Clubroot Risk Mitigation Initiative: Pathology Module

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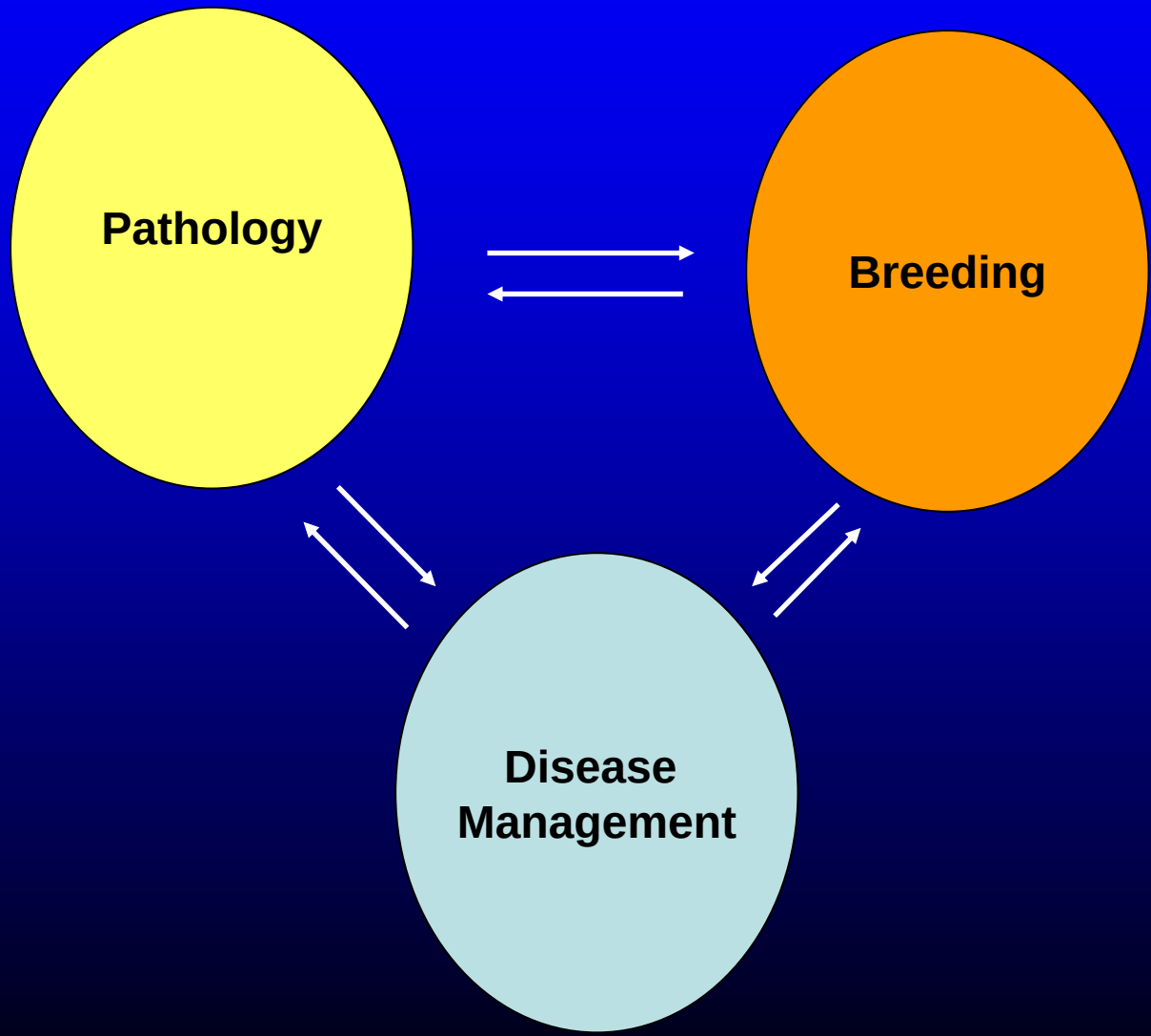
Vision

The management of clubroot in an integrated and sustainable manner, so as to secure a healthy canola crop and minimize the risk posed by this disease

The Clubroot Risk Mitigation Initiative

- To provide leadership, and better coordination and collaboration with industry stakeholders and governments
- Prioritization, new/additional funding sources
- Builds on current research projects, enabling synergies and a proactive approach
- Develop the knowledge, methods and effective /practical tools required for mitigating the risk of clubroot

Program Modules



Pathology Projects

- Research is needed in a number of critical areas
  - Addressed in specific projects
- Extensive overlap/synergy between “Pathology” and “Disease Management” modules

Individual Projects within Pathology Module

1. Clubroot resistance stewardship
2. Expanded surveillance (MB & SK)
3. Canadian clubroot differential system
4. Gene discovery in clubroot pathosystem
5. Role of differentially expressed proteins
6. Biology of *P. brassicae* strains (Temp/pH) – Factors affecting spore survival
7. Clubroot dispersal model
8. Yield loss model for canola

