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Canada

Pesticide Risk Reduction Program
Pest Management Centre

Reduced-Risk Strategy for Ascochyta Blight Management in Chickpea

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Preface

Pesticide risk reduction strategies are developed under the Pesticide Risk Reduction Program, a joint program of Agriculture and Agri-Food Canada (AAFC) and the Pest Management Regulatory Agency (PMRA) of Health Canada. The key objective of the program is to reduce the risks to human health and to the environment associated with pesticide use in agriculture. To achieve this objective, the Program works with grower groups, industry, provinces, and researchers to identify gaps in pest management and opportunities for pesticide risk reduction, and to develop and implement strategies to address these.

A pesticide risk reduction strategy is a detailed plan developed through consultation with stakeholders that aims to address grower needs for reduced-risk management tools and practices for specific pest issues. The strategy report presented herein is intended to provide an update on the activities supported by the Program in developing and implementing the strategy and new tools and practices made available through this process. The strategy also provides a baseline for tracking and measuring advancement in pesticide risk reduction.

For more information on the activities and outcomes of the Program's strategy work to date, visit the Pest Management Centre website www.agr.gc.ca/prrmup.

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1. Executive Summary

This report summarizes the collaborative efforts, activities and progress of the Pesticide Risk Reduction Program since 2003 in developing and implementing a reduced-risk strategy to manage Ascochyta blight disease of chickpea in Canada. The Program's Ascochyta blight strategy was developed in collaboration with pulse industry representatives including grower groups, commodity experts, researchers, and government specialists.

The objective of this strategy is to reduce risks to humans and to the environment from pesticides used to control Ascochyta blight in chickpea, while helping growers to ensure viable disease management and farm profitability. Within this strategy, pesticide risks and pest management issues are identified, reduced-risk solutions to address these issues are discussed and prioritized, and a plan of actions to support the strategy implementation is developed and carried out.

Chickpea is an important pulse crop in western Canada and is a priority commodity for the Program. The crop is grown annually primarily in Saskatchewan and Alberta, and there were about 150,000 hectares cropped to chickpea in 2007. Ascochyta blight is a major disease constraining chickpea production as it can kill entire chickpea plants and, if not adequately controlled, can result in up to 100% yield loss. The success of the chickpea industry depends on the effective and sustainable management of the Ascochyta blight disease. With warmer and wetter conditions becoming more prevalent and increasing infestation of fields, the threat of this disease to chickpea is expected to remain at high levels. Ascochyta blight of chickpea was, therefore, identified as a national priority issue for the pulse industry.

To manage the disease, growers apply as many as six fungicide sprays which are delivered on a regular basis through ground or aerial applicators. Lack of adequate disease forecasting and decision support systems to properly time applications is leading to inefficiencies and unnecessary sprays. Furthermore, there may be potential health and environmental concerns associated with the use of some fungicides, especially older chemistries. Health Canada is undertaking a re-evaluation program which uses up-to-date scientific approaches to examine older active ingredients and their end-use products to ensure the ongoing protection of human health and the environment. All active ingredients that were registered prior to 1995 are being re-evaluated under this program, and as a result, some of the currently used products may be removed from the marketplace. Also, some newer fungicides pose risks of inducing pathogen resistance to the chemical, and if used repeatedly in the field, these products may loose efficiency over time.

The Program's Ascochyta blight strategy is thus centered on developing reduced-risk tools and practices to help growers determine the need and appropriate timing for fungicide applications, and promoting integrated disease management approaches with the goal to minimize unnecessary sprays and manage pathogen resistance to fungicides.

As part of the Ascochyta blight strategy, a working group was established, risk reduction goals and targets were set, actions addressing reduced risk solutions were undertaken and milestones are in place to monitor progress in strategy implementation. Through the Program, AAFC's Pest Management Centre has funded two projects, valued at about $434K, to support the

implementation of the strategy. Key achievements to date include generating knowledge about new reduced-risk cultural control practices and publication of best scouting and management practices field guides. Work is underway to develop early disease warning and decision support tools to help growers make judicious control choices, and to promote grower adoption of these tools. It is anticipated that the use of the tools and practices developed through this strategy will lead to positive changes in Ascochyta blight management practices and reduced risks from pesticides used in chickpea production.

