

# Pollinators, Pesticides, and Biocontrol Basics

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Entomologist  
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# Overview

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- 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.

A close-up photograph of a ladybug (Coccinellidae) with its characteristic orange-red elytra and black spots, perched on a light-colored, textured plant stem. A yellow starburst graphic with the word 'BIOCONTROL' is positioned above the ladybug.

BIOCONTROL

Predator

A close-up photograph of a parasitoid wasp with a long, thin abdomen and dark body, positioned on a white flower. A yellow starburst graphic with the word 'BIOCONTROL' is positioned above the wasp.

BIOCONTROL

Parasitoid

A close-up photograph of a dark-colored bee with its wings spread, perched on a bright yellow flower. The bee is positioned in the center of the flower, facing right.

Pollinator



## 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:

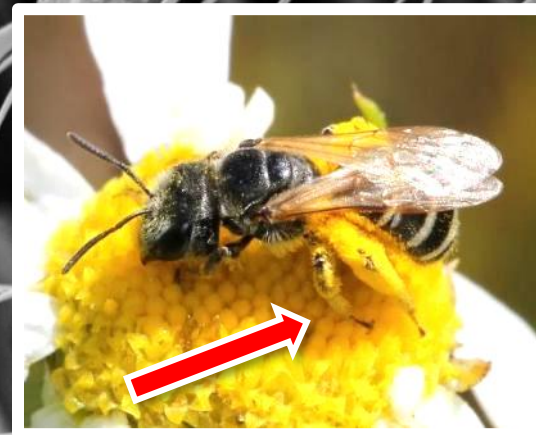
- Sawflies
- Solitary wasps
- Ants and other social wasps
- **Solitary bees**
- **Honey bees and other social bees**

