Recent Progress in our Understanding of Verticillium wilt of Lettuce

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Verticillium Wilt of Lettuce





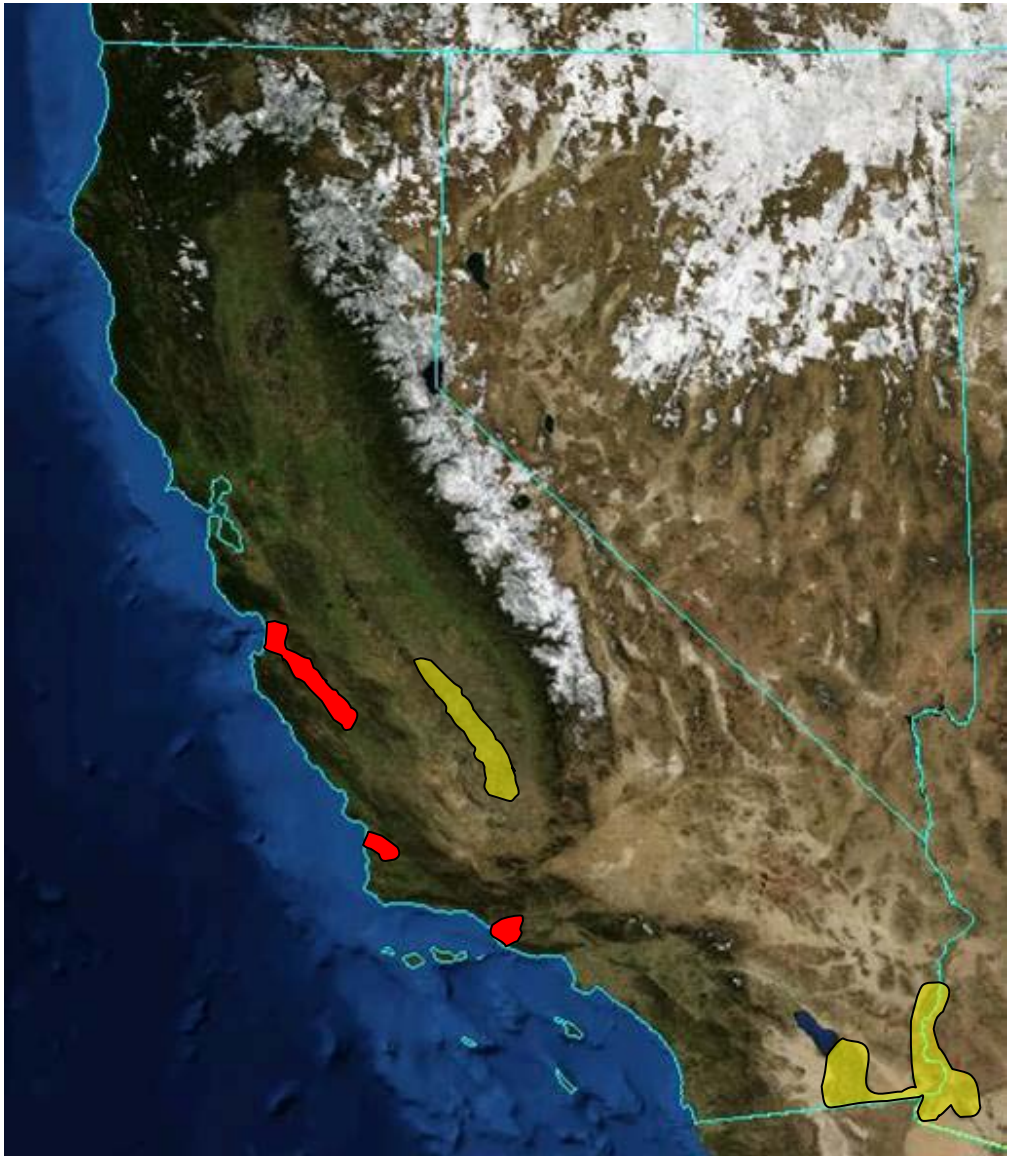



Verticillium Wilt of Lettuce

LETTUCE PRODUCTION

Year-round in CA:

- Imperial Valley production
- San Joaquin Valley (seed)
- Coastal production



Verticillium Wilt of Lettuce

VERTICILLIUM WILT

Foliar Symptoms:

- Angular Chlorosis
- Necrosis
- Wilting
- Darkening of Leaf Veins
- Acropetal Progression
- Collapse of Head