2. Introduction

Under the Pesticide Risk Reduction Program actions are being taken to address pest management and pesticide risk reduction issues related to Ascochyta blight control in chickpea. This issue was first identified through a gap analysis of information provided in the national Chickpea Crop Profile document developed and published by the Program. The issue was then established among the top national priorities of the pulse industry through consultations among Pulse Canada and the chickpea industry representatives in participating provinces. The reduced-risk strategy for Ascochyta blight management is unique to chickpea as, typically, the pathogen causing the disease is specific to chickpea.

Ascochyta blight is caused by the pathogenic fungus *Ascochyta rabiei*. The pathogen overwinters on crop residues and in or on seed, and is readily transmitted through infected seeds, rain-splashed conidia, and airborne ascospores. The presence of conidia can lead to several cycles of infection in a single season when conditions are favourable for the pathogen. Severe epidemics can develop particularly when warm and wet weather occur from late seedling to seed filling. The pathogen can survive for more than two years on exposed crop residue, but looses viability rapidly if buried deeply in soil.

Ascochyta blight is the single biggest threat to chickpea production in western Canada. The pathogen is found in all chickpea cropping areas in Saskatchewan and Alberta. Disease occurs every year and can cause extensive damage on a regional level. It affects all above-ground plant parts (stems, leaves, pods) at all growth stages. Even the most resistant varieties currently available in Canada can experience yield losses over 70% when conditions are favourable for disease development.

Overall, the management of Ascochyta blight in chickpea is beset with multiple challenges due to high susceptibility of chickpea to the disease, lack of epidemiological information specific to western Canada and the high dependency on fungicides. Planting chickpea cultivars resistant to *A. rabiei* could be an effective control option; however, such cultivars are not available in Canada. Currently available cultivars possess only partial resistance to the pathogen and this level of resistance can easily break down because of the high variability of the pathogen. Alternative, reduced-risk tools and practices, which can be incorporated within current production systems are required to minimize the damage caused by the disease. In addition to addressing the pest concern, adoption of these practices may offer significant opportunities for reducing pesticide risk and production costs.

3. Pest Management and Pesticide Risk Issues

Producers growing chickpea rely heavily on foliar fungicides to control Ascochyta blight, with as many as six applications of fungicides being used during the growing season. Calendar spray schedules starting at the detection of the first disease symptom is common for fungicide sprays because there is no effective forecasting system available for Ascochyta blight. Once established, Ascochyta blight develops quickly, so early detection of pathogen presence and timely sprays before the onset of infection are essential to prevent and mitigate the damage from this destructive disease.

Fungicide sprays targeting Ascochyta blight account for the majority of fungicide use in chickpea production. There are seven products currently registered for Ascochyta blight control in chickpea which represent both older chemistries (e.g. chlorothalonil and thiabendazole) and newer ones (e.g. strobilurins, boscalid, prothioconazole and fludioxonil). Most of these products are broad spectrum protectant fungicides with a few having both protectant and eradicant (curative) effects (e.g., pyraclostrobin). However, all these fungicides are recommended for application on a regular, preventative spray schedule basis (every 7, 10 or 14 days) for optimum results.

The most heavily used foliar products are the strobilurins and chlorothalonil, while thiabendazole-treated seeds account for a significant percentage of chickpea acreage. Chlorothalonil and thiabendazole are under re-evaluation by PMRA and some uses may be lost as a result. In addition, *A. rabiei* is a highly variable pathogen and prone to resistance development. Strains of *A. rabiei* resistant to strobilurin-based fungicides (e.g., Headline and Quadris) have already been detected among natural populations in many chickpea farms in Saskatchewan in 2008. A total loss of efficacy of these fungicides may occur over time if over-used in a season, without being rotated with compounds with different modes of action or combined with other IPM strategies.

Some crop production methods, such as cultivar and field selection, crop rotation and proper sanitation can help to prevent or suppress disease. However, innovative and effective cultural control practices are needed, as part of an integrated management approach, to significantly impact yield protection. These practices can complement the effect, and, therefore, minimize the use of fungicides.

