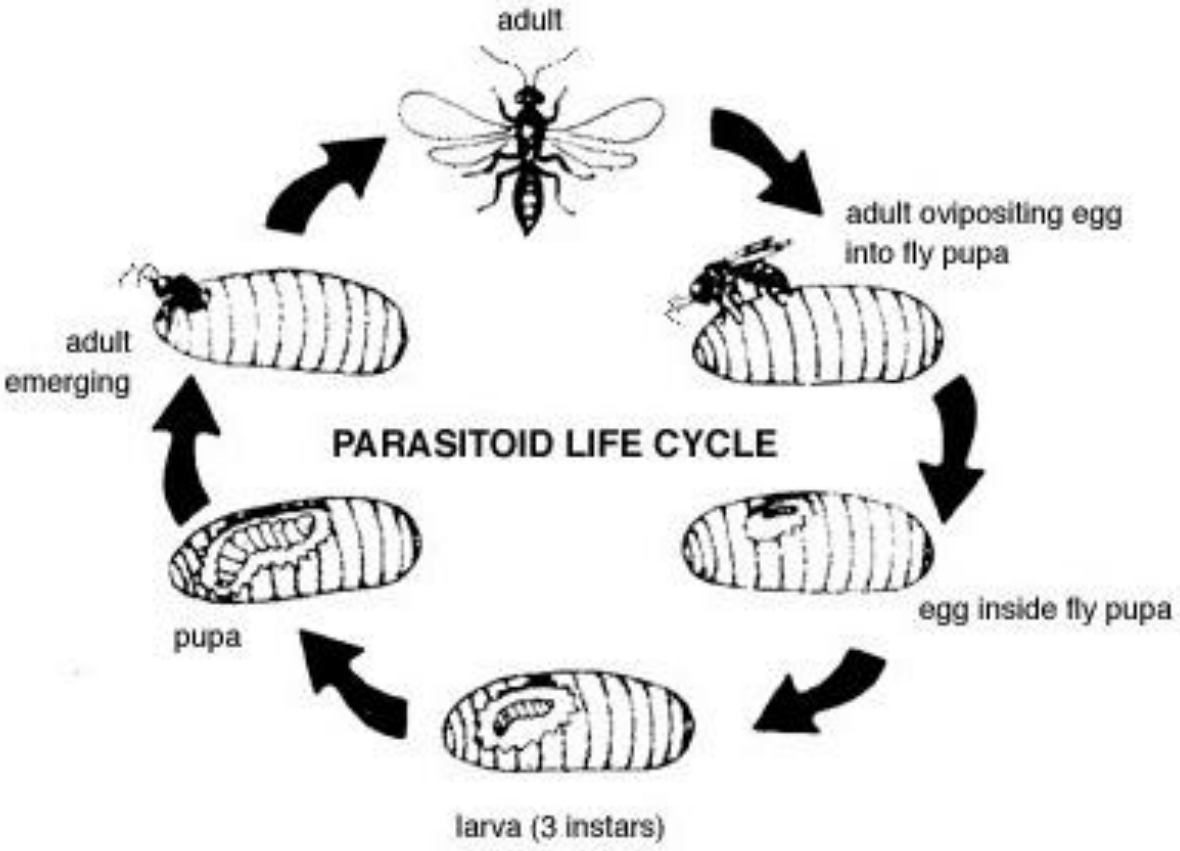
Dent 1991; Gordh & Headrick 2001; Pedigo 2002

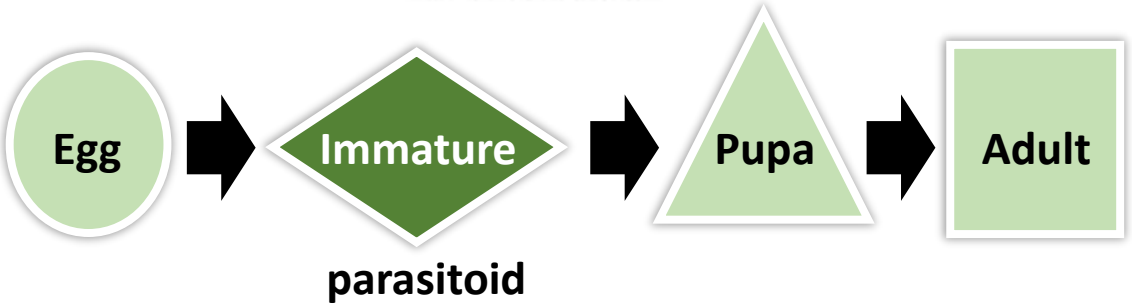
Life cycle diagrams courtesy of Ciba-Geigy Corporation.