Verticillium Wilt of Lettuce

VERTICILLIUM WILT

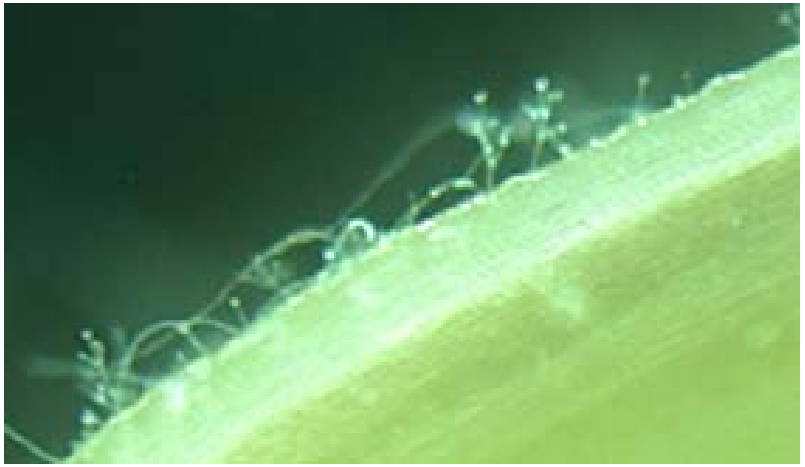
Root Symptoms:

- Vascular Discoloration
- Occur ~2 wk before foliar symptoms

Verticillium Wilt of Lettuce

- Caused by *V. dahliae*
  - Conidia
  - Microsclerotia
  - No known sexual stage
- Cross-pathogenic
  - Artichoke
  - Strawberry
  - Solanaceous crops
  - Non-domesticated plants
- Seedborne

  (Vallad et al. 2005)



Verticillium Wilt of Lettuce

Verticillium wilt development

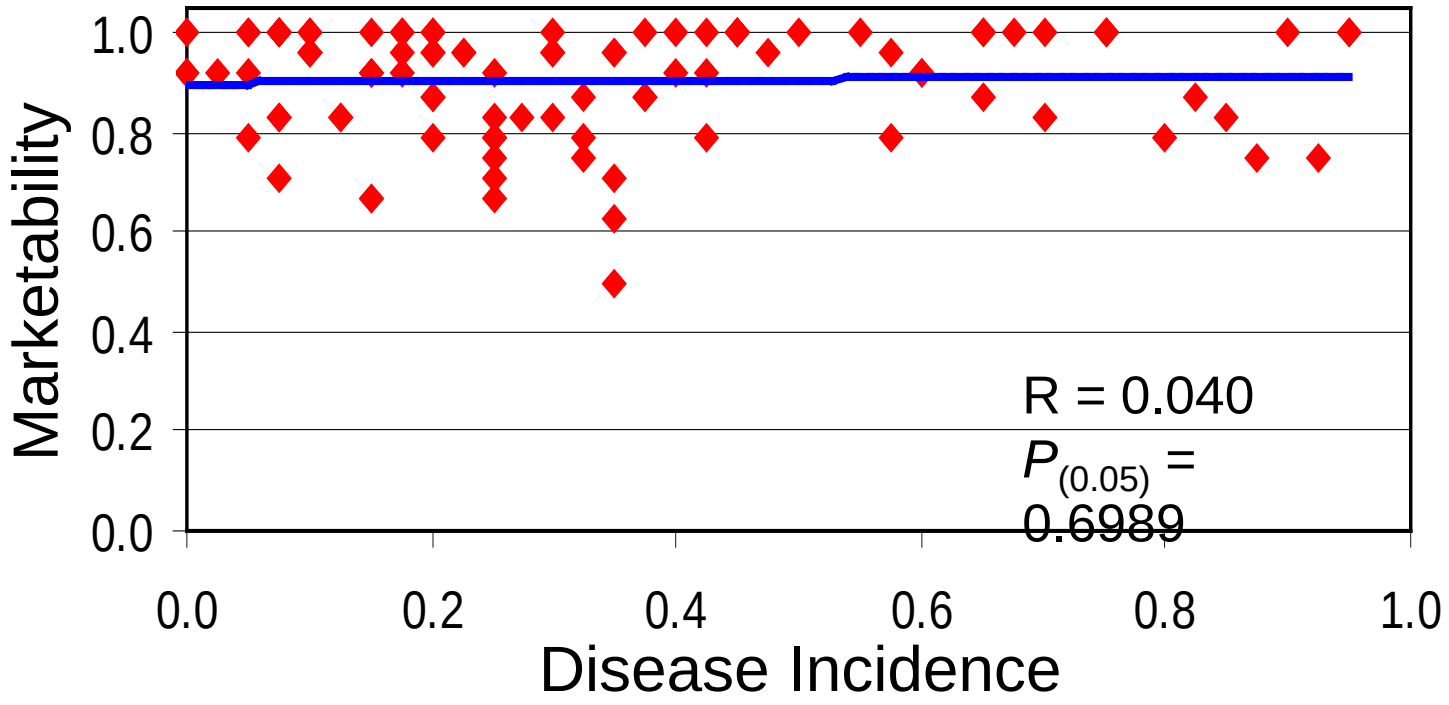
≤ 2 Weeks

Possible Short-term Solution:

Harvest Early

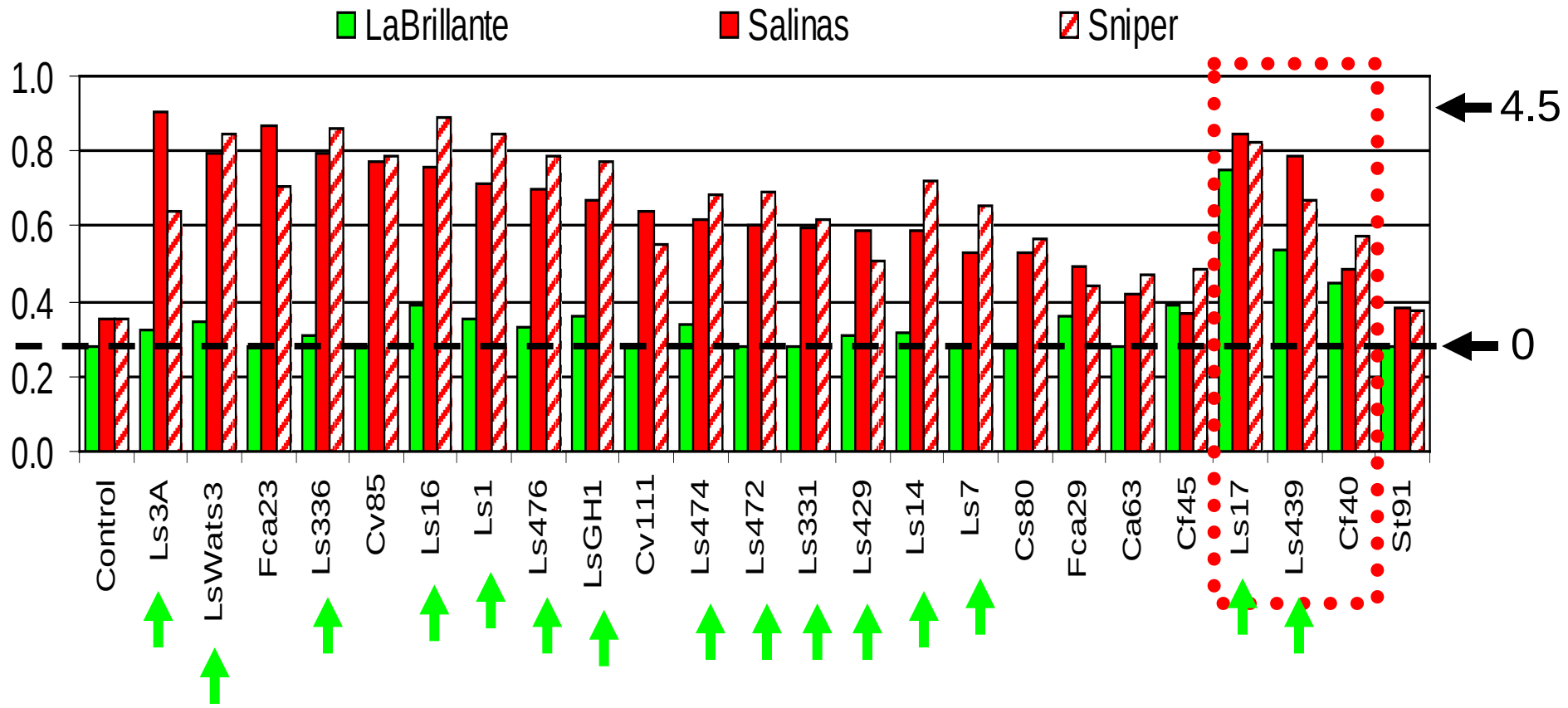
Post-Harvest Quality?