Planting chickpea cultivars which are at least partially resistant to Ascochyta blight can contribute to improving control by delaying the onset of disease and disrupting the repetitive cycle of spore production and dissemination. Some adapted cultivars of kabuli and desi chickpea types that have partial resistance to Ascochyta blight are available in western Canada. Young plants of these cultivars are moderately resistant, but resistance declines at flowering, when chickpea become more susceptible to disease. In addition, fern-leaf chickpea varieties are known to have delayed disease development or less severe disease symptoms compared to unifoliate varieties. Extensive breeding programs are currently underway for development of improved

resistant varieties at Crop Development Centre of University of Saskatchewan and other public sector laboratories.

4. Reduced-Risk Strategy for Ascochyta Blight Management

In the past, there has been limited opportunity for chickpea growers to gain access to alternative, reduced-risk products and practices. Concerns regarding trade barriers, the potential of loosing some of the available products to re-evaluation or resistance development, and the need to diversify the control options prompted the pulse industry to partner with the Pesticide Risk Reduction Program. The partnership initiated in 2003 with the development of a reduced risk management strategy.

The initial step towards strategy development was for the Reduced Risk Team of Pulse Canada to hold stakeholder consultations across participating provinces (Saskatchewan and Alberta) to identify and prioritize issues of concern to growers and the environment. Following the identification of Ascochyta blight of chickpea as a top priority issue, the strategy work was conducted in the context of a larger risk reduction strategy for pulse crops. In September 2006, with the support of the Program a cross-provincial Ascochyta Blight Working Group was established engaging key industry representatives, commodity experts and research scientists in a focused effort to develop and implement sustainable solutions to this issue. The group has convened on several occasions to discuss potential reduced-risk solutions, approaches and actions to be undertaken for addressing the issue. All consultations have been facilitated by the Program, with Mark Goodwin coordinating and leading the sessions on behalf of Pulse Canada.

Through consultations with the working group and other pulse stakeholders, the following gaps and areas of concern were identified to be addressed by the strategy. A number of proposed reduced-risk solution options were also brought forward for each of these areas.

1. Limited knowledge on resistance of chickpea cultivars to Ascochyta blight
2. Limited knowledge on the extent of pathogen resistance to fungicides
3. Need to investigate new cropping and cultural control practices
4. Need for accurate timing of fungicide applications
5. Need for integrated disease and fungicide resistance management systems

4.1. Strategic Action Plan and Progress

Analysis of gaps and solutions discussed through stakeholder consultations led to the development of a strategic action plan for Ascochyta blight control in chickpea (Table 1). The plan focuses on obtaining lower risk control tools and practices which i) reduce reliance on fungicides, ii) minimize unnecessary fungicide applications and iii) allow integration of various alternative control options. There were four goals targeted in this strategic plan:

1. Establish knowledge base
2. Identify and develop new reduced-risk solutions

3. Promote and facilitate adoption of reduced-risk solutions
4. Evaluate strategy results

Each of these goals has been actively pursued with targeted support through the Program, including the funding of two specific projects (Table 2). Table 1 below outlines the goals, targets and milestones identified to address these goals, activities taking place to implement the strategy and progress to date.

Table 1. Action plan and status of activities for implementing the reduced-risk strategy for Ascochyta blight management in chickpea production in Canada (November 2008). Note: green cell (√) indicates that the milestone has been addressed; yellow cell indicates an ongoing activity.

