

# Clubroot Sanitation

2012 Clubroot Summit

Delta Edmonton South, Edmonton, AB

March 7, 2012

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# Introduction

- *Plasmodiophora brassicae* is a soil-borne pathogen
- Soil movement has been implicated in spreading clubroot
- Infested soil can be moved by various means:
  - Agricultural machinery, equipment and farm vehicles
  - Agricultural products (dust and soil tag on seed, tubers, forages)
  - Custom operators (soil testing, fertilizing, seeding, harvesting)
  - Oil and gas companies (seismic, drilling, pipelining, servicing)
  - Contractors (road building, excavating, trenching, hauling soil)
  - Transportation industry (long-distance equipment hauling)
  - Recreational users (quadding, bogging, hunting)
  - Wind and water erosion, domestic livestock and wildlife movement
- Both local and long-distance spread of infested soil is possible, especially when fields are accessed by multiple users throughout the year



# Sanitation Practices

- Sanitation (cleaning and disinfection) of machinery, vehicles, tools and equipment has been used by vegetable producers as a means of clubroot prevention for many years
- Alberta Clubroot Management Plan recommends:
  - Removing soil and plant debris from farm equipment
  - Cleaning contaminated surfaces by pressure washing
  - Applying a disinfectant (1-2% bleach) to clean surfaces
- Oil and gas companies have adopted similar practices (<http://www.capp.ca>)
- Questions have been asked about the practicality and cost of sanitation measures, potential adverse environmental consequences, corrosion risks, hazards to applicators, and the relative effectiveness of available disinfectants



**Sanitation of Farm Machinery and Equipment  
Air Seeder**



**Air Compressor for Cleaning Soil and Dust from Farm Machinery and Equipment**



**Water Wagon for Cleaning Soil and Dust from Farm Machinery and Equipment**



**Air Seeder after Cleaning with Compressed Air and Water**

# Sanitation of Oilfield Equipment

Setting up to wash a drilling rig. >>



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# Sanitation Research - Objectives

1. To compare the effectiveness of various cleaning methods on machinery and equipment, e.g. scraping, brushing, compressed air and power washing
2. To assess the ability of various physical and chemical treatments to clean soil residues from hard surfaces and to kill clubroot spores
  - Physical methods – Dry heat, hot water, steam, freezing
  - Cleaners – Industrial detergents and related products
  - Disinfectants – sodium hypochlorite, hydrogen peroxide, acetic acid, quaternary ammonia, electrolyzed water, potassium peroxomonosulphate, chlorine dioxide, essential oils, etc.
3. Evaluate promising sanitation methods on a pilot scale in order to encourage adoption by canola producers, custom agricultural operators, and the petroleum, construction and transportation industries

# Sanitation Research - Disinfectants

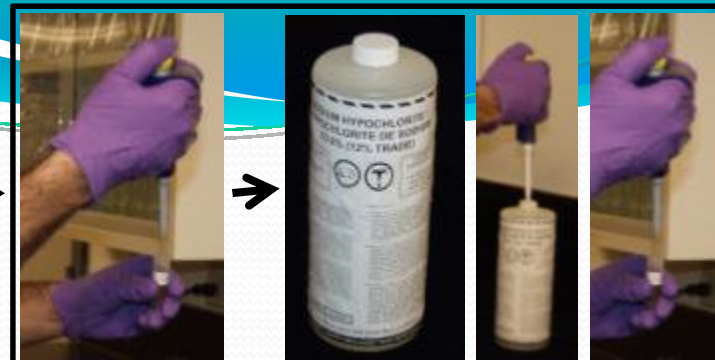
Product Names	Active Ingredients
General Storage Disinfectant	Quaternary ammonia
Industrial Bleach	Sodium hypochlorite
SaniDate	Hyd. peroxide + peracetic acid
Virkon	Potassium peroxomonosulphate
Dutrion	Chlorine dioxide
BioStel EO Anode Water	Mixture of disinfectant ions
KleenGrow	Quat. amm. + isopropyl alcohol
HyperOx	Hyd. peroxide + peracetic acid
EcoClear	Acetic acid
Thymox	Thymol oil