NO RELATIONSHIP BETWEEN DI AND PH QUALITY



- Across all lettuce types and three independent experiments

Relative Marginal Effects: Disease Severity

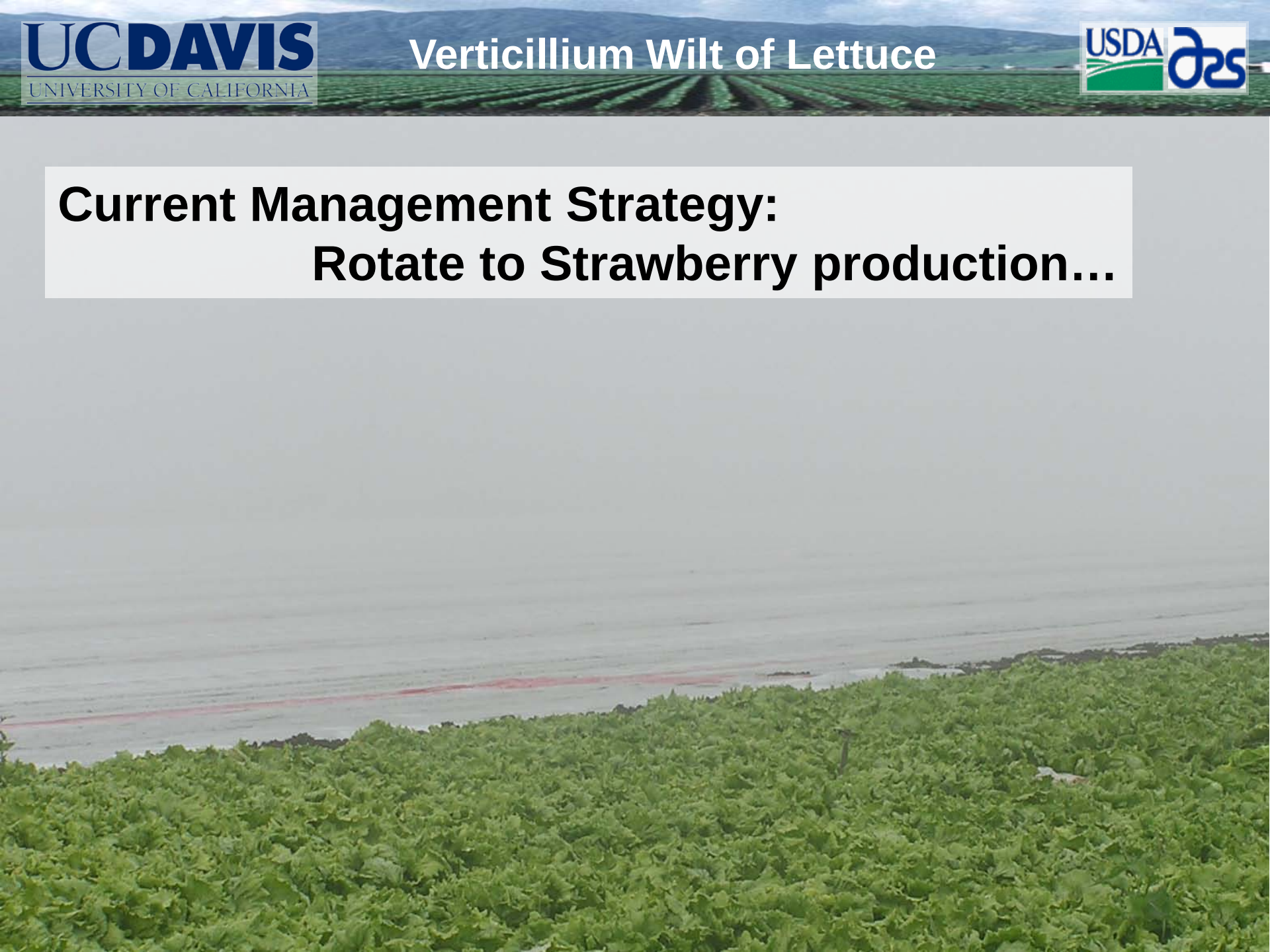


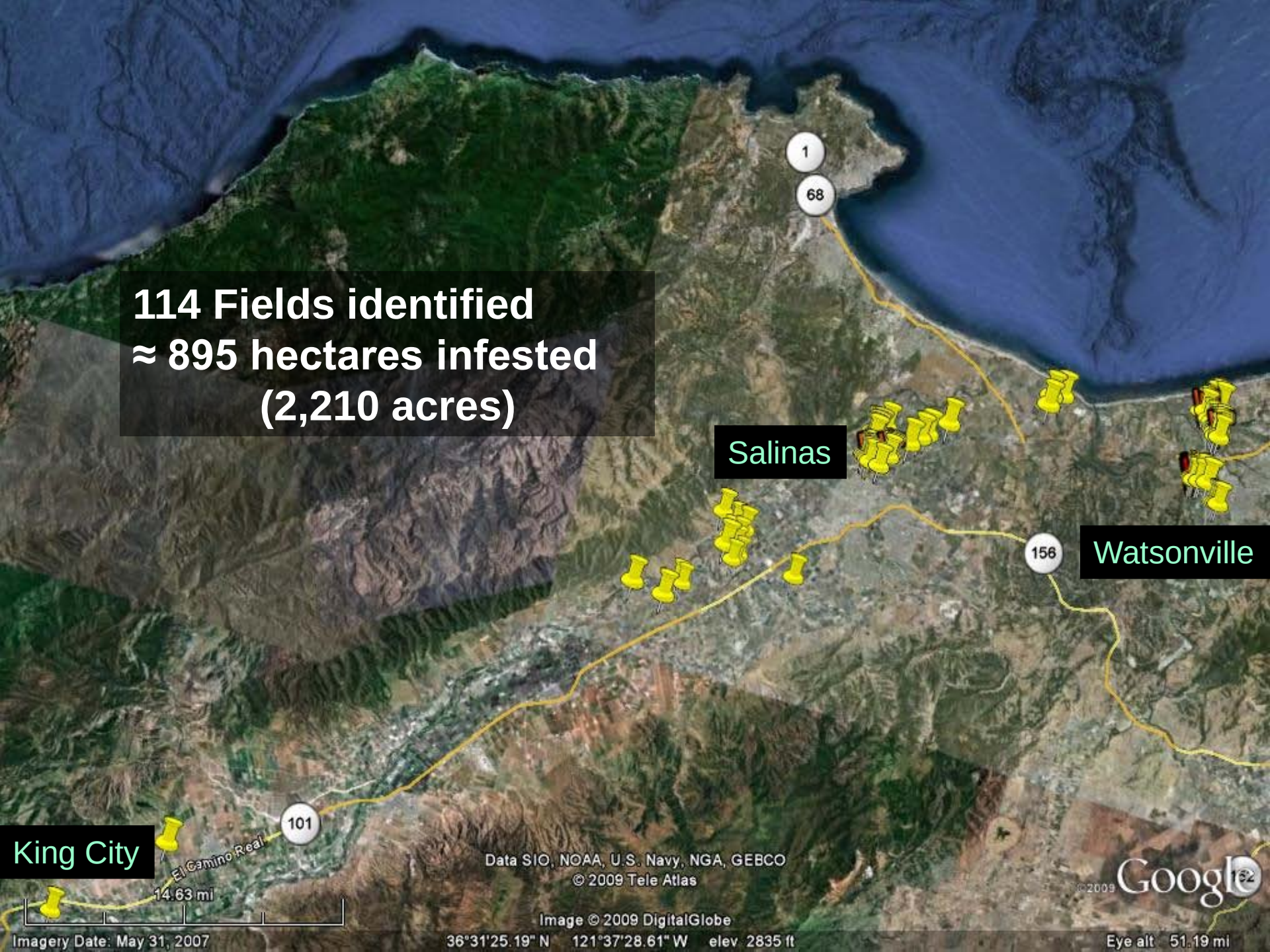
Cultivar-Isolate interactions
(32 isolates x 4 cultivars x 3 reps. x 3 experiments)

