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Pesticide Risk Reduction Program Pest Management Centre

Reduced-Risk Management Strategy for White Mold

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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 Program's objective is to reduce risks to the environment and to human health from pesticide use in agriculture. To achieve this, the Program works with grower groups, provincial experts 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 document presented here summarizes the framework and activities supported by the PRRP. It 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.

For more information, please visit the Pest Management Centre website: www.agr.gc.ca/pmc.

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Executive Summary

White mold is a serious disease limiting production of many economically important crops worldwide. This report summarizes the collaborative efforts and progress on activities undertaken by the Pesticide Risk Reduction Program (PRRP) since 2003 to support development and implementation of a reduced-risk strategy for white mold management in field and vegetable crops in Canada. The goal of the strategy is to minimize the need for using fungicides to control white mold, while helping growers achieve viable disease management and farm profitability.

This strategy was developed through consultations and collaboration with relevant stakeholders including growers, provincial specialists, researchers, and industry representatives. Many of these stakeholders and subject matter experts have been actively involved in several PRRP-led working groups tasked to develop specific elements of the white mold strategy. As part of the strategy work, pesticide risks and disease management issues were identified, reduced-risk solutions to address these issues were discussed and prioritized, and a plan of actions to develop and implement these solutions was established. This process provided a framework for the funding program delivered through AAFC's Pest Management Centre (PMC).

To implement the white mold strategy, the PMC funded 10 (6 risk reduction and 4 minor use pesticides) projects, and provided regulatory assistance for product registration. Some of the key outcomes made available to growers to date include:

- registration of five new fungicide uses
- registration of two new biofungicides, including numerous crop uses
- established foliage trimming as a cultural method for white mold control in carrot crops
- a field guide for *Sclerotinia* disease scouting and risk assessment

Detailed information on new technologies resulting from this strategy is provided in [Table 2](#) below. These results have been communicated and demonstrated to growers to facilitate adoption of new technologies.

Pest management and pesticide risk reduction issues

White mold is caused by the pathogenic fungus *Sclerotinia sclerotiorum*. The fungus can persist for several years in soil as hard-bodied sclerotia and is capable of infecting the plant tissue by either mycelium or airborne ascospores. Disease can develop rapidly during periods of cool and wet weather, especially when these coincide with dense and lodged crop canopies. White mold can cause significant damage in the field and storage thus reducing crop yields and marketability.

Sustainable management of white mold is key to the viable production of a number of economically important crops which are susceptible to *S. sclerotiorum*. Traditionally, growers have relied on numerous applications of a few chemical fungicides available for white mold control. However, some of the older fungicides were re-evaluated by the federal pesticides regulator and some uses have already been phased-out in Canada. Moreover, the repeated use of fewer remaining chemicals

could also lead to the risk of developing pathogen resistance. In fact, resistance of *S. sclerotiorum* to some of the existing products has been already reported.

The key issue identified at the outset of this strategy was the lack of a variety of alternative control options to fill the gap from lost product uses and enable sustainable white mold control.

This strategy is, thus centered on helping growers gain access to new, lower risk control products, tools and practices required to replace, or minimize the use of fungicides and allow for integrated disease management systems.

The strategy

Working groups

Actions were taken to jointly address risk reduction and pest management issues across crops where white mold was identified as a national priority, i.e. canola, dry bean, carrot and soybean. Although targeted toward these crops, it was anticipated that solutions developed would have potential for broader application to other crops affected by white mold.

Two crop-specific working groups were established in 2006 to assist the Program in developing the action plans to address white mold management in these crops: the *Dry Bean White Mold Working Group* and the *Carrot White Mold Working Group*. These groups brought together key experts and stakeholders of respective industries from various provinces. White mold of canola was addressed by the Canola Council of Canada (CCC)-led Working Group, also established in 2006, as part of a broader approach targeting pests of canola. A working group specific for soybean was not deemed necessary given the overlapping expertise and benefits resulting from work in other targeted crops.

In May 2008, an ad-hoc working group was established to specifically roll out an initiative for promoting the adoption of newly registered biopesticides (Contans® and Serenade Max®) as part of an integrated approach to white mold management in dry bean and canola. This group helped the Program to identify appropriate collaborators and trial locations, and set up protocols for an on-farm biofungicide implementation project to be established in the irrigated region of Southern Alberta.

