

An aerial photograph of a vegetable farm. The image shows numerous rows of crops, likely tomatoes, planted in neat lines. There are several greenhouses visible, some covered in black plastic mulch. A stream or irrigation channel runs through the farm, bordered by trees and vegetation. The overall scene is a well-organized agricultural landscape.

# Organic IPM for Insect Pests in Vegetable Systems

**Ellie Andrews**

UCCE Specialty Crops Advisor - Sonoma, Marin, & Napa Counties

# Quick Bio

- Bachelor's in Field Ecology (Ohio University)
- Worked on several small-scale certified organic farms: mixed vegetables, greens, cut flowers, culinary herbs & mushrooms, microgreens, etc.



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- Bachelor's in Field Ecology (Ohio University)
- Worked on several small-scale certified organic farms: mixed vegetables, greens, cut flowers, culinary herbs & mushrooms, microgreens, etc.
- Master's in Plant Health Management (Ohio State)
- PhD in Horticulture & Agronomy (UC Davis)



# My Role



- Specialty Crops Advisor for Sonoma, Marin, & Napa counties
- Orchard crops, veg crops, etc. –anything other than grapes!



# IPM Framework

- What is a pest?



Cucumber Beetles



Thistle



Field Bindweed



Gopher

# IPM Framework

- What is a pest?
  - An unwanted organism that damages/interferes with plants
  - Weeds, vertebrates, invertebrates, nematodes, pathogens that cause diseases (bacteria, fungus, virus)



Cucumber Beetles



Thistle



Field Bindweed



Gopher

# Active Management

- No management = bad management
  - Example: “Letting nature do it’s thing.”
  - Great for insect pests, plant pathogens, invasive species
  - Bad for the environment: pest reservoirs
  - Bad for your neighbor farmers and vineyards



# Active Management

- No management = bad management
  - Example: “Letting nature do it’s thing.”

*We are part of nature!*  
*Doing nothing does a lot.*



Statewide IPM Program

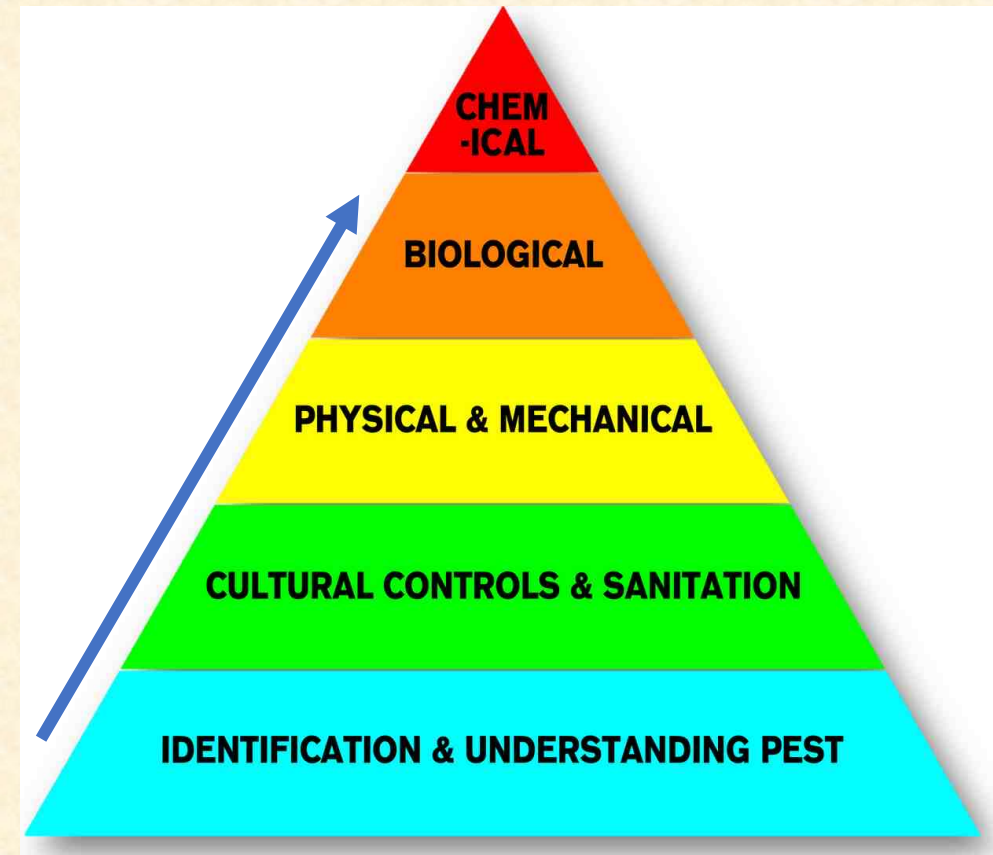


# What Is Integrated Pest Management (IPM)?

Integrated pest management, or IPM, is a process you can use to solve pest problems while minimizing risks to people and the environment. IPM can be used to manage all kinds of pests anywhere—in urban, agricultural, and wildland or natural areas.

