Disease Management in Organic Systems and Allium, Spinach, Strawberry Case Studies

Steven T. Koike
University of California
Cooperative Extension

Monterey County, California

Monterey County agriculture: $ 4.14 billion

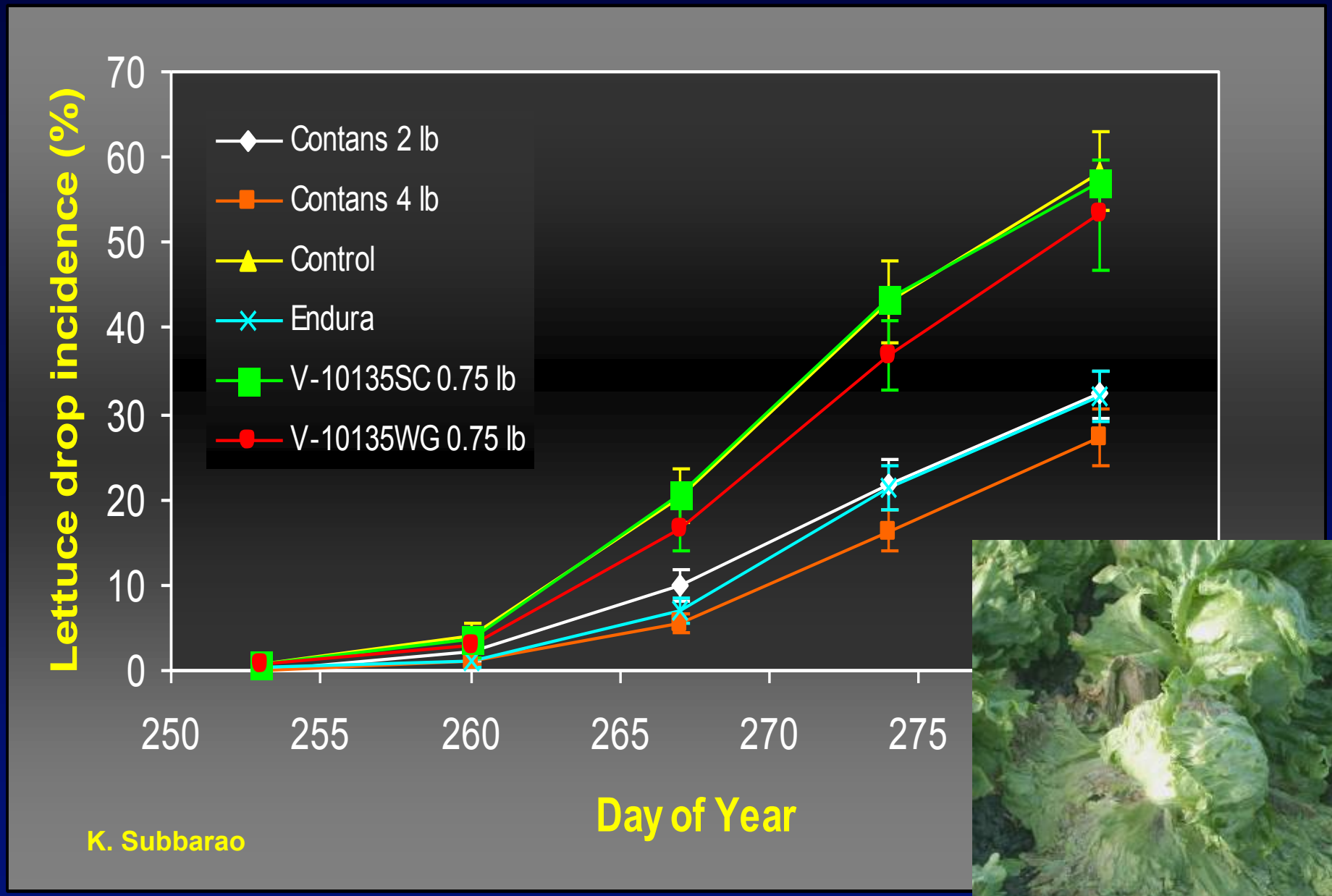
Artichoke
Arugula
Asparagus
Basil
Bean
Beet
Bok choy
Broccoli
Brussels spts.
Cabbage
Carrot
Cauliflower
Celery
Chickpea
Chinese cabbage
Cilantro
Corn salad
Cucumber
Endive
Escarole
Fava bean
Fennel
Garlic
Kale
Leafy mustards
Leek
Lettuce
Mint
Onion
Parsley
Pea
Pepper
Radicchio
Radish
Rappini
Spinach
Squash
Swiss chard
Tomatillo
Tomato
Blueberry
Caneberry
Grape
Strawberry
Ornamentals

