Lettuce drop:
Current and future management considerations

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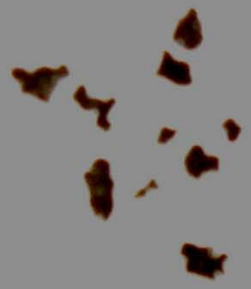
Sclerotinia drop on lettuce

Sclerotinia minor and *Sclerotinia sclerotiorum*

Disease cycle for Sclerotinia drop begins and ends with sclerotia

S. minor

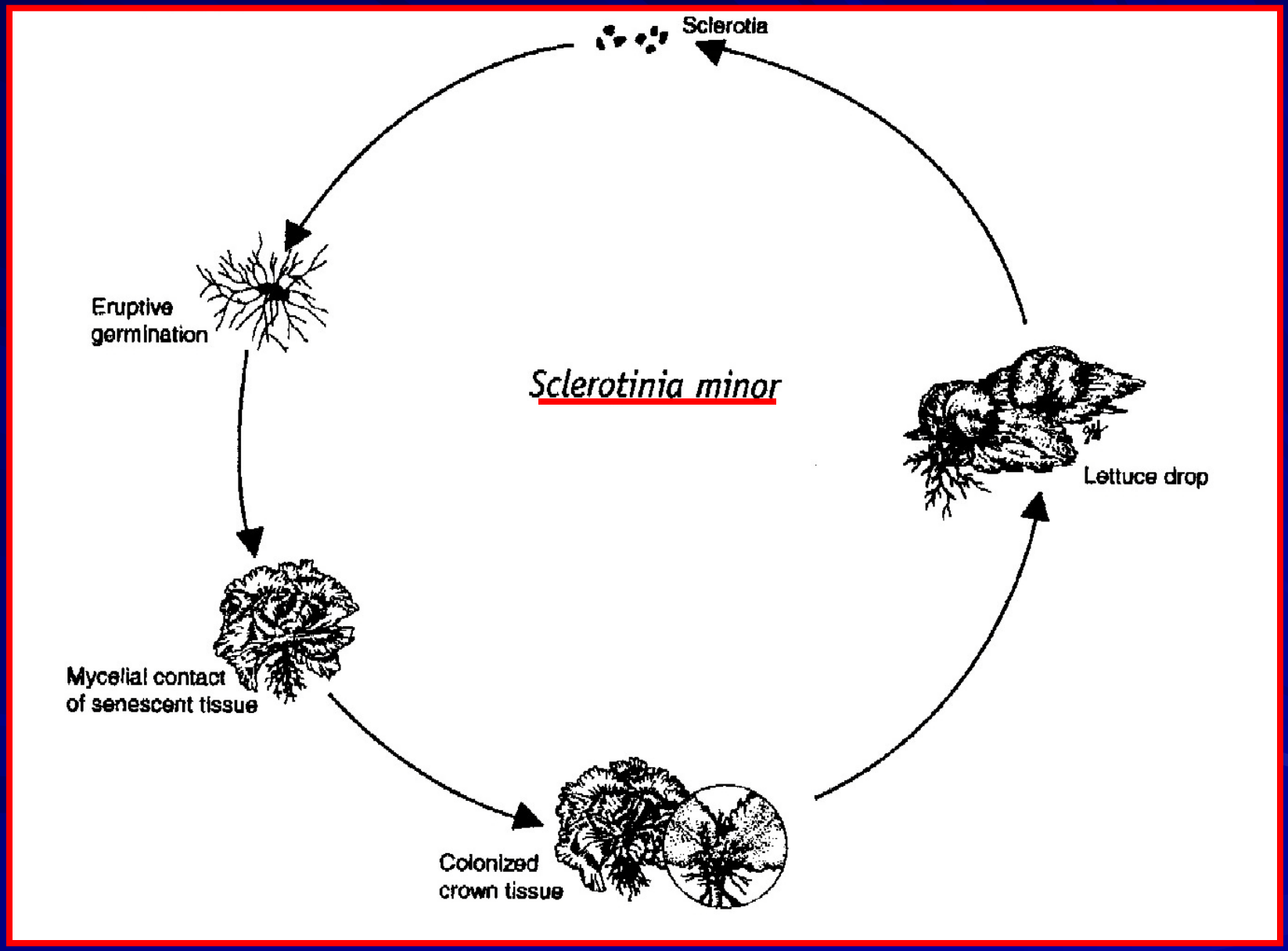


0.5 -2.0 mm long

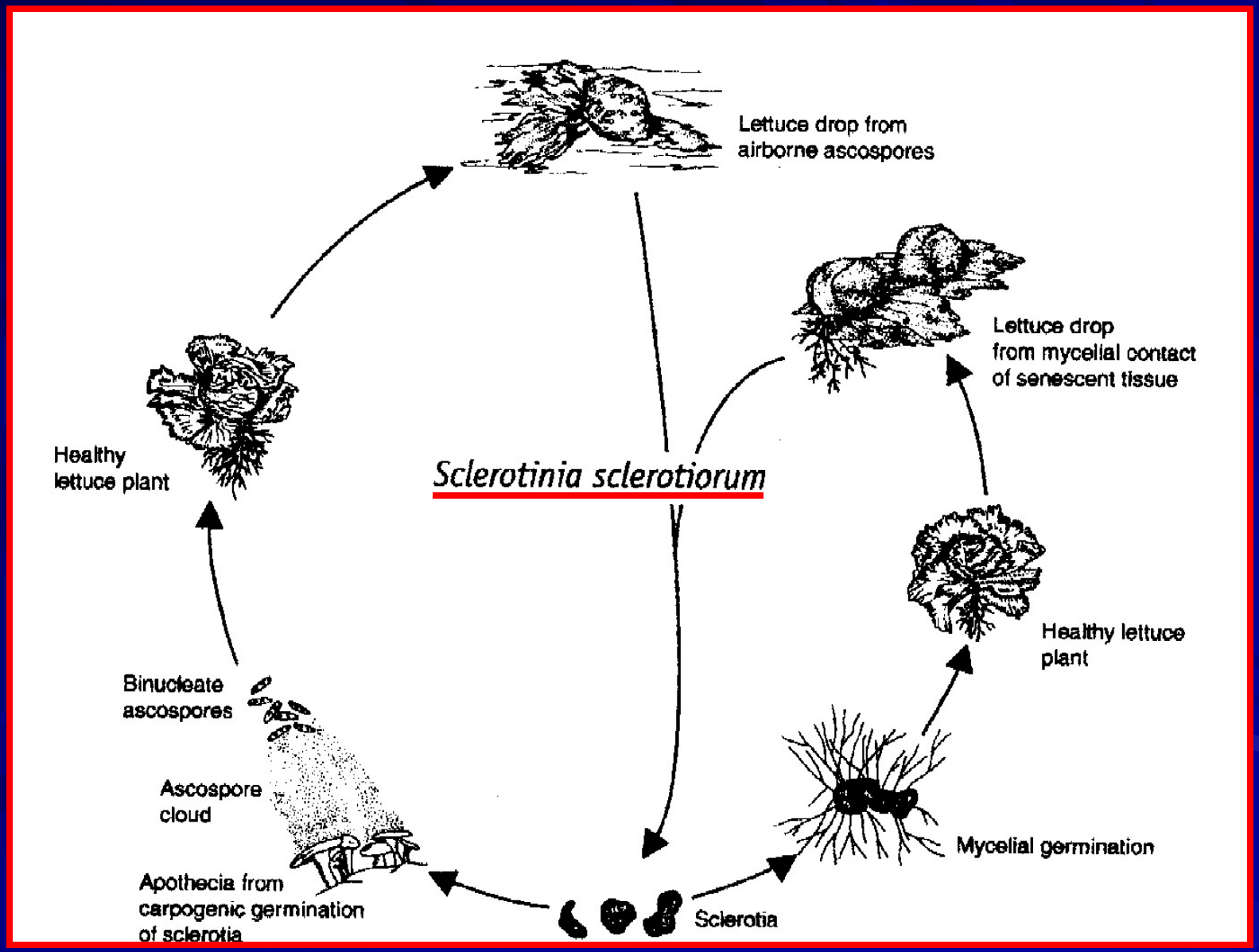
S. sclerotiorum

2.0 to 20.0 mm long

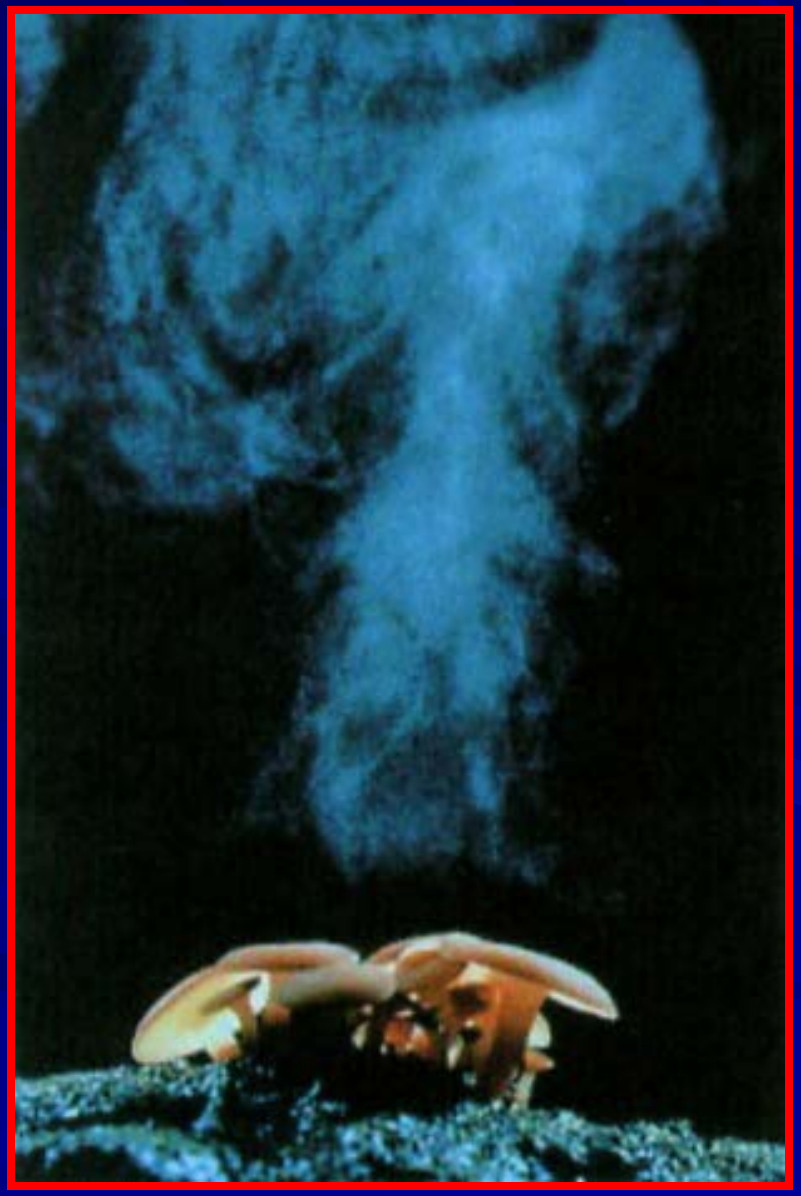
Disease cycle: *Sclerotinia minor*



Disease cycle: *Sclerotinia sclerotiorum*



Airborne spores of *S. sclerotiorum*

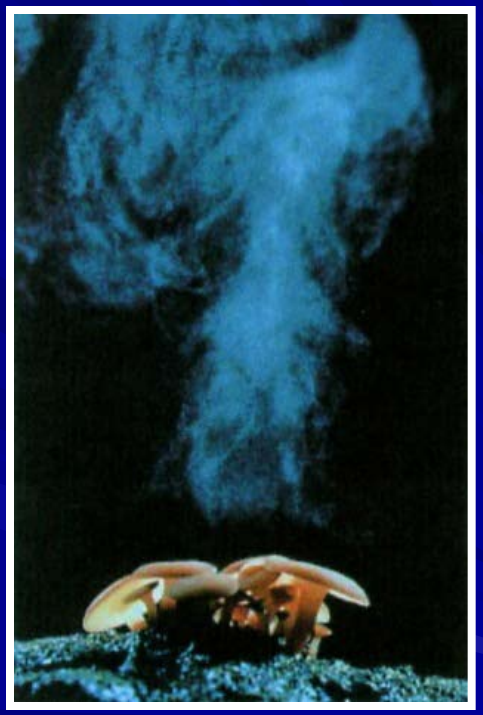


2010 Sclerotinia aerial infection outbreak

Requirements for aerial spore production and infection by *S. sclerotiorum*

- Aerial spore production
  - Sclerotia in the top 2 inches of soil
  - Wet soil
