Intro to Organic IPM for Soil Borne Diseases

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Fusarium crown & root rot in tomato

(photo by Ellie)

What is a pest?

- An unwanted organism that damages or interferes with plants

Insects like cucumber beetles

Weeds like thistle

Pathogens (bacteria, fungi, viruses) such as Fusarium

Rodents like gophers

What is IPM?

Integrated

- Combine multiple strategies (don’t rely on just one)

Pest Management

- Manage pest populations & keep the damage under your thresholds

What is IPM?

Integrated **Pest Management**

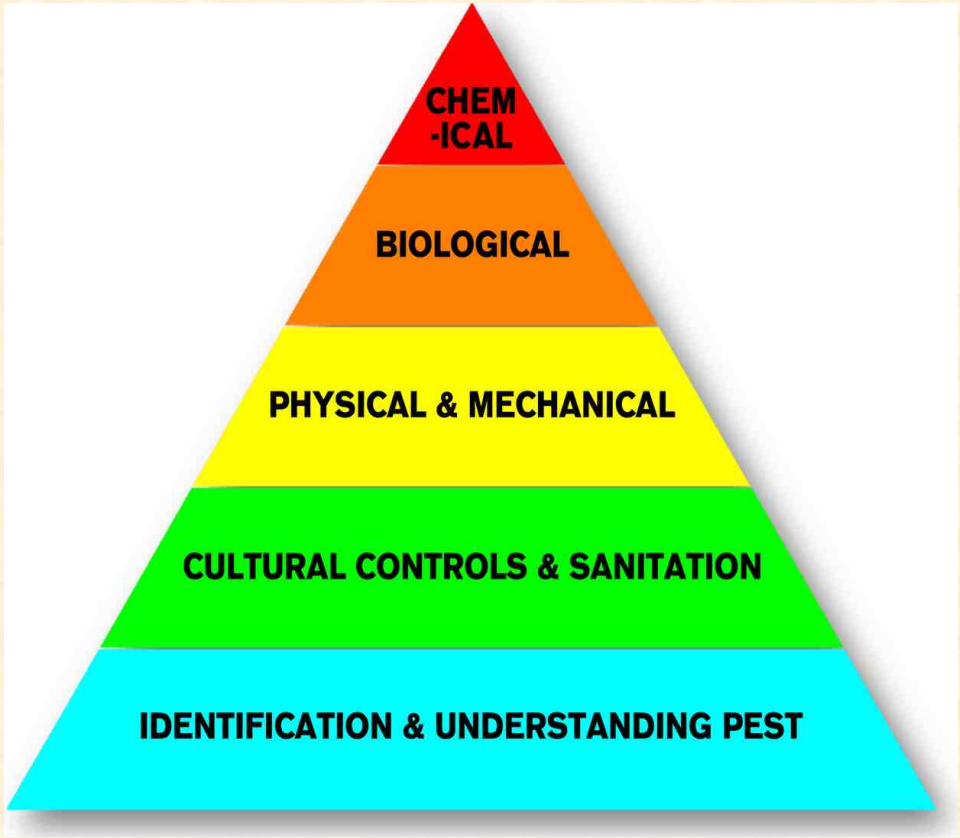
- A big-picture ecosystem-based approach
- Emphasis on long-term pest prevention
- A “toolbox” approach: select the tools/strategies that make sense for your unique context (no one-size-fits-all solution)

What is IPM?

Integrated **Pest Management**

- Only use pesticides after monitoring indicates they are needed & always follow the label directions
- Use strategies to minimize risks to nontarget organisms

What is IPM?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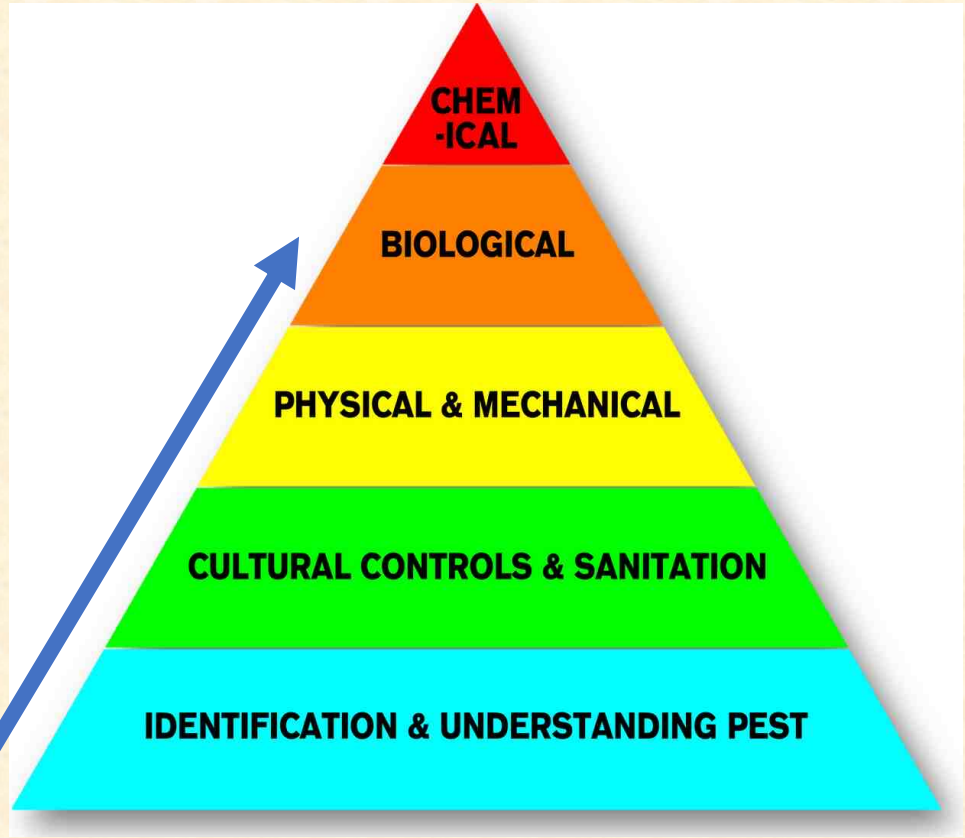
CULTURAL CONTROLS & SANITATION
IDENTIFICATION & UNDERSTANDING PEST

