



# Symphylans

## Integrated Pest Management (IPM)

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# Description

- *Scutigera immaculata*
- Elongate, white myriapods (“centipede-like” arthropods) with long antennae
- Approximately  $>1/2$  inch long with 11-12 pairs of legs when full grown



# Hosts

- Brassicas, solanaceous crops, cucurbits, root crops, some leafy greens
- Growers report:
  - The most susceptible crops tend to be root crops, eggplant, sweet potato, brassicas, cucurbits, solanaceous crops
  - Less susceptible crops include beans, lettuce, alliums, cover crops, certain grains
  - Weeds can also be hosts



# 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 symptoms in the field
- Often occur in hotspots: can be several square feet to several acres

(Jon Umble & Jim Leap, ATTRA)



# Damage



- They create a dramatic distinctive circular pattern of crop stunting in a field, aka “circle of death” as described by several growers

(Jon Umble & Jim Leap, ATTRA)



# Damage



(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, ATTRRA)

# Timing & Conditions

- Climate & rainfall anecdotes

*No reductions in symphylans populations were observed following the wet winter 2022-2023 and cool spring—it seems this weather may have encouraged symphylans. We need more information about how temperature and rainfall might affect symphylans.*

(Shared with permission from from Jim Leap, retired UCSC Farm Manager)



(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



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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)



# Integrated Pest Management (IPM)

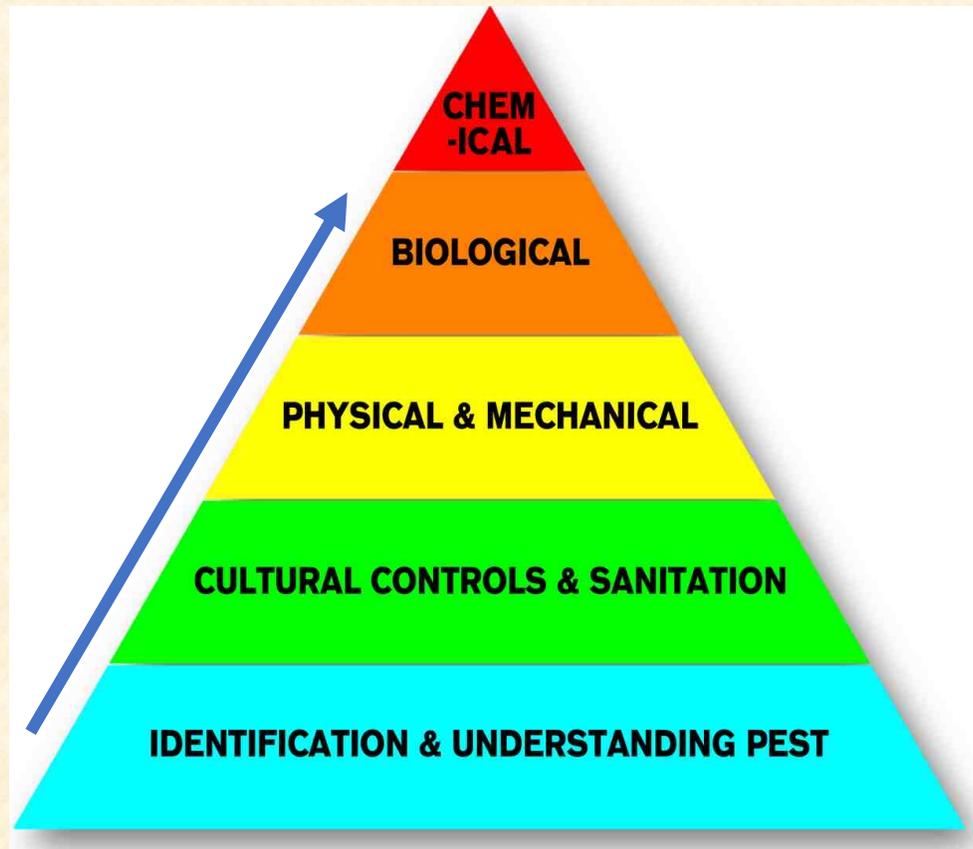


Statewide IPM Program

## 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.

# Integrated Pest Management (IPM)



IPM Pyramid (Diagram Credit: Bee Health Guide)

