

An aerial photograph of a vegetable farm. The image shows numerous rows of crops, likely tomatoes, planted in neat lines. There are several greenhouses of varying sizes, some covered in black plastic mulch. A stream or irrigation channel runs through the middle of the farm. The surrounding area is lush with green trees and vegetation.

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



UC Statewide IPM Project
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Field Bindweed



Statewide IPM Project
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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

We Need 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



We Need 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

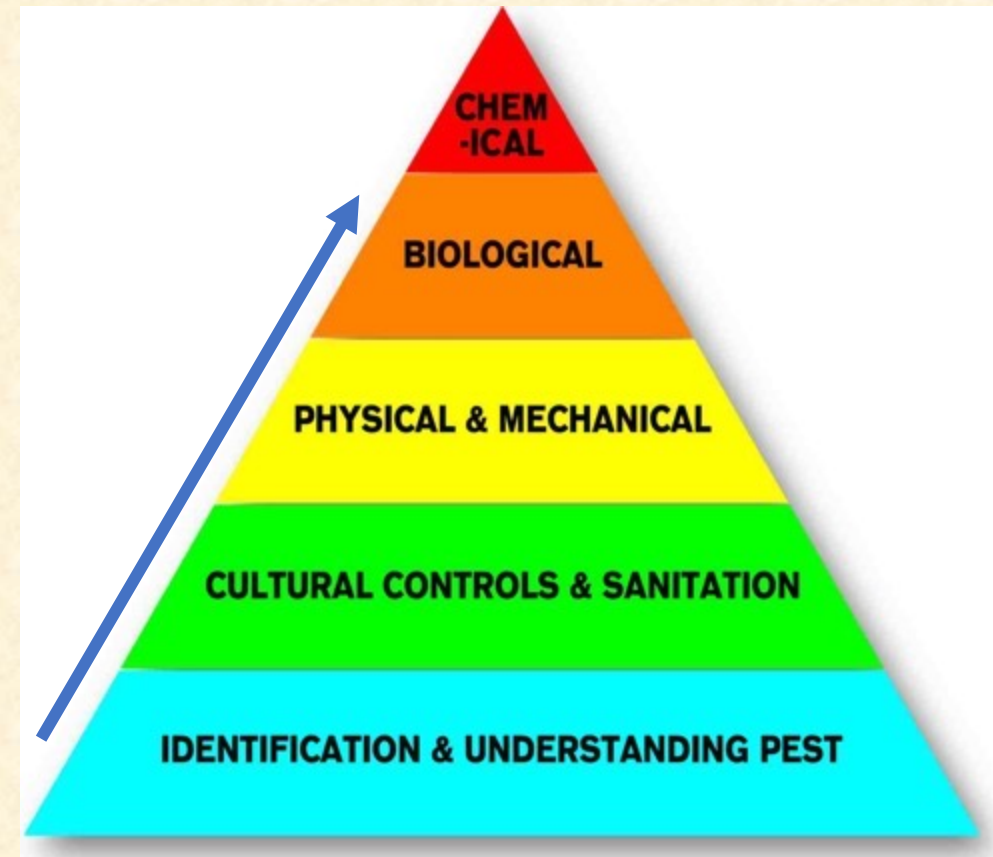


What Is Integrated Pest Management (IPM)?

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)

