Developing a new spinach breeding program for California

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Outline

• Breeding Baby Leaf Spinach for California Growers
  w/ Steve Klosterman and Steve Koike

• Developing Baby Leaf Spinach with Lower Cadmium Uptake
  w/ Richard Smith and Tim Hartz

• Synergistic Activities
  National Needs Fellowship (Greenhut)
  Spinach genome sequencing
  Exome capture array
Objective:
Open-pollinated, *market-ready* baby leaf spinach cultivars with durable downy mildew resistance

Developing hybrids down the road.
Getting going

**Obtained germplasm**
- 30+ OP and hybrid cultivars from seed companies
- 405 USDA accessions
- 108 Netherlands accessions (non-redundant)
- 186 Germany accessions (non-redundant)

**Developing populations**
- Screen OP cultivars directly
- Break down F1 hybrids
- Cross desirable germplasm
- Increase seed of crosses/populations
Greenhouse and isolator crossing
Field planting in Salinas (USDA-ARS station)
Field selection under high density

- Screen under high density
- Select plants with no/few symptoms
- Repeat – twice per year
- Recurrent selection (family based)
Selection for absence of DM symptoms, other traits
Digging selections and transplanting to isolators
Selections in isolator at Salinas
Screening DM in the growth chamber

- Screening in growth chamber (with Steve Koike)

- Select for broad-spectrum resistance to races not controlled by major gene resistances in that germplasm (e.g., if germplasm has resistance to DM races 1-3, screen it with race 4 to select best plants, and so on).

- Developing detached leaf assay with Steve Klosterman
  - Confirm field resistance to eliminate escapes
  - Additional selection cycles per year
  - Evaluation of known races
Screening germplasm for low Cd uptake

- 380 accessions worldwide including cultivars
- 2.5 ppm Cd soil
- Lattice design with high/low checks
  - Unipack 12 - low; Seaside - high Cd control (Smith and Mou)
Using Genomics to Screen Spinach for Targeted Traits

• Allen Van Deynze – sequenced spinach genome; developed other genomics tools with industry consortium

• With funding by CSA Spinach Committee:

Developing a genotyping array for genes predicted to be involved in resistance to *Peronospora effusa* and cadmium uptake, as well as other horticultural traits.

Genotyping ~450 spinach accessions from US and international gene banks, including non-IP protected commercial cultivars, for genetic diversity in targeted genes.
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