Collect & grind root galls

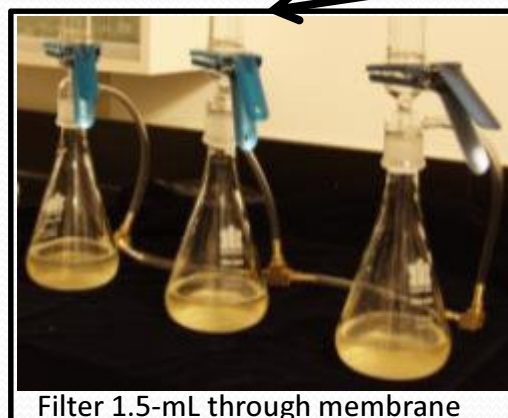
Dilute & filter

Quantify

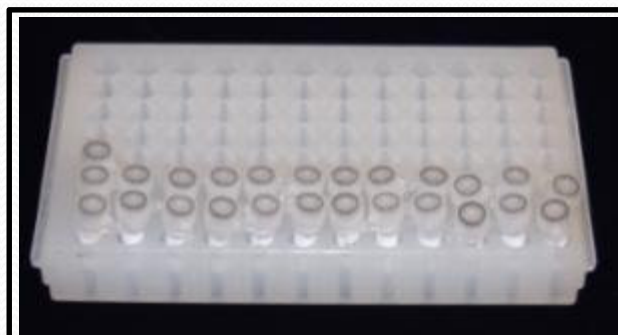


Place spores in vial

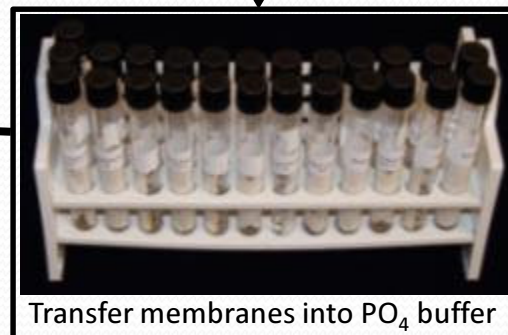
Expose spores to disinfectant



Filter 1.5-mL through membrane



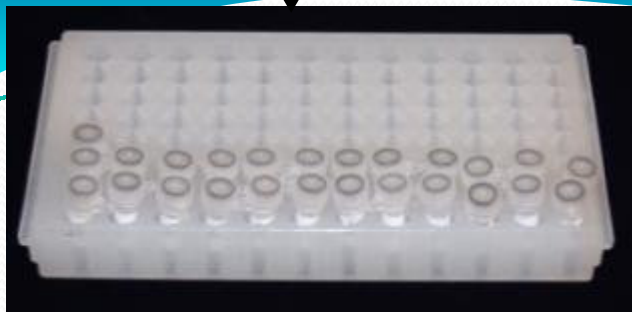
Vortex & transfer to 50uL centrifuge tubes