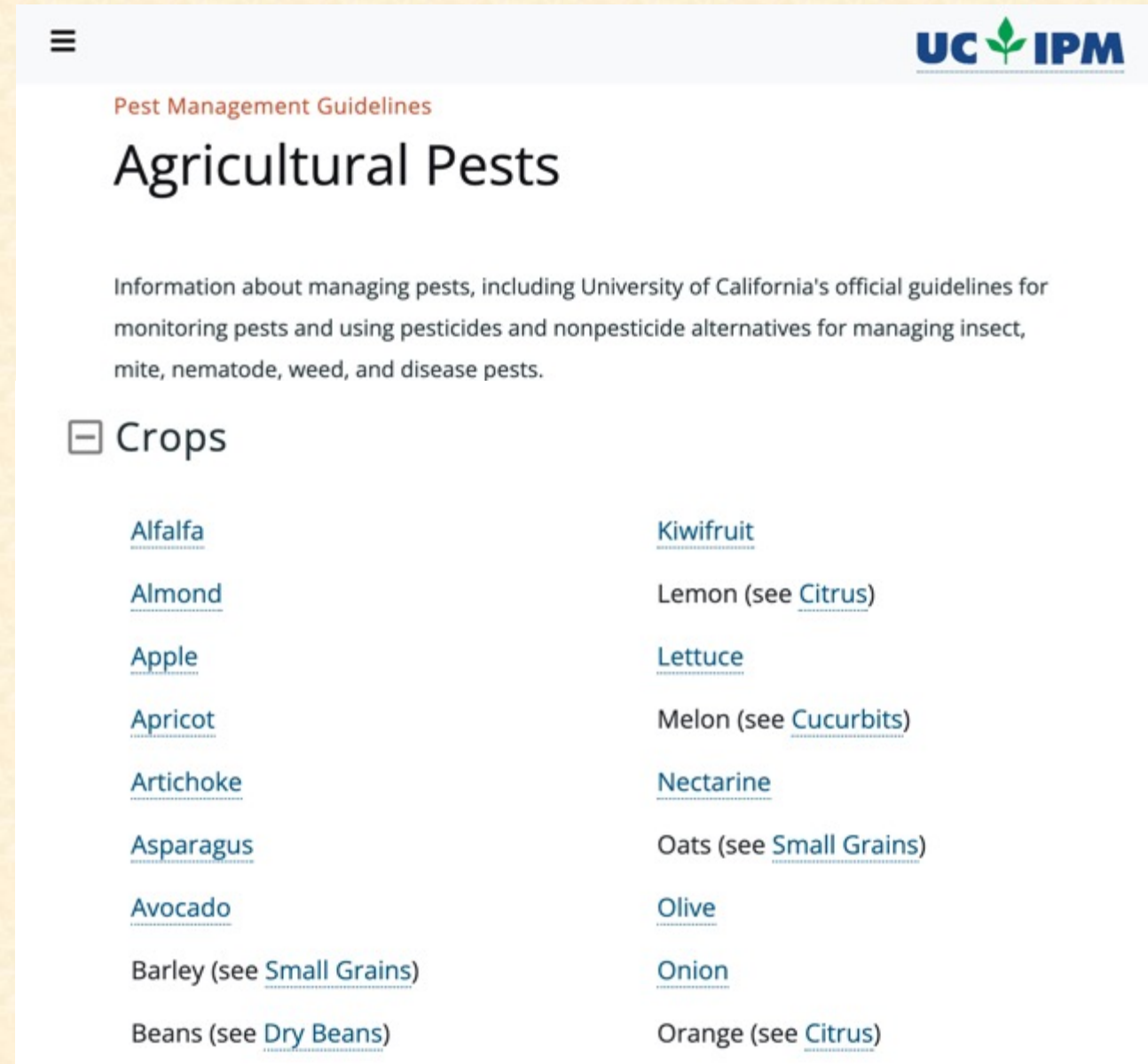
IPM


- 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



☰ 

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

Alfalfa	Kiwifruit
Almond	Lemon (see Citrus)
Apple	Lettuce
Apricot	Melon (see Cucurbits)
Artichoke	Nectarine
Asparagus	Oats (see Small Grains)
Avocado	Olive
Barley (see Small Grains)	Onion
Beans (see Dry Beans)	Orange (see Citrus)

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 thru Selection
 - 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.

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Agriculture and Natural Resources

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.

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.

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

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.

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

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.

