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……)

- **Clubroot-control products/agents**: 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)

- **Soil amendments**: Ca$^{++}$, organic by-products….

- **Integration of selected tools**: 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