Population biology of *Verticillium*

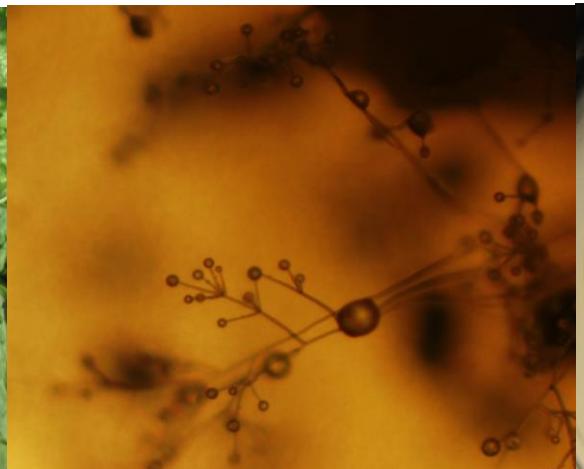
Dylan Short
UC Davis

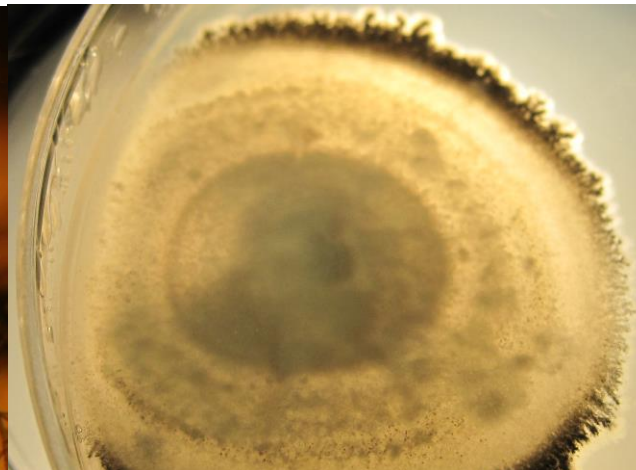
Outline

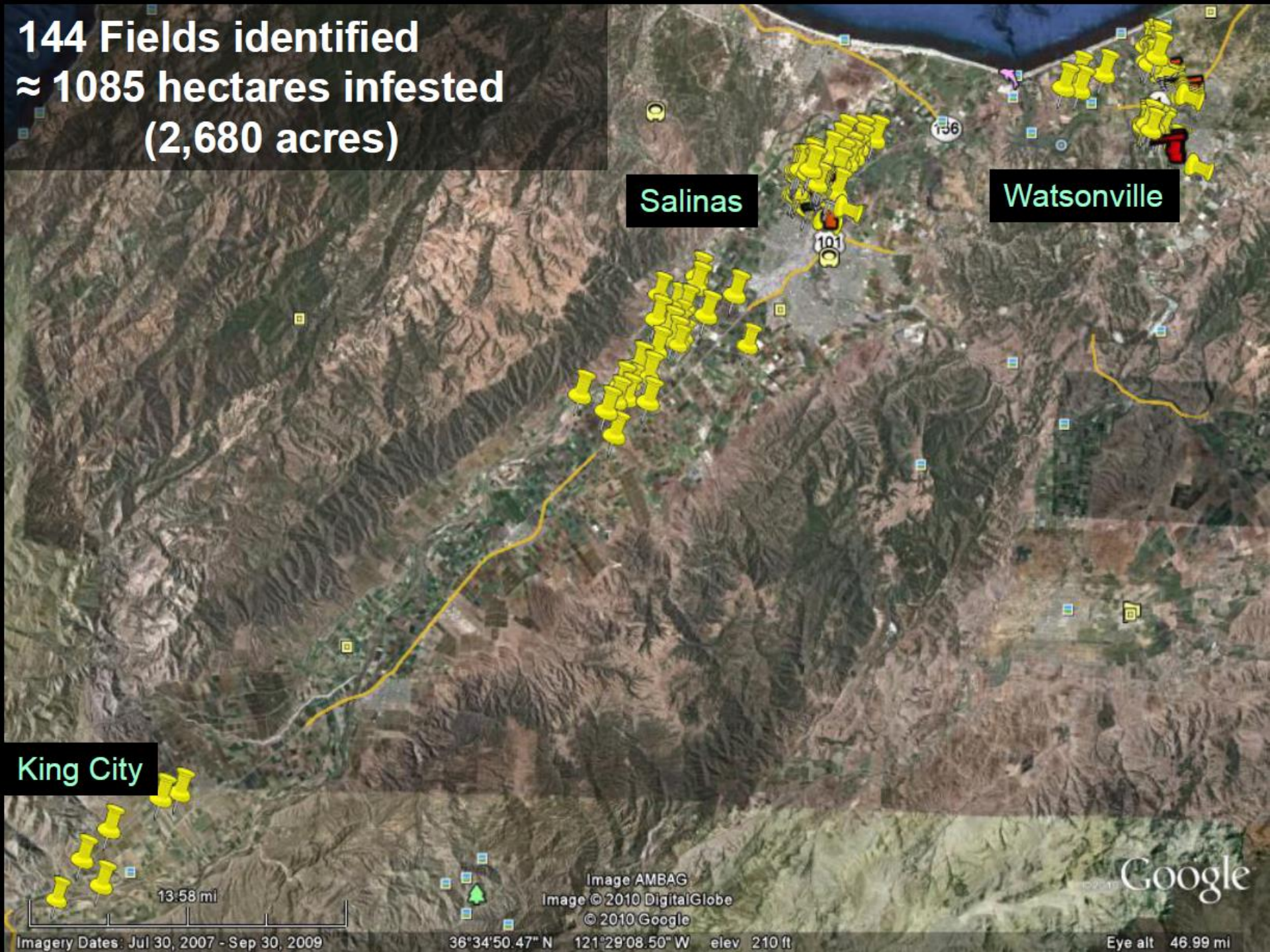
- **Background: Biology of *Verticillium***
- **Influence of infested spinach seed on lettuce**
- ***Verticillium* race characterizations**
- **Breeding for disease resistance**

