

A photograph of a large, dense field of green basil plants growing in a greenhouse. The plants are arranged in neat rows, and the leaves are vibrant green. In the background, the structure of the greenhouse is visible, including metal frames and translucent covering. The overall scene is bright and healthy.

Insect Pest Management in Organic Agriculture

Eric Middleton
Organic Agriculture Workshop
12/8/2022

Outline



A large field of green basil plants growing in a greenhouse. The plants are densely packed and appear healthy. The background shows the structure of the greenhouse with some trees visible outside.

Outline

Opportunities and Advantages

A photograph of a greenhouse filled with rows of green basil plants. The plants are growing in white trays, and the background shows the structure of the greenhouse and some trees outside.

Outline

Opportunities and Advantages

Monitoring, Scouting, and Knowing Your System

Cultural Control

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Natural Enemies and Biological Control

Organic Pesticides in Combination

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Where to find information

Provide useful principles and some specific techniques





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Your situation may vary

Make sure the techniques apply to your situation



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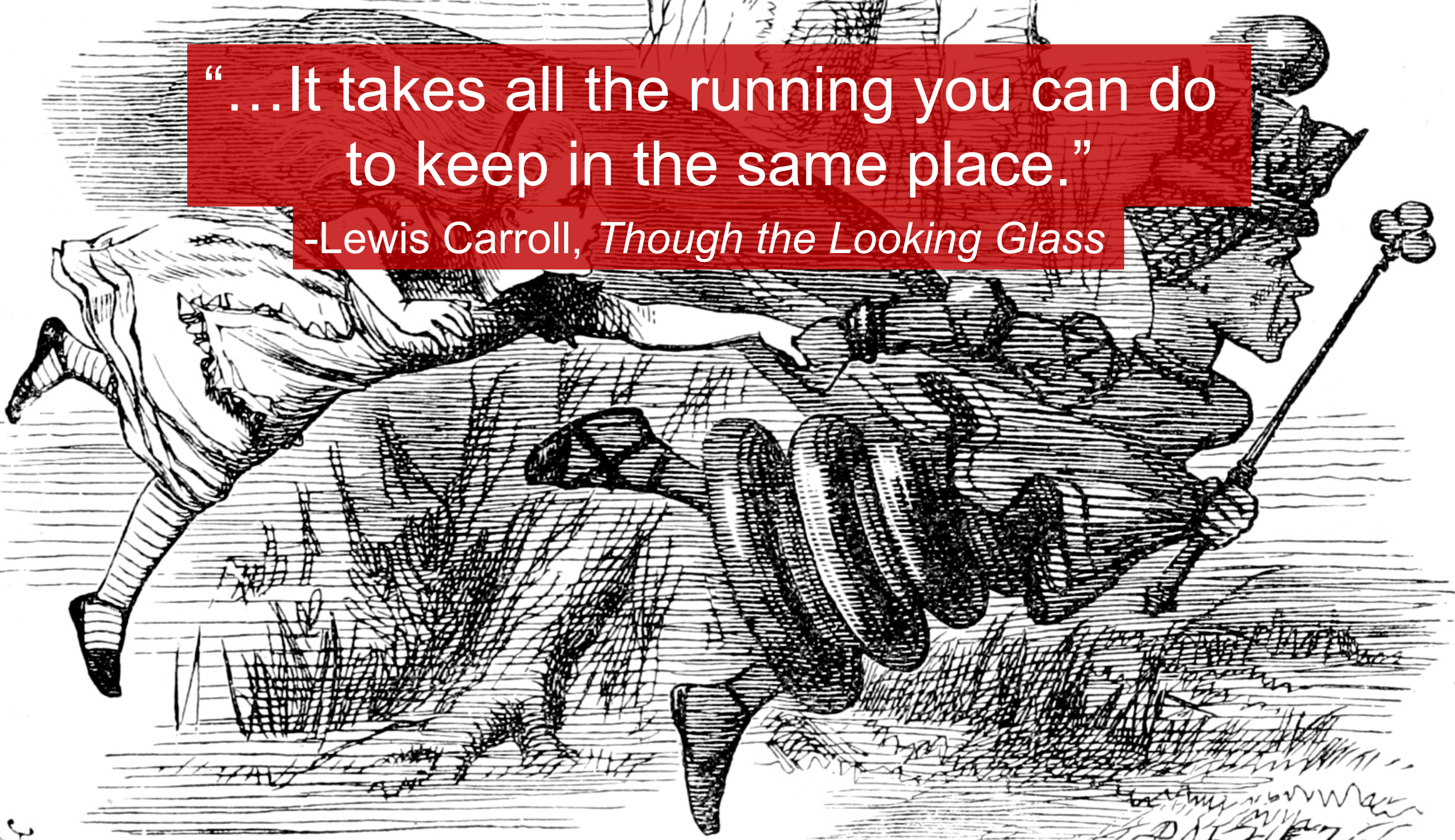
Make sure the techniques apply to your situation

Important for you to become expert in your own system



“...It takes all the running you can do
to keep in the same place.”

-Lewis Carroll, *Through the Looking Glass*

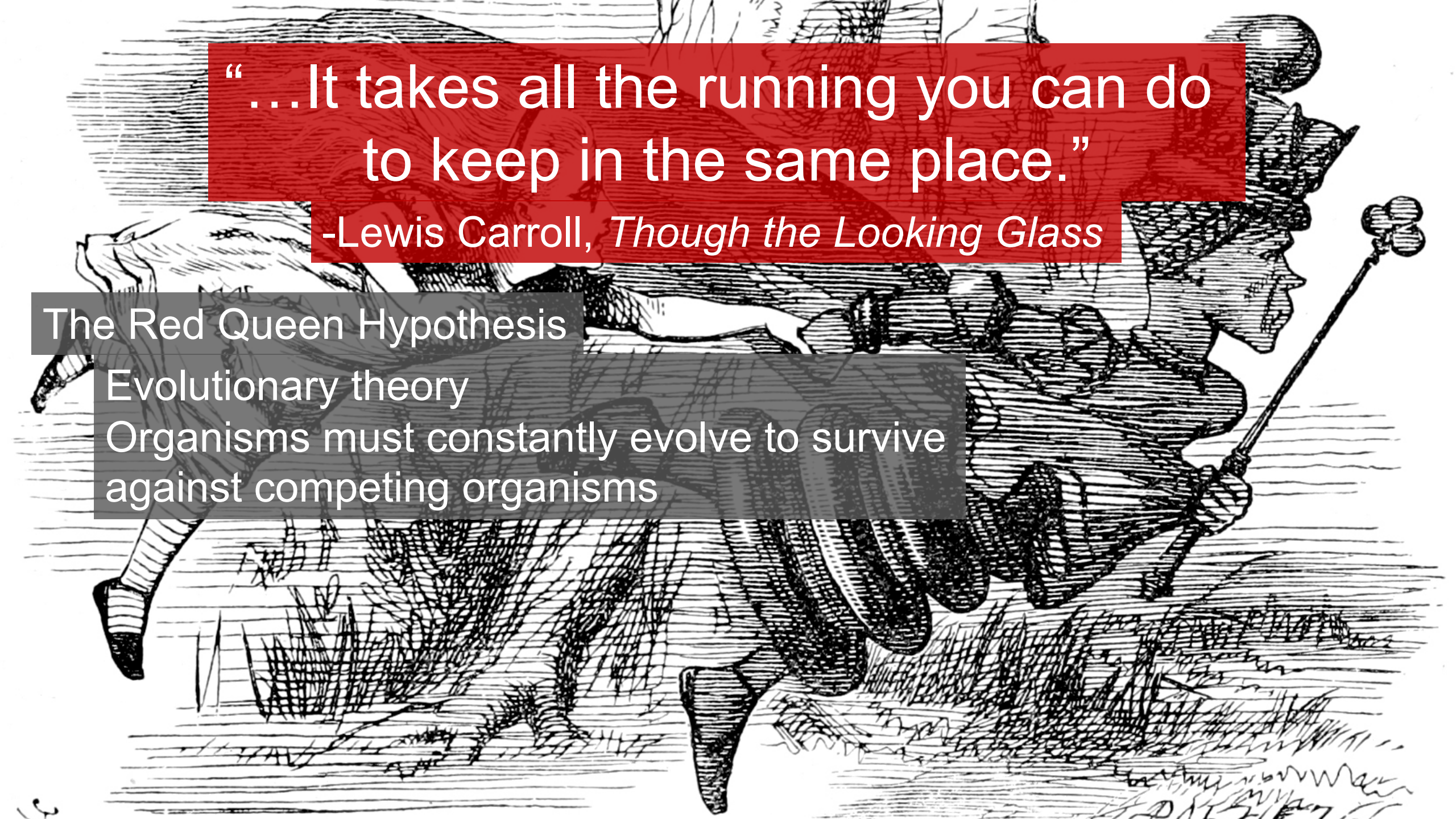


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The Red Queen Hypothesis





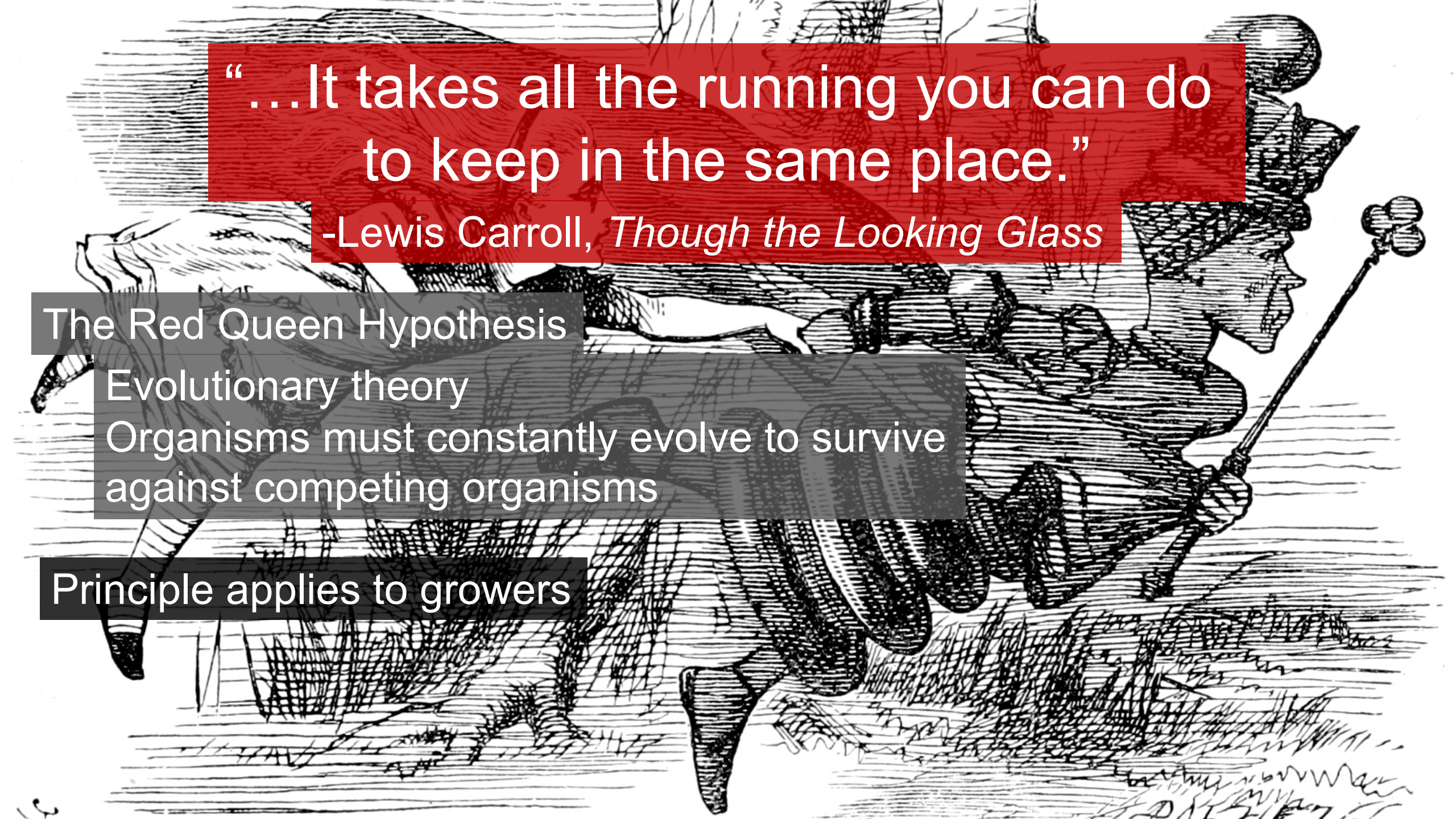
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The Red Queen Hypothesis

Evolutionary theory

Organisms must constantly evolve to survive
against competing organisms



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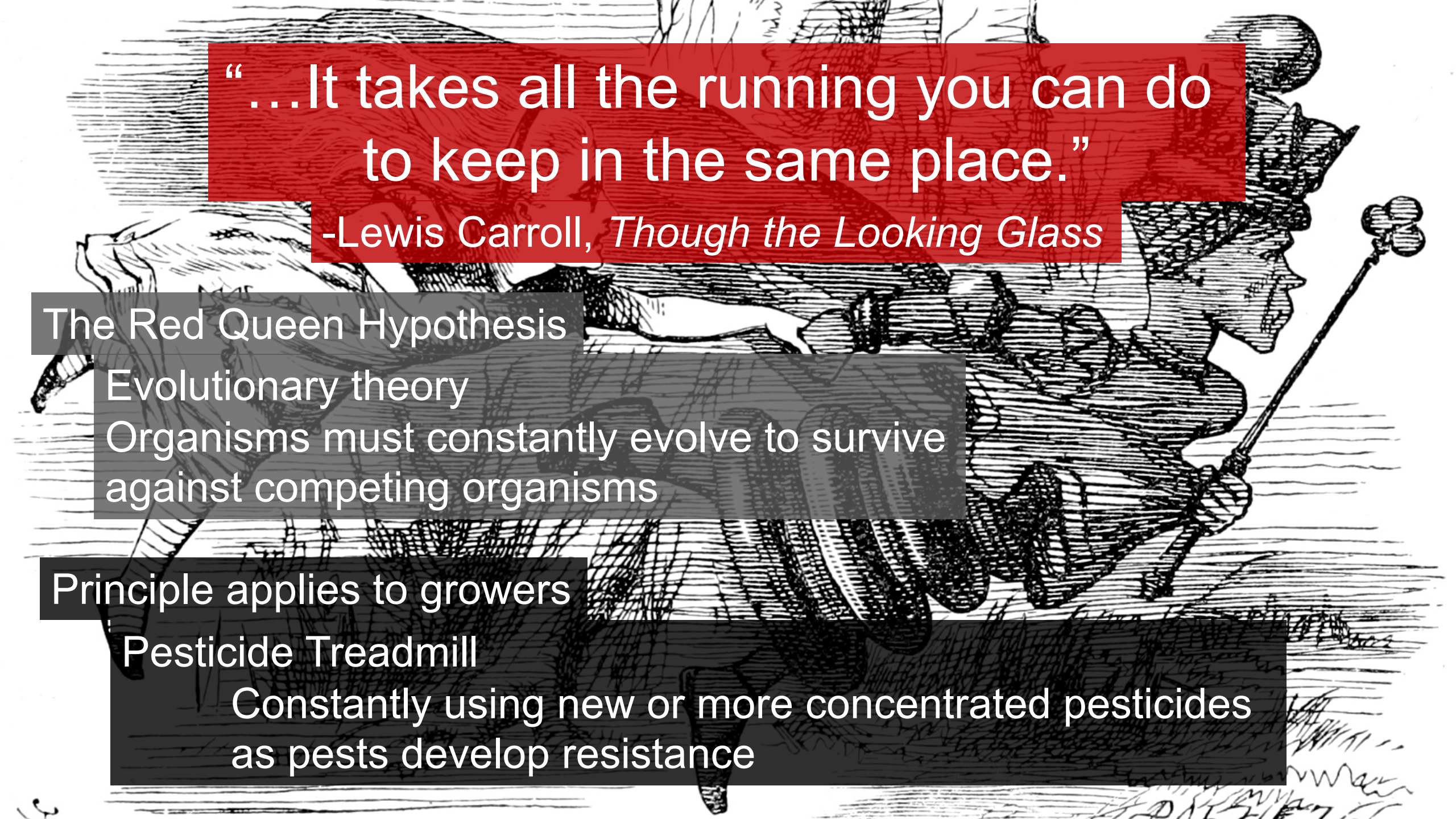
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Principle applies to growers



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Principle applies to growers

Pesticide Treadmill

Constantly using new or more concentrated pesticides
as pests develop resistance

Problems from Conventional Management



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Ex: Colorado Potato Beetle



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Insecticides primary control option

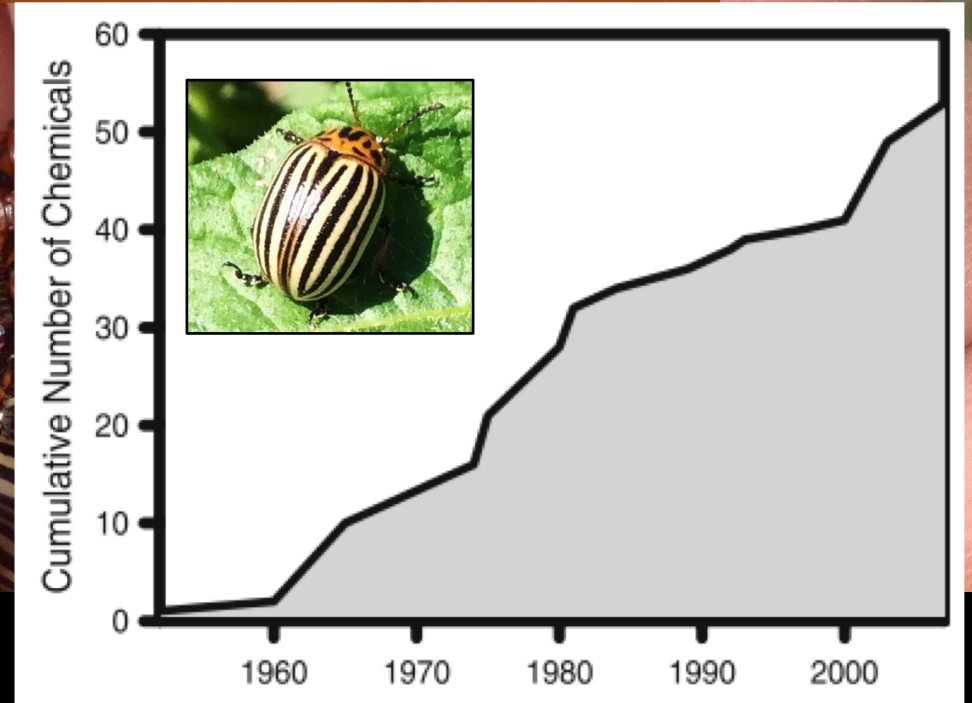


Problems from Conventional Management

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Potato beetles develop resistance