Organics: Coastal California

- Important, increasing, of great interest
- Has not supplanted conventional prod.
- Disease mgmt. remains challenging
- Soilborne pathogens are major issues
- Available IPM tools remain limited:
  - Resistant cultivars
  - Fungicides or other applied products*
  - Crop rotation / site selection
  - Cultural practices (esp. sanitation)

* Named products refer only to research and/or practices in CA.

Coniothyrium biocontrol agent: Lettuce drop control



Celery Fusarium yellows

Crop rotation Salinas Valley style*

lett	lett	spin	spin	spin	lett	caul
lett	spr mix	arug	lett	broc	cel	lett
lett	cil	par	caul	spr mix	lett	fava
broc	pep	lett	lett	cel	onion	lett

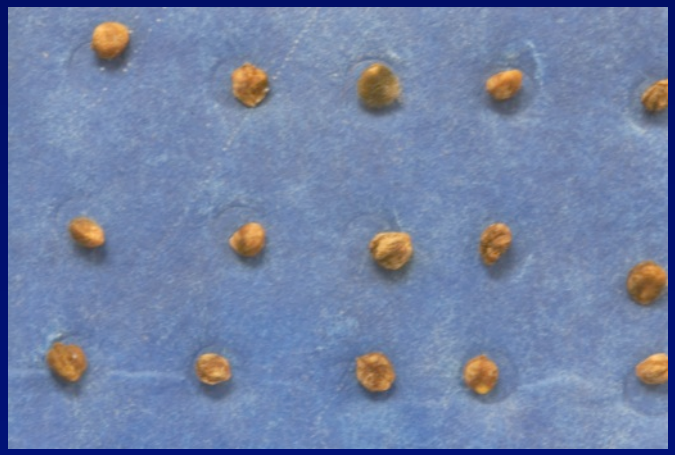
* Conventional

Importance of accurate disease diagnosis

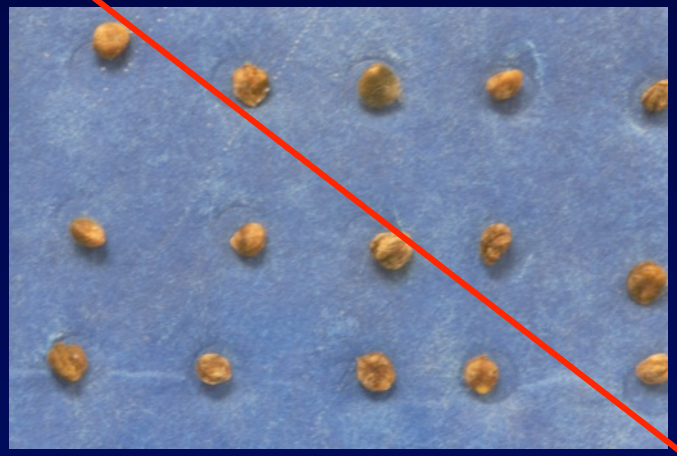
- Can't effectively manage a problem without knowing what is causing it.
- For the grower, finding the cause of the problem is a very high priority.
- Guessing is risky (agriculture/biology, business).
- Survival of the fittest: those who problem-solve more effectively will be more successful.

A. What is wrong?

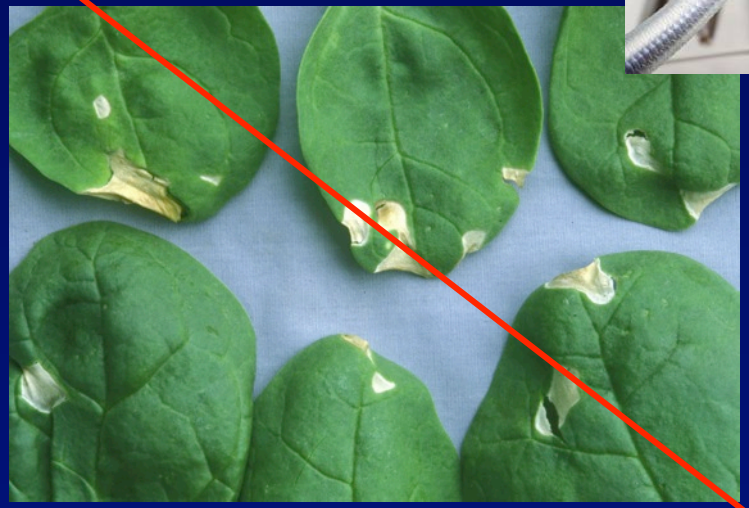
B. What can be done?