## 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.

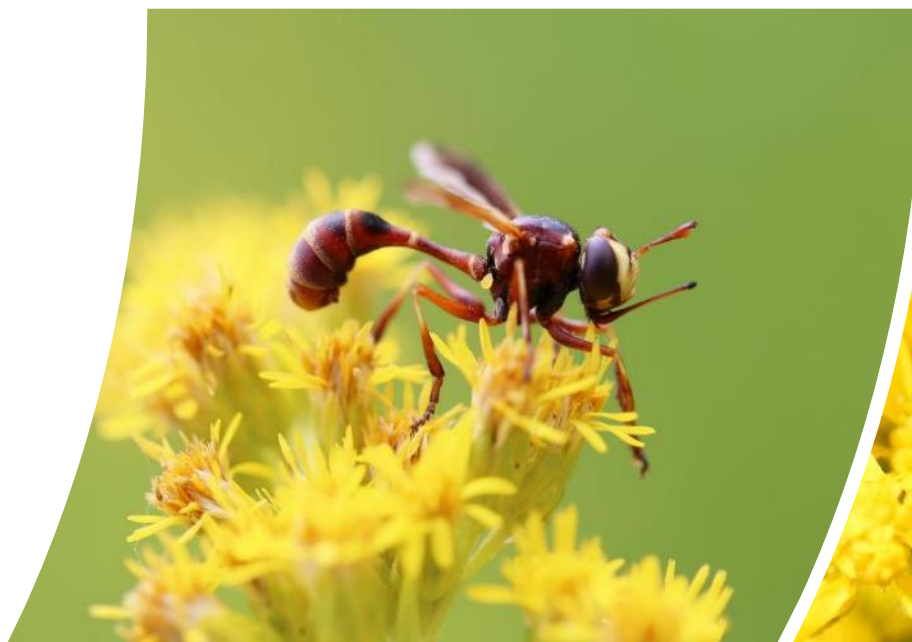


## Other pollinators

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

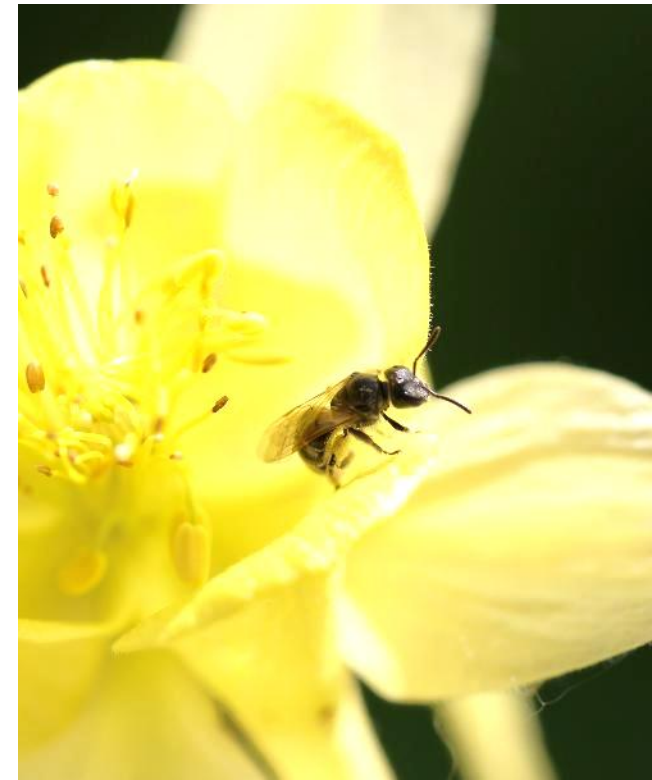
The accidental exposure of bees to pesticides, leading to lethal and sub lethal effects.

### 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.



## 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.



## 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/>

**FieldWatch**  
Communication, Cooperation, Collaboration.

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### Advancing Communication, Cooperation and Collaboration in Agriculture

FieldWatch is a non-profit company with a **FREE** and **VOLUNTARY** mapping registry that promotes communication between producers of specialty and row crops, beekeepers, seed companies and pesticide applicators in support of ongoing stewardship activities. With easy-to-use, reliable, secure and **FREE** mappings tools, FieldWatch is a trusted source of data in North America, promoting sustainability for plants, pollinators, people and planet.

- driftwatch**  
Specialty Crops User Registry  
By FieldWatch  
For Producers
- beecheck**  
Apiary Registry  
By FieldWatch  
For Beekeepers
- fieldcheck**  
By FieldWatch  
For Applicators
- seedfieldcheck**  
For Seed Companies

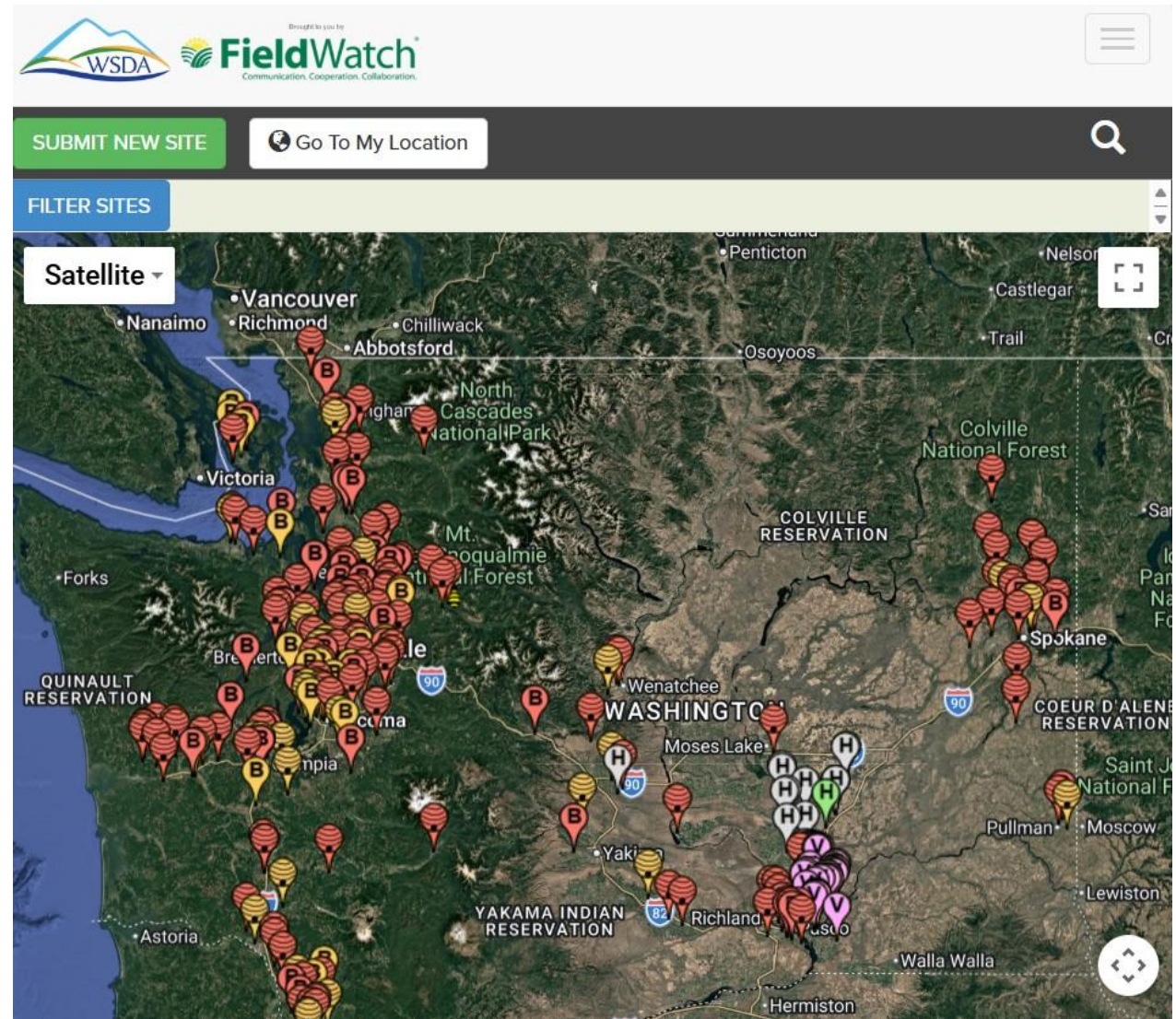
Using our registries is simple: producers of specialty crops, organic or conventional (not herbicide tolerant) row crops, beekeepers, and seed companies map the locations of fields, apiaries or seed field workers using dedicated mapping tools. Pesticide applicators check for mapped locations before spraying to improve decision-making and manage potential pesticide drift.

