Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

2007 Pest Management Research Report (PMRR) 2007 Growing Season

2007 Rapport de recherches sur la lutte dirigée (RRLD) pour la saison 2007

Canada

English

2007 PEST MANAGEMENT RESEARCH REPORT

Prepared by: **Pest Management Centre, Agriculture and Agri-Food Canada**
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The Official Title of the Report

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[1] This is the eighth year that the Report has been issued a volume number. It is based on the number of years that it has been published. See history on page ii.

This annual report is designed to encourage and facilitate the rapid dissemination of pest management research results, particularly of field trials, amongst researchers, the pest management industry, university and government agencies, and others concerned with the development, registration and use of effective pest management strategies. The use of alternative and integrated pest management products is seen by the ECIPM as an integral part in the formulation of sound pest management strategies. If in doubt about the registration status of a particular product, consult the Pest Management Regulatory Agency, Health Canada at 1-800-267-6315.

This year there were 70 reports. Agriculture and AgriFood Canada is indebted to the researchers from provincial and federal departments, universities, and industry who submitted reports, for without their involvement there would be no report. Special thanks is also extended to the section editors for reviewing the scientific content and merit of each report and to Andrea Labaj and Olivia D'Souza for editorial and computer compilation services.

Suggestions for improving this publication are always welcome.

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Procedures for the 2008 Annual PMR Report will be sent in Fall, 2008. They will also be available from Andrea Labaj or Olivia D'Souza.

Pest Management Research Report History.

1961 - The National Committee on Pesticide Use in Agriculture (NCPUA) was formed by its parent body, the National Coordinating Committee of Agricultural Services. It had three main duties: to define problems in crop and animal protection and to coordinate and stimulate research on pesticides; to establish principles for drafting local recommendations for pesticide use; and to summarize and make available current information on pesticides.

1962 - The first meeting of the NCPUA was held, and recommended the Committee should provide an annual compilation of summaries of research reports and pertinent data on crop and animal protection involving pesticides. The first volume of the Pesticide Research Report was published in 1962.

1970 - The NCPUA became the Canada Committee on Pesticide Use in Agriculture (CCPUA).

1978 - Name was changed to the Expert Committee of Pesticide Use in Canada (ECPUA).

1990 - The scope of the Report was changed to include pest management methods and therefore the name of the document was changed to the Pest Management Research Report (PMRR). The committee name was the Expert Committee on Pest Management (1990-1993) and the Expert Committee on Integrated Pest Management since 1994.

2006 - The Expert Committee on Integrated Pest Management was disbanded due to lack of funding.

2007 - Agriculture and Agri-Food Canada agreed temporarily to take over responsibility for funding and compilation of the Pest Management Research Report until an organisation willing to assume permanent responsibility was found.

The publication of the Report for the growing season 2007 has been assigned a Volume number for the eighth year. Although there was a name change since it was first published, the purpose and format of the publication remains the same. Therefore based on the first year of publication of this document, the Volume Number will be Volume 46.

An individual report will be cited as follows:
Author(s). 2007. Title. 2007 Pest Management Research Report - 2007 Growing Season. Agriculture and AgriFood Canada. June, 2008. Report No. x. Vol. 46: pp-pp.

Français

Rapport de recherches sur la lutte dirigée - 2007

Préparé par: **Centre de la lutte antiparasitaire, Agriculture et Agroalimentaire Canada**
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Titre officiel du document
2007 Rapport de recherches sur la lutte dirigée - pour la saison 2007. Compilé par Agriculture et Agroalimentaire Canada, 960 avenue Carling, Ed. 57, Ottawa, ON K1A 0C6, Canada
Juin, 2008. 218 pp.
Publié sur Internet à http://www.cps-scp.ca/publications.htm.

La compilation du rapport annuel vise à faciliter la diffusion des résultats de la recherche dans le domaine de la lutte anti-parasitaire, en particulier, les études sur la terrain, parmi les chercheurs, l'industrie, les universités, les organismes gouvernementaux et tous ceux qui s'intéressent à la mise au point, à l'homologation et à l'emploi de stratégies anti-parasitaires efficaces. L'utilisation de produits de lutte intégrée ou de solutions de rechange est perçue par Le Comité d'experts sur la lutte intégrée (CELI) comme faisant parti intégrante d'une stratégie judicieuse en lutte anti-parasitaire. En cas de doute au sujet du statut d'enregistrement d'un produit donné, veuillez consulter Santé Canada, Agence de Réglementation de la lutte anti-parasitaire à 1-800-267-6315.

Cette année, nous avons donc reçu 70 rapports. Les membres du Comité d'experts sur la lutte intégrée tiennent à remercier chaleureusement les chercheurs des ministères provinciaux et fédéraux, des universités et du secteur privé sans oublier les rédacteurs, qui ont fait la révision scientifique de chacun des rapports et en ont assuré la qualité, et Andrea Labaj et Olivia D'Souza qui ont fourni les services d'édition et de compilation sur ordinateur. Vos suggestions en vue de l'amélioration de cette publication sont toujours très appréciées.

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Des procédures pour le rapport annuel de 2008 PMR seront introduites l'automne, 2008. Elles seront aussi disponibles par Andrea Labaj ou Olivia D'Souza.

Historique du Rapport de recherche sur la lutte antiparasitaire
Le Comité national sur l'emploi des antiparasitaires en agriculture (CNEAA) a été formé en 1961 par le Comité national de coordination des services agricoles. Il s'acquittait d'un triple mandat: cerner les problèmes touchant la protection des cultures et des animaux et coordonner et stimuler la recherche sur les pesticides; établir des principes pour l'élaboration de recommandations de portée locale sur l'utilisation des pesticides; synthétiser et diffuser l'information courante sur les pesticides.

À la première réunion du CNEAA, en 1962, il a été recommandé que celui-ci produise un recueil annuel des sommaires des rapports de recherche et des données pertinentes sur la protection des cultures et des animaux impliquant l'emploi de pesticides. C'est à la suite de cette recommandation qu'a été publié, la même année, le premier volume du Rapport de recherche sur les pesticides.

En 1970, le CNEAA est devenu le Comité canadien de l'emploi des pesticides en agriculture. Huit ans plus tard, on lui a donné le nom de Comité d'experts de l'emploi des pesticides en agriculture. En 1990, on a ajouté les méthodes de lutte antiparasitaire aux sujets traités dans le rapport, qui est devenu le *Rapport de recherche sur la lutte antiparasitaire*. Par la suite, le nom du comité a changé deux fois: Comité d'experts de la lutte antiparasitaire de 1990 à 1993 puis, en 1994, Comité d'experts de la lutte antiparasitaire intégrée.

En 2000, on a commencé à attribuer un numéro de volume au rapport annuel. Même si ce dernier a changé de titre depuis sa création, sa vocation et son format demeurent les mêmes. Ainsi, si l'on se reporte à la première année de publication, le rapport portant sur la saison de croissance de 2007 correspond au volume 46.

En 2006, le Comité d'experts de la lutte antiparasitaire intégrée a été dissous en raison du manque de financement.

Pour l'année 2007, Agriculture et Agroalimentaire Canada assume temporairement la responsabilité du financement et de la compilation du Rapport de recherche sur la lutte antiparasitaire jusqu'à ce qu'une organisation désireuse d'assumer la responsabilité pour ce rapport sur une base permanente soit déterminée.

Modèle de référence:
Nom de l'auteur ou des auteurs. Année de parution 2007. Titre (2007 Rapport de recherche sur la lutte antiparasitaire). Agriculture et Agroalimentaire Canada Juin. 2008. Rapport n^{o} x. 46:** pp-pp.

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2007 PMR REPORT# 01 **SECTION A: TREE FRUIT - Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Apples *Malus domestica* (Borkh.), cv. Idared
PEST: European apple sawfly, *Hoplocampa testudinea* (Klug), Mullein leaf bug, *Campylomma verbasci* (Meyer), Plum curculio, *Conotrachelus nenuphar* (Herbst), Rosy apple aphid, *Dysaphis plantaginea* (Passerini), Tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois)

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TITLE: **ASSESSMENT OF APPLICATION TIMING OF THIACLOPRID, SPINETORAM AND AZINPHOS METHYL AGAINST INSECT PESTS OF APPLE, 2007**

MATERIALS: CALYPSO 480 SC (thiacloprid), DELEGATE WG (spinetoram), GUTHION 50 WP (azinphos methyl)

METHODS: The trial was conducted on mature 'Idared' apple trees in an orchard in Waupoos, Ontario. The trees were spaced 6.0 m between rows and 4.2 m within rows. Treatments consisted of three insecticides, CALYPSO 480 SC (210 g a.i./ha), DELEGATE WG (105 g a.i./ha), and GUTHION 50 WP (1100 g a.i./ha), each applied in three different programs: pre-bloom only, post-bloom only and pre-bloom plus post-bloom; all treatments were compared to an unsprayed control. Treatments were replicated four times, with single trees per replicate, and arranged according to a randomized complete block design. On 15 May (pre-bloom application) and 28 May (post-bloom application), insecticides were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. On 22 May (7 days after the first application), ten terminals and ten fruit clusters per plot were harvested and assessed for damage by spring feeding caterpillars (SFC). On 4 June (7 days after the second application), 50 apples per plot were harvested and examined for damage caused by European apple sawfly (EAS) and SFC. On 11 June (14 days after the second application), 50 apples per plot were harvested and examined for damage caused by European apple sawfly (EAS) and SFC. On 18 June (21 days after the second application), 50 terminals per plot were harvested and assessed for damage by SFC and 50 apples per plot were harvested and examined for damage caused by EAS, mullein leaf bug (MB), plum curculio (PC), tarnished plant bug (TPB), and SFC. On 5 September (100 days after the second application), 50 apples per plot were harvested, weighed and examined for damage caused by European apple sawfly (EAS), plum curculio (PC), rosy apple aphid (RAA), tarnished plant bug (TPB), and SFC. Data were expressed as percent fruit damage per plot and analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in the tables below. Pre-spray data of 50 terminals and 50 fruit clusters per plot taken 14 May showed 16% SFC terminal damage and 36% SFC fruit damage. There were no phytotoxic effects observed in any plots at seven or 14 days after either application. EAS data of 11 June and 18 June and PC data of 18 June and 5 September were transformed using log (x+1). Attempts to transform SFC fruit damage data of 11 June and EAS fruit damage of 5 September were unsuccessful, therefore raw data is presented.

CONCLUSIONS: European apple sawfly (EAS) damage can be characterized by two different types of damage - primary and secondary. Primary EAS damage is caused by a short period of feeding by first-instar larvae, and is characterised by a spiral scar on mature fruit; fruit exhibiting primary EAS damage may fall prior to harvest, depending on the severity of the damage. Secondary EAS damage is caused by extensive feeding by the developing larvae characterized by an entry/exit hole as larvae move from fruit to fruit; due to the extent of the damage, fruit exhibiting secondary EAS damage usually drops prior to harvest. Fruit damage data by EAS on a given sample date is the sum total of both types of damage. Seven days after the second application, only plots treated with CALYPSO post-bloom, CALYPSO pre-bloom plus post-bloom, and DELEGATE pre-bloom plus post-bloom had significantly less EAS damage than the unsprayed control; there were no significant differences between the insecticide treatments (Table 1). Fourteen days after the second application, all treatments except for DELEGATE pre-bloom and GUTHION pre-bloom had significantly less EAS damage than the control. No differences were observed between any post-bloom or pre-bloom plus post-bloom treatments. Similar results were observed twenty-one days after the second application; however, plots treated with DELEGATE pre-bloom had significantly more EAS damage than those treated with CALYPSO post-bloom, CALYPSO pre-bloom plus post-bloom and GUTHION post-bloom. By harvest, most fruit damaged by EAS had dropped to the ground. Only the DELEGATE post-bloom and GUTHION post-bloom treatments were not significantly different from the control; all insecticide treatments except DELEGATE post-bloom were statistically similar.

Twenty-one days after the second application, there were no significant differences in MB damage observed between the insecticide treated plots and the control (Table 2). All CALYPSO treated plots and GUTHION pre-bloom plus post-bloom had significantly less PC damage than the control; there were no significant differences between the insecticide treatments. One hundred days after the second application, all CALYPSO treatments and GUTHION post-bloom had significantly less PC damage than the controls and DELEGATE pre-bloom (Table 3). There were no significant differences in RAA damage observed among and between the treatments and the control in the 5 September sample (Table 4).

The sample taken seven days after the first application to assess SFC control showed a reduction in SFC fruit damage in all treated plots, but none of the treatments were statistically different from the control (Table 5). Seven days after the second application, all pre-bloom plus post-bloom treatments, in addition to the DELEGATE pre-bloom and GUTHION post-bloom treatments significantly reduced SFC fruit damage compared to the control; however, no significant differences were observed between any insecticide treatments. There were no significant differences observed between the insecticide treatments and the control at 14 or 21 days after the second application. The harvest assessment showed less SFC damage with all treatments, except those plots treated with CALYPSO pre-bloom, than the control. Levels of damage caused by SFC feeding on terminals were reduced by all insecticide treatments seven days after the first application; however, differences were not significant in either of the samples taken

seven days after the first application or 21 days after the second application (Table 6). Twenty-one days and 100 days after the second application, there were no significant differences in fruit damage by TPB among or between the insecticide treatments and the control (Table 7).
Examining total fruit damage by all insect pests 21 days after the second application, all treatments except GUTHION pre-bloom and DELEGATE pre-bloom had significantly less total fruit damage than the control (Table 8). Although the differences between the treatments were not significant, there was generally less total insect damage with post-bloom alone applications or both pre-bloom plus post-bloom applications. One hundred days after the second application, the plots treated with DELEGATE pre-bloom had significantly more total insect damage than all other insecticide treated plots except for GUTHION pre-bloom and DELEGATE post-bloom; there were no significant differences among the remaining treatments. There were no significant differences in yield between any treatments (Table 9).

Table 1. Percent European apple sawfly (EAS) fruit damage per plot.

Treatment	Rate (g a.i./ha)	% EAS fruit damage per plot			
		4 June (7 days)[4]	11 June (14 days)	18 June (21 days)	5 September (100 days)
CALYPSO 480 SC [1]	210	6.50 ab[5]	1.00 c	2.00 cd	0.00 c
CALYPSO 480 SC [2]	210	2.00 b	1.00 c	0.50 d	0.00 c
CALYPSO 480 SC [3]	210	2.00 b	0.50 c	0.00 d	0.00 c
GUTHION 50 WP [1]	1100	5.00 ab	9.00 ab	12.00 ab	0.00 c
GUTHION 50 WP [2]	1100	4.00 ab	0.00 c	0.00 d	1.00 bc
GUTHION 50 WP [3]	1100	3.50 ab	1.50 c	2.50 bcd	0.00 c
DELEGATE WG [1]	105	4.50 ab	8.50 abc	6.50 abc	0.00 c
DELEGATE WG [2]	105	9.00 ab	2.00 bc	2.00 cd	3.50 a
DELEGATE WG [3]	105	2.00 b	2.00 bc	1.50 cd	0.00 c
CONTROL	-	14.50 a	17.50 a	15.00 a	2.50 ab

[1] Applied 15 May (pre-bloom).
[2] Applied 28 May (post-bloom).
[3] Applied 15 May (pre-bloom) and 28 May (post-bloom).
[4] Number of days after the second application.
[5] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 2. Percent mullein bug (MB) fruit damage per plot.

Treatment	Rate (g ai/ha)	% MB fruit damage per plot 18 July (21 Days)[4]
CALYPSO 480 SC [1]	210	3.00 a[5]
CALYPSO 480 SC [2]	210	4.00 a
CALYPSO 480 SC [3]	210	3.50 a
GUTHION 50 WP [1]	1100	2.00 a
GUTHION 50 WP [2]	1100	3.00 a
GUTHION 50 WP [3]	1100	1.50 a
DELEGATE WG [1]	105	0.50 a
DELEGATE WG [2]	105	3.50 a
DELEGATE WG [3]	105	1.00 a
CONTROL	-	2.50 a

[1] Applied 15 May (pre-bloom).
[2] Applied 28 May (post-bloom).
[3] Applied 15 May (pre-bloom) and 28 May (post-bloom).
[4] Number of days after the second application.
[5] Numbers followed by the same letter are not significantly different *P*<0.05, Tukey test.

Table 3. Percent plum curculio (PC) fruit damage per plot.

Treatment	Rate	% PC fruit damage per plot	
	(g a.i./ha)	18 June (21 days)[4]	5 September (100 days)
CALYPSO 480 SC [1]	210	0.50 b[5]	0.50 c
CALYPSO 480 SC [2]	210	0.00 b	0.00 c
CALYPSO 480 SC [3]	210	0.50 b	0.00 c
GUTHION 50 WP [1]	1100	4.50 ab	3.00 abc
GUTHION 50 WP [2]	1100	1.00 ab	0.50 c
GUTHION 50 WP [3]	1100	0.50 b	1.50 bc
DELEGATE WG [1]	105	11.50 ab	14.00 a
DELEGATE WG [2]	105	1.50 ab	2.50 abc
DELEGATE WG [3]	105	1.00 ab	1.50 abc
CONTROL	-	9.50 a	10.00 ab

[1] Applied 15 May (pre-bloom).
[2] Applied 28 May (post-bloom).
[3] Applied 15 May (pre-bloom) and 28 May (post-bloom).
[4] Number of days after the second application.
Numbers followed by the same letter (within columns) are not significantly different *P*<0.05, Tukey test.

Table 4. Percent rosy apple aphid (RAA) fruit damage per plot.

Treatment	Rate	% RAA fruit damage per plot
	(g ai/ha)	5 September (100 days)[4]
CALYPSO 480 SC [1]	210	1.00 a[5]
CALYPSO 480 SC [2]	210	4.50 a
CALYPSO 480 SC [3]	210	0.50 a
GUTHION 50 WP [1]	1100	3.00 a
GUTHION 50 WP [2]	1100	2.50 a
GUTHION 50 WP [3]	1100	3.50 a
DELEGATE WG [1]	105	2.00 a
DELEGATE WG [2]	105	1.00 a
DELEGATE WG [3]	105	2.50 a
CONTROL	-	1.00 a

[1] Applied 15 May (pre-bloom).
[2] Applied 28 May (post-bloom).
[3] Applied 15 May (pre-bloom) and 28 May (post-bloom).
[4] Number of days after the second application.
[5] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 5. Percent spring feeding caterpillar (SFC) fruit damage per plot.

Treatment	Rate	% SFC fruit damage per plot				
	(g a.i./ha)	22 May (7 days)[4]	4 June (7 days)[5]	11 June (14 days)[5]	18 June (21 days)[5]	5 September (100 days)[5]
CALYPSO 480 SC [1]	210	17.50 a[6]	3.50 ab	2.50 a	2.50 a	2.50 ab
CALYPSO 480 SC [2]	210	17.50 a	1.50 ab	0.00 a	0.00 a	0.50 b
CALYPSO 480 SC [3]	210	22.50 a	1.00 b	4.00 a	0.50 a	1.50 b
GUTHION 50 WP [1]	1100	10.00 a	3.00 ab	3.50 a	2.50 a	1.00 b
GUTHION 50 WP [2]	1100	22.50 a	0.50 b	0.50 a	3.00 a	0.00 b
GUTHION 50 WP [3]	1100	7.50 a	0.50 b	3.00 a	2.00 a	0.00 b
DELEGATE WG [1]	105	12.50 a	1.00 b	2.50 a	2.50 a	0.50 b
DELEGATE WG [2]	105	22.50 a	3.00 ab	0.50 a	0.50 a	0.50 b
DELEGATE WG [3]	105	17.50 a	0.50 b	2.00 a	0.50 a	1.00 b
CONTROL	-	40.00 a	5.50 a	5.00 a	3.00 a	6.50 a

[1] Applied 15 May (pre-bloom).
[2] Applied 28 May (post-bloom).
[3] Applied 15 May (pre-bloom) and 28 May (post-bloom).
[4] Number of days after the second application.
[5] Number of days after the second application.
[6] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 6. Percent spring feeding caterpillar (SFC) terminal damage per plot.

Treatment	Rate (g a.i./ha)	% SFC terminal damage per plot 22 May (7 days)[4]	18 June (21 days)[5]
CALYPSO 480 SC [1]	210	7.50 a[6]	2.00 a
CALYPSO 480 SC [2]	210	12.50 a	3.00 a
CALYPSO 480 SC [3]	210	12.50 a	0.50 a
GUTHION 50 WP [1]	1100	2.50 a	0.50 a
GUTHION 50 WP [2]	1100	7.50 a	0.50 a
GUTHION 50 WP [3]	1100	2.50 a	0.50 a
DELEGATE WG [1]	105	2.50 a	1.50 a
DELEGATE WG [2]	105	15.00 a	2.50 a
DELEGATE WG [3]	105	7.50 a	1.00 a
CONTROL	-	27.50 a	2.50 a

[1] Applied 15 May (pre-bloom).
[2] Applied 28 May (post-bloom).
[3] Applied 15 May (pre-bloom) and 28 May (post-bloom).
[4] Number of days after the first application.
[5] Number of days after the second application.
[6] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 7. Percent tarnished plant bug (TPB) fruit damage per plot.

Treatment	Rate (g a.i./ha)	% TPB fruit damage per plot 18 June (21 days)[4]	5 September (100 days)
CALYPSO 480 SC [1]	210	2.50 a[5]	5.50 a
CALYPSO 480 SC [2]	210	1.50 a	2.00 a
CALYPSO 480 SC [3]	210	0.50 a	2.50 a
GUTHION 50 WP [1]	1100	2.00 a	4.00 a
GUTHION 50 WP [2]	1100	3.00 a	4.50 a
GUTHION 50 WP [3]	1100	0.50 a	4.50 a
DELEGATE WG [1]	105	1.00 a	6.50 a
DELEGATE WG [2]	105	1.50 a	4.50 a
DELEGATE WG [3]	105	1.50 a	3.50 a
CONTROL	-	3.00 a	3.50 a

[1] Applied 15 May (pre-bloom).
[2] Applied 28 May (post-bloom).
[3] Applied 15 May (pre-bloom) and 28 May (post-bloom).
[4] Number of days after the second application.
[5] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 8. Percent total fruit damage by all insect pests per plot.

Treatment	Rate	% total fruit damage per plot	
	(g a.i./ha)	18 June (21 days)[4]	5 September (100 days)
CALYPSO 480 SC [1]	210	11.00 b[5]	9.50 c
CALYPSO 480 SC [2]	210	6.00 b	7.00 c
CALYPSO 480 SC [3]	210	5.00 b	4.50 c
GUTHION 50 WP [1]	1100	23.00 ab	11.00 abc
GUTHION 50 WP [2]	1100	10.00 b	8.50 c
GUTHION 50 WP [3]	1100	7.00 b	9.50 c
DELEGATE WG [1]	105	22.00 ab	23.00 ab
DELEGATE WG [2]	105	9.00 b	12.00 abc
DELEGATE WG [3]	105	5.50 b	8.50 c
CONTROL	-	33.00 a	23.50 a

[1] Applied 15 May (pre-bloom).
[2] Applied 28 May (post-bloom).
[3] Applied 15 May (pre-bloom) and 28 May (post-bloom).
[4] Number of days after the second application.
[5] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 9. Weight of fifty apples per plot.

Treatment	Rate	Weight (g)
	(g a.i./ha)	5 September (21 days)[4]
CALYPSO 480 SC [1]	210	5675 a[5]
CALYPSO 480 SC [2]	210	5525 a
CALYPSO 480 SC [3]	210	5500 a
GUTHION 50 WP [1]	1100	5625 a
GUTHION 50 WP [2]	1100	5575 a
GUTHION 50 WP [3]	1100	5375 a
DELEGATE WG [1]	105	5525 a
DELEGATE WG [2]	105	5475 a
DELEGATE WG [3]	105	5475 a
CONTROL	-	5887 a

[1] Applied 15 May (pre-bloom).
[2] Applied 28 May (post-bloom).
[3] Applied 15 May (pre-bloom) and 28 May (post-bloom).
[4] Number of days after the second application.
[5] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 02 **SECTION A: FRUIT - Insect Pests**

CROP: Apple cv. Empire
PEST: Japanese Beetle, *Popillia japonica* (Newman)

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TITLE: **CONTROL OF JAPANESE BEETLE ON 'EMPIRE' APPLE; 2007**

MATERIALS: IMIDAN 50 WP (phosmet), ALTACOR 35 WDG (rynaxypyr), V-10170 50 WDG (clothianidin), DECIS 5 EC (deltamethrin)

METHODS: The trial was conducted in a seven-year-old apple orchard in Jordan Station, Ontario; apples cv. Empire were spaced 2.4 m by 4.6 m. Single rates of ALTACOR 35 WDG (100 g a.i./ha), V-10170 50 WDG (70 g a.i./ha), DECIS 5 EC (12.5 ml a.i./ha), and IMIDAN 50 WP (1875 g a.i./ha) were compared to an unsprayed control. Treatments were replicated four times, assigned to two-tree plots and arranged according to a randomized complete block design; application occurred on July 12, timed for elevated Japanese beetle populations. Spray mixes were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Plots were sampled 16 July, 19 July, and 27 July; numbers of live Japanese beetles on the trees were counted per plot. Data of 16 July and 19 July were transformed using log (x+1); data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Table 1. No phytotoxic effects were observed in any treated plots at four, seven, or fifteen days after application.

CONCLUSIONS: Four days after application, only DECIS and ALTACOR significantly reduced the number of live Japanese beetles compared to the control; DECIS, ALTACOR and IMIDAN treatments were not significantly different from each other, and plots treated with DECIS had significantly fewer live Japanese beetles than plots treated with V-10170 (Table 1). Seven days after application, DECIS, ALTACOR, and IMIDAN all significantly reduced the number of live Japanese Beetles compared to the control; there were no significant differences among the insecticide treatments (Table 1). Although there were no statistical differences among and between the insecticide treatments and the control fifteen days after treatment, the numbers of live Japanese beetles were greatly reduced in the plots treated with DECIS and ALTACOR (Table 1).

Table 1. Number of live Japanese beetle (JB) per sample.

Treatment[1]	Rate	Number of live JB per sample		
	(g a.i./ha)	16 July (4 days)[2]	19 July (7 days)	27 July (15 days)
IMIDAN 50 WP	1875	4.00 abc[3]	10.25 b	24.25 a
ALTACOR 35 WDG	100	3.25 bc	3.75 b	4.75 a
V-10170 50 WDG	70	8.25 ab	20.00 ab	31.00 a
DECIS 5 EC	12.5	0.25 c	5.25 b	0.25 a
CONTROL	-	39.50 a	86.75 a	31.25 a

[1] Applied 12 July.
[2] Number of days after application.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey Test.

2007 PMR REPORT# 03 **SECTION A: TREE FRUIT -Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Apples *Malus domestica* (Borkh.), cv. Spartan
PESTS: Mullein leaf bug, *Campylomma verbasci* (Meyer), Tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois)

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TITLE: **CONTROL OF MULLEIN LEAF BUG ON 'SPARTAN' APPLES WITH CLOTHIANIDIN, 2007**

MATERIALS: CALYPSO 480 SC (thiacloprid), V-10170 50 WDG (clothianidin)

METHODS: The trial was conducted on twenty-two-year-old 'Spartan' apple trees in an orchard in Brighton, Ontario. The trees were spaced 5.5 m apart between rows and 3.7 m apart within rows. Two rates of V-10170 50 WDG (52.5 g a.i./ha and 105 g a.i./ha) were compared to a single rate of CALYPSO 480 SC (140 g a.i./ha) and an unsprayed control; applications were timed for petal fall (May 28). Treatments were replicated four times, with single trees per replicate, and were arranged according to a randomized complete block design. Insecticides were diluted to a rate comparable to 1000 L/ha and applied with a SOLO 450 backpack sprayer. Plots were sampled on 31 May, 7 June, 11 June, and 20 June (3, 10, 14 and 23 days after application) for mullein leaf bug (MB) by tapping three limbs per plot (two taps per limb for a total of six taps per plot) over a 45 cm x 45 cm tapping tray; numbers of MB were recorded. One hundred fruit per plot were examined on the tree on 7 June and fruit damage by MB was recorded. Fifty fruit per plot were examined on the tree on 7 June, 11 June and 20 June and fruit damage by MB and spring feeding caterpillars (SFC) were recorded. Ten terminals per plot were examined for feeding damage by SFC on 31 May, 7 June, 11 June and 20 June and the number of damaged terminals was recorded. On 5 September, 50 apples per plot were harvested, weighed and assessed for MB and tarnished plant bug (TPB) damage. Data were analysed using analysis of variance and means separated with a Tukey test at the 0.05 significance level. Data are expressed as numbers of MB, and % MB, SFC and TPB fruit damage.

RESULTS: Data are presented in the tables below. No phytotoxic effects were observed in any plots at three, ten or 14 days after treatment. There were no apples found with SFC feeding damage fourteen days after application, therefore the data is not presented.

CONCLUSIONS: Three days after application, all treatments had significantly fewer MB compared to the control; the treatments were not significantly different from each other (Table 1). Ten days after application, the high rate of V-10170 50 WDG (105 g a.i./ha) and the CALYPSO 480 SC (140 g a.i./ha) treated plots had significantly fewer MB than the control although there were no significant differences in MB populations among the insecticide treated plots (Table 1). Fourteen days after application, all treatments had significantly fewer MB compared to the control; the treatments were not significantly different from each other (Table 1). Twenty-three days after application, there were no significant differences in MB populations among and between the treatments and the control (Table 1).
There were no significant differences in MB fruit damage among and between the treatments and the control ten and 14 days after application, although, 14 days after application, there appeared to be a rate affect among the V-10170 50 WDG treated plots (Table 2). Twenty-three days after application, all treatments had significantly fewer apples damaged by MB compared to the control; the treatments were not significantly different from each other (Table 2). At harvest, there were no fruit with MB damage found in the sample, possibly due to selective, mid-season hand-thinning of the crop (Table 2). There were no significant differences in SFC terminal feeding damage or SFC feeding fruit damage among and between the treatments and the control at any of the sampling dates (Tables 3 and 4). There were no significant differences in TPB fruit damage among and between the treatments and the control at any of the sampling dates (Table 5). There were no significant differences in yield among and between the treatments and the control at harvest (Table 6).

Table 1. Number of mullein leaf bugs (MB) per sample.

Treatment[1]	Rate (g a.i./ha)	Number of MB per sample			
		31 May (3 days)[2]	7 June (10 days)	11 June (14 days)	20 June (23 days)
V-10170 50 WDG	52.5	0.25 b[3]	1.00 ab	0.00 b	0.00 a
V-10170 50 WDG	105	0.00 b	0.25 b	0.50 b	1.25 a
CALYPSO 480 SC	140	2.00 b	0.50 b	0.50 b	0.25 a
CONTROL	-	10.00 a	2.50 a	3.50 a	2.25 a

[1] Applied 28 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different, *P*<0.05, Tukey test.

Table 2. Percent apples damaged by mullein leaf bug (MB) per plot.

Treatment[1]	Rate (g a.i./ha)	% apples damaged by MB per plot			
		7 June (10 days)[2]	11 June (14 days)	20 June (23 days)	5 Sept (100 days)
V-10170 50 WDG	52.5	0.25 a[3]	5.00 a	1.50 b	0.00 a
V-10170 50 WDG	105	0.00 a	1.50 a	2.00 b	0.00 a
CALYPSO 480 SC	140	0.00 a	3.00 a	1.00 b	0.00 a
CONTROL	-	0.25 a	3.00 a	6.00 a	0.00 a

[1] Applied 28 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different, *P*<0.05, Tukey test.

Table 3. Percent terminals damaged by spring feeding caterpillars (SFC) per plot.

Treatment[1]	Rate (g a.i./ha)	% terminals damaged by SFC per plot		
		7 June (10 days)[2]	11 June (14 days)	20 June (23 days)
V-10170 50 WDG	52.5	5.00 a[3]	2.50 a	0.00 a
V-10170 50 WDG	105	0.00 a	2.50 a	5.00 a
CALYPSO 480 SC	140	5.00 a	0.00 a	0.00 a
CONTROL	-	2.50 a	2.50 a	2.50 a

[1] Applied 28 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different, *P*<0.05, Tukey test.

Table 4. Percent apples damaged by spring feeding caterpillars (SFC) per plot.

Treatment[1]	Rate (g a.i./ha)	% apples damaged by SFC per plot		
		7 June (10 days)[2]	20 June (23 days)	5 Sept (100 days)
V-10170 50 WDG	52.5	0.00 a[3]	0.50 a	1.50 a
V-10170 50 WDG	105	0.00 a	0.00 a	0.00 a
CALYPSO 480 SC	140	0.75 a	0.00 a	1.00 a
CONTROL	-	0.00 a	0.50 a	1.00 a

[1] Applied 28 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different, *P*<0.05, Tukey test.

Table 5. Percent apples damaged by tarnished plant bug (TPB) per plot.

Treatment[1]	Rate (g a.i./ha)	% apples damaged by TPB per plot		
		11 June (14 days)[2]	20 June (23 days)	5 Sept (100 days)
V-10170 50 WDG	52.5	0.00 a[3]	1.00 a	0.00 a
V-10170 50 WDG	105	0.50 a	0.50 a	2.00 a
CALYPSO 480 SC	140	0.50 a	0.50 a	0.00 a
CONTROL	-	0.00 a	0.00 a	0.50 a

[1] Applied 28 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different, $P<0.05$, Tukey test.

Table 6. Weight of fifty apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight of fifty apples (g)
		5 Sept (100 days)[2]
V-10170 50 WDG	52.5	5400 a[3]
V-10170 50 WDG	105	5575 a
CALYPSO 480 SC	140	5125 a
CONTROL	-	5250 a

[1] Applied 28 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different, $P<0.05$, Tukey test.

2007 PMR REPORT# 04 **SECTION A: TREE FRUIT - Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Apples *Malus domestica* (Borkh.), cv. Empire
PESTS: Gypsy Moth, *Lymantria dispar* (L.), Mullein Leaf Bug, *Campylomma verbasci* (Meyer), Plum Curcullio*, Conotrachelus nenuphar* (Herbst), Spotted tentiform leafminer, *Phyllorycter blancardella* (Fabr.), White Apple Leafhopper, *Typhlocyba pomaria* (McAtee)

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TITLE: ASSESSMENT OF CLOTHIANIDIN ON INSECT PESTS OF 'EMPIRE' APPLES; 2007

MATERIALS: CALYPSO 480 SC (thiacloprid), V-10170 50 WDG (clothianidin)

METHODS: The trial was conducted on twelve-year-old 'Empire' apple trees in an AAFC orchard in Jordan Station, Ontario. The trees were spaced 4.6 m apart between rows and 2.4 m apart within rows. Two rates of V-10170 50 WDG (52.5 g a.i./ha and 105 g a.i./ha) were compared to a single rate of CALYPSO 480 SC (140 g a.i./ha) and an unsprayed control; applications were timed for petal fall (May 29). Treatments were replicated four times, with two trees per replicate, and were arranged according to a randomised complete block design. Insecticides were diluted to a rate comparable to 1000 L/ha and applied with a SOLO 450 backpack sprayer. Plots were sampled on 1 June, 5 June and 12 June for gypsy moth larvae (GM), sampled on 1 June, 5 June, 12 June, and 19 June for mullein leaf bug (MB), and sampled on 1 June, 5 June, 12 June and 19 June for white apple leafhopper nymphs (WALH) by tapping three limbs per tree (for a total of six taps per plot) over a 45 cm x 45 cm tapping tray. On 5 June, 50 leaves per plot were randomly sampled from the tree canopy and numbers of spotted tentiform leaf miner (STLM) mines were recorded per plot. On 12 June, 50 fruit per plot were collected and numbers of plum curcullio (PC) were recorded. On 14 August, 50 apples were harvested, weighed and assessed for MB and PC damage. Data were analysed using analysis of variance and means separated with a Tukey test at the 0.05 significance level.

RESULTS: Data are presented in the tables below. GM, MB, PC and STLM populations were all considered to be low. No phytotoxic effects were observed in any plots at three, seven or 14 days after treatment. MB data for 19 June (14 days after application) was transformed using log (x + 1). There were no apples found with MB damage on 14 August (77 days after application), therefore the data is not presented.

CONCLUSIONS: Three days after the application, only the plots treated with the low rate of V-10170 50 WDG (52.5 g a.i./ha) had significantly fewer GM larvae compared to the control; there were no significant differences among the insecticide treatments (Table 1). Seven days after application, all treatments had significantly fewer GM larvae than the control; there were no differences among the insecticide treatments (Table 1). Fourteen days after application, there were no significant differences in numbers of GM larvae among and between the treatments and the control (Table 1). There were no significant differences in MB populations among and between the treatments and the controls at any of the sampling dates (Table 2). Fourteen and 77 days after application, there were no significant differences in damage by PC among and between the treatments and the control (Table 3). Fourteen days after application, there were no significant differences in numbers of STLM mines among and between the treatments and the control (Table 4). Three and seven days after application, there were no significant differences in numbers of WALH among and between the treatments and the control; however, 14 and 21 days after application, all treated plots had significantly fewer WALH than the control, although there were no significant differences among the insecticide treatments (Table 5). Seventy-seven days after application, there were no differences in yield among and between the treatments and the control (Table 6).

Table 1. Number of gypsy moth (GM) larvae per sample.

Treatment[1]	Rate	Numbers of GM larvae per sample		
	(g a.i./ha)	1 June (3 days)[2]	5 June (7 days)	12 June (14 days)
V-10170 50 WDG	52.5	0.00 b[3]	0.00 b	0.00 a
V-10170 50 WDG	105	0.50 ab	0.00 b	0.25 a
CALYPSO 480 SC	140	1.25 ab	0.00 b	0.00 a
CONTROL	-	2.50 a	1.25 a	0.75 a

[1] Applied 29 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different
P<0.05, Tukey test.

Table 2. Number of mullein leaf bugs (MB) per sample.

Treatment[1]	Rate	Numbers of MB per sample			
	(g a.i./ha)	1 June (3 days)[2]	5 June (7 days)	12 June (14 days)	19 June (21 days)
V-10170 50 WDG	52.5	0.00 a[3]	0.00 a	0.00 a	0.00 a
V-10170 50 WDG	105	0.25 a	0.00 a	0.00 a	0.00 a
CALYPSO 480 SC	140	0.25 a	0.25 a	0.00 a	0.00 a
CONTROL	-	0.75 a	0.50 a	0.25 a	0.50 a

[1] Applied 29 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different
P<0.05, Tukey test.

Table 3. Percent apples with plum curcullio (PC) damage per plot.

Treatment[1]	Rate (g a.i./ha)	% PC damage per plot	
		12 June (14 days)[2]	14 August (77 days)
V-10170 50 WDG	52.5	0.50 a[3]	0.50 a
V-10170 50 WDG	105	0.50 a	3.00 a
CALYPSO 480 SC	140	1.00 a	3.00 a
CONTROL	-	3.00 a	3.50 a

[1] Applied 29 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different *P*<0.05, Tukey test.

Table 4. Number of spotted tentiform leafminer (STLM) mines per sample.

Treatment[1]	Rate (g a.i./ha)	Number of STLM mines per sample
		5 June (7 days)[2]
V-10170 50 WDG	52.5	0.25 a[3]
V-10170 50 WDG	105	3.00 a
CALYPSO 480 SC	140	0.75 a
CONTROL	-	1.25 a

[1] Applied 29 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different *P*<0.05, Tukey test.

Table 5. Number of white apple leafhoppers (WALH) per sample.

Treatment[1]	Rate (g a.i./ha)	Number of WALH per sample			
		1 June (3 days)[2]	5 June (7 days)	12 June (14 days)	19 June (21 days)
V-10170 50 WDG	52.5	5.00 a[3]	13.25 a	4.00 b	9.50 b
V-10170 50 WDG	105	5.75 a	7.75 a	4.00 b	6.75 b
CALYPSO 480 SC	140	3.50 a	9.75 a	5.75 b	7.75 b
CONTROL	-	3.25 a	11.75 a	14.50 a	117.25 a

[1] Applied 29 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different *P*<0.05, Tukey test.

Table 6. Weight of fifty apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g) 14 August (77 days)[2]
V-10170 50 WDG	52.5	3607 a[3]
V-10170 50 WDG	105	3482 a
CALYPSO 480 SC	140	3720 a
CONTROL	-	3570 a

[1] Applied 29 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 05 **SECTION A: TREE FRUIT - Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Apples *Malus domestica* (Borkh.), cv. McIntosh
PESTS: Codling Moth, *Cydia pomonella* (L.), Gypsy Moth, *Lymantria dispar* (L.), Mullein Leaf Bug, *Campylomma verbasci* (Meyer), Plum Curcullio, *Conotrachelus nenuphar* (Herbst), White Apple Leafhopper, *Typhlocyba pomaria* (McAtee)

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TITLE: **ASSESSMENT OF CLOTHIANIDIN ON INSECT PESTS OF 'MCINTOSH' APPLES, 2007**

MATERIALS: CALYPSO 480 SC (thiacloprid), V-10170 50 WDG (clothianidin)

METHODS: The trial was conducted on nine-year-old 'McIntosh' apple trees in an AAFC orchard in Jordan Station, Ontario. The trees were spaced 3.7 m apart between rows and 2.5 m apart within rows. Two rates of V-10170 50 WDG (52.5 g a.i./ha and 105 g a.i./ha) were compared to a single rate of CALYPSO 480 SC (140 g a.i./ha) and an unsprayed control; applications were timed for petal fall (May 29). Treatments were replicated four times, with three trees per replicate, and were arranged according to a randomized complete block design. Insecticides were diluted to a rate comparable to 1000 L/ha and applied with a SOLO 450 backpack sprayer. Plots were sampled 1 June, 5 June, 12 June and 20 June for gypsy moth larvae (GM), mullein leaf bug (MB) and white apple leafhoppers (WALH) by tapping two limbs per tree (for a total of six taps per plot) over a 45 cm x 45 cm tapping tray; numbers of GM, MB, and WALH were recorded for each plot. On 5 June, 50 leaves per plot were randomly sampled from the trees; numbers of WALH were recorded per plot. On 12 June and 20 June, 50 fruit per plot were randomly collected from each plot and numbers of plum curcullio (PC) and codling moth (CM) damaged fruit were recorded. Data were analysed using analysis of variance and means separated with a Tukey test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, 3, 4 and 5. MB populations were considered to be low. No phytotoxic effects were observed in any plots at three, seven or 14 days after treatment. MB populations were considered to be low in number. As attempts to transform 1 June (three days after application) MB data and 20 June (22 days after application) GM larvae data were unsuccessful, only the raw data is presented. CM, MB and WALH data of 20 June (22 days after application) were transformed using log (x + 1).