Clubroot Resistance Stewardship

- **Objective:**
  - **To monitor pathotype composition and changes in the virulence of the clubroot pathogen**
  - **Continue surveillance activities**
- **Research Team:**
  - **Strelkov, Hwang, Howard and Turkington**
- **Alberta**

Clubroot Resistance Stewardship

- **Rationale:**
  - **Clubroot-resistant canola varieties will soon be introduced**
  - **Pathotype composition can shift rapidly in response to selection pressure**
  - **Important to monitor pathotype composition and changes in virulence**
- ***Guide breeding efforts and allow proactive responses to shifts in predominant pathotypes***

Expanded Surveillance in SK & MB

- **Objectives:**
  - **To monitor for the occurrence of *P. brassicae* in "clubroot-free" regions**
- **Research Team:**
  - **Kutcher, Dokken (SK), McLaren (MB), Strelkov (AB)**
- **Location:**
  - **Saskatchewan, Manitoba**

Expanded Surveillance in SK & MB

- **Rationale:**
  - **Important to monitor clubroot spread**
  - **Avoid being "blind-sided" by clubroot!**
- ***Enable a quick response after discovery, implementation of management/containment strategies***

Canadian Clubroot Differential System

- **Objective:**
  - **To identify a set of host genotypes for the effective differentiation and classification of *P. brassicae* strains in Canada**
- **Research Team:**
  - **Strelkov, Hwang, Rahman and Howard**
- **Location:**
  - **University of Alberta, CDC-N**

Canadian Clubroot Differential System

- **Rationale:**
  - **Identification of pathogen strains is restricted by effectiveness of the differential set**
  - **Differential sets developed for *P. brassicae* from Europe or from vegetable hosts**
  - **New differential system geared towards Canadian situation will provide better picture of virulence patterns on canola**
- ***Increased and more accurate information on pathogenic diversity; help to contain clubroot and prevent movement of novel strains***

Gene Discovery in the Clubroot Pathosystem

- **Objectives:**
  - **To identify, and where possible, determine the biological functions of host and pathogen genes expressed during pathogenesis**
- **Research Team:**
  - **S.F. Hwang, S.E. Strelkov, J. Feng**
- **Location:**
  - **CDC-N, University of Alberta**

Gene Discovery in the Clubroot Pathosystem

- **Rationale:**
  - **Little known on how *P. brassicae* initiates infection of canola**
  - **Allow rapid identification of host & pathogen genes expressed during infection process**
  - **Selected genes validated & characterized**
- ***Identification of rational targets for resistance breeding, fungicide development; library of information on host-pathogen interaction***

Characterization and Role of Differentially Expressed Proteins

- **Objective:**
  - **To characterize and establish the roles of proteins differentially expressed in canola in response to *P. brassicae* infection**
- **Research Team:**
  - **S.E. Strelkov, S.F. Hwang, T. Cao**
- **Location:**
  - **University of Alberta, CDC-N**

Characterization and Role of Differentially Expressed Proteins

- **Rationale:**
  - **We have identified numerous proteins differentially abundant in response to *P. brassicae* infection (Cao et al. 2008)**
  - **Related to host defense response, expressed at earliest stages of pathogenesis; critical roles in outcome of interaction**
- ***Once characterized and validated, could serve as targets for resistance breeding efforts***

Developing Specific Knowledge on Biology of Pathogen Strains

- **Objective:**
  - **To investigate the interaction of climate (temperature), soil factors (pH) and the pathogen on infection and symptom development**
- **Research Team:**
  - **B. Gossen, G. Peng, M.R. McDonald, S.F. Hwang**
- **Location:**
  - **AAFC Saskatoon, U of Guelph**

Developing Specific Knowledge on Biology of Pathogen Strains

- **Rationale:**
  - **Practical information on clubroot risk, based on an understanding of how the pathogen interacts with weather and soil may improve the effectiveness of host resistance and biological control**
- ***Help growers select situations where these approaches are likely to be effective***

Factors Affecting Spore Survival

- **Objectives:**
  - **To determine the ½ life of *P. brassicae* spores under Prairie cropping conditions**
- **Research Team:**
  - **S.F. Hwang, S.E. Strelkov, R.J. Howard**
- **Location:**
  - **CDC-N, University of Alberta, CDC-S**

Factors Affecting Spore Survival

- **Rationale:**
  - **No data available on rate at which resting spores lose their viability in Prairie soils**
  - **All existing data comes from temperate zones**
- ***Provide much needed information on optimal length of rotations, possibility of clubroot control within patches***

Clubroot Dispersal Model

- **Objectives:**
  - **To determine and model inoculum dispersal and disease gradients due to rain, water and dust (wind-mediated spread), as well as soil**
- **Research Team:**
  - **S.F. Hwang, T.K. Turkington, S.E. Strelkov**
- **Location:**
  - **Alberta**

Clubroot Dispersal Model

- **Rationale:**
  - **No data exist on pathogen dispersal rates, concentration of resting spores along dispersal gradient, or amount of inoculum that may be moved in ditches**
- ***Provide important information for clubroot containment & modeling of spread***