# Parasitoid Wasps

Hymenoptera: Ichneumonidae, Braconidae, Chalcidoidea

- The adult female deposits an egg in or on the host.
- The larvae hatches and eventually kills the host by consuming its internal tissues and organs – while the prey is still alive.
- It only kills a single host before pupating into its adult stage.
- Many parasitoids are host-specific and can only develop within a particular taxa.




Arnett 2000; Berry 1978; Borror, DeLong, Triplehorn 1976; Pedigo 2002; Stoltz 1990

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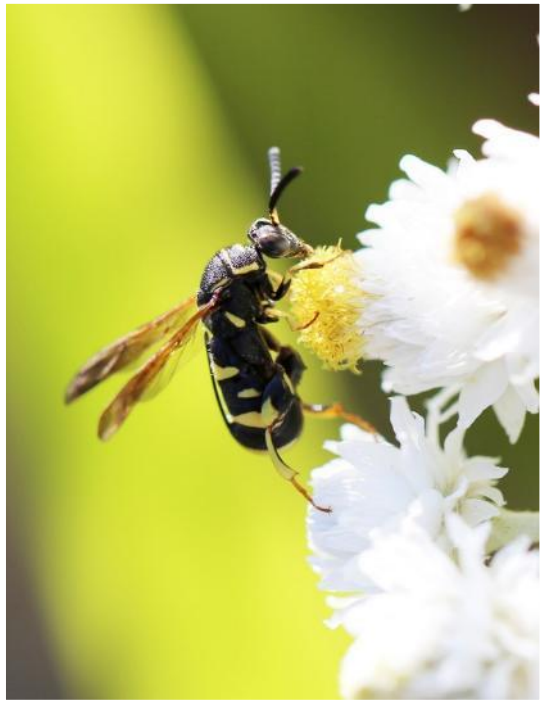


Adult parasitoids require nectar and pollen to complete their life cycle.

# Pathogens

- Pathogens are any disease producing organism.
- Also known as entomopathogens or microbial insecticides.
- There are commercial preparations that use bacteria, viruses, fungi, protozoa, and nematodes.

**“How A Clever Virus Kills A Very Hungry Caterpillar”**


**https://www.npr.org/2011/09/12/140226986/how-a-clever-virus-kills-a-very-hungry-caterpillar**

Dent 1991; Gordh & Headrick 2001; Pedigo 2002; www.npr.org

# “Natural enemies of *V. destructor*…”

## Posada-Florez et al 2025

A survey was conducted looking for microbes and arthropods associated with *V. destructor.*

The survey found 11 species capable of killing the varroa:

- 4 fungi
- 2 bacteria
- 1 parasitic nematode
- 2 insects
- 2 pseudoscorpions

More research is needed, but these organisms could potentially be used as biocontrol.

**Biocontrol can be implemented in 3 different ways…**

**https://www.tandfonline.com/doi/pdf/10.1080/09583157.2024.2430469**

*Chelifer getting ready to eat that Varroa. Photo by Torben Schiffers, Hobox (honey bee online studies), Hamburg.*