Learn How to Use Our Registries > GO

## 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/>



## 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”

# Protect Your Health Read the Label

**Top three pesticide safety tips:**

- 1) Read the entire label
- 2) Only apply where the label says it should be applied
- 3) Keep all pesticides in their original containers

**MOSQUITO REPELLENT**

KEEP OUT OF REACH OF CHILDREN  
**WARNING:** Read cautions on back.

Active ingredient: DEET ..... 7.0%  
Other listed ingredients ..... 93.0%  
NET 7.5 FL. OZ. (222 mL)

**SIGNAL WORDS**

How toxic is the product?  
Caution = mildly toxic  
Warning = moderately toxic  
Danger = highly toxic

**ACTIVE INGREDIENTS**

What is in the product?

**STORAGE & DISPOSAL**

How does this product have to be stored? What should I do with the leftovers I don't need?

**EPA REGISTRATION NUMBER**

What is the unique product number showing that the EPA has approved it?

**Repels Mosquitoes, Ticks, Biting Flies, Gnats, No-see-ums, Chiggers & Fleas**

STOP: Read and Follow all directions and precautions on this product label.

**DIRECTIONS FOR USE**

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

**NOTICE:** To the extent consistent with applicable law, buyer assumes all responsibility for safety and use not in accordance with directions.

**STORAGE AND DISPOSAL**

Storage: Store in a cool, dry place, out of reach of children.

Container Disposal: If empty: \_\_\_\_\_  
If partly filled: \_\_\_\_\_

**PRECAUTIONARY STATEMENTS**

Hazards to Humans and Domestic Animals.

First Aid: If in Eyes: \_\_\_\_\_

If Swallowed: Call a Poison Control Center or doctor immediately for treatment advice. Do not induce vomiting unless told to do so by a Poison Control Center or doctor.

IF YOU SUSPECT A REACTION TO THIS PRODUCT: Discontinue use. Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a Poison Control Center or doctor for treatment advice.

**QUESTIONS:** For non-emergency information concerning this product, call the National Pesticide Information Center (NPIC) at 1-800-858-7378. For emergencies, call the Poison Control Center 1-800-222-1222. Have the product container or label with you when calling a Poison Control Center or doctor, or going for treatment.

EPA Reg. No. XXX-XX-XX

**DIRECTIONS FOR USE**

How and where should I use the product? How much is okay?  
**Not following the product's instructions is not only dangerous, but it is illegal!**

**PRECAUTIONARY STATEMENTS**

How can the product be used safely?

**FIRST AID**

What should I do if it gets in my eyes, mouth, lungs, or on my skin?

**npic**  
NATIONAL PESTICIDE INFORMATION CENTER  
1.800.858.7378  
For general questions about pesticides, including the potential risk to humans, pets, or the environment, call NPIC at 1-800-858-7378.

**POISON Help**  
1-800-222-1222  
If someone breathes in, swallows, or gets pesticide in the eyes or on the skin, call a poison control center 24/7 at 1-800-222-1222.

