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Canada

Pesticide Risk Reduction Program
Pest Management Centre

Reduced-Risk Strategy for Grasshopper Management

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Preface

Pesticide risk reduction strategies are developed under the Pesticide Risk Reduction Program (PRRP), 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 the environment and to human health from pesticide use in agriculture. To achieve this objective, the PRRP 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 that aims to address grower needs for reduced-risk management tools and practices for specific pest issues. The strategies are developed through extensive consultation with stakeholders. The strategy report presented herein, summarizes the framework and activities supported by the PRRP and is intended to provide an update on the progress 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 PRRP'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 activities and progress of the Pesticide Risk Reduction Program since 2004 in developing and implementing a reduced-risk strategy to manage grasshopper pests of field crops in Canada. The Program's strategy was developed in collaboration with pulse industry representatives including grower groups, commodity experts, researchers and government specialists.

The goal of this strategy is to reduce risks to human health and the environment associated with pesticides used for grasshopper control, while helping growers to ensure viable pest 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.

Grasshoppers are a major pest of field crops including pulses, canola and wheat. With the warmer conditions becoming more prevalent, grasshopper activity and threat to these crops is expected to remain or even increase. Grasshoppers can cause damage that varies from feeding along crop margins to complete loss of whole fields of crops (as occurred during the outbreak in 2002-2003). Grasshoppers can also reduce the forage and range available for livestock and natural food sources available for wildlife, thus affecting biodiversity. Managing outbreaks of severe infestations may require the application of millions of litres of insecticides, which are mainly deployed through aerial applicators.

Grasshoppers have been controlled mainly using organophosphate and carbamate insecticides. 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, including organophosphates and carbamates. As a result of the re-evaluation, some of these older products may be removed from the marketplace leaving synthetic pyrethroids the only alternative control solution for grasshoppers. However, pyrethroids may not perform optimally when applied at air temperatures above 27ºC and their repeated use can lead to development of resistance in grasshoppers.

The objective of the Program's grasshopper risk reduction strategy is to develop lower risk pest control products and practices for safer alternatives to older chemistries, thus ensuring an effective and sustainable management of grasshoppers.

As part of the grasshopper strategy work, a working group was established, 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 four risk reduction projects to support the implementation of the grasshopper strategy. Achievements to date include the development of a grasshopper identification guide and training sessions leading to improved grower knowledge on decision making for grasshopper management. Promising research is being supported to develop a biological alternative for

grasshopper control, to develop an early grasshopper hatching model and to facilitate grower adoption of these tools. It is anticipated that adoption of knowledge and tools developed through this strategy will lead to a sustainable grasshopper management and enable growers to achieve pesticide risk reduction.

2. Introduction

Under the Pesticide Risk Reduction Program, actions are being taken to address pesticide risk reduction and pest management issues across several commodities where grasshoppers are an important pest. Some of the crops significantly affected by grasshoppers include lentil, canola, wheat and chickpea, all of which are priority crops for the Program. Grasshopper issues were first identified through the gap analyses of information provided in the Crop Profile documents that the Program has developed and published for each of the above commodities. Subsequently, through consultations with the pulse industry, grasshopper management was established as the top national priority in lentil production. Therefore, the focus of solutions addressed within this strategy is grasshopper management in lentil crops, with the expectation that information and tools developed may be applicable to other commodities affected by grasshoppers.

There are over 130 species of grasshoppers in Canada, but most species are harmless and only a few species are known to cause serious economic losses to agricultural crops. In addition, some pest species of grasshoppers will only damage crops when plants are in their early stages of development. There are several life-cycle, behavioural, and phenotypical features that set apart pest form non-pest species of grasshoppers. Accurate identification of pest grasshoppers is key information to ensure proper management and judicious use of pesticides.

Grasshopper occurrence is inconsistent from year to year. When weather conditions are suitable, the pest can reach outbreak densities causing significant crop losses. Damage to crops is highest especially during drought periods. Furthermore, warm and dry conditions in the spring and early summer increase grasshopper hatchling survival, while late summer and fall heat encourages mating and egg-laying. Ability to predict grasshopper infestation levels early in the season is key in determining the appropriate timing for control measures.