What is IPM?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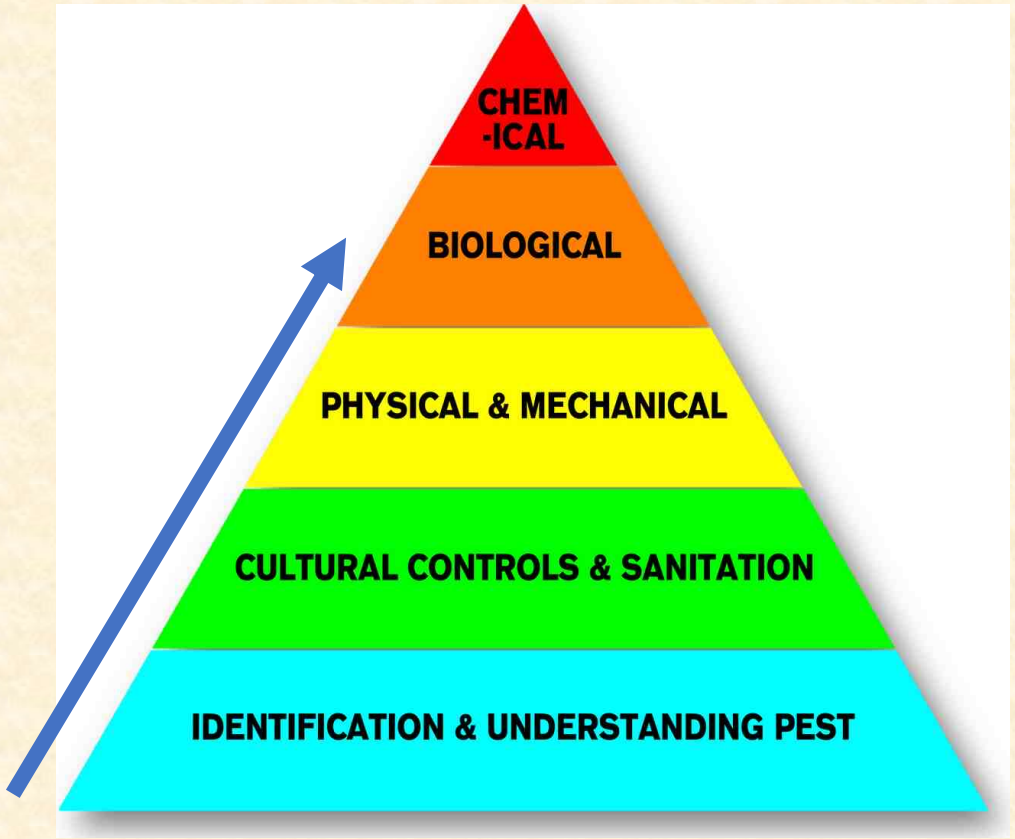
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