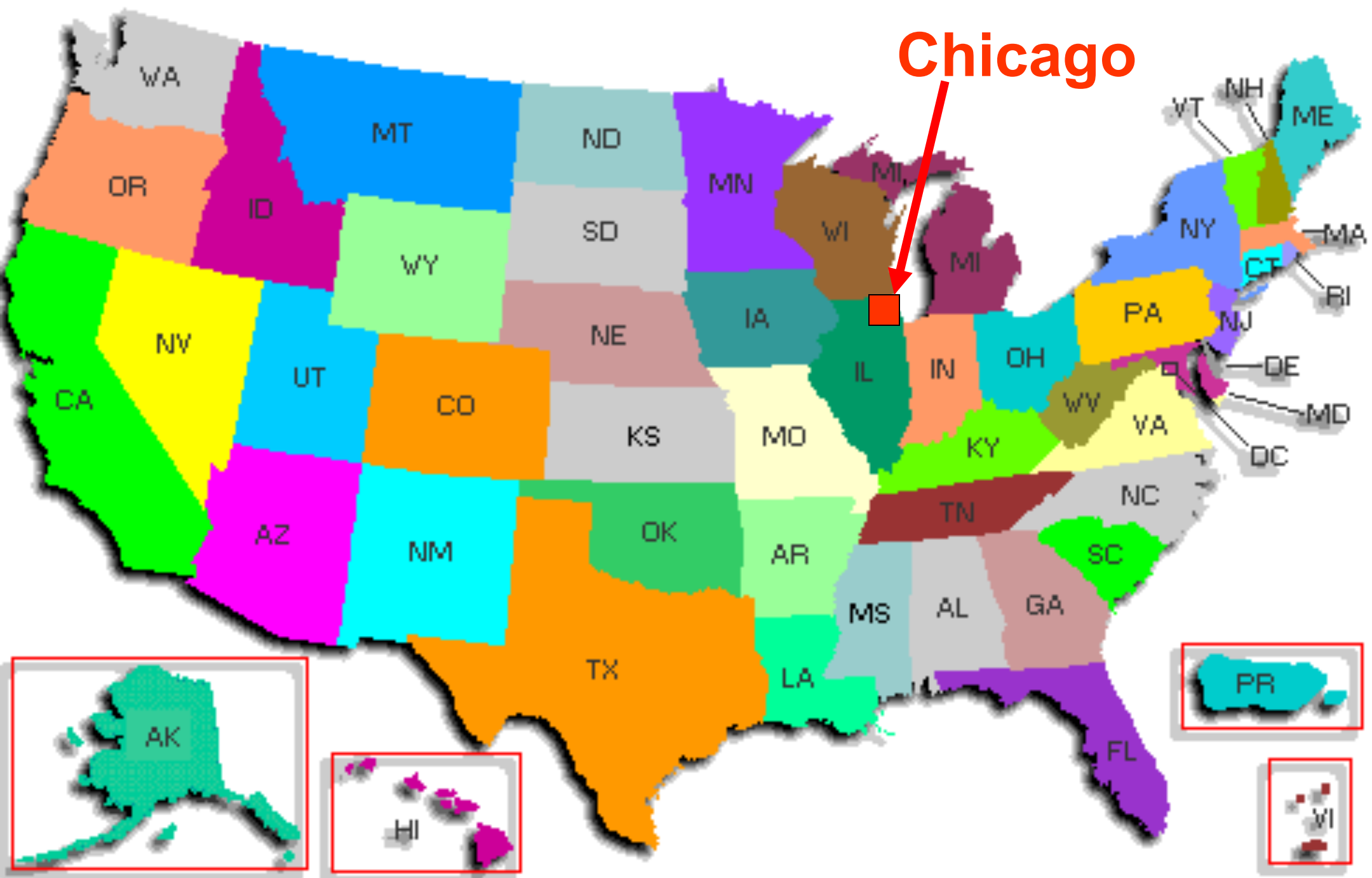


**Phytophthora Blight**  
*(Phytophthora capsici)*  
**of Peppers in Illinois**

**M. Babadoost**  
**University of Illinois**  
**Urbana-Champaign, Illinois**

Chicago



# Phytophthora Blight

*(Phytophthora capsici)*

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## Importance:

- Worldwide occurrence
- Affects >50 species in 15 plant families
- The most important disease of peppers and cucurbits in the US
- Causes up to 100% crop losses