  - Soil temperatures from 46 - 61°F

- Aerial spore infection of lettuce
  - Presence of free water on leaves
  - Senescent plant tissue



2010 Sclerotinia aerial infection outbreak

Field temperature and moisture data*:

- Nov 26-30
  - 2010: 5 days with low below 40°F (32-38°F)
  - 2007, 08, 09: No days with low below 40°F
  - 2006: One day with low below 40°F (35°F)
- December
  - 2010: 14 days (all consecutive) with RH ≥ 90% (92-100%)
  - 2009: 5 days (2 consecutive) with RH ≥ 90% (90-95%)
  - 2008: 12 days (7 consecutive) with RH ≥ 90% (91-100%)
  - 2007: 8 days (3 consecutive) with RH ≥ 90% (91-97%)
  - 2006: 1 day with RH ≥ 90% (94%)

*Yuma Valley AZMET station

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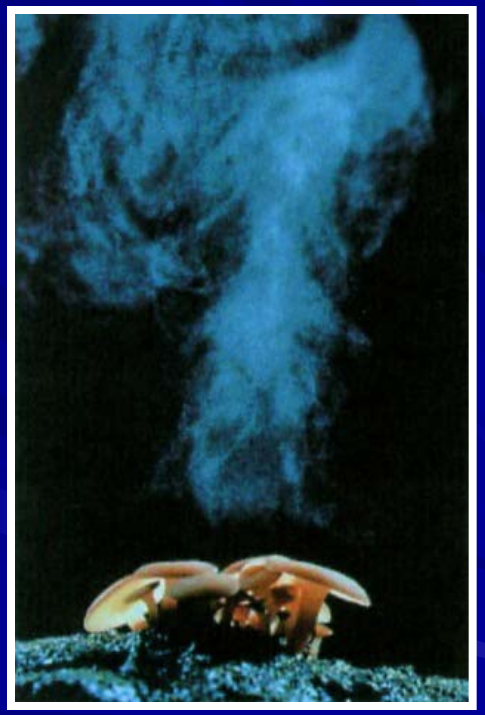
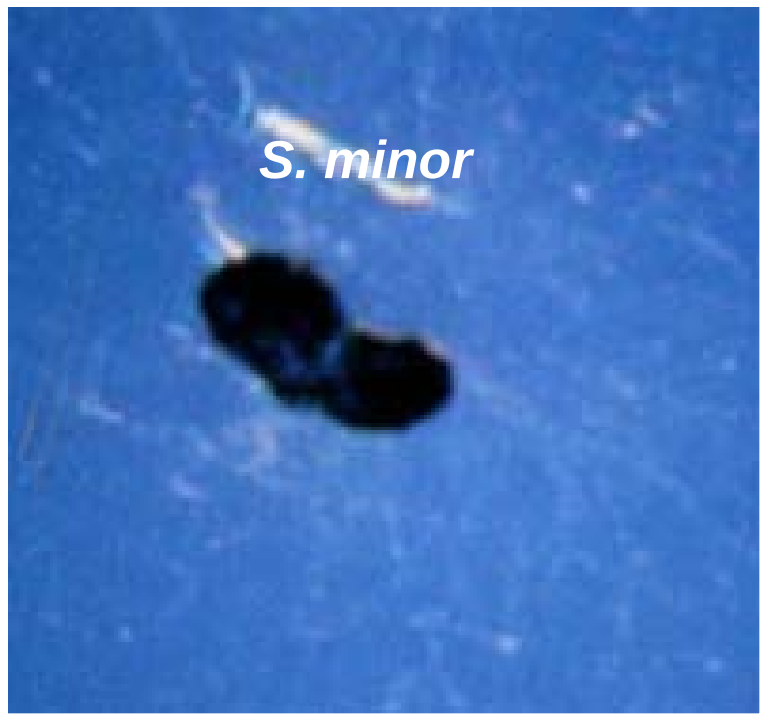
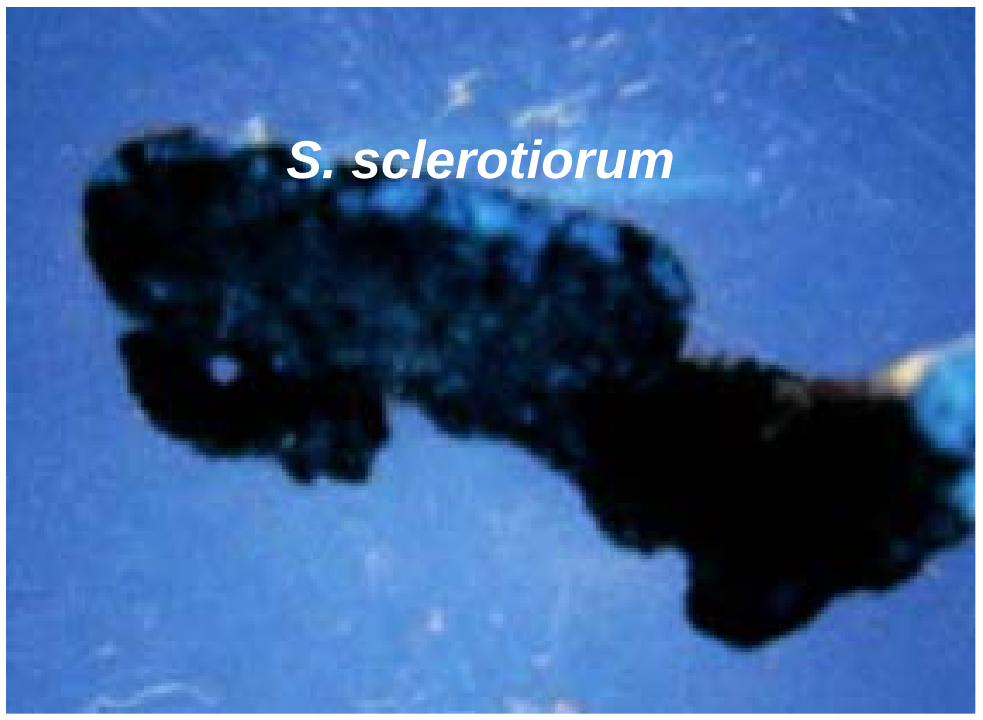