Verticillium dahliae

- **Soilborne wilt pathogen**
- **Broad host range**
- **Forms melanized resting structures**
- **Colonizes seeds of infected plants**
- **Some host resistance exists**






144 Fields identified
≈ 1085 hectares infested
(2,680 acres)
Salinas
Watsonville
King City
156
101
13.58 mi
Image AMBAG
Image © 2010 DigitalGlobe
© 2010 Google
Google
Imagery Dates: Jul 30, 2007 - Sep 30, 2009
36°34'50.47" N 121°29'08.50" W elev 210 ft
Eye alt 46.99 mi

Influence of infested spinach on lettuce

Verticillium Wilt in Spinach Seed Production

Lindsey J. du Toit, Vegetable Seed Pathologist, **Mike L. Derie,** Agricultural Research Technologist, and **Pablo Hernandez-Perez,** Graduate Student, Washington State University, Northwestern Washington REC, Mount Vernon 98273-4768

ANOVAs (*data not shown*). Wilt symptoms were observed primarily after bolting was initiated by increasing the duration of supplemental lighting to 14 h/day (i.e., when plants of cultivar J were 7 weeks old, and of cultivars E and 'Winter Bloomsdale' were 14 weeks old). The cultivar-by-isolate interaction term of the ANOVAs was not significant for any of the dependent variables except incidence of symptomatic plants rated 53 days after inoculation in trial 2 (*data not shown*). In the latter case, the incidence of plants with symptoms was 100% for all but 3 of the 18 cultivar-by-isolate treatment combinations, i.e., isolate 3 on cultivars J (25%) and E (75%), and isolate 1 on cultivar E (75%). Therefore, means separations are presented in Table 3 for the main effects of spinach cultivar and isolate of *V. dahliae*.

Incidence and severity of symptomatic plants increased with maturity of the plants (Table 3). In trial 1 (2002–03), the total incidence of symptomatic plants increased from 47% (28/60 plants) to 83% (50/60 the second rating (Table 3).

The incidence of symptomatic plants was not significantly different among isolates of *V. dahliae* at 25 or 49 days after inoculation in trial 1, nor at 22 days after inoculation in trial 2 (Table 3). By 53 days

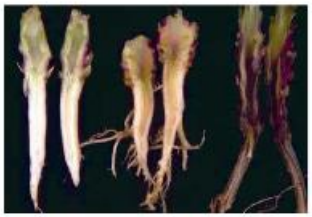


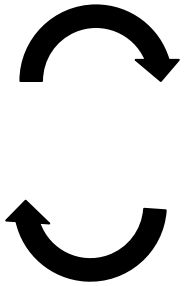
Fig. 3. Longitudinal section of the roots and crown of a healthy spinach plant (left), a spinach plant infected with *Verticillium dahliae* (center, showing pale brown discoloration), and a spinach plant infected with *Fusarium oxysporum* f. sp. *spinaciae* (right, showing dark brown to black discoloration).

Fig. 4. Longitudinal section of the stem of a spinach plant not inoculated (left) or inoculated (right) with *Verticillium dahliae* by dipping the root plug in a spore suspension of the fungus prior to transplanting. Note abundant microsclerotia in the vascular tissue of the inoculated plant, observed 5 days after incubation of the inoculated plant in a moist chamber following surface-sterilization in 0.5% NaOCl for 5 min.