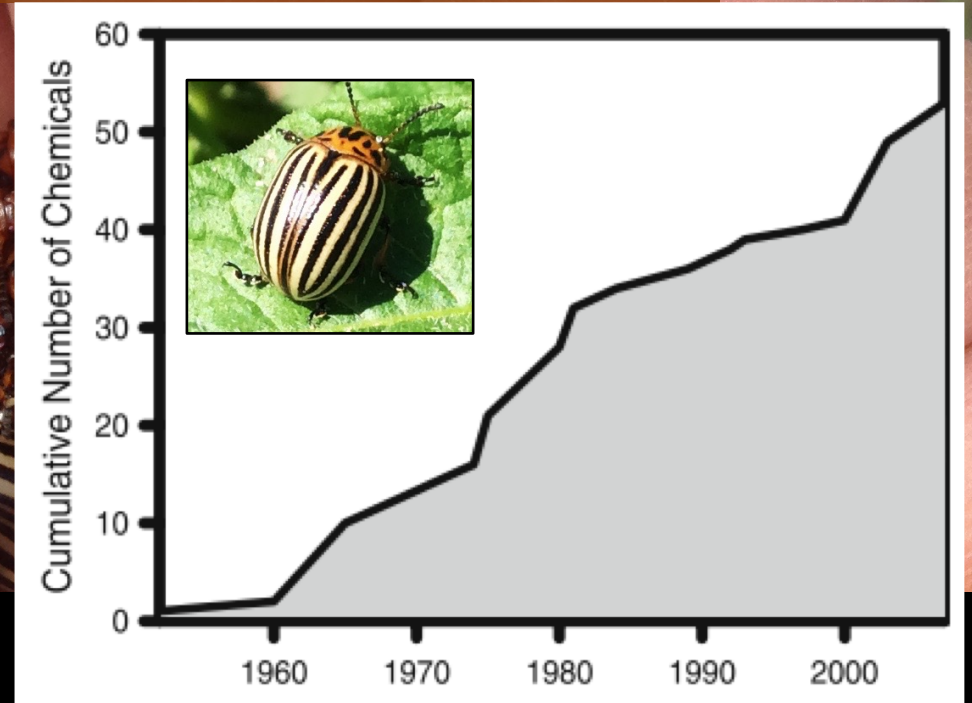
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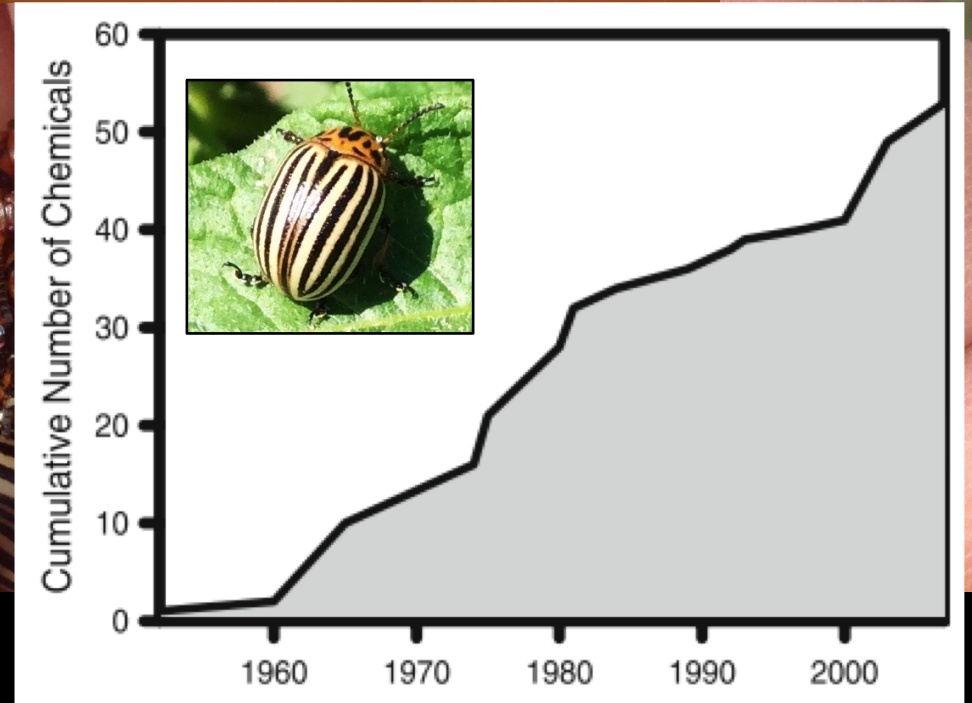
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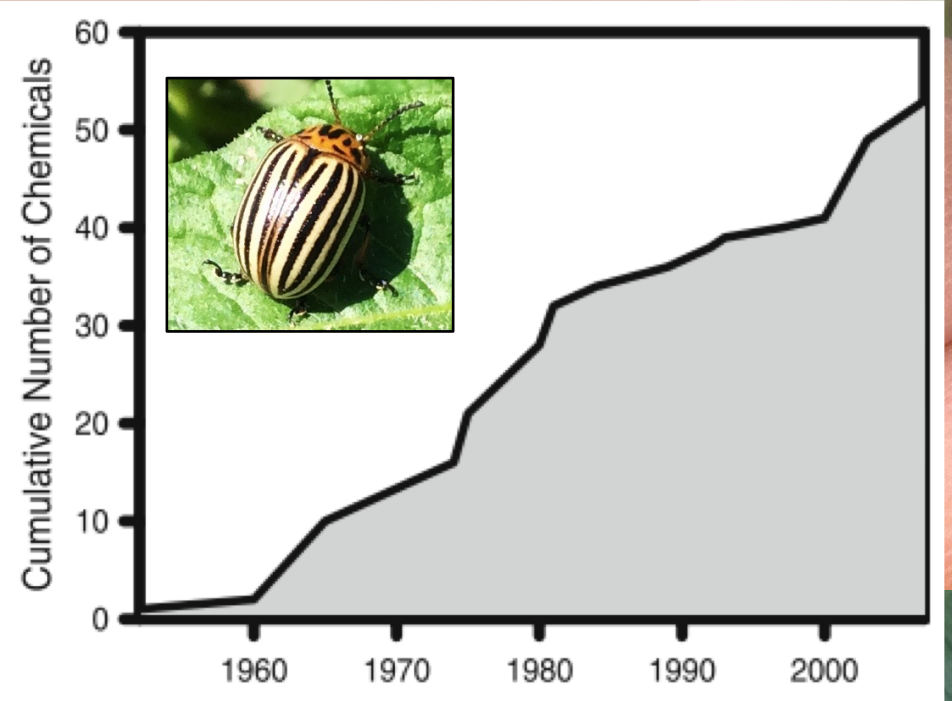
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Ex: Mealybugs



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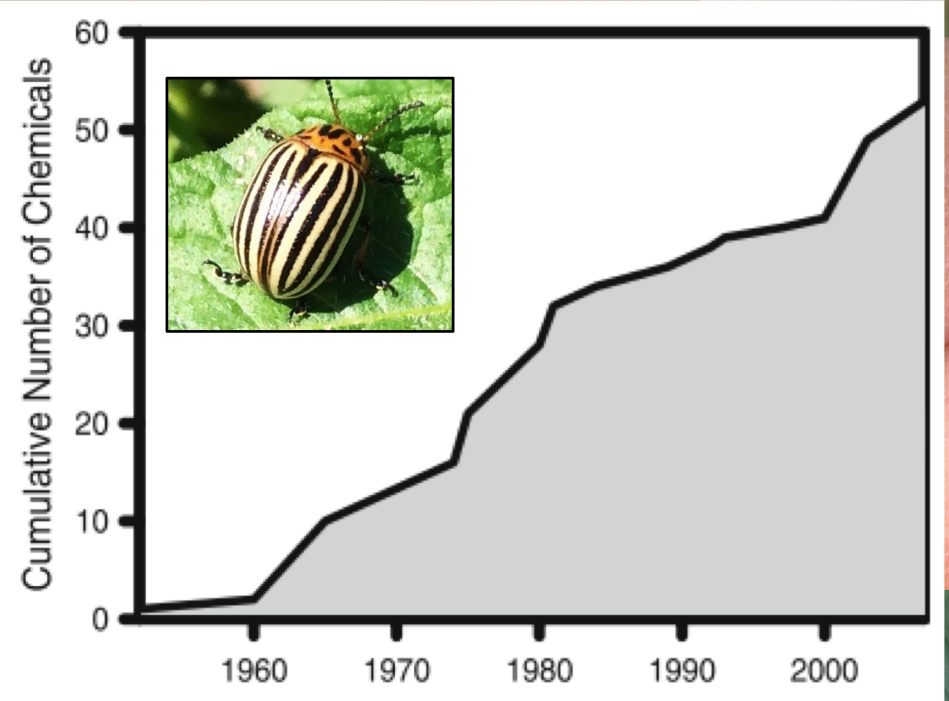
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Broad-spectrum insecticides lead to increased mealybug outbreaks

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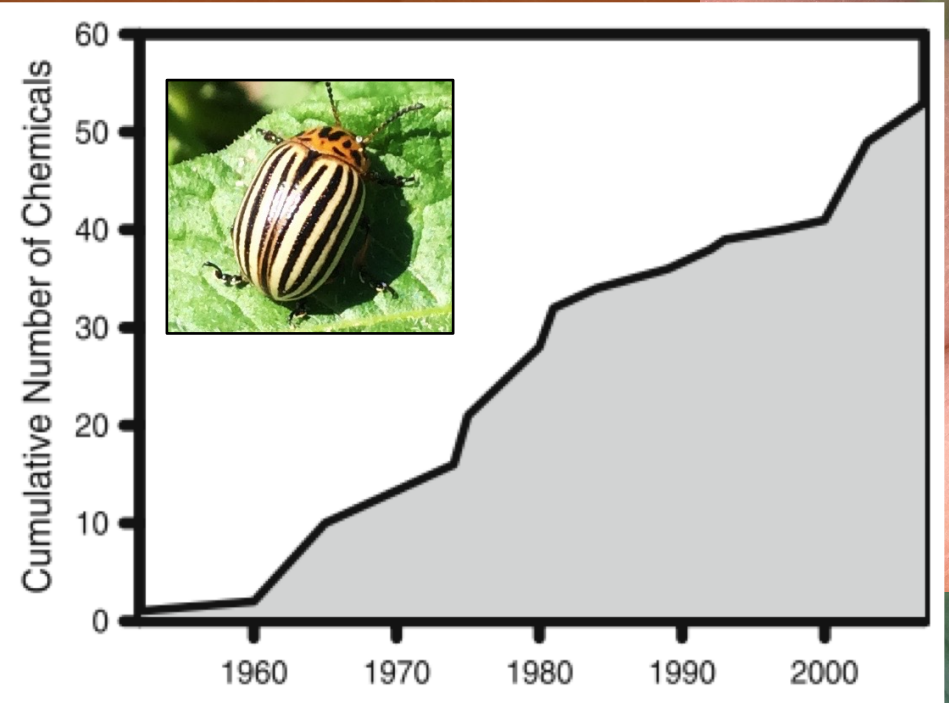
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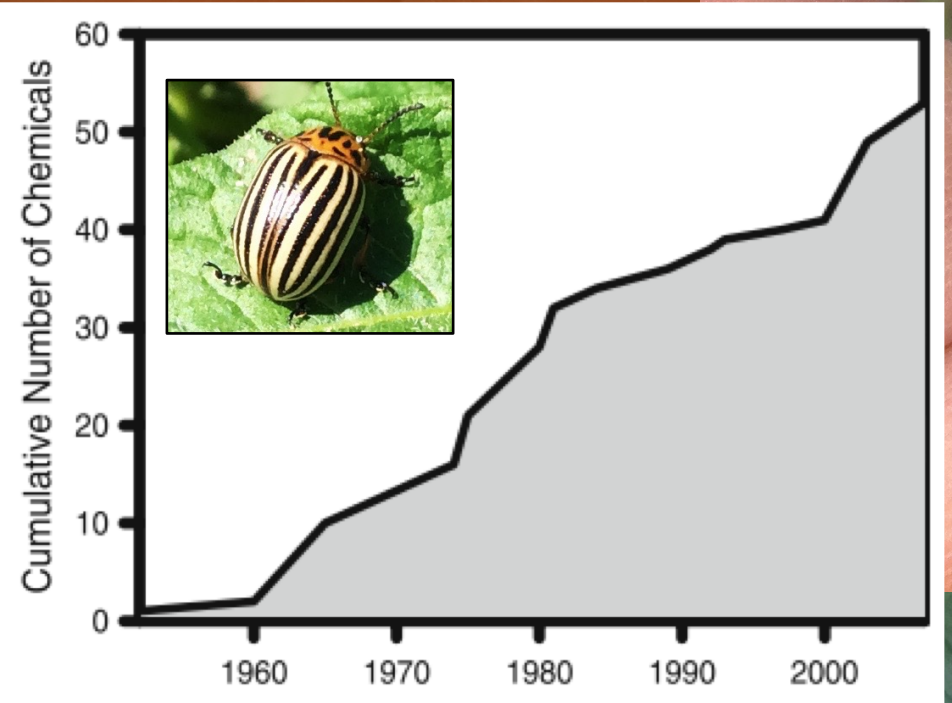
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Continue applying insecticides until problem is solved

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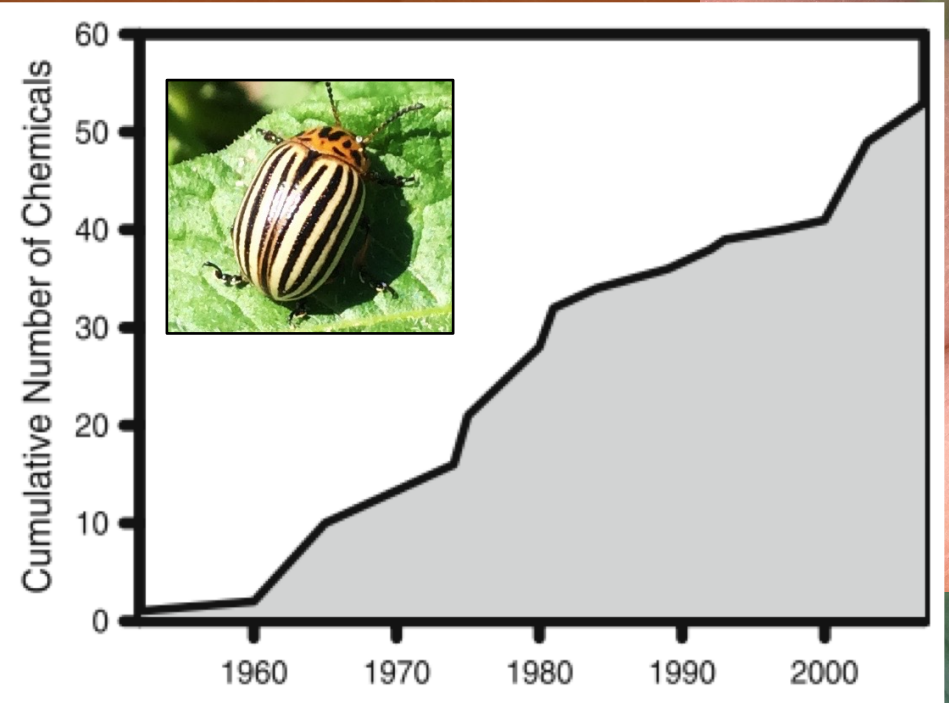
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Outbreaks controlled when natural enemies return