Design: Mary Fahey

For more information on hedgerows see:
Establishing Hedgerows on
Farms in California
<http://anrcatalog.ucdavis.edu>
(publication #8390)

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dpr The Department of Pesticide Regulation (DPR) provided partial or full funding for this project but does not necessarily recommend or endorse any opinion, commercial product, or trade name used.

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

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 Statewide Integrated Pest Management Program

Pesticide active ingredients database

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



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.



Ohioline

Ohio State University Extension

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**Protecting Pollinators While
Using Pesticides**

Scale & Goals Matter

- Mid-scale farm IPM can look a bit different than small-scale 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



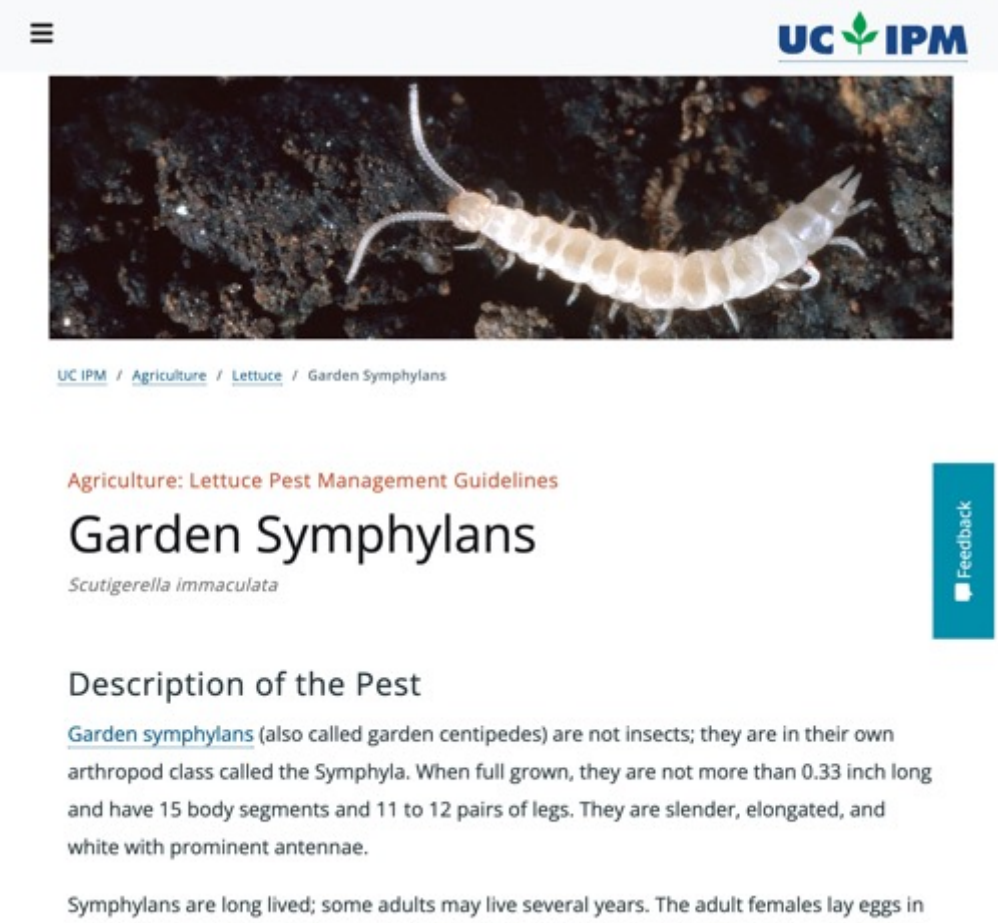
Scale & Goals Matter

- Mid-scale farm IPM can look a bit different than small-scale 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 "Agriculture: Lettuce Pest Management Guidelines" followed by "Garden Symphylans" and the scientific name *Scutigereilla immaculata*. A "Feedback" button is on the right. The "Description of the Pest" section states that garden symphylans are not insects but belong to the Symphyla class, are up to 0.33 inch long, have 15 body segments and 11-12 pairs of legs, and are white with prominent antennae. The text continues: "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