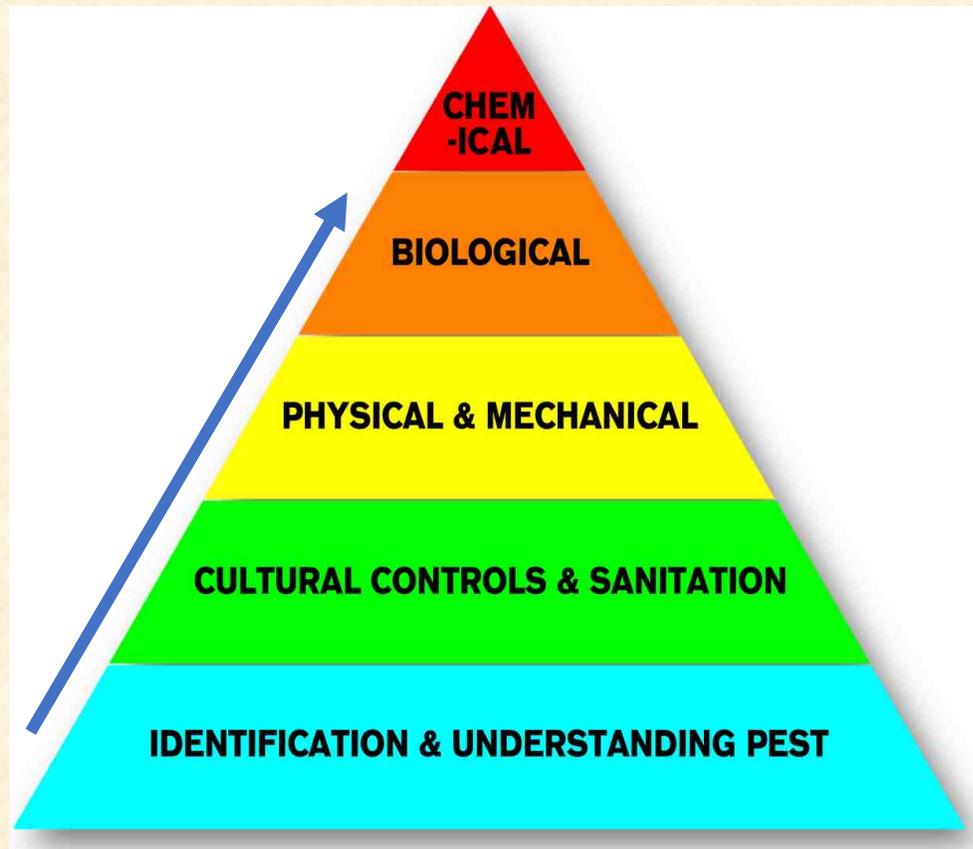
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- A toolbox approach: choose a combination of strategies that makes sense for your context

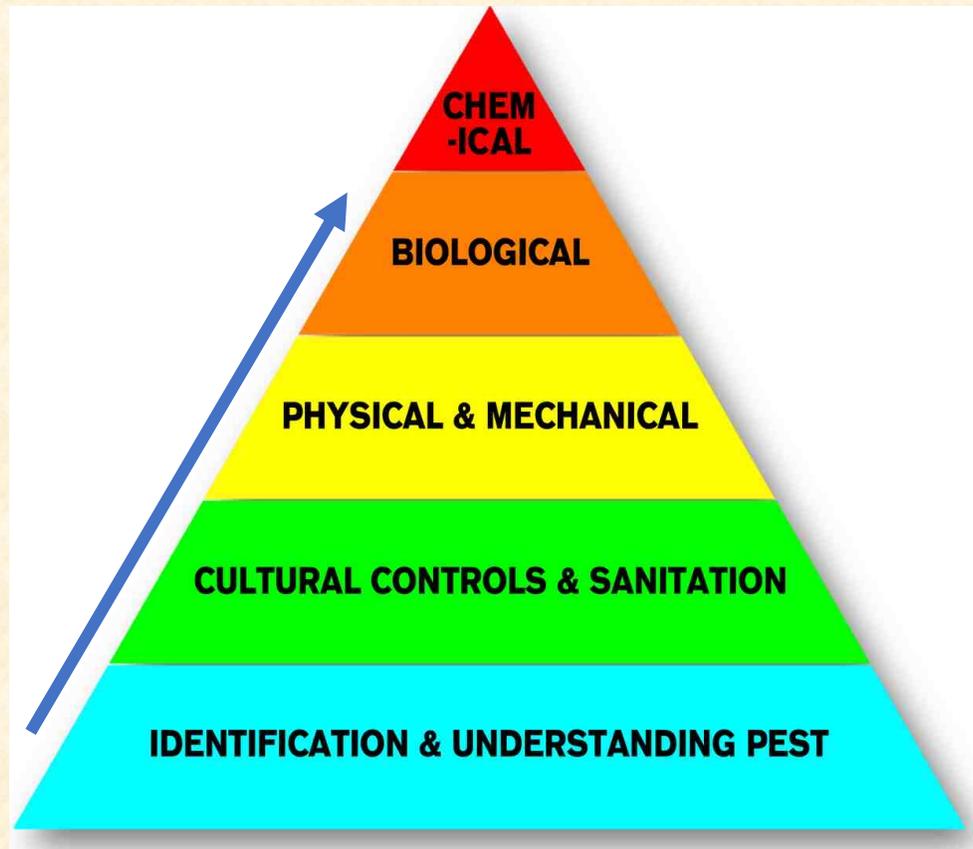
# A “Toolbox” Approach for Symphylans



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
- Biological Control
- 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.*