## 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
<b>Safest</b>	Late evening/night (from when bees cease foraging to midnight)
<b>Intermediate</b>	Midnight to first light
<b>Dangerous</b>	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

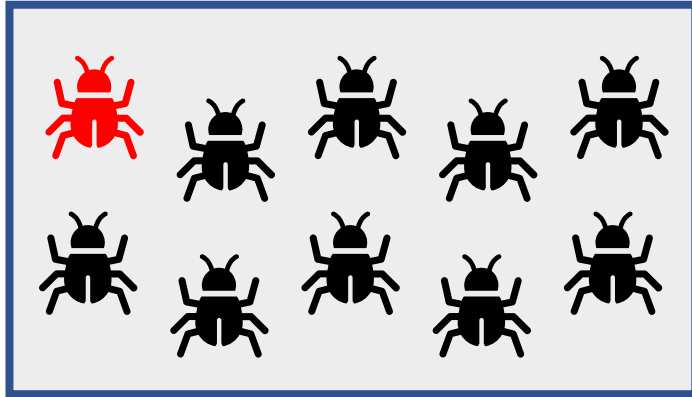
- 110% increase in reported colonies lost with CCD symptoms, compared to 2024
- 62% of commercial honey bee colonies in the US died
- Varroa mites were reported as the #1 stressor
- Nearly all the colonies tested were positive for bee viruses
- Every mite the USDA researchers screened was resistant to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

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

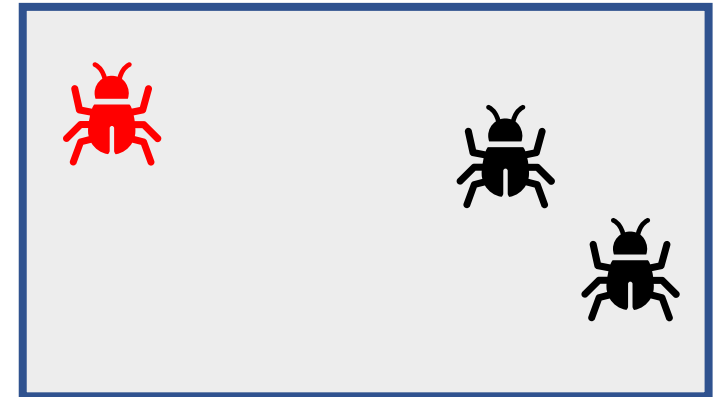


<https://www.science.org/content/article/scientists-identify-culprit-behind-biggest-ever-u-s-honeybee-die>