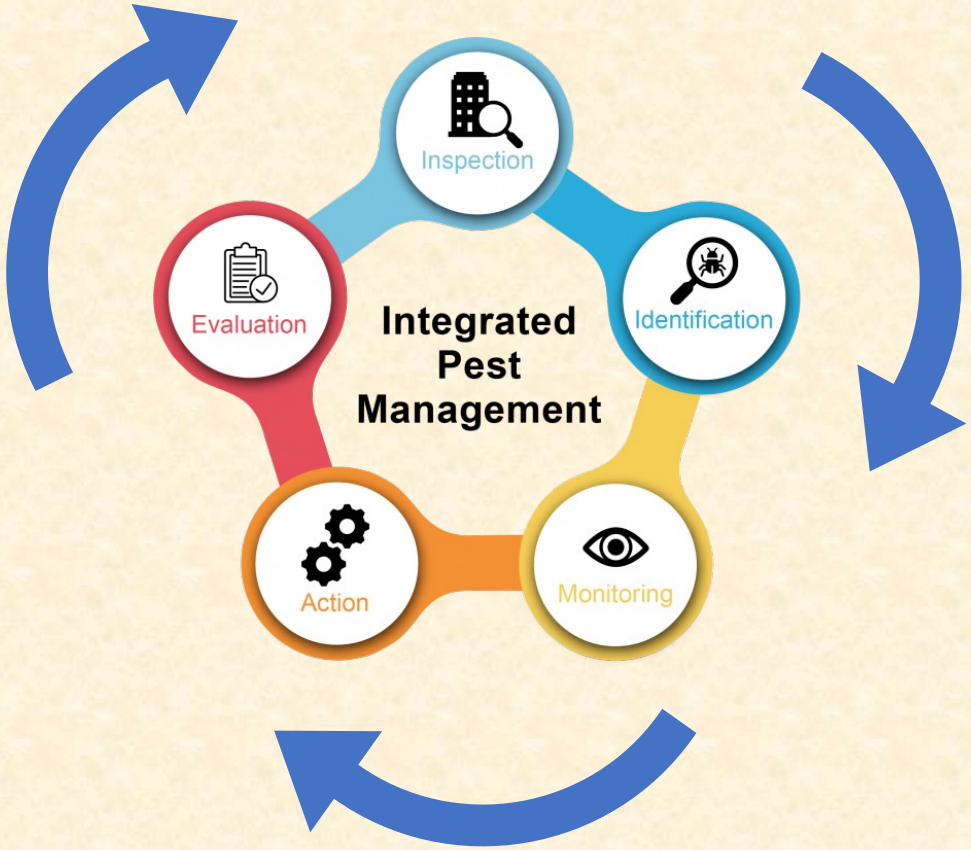
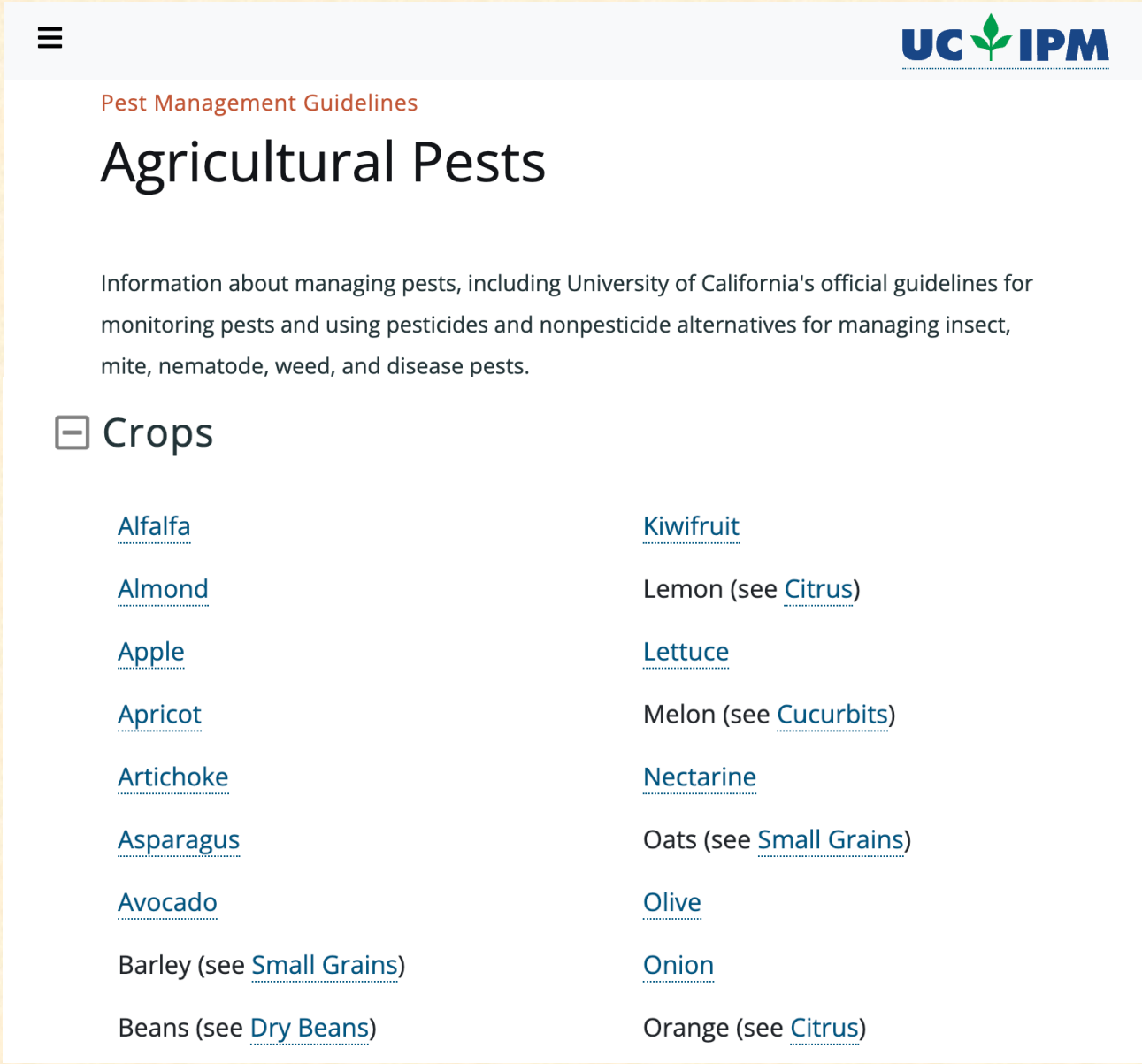
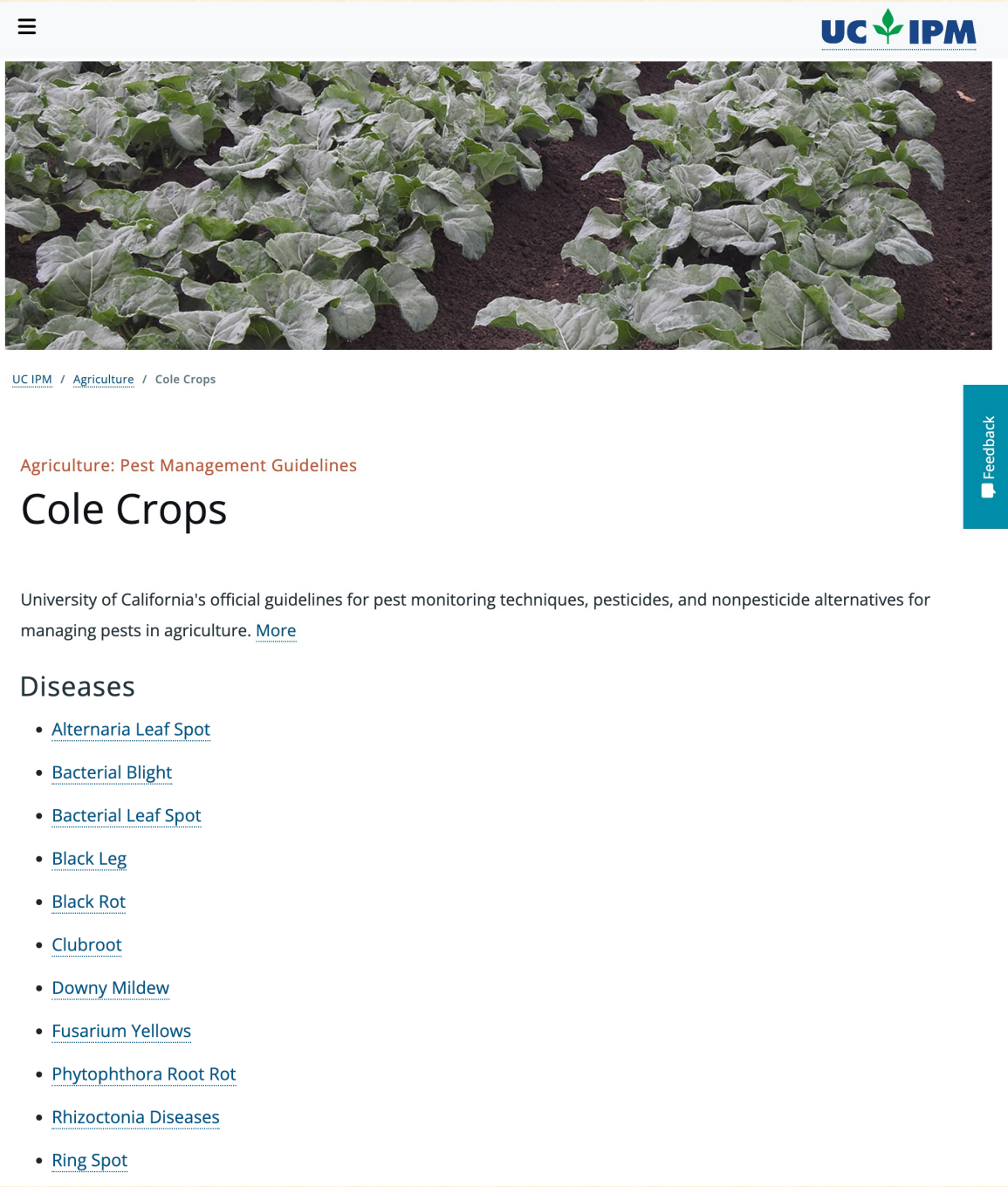