# Prevention

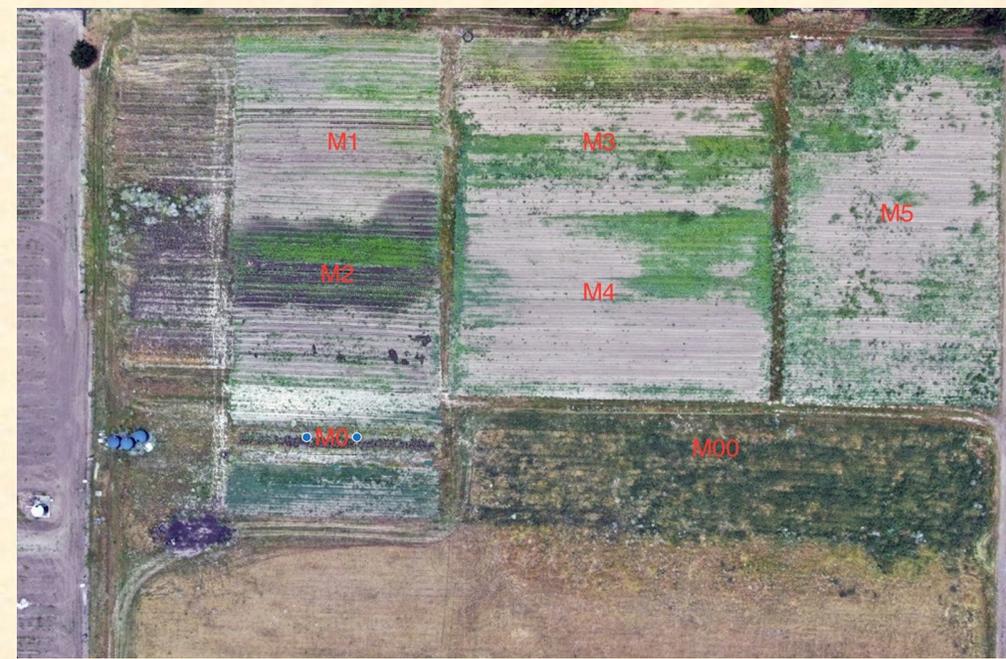
- In problem areas, plant tolerant crops such as beans, small grains, spring oat cover crops.
- If symphylans are known to be an issue in the area, moderate organic matter inputs especially of fresh plant residues.



Photo credit: Melissa Askew/Unsplash

# Monitoring

- Good record keeping:
  - Keep track of which fields have symphylans issues
  - Consider making a map of symphylans hotspots
  - Can note locations of stunting damage, maps of potato bait test results, drone imagery of damage



Drone imagery of fields with symphylans damage 5/6/2022 (top) and the first week of April, 2024 (bottom). Photo credit: Brian Nash.

# Monitoring



- If you can see them in the soil before planting, it means symphylans are numerous enough to cause economic damage
- Bait test (aka the potato test): just before planting in the spring, use bait trapping to monitor garden symphylans and determine population levels present
  - It can be helpful to compare symptomatic areas with nearby high performing areas.

# Monitoring – Bait Test

## 1. Install potato slices on soil surface

- After a recent irrigation or rainfall event, cut raw potatoes, beets, or carrots in thick slices.
- Carefully rake away the upper drier soil layer until moist soil is exposed.
- Scratch the cut surface of the potato immediately before placing it on the moist soil surface.
- Be careful when removing dry soil from the surface not to disturb the soil pores which could prevent symphylans from reaching the bait. This can be done by raking the surface soil away with a lettuce knife.
- Use at least 1 bait trap per acre, ideally more for small-scale farms.



# Monitoring – Bait Test

*“I have also used beets for the potato test and it’s kind of cool because the symphylans are easy to see with their pink/red insides.”*  
(-Tessa Henry, Clif Family Farm)



(Photos by  
Ellie Andrews)

# Monitoring – Bait Test

## 2. Cover the bait and wait

- Cover potato slices with a cup to protect them from drying out.
- Make sure the cup is large enough to prevent excessive heating of the area or to accumulate a lot of condensation. A cup or white plastic pot (with no drainage holes) about 6 inches x 6 inches is adequate.
- Cover with a stone or some soil to prevent the wind from removing it.
- Leave the bait in place for 24 to 36 hours.



# Monitoring – Bait Test

## 3. Count symphylans present

- Remove the cover to count the symphylans on the potato slice and on the soil surface underneath.
- Count the soil surface first as the symphylans there will quickly run away and hide (they move quickly).
- If any symphylans are present on the bait, significant stand loss can occur—take action!



Symphylans on soil and potato baits (photos by Ellie Andrews)

# Biological Control

- Promote predatory organisms such as predatory mites, ground beetles, true centipedes, fungi
- Consider installing and maintaining insectary plants to attract natural enemies of symphylans, but bear in mind that biocontrol alone will likely not be enough to control symphylans



(FAO)

# Mechanical Methods

- Tillage: an effective traditional control strategy
  - Benefits
    - Kills symphylans
    - Destroys the pore spaces they use to move thru the soil
  - Tradeoffs
    - Can reduce populations of key predators of symphylans too, such as centipedes & predaceous mites
    - Over time, reduces soil organic matter and degrades soil structure
  - When symphylans are near the soil surface, tillage can provide several weeks of control, but it does not control symphylans at lower soil depths
  - Consider benefits and soil health tradeoffs of tillage



A BCS used for bed prep after tillage on a small-scale farm

# Mechanical Methods

- Mild/moderate compaction:
  - Packing down the soil surface after planting compresses pore spaces that symphylans use to travel
  - Can help reduce symphylans movement through the soil
  - (Be careful not to overdo it)



A BCS used for bed prep after tillage on a small-scale farm

# Mechanical Methods

- Potato rotations:
  - Decrease symphylans populations
  - In some cases, can allow other more susceptible crops to be planted after potatoes



(Photo credit: Napa Master Gardeners)

# Mechanical Methods

- Potato rotation & interplanting anecdotes
  - Timing may make a difference: at a site with symphylans history, potato rotation showed effectiveness when planting a vegetable crop immediately after harvesting potatoes in the fall (-Scott Chang-Fleeman, Shao Shan Farm)
  - Interplanting potatoes with crops can provide some level of control for nearby susceptible crops (-Jacob Tracy, CIA Copia)
  - Planting potatoes before brassicas has been key. (-Tessa Henry, Clif Family Farm)