- ***Verticillium dahliae*** **was recently described in commercial spinach seed lots from Washington in 2005**
- **Is it possible that *V. dahliae* may spread from infested spinach seed to lettuce production fields?**

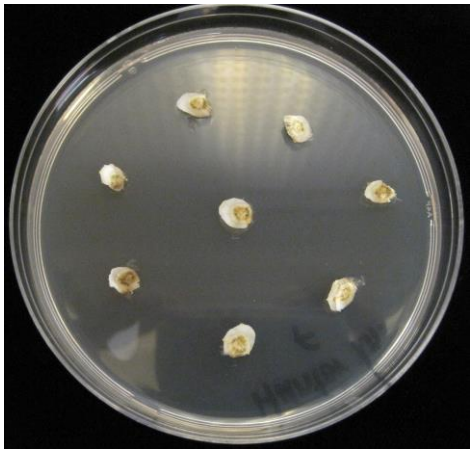
Influence of infested spinach on lettuce

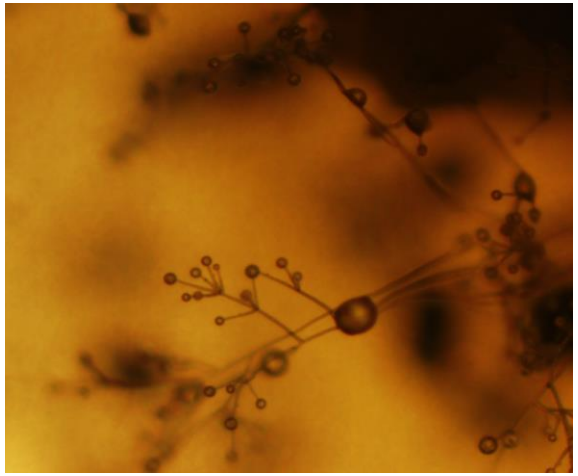
- Planted three crops of spinach followed by two crops of iceberg lettuce in square meter plots
- Used highly infested spinach seed mixed with treated seed in various proportions
- Repeated this pattern several times
- Checked the lettuce plants for disease to see if *Verticillium dahliae* was present



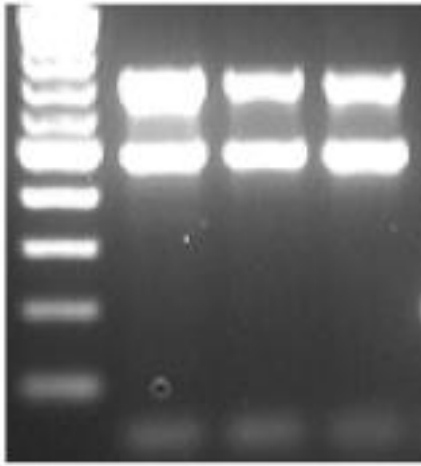

1-2

Plating discolored roots on selective medium



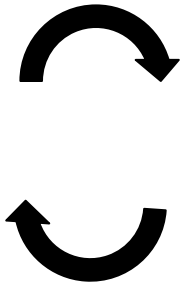


V. dahliae



Influence of infested spinach on lettuce

- ***Verticillium dahliae*** **appears to be able to spread from spinach seeds and plants into subsequent crops of lettuce**