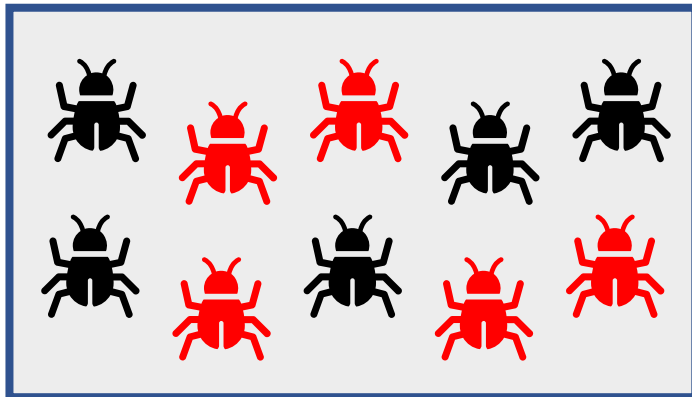
First generation



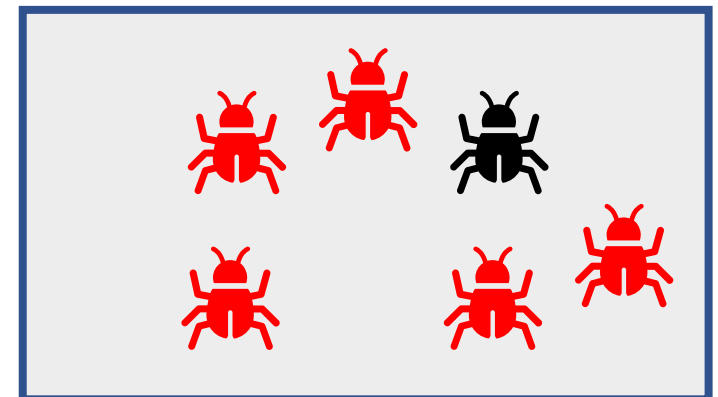
Pesticide



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.**

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



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

## 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

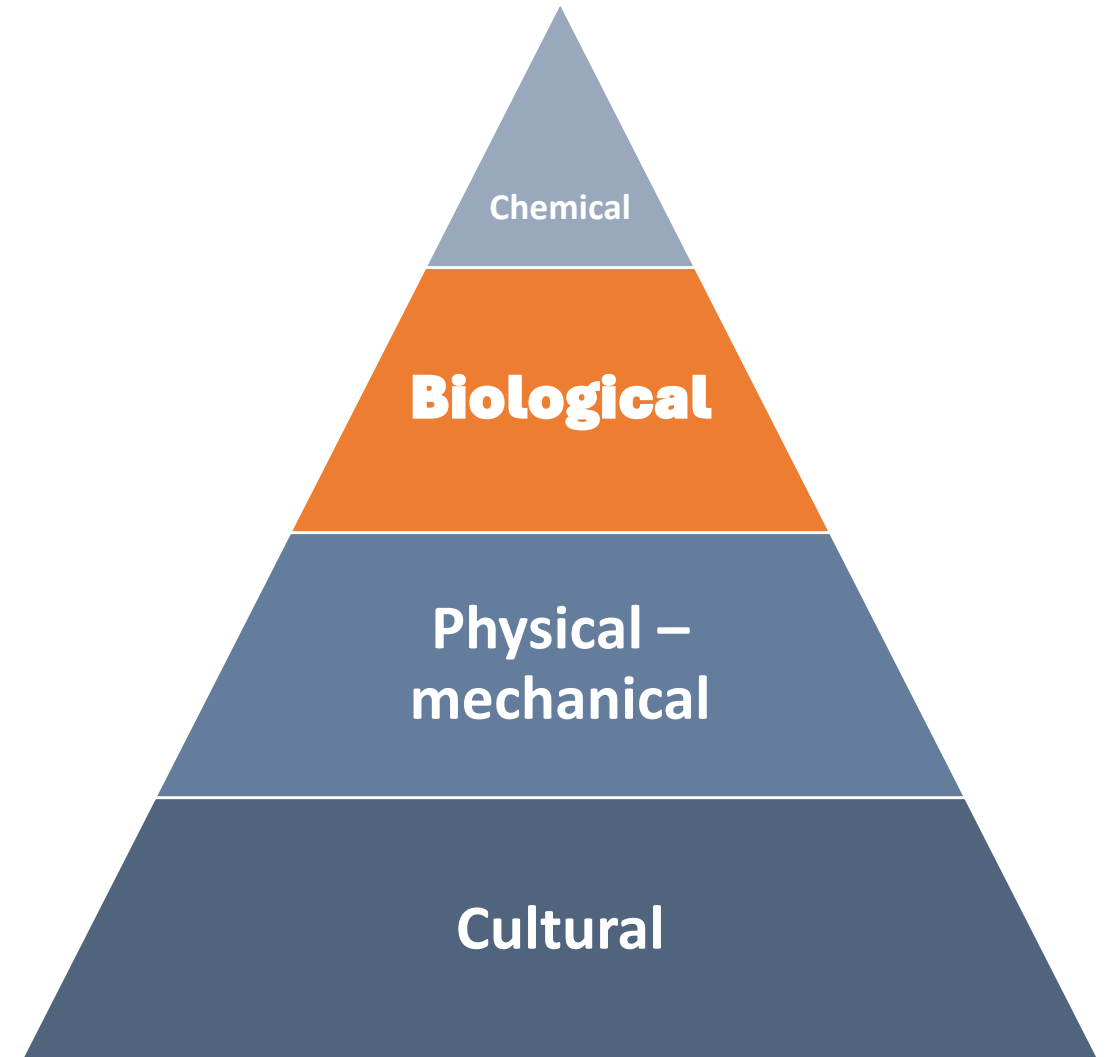
- Example: physical barriers, nest removal

### Cultural control

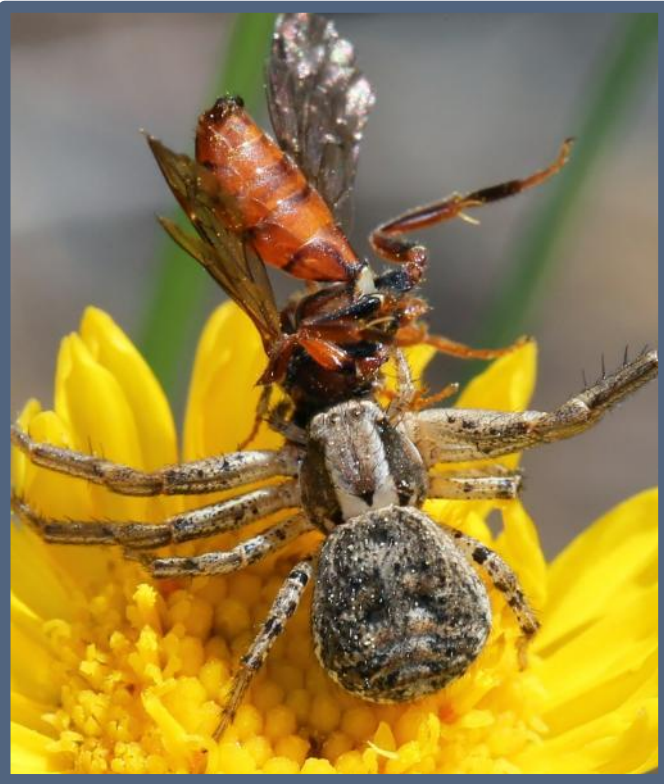
- Example: sanitation practices, timing of harvest