# IPM

- A toolbox approach: choose a combination of strategies that makes sense for your unique context
- An ecologically oriented framework
- Focuses on long-term prevention
- Minimize risks to human health, nontarget organisms, & the environment
- Pesticides are used only after monitoring indicates they are needed, using established guidelines



IPM Pyramid (Diagram Credit: Bee Health Guide)

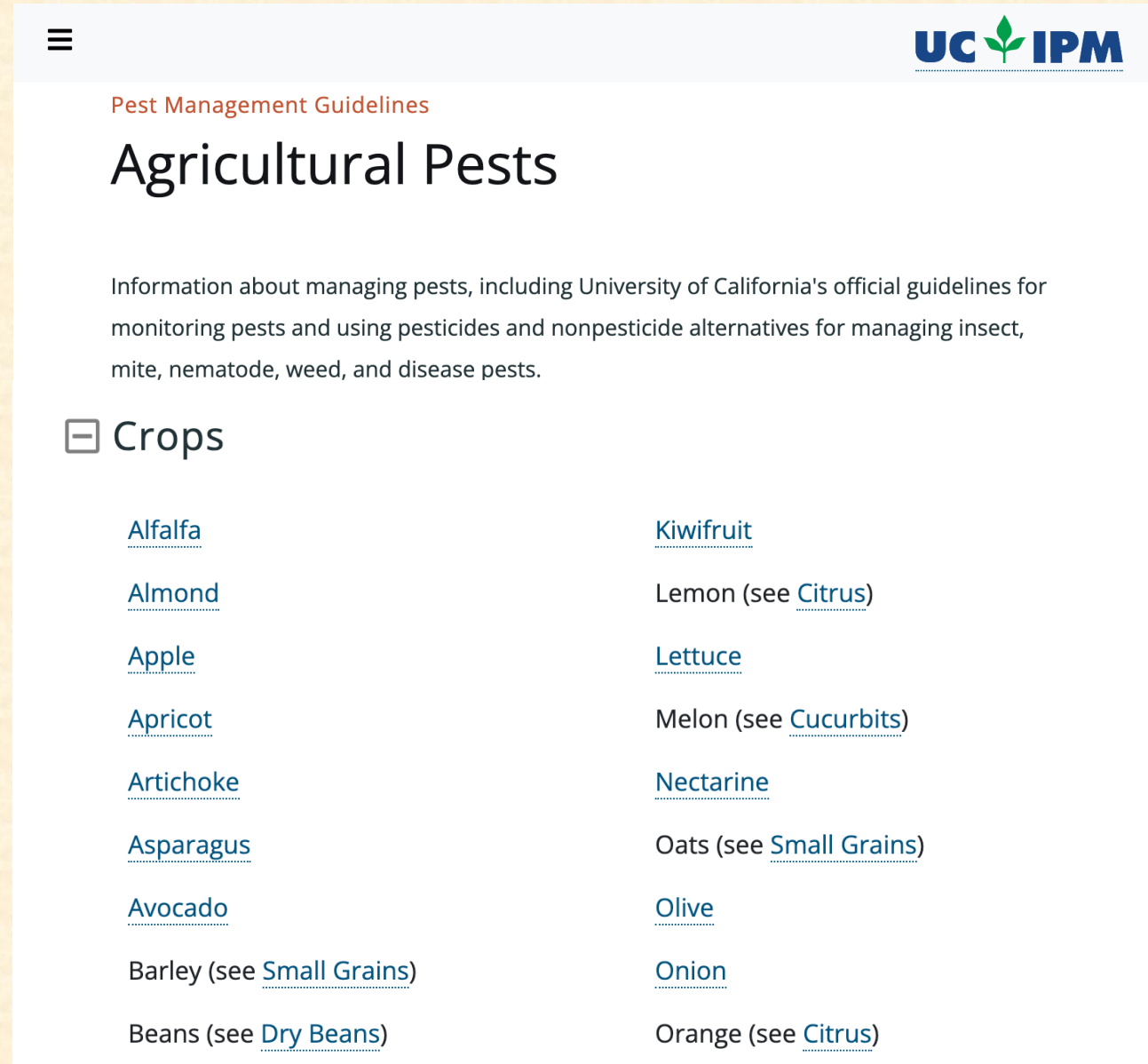
# IPM

- Proactive management helps prevent spread to other plants, neighbors, the region
- An iterative process





# IPM

- Check out the UC IPM website for resources
- Start with your crop type



The screenshot shows the UC IPM website interface. At the top right is the UC IPM logo. Below it, the text 'Pest Management Guidelines' is displayed in a smaller font. The main heading is 'Agricultural Pests'. A paragraph of text follows, providing information about managing pests. Below this is a section titled 'Crops' with a list of links to various crop-specific pages. The links are arranged in two columns.