Most Sclerotinia drop on lettuce in Arizona is initiated by direct germination of sclerotia

- Direct germination of sclerotia favored by wet soil at temperatures ranging from 50 to 75°F





More abundant production of sclerotia (10 to 100X) by *S. minor* compared to *S. sclerotiorum*

Summary of differences between *Sclerotinia minor* and *S. sclerotiorum*

- Size of sclerotia
- Abundance of sclerotia
- Ability of *S. sclerotiorum* to produce aerial spores
  - When this occurs, entire fields can be infected and destroyed

At the end of the crop, sclerotia mixed back into soil to await the next lettuce crop

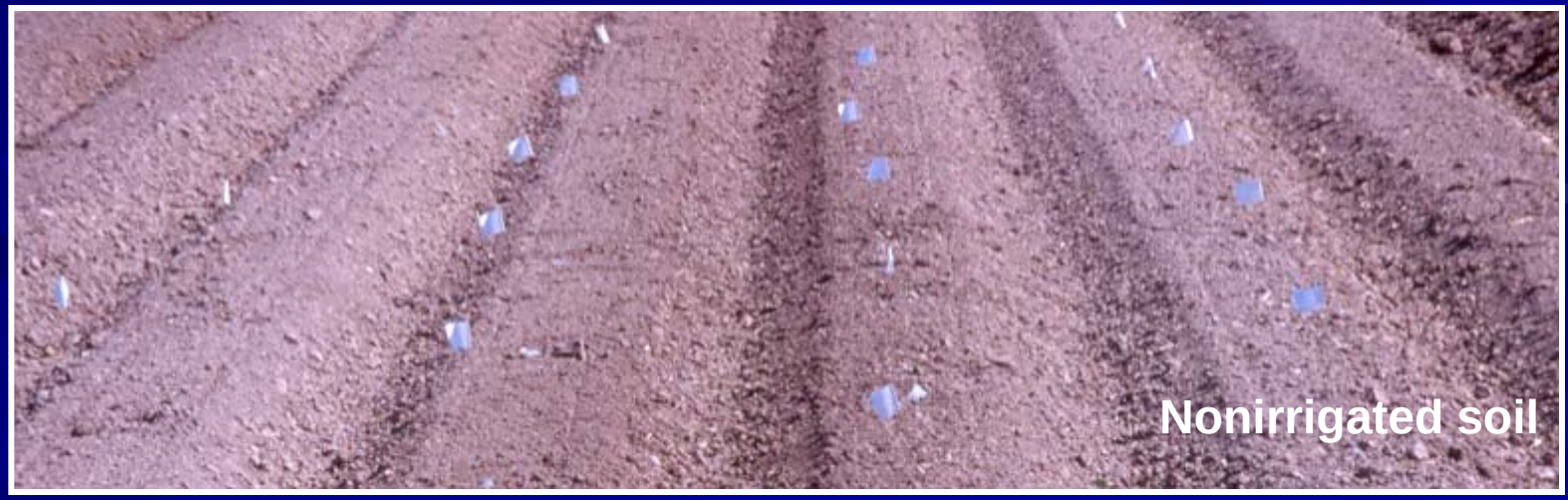
Management of Sclerotinia drop

- The target of disease control efforts are the sclerotia
- Sclerotia allow the pathogens to carry over in soil from one lettuce crop to another
- Disease management tools
  - Cultural
  - Biological
  - Chemical

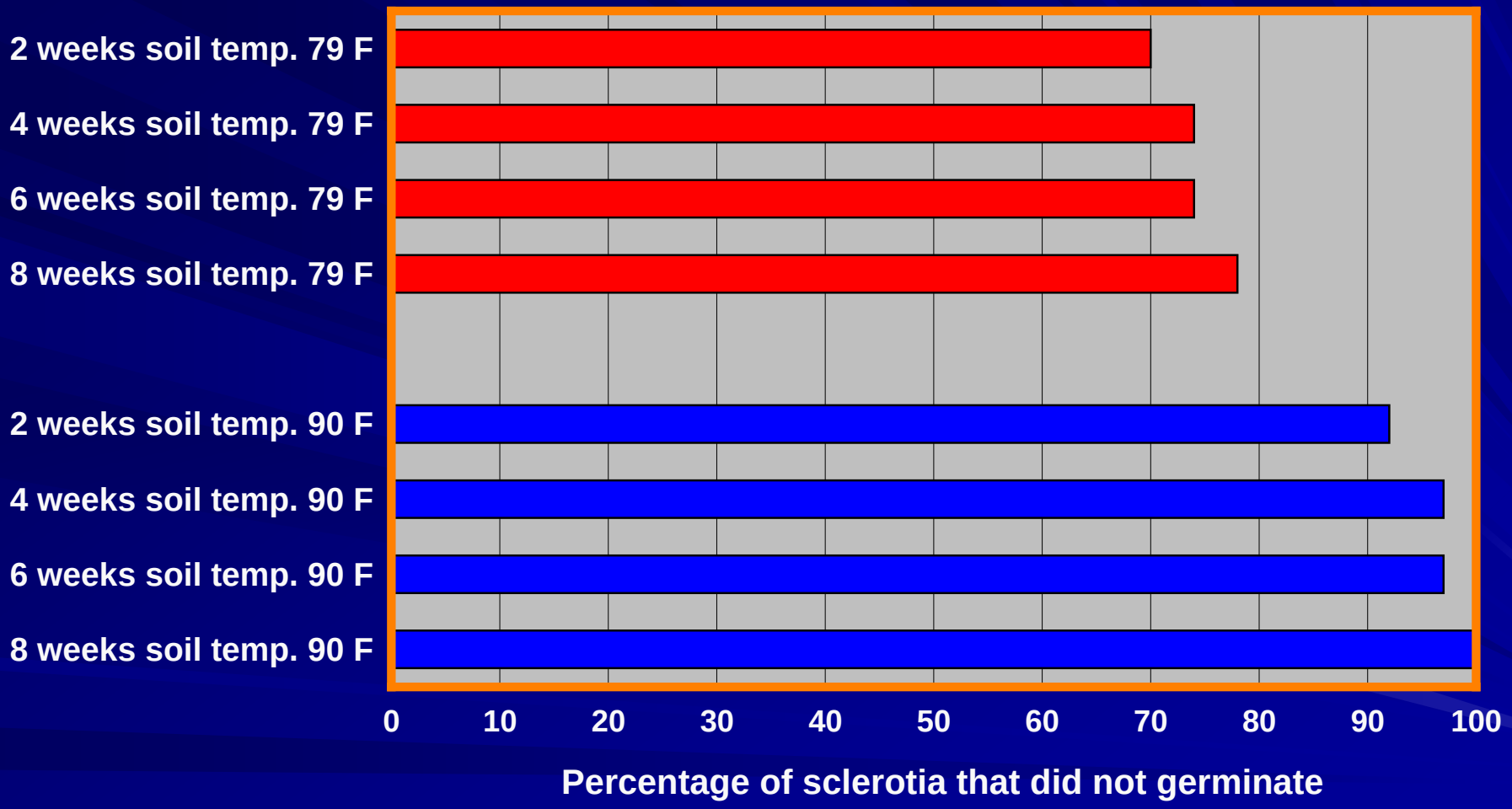
Cultural disease management tools

- Do nothing
  - Population of sclerotia will decline over time
- Soil solarization
  - Sclerotia in nonsolarized furrows will not be affected
- Summer soil flooding for 3-4 weeks