### Biological control

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



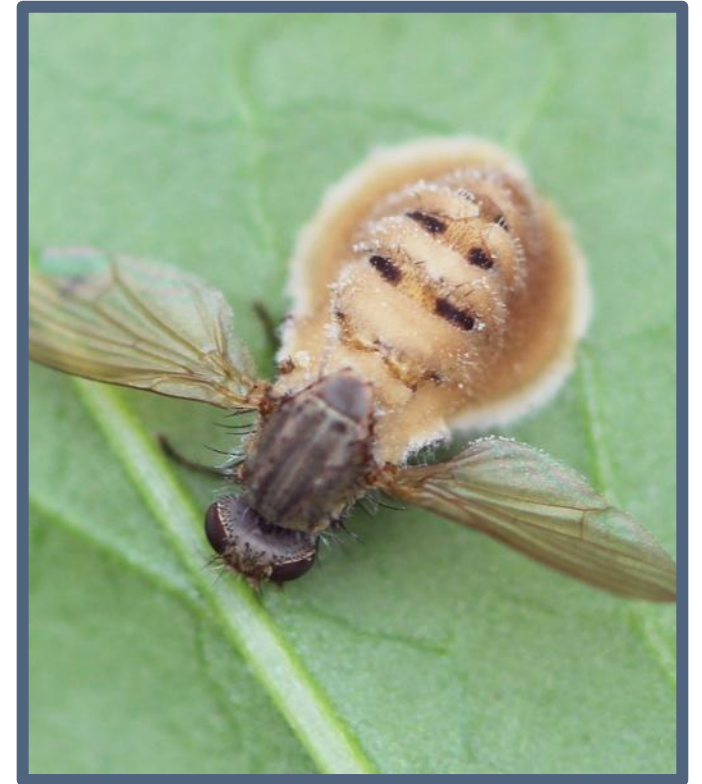
## 3 Types of Biological Control Organisms