CONCLUSIONS: Fourteen days after treatment, the low rate of V-10170 50 WDG (52.5 g a.i./ha) and the CALYPSO treated plots had significantly fewer CM damaged apples than the control; the treatments were not significantly different from each other (Table 1). Twenty-two days after application, only the CALYPSO treated plots had significantly fewer CM damaged apples compared to the control; there were no significant differences among the insecticide treatments (Table 1). There were no significant differences in numbers of GM, numbers of MB or the percentage of PC damage among and between the treatments and the control at any of the sampling dates (Tables 2, 3 and 4). There were no significant differences in numbers of WALH among and between the treatments and the controls three, seven or 14 days after application (Table 5). Twenty-two days after application, all treatments had significantly fewer WALH compared to the control; there were no significant differences among the treatments (Table 5).

Table 1. Percent apples damaged by codling moth (CM) per plot.

Treatment[1]	Rate	% CM damaged apples per plot	
	(g a.i./ha)	12 June (14 days)[2]	20 June (22) days
V-10170 50 WDG	52.5	0.00 b[3]	1.00 ab
V-10170 50 WDG	105	0.50 ab	1.50 ab
CALYPSO 480 SC	140	0.00 b	0.00 b
CONTROL	-	3.00 a	4.50 a

[1] Applied 29 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different *P*<0.05, Tukey test.

Table 2. Number of gypsy moth (GM) larvae per sample.

Treatment[1]	Rate	Numbers of GM larvae per sample			
	(g a.i./ha)	1 June (3 days)[2]	5 June (7 days)	12 June (14 days)	20 June (22 days)
V-10170 50 WDG	52.5	3.50 a[3]	0.50 a	0.00 a	0.25 a
V-10170 50 WDG	105	1.25 a	0.00 a	0.25 a	0.00 a
CALYPSO 480 SC	140	3.50 a	0.00 a	0.00 a	0.00 a
CONTROL	-	5.50 a	1.00 a	1.00 a	0.50 a

[1] Applied 29 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different *P*<0.05, Tukey test.

Table 3. Number of mullein leaf bugs (MB) per sample.

Treatment[1]	Rate	Numbers of MB per sample			
	(g a.i./ha)	1 June (3 days)[2]	5 June (7 days)	12 June (14 days)	20 June (22 days)
V-10170 50 WDG	52.5	0.00 a[3]	0.00 a	0.00 a	0.25 a
V-10170 50 WDG	105	0.00 a	0.00 a	0.00 a	0.00 a
CALYPSO 480 SC	140	1.00 a	0.75 a	0.00 a	0.25 a
CONTROL	-	1.00 a	1.25 a	0.50 a	0.25 a

[1] Applied 29 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different *P*<0.05, Tukey test.

Table 4. Percent plum curcullio (PC) damaged apples per plot.

Treatment[1]	Rate	% PC damaged apples per plot	
	(g a.i./ha)	12 June (14 days)[2]	20 June (22 days)
V-10170 50 WDG	52.5	1.00 a[3]	2.50 a
V-10170 50 WDG	105	4.00 a	4.00 a
CALYPSO 480 SC	140	3.00 a	1.50 a
CONTROL	-	1.50 a	2.50 a

[1] Applied 29 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different $P<0.05$, Tukey test.

Table 5. Number of white apple leafhoppers (WALH) per sample.

Treatment[1]	Rate	Numbers of WALH per sample			
	(g a.i./ha)	1 June (3 days)[2]	5 June (7 days)	12 June (14 days)	20 June (22 days)
V-10170 50 WDG	52.5	6.50 a[3]	7.25 a	6.00 a	3.75 b
V-10170 50 WDG	105	8.75 a	9.00 a	5.25 a	4.50 b
CALYPSO 480 SC	140	7.00 a	10.50 a	7.25 a	8.00 b
CONTROL	-	5.00 a	9.50 a	10.75 a	116.75 a

[1] Applied 29 May.
[2] Number of days after application.
[3] Numbers followed by the same letter within columns are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 06 **SECTION A: TREE FRUIT - Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Apple cv. Idared
PEST: European apple sawfly *Hoplocampa testudinea* (Klug), Plum curcullio *Conotrachelus nenuphar* (Herbst), Tarnished plant bug *Lygus lineolaris* (Palisot de Beauvois)

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TITLE: ASSESSMENT OF INSECTICIDES AGAINST EUROPEAN APPLE SAWFLY ON APPLE; 2006

MATERIALS: ASSAIL 70 WP (acetamiprid), DELEGATE WG (spinetoram), GUTHION 50 WP (azinphos methyl), IMIDAN 50 WP (phosmet)

METHODS: Note: The ASSAIL 70 WP data in this report has been submitted to the AAFC Pesticide Minor Use Program as trial AAFC06-024E-065.
The trial was conducted on mature 'Idared' apple trees in an orchard in Waupoos, Ontario. The trees were spaced 6.0 m between rows and 4.2 m within rows. A single rate of DELEGATE (105 g a.i./ha) was compared to two rates of ASSAIL (84 g a.i./ha and 168 g a.i./ha), single rates of GUTHION (1100 g a.i./ha) and IMIDAN (1875 g a.i./ha), and an unsprayed control. Treatments were replicated four times, with single trees per replicate and arranged according to a randomized complete block design. On 30 May (timed for petal fall), insecticides were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. On 7 June, fifty apples per plot were harvested and examined for damage caused by European apple sawfly (EAS). Efficacy was expressed as percent damage and sorted by type of EAS damage (primary damage, secondary damage, and total damage). On 21 June, fifty apples per plot were harvested and examined for damage caused by codling moth (CM), EAS, mullein bug (MB), oblique banded leafroller (OBLR), plum curcullio (PC), rosy apple aphid (RAA) and tarnished plant bug (TPB). Efficacy was expressed as percent damage by pest, and by type of EAS damage. On 20 September, fifty apples per plot were harvested, weighed and examined for damage caused by CM, EAS, MB, OBLR, PC, RAA and TPB. Efficacy was expressed as per cent damage by pest, and by type of EAS damage. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, 3, 4, 5 and 6. A rate effect for control of primary EAS damage and total EAS damage by ASSAIL was evident on all sample dates. There were no phytotoxic effects observed in any plots at either seven or fourteen days after application. Some data were not normally distributed and so transformations log (x+1) were performed; where applicable, data presented are non-transformed means while separation values are from transformed data. The data for damage by CM, MB, OBLR, and RAA is not included as there was not enough damage to analyze.

CONCLUSIONS: Primary EAS damage is caused by a short period of feeding by first-instar larvae, and is characterised by a spiral scar on mature fruit; fruit exhibiting primary EAS damage may fall prior to harvest, depending on the severity of the damage. Secondary EAS damage is caused by extensive feeding by the developing larvae characterized by an entry/exit hole as larvae move from fruit to fruit; due to the extent of the damage, fruit exhibiting secondary EAS damage usually drop prior to harvest.
In the 7 June samples, there were no significant differences in the percentage of apples with primary EAS damage observed in any plots (Table 1). In the 21 June sample, only IMIDAN had significantly more primary EAS damage than the control, all other treatments were similar to the control and all insecticide treatments were similar to each other (Table 1). At harvest, plots treated with DELEGATE and GUTHION had significantly more EAS primary damaged apples than the control; all insecticide treatments were similar to each other (Table 1). In the 7 June sample, higher levels of damage in some treated plots than in the controls could indicate that treatments were applied after some egg hatch and feeding had occurred. Applications were delayed this season by an extended bloom; earlier applications may have given better control of primary EAS damage. The lower incidence of primary EAS damage in the controls than in the treated plots in the 21 June and 20 September samples was likely due to more extensive feeding, resulting in more secondary EAS damage in the controls and increased fruit drop. This was not the case in the treated plots, as the larvae were killed before they could develop and cause extensive damage, resulting in less fruit drop. In the 7 June sample, DELEGATE had significantly less EAS secondary damaged apples then the control but had significantly more EAS secondary damaged apples than both rates of ASSAIL and IMIDAN; DELEGATE and GUTHION were statistically similar to each other (Table 2). There were no apples with EAS secondary damage in any of the insecticide treated plots in the 21 June sample while there was 14.5% EAS secondary damage in the control plots; all damaged fruit had fallen to the ground by the time of this sample (Table 2). In the 20 September sample, no secondary EAS damage was found in any plots; all damaged fruit had probably dropped to the ground by this time (Table 2). Primary EAS damage was added to secondary EAS damage to give the percentage of fruit containing any EAS damage (called total EAS damage). In the 7 June sample, all treatments except the low rate of ASSAIL (84 g a.i./ha) significantly reduced the percentage of apples with total EAS damage; all insecticide treatments were similar to each other (Table 3). In the 21 June sample, all treatments except the low rate of ASSAIL (84 g a.i./ha) and IMIDAN had less total EAS damaged apples than the control (Table 3). In the 20 September sample, DELEGATE and GUTHION had significantly more total EAS damaged apples than the control; all insecticide treatments were statistically similar to each other (Table 3). Total EAS damage levels in the control plots were observed to decline sharply as the season progressed, mainly due to fruit drop caused by EAS secondary damage. There were no significant differences in the percentage of PC damaged apples in the 21 June sample between the treated plots and the control (Table 4). At harvest, the high rate of ASSAIL (168 g a.i./ha) and IMIDAN treatments had significantly less fruit with PC damage than the control; all insecticide treatments were statistically similar to each other (Table 4). There were no significant differences in TPB damage in either assessment (Table 5) or yield at harvest (Table 6) between the control and the treated plots.

Table 1. Percent primary damage by European apple sawfly (EAS) per plot.

Treatment[1]	Rate	% primary damage (EAS) per plot		
	g a.i./ha	7 June	21 June	20 Sept
DELEGATE WG	105	6.00 a[2]	6.00 ab	13.50 b
ASSAIL 70 WP	84	12.00 a	10.00 ab	11.00 ab
ASSAIL 70 WP	168	6.00 a	7.50 ab	8.00 ab
GUTHION 50 WP	1100	10.50 a	8.50 ab	14.00 b
IMIDAN 50 WP	1875	5.00 a	10.50 b	11.50 ab
CONTROL	-	9.50 a	3.50 a	2.50 a

[1] Applied 30 May.
[2] Numbers followed by the same letter (within columns) are not significantly different *P*<0.05, Tukey test.

Table 2. Percent secondary damage by European apple sawfly (EAS) per plot.

Treatment[1]	Rate	% secondary damage (EAS) per plot		
	(g a.i./ha)	7 June	21 June	20 Sept
DELEGATE WG	105	3.00 b[2]	0.00 b	0.00 a
ASSAIL 70 WP	84	0.00 c	0.00 b	0.00 a
ASSAIL 70 WP	168	0.00 c	0.00 b	0.00 a
GUTHION 50 WP	1100	0.50 bc	0.00 b	0.00 a
IMIDAN 50 WP	1875	0.00 c	0.00 b	0.00 a
CONTROL	-	21.50 a	14.50 a	0.00 a

[1] Applied 30 May.
[2] Numbers followed by the same letter (within columns) are not significantly different *P*<0.05, Tukey test.

Table 3. Percent total damage by European apple sawfly (EAS) per plot.

Treatment[1]	Rate	% total damage (EAS) per plot		
	(g a.i./ha)	7 June	21 June	20 Sept
DELEGATE WG	105	9.00 b[2]	6.00 b	13.50 b
ASSAIL 70 WP	84	12.00 ab	10.00 ab	11.00 ab
ASSAIL 70 WP	168	6.00 b	7.50 b	8.00 ab
GUTHION 50 WP	1100	11.00 b	8.50 b	14.00 b
IMIDAN 50 WP	1875	5.00 b	10.50 ab	11.50 ab
CONTROL	-	31.00 a	18.00 a	2.50 a

[1] Applied 30 May.
[2] Numbers followed by the same letter (within columns) are not significantly different *P*<0.05, Tukey test.

Table 4. Percent plum curcullio (PC) damage per plot.

Treatment[1]	Rate	% PC damage per plot	
	g a.i./ha	21 June	20 Sept
DELEGATE WG	105	4.50 a[2]	3.50 ab
ASSAIL 70 WP	84	8.00 a	6.00 ab
ASSAIL 70 WP	168	1.50 a	0.00 b
GUTHION 50 WP	1100	2.00 a	0.50 ab
IMIDAN 50 WP	1875	0.00 a	0.00 b
CONTROL	-	11.50 a	16.50 a

[1] Applied 30 May.
[2] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 5. Percent tarnished plant bug (TPB) damage per plot.

Treatment[1]	Rate	% TPB damage per plot	
	g a.i./ha	21 June	20 Sept
DELEGATE WG	105	3.50 a[2]	5.50 a
ASSAIL 70 WP	84	0.50 a	2.50 a
ASSAIL 70 WP	168	2.00 a	0.50 a
GUTHION 50 WP	1100	2.50 a	2.00 a
IMIDAN 50 WP	1875	4.50 a	4.00 a
CONTROL	-	2.50 a	2.50 a

[1] Applied 30 May.
[2] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 6. Weight of fifty fruit per plot.

Treatment[1]	Rate	Weight (g)
	g a.i./ha	20 Sept
DELEGATE WG	105	6341 a[2]
ASSAIL 70 WP	84	6579 a
ASSAIL 70 WP	168	6326 a
GUTHION 50 WP	1100	7006 a
IMIDAN 50 WP	1875	7047 a
CONTROL	-	7175 a

[1] Applied 30 May.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 07 **SECTION A: FRUIT - Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Apple cv. McIntosh
PEST: Codling moth *Cydia pomonella* (L.), Oriental fruit moth *Grapholita molesta* (Busck), Spotted tentiform leafminer *Phyllonorycter blancardella* (Fabr.)

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TITLE: **ASSESSMENT OF SPINETORAM AGAINST SECOND-GENERATION ORIENTAL FRUIT MOTH ON APPLE; 2006**

MATERIALS: ASSAIL 70 WP (acetamiprid), DELEGATE WG (spinetoram), INTREPID 2F (methoxyfenozide)

METHODS: The trial was conducted on twelve-year-old 'McIntosh' apple trees in an AAFC orchard in Jordan Station, Ontario. The trees were spaced 4.8 m between rows and 3.0 m within rows. Treatments were replicated four times, with two trees per replicate, and arranged according to a randomized complete block design. The trial compared three rates of DELEGATE WG (50 g a.i./ha, 80 g a.i./ha and 105 g a.i./ha) to a single rate of INTREPID 2F (240 g a.i./ha), a single rate of ASSAIL 70WP (168 g a.i./ha) and an unsprayed control. Prior to application, all first generation OFM damage was removed. Treatments were applied 5 July and 19 July, (656 $DD_{7.2}$ and 869 $DD_{7.2}$, respectively, after Biofix (1 May)). Insecticides were diluted to a rate comparable to 3000 L/ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. On 11 July, fifty leaves per plot were sampled for spotted tentiform leafminer (STLM) mines. On 18 July, one hundred terminals per plot were examined for OFM damage and one hundred apples per plot were examined on the trees for damage caused by spring feeding caterpillars (SFC - predominately codling moth, oblique banded leafroller, or Oriental fruit moth). On 4 August, fifty fruit per plot were harvested, weighed and examined for damage by codling moth (CM) and OFM. Damaged apples were cut open and any live larvae found were identified. On 8 August, one hundred terminals per plot were examined for OFM damage. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, 3, 4, 5, 6, and 7. No phytotoxic effects were observed in any plots at 7 days or 13 days after either application. All live larvae collected in the 4 August harvest assessment were identified to be CM larvae (16/16 from the control plots and 5/5 from the treated plots). Attempts to transform the OFM data of 4 August were unsuccessful (OFM data given in Table 7 are non-transformed data).

CONCLUSIONS: Six days after the first application, all treatments had significantly fewer total STLM mines and significantly less leaves with STLM mines than the control; there were no differences among the insecticide treatments in either assessment (Tables 1 and 2). Thirteen days after the first application and twenty days after the second application there were no significant differences in percent terminals damaged by OFM among or between the treatments and the control (Table 3). All treatments except the low rate of DELEGATE (50 g a.i./ha) significantly reduced the total second generation OFM terminal damage compared to the control; there appeared to be a rate affect with DELEGATE (Table 3). All treatments had significantly less total SFC damaged apples compared to the control thirteen days after the first application; there was no significant differences among the insecticide treatments (Table 4). Although the applications were not timed for CM, all treatments significantly reduced the damage by CM sixteen days after the second application; there were no significant differences among the insecticide treatments (Table 5). Sixteen days after the second treatment, there were no significant differences in damage by OFM among or between the insecticide treatments and the control; probably because the populations of OFM were too low to get separation (Table 6). There were no differences in yield among the treatments and the control (Table 7).

Damage by OFM to apple may become more of a concern later in the season as the peach terminals harden off and the peaches are harvested; at that time, OFM may migrate into other crop hosts.

Table 1. Total number of spotted tentiform leafminer (STLM) mines per sample.

Treatment[1]	Rate	Total number of STLM mines per sample
	g a.i./ha	11 July
DELEGATE WG	50	2.75 b[2]
DELEGATE WG	80	2.00 b
DELEGATE WG	105	2.00 b
INTREPID 2F	240	1.75 b
ASSAIL 70 WP	168	1.00 b
CONTROL	-	6.00 a

[1] Applied 5 July and 19 July.
[2] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

Table 2. Percent leaves with spotted tentiform leafminer (STLM) mines per plot.

Treatment[1]	Rate	% leaves with STLM mines per plot
	g a.i./ha	11 July
DELEGATE WG	50	5.50 b[2]
DELEGATE WG	80	3.50 b
DELEGATE WG	105	4.00 b
INTREPID 2F	240	3.50 b
ASSAIL 70 WP	168	2.00 b
CONTROL	-	12.00 a

[1] Applied 5 July and 19 July.
[2] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

Table 3. Percent damaged terminals by second generation Oriental fruit moth (OFM) per plot.

Treatment[1]	Rate	% OFM damaged terminals		Total % of OFM damaged terminals
	g a.i./ha	18 July	8 August	
DELEGATE WG	50	0.75 a[2]	0.50 a	0.63 ab
DELEGATE WG	80	0.25 a	0.50 a	0.38 b
DELEGATE WG	105	0.25 a	0.00 a	0.13 b
INTREPID 2F	240	0.75 a	0.00 a	0.38 b
ASSAIL 70 WP	168	0.00 a	0.50 a	0.25 b
CONTROL	-	1.50 a	1.75 a	1.63 a

[1] Applied 5 July and 19 July.
[2] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 4. Percent apples damaged by spring feeding caterpillars (SFC) per plot.

Treatment[1]	Rate	% SFC damaged apples
	g a.i./ha	18 July
DELEGATE WG	50	8.75 b[2]
DELEGATE WG	80	10.25 b
DELEGATE WG	105	7.75 b
INTREPID 2F	240	13.25 b
ASSAIL 70 WP	168	9.75 b
CONTROL	-	37.50 a

[1] Applied 5 July and 19 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 5. Percent codling moth (CM) damaged apples per plot.

Treatment[1]	Rate	% CM damaged apples per plot
	g a.i./ha	4 August
DELEGATE WG	50	2.00 b[2]
DELEGATE WG	80	6.00 b
DELEGATE WG	105	1.50 b
INTREPID 2F	240	1.50 b
ASSAIL 70 WP	168	5.00 b
CONTROL	-	20.50 a

[1] Applied 5 July and 19 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 6. Percent Oriental fruit moth (OFM) damaged apples per plot.

Treatment[1]	Rate	% OFM damaged apples per plot
	g a.i./ha	4 August
DELEGATE WG	50	1.00 a[2]
DELEGATE WG	80	0.00 a
DELEGATE WG	105	0.00 a
INTREPID 2F	240	0.50 a
ASSAIL 70 WP	168	0.50 a
CONTROL	-	3.50 a

[1] Applied 5 July and 19 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 7. Weight of fifty apples per plot.

Treatment[1]	Rate	Weight (g)
	g a.i./ha	4 August
DELEGATE WG	50	4119 a[2]
DELEGATE WG	80	4082 a
DELEGATE WG	105	3881 a
INTREPID 2F	240	4020 a
ASSAIL 70 WP	168	4143 a
CONTROL	-	4287 a

[1] Applied 5 July and 19 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 08 **SECTION A: FRUIT-Insect Pests**
STUDY DATA BASE:WBSE-T.1206.QM

CROP: Apple cv. McIntosh
PESTS: Codling Moth, *Cydia pomonella* (L.), Oblique Banded Leafroller, *Choristoneura rosaceana* (Harris), Oriental Fruit Moth, *Grapholita molesta* (Busck), Plum Curcullio, *Conotrachelus nenuphar* (Herbst)

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TITLE: **ASSESSMENT OF INSECTICIDES AGAINST CODLING MOTH, OBLIQUE BANDED LEAFROLLER, PLUM CURCULLIO AND ORIENTAL FRUIT MOTH; 2005**

MATERIALS: ASSAIL 70 WP (acetamiprid), DELEGATE WG (spinetoram), IMIDAN 50 WP (phosmet), INTREPID 2F (methoxyfenozide), SUCCESS 480 SC (spinosad)

METHODS: The trial was conducted on ten-year-old 'McIntosh' apple trees in an AAFC orchard in Jordan Station, Ontario. The trees were spaced 4.8 m between rows and 3.0 m within rows. Treatments were replicated four times, with two trees per replicate, and arranged according to a randomized complete block design. The trial compared three rates of DELEGATE (53 g a.i./ha, 80 g a.i./ha and 105 g a.i./ha) to single rates of ASSAIL (168 g a.i/ha), INTREPID (248 g a.i./ha), IMIDAN (1875 g a.i./ha), SUCCESS (87.4 g a.i./ha) and an unsprayed control. First generation codling moth (CM) insecticide applications occurred 7 June and 22 June (66.2 DD_{10} and 243.4 DD_{10} after Biofix, respectively). Second generation CM applications occurred 28 July and 11 August (33.9 DD_{10} and 223.3 DD_{10} after Biofix, respectively). Insecticides were diluted to a rate comparable to 3000 L/ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. On 21 June, fifty apples per plot were harvested and examined for CM and plum curcullio (PC) damage. On 12 July, fifty apples per plot were harvested, weighed and examined for CM and plum curcullio (PC) damage. On 26 August, fifty apples per plot were harvested, weighed and examined for damage by CM, oblique banded leafroller (OBLR) and Oriental fruit moth (OFM). Apples with internal feeding were cut open and any live larvae found were identified. Efficacy was expressed as percent fruit damaged by each pest. Data were analyzed using analysis of variance and means were separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, 3, 4, 5 and 6. No phytotoxic effects were observed in any plots at any evaluation date (assessed 15 June, 21 June, 30 June, 6 July, 4 August, 10 August, 18 August and 26 August). PC data of 21 June was transformed using: square root (x + 0.5). No live OFM larvae were found in any apples on 26 August.

CONCLUSIONS: Fourteen days after the first application, there were no significant differences in CM damage between the insecticide treatments and the control; all plots treated with DELEGATE showed significantly less CM damage than the plots treated with SUCCESS (Table 1). Twenty days after the second application, all treatments, except for INTREPID and SUCCESS, had significantly less damage than the control; all plots treated with DELEGATE and IMIDAN had significantly less CM damage than the plots treated with INTREPID and SUCCESS.

Damage by PC was not significantly reduced by any of the treatments on either sampling date; better control of this pest may have occurred with earlier applications of insecticide (Table 2). Fifteen days after the last application, all treatments except SUCCESS significantly reduced CM damage compared to the control; there were no significant differences among the treatments (Table 3). Fifteen days after the last application, OBLR damage and OFM damage were not significantly reduced by any of the insecticide treatments compared to the control (Tables 4 and 5). There were no significant differences in yield between the treatments and the control at either sampling date (Table 6).

Table 1. Percent fruit damage by first generation codling moth (CM) per plot.

Treatment[1]	Rate	% CM fruit damage	
	(g a.i./ha)	21 June	12 July
DELEGATE WG	53	0.50 b[2]	0.50 c[2]
DELEGATE WG	80	0.50 b	0.50 c
DELEGATE WG	105	0.50 b	0.50 c
INTREPID 2F	248	2.50 ab	7.50 ab
IMIDAN 50 WP	1875	1.50 ab	0.50 c
ASSAIL 70 WP	168	2.50 ab	2.50 bc
SUCCESS 480 SC	87.4	5.50 a	7.50 ab
CONTROL	-	2.50 ab	12.50 a

[1] Applied 7 June, 22 June, 28 July and 11 August..
[2] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 2. Percent fruit damage by plum curcullio (PC) per plot.

Treatment[1]	Rate	% PC fruit damage	
	(g a.i./ha)	21 June	21 July
DELEGATE WG	53	0.93 a[2]	1.50 a
DELEGATE WG	80	2.05 a	8.50 a
DELEGATE WG	105	0.93 a	2.00 a
INTREPID 2F	248	1.83 a	6.05 a
IMIDAN 50 WP	1875	1.14 a	2.00 a
ASSAIL 70 WP	168	1.76 a	3.00 a
SUCCESS 480 SC	87.4	2.40 a	5.00 a
CONTROL	-	2.29 a	6.50 a

[1] Applied 7 June, 22 June, 28 July and 11 August..
[2] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 3. Percent fruit damage by second generation codling moth (CM) per plot.

Treatment[1]	Rate (g a.i./ha)	% CM fruit damage 26 August
DELEGATE WG	53	2.00 b[2]
DELEGATE WG	80	1.50 b
DELEGATE WG	105	1.00 b
INTREPID 2F	248	1.50 b
IMIDAN 50 WP	1875	1.50 b
ASSAIL 70 WP	168	0.50 b
SUCCESS 480 SC	87.4	3.00 ab
CONTROL	-	7.00 a

[1] Applied 7 June, 22 June, 28 July and 11 August.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 4. Percent fruit damage by oblique banded leafroller (OBLR) per plot.

Treatment[1]	Rate (g a.i./ha)	% OBLR fruit damage 26 August
DELEGATE WG	53	9.50 a[2]
DELEGATE WG	80	11.50 a
DELEGATE WG	105	5.00 a
INTREPID 2F	248	12.50 a
IMIDAN 50 WP	1875	5.50 a
ASSAIL 70 WP	168	3.50 a
SUCCESS 480 SC	87.4	5.50 a
CONTROL	-	6.50 a

[1] Applied 7 June, 22 June, 28 July and 11 August.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 5. Percent fruit damage by Oriental fruit moth (OFM) per plot.

Treatment[1]	Rate (g a.i./ha)	% OFM fruit damage 26 August
DELEGATE WG	53	0.50 a[2]
DELEGATE WG	80	0.00 a
DELEGATE WG	105	0.00 a
INTREPID 2F	248	0.00 a
IMIDAN 50 WP	1875	1.00 a
ASSAIL 70 WP	168	0.00 a
SUCCESS 480 SC	87.4	0.50 a
CONTROL	-	1.50 a

[1] Applied 7 June, 22 June, 28 July and 11 August.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 6. Total weight of fifty fruit per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g)	
		12 July	26 August
DELEGATE WG	53	1286 a[2]	4580 a
DELEGATE WG	80	1296 a	4602 a
DELEGATE WG	105	1351 a	5124 a
INTREPID 2F	248	1370 a	4552 a
IMIDAN 50 WP	1875	1308 a	5079 a
ASSAIL 70 WP	168	1304 a	4807 a
SUCCESS 480 SC	87.4	1347 a	4854 a
CONTROL	-	1294 a	4833 a

[1] Applied 7 June, 22 June, 28 July and 11 August.
[2] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 09 **SECTION A: FRUIT-Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Apple cv. Empire
PESTS: Codling Moth, *Cydia pomonella* (L.), Oblique Banded Leafroller, *Choristoneura rosaceana* (Harris), Oriental Fruit Moth, *Grapholita molesta* (Busck)

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TITLE: **ASSESSMENT OF INSECTICIDES AGAINST SECOND GENERATION CODLING MOTH; 2005**

MATERIALS: ASSAIL 70 WP (acetamiprid), DELEGATE WG (spinetoram), IMIDAN 50 WP (phosmet), INTREPID 2F (methoxyfenozide), SUCCESS 480 SC (spinosad)

METHODS: The trial was conducted on five-year-old 'Empire' apple trees in an AAFC orchard in Jordan Station, Ontario. The trees were spaced 4.6 m between rows and 2.4 m within rows. Treatments were replicated four times, with two trees per replicate, and arranged according to a randomized complete block design. The trial compared three rates of GF-1640 (53 g a.i./ha, 80 g a.i./ha and 105 g a.i./ha) to single rates of ASSAIL (168 g a.i./ha), INTREPID (248 g a.i./ha), IMIDAN (1875 g a.i./ha), SUCCESS (87.4 g a.i./ha) and an unsprayed control. All treatments were targeted for first egg hatch of second generation codling moth as determined by trap catches. Insecticides were applied 28 July and 11 August (33.9 DD_{10} and 223.3 DD_{10} after Biofix, respectively). Insecticides were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. On 25 August, fifty apples per plot (twenty-five apples per tree) were harvested, weighed and examined for codling moth (CM), oblique banded leafroller (OBLR) and Oriental fruit moth (OFM) damage. Efficacy was expressed as percent fruit damaged by each pest. Apples with internal feeding damage were cut open and any live larvae found were identified. Data were analyzed using analysis of variance and means were separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, 3 and 4. No phytotoxic effects were observed in any plots at any of the observation dates (3 August, 10 August, 17 August, or 24 August). No live OFM larvae were found in any of the apples examined for internal pests.

CONCLUSIONS: Fourteen days after the second application, all treated plots except INTREPID showed significantly less CM damage compared to the control, there were no significant differences between the insecticide treatments (Table 1). Fruit damage by OBLR or OFM was not significantly reduced by any of the treatments compared to the control (Tables 2 and 3). There were no significant differences in yield between the treatments and the control (Table 4).

Table 1. Percent fruit damaged by codling moth (CM) per plot.

Treatment[1]	Rate (g a.i./ha)	% CM fruit damage 25 August
DELEGATE WG	53	7.5 b[2]
DELEGATE WG	80	3.5 b
DELEGATE WG	105	7.0 b
INTREPID 2F	248	15.0 ab
IMIDAN 50 WP	1875	8.0 b
ASSAIL 70 WP	168	5.0 b
SUCCESS 480 SC	87.4	8.5 b
CONTROL	-	30.0 a

[1] Applied 28 July and 11 August.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent fruit damaged by oblique banded leafroller (OBLR) per plot.

Treatment[1]	Rate (g a.i./ha)	% OBLR fruit damage 25 August
DELEGATE WG	53	5.5 a[2]
DELEGATE WG	80	5.5 a
DELEGATE WG	105	4.0 a
INTREPID 2F	248	3.5 a
IMIDAN 50 WP	1875	3.0 a
ASSAIL 70 WP	168	3.0 a
SUCCESS 480 SC	87.4	2.5 a
CONTROL	-	5.0 a

[1] Applied 28 July and 11 August.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 3. Percent fruit damaged by Oriental fruit moth (OFM) per plot.

Treatment[1]	Rate (g a.i./ha)	% OFM fruit damage 25 August
DELEGATE WG	53	0.0 a[2]
DELEGATE WG	80	2.0 a
DELEGATE WG	105	4.0 a
INTREPID 2F	248	1.5 a
IMIDAN 50 WP	1875	0.5 a
ASSAIL 70 WP	168	0.5 a
SUCCESS 480 SC	87.4	0.5 a
CONTROL	-	5.5 a

[1] Applied 28 July and 11 August.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 4. Weight of fifty apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g) 25 August
DELEGATE WG	53	4580.3 a[2]
DELEGATE WG	80	4602.3 a
DELEGATE WG	105	5124.3 a
INTREPID 2F	248	4660.3 a
IMIDAN 50 WP	1875	5078.5 a
ASSAIL 70 WP	168	4806.8 a
SUCCESS 480 SC	87.4	4853.8 a
CONTROL	-	4833.3 a

[1] Applied 28 July and 11 August.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 10 **SECTION A: TREE FRUIT - Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Apples *Malus domestica* (Borkh.), cv. Empire
PEST: Codling moth, *Cydia pomonella* (L.), Mullein bug, *Campylomma verbasci* (Meyer), Oblique banded leafroller, *Choristoneura rosaceana* (Harris), Plum curculio, *Conotrachelus nenuphar* (Herbst), Spotted tentiform leafminer, *Phyllorycter blancardella* (Fabr.), White apple leafhopper, *Typhlocyba pomaria* (McAtee)

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TITLE: **ASSESSMENT OF NOVALURON ON EARLY SEASON INSECT PESTS OF 'EMPIRE' APPLES, 2007**

MATERIALS: RIMON 10 EC (novaluron), SUCCESS 480 SC (spinosad)

METHODS: The trial was conducted on five-year-old 'Empire' apple trees in an AAFC orchard in Jordan Station, Ontario. The trees were spaced 4.6 m between rows and 2.4 m within rows. A single rate of RIMON 10 EC (140 g a.i./ha) was compared to a single rate of SUCCESS 480 SC (87.4 g a.i./ha) and an unsprayed control. Treatments were replicated four times, with three trees per replicate, and arranged according to a randomized complete block design. Applications were targeted for petal fall (29 May) and were reapplied 13 days later (11 June). Insecticides were diluted to a rate comparable to 1000 L/ha, and applied with a SOLO 450 backpack mist-blower. On 4 June, plots were sampled for mullein bug (MB) and on 4 June and 20 June, plots were sampled for white apple leafhoppers (WALH) by tapping three limbs per tree (for a total of nine limbs per plot) over a 45 cm x 45 cm tapping tray. On 5 June, 50 leaves per plot were harvested and assessed for number of spotted tentiform leafminer (STLM) mines. On 3 July, 50 apples per plot were harvested and all of the apples fallen to the ground (grounders) per plot were collected and assessed for codling moth (CM) and oblique banded leafroller (OBLR) feeding damage; apples with CM feeding damage were cut open to determine if live larvae were present within the fruit. On 15 August, 50 apples per plot were harvested, weighed and assessed for damage by OBLR and plum curculio (PC). Efficacy is expressed as number of MB, STLM mines and WALH and as percent damage by CM, OBLR and PC. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented below. There were no phytotoxic effects observed in any of the treated plots at either seven or 10 days after either application. MB and STLM populations were considered to be very low.

CONCLUSIONS: Twenty-two days after the second treatment, there were no significant differences in OBLR feeding damage among and between the treatments and the control (Table 1); 65 days after the second treatment, the plots treated with RIMON had significantly fewer apples damaged by OBLR compared to the control plots and the SUCCESS treatment (Table 1). Twenty-two days and 65 days after the second application, both RIMON and SUCCESS significantly reduced the percentage of CM feeding damage compared to the control (Table 2); although, there were no significant differences between the insecticide treatments, the plots treated with RIMON had fewer CM damaged apples than the plots treated with SUCCESS on both sampling dates. Twenty-two days after the second application, only the plots treated with RIMON 10 EC had significantly fewer harvested apples with live codling moth larvae residing in the fruit compared to the control; the insecticide treatments were not significantly different from each other (Table 3).

Twenty-two days after the second application, there was no CM or OBLR feeding damage found on any grounder apples in any of the plots treated with RIMON (a total of 16 grounder apples were found in all four replicates) or SUCCESS (a total of 31 grounder apples were found in all four replicates). Of the thirty-nine grounders found in all of the untreated plots, 13 apples had CM feeding damage and two apples had OBLR feeding damage); however, there were no live CM larvae found in any of the grounder apples in the untreated plots (Table 4).

There were no significant differences in numbers of MB, percent PC damaged apples, numbers of STLM mines, numbers of WALH or yield among and between the treatments and the controls on any of their respective sampling dates (Tables 5, 6, 7, 8 and 9).

Table 1. Percent apples (from harvested fruit) with oblique banded leafroller (OBLR) feeding damage per plot.

Treatment[1]	Rate	% apples with OBLR feeding damage	
	(g a.i./ha)	3 July (22 days)[2]	15 August (65 days)[2]
RIMON 10 EC	140	3.00 a[3]	1.50 b
SUCCESS 480 SC	87.4	3.50 a	14.00 a
CONTROL	-	4.00 a	14.00 a

[1] Applied 29 May and 11 June.
[2] Number of days after second application.
[3] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 2. Percent apples (from harvested fruit) with codling moth (CM) feeding damage per plot.

Treatment[1]	Rate	% apples with CM feeding damage	
	(g a.i./ha)	3 July (22 days)[2]	15 August (65 days)[2]
RIMON 10 EC	140	0.50 b[3]	1.00 b
SUCCESS 480 SC	87.4	5.50 b	8.50 b
CONTROL	-	27.50 a	30.50 a

[1] Applied 29 May and 11 June.
[2] Number of days after second application.
[3] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 3. Number of live codling moth (CM) larvae (from harvested fruit) per sample.

Treatment[1]	Rate (g a.i./ha)	Number of live CM larvae 3 July (22 days)[2]
RIMON 10 EC	140	0.00 b[3]
SUCCESS 480 SC	87.4	0.75 ab
CONTROL	-	3.75 a

[1] Applied 29 May and 11 June.
[2] Number of days after second application.
[3] Numbers followed by the same letter are not significantly different *P*<0.05, Tukey test.

Table 4. Percent grounder apples with feeding damage per plot.

Treatment[1]	Rate (g a.i./ha)	% grounder apples with feeding damage 3 July (22 days)[2]	
		CM	OBLR
RIMON 10 EC	140	0.00 b[3]	0.00 a
SUCCESS 480 SC	87.4	0.00 b	0.00 a
CONTROL	-	34.78 a	9.82 a

[1] Applied 29 May and 11 June.
[2] Number of days after second application.
[3] Numbers followed by the same letter (within columns) are not significantly different *P*<0.05, Tukey test.

Table 5. Number of mullein bugs (MB) per sample.

Treatment[1]	Rate (g a.i./ha)	Number of MB per sample 4 June (6 days)[2]
RIMON 10 EC	140	0.25 a[3]
SUCCESS 480 SC	87.4	0.75 a
CONTROL	-	0.75 a

[1] Applied 29 May and 11 June.
[2] Number of days after first application.
[3] Numbers followed by the same letter are not significantly different *P*<0.05, Tukey test.

Table 6. Percent plum curculio (PC) damaged apples per plot.

Treatment[1]	Rate (g a.i./ha)	% PC damaged apples per plot 15 August (65 days)[2]
RIMON 10 EC	140	3.00 a[3]
SUCCESS 480 SC	87.4	6.50 a
CONTROL	-	3.00 a

[1] Applied 29 May and 11 June.
[2] Number of days after second application.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 7. Number of spotted tentiform leafminer (STLM) mines per sample.

Treatment[1]	Rate (g a.i./ha)	Number of STLM mines per sample 5 June (7 days)[2]
RIMON 10 EC	140	0.00 a[3]
SUCCESS 480 SC	87.4	0.50 a
CONTROL	-	1.50 a

[1] Applied 29 May and 11 June.
[2] Number of days after first application.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 8. Number of white apple leafhoppers (WALH) per sample.

Treatment[1]	Rate	Number of WALH per sample	
	(g a.i./ha)	4 June (6 days)[2]	20 June (9 days)[3]
RIMON 10 EC	140	20.5 a[4]	35.50 a
SUCCESS 480 SC	87.4	30.0 a	61.75 a
CONTROL	-	33.0 a	78.75 a

[1] Applied 29 May and 11 June.
[2] Number of days after first application.
[3] Number of days after second application.
[4] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$,Tukey test.

Table 9. Weight of fifty apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g) 15 August (65 days)[2]
RIMON 10 EC	140	7235 a[3]
SUCCESS 480 SC	87.4	7057 a
CONTROL	-	6512 a

[1] Applied 29 May and 11 June.
[2] Number of days after second application.
[3] Numbers followed by the same letter are not significantly different *P*<0.05, Tukey test.

2007 PMR REPORT# 11

SECTION A: TREE FRUIT - Insect Pests
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Apples *Malus domestica* (Borkh.), cv. Empire
PEST: Codling moth, *Cydia pomonella* (L.), Oblique banded leafroller, *Choristoneura rosaceana* (Harris), San Jose scale, *Quadraspidiotus perniciosus* (Comstock)

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TITLE: **ASSESSMENT OF NOVALURON ON MID-SEASON INSECT PESTS OF 'EMPIRE' APPLES, 2007**

MATERIALS: RIMON 10 EC (novaluron), SUCCESS 480 SC (spinosad)

METHODS: The trial was conducted on five-year-old 'Empire' apple trees in an AAFC orchard in Jordan Station, Ontario. The trees were spaced 4.6 m between rows and 2.4 m within rows. A single rate of RIMON 10 EC (140 ml a.i./ha) was compared to a single rate of SUCCESS 480 SC (87.4 g a.i./ha) and an unsprayed control. Treatments were replicated four times, with two trees per replicate, and arranged according to a randomized complete block design. On 28 June (217 $DD_{6.1}$ after Biofix) and 14 days later (12 July), insecticides were diluted to a rate comparable to 1000 L/ha, and applied with a SOLO backpack sprayer. On 11 July, 50 apples per plot were harvested and examined for damage by codling moth (CM), San Jose scale (SJS), and oblique banded leafroller (OBLR). On 11 July, 50 terminals per plot were assessed for number of OBLR larvae. On 27 July, 100 terminals per plot were assessed for number of OBLR larvae. On 16 August, 50 apples per plot were harvested, weighed and assessed for damage by CM, SJS and OBLR; apples with feeding damage were cut open to determine if live CM larvae were present. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1 through 6. There were no phytotoxic effects observed in any of the treated plots at seven or 14 days after either application. The high level of OBLR damage 35 days after the second application may have been caused by a late hatch of OBLR (Table 3). As the attempts to transform 27 July (14 days after the second application) OBLR larval data were unsuccessful, only the raw data is presented.