Transfer membranes into PO<sub>4</sub> buffer



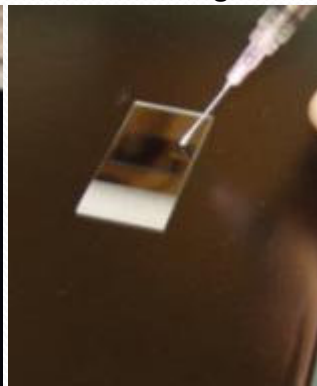
Inoculate canola seedlings with spores



Vortex and transfer 50-uL to microfuge tubes



Add stain



Prepare slide



View under microscope



Inoculate canola seedlings with spores

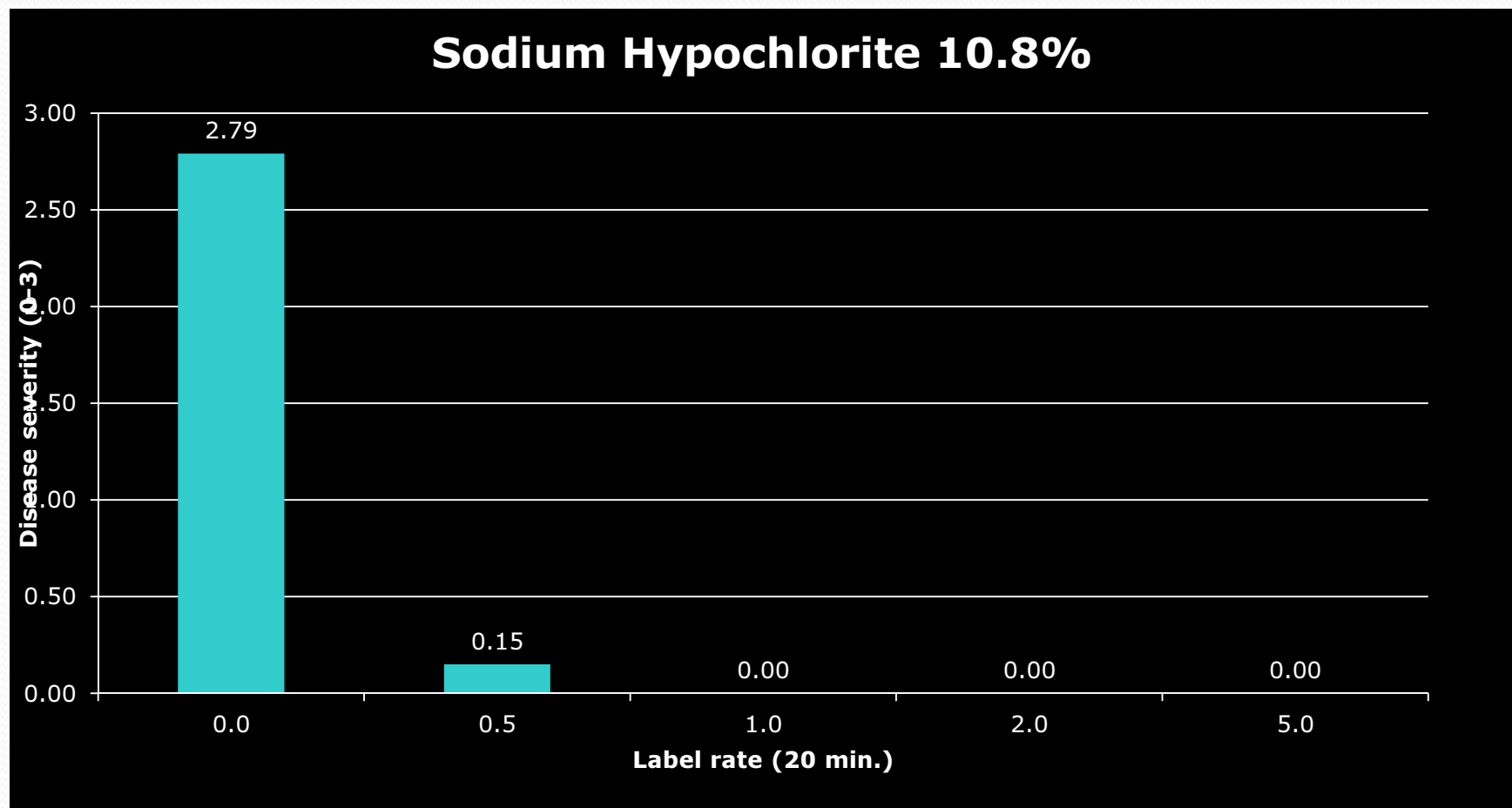