- Symphylans cause problems in organic systems with:
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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



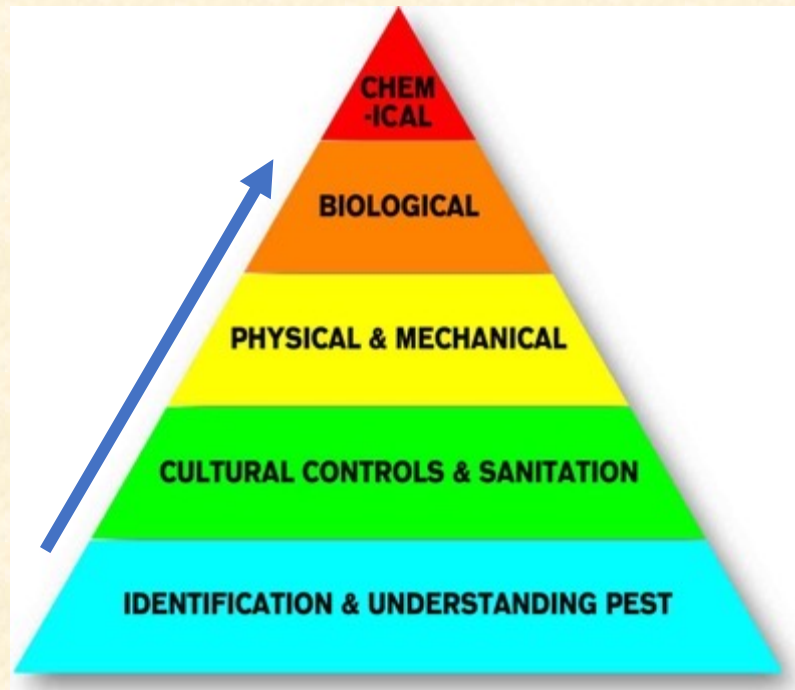
Symphylans Mobility

- 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)



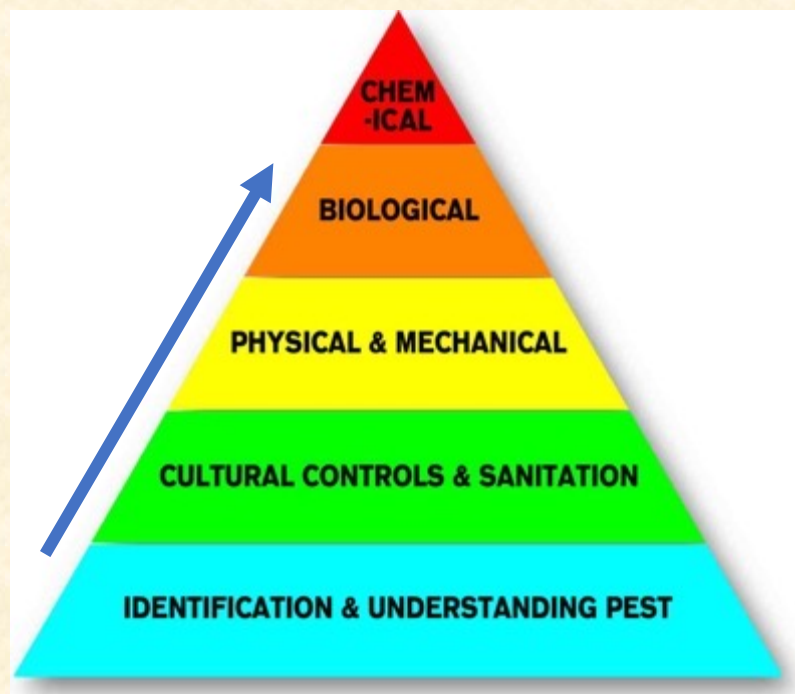
IPM “Toolbox” Approach for Symphylans



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
- Organic Insecticides & Oil-Based Products