CONCLUSIONS: Thirteen days after the first application, the plots treated with RIMON and SUCCESS had significantly less apples with CM feeding damage than the control; there were no significant differences among the insecticide treatments (Table 1). Thirty-five days after the second application, the plots treated with RIMON had significantly less apples damaged by CM and significantly fewer apples with CM larvae compared to the plots treated with SUCCESS and the control plots (Tables 1 and 2). There were no significant differences in damage by OBLR, the number of OBLR larvae, damage by SJS or yield among and between the treatments and the control on their respective sampling dates (Tables 3, 4, 5 and 6).

Table 1. Percent apples with codling moth (CM) feeding damage per plot.

Treatment[1]	Rate (a.i./ha)	% apples with CM feeding damage per plot	
		11 July (13 days)[2]	16 August (35 days)[3]
RIMON 10 EC	140 ml	2.50 b[4]	0.00 b
SUCCESS 480 SC	87.4 g	5.00 b	11.00 a
CONTROL	-	12.50 a	17.00 a

[1] Applied 28 June and 12 July.
[2] Number of days after second application.
[3] Number of days after second application.
[4] Numbers followed by the same letter (within columns) are not significantly different *P*<0.05, Tukey test.

Table 2. Number of live codling moth (CM) larvae per sample.

Treatment[1]	Rate (a.i./ha)	Number of live CM larvae per sample
		16 August (35 days)[2]
RIMON 10 EC	140 ml	0.00 b[3]
SUCCESS 480 SC	87.4 g	4.25 a
CONTROL	-	6.75 a

[1] Applied 28 June and 12 July.
[2] Number of days after second application.
[3] Numbers followed by the same letter are not significantly different *P*<0.05, Tukey test.

Table 3. Percent apples with oblique banded leafroller (OBLR) feeding damage per plot.

Treatment[1]	Rate (a.i./ha)	% apples with OBLR feeding damage per plot	
		11 July (13 days)[2]	16 August (35 days)[3]
RIMON 10 EC	140 ml	4.50 a[4]	16.00 a
SUCCESS 480 SC	87.4 g	1.50 a	17.00 a
CONTROL	-	3.00 a	19.00 a

[1] Applied 28 June and 12 July.
[2] Number of days after second application.
[3] Number of days after second application.
[4] Numbers followed by the same letter (within columns) are not significantly different *P*<0.05, Tukey test.

Table 4. Number of live oblique banded leafroller (OBLR) larvae per plot.

Treatment[1]	Rate (a.i./ha)	# of live OBLR larvae per plot	
		11 July (13 days)[2]	27 July (14 days)[3]
RIMON 10 EC	140 ml	0.75 a[4]	0.00 a
SUCCESS 480 SC	87.4 g	0.00 a	0.00 a
CONTROL	-	0.25 a	0.25 a

[1] Applied 28 June and 12 July.
[2] Number of days after second application.
[3] Number of days after second application.
[4] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 5. Percent apples with San Jose scale (SJS) damage per plot.

Treatment[1]	Rate (a.i./ha)	% apples with SJS damage per plot	
		11 July (13 days)[2]	16 August (35 days)[3]
RIMON 10 EC	140 ml	6.50 a[4]	2.00 a
SUCCESS 480 SC	87.4 g	5.00 a	0.50 a
CONTROL	-	8.50 a	8.50 a

[1] Applied 28 June and 12 July.
[2] Number of days after second application.
[3] Number of days after second application.
[4] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 6. Weight of fifty apples per plot.

Treatment[1]	Rate (a.i./ha)	Weight (g)
		15 August (65 days)[2]
RIMON 10 EC	140 ml	5408 a[3]
SUCCESS 480 SC	87.4 g	4915 a
CONTROL	-	5198 a

[1] Applied 28 June and 12 July.
[2] Number of days after second application.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 12 **SECTION A: TREE FRUIT - Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Apples *Malus domestica* (Borkh.), cv. Empire
PEST: Oblique banded leafroller, *Choristoneura rosaceana* (Harris)

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TITLE: **MID-SEASON CONTROL OF OBLIQUE BANDED LEAFROLLER ON 'EMPIRE' APPLES, 2007**

MATERIALS: DELEGATE WG (spinetoram), INTREPID 2F (methoxyfenozide), SUCCESS 480 SC (spinosad)

METHODS: The trial was conducted on mature 'Empire' apple orchard in Simcoe, Ontario. The trees were spaced 7.8 m apart between rows and 4.9 m within rows. Four rates of DELEGATE WG (25 g a.i./ha, 50 g a.i./ha, 80 g a.i./ha and 105 g a.i./ha) were compared to two rates of SUCCESS 480 SC (44 g a.i./ha and 87.4 g a.i./ha), a single rate of INTREPID 2F (180 g a.i./ha) and an unsprayed control. Treatments were replicated four times, with one tree per replicate, and arranged according to a randomized complete block design. On 26 June (220 $DD_{6.1}$ after Biofix) and 14 days later (10 July), insecticides were diluted to a rate comparable to 1000 L/ha, and applied with a SOLO backpack sprayer. On 6 July and 24 July, 100 terminals per plot were visually assessed for number of oblique banded leafroller (OBLR) larvae and number of terminals damaged by OBLR larvae, as well as 50 apples per plot were examined on the tree for feeding damage by OBLR. On 21 August, 50 apples per plot were harvested, weighed and assessed for damage by OBLR. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, 3, and 4. There were no phytotoxic effects observed in any plots three, ten or 14 days after the first application and ten or 22 days after the second application. There were egg masses and newly emerging OBLR larvae found in some plots on 6 July (10 days after the first application), therefore 6 July data is not presented. The number of OBLR damaged apples found in the 6 July and 24 July (14 days after the second application) samples were considered to be low (in total, only four damaged apples were found in the 24 July sample; no OBLR damaged apples were found in the control plots). Live larval data of 24 July were transformed using the formula log (x+1).

CONCLUSIONS: Fourteen days after the second application, all treatments had significantly fewer terminals damaged by OBLR larvae compared to the control; there were no significant differences among the insecticide treatments (Table 1). Fourteen days after the second application, all treatments, except the low rate of SUCCESS (44 g a.i./ha), had significantly fewer live OBLR larvae compared to the control; there were no significant differences among the insecticide treatments (Table 2). Ten days after the first application, there were no significant differences in fruit damage caused by OBLR among and between treatments and the control. Fourteen days after the second application, the low rate of DELEGATE (25 g a.i./ha) and the low rate of INTREPID (180 g a.i./ha) had significantly more damaged fruit by OBLR than the other insecticide treatments and the control (Table 3). Forty-two days after the second application, there were significantly fewer apples damaged by OBLR in the plots treated with the high rate of DELEGATE (105 g a.i./ha) than the control; there were no significant differences among the insecticide treatments (Table 3). There appeared to be a rate effect with DELEGATE and SUCCESS, 42 days after the second treatment (Table 3). There were no significant differences in the yield among and between the treatments and the control (Table 4).

Table 1. Percent of oblique banded leafroller (OBLR) damaged terminals per plot.

Treatment[1]	Rate (g a.i./ha)	% OBLR damaged terminals per plot 24 July (14 days)[2]
DELEGATE WG	25	2.75 b[3]
DELEGATE WG	50	1.50 b
DELEGATE WG	80	1.00 b
DELEGATE WG	105	2.00 b
SUCCESS 480 SC	44	1.00 b
SUCCESS 480 SC	87.4	1.50 b
INTREPID 2F	180	2.50 b
CONTROL	-	8.00 a

[1] Applied 26 June and 10 July.
[2] Number of days after second treatment.
[3] Numbers followed by the same letter within columns are not significantly different $P<0.05$, Tukey test.

Table 2. Number of live oblique banded leafroller (OBLR) larvae per sample.

Treatment[1]	Rate (g a.i./ha)	Number of live OBLR larvae per sample 24 July (14 days)[2]
DELEGATE WG	25	0.00 b[3]
DELEGATE WG	50	0.00 b
DELEGATE WG	80	0.00 b
DELEGATE WG	105	0.00 b
SUCCESS 480 SC	44	1.25 ab
SUCCESS 480 SC	87.4	0.50 b
INTREPID 2F	180	0.50 b
CONTROL	-	6.50 a

[1] Applied 26 June and 10 July.
[2] Number of days after second treatment.
[3] Numbers followed by the same letter within columns are not significantly different $P<0.05$, Tukey test.

Table 3. Percent of oblique banded leafroller (OBLR) damaged apples per plot.

Treatment[1]	Rate (g a.i./ha)	% OBLR damaged apples per plot		
		6 July (10 days)[2]	24 July (14 days)[3]	21 August (42 days)[3]
DELEGATE WG	25	0.50 a[4]	0.75 b	5.50 ab
DELEGATE WG	50	1.00 a	0.00 a	2.00 ab
DELEGATE WG	80	0.50 a	0.00 a	2.00 ab
DELEGATE WG	105	0.00 a	0.00 a	1.00 b
SUCCESS 480 SC	44	0.00 a	0.00 a	7.50 ab
SUCCESS 480 SC	87.4	1.00 a	0.00 a	4.00 ab
INTREPID 2F	180	1.00 a	0.25 ab	7.00 ab
CONTROL	-	2.00 a	0.00 a	12.00 a

[1] Applied 26 June and 10 July.
[2] Number of days after first treatment.
[3] Number of days after second treatment.
[4] Numbers followed by the same letter within columns are not significantly different *P*<0.05, Tukey test.

Table 4. Weight of fifty apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g) 21 August (42 days)[2]
DELEGATE WG	25	4823 a[3]
DELEGATE WG	50	4713 a
DELEGATE WG	80	4530 a
DELEGATE WG	105	4402 a
SUCCESS 480 SC	44	4810 a
SUCCESS 480 SC	87.4	4790 a
INTREPID 2F	180	4545 a
CONTROL	-	5073 a

[1] Applied 26 June and 10 July.
[2] Number of days after second treatment.
[3] Numbers followed by the same letter within columns are not significantly different *P*<0.05, Tukey test.

2007 PMR REPORT# 13 **SECTION A: TREE FRUIT - Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Apples *Malus domestica* (Borkh.), cv. Empire
PEST: Codling moth, *Cydia pomonella* (L.), Oblique banded leafroller, *Choristoneura rosaceana* (Harris), San Jose scale, *Quadraspidiotus perniciosus* (Comstock)

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TITLE: **ASSESSMENT OF SPINETORAM TO CONTROL MID-SEASON INSECT PESTS OF 'EMPIRE' APPLES, 2007**

MATERIALS: DELEGATE WG (spinetoram), INTREPID 2F (methoxyfenozide), SUCCESS 480 SC (spinosad)

METHODS: The trial was conducted on seven-year-old 'Empire' apple trees in an AAFC orchard in Jordan Station, Ontario. The trees were spaced 4.6 m between rows by 2.4 m within rows. Four rates of DELEGATE WG (25 g a.i./ha, 50 g a.i./ha, 80 g a.i./ha and 105 g a.i./ha) were compared to two rates of SUCCESS 480 SC (44 g a.i./ha and 87.4 g a.i./ha), a single rate of INTREPID 2F (180 g a.i./ha) and an unsprayed control. Treatments were replicated four times, with two trees per replicate, and arranged according to a randomized complete block design. On 28 June (217 $DD_{6.1}$ after Biofix) and 14 days later (12 July), insecticides were diluted to a rate comparable to 1000 L/ha, and applied with a SOLO backpack sprayer. On 11 July (13 days after the first application), 50 terminals per plot were assessed for number of oblique banded leafroller (OBLR) larvae. On 11 July, 50 apples per plot were harvested and examined for damage by codling moth (CM), San Jose scale (SJS), and OBLR. On 27 July (14 days after the second application), 100 terminals per plot were assessed for number of OBLR larvae. On 16 August (35 days after the second application), 50 apples per plot were harvested, weighed and assessed for damage by CM, SJS and OBLR. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in the tables below. There were no phytotoxic effects observed in any of the treated plots seven or 14 days after the first application and seven or 15 days after the second application. There were many different insect species feeding on terminals throughout the season, therefore OBLR terminal feeding data of 11 July (13 days after application) is not presented.

CONCLUSIONS: Thirteen days after the first application, all treatments had significantly less apples damaged by CM compared to the control; there were no significant differences among the insecticide treatments (Table 1). Thirty-five days after the second application, all treatments, except the low rate of SUCCESS (44 g a.i./ha) and the high rate of SUCCESS (87.4 g a.i./ha), had significantly less apples damaged by CM compared to the control; there were no significant differences among the insecticide treatments (Table 1). Fourteen days after the first application and 35 days after the second application, there were no significant differences in fruit damage caused by OBLR among and between treatments and the control; the OBLR damage was high in all plots 35 days after the second application possibly due to a late hatch of OBLR larvae (Table 2).

There were no significant differences in the number of OBLR larvae, SJS damage or yield found among or between the treatments and the control on any of their respective sampling dates (Tables 3, 4, and 5).

Table 1. Percent apples damaged by codling moth (CM) per plot.

Treatment[1]	Rate (g a.i./ha)	% CM damaged apples per plot	
		11 July (13 days)[2]	16 August (35 days)[3]
DELEGATE WG	25	4.50 b[4]	4.00 b
DELEGATE WG	50	4.50 b	4.50 b
DELEGATE WG	80	2.00 b	2.00 b
DELEGATE WG	105	2.00 b	0.50 b
SUCCESS 480 SC	44	4.00 b	8.50 ab
SUCCESS 480 SC	87.4	5.00 b	11.00 ab
INTREPID 2F	180	5.50 b	2.50 b
CONTROL	-	12.50 a	17.00 a

[1] Applied 28 June and 12 July.
[2] Number of days after first application.
[3] Number of days after second application.
[4] Numbers followed by the same letter within columns are not significantly different $P<0.05$, Tukey test.

Table 2. Percent oblique banded leafroller (OBLR) damaged apples per plot.

Treatment[1]	Rate (g a.i./ha)	% OBLR damaged apples	
		11 July (13 days)[2]	16 August (35 days)[3]
DELEGATE WG	25	3.50 a[4]	19.00 a
DELEGATE WG	50	1.00 a	13.50 a
DELEGATE WG	80	2.00 a	14.50 a
DELEGATE WG	105	0.50 a	14.00 a
SUCCESS 480 SC	44	1.00 a	13.00 a
SUCCESS 480 SC	87.4	1.50 a	17.00 a
INTREPID 2F	180	1.00 a	17.50 a
CONTROL	-	3.00 a	19.00 a

[1] Applied 28 June and 12 July.
[2] Number of days after first application.
[3] Number of days after second application.
[4] Numbers followed by the same letter within columns are not significantly different $P<0.05$, Tukey test.

Table 3. Number of live oblique banded leafroller (OBLR) larvae per sample.

Treatment[1]	Rate (g a.i./ha)	Number of live OBLR larvae per sample: 11 July (13 days)[2]	27 July (15 days)[3]
DELEGATE WG	25	0.00 a[4]	0.00 a
DELEGATE WG	50	0.00 a	0.00 a
DELEGATE WG	80	0.00 a	0.00 a
DELEGATE WG	105	0.00 a	0.00 a
SUCCESS 480 SC	44	0.50 a	0.00 a
SUCCESS 480 SC	87.4	0.00 a	0.00 a
INTREPID 2F	180	0.00 a	0.00 a
CONTROL	-	0.50 a	0.25 a

[1] Applied 28 June and 12 July.
[2] Number of days after first application.
[3] Number of days after second application.
[4] Numbers followed by the same letter within columns are not significantly different $P<0.05$, Tukey test.

Table 4. Percent apples damaged by San Jose scale (SJS) per plot.

Treatment[1]	Rate (g a.i./ha)	% SJS damaged apples per plot: 11 July (13 days)[2]	16 August (35 days)[3]
DELEGATE WG	25	12.50 a[4]	2.50 a
DELEGATE WG	50	9.50 a	3.50 a
DELEGATE WG	80	4.50 a	4.50 a
DELEGATE WG	105	7.00 a	1.00 a
SUCCESS 480 SC	44	6.00 a	2.50 a
SUCCESS 480 SC	87.4	5.00 a	0.50 a
INTREPID 2F	180	6.00 a	0.00 a
CONTROL	-	8.50 a	8.50 a

[1] Applied 28 June and 12 July.
[2] Number of days after first application.
[3] Number of days after second application.
[4] Numbers followed by the same letter within columns are not significantly different $P<0.05$, Tukey test.

Table 5. Weight of fifty apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g) 16 August (35 days)[2]
DELEGATE WG	25	4990 a[3]
DELEGATE WG	50	5575 a
DELEGATE WG	80	4970 a
DELEGATE WG	105	5010 a
SUCCESS 480 SC	44	4670 a
SUCCESS 480 SC	87.4	4915 a
INTREPID 2F	180	5265 a
CONTROL	-	5197 a

[1] Applied 28 June and 12 July.
[2] Number of days after second application.
[3] Numbers followed by the same letter within columns are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 14 **SECTION A: FRUIT - Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Apple cv. Empire
PEST: Oriental fruit moth, *Grapholita molesta* (Busck)

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TITLE: **ASSESSMENT FOR CONTROL OF SECOND GENERATION INTERNAL LEPIDOPTERA ON APPLE; 2005**

MATERIALS: ASSAIL 70 WP (acetamiprid), DELEGATE WG (spinetoram), IMIDAN 50 WP (phosmet), INTREPID 2F (methoxyfenozide), SUCCESS 480 SC (spinosad)

METHODS: The trial was conducted on five-year-old 'Empire' apple trees in an AAFC orchard in Jordan Station, Ontario. The trees were spaced 4.6 m between rows and 2.4 m within rows. Treatments were replicated four times, with two trees per replicate and arranged according to a randomized complete block design. The trial compared three rates of DELEGATE (53 g a.i./ha, 80 g a.i./ha, and 105 g a.i./ha) to single rates of ASSAIL (168 g a.i./ha), IMIDAN (1875 g a.i./ha), INTREPID (248 g a.i./ha), SUCCESS (87.4 g a.i./ha) and an unsprayed control. Prior to second generation applications, apples with first generation internal Lepidoptera (codling moth (CM) and Oriental fruit moth (OFM)) damage were removed from all plots. Treatments were applied 7 July and 21 July, (659.4 $DD_{7.2}$ and 904.3 $DD_{7.2}$ respectively, after Biofix). Insecticides were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Fifty apples per plot were harvested, weighed and examined for internal Lepidoptera damage on 19 July and 4 August. Apples with internal feeding damage were cut open, examined for live larvae and any live larvae found were identified. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2 and 3. No phytotoxic effects were observed in any treated plots seven or twelve days after the first application or seven days or thirteen days after the second application. The live larvae in 19 July sample were too immature to properly identify.

CONCLUSIONS: Twelve days after the first application, all treatments except INTREPID had significantly less Lepidoptera damaged apples than the control; there were no differences between the treatments (Table 1). Fourteen days after the second application, there were significantly less CM damaged apples in all insecticide treated plots compared to the control; there were no differences between the treatments (Table 2). There was no significant differences in OFM damage between the treated plots and the control, although there appeared to be a rate affect with DELEGATE (Table 2). When total Lepidoptera damage was considered, all treated plots had significantly less total damaged apples compared to the control; there were no significant differences between the insecticide treatments (Table 2). There were no differences in yield between the treatments and the control at either sample date (Table

3).

Table 1. Percent internal Lepidoptera (CM and OFM) damage per plot.

Treatment[1]	Rate g a.i./ha	% Lepidoptera infested apples 19 July
DELEGATE WG	53	3.00 b[2]
DELEGATE WG	80	2.75 b
DELEGATE WG	105	5.30 b
ASSAIL 70 WP	168	3.00 b
INTREPID 2F	248	7.50 a
IMIDAN 50 WP	1875	3.50 b
SUCCESS 480 SC	87.4	4.50 b
CONTROL	-	11.50 a

[1] Applied 7 July and 21 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent internal Lepidoptera (CM and OFM) damage per plot.

Treatment[1]	Rate g a.i./ha	% CM infested apples 4 August	% OFM infested apples 4 August	% Total infested apples 4 August
DELEGATE WG	53	5.50 b[2]	13.50 a	19.00 b
DELEGATE WG	80	4.50 b	12.00 a	16.50 b
DELEGATE WG	105	5.50 b	8.00 a	13.50 b
ASSAIL 70 WP	168	5.50 b	5.50 a	11.00 b
INTREPID 2F	248	7.00 b	13.50 a	20.50 b
IMIDAN 50 WP	1875	5.00 b	10.50 a	15.50 b
SUCCESS 480 SC	87.4	5.50 b	10.50 a	16.00 b
CONTROL	-	24.00 a	21.00 a	45.00 a

[1] Applied 7 July and 21 July.
[2] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 3. Weight of fifty apples per plot.

Treatment[1]	Rate	Weight (g)	
	g a.i./ha	19 July	17 August
DELEGATE WG	53	1856 a[2]	3096 a
DELEGATE WG	80	1969 a	3399 a
DELEGATE WG	105	1878 a	3407 a
ASSAIL 70 WP	168	1881 a	3270 a
INTREPID 2F	248	1711 a	3136 a
IMIDAN 50 WP	1875	1814 a	3125 a
SUCCESS 480 SC	87.4	1773 a	3254 a
CONTROL	-	1833 a	3155 a

[1] Applied 7 July and 21 July.
[2] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 15

SECTION A: TREE FRUIT - Insects
STUDY BASE: WBSE-T.1206.QM

CROP: Apples, *Malus domestica* (Borkh.)
PEST: Oblique banded leafroller, *Choristoneura rosaceana*, (Harris)

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TITLE: **MID-SEASON CONTROL OF OBLIQUE BANDED LEAFROLLER ON APPLE WITH SPINETORAM; 2005**

MATERIALS: DELEGATE WG (spinetoram), INTREPID 248 SC (methoxyfenozide), SUCCESS 480 SC (spinosad)

METHODS: The trial was conducted on twenty-year-old ‘Red delicious’ apple trees in an orchard in Grimsby, Ontario. The trees were spaced 5.0 m between rows and 2.3 m within rows. Three rates of DELEGATE WG (27 g a.i./ha, 53 g a.i./ha, and 105 g a.i./ha) were compared to three rates of SUCCESS (44 g a.i./ha, 87.4 g a.i./ha, and 120 g a.i./ha), a single rate of INTREPID (186 g a.i./ha), and an unsprayed control. Treatments were replicated four times, with two trees per replicate, and arranged according to a randomized complete block design. On 30 June (253 DD_{10} after BIOFIX) and fourteen days later (14 July), insecticides were diluted to a rate comparable to 3000 L/ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Plots were sampled 8 August by visually assessing two hundred terminals per plot for OBLR feeding damage and larvae. On 8 August, one hundred apples per plot were harvested, weighed and examined for OBLR feeding damage. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, and 3. There were no phytotoxic effects observed in any of the treated plots at either seven days or fourteen days after either application.

CONCLUSIONS: Twenty-five days after the second application, all treatments significantly reduced the number of OBLR infested terminals compared to the control; there were no significant differences between the insecticide treatments (Table 1). Fruit damage by OBLR was significantly reduced by all treatments except Intrepid compared to the unsprayed control; there were no significant differences between the insecticide treatments (Table 2). There were no significant differences in yield between any of the treatments and the control (Table 3). Although not significant, there appeared to be a rate affect for the control of damage by OBLR to both fruit and terminals with DELEGATE.

Table 1. Number of OBLR infested terminals per sample.

Treatment[1]	Rate	Number of OBLR infested terminals per sample
	g a.i./ha	8 August
DELEGATE WG	27	1.75 b[2]
DELEGATE WG	53	1.75 b
DELEGATE WG	105	1.50 b
SUCCESS 480 SC	44	3.75 b
SUCCESS 480 SC	87.4	2.50 b
SUCCESS 480 SC	120	1.75 b
INTREPID 248 SC	186	1.75 b
CONTROL	-	8.50 a

[1] Applied 30 June and 14 July.
[2] Numbers followed by the same letter are not significantly different *P*<0.05, Tukey test.

Table 2. Percent apples with OBLR feeding damage per plot.

Treatment[1]	Rate	% OBLR fruit damage per plot
	g a.i./ha	8 August
DELEGATE WG	27	2.00 b[2]
DELEGATE WG	53	1.75 b
DELEGATE WG	105	0.50 b
SUCCESS 480 SC	44	3.75 b
SUCCESS 480 SC	87.4	4.25 b
SUCCESS 480 SC	120	2.75 b
INTREPID 248 SC	186	5.75 ab
CONTROL	-	10.00 a

[1] Applied 30 June and 14 July.
[2] Numbers followed by the same letter are not significantly different *P*<0.05, Tukey test.

Table 3. Weight of one hundred apples per plot.

Treatment[1]	Rate	Weight (g)
	g a.i./ha	8 August
DELEGATE WG	27	3577 a[2]
DELEGATE WG	53	3650 a
DELEGATE WG	105	3516 a
SUCCESS 480 SC	44	3455 a
SUCCESS 480 SC	87.4	3350 a
SUCCESS 480 SC	120	3503 a
INTREPID 248 SC	186	3564 a
CONTROL	-	3557 a

[1] Applied 30 June and 14 July.
[2] Numbers followed by the same letter are not significantly different *P*<0.05, Tukey test.

2007 PMR REPORT# 16 **SECTION A: TREE FRUIT - Insect Pests**
STUDY DATA BASE# WBSE-T.1206.QM

CROP: Apples cv. Red Delicious
PEST: Mullein bug *Campylomma verbasci* (Meyer), Oblique banded leafroller *Choristoneura rosaceana* (Harris), Spotted tentiform leafminer *Phyllonorycter blancardella* (Fabr.), White apple leafhopper *Typhlocyba pomaria* (McAtee)

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TITLE: EARLY SEASON CONTROL OF OVER-WINTERING OBLIQUE BANDED LEAFROLLER ON APPLE WITH SPINETORAM; 2006

MATERIALS: DELEGATE WG (spinetoram), SUCCESS 480 SC (spinosad)

METHODS: The trial was conducted on four-year-old 'Red delicious' apple trees in an AAFC orchard in Jordan Station, Ontario. The trees were spaced 4.8 m between rows and 3.0 m within rows. Four rates of DELEGATE WG (25 g a.i./ha, 50 g a.i./ha, 80 g a.i./ha and 105 g a.i./ha) were compared to two rates of SUCCESS 480 SC (44 g a.i./ha and 87.4 g a.i./ha) and an unsprayed control. Treatments were replicated four times, with two trees per replicate and arranged according to a randomized complete block design. On 29 May (timed for petal fall), insecticides were diluted to a rate comparable to 3000 L/ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Plots were sampled 8 June by visually assessing fifty terminals (twenty-five terminals per tree) per plot for evidence of oblique banded leafroller (OBLR) feeding or presence of OBLR larvae (alive or dead). On 8 June, one hundred leaves per plot were harvested and assessed for numbers of white apple leafhopper (WALH) and spotted tentiform leafminer (STLM) mines. On 13 June, three limbs per tree were struck three times each with a rubber mallet over a 45 cm x 45 cm tapping tray and numbers of mullein Bug (MB) and WALH per plot were recorded. On 13 June, fifty fruit per plot were assessed on the tree for damage by OBLR larvae. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, 3, 4, 5, and 6. There were no phytotoxic effects observed in any of the treated plots at either seven days or fifteen days after application. The population of MB and the number of OBLR larvae found were considered to be low in all plots. Fifteen days after application, there was no fruit damage by over-wintering OBLR larvae found.

CONCLUSIONS: Ten days after application, all treatments significantly reduced the percentage of terminals damaged by OBLR compared to the control; there were no significant differences among the insecticide treatments (Table 1). Ten days after application, there were no significant differences of numbers of dead OBLR larvae or live OBLR larvae found among and between the treatments and the control (Table 2). There were no live larvae found in any of the plots treated with DELEGATE or in plots treated with the low rate of SUCCESS (44 g a.i./ha) while live larvae were found in the control plots and in plots treated with the high rate of SUCCESS (87.4 g a.i./ha); dead larvae were found in all plots except the control plots (Table 2).

Ten days after application, all treatments except the low rate of SUCCESS (44 g a.i./ha) significantly reduced the number of WALH compared to the control; there were no significant differences among the insecticide treatments (Table 3). Ten days after application, although the differences were not significant, all rates of DELEGATE had fewer WALH than the plots treated with either rate of SUCCESS (Table 3).

Fifteen days after application, there were no significant differences in numbers of WALH among or between the treatments and the control; although the numbers of WALH were lower in all DELEGATE treated plots than the plots treated with either rate of SUCCESS or the control plots, the differences were not significant (Table 3).

Ten days after application, there were no significant differences in numbers of STLM mines or percentage of leaves with mines among or between the treatments or the control (Tables 4 and 5). Fifteen days after application, there were no significant differences in numbers of MB among or between the treatments or the control (Table 6).

Table 1. Percent oblique banded leafroller (OBLR) damaged terminals per plot.

Treatment[1]	Rate (g a.i./ha)	Percent OBLR damaged terminals (8 June)
DELEGATE WG	25	8.50 b[2]
DELEGATE WG	50	7.50 b
DELEGATE WG	80	9.50 b
DELEGATE WG	105	5.50 b
SUCCESS 480 SC	44	7.00 b
SUCCESS 480 SC	87.4	6.50 b
CONTROL	-	18.50 a

[1] Applied 29 May.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Number of oblique banded leafroller (OBLR) larvae per plot.

Treatment[1]	Rate	Number of OBLR larvae found per plot (8 June)	
	(g a.i./ha)	# dead larvae	# live larvae
DELEGATE WG	25	0.75 a[2]	0.00 a
DELEGATE WG	50	0.50 a	0.00 a
DELEGATE WG	80	0.50 a	0.00 a
DELEGATE WG	105	1.50 a	0.00 a
SUCCESS 480 SC	44	0.75 a	0.00 a
SUCCESS 480 SC	87.4	0.50 a	0.25 a
CONTROL	-	0.00 a	0.50 a

[1] Applied 29 May.
[2] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 3. Number of white apple leafhopper (WALH) per sample.

Treatment[1]	Rate (g a.i./ha)	Number of WALH per sample	
		8 June	13 June
DELEGATE WG	25	8.00 b[2]	10.00 a
DELEGATE WG	50	11.25 b	15.00 a
DELEGATE WG	80	9.25 b	16.00 a
DELEGATE WG	105	12.75 b	17.25 a
SUCCESS 480 SC	44	27.25 ab	26.50 a
SUCCESS 480 SC	87.4	15.25 b	24.25 a
CONTROL	-	38.25 a	27.00 a

[1] Applied 29 May.
[2] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey test.

Table 4. Number of spotted tentiform leafminer (STLM) mines per sample.

Treatment[1]	Rate (g a.i./ha)	Number of STLM mines per sample
		8 June
DELEGATE WG	25	6.50 a[2]
DELEGATE WG	50	2.25 a
DELEGATE WG	80	2.50 a
DELEGATE WG	105	2.50 a
SUCCESS 480 SC	44	3.75 a
SUCCESS 480 SC	87.4	3.00 a
CONTROL	-	6.50 a

[1] Applied 29 May.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 5. Percent leaves with spotted tentiform leafminer (STLM) mines per plot.

Treatment[1]	Rate (g a.i./ha)	% leaves with STLM mines per plot
		8 June
DELEGATE WG	25	11.00 a[2]
DELEGATE WG	50	4.00 a
DELEGATE WG	80	4.00 a
DELEGATE WG	105	4.50 a
SUCCESS 480 SC	44	7.00 a
SUCCESS 480 SC	87.4	6.00 a
CONTROL	-	13.00 a

[1] Applied 29 May.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 6. Number of mullein bugs (MB) per sample.

Treatment[1]	Rate (g a.i./ha)	Number of MB per sample 13 June
DELEGATE WG	25	2.25 a[2]
DELEGATE WG	50	2.00 a
DELEGATE WG	80	2.50 a
DELEGATE WG	105	1.25 a
SUCCESS 480 SC	44	2.00 a
SUCCESS 480 SC	87.4	2.00 a
CONTROL	-	1.50 a

[1] Applied 29 May.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 17 **SECTION A: FRUIT - Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Apple cv. Empire
PEST: Codling moth *Cydia pomonella* (L.), Oblique banded leafroller *Choristoneura rosaceana* (Harris), Oriental fruit moth *Grapholita molesta* (Busck), Plum curculio *Conotrachelus nenuphar* (Herbst)

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TITLE: **SEASON LONG CONTROL OF CODLING MOTH ON APPLE WITH ACETAMIPRID AND SPINETORAM; 2006**

MATERIALS: ASSAIL 70 WP (acetamiprid), DELEGATE WG (spinetoram)

METHODS: The trial was conducted on seven-year-old 'Empire' apple trees in an AAFC orchard in Jordan Station, Ontario. The trees were spaced 4.6 m between rows and 2.4 m within rows. Treatments were replicated four times, with two trees per replicate, and arranged according to a randomized complete block design. The trial compared three rates of DELEGATE WG (50 g a.i./ha, 80 g a.i./ha and 105 g a.i./ha with two applications for each generation of codling moth (CM)); a single rate of ASSAIL 70WP (168 g a.i./ha with two applications for each generation of CM); a rotation of two applications of DELEGATE WG (105 g a.i./ha) followed by two applications of ASSAIL 70WP (168 g a.i./ha); a rotation of two applications of ASSAIL 70WP (168 g a.i./ha) followed by two applications of DELEGATE WG (105 g a.i./ha) and an unsprayed control. Treatments were applied 5 June (122 DD_{10} after Biofix) and fourteen days later (19 June); and 24 July (666 DD_{10} after Biofix) and eleven days later (4 August). Insecticides were diluted to a rate comparable to 3000 L/ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. On 30 June, fifty apples per plot were harvested, weighed and assessed for damage by CM, Oriental fruit moth (OFM), oblique banded leafroller (OBLR) and plum curculio (PC). Damaged apples were cut open and any live larvae found were identified. On 3 October (fruit maturity date for 'Empire' is 30 September - Mori Nurseries Ltd. guide), forty fruit per plot were harvested, weighed and examined for damage by CM, OBLR, OFM and PC. Damaged apples were cut open and any live larvae found were identified. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, 3, 4 and 5. No phytotoxicity was observed at either seven or thirteen days after any application in any of the plots. The fruit assessment data for CM on both harvest dates and for OFM on 30 June was not normally distributed , therefore a transformation log (x+1) was performed (non-transformed mean values are given in Tables 1 and 2).

CONCLUSIONS: Eleven days after the second application, all treatments significantly reduced CM damage compared to the control; there were no differences among the treatments (Table 1). Sixty days after the fourth application, all treatments except ASSAIL 70 WP (168 g a.i./ha) significantly reduced the damage caused by CM compared to the control; there were no significant differences among any of treatments except for the DELEGATE/ASSAIL rotation which had significantly fewer damaged apples than the ASSAIL season-long regime (Table 1).

Eleven days after the second application, there was no significant differences in damage caused by OFM among and between the treatments and the control (Table 2). Sixty days after the fourth application, the only treatments that significantly reduced damage by OFM compared to the control were the two highest rates of DELEGATE (80 and 105 g a.i./ha) and the DELEGATE/ASSAIL rotation; the middle rate of DELEGATE (80 g a.i./ha) and the DELEGATE/ASSAIL rotation had significantly fewer OFM damaged apples than the low rate of DELEGATE (50 g a.i./ha), the ASSAIL regime and the control (Table 2).

Eleven days after the second treatment, there was no significant differences in damage caused by OBLR among or between treatments and the control (Table 3). Sixty days after the fourth treatment, the only treatments that significantly reduced damage by OBLR compared to the control were the middle rate of DELEGATE (80 g a.i./ha) and the DELEGATE/ASSAIL rotation; there were no significant differences among the treatments except for the ASSAIL regime which had significantly more apples damaged by OBLR compared to the rest of the insecticide treatments (Table 3).

There were no significant differences in damage by PC among or between the treatments and the control at either harvest assessment (Table 4). There were no significant differences in apple weights among or between the treatments and the control at either harvest date (Table 5).

Table 1. Percent CM damaged apples per plot.

Treatment[1]	Rate	Percent CM damaged apples per plot	
	g a.i./ha	30 June	3 October
DELEGATE WG	50	0.50 b[2]	0.63 bc
DELEGATE WG	80	0.00 b	0.63 bc
DELEGATE WG	105	0.00 b	1.25 bc
ASSAIL 70 WP/DELEGATE WG	168/105	0.00 b	5.00 bc
DELEGATE WG/ASSAIL 70 WP	105/168	0.50 b	0.00 c
ASSAIL 70 WP	168	1.00 b	5.63 ab
CONTROL	-	19.00 a	15.00 a

[1] Applied 5 June, 19 June, 24 July and 4 August.

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent OFM damaged apples per plot.

Treatment[1]	Rate g a.i./ha	Percent OFM damaged apples per plot 30 June	3 October
DELEGATE WG	50	0.00 a[2]	16.25 a
DELEGATE WG	80	0.00 a	3.75 c
DELEGATE WG	105	0.00 a	5.63 bc
ASSAIL 70 WP/DELEGATE WG	168/105	0.00 a	11.25 abc
DELEGATE WG/ASSAIL 70 WP	105/168	0.00 a	3.75 c
ASSAIL 70 WP	168	0.50 a	15.63 ab
CONTROL	-	3.00 a	19.38 a

[1] Applied 5 June, 19 June, 24 July and 4 August.
[2] Numbers followed by the same letter are not significantly different *P*<0.05, Tukey test.

Table 3. Percent OBLR damaged apples per plot.

Treatment[1]	Rate g a.i./ha	Percent OBLR damaged apples per plot 30 June	3 October
DELEGATE WG	50	7.50 a[2]	19.38 abc
DELEGATE WG	80	3.50 a	7.50 c
DELEGATE WG	105	3.00 a	10.00 bc
ASSAIL 70 WP/DELEGATE WG	168/105	1.00 a	13.75 abc
DELEGATE WG/ASSAIL 70 WP	105/168	4.00 a	6.25 c
ASSAIL 70 WP	168	3.00 a	25.00 a
CONTROL	-	7.50 a	23.13 ab

[1] Applied 5 June, 19 June, 24 July and 4 August.
[2] Numbers followed by the same letter are not significantly different *P*<0.05, Tukey test.

Table 4. Percent PC damaged apples per plot.

Treatment[1]	Rate g a.i./ha	Percent PC damaged apples per plot 30 June	3 October
DELEGATE WG	50	9.50 a[2]	8.13 a
DELEGATE WG	80	12.50 a	13.13 a
DELEGATE WG	105	9.00 a	10.63 a
ASSAIL 70 WP/DELEGATE WG	168/105	13.50 a	3.75 a
DELEGATE WG/ASSAIL 70 WP	105/168	6.00 a	7.25 a
ASSAIL 70 WP	168	7.00 a	10.63 a
CONTROL	-	22.50 a	12.50 a

[1] Applied 5 June, 19 June, 24 July and 4 August.
[2] Numbers followed by the same letter are not significantly different *P*<0.05, Tukey test.

Table 5. Average weight per apple per plot.

Treatment[1]	Rate	Weight (g)	
	g a.i./ha	30 June	3 October
GF 1640 25 WDG	50	25.92 a[2]	195.88 a
GF 1640 25 WDG	80	26.24 a	187.93 a
GF 1640 25 WDG	105	27.00 a	199.92 a
ASSAIL 70 WP/DELEGATE WG	168/105	25.46 a	173.55 a
DELEGATE WG/ASSAIL 70 WP	105/168	27.52 a	194.81 a
ASSAIL 70 WP	168	26.52 a	170.56 a
CONTROL	-	23.64 a	201.01 a

[1] Applied 5 June, 19 June, 24 July and 4 August.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 18 **SECTION A: FRUIT - Insect Pests**
STUDY DATA BASE: 280-1261-9341

CROP: Cherry cv. Tehranivee
PEST: Black Cherry Aphid, *Myzus cerasi* (F.)

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TITLE: **CONTROL OF BLACK CHERRY APHID ON SWEET CHERRY; 2007**

MATERIALS: CLOTHIANIDIN 50 WDG (clothianidin), THIODAN 50 WP (endosulfan)

METHODS: Note: This study has been submitted as part of AAFC Pesticide Minor Use Project AAFC07-034E-221. The trial was conducted in a four-year-old orchard in the Jordan Station, Ontario area; sweet cherry trees cv. Tehranivee were spaced 5.5 m by 5.5 m. Treatments were replicated four times, assigned to one-tree plots and arranged according to a randomised complete block design; four rates of CLOTHIANIDIN (105.0, 70.0, 52.5, and 35.0 g a.i./ha) were compared to a THIODAN standard and an unsprayed control. An additional treatment studied the efficacy of only one application of CLOTHIANIDIN at 70.0 g a.i./ha. First application of all treatments was made 7 June (when black cherry aphid application thresholds were reached). Treatments were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. The 35.0, 52.5 and 70.0 g a.i./ha rates of CLOTHIANDIN were reapplied on 14 June and 22 June (seven and 15 days after first application, respectively), while the 105.0 g a.i./ha rate of CLOTHIANIDIN and the THIODAN standard were reapplied 14 June (seven days after initial application). Plots were sampled pre-treatment 5 June, and post-treatment 11 June, 18 June and 25 June (four, 11 and 18 days after initial application, respectively); 50 terminals per plot were examined on the tree and the numbers of colonies of live aphids per plot were recorded and expressed as per cent infested terminals. All cherries were harvested from each plot on 6 July and the percentage of fruit damaged by aphids was recorded for each plot; to assess yield, the total weights of fruit per plot were recorded. Plots were examined for phytotoxic injury at each sampling event (11 June, 18 June, 25 June and 6 July). Data were transformed where necessary and analysed using analysis of variance; means were separated with a Tukey Test at the 0.05 level.

RESULTS: Data are presented in Tables 1, 2 and 3. No adverse effects on yield or phytotoxic effects were observed.