B. What can be done?

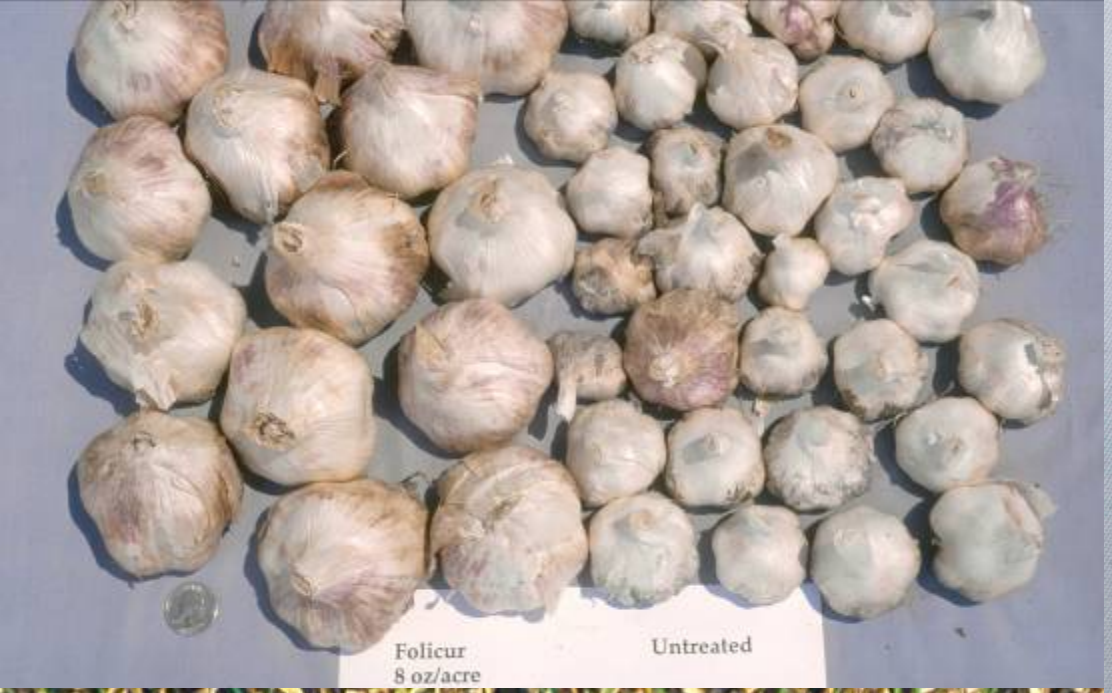


A. What is wrong?



Disease mgmt.: Organic alliums

- Rust, downy mildew, Botrytis, bact. bl.
  - Some cultivars less susceptible?
- Soilborne diseases
  - Crop rotation with non-hosts
  - Sanitation: avoid pathogen spread in soil
- Viruses (IYSV)
  - Vector mgmt.
  - Pathogen reservoirs


Folicur
8 oz/acre
Untreated

untreated
Quilt

Wild garlic

Chives

2007:
Rust on leek

Different strains / species of allium rust in California?