Strategy Goal	Target	Milestone	Status	Strategy Implementation Activities	Expected Completion Date
GOAL 1. Establish base knowledge	Improve knowledge on the pathogen	Assess the potential of several *A. rabiei* isolates to develop resistance to strobilurin fungicides	√	Work conducted through **AAFC** project **PRR03-200**. Among over 100 screened isolates, the majority were sensitive to both strobilurins (azoxystrobin and pyraclostrobin), only one was highly resistant to both fungicides, and several were rate insensitive. Project completed.	March 2007
		Obtain information on disease epidemiology	In progress	Work is underway through **AAFC** project **PRR07-360** to study key factors for Ascochyta blight development in chickpea, including timing of occurrence of *A. rabiei* inoculum vs disease appearance in the field and importance of distance from inoculum source. Project is currently in the 2nd year of the 3 year term.	March 2010
	Improve knowledge on host/pathogen interaction	Assess relative resistance level of chickpea cultivars	√	Work conducted through **AAFC** project **PRR03-200** where 24 chickpea cultivars and genetic lines representing three market classes i.e. small sized kabuli, large-sized kabuli and desi and two leaf types were ranked according to their relative resistance and field performance. Generally, fern-leaf (pinnate) and more upright cultivars appeared less susceptible (developed up to 65% less disease) and performed better than unifoliate and more prostrate cultivars under same disease pressure. Project completed.	March 2007
		Assess the effect of crop density, seeding pattern & plant architecture on disease severity	√	Work conducted through **AAFC** project **PRR03-200**. Increased disease suppression (by ~16%) and higher seed yield (by ~30%) were achieved in paired-row seeding patterns, especially benefiting unifoliate-leaf varieties. Field scale trials are further required to validate the efficacy of this method and work out the specifics for commercial implementation. Project completed.	March 2007

Strategy Goal	Target	Milestone	Status	Strategy Implementation Activities	Expected Completion Date
GOAL 2. Identify and develop new reduced-risk solutions	Investigate combinations of cultural and chemical control options	Evaluate fungicide coverage, rates, types and number /sequence of sprays and nozzle/spray patterns for efficacy under various crop planting densities, foliar types and seeding patterns	√	Work conducted through **AAFC** project **PRR03-200**. Generally, better fungicide coverage was achieved and about 30% less fungicide was needed to efficiently control disease and attain equal or greater seed yield using the spraying system with 3 nozzles in paired-row seeding patterns, especially for unifoliate varieties with heavier canopy. Project completed.	March 2007
		Evaluate efficiency of aerial versus ground sprayer applications	√	Work conducted through **AAFC** project **PRR03-200** in collaboration with industry partners. Both aerial and ground delivery systems appeared equally effective with similar spray efficiency. Research results are reported in provincial extension publications. Project completed.	March 2007
	Improved timing of fungicide applications	Develop early disease risk warning system and deliver recommendations for timing 1st fungicide spray on need basis Develop a seasonal pathogen & disease risk based spray schedule Implement a user-friendly information delivery system to ssupport a sound management decision making process	In progress	Work is underway through **AAFC** project **PRR07-360** to: i) develop a sentinel spore trap line protocol for early detection of spore presence and determining the risk for disease initiation; ii) issue disease risk reports and 1st spray recommendations; and iii) deliver extension guide to help growers implement a step-by step season-long disease management decision system to optimize timing and use of fungicide applications. Project is currently in the 2nd year of the 3 year term.	March 2010
	Develop extension material on integrated control practices	Develop and publish information packages which integrate reduced risk control tools	In progress	A Best Management Practices (BMP) information package is being developed based on findings from **AAFC** project **PRR03-200**. The BMP package to address cultural and chemical control strategies for *Ascochyta* blight management in chickpea including recommendations for: i) cultivar selection; ii) planting densities iii) seeding patterns; iv) seed treatments and foliar fungicide methods and v) crop rotation/tillage options. BMP package is anticipated to be available to growers in time for 2009 cropping season.	March 2009