CONCLUSIONS: No differences in infestation levels were observed between plots in the pre-spray (5 June) sample (Table 1); all plots contained greater than the minimum 20 colonies/tree threshold for control action.
All treated plots contained significantly fewer aphid colonies than the control in the 11 June sample

(Table 1); however, plots treated with THIODAN and the lowest (35.0 g a.i./ha) rate of CLOTHIANIDIN contained significantly more aphid colonies than all other rates of CLOTHIANIDIN. It should be noted that while live colonies were still present in the plots treated with THIODAN, most (estimated at 95%) of the aphids in these colonies were dead; only the largest nymphs were still alive.

Numbers of aphid colonies in all treated plots were still significantly lower than the control in the 18 June sample (4 days after the second application) (Table 1). A rate effect was observed, numbers of colonies increased as the rate of CLOTHIANIDIN decreased; however, plots treated with the 35.0 g a.i./ha rate of CLOTHIANIDIN contained significantly more aphid colonies than all other treated plots. Also, plots treated with a single application of CLOTHIANIDIN at 70.0 g a.i./ha contained more colonies than those treated with a two applications, but the difference was not statistically significant. All colonies treated with a second application of THIODAN were dead at this sampling date.

Similar results were observed in the 25 June sample (Table 1); all treated plots contained significantly fewer live colonies than the control. A rate effect was observed, but only the 105.0 g a.i./ha rate of CLOTHIANIDIN was statistically different from the lowest (35.0 g a.i./ha) rate of CLOTHIANIDIN.

At harvest (6 July), all treated plots contained less aphid-damaged fruit than the control (Table 2), but no statistical differences were observed.

No phytotoxic effects (Table 3) or adverse effects on yield (Table 2) were observed in this trial.

In summary, the 70.0 g a.i./ha rate of CLOTHIANIDIN provided control of black cherry aphid that was comparable to the THIODAN standard, and two applications at this rate were more efficacious than a single application. Two applications of CLOTHIANIDIN at 105.0 g a.i./ha were as effective as three applications at 70.0 g a.i./ha. The 35.0 g a.i./ha rate of CLOTHIANIDIN reduced aphid populations compared to the control, but was not as effective as the 70.0 and 105.0 g a.i./ha rates.

Table 1. Percent of terminals infested by black cherry aphid (BCA) colonies per plot.

Treatment	Rate (a.i./ha)	% of terminals infested by BCA 5 June (pre-spray)[4]	% of terminals infested by BCA 11 June[4,5]	% of terminals infested by BCA 18 June[4,5]	% of terminals infested by BCA 25 June[4]
THIODAN 50 WP[1]	2.25 kg	75.5 a	21.5 b	0.0 c	1.0 bc
CLOTHIANIDIN 50 WDG[1]	105.0 g	60.0 a	0.0 d	0.0 c	0.0 c
CLOTHIANIDIN 50 WDG[2]	70.0 g	64.5 a	0.0 d	0.0 c	2.0 bc
CLOTHIANIDIN 50 WDG[3]	70.0 g	71.0 a	0.0 d	5.0 bc	1.5 bc
CLOTHIANIDIN 50 WDG[2]	52.5 g	70.0 a	2.0 cd	1.0 c	0.0 c
CLOTHIANIDIN 50 WDG[2]	35.0 g	69.0 a	13.0 bc	17.0 b	6.0 b
CONTROL	-	67.5 a	98.0 a	100.0 a	100.0 a

[1] Applied 7 June, reapplied 14 June.
[2] Applied 7 June, reapplied 14 June and 22 June.
[3] Applied 7 June only.
[4] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.
[5] Data were transformed (log(x+1)) for analysis; de-transformed means are shown in this table.

Table 2. Percentage of fruit damaged by BCA and yield data.

Treatment	Rate (a.i./ha)	% fruit damaged by BCA 6 July (harvest)[4]	Yield per plot (g) 6 July (harvest)[4,5]
THIODAN 50 WP[1]	2.25 kg	4.5 a	345.8 a
CLOTHIANIDIN 50 WDG[1]	105.0 g	6.3 a	580.8 a
CLOTHIANIDIN 50 WDG[2]	70.0 g	7.6 a	318.3 a
CLOTHIANIDIN 50 WDG[3]	70.0 g	6.5 a	869.0 a
CLOTHIANIDIN 50 WDG[2]	52.5 g	5.7 a	860.5 a
CLOTHIANIDIN 50 WDG[2]	35.0 g	2.5 a	1656.5 a
CONTROL	-	11.5 a	493.3 a

[1] Applied 7 June, reapplied 14 June.
[2] Applied 7 June, reapplied 14 June and 22 June.
[3] Applied 7 June only.
[4] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.
[5] Data were transformed (log(x+1)) for analysis; de-transformed means are shown in this table.

Table 3. Phytotoxicity ratings.

Treatment	Rate (a.i./ha)	Phytotoxicity (0-100) 11 June[4]	Phytotoxicity (0-100) 18 June[4]	Phytotoxicity (0-100) 25 June[4]
THIODAN 50 WP[1]	2.25 kg	0.0 a	0.0 a	0.0 a
CLOTHIANIDIN 50 WDG[1]	105.0 g	0.0 a	0.0 a	0.0 a
CLOTHIANIDIN 50 WDG[2]	70.0 g	0.0 a	0.0 a	0.0 a
CLOTHIANIDIN 50 WDG[3]	70.0 g	0.0 a	0.0 a	0.0 a
CLOTHIANIDIN 50 WDG[2]	52.5 g	0.0 a	0.0 a	0.0 a
CLOTHIANIDIN 50 WDG[2]	35.0 g	0.0 a	0.0 a	0.0 a
CONTROL	-	0.0 a	0.0 a	0.0 a

[1] Applied 7 June, reapplied 14 June.
[2] Applied 7 June, reapplied 14 June and 22 June.
[3] Applied 7 June only.
[4] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 19 **SECTION A: FRUIT - Insect Pests**
STUDY DATA BASE: 280-1261-9341

CROP: Cherry cv. Montmorency
PEST: Black Cherry Aphid, *Myzus cerasi* (F.)

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TITLE: **EFFICACY OF CLOTHIANIDIN FOR THE CONTROL OF BLACK CHERRY APHID ON TART CHERRY; 2007**

MATERIALS: CLOTHIANIDIN 50 WDG (clothianidin), THIODAN 50 WP (endosulfan)

METHODS: Note: This study has been submitted as part of AAFC Pesticide Minor Use Project AAFC07-034E-222. The trial was conducted in a four-year-old orchard in the Jordan Station, Ontario area; sour cherry trees cv. Montmorency were spaced 5.5 m by 5.5 m. Treatments were replicated four times, assigned to one-tree plots and arranged according to a randomised complete block design; four rates of CLOTHIANIDIN (105.0, 70.0, 52.5, and 35.0 g a.i./ha) were compared to a THIODAN standard and an unsprayed control. An additional treatment studied the efficacy of only one application of CLOTHIANIDIN at 70.0 g a.i./ha. First application of all treatments was made 25 June (when black cherry aphid application thresholds were reached), and repeated 3 July (eight days after first application). Treatments were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Plots were sampled pre-treatment 22 June, and post-treatment 28 June and 6 July (3 and 11 days after initial application, respectively); 50 terminals per plot were examined on the tree and the numbers of colonies of live aphids per plot were recorded and expressed as per cent infested terminals. Plots were examined for phytotoxic injury at each sampling event (28 June and 6 July). Data were transformed where necessary and analysed using analysis of variance; means were separated with a Tukey Test at the 0.05 level.

RESULTS: Data are presented in Tables 1 and 2. No phytotoxic effects were observed.

CONCLUSIONS: No differences in infestation levels were observed between plots in the pre-spray (22 June) sample (Table 1); all plots contained greater than the minimum 20 colonies/tree threshold for control action.
All treated plots contained fewer aphid colonies than the control in the 28 June sample (Table 1); however, plots treated with the lowest (35.0 g a.i./ha) rate of CLOTHIANIDIN were not statistically different from the control, and contained significantly more aphid colonies than the THIODAN standard and the 70.0 and 105.0 g a.i./ha rates of CLOTHIANIDIN. The 52.5 g a.i./ha rate of CLOTHIANIDIN was not statistically different from the 35.0 g a.i./ha rate of CLOTHIANIDIN.

Numbers of aphid colonies in all treated plots were significantly lower than the control in the 6 July sample (3 days after the second application) (Table 1). It should be noted that the numbers of live aphids in all colonies were considerably reduced within seven days of the 6 July sample date; aphid populations had started to develop to the winged adult stage and migrate to wild hosts.

Due to the young age of this orchard, fruit load was too light to assess aphid damage or yield effects.

No phytotoxic effects were observed in this trial (Table 2).

In summary, the 70.0 g a.i./ha and 105.0 g a.i./ha rates of CLOTHIANIDIN provided control of black cherry aphid that was similar to the THIODAN standard. The 35.0 and 52.5 g a.i./ha rates of CLOTHIANIDIN reduced aphid populations compared to the control, but were not as effective as the 70.0 and 105.0 g a.i./ha rates.

Table 1. Percent of terminals infested by black cherry aphid (BCA) colonies per plot.

Treatment	Rate (a.i./ha)	% of terminals infested by BCA 22 June (pre-spray)[3]	% of terminals infested by BCA 28 June[3,4]	% of terminals infested by BCA 6 July[3,4]
THIODAN 50 WP[1]	2.25 kg	42.8 a	0.8 d	0.0 b
CLOTHIANIDIN 50 WDG[1]	105.0 g	39.0 a	0.8 d	0.0 b
CLOTHIANIDIN 50 WDG[1]	70.0 g	40.3 a	1.3 d	0.0 b
CLOTHIANIDIN 50 WDG[2]	70.0 g	38.3 a	1.5 cd	0.5 b
CLOTHIANIDIN 50 WDG[1]	52.5 g	34.0 a	12.8 bc	0.5 b
CLOTHIANIDIN 50 WDG[1]	35.0 g	35.3 a	24.8 ab	0.0 b
CONTROL	-	42.8 a	42.5 a	27.5 a

[1] Applied 25 June, reapplied 3 July.
[2] Applied 25 June only.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.
[4] Data were transformed (log(x+1)) for analysis; de-transformed means are shown in this table.

Table 2. Phytotoxicity ratings.

Treatment	Rate (a.i./ha)	Phytotoxicity (0-100) % of terminals infested by BCA 28 June[3]	Phytotoxicity (0-100) % of terminals infested by BCA 6 July[3]
THIODAN 50 WP[1]	2.25 kg	0.0 a	0.0 a
CLOTHIANIDIN 50 WDG[1]	105.0 g	0.0 a	0.0 a
CLOTHIANIDIN 50 WDG[1]	70.0 g	0.0 a	0.0 a
CLOTHIANIDIN 50 WDG[2]	70.0 g	0.0 a	0.5 a
CLOTHIANIDIN 50 WDG[1]	52.5 g	0.0 a	0.5 a
CLOTHIANIDIN 50 WDG[1]	35.0 g	0.0 a	0.0 a
CONTROL	-	0.0 a	0.0 a

[1] Applied 25 June, reapplied 3 July.
[2] Applied 25 June only.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 20 **SECTION A: FRUIT - Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Grapes *Vitis vinifera* (L.), cv. Baco noir
PEST: Grape Berry Moth, *Endopiza viteana* (Clemens), Japanese beetle, *Popillia japonica* (Newman)

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TITLE: **CONTROL OF GRAPE BERRY MOTH AND JAPANESE BEETLE ON 'BACO NOIR' GRAPES WITH FLUBENDIAMIDE, 2007**

MATERIALS: BELT 480 SC (flubendiamide), GUTHION SOLUPAK 50 WP (azinphos methyl)

METHODS: The trial was conducted in a mature 'Baco noir' vineyard in Niagara-on-the-Lake Ontario. Grapevines were spaced 3.0 m apart between rows and vines were 1.5 m apart within rows. A single rate of BELT 480 SC (135 g a.i./ha) was compared to a single rate of GUTHION SOLUPAK 50 WP (1870 g a.i./ha), and an unsprayed control. Treatments were replicated four times, applied to 8.0 m long by 1.5 m wide plots (four to five vines per plot) and arranged according to a randomized complete block design. Prior to the first application of insecticides, all bunches infested with grape berry moth (GBM) were removed from the test plots. The first application occurred on 5 July and was timed for egg hatch of second generation GBM; treatments were reapplied twelve days later (17 July). Insecticides were diluted to a rate comparable to 3000 L/ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Plots were sampled for Japanese beetle (JB) on 9 July and 12 July by counting and recording numbers of live and dead JB per plot. Plots were sampled for GBM damage by examining 50 bunches of grapes per plot on 16 July, 31 July, and 8 August; percent infested bunches were recorded per plot. All JB data were transformed using log (x+1) as JB populations were not uniformly distributed throughout the plots. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, and 3. No phytotoxic effects were observed in any of the treated plots seven days after the first application and six days after the second application. Bi-weekly trap catches indicated a constant flight of GBM adults throughout the growing season.

CONCLUSIONS: Eleven days after the first application, the percentage of GBM damaged bunches found in the BELT and GUTHION treated plots was significantly reduced compared to the control (Table 1). Fourteen days after the second application, only plots treated with BELT had significantly fewer GBM damaged bunches compared to the control (Table 1). Twenty-two days after the second application, the percentage of GBM damaged bunches was lower in the BELT and GUTHION treatments compared to the control, however, the differences were not significant (Table 1).
Four days after the first application, the plots treated with GUTHION had significantly fewer live JB compared to the control; although plots treated with BELT had fewer live JB compared to the control, the

differences were not significant (Table 2). Plots treated with BELT or GUTHION had fewer live JB compared to the control seven days after the first application, however, the differences were not significant (Table 2). At both four and seven days after the first application, only plots treated with GUTHION had significantly more dead JB compared to the control (Table 3).

Table 1. Percent Grape berry moth (GBM) damaged bunches per plot.

Treatment[1]	Rate	% GBM damaged bunches		
	(g a.i./ha)	16 July	31 July	8 August
		(11 days)[2]	(14 days)[3]	(22 days)[3]
BELT 480 SC	135	8.00 b[4]	8.00 b	4.00 a
GUTHION SOLUPAK 50 WP	1870	10.50 b	14.00 ab	9.50 a
CONTROL	-	30.00 a	22.00 a	18.50 a

[1] Applied 5 July and 17 July.
[2] Number of days after first application.
[3] Number of days after second application.
[4] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey Test.

Table 2. Number of live Japanese beetle (JB) per plot.

Treatment[1]	Rate	Number of live JB per plot	
	(g a.i./ha)	9 July[2]	12 July[2]
		(4 days)	(7 days)[2]
BELT 480 SC	135	117.75 ab[3]	102.75 a
GUTHION SOLUPAK 50 WP	1870	20.00 b	21.75 a
CONTROL	-	275.75 a	461.25 a

[1] Applied 5 July and 17 July.
[2] Number of days after first application.
[3] Numbers followed by the same letter (within columns) are not significantly different $P<0.05$, Tukey Test.

Table 3. Number of dead Japanese beetle (JB) per plot.

Treatment[1]	Rate (g a.i./ha)	Number of dead JB per plot	
		9 July (4 days)[2]	12 July (7 days)[2]
BELT 480 SC	135	37.50 a[3]	25.25 a
GUTHION SOLUPAK 50 WP	1870	219.00 b	216.75 b
CONTROL	-	20.50 a	33.25 a

[1] Applied 5 July and 17 July.
[2] Number of days after first application.
[3] Numbers followed by the same letter (within columns) are not significantly different *P*<0.05, Tukey Test.

2007 PMR REPORT# 21

SECTION A: FRUIT - Insect Pests
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Grape cv. Baco noir
PEST: Grape berry moth, *Endopiza viteana* (Clemens)

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TITLE: CONTROL OF GRAPE BERRY MOTH ON GRAPE; 2006

MATERIALS: DELEGATE WG (spinetoram), IMIDAN 50 WP (phosmet), SUCCESS 480 SC (spinosad)

METHODS: The trial was conducted in a mature 'Baco noir' vineyard in Niagara-on-the-Lake, Ontario. Grapevines were spaced 3.0 m between rows and 1.5 m within rows. The trial compared two rates of DELEGATE WG (35 g a.i./ha and 70 g a.i./ha) to two rates of SUCCESS 480 SC (70 g a.i. /ha and 140 g a.i./ha), a single rate of IMIDAN 50 WP (1550 g a.i./ha) and an unsprayed control. Treatments were arranged according to a randomized complete block design, replicated four times, with plots (with four to five vines per plot) 8 m long. Applications were timed for egg hatch of second generation grape berry moth (GBM) (6 July) based on adult moth trap catches and fourteen days later (20 July). Insecticides were diluted to a rate comparable to 3000 L/ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Fifty bunches of grapes per plot were examined for damage by GBM eleven days after first application (17 July) and thirteen days after second application (2 August). Numbers of infested bunches were recorded for each plot. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Table 1. No phytotoxic effects were observed in any of the treated plots seven and thirteen days after either treatment. Bi-weekly trap catches indicated an erratic but continuous flight of GBM from 1 June (traps were placed in the vineyard 29 May) through 31 August when the traps were removed. A assessment for GBM damage prior to the first application showed an average of 10% damaged bunches in the plot.

CONCLUSIONS: Eleven days after the first application, all treatments had significantly fewer GBM infested bunches than the control, there were no significant differences among the insecticide treatments. Thirteen days after the second application, both the low rate of DELEGATE (35 g a.i./ha) and the high rate of DELEGATE (70 g a.i./ha) had significantly fewer bunches infested with GBM compared to the control; all other treatments were not different from each other except for the low rate of DELEGATE (35 g a.i./ha) which had significantly fewer GBM infested bunches than the low rate of SUCCESS (70 g a.i./ha) (Table 1).

Table 1. Percent grape berry moth (GBM) damaged bunches per plot.

Treatment[1]	Rate	% GBM damaged bunches per plot	
	g a.i./ha	17 July	2 August
DELEGATE WG	35	10.00 b[2]	17.50 c
DELEGATE WG	70	13.50 b	21.50 bc
SUCCESS 480 SC	70	14.50 b	45.50 ab
SUCCESS 480 SC	140	17.00 b	42.00 abc
IMIDAN 50 WP	1550	17.00 b	40.50 abc
CONTROL	-	34.00 a	62.50 a

[1] Applied 6 July and 20 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 22 **SECTION A: TREE FRUIT - Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Grapes *Vitis vinifera* (L.), cv. Baco noir
PESTS: Grape Berry Moth, *Endopiza viteana* (Clemens)

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TITLE: **CONTROL OF GRAPE BERRY MOTH ON 'BACO NOIR' GRAPES WITH SPINETORAM, 2007**

MATERIALS: DELEGATE WG (spinetoram), SUCCESS 480 SC (spinosad), INTREPID 2F (methoxyfenozide), IMIDAN 50 WP (phosmet)

METHODS: The trial was conducted in a mature 'Baco noir' vineyard in Niagara-on-the-lake, Ontario. Grapevines were spaced 3.0 m apart between rows and 1.5 m apart within rows. Two rates of DELEGATE WG (35 g a.i./ha and 70 g a.i./ha) were compared to two rates of SUCCESS 480 SC (87.4 g a.i./ha and 140 g a.i./ha), a single rate of INTREPID 2F (144 g a.i./ha), a single rate of IMIDAN 50 WP (1550 g a.i./ha) and an untreated control. Treatments were replicated four times, plots were eight meters long with five vines per plot, and arranged according to a randomized complete block design. Applications were timed for egg hatch of second generation grape berry moth (GBM) and were reapplied 12 days later (5 July and 17 July). Insecticides were diluted to a rate comparable to 1000 L/ha and applied with a SOLO 450 backpack sprayer. Prior to the first application, all bunches with GBM damage were removed from all plots. Plots were sampled on 16 July, 31 July and 8 August by examining 50 random bunches of grapes per plot. Percentage of bunches with GBM damage were recorded. Data were analyzed using analysis of variance and means separated with a Tukey test at the 0.05 significance level.

RESULTS: Data are presented in Table 1. No phytotoxic effects were observed in any plots seven or eleven days after the first application and six, nine or 14 days after the second application.

CONCLUSIONS: Eleven days after the first application, the low rate of DELEGATE (35 g a.i./ha), the high rate of SUCCESS (140 g a.i./ha), and the INTREPID (144 g a.i./ha) treated plots all had a significantly lower percentage of bunches damaged by GBM than the control; there were no significant differences among the treatments (Table 1). Fourteen days after the second application, the low rate of DELEGATE (35 g a.i./ha), the high rate of SUCCESS (140 g a.i./ha), and the IMIDAN (1550 g a.i./ha) treated plots had significantly fewer bunches damaged by GBM than the control; there were no significant differences among the treatments (Table 1). Twenty-two days after the second application, all treated plots, except for the low rate of SUCCESS (87.4 g a.i./ha), had significantly fewer GBM damaged bunches than the control; there were no significant differences among the treatments (Table 1).

Table 1. Percent grape bunches damaged by grape berry moth (GBM) per plot.

Treatment[1]	Rate (g a.i.ha)	% bunches damaged by GBM per plot		
		16 July (11 days)[2]	31 July (14 days)[3]	8 August (22 days)[3]
DELEGATE WG	35	8.50 b[4]	5.50 b	7.50 b
DELEGATE WG	70	10.50 ab	9.00 ab	8.00 b
SUCCESS 480 SC	87.4	13.50 ab	10.50 ab	13.00 ab
SUCCESS 480 SC	140	7.00 b	7.00 b	9.50 b
INTREPID 2F	144	8.50 b	8.50 ab	8.00 b
IMIDAN 50 WP	1550	13.00 ab	7.50 b	7.50 b
CONTROL	-	21.00 a	18.50 a	22.50 a

[1] Applied 5 July and 17 July.
[2] Number of days after first application.
[3] Number of days after second application.
[4] Numbers followed by the same letter within columns are not significantly different $P < 0.05$, Tukey test.

2007 PMR REPORT# 23 **SECTION A: FRUIT - Insect Pests**
STUDY DATA BASE: 280-1261-9341

CROP: Peach cv. Redhaven
PEST: Green Peach Aphid, *Myzus persicae* (Sulzer)

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TITLE: **CONTROL OF GREEN PEACH APHID ON PEACH; 2007**

MATERIALS: CLOTHIANIDIN 50 WDG (clothianidin), THIODAN 50 WP (endosulfan)

METHODS: Note: This study has been submitted as part of AAFC Pesticide Minor Use Project AAFC07-032E. The trial was conducted in a twelve-year-old orchard in the St. Catharines, Ontario area; trees cv. Redhaven were spaced 5.5 m by 4.6 m. Treatments were replicated four times, assigned to one-tree plots and arranged according to a randomised complete block design; four rates of CLOTHIANIDIN (105.0, 70.0, 52.5, and 35.0 g a.i./ha) were compared to a THIODAN standard and an unsprayed control. An additional treatment studied the effect of only one single application of CLOTHIANIDIN at 70.0 g a.i./ha. First application of all treatments was made 25 May (when green peach aphid application thresholds were reached), and repeated 1 June (seven days after first application). Treatments were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Plots were sampled pre-treatment 24 May, and post-treatment 28 May and 5 June (3 and 11 days after initial application, respectively); 100 terminals per plot were examined on the tree and the numbers of colonies of live aphids were recorded per plot. All peaches were harvested from each plot on 31 July, and the percentage of fruit damaged by aphids was recorded for each plot; to assess yield, the total weights of fruit per plot were recorded. Data were transformed where necessary and analysed using analysis of variance; means were separated with a Tukey Test at the 0.05 level.

RESULTS: Data are presented in Tables 1 and 2. No adverse effects on yield or phytotoxic effects were observed.

CONCLUSIONS: No differences in infestation levels were observed between plots in the pre-spray (24 May) sample (Table 1); all plots contained greater than the minimum 20 colonies/tree threshold for control action.
All treated plots contained significantly fewer aphid colonies than the control in the 28 May sample; however, plots treated with the lowest (35.0 g a.i./ha) rate of CLOTHIANIDIN contained significantly more aphid colonies than all other rates of CLOTHIANIDIN and the THIODAN standard.
Numbers of aphid colonies were still significantly lower than the control in the 5 June sample (4 days after the second application). A rate effect was observed, numbers of colonies increased as the rate of

CLOTHIANIDIN decreased; however, these differences were not statistically significant. Plots treated with the THIODAN standard contained significantly fewer aphid colonies than those treated with the lowest (35.0 g a.i./ha) rate of CLOTHIANIDIN. Also, plots treated with two applications of CLOTHIANIDIN at 70.0 g a.i./ha contained fewer colonies than those treated with a single application, but the difference was not statistically significant.

It should be noted that the numbers of live aphids in all colonies were considerably reduced within seven days of the 5 June sample date; aphid populations had started to develop to the winged adult stage and migrate to wild hosts.

At harvest (31 July) plots treated with the highest (105.0 g a.i./ha) rate of CLOTHIANIDIN contained significantly less aphid-damaged fruit than those treated with the lowest (35.0 g a.i./ha) rate of CLOTHIANIDIN. A rate effect was observed, but no statistical differences were observed between all other rates of CLOTHIANIDIN and the THIODAN standard. Levels of fruit damage were higher in plots treated with the single 70.0 g a.i./ha application of CLOTHIANIDIN than in those treated with two applications of the same rate, but these differences were also not statistically significant.

No phytotoxicity or adverse effects on yield were observed in this trial.

In summary, the 70.0 g a.i./ha rate of CLOTHIANIDIN provided control of green peach aphid that was similar to the THIODAN standard, and two applications at this rate were more efficacious than a single application. The 35.0 and 52.5 g a.i./ha rates of CLOTHIANIDIN reduced aphid populations compared to the control, but were not as effective as the 70.0 and 105.0 g a.i./ha rates.

Table 1. Number of live green peach aphid (GPA) colonies and per cent damage fruit per plot.

Treatment	Rate (a.i./ha)	GPA colonies per plot 24 May (pre-spray)[3]	GPA colonies per plot 28 May[3,4]	GPA colonies per plot 5 June[3,4]	% Damaged Fruit 31 July (harvest)[3]
THIODAN 50 WP[1]	2.25 kg	41.0 a	1.0 c	0.3 c	4.4 bc
CLOTHIANIDIN 50 WDG[1]	105.0 g	28.5 a	0.3 c	1.0 bc	2.0 c
CLOTHIANIDIN 50 WDG[1]	70.0 g	34.0 a	0.8 c	1.3 bc	2.7 bc
CLOTHIANIDIN 50 WDG[2]	70.0 g	31.8 a	1.0 c	2.8 bc	7.2 bc
CLOTHIANIDIN 50 WDG[1]	52.5 g	35.0 a	6.0 bc	3.5 bc	6.9 bc
CLOTHIANIDIN 50 WDG[1]	35.0 g	43.5 a	14.0 b	5.0 b	10.4 ab
CONTROL	-	41.0 a	39.0 a	39.8 a	18.3 a

[1] Applied 25 May, reapplied 1 June.
[2] Applied 25 May only.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.
[4] Data were transformed (log(x+1)) for analysis; de-transformed means are shown in this table.

Table 2. Phytotoxicity ratings and yield data.

Treatment	Rate (a.i./ha)	Phytotoxicity (0-100) 28 May[3]	Phytotoxicity (0-100) 5 June[3]	Yield per plot (kg) 31 July (harvest)[3]
THIODAN 50 WP[1]	2.25 kg	0.0 a	0.0 a	13.9 a
CLOTHIANIDIN 50 WDG[1]	105.0 g	0.0 a	0.0 a	17.1 a
CLOTHIANIDIN 50 WDG[1]	70.0 g	0.0 a	0.0 a	18.6 a
CLOTHIANIDIN 50 WDG[2]	70.0 g	0.0 a	0.0 a	12.3 a
CLOTHIANIDIN 50 WDG[1]	52.5 g	0.0 a	0.0 a	15.8 a
CLOTHIANIDIN 50 WDG[1]	35.0 g	0.0 a	0.0 a	12.0 a
CONTROL	-	0.0 a	0.0 a	7.1 a

[1] Applied 25 May, reapplied 1 June.
[2] Applied 25 May only.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 24 **SECTION A: FRUIT - Insect Pests**
STUDY DATA BASE: WBSE-T.1206.QM

CROP: Peach cv. Vivid
PEST: Oriental Fruit Moth, *Grapholita molesta* (Busck)

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TITLE: **CONTROL OF SECOND-GENERATION ORIENTAL FRUIT MOTH ON PEACH WITH SPINETORAM; 2006**

MATERIALS: ASSAIL 70 WP (acetamiprid), DELEGATE WG (spinetoram), INTREPID 2F (methoxyfenozide)

METHODS: The trial was conducted on four-year-old 'Vivid' peach trees in an AAFC orchard in Jordan Station, Ontario. The trees were spaced 5.5 m between rows and 4.6 m within rows. Treatments were replicated four times, with two trees per replicate, and arranged according to a randomized complete block design. The trial compared three rates of DELEGATE WG (50 g a.i./ha, 80 g a.i./ha and 105 g a.i./ha) to two rates of INTREPID 2F (240 g a.i./ha and 360 g a.i./ha), a single rate of ASSAIL 70 WP (168 g a.i./ha) and an unsprayed control. Prior to application, all first generation OFM damage was removed. Treatments were applied 5 July and 19 July (656 $DD_{7.2}$ and 869 $DD_{7.2}$, respectively, after Biofix). Insecticides were diluted to a rate comparable to 3000 L/ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Plots were sampled for OFM damaged terminals 17 July (12 days after the first application), 2 August (fourteen days after the second application) and 15 August (twenty-seven days after the second application). All fruit per plot were harvested 18 August and weighed. Fifty random fruit per plot were examined for OFM damage. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, and 3. No phytotoxic effects were observed on either seven days or thirteen days post-application in any of the treated plots. OFM terminal damage data of 17 July and total second generation OFM terminal damage data were transformed using log (x+1), data presented are non-transformed data.

CONCLUSIONS: Twelve days after the first application, all treatments except for the high rate of INTREPID (360 g a.i./ha) had significantly fewer OFM damaged terminals than the control; there were no significant differences found among the plots treated with ASSAIL and the plots treated with DELEGATE (Table 1). Fourteen days after the second application, all rates of DELEGATE and ASSAIL had significantly fewer damaged terminals than the controls while the plots treated with either rate of INTREPID were not significantly different from the control. Twenty-seven days after the second application, all treatments had significantly fewer damaged terminals than the control; the high rate of DELEGATE (105 g a.i./ha) had significantly fewer damaged terminals than the middle rate of

DELEGATE (80 g a.i./ha). When total second generation OFM terminal damage is considered, all treatments significantly reduced total OFM terminal damage compared to the control; the high rate of DELEGATE (105 g a.i./ha) and the ASSAIL treatments had significantly fewer damaged terminals than both rates of INTREPID.

All treatments except ASSAIL, the low rate of DELEGATE (50 g a.i./ha) and the high rate of INTREPID had fewer damaged fruit than the control (Table 2). There were no significant differences in the weight per peach among any of the treatments or the control (Table 3).

Table 1. Number of terminals damaged by Oriental fruit moth (OFM) per plot.

Treatment[1]	Rate	Number of (OFM) damaged terminals			
	g a.i./ha	17 July	2 August	15 August	Total
INTREPID 2F	240	17.00 b[2]	10.25 abc	5.00 bc	32.25 bc
INTREPID 2F	360	20.00 ab	10.75ab	5.00 bc	35.75 b
DELEGATE WG	50	10.50 bc	4.25 bc	5.50 bc	20.25 cd
DELEGATE WG	80	7.00 c	4.00 bc	8.00 b	19.00 cde
DELEGATE WG	105	5.75 c	2.50 c	2.50 c	10.75 f
ASSAIL 70 WP	168	6.00 c	2.75 c	5.75 bc	14.50 def
CONTROL	-	46.25 a	18.00 a	13.50 a	77.75 a

[1] Applied 5 July and 19 July.
[2] Numbers followed by the same letter (within columns) are not significantly different *P*<0.05, Tukey test.

Table 2. Total percentage OFM damaged fruit per plot.

Treatment[1]	Rate	Total % OFM damaged fruit
	g a.i./ha	(second generation)
INTREPID 2F	240	2.50 b[2]
INTREPID 2F	360	4.25 ab
DELEGATE WG	50	4.00 ab
DELEGATE WG	80	1.75 b
DELEGATE WG	105	2.25 b
ASSAIL 70 WP	168	4.25 ab
CONTROL	-	10.25 a

[1]Applied 5 July and 19 July.
[2]Numbers followed by the same letter are not significantly different *P*<0.05, Tukey test.

Table 3. Average weight per peach per plot.

Treatment[1]	Rate g a.i./ha	Weight (g) 18 August
INTREPID 2F	240	112.8 a[2]
INTREPID 2F	360	114.6 a
DELEGATE WG	50	121.1 a
DELEGATE WG	80	131.2 a
DELEGATE WG	105	118.3 a
ASSAIL 70 WP	168	119.0 a
CONTROL	-	118.5 a

[1] Applied 5 July and 19 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2007 PMR REPORT# 25 **SECTION A: FRUIT - Insect Pests**
STUDY DATA BASE: 280-1261-9341

CROP: Strawberry cv. Annapolis
PEST: Tarnished Plant Bug, *Lygus lineolaris* (Palisot de Beauvois)

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TITLE: **EFFICACY OF METAFLUMIZONE FOR THE CONTROL OF TARNISHED PLANT BUG ON STRAWBERRY; 2007**

MATERIALS: ALVERDE SC (BAS 320 00 I) (metaflumizone), THIODAN 50 WP (endosulfan)

METHODS: Note: This study has been submitted as part of AAFC Pesticide Minor Use Project AAFC07-036E-238. The trial was conducted in a two-year-old strawberry patch in the Jordan Station, Ontario area; strawberry plants cv. Annapolis were spaced 1.5 m by 0.15 m. Treatments were replicated four times, assigned to plots 1.5 m wide by 2.0 m long and arranged according to a randomised complete block design; four rates of ALVERDE (114, 170, 228 and 288 g a.i./ha) were compared to a THIODAN standard and an unsprayed control. An additional treatment studied the efficacy of only one application of ALVERDE at 228 g a.i./ha. First application of all treatments was made 6 June (when tarnished plant bug (TPB) application thresholds were reached). Treatments were diluted to a rate comparable to 400 L per ha, and sprayed to runoff with a backpack-mounted spray boom equipped with four TeeJet XR1102VS nozzles at 50 cm spacing; carbon dioxide propellant pressure was set at 30 psi. The 114, 170, 228 and 288 g a.i./ha rates of ALVERDE were reapplied on 13 June, 22 June and 29 June (seven, 16, 23 days after first application, respectively), while the THIODAN standard was reapplied 13 June (7 days after initial application). Plots were sampled pre-treatment 6 June, and post-treatment 12 June, 18 June and 25 June (6, 12 and 19 days after initial application, respectively); 25 flower/berry clusters were examined per plot and the numbers of TPB nymphs and adults were recorded. On 12 June and 18 June, 25 berries per plot were examined for TPB damage; results were expressed as percent TPB-damaged fruit per plot. All strawberries were harvested on 5 July and the percentage of strawberries damaged by TPB was recorded for each plot; to assess yield, the total weights of strawberries per plot were recorded. Plots were examined for phytotoxic injury at each sampling event (12 June, 18 June, 25 June and 5 July). Data were transformed where necessary and analysed using analysis of variance; means were separated with a Tukey Test at the 0.05 level.

RESULTS: Data are presented in Tables 1, 2 and 3. No phytotoxic effects or adverse effects on yield were observed.

CONCLUSIONS: No differences in infestation levels were observed between plots in the pre-spray (6 June) sample (Table 1); all plots contained greater number of TPB nymphs than the threshold for control action (minimum 2 nymphs/10 blossoms).

All treated plots contained significantly fewer TPB nymphs than the control in the 12 June sample (Table 1); a rate effect was observed, but differences between treatments were not statistically different. Only plots treated with the THIODAN standard, the 228 g a.i./ha, and 288 g a.i./ha rates of ALVERDE contained significantly less TPB-damaged fruit than the control (Table 3); no differences were observed between these treatments.

In the sample taken 18 June (Table 1), all treatments significantly reduced numbers of TPB nymphs; plots treated with only one application of ALVERDE at 228 g a.i./ha contained more TPB nymphs, but the differences were not statistically significant. A rate effect was observed when numbers of TPB adults were counted (Table 2); however, only plots treated with the THIODAN standard and the highest (288 g a.i./ha) rate of ALVERDE contained significantly fewer TPB adults than the control. Examination of fruit damage revealed a rate effect (Table 3); TPB damage levels increased as the rate of ALVERDE decreased, but differences between insecticide treatments were not statistically significant.

Numbers of TPB nymphs and adults were observed to decline naturally by the 25 June sample (Tables 1 and 2). All treated plots had significantly fewer TPB nymphs than the control, but no differences were observed between insecticide treatments. Numbers of TPB adults were low in all plots; none of the treatments were different from the control.

At harvest (5 July), only plots treated with THIODAN and four applications of ALVERDE at 228 and 288 g a.i./ha showed levels TPB damaged fruit that were significantly lower than the control (Table 3). Percentage of fruit damaged by TPB was not different from the control in plots treated with a single application of ALVERDE at 228 g a.i./ha or with four applications of ALVERDE at 114 and 170 g a.i./ha.

In summary, multiple applications of the 288 and 228 g a.i./ha rates of ALVERDE provided control of TPB that was similar to the THIODAN standard. A single application of ALVERDE at 228 g a.i./ha was not effective in reducing TPB damage in fruit at harvest. The 114 and 170 g a.i./ha rates of ALVERDE were not as effective as the 228 and 288 g a.i./ha rates.

Table 1. Numbers of tarnished plant bug (TPB) nymphs found in 25 clusters per plot.

Treatment	Rate (a.i./ha)	TPB nymphs per plot 6 June (pre-spray)[4]	TPB nymphs per plot 12 June[4]	TPB nymphs per plot 18 June[4]	TPB nymphs per plot 25 June[4,5]
THIODAN 50 WP[1]	1.0 kg	8.0 a	1.0 b	0.3 b	0.3 b
ALVERDE SC[2]	288 g	5.8 a	0.8 b	0.3 b	0.3 b
ALVERDE SC[3]	228 g	9.5 a	0.8 b	1.0 b	0.0 b
ALVERDE SC[2]	228 g	8.0 a	0.5 b	0.0 b	0.0 b
ALVERDE SC[2]	170 g	7.0 a	2.0 b	0.5 b	0.8 b
ALVERDE SC[2]	114 g	6.8 a	2.0 b	0.3 b	0.3 b
CONTROL	-	8.3 a	5.0 a	10.0 a	3.5 a

[1] Applied 6 June, reapplied 13 June.
[2] Applied 6 June, reapplied 13 June, 22 June and 29 June.
[3] Applied 7 June only.
[4] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.
[5] Data were transformed (log(x+1)) for analysis; de-transformed means are shown in this table.

Table 2. Numbers of tarnished plant bug (TPB) adults found in 25 clusters per plot.

Treatment	Rate (a.i./ha)	TPB adults per plot 6 June (pre-spray)[4]	TPB adults per plot 18 June[4]	TPB adults per plot 25 June[4]
THIODAN 50 WP[1]	1.0 kg	3.8 a	0.5 bc	0.3 a
ALVERDE SC[2]	288 g	4.3 a	0.0 c	1.0 a
ALVERDE SC[3]	228 g	3.8 a	1.8 abc	1.5 a
ALVERDE SC[2]	228 g	3.3 a	1.0 abc	0.0 a
ALVERDE SC[2]	170 g	3.8 a	1.5 abc	0.3 a
ALVERDE SC[2]	114 g	3.8 a	3.5 a	0.8 a
CONTROL	-	4.3 a	3.0 ab	0.8 a

[1] Applied 6 June, reapplied 13 June.
[2] Applied 6 June, reapplied 13 June, 22 June and 29 June.
[3] Applied 7 June only.
[4] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 3. Percent fruit damaged by tarnished plant bug (TPB) and yield per plot.

Treatment	Rate (a.i./ha)	% TPB-damaged fruit per plot 12 June[4]	% TPB-damaged fruit per plot 18 June[4]	% TPB-damaged fruit per plot 5 July (harvest)[4]	Yield (g) per plot 5 July (harvest)[4,5]
THIODAN 50 WP[1]	1.0 kg	10.0 b	7.0 b	10.0 b	289.8 a
ALVERDE SC[2]	288 g	7.0 b	7.0 b	9.0 b	277.0 a
ALVERDE SC[3]	228 g	5.0 b	6.0 b	20.0 ab	316.5 a
ALVERDE SC[2]	228 g	18.0 ab	6.0 b	7.0 b	562.3 a
ALVERDE SC[2]	170 g	25.0 ab	14.0 b	14.0 ab	367.3 a
ALVERDE SC[2]	114 g	23.0 ab	15.0 b	20.0 ab	421.8 a
CONTROL	-	35.0 a	28.0 a	24.0 a	469.0 a

[1] Applied 6 June, reapplied 13 June.
[2] Applied 6 June, reapplied 13 June, 22 June and 29 June.
[3] Applied 7 June only.
[4] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.
[5] Data were transformed (log(x+1)) for analysis; de-transformed means are shown in this table.

2007 PMR REPORT# 26 **SECTION A : BERRIES - Insect Pests**

CROP: Strawberry (*Fragaria* x *ananassa*), cv. Jewel
PEST: Black vine weevil (BVW), *Otiorhynchus sulcatus* (F.)