Effect of soil temperature and moisture On viability of *Sclerotinia* sclerotia

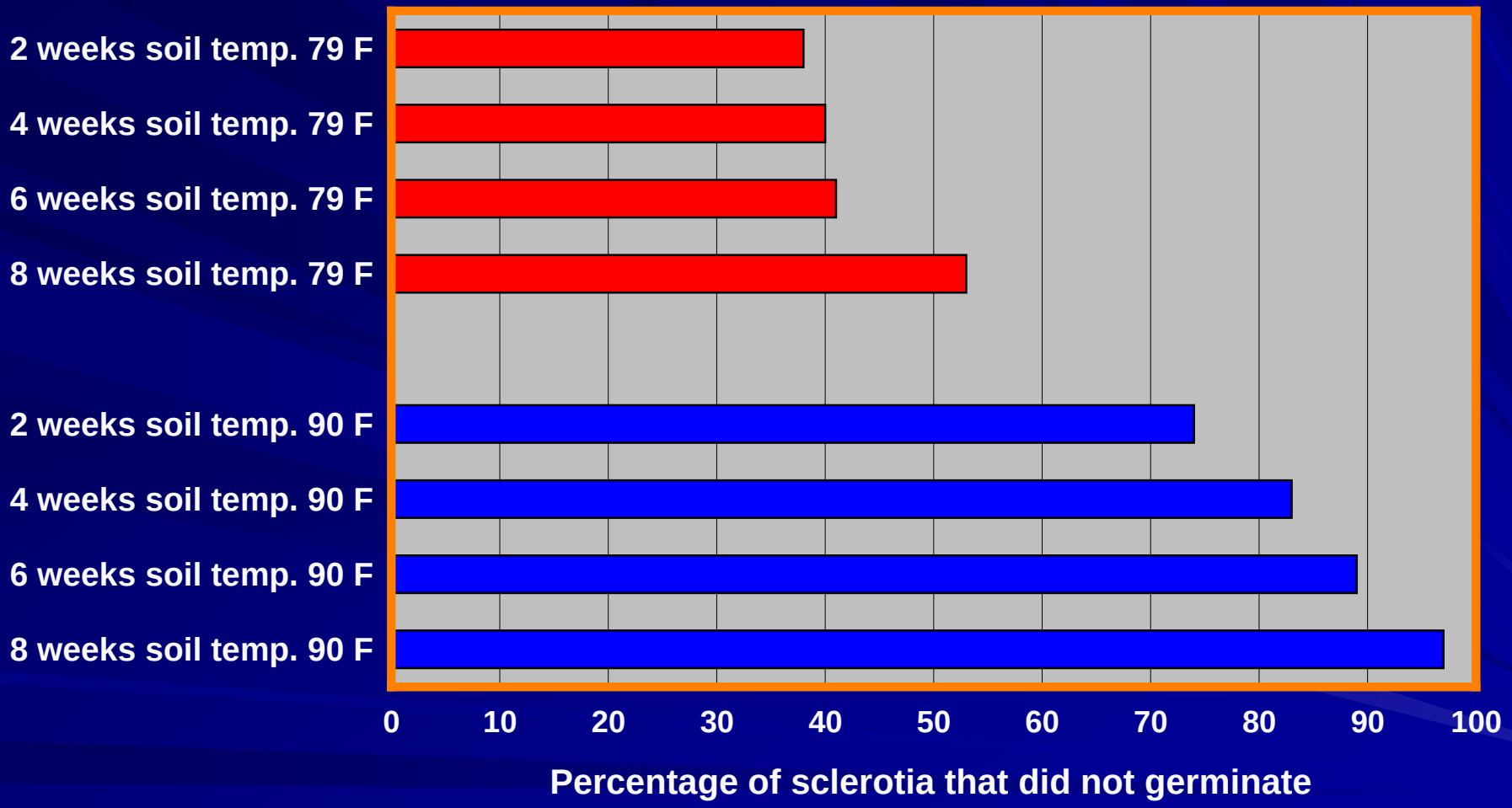


Effect of soil temperature on viability of sclerotia of *S. minor*



Summary of 3 trials. Soil irrigated every 1-2 wk, depending on the trial
Sclerotia at 0 and 2 inch depth.

Effect of soil temperature on viability of sclerotia of *S. sclerotiorum*



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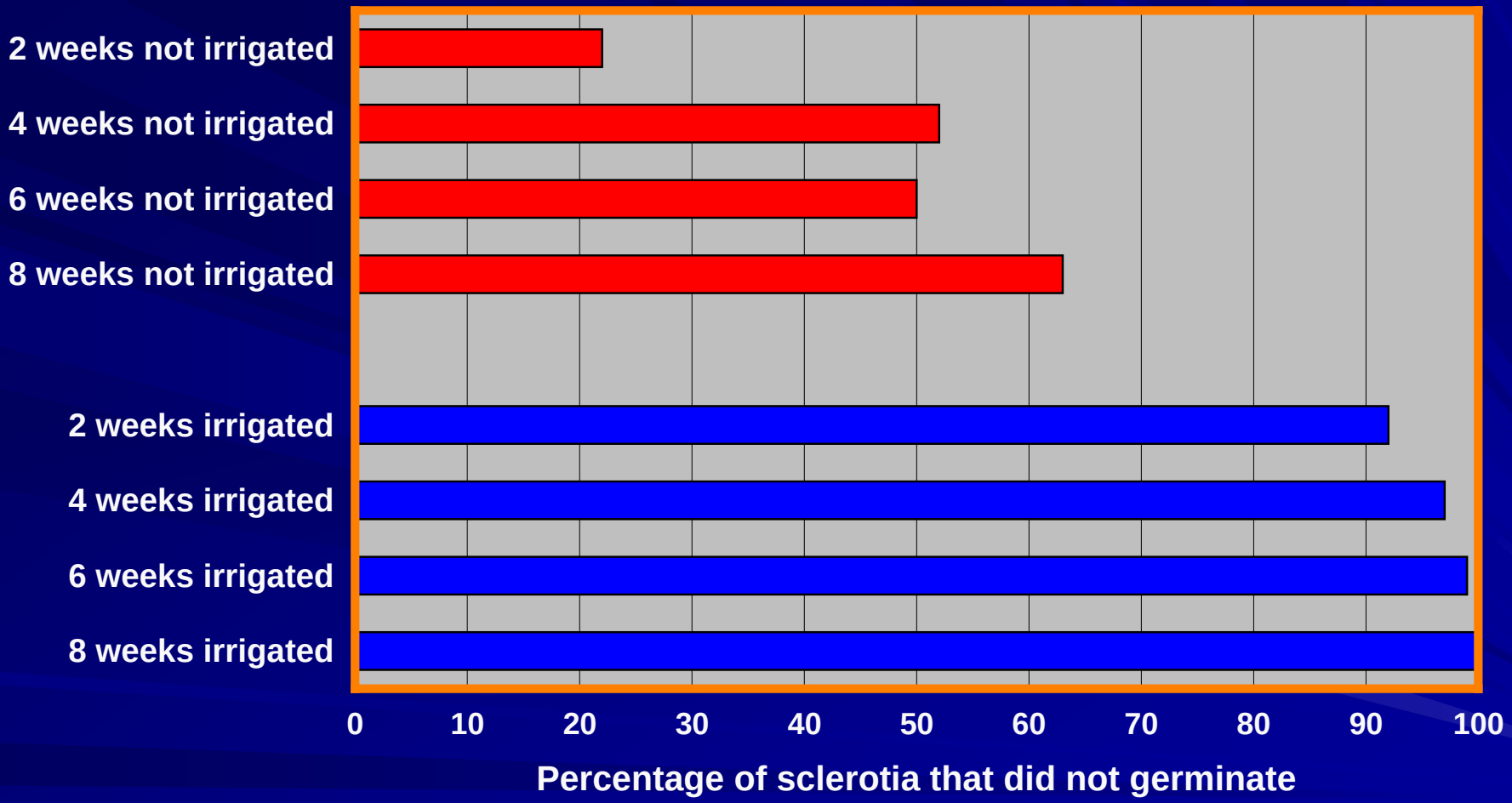
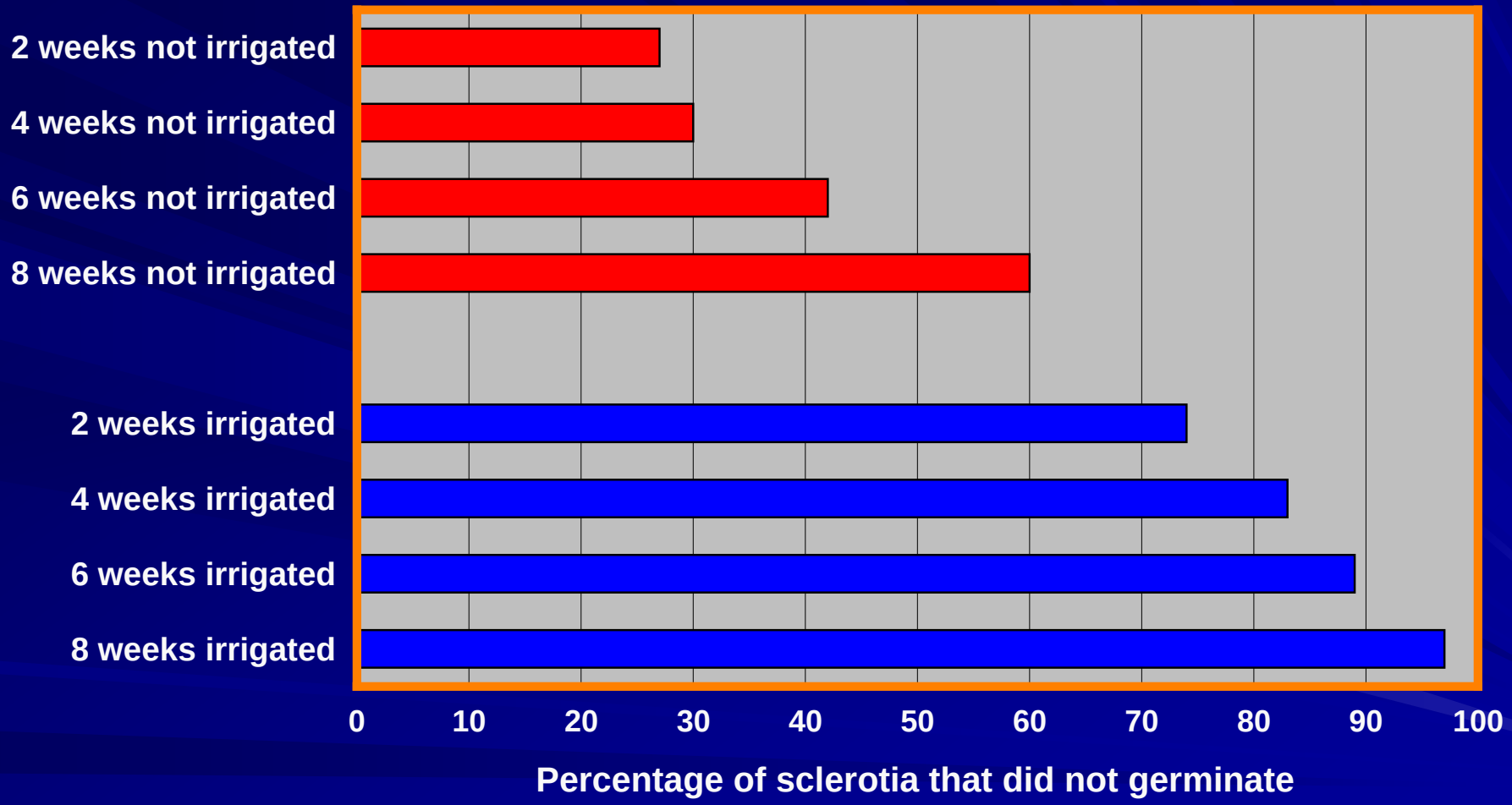


Summary of 3 trials. Soil irrigated every 1-2 wk, depending on the trial. Sclerotia 0 – 2 inches deep. Mean soil temp. 90°F for irrigated and 102°F for nonirrigated soil.