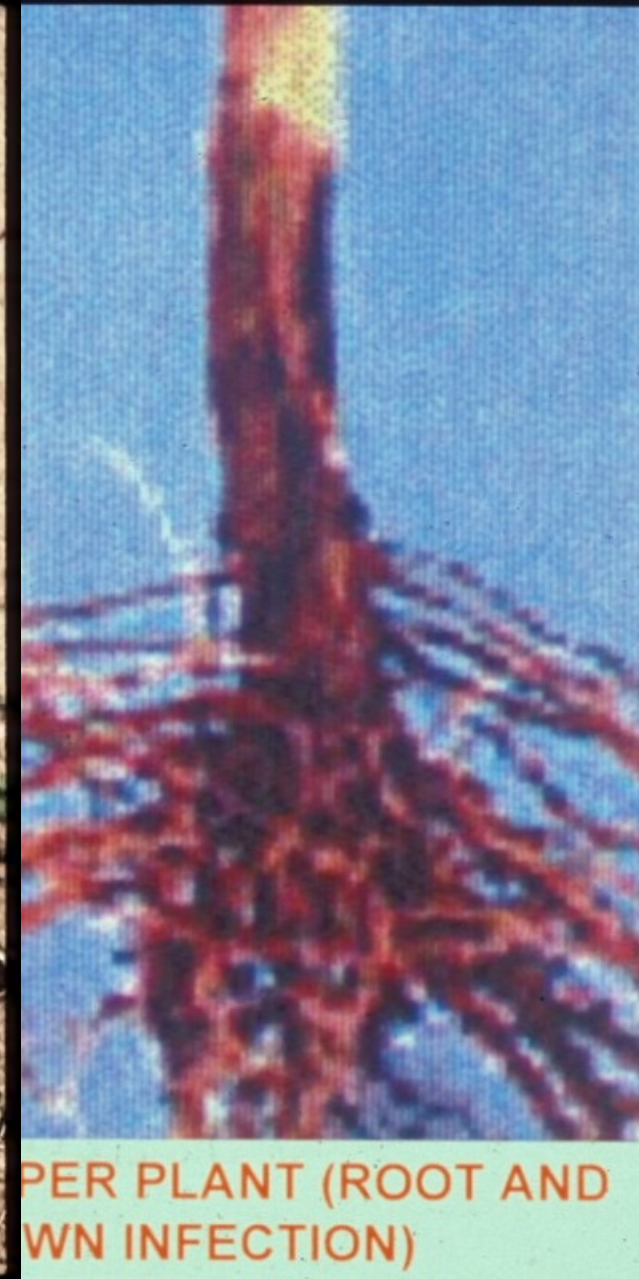
**Phytophthora blight of bell pepper**





**Phytophthora blight on chili Pepper**





PER PLANT (ROOT AND  
CROWN INFECTION)

# Phytophthora crown infection of peppers



# Phytophthora blight of, 100% crop losses







**Phytophthora blight of pepper**





**Phytophthora blight and fruit rot of eggplant**





**Fruit rot of cucurbits (*Phytophthora capsici*)**

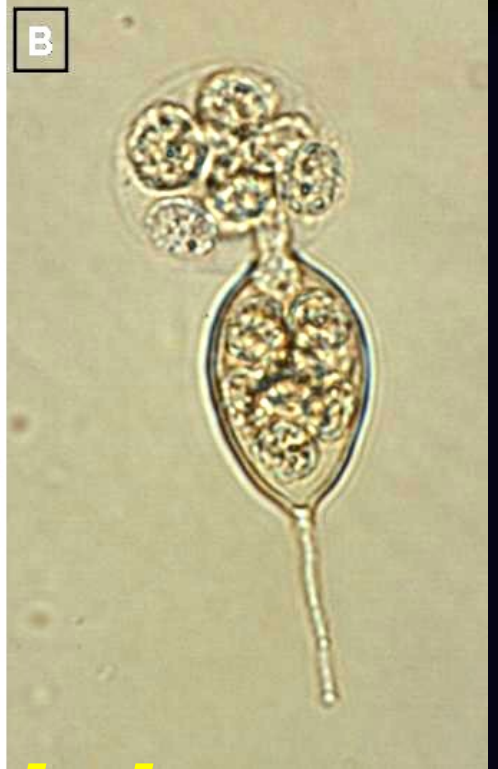
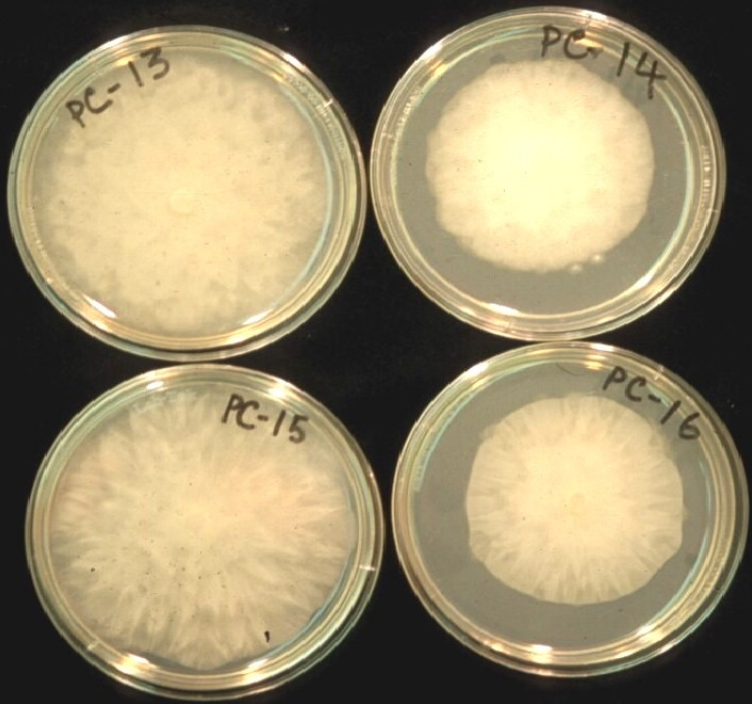
# Phytophthora Blight