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 - Encouraging Natural Predators
 - Organic Insecticides & Oil-Based Products
- You don't have to do everything! Just choose the strategies that are appropriate for your context and goals.*



YouTube

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Symphylans

Integrated Pest Management (IPM)

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0:06 / 29:57



Symphylans IPM



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Analytics

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Share



Example: Shao Shan Farm

- Scott Chang-Fleeman shared that the success of the potato rotation may 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 (shared with permission)

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!

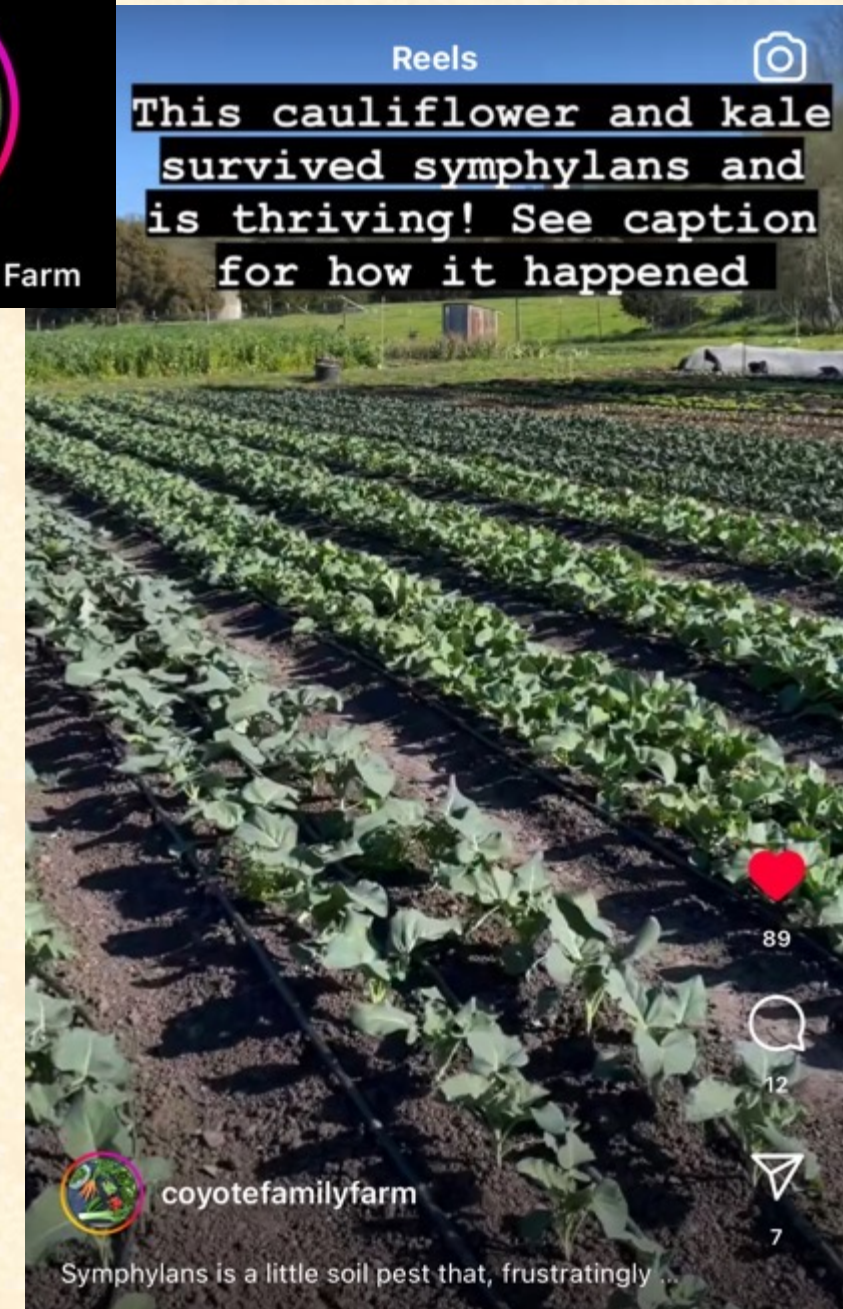


Shao Shan Farm: soybeans growing next to potatoes
in a field known to have symphylans

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...

