# Clubroot management research

## Needs and priorities

- A reliable site for field trials – regularly maintained (disease pressure), irrigated, versatile for different research projects, accommodating multiple users
- Information on pathogen biology, impact of agronomic and cultural practices (e.g. 2-yr. vs. 4-yr crop rotation)
- Lack of effective & practical products
- Maintain performance of resistant canola cultivars and extend their longevity
- Effective/practical measures to reduce risk of clubroot pathogen spreading (10% bleach enough?)
- Integration of different management tools in cropping systems – field based implementation/validation

# Proposed research projects

## 1. A consortium clubroot field nursery (Hwang, Strelkov, Peng, Gossen, Howard, Rahman, McVetty)

- Consolidating field research trials, maintained and coordinated by AARD and U of Alberta scientists to establish uniform & reliable clubroot infested plots for a variety of field trials
- Multiples users, versatile –agronomic, variety, and efficacy trials
- Field plot & mini field plot design, soil infestation, varying pathogen inoculum levels
- Major infrastructure/equipment expenses required, on-going maintenance cost – fee based?

# 2. Management of clubroot in canola cropping systems (Hwang, Strelkov, Peng, Gossen, Turkington)

**Critical research components:** impact of tillage, crop rotation, canola seeding date, chemical and biological treatments, soil amendments, field-based integration

- **Tillage**: impact on pathogen inoculum distribution: conventional vs. no-till, in-row vs. inter-row; inter-row seeding? Methodology – bioassay, real-time PCR?
- **Crop rotation:** short-term: monitoring of selected fields of varying crop rotation practices for disease potential (soil sample, bioassay) and field history surveys; long-term, crop rotation plot trials on the clubroot nursery, may be combined with “trap-crops”
- **Seeding date:** based on pathogen biology studies, impact of soil temperature and moisture, variety resistance

# 2. Management of clubroot in cropping systems (continues……)

- **<u>Clubroot-control products/agents</u>:** Efficacy of chemical or microbial treatments in field conditions – placement, rates, timing, interaction with resistant cultivars; proper agent formulations for delivery (seed coating, in-furrow granules)
- **<u>Soil amendments</u>:** $Ca^{++}$, organic by-products….
- **<u>Integration of selected tools</u>:** for optimal clubroot control in field conditions: agronomic and cultural measures, resistant/tolerant canola varieties, disease-control products/agents

## 3. Developing biocontrol technologies for clubroot management (Peng, Gossen, Hwang, Strelkov, McDonald)

- **Develop promising microbial agents/technologies**
  - Biological assessments: dose, molecular ID (IP), crop safety, health risk, colonization of canola roots, and modes of action.
  - Potential mass production: solid vs. submerged fermentation systems, nutritional & environmental factors, essential info. for commercial evaluation
  - Formulation technologies for practical delivery (separate study)
  - Evaluation of developed formulations/technologies for efficacy, rates, release of a.i. in soil (linked to Hwang's), colonization & movement in roots, dispersal/persistence (environ. impact assessment) – regulatory requirements

- **Microbial-varietal resistance synergy**
  - Selected microbial agents are evaluated with canola cultivars/lines of varying resistance for synergy
  - Under a single and mixed pathotype populations
  - Varying pathogen inoculum pressure (moderate to very high)
  - Impact of soil moisture, temperature, pH
  - Field testing of selected microbial-cultivar combinations (link to Hwang's).
- **Integration of microbial technologies**
  - Microbial formulations, resistant cultivars, crop rotation effect (simulated), product placement strategies, canola seeding date (Gossen's), or soil amendment (Hwang's)
  - Progressively from mini plots (with more control over certain parameters) to regular field plots

## 4. Development of biocontrol formulation and delivery technologies (Hynes, Peng)

- **To develop a cost-effective and practical formulation and delivery strategy for biocontrol agents**
  - Formulation ingredients & process: compatibility with microbial agents
  - Seed coating, seed row placed granular formulations
  - Granule size, release of a.i. in soil, efficiency and extend of root colonization
- **Formulation research data for product registration**
  - Shelf-life studies
  - Dose effect optimization

## 5. Interactions of climate, soil and pathogen biology on management of clubroot of canola (Gossen, McDonald, Peng, Hwang)

- Developing techniques for assessing the incidence and intensity of infection prior to the development of clubroot symptoms for detailed studies of host resistance, biological control, and pathogen biology
- Assess the impact of temperature & pH on infection: temperature-gradient plate, validation with infested soils
- Impact of temperature on pathogen proliferation and symptom development, with field studies to validate optimal seeding dates (link to Hwang's)

## 5. Interaction of climate, soil and pathogen biology (continues….)

- Impact of host resistance on infection, pathogen proliferation and symptom development: timing and intensity of infection, real-time PCR
- Assess the impact of effective biocontrol agents on infection, pathogen proliferation and symptoms
- Field trials to validate pathogen biology information and host resistance, with different pathogen race composition (additional variables)

## 6. Utilizing plant nutrients, soil chemistry for integrated management of clubroot on canola (Gossen, McDonald, Peng, Hwang)

- Determine the impact of boron on clubroot of canola and investigate interactions among boron, calcium and soil pH
- Assess potential interactions between boron, resistant canola cultivars, and biofungicides
- Determine most effective formulations & economical boron applications for the control of clubroot
- Identify stages and mechanisms in host-pathogen interaction that are affected by boron and other soil factors

## 7. Development of effective sanitation methods and spore viability assays (Howard, Strelkov, Harding, Turkington)

- Identifying effective and non-corrosive cleaners, disinfectants and physical methods to eliminate *P. brassicae* spores from agricultural, oil & gas and construction equipment
- Develop a rapid viability assay to evaluate whether pathogen resting spores are killed or pathogenicity is reduced by sanitation methods
- Define practical sanitation protocols