Lentil, in particular, is one of the crops most susceptible to grasshopper damage as these feed on flower buds, flowers and developing pods, thereby causing direct yield loss. Grasshoppers are prevalent in all lentil cropping areas of Saskatchewan and Alberta and can cause extensive damage on a regional level within a very short time. Sustainable management of grasshoppers is thus critical for successful lentil production.

3. Pest Management and Pesticide Risk Issues

Currently, growers dealing with grasshopper management rely heavily on the few insecticide options available. Overall, there are seven active ingredients registered for grasshopper control which belong to three chemical classes, including organophosphates, carbamates (e.g. carbaryl

used in bran baits) and synthetic pyrethroids. In lentil, there are only four products registered for grasshopper control, two of which are organophosphates (chlorpyrifos and malathion) and two synthetic pyrethroids (deltamethrin and lambda-cyhalothrin). Some of these products have MRL (Minimal Residue Limit) issues, therefore limiting the control options for crops intended for export. With the potential loss of a number of organophosphate products to re-evaluation (e.g. PMRA proposes discontinuation of uses on lentils among others), pyrethroids may be the only remaining control option, at least for lentil.

Pyrethroid insecticides have been cost-effective and have provided excellent control for many pests. However, resistance of several insect species to pyrethroids has been reported. Grasshopper tolerance to this group of insecticides may also increase if these insecticides are used repetitively, without rotation with other chemical groups and alternative control practices.

Because of the critical impact on yields, grasshopper control requires a quick and chemically intensive response at what are still relatively low pest population levels. Average economic thresholds recommended for spray applications are very low for lentil during the blooming period (2 grasshoppers/m^2), but higher for cereals and canola (7 grasshoppers/m^2). In addition, aerial application of insecticides is the only effective method due to the rapid emergence and region-wide nature of grasshopper outbreaks. Widespread and intensive use of pesticides increases the chemical load on environment and the possibility of grasshoppers developing resistance to some of the chemicals.

4. Reduced Risk Strategy for Grasshopper Management

Although grasshoppers are an issue for many crops, the lentil industry is faced with particular challenges given the high susceptibility of lentil crops to grasshoppers, high dependency on chemical control, and the limited availability of viable control options. The need to develop alternative tools to address these concerns have prompted the lentil industry to partner with the Pesticide Risk Reduction Program in investigating viable management options. The partnership was initiated through Pulse Canada in 2004 and proceeded 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 to identify and prioritize issues of concern to growers and environment. Such consultations identified the high priority need to develop and improve access to new knowledge, lower risk products and practices suitable for an integrated approach to grasshopper management in lentil. The goal was to develop alternative tools to help growers transitioning away from the use of organophosphate pesticides.

With the support of the Pesticide Risk Reduction Program, a cross-provincial Grasshopper Working Group was established in September 2006 to engage key industry representatives, research scientists and provincial commodity experts in a focused effort to develop and implement sustainable solutions to the grasshopper issue. The group has convened on several occasions to discuss potential approaches and actions 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. Accurate identification of harmful grasshoppers
2. Development of lower risk alternatives to organophosphates
3. Ascertain impact of high air temperatures on efficacy of synthetic pyrethroids
4. Investigation of biocontrol options
5. Better monitoring and prediction of grasshopper outbreaks
6. Late season control of grasshoppers

4.1. Strategic Action Plan and Progress

The analysis of gaps and solutions brought forward through the consultation process led to the development of a strategic action plan for grasshopper management in lentil (Table 1). The plan focussed on obtaining lower risk control options which would: i) minimize the use of, or replace older chemistries; ii) eliminate unnecessary spray applications; and iii) diversify the tool box to allow integration of options and resistance management. There were four goals targeted in this strategic plan:

1. Develop reduced risk control products alternative to older chemistries
2. Bridge technology gaps with reduced risk tools and practices
3. Promote and facilitate adoption of reduced risk control options
4. Evaluate strategy results