Pest Management Guidelines

## Agricultural Pests

Information about managing pests, including University of California's official guidelines for monitoring pests and using pesticides and nonpesticide alternatives for managing insect, mite, nematode, weed, and disease pests.

### Crops

<a href="#">Alfalfa</a>	<a href="#">Kiwifruit</a>
<a href="#">Almond</a>	Lemon (see <a href="#">Citrus</a> )
<a href="#">Apple</a>	<a href="#">Lettuce</a>
<a href="#">Apricot</a>	Melon (see <a href="#">Cucurbits</a> )
<a href="#">Artichoke</a>	<a href="#">Nectarine</a>
<a href="#">Asparagus</a>	Oats (see <a href="#">Small Grains</a> )
<a href="#">Avocado</a>	<a href="#">Olive</a>
Barley (see <a href="#">Small Grains</a> )	<a href="#">Onion</a>
Beans (see <a href="#">Dry Beans</a> )	Orange (see <a href="#">Citrus</a> )

# Identification

- ID pest & assess which IPM strategies make sense in your context



UC IPM / Agriculture / Lettuce

Agriculture: Pest Management Guidelines

## Lettuce

University of California's official guidelines for pest monitoring techniques, pesticides, and nonpesticide alternatives for managing pests in agriculture. [More](#)

### ☐ Year-Round IPM Program

- [Introduction](#)
- [Preplant](#)
- [Planting to Rosette](#)
- [Rosette to Heading](#)
- [Heading to Harvest](#)
- [Harvest and Postharvest](#)
- [Pesticide Application Checklist](#)

Publication Information

[Authors and Credits](#)

[Recent Updates \(all crops\)](#)

### ☐ General Management in an IPM Program

- [Measures to Minimize Water Quality Impairments to Surface and Ground Water](#)
- [Selecting The Field](#)

### ☐ Insects, Mites, and Other Invertebrates

#### General Information

- [Relative Toxicities of Insecticides and Miticides Used in Lettuce to Natural Enemies and Honey Bees](#)

#### Insect, Mite, and Other Invertebrate Management

- [Armyworm](#)
- [Beet Armyworm](#)
- [Bulb Mites](#)
- [Corn Earworm and Tobacco Budworm](#)
- [Cutworms](#)
- [Darkling Beetles](#)
- [Field Cricket](#)
- [Foxglove Aphid](#)
- [Garden Symphylans](#)

# IPM Concepts for Veg Crops

- Prevention
  - Find out what pests are common in the area for vegetables you'd like to grow
  - Look for resistant varieties
- Cultural Options
  - Disrupt pest habitat
  - Sanitize equipment to minimize spread
  - Shift crop planting location/time
  - Diversion thru trap cropping
- Physical/Mechanical Options
  - Floating row covers to exclude pests
  - Cultivation



Row cover can help exclude insect pests

# General IPM Concepts

- Biological Options
  - Promoting natural predators of pests thru creating habitat
    - Hedgerows to encourage beneficial insects
    - Raptor perches & owl boxes to encourage rodent predation
    - Etc.

# Hedgerows Benefits on Farms

A hedgerow is a row of trees, shrubs, bunch grasses and forbs on field edges.

## Natural Enemies

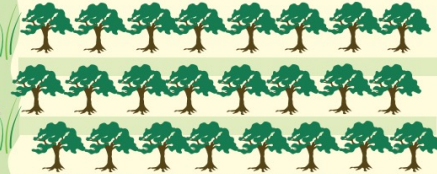
Hedgerows provide habitat and floral resources (pollen and nectar) for parasitoid wasps, lady beetles and other natural enemies of crop pests.

## Native Bees

Hedgerows provide nesting habitat and floral resources (pollen and nectar) for native bees. Of California's 1,600 native bees 30% are cavity nesters, in old logs and hollow plant stems, and 70% nest underground.

## Economics

Hedgerows enhance native bees and natural enemies in adjacent crops that can benefit crop production.



## Weed Control

Hedgerow plantings help out-compete weedy vegetation that harbors pests and diseases.

## Biodiversity

Hedgerows provide cover, nesting, and foraging habitat for migratory and resident birds that call the Central Valley their home.