Advantages of Organic



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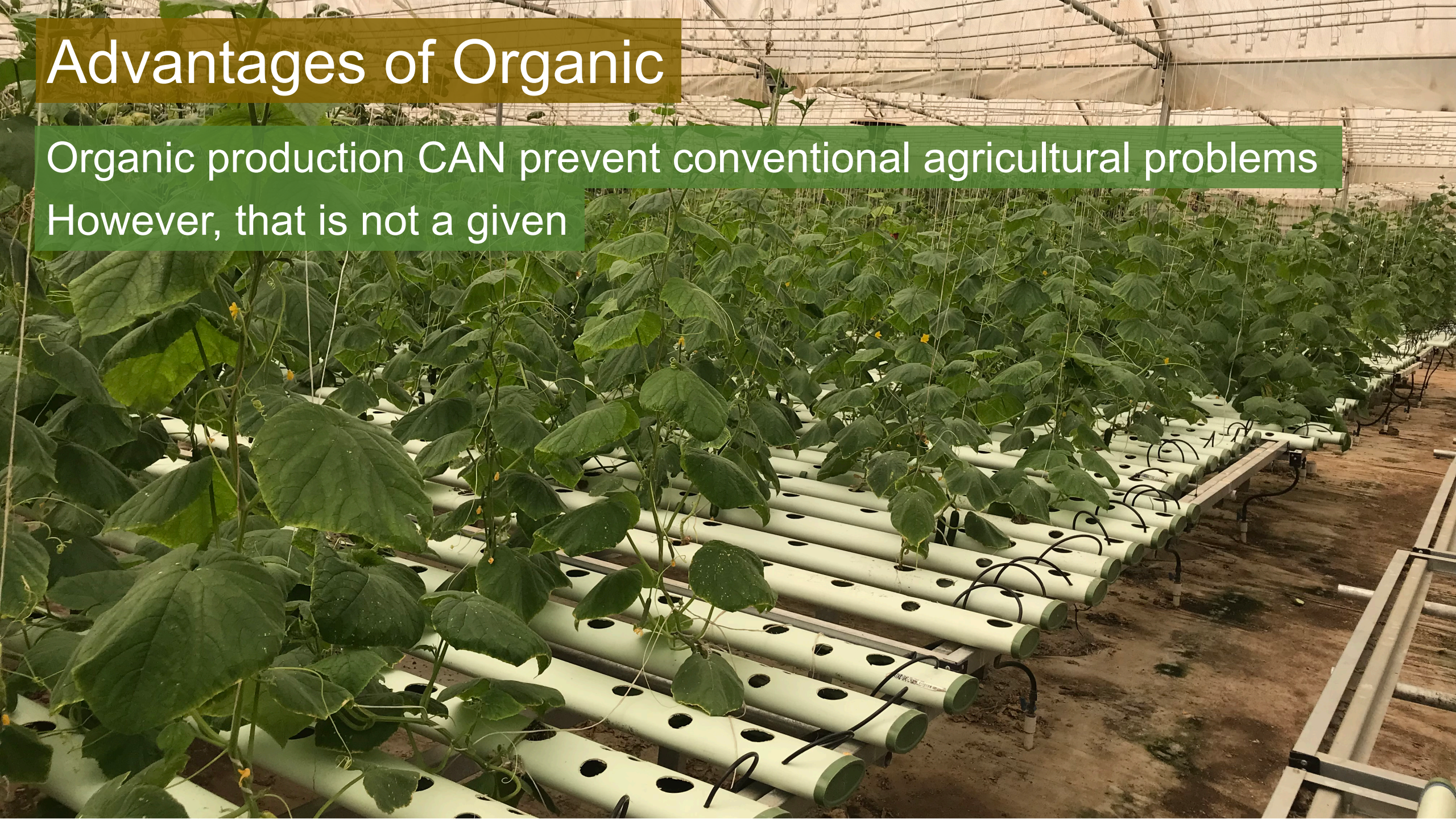
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Advantages of Organic

Organic production CAN prevent conventional agricultural problems

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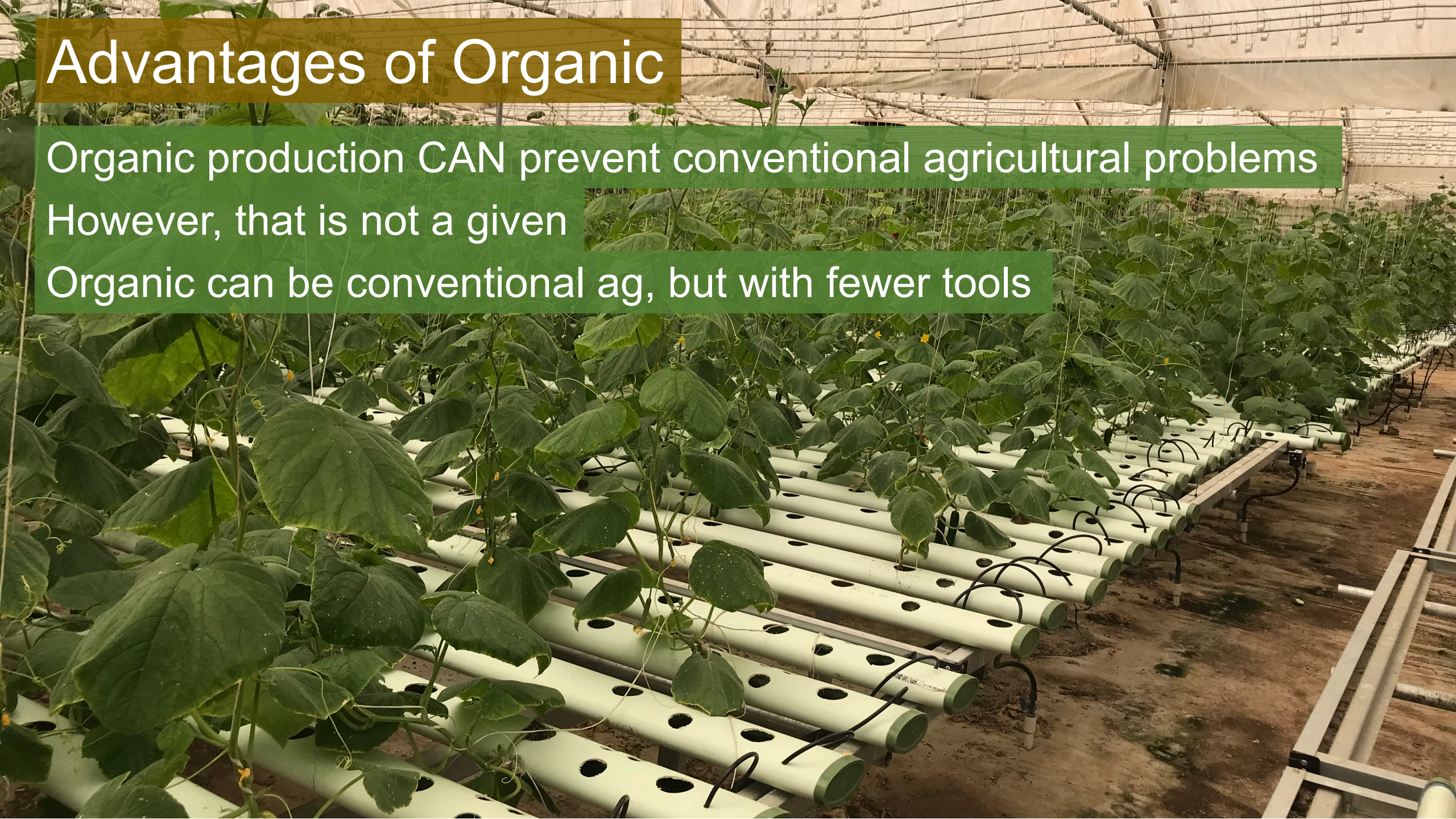


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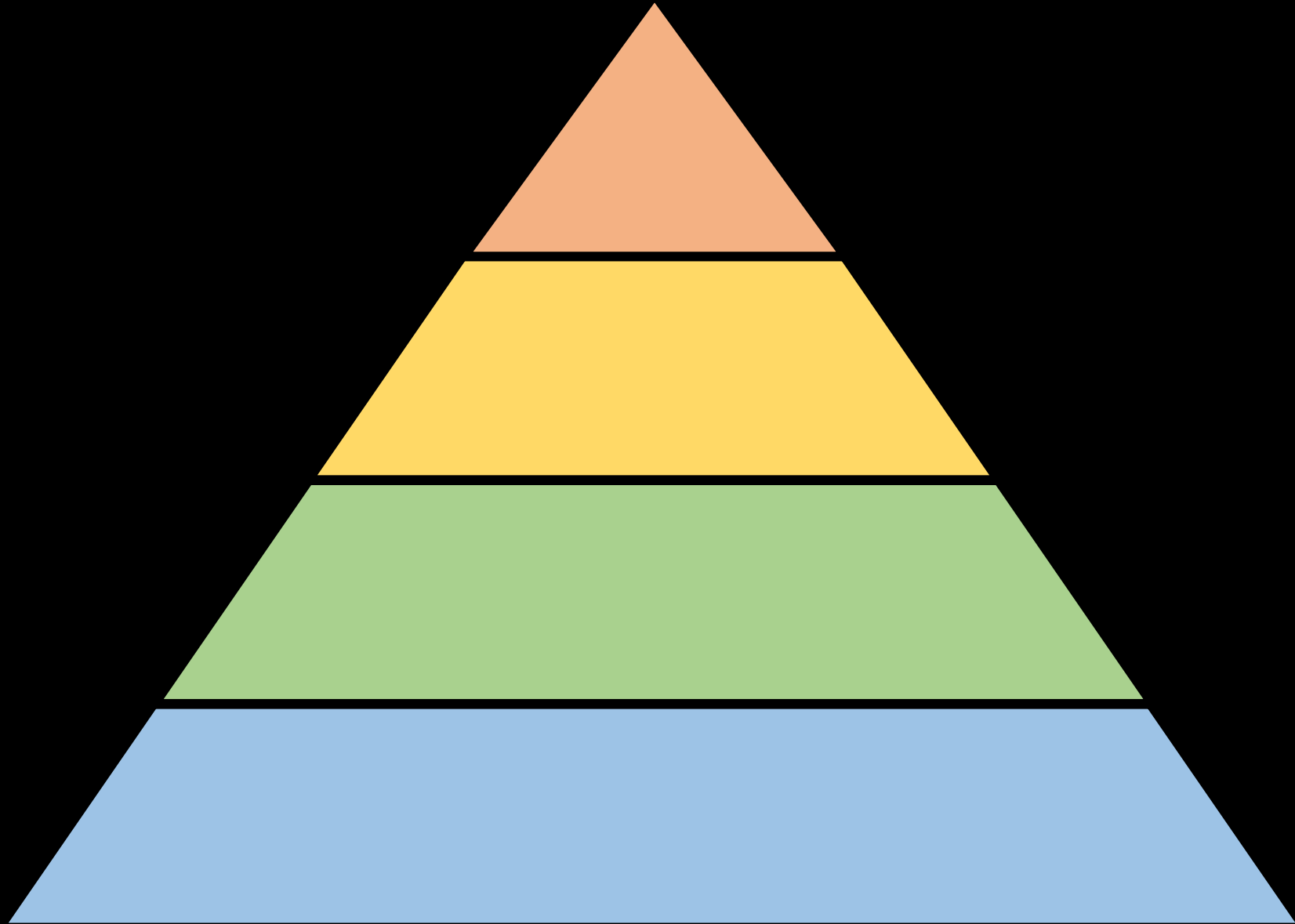
Best control hard for pests to adapt to, adapts with pest

Involves multiple techniques, based on knowledge

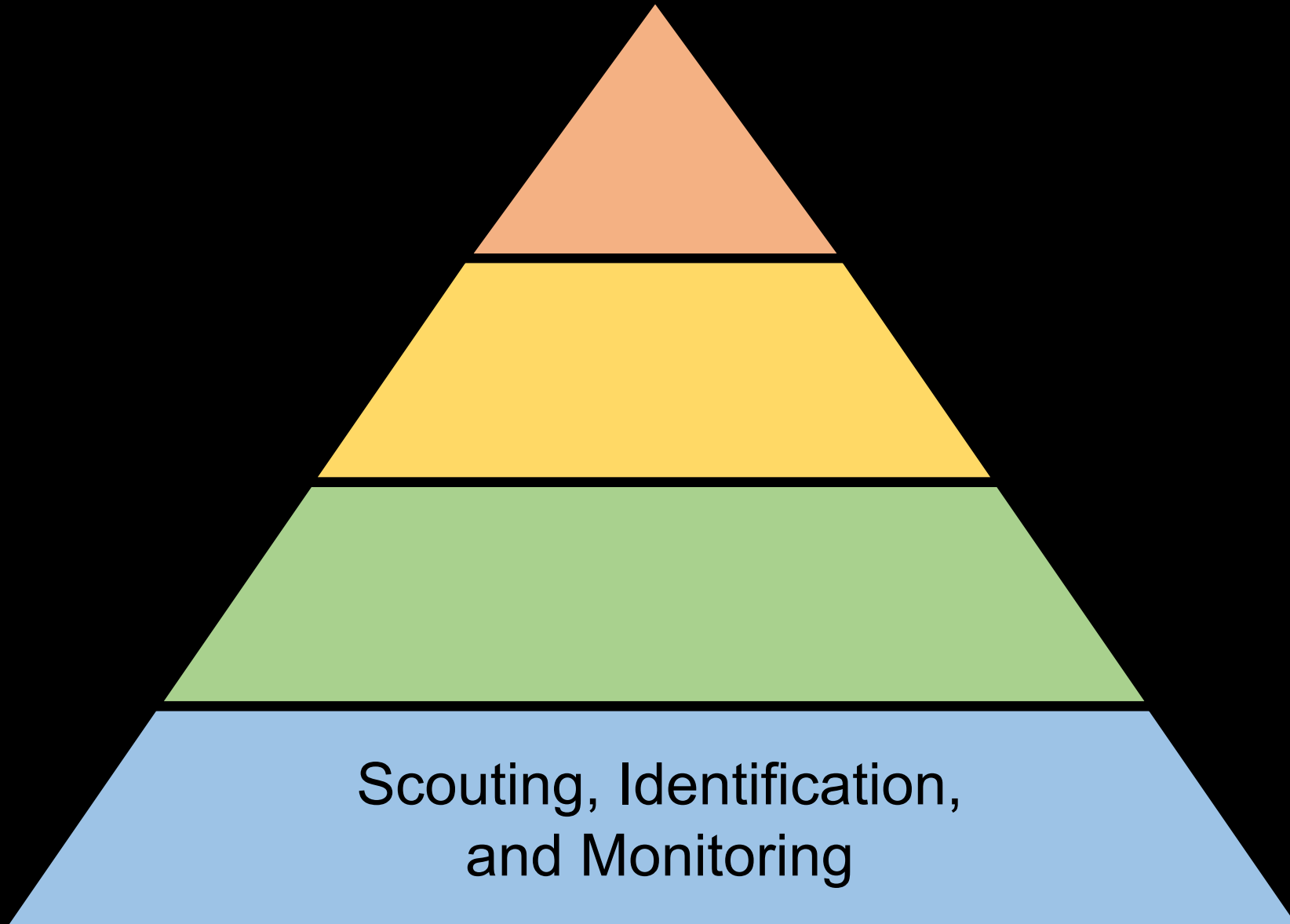
The basics really are important



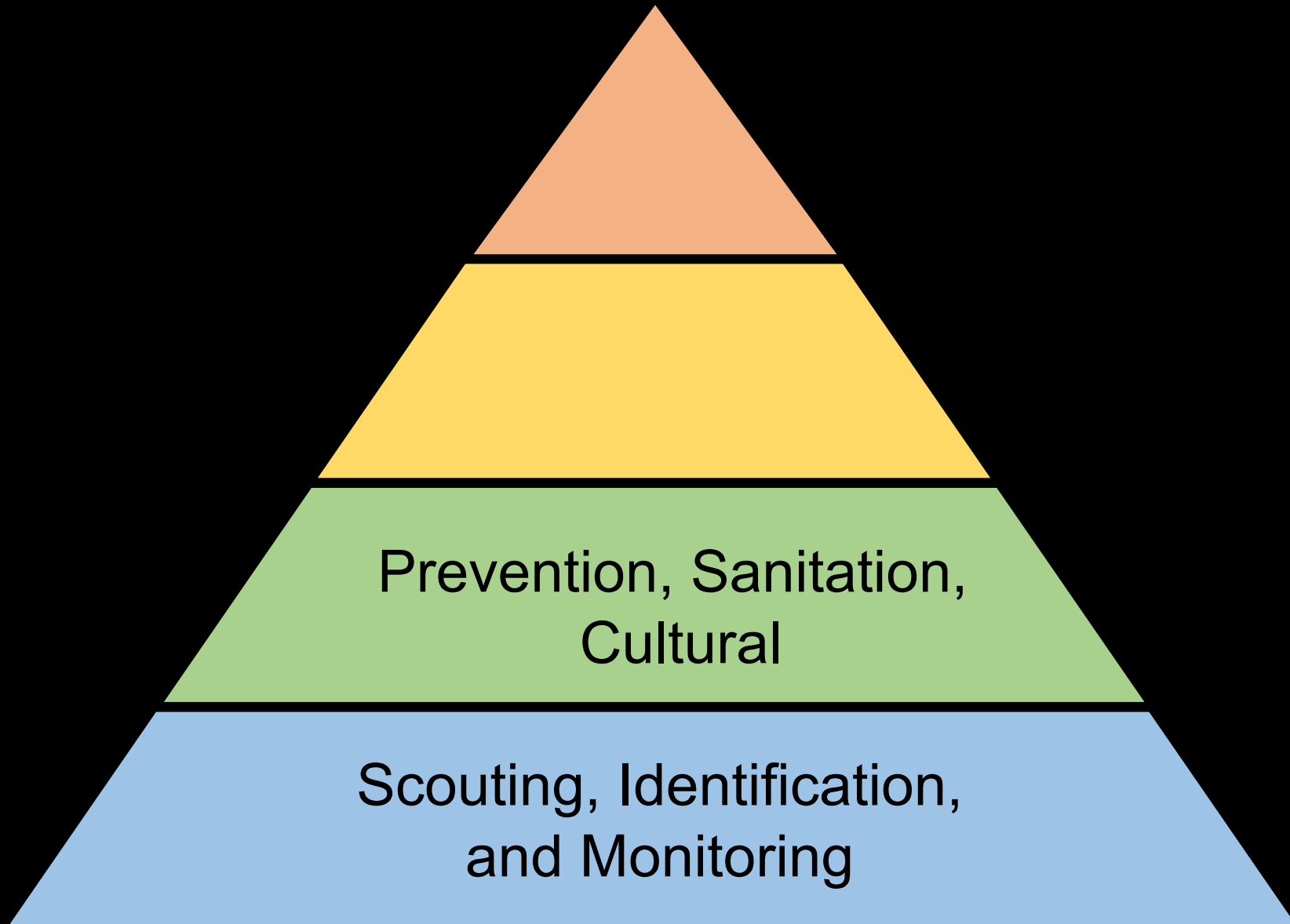
Implement Integrated Pest Management (IPM)