(Photo credit: Napa Master Gardeners)

# Cultural Methods

- Limit organic matter inputs: reduce input of undecomposed organic matter
- Limit organic matter remaining in the field:
  - Remove crop residues
  - Do not till in crop residues where symphylans are present
  - Do not leave any unharvested root crops in the field
- Wait to seed/transplant until organic materials have visibly broken down



(Photo credit: Krista Marshall, UC ANR Organic Agriculture Institute)

# Cultural Methods

- Sanitation: clean farm equipment between going from field to field and to new farms to minimize the risk of spreading symphylans to new areas
- Overplanting: plant a higher number of seeds/transplants in problem areas to help compensate for anticipated damage
- Using transplants rather than seeds can help give crops more of a head start
- Soil amendments vary greatly in their effects and reports are often contradictory



Transplants at Longer Table Farm  
(photo from their Instagram  
account, shared with permission)

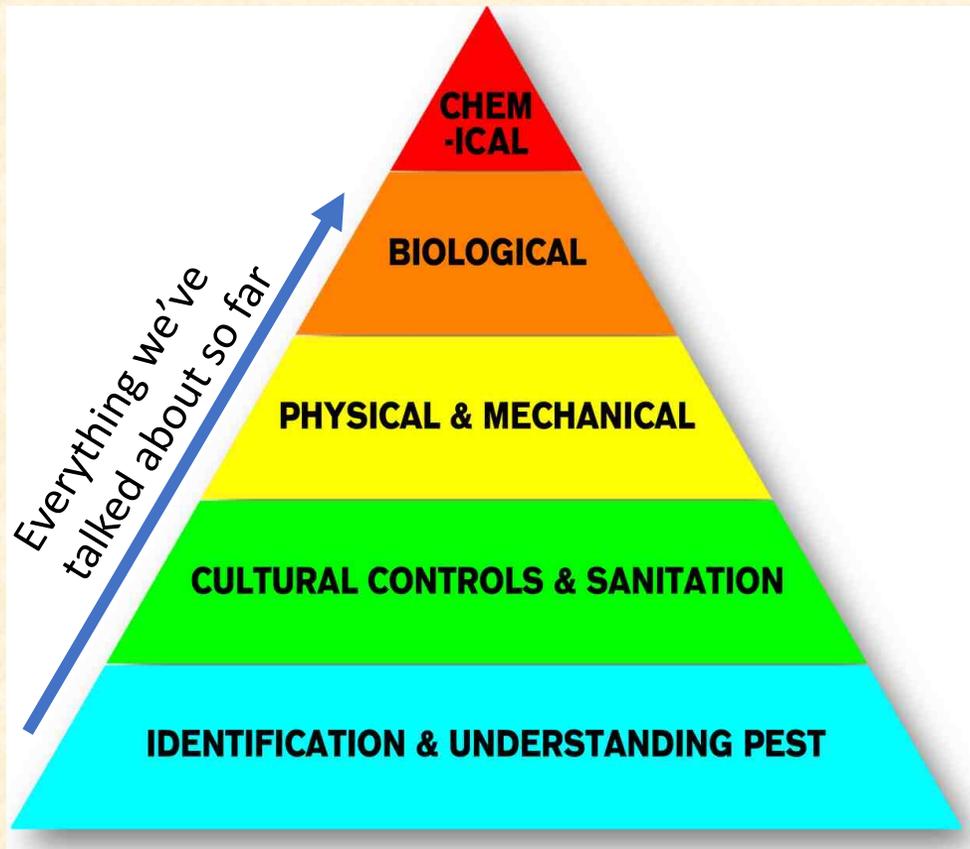
# Integrated Pest Management



Statewide IPM Program

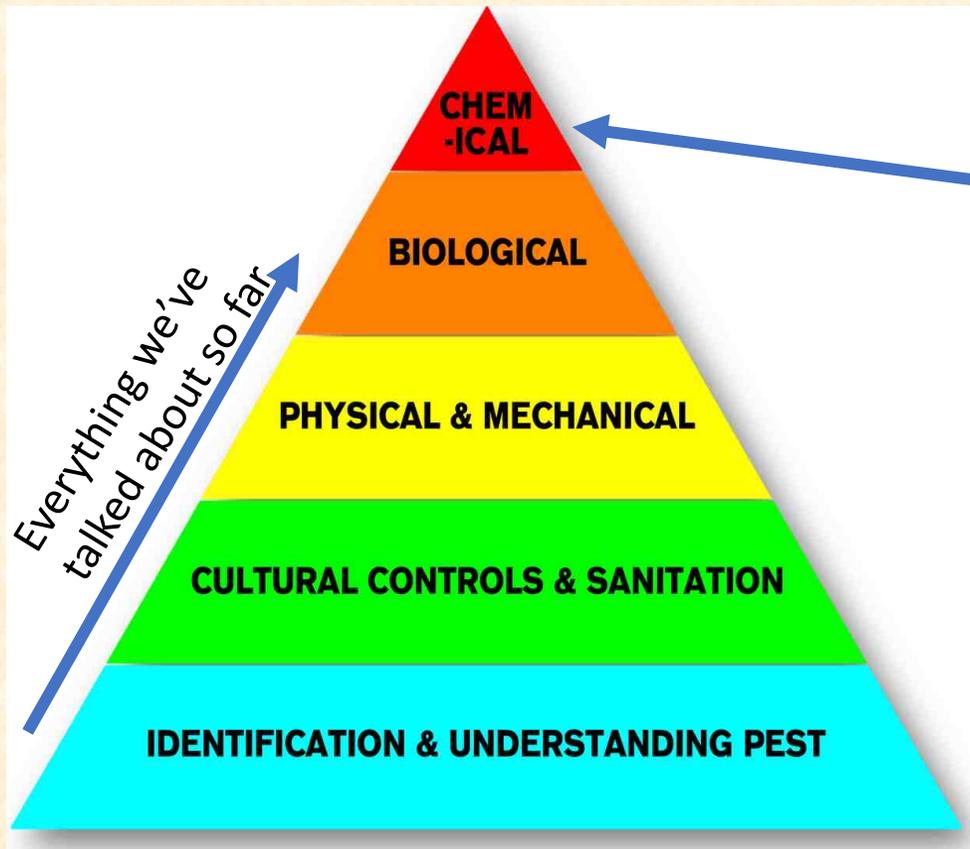
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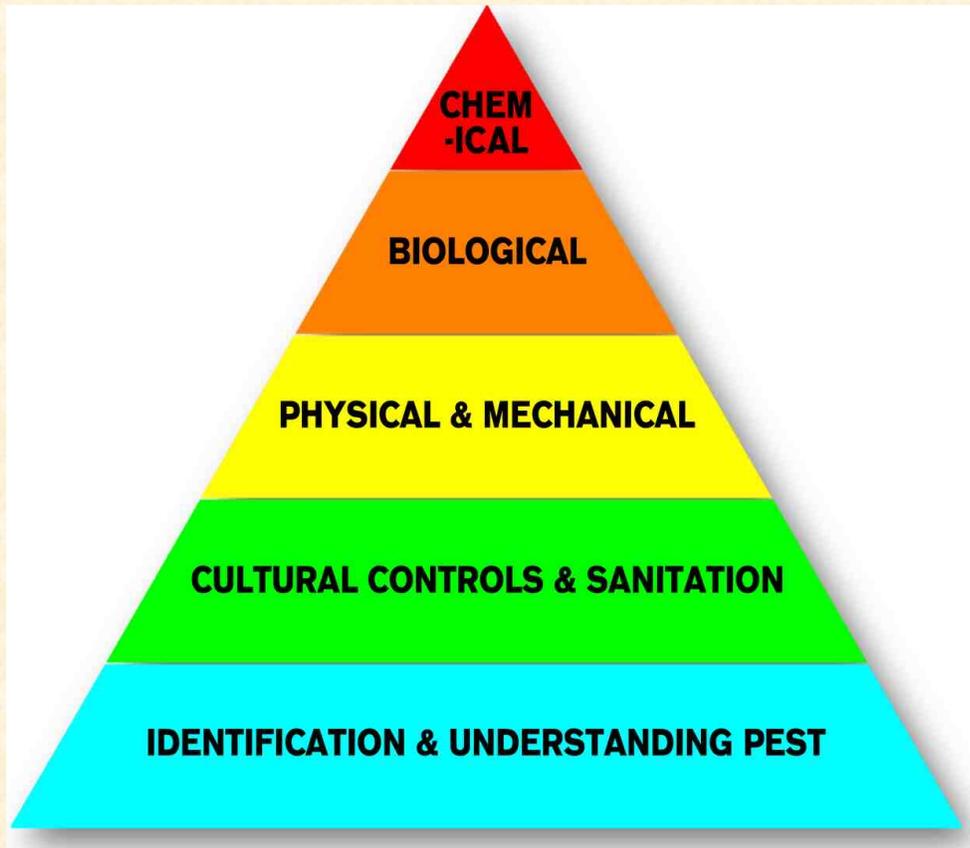
# Organic Insecticides & Oil-Based Products



- In IPM, pesticides are only used when needed and in combination with other approaches for more effective, long-term control

IPM Pyramid (Diagram Credit: Bee Health Guide)

# Organic Insecticides & Oil-Based Products

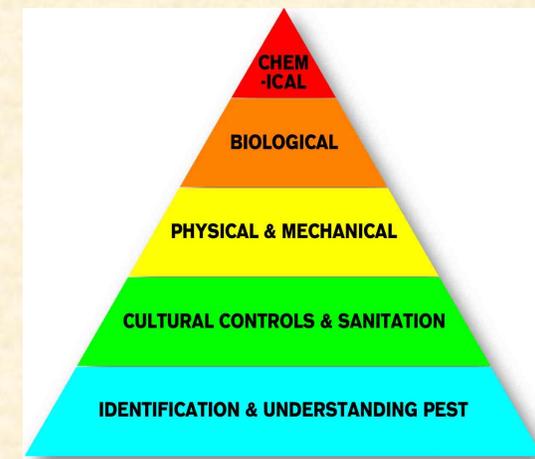


IPM Pyramid (Diagram Credit: Bee Health Guide)

- There are many options to consider
- Mention of pesticide products here do not constitute endorsements, merely examples of registered products that can be used for this specific pest
- The crop system where you intend to use a pesticide product must be listed on the label
- Always follow the pesticide label carefully and consult [ipm.ucanr.edu](http://ipm.ucanr.edu) for further resources
- Organic insecticides are likely most effective if applied before planting