## *(Phytophthora capsici)*

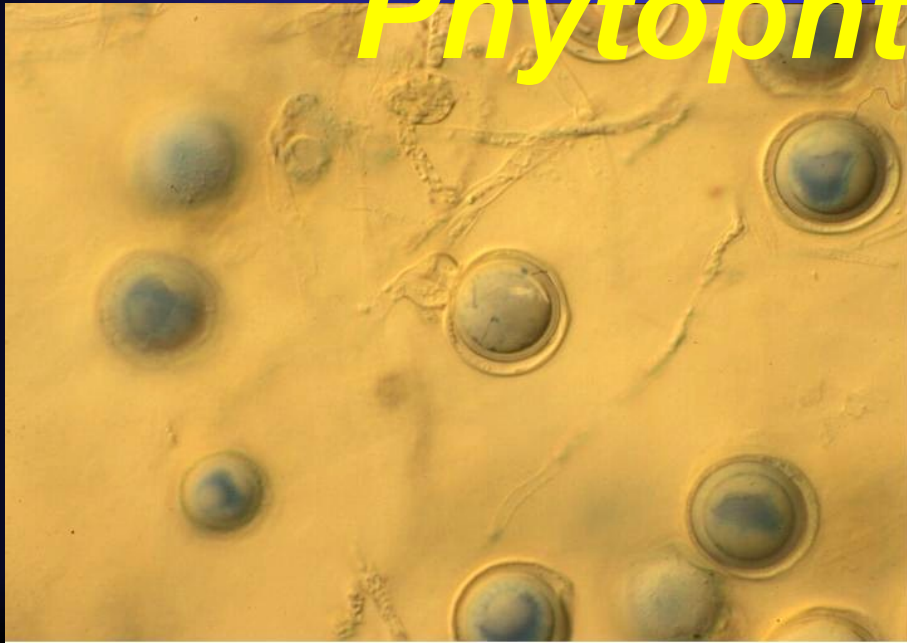
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- An oomycete pathogen
- Genetic and pathogenic variations
- Multi-cycle pathogen
- Survival: oospores and mycelium
- Favorable conditions: moist & warm