**Predators**



**Parasitoids**



**Pathogens**

## Predators

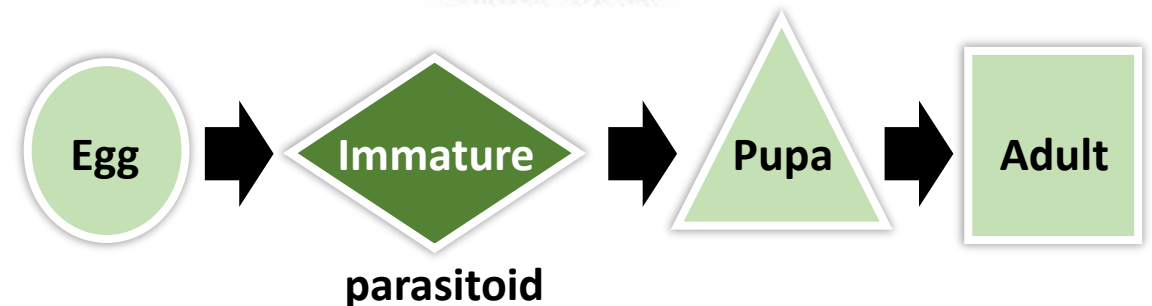
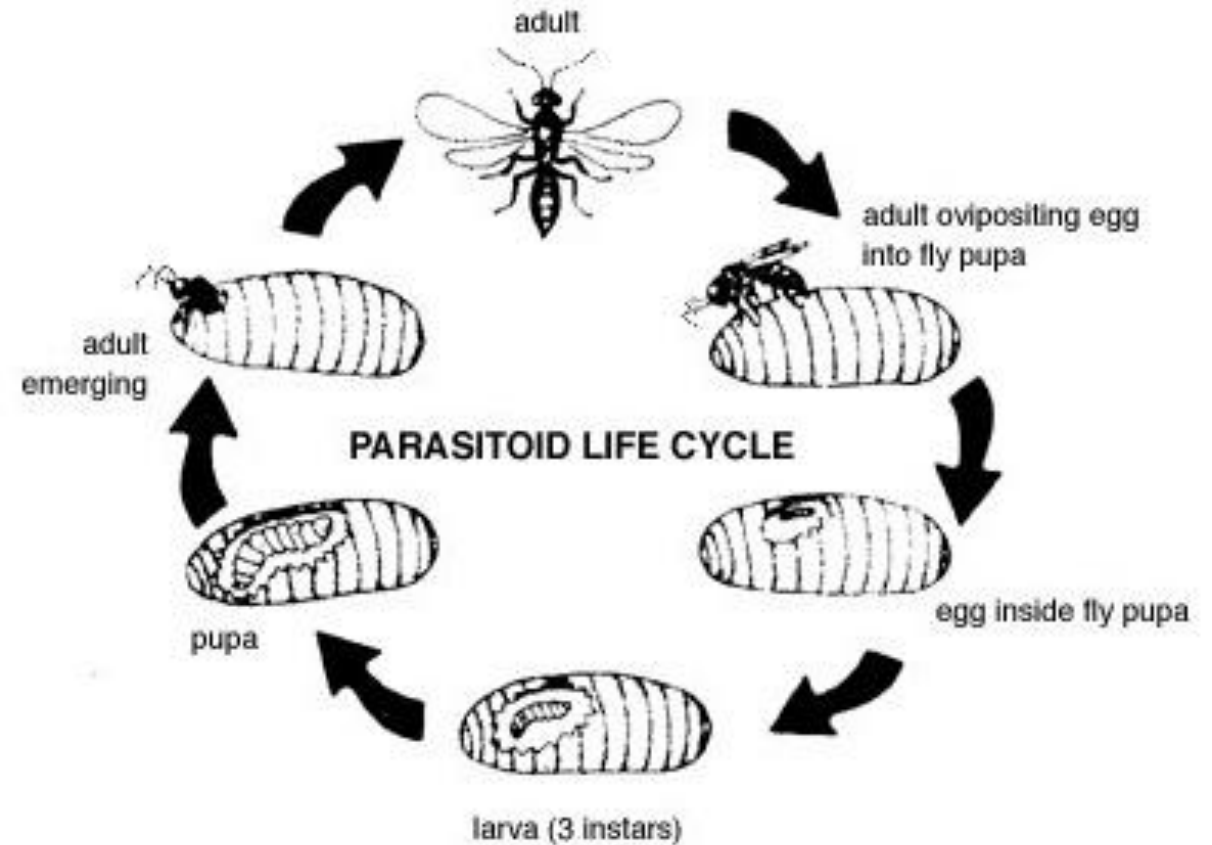
- An organism that attacks and feeds on other animals – usually smaller and less powerful than themselves.
- They consume more than one animal in their lifetime.
- Most arthropod predators are generalists.
- These arthropods may be predatory in one or more life stages.



## 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.

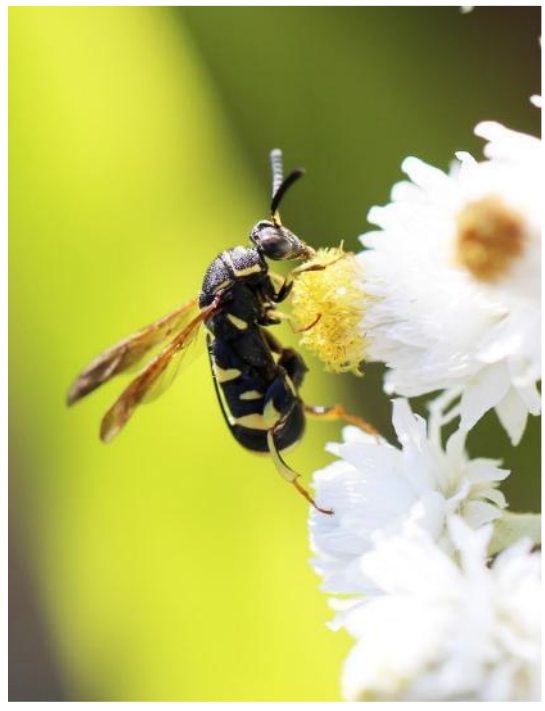


## Parasitoid Wasps

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

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

### 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.



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

## “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.

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 supplier.
- The goal is not to replace existing natural enemies but to provide an additional source of mortality to help manage a pest population.