## Other Benefits

Windbreaks, living fence lines, buffer zones, shade, farm aesthetics

## Soil & Water Quality Protection

Deep roots and ground cover provided by hedgerows help stabilize soil, reduce erosion, filter runoff, increase water infiltration and improve soil structure.



# General IPM Concepts

- Organic Chemical Options
  - Make sure you ID'ed the pest correctly
  - Make sure you've combined multiple other strategies & you're not relying on pesticides alone
  - Look up options for your pest and your crop: UC IPM website, local garden supply store
  - You read the label before you buy to learn more about it



UNIVERSITY OF CALIFORNIA AGRICULTURE & NATURAL RESOURCES  
**UC IPM**  
 Statewide Integrated Pest Management Program

## Pesticide active ingredients database

Insecticides & Miticides	Herbicides	Fungicides & Bactericides
<a href="#">abamectin</a>	<a href="#">2,4-D</a>	<a href="#">Bacillus subtilis</a>
<a href="#">acephate</a>	<a href="#">benefin</a>	<a href="#">Bordeaux mixture</a>
<a href="#">acetamiprid</a>	<a href="#">bensulide</a>	<a href="#">calcium polysulfide</a>
<a href="#">allethrin</a>	<a href="#">bentazon</a>	<a href="#">chlorothalonil</a>
<a href="#">arsenic trioxide</a>	<a href="#">bromoxynil</a>	<a href="#">copper ammonium complex</a>
<a href="#">azadirachtin</a>	<a href="#">cacodylic acid</a>	<a href="#">copper hydroxide</a>
<a href="#">Bacillus thuringiensis ssp. israelensis</a>	<a href="#">calcium acid methanearsonate</a>	<a href="#">copper octanoate</a>
<a href="#">Bacillus thuringiensis ssp. kurstaki</a>	<a href="#">carfentrazone</a>	<a href="#">copper oxychloride sulfate</a>
<a href="#">Beauveria bassiana</a>	<a href="#">chlorsulfuron</a>	<a href="#">cupric hydroxide</a>
	<a href="#">clethodim</a>	

# General IPM Concepts

- Organic Chemical Options
  - Look for certified organic (OMRI listed) options
  - Check with your organic certifier before applying
  - Learn strategies for protecting pollinators before applying
  - Always follow label instructions: rate, timing, personal protective equipment (PPE), etc.



**Ohio**line

Ohio State University Extension

Search

## Protecting Pollinators While Using Pesticides

# Scale & Goals Matter

- Mid-scale farm IPM can look a bit different than backyard IPM due to scale & goals
  - For instance, handpicking bugs off plants is often not practical at commercial scales
  - Lower tolerance for blemishes if selling produce fresh
  - Higher tolerance if creating a value-added commercial product that gets processed



# Scale & Goals Matter

- Mid-scale farm IPM can look a bit different than backyard IPM due to scale & goals
  - What works best at your scale? ...for your goals? Lots of different answers!
  - IPM provides a “toolbox” of options for strategies you can tailor to your unique situation



# Example: Symphylans

- Start with pest identification
- Understanding the pest's life cycle is important for effective management



The screenshot shows a webpage from UC IPM. At the top right is the UC IPM logo. Below it is a photograph of a white, segmented garden symphylan on dark soil. Under the photo is a breadcrumb trail: [UC IPM](#) / [Agriculture](#) / [Lettuce](#) / Garden Symphylans. The main heading is "Garden Symphylans" with the scientific name *Scutigereella immaculata* below it. A section titled "Description of the Pest" contains text about their classification and physical characteristics. A vertical "Feedback" button is on the right side of the page.

[UC IPM](#) / [Agriculture](#) / [Lettuce](#) / Garden Symphylans

[Agriculture: Lettuce Pest Management Guidelines](#)

## Garden Symphylans

*Scutigereella immaculata*

### Description of the Pest

[Garden symphylans](#) (also called garden centipedes) are not insects; they are in their own arthropod class called the Symphyla. When full grown, they are not more than 0.33 inch long and have 15 body segments and 11 to 12 pairs of legs. They are slender, elongated, and white with prominent antennae.