Verticillium Wilt of Lettuce

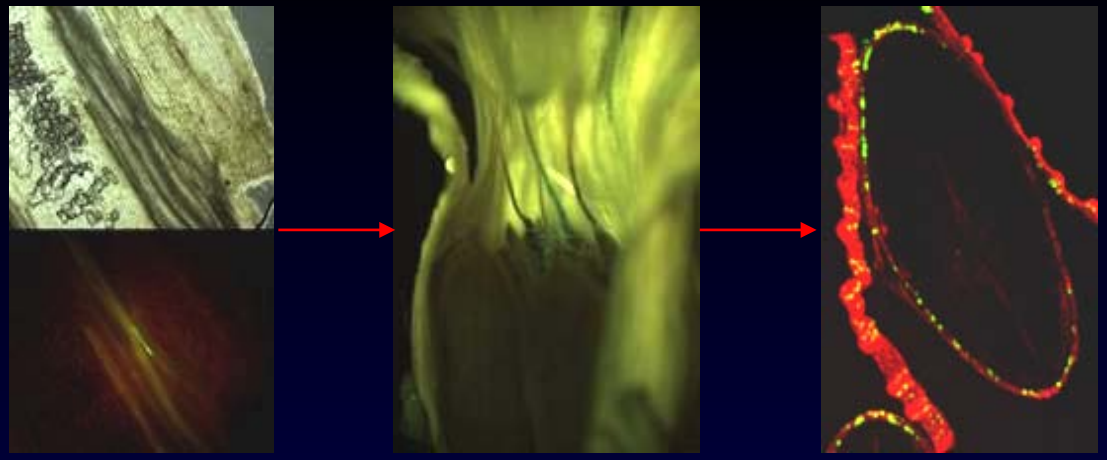
Current Management Strategy:

Rotate to Strawberry production…




114 Fields identified
≈ 895 hectares infested
(2,210 acres)
Salinas
Watsonville
King City
1
68
156
101
El Camino Real
14.63 mi
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2009 Tele Atlas
Image © 2009 DigitalGlobe
Imagery Date: May 31, 2007
36°31'25.19" N 121°37'28.61" W elev 2835 ft
Eye alt 51.19 mi