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TITLE: SMALL PLOT FIELD EVALUATION OF MATADOR 120 EC FOR CONTROL OF BLACK VINE WEEVIL IN STRAWBERRY, 2007

MATERIALS: MATADOR 120 EC (lambda-cyhalothrin 120 g/l)

METHODS: Three-row plots were established on 21 August in a block of strawberries planted near Campbelleville, ON (Latitude 43˚ 27' 26.16" N; Longitude 79˚ 56' 25.41" W) in May 2005. Both treatments (Table 1) were replicated 4x in a Randomized Complete Block Design; a Block comprised a replicate of each treatment. Blocks, separated by a 1 m buffer, were located serially into the field. Individual plots measured 5 m long. Each plot within a Block was separated from the adjacent plot by an untreated buffer row. Treatments were applied in 400 L/ha at 220 kPa in a 1.2 m swath centred on each row, using a hand-held, CO_2-pressurized R&D field-plot sprayer fitted with three XR8002VS flat spray tips.
Immediately prior to application, a single barrier pitfall trap (BPFT) consisting of a 1 m x 15 cm barrier of fibreglass with a collection cup at each end of the barrier was located at the edge of the centre row in the middle of each plot. Collection cups were replaced on 23 Aug, 2 Days after Treatment (DAT) and thereafter at approximately weekly intervals until 11 Oct, 51 DAT. On each date, collection cups were returned to the laboratory for inspection and numbers of captured BVW counted. On 11 Sept, 21 DAT, 10 individual compound leaves were randomly collected from each side of the centre row of each plot. Each sample from each plot was separately inspected for the "notches" characteristic of BVW feeding and the number of damaged leaves recorded for each sample. The significance of the observed differences in leaf damage was determined by analysis of variance.

OBSERVATIONS: No phytotoxicity was observed following treatment. The experiment was initiated relatively late in the season, likely after the peak in BVW activity.

RESULTS: Results are outlined in Table 1. While BVW feeding damage was quite low in leaves sampled 21 DAT, more "notched" leaves were collected in untreated plots than in plots treated with MATADOR 120 EC; the difference, however, was not statistically significant. Although relatively few BVW were captured by BPFT's during the 4 weeks following treatment, a total of 5 adults were collected from untreated plots and only 1 adult BVW from plots treated with MATADOR 120 EC.

CONCLUSIONS: Under the conditions of this trial, application of MATADOR 120 EC reduced activity by adult BVW in strawberry.

Table 1. Effect of foliar application of MATADOR 120 EC on activity of black vine weevil (BVW), *Otiorhynchus sulcatus*, in strawberry, Campbellville, ON, 2007.

Tmt. No.	Insecticide Applied	Formulation Applied	Rate/ha	Mean No. Notched Leaves	No. (BVW) Collected
1	lambda-cyhalothrin	MATADOR 120 EC	104.0 ml	1.1	1
2	no insecticide	---	---	2.1	5
		Probability		$p = 0.11$	

2007 PMR REPORT# 27 **SECTION B: VEGETABLES AND SPECIAL CROPS - Insect Pests**

CROP: Broccoli (*Brassica oleracea*); Cabbage (*Brassica oleracea)*
PEST: Swede midge, *Contarinia nasturtii* (Keiffer) (Diptera: Cecidomydiae)

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TITLE: **EVALUATION OF INSECTICIDES FOR CONTROL OF SWEDE MIDGE ON COLE CROPS, 2007**

MATERIALS: CORAGEN SC (chlorantraniliprole 200 g/L), MATADOR 120 EC (lambda-cyhalothrin 120 g/L), AVAUNT 30 WG (indoxacarb 30%), HASTEN™ NT (methyl and ethyl oleate 71.44%).

METHODS: Two rows of broccoli seedlings were transplanted (20 plants/row) into 5 x 2 m plots in a field in Breslau, ON on 8 June 2007. On 20 July 2007, two rows of cabbage seedlings (20 plants/row) were transplanted into 5 x 2 m plots into a field adjacent to the broccoli planting. All treatments were replicated 4 times in a randomized complete block design. On 21 July, treatments were applied to broccoli plants in 300 L/ha, at 275 kPa, using a hand-held, CO2-pressurized R&D field-plot sprayer fitted with a 1.1 m boom equipped with four ceramic hollow cone nozzles (AGDCER4/AG25CER). On 27 August and 12 September, all treatments were applied to cabbage plants at the same rates with same equipment used in the broccoli trial. On 6, 13 and 21 August, damage assessments were made on all broccoli plants. On 21 August, 4, 10, 20 September and 2 October, damage assessments were made on all cabbage plants. The percentage of undamaged and damaged plants were calculated and transformed using log (x +1) and then analyzed using ANOVA and Fisher's Protected LSD test. Only untransformed data are presented.

RESULTS: Experimental results for broccoli and cabbage are outlined in Tables 1 and 2, respectively. Less than 5% damage was recorded in all treatments applied to broccoli, with the exception of CORAGEN (25 g ai/ha) + HASTEN and MATADOR on the first assessment date (Table 1). On the second assessment date, the highest level of damage was observed in plots treated with CORAGEN (25 g ai/ha) + HASTEN. On the final assessment, the highest level of damage was observed in plots treated with CORAGEN (75 g ai/ha) + HASTEN. On the first assessment date of cabbage, CORAGEN (50 g ai/ha), CORAGEN (75 g ai/ha), CORAGEN (75 g ai/ha) + HASTEN and CONTROL plots had no observable damage (data not shown). On the second assessment date, damage levels increased significantly in all plots (Table 2). Only cabbage plants treated with CORAGEN (50 g ai/ha) or AVAUNT had significantly less damage than CONTROL plots on this date. By the third assessment period, the cabbage plants appeared to grow out of previously observed damage. The exception was cabbage plants treated with CORAGEN (50 g ai/ha) where damage increased 166%. On the fourth assessment date, several treatments appeared to have significantly less damage than the CONTROL, which may have been due to plant growth. On the final assessment date, no damage was observed on plants treated with either CORAGEN (25 g ai/ha) or CORAGEN (75 g ai/ha) + HASTEN.

CONCLUSIONS: In the broccoli trial, CORAGEN (50 g ai/ha) was the only treatment that appeared to reduce swede midge damage when compared to the CONTROL. Plots treated with the industry standard, MATADOR, consistently had more damage than CONTROL plots. In the cabbage trial, foliar applications of CORAGEN (25 g ai/ha) + HASTEN or CORAGEN (75 g ai/ha) + HASTEN were the only treatments which appeared to reduced swede midge damage compared to CONTROL plots.

Table 1. Impact of foliar treatments on swede midge damage of broccoli, Breslau, ON, 2007.

Treatment	Rate (g ai/ha)	% of Broccoli Plants Undamaged (UD) and Damaged (D)					
		39665		39672		39680	
		UD	D	UD	D	UD	D
CORAGEN + HASTEN	25.0 + 0.25%	90.0 ab[1]	10.0 a	82.5 b	17.5 b	75.0 b	25.0 ab
CORAGEN	25	97.5 a	5.0 a	90.0 a	10.0 ab	65.0 c	35.0 bc
CORAGEN + HASTEN	50.0 + 0.25%	100.0 a	0.0 b	90.0 a	10.0 ab	82.5 a	17.5 a
CORAGEN	50	95.0 a	5.0 a	90.0 a	5.0 ab	80.0 a	20.0 a
CORAGEN + HASTEN	75.0 + 0.25%	97.5 a	5.0 a	95.0 a	5.0 a	62.5 c	37.5 c
CORAGEN	75	97.5 a	2.5 ab	95.0 a	5.0 a	72.5 b	27.5 ab
AVAUNT	75.0 + 0.25%	100.0 a	0.0 b	92.5 a	7.5 a	70.0 b	30.0 b
MATADOR	9.96	87.5 b	12.5 a	90.0 a	10.0 ab	65.0 c	35.0 bc
CONTROL	-2	95.0 a	5.0 a	95.0 a	5.0 a	72.5 b	27.5 ab

[1] Percentages within a column followed by the same letter are not significantly different ($P < 0.05$) as determined by ANOVA and Fisher's Protected LSD.
[2] No insecticide applied.

Table 2. Impact of foliar treatments on swede midge damage of cabbage, Breslau, ON, 2007.

Treatment	Rate (g ai/ha)	% of Cabbage Plants Undamaged (UD) and Damaged (D)							
		39694		39700		39710		39722	
		UD	D	UD	D	UD	D	UD	D
CORAGEN+ HASTEN	25.0 +0.25%	82.9 b[1]	17.1 b	97.1 c	2.9 a	100.0 b	0.0 a	100.0 a	0.0 a
CORAGEN	25	77.1 ab	22.9 b	97.1 c	2.9 a	94.3 ab	5.7 a	94.3 a	5.7 a
CORAGEN + HASTEN	50.0 + 0.25%	85.7 b	14.3 ab	91.4 c	8.6 a	88.6 a	11.4 b	94.2 a	5.8 a
CORAGEN	50	91.4 c	8.6 a	77.1 a	22.9 b	82.9 a	17.1 b	94.3 a	5.7 a
CORAGEN + HASTEN	75.0 + 0.25%	82.9 b	17.1 b	88.6 b	11.4 a	97.1 b	2.9 a	100.0 a	0.0 a
CORAGEN	75	71.4 ab	28.6 c	94.3 c	5.7 a	88.6 a	11.4 b	94.2 a	5.8 a
AVAUNT	75.0 + 0.25%	94.3 c	5.7 a	94.3 c	5.8 a	97.1 b	2.9 a	85.7 b	14.3 b
MATADOR	9.96	65.7 a	25.7 bc	94.3 c	5.7 a	88.6 a	11.5 b	88.5 a	11.5 b
CONTROL	-2	77.1 ab	22.9 b	88.0 b	12.0 a	88.6 a	11.5 b	94.3 a	5.7 a

[1] Percentages within a column followed by the same letter are not significantly different ($P < 0.05$) as determined by ANOVA and Fisher's Protected LSD.
[2] No insecticide applied.

2007 PMR REPORT# 28 **SECTION B: VEGETABLES AND SPECIAL CROPS - Insect Pests**

CROP: Celery (*Apium graveolens*), cv. Florida 683
PEST: Tarnished plant bug, *Lygus lineolaris* (Palisot de Beavois)

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TITLE: **EVALUATION OF INSECTICIDES FOR CONTROL OF TARNISHED PLANT BUG ON CELERY, 2007**

MATERIALS: MATADOR 120 EC (lambda-cyhalothrin 120 g/L), THIODAN 4 EC (endosulfan 400 g/L), ALVERDE SC (metaflumizone 240 g/L), ACTARA 25 WG (thiamethoxam 25%)

METHODS: Leaf dip and whole plant bioassays were conducted during the summer of 2007 to determine the efficacy of a number of insecticides against tarnished plant bug (TPB) nymphs and adults, respectively. Nymphal bioassays consisted of leaf dips. Leaves from celery plants purchased directly from a commercial grower were harvested and cut into 1.5 cm diam. discs using a leaf cutter. Individual leaf discs were dipped into one of the insecticide treatments for 10 s, removed and allowed to dry. Once dry, 2 leaf discs/treatment were placed into individual plastic wells of a 20-well tray. Each well also contained a piece of filter paper to absorb excess moisture. After TPB nymphs were cooled at 4ºC for 45 min in a refrigerator 5 nymphs were transferred into each well. Wells were sealed with a perforated plastic cover. All treatments were replicated 4 times. Trays were then held in a growth chamber maintained at 24±2 °C and 16:8 h L:D. Mortality was assessed at 24, 48 and 72 h. Adult bioassays consisted of whole celery plants, potted into individual 10 cm diam. pots. All treatments were applied as a foliar spray in 300 L/ha. Once deposits had dried, 4 potted plants/treatment were placed into individual screened cages in a growth chamber maintained at 24±2 °C and 16:8 h L:D. Ten adult TPB were released into each cage. Mortality assessments were made 24 h, 48 h and 7 days after treatment. Damage assessments using a scale of 0 - 2; 0 = no damage, 1 = leaf discolouration, 2 = growing point necrosis were made at the end of the experiment (7 days). All mortality data were corrected using Abbott's Formula.

RESULTS: Twenty-four h after exposure to treated leaf discs, 95-100% TPB nymph mortality was observed in the MATADOR, THIODAN and ACTARA treatments (Table 1). Forty-eight h after exposure, 100% mortality was recorded in all of the above treatments while < 20% mortality was observed in the ALVERDE treatment. By 72 h, 100% mortality was recorded in all treatments. Twenty-four h after exposure whole plants treated with a foliar spray of MATADOR, 80% of TPB adults were dead (Table 1); mortality in the other treatments ranged from 40-50% at that time. Seven days after treatment, 100% of TPB adults were dead in the MATADOR treatment and mortality had increased to 75% and 85% in the ALVERDE and ACTARA treatments, respectively. Adult mortality did not exceed 50% in the THIODAN treatment. No damage was observed on any of the plants treated with MATADOR 7 d after treatment (Table 2). All plants treated with ALVERDE displayed levels of damage similar to that observed on CONTROL plants.

CONCLUSIONS: While all four insecticides offered some degree of activity against TPB, response to ALVERDE was the slowest of the tested compounds. ACTARA and THIODAN provided excellent and rapid control of nymphs but were slower to act against adults. MATADOR was the only tested treatment that offered excellent control of nymphs and adults within 48 h of application.

Table 1. Mortality of tarnished plant bug nymphs and adults exposed to insecticide treated celery in leaf dip (nymphs) and whole plant – foliar spray (adults) bioassays, 2007.

Treatments	Rate product/ha	Corrected Percent Mortality					
		Leaf Dip (nymphs)			Foliar Spray (adults)		
		24 h	48 h	72 h	24 h	48 h	7 days
MATADOR	83.0 ml	97.0	100.0	100.0	80.0	88.8	100
THIODAN	2.0 L	100	100	100.0	40.0	44.4	50.0
ALVERDE	1.17 L	5	18	100.0	40.0	44.4	75.0
ACTARA	155.0 g	100	100	100.0	50.0	55.5	87.5

Table 2. Impact of foliar insecticides on adult tarnished plant bug damage to celery, 2007.

Treatments	Rate product/ha	Damage Rating[1] (7 days after application)				Mean Damage Rating
		Plant 1	Plant 2	Plant 3	Plant 4	
MATADOR	83.0 ml	0	0	0	0	0.00
THIODAN	2.0 L	1	0	1	2	1.00
ALVERDE	1.17 L	1	2	2	2	1.75
ACTARA	155.0 g	1	1	1	0	0.75
CONTROL	-2	2	2	2	1	1.75

[1] 0 = no damage; 1 = leaf yellowing/deformation; 2 = growing point necrosis.
[2] No insecticide applied.

2007 PMR REPORT# 29 **SECTION B: VEGETABLES AND SPECIAL CROPS - Insect Pests**

CROP: Garlic (*Allium sativum* L.); Onion sets (*Allium cepa* L.)
PEST: Leek moth, *Acrolepiopsis assectella* Zeller (Lepidoptera: Acrolepiopidae)

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TITLE: **EVALUATION OF ORGANIC AND CONVENTIONAL INSECTICIDES FOR CONTROL OF LEEK MOTH ON GARLIC AND ONION, 2007**

MATERIALS: SUCCESS 480 SC (spinosad 480 g/L), ENTRUST 80W (spinosad 80%), ASSAIL 70 WP (acetamiprid 70%), MATADOR 120 EC (lambda-cyhalothrin 120 g/L), DIPEL 2X (*Bacillus thuringiensis* subsp. *Kurstaki* strain HD-1. 32 BIU/kg), CORAGEN SC (chlorantraniliprole 200 g/L), ALVERDE™ (metaflumizone 240 g/L), NEEMAZAL EC (neem 1.2%), leek moth pheromone ((Z)-11-hexadecenal and (Z)-11-hexadecen-1-ol acetate)

METHODS: Field trials were conducted in three commercial sites naturally infested with leek moth. At sites 1 (Osgoode, ON) and 2 (Almonte, ON), garlic cloves were planted on 12 and 13 October 2006, respectively. Plots (6 m long x 2 m wide) were planted with two rows of garlic, 20 cloves per row. Rows were 0.30 m apart. At site 3 (Russell, ON), set onions were planted by the grower on 5 June 2007. Plots (5 m long x 0.5 m wide) were planted with two rows of set onions, 25 onions per row. All treatments were replicated 4 times in a randomized complete block design. Insecticide applications were made on 7 June (garlic), 12 July (garlic and onions) and 13 August (onions). All applications were made 7-10 days following a peak flight as determined using pheromone traps. The use of pheromone traps is critical to application timing. Since applications are targeted at the larval stages, a period of 7 -10 days following peak flight helps to ensure maximal egg hatch. All treatments were applied in 400 L/ha, at 276 kPa, using a hand-held, CO_2-pressurized R&D field-plot sprayer fitted with a 1.1 m boom equipped with four flat fan (110-03VP) nozzles. On 14 June and 19 July, five garlic plants were randomly selected and harvested from each plot, individually bagged, packed on ice and delivered to the lab for inspection. On 19 July and 20 August, 10 onion plants were harvested, individually bagged, packed on ice and delivered to the lab for inspection. All plants were assessed for damage, number of leek moth larvae and pupae. Data were analysed using ANOVA and Fisher’s Protected LSD test.

RESULTS: Experimental results are outlined in Tables 1, 2, 3 and 4. At Osgoode, leek moth captures on pheromone traps were low throughout the season. Although not statistically significant, garlic plants treated with CORAGEN, ALVERDE, SUCCESS or MATADOR had less damage than garlic plants harvested from CONTROL plots following both treatments (Table 1). Following the first application, plots treated with NEEMAZAL had more damage than CONTROL plots at this site. However, no damage was recorded in plots treated with NEEMAZAL following the second application. At Almonte, all treatment plots had numerically less damage than CONTROL plots throughout the experiment (Table 2). Following the second treatment application, significantly less damage was observed in plots treated with either DIPEL or the high rate of NEEMAZAL than in CONTROL plots. At Russell, following the first treatment in July, while no damage was recorded in CONTROL plots or plots treated with either CORAGEN or ASSAIL, damage was recorded in all other treatments (Table 1). Following the second treatment in August, two treatments, MATADOR and SUCCESS had significantly less damage than CONTROL plots. In fact, no damage was observed in plots treated with MATADOR while >25% damage was recorded in CONTROL plots. Very few leek moth larvae were recorded on plants at the Osgoode site throughout the experiment (Table 3). At this site, while numbers of larvae were very low, plants treated with NEEMAZAL had significantly more larvae than plants harvested from CONTROL plots following the first treatment application. No differences were observed following the second application. At the site in Russell, the reverse was true. Very few leek moth larvae were detected on any of the treatments in July; however, following the second application in August, significantly fewer leek moth larvae were found in plots treated with CORAGEN, SUCCESS or MATADOR. At Almonte, numerically more leek moth larvae were detected in plots treated with either ENTRUST (first application) or the high rate of NEEMAZAL (second application) than in CONTROL plots. Following both applications, the fewest leek moth larvae were found in plots treated with DIPEL.

CONCLUSIONS: At the conventional sites, garlic and onion plants treated with MATADOR, CORAGEN and SUCCESS had numerically less damage than CONTROL plots. At the organic site, garlic treated with DIPEL had numerically less damage and fewer larvae than CONTROL plots.

Table 1. Impact of foliar application of insecticides on damage caused by leek moth to garlic and onion, Osgoode, ON and Russell ON, 2007.

Treatment	Rate (product/ha)	Percent Plants Damaged			
		Osgoode – Garlic Plants		Russell – Onion Plants	
		14 June	19 July	19 July	20 August
CORAGEN	0.75 L	0.0 a[1]	5.0 a	0.0 a	17.5 a
ALVERDE	1.6 L	0.0 a	5.0 a	10.0 a	27.5 a
SUCCESS	300.0 ml	5.0 a	5.0 a	10.0 a	10.0 b
ASSAIL	120.0 ml	10.0 a	5.0 a	0.0 a	25.0 a
NEEMAZAL	1.8 L	25.0 a	0.0 a	10.0 a	20.0 a
MATADOR	188.0 ml	0.0 a	5.0 a	2.5 a	0.0 b
CONTROL	-2	10.0 a	10.0 a	0.0 a	27.5 a

[1] Means within a column followed by the same letter are not significantly different ($P < 0.05$) as determined by ANOVA and Fisher's Protected LSD.
[2] No insecticide applied.

Table 2. Impact of foliar application of organic insecticides on damage caused by leek moth to garlic, Almonte ON, 2007.

Treatment	Rate product/ha	Percent Plants Damaged	
		Garlic Plants	
		14 June	19 July
ENTRUST	210.0 g	40.0 a[1]	45.0 a
DIPEL	1.12 kg	35.0 a	25.0 b
NEEMAZAL	1.2 L	40.0 a	50.0 a
NEEMAZAL	1.8 L	15.0 a	35.0 b
CONTROL	-2	45.0 a	72.0 a

[1] Means within a column followed by the same letter are not significantly different ($P < 0.05$) as determined by ANOVA and Fisher's Protected LSD.
[2] No insecticide applied.

Table 3. Impact of foliar application of insecticides on leek moth larvae, Osgoode, ON and Russell, ON, 2007.

Treatment	Rate product/ha	Mean No. Larvae			
		Osgoode – Garlic Plants		Russell – Onion Plants	
		14 June	19 July	19 July	20 August
CORAGEN	0.75 L	0.00 a[1]	0.00 a	0.00 a	0.05 bc
ALVERDE	1.6 L	0.00 a	0.00 a	0.00 a	0.20 abc
SUCCESS	300.0 ml	0.05 a	0.00 a	0.02 a	0.05 bc
ASSAIL	120.0 ml	0.05 a	0.00 a	0.00 a	0.40 a
NEEMAZAL	1.8 L	0.20 b	0.00 a	0.00 a	0.30 ab
MATADOR	188.0 ml	0.00 a	0.00 a	0.00 a	0.00 c
CONTROL	-2	0.00 a	0.10 a	0.00 a	0.35 a

[1] Means within a column followed by the same letter are not significantly different ($P < 0.05$) as determined by ANOVA and Fisher's Protected LSD.
[2] No insecticide applied.

Table 4. Impact of foliar application of organic insecticides on leek moth larvae, Almonte, ON, 2007.

Treatment	Rate product/ha	Mean No. Larvae	
		Garlic Plants	
		14 June	19 July
ENTRUST	210.0 g	0.75 a[1]	0.20 a
DIPEL	1.12 kg	0.05 a	0.00 a
NEEMAZAL	1.2 L	0.30 a	0.10 a
NEEMAZAL	1.8 L	0.20 a	0.70 a
CONTROL	-2	0.32 a	0.40 a

[1] Means within a column followed by the same letter are not significantly different ($P < 0.05$) as determined by ANOVA and Fisher's Protected LSD.
[2] No insecticide applied.

2007 PMR REPORT# 30 **SECTION B: VEGETABLES AND SPECIAL CROPS - Insect Pests**

CROP: Onion sets (*Allium cepa L.*)
PEST: Onion thrips (*Thrips tabaci* Lindeman) (Thysanoptera: Thripidae)

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TITLE: **EVALUATION OF INSECTICIDES FOR CONTROL OF ONION THRIPS ON ONIONS, 2007**

MATERIALS: DPX-HGW86 SC (100 g/L), MATADOR 120 EC (lambda-cyhalothrin 120 g/L), HASTEN™ NT (methyl and ethyl oleate 71.44%).

METHODS: Two rows of onion sets were planted (50 plants/row) into 5 m x 1 m plots in a field in Breslau, ON on 12 June 2007. All treatments were replicated 4 times in a randomized complete block design. On 29 July and 10 August, all treatments were applied in 300 L/ha, at 276 kPa, using a CO2-pressurized sprayer fitted with a 1.0 m boom equipped with two ceramic hollow cone nozzles (AGDCER4/AG25CER). On 30 July, 1, 5, 13, 21 August, number of onion thrips on the inner three leaves were counted and recorded. Data were analyzed using ANOVA and Fisher's Protected LSD test.

RESULTS: Experimental results are outlined in Table 1. On 1 August, 3 days after the first treatment (DAT), none of the treatments were significantly different from the CONTROL. By 5 August (7 DAT), all plots treated with DPX-HGW86 had significantly fewer onion thrips than CONTROL and MATADOR or MATADOR + HASTEN plots. On 13 August, 3 days after the second treatment (DAST), all DPX-HGW86 treatments continued to have numerically fewer onion thrips than CONTROL plots; the decrease was significant, however, only for plots treated with 75.0 g ai/ha. On this date, more onion thrips were counted in MATADOR and MATADOR + HASTEN plots than in CONTROL plots. This trend continued on 21 August (11 DAST) with significantly more onion thrips recorded in MATADOR and MATADOR + HASTEN plots than in the CONTROL plots.

CONCLUSIONS: Foliar application of HGW86 reduced the number of onion thrips observed on onion plants during this trial. Further investigation is warranted to better define the optimum rate of application.

Table 1. Impact of foliar insecticides on number of onion thrips on set onions, Breslau, ON, 2007.

Treatments	Rate g ai/ha	Mean No. of Onion Thrips on the Inner Three Leaves on Each Assessment Date				
		30 July	1 August	5 August	13 August	21 August
DPX-HGW86	50	21.7 a[1]	32.8 a	9.3 c	7.7 cd	6.9 c
DPX-HGW86	75	17.8 a	27.8 a	13.7 bc	6.6 d	11.7 c
DPX-HGW86	100	15.8 a	21.3 a	14.9 bc	9.8 cd	13.7 c
DPX-HGW86 + HASTEN	75.0 + 0.25%	21.2 a	16.5 a	9.5 c	7.9 cd	8.2 c
MATADOR	9.96	18.5 a	24.8 a	22.1 ab	20.8 b	31.5 b
MATADOR + HASTEN	9.96 + 0.25%	34.8 a	32.0 a	28.3 a	48.7 a	46.5 a
CONTROL	-[2]	21.9 a	30.3 a	24.9 a	17.9 bc	10.3 c

[1] Means within a column followed by the same letter are not significantly different (P>0.05) as determined by ANOVA and Fisher's Protected LSD.
[2] No insecticide applied.

CROP: Dry set cooking onion (*Allium cepa* L.), cv. Yellow Ebenezer
PEST: Onion thrips, (OT), *Thrips tabaci* Lindeman

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TITLE: EVALUATION OF FOLIAR TREATMENTS FOR CONTROL OF ONION THRIPS ON DRY SET COOKING ONION ON MINERAL SOIL, 2007

MATERIALS: MATADOR 120 EC (lambda cyhalothrin 120 g/L), XDE-175 25 WG (spinetoram 25% [w/w]), DPX HGW86 10 SC (DPX HGW86 10% [w/w]), CORAGEN SC (chlorantraniliprole 18.4% [w/w]), CONCEPT 85 OD (imidacloprid + deltamethrin 75.0 + 10.0 g/L), SYLGARD 309 (siloxylated polyether 76% + surfactant mixture 24%)

METHODS: On 24 May, dry set cooking onion bulbs were planted (65 bulbs/row) on the SCPFRC-London Research Farm in 3-row microplots (2.25 m long x 0.9 m wide) filled with insecticide-residue free mineral soil. Nine treatments (Table 1) were replicated 4x in a randomized complete block design. On 22, 29 June and 03 July, to monitor development of OT populations, a single plant was randomly selected from each microplot and the number of OT on the inner 4 leaves counted by destructive sampling. On 09 July destructive sampling of 3 plants/microplot revealed OT populations of at least 1 OT/leaf in all treatments (Table 2). On 10 July all treatments were applied in 900 L/ha, at 265 kPa, using a hand-held, CO_2 pressurized R&D field-plot sprayer fitted with a 0.6 m boom equipped three XR8002VS flat spray tips. On 13 and 17 July OT were counted on the inner 4 leaves by destructive sampling of 5 randomly selected onion plants in each microplot. On 20 July all treatments were applied as described above in 0.375% SYLGARD 309. On 23, 27, 30 July and 03 August, OT numbers were again counted as described for 13 July. Significance of observed differences among treatment means was determined using ANOVA and Student-Neuman-Keul's Multiple Range Test. Untransformed data are presented in Table 2.

OBSERVATIONS: No phytotoxicity was observed following any treatment. The experimental formulation XDE-175 25 WG did not readily suspend in water and required considerable agitation to prepare a sprayable solution.

RESULTS: Experimental results are outlined in Table 2. On 09 July, prior to the first application on 10 July, although mean OT populations varied from 4.2-15.7 OT/plant, the differences were not statistically significant (Table 2). When OT were counted on 13 and 17 July, 3 and 7 days after treatment (DAT), there were no significant differences in OT numbers among plots for any of the treatments or between any of the treated and untreated plots. Three days following re-application on 20 July of all treatments in 0.375% SYLGARD 309, OT numbers were significantly lower in all treated plots than in untreated plots (Table 2). On that date while there were no significant differences in OT numbers among treatments, population reductions relative to untreated plots ranged from 50.7% in plots treated with CORAGEN SC

(Tmt. 6) to 95.1% in plots treated with the higher rate of CONCEPT 85 OD. By 30 July, 10 DAT, statistically significant OT populations reductions ranged from 79.5 % in plots treated with the lower rate of CONCEPT 85 OD to 95.5% in plots treated with the lower rate of XDE-175 25 WG. On that date, while OT populations in plots treated with CORAGEN SC were 45.5% lower than populations in untreated plots, the difference was not significant (Table 2). By 03 Aug, 14 DAT, maturing onions had lodged in all plots and OT populations had declined dramatically in untreated plots. No significant differences among any treatments were recorded on that date (Table 2).

CONCLUSIONS: When combined with the surfactant SYLGARD 309, foliar application of XDE-175 25WG, DPX-HGW86 10SC, CORAGEN SC or CONCEPT 85 OD reduced OT populations as effectively as the current commercial standard, MATADOR 120 EC. In this trial residual activity of DPX-HGW86 10 SC was greater than that of its analogue CORAGEN SC. Further investigation of all control agents is recommended to verify the need for combination with a surfactant and better define the rate of application.

Table 1. Foliar insecticides applied for evaluation of control of onions thrips, *Thrips tabaci* Lindeman, on set cooking onions in mineral soil, London, ON, 2007.

Tmt No.	Insecticide[1]	Formulation[1]	Rate/ha	
			a.i.	Product
1	lambda-cyhalothrin	MATADOR 120EC	22.5 g	188.0 ml
2	spinetoram	XDE-175 25WG	75.0 g	300.0 g
3	spinetoram	XDE-175 25WG	100.0 g	400.0 g
4	DPX-HGW86	DPX-HGW86 10SC	75.0 g	750.0 ml
5	DPX-HGW86	DPX-HGW86 10SC	100.0 g	1000.0 ml
6	chlorantraniliprole	CORAGEN SC	75.0 g	372.6 ml
7	imidacloprid + deltamethrin	CONCEPT 85 OD	41.3 g + 5.5 g	550.0 ml
8	imidacloprid + deltamethrin	CONCEPT 85 OD	48.8 g + 6.5 g	650.0 ml
9	untreated	----	---	---

Table 2. Effect of foliar application of insecticides on populations of onion thrips, *Thrips tabaci* Lindeman, on set cooking onions in mineral soil, London, ON, 2007.

Tmt. No.	Insecticide Applied	Rate (Pdct./ha)	Mean Number of Onion Thrips / Plant[1] on Indicated Date						
			39637	39641	39645	39651	39655	39658	03 Aug
1	MATADOR 120EC	188.0 ml	4.2 a[2]	7.9 a	6.3 a	4.1 b	4.5 b	2.3 b	3.1 a
2	XDE-175 25WG	300.0 g	11.1 a	4.7 a	7.8 a	1.0 b	1.6 b	1.1 b	2.7 a
3	XDE-175 25WG	400.0 g	6.1 a	6.0 a	12.8 a	2.6 b	3.2 b	1.1 b	2.2 a
4	DPX-HGW86 10SC	750.0 ml	15.7 a	5.4 a	14.0 a	0.9 b	4.2 b	2.0 b	3.4 a
5	DPX-HGW86 10SC	1000.0 ml	11.7 a	3.0 a	11.7 a	1.4 b	1.4 b	1.7 b	0.2 a
6	CORAGEN SC	372.6 ml	9.5 a	9.2 a	14.5 a	7.0 b	10.1 ab	13.3 ab	3.6 a
7	CONCEPT 85 OD	550.0 ml	13.1 a	5.3 a	9.7 a	3.2 b	3.3 b	5.0 b	6.9 a
8	CONCEPT 85 OD	650.0 ml	10.2 a	3.5 a	11.0 a	0.7 b	5.4 b	1.8 b	3.3 a
9	NO INSECTICIDE	---	11.0 a	9.0 a	13.7 a	14.2 a	15.5 a	24.4 a	3.9 a

[1] OT counted on only the 4 inner leaves of each plant on each date.
[2] Means within a column followed by the same letter are not significantly different ($P > 0.05$) as determined using ANOVA and Student-Neuman-Keul's Multiple Range means separation test.

2007 PMR REPORT# 32 **SECTION B : VEGETABLES and SPECIAL CROPS - Insect Pests**

CROP: Radish (*Raphanus sativus*), cv. Altebelle
PEST: Cabbage maggot (CM), *Delia radicum* (Linnaeus)

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TITLE: EVALUATION OF PLANTING TREATMENTS FOR CONTROL OF DAMAGE BY CABBAGE MAGGOT TO RADISH ON MINERAL SOIL, 2007

MATERIALS: PONCHO 600 FS (clothianidin 48% [w/w]), DPX-HGW 86 10 SC (DPX-HGW86 10% [w/w]), XDE-175 25 WG (spinetoram 25.0% [w/w]), RIMON 0.83 EC (novaluron 9.3% [w/w]), PYRINEX 480 EC (chlorpyrifos 480 g/L)

METHODS: On 11 May, radish seed (SD) treatments (Tmts. 1-2) were applied in the laboratory at SCPFRC-London by tumbling seed and insecticide formulation for each treatment together in a clean 2 lb plastic bag for 1-2 minutes until all seed was uniformly coated. Seed for all treatments (Table 1) was planted at the SCPFRC-London Research Farm on 18 May in 3-row microplots (2.25 m long x 0.9 m wide) filled with insecticide residue-free mineral soil (sandy loam - pH 6.5; 67% sand; 20% silt; 13% clay; 2.2% organic matter). All treatments were replicated three times in a randomized complete block design. In-furrow spray (IFS) treatments (Tmts. 3-8, 10) were applied in a 3-5 cm band at 125 kPa in 5 L/100 m row, using a hand-held, CO_2-pressurized, single-nozzled R&D plot sprayer fitted with a 4004E even flat spray tip, centred over the seed in the open seed furrow. Tmt. 9 was applied on 28 May at BBCH growth stage 10-11 (BBCH 10-11) at 135 kPa in 500 L/ha using a hand-held CO_2-pressurized R&D plot sprayer with a 0.6 m boom fitted with three XR8002VS flat spray tips. On 01 June when radishes were at BBCH 12, a total of 250 CM eggs from an insecticide-susceptible strain were buried 1 cm deep beside a 1 m length of the north (N) row in each plot. The infested row length was delineated by stakes and the infested row watered to optimize egg hatch and maggot survival. On 04 June the south (S) row in each plot was similarly infested. All radishes from the infested portions of N row of each plot were harvested on 15 June (BBCH 48-49) and from the S rows on 18 June (BBCH 49). Roots were washed, counted and inspected for CM damage. The percent roots showing any feeding damage was calculated for each plot. Data were subjected to arcsin square root transformation prior to statistical analysis by analysis of variance (ANOVA); significance of differences among treatments means was determined using Student-Neuman-Keul's Multiple Range means separation test. Untransformed data are presented.

OBSERVATIONS: No phytotoxicity was observed following any treatment. The experimental formulation XDE-175 25 WG did not readily suspend in water and required considerable agitation to prepare a sprayable solution.

RESULTS: Experimental results are outlined in Table 1. For both infestations, CM damage to radish in untreated CONTROL plots exceeded 30%. For both infestations, CM damage to radish was significantly reduced by at least 95% following IFS-application of chlorpyrifos (Tmt. 10), the current commercial standard for CM control in this crop. For both infestations CM damage was significantly reduced by at least 85% following SD-application of the higher rate of clothianidin (Tmt. 2). The only other treatment to significantly reduce CM damage to radish relative to damage recorded in untreated CONTROL plots for both infestations was IFS-application of the higher rate of DPX-HGW86 (Tmt. 4). For the first infestation only, SD-application of the lower rate of clothianidin (Tmt. 1) and IFS-application of the higher rate of application of spinetoram (Tmt. 6) also significantly reduced CM-damage relative to damage recorded in CONTROL plots. No method of application of novaluron (Tmt. 7-9) resulted in a significant reduction in CM-damage for either infestation.

CONCLUSIONS: IFS-application of chlorpyrifos, currently registered and recommended for control of CM damage to radish, was the most effective management strategy in this experiment. Further evaluation of SD-application of clothianidin is warranted to finalize application rates and determine possible residues in harvested radish following treatment. IFS-application of DPX-HGW86 and spinetoram demonstrated sufficient activity against CM to justify further investigation. Novaluron did not provide reliable control of CM-damage to radish.

Table 1. Effect of planting treatments on damage due to cabbage maggot attacking radishes on mineral soil, London, ON, 2007.

Tmt No.	Treatment Applied			Rate/1000 m Row[2]		Results for Indicated Infestation			
						Infestation 1		Infestation 2	
	Insecticide	Formulation	Method[1]	a.i.	Product	% Dam. Roots	% Dam. Reduction	% Dam. Roots	% Dam. Reduction
1	clothianidin	PONCHO 600 FS	SD	20.0 g[3]	33.0 ml[3]	4.4 bcd[5]	85.8	7.6 ab	75.3
2	clothianidin	PONCHO 600 FS	SD	30.0 g[3]	49.5 ml[3]	1.5 cd	95.2	4.3 b	86
3	DPX-HGW86	DPX-HGW86 SC	IFS	15.0 g	150.0 ml	8.0 abcd	74	7.2 ab	76.5
4	DPX-HGW86	DPX-HGW86 SC	IFS	25.0 g	250.0 ml	3.9 bcd	87.6	6.6 b	78.6
5	spinetoram	XDE-175 25 WG	IFS	15.0 g	60.0 g	6.8 abcd	78.1	12.2 ab	60.4
6	spinetoram	XDE-175 25 WG	IFS	25.0 g	100.0 g	3.3 cd	89.2	10.7 ab	65.3
7	novaluron	RIMON 10 EC	IFS	15.0 g	150.0 ml	19.9 abc	35.3	18.1 ab	41
8	novaluron	RIMON 10 EC	IFS	2.25 g	22.5 ml	28.8 a	6.9	13.3 ab	56.7
9	novaluron	RIMON 10 EC	F	90.0 g[4]	900.0 ml[4]	21.6 ab	30.2	6.4 ab	79.1
10	chlorpyrifos	PYRINEX 480 EC	IFS	40.8 g	85.0 ml	0.8 d	97.3	1.2 b	96.1
11	untreated	----	---	---	---	30.9 a	---	30.7 a	---

[1] method of application: SD - seed dressing applied to seed at least 48 h prior to planting; IFS - in seed-furrow spray over seed; F - broadcast foliar spray over entire plot at BBCH 10-11.
[2] amount/1000 m row; 0.25 m row spacing.
[3] - amount/kg seed.
[4] amt/ha.
[5] For each infestation, means followed by the same letter are not significantly different ($P < 0.05$) as determined using ANOVA and Student-Neuman-Keul's Multiple Range means separation test.

2007 PMR REPORT# 33 **SECTION C: POTATOES - Insect Pests**
STUDY DATABASE: 303-1251-9601

CROP: Potato (*Solanum tuberosum*), cv. Chieftain and cv. Superior
PEST: Wireworm, Agriotes spp.

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TITLE: EFFICACY OF SEED-PIECE OR IN-FURROW INSECTICIDE TREATMENTS AGAINST WIREWORM IN POTATOES, 2007

MATERIALS: PONCHO 600 FS (clothianidin 47-49% [w/w]), CRUISER 5FS (thiamethoxam 47.6% [w/w]), MAXIM PSP (fludioxonil 0.5% [w/w]), THIMET 15 G (phorate 15% [w/w]), ADMIRE 240 FS (imidacloprid 22% [w/w])

METHODS: Field trials were conducted at two sites in Canoe Cove and Bonshaw, Prince Edward Island, on land belonging to farmers with previous wireworm problems in a potato crop. From early spring until planting time, the land was lightly cultivated to prevent establishment of weeds which would act as an alternative food source for the insects. The experiment was set up in a randomized complete block design, with six treatments and four replications. The potato variety Chieftain was used at Canoe Cove and the variety Superior was used at Bonshaw. Each plot consisted of four treated rows spaced at 0.9 metres apart, with in-row seed-piece spacing of 0.3 metres. Two ADMIRE-treated buffer rows were planted between plots and on the outside edges of each replication. A two-metre bare soil pathway was left between replications, and a three-metre buffer zone of bare soil surrounded the entire plot area. Tubers were cut into seed pieces containing at least two eyes on 18 June. CRUISER at 4.2 g ai (Treatment 3) or 9.0 g ai (Treatment 4) per 100 kg of seed, and PONCHO at 6.2 g ai (Treatment 5) or 12.5 g ai (Treatment 6) per 100 kg of seed, were applied to pre-counted cut seed pieces. MAXIM fungicide at 2.5 g ai/100 kg seed was applied to the seed pieces for all treatments. Planting was done on 19 June at both sites using a two-row planter which dropped seed pieces into fertilized open rows, enabling the number and positioning of seed pieces in each row to be checked before being covered with soil. Prior to covering, THIMET at 32 g ai per 100 m of row was applied over the seed pieces in Treatment 2 using a hand shaker. The CHECK plots, Treatment 1, received only the MAXIM fungicide. On 16 July, emergence counts were done on all plots and all rows were hilled. Throughout the summer, applications of chlorothalonil were made on a regular spray schedule for late-blight prevention, and plants were periodically examined for signs of insecticide phytotoxicity. Weeds were removed by hand as required, as were Colorado potato beetle adults early in the season. To control Colorado potato beetle larvae in the CHECK plots, it was necessary to spot-spray ADMIRE on 2 August. REGLONE top-killer was applied to the entire experiment in Bonshaw on 10 September and in Canoe Cove on 2 October. Two samples were taken at each site, each sample consisted of hand harvesting tubers from six plants from the centre two rows of each treatment plot. From Bonshaw the first sample was taken on 27 September and the second set was taken on 11 October. In Canoe Cove the first set of samples were taken on 11 October and the second set on 22 October. All tubers collected were bagged on an individual plant basis. Subsequently, all tubers from each bag were washed, counted, and measured, and wireworm damage was rated as either scars (old damage) or holes (fresh damage) as per the protocol. Analyses of variance (ANOVA) were performed on the data. Differences in means was calculated using Least Significant Differences (LSD). Counts of blemishes were transformed to Ln(x+1) before analysis. Untransformed means are presented.