Effect of soil moisture on viability of sclerotia of *S. sclerotiorum*



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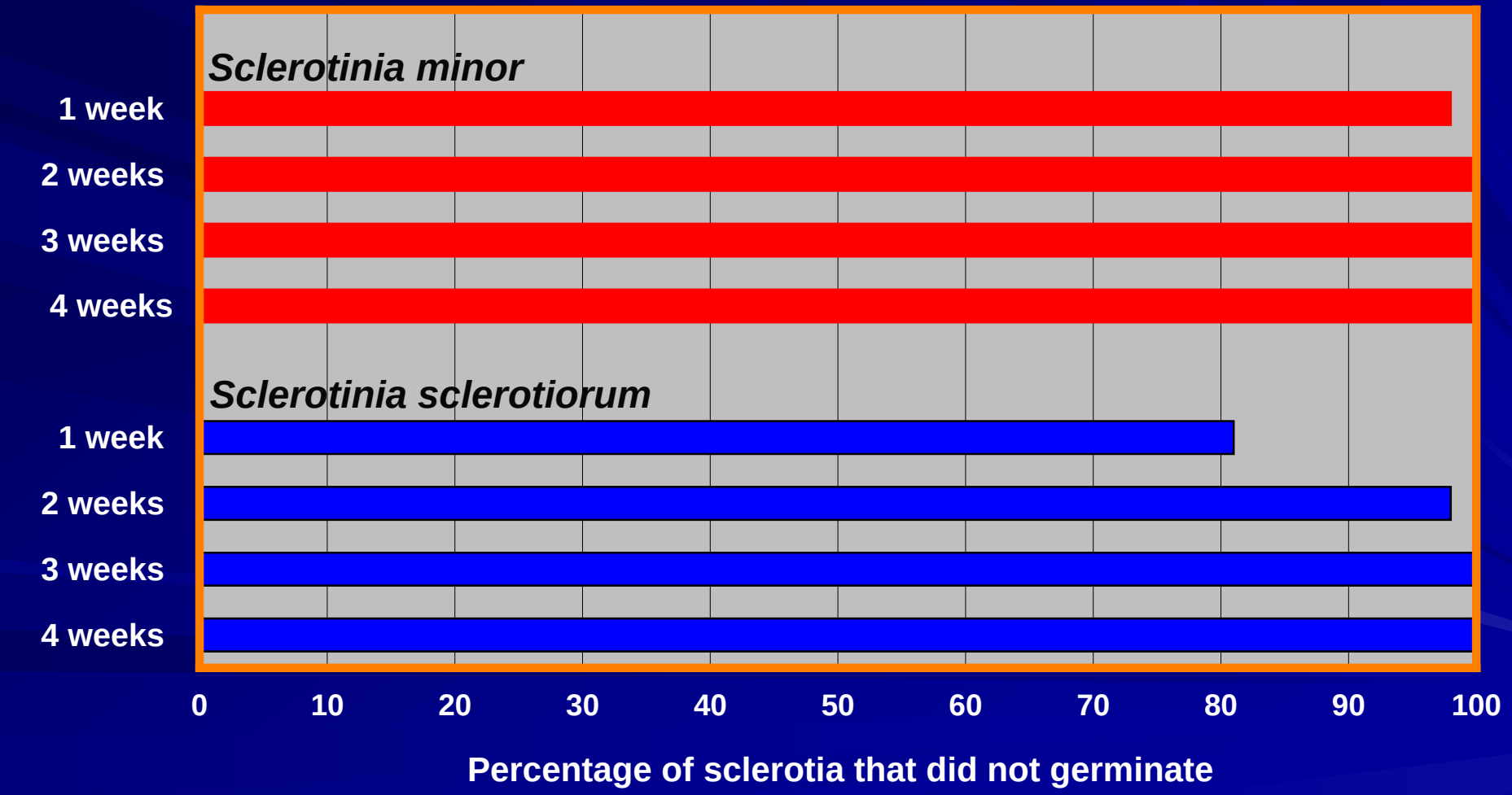
Effect of soil flooding on viability of *Sclerotinia* sclerotia

Effect of summer soil flooding on viability of sclerotia



Sclerotinia drop management tools

- Cultural
- Biological
- Chemical

Management of Sclerotinia drop with biofungicides

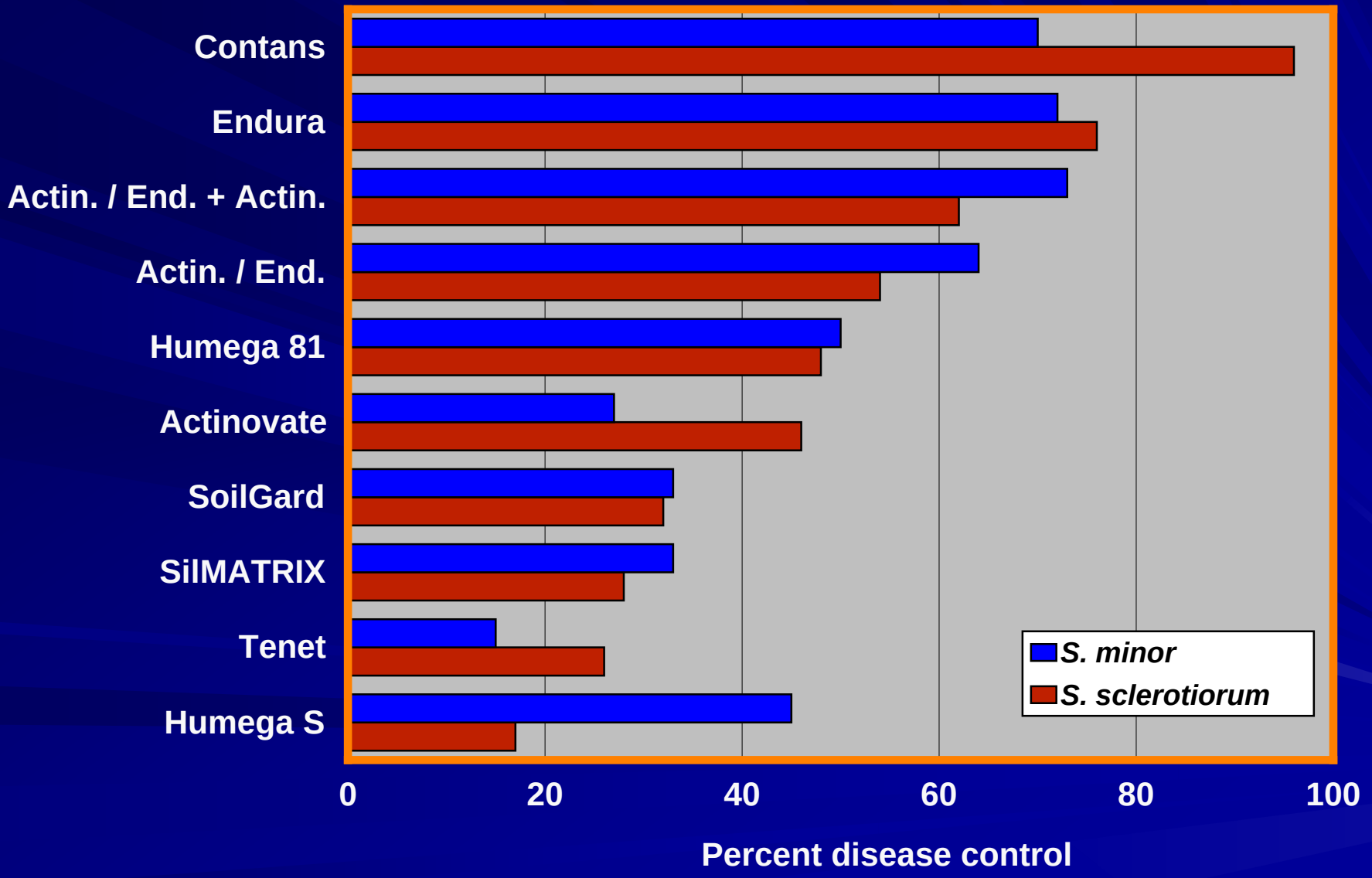
Evaluating efficacy

Biofungicides evaluated in 2009 trial

Product	Active ingredient	Source	Applications
Actinovate	*Streptomyces lydicus*	Natural Industries	At seeding, after thinning
Contans	*Coniothyrium minitans*	SipcamAdvan	At seeding, after thinning
Endura	Boscalid	BASF	At seeding, after thinning
Humega 81 Humega S	*Bacillus amyloliquefaciens* *B. amyloliquefaciens, B. megaterium, B. subtilis*	BioFlora	At seeding, +14 and 28 days
Sil-Matrix	Potassium silicate	Certis USA	At seeding, +6 times
SoilGard	*Gliocladium virens*	Certis USA	At seeding, after thinning
Tenet	*Trichoderma asperellum* *T. gamsii*	SipcamAdvan	At seeding, after thinning