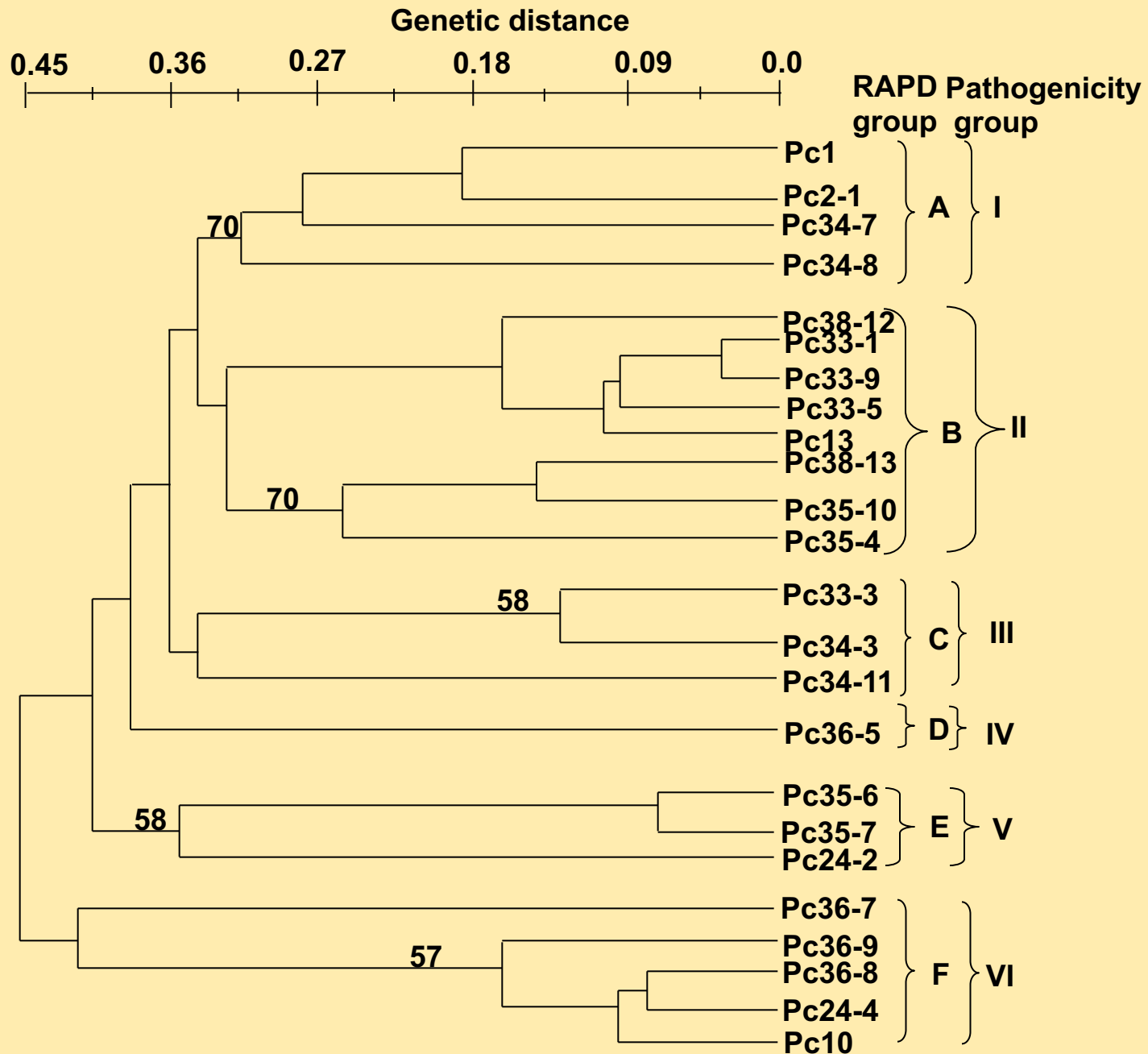




# *Phytophthora capsici*







# **Phytophthora Blight of Peppers (Management)**

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- **Resistant cultivars**
- **Chemical control**
- **Cultural practices**
- **Red-light treatment**

# Phytophthora Blight of Peppers (Management)

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- **Resistant cultivars**
- **Chemical control**
- **Cultural practices**
- **Red-light treatment**

A close-up photograph of a person's hand hovering over several pepper plants in a greenhouse. A white pipette-like device is positioned over one of the plants. The plants are green and appear to be in a controlled environment. The background is filled with more plants, creating a sense of a large-scale experiment.

**Evaluating pepper cultivars for resistance  
to *Phytophthora capsici***





**Evaluating pepper cultivars for resistance to *Phytophthora capsici***



# Evaluating pepper cultivars for resistance to *Phytophthora capsici*





# Phytophthora Blight Management, 2002

## Resistant pepper cultivars/lines (**Field**)

### Plant survival (%)

CV/Line	11 June	11 July	8 August	22 August
Emerald Isle	100	95 a	90 a	85 a
Paladin	100	95 a	92 a	92 a
Reinger	100	95 a	92 a	92 a
BHN-1P	100	92 ab	82 a	82 a
Line #1	100	100 a	100 a	100 a
Line #2	100	100 a	92 a	92 a
Line #13	100	97 a	97 a	92 a
Line #7326	100	100 a	100 a	100 a
<b>Maxi Bell</b>	100	72 bc	57 b	57 b
<b>Cal. Wonder</b>	100	57 c	50 b	50 b

# Phytophthora Blight Management, 2007

## Resistant pepper cultivars/lines (**Field**)

### Plant survival (%)

CV/Line	15 May	12 June	10 July	14 August
Alliance	100	78 ab	70 a-d	65 bc
Aristatol	100	80 ab	80 abc	78 ab
HMX-6696	100	80 ab	50 d	40 cd
HMX-7648	100	78 ab	68 bcd	60 bcd
Paladin	100	90 a	90 ab	83 ab
Polaris	100	68 b	55 cd	38 cd
Revolution	100	90 a	85 ab	75 ab
Seigers-9915776	100	98 a	95 a	95 a
Snapper	100	93 a	83 ab	60 bcd
<u>Cal. Wonder</u>	100	85 ab	70 a-d	35 d



# Conclusions

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Greenhouse and field trials showed that following bell pepper cultivars are resistant/tolerant to *Phytophthora capsici* (Illinois Isolates)

- Alliance
- Aristotle
- Emerald Isle
- Enza
- Paladin
- Reinger
- Revolution

# Phytophthora Blight of Peppers (Management)

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- Resistant cultivars
- **Chemical control**
- Cultural practices
- Red-light treatment

# Phytophthora Blight of Vegetables (Chemical Control)

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- Since 2000, we have tested more than 40 fungicides for their efficacy for control of *Phytophthora capsici*



# **Phytophthora capsici –Fungicide Effect/IN VITRO (100 ppm)**

<b>Fungicide</b>	<b>Mycelial radial growth (mm)</b>	<b>Sporangia formation inhibition (%)</b>	<b>Zoospore release inhibition (%)</b>	<b>Zoospore germination inhibition (%)</b>
<b>Acrobat</b>	<b>0.0</b>	<b>100</b>	<b>99.0</b>	<b>99.7</b>
<b>Aliette</b>	<b>71.6</b>	<b>73.0</b>	<b>0.0</b>	<b>0.0</b>
<b>Bravo Ultrex</b>	<b>34.6</b>	<b>98.0</b>	<b>97.8</b>	<b>0.0</b>
<b>Cuprofix</b>	<b>47.6</b>	<b>100</b>	<b>95.0</b>	<b>99.0</b>
<b>Quadris</b>	<b>50.0</b>	<b>69.6</b>	<b>25.0</b>	<b>0.0</b>
<b>Ridom Gold/Bravo</b>	<b>26.0</b>	<b>100</b>	<b>88.7</b>	<b>90.0</b>
<b>Ridom Gold/Copp</b>	<b>40.0</b>	<b>96.0</b>	<b>80.6</b>	<b>1.4</b>
<b>Ridom Gold EC</b>	<b>39.3</b>	<b>100</b>	<b>97.0</b>	<b>2.0</b>
<b>Ridom Gold/MZ</b>	<b>37.0</b>	<b>100</b>	<b>96.9</b>	<b>68.0</b>
<b>Zoxium</b>	<b>2.6</b>	<b>100</b>	<b>0.0</b>	<b>0.0</b>
<b>Control</b>	<b>80.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>