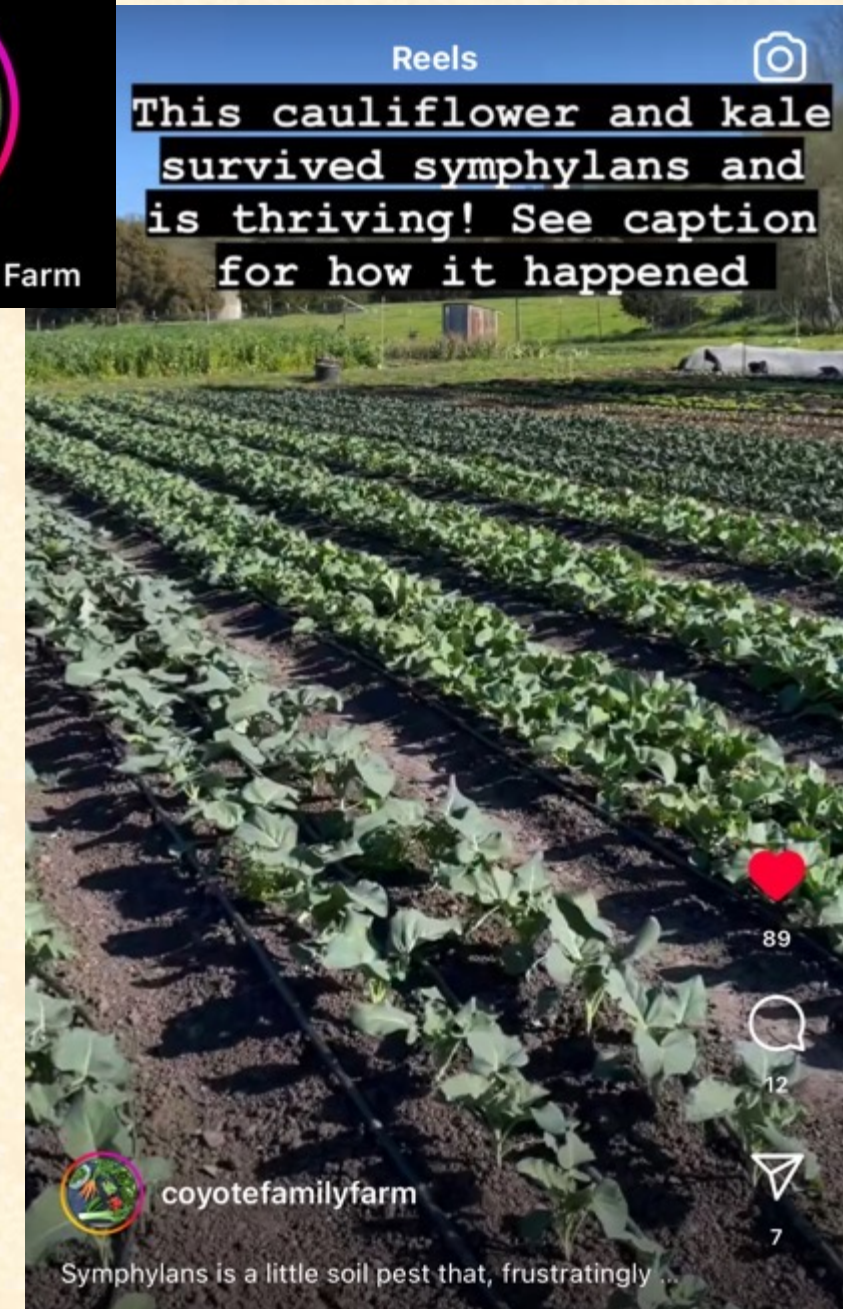


*“Intentionally creating **extra disturbance and compaction** is counter to all we know about good soil management, **but in this case** it was the right prescription!”*