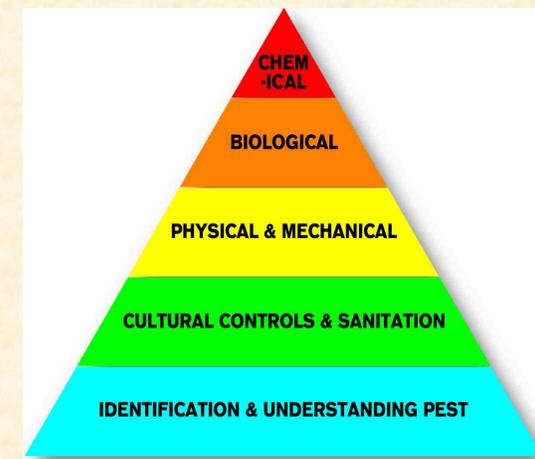
# Organic Insecticides & Oil-Based Products

- Insecticides will kill symphylans near the surface and allow better root establishment
- Spot treatments with insecticide may be adequate
- However, symphylans deeper in soil may eventually reinfest the root zone
- Using a combination of IPM strategies will provide the highest level of pest control, rather than relying on one strategy alone



# Organic Insecticides & Oil-Based Products

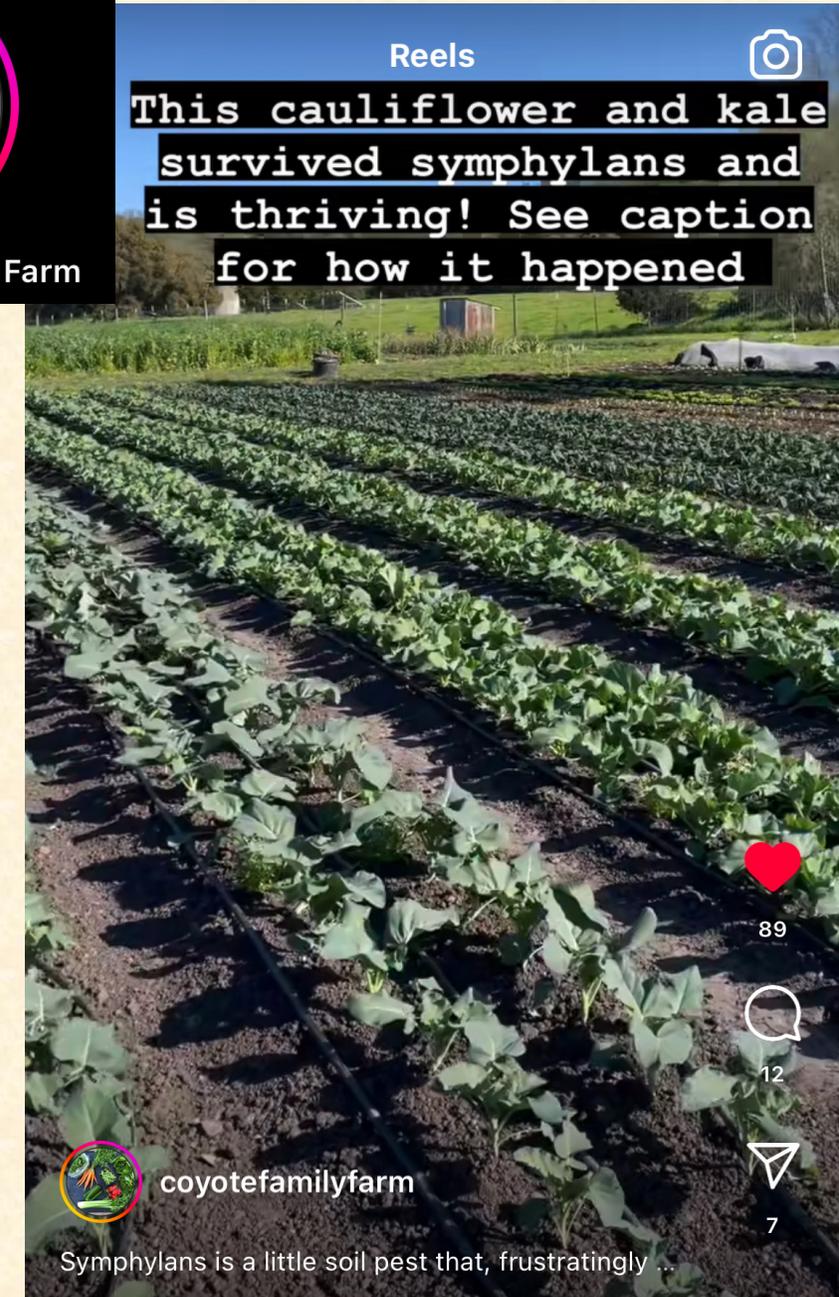
- Azadirachtin based insecticides: an active ingredient extracted from the neem tree
- Pyrethrin based insecticides: an active ingredient found naturally occurring in Chrysanthemum flowers, provides some low level of control
- Oil based products: can provide a moderate level of control, ingredients examples include clove oil, cinnamon oil, thyme oil, rosemary oil