Each of these goals has been actively pursued with the help of targeted support through the Program, including the funding of four 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 Pesticide Risk Reduction Program's reduced-risk strategy for grasshopper management in lentil production in Canada (December 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. Develop reduced risk control products alternative to older chemistries	Develop an effective biocontrol alternative to organophosphates	Examine *Metarhizium anisopliae* as a biocontrol option	√	Work is underway through **AAFC** projects **BPI06-070** and **PRR07-370** to assess the laboratory and field efficacy of the newly discovered Canadian Prairie native strain of *M. anisopliae* as a biocontrol option for grasshopper control. Project BPI06-070 is complete; PRR07-370 is currently in the 2nd year of the 3 year term.	March 2008
		Field evaluation of biocontrol efficacy	In progress		March 2010
		Identify an industry partner interested in commercialization	In progress	Negotiations are underway with potential industry partners to proceed with the commercialization plans for the biocontrol agent.	March 2010
		Biopesticide registration	√	Work was conducted through **AAFC project BPI07-190** to evaluate non-target safety of the Canadian Prairie native strain of *M. anisopliae* as part of the toxicology data required by PMRA for registration purposes. Project is complete. Project team is currently putting together the required information for a pre-submission consultation with PMRA regarding registration of the new biocontrol (submission anticipated in Spring 2010).	March 2008
			In progress		March 2010
	Develop effective pesticide application methods	Investigate in-ground bran bait technology		Plans (**AAFC** project **PRR07-370)** to investigate reduced risk active candidates for the existing carbaryl-based bran bait and determine the efficacy and economic viability of the technology in lentils were cancelled. To revisit the plan at a later time.	
		Stewardship review of aerial applicators			

Strategy Goal	Target	Milestone	Status	Strategy Implementation Activities	Expected Completion Date
GOAL 2. Bridge technology gaps with reduced risk tools and practices	Improve pest identification by scouts, growers and agri-dealers	Develop an illustrated field guide depicting adult pest vs non-pest grasshopper species	√	Work conducted through **AAFC** project **PRR05-010** to develop the *Grasshopper Identification & Control Methods* field guide for improving grower knowledge and promote reduce risk management practices. Project is complete. The guide was published in January 2006 and 500 printed copies were distributed to lentil growers, crop consultants and agri-dealers prior to the 2006 growing season.	March 2006
		Develop an illustrated field guide addendum depicting juvenile stages of pest grasshoppers	√	Work conducted through **AAFC** project **PRR07-370** to upgrade and reprint the 2nd edition of the *Grasshopper Identification & Control Methods* booklet. This edition was published in March 2008 and includes identification features of both juvenile and adult stages of pest grasshoppers.	March 2008
	Improve prediction of critical pest stages and timing of pesticide applications	Develop a grasshopper spring hatching model	In progress	Work is underway through **AAFC** project **PRR07-370** to develop a spring hatching model that will enable early season grasshopper prediction, prediction of summer infestation dynamics based on hatching rates, and effective timing of the 1st and subsequent spray applications. The project is also establishing an on-line system to deliver prediction and control recommendation information to users such as progressive grasshopper risk maps. Project is currently in the 2nd year of the 3 year term.	March 2010
		Predict grasshopper infestation levels in summer			
		Develop a spray schedule based on pest development & pressure			
		Develop a system to deliver prediction and control recommendation information to users			