## ***Phytophthora capsici* –Fungicide Effect/*IN VITRO* (10 ppm)**

<b>Fungicide</b>	<b>Mycelial radial growth (mm)</b>	<b>Sporangia formation inhibition (%)</b>	<b>Zoospore release inhibition (%)</b>	<b>Zoospore germination inhibition (%)</b>
<b>Acrobat</b>	<b>0.0</b>	<b>100</b>	<b>96.7</b>	<b>96.9</b>
<b>Bravo Ultrex</b>	<b>60.4</b>	<b>89.2</b>	<b>28.8</b>	<b>0.0</b>
<b>Cuprofix</b>	<b>73.0</b>	<b>78.0</b>	<b>8.2</b>	<b>99.0</b>
<b>Ridom Gold/Bravo</b>	<b>36.0</b>	<b>94.0</b>	<b>6.0</b>	<b>25.4</b>
<b>Ridom Gold EC</b>	<b>42.6</b>	<b>100</b>	<b>10.0</b>	<b>0.0</b>
<b>Ridom Gold/MZ</b>	<b>62.6</b>	<b>97.0</b>	<b>49.0</b>	<b>0.0</b>
<b>Zoxium</b>	<b>9.5</b>	<b>100</b>	<b>0.0</b>	<b>0.0</b>
<b>Control</b>	<b>80.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>



## **Phytophthora capsici – Effect of Acrobat (10 ppm)**

<b>Pathogen isolate</b>	<b>Mycelial radial growth (mm)</b>	<b>Zoospore release inhibition (%)</b>	<b>Zoospore germination inhibition (%)</b>
<b>Pumpkin-1</b>	<b>0.0</b>	<b>88.6</b>	<b>100</b>
<b>Pumpkin-4</b>	<b>0.0</b>	<b>86.6</b>	<b>100</b>
<b>Pumpkin-6</b>	<b>0.0</b>	<b>14.0</b>	<b>93.8</b>
<b>Pumpkin-10</b>	<b>0.0</b>	<b>93.4</b>	<b>100</b>
<b>Pumpkin-15</b>	<b>0.0</b>	<b>50.3</b>	<b>100</b>
<b>Pumpkin-16</b>	<b>0.0</b>	<b>71.2</b>	<b>79.4</b>
<b>Squash-7</b>	<b>0.0</b>	<b>27.7</b>	<b>100</b>
<b>Pepper-8</b>	<b>0.0</b>	<b>77.2</b>	<b>100</b>

# **Phytophthora Blight Management (Chemical Control)**

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- **2000-2009: Spray application**
- **2010: Drip-irrigation delivery**







# Phytophthora Blight – Management, 2007 (Chemical Control, 7-Day)

## Plant Survival (%)

Treatment ( <b>1S,7F</b> )	15 May	10 July	14 August
Control	100	65.0 b	35.0 a
Ra, Ra+Ko+Sil	100	95.0 a	65.0 a
Om, Om/Ra+Ko+Sil	100	87.5 ab	45.0 a
Ma, Ma	100	80.0 ab	57.5 a
Re, Re+Ko+A90	100	92.5 a	70.0 a
Fo, Fo+Ko/Ta+Ko	100	92.5 a	45.0 a

A-90=Activator-90; Ko=Kocide-3000; Ma=Maestro;  
Om=Omega; Ra=Ranman; Sil=Silwet; Ta=Tanos



# Phytophthora Blight – Management, 2010 (Chemical Control, 7-Day: Drip Irr. Delivery)

## Plant Survival (%)

Treatment ( <b>D</b> , <b>F</b> )	14 May	11 June	9 July
Control	100	45.5 c	10.0 e
RG/RS/RGC/PO (7)	100	95.0 ab	70.0 a
RG/RS+AD/RGC (7)	100	82.5 ab	55.0 a-d
ZO/ZO( <b>D</b> )+ZO( <b>F</b> ) (8)	100	95.0 ab	65.0 ab
ZO/ZO( <b>D</b> ) (8)	100	95.0 ab	60.0 a-c
RG/RG( <b>D</b> )+ZO( <b>F</b> ) (8)	100	87.5 ab	52.5 a-d

AD=Actigard; PO=presidio; RG=Ridomil Gold EC; RGC=Ridomil Gold Copper; RS=Revus; ZO=Zampro525SC.