Inspection
Identification
Monitoring
Action
Evaluation
Integrated
Pest
Management

IPM Resources

- UC IPM website
- Start with your crop type

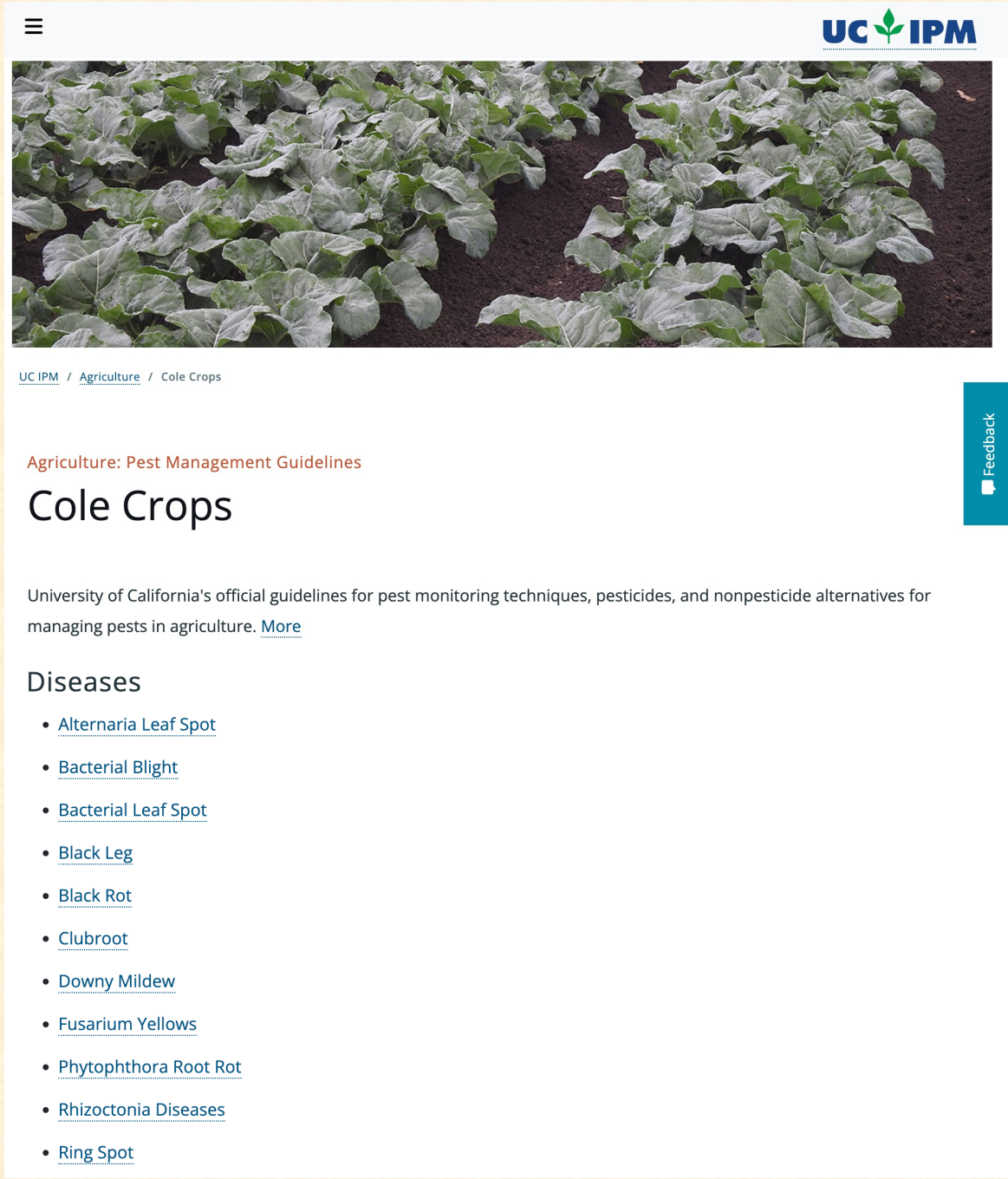


- Use online resources to help ID pest & assess which IPM strategies make sense in your context



- Bear in mind, we need more California-specific research on soil borne disease IPM in organic systems!

...more on that later...



IPM Framework

Correctly identify the pest

IPM Framework

Consult resources & choose actions

Scout & keep records over time

IPM Framework