# Example: Coyote Family Farm



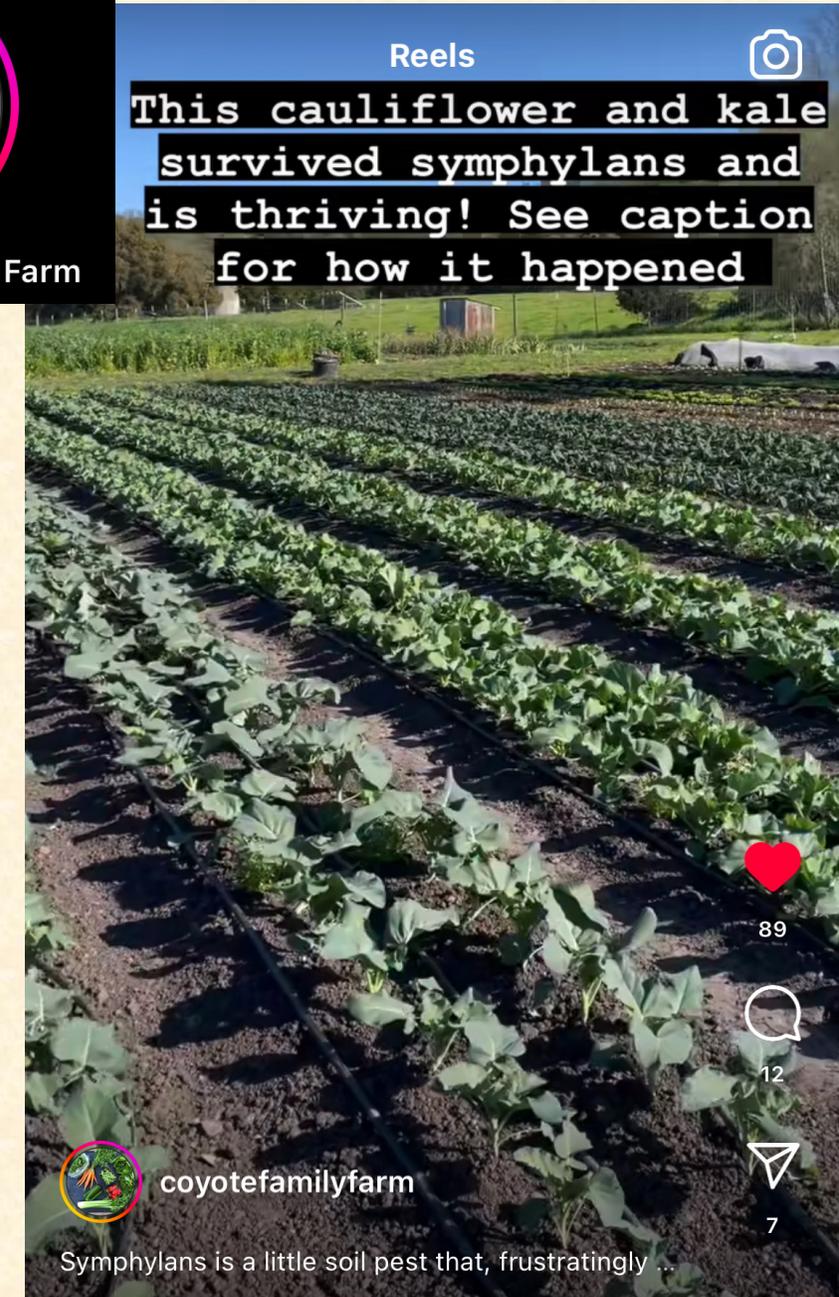
- See their Instagram post for details
- They needed to plant early brassicas in a bed they new had symphylans – risky!
- Their strategies:
  - Tilled soil with a power harrow
  - Added lime to raise the pH, then planted
  - Then compacted soil by stepping all over the bed
- The plants looked uniform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