RESULTS: In Bonshaw, there was no significant difference in the number of scars and holes between treatments in the first sample, however for the second sample taken two weeks later, there were significantly fewer scars and holes in the THIMET treated plots as compared to CRUISER, PONCHO and the untreated CHECK (Table 1). When two samples were combined there was a significant reduction in scars in the THIMET treatment only (Table 2). A significant decrease in number of holes was found in the THIMET treatment but a significant increase in the number of holes was found in the CRUISER low rate treatment when compared to the untreated control. There was no significant difference between CRUISER low rate and high rate and the two rates of PONCHO. No significant difference in the number of holes was found between CRUISER high rate, PONCHO high and low rates and the untreated control. The percentage of damaged tubers was significantly reduced in the THIMET treatment with no significant difference found between the other treatments and the untreated CHECK. There was however, a significantly lower percentage of damaged tubers in PONCHO high rate when compared to the CRUISER low rate treatment but no significant difference was found between CRUISER low and high rate and PONCHO low rate. Results from the Canoe Cove site showed a significant decrease in the number of scars for all the treatment when compared to the untreated CHECK in the first sample but no significant difference was detected in the number of holes (Table 3). No significant difference were found in the number of scars or hole in the second sample. When the data were combined, a significant decrease in the number of scars was found for all treatments when compared to the untreated CHECK, however there were no significant differences between treatments (Table 4). No significant differences were found in the number of holes or the percent damaged tubers between treatments.

CONCLUSION: Under the conditions of this experiment, the seed piece treatments of CRUISER and PONCHO at the high and low rates were not effective in reducing the numbers of holes in the tubers or the percentage of damaged tubers at both sites. The in-furrow treatment of THIMET was effective at reducing holes and scars at one site but only scars at the other site. THIMET also reduced the percentage of damaged tubers at one site only.

Table 1. Effectiveness of seed-piece or in-furrow insecticide treatments in controlling wireworm damage to Superior potato tubers at two sample dates, Bonshaw, PEI, 2007.

Insecticide Applied	Rate (g a.i.)	Method[3]	Sample 1		Sample 2	
			Mean # of scars	Mean # of holes	Mean # of scars	Mean # of holes
CHECK - none	-	-	47.25	58	73.00 a[4]	88.50 a
THIMET 15 G	32.3 g[1]	IFG	16.5	17.25	30.75 b	28.75 b
CRUISER 5FS	4.2 g[2]	SPT	42.25	95	81.25 a	126.00 a
CRUISER 5FS	9.0 g[2]	SPT	34.75	57	59.25 a	107.75 a
PONCHO 600	6.2 g[2]	SPT	45.25	93.75	103.50 a	104.25 a
PONCHO 600	12.5 g[2]	SPT	45	77.25	64.00 a	108.00 a
ANOVA $p \leq 0.05$			ns	ns	s	s

[1] g ai per 100 m of row
[2] g ai per 100 kg of seed
[3] Method of application: IFG - in-furrow granular treatment; SPT - seed-piece treatment.
[4] Numbers in a column followed by the same letter are not statistically different ($P \leq 0.05$, Protected Least Significant Differences Test).

Table 2. Effectiveness of seed-piece or in-furrow insecticide treatments in controlling wireworm damage to Superior potato tubers, Bonshaw, PEI, 2007. (Data from the two samples combined)

Insecticide applied	Rate (g ai)	Method[3]	Mean # scars per plot	Mean # holes per plot	% damaged tubers/plot
CHECK - none	-	-	60.13 a[4]	73.25 b	49.28 ab
THIMET 15 G	32.3 g[1]	IFG	23.63 b	23.00 c	25.65 c
CRUISER 5FS	4.2 g[2]	SPT	61.75 a	110.50 a	61.08 a
CRUISER 5FS	9.0 g[2]	SPT	47.00 a	82.38 ab	47.70 ab
PONCHO 600	6.2 g[2]	SPT	74.38 a	99.00 ab	59.80 ab
PONCHO 600	12.5 g[2]	SPT	54.50 a	92.63 ab	47.20 b
ANOVA $p \leq 0.05$			s	s	s

[1] g ai per 100 m of row
[2] g ai per 100 kg of seed
[3] Method of application: IFG - in-furrow granular treatment; SPT - seed-piece treatment.
[4] Numbers in a column followed by the same letter are not statistically different ($P \leq 0.05$, Protected Least Significant Differences Test).

Table 3. Effectiveness of seed-piece or in-furrow insecticide treatments in controlling wireworm damage to Chieftain potato tubers at two sample dates, Canoe Cove, PEI, 2007.

Insecticide applied	Rate (g ai)	Method[3]	Sample 1		Sample 2	
			Mean # of scars	Mean # of holes	Mean # of scars	Mean # of holes
CHECK - none	-	-	14.75 a[4]	1	2.33	0.67
THIMET 15 G	32.3 g[1]	IFG	1.25 b	0.25	0.33	0.67
CRUISER 5FS	4.2 g[2]	SPT	8.75 b	14.5	3.33	3.67
CRUISER 5FS	9.0 g[2]	SPT	1.00 b	0.5	2	4
PONCHO 600	6.2 g[2]	SPT	0.25 b	0.75	0	0.67
PONCHO 600	12.5 g[2]	SPT	1.75 b	0.25	1.67	1
ANOVA $p \leq 0.05$			s	ns	ns	ns

[1] g ai per 100 m of row
[2] g ai per 100 kg of seed
[3] Method of application: IFG - in-furrow granular treatment; SPT - seed-piece treatment.
[4] Numbers in a column followed by the same letter are not statistically different ($P \leq 0.05$, Protected Least Significant Differences Test).

Table 4. Effectiveness of seed-piece or in-furrow insecticide treatments in controlling wireworm damage to Chieftain potato tubers, Canoe Cove, PEI, 2007. (Data from the two samples combined)

Insecticide Applied	Rate (g ai)	Method[3]	Mean # scars/plot	Mean # holes/plot	% damaged tubers/plot
CHECK - none	-	-	9.43 a[4]	0.86	12.2
THIMET 15 G	32.3 g[1]	IFG	0.86 b	0.43	2.25
CRUISER 5FS	4.2 g[2]	SPT	6.43 b	9.86	8.7
CRUISER 5FS	9.0 g[2]	SPT	1.43 b	2	4.7
PONCHO 600	6.2 g[2]	SPT	0.14 b	0.71	1.3
PONCHO 600	12.5 g[2]	SPT	1.71 b	0.57	3.63
ANOVA $p \leq 0.05$			s	ns	ns

[1] g ai per 100 m of row
[2] g ai per 100 kg of seed
[3] Method of application: IFG - in-furrow granular treatment; SPT - seed-piece treatment.
[4] Numbers in a column followed by the same letter are not statistically different ($P \leq 0.05$, Protected Least Significant Differences Test).

CROP: Corn, *Zea mays* (L.), Maizex cvs. MZ535 and MZ31-03RR
PEST: Western corn rootworm, *Diabrotica virgifera virgifera* (LeConte)

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TITLE: EVALUATION OF CORN SEED TREATMENTS FOR CONTROL OF WESTERN CORN ROOTWORM

MATERIALS: MAXIM XL (fludioxonil + metalaxyl-M, 229.59 + 87.66 g ai/L); DYNASTY 100 FS (azoxystrobin 100 g ai/L), CRUISER 5 FS (thiamethoxam, 5 g ai/L); PONCHO 600 FS (clothianidin, 600 g ai/L); FORCE 3.0 G (tefluthrin, 3 % v/v).

METHODS: Seed was treated on 7 May, 2007 in 500 g lots in individual plastic bags by applying a slurry of the material via syringe to each bag (all treatments diluted to a total volume of 4.75 ml/kg using water). The bag was inflated, and the seed was mixed for 1 min to ensure thorough seed coverage. Seed weights were 275 and 265 g/1000 seeds for MZ535 and MZ31-03RR, respectively. At Ridgetown, ON, corn was planted on 15 May as third year corn. MZ31-03RR was planted on 23 May at Wyoming, ON as second year corn. Trials at both locations were planted on clay loam soil in a RCBD with four replications. Plots were planted using a two-row cone-seeder at a rate of 8 seeds/m. Plots were 4 rows, 0.76 m wide and 10 and 6 m long at Ridgetown and Wyoming, respectively. FORCE 3G was applied in-furrow at planting using a Noble® plot scale applicator. The trial at Wyoming was inoculated with corn rootworm eggs prior to planting using a two-row cultivator modified to apply a 4 cm band of eggs, 5 cm deep and 9 cm on each side of the corn row. Eggs were suspended uniformly in a 0.15% agar solution at a concentration of 20 eggs/mL and delivered through tubes from a holding tank at a rate of 2000 eggs/m by a ground driven metering pump (Demco model MP-466). Plots were fertilized and maintained according to provincial recommendations.
Plant populations were recorded by counting all plants in the interior two rows of each plot. Vigour of the entire plot was assessed using a scale of 0-100% (100 = furthest developed plants and 0 = dead plants). Plant height and fresh weight assessments were conducted on ten plants from the outer rows of each plot. Six plants per plot were carefully dug from the outside two rows to maintain the entire root mass and were thoroughly washed to assess corn rootworm feeding injury using the Iowa State Node-Injury scale where 0.00 = no damage and 3.00 = 3 or more nodes pruned to within 3.8 cm (Oleson, J.D. et al. 2005). The interior two rows of each plot were harvested to obtain yield and test weight measurements and all yields were corrected to 15.5% moisture. Data were analysed by analysis of variance in SAS v. 9.1 (SAS Institute, Cary, NC) using PROC MIXED and means were separated using Fisher's least significant difference test at $P \leq 0.05$. Tukey's HSD test was used for multiple treatment comparisons.

OBSERVATIONS: At the Wyoming location, inoculation of western corn rootworm eggs was successful and adult populations were very high (approx. 20-30 beetles/plant) in July and August, causing severe silk clipping and reduced pollination. Following planting at Wyoming, wet conditions caused the soil to crust (26 May to 8 June: 38 mm total precipitation) resulting in difficult plant emergence, and for the remainder of the growing season, drought conditions were experienced with very little rainfall; 63.8 mm total rainfall from 23 May to 10 October. At Ridgetown, western corn rootworm adult populations were also high in July and August (approx. 15-20 beetles/plant).

RESULTS: At both trial locations, no differences were detected among treatments in plant population (Tables 1, 2). Vigour was unaffected by treatments at Ridgetown (Table 1). At Wyoming, vigour at the V1 stage was highest in Force 3.0 G treated plots and lowest in plots treated with Cruiser 5 FS at a rate of 0.625 mg ai/seed, but differences were not observed on subsequent sampling dates (Table 2). Height and fresh weight of plants was not different among treatments at the V8 stage at Ridgetown (Table 3). At the R1 stage, plots treated with Cruiser (0.625 g ai/100 kg seed) were significantly taller than those treated with Poncho 600 FS (1.25 mg ai/seed); fresh weight is not reported due to missing data points (Table 3). No differences were measured in plant height and fresh weight at the Wyoming location (Table 4). Feeding injury by corn rootworm was significantly decreased by all insecticide treatments at Ridgetown (Table 3). The least amount of injury was rated consistently on plants treated with the high rate of Cruiser (2.5 mg ai/seed) followed by Poncho (Table 3). Similar levels of damage were observed on Force and Cruiser (1.25 mg ai/seed) treated plants, but protection by Force was more consistent (Table 3). At Wyoming, rootworm feeding injury ratings averaged higher than at Ridgetown and treatment performance was not as consistent (Table 4). Plots treated with Cruiser (2.5 mg ai/seed) had the least amount of injury followed closely by Poncho (Table 4). Again, Cruiser (1.25 mg ai/seed) and Force-treated plots had similar levels of feeding damage (Table 4).
No differences in test weight were detected among any treatment (Table 5). No statistical differences existed among treatments in yield at either location (Table 5). At the Wyoming location, the high rate seed treatments of Cruiser (2.5 mg ai/seed) and Poncho produced numerically higher yields, followed by Force, but all plots yielded poorly (Table 5).

CONCLUSIONS: No consistent significant differences were measured in plant population and vigour among treatments. All insecticide treatments provided some root protection from injury by western corn rootworm under high population pressure. The high rate of Cruiser 5 FS (2.5 mg ai/seed) provided the greatest protection from root injury. Force 3.0 G and Cruiser (1.25 mg ai/seed) had similar levels of root injury. Low rates of Cruiser (0.3125 and 0.625) did not provide root protection. Only Cruiser (2.5 mg ai/seed) had a root injury rating less than 0.25 at Blenheim, ON; this is the level considered to provide very good root protection (Rice et al., 2007).

REFERENCES:

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Oleson, J.D., Y.L. Park, T.M. Nowatzki, and J.J. Tollefson. 2005. Node-injury scale to evaluate root injury by corn rootworms (Coleoptera: Chrysomelidae). J. Econ. Entomol. 98(1): 1-8.

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Table 1. Mean plant population and vigour of corn with seed and in-furrow applied insecticides for corn rootworm control in a continuous corn rotation at Ridgetown, Ontario in 2007.

Treatment	Rate (g ai/100 kg seed)	Mean Plant Population (# plants/m^2)			Mean Plant Vigour (0-100%)[3]		
		29 May (VE)	5 June (V4)	11 June (V4)	29 May (VE)	5 June (V4)	11 June (V4)
Untreated Check	--	4.1 a[4]	4.4 a	4.4 a	85.0 a	92.5 a	78.8 a
Maxim XL	3.5						
+ Dynasty 100 FS	1	3.7 a	4.2 a	4.3 a	79.5 a	85.0 a	80.0 a
Maxim XL	3.5						
+ Dynasty 100 FS	1						
+ Cruiser 5 FS	0.3125[1]	3.7 a	4.0 a	4.0 a	87.5 a	88.8 a	83.8 a
Maxim XL	3.5						
+ Dynasty 100 FS	1						
+ Cruiser 5 FS	0.625[1]	3.7 a	4.1 a	4.2 a	88.8 a	90.0 a	78.8 a
Maxim XL	3.5						
+ Dynasty 100 FS	1						
+ Cruiser 5 FS	1.25[1]	3.6 a	3.8 a	4.0 a	82.5 a	83.8 a	71.3 a
Maxim XL	3.5						
+ Dynasty 100 FS	1						
+ Cruiser 5 FS	2.5[1]	3.8 a	4.0 a	3.9 a	87.5 a	87.5 a	75.0 a
Maxim XL	3.5						
+ Dynasty 100 FS	1						
+ Poncho 600 FS	1.25[1]	4.1 a	4.4 a	4.4 a	82.5 a	96.3 a	83.8 a
Maxim XL	3.5						
+ Dynasty 100 FS	1						
+ Force 3.0 G	37.5[2]	4.0 a	4.2 a	4.3 a	88.8 a	92.5 a	88.8 a
SEM		0.39	0.32	0.30	5.827	4.059	6.663

[1] mg ai/seed.
[2] g per 100 m length of row applied in-furrow at planting.
[3] 0 = plants dead in plot and 100 = furthest developed plants in the trial.
[4] Means followed by the same letter do not significantly differ ($P \leq 0.05$, LSD) as determined by ANOVA and Fisher's Protected LSD.

Table 2. Mean plant population and vigour of corn with seed and in-furrow applied insecticides for corn rootworm control in second year corn at Wyoming, Ontario in 2007.

Treatment	Rate (g ai/100 kg seed)	Mean Plant Population (# plants/m^2)			Mean Plant Vigour (0-100%)[3]		
		5 June (V1)	13 June (V2)	19 June (V4)	5 June (V1)	13 June (V2)	19 June (V4)
Untreated Check	--	4.4 a[4]	4.7 a	4.6 a	87.5 ab	77.5 a	83.8 a
Maxim XL	3.5						
+ Dynasty 100 FS	1	4.3 a	4.7 a	4.7 a	80.0 ab	77.5 a	78.8 a
Maxim XL	3.5						
+ Dynasty 100 FS	1						
+ Cruiser 5 FS	0.3125[1]	4.3 a	4.7 a	4.8 a	80.0 ab	80.0 a	78.8 a
Maxim XL	3.5						
+ Dynasty 100 FS	1						
+ Cruiser 5 FS	0.625[1]	3.9 a	4.6 a	4.7 a	72.5 b	70.0 a	78.8 a
Maxim XL	3.5						
+ Dynasty 100 FS	1						
+ Cruiser 5 FS	1.25[1]	4.4 a	4.8 a	4.9 a	82.5 ab	78.8 a	81.3 a
Maxim XL	3.5						
+ Dynasty 100 FS	1						
+ Cruiser 5 FS	2.5[1]	4.1 a	4.5 a	4.7 a	82.5 ab	75.0 a	80.0 a
Maxim XL	3.5						
+ Dynasty 100 FS	1						
+ Poncho 600 FS	1.25[1]	4.3 a	4.8 a	5.0 a	82.5 ab	70.0 a	83.8 a
Maxim XL	3.5						
+ Dynasty 100 FS	1						
+ Force 3.0 G	37.5[2]	4.5 a	4.9 a	5.0 a	90.0 a	80.0 a	85.0 a
SEM		0.22	0.14	0.14	3.785	3.912	2.627

[1] mg ai/seed.
[2] g per 100 m length of row applied in-furrow at planting.
[3] 0 = plants dead in plot and 100 = furthest developed plants in the trial.
[4] Means followed by the same letter do not significantly differ ($P \leq 0.05$, LSD) as determined by ANOVA and Tukey's LSD test.

Table 3. Mean plant height, fresh weight, corn rootworm injury, and product performance consistency of seed and in-furrow applied insectcides for corn rootworm control in a continuous corn rotation at Ridgetown, Ontario in 2007.

Treatment	Rate (g ai/100 kg seed)	Mean Plant Height (cm)		Mean Fresh Weight (kg)	Mean Node Injury[3]	Product Consistency[4]
		25 June (V8)	20 July (R1)	25 June (V8)	20 July (R1)	
Untreated Check	--	81.8 a[5]	143.5 ab	0.77 a	1.42 c	12.5 ab
Maxim XL + Dynasty 100 FS	3.5 1	83.4 a	149.3 ab	0.88 a	1.16 bc	0.0 b
Maxim XL + Dynasty 100 FS + Cruiser 5 FS	3.5 1 0.3125[1]	85.5 a	157.5 ab	0.95 a	0.56 ab	33.3 ab
Maxim XL + Dynasty 100 FS + Cruiser 5 FS	3.5 1 0.625[1]	86.7 a	160.9 a	1.00 a	0.68 ab	25.0 ab
Maxim XL + Dynasty 100 FS + Cruiser 5 FS	3.5 1 1.25[1]	84.3 a	155.3 ab	0.85 a	0.32 a	46.0 ab
Maxim XL + Dynasty 100 FS + Cruiser 5 FS	3.5 1 2.5[1]	81.3 a	152.2 ab	0.82 a	0.23 a	66.8 a
Maxim XL + Dynasty 100 FS + Poncho 600 FS	3.5 1 1.25[1]	81.2 a	138.1 b	0.78 a	0.30 a	62.5 a
Maxim XL + Dynasty 100 FS + Force 3.0 G	3.5 1 37.5[2]	82.3 a	150.8 ab	0.80 a	0.34 a	62.5 a
SEM		1.886	5.8900	0.0549	0.1372	13.37

[1] mg ai/seed.
[2] g per 100 m length of row applied in-furrow at planting.
[3] Iowa State Node-Injury Scale (0.00-3.00).
[4] Percentage of times node-injury rating was ≤ 0.25.
[5] Means followed by the same letter do not significantly differ ($P \leq 0.05$, LSD) as determined by ANOVA and Tukey's HSD test.

Table 4. Mean plant height, fresh weight, corn rootworm injury, and product performance consistency of seed and in-furrow applied insecticides for corn rootworm control in second year corn at Wyoming, Ontario in 2007.

Treatment	Rate (g ai/100 kg seed)	Mean Plant Height (cm)		Mean Fresh Weight (kg)		Mean Node Injury[3]	Product Consistency[4]
		6 July (V4)	3 August (R1)	6 July (V4)	3 August (R1)	3 August (R1)	
Untreated Check	--	75.9 a[5]	112.7 a	0.65 a	1.47 a	1.49 a	0.0 b
Maxim XL + Dynasty 100 FS	3.5 1	76.0 a	112.8 a	0.58 a	1.56 a	1.70 a	0.0 b
Maxim XL + Dynasty 100 FS + Cruiser 5 FS	3.5 1 0.3125[1]	73.7 a	113.5 a	0.55 a	1.43 a	1.29 ab	12.5 ab
Maxim XL + Dynasty 100 FS + Cruiser 5 FS	3.5 1 0.625[1]	72.2 a	115.4 a	0.73 a	1.49 a	0.84 ab	8.5 ab
Maxim XL + Dynasty 100 FS + Cruiser 5 FS	3.5 1 1.25[1]	81.0 a	124.3 a	0.85 a	1.88 a	0.78 ab	12.5 ab
Maxim XL + Dynasty 100 FS + Cruiser 5 FS	3.5 1 2.5[1]	84.6 a	127.2 a	0.88 a	1.85 a	0.45 b	33.3 ab
Maxim XL + Dynasty 100 FS + Poncho 600 FS	3.5 1 1.25[1]	77.6 a	117.3 a	0.73 a	1.55 a	0.45 b	46.0 a
Maxim XL + Dynasty 100 FS + Force 3.0 G	3.5 1 37.5[2]	77.6 a	119.4 a	0.68 a	1.61 a	0.80 ab	8.3 ab
SEM		4.069	5.5524	0.1185	0.1450	0.2203	9.932

[1] mg ai/seed.
[2] g per 100 m length of row applied in-furrow at planting.
[3] Iowa State Node-Injury Scale (0.00-3.00).
[4] Percentage of times node-injury rating was ≤ 0.25.
[5] Means followed by the same letter do not significantly differ ($P \leq 0.05$, LSD) as determined by ANOVA and Tukey's HSD test.

Table 5. Mean test weight and yield of corn with seed and in-furrow applied insecticides for corn rootworm control in continuous corn at Ridgetown and Wyoming, Ontario in 2007.

Treatment	Rate (g ai/100 kg seed)	Ridgetown 19 October		Wyoming 11 October	
		Mean Test Weight (kg/hL)	Mean Yield (T/ha)	Mean Test Weight (kg/hL)	Mean Yield (T/ha)
Untreated Check	--	67.5 a[3]	6.33 a	0.15 a	1.74 a
Maxim XL	3.5				
+ Dynasty 100 FS	1	67.8 a	6.27 a	0.16 a	1.40 a
Maxim XL	3.5				
+ Dynasty 100 FS	1				
+ Cruiser 5 FS	0.3125[1]	67.5 a	7.81 a	0.16 a	1.90 a
Maxim XL	3.5				
+ Dynasty 100 FS	1				
+ Cruiser 5 FS	0.625[1]	67.6 a	8.23 a	0.16 a	2.05 a
Maxim XL	3.5				
+ Dynasty 100 FS	1				
+ Cruiser 5 FS	1.25[1]	67.6 a	6.44 a	0.16 a	2.32 a
Maxim XL	3.5				
+ Dynasty 100 FS	1				
+ Cruiser 5 FS	2.5[1]	67.6 a	7.90 a	0.16 a	3.66 a
Maxim XL	3.5				
+ Dynasty 100 FS	1				
+ Poncho 600 FS	1.25[1]	67.6 a	5.91 a	0.15 a	2.99 a
Maxim XL	3.5				
+ Dynasty 100 FS	1				
+ Force 3.0 G	37.5[2]	67.6 a	7.23 a	0.15 a	1.70 a
SEM		0.3197	0.7712	0.001	0.5425

[1] mg ai/seed.
[2] g per 100 m length of row applied in-furrow at planting.
[3] Means followed by the same letter do not significantly differ ($P \leq 0.05$, LSD) as determined by ANOVA and Fisher's Protected LSD.

2007 PMR REPORT# 35 **SECTION E: CEREAL, FORAGE, AND OILSEED CROPS - Insects**

CROP: Dry Bean, *Phaseolus vulgaris*, (L.), cv. AC Harohawk
PEST: Seedcorn maggot, *Delia platura* (Meigen), Wireworm, *Melanotus* spp. (LeConte)

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TITLE: EVALUATION OF SEED TREATMENTS TO CONTROL SEEDCORN MAGGOT AND WIREWORM IN EDIBLE BEANS

MATERIALS: TRILEX AL FS (metalaxyl + trifloxystrobin, 10.8 + 13.5 g ai/L), CAPTION CT WP (captan + thiophanate-methyl, 18% + 14% w/w), APRON MAXX RTA FS (fludioxonil + metalaxyl-M, 7.69 + 11.54 g ai/L); GAUCHO 480 FS (imidacloprid, 480 g ai/L); CRUISER 5 FS (thiamethoxam, 600 g ai/L); DCT DS (diazinon + captan + thiophanate methyl, 6% + 18% + 14% w/w).

METHODS: The black bean cultivar AC Harohawk was received pre-treated with insecticide and fungicide combinations from the research sponsor and seed weight was 193.8 g/1000 seed. Cattle manure was broadcast on the plots 2 weeks before planting and the soil was disked shortly after manure application. The crop was planted on 9 May 2007 at a seeding rate of 20 seeds/m at Ridgetown, ON using a 2-row cone seeder. Plots were 2 rows, spaced 0.76 m apart and 4 m in length placed in a RCBD with 4 replications. The plots were fertilized and maintained according to provincial recommendations. Dual II Magnum (s-metolachlor/benoxacor) plus Pursuit (imazethapyr) herbicides were applied pre-plant at rates of 1.15 and 0.312 L/ha, respectively.
Plant population and vigour were evaluated on each plot at V1, V3, and V8 stages. Vigour was assessed using a scale of 0-100% (0 = plants dead in plot and 100 = furthest developed plants in the trial). Two one metre row lengths were destructively sampled from one row of each plot to evaluate seed corn maggot damage at V1 and V10 stages, respectively using a rating scale of 0-3 (0 = no damage, 1 = some damage on cotyledons, 2 = seed emerged but feeding evident, and 3 = damaged and rotted seed). The soil within a 10 cm wide by 10 cm deep trench surrounding the seedlings was sifted through at the time of destructive sampling to exhume, identify, and count all soil inhabiting pests. Bean leaf beetle defoliation was also rated at V1 by estimating the percent defoliation on the last fully expanded trifoliate. The unsampled row of each plot was hand harvested and yields were corrected to 14.5% moisture. Data were analysed by analysis of variance in SAS v. 9.1 (SAS Institute, Cary, NC) using PROC MIXED and means were separated using Fisher's least significant difference test at $P \leq 0.05$. Tukey's HSD test was used for multiple treatment comparisons.

OBSERVATIONS: Seedcorn maggots, wireworms, and millipedes were found feeding on seedlings on both sampling dates; pest counts and damage ratings were lower on the second sampling date of 10 June (Tables 3, 4). Because bean leaf beetles were found defoliating leaves at the V1 stage, defoliation was also rated at the time of first destructive sampling (Table 3).

RESULTS: Plant population was highest in plots treated with the high rate of Cruiser 5 FS (50 g ai/100 kg seed) and Apron Maxx followed by seed treated with Trilex AL FS +Gaucho 480 FS +DCT DS (Table 1). Plots treated with Caption CT WP on its own or in combination with Trilex AL FS had the lowest plant population (Table 1). No significant differences were measured in vigour among treatments (Table 1).
Overall mean damage ratings were not significantly different among treatments on either sampling date (Table 4). On 28 May, seedlings treated with Trilex AL FS + DCT DS + Gaucho 480 FS and those treated with both rates of Cruiser 5 FS + Apron Maxx had more undamaged plants than those treated with Caption CT WP or Trilex AL FS + Caption CT WP (Table 2). More feeding damage was generally observed on seed without any insecticide treatment on 28 May, but the similarity in damage ratings between fungicide and insecticide treatments suggests that fungal pathogens may have exacerbated the damage caused by insect feeding with secondary infections leading to necrosis (Table 2). No differences were measured between the mean fresh weights of seedlings exhumed on either sampling date (Table 4). No reduction in seedcorn maggot or wireworm incidence can be attributed to any insecticide seed treatment in the trial (Table 3). All insecticide seed treatments significantly reduced bean leaf beetle defoliation, but no differences existed among treatments (Table 3). No differences were observed in yield among any treatment combinations (Table 4), suggesting that neither insect nor disease pressure reached economic injury levels during the trial.

CONCLUSIONS: No significant differences were measured in vigour among treatments. Overall damage ratings from insect feeding were not statistically different among treatments. Damage was generally reduced on insecticide treated seedlings, but secondary fungal infections likely contributed to the damaged appearance of seedlings as fungicide treated plots tended to have reduced damage ratings. Seedlings treated with Trilex AL FS + DCT DS + Gaucho 480 FS or with either rate of Cruiser 5 FS + Apron Maxx had more undamaged plants at the V1 stage than those treated with Caption CT WP or Trilex AL FS + Caption CT WP. No differences in seedling fresh weight were measured. Insect populations were not decreased in treated plots; all insecticide treatments decreased bean leaf beetle defoliation without differences among treatments. No differences were found in yield, suggesting that neither insect nor disease pests reached economic injury levels in this trial.

Table 1. Mean plant population and vigour of edible bean cv. AC Harohawk with seed applied fungicides and insecticides for seedcorn maggot control at Ridgetown, Ontario, 2007.

Treatment	Rate (g ai /100 kg seed)	Mean Plant Population (# plants/m^2)			Mean Plant Vigour (0-100%)[1]		
		28 May (V1)	8 June (V3)	18 June (V8)	28 May (V1)	8 June (V3)	18 June (V8)
Untreated Check	---	10.1 bcd[2]	10.2 bcd	10.6 bc	52.5 a	62.5 a	62.5 a
Trilex AL FS	9	14.8 abcd	14.8 abc	15.5 abc	75.0 a	77.5 a	75.0 a
Caption CT WP	166	9.6 bcd	9.2 cd	9.9 c	45.0 a	58.8 a	62.5 a
Trilex AL FS + Caption CT WP	9 166	9.0 bd	8.9 bcd	10.1 bc	50.0 a	57.5 a	53.8 a
Apron Maxx RTA FS	6.25	12.0 abcd	11.0 bcd	12.5 abc	67.5 a	75.0 a	71.3 a
Gaucho 480 FS	62.5	12.0 abcd	13.0 bcd	13.7 abc	62.5 a	75.0 a	77.5 a
Trilex AL FS + Gaucho 480 FS	9 62.5	11.0 abcd	11.8 abcd	12.2 abc	52.5 a	71.3 a	68.8 a
Apron Maxx RTA FS + Gaucho 480 FS	6.25 62.5	13.6 abcd	13.9 abcd	14.7 abc	65.0 a	81.3 a	73.8 a
Trilex AL FS + Caption CT WP + Gaucho 480 FS	9 166 62.5	10.9 bcd	11.5 abcd	12.1 abc	57.5 a	66.3 a	61.3 a
Trilex AL FS + DCT DS + Gaucho 480 FS	9 198 62.5	15.9 abcd	16.3 ab	16.4 ab	92.5 a	90.0 a	87.5 a
Apron Maxx RTA FS + Cruiser 5 FS	6.25 30	13.8 abcd	14.0 abcd	15.9 abc	70.0 a	77.5 a	71.3 a
Apron Maxx RTA FS + Cruiser 5 FS	6.25 50	17.0 a	17.3 a	17.9 a	92.5 a	88.8 a	88.8 a
SEM		1.873	1.627	1.739	10.417	8.767	7.768

[1] 0 = plants dead in plot and 100 = furthest developed plants in the trial.
[2] Means followed by the same letter do not significantly differ ($P \leq 0.05$, LSD) as determined by ANOVA and Tukey's HSD test.

Table 2. Percentage of plants per damage category resulting from destructive sampling of one metre row of edible bean seedlings cv. AC Harohawk treated with seed treatments at Ridgetown, Ontario, and rated on 28 May and 21 June, 2007.

Treatment	Rate (g ai /100 kg seed)	Mean % of plants damaged per category[1,2]							
		28 May (V1)				21 June (V10)			
		0	1	2	3	0	1	2	3
Untreated Check	---	18.8 ab[3]	36.8 a	18.5 ab	26.0 a	68.0 a	32.0 a	0.0 a	0.0 a
Trilex AL FS	9	32.5 ab	23.8 a	19.5 ab	24.3 a	73.8 a	21.5 a	4.8 a	0.0 a
Caption CT WP	166	14.0 b	13.8 a	16.0 ab	41.8 a	47.8 a	47.3 a	2.8 a	2.3 a
Trilex AL FS + Caption CT WP	9 166	11.3 b	29.5 a	26.8 a	27.8 a	57.0 a	35.5 a	4.0 a	3.5 a
Apron Maxx RTA FS	6.25	20.8 ab	38.0 a	14.0 ab	27.3 a	64.8 a	29.3 a	0.0 a	6.3 a
Gaucho 480 FS	62.5	21.0 ab	39.8 a	2.5 b	36.8 a	72.3 a	26.0 a	0.0 a	1.8 a
Trilex AL FS + Gaucho 480 FS	9 62.5	33.0 ab	20.5 a	12.0 ab	34.3 a	55.5 a	42.3 a	0.0 a	2.3 a
Apron Maxx RTA FS + Gaucho 480 FS	6.25 62.5	42.5 ab	20.0 a	9.5 ab	28.0 a	62.8 a	35.8 a	1.5 a	0.0 a
Trilex AL FS + Caption CT WP + Gaucho 480 FS	9 166 62.5	38.8 ab	21.5 a	7.8 ab	34.0 a	57.5 a	42.5 a	0.0 a	0.0 a
Trilex AL FS + DCT DS + Gaucho 480 FS	9 198 62.5	52.8 a	20.3 a	11.0 ab	16.0 a	72.8 a	23.0 a	1.5 a	3.0 a
Apron Maxx RTA FS + Cruiser 5 FS	6.25 30	56.3 a	23.8 a	3.0 ab	17.5 a	80.3 a	17.0 a	1.5 a	1.0 a
Apron Maxx RTA FS + Cruiser 5 FS	6.25 50	53.3 a	17.8 a	6.5 ab	22.2 a	72.5 a	26.3 a	1.3 a	0.0 a
SEM		0.166	0.1131	0.0387	0.1519	0.1152	0.1261	0.0556	0.06

[1] 0 = no damage, 1 = some damage on cotyledons, 2 = seed emerged but feeding evident, 3 = damaged and rotted seed.

[2] Percentages were transformed using the arcsine square root transformation prior to ANOVA; means reported are transformed back to the original scale. SEM reported from transformed data.

[3] Means followed by the same letter do not significantly differ ($P \leq 0.05$, LSD) as determined by ANOVA and Tukey's HSD test.

Table 3. Mean percent defoliation from bean leaf beetle *Cerotoma trifurcata* Förster feeding on 10 plants per plot and the mean number of soil inhabiting pests found by sifting through the soil around one metre row of edible bean seedlings cv. AC Harohawk treated with seed treatments at Ridgetown, Ontario, and sampled on 28 May and 21 June, 2007.

Treatment	Rate (g ai /100 kg seed)	% BLB defoliation[1] 28 May (V1)	Mean Number of Insects per Metre Row[2]					
			28 May (V1)			21 June (V10)		
			SCM[4]	WWM	Millipedes	SCM	WWM	Millipedes
Untreated Check	---	27.5 bc[3]	0.3 a	2.3 a	0.5 a	0.0 a	0.5 a	1.0 a
Trilex AL FS	9	16.5 b	0.8 a	1.0 a	0.5 a	0.5 a	0.3 a	1.0 a
Caption CT WP	166	22.3 bc	1.0 a	1.5 a	0.3 a	0.3 a	1.5 a	0.3 a
Trilex AL FS + Caption CT WP	9 166	27.5 c	3.3 a	1.8 a	0.0 a	0.3 a	1.0 a	1.5 a
Apron Maxx RTA FS	6.25	24.8 bc	1.5 a	0.5 a	0.0 a	0.3 a	0.3 a	0.8 a
Gaucho 480 FS	62.5	4.5 a	2.8 a	1.5 a	0.8 a	0.5 a	0.3 a	1.0 a
Trilex AL FS + Gaucho 480 FS	9 62.5	4.5 a	1.8 a	0.8 a	1.8 a	0.3 a	0.5 a	0.5 a
Apron Maxx RTA FS + Gaucho 480 FS	6.25 62.5	3.0 a	3.5 a	0.3 a	0.0 a	0.3 a	1.3 a	0.3 a
Trilex AL FS + Caption CT WP + Gaucho 480 FS	9 166 62.5	4.8 a	2.3 a	1.0 a	0.0 a	0.8 a	1.3 a	0.8 a
Trilex AL FS + DCT DS + Gaucho 480 FS	9 198 62.5	3.5 a	1.3 a	1.5 a	0.3 a	0.0 a	0.8 a	0.5 a
Apron Maxx RTA FS + Cruiser 5 FS	6.25 30	3.3 a	0.8 a	1.0 a	1.3 a	0.0 a	0.0 a	0.3 a
Apron Maxx RTA FS + Cruiser 5 FS	6.25 50	2.8 a	1.8 a	2.3 a	0.5 a	0.3 a	0.5 a	0.8 a
SEM		0.0232	0.186	0.152	0.110	0.081	0.119	0.129

[1] Percentages were transformed using the arcsine square root transformation prior to ANOVA; means reported are transformed back to the original scale. SEM reported from transformed data. An outlier (treatment: Caption CT WP (166 g ai/100 kg seed), block 2) was removed to meet the assumptions of the analysis.
[2] Percentages were transformed using the $\log_{10}$ (y+1) transformation prior to ANOVA; means reported are transformed back to the original scale. SEM reported from transformed data.
[3] Means followed by the same letter do not significantly differ ($P \leq 0.05$, LSD) as determined by ANOVA and Tukey's HSD test.
[4] SCM = seedcorn maggot *Delia platura* Meighen, WWM = wireworm *Melanotus* spp.

Table 4. Results of destructive sampling of one metre row and yield of edible beans seedlings cv. AC Harohawk with seed applied insecticides for seedcorn maggot control at Ridgetown, Ontario, 2007.

Treatment	Rate (g ai /100 kg seed)	Mean Damage Rating[1]	Mean Fresh Weight per Plant (g)	Mean Damage Rating	Mean Fresh Weight per Plant (g)	Yield (T/ha)
		28 May (V1)		21 June (V10)		19 Sept
Untreated Check	--	1.29 a[2]	5.51 a	0.32 a	8.75 a	3.15 a
Trilex AL FS	9	1.21 a	6.18 a	0.31 a	9.75 a	2.96 a
Caption CT WP	166	0.94 a	5.04 a	0.59 a	9.25 a	2.68 a
Trilex AL FS + Caption CR WP	9.0 166.0	1.62 a	5.48 a	0.54 a	7.25 a	3.19 a
Apron Maxx RTA FS	6.25	1.08 a	5.95 a	0.48 a	8.00 a	2.92 a
Gaucho 480 FS	62.5	0.52 a	4.55 a	0.31 a	10.5 a	3.06 a
Trilex AL FS + Gaucho 480 FS	9 62.5	0.82 a	5.08 a	0.49 a	9.25 a	2.66 a
Apron Maxx RTA FS + Gaucho 480 FS	6.25 62.5	0.68 a	5.17 a	0.39 a	14.0 a	3.19 a
Trilex AL FS + Caption CT WP + Gaucho 480 FS	9 166 62.5	0.60 a	5.65 a	0.42 a	12.5 a	2.74 a
Trilex AL FS + DCT DS + Gaucho 480 FS	9 198 62.5	0.75 a	7.03 a	0.35 a	14.5 a	2.94 a
Apron Maxx RTA FS + Cruiser 5 FS	6.25 30	0.39 a	5.61 a	0.24 a	6.50 a	2.44 a
Apron Maxx RTA FS + Cruiser 5 FS	6.25 50	0.50 a	6.22 a	0.29 a	12.3 a	3.24 a
SEM		0.2580	0.5672	0.109	2.307	0.3985

[1] 0 = no damage, 1 = some damage on cotyledons, 2 = seed emerged but feeding evident, 3 = damaged and rotted seed.
[2] Means followed by the same letter do not significantly differ ($P \leq 0.05$, LSD) as determined by ANOVA and Tukey's HSD test.

2007 PMR REPORT# 36 **SECTION E: CEREAL, FORAGE CROPS, and OILSEEDS - Insects**

CROP: Soybean, *Glycine max* (L.) Merr., cvs. OAC Kent and Pioneer M33RR
PEST: Bean Leaf Beetle, *Cerotoma trifurcata* (Förster)

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TITLE: EVALUATION OF FOLIAR INSECTICIDES FOR CONTROL OF OVERWINTERING AND FIRST GENERATION BEAN LEAF BEETLES

MATERIALS: ACTARA 25 WG (thiamethoxam, 25% v/v), MATADOR 120 EC (lambda-cyhalothrin 120 g ai/L), A13623B (experimental), CYGON 480 EC (dimethoate, 480 g ai/L).