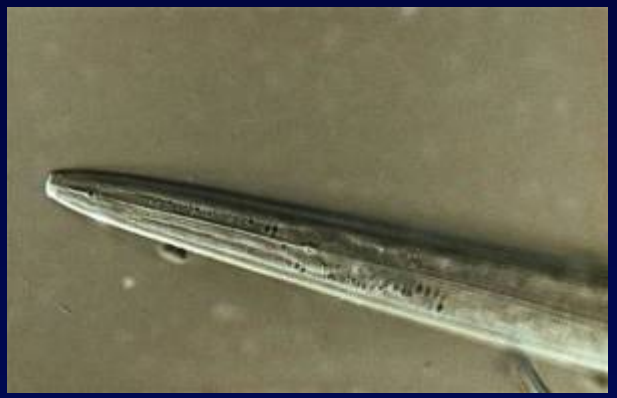
	Garlic rust from late 1990s	Garlic rust from 2007-2014
Infect garlic?	yes	yes
Infect leek?	no	yes

Bacterial blight of leek: Pseudomonas

Bacterial blight of chives: Xanthomonas

Skin blotch & bulb canker: *Embellisia allii*

Stem and bulb nematode (Ditylenchus)



Fusarium culmorum: basal plate rot

F. avenaceum

Leek

Basal plate rot?
Fusarium oxysporum

Sclerotium cepivorum

Iris yellow spot virus

H. Pappu

Iris yellow spot virus

IYSV

Disease mgmt.: Organic spinach

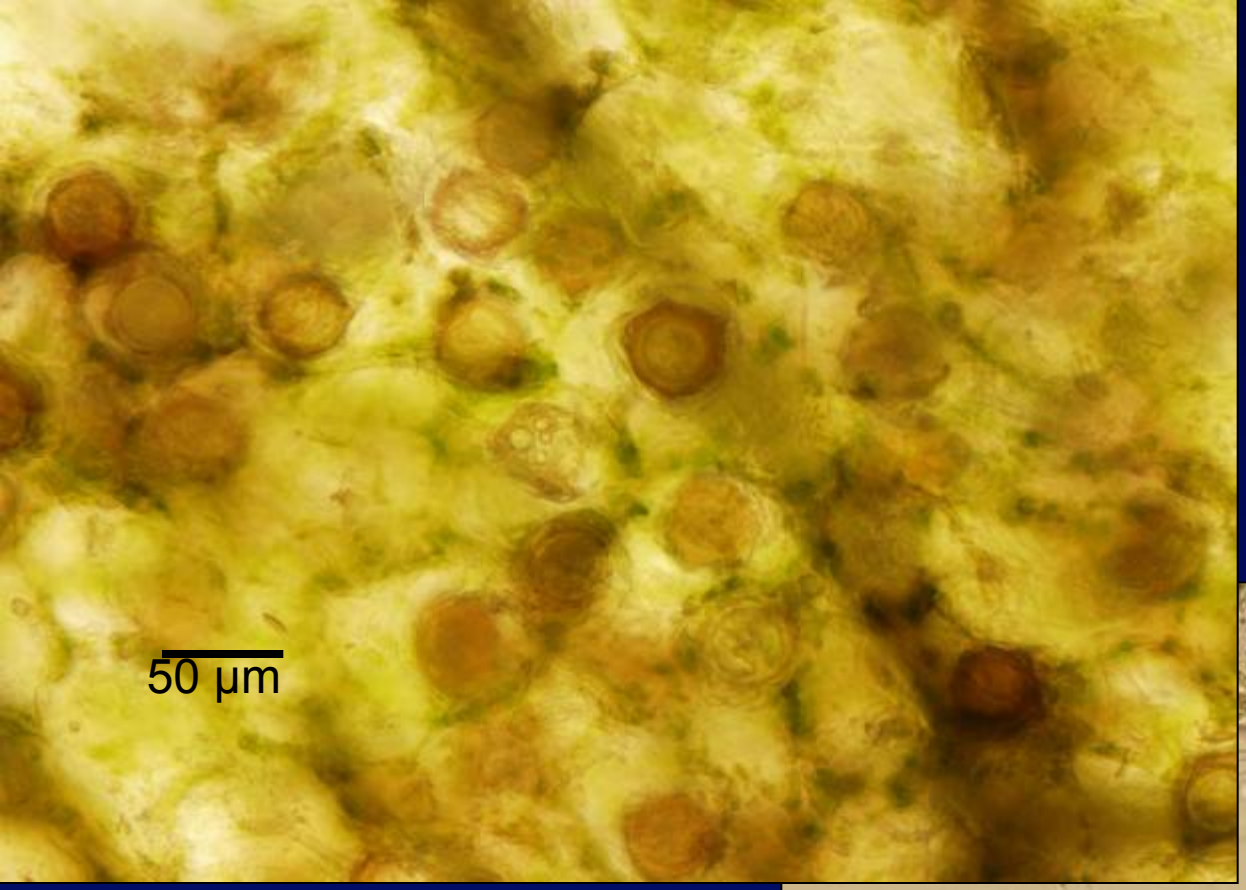
- Downy mildew, leaf spots
  - Resistance
  - Fungicides?
- Soilborne diseases
  - Crop rotation with non-hosts
  - Sanitation: avoid pathogen spread in soil