Symphylans are long lived; some adults may live several years. The adult females lay eggs in

# Damage

- They feed on living roots, sprouting seeds, & fungal hyphae
- Feeding damage causes:
  - Root death
  - Gnarled root appearance
  - Corky tissues in older roots
  - Plant stunting
  - Increased susceptibility to soil-borne pathogens



Stunted eggplant due to symphylans damage (left) and undamaged eggplant in the same field (right) (ATTR)

# Damage



- They cause patchy distribution of stunting symptoms in the field
- Often occur in hotspots: can be several square feet to several acres

(Jon Umble & Jim Leap, ATTRA)



# Timing & Conditions

- Timing: high numbers are often observed in April/May, especially during rainy springs
- Soil moisture:
  - Symphylans tend to occur in heavier soils with high irrigation
  - They may be spread by flooding
  - They are common in alluvial soils in California
  - They tend to congregate in the upper soil layer when conditions are warm & moist



(Jon Umble & Jim Leap, ATTRA)

# Soil Conditions

- Symphylans cause problems in organic systems with:
  - High soil organic matter
  - Plant residue incorporations
  - Non-decomposed organic matter
- Symphylans are more often associated with good soil structure compared to soils that are compacted or sandy



# Soil Conditions

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*Ironically, they could be considered the single pest that is an indicator of good soil management where soil aggregation & soil organic matter are high.*

(-Rex Dufour, ATTRA)



# Symphylans Mobility

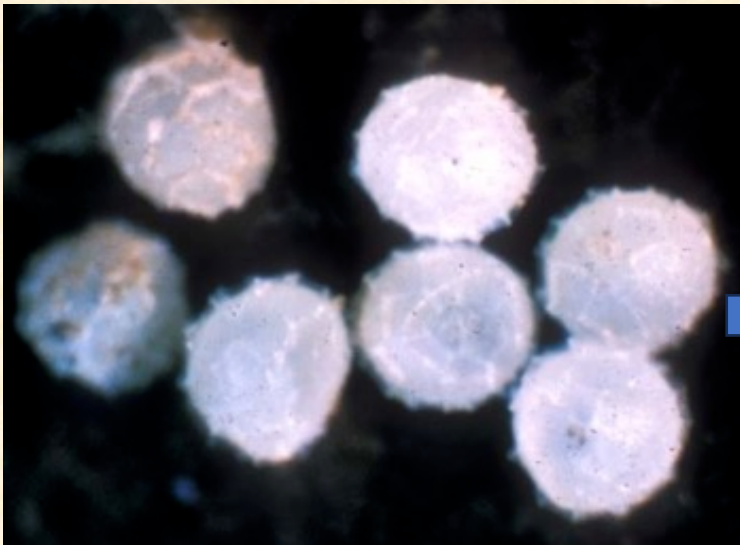
- They rely on soil pore spaces made by roots & other organisms to move
- Very vertically mobile in soil profile thru soil pores, cracks & channels
- Need well aggregated soil to move, so sandy soils are less hospitable
- They can be found >3 ft below the soil surface



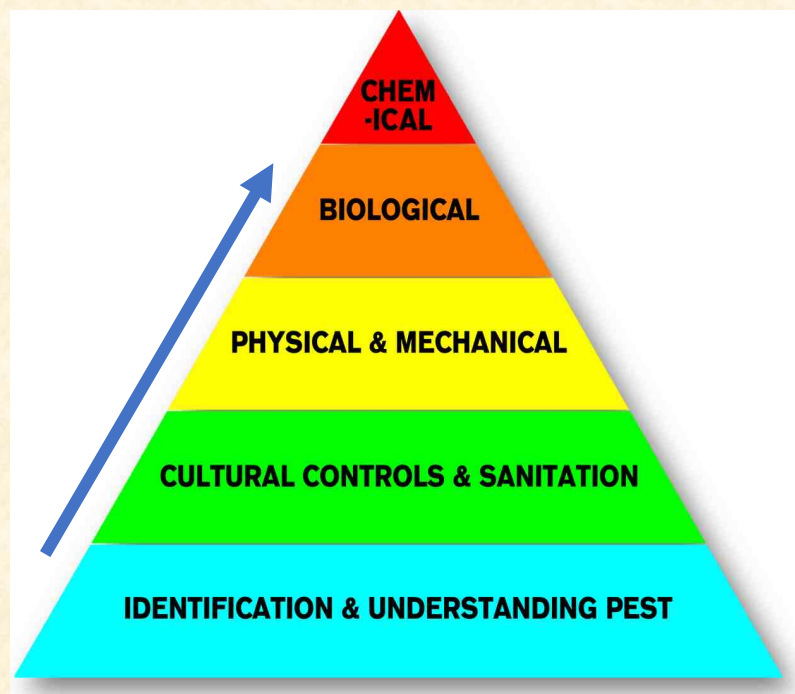
# Symphylans Mobility

- All life stages occur in the soil: they molt in the deeper soil layers & migrate up to the root zone to feed

Symphylans eggs and newly emerged symphylans (first instar) (Ralph Berry, ATTRA)