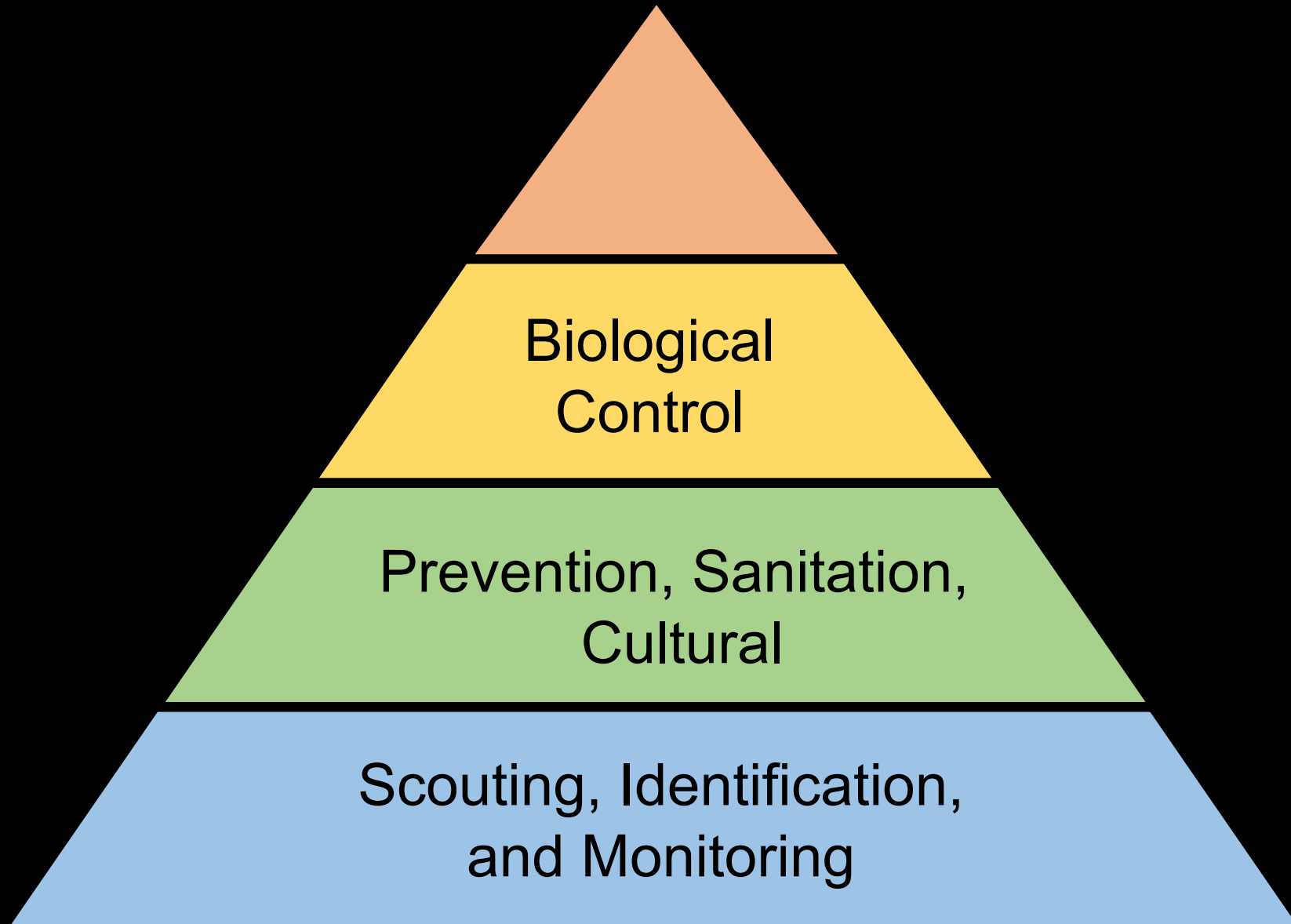
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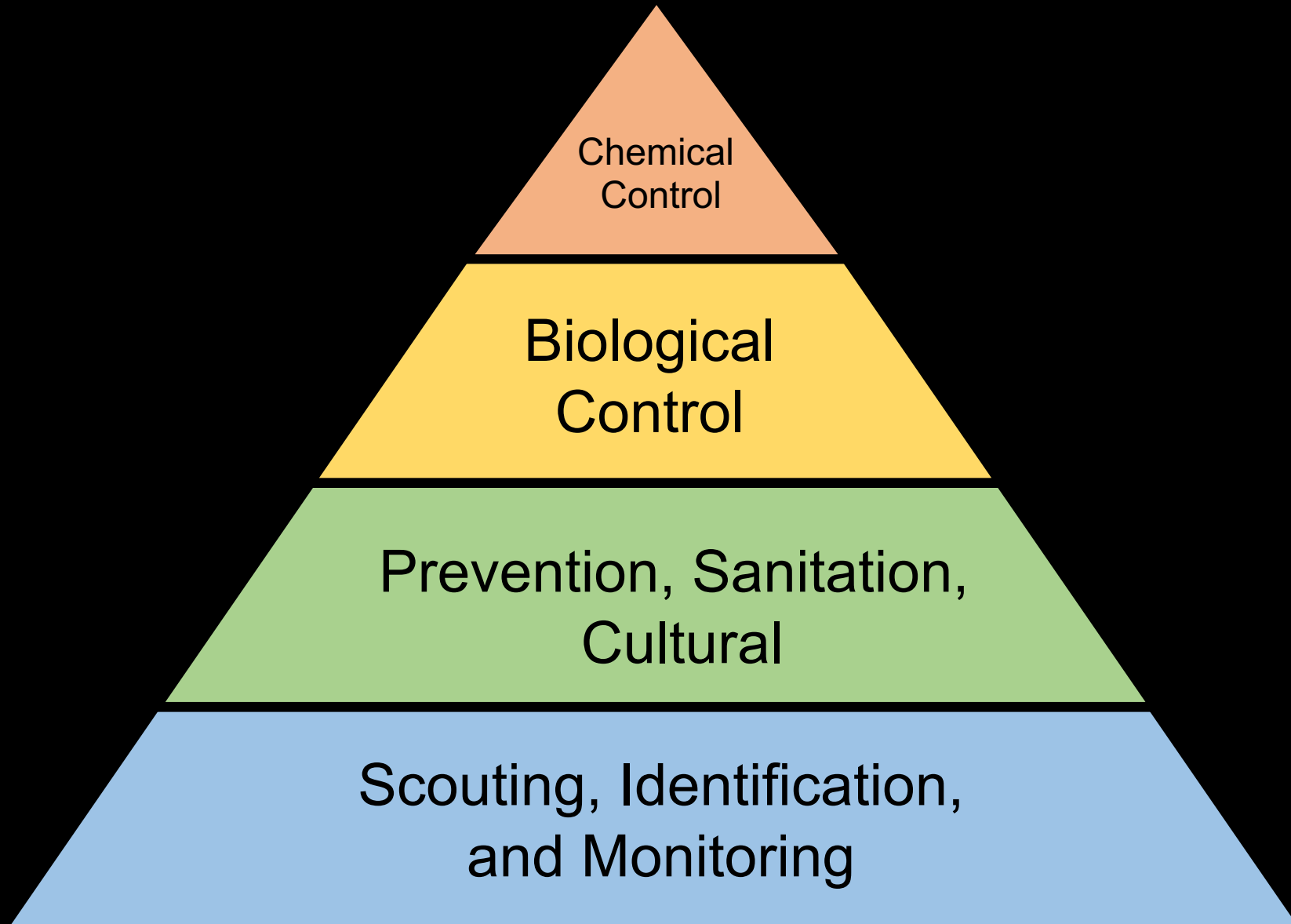
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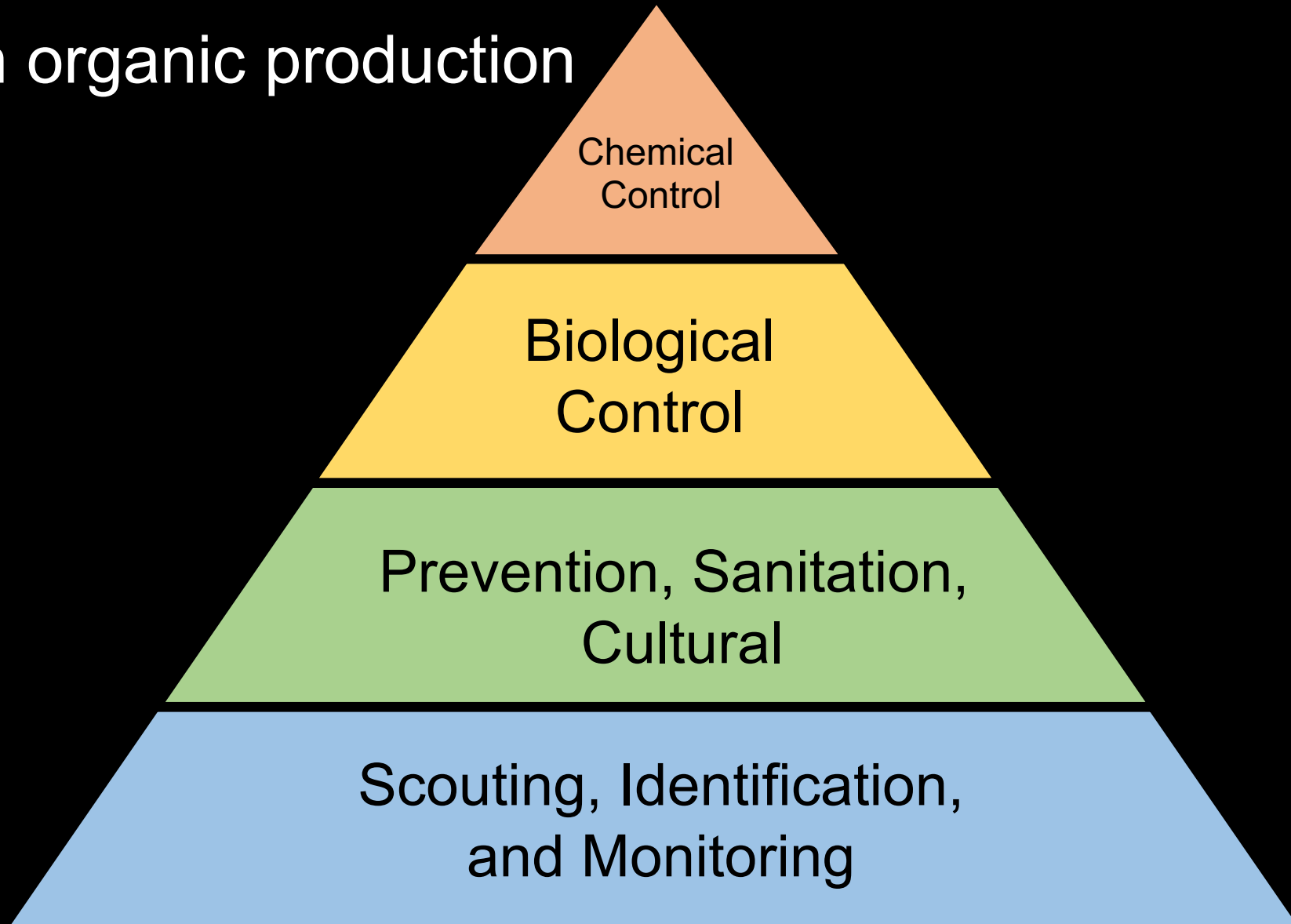


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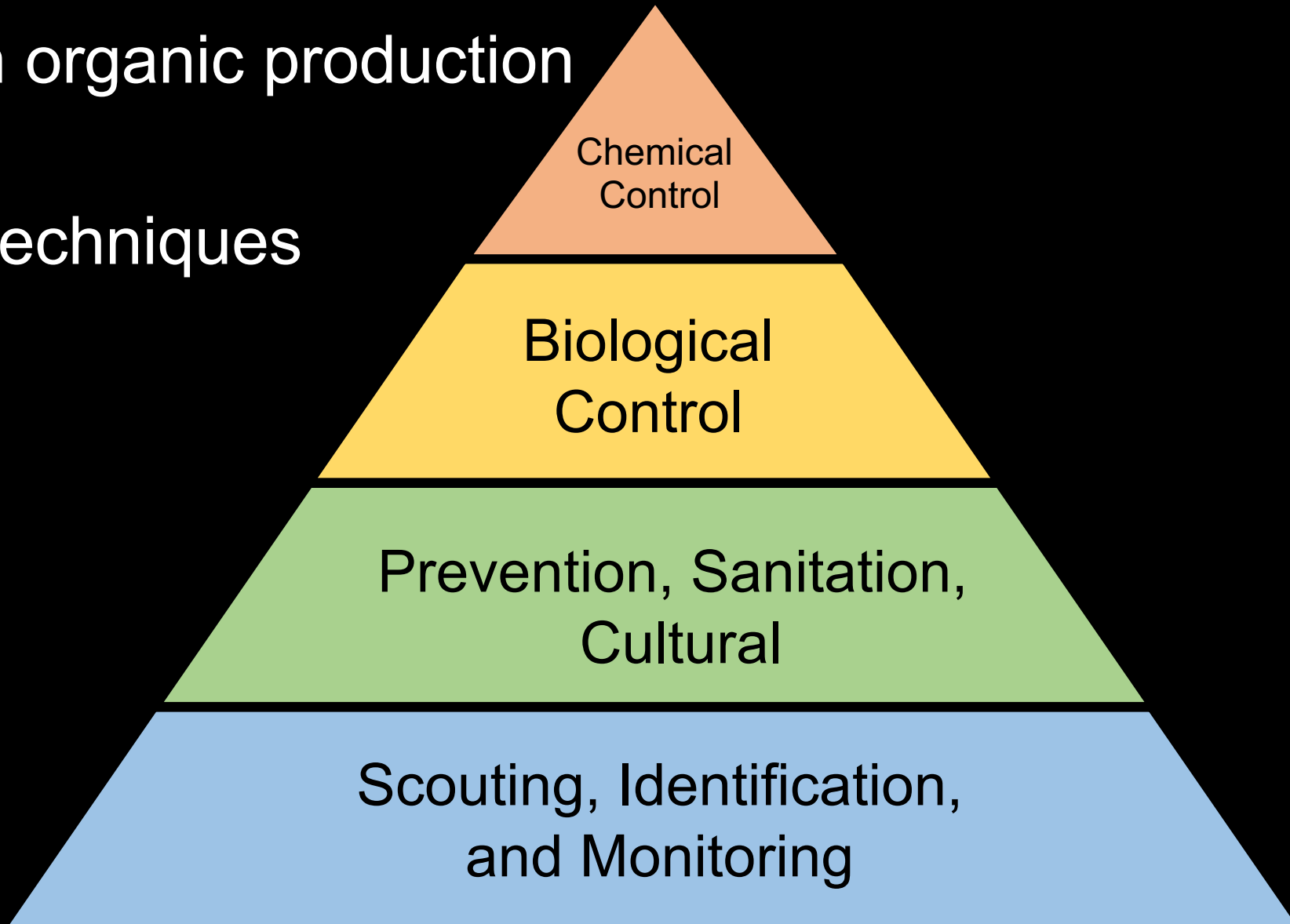
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Implement Integrated Pest Management (IPM)

Especially important in organic production

Utilize many different techniques

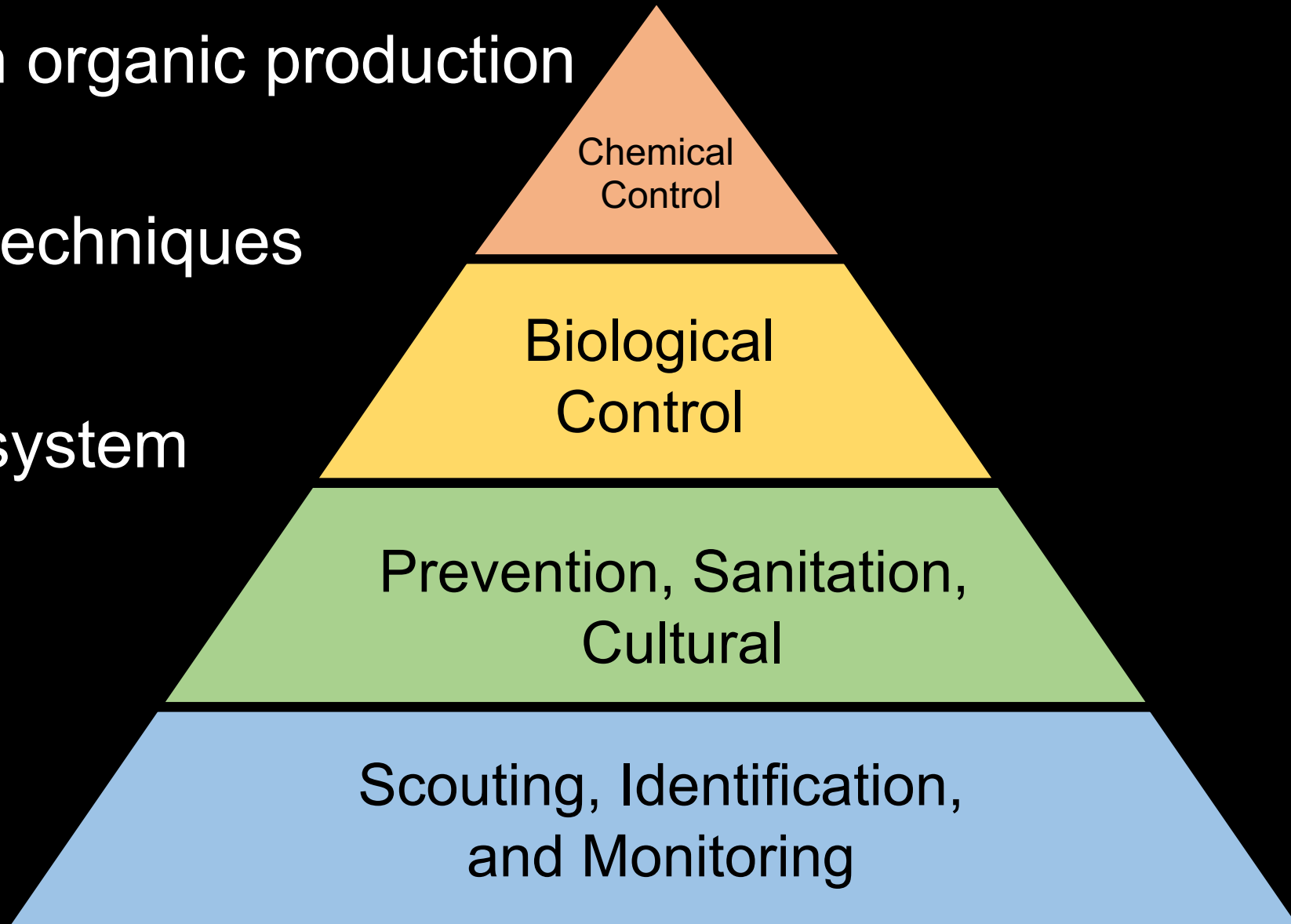


Implement Integrated Pest Management (IPM)

