

Toxicity of commercial algaecides to species of *Phytophthora*

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Introduction

- Oomycetes like species of *Phytophthora* are more closely related to brown algae than they are to fungi.
- Both algae and species of *Phytophthora* are sensitive to copper compounds.
- Commercial algaecides registered to manage algae might be useful to manage *Phytophthora* species, including *P. ramorum*, in natural waterways and irrigation water.

Objective

- Evaluate the efficacy of commercial algaecides as mitigation treatments for *Phytophthora* spp. in water

Materials and Methods

■ *P. ramorum* isolates

- PRG2: an A1 isolate from a rhododendron plant in Germany
- C5: an A2 isolate from a camellia plant in California

■ Spore types and production

- Hyphae were grown for 2 months at 20°C in the dark in clarified 5% V8 juice broth in 250 ml flasks to produce chlamydospores
- Sporangia were produced by growing the isolates on V8 agar and placing agar plugs with mycelium in sterile 1% soil extract solution
- Zoospores were produced by cooling sporangia to 4°C and warming to 20°C

Algaecides and labeled rates

- Captain™ from SePRO Corporation
 - active ingredient = copper carbonate
 - rate = 0.8 ppm
- K-Tea™ from SePRO Corporation
 - active ingredient = copper-triethanolamine & copper hydroxide
 - rate = 1.0 ppm

Experimental design

- 2 ml of water (control) or algaecide was placed in each of 3 replicate wells of a 24-well microtiter plate; each well held approximately 5 ml
- Zoospore exposure times: 0, 30, 60 min
- Sporangium and chlamydospore exposure times: 0, 2, 4, 8, 24 hr
- Spore densities used:
 - 1×10^5 zoospores/ml
 - 2.5×10^3 sporangia/ml
 - 5×10^3 chlamydospores/ml
- Collect on membrane filters with 5 μm pores
- No. of colony-forming units (CFU) counted