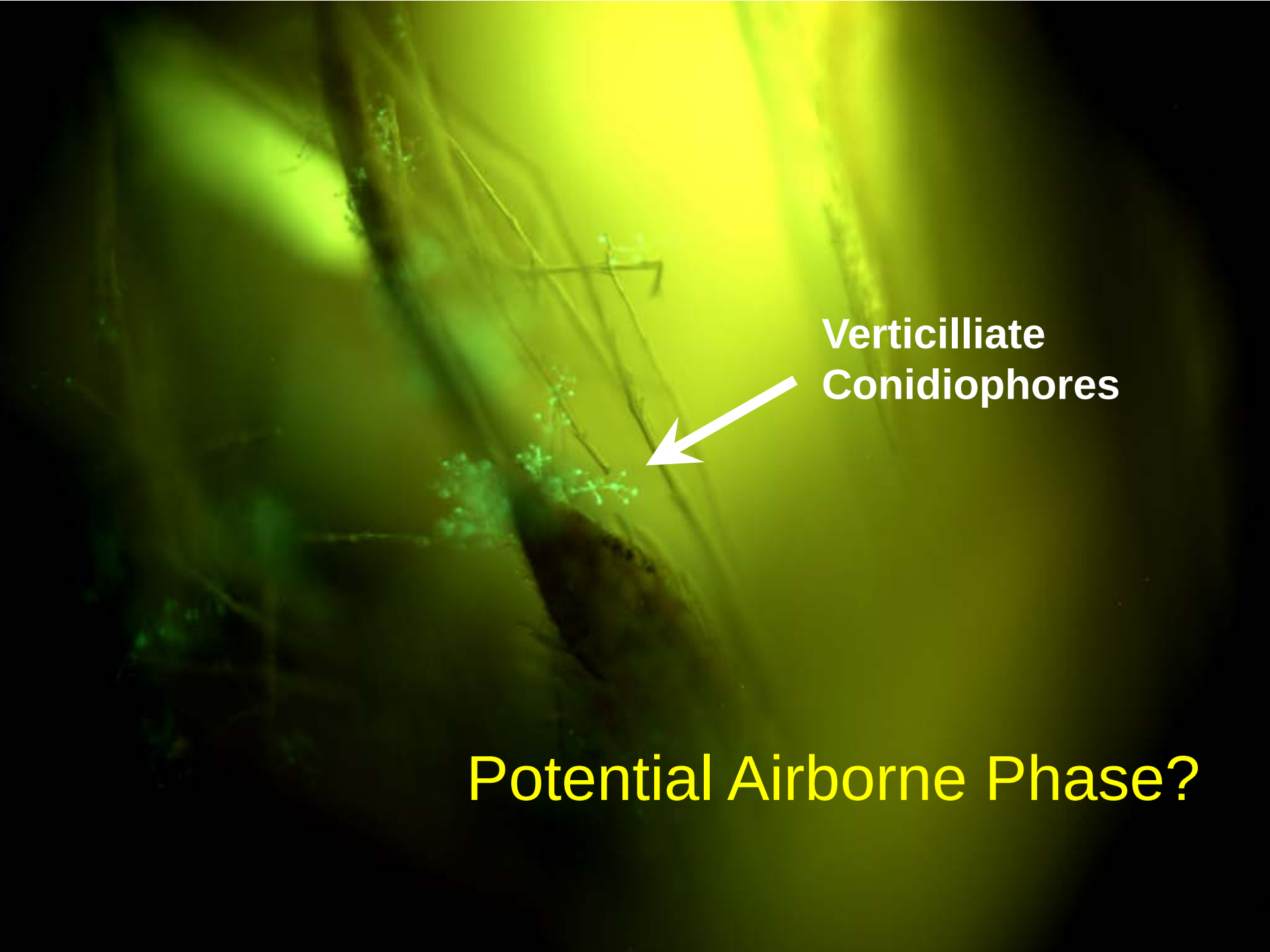
FACTS



- *Verticillium dahliae* is seedborne in lettuce and other crops and weeds.
- It is both externally seedborne and internally seedborne.
- Infested seed germinates, plants grow and develop wilt.
- Seed harvested from infected plants are infested with *V. dahliae*.

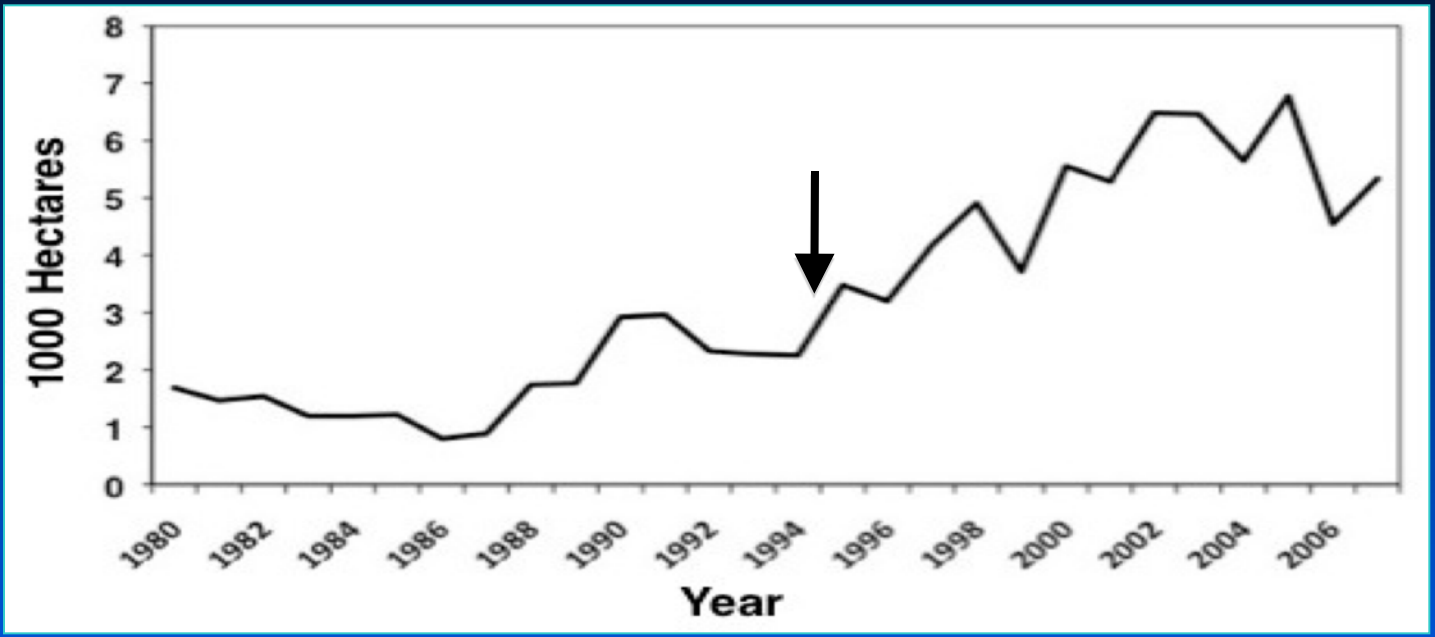
Where produced (2008-09)?