Strategy Goal	Target	Milestone	Status	Strategy Implementation Activities	Expected Completion Date
GOAL 3. Promote and facilitate adoption of reduced risk solutions	Communicate results and improve grower knowledge on newly introduced tools & practices	Education of intended users on adopting the BMP package	√	Work partially conducted through **AAFC** project **PRR03-200** by making results from the project available and accessible through: i) publishing scientific articles, ii) presentations at growers' meetings and iii) incorporating findings in provincial crop production guides and extension literature. Educational work promoting the uptake of BMP package to follow the publication of the package.	March 2007
			In progress		March 2009
		Education of growers on the use of the disease risk and action recommendations	In progress	Work is underway through **AAFC** project **PRR07-360** to train and encourage growers to use the Ascochyta blight disease risk warning information and follow respective action recommendations. When validated in the field, such information will be incorporated as part of an IPM protocol for grower use.	March 2010
		Develop and distribute extension material on management decision support system	In progress	First issue of a field guide titled "Scouting and Management of Ascochyta Blight in Chickpea" was published and introduced to chickpea growers in Spring 2008 as part of **AAFC** project **PRR07-360.** The guide contains elements of the Decision Tree support system, is easy to use, and is designed to assist growers and agronomists in making management decisions in the field. A revised issue will be published in March 2010 to include new information from the ongoing project.	March 2010
	Demonstrate the economic viability and feasibility of newly introduced tools & practices	Field demonstration of recommended tools	In progress	Work is underway through **AAFC** project **PRR07-360** to demonstrate to the growers the use of the Ascochyta blight early warning and decision support systems as part of an IPM system.	March 2010
		Cost benefit analyses of recommended tools & practices	In progress	Work is underway through **AAFC** project **PRR07-360** to assess the cost benefit analyses of using the disease warning and decision support systems to manage Ascochyta blight in chickpea.	
GOAL 4. Evaluate strategy results	Monitor progress of strategy work	Obtain data on pesticide use and IPM adoption	√	Focus groups were held with PMC and PMRA support to complete an Expert Poll for pulses which includes some information on current pesticide use patterns and IPM adoption in chickpea.	March 2008
		Design and conduct comparative grower survey on use of new tools & practices	In progress	Grower survey will be conducted under **AAFC** project **PRR07-360** before and after the chickpea growing season to determine the usefulness of the disease warning and decision support systems in leading growers to change practices and make judicious management decisions in the field.	March 2010
	Measure risk reduction potential	Design indicators to measure risk reduction resulting from adopting recommended tools	In progress	Most of indicators are project-specific and may include: amount of reduced pesticide use per unit area (less sprays or area sprayed) as a result of the changes in practice, reduction in EIQ levels, number of growers informed about (or adopting) the reduced risk tool and acreage they represent, chickpea acreage where the reduced risk tool and practices are potentially applicable, etc.	March 2010

Table 2: Overview of projects funded through Pest Management Centre's Pesticide Risk Reduction Program to address reduced-risk management of Ascochyta blight in chickpea (December 2008). Click on the hyperlinked project code to view individual descriptions.

Project Code	Principal Investigator	Start/End	Project Title	Anticipated/Final Outputs	Budget
PRR03-200	Yantai Gan, AAFC, Swift Current, SK	2003-2007	Developing cultural and alternative tools to manage Ascochyta blight in chickpea	Beneficial Management Practices package prepared from the research results will be made available to chickpea producers to assist them in making decisions for Ascochyta blight management regarding: • cultivar selection, • planting densities and configuration • fungicide application methods	$322,600
PRR07-360	Mark Goodwin, Pulse Canada	2007-2010	Two decision support tools that will target ascochyta blight on chickpea	• Tools to accurately predict disease and make informed decisions for fungicide applications; • A "Scouting and Management" field guide	$111,724
Total					**$434,324**

5. Summary of Strategy Outcomes

The chickpea Ascochyta blight strategy and projects supported thought the Program are generating useful results towards attaining sustainable management of Ascochyta blight.

The main outcomes expected from this strategy work include:

- an early Ascochyta blight disease warning system
- a field-specific support system for making disease management decisions
- a delivery vehicle to communicate management recommendations to users
- field guides on best disease scouting and management practices
- a cohort of collaborating chickpea growers and agri-retailers reached and trained to implement newly developed practices.

It is anticipated that in combination, these outcomes will help chickpea growers reduce reliance on chemicals, achieve more effective and reduced risk management of ascochyta blight, while maintaining viable chickpea production.

Through this strategy work, the Program is also providing collaboration opportunities and promoting new partnerships. A number of partnerships and in-kind contributions valued at approximately $164,000 were generated through collaboration among Pulse Canada, Saskatchewan Pulse Growers, Saskatchewan Ministry of Agriculture, Crop Development Centre of University of Saskatchewan, and Agriculture and Agri-Food Canada. Working together, increases the likelihood that risk reduction goals in Ascochyta blight control are achieved and sustainable chickpea production becomes a reality.

This document will be updated regularly to reflect new information as it becomes available.