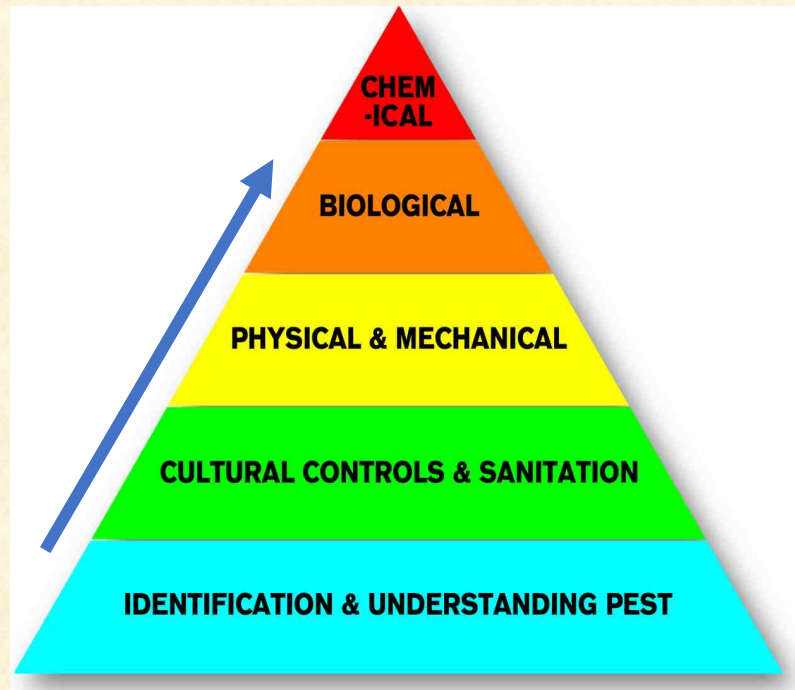
# IPM “Toolbox” Approach for Symphylans



IPM Pyramid (Diagram Credit: Bee Health Guide)

- Prevention
- Monitoring
- Strategic Tillage
- Mild/Moderate Compaction
- Potato Rotation
- Limiting Undecomposed Residues
- Moderating Organic Matter Inputs
- Transplants
- Overplanting
- Sanitizing Farm Equipment
- Encouraging Natural Predators
- Insecticides & Oil-Based Products

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*You don't have to do everything! Just choose the strategies that are appropriate for your context and goals.*



YouTube

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@UCCENorthBaySpecialtyCrops · 30 subscribers · 11 videos

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# Symphylans

## Integrated Pest Management (IPM)

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UNIVERSITY OF CALIFORNIA  
Agriculture and Natural Resources



UC Cooperative Extension



0:06 / 29:57



HD



### Symphylans IPM



UCCE North  
30 subscribers

Analytics

Edit video

1



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# Example: Shao Shan Farm

- Scott Chang-Fleeman shared that the success of the potato rotation might depend on planting timing after potato rotation
- Immediate fall planting after potato harvest led to no problems with symphylans in the following crop
- But waiting to plant until spring might have led to issues



Shao Shan Farm: potatoes growing in a field known to have symphylans

# Example: Shao Shan Farm

- Scott and several other local growers have suggested that intercropping potatoes around other crops could potentially help provide some level of control
- Growers continue to innovate and experiment!



Shao Shan Farm: soybeans growing next to potatoes  
in a field known to have symphylans

# Example: Coyote Family Farm



- See their Instagram post for details
- They needed to plant early brassicas in a bed they new had symphylans – risky!
- Their strategies:
  - Tilled soil with a power harrow
  - Added lime to raise the pH, then planted
  - Then compacted soil by stepping all over the bed
- The plants looked uniform and lush, no stunting!

# Example: Coyote Family Farm



Reels



This cauliflower and kale survived symphylans and is thriving! See caption for how it happened

*“Intentionally creating **extra disturbance and compaction** is counter to all we know about good soil management, **but in this case** it was the right prescription!”*

– Sonya Perrotti (shared with permission)



# Example: Coyote Family Farm



Integrated multiple pest management strategies...