Especially important in organic production

Utilize many different techniques

Knowledge-intensive system



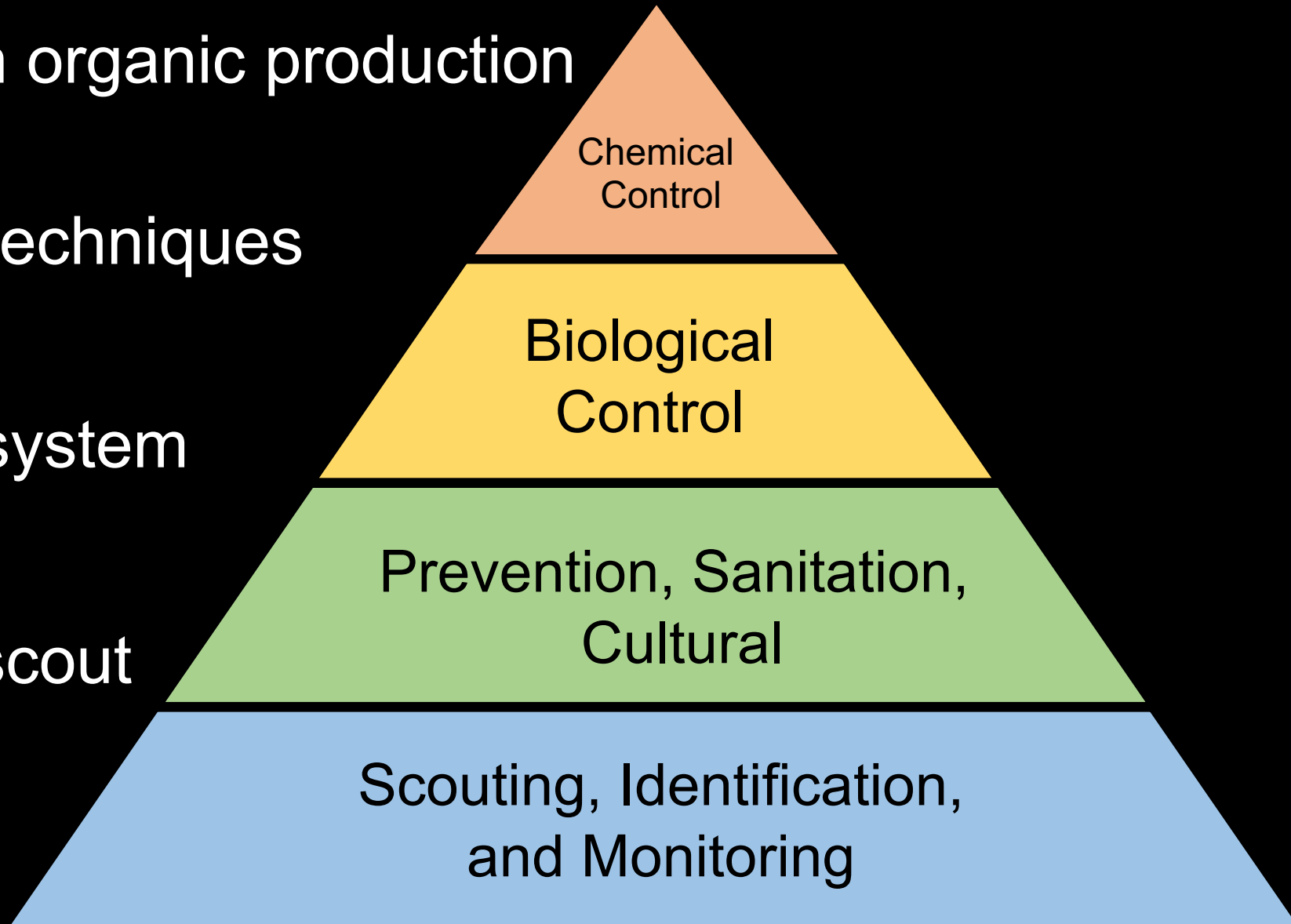
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IPM shouldn't just be scout
and spray



Organic Pesticides



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Insecticidal Soap

Pyrethrins

Spinetoram

Spinosad



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They should be integrated as options in your control measures

Ideally, do not form the basis of your pest management

Don't just do conventional agriculture with your hands tied



Pest Identification



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If you don't know what is causing the problem...
...It is much harder to manage



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Could apply ineffective treatment, harm beneficials



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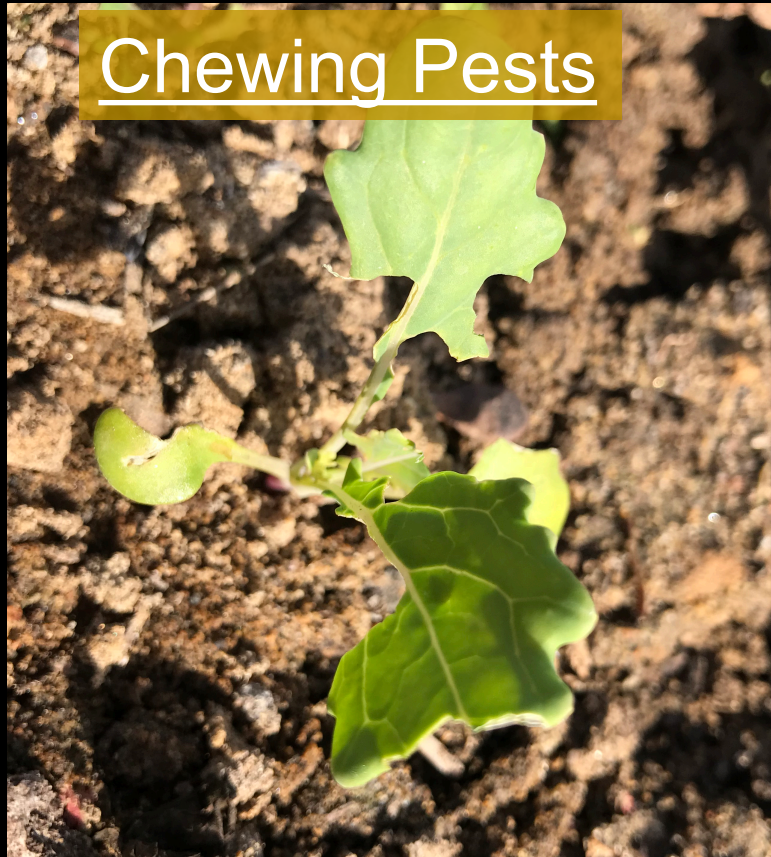
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Sucking Pests



Chewing Pests



Mites/Thrips



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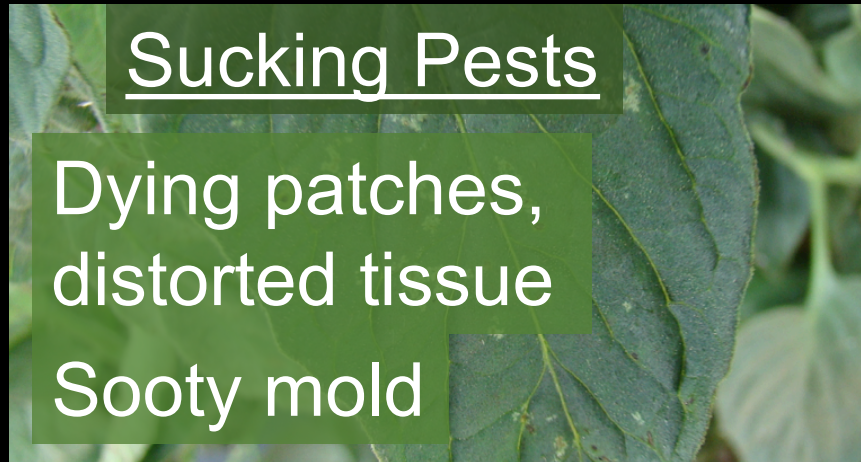
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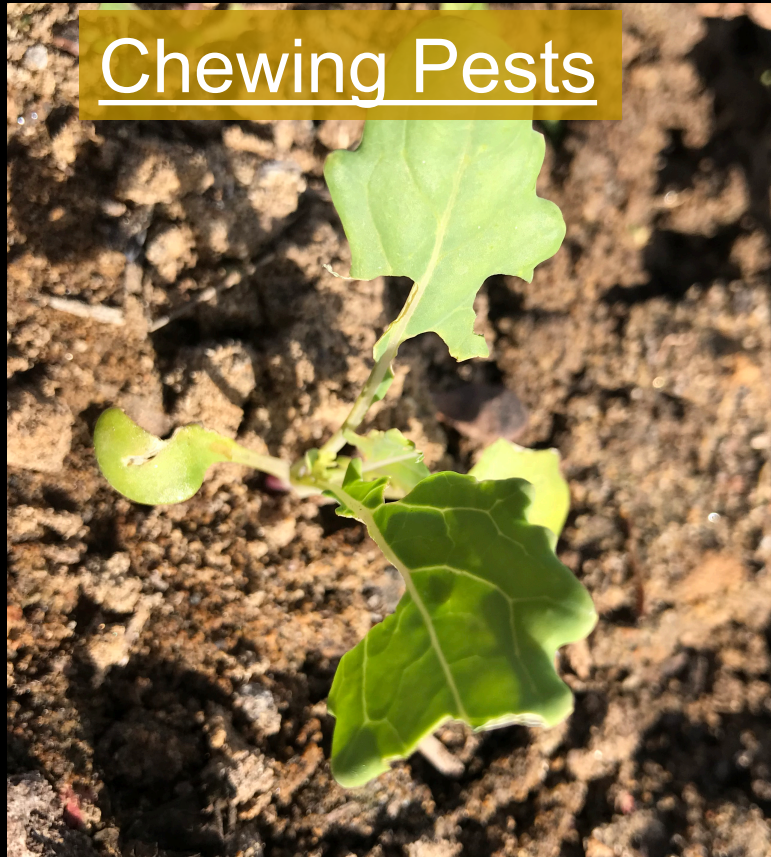
Sucking Pests

Dying patches,
distorted tissue

Sooty mold



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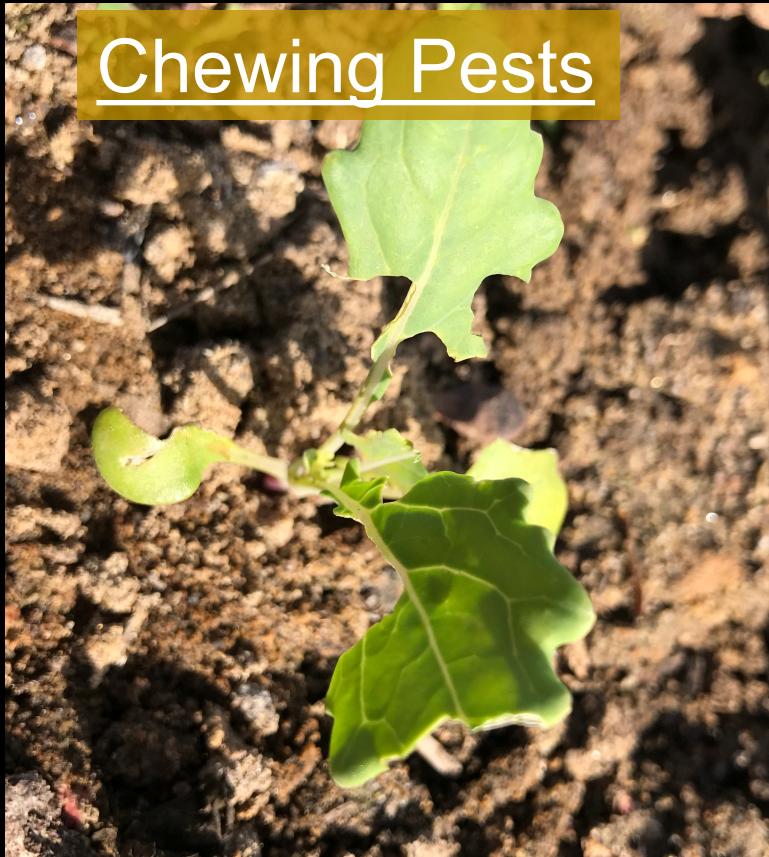
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Aphids, whiteflies,
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Mites/Thrips

Dying patches,
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Spider mites,
eriophyid mites
thrips

Monitoring and Scouting



Monitoring and Scouting

Know what kinds of insect pests you might encounter in your system



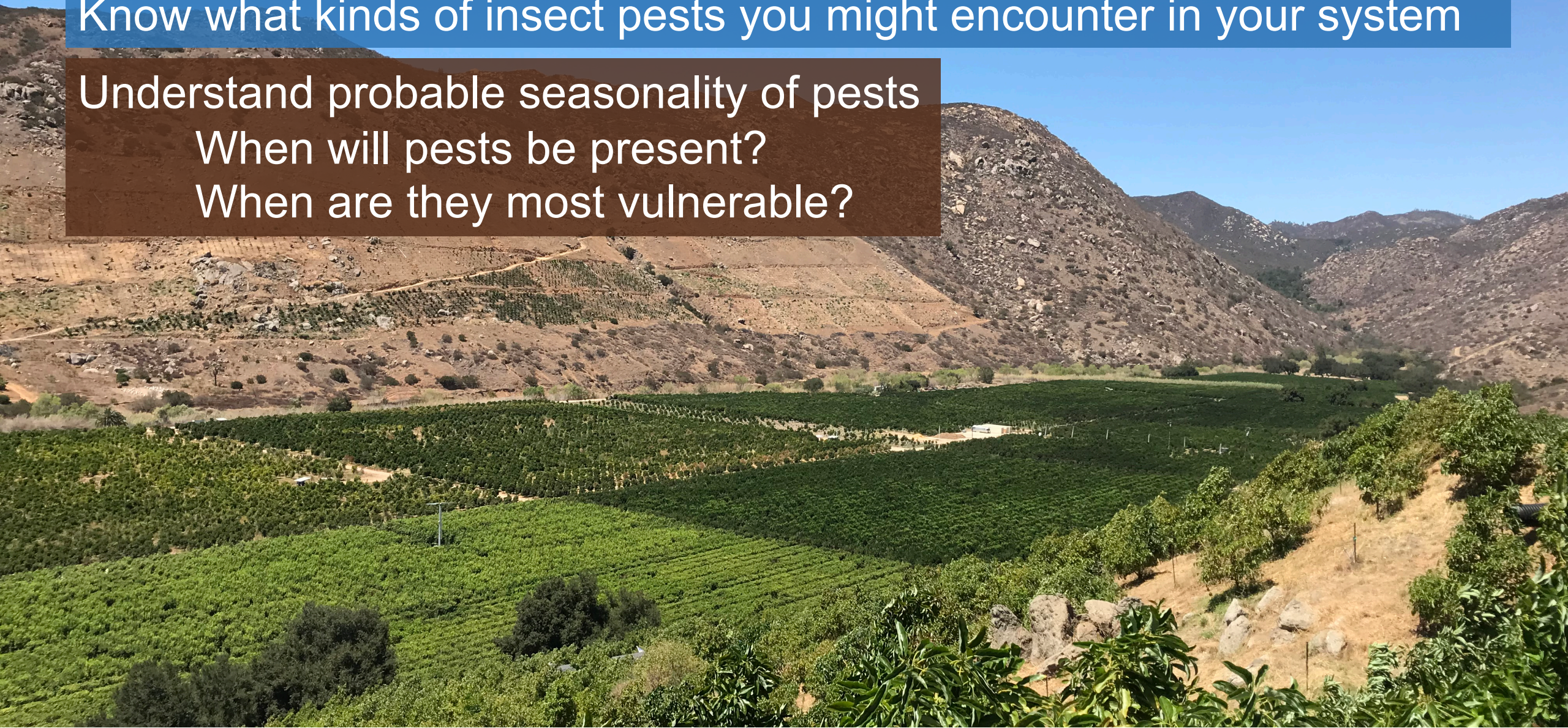
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Know what kinds of insect pests you might encounter in your system

Understand probable seasonality of pests

When will pests be present?

When are they most vulnerable?