The gaps and priority issues

Since inception, the dry bean and carrot working groups have engaged in multiple consultation sessions leading to identification of 5 top areas of concern to be addressed by the strategy. These priority issues are summarized below, along with solutions proposed over the years.

- *Lack of alternative control options in the tool-box*

Growers were facing new challenges for white mold control as they were in the verge of losing existing key products (e.g. vinclozolin) which would leave few chemical options to protect their yields. There was a need for lower risk fungicide alternatives to replace phased out products and

also allow for adequate rotation among different fungicide groups. This need was especially critical for crops without any fungicide option available at the time (carrot, soybean).

There was also a need for effective, IPM-compatible control tools and practices to support a systems approach that reduced reliance on fungicides. For instance, previous studies suggested that opening up the carrot canopy by side-trimming the leaves can help improve air circulation and reduce moisture within the canopy, thus making the environment less conducive for pathogen and disease development. However, more work was required to determine the efficacy and viability of foliar trimming for white mold control in commercial carrot production.

- *Lack of access to biopesticides*

Various biopesticides (e.g. Contans® and Serenade Max®) for white mold control were available to growers in other countries, but not accessible for use in Canada. These tools were considered suitable for use in IPM systems, and a need was identified to facilitate their registration in Canada.

- *Lack of adequate knowledge of pest and disease*

Correct identification of *S. sclerotiorum* to determine pathogen presence and disease risk in the field is important to make informed management decisions. There are several species of fungi which develop reproductive bodies similar to *S. sclerotiorum*. When growers miss-identify the disease causing fungi, unnecessary fungicide applications may be the result. A guide to help growers identify the pathogen and determine disease risk in the field was proposed.

- *Lack of accurate timing for fungicide applications*

Most of currently used fungicides are protective, requiring application before disease onset for optimal efficacy. Disease forecasters had been developed for white mold in the past, but none had been validated for growing regions in Canada. Effective forecasting tools and delivery systems, as well as relevant education and demonstration activities were needed to help growers with accurate disease risk warnings and fungicide spray timing recommendations.

- *Lack of knowledge on proper use of new products*

New control products, including biopesticides, were becoming available for which optimal timing, rates, and application methods were not well established. Even when these parameters are known, the new products often require more know-how for successful results. Lack of knowledge may lead to apparent product failure and limited uptake of newer reduced-risk products at farm level. For instance, Contans® is a biopesticide incorporated into the soil for long term suppression of sclerotia, with perhaps no immediate obvious disease control impact. Education through training, demonstrations, and field guides on integrated disease management approaches was proposed to help growers make informed decisions, know what to expect, and effectively use these products.

Action Plan

Based on these collective issues and proposed solutions, a joint action plan was developed for all targeted crops. As summarized in Table 1, this action plan included the strategy goals, milestones and specific solutions proposed by the working groups, as well progress on research and development activities undertaken by the Program to advance strategy implementation.

Three key goals were defined in this strategy for addressing the above 5 priorities (Table 1):

- Fill technology gaps with reduced risk control solutions
- Reduce fungicide use through better informed decision making process
- Transfer new reduced-risk solutions and facilitate their adoption by growers.

Table 1. Action plan to implement a reduced-risk strategy for white mold management in field crop and vegetable productions in Canada (March 2014). *Status legend:* Project addressing a milestone is complete (**Complete**)

