

Current Production and Disease Management for Spinach in California

**Steven Koike
University of California
Cooperative Extension
Monterey County**



Bettiga



Monterey County agriculture

- **\$4.0 billion total production (2010).**
 - cool season vegetables
 - strawberry and caneberry
 - winegrape
 - ornamental/greenhouse plants
- **Most are considered “specialty crops”**

Features of Salinas Valley vegetables

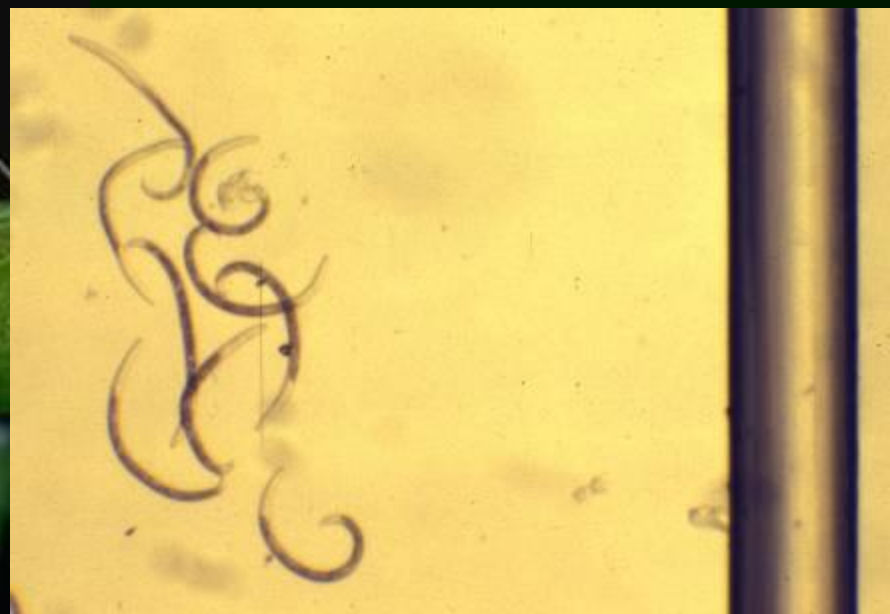
- Diverse range of high value crops.
- Large acreages.
- Long growing season (Feb. through Dec.).
- Short duration crop cycles.
- Multiple crops per acre per season (2 to 4).
- Limited crop rotations:
 - expensive growing costs
 - market pressures and obligations
 - pseudo-monoculture
- High standards: quality and food safety

California spinach

- **Spinach: State of California**
 - 40,000 acres (16,200 ha)
 - US \$ 176 million
- **Spinach: Monterey County (Salinas Valley)**
 - 9,330 acres (3,780 ha)
 - US \$ 128 million







Foliar

- Downy mildew
- Cladosporium leafspot
- Stemphylium leafspot
- Anthracnose
- Bacterial leafspot
- Viruses: BCTV, BWYV, CMV, INSV, TRV, TSWV

Root / Crown

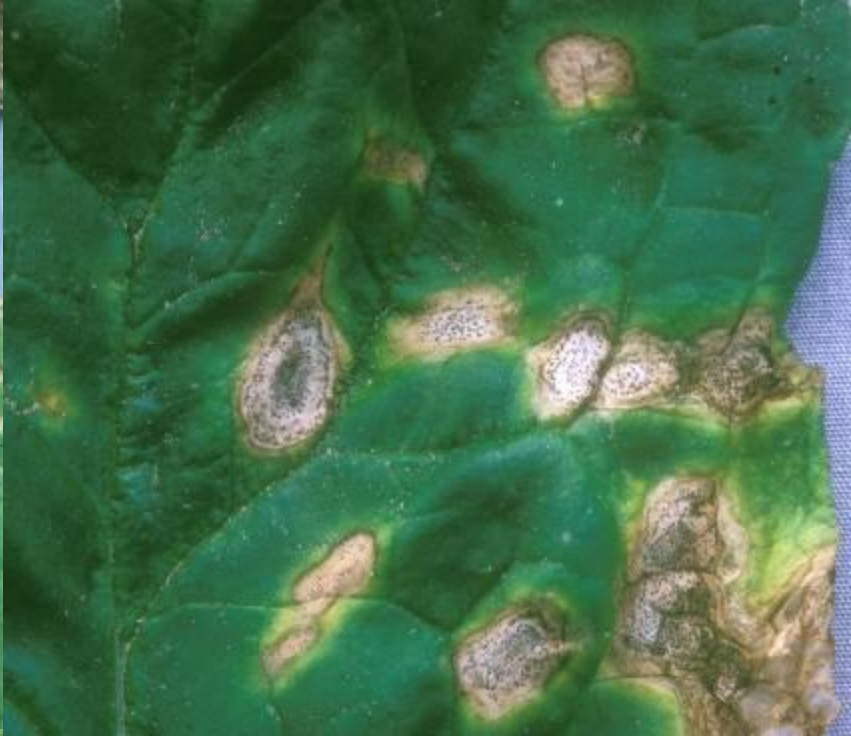
- Pythium spp.
- Rhizoctonia solani
- Fusarium oxysporum
- Phytophthora cryptogea