Monitoring and Scouting

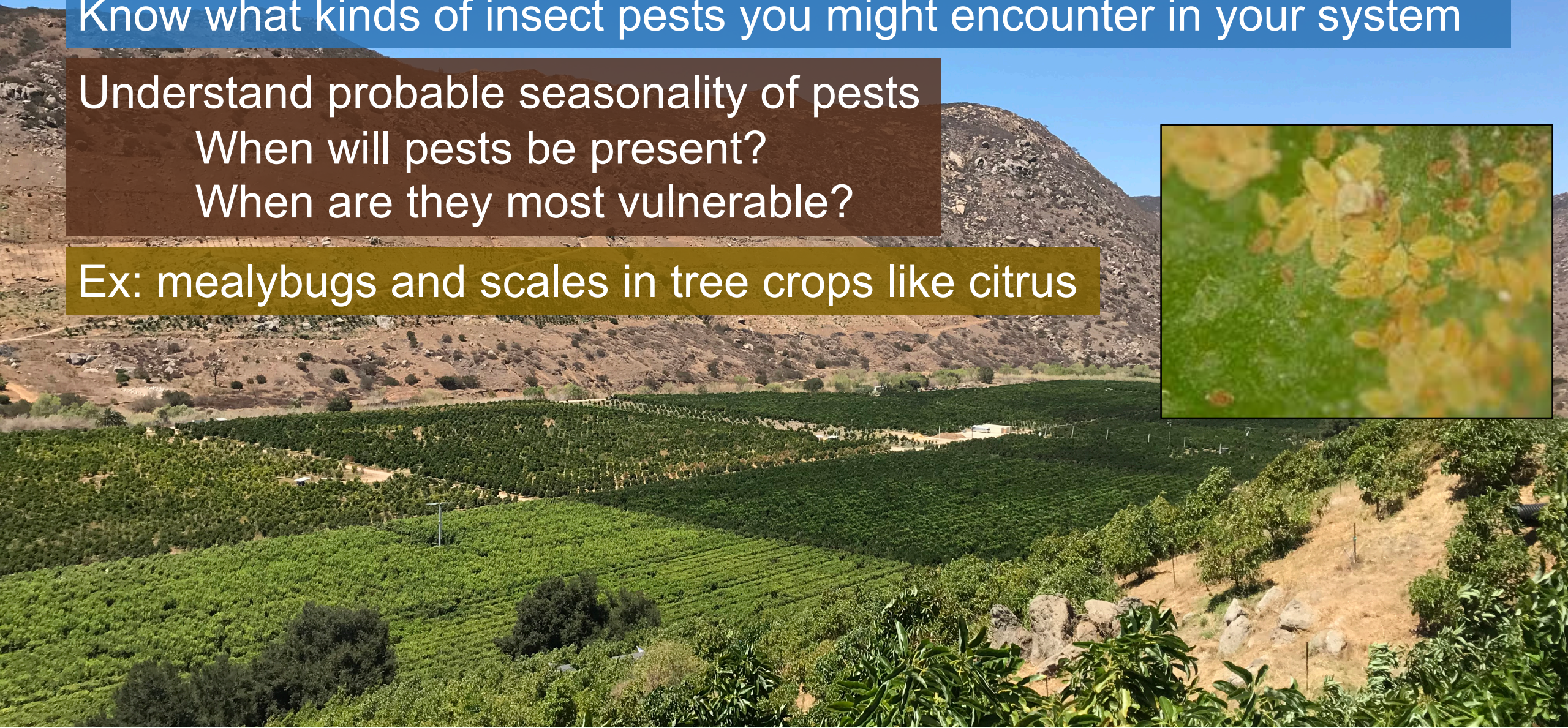
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Most vulnerable when crawlers present

Target treatments then



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Ex: Asian citrus psyllid in citrus

Feed on new flush

Target treatments when trees producing flush



Monitoring and Scouting



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Check your plants, keep notes



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Grape example

Divide the vineyard into quadrants.

Randomly select 5 vines (few vines in from the end of the row)

Look for mealybugs, leafhoppers, mites on each of the 20 vines.



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Sticky cards, pheromone traps



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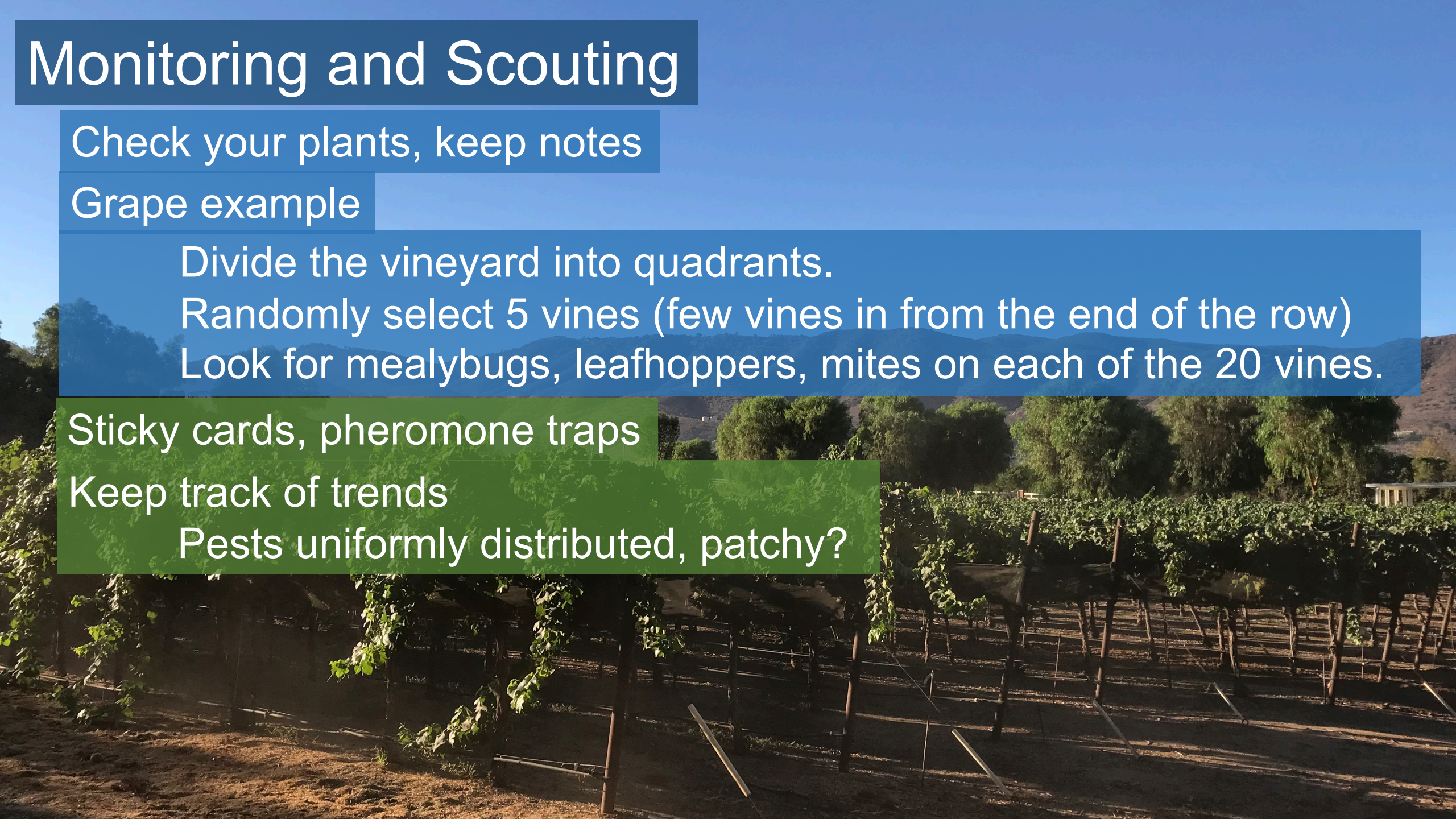
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Pests uniformly distributed, patchy?



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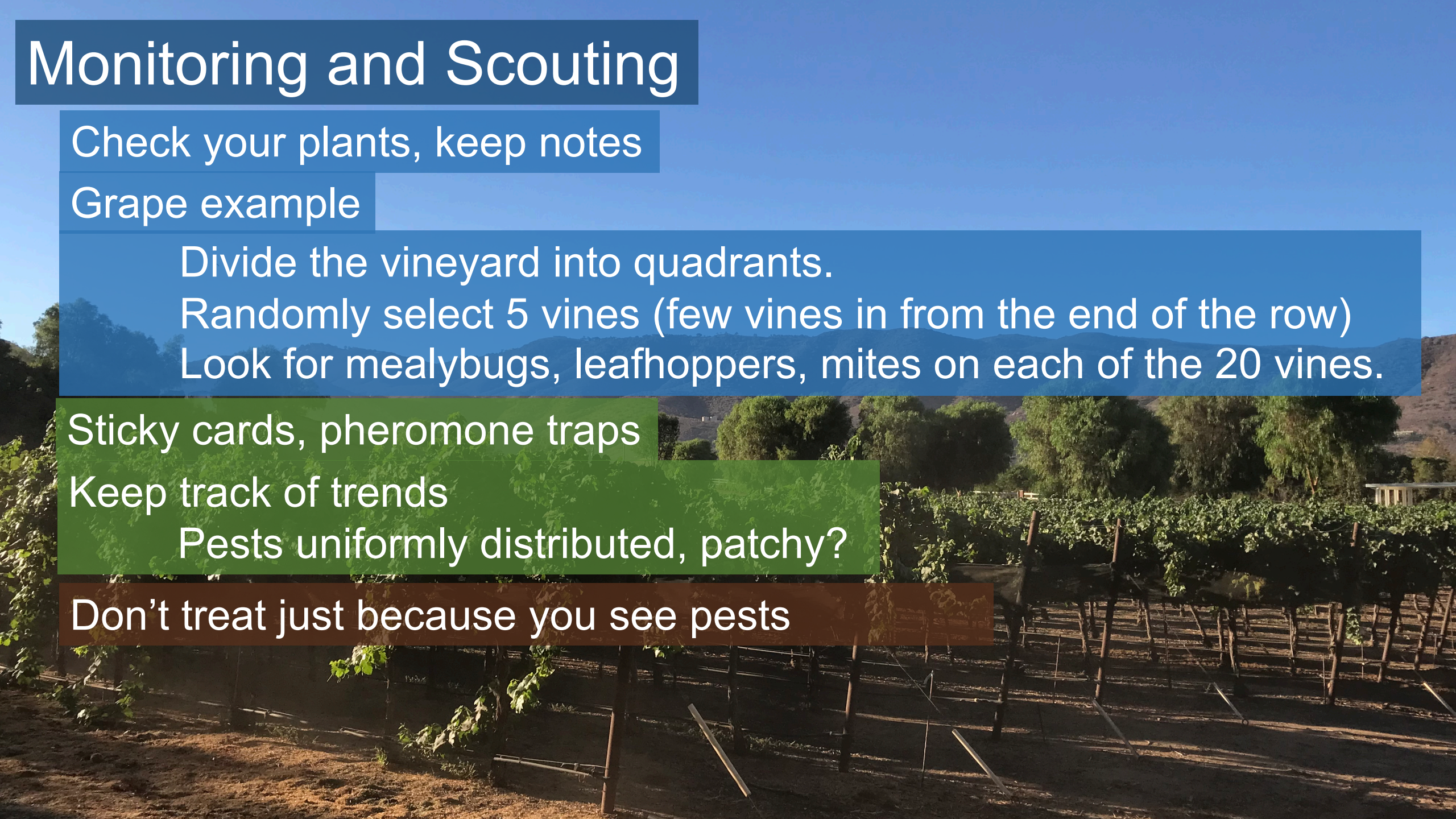
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Avocado brown mite

Often controlled by spider mite destroyers



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Monitor your system, know the trends



Prevention



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Proper water/nutrient management is pest management



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- Properly irrigated, fertilized

- Will prevent many insect pests



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Caused lots of concern



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Cause damage to tissue, fruit

Sting workers



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Fire ant in dragonfruit?

- Cause damage to tissue, fruit

- Sting workers

- More in water-stressed plants



Biological Control: Conservation



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Conservation Biological Control

Provide limiting resources for natural enemies

Pollen, nectar, stable habitat, alternative prey



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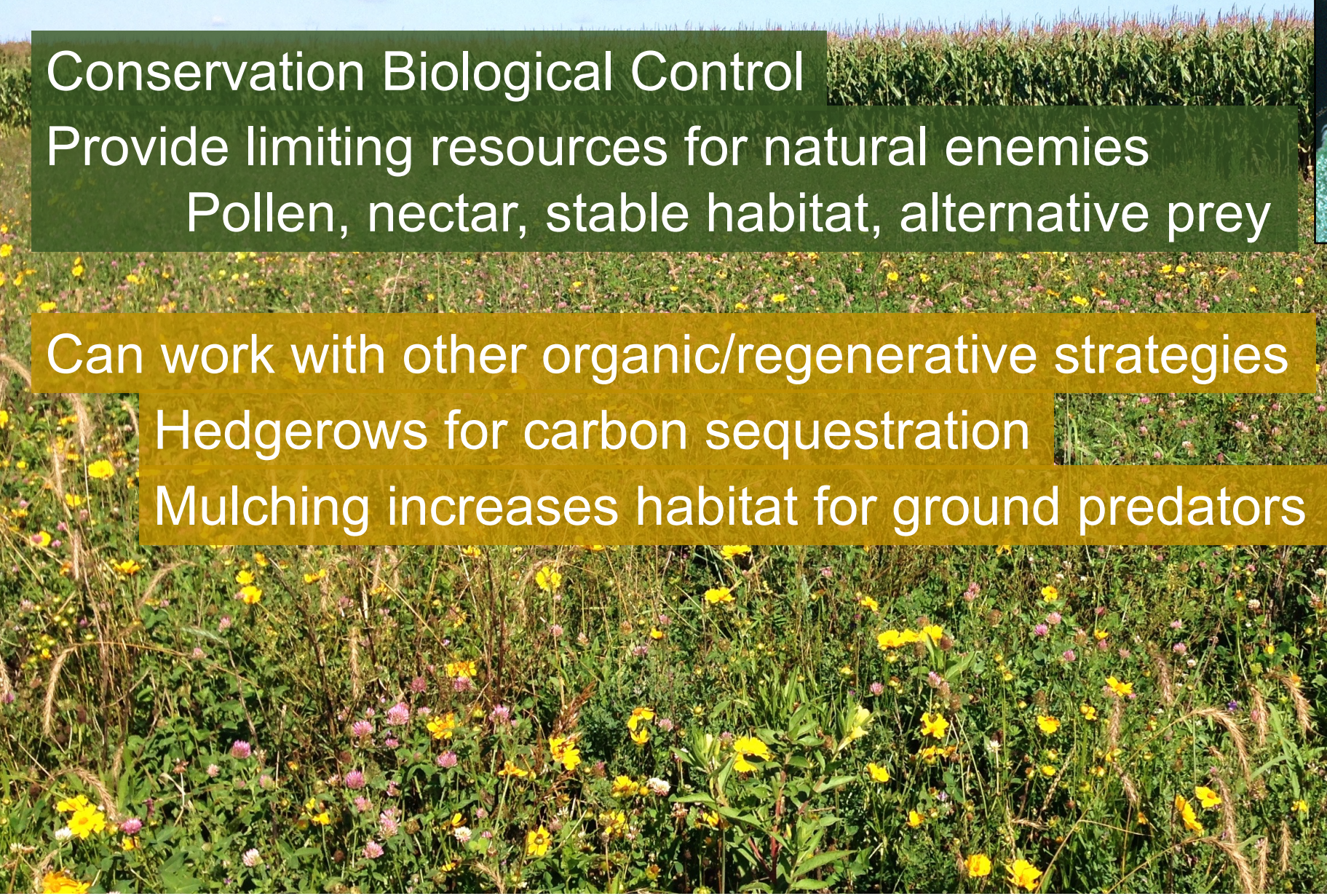
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Hedgerows for carbon sequestration

Mulching increases habitat for ground predators



Biological Control: Conservation

Conservation Biological Control

Provide limiting resources for natural enemies

Pollen, nectar, stable habitat, alternative prey

Can work with other organic/regenerative strategies

Hedgerows for carbon sequestration

Mulching increases habitat for ground predators

Often provides only baseline level of control...
...except in specific circumstances



Biological Control: Conservation



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Alyssum and Syrphid flies
Easily integrated into groves



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Oblique streaktail
Alyssum provides nectar for adults



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Provides for other natural enemies



Biological Control: Augmentative



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Cryptolaemus montrouzieri

Mealybug destroyer



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Can destroy large mealybug populations



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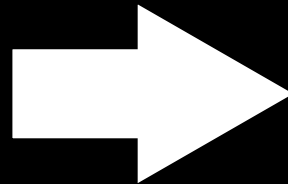
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Consumes most mealybug species

Can destroy large mealybug populations



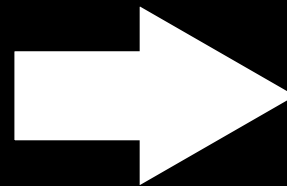
Biological Control: Augmentative

Cryptolaemus montrouzieri

Mealybug destroyer

Consumes most mealybug species

Can destroy large mealybug populations



Biological Control: Augmentative

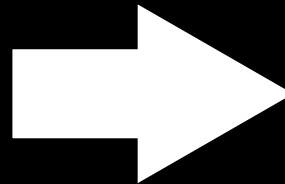
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Biological Control: Augmentative

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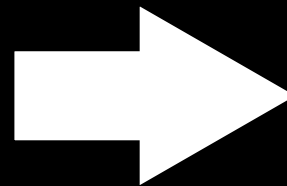
Mealybug destroyer

Consumes most mealybug species

Can destroy large mealybug populations

Will leave if mealybug populations drop

Also present in landscape



Biological Control: Conservation/Augmentative



Biological Control: Conservation/Augmentative

Banker plants in greenhouses for aphids



Biological Control: Conservation/Augmentative



Banker plants in greenhouses for aphids

Grow grasses (wheat, maize) with nonpest aphids

Biological Control: Conservation/Augmentative

Banker plants in greenhouses for aphids

Grow grasses (wheat, maize) with nonpest aphids

Parasitoids or predators survive on cereal aphids



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Aphidius colemani on bird cherry oat aphid
Controls green peach aphid, soybean aphid



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Controls Western flower thrips