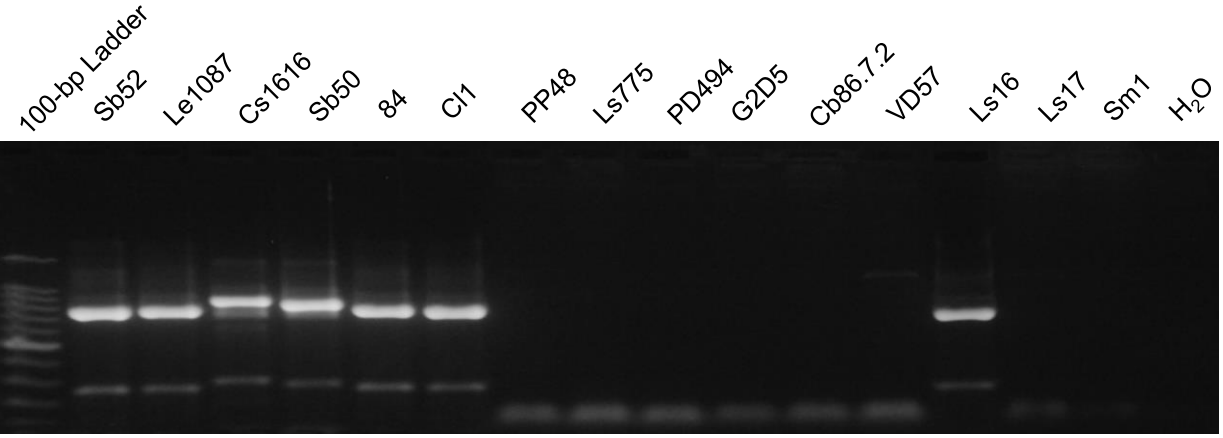
Resistance and races of *V. dahliae*

Race 1 → 

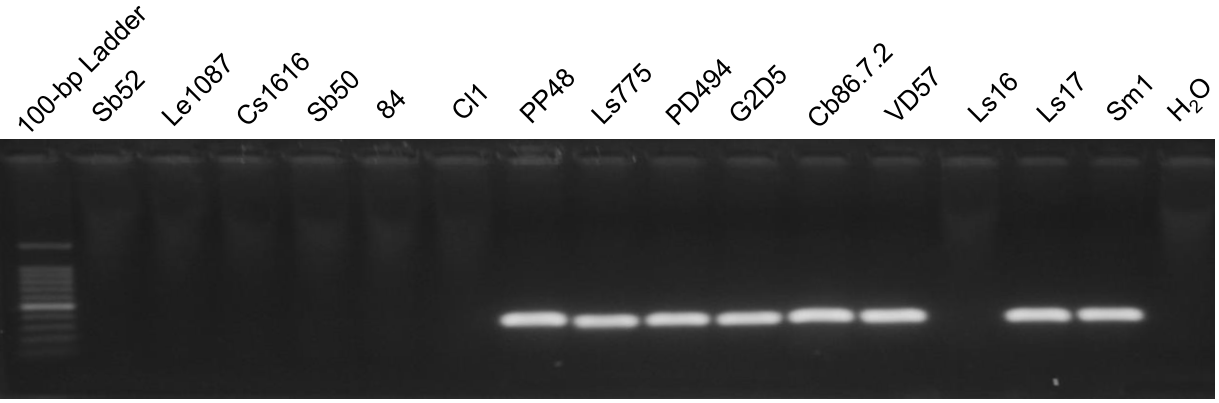
Race 2 →

- **Certain cultivars of a few crops are resistant to race 1**
- **Only partial resistance to race 2 exists in lettuce**