Yield Loss Model

- **Objective:**
  - **To establish relationship between clubroot severity and yield losses in canola**
- **Research Team:**
  - **S.F. Hwang, S.E. Strelkov, G. Peng**
- **Location:**
  - **Alberta**

Yield Loss Model

- **Rationale:**
  - **There is little information about the relationship between clubroot severity and yield losses in canola**
- ***Will allow knowledge-based development of resistance categories for variety registration purposes; provide guidance for development/implementation of management strategies***

Deliverables

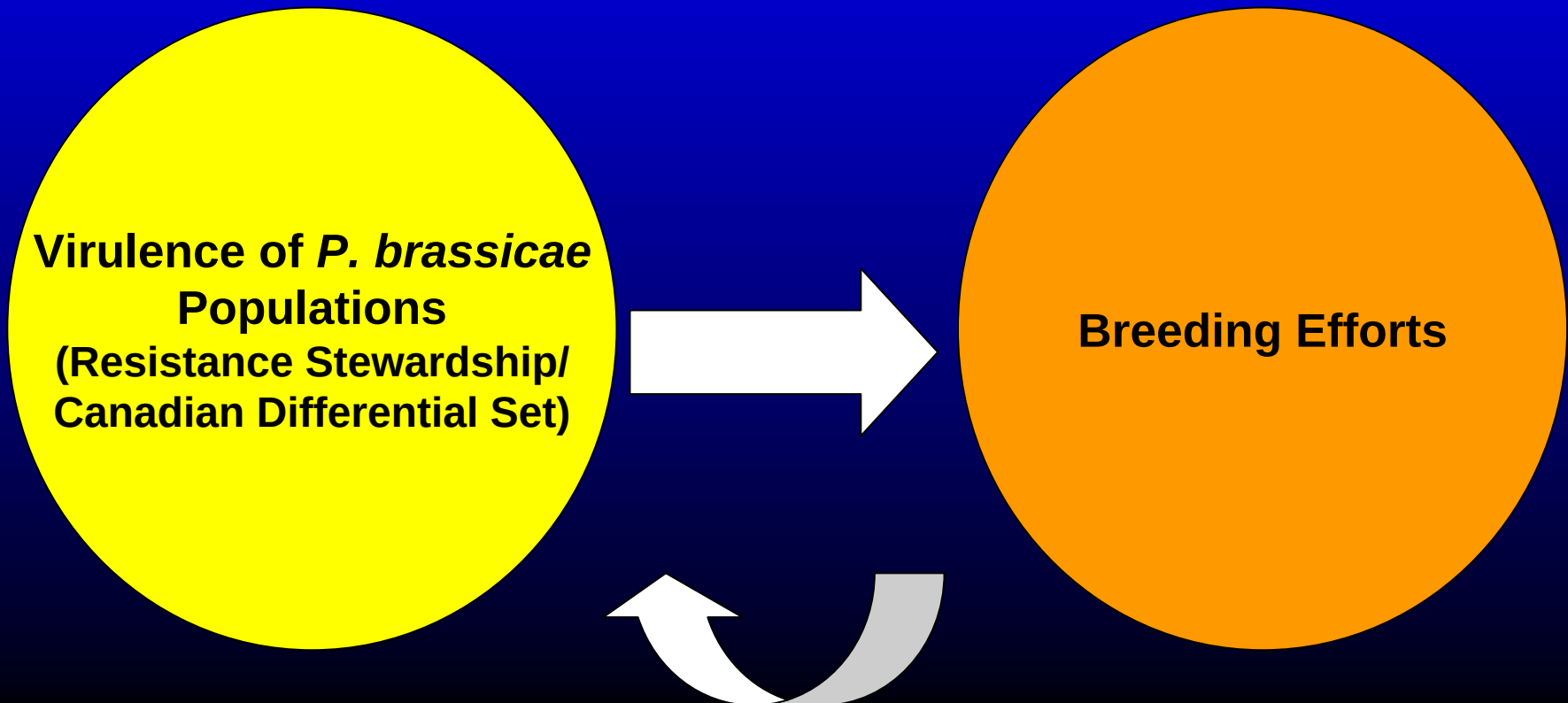
1. Knowledge regarding changes in virulence & pathotype composition of *P. brassicae*
2. Development of an effective Canadian Clubroot Differential Set
3. An EST database of pathogenesis-related *P. brassicae* and host genes, identification of differences in gene expression among pathotypes
4. Identification of rational targets for clubroot resistance breeding efforts and chemical control

Deliverables

8. Cropping systems -longevity of genetic resistance
9. Clubroot dispersal and yield loss models for canola
10. Knowledge of resting spore survival rates/biology of predominant *P. brassicae* pathotypes and implications for management

Deliverables – Pathology Module

- **Provide the basic information needed to develop management and breeding modules**
  - ***Permit knowledge-based strategies***



Questions/Discussion