– 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



The screenshot shows a webpage from UC IPM. At the top right is the UC IPM logo. Below it is a photograph of two cucumber beetles on a green leaf: one with black spots on a yellow-green body, and one with black stripes on a black body. Below the photo is a breadcrumb trail: [UC IPM](#) / [Agriculture](#) / [Cucurbits](#) / [Cucumber Beetles](#). The main heading is "Agriculture: Cucurbits Pest Management Guidelines" followed by "Cucumber Beetles". Below this are three lines of text: "Banded cucumber beetle: *Diabrotica balteata*", "Western spotted cucumber beetle: *Diabrotica undecimpunctata*", and "Western striped cucumber beetle: *Acalymma trivittatum*". A section titled "Description of the Pest" contains a link "(Adult Field Key—PDF)". The final paragraph states: "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

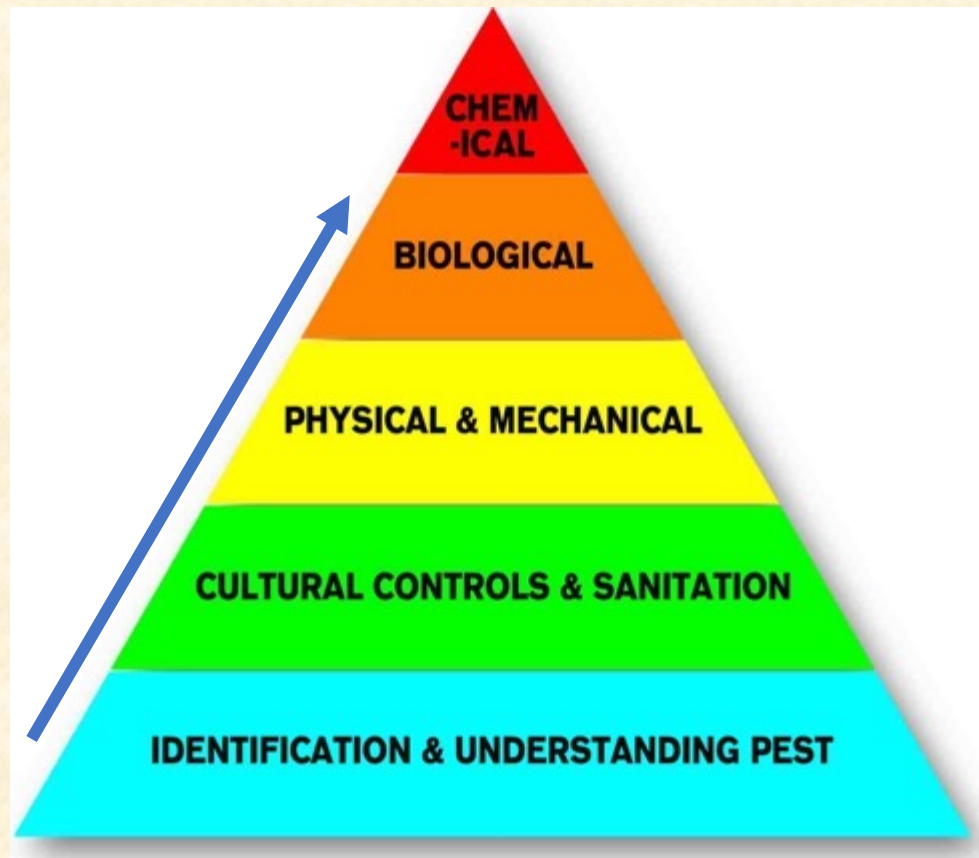
- Damage
 - Destroy flowers, leaves, and melons by feeding on them
 - When temperatures are high, adults feed on undersides of young melons, scarring them
 - Larvae can feed on roots
 - Can vector squash mosaic virus and bacterial wilt