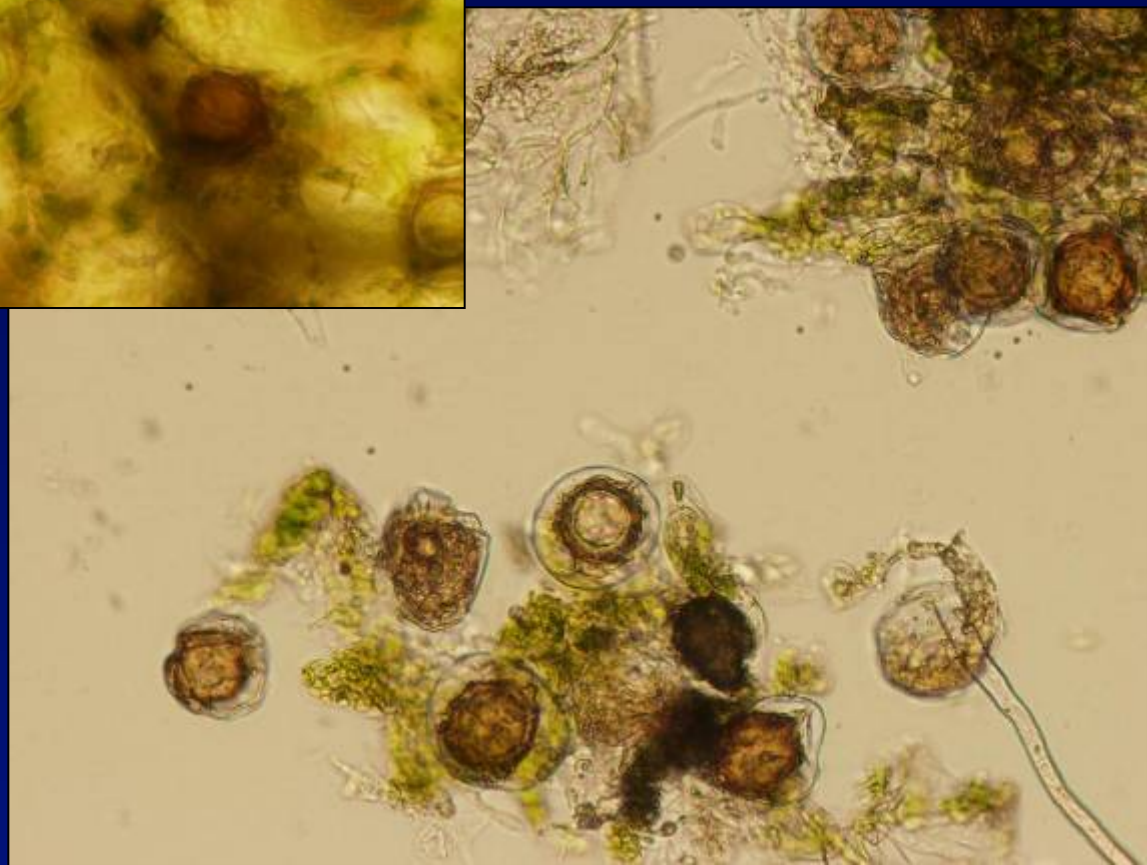
Spinach downy mildew races: new race 15

R2 R3 R4 R5 R6 R7 R9 R10 11 12 13 14 15

1990
in CA

‘08 ‘09 ’10 ’12 ‘14





Oospore stage of spinach downy mildew

Spinach DM oospores?

- Found on seed: Viable? Importance?
- Enable survival in soil / between crops?
- Means of introduction of new races?