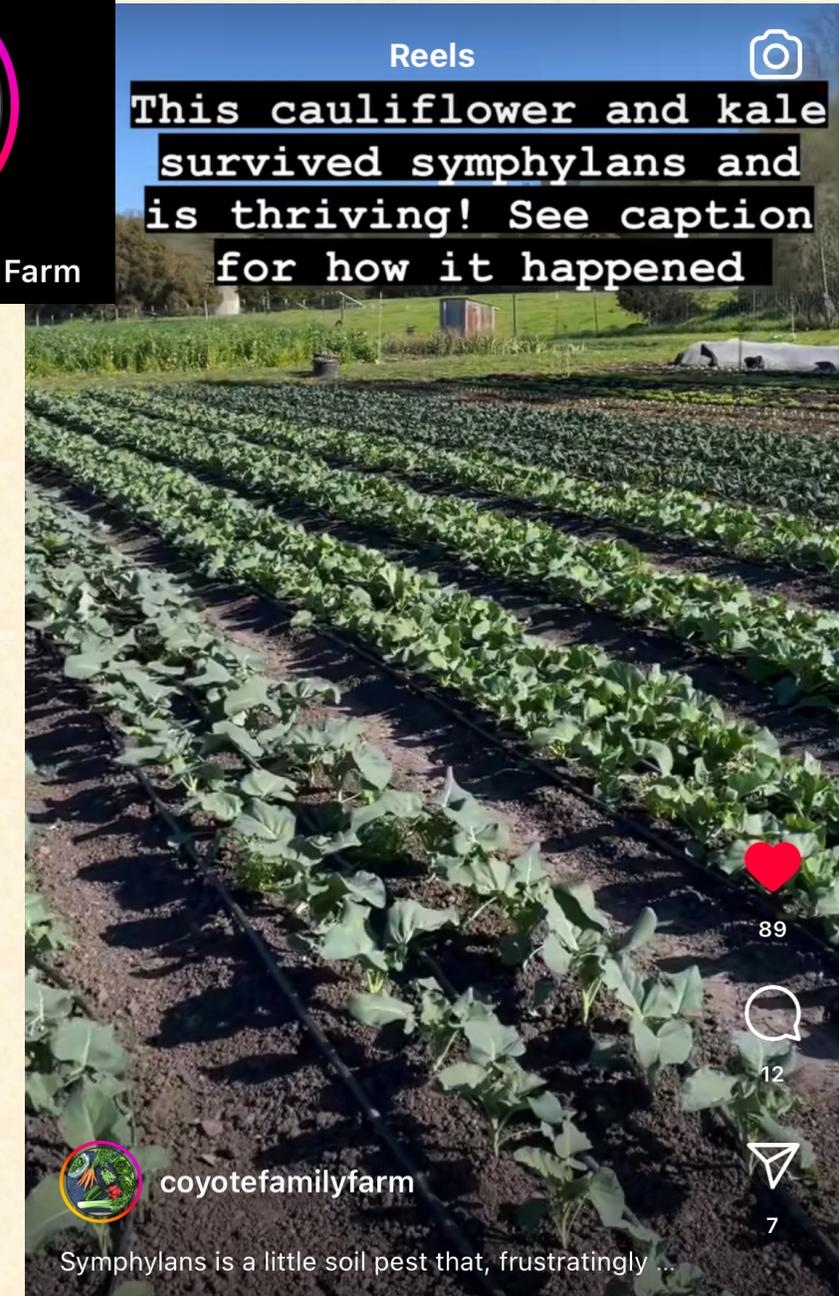
# Example: Coyote Family Farm



*“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)*



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*“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)

This is a great example of integrating **multiple pest management strategies** in a way that effectively reduces pest pressure in a **specific farm context!**



# Areas for Future Research

- Symphylans biology & behavior
  - Can you import symphylans to your site through compost, or do they grow “in place” as soil health improves over time? It seems likely they could be imported in compost and survive on the edges of compost piles where temperatures are less extreme (-Jim Leap)
  - Is fully decomposed compost less likely to encourage symphylans population growth compared to use than non-decomposed residues?
  - Why do symphylans start in a hotspot? How does this start? How can we better understand their growth pattern?
  - How long do the benefits of the potato rotation last in the field?



# Areas for Future Research

- What is the mechanism behind the reduction of symphylans populations after a potato rotation? Hypotheses from growers:
  - The physical soil disruption involved with harvesting them? (-Johnny Campbell at Santa Rosa Jr. College Shone Farm)
  - A biochemical effect from the potatoes? (-Rex Dufour at ATTRA, Jen Lang at 7 Roots Ranch)
  - A long-term bait effect? Since there are usually a small number of potatoes left in the field after harvesting them, maybe those leftover potatoes act as baits and distract the symphylans away from any new transplants? (-Emma Torbert at UC Davis Student Farm)
  - Removal through harvested potatoes? Maybe they are in the potatoes and you're moving them out of the field at harvest? (-Scott Chang-Fleeman at Shao Shan Farm)



# Areas for Future Research

- Could solarization and tarping help?
- Biocontrol & natural predators
  - Are there any biocontrol options / beneficial predators that could help control symphylans?
  - Several growers mentioned observing high levels of predatory centipedes in beds with high symphylans levels. Centipedes and ground beetle larvae are predators known to attack symphylans. How can we best promote predatory organisms?
  - What are other soil-ecology oriented approaches to symphylans IPM and practical tests and tools growers can use?



# Areas for Future Research

- Need more research-based information to help guide IPM best practices
  - Organic essential oil products & organic insecticides
  - Practical and affordable management solutions
  - Science-based research results from randomized and sufficiently replicated field trials that are centered around grower-driven research questions
- As more and more growers adopt healthy soil practices, we will probably continue to see symphylans pressures increase (-Rex Dufour at ATTRA)

# References

<https://ipm.ucanr.edu/agriculture/cole-crops/garden-symphylans/>

<https://ipm.ucanr.edu/agriculture/lettuce/garden-symphylans/>

<https://attra.ncat.org/publication/symphylans/>

[https://extension.usu.edu/pests/ipm/notes\\_ag/veg-garden-symphylans](https://extension.usu.edu/pests/ipm/notes_ag/veg-garden-symphylans)

<https://pnwhandbooks.org/insect/ipm/garden-symphylan>

<https://projects.sare.org/project-reports/sw03-033/>

<https://ipm.ucanr.edu/agriculture/dry-beans/symphylans/>

<https://ipm.ucanr.edu/agriculture/lettuce/garden-symphylans/>

Communications with Jim Leap, retired UCSC Farm Manager

Communications with Rex Dufour, ATTRA NCAT

Communications with Emma Torbert, UC Davis Farm Manager

Communications with many growers in the North Bay Area who have experience managing symphylans via focus groups, farm visits, emails, and phone calls.

# Thank you for listening!

Please reach out to Ellie Andrews (UCCE Specialty Crops Advisor) at [eandrews@ucanr.edu](mailto:eandrews@ucanr.edu) with any questions.