Country	Seed lots	Infested	Range
USA	179	33	0.5-5
China	22	8	0.5-3
Chile	29	5	0.5-2
The Netherlands	5	0	-
Australia	7	0	-
Total	242	46	



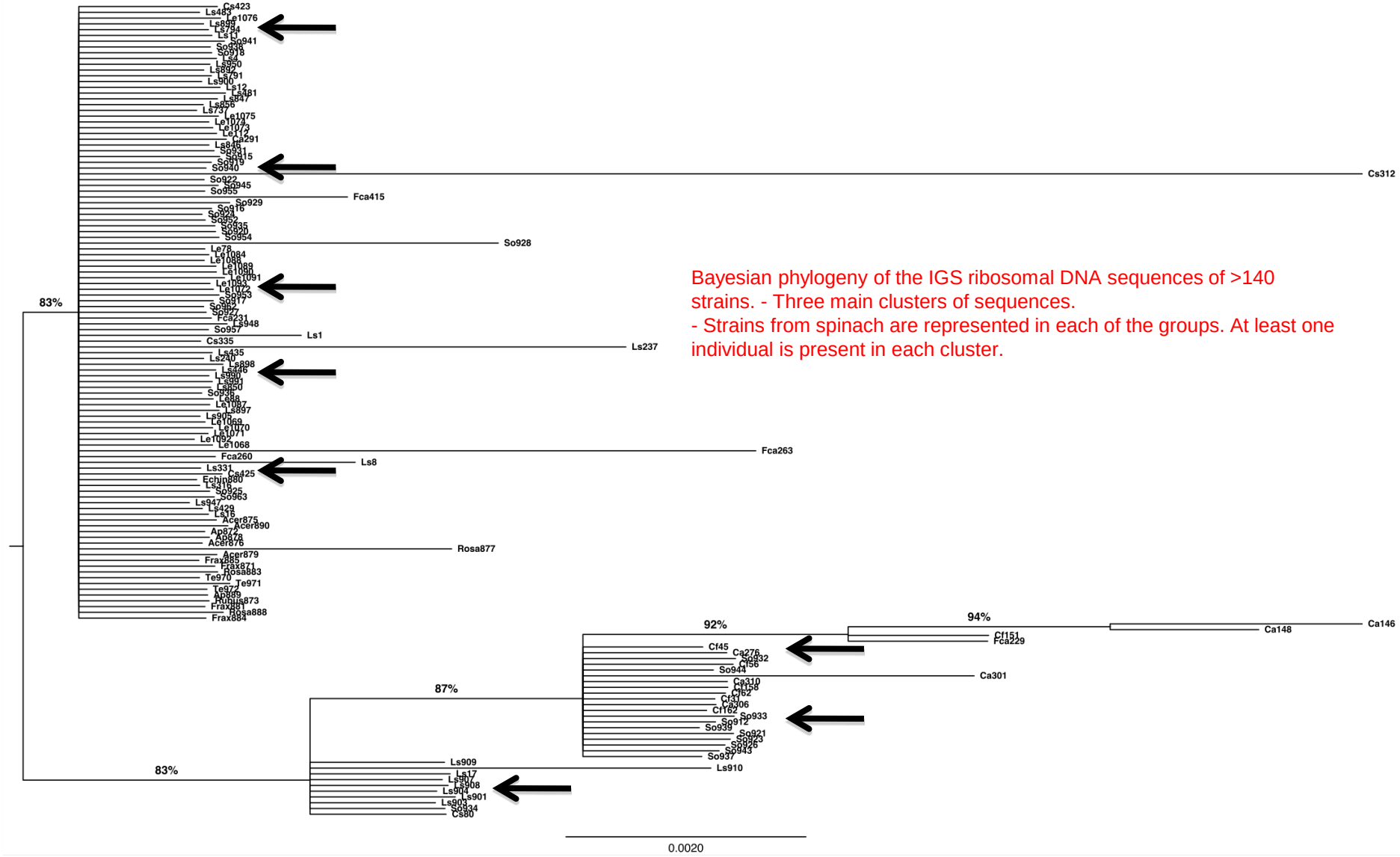
Potential Airborne Phase?

