

# Clubroot Prevention: Challenges and Opportunities

**International Clubroot Workshop**

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# Prevention

- Prevention is the first principle of disease management
- It refers to strategies that are applied before a disease is introduced or becomes established
- Prevention is the most cost-effective approach when it comes to dealing with most infectious plant diseases
- Many diseases cannot be effectively controlled once they become well established
- Clubroot is an example of a disease where reducing the risk of both short- and long-distance dispersal of the pathogen is a viable option for preventing its establishment over a wider geographical area



# Mechanisms of Clubroot Spread

- *Plasmodiophora brassicae* can be spread in many ways:
  - Infected plants (vegetable transplants)
  - Crop residues (forages) and roots (fodder crops, vegetables)
  - Seeds and tubers (dust and earth tag)
  - Soil movement
    - 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)
    - Domestic livestock and wildlife movement
  - Water movement
    - Wind and water erosion
    - Irrigation water

# Strategies for Clubroot Prevention

- Sanitization (cleaning and disinfection) of machinery, vehicles, tools and equipment has been used by vegetable producers as a means of clubroot prevention for many years
- The Alberta Clubroot Management Plan recommends:
  - Removing soil and plant debris from equipment (rough cleaning)
  - Decontaminating surfaces by pressure washing/air (fine cleaning)
  - Applying a disinfectant (e.g. 1-2% bleach) to cleaned surfaces
- Oil and gas companies have adopted similar practices to those used in the ag industry (<http://www.capp.ca>)
- Questions have been asked about the practicality and cost of sanitation measures, potential adverse environmental impacts, corrosion risks, hazards to applicators, and the relative effectiveness of current protocols, esp. disinfectants

# Barriers to Adoption of Sanitation Practices

- Sanitization is a key element of “On-farm Biosecurity” which is a new concept to many crop producers
- The practicality, cost and time required to implement an effective sanitization program can be a major impediment
- Potentially harmful environmental impacts may exist
- It may be difficult to dispose of infested soil and wash water
- Repeated use of some chemical disinfectants can cause corrosion and other types of damage to sensitive equipment
- There may be personal exposure hazards to operators who are cleaning and/or disinfecting equipment
- The need to use disinfectants is often questioned
- There are no established standards for clubroot sanitization

# Agricultural Equipment Sanitization Challenges





**Sanitization 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**

# Petroleum Industry



# Decontamination of Drilling Equipment

- Usually performed on-site by company staff or contractors
- Done just before the rigs move of site to the next job
- May be 50-100 pieces of equipment to clean
  - Rig structure, drilling platform and mats
  - Mud, water and fuel tanks
  - Generators, drilling pipe and vehicles
  - Storage trailers, offices and worker quarters
- Usually loaded onto trucks to clean, with special attention given to skids and lower panels
- Cleaned so as to be “free of visible soil”

# 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 – Hot water, steam, freezing
  - Cleaners – Industrial detergents
  - Disinfectants – sodium hypochlorite, hydrogen peroxide, acetic acid, quaternary ammonia compounds, electrolyzed water, potassium peroxomonosulphate, chlorine dioxide, essential oils
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

# 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 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

# 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 Sanitization Trials

- 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 Sanitization Trials

- Surfaces were sampled pre- and post-washing and post-disinfection
- Disinfectants were applied with a CO<sub>2</sub>-pressurized sprayer at label rates
- County of Newell applied 1% bleach to pivot towers, 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 were analyzed for viable clubroot spores by greenhouse bioassays on susceptible canola plants and virtually none was found after a full sanitization protocol had been carried out











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