Goal	Target	Milestone	Status	Implementation Activities <i>(please click on hyperlink to view project details)</i>	Completion period
GOAL 1. Fill technology gaps with reduced risk control solutions	1.a Increase access to new modes of actions, including biopesticides	Registration of new fungicide products	Complete	Minor Use project AAFC05-053 generated efficacy data to support registration of Allegro (fluazinam) on carrots in the field. Allegro was approved for use in 2010.	2005-2008
			Complete	Minor Use project AAFC07-043 generated efficacy data to support registration of Allegro (fluazinam) on dry bean. Allegro was approved for use on snap beans in 2008 and on dry bean in 2009.	2007-2009
			Complete	Minor Use project AAFC04-056 generated efficacy data to support registration of Lance (boscalid) on canola. This was a joint project with the registrant who had a major role in the submission. Lance was approved for use on canola in 2007.	2004-2006
			Complete	Minor Use project AAFC08-013 generated efficacy data to support registration of Scholar 230SC (fludioxonil) for post-harvest control of white mold of carrots in storage. Scholar was approved for use in 2013.	2008-2012
		Investigate biocontrol options	Complete	Project BPI06-190 evaluated the efficacy of biofungicide Contans (<i>Coniothyrium minitans</i>) in suppressing the sclerotia of <i>Sclerotinia sclerotiorum</i> in soil and white mold disease of carrots. Contans treatments were efficacious in degrading sclerotia under controlled conditions, but did not appear to achieve similar results in the field. Efficacy of Contans can be optimized by incorporating it well into the soil (e.g. using shallow tillage).	2006-2008
			Completed	Project PRR03-380 evaluated the efficacy of a Manitoba native strain of <i>Coniothyrium minitans</i> to suppress sclerotia in soils and control white mold in dry bean and canola. This <i>C. minitans</i> strain reduced white mold incidence by up to 75% (dry bean) and 84% (canola) which was comparable to standard fungicide. Further work would be required to make this strain commercially available.	2003-2007
		Registration of new biofungicides	Completed	The Pesticide Risk Reduction Program provided regulatory support to registrants assisting with collection and submission of data packages for registration in Canada of biofungicides Serenade Max (AgraQuest Inc.) and Contans (Prophyta GmbH). Serenade Max was registered in 2007, Contans in 2009. Both have multiple crop uses included in their labels.	2006-2008

	1.b Increase access to cultural control methods	Evaluate carrot foliage trimming in commercial crops	Completed	Project PRR06-310 assessed the efficacy and commercial viability of mechanical trimming of carrot foliage to control white mold in the field in PEI. Using a custom-built trimmer prototype, effective control of disease was achieved without using fungicides and with no adverse effects on carrot yield. Trimming was demonstrated at local carrot farms and featured at field tours.	2006-2009
			Completed	Project PRR09-010 demonstrated the commercial viability of using foliar trimming to control white mold of carrot under production conditions of Ontario. Using an adapted trimmer implement (from the PEI model), effective disease reduction was achieved in several test plots without adverse effects on yield.	2009-2012
		Investigate cultural control practices for bean and canola	Completed	Project PRR03-380 evaluated the effect of seeding rates (plant density) and varietal differences to manage white mold in dry bean and canola. Disease incidence was lower in upright and lodge-resistant cultivars and at lower plant densities. Therefore cultivar selection and seeding rate can be important management choices for minimizing risk of white mold.	2003-2007
GOAL 2. Reduce fungicide use through better decision making	2.a Improve grower capacity to identify the pest & assess disease risk	Develop illustrated field guides	Completed	Project PRR05-130 developed the “ Canola Disease Identification & Sclerotinia Risk Assessment Card ” for use as a guide to help scouts, growers and crop advisors identify apothecia of <i>S. sclerotiorum</i> in the field, assess disease risk and make informed decisions about the need and accurate timing of fungicide sprays. About 15,000 copies of the card were printed and distributed to canola growers, scouts, crop consultants and agri-dealers.	2005-2006
	2.b Improve timing of fungicide sprays	Develop effective disease forecasting	Completed	Project PRR03-380 tested a modified version of the Bailey white mold forecasting warning system to improve the timing and minimize unnecessary fungicide sprays in dry bean. Better disease control was achieved following adequate spray timing recommended by the model. Further efforts would be required to make this tool commercially available.	2003-2007
GOAL 3. Transfer reduced risk solutions to facilitate their adoption	A cohort of growers aware of, and able to properly implement, new approaches to white mold management	Publish results on project outcomes	Completed	Project PRR06-310 disseminated the information on the foliage trimmer technology and its benefits through published factsheets “ Carrot Foliage Trimmer Reduces Storage Rot ” and “ Carrot Foliage Trimming Equipment Technology ”. Other communication vehicles were also used to increase grower awareness and promote adoption of trimming technology, such as field tours, grower presentations, videos, radio announcements, and farm press articles.	2006-2009
			Completed	Project BPI06-190 organized a number of presentations and a field day to communicate the benefits of Contans as a biological control method and to assess potential grower uptake of this technology.	2006-2008
		Demonstrate viability of integrated use of new tools & practices	Completed	Project BPI08-030 conducted on-farm demonstrations on use of the newly registered biofungicides (Contans and Serenade), as part of an integrated approach to control white mold in dry bean and canola under irrigation in southern Alberta. In some cases, Contans combined with Lance resulted in superior yield advantages. Project results were disseminated to growers through field days, crop walks and local extension publications.	2008-2011