Cucumber Beetles



IPM “Toolbox” for Cucumber Beetles



IPM Pyramid (Diagram Credit: Bee Health Guide)

- Prevention thru crop & site selection
- Crop rotation out of cucurbits
- Monitoring with appropriate threshold
- Row cover for exclusion
- 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



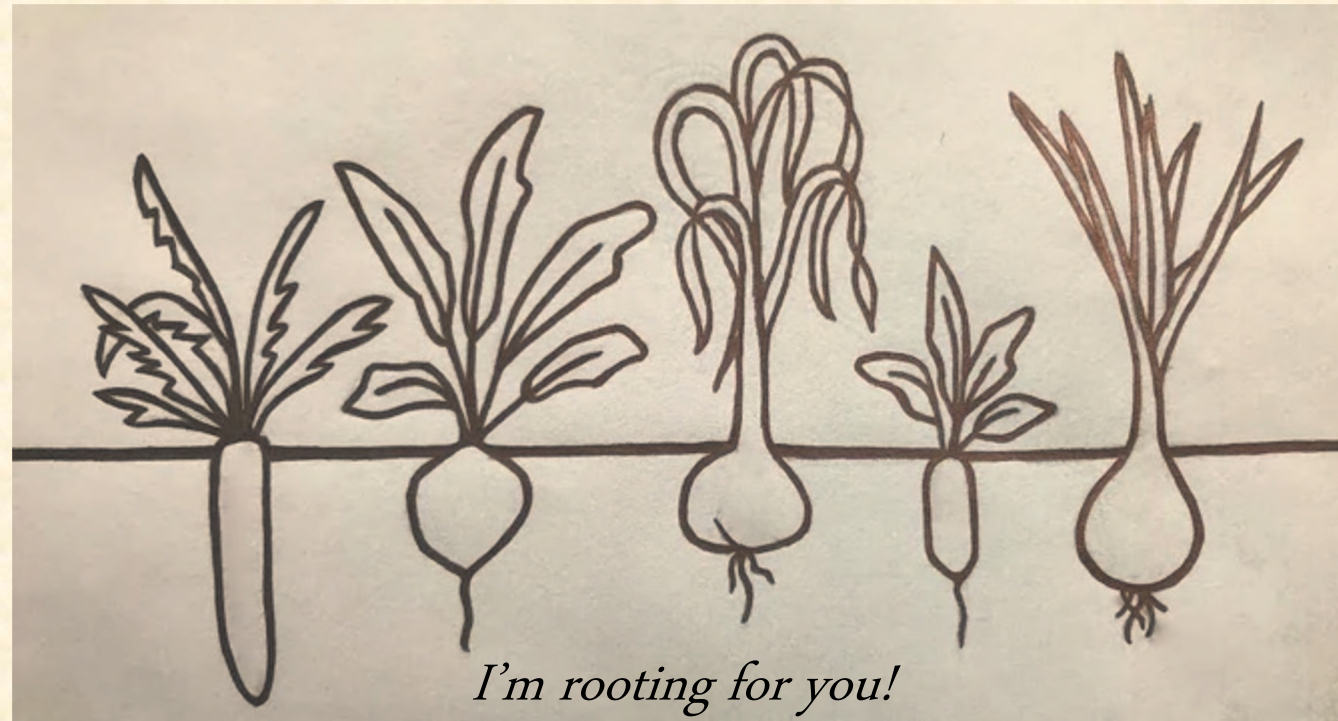
It's a process.



Thank you!



Questions?



I'm rooting for you!

References & Resources

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