Verticillium wilt in spinach



- Pathogen present in every seed lot from all production areas (du Toit *et al*. 2005)
- Frequently incidence exceeds 75%
- Not a major problem for spinach seed or salad

Spinach isolates no different from isolates from coastal California



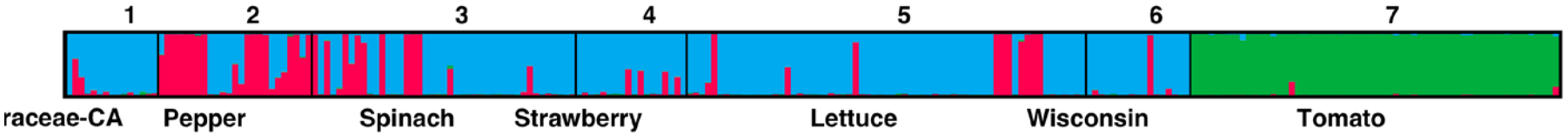
Bayesian phylogeny of the IGS ribosomal DNA sequences of >140 strains. - Three main clusters of sequences.

- Strains from spinach are represented in each of the groups. At least one individual is present in each cluster.

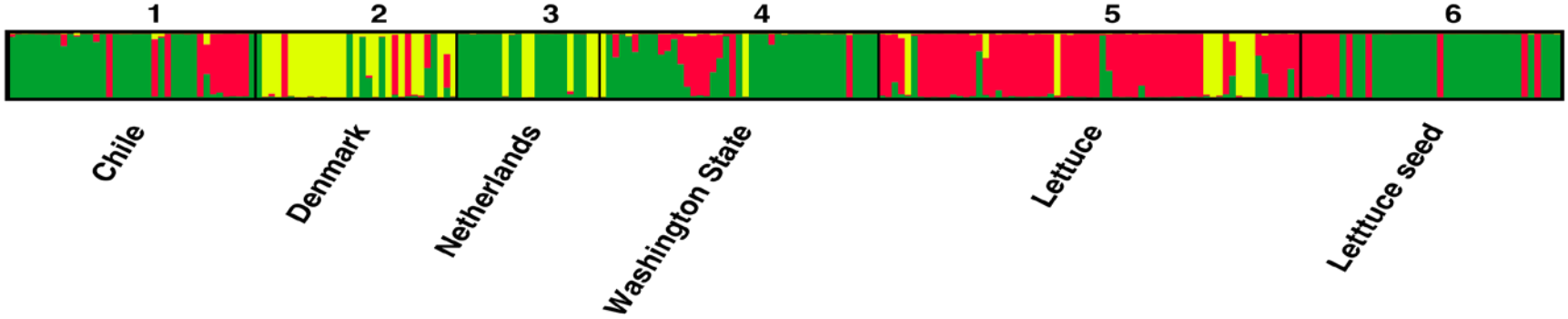
Is it spinach seed or lettuce seed?

- Expanded the analyses to include
  - 61 strains from lettuce seed
  - 169 strains from spinach
    - 45 from Chile
    - 38 Denmark
    - 32 Netherlands
    - 54 Washington State
  - 65 strains from lettuce grown in coastal California
- 15 SSR markers were used

Population structures very similar



Structure of populations using microsatellite markers.
- Sample of 43 strains from spinach and 65 from lettuce.
- Lettuce and spinach are not that different from one another in terms of their population structures.
- Tomato population is distinct.



A total of 169 strains from 4 spinach-producing regions, 65 strains from lettuce and 61 strains from lettuce seed.
- The structure of the Lettuce sub-population seems to have a lot of similarity with the spinach sub-populations from Chile and Washington State (red bars) and also Denmark (yellow bars).
- Lettuce seed sub-population seems to have a similar structure too.

Recent global immigration

	Migrants in each population							
	Chile	Denmark	Netherlands	Washington	Lettuce	Lettuce seed	% Multi-origin	% Unknown origin
Chile	31	25	26	28	8	0	81.6	10.5
Denmark	5	15	6	6	1	0	25.8	41.9
Netherlands	13	18	16	16	0	0	72.7	18.2
Washington	28	30	35	38	17	0	88.4	7.0
Lettuce	17	9	5	20	48	0	38.5	20.0
Lettuce seed	11	0	2	1	0	34	30.0	15.0

Frequent migration of *V. dahliae* among spinach seed production regions. Denmark a little different, why?

	First generation immigrants						
	Chile	Denmark	Netherlands	Washington	Lettuce	Lettuce seed	% Migrants
Chile	28	2	1	6	1	0	26.3
Denmark	4	19	6	2	0	0	38.7
Netherlands	1	6	10	5	0	0	54.5
Washington	6	2	4	27	4	0	37.2
Lettuce	3	3	0	6	53	0	18.5
Lettuce seed	0	0	0	0	0	40	0.0

Lettuce seed production seems to control migration better than spinach.

Lettuce seed may not be contributing to the diversity of *Verticillium dahliae* found in coastal California