Transplant inoculated seedlings into Cone-trainers filled with peat-based medium

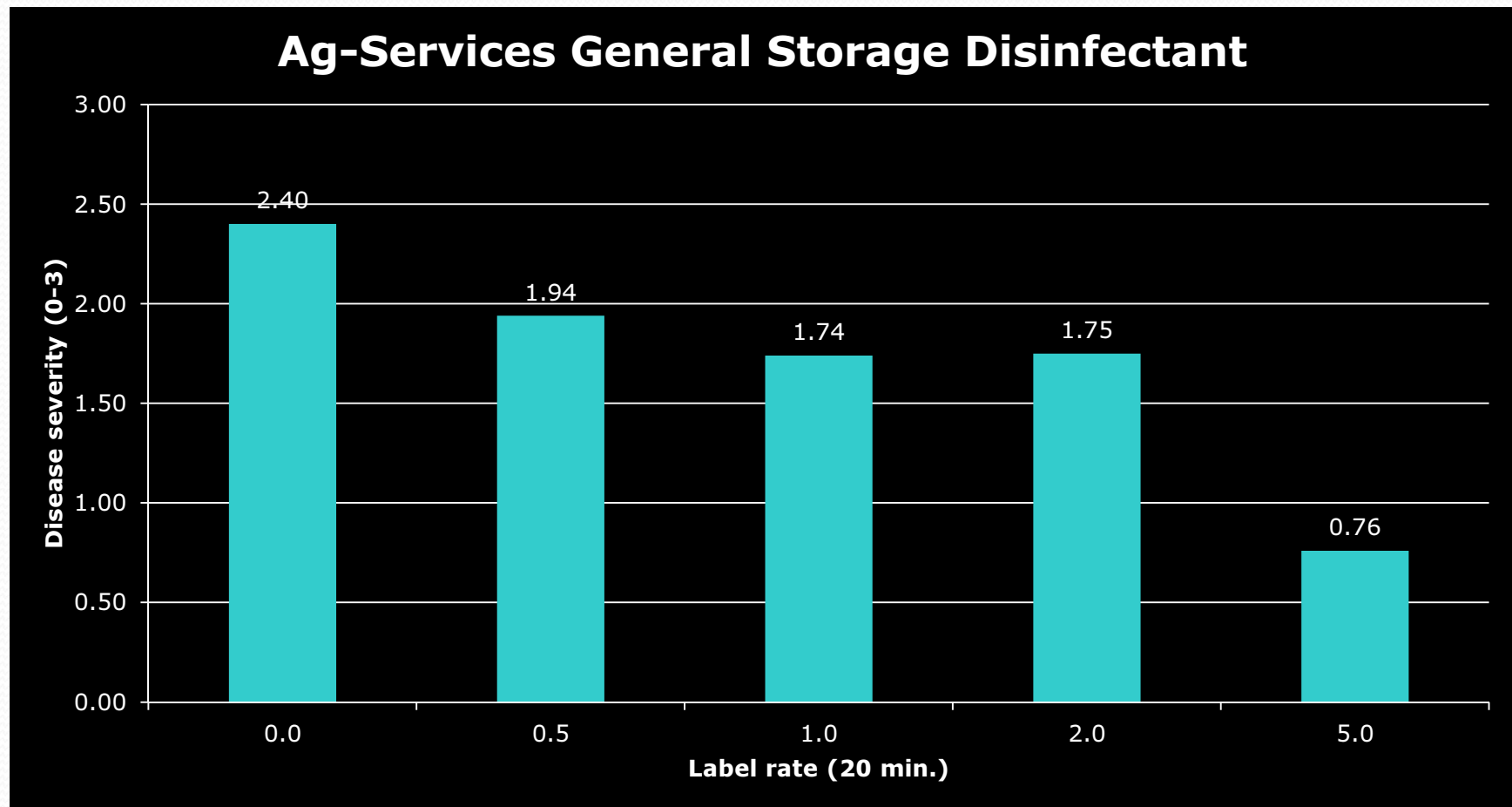


Bioassay in growth chamber or greenhouse

Disease severity on canola seedlings inoculated with sodium hypochlorite-treated clubroot resting spores



Disease severity on canola seedlings inoculated with GSD-treated clubroot resting spores