Percent lettuce drop control

2010 biofungicide trial



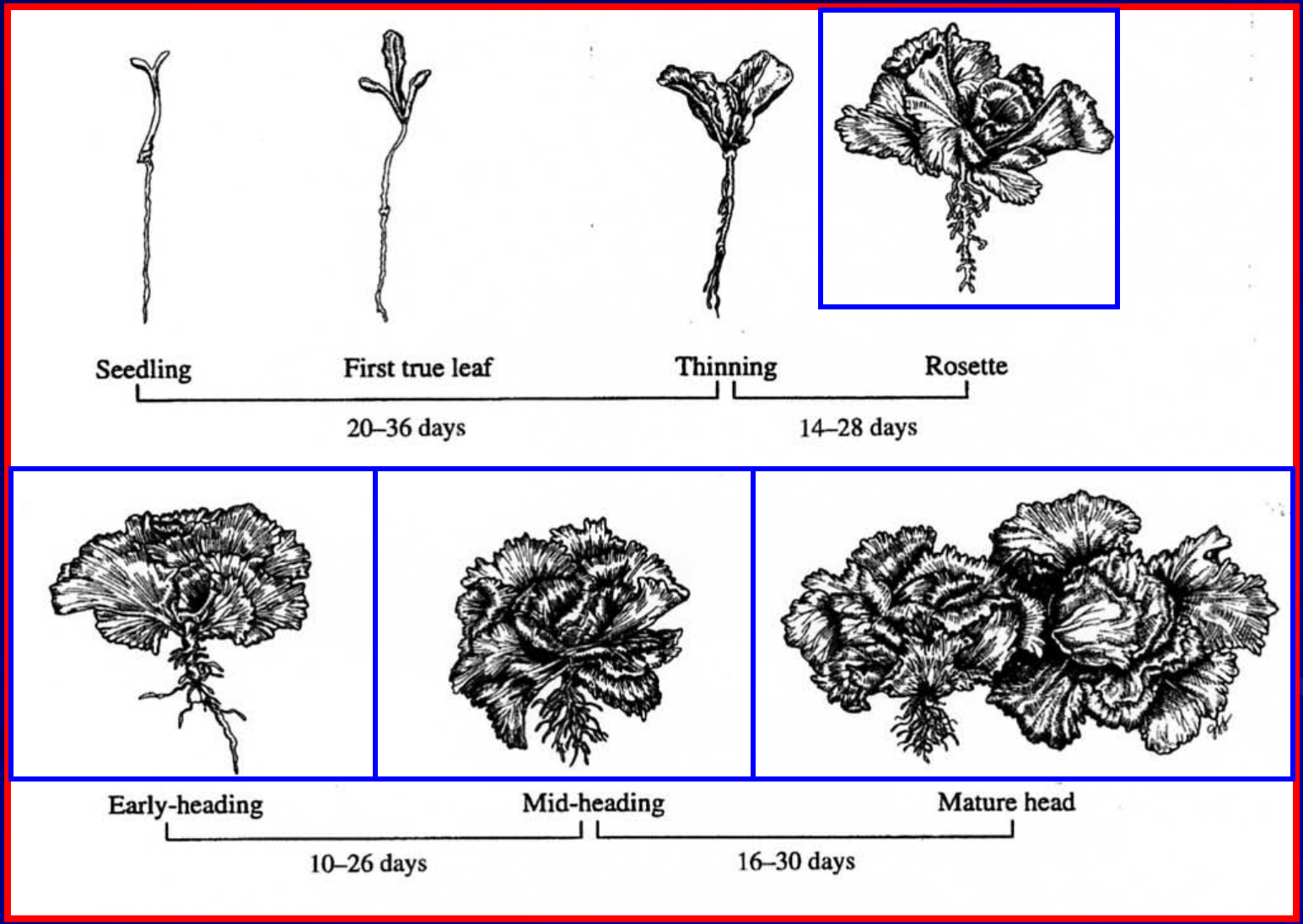
Sclerotinia drop management tools

- Cultural
- Biological
- Chemical

Management of Sclerotinia drop with conventional chemistries

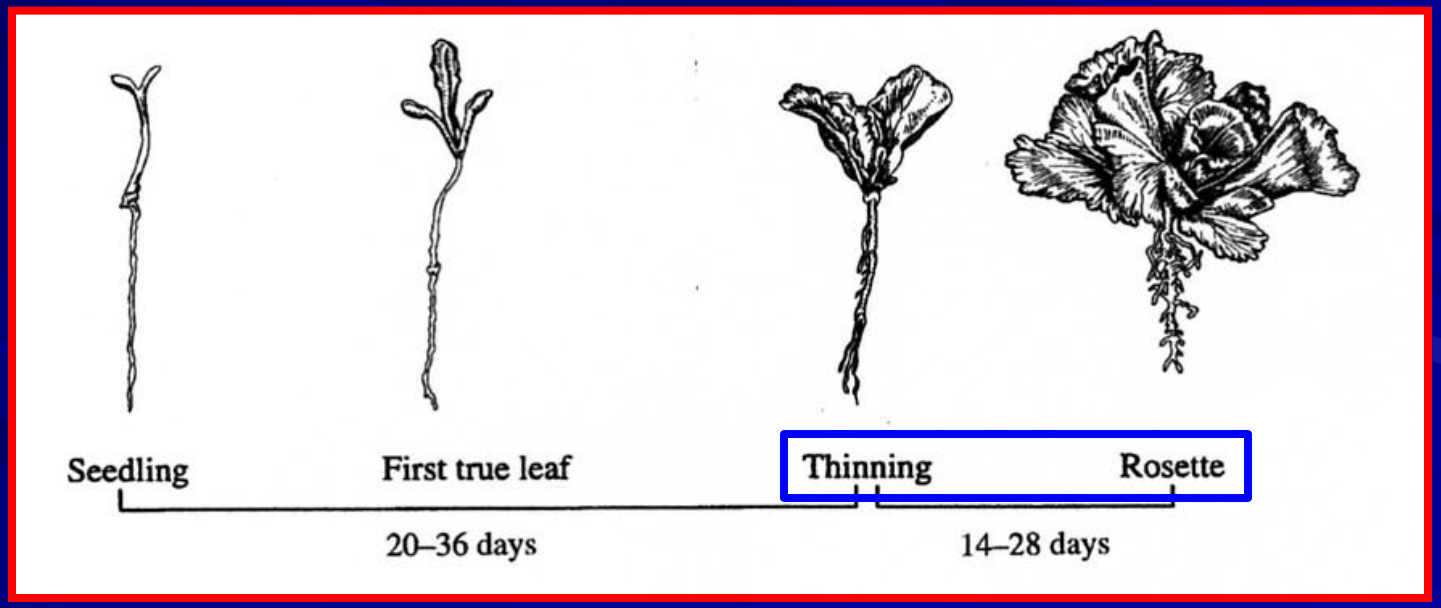
Evaluating efficacy

Growth stages of crisphead lettuce and occurrence of Sclerotinia drop

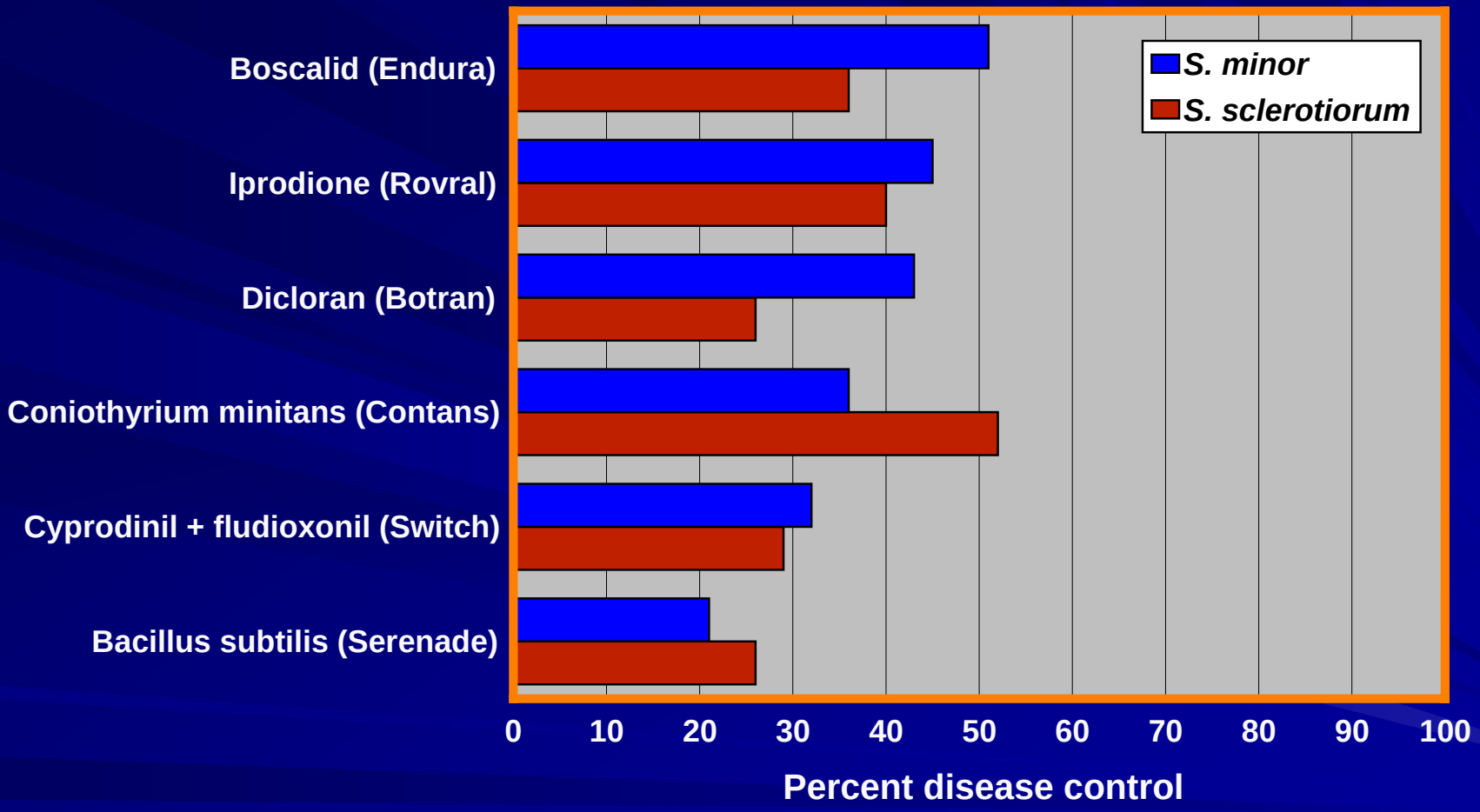


Chemical disease management

- Traditional application timing: Applied to bed and base of plants to prevent germination of sclerotia at or near soil surface
  - Immediately after thinning and cultivation
  - At rosette stage (2-3 weeks after thinning)



Relative efficacy of products for management of lettuce drop caused by each species of *Sclerotinia*



Each value is the mean from 4 trials, with 2 applications of each product per trial

Field trial protocol 2010-11 field trial
Evaluation of new chemistries

- Lettuce seeded on raised beds in double rows, 12 inches apart
- At thinning, sclerotia produced in the laboratory were spread on the surface of each 25-ft-long plot between the rows of lettuce seed and mixed into the top 2-inches of soil