- A proposed theory: organic spinach fields are the source of new races
  - No fungicides on seed: oospore survival
  - Problems with control of dm in the field

Spinach downy mildew races: new race 15

R2 R3 R4 R5 R6 R7 R9 R10 11 12 13 14 15

1990
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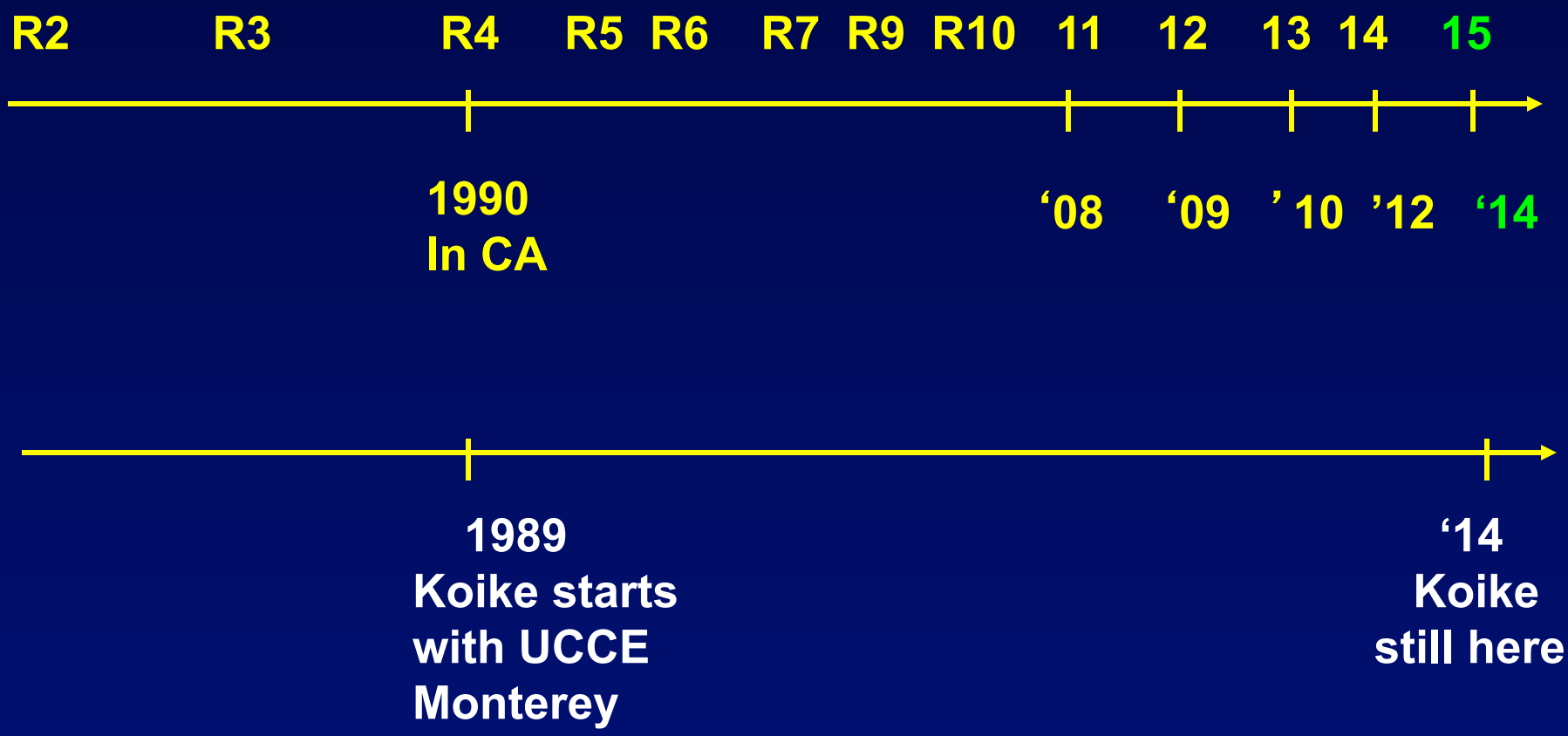
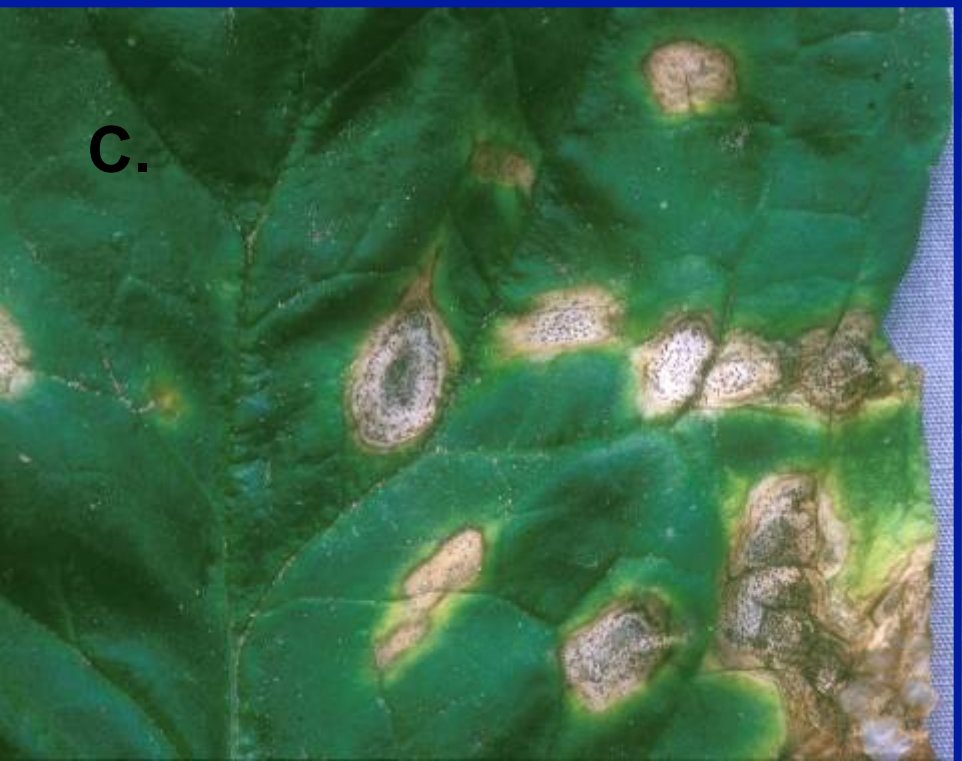
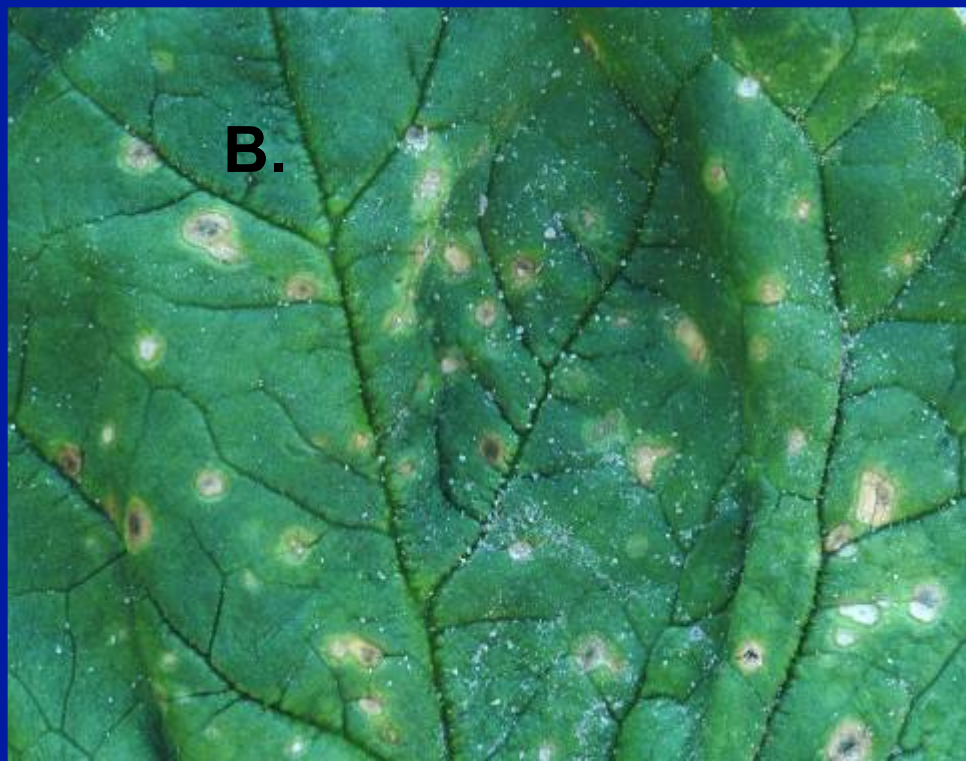
‘08 ‘09 ’10 ’12 ‘14