**https://beeculture.com/chelifers-or-pseudoscorpions-as-varroa-control-agents/**

# Classical Biological Control

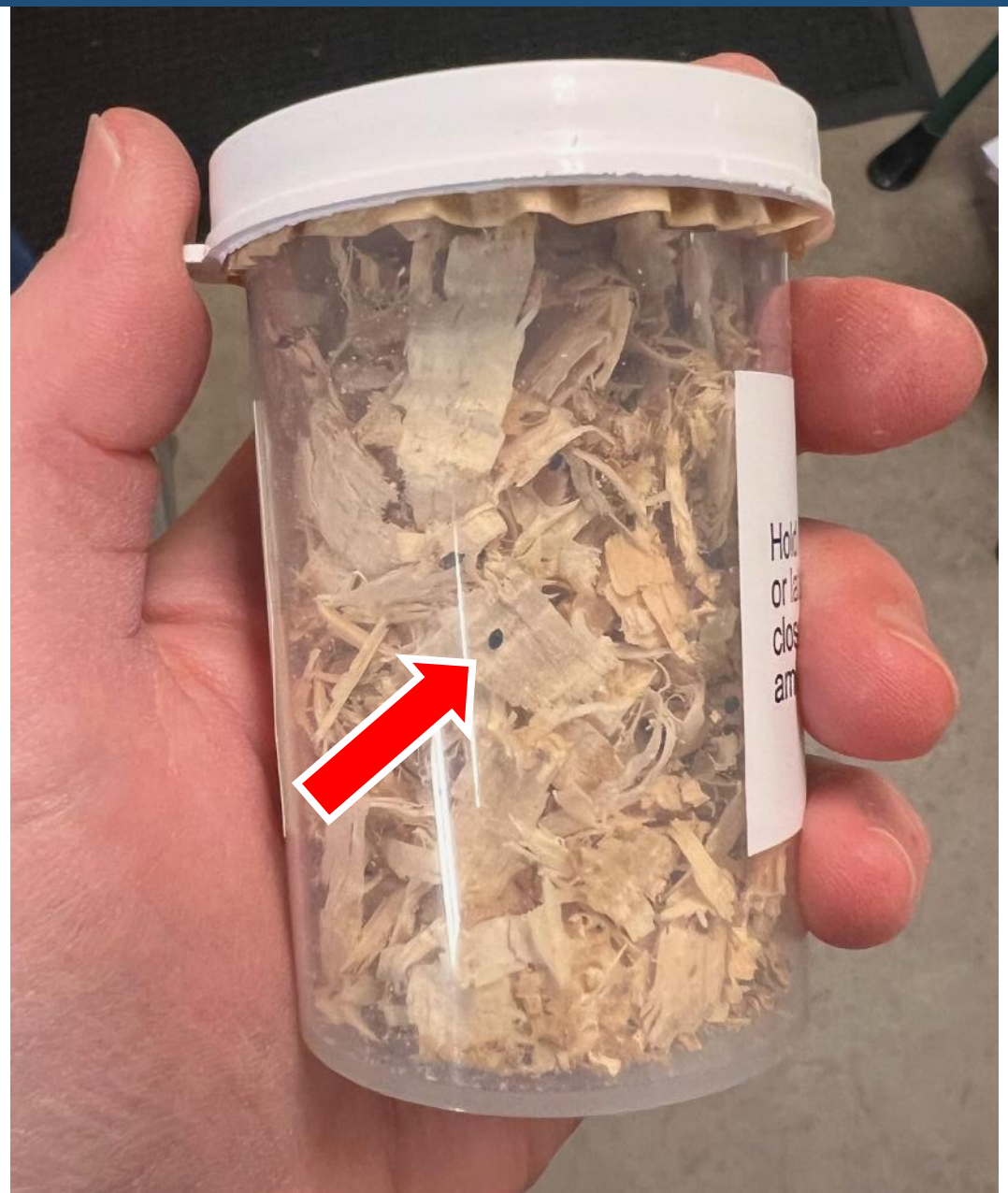
- The collection, importation, and release, of a host-specific natural enemies by scientists.
- This strategy takes years of research to be approved because it requires introducing a new species into an environment.
- **Example**: vedalia beetle to control of cottony cushion scale pest in California's citrus groves.


biocontrol.entomology.cornell.edu

Dent 1991; Fenn-Moltu et al 2024; gardenecology.oregonstate.edu; Gordh & Headrick 2001; Hoddle 2024

# Augmentation Biological Control

- Release of natural enemies to supplement indigenous enemies to control a pest population.
- Or the release of natural enemies into a controlled closed system, such as a greenhouse.
- This typically involves purchasing biocontrol organisms from a commercial suppler.
- The goal is not to replace existing natural enemies but to provide an additional source of mortality to help manage a pest population.