Re-evaluate & refine your approach

Assess whether they worked using thresholds

Examples of Soil-Borne Diseases:

Visual Signs & Symptoms

Damping Off Pathogens

- A complex of multiple pathogens such as *Pythium*, *Rhizoctonia*, *Fusarium*, *Phytophthora*
- Stems are attacked near the soil line causing young plants to collapse
- Base of stem looks pinched

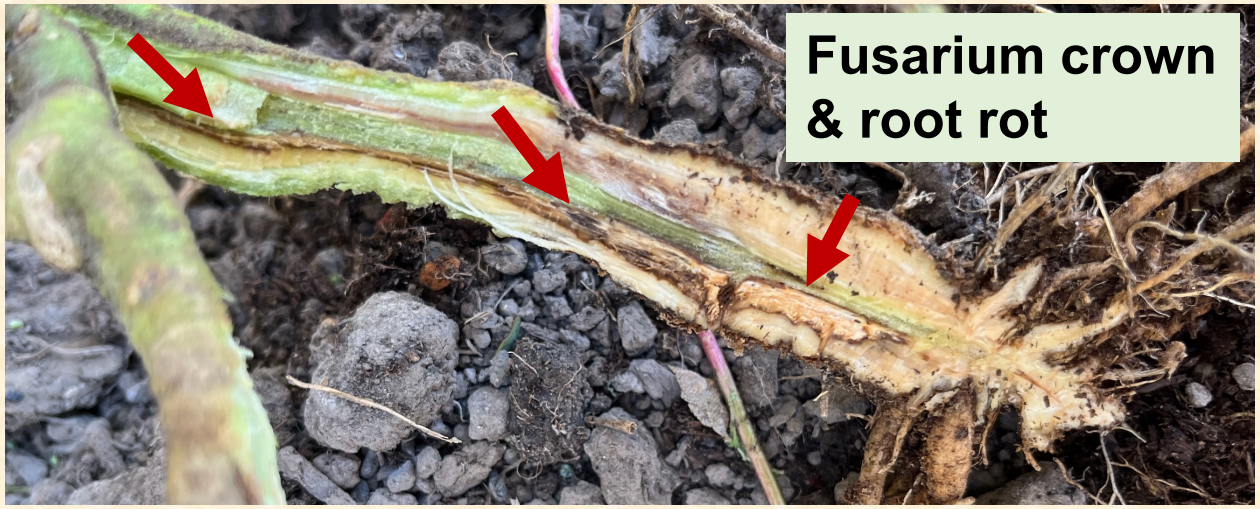
(photo from UC IPM website)

(photos by Ellie)

Fusarium in Tomatoes

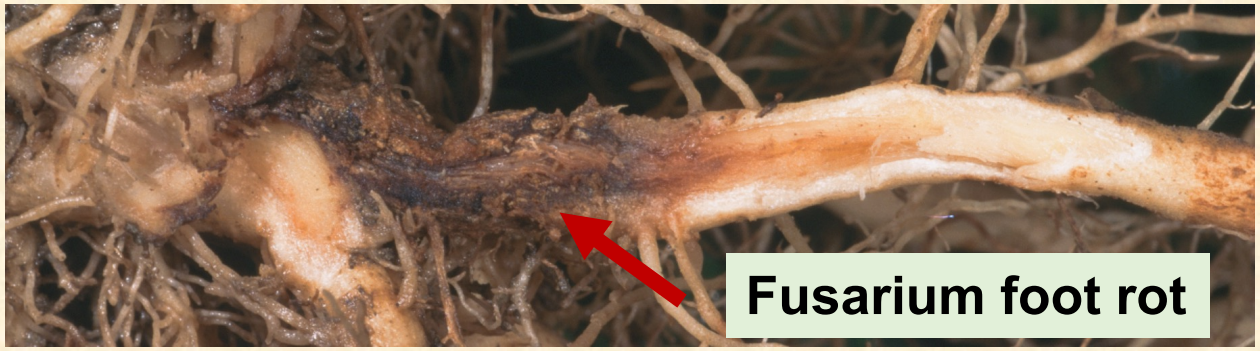
caused by *Fusarium oxysporum* forma specialis *lycopersici*