PCR tests that identify race

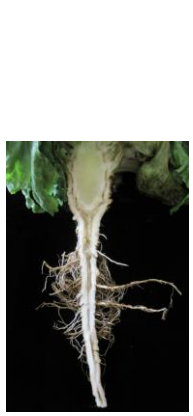


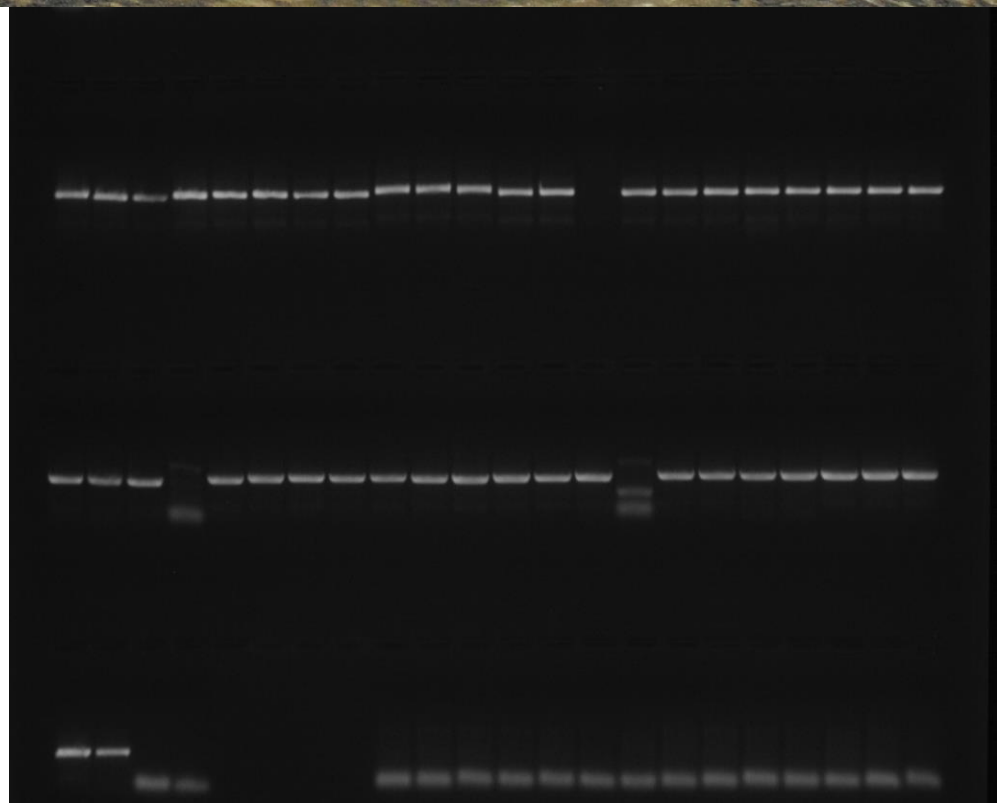
Race 1-specific PCR



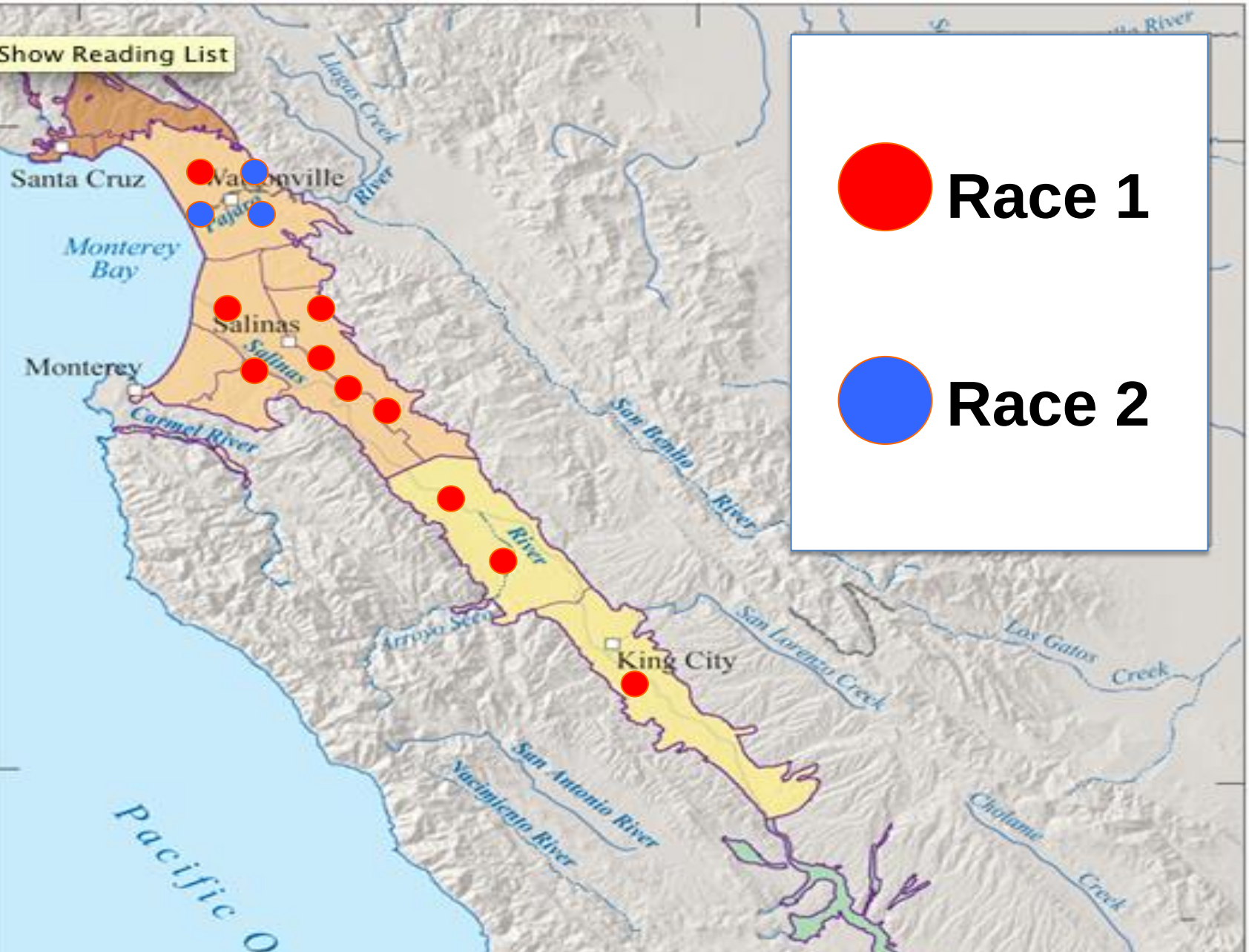
Race 2-specific PCR