Dent 1991; Fenn-Moltu et al 2024; gardenecology.oregonstate.edu; Gordh & Headrick 2001; Hoddle 2024; extension.okstate.edu/fact-sheets

## Conservation Biological Control

- Providing the resources necessary so biological control organism can be self sustaining.
- This is a long-term strategy, which if done correctly can maintain a healthy ecology.
- **This is the easiest way to utilize biocontrol at your home or apiary.**
- **Conservation biocontrol strategies benefit honey bees as well**

## 4 Steps to get started…

1. Learn about beneficial insects
2. Careful use of pesticides
3. Provide food and shelter
4. Diversity of plants

**Dent 1991; Fenn-Moltu et al 2024; gardenecology.oregonstate.edu; Gordh & Headrick 2001; Hoddle 2024; extension.okstate.edu/fact-sheets**

# 1. **Learn** [more] **about beneficial insects**

- Perform a survey to determine what beneficial taxa frequent your crops and gardens and the services they provide.
- This knowledge will help you figure out what resources they need to thrive.

Coop et al 2025; Chalker-Scott & Bush 2023;

DONATE RENEW JOIN

XERCES SOCIETY for Invertebrate Conservation

Xerces Society - Publications Library - Scouting Guides

## Scouting Guides


Beneficial Insect Scouting Guide


Beneficial Insects For Natural Pest Control: Soil Scouting


Beneficial Insects For Natural Pest Control: Foliage Scouting

https://xerces.org/publications/scouting-guides


# OSU Natural Enemies Pocket guide

https://agsci.oregonstate.edu/sites/agscid7/files/nwrec/attachments/pocket_guide_of_natural_enemies_1.pdf


## Beneficials

### Natural Enemies and Beneficial Insects

**Lady beetles**
- Convergent

**Parasitic flies**
- Tachinid flies

**Parasitic wasps**
- *Anagrus* sp.

https://treefruit.wsu.edu/crop-protection/opm/beneficials/

## 2. Careful use of pesticides

- Careful use of pesticide and tillage will help to avoid disrupting populations of beneficial insects.
- Be sure to apply pesticides according to the label.
- Avoid non-target areas that biocontrol organisms rely on for food and overwintering sites.

Coop et al 2025; Chalker-Scott & Bush 2023

**WSU's OPENED – Orchard Pesticide Effects on Natural Enemies Database**

https://enhancedbc.tfrec.wsu.edu/opened/

**OSU's Low Risk Pesticide List**

https://agsci.oregonstate.edu/oipmc/pesticide-risk-management/pesticide-risk-reduction-low-risk-list

# 3. Provide food and shelter

- Beneficial insects need:
  - A place to hibernate during the winter
  - A place to lay their eggs and pupate
  - Alternative food sources
- Non-crop plantings, or unmanaged spaces, can provide shelter, alternative prey, nectar, and pollen.

Coop et al 2025; Chalker-Scott & Bush 2023

## Cover Cropping for Pollinators and Beneficial Insects

**https://www.sare.org/wp-content/uploads/Cover-Cropping-for-Pollinators-and-Beneficial-Insects.pdf**

## PNW Insect Management Handbook

**https://pnwhandbooks.org/node/260/print**

# 4. Diversity of plants

- A wide variety of flowering plants will attract a diversity of beneficial insects.
- There are many great resources available to help you choose the best plants to support your local beneficial insects.

Coop et al 2025; Chalker-Scott & Bush 2023; Stiling & Cornelissen 2004

GARDEN ECOLOGY LAB BRIEFS

A joint effort of 10-Minute University™ and Oregon State University's Garden Ecology Lab

## Supporting Biocontrol with Garden Plants

### Our research

Biological control ("Biocontrol") is the use of living organisms to suppress pest populations. Insect predators and parasitoids are important biocontrol agents (also known as natural enemies) in garden systems. Studies have examined the relative attractiveness of garden plants to insect natural enemies in other areas of the United States, but no studies were available for plants native to the Pacific Northwest. We conducted a three-year study to identify PNW native plants that support robust communities of insect predators and parasitoids. We wanted to find plants that had a high abundance and diversity of natural enemies, as well as a relatively low abundance of herbivorous prey (that might be garden pests). We also included 4 non-native plants that are common in gardens in our study (lavender, oregano, pineapple sage, and catnip).