Foliar

- Downy mildew
- Cladosporium leafspot
- Stemphylium leafspot
- Anthracnose
- Bacterial leafspot
- Viruses: BCTV, BWYV, CMV, INSV, TRV, TSWV

Root / Crown

- Pythium spp.
- Rhizoctonia solani
- Fusarium oxysporum
- Phytophthora cryptogea









Susceptible

Spinach differential cultivars for determining downy mildew pathotypes

Resistant

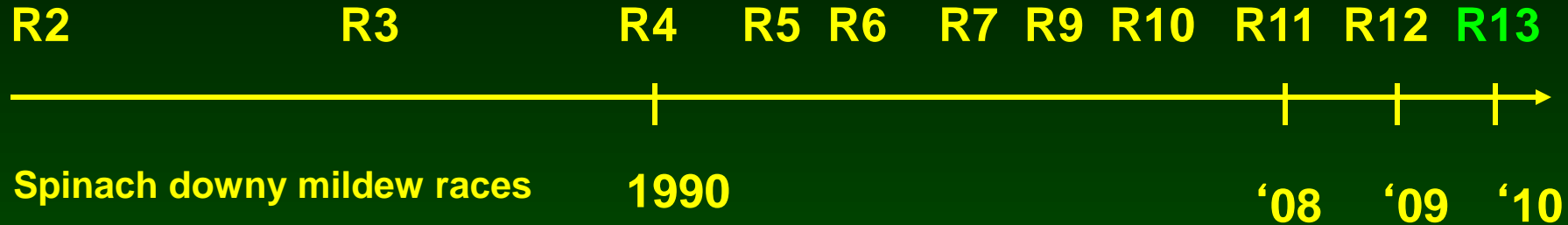
Susceptible



US/E.U. differential set used to characterize races of the spinach downy mildew pathogen (2009)

Genotype	Race											
	1	2	3	4	5	6	7	8	9	10	11	12
Viroflay	+	+	+	+	+	+	+	+	+	+	+	+
Resistoflay	-	-	+	+	+	+	+	+	+	+	+	+
Califlay	-	+	-	+	-	+	+	-	-	+	-	-
Polka	-	-	-	+	-	+	+	-	-	+	-	-
Bolero	-	-	-	-	+	+	+	+	-	+	+	+
Campania	-	-	-	-	+	+	-	+	+	+	-	+
Dolphin	-	-	-	-	-	-	-	+	-	+	-	+
Avenger	-	-	-	-	-	-	-	+	-	+	-	+
Lion	-	-	-	-	-	-	-	-	-	+	-	-
Lazio	-	-	-	-	-	-	-	-	-	-	+	+

Salinas Valley: Why so many new DM races?