  - 2100 sclerotia of *S. minor*, 800 of *S. sclerotiorum* per plot
  - Five replicate plots per treatment

Field trial protocol (continued)

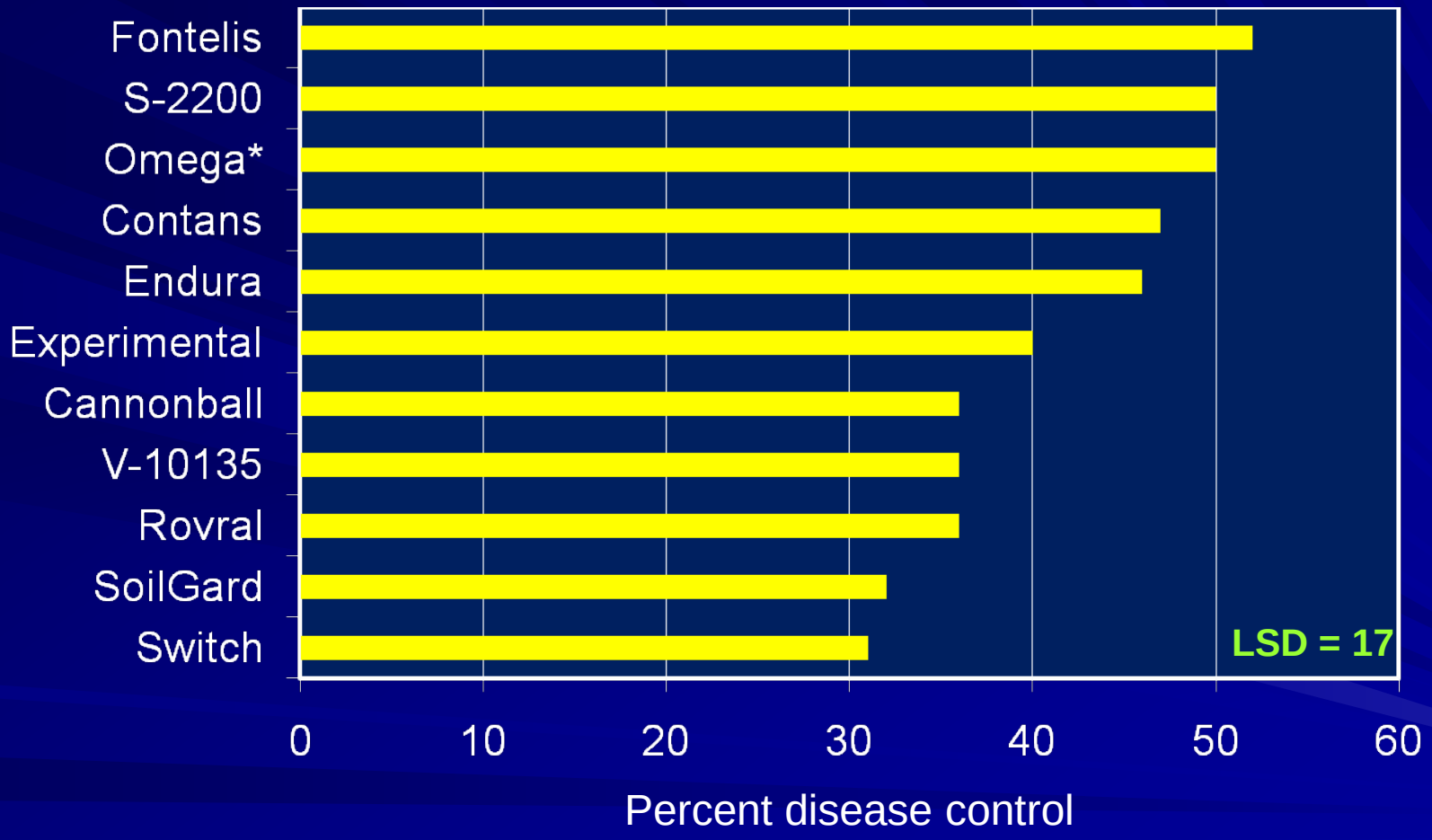
- First application of products after thinning
- Field irrigated by sprinkler irrigation to germinate seed, then furrow irrigated for remainder of trial
- One subsequent application of products 2 weeks after thinning
- At crop maturity, the number of dead plants per plot due to *Sclerotinia* infection was recorded

Products tested in 2010-11 lettuce drop trial

Trade name	Active ingredient	Source	FRAC #
Contans	*Coniothyrium minitans*	Sipcam/Advan	
Endura	Boscalid	BASF	7
Rovral	Iprodione	Bayer	2
SoilGard	Gliocladium virens	Certis	
Switch	Cyprodinil + fludioxonil	Syngenta	9+12
Cannonball	Fludioxonil	Syngenta	12
Fontelis	Penthiopyrad	DuPont	7
Omega	Fluazinam	Syngenta	29
Experimental	----------	----------	----------
S-2200	----------	----------	----------
Registered on lettuce			

Lettuce drop control: *S. minor* 2010 trial

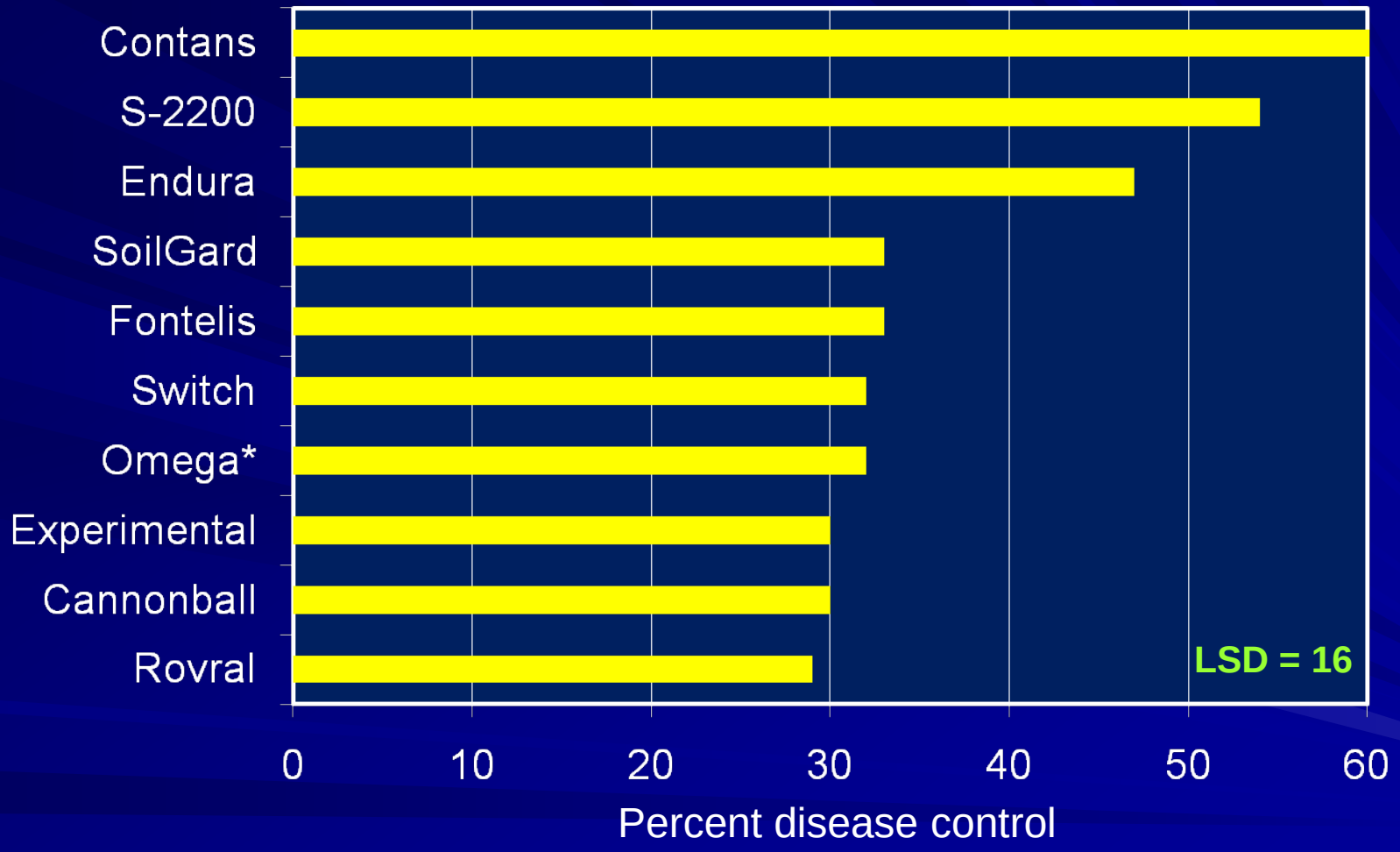
Two applications: at thinning and 2 wk later