(photo from UC IPM website)



caused by *Fusarium oxysporum* f. sp. *radicis-lycopersici*

(photo by Ellie)



caused by *Fusarium solani* f. sp. *eumartii*

(photo from UC IPM website)

Fusarium in Strawberries

caused by *Fusarium oxysporum f.* sp. *fragariae*

(photos by Steve Koike)

(photo from UC IPM website)

(photos by Ellie Andrews)

(There are many more examples
of helpful visual symptoms!)

ID: Pathogen Diagnostic Labs

- Lots of options, consider cost
- Note that you need a **diagnostics** lab for plant pathogens
  - this is different from a lab that analyzes soil & plant samples for nutrients
- Common diagnostics labs that growers use include:
  - AL&L Lab
  - TriCal Diagnostics

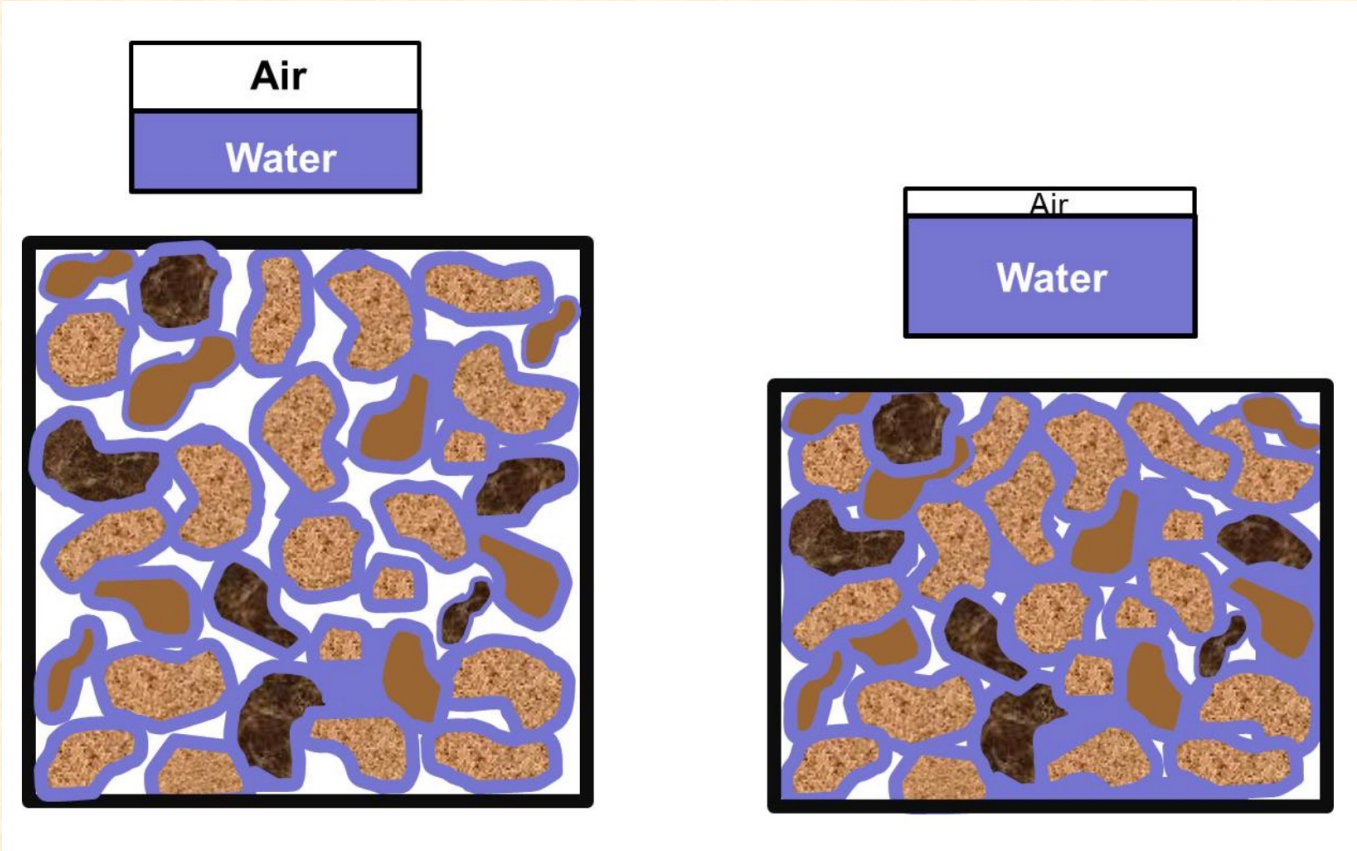
What do soil-borne diseases tend to have in common?