## Disinfectant Evaluation Summary

- Efficacy of most products improved in response to increasing concentrations, e.g.  $\frac{1}{2}x < 1x < 2x < 5x$  label rates
- Products evaluated at 20- and 30- minute exposure times were more effective than at 10-minute exposures
- At the various rates and timings evaluated, the relative performance of the products was:
  - Highly effective – Industrial Bleach, HyperOx, EcoClear
  - Moderately effective – Virkon, SaniDate
  - Marginally effective – KleenGrow, General Storage Disinfectant, Dutrion, BioStel EO Water, Thymox

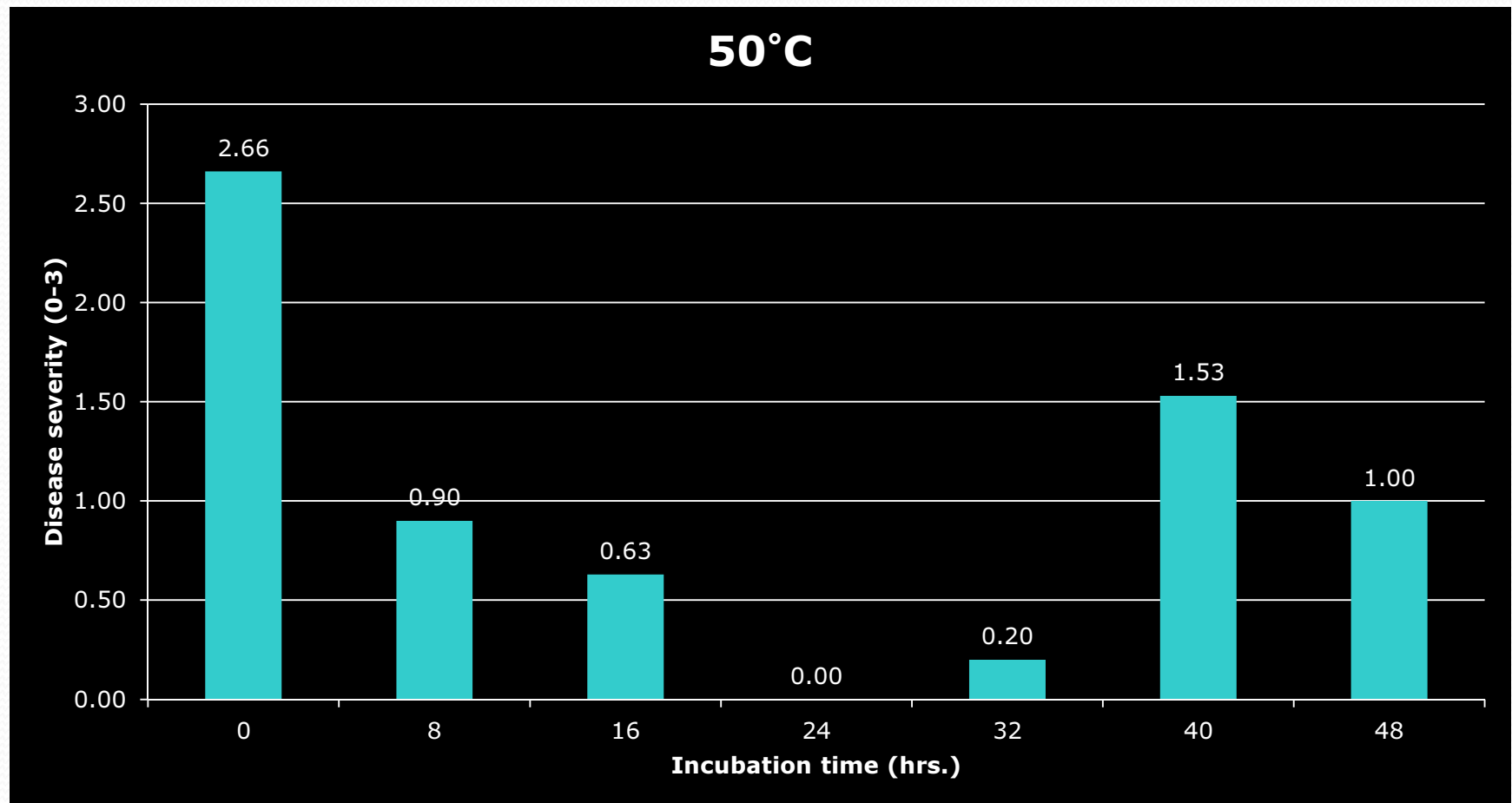