# Fungicides for Control of *Phytophthora capsici*

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## ➤ Effective Fungicides

- \*\* **Cyazofamid** (Ranman 400SC)
- \*\* **Captan** (Maestro 80DF)
- \* **Dimethomorph** (Forum 4.16SC )
- \*\* **Famoxadon + Cymoxanil** (Tanos 50WDG)
- \* **Fluopicolide** (Presidio 4SC)
- \*\* **Mandipropamid** (Revus 2.09SC)
- \* **Mefenoxam** (Ridomil G. EC 4SC, R. G. Copper 65WP)
- **Phosphorous acid** (ProPhyt) – **inconsistent results**
- (Zampro 525SC) – **further studies needed**

**No fungicide is effective with heavy rainfalls**



# Fungicides for Pumpkin Phytophthora

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<u>Name</u>	<u>FRAC Code</u>
<b>Copper</b> (Kicide, Cuprofix)	<b>M</b>
<b>Cyazofamid</b> (Ranman 400SC)	<b>21</b>
<b>Dimethomorph</b> (Forum)	<b>40</b>
<b>Famoxadon + Cymoxanil</b> (Tanos)	<b>11, 27</b>
<b>Mandipropamid</b> (Revus)	<b>40</b>
<b>Mefenoxam</b> (RG EC, RG Copper)	<b>4</b>
<b>Fluopicolide</b> (Presidio)	<b>43</b>
<b>Phosphonates</b> (ProPhyt, .....)	<b>33</b>

# Phytophthora Blight of Peppers (Management)

---

- Resistant cultivars
- Chemical control
- **Cultural practices**
- Red-light treatment



# Phytophthora Blight of Peppers (Management)

---

## ➤ Cultural practices

### ❖ Crop rotation

- ✓ Host range of the pathogen
- ✓ Survival of the pathogen in soil

# Phytophthora Blight Management

(Host Range: 36 Crops and 9 Weed Species)

## Host

Cantaloupe	Cucumber	Gourd
Eggplant	pepper	Beet
Pumpkin	Squash	Radish
Zucchini	Watermelon	Turnip
Honeydew	Swiss-chard	Carrot
Spinach	Nightshade	Onion
Green bean	Lima bean	Tomato
Velvet-leaf	Snow pea	Tobacco

## Non-Host

Corn	Pigweed	Soybean
Broccoli	Kale	Cabbage
Crabgrass	Basil	Chive
Sandbur	Celery	Dill
Wheat	Water hemp	Barley
Cocklebur	Lamb's-quarters	
Mustard	Cauliflower	
Parsley	Puncture vine	

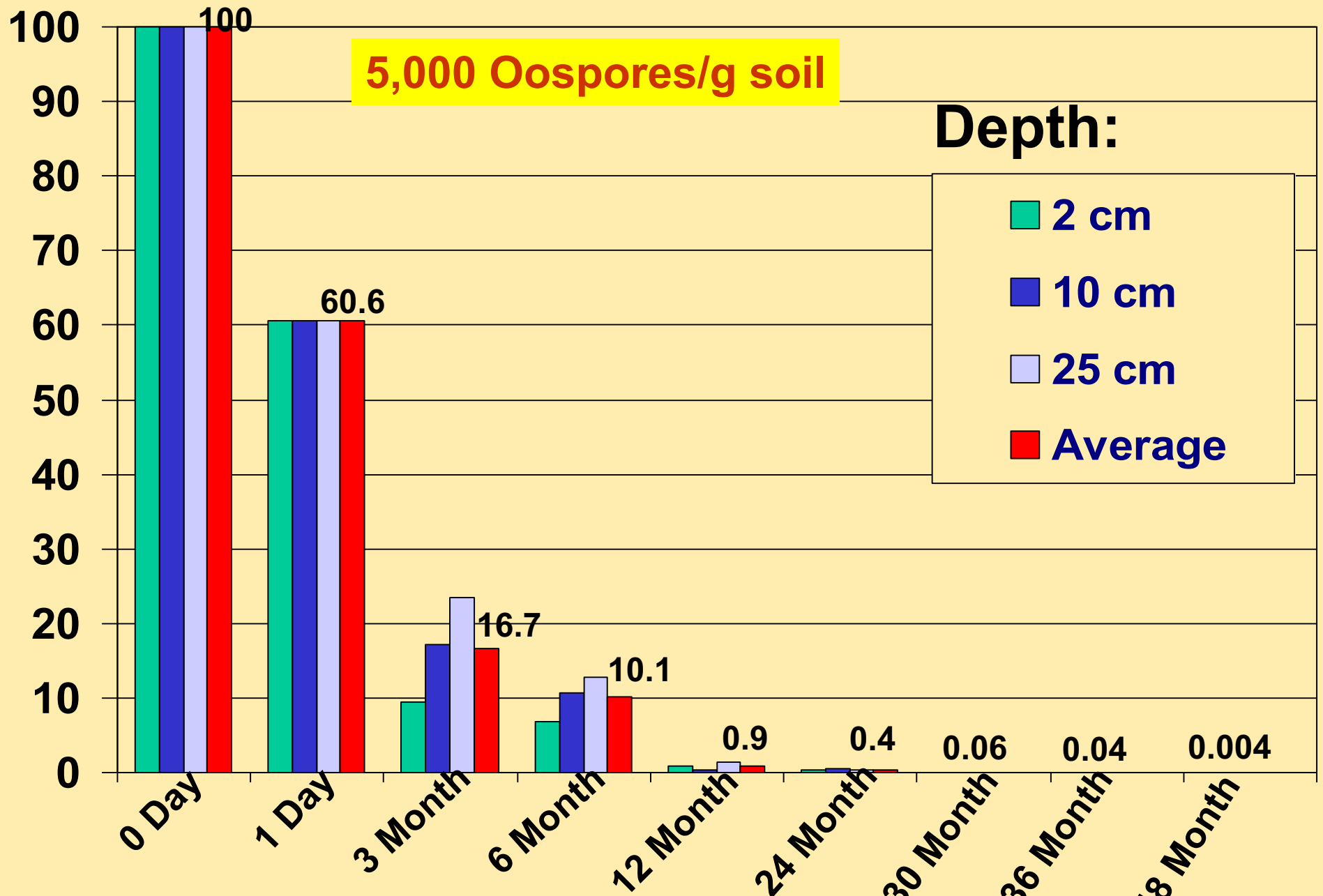
# Phytophthora Blight of Peppers (Management)