Strategy outcomes

The main outcomes achieved from the implementation of white mold strategy include:

- Support provided by the Minor Use Pesticides Program in generating efficacy data and submitting regulatory packages led to registration of five new fungicide uses: Allegro (carrot, dry & snap bean) and Scholar (carrot), and label expansion for Lance on canola.
- Regulatory assistance provided in assembling submission packages led to registration of two new biopesticides, Contans and Serenade Max for use against white mold in ten and four crops, respectively.
- Support enabled validation and demonstration of foliar trimming as an efficacious cultural practice that minimizes the need for, and in some cases replaces fungicide sprays for white mold control in carrots. Trimming has become now a standard practice in many carrot farms of Atlantic Provinces and Ontario, as well as outside Canada.
- Demonstration trials and extension activities have educated growers on use of new biopesticides products and the carrot foliage trimming
- Two factsheets published by the Program contribute to dissemination of information and transfer of the carrot foliar trimming technology to growers
- Support led to publication of a Sclerotinia disease scouting and risk identification guide to help canola growers make informed management decisions in the field
- Through consultations, collaborative research and demonstration projects and extensive dissemination of information, a large cohort of growers and crop advisors have become aware of resulting new tools and educated on sustainable white mold management.

Strategy impact: *then and now*

This strategy work and support by the Program has diversified the profile of products, tools and practices available, thus expanding the toolbox for white mold control in Canada. When the strategy was initiated in 2003, management solutions available for the target crops were limited to 6 chemical fungicides, 4 of them older chemistries slated for re-evaluation, and none of them registered for use in carrot or soybean. Following a sustained, 9 year commitment through this strategy, five new modes of actions, amounting to a total of 19 new fungicide and biopesticide crop uses, as well as new control practices and tools are now added to the toolbox, while highest risk fungicides have been phased out.

As highlighted in Table 2, implementation of these newly introduced solutions has the potential to impact large acreages in terms of reducing the risk from pesticides and sustainable white mold management.

Table 2. Potential impact of control solutions developed through the white mold strategy

Solution	Pesticide risk reduction mechanism	Crop(s)* the solution is applicable to	Total crop acreage** (000 Ha)	Potential acreage for adoption (%)	Additional benefits/ Comments
New biopesticides (Contans & Serenade)	Reduce reliance on conventional pesticides	carrot, canola & dry bean	8,720	100	Enable protection of non-target & beneficial organisms, IPM systems, rotation with other modes of actions, resistance management, mitigation of REI/PHI & MRL issues
New fungicides	Use lower rates of application compared to old chemistries	carrot, canola & dry bean	8,720	100	Enables rotation with other modes of actions, and resistance management
Carrot foliage trimmer	Avoids disease and reduces the need for using control products	carrot	20	85	Reduces production cost by lowering fungicide use, suitable for conventional & organic productions. Higher adoption potential in Eastern Canada because of longer periods of wet weather and storage.
Factsheets featuring carrot trimming	Increase likelihood of growers adopting carrot trimming	Carrot	20	85	
Optimal cultivar/seed density selection	Avoids disease and reduces the need for using conventional pesticides	Dry bean, canola	8,700	100	Enables IPM systems and resistance management
Disease identification & risk assessment tool	Avoid unnecessary sprays	Canola	8,600	100	Enables IPM systems, better decision making, improved timing/efficacy of control products

*Includes only crops targeted by this strategy; impact can be larger if all crop uses included in the products labels are considered.

**Acreage of the indicated crops planted in Canada in 2012.