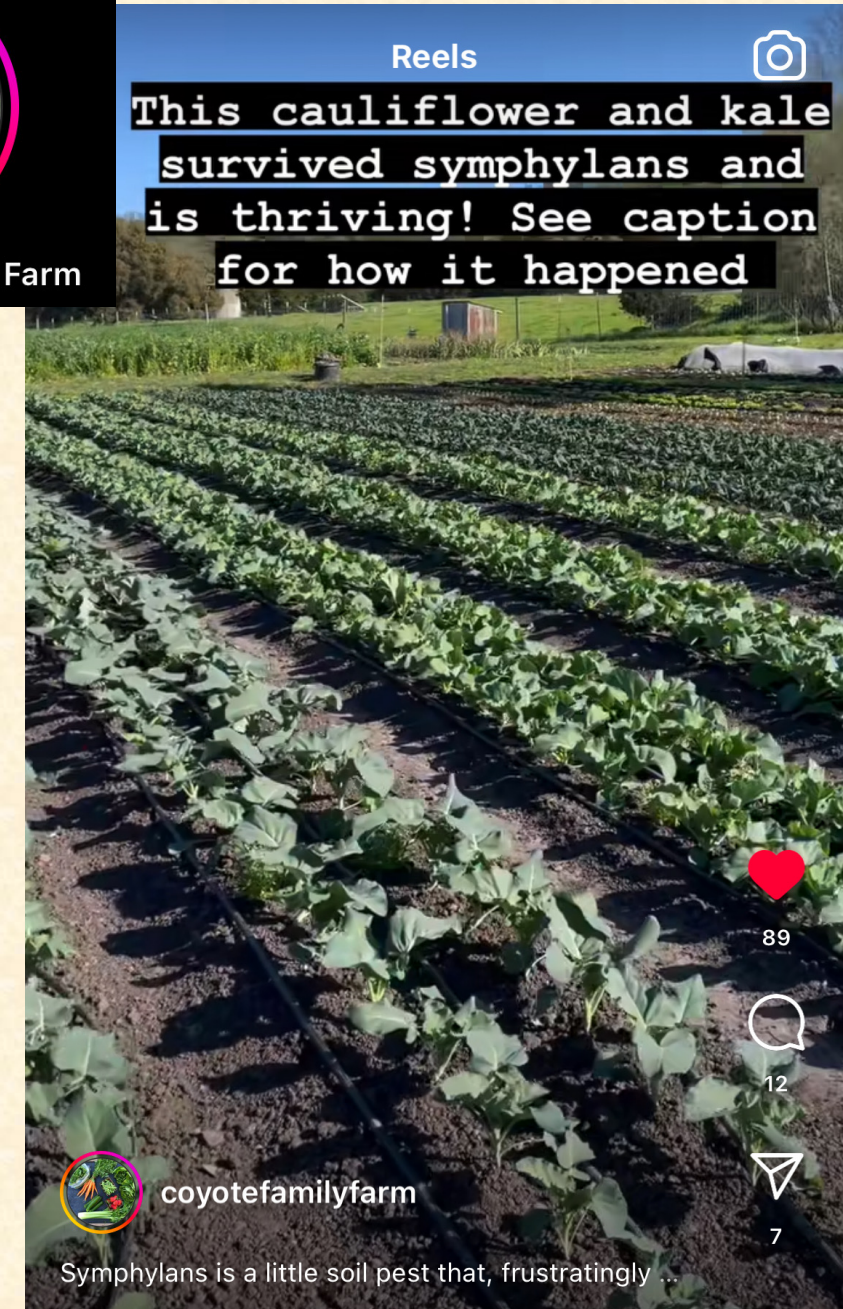


*“Intentionally creating **extra disturbance and compaction** is counter to all we know about good soil management, **but in this case** it was the right prescription!”*



– Sonya Perrotti (shared with permission)

...in a way that effectively reduced pest pressure in a specific farm context!



# Example: Cucumber Beetles

- Start with identification
- Learn about the pest's life cycle



[UC IPM](#) / [Agriculture](#) / [Cucurbits](#) / [Cucumber Beetles](#)

[Agriculture: Cucurbits Pest Management Guidelines](#)

## Cucumber Beetles

Banded cucumber beetle: *Diabrotica balteata*

Western spotted cucumber beetle: *Diabrotica undecimpunctata*

Western striped cucumber beetle: *Acalymma trivittatum*

### Description of the Pest

[\(Adult Field Key—PDF\)](#)

The [western spotted](#) and the [western striped](#) cucumber beetles occur throughout California and are major pests of cucurbits; the banded cucumber beetle occurs primarily in southern California. Cucumber beetles overwinter as adults and are active by the time the earliest