## Sanitation Research – Thermal Treatments

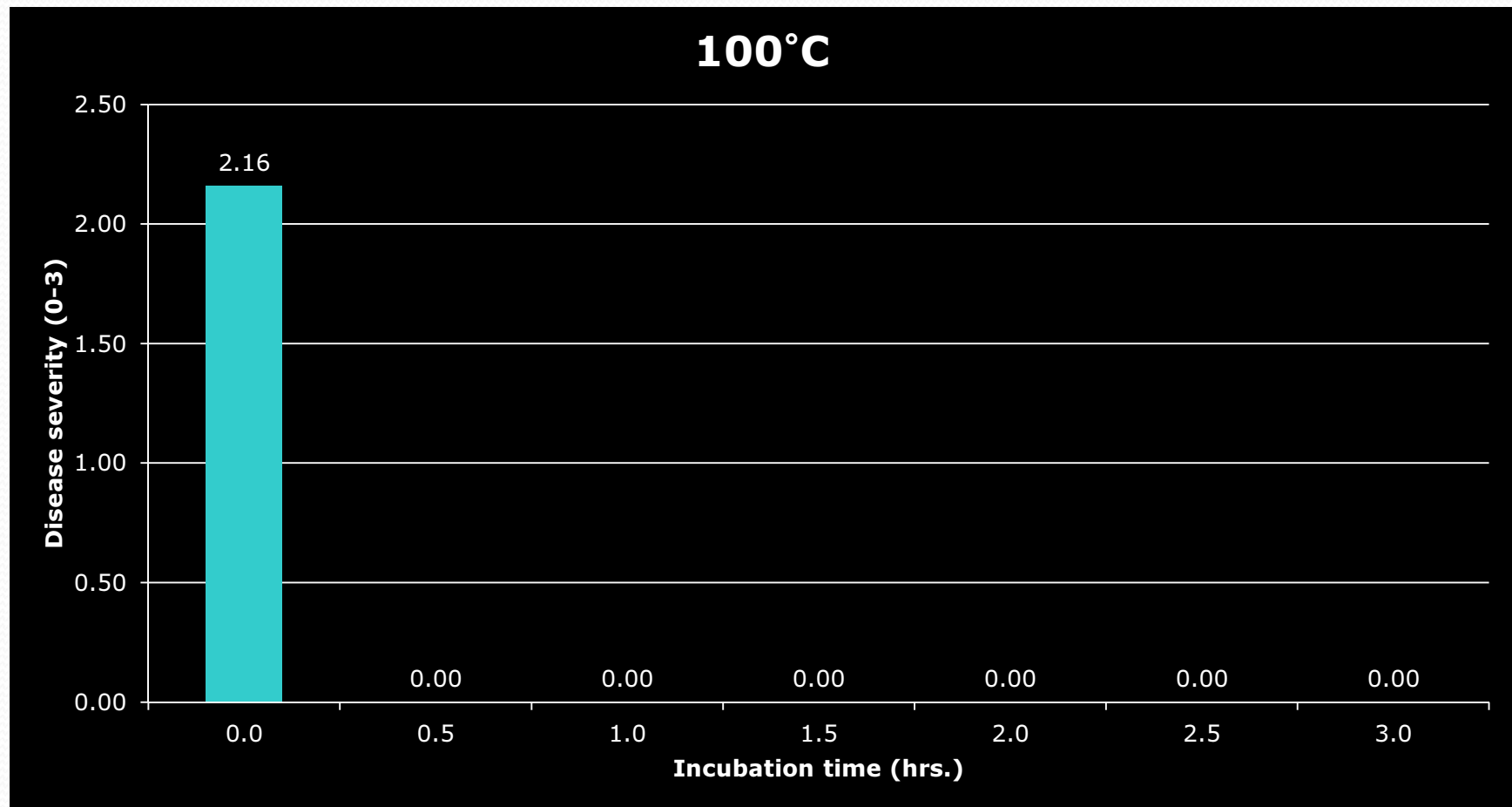
- Evaluate the effectiveness of various temperature thermal treatments on the viability of clubroot spores in water, soil and soil-water slurries
- Applications could include steam and hot water cleaning systems, decontamination of wash water, soil pasteurization and water treatment
- Temperature range: 40-100°C in 10° increments
- Check spore viability with vital stains and by inoculation onto canola seedlings
- Validate the most promising treatment in pilot-scale lab and field trials