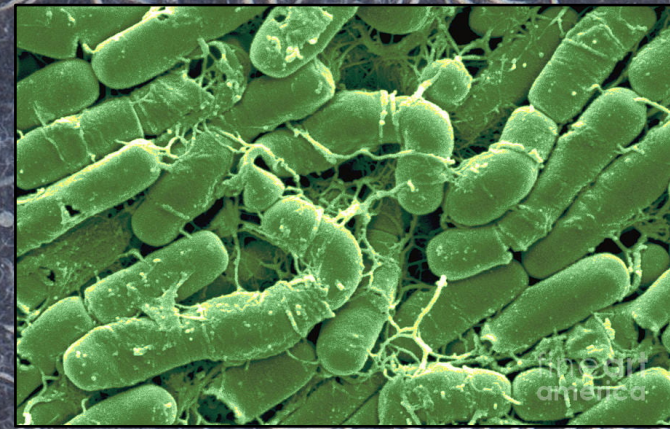


Biological Control: Entomopathogens



Biological Control: Entomopathogens

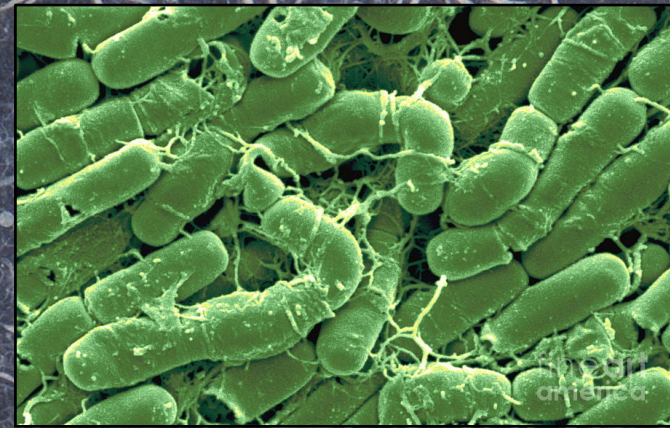
Bacillus thuringiensis



Biological Control: Entomopathogens

Bacillus thuringiensis

Insect larvae: flies, moths, beetles

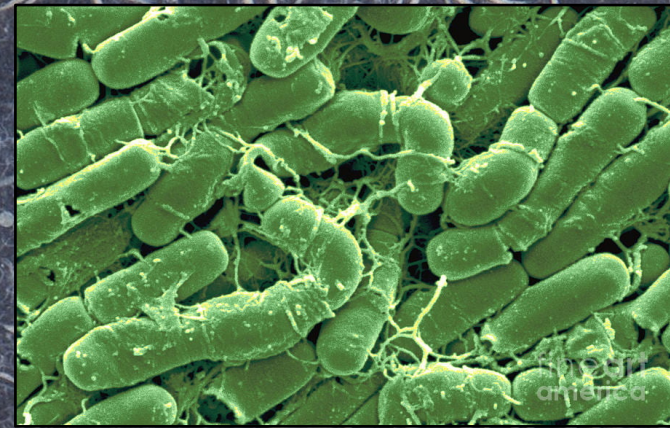


Biological Control: Entomopathogens

Bacillus thuringiensis

Insect larvae: flies, moths, beetles

Beauveria bassiana



Biological Control: Entomopathogens

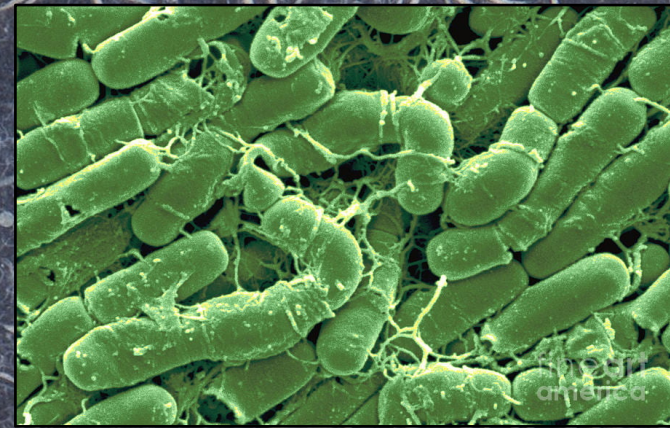
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Entomopathogenic fungus

Aphids, whiteflies, thrips



Biological Control: Entomopathogens

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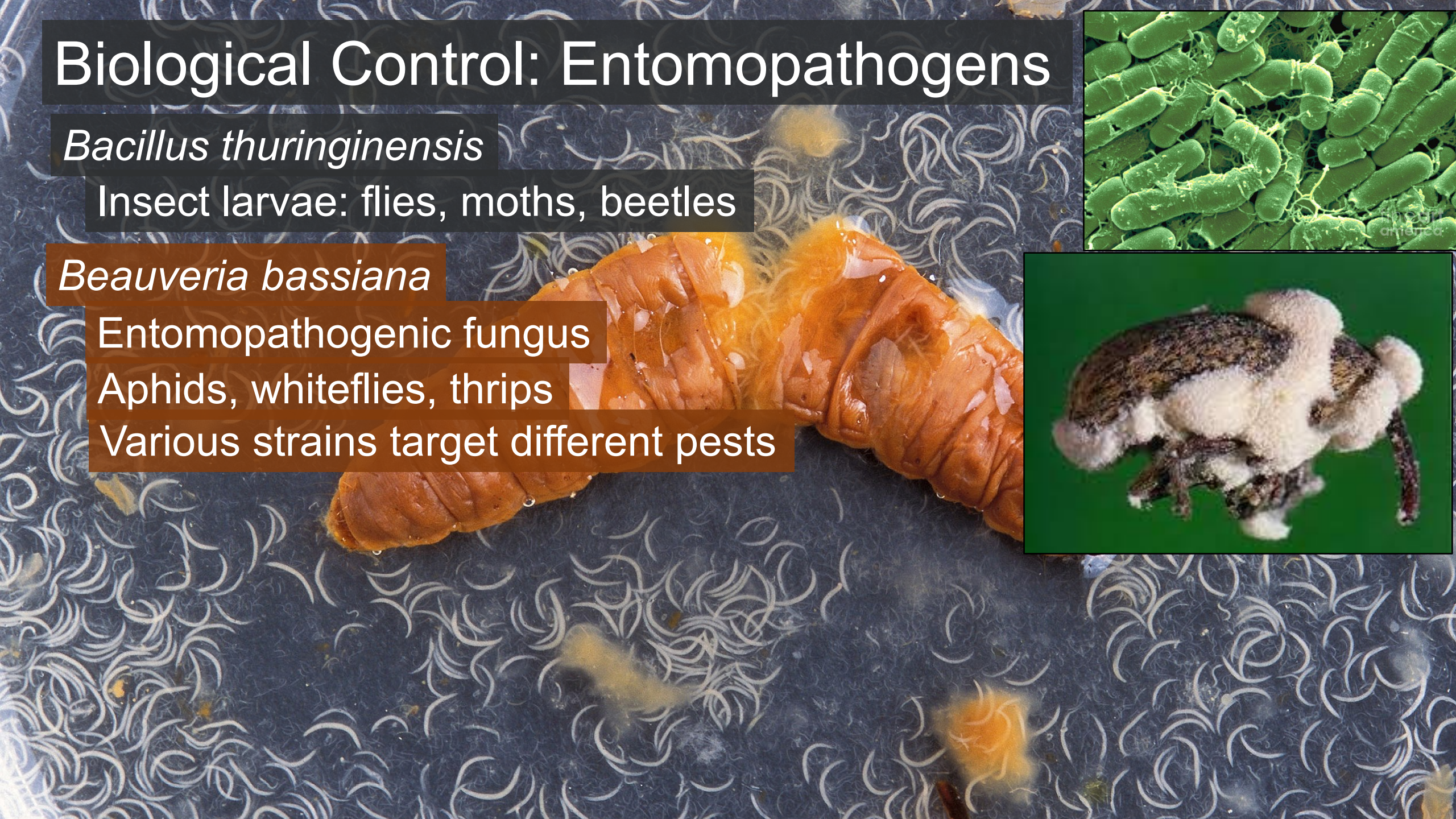
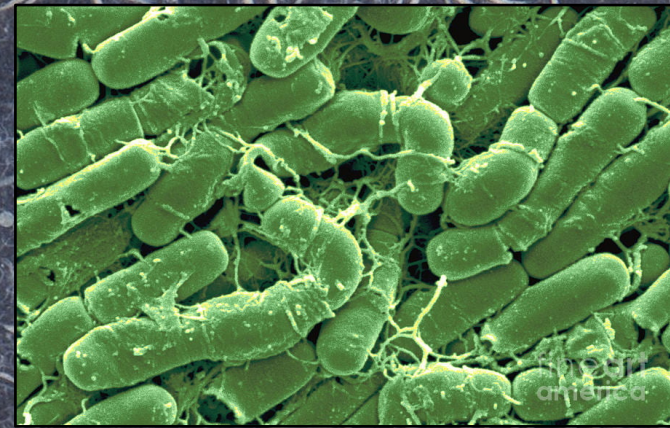
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Entomopathogenic fungus

Aphids, whiteflies, thrips

Various strains target different pests



Biological Control: Entomopathogens

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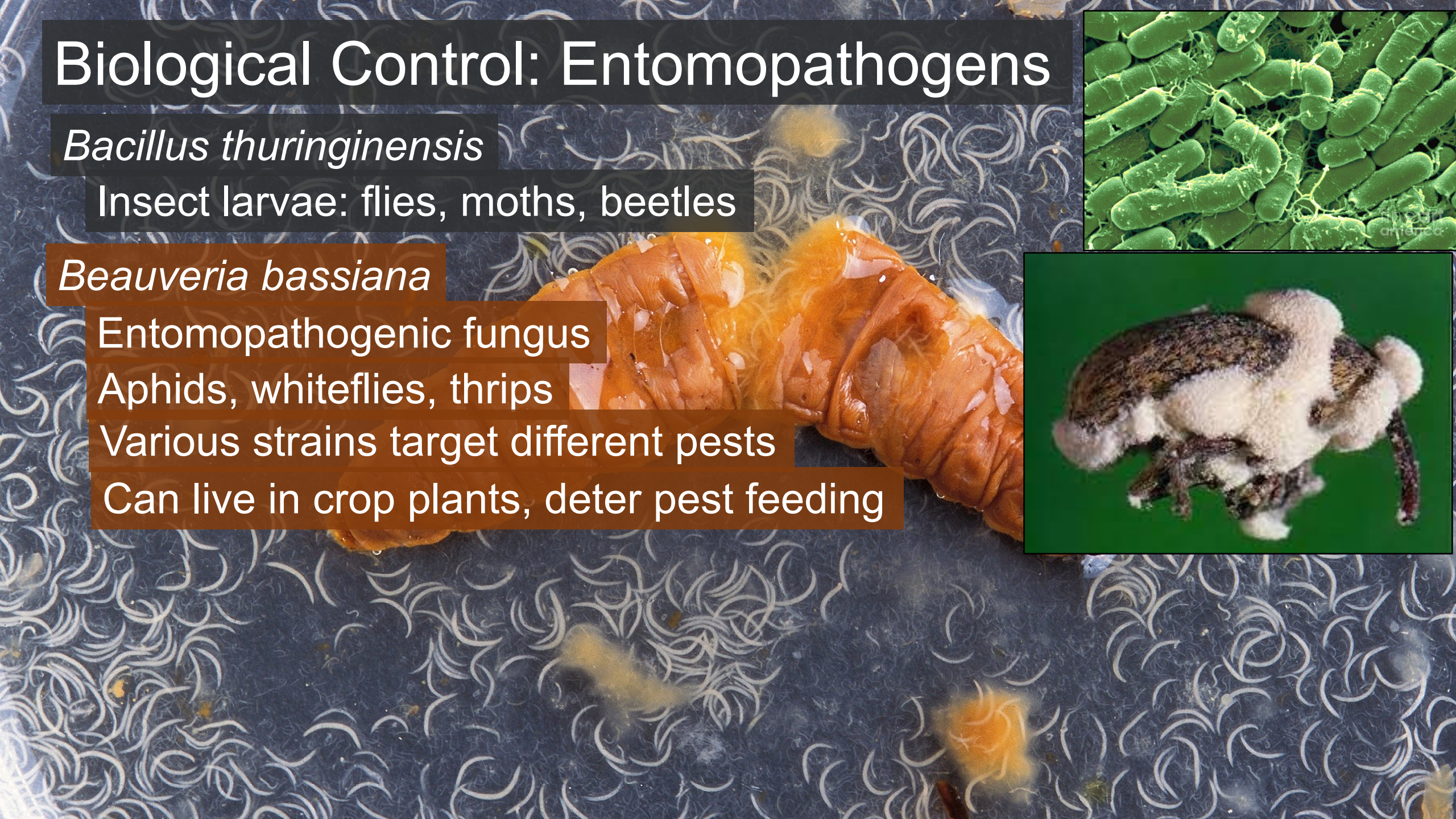
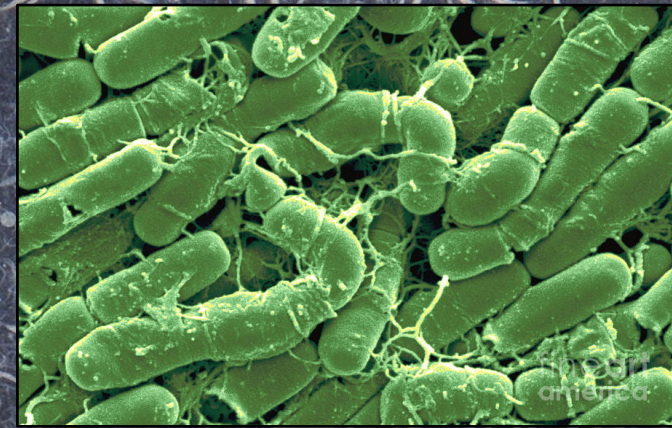
Beauveria bassiana

Entomopathogenic fungus

Aphids, whiteflies, thrips

Various strains target different pests

Can live in crop plants, deter pest feeding



Biological Control: Entomopathogens

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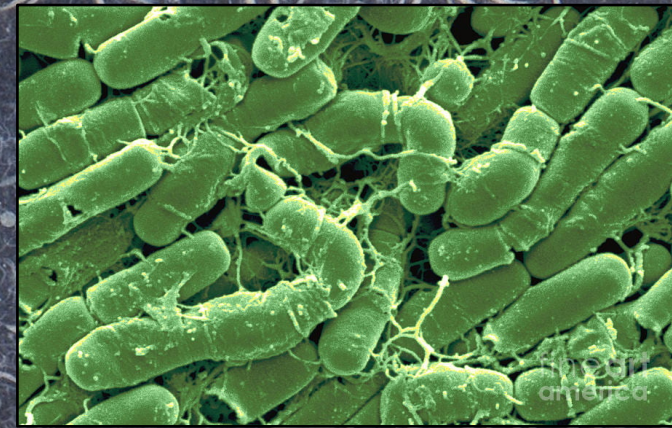
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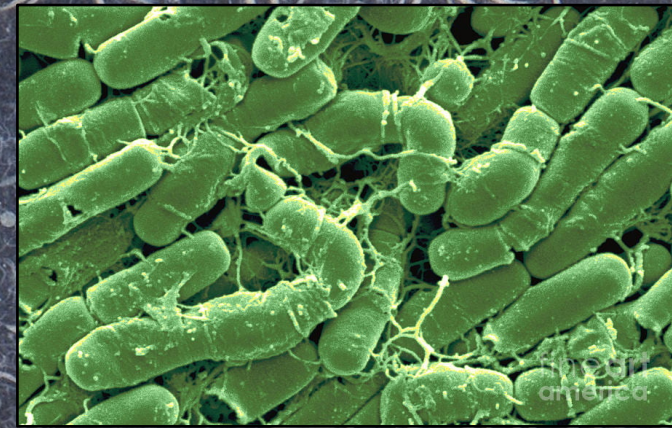
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Nematodes target soil-dwelling pests



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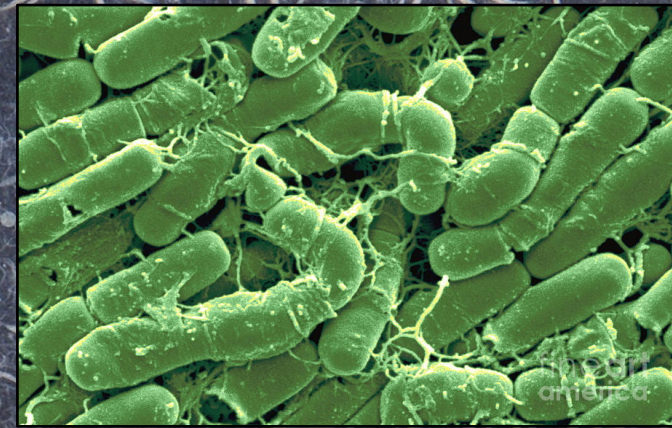
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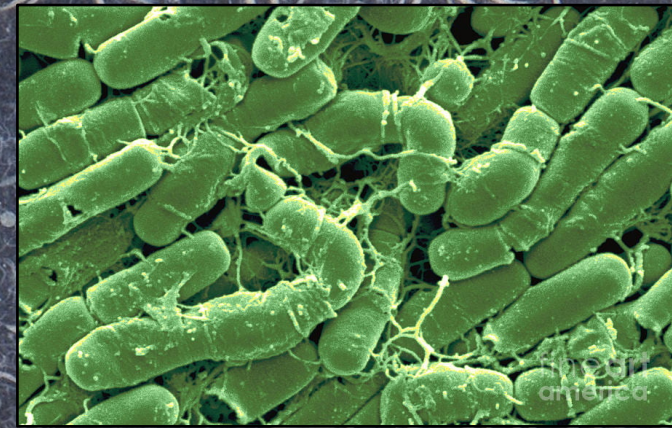
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Can inoculate soil to provide long-term control

Pests can develop resistance (harder)



Combine Chemical Control with Other Options

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Biological control and chemical control can be compatible

Especially true of organic pesticides which can have shorter residual

Tend to be softer on beneficials

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Relative toxicity of insecticides to natural enemies.		
INSECTICIDE	TOXICITY TO PARASITES AND PREDATORS ¹	
	Direct	Residual
microbial (<i>Bacillus thuringiensis</i>)	no	no
botanicals (pyrethrins)	yes/no ²	no
oil (horticultural), soap (potash soap)	yes	no
microbial (spinosad)	yes/no ²	yes/no ²
neonicotinoids (imidacloprid)	yes/no ²	yes
carbamates (carbaryl*), organophosphates (malathion), pyrethroids (bifenthrin)	yes	yes

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Timing is key
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Not always true: Spinosad, spinetoram harm syrphids

Ants: Control



Ants: Control

Boric Acid Baits



Ants: Control

Boric Acid Baits

Sugar solutions for Argentine ant

0.5% boric acid in 25% sucrose/water

Commercially available liquid bait stations



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Boric Acid Baits

Sugar solutions for Argentine ant

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Southern Fire Ant

Less likely to go for sugar. Sugar baits may work

Prefer fats, proteins

Baits exist, but frequently not organic



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Spot Treat Colonies: Spinosad, pyrethrins (not fire), hot water

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Spot Treat Colonies: Spinosad, pyrethrins (not fire), hot water
Ensure colony not near roots

Overview

Overview

Don't get stuck running in one place



Overview

Don't get stuck running in one place

Multiple techniques, get system to do work for you



Overview

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Multiple techniques, get system to do work for you

Monitoring, Scouting, and ID critical



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Natural Enemies and Biological Control important tools



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Ants good example of this



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Ants good example of this

Become an expert in your system



Where to Find Info?