### What we found

Hosted a high abundance of natural enemies

Douglas' Aster
*Symphyotrichum subspicatum*

Canada Goldenrod
*Solidago canadensis*

Yarrow
*Achillea millefolium*

https://gardenecology.oregonstate.edu/sites/agscid7/files/gardenecology/biocontrol-ua.pdf

GARDEN ECOLOGY LAB BRIEFS

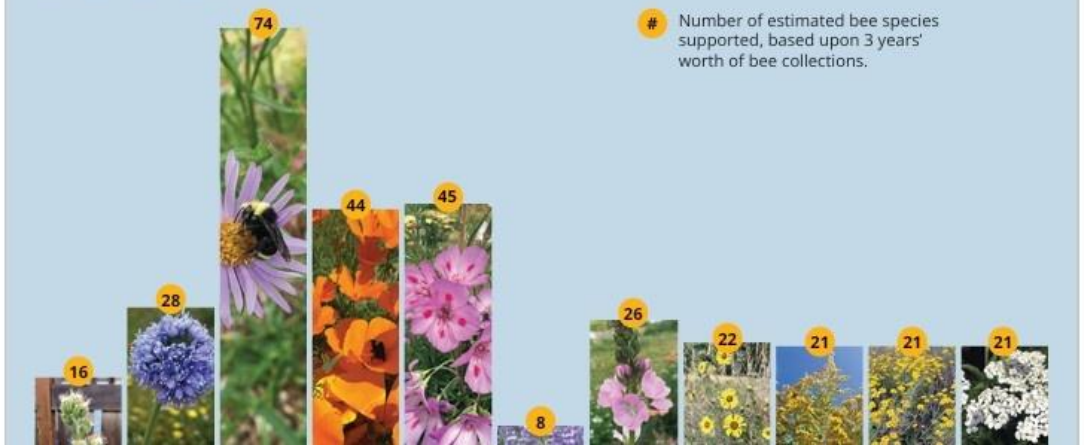
A joint effort of 10-Minute University™ and Oregon State University's Garden Ecology Lab

# Supporting Diverse Bees with Native Plants

## Our research

Native plants are popular with gardeners, in part due to their purported benefits to pollinators. Studies have examined the relative attractiveness of regionally relevant native plants to wild bees in other areas of the United States, but no studies were available for plants native to the Pacific Northwest. We conducted a three-year study to identify native Pacific Northwest flowering plants that support robust bee communities. We included lavender in our study, because we wanted to provide a well-known plant for gardeners as a reference, when assessing the bee-friendly nature of native plants.

## What we found




https://gardenecology.oregonstate.edu/sites/agscid7/files/gel_brief_1_native_plants.pdf

NATIVE PLANTS FOR POLLINATORS & BENEFICIAL INSECTS:

# Maritime Northwest

LEFT— Black-tailed bumble bee (*Bombus melanopygus*) visiting *Ribes sanguineum* blossoms. RIGHT—Red admiral butterfly (*Vanessa atalanta*) on *Plectritis congesta*.

## Plant Selection

These plants are attractive to a diversity of pollinators, providing pollen and nectar to bees, butterflies, flies, beetles, wasps, and moths. Some plants provide additional resources as caterpillar host plants or nesting sites and nesting materials for above-ground nesting bees. Many support specialist bees that require pollen from specific plants to survive and supplement beneficial insects that can help control pests of ornamental and crop plants. These plants are native to this region—determine if a species is native in your area at plants.usda.gov—and can be used to create or enhance pollinator habitat across rural and urban landscapes.

When purchasing plants, let your local garden center or nursery know you want plant material free of pesticides that may harm pollinators.

### Resources

- Pollinator Conservation Resource Center: xerces.org/pollinator-resource-center
- Bring Back The Pollinators: BringBackthePollinators.org
- Reducing Pesticide Use & Impacts: xerces.org/pesticides

| SCIENTIFIC NAME | COMMON NAME | BLOOM | LIFE | FORM | SUN | SOIL | ADDITIONAL DETAILS |
|---|---|---|---|---|---|---|---|
| *Acer circinatum* | Vine maple | Apr–May | P | | | D–M | |
| *Acer macrophyllum* | Bigleaf maple | Apr–May | P | | | D–M | |
| *Achillea millefolium* | Common yarrow | May–Jul | P | | | D–M | |
| *Amelanchier alnifolia* | Saskatoon serviceberry | Jun–Jul | P | | | D–M | |

https://xerces.org/sites/default/files/publications/22-023_02_NPPBI%E2%80%94MaritimeNW_web.pdf


Taylor & Francis

Biocontrol Science and Technology

ISSN: 0958-3157 (Print) 1360-0478 (Online) Journal homepage: www.tandfonline.com/journals/cbst20