Strategy Goal	Target	Milestone	Status	Strategy Implementation Activities	Expected Completion Date
GOAL 3. Promote and facilitate adoption of reduced risk control options	Communicate results on newly introduced tools & practices	Develop and distribute extension material to instruct use of biocontrol		To be undertaken (as part of an IPM protocol) when complete efficacy data are available and commercialization efforts materialize. Timing depends on study results and PMRA timelines. Preliminary results are already published in two scientific journal articles and growers media.	March 2010
		Education of intended users on adopting the grasshopper identification guide	√	Work conducted through **AAFC** project **PRR05-010;** pest clinics were organized to train growers how to use the guide (1st edition) to identify pest grasshoppers in the field and make informed spray application decisions accordingly. Project is complete. Through **AAFC** project **PRR07-370,** the 2nd edition was printed in 3,000 copies and widely distributed and introduced to lentil and canola growers.	March 2006/ March 2008
		Review weather impact on pyrethroids			
		Education of growers on the use of predictor and action recommendations	In progress	Workshops are planned under **AAFC** project **PRR07-370** to train growers in adopting the grasshopper prediction model and follow action recommendations. Predictor instructions will be incorporated in an IPM protocol for grower implementation.	March 2010
	Demonstrate the economic viability and feasibility of newly introduced tools & practices	Field demonstration of recommended tools		Work is underway through **AAFC** project **PRR07-370** to demonstrate to growers how to use of the forecasting model and the grasshopper identification guide as part of an IPM system.	
		Cost benefit analyses of recommended tools & practices		Work is underway through **AAFC** project **PRR07-370** to assess cost benefit analyses of using the forecasting model and the grasshopper identification guide along with other available tools as part of an IPM system.	
GOAL 4. Evaluate strategy results	Monitor progress of strategy work	Obtain data on pesticide use and IPM adoption	√	Focus groups were held and Expert Polls were completed for pulses; this resulted in obtaining some baseline data on current pesticide use and IPM adoption in lentils.	March 2008
		Design and conduct comparative grower survey on use of new tools & practices	√	Under **AAFC** project **PRR05-010**, lentil growers were surveyed before and after the growing season following the workshop and introduction of grasshopper identification guide (1st edition). Survey indicated that the workshop and the guide were well received and information helped growers in making judicious management decisions in the field.	January-February 2007
			In progress	Similar surveys to be conducted for the 2nd edition under **AAFC** project **PRR07-370**.	March 2010
	Measure risk reduction potential	Design indicators to measure risk reduction resulting from adopting recommended tools		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, lentil 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 grasshoppers (December 2008). Click on the hyperlinked project code to view individual descriptions.

Project Code	Principal Investigator	Start/End	Project Title	Anticipated/Final Outputs	Budget
PRR05-010	Dan Johnson, U. of Lethbridge, AB	2005 - 2006	Improve grower knowledge and practice to reduced risk management of grasshoppers in lentil	• Laminated grasshopper identification guide for use as a scouting tool • 3 workshops to train growers on the use of the scouting tool • Post-workshop/post-season grower survey	$22,177
BPI06-070	Dan Johnson, U. of Lethbridge, AB	2006-2008	Research and development of a newly discovered, effective grasshopper biocontrol agent found in Canadian Prairie soil	• Efficacy data required for registration package	$84, 000
PRR07-370	Mark Goodwin, Pulse Canada	2007-2010	Reducing the use of insecticides for grasshopper control in lentils	• An upgraded grasshopper ID booklet • A spring grasshopper hatching model • Field efficacy for biocontrol • Field demonstration of developed tools	$165,500
BPI07-190	Dan Johnson, U. of Lethbridge, AB	2007-2008	Evaluation of non-target safety of a native fungal biocontrol agent under development for control of grasshoppers in pulses and other crops.	• Non-target efficacy data • Biocontrol commercialization plan	$51,821
Total					**$323,498**

5. Summary of Strategy Outcomes

The grasshopper risk reduction strategy and projects supported through the Program are generating promising results towards attaining sustainable grasshoppers management.

The main outcomes expected from this strategy work include:

- a biopesticide product as alternative to chlorpyrifos and carbamates
- a practical and user friendly grasshopper spring hatching predictor available to growers
- an extension service (i.e. risk maps) to deliver, and support grower use of the predictor
- an IPM protocol combining new and already available grasshopper control approaches
- a cohort of collaborating growers reached with this strategy through workshops, media communications, and on-farm demonstration of new tools and techniques.

It is anticipated that in combination, these outcomes will help growers reduce reliance on chemicals and achieve more effective and sustainable control of grasshoppers, while maintaining economic viability of the lentil industry. Information and results obtained through this strategy have been made accessible to other commodity groups where relevant and applicable (e.g. canola and wheat growers).

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 Agriculture and Food, University of Lethbridge, and provincial pulse associations in Saskatchewan and Alberta. Working together increases the likelihood that risk reduction goals in grasshopper control are achieved and sustainable crop production becomes a reality.

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