Identifying races in field samples of *V. dahliae*

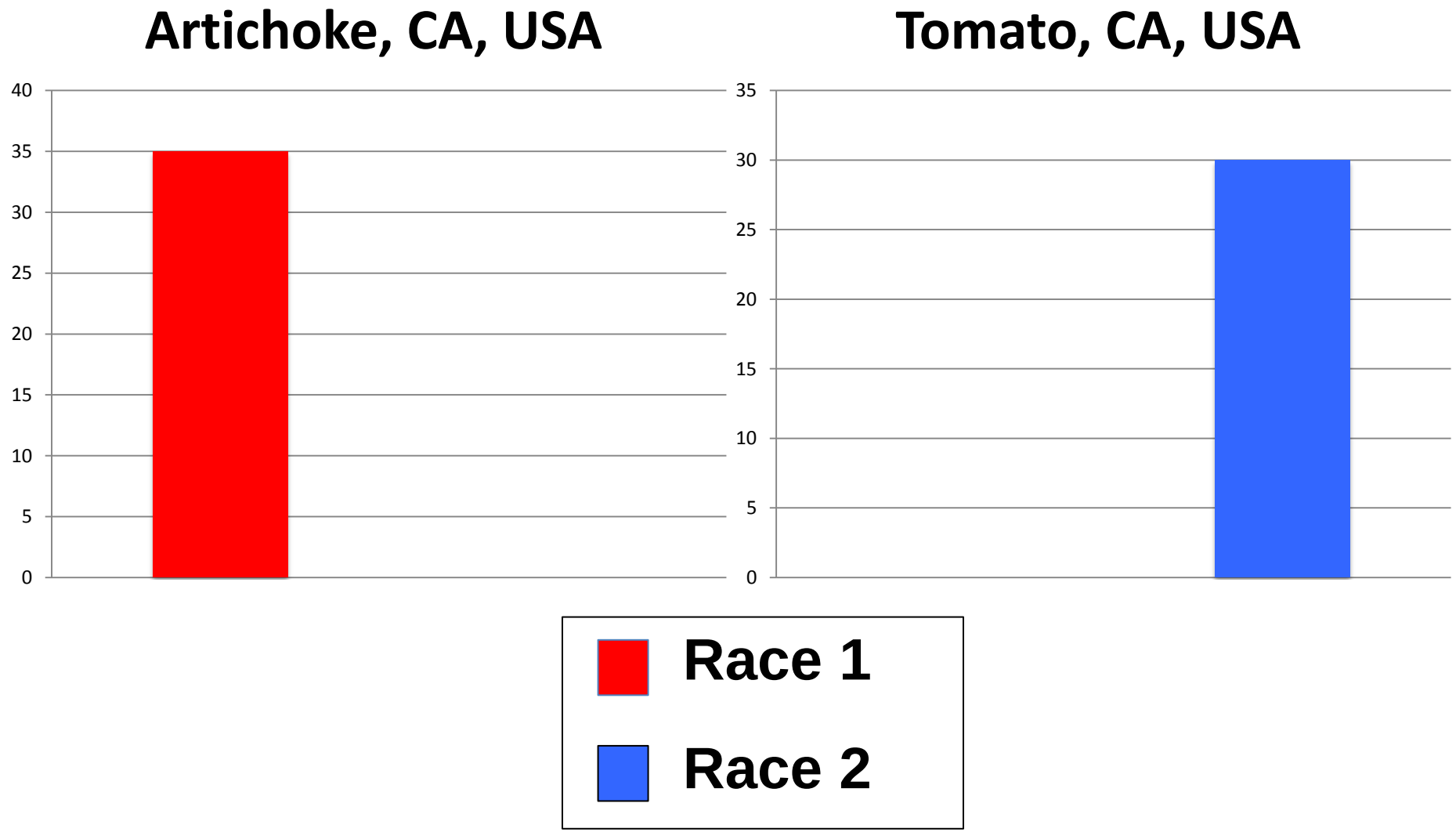




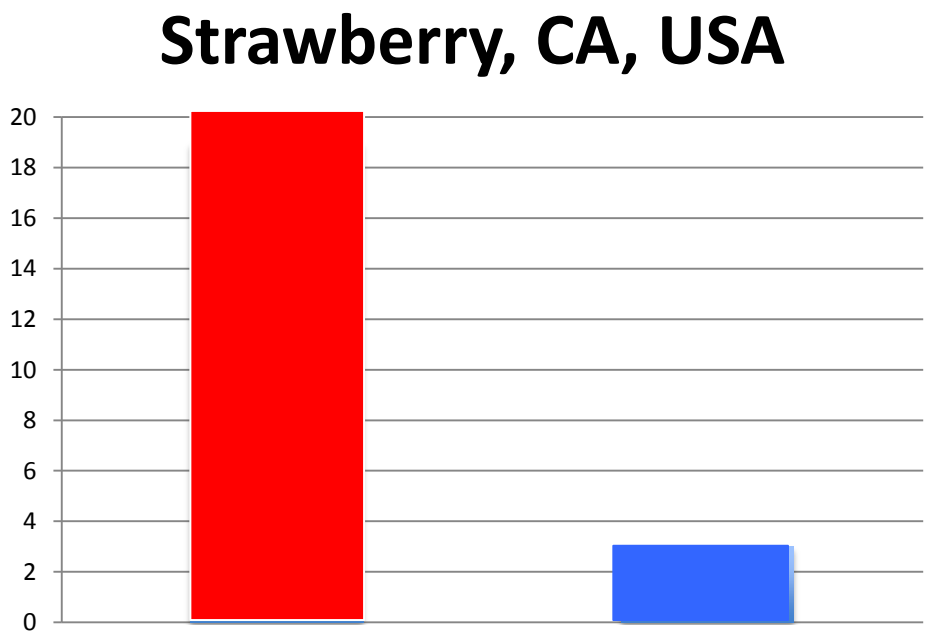
V. dahliae races in lettuce in the Salinas Valley