# Natural enemies of *Varroa destructor* identified from Eastern North American honey bee colonies: a biological survey of candidates for mite control from Maryland, USA

Francisco Posada-Flórez, Daniel Sonenshine, Jay Evans, Dawn Boncristiani, Monica Pava-Ripoll & Steven Cook

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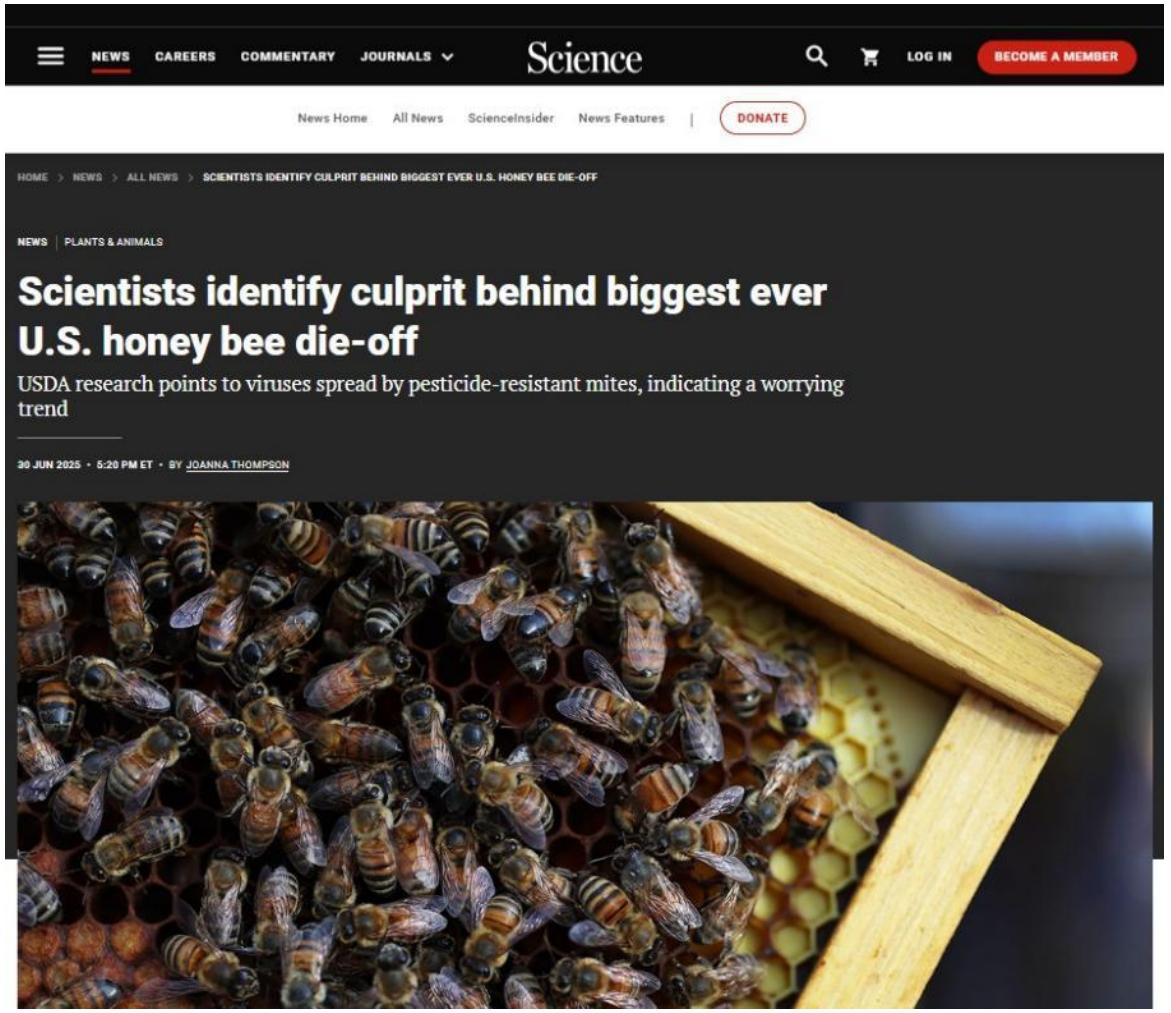


**https://www.science.org/content/article/scientists-identify-culprit-behind-biggest-ever-u-s-honeybee-die**


# Any Questions?

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