## 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

# 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.

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## Scouting Guides



Beneficial Insect Scouting Guide



Beneficial Insects For Natural Pest Control: Soil Scouting



Beneficial Insects For Natural Pest Control: Foliage Scouting

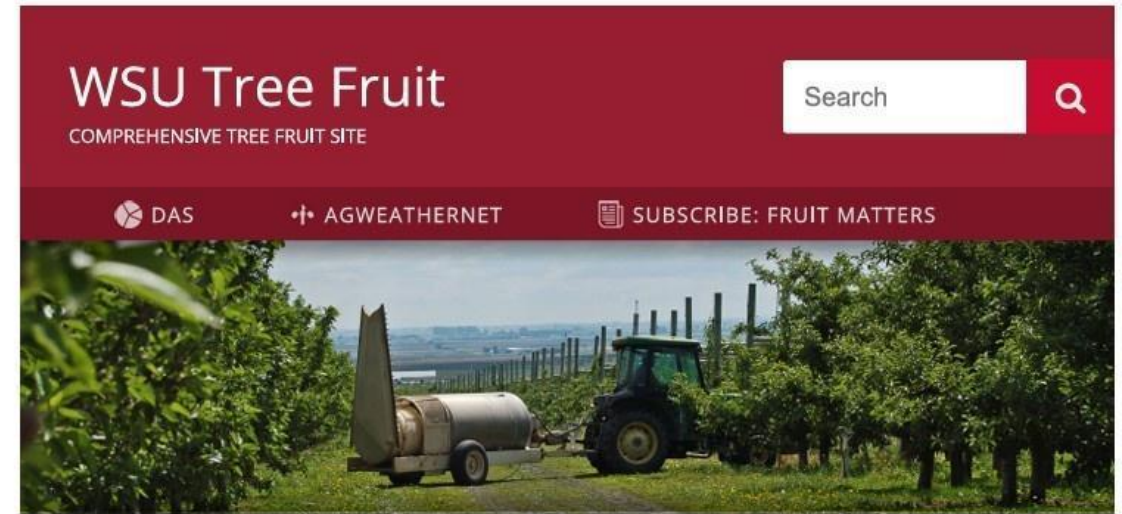
<https://xerces.org/publications/scouting-guides>



## OSU Natural Enemies Pocket guide



[https://agsci.oregonstate.edu/sites/agscid7/files/nwrec/attachments/pocket\\_guide\\_of\\_natural\\_enemies\\_1.pdf](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.

## 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.

### 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.



## 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  
*Symphoricarpos*  
*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://gardeneecology.oregonstate.edu/sites/agscid7/files/gel\\_brief\\_1\\_native\\_plants.pdf](https://gardeneecology.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](http://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](http://xerces.org/pollinator-resource-center)
- ⇒ Bring Back The Pollinators: [BringBackthePollinators.org](http://BringBackthePollinators.org)
- ⇒ Reducing Pesticide Use & Impacts: [xerces.org/pesticides](http://xerces.org/pesticides)

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

[https://xerces.org/sites/default/files/publications/22-023\\_02\\_NPPBI%E2%80%9494MaritimeNW\\_web.pdf](https://xerces.org/sites/default/files/publications/22-023_02_NPPBI%E2%80%9494MaritimeNW_web.pdf)



## Biocontrol Science and Technology



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

To cite this article: Francisco Posada-Flórez, Daniel Sonenshine, Jay Evans, Dawn Boncristiani, Monica Pava-Ripoll & Steven Cook (2025) Natural enemies of *Varroa destructor* identified from Eastern North American honey bee colonies: a biological survey of candidates for mite control from Maryland, USA, *Biocontrol Science and Technology*, 35:1, 52-70, DOI: [10.1080/09583157.2024.2430469](https://doi.org/10.1080/09583157.2024.2430469)

To link to this article: <https://doi.org/10.1080/09583157.2024.2430469>



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<https://www.tandfonline.com/doi/pdf/10.1080/09583157.2024.2430469>



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HOME > NEWS > ALL NEWS > SCIENTISTS IDENTIFY CULPRIT BEHIND BIGGEST EVER U.S. HONEY BEE DIE-OFF

NEWS | PLANTS & ANIMALS

### Scientists identify culprit behind biggest ever U.S. honey bee die-off

USDA research points to viruses spread by pesticide-resistant mites, indicating a worrying trend

30 JUN 2025 • 5:20 PM ET • BY JOANNA THOMPSON



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



**Thank  
you!**

# Any Questions?

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