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Statewide Integrated Pest Management Program

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What's New

- Ag Pest Management: [Cherry, Citrus, Cole Crops and Floriculture and Ornamental Nurseries](#) revised
- Pest Notes: [Wild Blackberries, Dallisgrass and Rabbits](#) revised, [Botryosphaeria Canker](#) added
- Home & Garden Pest Newsletter: [Fall 2022](#)
- Agriculture: [2022 Fungicides, Bactericides, Biocontrols, and Natural Products for Deciduous Tree Fruit and Nut, Citrus, Strawberry, and Vine Crops in California](#) (PDF)
- Three new videos about the invasive shothole borers' [biology](#), [trapping](#), and [management](#) were published

Home, Garden, Turf & Landscape Pests



Agricultural Pests



Natural Environment Pests



Exotic & Invasive Pests



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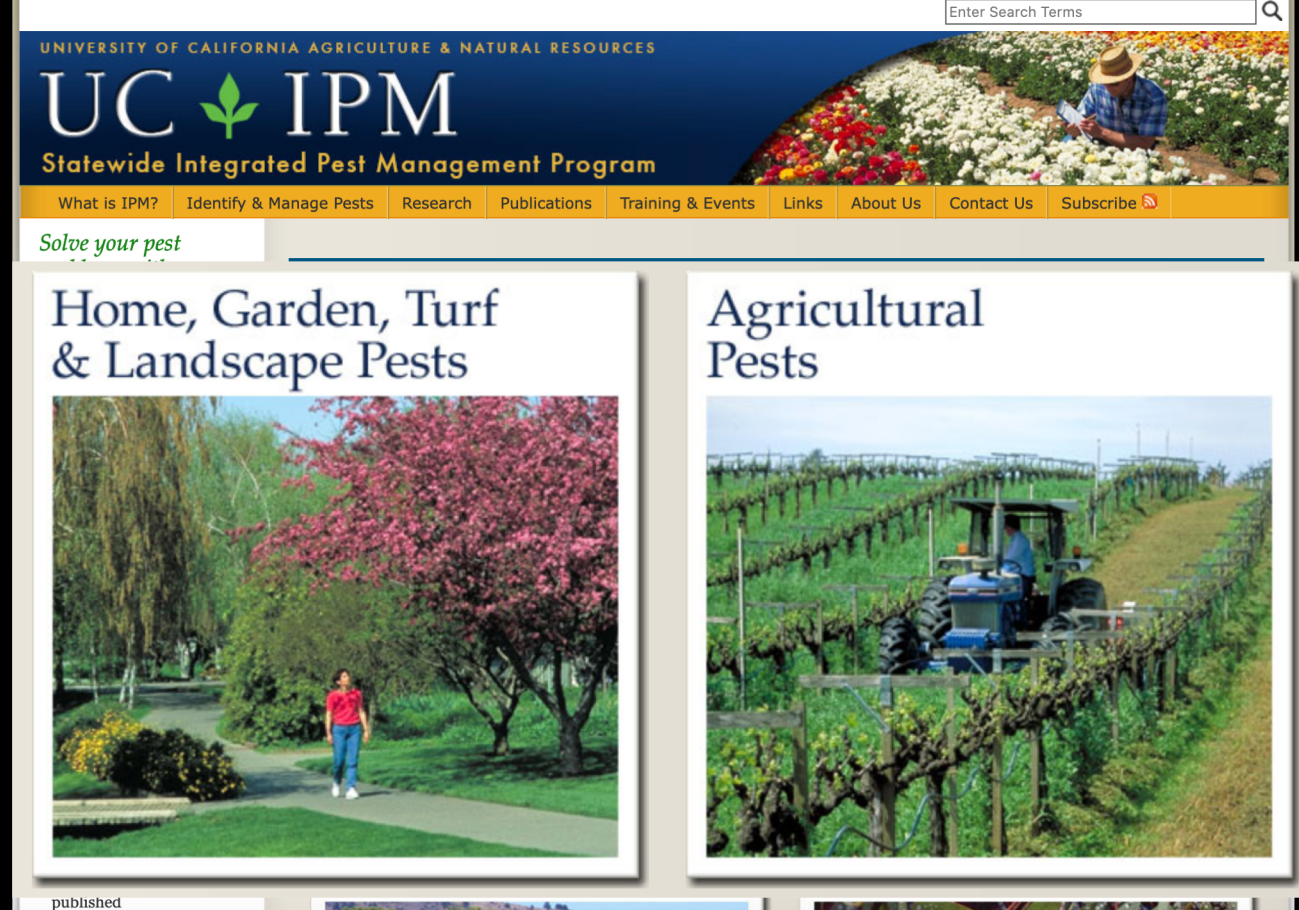


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Homes vs. Agricultural
Know where you are



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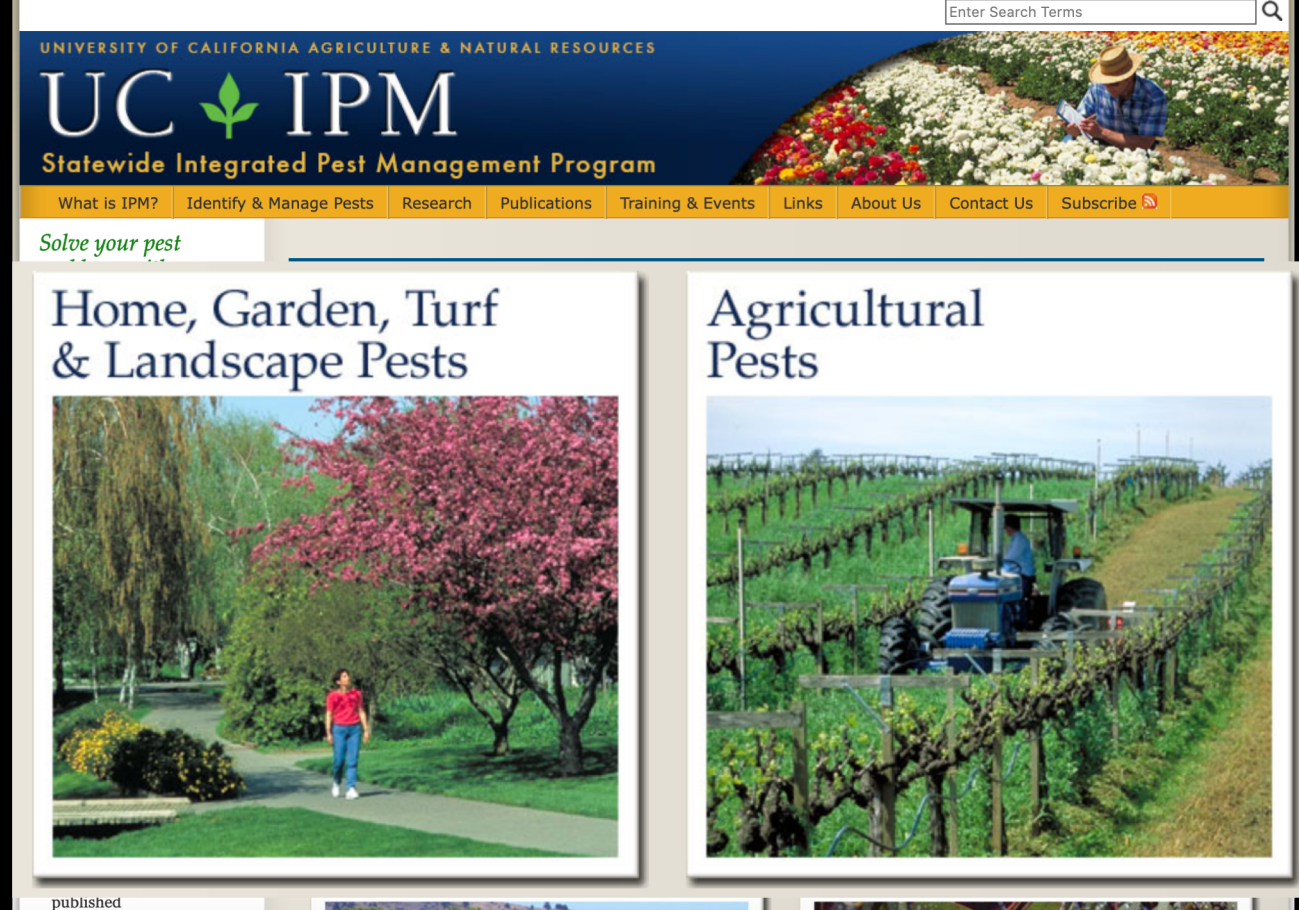
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Homes vs. Agricultural

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Depending on your scale,
both are applicable



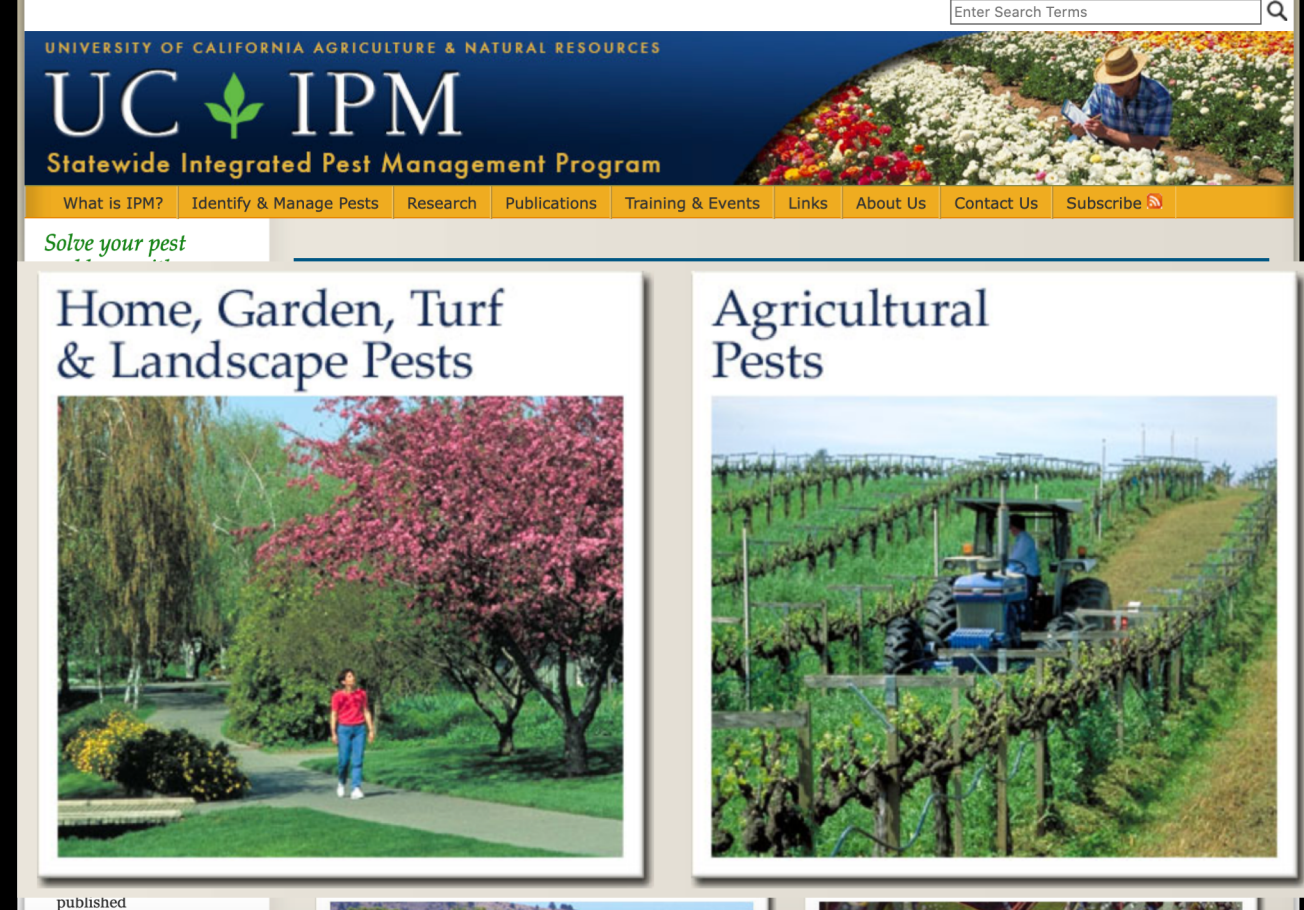
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[UC IPM Home](#) > [Homes, Gardens, Landscapes, and Turf](#) > [Fruits and Nuts](#) >

How to Manage Pests

Pests in Gardens and Landscapes

Pacific flatheaded borer—*Chrysobothris mali*

[Agriculture](#) / [Plum](#) / Pacific Flatheaded Borer

Agriculture: Plum Pest Management Guidelines

Pacific Flatheaded Borer

Chrysobothris mali

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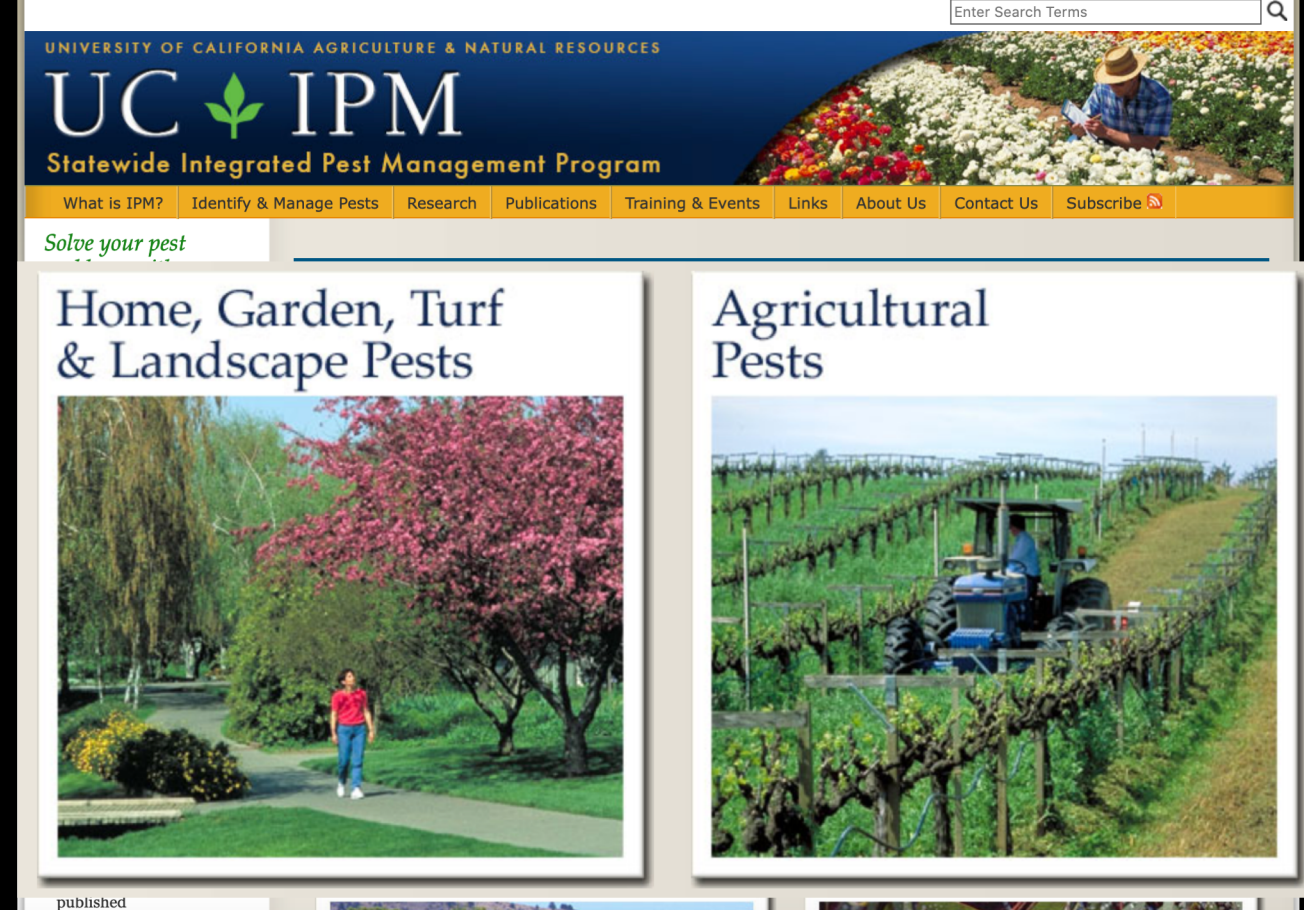
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Homes vs. Agricultural
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Both have relevant information



[UC IPM Home](#) > [Homes, Gardens, Landscapes, and Turf](#) > [Fruits and Nuts](#) >

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Avocado

University of California's official guidelines for pest monitoring techniques, pesticides, and nonpesticide alternatives

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☐ Insects, Mites, and Other Invertebrates



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Present in each county



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Present in each county

Won't necessarily be specialist in your system
Can find someone who knows, or can help



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Reach out to us with more specific questions
The more info you have, the better



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We may not know, but have tools to find out

A photograph of a large, dense field of green basil plants growing in a greenhouse. The plants are arranged in neat rows, and the leaves are vibrant green. In the background, the structure of the greenhouse is visible, including metal frames and translucent covering. The overall scene is bright and healthy.

Questions?

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egmmiddleton@ucanr.edu

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