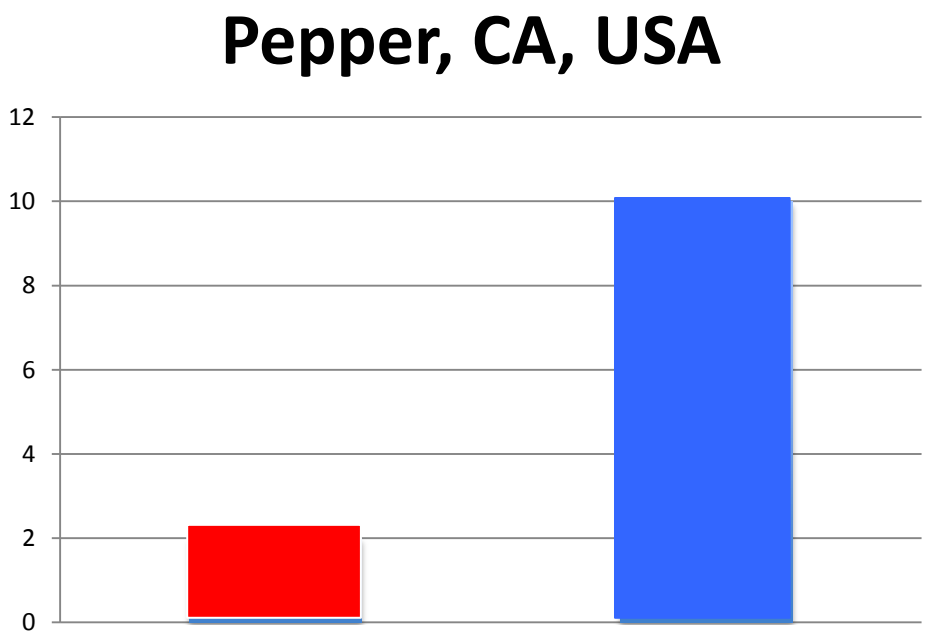


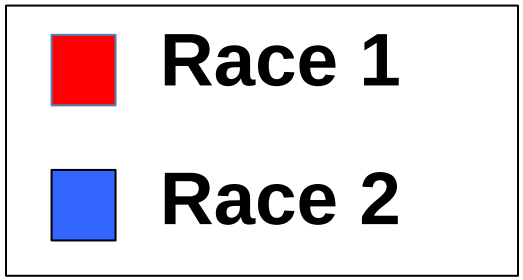
V. dahliae races in other crops



V. dahliae races in other crops

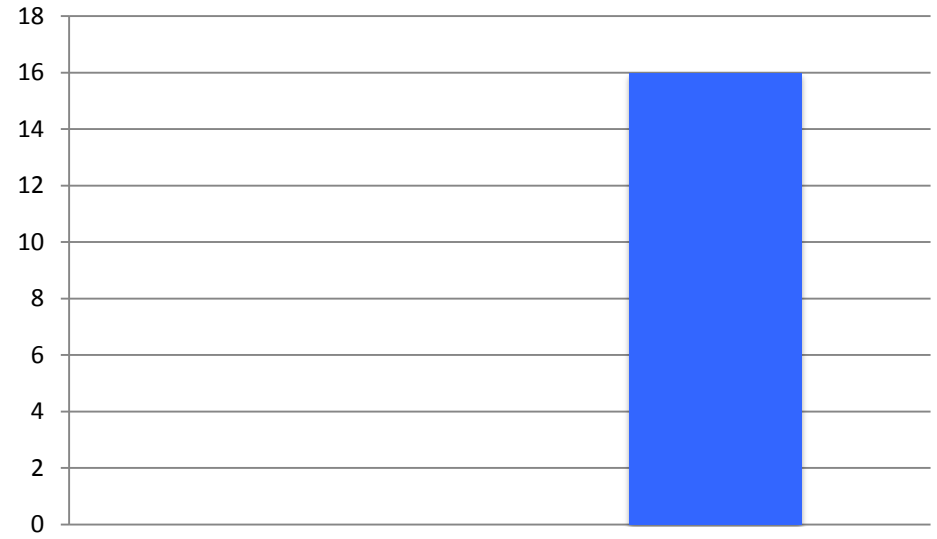




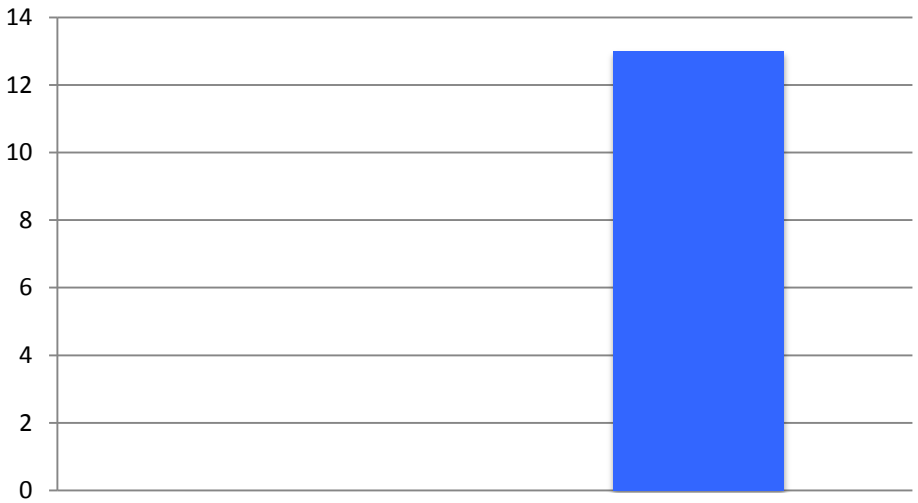


V. dahliae races in other crops

Mint, WA, USA



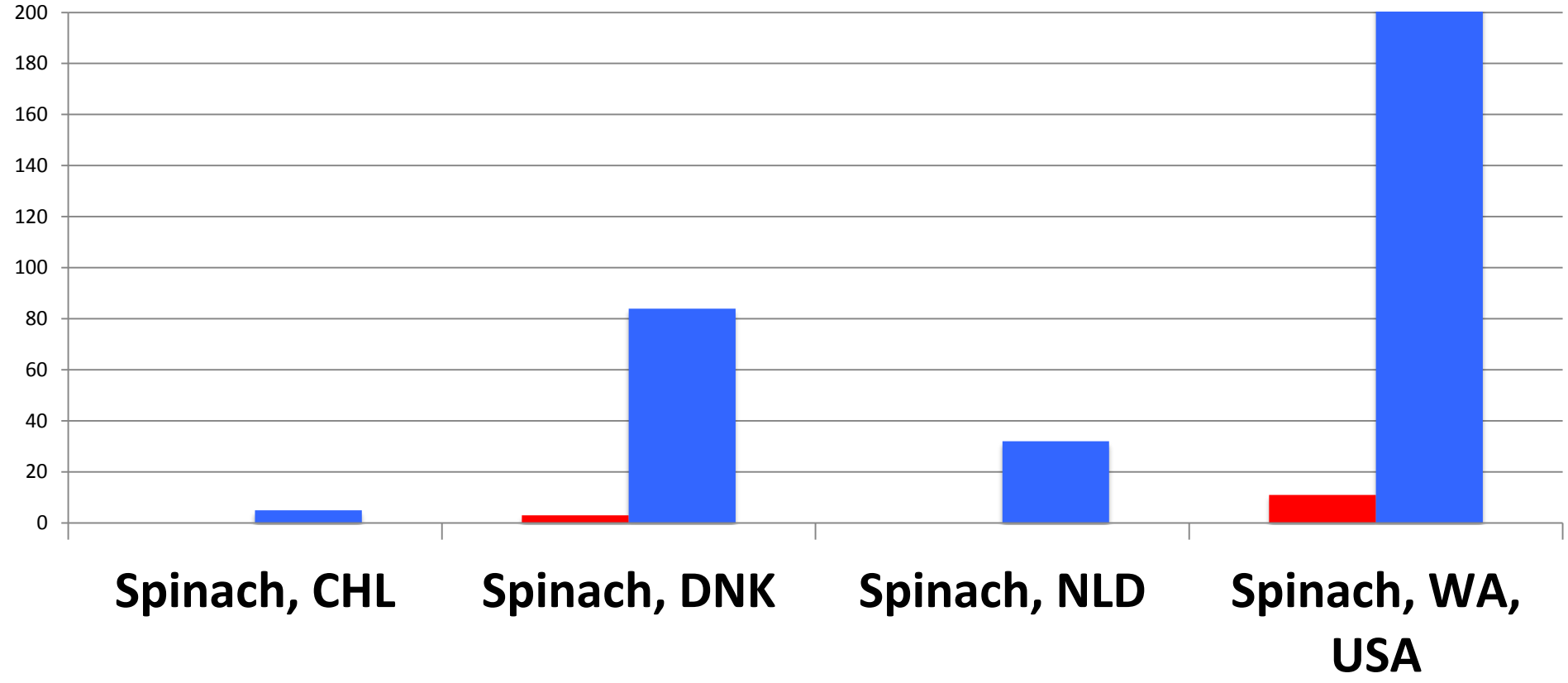
Potato, WA, USA



Race 1

Race 2

V. dahliae races in other crops



Breeding for resistance to *V. dahliae* race 2 in lettuce

Germán Sandoya

Sources of resistance

- **There is no complete resistance to race 2 of *V. dahliae***
- **Four Plant Introductions from germplasm bank USDA-Pullman were identified as partial resistant (significantly less disease than susceptible cultivar Salinas)**

Genetics of the resistance trait

- **Breed the four partially resistant lines to each other, and to the susceptible variety Salinas**
- **Study the effects of *Verticillium* inoculations under greenhouse and field conditions**
- **If segregation is found, families will be genotyped to search for QTLs (Quantitative Trait Loci)**

Summary

- **There is evidence that *V. dahliae* can spread from infested spinach seed to subsequent lettuce crops**
- **race 1 and race 2 are found on spinach seed and in lettuce, though race 1 is currently the only race in Salinas**
- **Resistance to race 1 is basically complete, race 2 resistance breeding is on-going**