METHODS: Soybean fields at Petrolia and Blenheim, Ontario were identified with high populations of overwintering (F_0) and first generation (F_1) bean leaf beetles, respectively, to evaluate the effectiveness of foliar insecticides for their control. Both fields were planted by the grower after winter wheat on clay loam soil with no-till planters in 18.8 cm rows. At Petrolia, ON, the cultivar OAC Kent was planted on 20 May, and at Blenheim, ON, Pioneer M33RR was planted on 23 May. Trials were placed a minimum of 20 m from any field edge and plots 3 m wide by 10 m long were staked in a RCBD. Insecticide was applied using a handheld three-nozzle CO_2 precision sprayer (R&D Sprayers Inc.). The nozzle type was XR Teejet 11002 VS with a nozzle spacing of 50 cm. Insecticide was prepared in two-litre plastic pop bottles according to assigned rates with 0.600 L of distilled water or 200 L/ha. Two passes covered the plot at a height of 0.5 m from the ground at a walking speed of 0.5 m/s. At Petrolia, conditions during spraying were 18.3ºC, 60% RH with 2.3 mph average wind speed, and 19.4ºC, 63% RH and 3.8 mph average wind speed at Blenheim.
Assessments were made at 0, 3, 7, and 14 days after application of insecticides. Vigour of the entire plot was assessed using a scale of 0-100% (100 = furthest developed plants and 0 = dead plants). Bean leaf beetle population was assessed by counting all beetles captured in a sweep net following 10 sweeps per plot. The last fully expanded trifoliate was assessed for percent defoliation on 20 plants per plot. A swath 1.3 m wide and 8 m long was harvested from the centre of each plot with a Hege plot combine and yields were corrected to 14.5% moisture. Data were analysed by analysis of variance in SAS v. 9.1 (SAS Institute, Cary, NC) using PROC MIXED and means were separated using Fisher's least significant difference test at $P \leq 0.05$. Tukey's HSD test was used for multiple treatment comparisons.

OBSERVATIONS: At the Petrolia location, beetle numbers seemed to be declining at the time of insecticide application, likely due to completion of the overwintering generation; identification of an infested field earlier in the season may have had a higher population.

RESULTS: No significant differences were detected among treatments in vigour at either location (Table 1). No differences in beetle counts were observed at the Petrolia location three days after application, and no beetles were caught after this date (Table 2), likely due to completion of the overwintering generation. Beetle knockdown was evident at the Blenheim location three days after application; beetle numbers were significantly lower in all treated plots (Table 2). The fewest beetles were counted in plots treated with the high rate of Matador (28 g ai/ha), and no differences were measured between Actara, Matador low and medium rates (10.0 and 16.8 g ai/ha), and A13623B (Table 2). Significantly higher numbers of beetles were counted in the Cygon treated plots on this date (Table 2). Following seven days after application, beetle numbers had decreased in all treated plots from three days after application; plots treated with Actara and Cygon had the highest numbers of beetles, while all other insecticide treated plots had less than 1 beetle/10 sweeps (Table 2). By 14 days after application, beetle numbers in all plots had resurged to the level in the untreated plots (Table 2). The small plot size and close proximity of plots likely allowed beetles to move across all plots, but significant residual activity was not demonstrated by the insecticide treatments, although plots treated with the high rate of Matador had the fewest beetles present on the last sampling date (Table 2).

Defoliation was decreased three days after insecticide application at the Petrolia location, although no differences were measured among treatments (Table 3). Defoliation was not different among treatments at the Blenheim location at three or seven days after application (Table 3). Fourteen days after application, defoliation was lower in all treated plots than untreated, although only significantly different in plots treated with the mid rate of Matador (16.8 g ai/ha) and the low rates of A13623B (11.7, and 23.3 g ai/ha) (Table 3).

No significant differences were measured in yield at either location, indicating that bean leaf beetle populations did not reach economic injury levels in these trials (Table 4).

CONCLUSIONS: Conclusions cannot be made about control of the overwintering generation of bean leaf beetles from this study due to very low numbers of beetles completing that generation at the time of the trial. Matador 120 EC, A13623B, Cygon 480 EC and Actara 25 WG treatments provided control of first generation bean leaf beetle populations at one location. The greatest effect was observed with Matador 120 EC at a rate of 28.0 g/ha. All concentrations of Matador and A13623B provided better control than Cygon and Actara. Fourteen days after application, beetles had returned to the plots and no differences were observed among treated and untreated plots. Defoliation did not appear to be reduced until fourteen days after application in treated plots, but no differences existed among treatments. The treatments did not affect vigour or yield. Bean leaf beetle numbers did not reach economic injury levels in this study.

Table 1. Mean plant vigour at 0, 3, 7, and 14 days after application of foliar insecticides for control of overwintering (F_0) and first (F_1) generation bean leaf beetles in soybeans at Petrolia and Blenheim, Ontario in 2007.

Treatment	Rate (g ai/ha)	Mean Plant Vigour (0-100%)[1]			
Petrolia (F_0)		12 June (V2) 0 DAA	15 June (V3) 3 DAA	19 June (V3) 7 DAA	27 June (V8) 14 DAA
Untreated Check	--	95	95.0 a[2]	95.0 a	93.8 a
Actara 25 WG	28.0	93.8	92.5 a	91.3 a	91.3 a
Matador 120 EC	10.0	95.0	93.8 a	91.3 a	90.0 a
Matador 120 EC	16.8	96.3	97.5 a	93.8 a	95.0 a
Matador 120 EC	28.0	98.8	98.8 a	100.0 a	96.3 a
A13623B	11.7	100.0	100.0 a	93.8 a	95.0 a
A13623B	23.3	98.8	98.8 a	95.0 a	93.8 a
A13623B	37.0	95.0	96.3 a	91.3 a	90.0 a
A13623B	45.5	96.3	95.0 a	91.3 a	90.0 a
Cygon 480 EC	480.0	98.8	97.5 a	96.3 a	92.5 a
SEM			2.327	3.070	2.814
Blenheim (F_1)		12 July (R1) 0 DAA	16 July (R1) 3 DAA	20 July (R2) 7 DAA	27 July (R3) 14 DAA
Untreated Check	--	88.8	92.5 a	98.8 a	90.0 a
Actara 25 WG	28.0	96.3	100.0 a	96.3 a	98.8 a
Matador 120 EC	10.0	92.5	95.0 a	95.0 a	93.8 a
Matador 120 EC	16.8	97.5	93.8 a	95.0 a	93.8 a
Matador 120 EC	28.0	95.0	97.5 a	90.0 a	93.8 a
A13623B	11.7	93.8	100.0 a	96.3 a	97.5 a
A13623B	23.3	98.8	98.8 a	97.5 a	95.0 a
A13623B	37.0	91.3	96.3 a	98.8 a	95.0 a
A13623B	45.5	98.8	100.0 a	97.5 a	95.0 a
Cygon 480 EC	480.0	95.0	93.8 a	90.0 a	86.3 a
SEM			2.458	2.776	3.252

[1] 0 = plants dead in plot and 100 = furthest developed plants in the trial.
[2] Means followed by the same letter do not significantly differ ($P \leq 0.05$, LSD) as determined by ANOVA and Fisher's Protected LSD.

Table 2. Bean leaf beetle counts 0, 3, 7, and 14 days after application of foliar insecticides for control of overwintering (F_0) and first (F_1) generation bean leaf beetles in soybeans at Petrolia and Blenheim, Ontario in 2007.

Treatment	Rate (g ai/ha)	Bean Leaf Beetle Sweep Counts			
		12 June (V2)	15 June (V3)	19 June (V3)	27 June (V8)
Petrolia (F_0)		0 DAA	3 DAA	7 DAA	14 DAA
Untreated Check	--	0.52	0.75 a[1,2]	0.00	0.00
Actara 25 WG	28.0	0.17	0.25 a	0.00	0.00
Matador 120 EC	10.0	0.27	0.50 a	0.00	0.00
Matador 120 EC	16.8	0.00	0.00 a	0.00	0.00
Matador 120 EC	28.0	0.52	1.00 a	0.00	0.00
A13623B	11.7	0.35	0.50 a	0.00	0.00
A13623B	23.3	0.00	0.00 a	0.00	0.00
A13623B	37.0	0.35	0.75 a	0.00	0.00
A13623B	45.5	0.62	1.00 a	0.00	0.00
Cygon 480 EC	480.0	0.17	0.25 a	0.00	0.00
SEM			0.096		
		12 July (R1) 0	16 July (R1)	20 July (R2)	27 July (R3)
Blenheim (F_1)		DAA	3 DAA	7 DAA	14 DAA
Untreated Check	--	49.0	22.0 c	21.3 c	23.5 a
Actara 25 WG	28.0	45.5	3.8 ab	3.8 b	17.0 a
Matador 120 EC	10.0	50.5	2.0 ab	0.3 a	16.0 a
Matador 120 EC	16.8	62.5	3.0 ab	0.3 a	17.0 a
Matador 120 EC	28.0	49.5	0.5 a	0.3 a	8.8 a
A13623B	11.7	52.0	3.3 ab	0.3 a	12.5 a
A13623B	23.3	58.0	1.3 ab	0.5 a	18.5 a
A13623B	37.0	2.5	2.0 ab	0.0 a	16.5 a
A13623B	45.5	49.3	3.3 ab	0.0 a	17.3 a
Cygon 480 EC	480.0	41.3	5.5 b	4.0 b	16.8 a
SEM			0.1275	0.0733	0.0964

[1] Means followed by the same letter do not significantly differ ($P \leq 0.05$, LSD) as determined by ANOVA and Tukey's HSD test.
[2] Analyses and SEM derived from data transformed using $\log_{10}(y+1)$. Means reported are transformed back to the original scale.

Table 3. Mean plant defoliation at 0, 3, 7, and 14 days after application of foliar insecticides for control of overwintering (F_0) and first (F_1) generation bean leaf beetles in soybeans at Petrolia and Blenheim, Ontario in 2007.

Treatment	Rate (g ai/ha)	Mean Defoliation (%)			
		12 June (V2)	15 June (V3)	19 June (V3)	27 June (V8)
Petrolia (F_0)		0 DAA	3 DAA	7 DAA	14 DAA
Untreated Check	--	10.38	4.80 a[1,2]	4.88 a	1.56 a
Actara 25 WG	28.0	11.56	6.00 a	12.13 a	2.00 a
Matador 120 EC	10.0	13.44	6.50 a	7.25 a	2.44 a
Matador 120 EC	16.8	8.69	5.62 a	5.81 a	2.06 a
Matador 120 EC	28.0	11.19	3.94 a	9.44 a	1.50 a
A13623B	11.7	8.25	5.03 a	7.63 a	1.38 a
A13623B	23.3	13.25	5.63 a	7.69 a	1.09 a
A13623B	37.0	11.38	6.81 a	4.25 a	1.31 a
A13623B	45.5	12.31	4.69 a	9.19 a	1.13 a
Cygon 480 EC	80.0	9.38	6.44 a	8.13 a	1.69 a
SEM			0.1231	0.1083	0.0596
		12 July (R1)	16 July (R1)	20 July (R2)	27 July (R3)
Blenheim (F_1)		0 DAA	3 DAA	7 DAA	14 DAA
Untreated Check	--	10.56	12.81 a	12.94 a	6.56 b
Actara 25 WG	28	9.63	13.13 a	13.44 a	4.25 ab
Matador 120 EC	10	11.88	13.88 a	13.69 a	3.19 ab
Matador 120 EC	16.8	13.56	15.06 a	15.69 a	2.31 a
Matador 120 EC	28.0	12.19	13.63 a	13.94 a	3.06 ab
A13623B	11.7	11.63	16.38 a	14.00 a	2.25 a
A13623B	23.3	11.50	11.13 a	12.94 a	1.88 a
A13623B	37.0	9.63	13.25 a	15.19 a	3.00 ab
A13623B	45.5	11.13	11.06 a	12.38 a	2.31 ab
Cygon 480 EC	480.0	10.00	12.25 a	12.06 a	3.88 ab
SEM			0.0544	0.0513	0.0740

[1] Means followed by the same letter do not significantly differ ($P \leq 0.05$, LSD) as determined by ANOVA and Tukey's HSD test.

[2] Analyses and SEM derived from data transformed using $\log_{10}(y+1)$. Means reported are transformed back to the original scale.

Table 4. Yield of soybeans treated with foliar applications of insecticides for control of overwintering (F_0) and first generation (F_1) bean leaf beetles in 2007.

Treatment	Rate (g ai/ha)	Mean Yield (T/ha)	
		Petrolia (F_0)	Blenheim (F_1)
Untreated Check	--	2.76 a[1]	2.50 a
Actara 25 WG	28	2.72 a	2.53 a
Matador 120 EC	10.0	2.75 a	2.61 a
Matador 120 EC	16.8	2.71 a	2.60 a
Matador 120 EC	28.0	2.81 a	2.44 a
A13623B	11.7	2.81 a	2.54 a
A13623B	23.3	2.71 a	2.70 a
A13623B	37.0	2.82 a	2.59 a
A13623B	45.5	2.76 a	2.75 a
Cygon 480 EC	480.0	2.93 a	2.39 a
SEM		0.0858	0.1658

[1] Means followed by the same letter do not significantly differ ($P \leq 0.05$, LSD) as determined by ANOVA and Fisher's Protected LSD.

2007 PMR REPORT# 37 **SECTION F: ORNAMENTALS and GREENHOUSE – Insect Pests**

CROP: Hybrid rose (*Rosa* L. *x hybrida)* cv. 'Orange Blossom Special'
PEST: Rose midge, *Dasineura rhodophaga* Coquillett

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TITLE: EVALUATION OF INSECTICIDES FOR CONTROL OF ROSE MIDGE, 2007

MATERIALS: AVID 1.9 % EC (abamectin, 19 g/L); DOKTOR DOOM 0.5 % RTU (permethrin, 5 g/L) plus a spreader-sticker; SCIMITAR CS (lambda-cyhalothrin, 100 g/L).

METHODS: The trial was conducted at a commercial nursery in Langley, British Columbia, Canada on hybrid rose cv. 'Orange Blossom Special' grown outdoors in a standard sand/bark/peat mix pH 6.0 in two-gallon containers. Treatments were arranged in four replicates with two plants per replicate in a randomized complete block (RCB) design. Each plot (two pots) had a surface area of 0.125 m^2 for a total area of 0.5 m^2 per treatment. Plants were overhead irrigated by the grower as needed, pruned once on June 26 and fertilized with Quality Rose Food 15-9-12 slow release (1 tablespoon per pot) on May 22. Subdue MAXX (metalaxyl-m) was applied at 0.08 mL/L on May 1 and June 18 to control downy mildew. Floramite SC (bifenazate) was applied at 0.06 mL/L on July 3 and 0.03 mL/L on Aug. 8 to control two-spotted spider mites. To ensure midge adults were present in the trial area, maggot-infested buds picked from neighbouring plants at the nursery were placed in extra pots spaced between reps I and II and reps III and IV and replaced weekly, starting on May 15. Adult midge populations at the nursery were monitored weekly with two yellow sticky cards placed in a nearby infested rose bed. DOKTOR DOOM 0.5 % permethrin (Ultrasol Industries Ltd.) formulated by the manufacturer with either a 2X or 4X concentration of a spreader-sticker (proprietary composition) was applied every four weeks on May 15, June 12, July 10 and August 7 to the soil (container media) surface at 60 or 30 mL per pot in a split application: half of the solution (30 or 15 mL) was sprayed onto the soil surface and worked in lightly, followed by a second surface spray of 30 or 15 mL within one to two hours. AVID 1.9 % EC (Syngenta Crop Protection) was applied at 0.6 mL product/L after the solution was adjusted with phosphoric acid to pH 5.0. For SCIMITAR CS (Syngenta Crop Protection), 10 mL of a 0.5 mL/L solution was added to one litre of water for a final concentration of 0.005 mL product/L. AVID and SCIMITAR were applied as foliar "mist" sprays in a solution volume of 120 mL per treatment using a CO_2 backpack sprayer at 40 psi (276 kPa) and a single adjustable nozzle. The total number of floral and vegetative buds was counted in each plot (two plants) weekly. The number of buds containing midge maggots or thrips, or which were black or distorted from midge feeding or egg-laying was recorded, as well as the number of shoots with aphids. All blooms and midge-infested or damaged buds were removed from the trial plants each week before treatments were applied. Phytotoxicity (stunting, chlorosis, necrosis, leaf distortion or bud abortion) was rated on a scale of 0 to 10, where 0 = no symptoms and 10 = plant death. Environmental data was recorded at each application date. Statistical analysis (ANOVA) was performed using Co-Stat Version 6.204, 2003 Co-Hort Software, Monterey, California, USA copyright © 1998-2003.

RESULTS: Results are presented in Table 1. Pest pressure was low (thrips) to moderate (rose midge and aphids). Weather was generally cool and wet (mean temperature 16.7 °C and rainfall 204.2 mm); soil temperature in the pots ranged from 15.2 to 35.5 °C. One to 16 adult rose midges were caught on two yellow sticky traps at the nursery each week. Peak adult emergence was recorded the first week of June followed by less numerous adult flights approximately every 14 days to the end of August (data not shown).

CONCLUSIONS: Monthly soil applications of DOKTOR DOOM 0.5 % permethrin RTU solution at all rates reduced the number of rose midge-infested and damaged buds by 66 % on average. Thrips-infested buds were reduced by an average of 71 % and aphid-infested shoots by 87 %. All results were statistically significant from the check in Tukey's HSD at $P < 0.05$. The low rate (0.5 L/m^2) and high rate (1.0 L/m^2) of DOKTOR DOOM were equally effective and there was no difference with the 2X or 4X concentration of spreader-sticker. SCIMITAR CS (lambda-cyhalothrin) applied every 14 days as a foliar mist spray at a very low rate (0.005 mL of product/L) reduced rose midge damage by 70 % and aphid infestations by 64 % compared to the untreated check, but was not significantly effective on thrips. Foliar sprays of AVID 1.9 % EC (abamectin) every 14 days in a solution acidified to pH 5.0 suppressed rose midge by 45 % and reduced the number of thrips-infested buds by 73 % (both statistically significant in Duncan's Multiple Range Test but not Tukey's HSD at $P \leq 0.05$). AVID reduced aphid-infested shoots by 88 % (statistically significant in Tukey's HSD). No phytotoxicity was observed in any treatment, except minor yellowing and curling of a few lower leaves which came in contact with the DOKTOR DOOM solution during soil application.

Table 1: Mean cumulative sum of leaf and flower buds produced, mean percent reduction in buds damaged or infested with rose midge compared to the untreated check, and mean sum of buds or shoots infested with midge, thrips and aphids, 2007.[1]

Treatment	Application Interval (Days)	Application Method and Product Rate	Mean No. Leaf and Flower Buds[2]	Mean No. Midge Infested/ Damaged Buds[2]	Mean % Midge Damage Reduction wrt UTC[2]	Mean No. Buds with Thrips[2]	Mean No. Shoots with Aphids[2]
UTC	-	-	1042.5 a	20.0 a (a)	0 a (a)	4.5 a (a)	36.8 a
Avid 1.9% EC (abamectin)	14	Foliar Spray: 15 mL per pot @ 0.6 mL/L	973.5 a	11.0 ab (b)	45.0 ab (b)	1.2 ab (bc)	4.5 b
Scimitar SC (lambda-cyhalothrin)	14	Foliar Spray: 15 mL per pot @ 0.005 mL/L	1059.2 a	6.0 b (b)	70.0 b (b)	3.2 ab (ab)	13.2 b
Doktor Doom RTU (0.5 % permethrin + 2X spreader-sticker)	28	Soil: 1.0 L/m^2 = 60 mL per pot: 30 mL per split application	1055.8 a	5.8 b (b)	72.0 b (b)	1.0 b (bc)	4.8 b
Doktor Doom RTU (0.5 % permethrin + 2X spreader-sticker)	28	Soil: 0.5 L/m^2 = 30 mL per pot: 15 mL per split application	1003.5 a	7.2 b (b)	64.0 b (b)	0.8 b (c)	7.8 b
Doktor Doom RTU (0.5 % permethrin + 4X spreader-sticker)	28	Soil: 1.0 L/m^2 = 60 mL per pot: 30 mL per split application	1039.0 a	8.0 b (b)	60.0 b (b)	1.0 b (bc)	3.5 b
Doktor Doom RTU (0.5 % permethrin + 4X spreader-sticker)	28	Soil: 0.5 L/m^2 = 30 mL per pot: 15 mL per split application	945.5 a	6.5 b (b)	67.5 b (b)	2.5 ab (abc)	2.5 b

[1] Mean of two plants per replicate; four replicates per treatment; RCB design.
[2] Numbers followed by the same letter are not significantly different in Tukey's HSD or Duncan's Multiple Range Test (brackets) at $P \leq 0.05$.

2007 PMR REPORT# 38 **SECTION K: FRUIT - Diseases**

CROP: Apple (*Malus domestica* Borkh.) cv. Royal Gala
PEST: Black Rot, *Botryosphaeria obtusa* (Schwein.) Cooke

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TITLE: BLACK ROT IN ROYAL GALA APPLES IN RESPONSE TO CHEMICAL THINNING

MATERIALS: FRUITONE N (3.5% 1-naphthaleneacetic acid), MAXCEL (1.9% 6-benzyladenine), SEVIN XLR (42.8% carbryl), SYLGARD 309 (76% siloxylate polyether, 24% surfactant)

METHODS: A trial was conducted in a seven year old 'Royal Gala' commercial apple orchard on M9 rootstock to investigate the effect of timing of chemical thinners on the incidence and severity of Black rot on fruit and to compare these treatments with hand-thinning. Trees were pruned to maintain uniformity on May 9, 2007. Individual trees were either treated with FRUITONE N at 25 mg/L, MAXCEL at 100 mg/L or hand thinned at petal fall on May 23, 2007, 6-8 mm king fruit diameter on May 28, 2007 and 12-14 mm king fruit diameter on May 31,2007. The FRUITONE N and MAXCEL treatments were tank mixed with SEVIN XLR at 500 mg/L and SYLGARD 309 at 0.015% (v/v) and applied to the point of drip. The treatments were replicated 4 times and arranged in a randomized complete block design. Fruit were hand picked on September 18, 2007, weighed and rated for Black rot incidence and severity (0 = no disease; 1= lesion<1cm; 2 = lesion 1-2 cm; 3 = expanding lesion 2-3 cm; 4 = expanding lesion 3-4 cm and several small lesions 1-2 cm; 5 = expanding lesion with concentric rings > 4 cm). Mummified fruitlets were also counted in each tree.

RESULTS: As outlined in Tables 1, 2 and 3.

CONCLUSIONS: Applying chemical thinners when developing fruit were 6-8 mm in diameter reduced the crop load, maximized fruit size and minimized Black rot infected fruit at harvest.

Table 1. The effect of application timing and thinning method on fruit load, mummified fruitlets, and incidence and severity of Black rot on mature apple fruit cv. Royal Gala at harvest.

						Black Rot	
Treatment	Application Timing	Yield (g)[1]	Mean Number of Fruit/Tree[2]	Average Fruit Wt. (g)[1]	Mean Number of Mummies[2]	% Incidence of Diseased Fruit[3]	Disease Severity Index (1-100)[1,4]
Hand Thinned	petal fall	8958 bc	52.8 bc	175.8 b	1.5 e	10.4 d	7.8 a
Hand Thinned	6-8 mm diameter King Fruit	12020 ab	77.5 ab	154.9 b	1.3 e	11.1 cd	7.8 a
Hand Thinned	12-14 mm diameter King Fruit	12134 ab	78.8 ab	155.0 b	1.8 de	9.2 d	6.5 a
MAXCEL	petal fall	12247 ab	77.0 ab	164.2 b	7.3 bc	22.4 abc	16.9 a
MAXCEL	6-8 mm diameter King Fruit	3175 de	18.0 d	183.3 b	6.5 bc	13.2 bcd	11.3 a
MAXCEL	12-14 mm diameter King Fruit	4196 cde	24.3 cd	180.0 b	8.3 bc	24.6 ab	19.7 a
FRUITONE N	petal fall	17577 a	110.8 a	160.8 b	6.3 cd	11.8 cd	6.4 a
FRUITONE N	6-8 mm diameter King Fruit	8732 bcd	55.0 bc	160.0 b	14.0 ab	12.4 cd	9.8 a
FRUITONE N	12-14 mm diameter King Fruit	2268 e	12.0 d	243.0 a	16.8 a	29.6 a	15.9 a

[1] Figures within columns followed by different letters are significantly different using a protected LSD (P<0.05).
[2] Figures within columns followed by different letters are significantly different using a protected LSD (P<0.05). Data were transformed using square root to normalize data before statistically analyzed, however, actual means are presented.
[3] Figures within columns followed by different letters are significantly different using a protected LSD (P<0.05). Data were transformed using arcsine to normalize data before statistically analyzed, however, actual means are presented.
[4] Severity Index = $\frac{\sum(\text{disease severity class no.})(\text{no. of fruit in each disease severity class})}{(\text{total no. of fruit per sample})(\text{no. of disease severity classes} - 1)}$

Table 2. The main effect of thinning method on fruit load, mummified fruitlets, and incidence and severity of Black rot on mature apple fruit cv. Royal Gala at harvest.

					Black Rot	
Treatment	Yield (g)[1]	Mean Number of Fruit/Tree[2]	Average Fruit Wt. (g)[1]	Mean Number of Mummies[2]	% Incidence of Diseased Fruit[3]	Disease Severity Index (1-100)[1,4]
Hand Thinned	11038 a	69.7 a	161.9 a	1.5 c	10.2 b	7.4 b
MAXCEL	6539 b	39.8 b	175.8 a	7.3 b	20.0 a	16.0 a
FRUITONE N	9526 ab	59.3 ab	187.9 a	12.3 a	17.9 a	10.7 ab

[1] Figures within columns followed by different letters are significantly different using a protected LSD ($P<0.05$).
[2] Figures within columns followed by different letters are significantly different using a protected LSD ($P<0.05$). Data were transformed using square root to normalize data before statistically analyzed, however, actual means are presented.
[3] Figures within columns followed by different letters are significantly different using a protected LSD ($P<0.05$). Data were transformed using arcsine to normalize data before statistically analyzed, however, actual means are presented.
[4] Severity Index = $\frac{\sum(\text{disease severity class no.})\ (\text{no. of fruit in each disease severity class})}{(\text{total no. of fruit per sample})\ (\text{no. of disease severity classes - 1})}$

Table 3. The main effect of thinning application timing on fruit load, mummified fruitlets and incidence and severity of Black rot on mature apple fruit cv. Royal Gala at harvest.

					Black Rot	
Application Timing	Yield (g)[1]	Mean Number of Fruit/Tree[2]	Average Fruit Wt. (g)[1]	Mean Number of Mummies[2]	% Incidence of Diseased Fruit[3]	Disease Severity Index (1-100)[1,4]
petal fall	12928 a	80.7 a	167.0 a	5.0 b	14.8 ab	10.4 a
6-8 mm diameter King Fruit	7676 b	50.2 b	166.0 a	7.3 ab	12.2 b	9.6 a
12-14 mm diameter King Fruit	6199 b	38.3 b	192.7 a	8.9 a	21.1 a	14.0 a

[1] Figures within columns followed by different letters are significantly different using a protected LSD (P<0.05).
[2] Figures within columns followed by different letters are significantly different using a protected LSD (P<0.05). Data was transformed using square root to normalize data before statistically analyzed, however, actual means are presented.
[3] Figures within columns followed by different letters are significantly different using a protected LSD (P<0.05). Data was transformed using arcsine to normalize data before statistically analyzed, however, actual means are presented.
[4] Severity Index = $\frac{\sum \text{(disease severity class no.) (no. of fruit in each disease severity class)}}{\text{(total no. of fruit per sample) (no. of disease severity classes - 1)}}$

2007 PMR REPORT# 39 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. McIntosh
PEST: Blue mold (*Penicillium expansum* Link)

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TITLE: EFFECT OF SMARTFRESH (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF BLUE MOLD WITH POSTHARVEST FUNGICIDES IN 'MCINTOSH' APPLES, 2006-07

MATERIALS: SmartFresh™ (1-methylcyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), VANGARD 75 WG (75% Cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) on the control of postharvest blue mold with postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10) and MERTECT in wounded apples. Optimum harvest time for long-term storage for the apples was determined by the internal ethylene concentration and starch staining. 'McIntosh' apple fruits were harvested on 18 September, 2006. There were two main treatments: 1. Fruit were co-treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); and 2. Fruit were wounded, co-treated with fungicides and inoculum. and cooled overnight and then 1-MCP treated. In each of the main treatments, 5 fungicide subtreatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD@ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. For inoculum, TBZ-resistant *P. expansum* PS-1R at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had

3 replicates with 6 fruits per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0.5-2°C. 'McIntosh' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit were moved to 20ºC, 85% RH and incubated for 7 days. After the shelf-life study, the fruit was again evaluated for blue mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest blue mold incidence. The test fungicide treatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L) gave complete control with or without 1-MCP treatments. As expected MERTECT was not effective against TBZ-resistant isolates of *Penicillium*. In the case of BIOSAVE, higher disease incidence was observed in the fruit that were co-inoculated and then treated with 1-MCP. After 56 days the blue mold incidence reached 100%. The results show that the 1-MCP had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L in 'McIntosh' apples for up to 114 days. Higher disease incidence was observed in the subsequent shelf-life after 142 days of storage in air at 0.5 to 2°C.

Table 1. Effect of 1-MCP on the control of postharvest blue mold (*Penicillium expansum*) with fungicides in 'McIntosh' apples, 2006-07.

Treatment	% Blue mold incidence in cold storage at 0.5 to 2°C after					
	28 Days	56 Days	86 Days	114 Days	142 Days	142 Days + Shelf-life of 7 days
Fruit co-inoculated and fungicide treated only but no 1-MCP						
Inoculum only	16.67 b[ab]	100.00 d	100.00 c	100.00 c	100.00 e	100.00 f
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	27.78 c	38.89 d
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	5.56 b	22.22 b
BIOSAVE @ 1.59 g/L	0.00 a	94.44 c	94.44 b	94.44 b	100.00 e	100.00 f
MERTECT @ 1.15 g/L	27.78 c	100.00 d	100.00 c	100.00 c	100.00 e	100.00 f
Fruit co-inoculated and fungicide treated and then treated with 1-MCP						
Inoculum only	0.00 a	83.33 b	94.44 b	100.00 c	100.00 e	100.00 f
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	33.33 d	55.56 e
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	27.78 c
BIOSAVE @ 1.59 g/L	0.00 a	100.00 d	100.00 c	100.00 c	100.00 e	100.00 f
MERTECT @ 1.15 g/L	33.33 c	100.00 d	100.00 c	100.00 c	100.00 e	100.00 f

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$
[b] Data represent the mean of three replicates

2007 PMR REPORT# 40 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. McIntosh
PEST: Gray mold (*Botrytis cinerea* Pers)

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TITLE: EFFECT OF SMARTFRESH (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF GRAY MOLD WITH POSTHARVEST FUNGICIDES IN 'MCINTOSH' APPLES, 2006-07

MATERIALS: SmartFresh™ (1-methylcyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), VANGARD 75 WG (75% Cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) on the control of postharvest blue mold with postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10) and MERTECT in wounded apples. Optimum harvest time for long-term storage for the apples was determined by the internal ethylene concentration and starch staining. 'McIntosh' apple fruits were harvested on 18 September, 2006. There were two main treatments: 1. Fruit were co- treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); and 2. Fruit were wounded, co-treated with fungicides and inoculum. and cooled overnight and then 1-MCP treated. In each of the main treatments, 5 fungicide subtreatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. For inoculum, TBZ-resistant *B. cinerea* at a concentration of 1×10^4 conidia/ml was used. Each treatment had 3 replicates with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0.5-2°C. 'McIntosh' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit were moved to 20ºC, 85% RH and incubated for 7 days. After the shelf-life study, the fruit were again evaluated for blue mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest gray mold incidence. The test fungicide treatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L) gave complete control with or without 1-MCP treatments. As expected MERTECT was not effective against TBZ-resistant isolates of *Botrytis*. In the case of BIOSAVE, higher disease incidence was observed in the fruit that were co-inoculated and then treated with 1-MCP. After 56 days the blue mold incidence reached 100%. The results show that 1-MCP had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @ 1.12 g/L, PENBOTEC @ 1.16 g/L, or VANGARD @ 0.8 g/L in 'McIntosh' apples for up to 114 days. Higher disease incidence was observed in the subsequent shelf-life after 142 days of storage in air at 0.5 to 2°C.

Table 1. Effect of 1-MCP on the control of postharvest gray mold (*Botrytis cinerea)* with fungicides in 'McIntosh' apples, 2006-07.

	% Gray mold incidence in cold storage at 0.5 to 2°C after					
Treatment	28 Days	56 Days	86 Days	114 Days	142 Days	142 Days + Shelf-life of 7 days
Fruit co-inoculated and fungicide treated only but no 1-MCP						
Inoculum only	89.89 c[ab]	100.00 b	100.00 b	100.00 c	100.00 c	100.00 d
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	11.11 c
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	5.56 b	5.56 b
BIOSAVE @ 1.59 g/L	83.33 b	100.00 b	94.44 b	100.00 b	100.00 c	100.00 d
MERTECT @ 1.15 g/L	100.00 e	100.00 b	100.00 c	100.00 b	100.00 c	100.00 d
Fruit co-inoculated and fungicide treated and then treated with 1-MCP						
Inoculum only	94.44 d	100.00 b	94.44 b	100.00 b	100.00 c	100.00 d
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	94.44 d	100.00 b	100.00 c	100.00 b	100.00 c	100.00 d
MERTECT @ 1.15 g/L	100.00 e	100.00 b	100.00 c	100.00 b	100.00 c	100.00 d

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of four replicates.

2007 PMR REPORT# 41 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Gala
PEST: Blue mold (*Penicillium expansum* Link)

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TITLE: EFFECT OF SMARTFRESH (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF BLUE MOLD WITH POSTHARVEST FUNGICIDES IN 'GALA' APPLES, 2006-07

MATERIALS: SmartFresh™ (1-methylcyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), VANGARD 75 WG (75% Cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) on the control of postharvest blue mold with postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10) and MERTECT in wounded apples. Optimum harvest time for long-term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Gala' apple fruits were harvested on 18 September, 2006. There were three main treatments: 1. Fruit were co-treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); 2. Fruit were co-treated and cooled overnight and then 1-MCP treated; 3. Fruit were cooled overnight, 1-MCP treated for 24 hours and then apples were wounded, co-treated with fungicides and inoculum. In each of the main treatments, 5 fungicide subtreatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. For inoculum, TBZ-resistant *P. expansum* PS-1R at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 3 replicates with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0.5-2°C. 'Gala' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit were moved to 20ºC, 85% RH and incubated for 7 days. After the shelf-life study, the fruit were again evaluated for blue mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest blue mold incidence. The test fungicide treatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L) gave complete control with or without 1-MCP treatments. As expected MERTECT was not effective against TBZ-resistant isolates of *Penicillium*. In the case of BIOSAVE, higher disease incidence was observed in the fruit that were co-inoculated and not treated with 1-MCP. After 168 days the blue mold incidence reached 100%. However, no blue mold disease incidence was observed in BIOSAVE+ inoculum treatment in 1-MCP treated apples. The results show that 1-MCP had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, or VANGARD @ 0.8 g/L in 'Gala' apples for up to 168 days. SCHOLAR AND PENBOTEC treatments had only 5.56 disease incidence in the subsequent shelf-life after 168 days of storage in air at 0.5-2°C.

Table 1. Effect of 1-MCP on the control of postharvest blue mold (*Penicillium expansum*) with fungicides in 'Gala' apples, 2006-07

Treatment	% Blue mold incidence in cold storage at 0.5 - 2°C after						
	28 Days	56 Days	84 Days	112 days	140 Days	168 Days	168 Days + Shelf-life 7 days
Fruit co-inoculated and fungicide treated only but no 1-MCP							
Inoculum only	44.44 d[ab]	100.00 e	100.00 c	100.00 c	100.00 e	100.00 c	100.00 d
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	5.56 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	5.56 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	0.00 a	11.11 b	66.67 b	83.33 b	88.89 d	100.00 c	100.00 d
MERTECT @ 1.15 g/L	50.00 e	100.00 e	100.00 c	100.00 c	100.00 e	100.00 c	100.00 d
Fruit co-inoculated and fungicide treated and then treated with 1-MCP							
Inoculum only	27.78 c	100.00 e	100.00 c	100.00 c	100.00 e	100.00 c	100.00 d
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	77.78 c	88.89 b	88.89 c
BIOSAVE @ 1.59 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
MERTECT @ 1.15 g/L	5.56 b	100.00 e	100.00 c	100.00 c	100.00 e	100.00 c	100.00 d
Fruit treated with 1-MCP and then co-inoculated and fungicide treated.							
Inoculum only	5.56 b	66.67 c	100.00 c	100.00 c	100.00 e	100.00 c	100.00 d
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	44.44 b	100.00	100.00 d
BIOSAVE @ 1.59 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
MERTECT @ 1.15 g/L	0.00 a	94.44 d	100.00 c	100.00 c	100.00 e	100.00 c	100.00 d

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

2007 PMR REPORT# 42 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Gala
PEST: Gray mold (*Botrytis cinerea* Pers)

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TITLE: EFFECT OF SMARTFRESH (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF GRAY MOLD WITH POSTHARVEST FUNGICIDES IN ‘GALA’ APPLES, 2006-07

MATERIALS: SmartFresh™ (1-methyclyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), VANGARD 75 WG (75% Cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) on the control of postharvest graymold with postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10) and MERTECT in wounded apples. Optimum harvest time for long-term storage for the apples was determined by the internal ethylene concentration and starch staining. ‘Gala’ apple fruits were harvested and treated on 18 September, 2006. There were three main treatments: 1. Fruit were co-treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); 2. Fruit were co-treated and cooled overnight and then 1-MCP treated; 3. Fruit were cooled overnight, 1-MCP treated for 24 hours and then apples were wounded, co-treated with fungicides and inoculum. In each of the main treatments, 5 fungicide subtreatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. For inoculum, TBZ-resistant *B. cinerea* at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 3 replicates with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0°C. 'Gala' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit was moved to 20ºC, 85% RH and incubated for 7 days. After the shelf-life study, the fruit was again evaluated for graymold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest gray mold incidence. The test fungicide treatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L) gave complete control with or without 1-MCP treatments. As expected MERTECT was not effective against TBZ-resistant isolates of *Botrytis*. In the case of BIOSAVE, a higher disease incidence was observed in the fruit that were co-inoculated and then treated with or without 1-MCP. After 56 days the blue mold incidence reached 89%. The results show that the 1-MCP had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @1.2 g/L, PENBOTEC @1.16 g/L, or VANGARD @ 0.8 g/L in 'Gala' apples for up to 168 days. Only in the BIOSAVE treatment, a higher disease incidence was observed in the subsequent shelf-life after 168 days of storage in air at 05-2°C.

Table 1. Effect of 1-MCP on the control of postharvest gray mold (*Botrytis cinerea)* with fungicides in 'Gala' apples, 2006-07.

Gray mold incidence in cold storage at 0.5 - 2°C after							
Treatment	28 Days	56 Days	84 Days	112 days	140 Days	168 Days	168 Days + Shelf-life at 7 days
Fruit co-inoculated and fungicide treated only but no 1-MCP							
Inoculum only	100.00 e[ab]	100.00 d	100.00 c	100.00 c	100.00 c	100.00 b	100.00 b
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	5.56 b	88.89 b	88.89 b	88.89 b	88.89 b	100.00 b	100.00 b
MERTECT @ 1.15 g/L	100.00 e	100.00 d	100.00 c	100.00 c	100.00 c	100.00 b	100.00 b
Fruit co-inoculated and fungicide treated and then treated with 1-MCP							
Inoculum only	94.44 d	100.00 d	100.00 a	100.00 c	100.00 c	100.00 b	100.00 b
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	0.00 a	100.00 d	100.00 c	100.00 c	100.00 c	100.00 b	100.00 b
MERTECT @ 1.15 g/L	100.00 e	100.00 a	100.00 c	100.00 c	100.00 c	100.00 b	100.00 b
Fruit treated with 1-MCP and then co-inoculated and fungicide treated							
Inoculum only	100.00 e	100.00 d	100.00 c	100.00 c	100.00 c	100.00 b	100.00 b
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	11.11 c	94.44 c	100.00 c	100.00 c	100.00 c	100.00 b	100.00 b
MERTECT @ 1.15 g/L	100.00 e	100.00 d	100.00 c	100.00 c	100.00 c	100.00 b	100.00 b

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

2007 PMR REPORT# 43 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Honeycrisp
PEST: Blue mold (*Penicillium expansum* Link)

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TITLE: EFFECT OF SMARTFRESH (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF BLUE MOLD WITH POSTHARVEST FUNGICIDES IN 'HONEYCRISP' APPLES, 2006-07

MATERIALS: SmartFresh™ (1-methylcyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), VANGARD 75 WG (75% Cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) on the control of postharvest blue mold with postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10) and MERTECT in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Honeycrisp' apple fruits were harvested on 19 September, 2006. There were three main treatments: 1. Fruit were co-treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); 2. Fruit were co-treated and cooled overnight and then 1-MCP treated; 3. Fruit were cooled overnight, 1-MCP treated for 24 hours and then apples were wounded, co-treated with fungicides and inoculum. In each of the main treatments, 5 fungicide subtreatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. For inoculum, TBZ-resistant *P. expansum* PS-

1R at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 3 replicates with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0.5-2°C. 'Honeycrisp' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit were moved to 20ºC, 85% RH and incubated for 7 days. After the shelf-life study, the fruit were again evaluated for blue mold incidence (percent infected apples). 1-MCP treated apples were evaluated after 28 days of inoculation and fungicide treatment. Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Tables 1 and 2.

CONCLUSIONS: The control had the highest blue mold incidence. The test fungicide treatments (SCHOLAR @ 1.2 g/L, and VANGARD @ 0.8 g/L) gave complete control for up to 168 days (Table 1). In the PENBOTEC @ 1.16 g/L, treatment, 11% blue mold was observed at 168 days. In the case of BIOSAVE, 67% blue mold incidence was observed at 56 days, and after 84 days the blue mold incidence reached 100%. As expected, MERTECT was not effective against TBZ-resistant isolates of *Penicillium*. The results show that SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L in 'Honeycrisp' apples for up to 168 days. A higher disease incidence was observed in the subsequent shelf-life after 168 days of storage in air at 0.5 to 2°C. It was shown that 1-MCP had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @1.2 g/L, PENBOTEC @1.16 g/L, or VANGARD @ 0.8 g/L in 'Honeycrisp' apples for up to 28 days (Table 2).

Table 1. Effect of postharvest blue mold (*Penicillium expansum*) with fungicides in 'Honey Crisp' apples, 2006-07.