# Cucumber Beetles

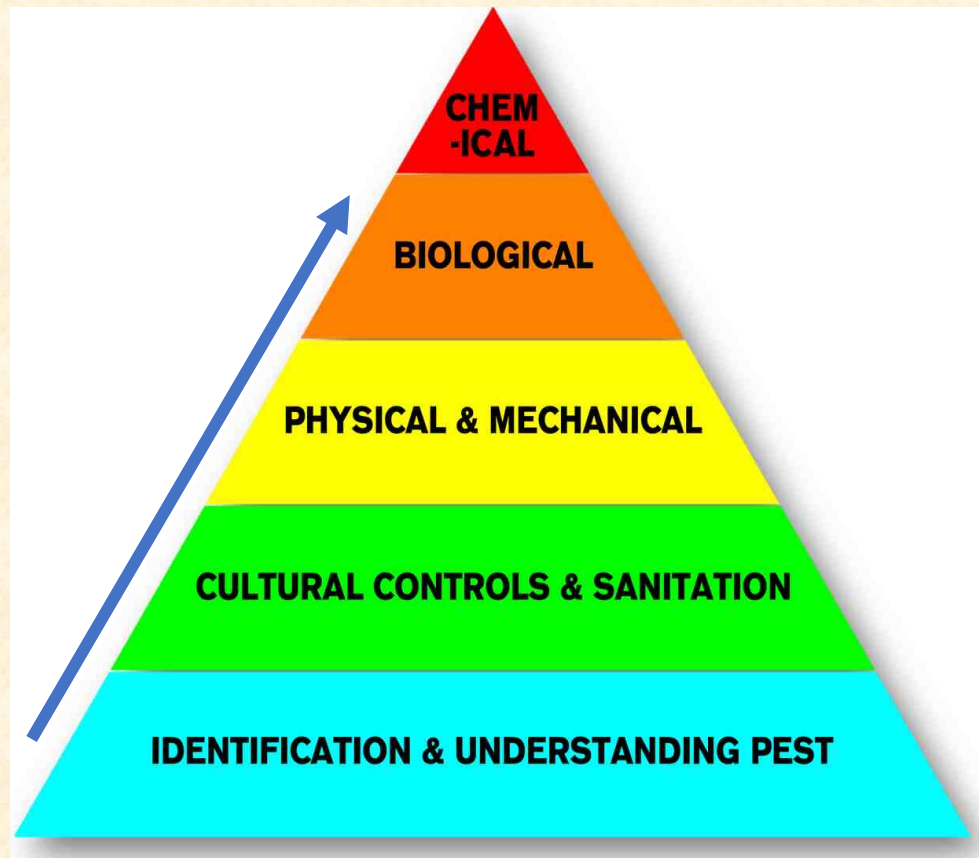
- Damage
  - Destroy flowers, leaves, and melons by feeding on them
  - When temperatures are high, adults feed on undersides of young melons, scarring them
  - Larvae can feed on roots
  - Can vector squash mosaic virus and bacterial wilt



# Cucumber Beetles



# IPM “Toolbox” for Cucumber Beetles



IPM Pyramid (Diagram Credit: Bee Health Guide)

- Prevention
- Crop rotation out of cucurbits
- Monitoring
- Row cover
- Transplants to give plants a head start
- Mulches to discourage egg laying around plants
- Trap cropping with Hubbard squash can distract
- Physical deterrent spray with kaolin clay
- Biological & organic insecticide products

# Cucumber Beetle



- Biological and organic insecticides:  
*(mention of product names serve as examples, not endorsements)*
  - Products using beneficial nematodes such as NemaSeek kill the pre-emergent grub stage of cucumber beetles in the soil, so very low risk to pollinator insects
  - There are many organic products: Pyganic, Azera, Spinosad, Beauveria, Bacillus, etc. kill cucumber beetles, but they are riskier when it comes to off-target damage to pollinator insects

# Cucumber Beetle



University of New Hampshire

Extension

## Over-informed on IPM - Episode 025 What cucumber beetles want

Anna dives deep into what we know about cucumber beetle behavior and chats with Simon Zebulo (UMD Eastern Shore) about how to make the most of that knowledge in organically-produced watermelon.

THURSDAY, AUGUST 13, 2020



# It's a process.



# Thank you!



# Questions?



# References & Resources

- <https://ipm.ucanr.edu/>
- <https://ipm.ucanr.edu/home-and-landscape/pesticide-active-ingredients-database/#gsc.tab=0>
- <http://npic.orst.edu/>
- <https://ucanr.edu/sites/ccpestmanagement/files/237331.pdf>
- <https://ohioline.osu.edu/factsheet/anr-68>
- [https://ipm.ucanr.edu/mitigation/protect\\_bees.html](https://ipm.ucanr.edu/mitigation/protect_bees.html)
- <https://attra.ncat.org/publication/symphylans/>
- <https://ipm.ucanr.edu/agriculture/cole-crops/garden-symphylans/#gsc.tab=0>
- <https://www.youtube.com/watch?v=JdhbXp6hcTM&t=349s>
- <https://ipm.ucanr.edu/agriculture/cucurbits/cucumber-beetles/>
- <https://extension.unh.edu/blog/2020/08/over-informed-ipm-episode-025-what-cucumber-beetles-want>