Pathogens infecting spinach

In California

- Pythium spp.
- Fusarium oxysporum
- Rhizoctonia solani
- Verticillium dahliae

In Washington

- Pythium spp.
- Fusarium oxysporum
- Rhizoctonia solani
- Verticillium dahliae

Pathogens causing diseases of spinach

In California

- Pythium spp.
- Fusarium oxysporum
- Rhizoctonia solani
- ---

In Washington

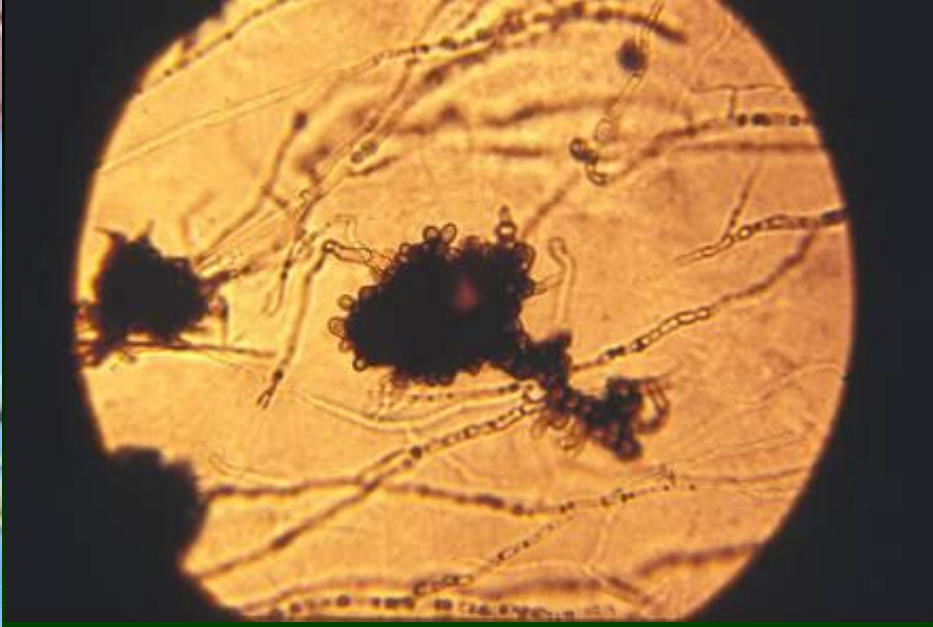
- Pythium spp.
- Fusarium oxysporum
- Rhizoctonia solani
- Verticillium dahliae

Verticillium wilt





Koike



Seed lot **Year** **% Infested Seed**

1 **2004** **10.0**

2 **2006** **32.5**

3 **2005** **0.5**

4 **2006** **1.0**

5 **2004** **0.5**

6 **2002** **18.0**

7 **2004** **2.0**

8 **2004** **18.5**

9 **2004** **6.5**

Verticillium



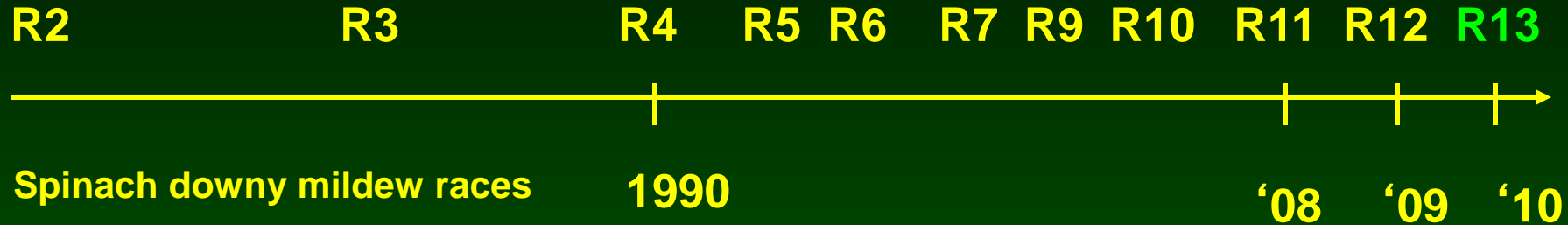
Spinach / Lettuce Connections



Current and future concerns

- **Downy mildew**
- **Increasing soilborne problems**
- **Food safety, E. coli, Salmonella**
- **Fertilizer, nitrates, plant nutrition**

Salinas Valley: Why so many new DM races?



Salinas Valley: Why so many new DM races?