Conditions

- Often thrive in certain environmental conditions:
  - moisture
  - humidity
  - rain
  - flooding
  - poor soil drainage
  - soil compaction
  - clayey soil

- In some cases, there are differences in preferences

Soil Compaction & Water



(photo from UMN Extension)

Plant Stress

- They love stressed plants because they are easier to colonize
  - nutrient deficient
  - water stressed
  - restricted root growth
  - already damaged by other pests
- On the flip side, they can make plants more susceptible to other pests too

Tomato plant with whiteflies, spider mites, & aphids plus Fusarium

(photo by Ellie)

Diverse Reproduction

- Soil borne diseases produce a wide variety of different spore structures that can survive in the soil and on plant tissues

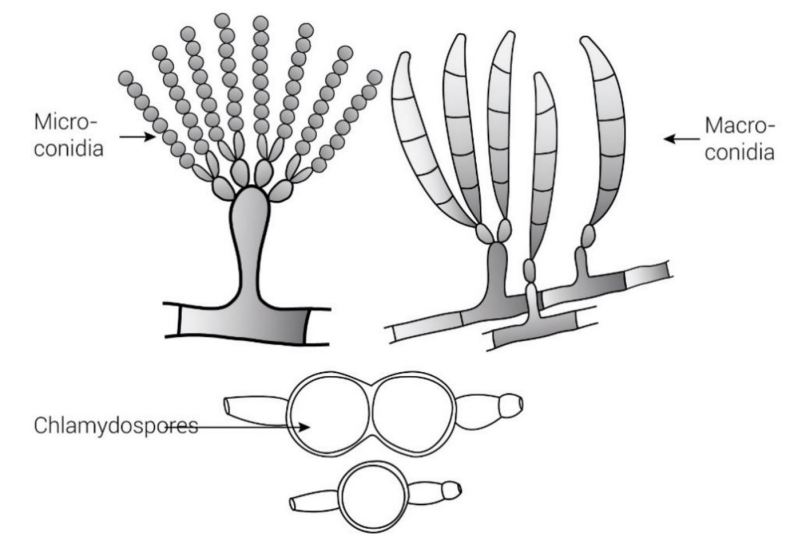


Diagram of
Fusarium spores

(Ajmal et al. 2022)

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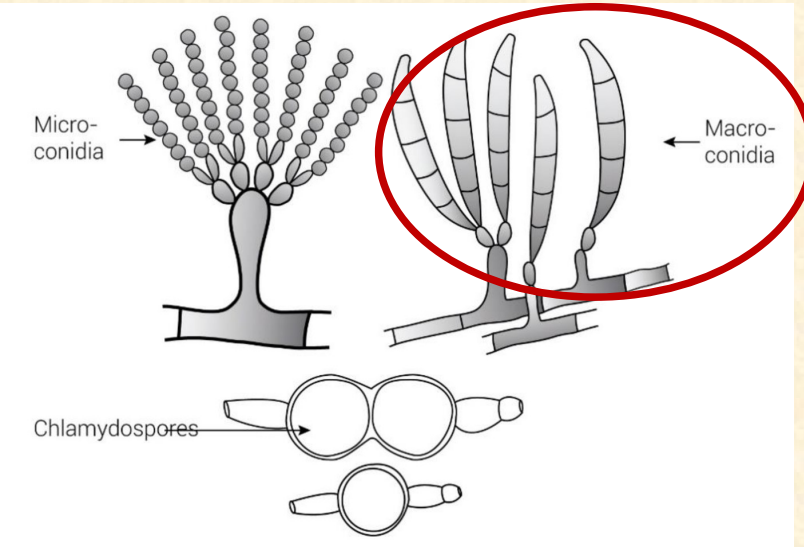

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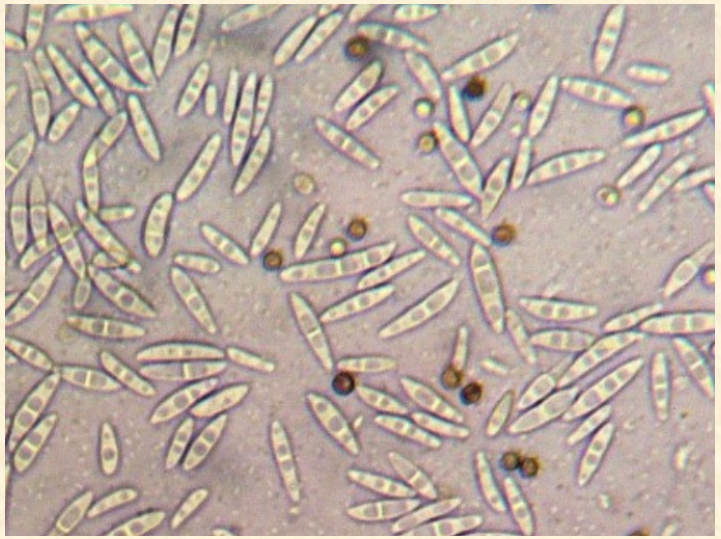
Diagram of Fusarium spores

Photo of Fusarium spores



(photo by Utah State Extension)

General IPM for Soil-Borne Diseases

Prevention

- Genetics
  - High quality, vigorous seeds/transplants that grow quickly
  - Explore tolerant or resistant crop types & varieties

Example: strawberry cultivars

Fronteras, Portola, & San Andreas strawberry cultivars are resistant to Fusarium wilt

(photo by Doug Shaw)

Albion & Monterey are particularly susceptible to Fusarium wilt

(Albion strawberries, photo by Pamela Kan-Rice)

Location

- No history of soil borne diseases
- Crop rotation & diversification

When rotating crops, it is best to have separated garden plots or beds, similar to the beds pictured here.