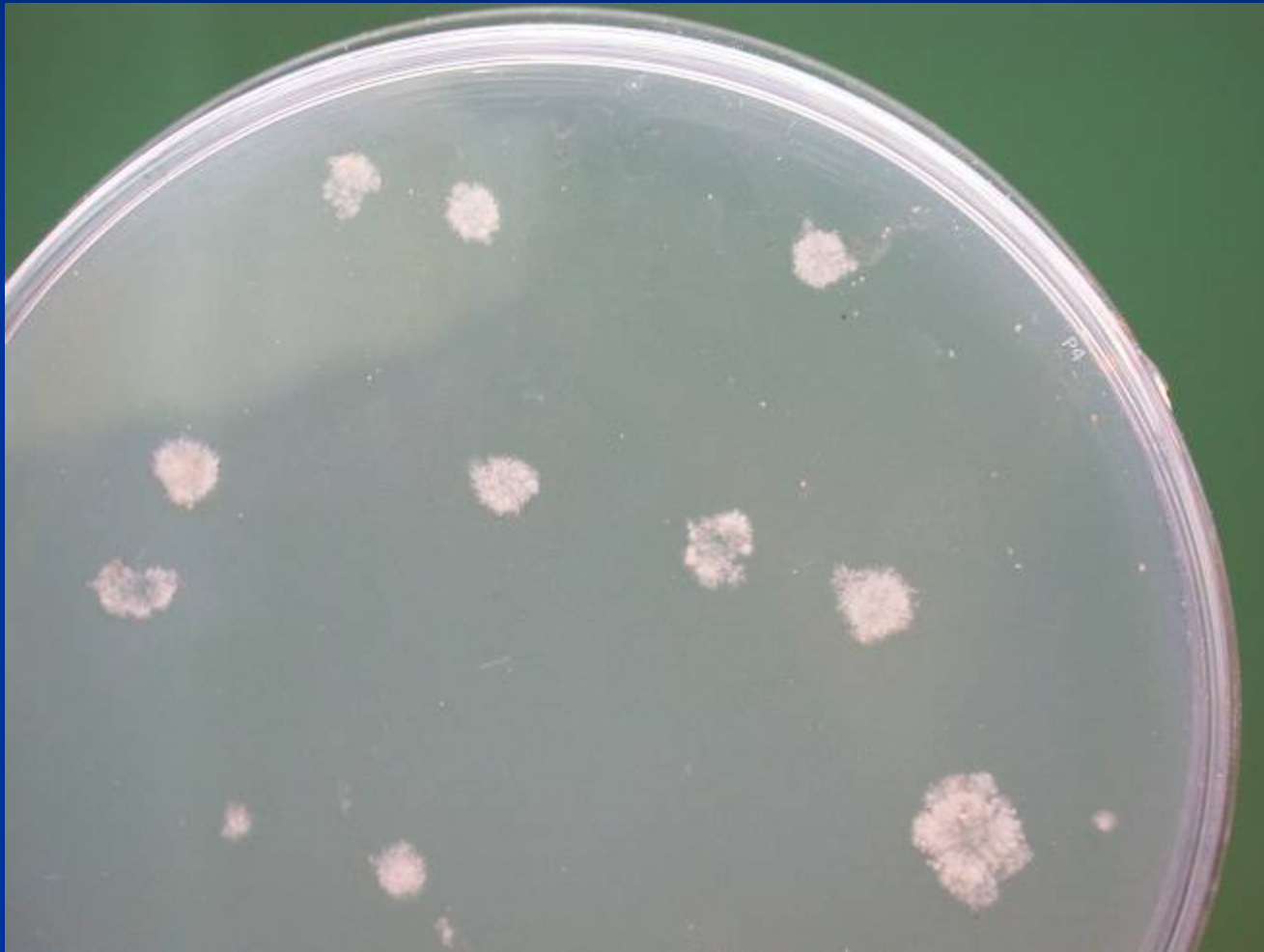


Mixing the spores into the
algaecides



Filtration system to wash
the algaecides from the
spores

Colonies of *P. ramorum* from chlamydospores on PAR-V8



Zoospores: Average number of CFU/filter

PRG2

Time (min)	0	30	60
Control	24.2 a	26.3 a	22.4 a
Captain	23.2 a	0 b	0 b
K-Tea	22.7 a	0 b	0 b

C5

Time (min)	0	30	60
Control	15.1 a	17 a	16.8 a
Captain	15.3 a	0 b	0 b
K-Tea	16 a	0 b	0 b

Sporangia: Average number of CFU/filter

PRG2

Time (hr)	0	2	4	8	24
Control	9.8 a	9.1 a	9.8 a	8.2 a	10.0 a
Captain	7.6 a	1.8 b	0 b	0 b	0 b
K-Tea	7.9 a	0.3 c	0 b	0 b	0 b

C5

Time (hr)	0	2	4	8	24
Control	11.7 a	12.4 a	12.3 a	14 a	16.7 a
Captain	12.5 a	0.9 b	0 b	0 b	0 b
K-Tea	11.5 a	0.5 b	0 b	0 b	0 b

Chlamydospores: Average number of CFU/filter

PRG2

Time (hr)	0	2	4	8	24
Control	10.4 a	10.6 a	11.6 a	10.6 a	8.5 a
Captain	10.1 a	3 b	0.2 b	0 b	0 b
K-Tea	10.4 a	3.1 b	0.2 b	0 b	0 b

C5

Time (hr)	0	2	4	8	24
Control	11.3 a	13.8 a	15.4 a	12.8 a	16.9 a
Captain	11.8 a	4.4 b	1 b	0 b	0 b
K-Tea	9.7 a	5.4 b	1 b	0 b	0 b

Six Other Species of *Phytophthora*

Zoospores: Average number of CFU/filter

P. nicotianae

Time	0	30	60
Control	9.4	8.9	0
Captain	8.1	0	0
K-Tea	8.3	0	0

P. citricola

Time	0	30	60
Control	20.1	22.3	21.7
Captain	19.8	0	0
K-Tea	20.7	0	0

P. cactorum

Time	0	30	60
Control	22.3	21.3	21.9
Captain	19.7	0	0
K-Tea	20.3	0	0

P. palmivora

Time	0	30	60
Control	17.8	18.6	19.3
Captain	17.3	0.1	0
K-Tea	18.2	0	0

P. citrophthora

Time	0	30	60
Control	18.6	20.3	19.7
Captain	17.8	0.7	0
K-Tea	18.3	0	0

P. cryptogea

Time	0	30	60
Control	12.7	13.2	11.8
Captain	13.6	0	0
K-Tea	11.8	0	0

Treatment of naturally-infested stream water with algaecides

- Water from two Clemson area streams was sampled
- 15 L of stream water was placed in each of 4 replicate 20-L buckets per treatment
- Captain and K-Tea were added at labeled rates
 - 4 buckets were not treated = controls
- Algaecide exposure times: 0, 1, 2, 4 hr
- Results
 - Controls: 5-20 CFU/filter of *Phytophthora* spp.
 - Algaecides: *Phytophthora* spp. were not recovered on any filter regardless of exposure time

Conclusions

- Both algaecides were very effective at eliminating propagules of *P. ramorum* and other species of *Phytophthora* in water
- Zoospores were more sensitive to algaecides than were sporangia or chlamydospores
- At least 8 hours of exposure to the algaecides was needed to eliminate all propagules in water
- Algaecides have potential to manage species of *Phytophthora*, including *P. ramorum*, in waterways

Acknowledgements

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