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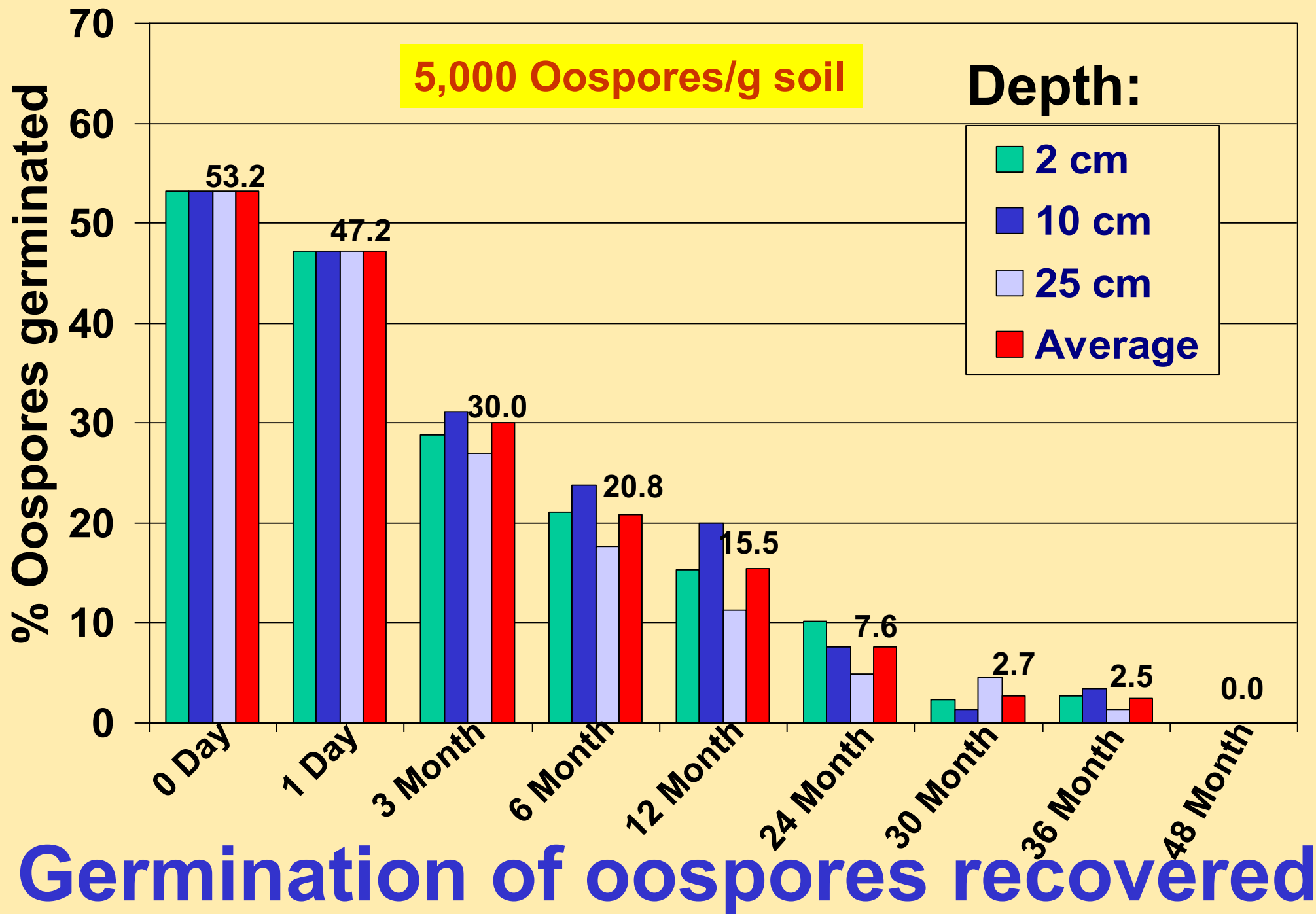
- **Survival of *Phytophthora capsici* in soil**
  - **5,000 oospores/ g soil**
  - **4 soil type X 3 depths (2, 10, 25 cm) for 4 years**