Bek Diamond, ©2021, Clemson University

(diagram by Clemson Cooperative Extension)

Sanitation

- Regularly disinfect
  - tools
  - greenhouse benches
  - work areas
  - reusable pots

Damping off symptoms in pansy seedlings – sanitize trays after use

(photo from NC State Extension)

Growing Conditions

- Germinate seeds at high temperatures so seedlings grow rapidly out of their most susceptible phase
- Use well-drained, pasteurized potting mix (don’t use field soil)
- Do not over water

(photo from South Dakota State Extension)

Good Drainage & Soil Aeration

- Broad fork on small scale
- Diversify root architecture
- Minimize activities that compact soil such as equipment traffic

Broad fork

(photo from Kansas State Extension)

Cover crops

(photo from Ellie)

Good Plant Health

- Sufficient nutrients & water
- In general, stressed plants are more susceptible plants

Healthy vs. unhealthy tomato leaves

(photo by OSU Extension)

(photo by Ellie)

Eliminate Sources of Inoculum

- Promptly remove & discard diseased plants immediately
  - they are a source of inoculum (spores) that can infect nearby plants

(photos by Steve Koike)

(photo from UC IPM website)

Soil Solarization

- During fallow periods during the hottest part of the summer
- Clear plastic tarps on moist bare soil for 4-6 weeks
- Can help reduce pathogens
- Many beneficial soil microbes can survive or recolonize quickly

Biological Options

- Cover Crops
  - Studies suggest they can promote suppression of some diseases by influencing the soil microbial community & increasing beneficial microbes
  - We need more research to understand how this works...

Photo by Ellie

Organic Fungicide Options

- Products using hydrogen peroxide & peroxyacetic acid

Mention of product names are examples, not endorsements.

Organic Biofungicide Options

- Streptomyces-based products
- Bacillus-based products
- Trichoderma-based products can help prevent further infections after using fungicides
- Compost can help promote beneficial soil microbes

Mention of product names are examples, not endorsements.

Organic Biofungicide Options

- Always consider cost – is it worth it?
- We need more research on these types of products...

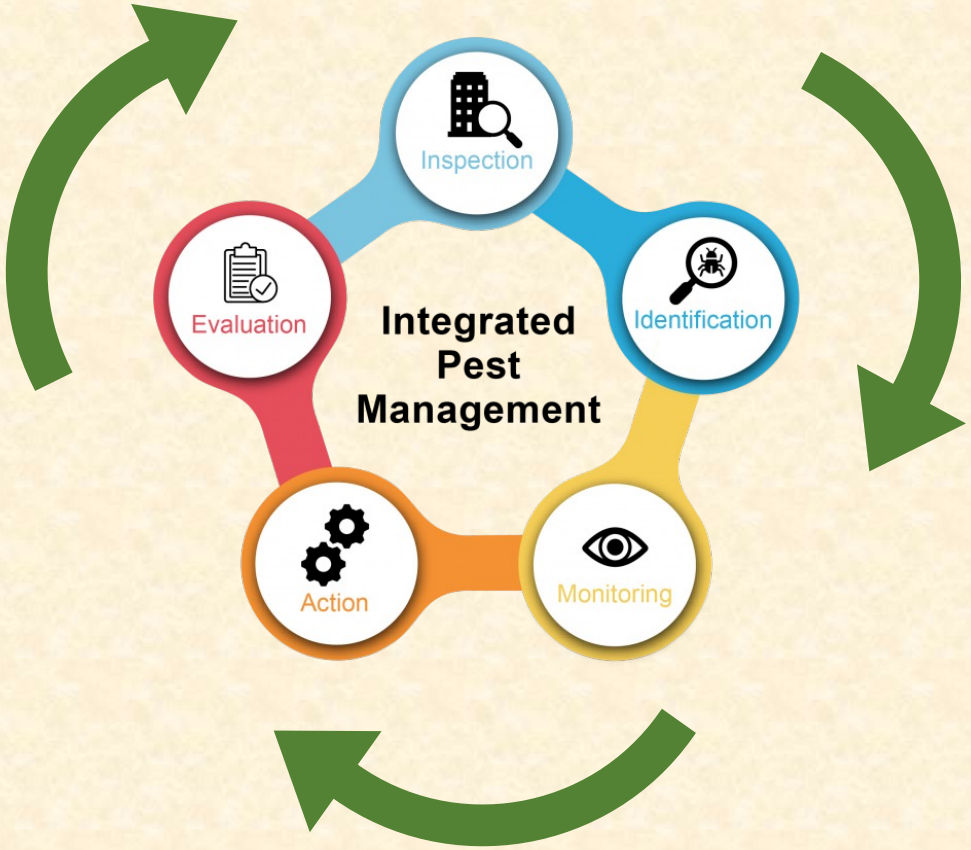
Mention of product names are examples, not endorsements.

Soil Borne Diseases IPM Toolbox

Photo by Ellie

- Visual ID, maybe send to diagnostics lab
- Good genetics
- Location, rotation
- Sanitation
- Growing conditions

- Drainage & soil aeration
- Good plant health
- Remove inoculum
- Soil solarization
- Organic fungicides & biofungicides?
- Cover crops?



It’s a process.

We need more research focused on organic IPM for soil borne diseases here in California!

It’s a major knowledge gap.

Fusarium was the most common one last year in our region.

...which brings us to Gabriel’s presentation...

I’m rooting for you!