Disease severity on canola seedlings inoculated with heat-treated (50°C) clubroot resting spores



Disease severity of canola seedlings inoculated with heat- treated (100°C) clubroot resting spores



# Thermal Inactivation Summary

- Warm water, even for extended periods of time, had little detrimental effect on resting spore viability
- Spore viability declined as temperatures and the duration of exposure increased
- Hot water (100°C) was the most effective treatment, but the duration of exposure needs to be several minutes
- Metal objects tend to conduct heat away from the surface resulting in sub-lethal temperatures
- Wet steam may be an option, but it requires special equipment





# Farm Equipment Sanitation Trials 2011

- Clubroot-contaminated equipment was provided by the Lathom Hutterite Colony, Bassano, AB
  - Bourgault 9400 40 foot cultivator with a harrow bar
  - John Deere 9540 tractor with triple-tired wheels
  - Eight pivot irrigation towers disassembled for transport
- Three-step sanitation procedure:
  - Rough cleaning - Scraping/knocking off loose soil
  - Fine cleaning - Pressure washing/compressed air
  - Surface disinfectants -15 to 20 minutes of contact time
    - Pivot – General Storage Disinfectant, Sanidate, KleenGrow, Thymox
    - Cultivator – Bleach, HyperOx, KleenGrow, Virkon
- Estimated soil load:
  - Tractor = ca. 150 kg ; Cultivator = ca. 50 kg



## Farm Equipment Sanitation Trials 2011

- Surface sampling pre- and post-washing and post-disinfection
- Disinfectants were applied with a CO<sub>2</sub>-pressurized sprayer at optimum rates
- County of Newell applied 1% bleach to the pivot, tractor and cultivator as a final step
- Time commitment for rough cleaning, washing, sampling and disinfecting was ca. 35 man hours
- Soil and swab samples are being analyzed for viable clubroot spores by greenhouse bioassays on susceptible canola plants



































## Barriers to Adoption of Sanitation Practices

- Practicality, cost and time commitment to implement an effective sanitation program
- Potential adverse environmental consequences
- Difficulty of disposing of infested soil/wash water
- Risk of corrosion and other types of damage to sensitive equipment
- Personal exposure hazards to applicators
- Relative effectiveness of available disinfectants
- Biosecurity is a new concept to crop producers

# Plans for 2012

## Machinery and Equipment Sanitation

- Complete greenhouse bioassays and analyze 2011 data
- Repeat disinfectant/thermal inactivation experiments
- Continue pilot-scale agricultural trials
- Initiate petroleum/construction industry sanitation trials

## Technology Transfer

- Continue efforts to improve grower and industry awareness of clubroot sanitation practices based on feedback and research





# Acknowledgements

- Alberta Crop Industry Development Fund
- Canola Council of Canada
- Alberta Agriculture and Rural Development
- University of Alberta, Edmonton, AB
- EnCana Corporation, Calgary, AB
- Harvest Energy Trust, Calgary, AB
- Enerplus Resources, Calgary, AB
- Innovotech, Inc., Edmonton, AB
- Brenntag Canada Inc., Winnipeg, MB
- Vétoquinol Canada Inc., Lavaltrie, PQ
- Pace Chemicals Ltd., Burnaby, BC
- Dutrion Corp., Calgary, AB
- M<sup>2</sup> Laboratory Inc., Sherbrooke, PQ
- BioStel Ltd., Olds, AB
- County of Newell, Brooks, AB