Spinach downy mildew races: CA correlation



A. Stemphylium
B. Cladosporium
C. Colletotrichum





Phytophthora

Fusarium oxysporum

Rhizoctonia solani

Disease mgmt.: Organic strawberry

- Powdery mildew
  - Tolerant cultivars
  - Fungicides: sulfur, others?
- Botrytis gray mold?
- Soilborne diseases
  - Tolerant cultivars
  - Crop rotation with non-hosts
  - Sanitation: avoid pathogen spread in soil

Charcoal rot

Fusarium wilt

Verticillium wilt

Diagnostic challenge: Similar symptoms

Symptoms	*Mac.*	*Fus.*	*Verticillium*	*Phytoph.*
Poor growth	yes	yes	yes	yes
Stunting	yes	yes	yes	yes
Dieback	yes	yes	yes	yes
Pl. collapse	yes	yes	yes	yes
Crown discolor	yes	yes	no	yes
Stress factor	yes	yes	yes	no
Assoc. w/ H_2O	no	no	no	yes

June 21, Salinas, Macrophomina

July 5, Salinas, Macrophomina

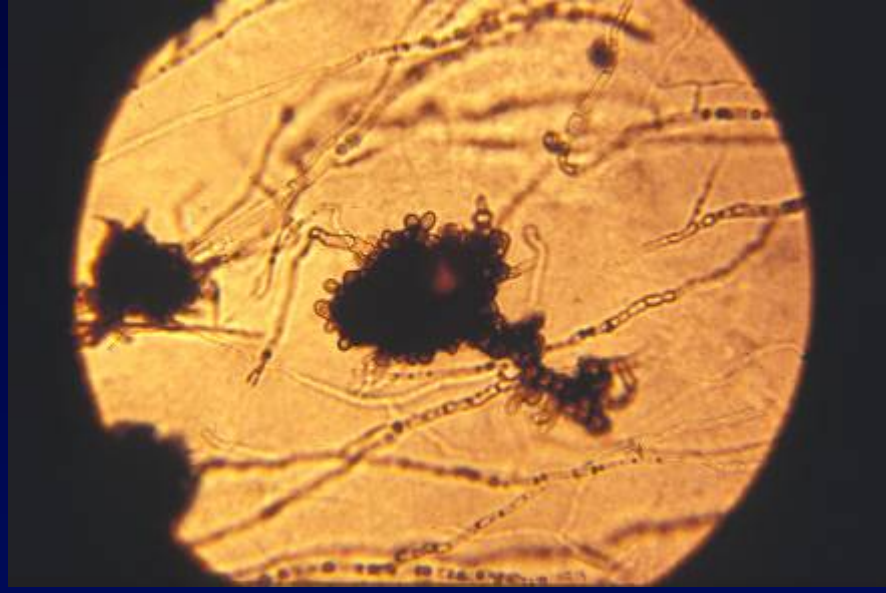
July 26, Salinas, Macrophomina

Cultivar comparisons

Cultivar	*Macroph.*	*Fusarium*
Chandler	"resistant"	susceptible
Seascape	"resistant"	susceptible
Monterey	susceptible	"resistant"
San Andreas	susceptible	"resistant"
Ventana	susceptible	"resistant"
Albion	susceptible	susceptible

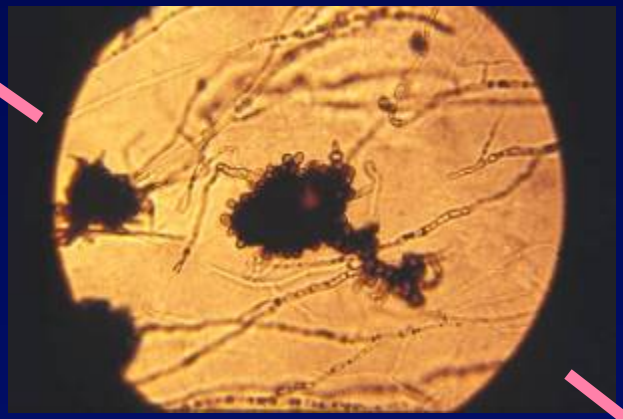
* Resistant ≠ Immune

Koike



Verticillium wilt

Strawberry



Lettuce