* Omega applied only after thinning

Lettuce drop control: *S. sclerotiorum 2010*

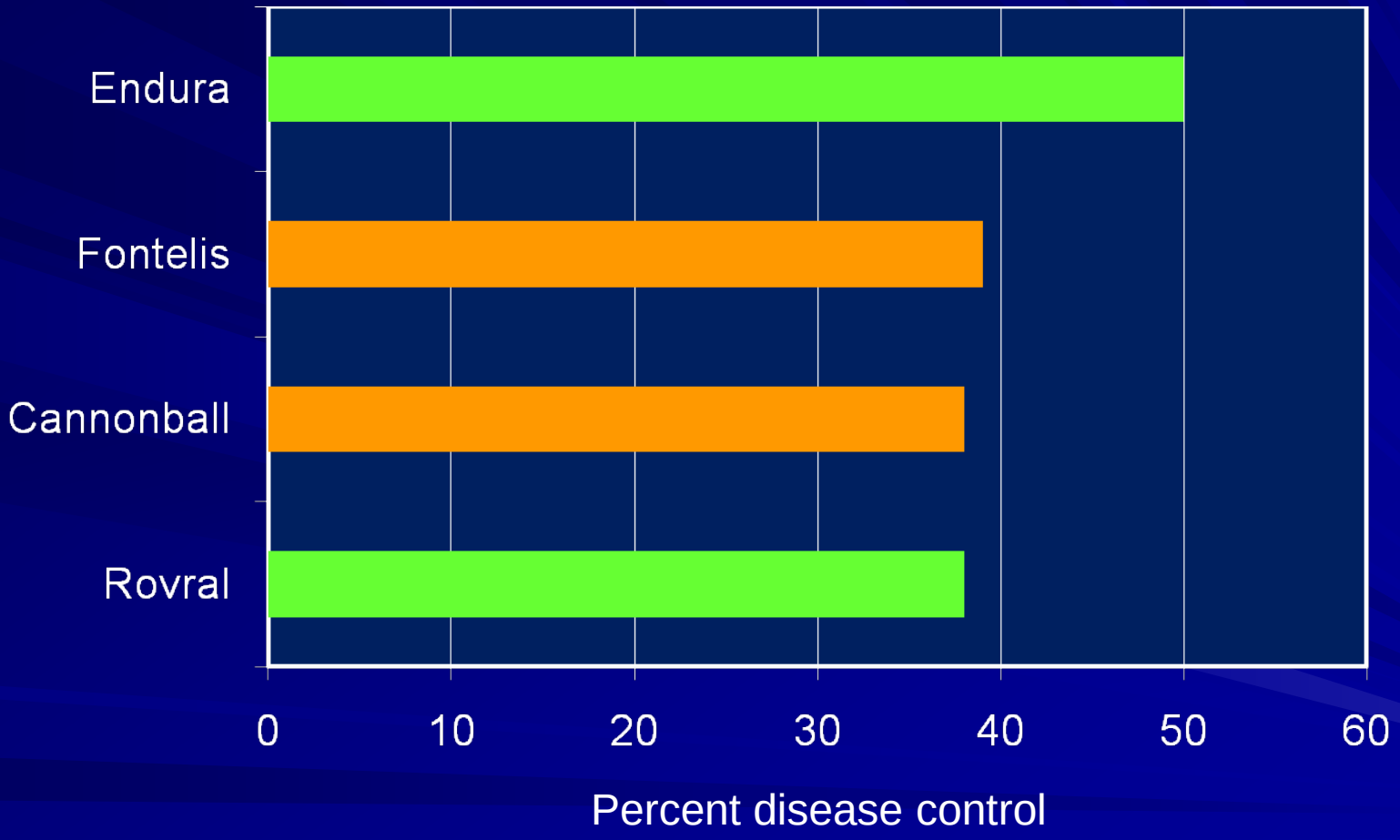
Two applications: at thinning and 2 wk later



* Omega applied only after thinning

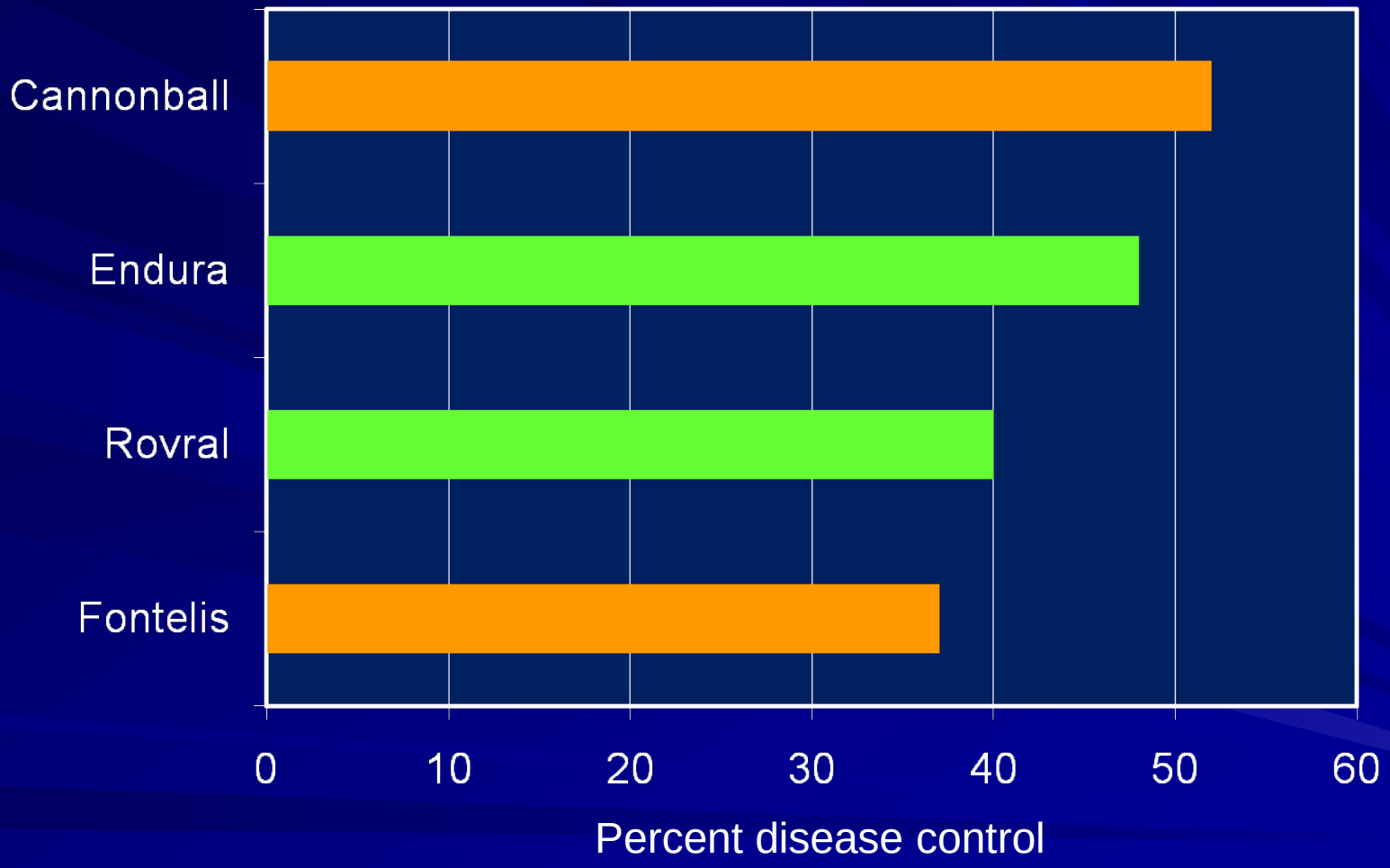
Lettuce drop control: *S. minor*

Two year average



Lettuce drop control: *S. sclerotiorum*

Two year average



Future research

- Examine alternate methods of application with the goal of maximizing control of Sclerotinia drop
  - Application at seeding vs. at thinning
  - Incorporation into soil vs. application to soil surface
  - Single compared to multiple applications

Thank you for your attention