**% Oospores recovered**



# Oospore survival in soil



# Conclusions

## (Cultural Practices: Cropping Rotations)

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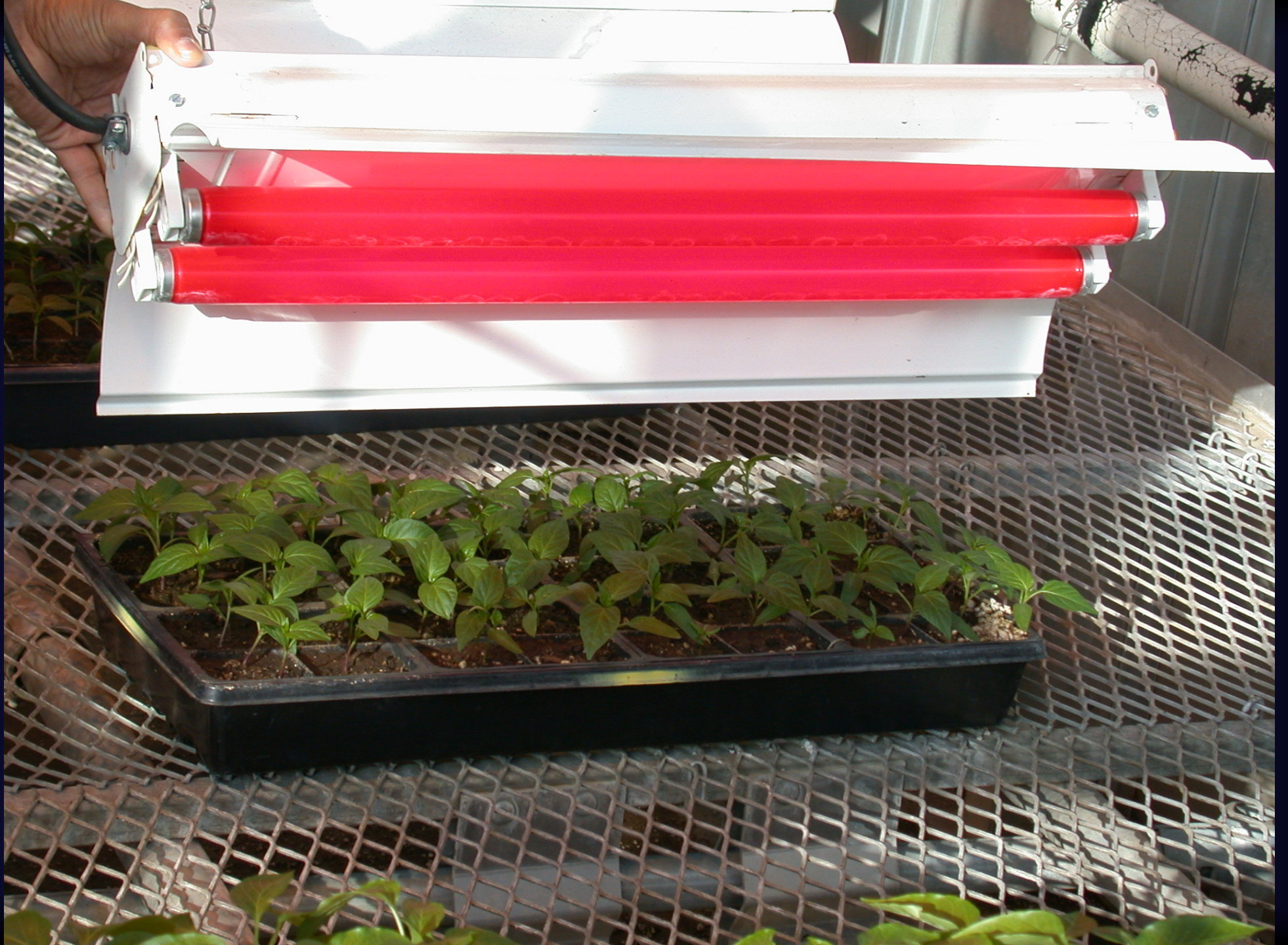
- $\geq 3$  years crop rotations with non-host plants and effective weed control is necessary for managing Phytophthora blight (*P. capsici*)



# Phytophthora Blight of Peppers (Management)

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- **Resistant cultivars**
- **Cultural practices**
- **Chemical control**
- **Red-light treatment**  
**(Induced Resistance)**







**Natural Light**

**Red Light**





# Phytophthora Blight Management (Red-Light Treatment, ) - Greenhouse

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Grow seedling under red light ( $\lambda = \sim 650$  nm) for 4 weeks – resistance induced

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## Seedling death (%)

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Red-light	36
Natural light	100

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# **Phytophthora Blight Management (Red-Light Treatment) - Field**

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- **Inconsistent results in the fields**



# Managing Phytophthora Blight

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- **Recommended practices**
  - ❖ **Plant resistant cultivars**
  - ❖ **≥3 years of effective crop rotations**
  - ❖ **Grow on raised beds**
  - ❖ **Avoid using contaminated water**
  - ❖ **Fungicide applications (7-day, alternate)**
  - ❖ **Tolerant cultivars with fungicides**

# Acknowledgements

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- ❖ D. Tian: Graduate Student
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- ❖ C. Pavon: Graduate Student
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- ❖ Chemical Companies: BASF, DuPont, Syngenta, ISK, Cerexagri

**QUESTIONS**