	Blue mold incidence in cold storage at 0.5 - 2˚C after						
Treatment	28 Days	56 Days	84 Days	112 days	140 Days	168 Days	168 Days + shelf-life at 7 days
Inoculum only	100.00 b[ab]	100.00 c	100.00 b	100.00 b	100.00 c	100.00 c	100.00 d
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	16.67 b
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	11.11 b	27.78 c
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	0.00 a	67.00 b	100.00 b	100.00 b	100.00 c	100.00 c	100.00 d
MERTECT @ 1.15 g/L	100.00 b	100.00 c	100.00 b	100.00 b	100.00 c	100.00 c	100.00 d

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

Table 2. The effect of 1-MCP on the control of blue mold with fungicides in 'Honey Crisp' apples, 2006-07.

% Blue mold incidence in cold storage at 0.5 - 2˚C after 28 days		
Treatment	Fruit co-inoculated and fungicide treated and then treated with 1-MCP	Fruit treated with 1-MCP and then co-inoculated and fungicide treated
Inoculum only	100.00 b[ab]	94.40 c
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	0.00 a	50.00 b
MERTECT @ 1.15 g/L	100.00 b	100.00 d

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of four replicates.

2007 PMR REPORT# 44 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Honeycrisp
PEST: Gray mold (*Botrytis cinerea* Pers)

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TITLE: EFFECT OF SMARTFRESH (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF GRAY MOLD WITH POSTHARVEST FUNGICIDES IN 'HONEYCRISP' APPLES, 2006-07

MATERIALS: SmartFresh™ (1-methylcyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), VANGARD 75 WG (75% Cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) on the control of postharvest graymold with postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10) and MERTECT in wounded apples. Optimum harvest time for long-term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Honeycrisp' apple fruits were harvested and treated on 19 September, 2006. There were three main treatments: 1. Fruit were co-treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); 2. Fruit were co-treated and cooled overnight and then 1-MCP treated; 3. Fruit were cooled overnight, 1-MCP treated for 24 hours and then apples were wounded, co-treated with fungicides and inoculum. In each of the main treatments, 5 fungicide subtreatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. For inoculum, TBZ-resistant *B. cinerea* at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 3 replicates with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0.5-2°C. 'Honeycrisp' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit was moved to 20ºC, 85% RH and incubated for 7 days. After the shelf-life study, the fruit was again evaluated for gray mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Tables 1 and 2.

CONCLUSIONS: The control had the highest gray mold incidence. The test fungicide treatments (SCHOLAR @ 1.2 g/L, and PENBOTEC @ 1.16 g/L) gave complete control for up to 168 days (Table 1). In the VANGARD @ 0.8 g/L treatment, 22% gray mold was observed at 168 days. In the case of BIOSAVE, 78% gray mold incidence was observed at 28 days, and after 56 days the blue mold incidence reached 100%. As expected MERTECT was not effective against TBZ-resistant isolates of *Botrytis*. A higher disease incidence was observed in the subsequent shelf-life after 168 days of storage in air at 0.5 to 2°C. It was shown that 1-MCP had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, or VANGARD @ 0.8 g/L in 'Honeycrisp' apples for up to 28 days (Table 2).

Table 1. Effect of postharvest gray mold (*Botrytis cinerea)* with fungicides in 'Honey Crisp' apples, 2006-07.

	% Gray mold incidence in cold storage at 0.5 - 2˚C after						
Treatment	28 Days	56 Days	84 Days	112 days	140 Days	168 Days	168 Days + shelf-life at 7 days
Inoculum only	100.00 c[ab]	100.00 b	100.00 b	100.00 b	100.00 c	100.00 c	100.00 c
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	22.22 b	22.22 b	38.89 b
BIOSAVE @ 1.59 g/L	78.00 b	100.00 b	100.00 b	100.00 b	100.00 c	100.00 c	100.00 c
MERTECT @ 1.15 g/L	100.00 d	100.00 b	100.00 b	100.00 b	100.00 c	100.00 c	100.00 c

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

Table 2. The effect of 1-MCP on the control of gray mold (*Botrytis cinerea)* with fungicides in 'Honey Crisp' apples, 2006-07.

	% Gray mold incidence in cold storage at 0.5 - 2˚C after 28 days	
Treatment	Fruit co-inoculated and fungicide treated and then treated with 1-MCP	Fruit treated with 1-MCP and then co-inoculated and fungicide treated
Inoculum only	100.00 c[ab]	100.00 c
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	83.33 b	83.33 b
MERTECT @ 1.15 g/L	100.00 c	100.00 c

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of four replicates.

2007 PMR REPORT# 45 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Empire
PEST: Blue mold (*Penicillium expansum* Link)

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TITLE: EFFECT OF SMARTFRESH (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF BLUE MOLD WITH POSTHARVEST FUNGICIDES IN 'EMPIRE' APPLES, 2006-07

MATERIALS: SmartFresh™ (1-methylcyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), VANGARD 75 WG (75% Cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) on the control of postharvest blue mold with postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10) and MERTECT in wounded apples. Optimum harvest time for long-term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Empire' apple fruits were harvested on 2 October, 2006. There were three main treatments: 1. Fruit were co-treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); 2. Fruit were co-treated and cooled overnight and then 1-MCP treated; 3. Fruit were cooled overnight, 1-MCP treated for 24 hours and then apples were wounded, co-treated with fungicides and inoculum. In each of the main treatments, 5 fungicide subtreatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. For inoculum, TBZ-resistant *P. expansum* PS-

1R at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 3 replicates with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0.5-2 °C. 'Empire' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit were moved to 20ºC, 85% RH and incubated for 7 days. After the shelf-life study, the fruit were again evaluated for blue mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest blue mold incidence. The test fungicide treatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L) gave complete control with or without 1-MCP treatments. As expected MERTECT was not effective against TBZ-resistant isolates of *Penicillium*. In the case of BIOSAVE, higher disease incidence was observed in the fruit that was co-inoculated and not treated with or without 1-MCP. After 168 days the blue mold incidence reached 100%. The results show that 1-MCP had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, or VANGARD @ 0.8 g/L in 'Empire' apples for up to 168 days. Only SCHOLAR and PENBOTEC treatments had 5.56% disease incidence in the subsequent shelf-life after 168 days of storage in air at 0.5-2°C.

Table 1. Effect of 1-MCP on the control of postharvest blue mold (*Penicillium expansum*) with fungicides in 'Empire' apples, 2006-07

	% Blue mold incidence in cold storage at 0.5 - 2°C after						
Treatment	28 Days	56 Days	84 Days	112 days	140 Days	168 Days	168 days + shelf-life 7 days
Fruit co-inoculated and fungicide treated only but no 1-MCP							
Inoculum only	100.00 g	100.00 c	100.00 c	100.00 b	100.00 b	100.00 d	100.00 f
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	11.11 c	55.56 e
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	11.11 c	27.78 d
BIOSAVE @ 1.59 g/L	11.11 b	66.67 b	77.78 b	100.00 b	100.00 b	100.00 d	100.00 f
MERTECT @ 1.15 g/L	100.00 g	100.00	100.00 c	100.00 b	100.00 b	100.00 d	100.00 f
Fruit co-inoculated and fungicide treated and then treated with 1-MCP							
Inoculum only	94.44 f	100.00 c	100.00 c	100.00 b	100.00 b	100.00 d	100.00 f
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	11.11 c
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	5.56 b
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	38.89 d	100.00 c	100.00 c	100.00 b	100.00 b	100.00 d	100.00 f
MERTECT @ 1.15 g/L	100.00 g	100.00 c	100.00 c	100.00 b	100.00 b	100.00 d	100.00 f
Fruit treated with 1-MCP and then co-inoculated and fungicide treated							
Inoculum only	77.78 e	100.00 c	100.00 c	100.00 b	100.00 b	100.00 d	100.00 f
SCHOLAR @ 1.12 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	5.56 b	11.11 c
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	5.56 b
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	16.67 c	66.67 b	100.00 c	100.00 b	100.00 b	100.00 d	100.00 f
MERTECT @ 1.15 g/L	100.00 g	100.00 c	100.00 c	100.00 b	100.00 b	100.00 d	100.00 f

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

2007 PMR REPORT# 46

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Empire
PEST: Gray mold (*Botrytis cinerea* Pers)

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TITLE: EFFECT OF SMARTFRESH (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF GRAY MOLD WITH POSTHARVEST FUNGICIDES IN 'EMPIRE' APPLES, 2006-07

MATERIALS: SmartFresh™ (1-methylcyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), VANGARD 75 WG (75% Cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) on the control of postharvest graymold with postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10) and MERTECT in wounded apples. Optimum harvest time for long-term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Empire' apple fruits were harvested on 2 October, 2006. There were three main treatments: 1. Fruit were co-treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); 2. Fruit were co-treated and cooled overnight and then 1-MCP treated; 3. Fruit were cooled overnight, 1-MCP treated for 24 hours and then apples were wounded, co-treated with fungicides and inoculum. In each of the main treatments, 5 fungicide subtreatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. For inoculum, TBZ-resistant *B. cinerea* at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 3 replicates with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0.5-2°C. 'Empire' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit were moved to 20ºC, 85% RH and incubated for 7 days. After the shelf-life study, the fruit were again evaluated for gray mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest gray mold incidence. The test fungicide treatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L) gave complete control with or without 1-MCP treatments. As expected, MERTECT was not effective against TBZ-resistant isolates of *Botrytis*. In the case of BIOSAVE, a higher disease incidence was observed in the fruit that was co-inoculated and then treated with or without 1-MCP. The results show that 1-MCP had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L in 'Empire' apples for up to 168 days, and in the subsequent shelf-life.

Table 1. Effect of 1-MCP on the control of postharvest gray mold (*Botrytis cinerea)* with fungicides in 'Empire' apples, 2006-07.

	% Gray mold incidence in cold storage at 0.5 - 2°C after						
Treatment	28 Days	56 Days	84 Days	112 days	140 Days	168 Days	168 Days + Shelf-life at 7 days
Fruit co-inoculated and fungicide treated only but no 1-MCP							
Inoculum only	94.44 e	100.00 d	100.00 d	100.00 b	100.00 b	100.00 b	100.00 b
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	50.00 c	77.78 c	88.89 c	100.00 b	100.00 b	100.00 b	100.00 b
MERTECT @ 1.15 g/L	100.00 f	100.00 d	100.00 d	100.00 b	100.00 b	100.00 b	100.00 b
Fruit co-inoculated and fungicide treated and then treated with 1-MCP							
Inoculum only	100.00 f	100.00 d	100.00 d	100.00 b	100.00 b	100.00 b	100.00 b
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	100.00 f	100.00 d	100.00 d	100.00 b	100.00 b	100.00 b	100.00 b
MERTECT @ 1.15 g/L	94.44 d	100.00 d	100.00 d	100.00 b	100.00 b	100.00 b	100.00 b
Fruit treated with 1-MCP and then co-inoculated and fungicide treated							
Inoculum only	77.78 d	100.00 d	100.00 d	100.00 b	100.00 b	100.00 b	100.00 b
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	22.22 b	66.67 b	83.33 b	100.00 b	100.00 b	100.00 b	100.00 b
MERTECT @ 1.15 g/L	100.00 f	100.00 d	100.00 d	100.00 b	100.00 b	100.00 b	100.00 b

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

2007 PMR REPORT# 47

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Red Delicious
PEST: Blue mold (*Penicillium expansum* Link)

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TITLE: EFFECT OF SMARTFRESH (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF BLUE MOLD WITH POSTHARVEST FUNGICIDES IN 'RED DELICIOUS' APPLES, 2006-07

MATERIALS: SmartFresh™ (1-methylcyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), VANGARD 75 WG (75% Cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) on the control of postharvest blue mold with postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10) and MERTECT in wounded apples. Optimum harvest time for long-term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Red Delicious' apple fruits were harvested on 13 October, 2006. There were three main treatments: 1. Fruit were co- treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); 2. Fruit were co-treated and cooled overnight and then 1-MCP treated; 3. Fruit were cooled overnight, 1-MCP treated for 24 hours and then the apples were wounded, co-treated with fungicides and inoculum. In each of the main treatments, 5 fungicide subtreatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. For inoculum, TBZ-resistant *P. expansum* PS-1R at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 4 replicates with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0.5-2 °C. 'Empire' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit were moved to 20ºC, 85% RH and incubated for 7 days. After the shelf-life study, the fruit were again evaluated for blue mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest blue mold incidence. The test fungicide treatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L) gave complete control for up to 112 days with or without 1-MCP treatments. As expected MERTECT was not effective against TBZ-resistant isolates of *Penicillium*. In the case of BIOSAVE, higher disease incidence was observed in the fruit that was co-inoculated and not treated with 1-MCP. After 112 days the blue mold incidence reached 100%. Blue mold disease incidence was observed in BIOSAVE + inoculum treatment in 1-MCP treated apples. The results show that 1-MCP had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, or VANGARD @ 0.8 g/L in 'Empire' apples for up to 168 days. Only SCHOLAR and PENBOTEC treatments had 5.56% disease incidence in the subsequent shelf-life following 168 days of storage in cold storage.

Table 1. Effect of 1-MCP on the control of postharvest blue mold (*Penicillium expansum*) with fungicides in 'Red Delicious' apples, 2006-07.

	Blue mold incidence in cold storage at 0.5 - 2°C after						
Treatment	28 Days	56 Days	84 Days	112 days	140 Days	168 Days	168 Days + Shelf-life 7 days
Fruit co-inoculated and fungicide treated only but no 1-MCP							
Inoculum only	77.78 d[ab]	100.00 d	100.00 e	100.00 d	100.00 e	100.00 g	100.00 f
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	11.11 c	27.78 b	66.67 b
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	5.56 b	44.44 d	72.22 c
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	11.11 c	33.33 c	72.22 c
BIOSAVE @ 1.59 g/L	0.00 a	61.11 b	77.78 c	100.00 e	100.00 e	100.00 g	100.00 f
MERTECT @ 1.15 g/L	77.78 d	100.00 d	100.00 e	100.00 d	100.00 e	100.00 g	100.00 f
Fruit co-inoculated and fungicide treated and then treated with 1-MCP							
Inoculum only	55.56 b	100.00 d	100.00 e	100.00 d	100.00 e	100.00 g	100.00 f
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	27.78 b	61.11 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	27.78 b	77.78 d
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	27.78 b	77.78 d
BIOSAVE @ 1.59 g/L	0.00 a	5.56 b	44.44 b	66.67 b	66.67 d	66.67 f	100.00 f
MERTECT @ 1.15 g/L	100.00 e	100.00 d	100.00 e	100.00 d	100.00 e	100.00 g	100.00 f
Fruit treated with 1-MCP and then co-inoculated and fungicide treated							
Inoculum only	61.11 c	100.00 d	100.00 e	100.00 d	100.00 e	100.00 g	100.00 f
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	5.56 b	27.78 b	66.67 b
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	5.56 b	33.33 c	72.22 c
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	88.89 e
BIOSAVE @ 1.59 g/L	0.00 a	77.78 c	88.89 d	94.44 c	100.00 e	100.00 g	100.00 f
MERTECT @ 1.15 g/L	100.00 e	100.00 d	100.00 e	100.00 d	100.00 e	100.00 g	100.00 f

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

2007 PMR REPORT# 48 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Red Delicious
PEST: Gray mold (*Botrytis cinerea* Pers)

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TITLE: EFFECT OF SMARTFRESH (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF GRAY MOLD WITH POSTHARVEST FUNGICIDES IN 'RED DELICIOUS' APPLES, 2006-07

MATERIALS: SmartFresh™ (1-methylcyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), VANGARD 75 WG (75% Cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) on the control of postharvest graymold with postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10) and MERTECT in wounded apples. Optimum harvest time for long-term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Red Delicious' apple fruits were harvested on October 13 and treated on 24 October, 2006. There were three main treatments: 1. Fruit were co-treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); 2. Fruit were co-treated and cooled overnight and then 1-MCP treated; 3. Fruit were cooled overnight, 1-MCP treated for 24 hours and then apples were wounded, co-treated with fungicides and inoculum. In each of the main treatments, 5 fungicide subtreatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. For inoculum, TBZ-resistant *B. cinerea* isolate BC-8D at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 3 replicates with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0.5-2 °C. 'Red Delicious' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit were moved to 20ºC, 85% RH and incubated for 7 days. After the shelf-life study, the fruit was again evaluated for gray mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest gray mold incidence. The test fungicide treatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L) gave complete control with or without 1-MCP treatments for up to 112 days. As expected, MERTECT was not effective against TBZ-resistant isolates of *Botrytis*. In the case of BIOSAVE, a higher disease incidence was observed in the fruit that was co-inoculated and then treated with or without 1-MCP. The results show that 1-MCP had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L in 'Red Delicious' apples for up to 168 days, and in the subsequent shelf-life after 168 days of storage in air at 05-2°C.

Table 1. Effect of 1-MCP on the control of postharvest gray mold (*Botrytis cinerea)* with fungicides in 'Red Delicious' apples, 2006-07.

	% Gray mold incidence in cold storage at 0.5 - 2°C after						
Treatment	28 Days	56 Days	84 Days	112 days	140 Days	168 Days	168 Days + Shelf-life at 7 days
Fruit co-inoculated and fungicide treated only but no 1-MCP							
Inoculum only	88.89 e[ab]	100.00 e	100.00 d	100.00 c	100.00 d	100.00 g	100.00 f
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	22.22 e	50.00 e
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	16.67 c	27.78 f	44.44 d
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	11.11 c	50.00 e
BIOSAVE @ 1.59 g/L	22.22 c	66.67 b	72.22 b	83.33 b	100.00 d	100.00 g	100.00 f
MERTECT @ 1.15 g/L	94.44 f	100.00	100.00 d	100.00 c	100.00 d	100.00 g	100.00 f
Fruit co-inoculated and fungicide treated and then treated with 1-MCP							
Inoculum only	100.00 g	100.00	100.00 d	100.00 c	100.00 d	100.00 g	100.00 f
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	11.11 f
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	5.56 b	5.56 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	5.56 a
BIOSAVE @ 1.59 g/L	100.00 g	100.00 e	100.00 d	100.00 c	100.00 d	100.00 g	100.00 f
MERTECT @ 1.15 g/L	100.00 g	100.00 e	100.00 d	100.00 c	100.00 d	100.00 g	100.00 f
Fruit treated with 1-MCP and then co-inoculated and fungicide treated							
Inoculum only	16.67 a	77.78 c	88.89 c	100.00 c	100.00 d	100.00 g	100.00 f
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	22.22 d	44.44 d
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a	5.56 b	5.56 b	11.11 b
VANGARD @ 0.8 g/L	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	16.67 d	22.22 c
BIOSAVE @ 1.59 g/L	33.33 d	83.33 d	83.33 c	83.33 b	100.00 d	100.00 g	100.00 f
MERTECT @ 1.15 g/L	100.00 g	100.00 e	100.00 d	100.00 c	100.00 d	100.00 g	100.00 f

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

2007 PMR REPORT# 49 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Red Delicious
PEST: Blue mold (*Penicillium expansum* Link); Gray mold (*Botrytis cinerea* Pers)

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TITLE: EFFECT 1-MCP AND CA STORAGE CONDITIONS ON THE CONTROL OF BLUE MOLD AND GRAY MOLD WITH POSTHARVEST FUNGICIDES IN 'RED DELICIOUS' APPLES, 2006-07

MATERIALS: SmartFresh™ (1-methylcyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) and controlled atmosphere storage (CA) on the control of postharvest blue mold and gray mold with postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC and MERTECT in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Red Delicious' apple fruits were harvested on 18 October, 2006. There were two main treatments: 1. Fruit were cooled overnight and then treated with 1 µl/ml of 1-MCP for 24 h at 0.5-2°C; and 2. Fruit were cooled overnight, and not treated with 1-MCP. Then the apples were stored in CA storage for 6 months (17 October, 2006 to 11 April, 2007). Following the 6 month storage in CA , the fruit were wounded, co-treated with fungicides and inoculum. The apples were drop inoculated with the pathogen and the fungicides and incubated for 7 days at 20 °C. In each of the main treatments, 6 fungicide subtreatments (SCHOLAR @ 0.3 g/L, SCHOLAR @ 0.6 g/L, PENBOTEC @ 0.58 g/L, SCHOLAR @ 0.3 g/L + PENBOTEC @ 0.58 g/L, SCHOLAR @ 0.6 g/L + PENBOTEC @ 0.58 g/L and MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For inoculum, TBZ-resistant *P. expansum* PS-1R or TBZ-resistant *B. cinerea* isolate BC-8D at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 3 replicates with 6 fruit per replicate. The fruit were evaluated for blue mold and gray mold incidence (percent infected apples) and the fruit were considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Tables 1 and 2.

CONCLUSIONS: The control had the highest blue mold (Table 1) and gray mold (Table 2) incidence. The test fungicide treatments (SCHOLAR @ 0.3 g/L and 0.6 g/L, PENBOTEC @ 0.58 g/L, and the two combinations) gave complete control with or without 1-MCP treatments. As expected MERTECT was not effective against TBZ-resistant isolates of *Penicillium* or *Botrytis.* The results show that the 1-MCP had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @ 0.3 g/L and 0.6 g/L, PENBOTEC @ 0.58 g/L, and the combination of the two in apples that were stored in CA prior to testing.

Table 1. Effect of control of postharvest blue mold (*Penicillium expansum*) with fungicides in 'Red Delicious' apples stored in CA storage for six months and then co-inoculated and treated with fungicides, 2006-07.

	% Blue mold incidence in cold storage after 7 days at 20˚C	
Treatment	NO 1-MCP	1-MCP
Inoculum only	100.00 b [ab]	100.00 b
SCHOLAR @ 0.3 g/L	0.00 a	0.00 a
SCHOLAR @ 0.6 g/L	0.00 a	0.00 a
PENBOTEC @ 0.58 g/L	0.00 a	0.00 a
SCHOLAR @ 0.3 g/L + PENBOTEC @ 0.58 g/L	0.00 a	0.00 a
SCHOLAR @ 0.6 g/L & PENBOTEC @ 0.58 g/L	0.00 a	0.00 a
MERTECT @ 1.15 g/L	100.00 b	100.00 b

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

Table 2. Effect of control of postharvest gray mold (*Botrytis cinerea*) with fungicides in 'Red Delicious' apples stored in CA storage for six months and then co-inoculated and treated with fungicides, 2006-07.

	% Gray mold incidence in cold storage after 7 days at 20˚C	
Treatment	NO 1-MCP	1-MCP
Inoculum only	100.00 b [ab]	100.00 b
SCHOLAR @ 0.3 g/L	0.00 a	0.00 a
SCHOLAR @ 0.6 g/L	0.00 a	0.00 a
PENBOTEC @ 0.58 g/L	0.00 a	0.00 a
SCHOLAR @ 0.3 g/L & PENBOTEC @ 0.58 g/L	0.00 a	0.00 a
SCHOLAR @ 0.6 g/L & PENBOTEC @ 0.58 g/L	0.00 a	0.00 a
MERTECT @ 1.15 g/L	100.00 b	100.00 b

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

2007 PMR REPORT# 50 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Empire
PEST: Blue mold (*Penicillium expansum* Link); Gray mold (*Botrytis cinerea* Pers.)

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TITLE: EFFECT 1-MCP AND CA STORAGE CONDITIONS ON THE CONTROL OF BLUE MOLD AND GRAY MOLD WITH POSTHARVEST FUNGICIDES IN 'EMPIRE' APPLES, 2006-07

MATERIALS: SmartFresh™ (1-methylcyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), VANGARD 75 WG (75% Cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) and controlled atmosphere storage (CA) on the control of postharvest blue mold with postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10) and MERTECT in wounded apples. Optimum harvest time for long-term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Empire' apple fruits were harvested on 10 October, 2006. There were two main treatments: 1. Fruit were cooled overnight and then treated with 1-MCP; and 2. Fruit were cooled overnight, and not treated with 1-MCP. Then the apples were stored in CA storage for 6 months (10 October, 2006 to 20 March, 2007). Following the 6 month storage in CA, the fruit were wounded, co-treated with fungicides and inoculum. The apples were drop inoculated with the pathogen and the fungicides and incubated for 7 days at 20 °C. In each of the main treatments, 5 fungicide treatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For inoculum, TBZ-resistant *P. expansum* PS-1R or TBZ-resistant *B. cinerea* isolate BC-8D at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 3 replicates with 8 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0 5-2°C. 'Empire' apples were incubated in cold storage. The fruit were evaluated for blue mold and gray mold incidence (percent infected apples) and fruit were considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Tables 1and 2.

CONCLUSIONS: The control had the highest blue mold (Table 1) and gray mold (Table 2) incidence. The test fungicide treatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, and VANGARD @ 0.8 g/L) gave complete control with or without 1-MCP treatments. In the case of BIOSAVE, higher disease incidence of blue and gray mold were observed. As expected MERTECT was not effective against TBZ-resistant isolates of *Penicillium* or *Botrytis*. The results show that 1-MCP and CA storage conditions had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, and the combination of the two in apples that were stored in CA prior to the testing.

Table 1. Effect of control of postharvest blue mold (*Penicillium expansum*) with fungicides in 'Empire' apples stored in CA storage for six months and then co-inoculated and treated with fungicides, 2006-07.

	% Blue mold incidence in cold storage after 7 days at 20°C	
Treatment	NO 1-MCP	with 1-MCP
Inoculum only	75.0 c [ab]	100.00 b
SCHOLAR @ 01.2 g/L	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	87.50 b	100.00 b
MERTECT @ 1.15 g/L	100.00 d	100.00 b

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b]Data represent the mean of three replicates.

Table 2. Effect of control of postharvest gray mold (*Botrytis cinerea*) with fungicides in 'Empire' apples stored in CA storage for six months and then co-inoculated and treated with fungicides, 2006-07.

	% Gray mold incidence in cold storage after 7 days at 20˚C	
Treatment	NO 1-MCP	with 1-MCP
Inoculum only	100.0 c [ab]	100.00 b
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	87.50 b	100.00 b
MERTECT @ 1.15 g/L	100.00 c	100.00 b

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

2007 PMR REPORT# 51 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. McIntosh
PEST: Blue mold (*Penicillium expansum* Link); Gray mold (*Botrytis cinerea* Pers.)

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TITLE: EFFECT 1-MCP AND CA STORAGE CONDITIONS ON THE CONTROL OF BLUE MOLD AND GRAY MOLD WITH POSTHARVEST FUNGICIDES IN 'MCINTOSH' APPLES, 2006-07

MATERIALS: SmartFresh™ (1-methylcyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), VANGARD 75 WG (75% Cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) and controlled atmosphere storage (CA) on the control of postharvest blue mold with postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10 and MERTECT in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'McIntosh' apple fruits were harvested on 20 September, 2006. There were two main treatments: 1. Fruit were cooled overnight and then treated with 1-MCP and 2. Fruit were cooled overnight, and not treated with 1-MCP. Then the apples were stored in CA storage for 6 months (20 September, 2006 to 20 February, 2007). Following the 6 month storage in CA, the fruit were wounded, co-treated with fungicides and inoculum. The apples were drop inoculated with the pathogen and the fungicides and incubated for 7 days at 20 °C. In each of the main treatments, 5 fungicide treatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For inoculum, TBZ-resistant *P. expansum* PS-1R or TBZ-resistant *B. cinerea* isolate BC-8D at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 3 replicates with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0.5-2 °C. 'McIntosh' apples were incubated in cold storage. The fruit were evaluated for blue mold and gray mold incidence (percent infected apples) and fruit were considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Tables 1and 2.

CONCLUSIONS: The control had the highest blue mold (Table 1) and gray mold (Table 2) incidence. The test fungicide treatments (SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, and VANGARD @ 0.8 g/L) gave complete control with or without 1-MCP treatments. In the case of BIOSAVE, higher disease incidence of blue and gray mold were observed. As expected MERTECT was not effective against TBZ-resistant isolates of *Penicillium* or *Botrytis*. The results show that 1-MCP and CA storage conditions had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @ 1.2 g/L, PENBOTEC @ 1.16 g/L, and VANGARD @ 0.8 g/L in apples that were stored in CA prior to the testing.

Table 1. Effect of control of postharvest blue mold (*Penicillium expansum*) with fungicides in 'McIntosh' apples stored in CA storage for six months and then co-inoculated and treated with fungicides, 2006-07.

	% Blue mold incidence in cold storage after 7 days at 20˚C	
Treatment	NO 1-MCP	with 1-MCP
Inoculum only	100.00 b [ab]	100.00 b
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	100.00 b	100.00 b
MERTECT @ 1.15 g/L	100.00 b	100.00 b

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

Table 2. Effect of control of postharvest gray mold (*Botrytis cinerea*) with fungicides in 'McIntosh' apples stored in CA storage for six months and then co-inoculated and treated with fungicides, 2006-07.

	% Gray mold incidence in cold storage after 7 days at 20˚C	
Treatment	NO 1-MCP	with 1-MCP
Inoculum only	100.00 b [ab]	100.00 b
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a
VANGARD @ 0.8 g/L	0.00 a	0.00 a
BIOSAVE @ 1.59 g/L	100.00 b	100.00 b
MERTECT @ 1.15 g/L	100.00 b	100.00 b

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

2007 PMR REPORT# 52 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. SILKEN
PEST: Blue mold (*Penicillium expansum* Link); Gray mold (*Botrytis cinerea* Pers.)

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TITLE: CONTROL OF BLUE MOLD AND GRAY MOLD WITH POSTHARVEST FUNGICIDES IN 'SILKEN' APPLES, 2006-07

MATERIALS: SmartFresh™ (1-Methylcyclopropene), SCHOLAR 50 WG (50% Fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil), MERTECT (45% Thiabendazole)

METHODS: A trial was conducted to determine the effect of postharvest fungicides, SCHOLAR 50 WG and PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10) and MERTECT on the control of postharvest blue mold and gray mold in wounded apples. Optimum harvest time for long-term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Silken apple fruits were harvested on 18 October, 2006. There were two experiments. In each of the experiments, 8 fungicide treatments (SCHOLAR @ 0.3 g/L, SCHOLAR @ 0.6g/L, SCHOLAR @ 1.2 g/L, PENBOTEC @ 0.4 g/L, PENBOTEC @ 0.58 g/L, PENBOTEC @ 1.16 g/L, MERTECT @ 1.15 g/L and BIOSAVE 1.59g/L) and a control without fungicide treatment were included. For inoculum, TBZ-resistant *P. expansum* PS-1R or TBZ-resistant *B. cinerea* isolate BC-8D at a concentration of 1×10^4 conidia/ml was used. Each treatment had 3 replicates with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0.5-2 °C. 'Silken apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. The fruit was evaluated for blue mold incidence (percent infected apples) and the fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest blue mold and gray mold incidence. The different concentrations of the test fungicide treatments (SCHOLAR @ 1.2 g/L, and PENBOTEC @ 1.16 g/L) gave complete control. As expected MERTECT was not effective against TBZ-resistant isolates of *Penicillium* or *Botrytis*.

Table 1. Effect of control of postharvest blue mold (*Penicillium expansum*) and gray mold (*Botrytis cinerea*) with fungicides in 'Silken' apples, 2006.

	% Disease incidence after 5 days at 20°C			
	Blue mold		Gray mold	
Treatment	Experiment 1	Experiment 2	Experiment 1	Experiment 2
Inoculum only	100.00 b [ab]	100.00 b	100.00 b	100.00 b
SCHOLAR @ 0.3 g/L	0.00 a	0.00 a	0.00 a	0.00 a
SCHOLAR @ 0.6 g/L	0.00 a	0.00 a	0.00 a	0.00 a
SCHOLAR @ 1.2 g/L	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 0.40 g/L	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 0.58 g/L	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	0.00 a	0.00 a
MERTECT @ 1.15 g/L	100.00 b	100.00 b	100.00 b	100.00 b
BIOSAVE @ 1.59 g/L	100.00 b	100.00 b	100.00 b	100.00 b

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of three replicates.

2007 PMR REPORT# 53 **SECTION K: FRUIT - Diseases**
WBSE: 3.2041.03

CROP: Apple, cv. Aurora Golden Gala
PEST: Fire Blight, *Erwinia amylovora* (Burrill) Winslow et al.

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TITLE: EFFICACY OF ACTIGARD, Bacterial soap, KASUMIN, SERENADE MAX FOR FIRE BLIGHT CONTROL ON APPLE, 2007

MATERIALS: ACTIGARD WG (Acibenzolar-S-methyl 50%), Bactericidal soap, DITHANE WP (Mancozeb 80%), KASUMIN (Kasugamycin 2.2%), SERENADE MAX (*Bacillus subtillis* QRD 141, 10-15%) and UAP STREPTOMYCIN 17 (Streptomycin sulfate 22.5%).

METHODS: The trial was conducted in a screenhouse at the Pacific Agri-Food Research Centre in Summerland, BC. It included two-year-old ‘Aurora Golden Gala’ apple trees on B9 rootstocks. On 23 April 2007, 55 bare root trees were planted in 5-gallon pots containing Premier Pro-Mix growing media (Premier Horticulture Ltd, Riviere-du-Loup, Quebec). The trees were fertilized at planting with 10-52-10 (5 g/L) and 50 g/tree of Nutricote (14-14-14) (WestGro Sales, Delta, BC) and irrigated twice a week thereafter. Each tree was a single replicate and each treatment was replicated 5 times according to the randomized block design. Trees were separated from one another by one meter on all sides and were arranged in 5 rows within the screenhouse. The treatments Bactericidal soap, KASUMIN, KASUMIN mixed with DITHANE, SERENADE MAX (1.0 g/L), SERENADE MAX (1.0 g/L) mixed with STREPTOMYCIN, SERENADE MAX (2.0 g/L), and STREPTOMYCIN were applied with a spray bottle (90 ml/tree) on 14 May (50% bloom) and 17 May (Full bloom). ACTIGARD was applied on 10 May (pink stage), 14 May and 17 May. Blossoms were inoculated on 18 May with a cell suspension of a mixture of two isolates of *Erwinia amylovora* (#1337 and #2345) of 4.9×10^6 CFU/ml grown in nutrient broth for 24 hours, the isolates were know to be virulent to apple and sensitive to STREPTOMYCIN. The suspension was sprayed with a “Solo” backpack sprayer (133 ml/tree). Forty-eight hours after the blossoms were inoculated, the trees were wetted for 3 hours with overhead sprinklers. Clusters displaying symptoms of fire blight indicated by blackening of flowers were recorded on 30 May, 2007. Shoots displaying symptoms of fire blight indicated by blackening and wilting were recorded on 8 June, 2007. Measurements were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NJ). The Waller-Duncan k-ratio t test (k = 100) was used for multiple comparison of means.

RESULTS and DISCUSSION: The treatments ACTIGARD alone or SERENADE MAX mixed with STREPTOMYCIN, reduced the incidence of fire blight on flowers and shoots as well as the STREPTOMYCIN treatment (Table 1). ACTIGARD was applied early to allow for systemic acquired resistance (SAR) to develop in the plant. Early application of the other treatments should be studied in future trials to determine if the effect is unique to ACTIGARD. The addition of SERENADE MAX to STREPTOMYCIN may help to prevent the development of resistance to streptomycin. The SERENADE

MAX alone (1.0 and 2.0 g/L), KASUMIN alone, KASUMIN mixed with DITHANE, and Bactericidal soap treatments did not significantly reduce fire blight symptoms on flowers or shoots. There was no phytotoxicity observed.

CONCLUSIONS: The treatments ACTIGARD alone or SERENADE MAX (1.0 g/L) mixed with STREPTOMYCIN constitute two options as alternatives to application of STREPTOMYCIN alone.

Table 1. Percent 'Aurora Golden Gala' apple flower clusters and shoots blighted by *Erwinia amylovora* recorded on 30 May (flowers) and 8 June (shoots) 2007.

Treatment and Rate		Percent Fire Blight Incidence [1]	
		Flowers	Shoots
SERENADE MAX	1.0 g/L	75.6 a[2]	71.3 a
Bactericidal Soap	4.0 ml/L	74.9 ab	69.6 a
Untreated	--	3.7 ab	58.3 ab
KASUMIN mixed with DITHANE	5.0 ml/L 2.0 g/L	75.1 ab	54.0 ab
KASUMIN	5.0 ml/L	68.0 ab	58.0 ab
SERENADE MAX	2.0 g/L	65.6 ab	56.6 ab
SERENADE MAX mixed with STREPTOMYCIN	1.0 g/L 0.6 g/L	44.5 cd	44.8 bc
STREPTOMYCIN	0.6 g/L	34.6 d	27.4 cd
ACTIGARD	0.6 g/L	26.3 d [3]	16.1 d
ANOVA Pr > F		< 0.0001	< 0.0001

[1] These values are means of five replications of 'Aurora Golden Gala' potted apple trees.
[2] Numbers in each column followed by the same letter are not significantly different at $p \leq 0.05$ as decided by Waller-Duncan k-ratio (k = 100) t test.
[3] ACTIGARD was applied 3 times at pink, 50% bloom and 100% bloom. All other treatments were applied 2 times at 50% bloom and 100% bloom.

Acknowledgments
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2007 PMR REPORT# 54

SECTION K: FRUIT - Diseases
WBSE: 3.2041.03

CROP: Apple, cv. Pacific Gala
PEST: Fire Blight, *Erwinia amylovora* (Burrill) Winslow et al.

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TITLE: EFFICACY OF APOGEE, BLIGHTBAN, BLOOMTIME, SERENADE MAX FOR FIRE BLIGHT CONTROL ON APPLE, 2007

MATERIALS: APOGEE (Prohexadione Calcium 27.5 %), BLIGHT BAN (*Pantoea aggglomerans* strain C9-1, 1 x 10^{11} CFU/g), BLOOMTIME (*Pantoea aggglomerans* strain E325, 1 x 10^{10} CFU/g), SERENADE MAX (*Bacillus subtillis* QRD 141, 10-15%) and UAP STREPTOMYCIN 17 (Streptomycin sulfate 22.5%).

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre in Agassiz, BC on three-year-old 'Pacific Gala' apple trees on M9 rootstocks. Each tree was a single replicate and each treatment was replicated 6 times according to the randomized block design. The treatments were BLIGHT BAN (25% bloom) followed by BLIGHT BAN (100% bloom) followed by 2 applications of APOGEE (2.5-7.5 cm shoot and 14 days later); BLIGHT BAN (25% bloom) followed by STREPTOMYCIN 17 (100% bloom) followed by 2 applications of APOGEE (2.5-7.5 cm shoot and 14 days later); BLOOMTIME (25% bloom) followed by BLOOMTIME (100% bloom) followed by 2 applications of APOGEE (2.5-7.5 cm shoot and 14 days later); BLOOMTIME (25% bloom) followed by STREPTOMYCIN 17 (100% bloom) followed by 2 applications of APOGEE (2.5-7.5 cm shoot and 14 days later); SERENADE MAX (25% bloom) followed by STREPTOMYCIN 17 (100% bloom) followed by 2 applications of APOGEE (2.5-7.5 cm shoot and 14 days later); STREPTOMYCIN 17 (25% bloom) followed by STREPTOMYCIN 17 (100% bloom) followed by 2 applications of APOGEE (2.5-7.5 cm shoot and 14 days later); and APOGEE (2.5-7.5 cm shoot) followed by APOGEE (14 days later). Twenty-five percent bloom occurred on 1 May and 100% bloom on 7 May 2007. APOGEE was applied on all treated trees on 15 and 29 May 2007. Blossoms were inoculated on 8 May with a cell suspension of *Erwinia amylovora* (3.7 x 10^6 CFU/ml). The suspension was a mixture of two different isolates of *E. amylovora* grown in nutrient broth for 24 hours. The isolates #1337 and #2345 were known to be virulent to apple and sensitive to streptomycin. The suspension as well as the treatments were sprayed with a "Solo" backpack sprayer (375 ml/tree). The trees were wetted for a 3 hour period on 10 May. Clusters displaying symptoms of fire blight indicated by blackening of tissue were recorded on 29 May and shoots on 12 June 2007. Shoot length was measured on 5 shoots per replicate on 12 June 2007. Measurements were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NJ). The Waller-Duncan *k*-ratio *t* test (k = 100) was used for multiple comparison of means.

RESULTS and DISCUSSION: BLOOMTIME followed by STREPTOMYCIN or SERENADE followed by STREPTOMYCIN reduced the incidence of fire blight on flowers and shoots as well as the STREPTOMYCIN followed by STREPTOMYCIN treatment (Table 1). BLIGHTBAN followed by BLIGHTBAN and BLIGHTBAN followed by STREPTOMYCIN reduced the incidence of shoot blight only. All were followed by two applications of APOGEE. Such control programs can be used to reduce the selection of streptomycin-resistant bacteria. BLOOMTIME followed by APOGEE and APOGEE alone did not reduce the incidence of fire blight on flowers or shoots. The lack of efficacy of APOGEE on fire blight was confirmed by the fact that it did not have an effect on shoot growth (Table 2). The low vigor and the high variability between trees may be responsible for the lack of response to APOGEE. Moreover, some material was washed off by rain events following treatments on 18-20 May (24.4 mm), 26 May (4.2 mm), 3-6 June (38.3 mm) and 9-12 June (22.2 mm) (Table 3). There was no phytotoxicity observed from any of the materials.

CONCLUSIONS: The treatments BLOOMTIME followed by STREPTOMYCIN and SERENADE followed by STREPTOMYCIN, when followed by two applications of APOGEE, constitute two options for an effective program for the control of apple fire blight on flowers and shoots.

Table 1. Percent 'Pacific Gala' apple flower clusters and shoots blighted by *Erwinia amylovora* recorded on 29 May (flowers) and 12 June (shoots) 2007.

Treatment	Rate	Percent Fire Blight Incidence [1]	
		Flowers	Shoots
Untreated		77.9 ab [2]	41.7 a
BLOOMTIME [3]	0.5 g/L	84.9 a	22.8 ab
APOGEE	0.3 g/L	82.5 a	22.5 ab
BLIGHTBAN [3]	0.5 g/L	66.1 abc	14.9 b
BLIGHTBAN followed by STREPTOMYCIN [3]	0.5 g/L 0.6 g/L	53.7 abc	15.6 b
SERENADE MAX followed by STREPTOMYCIN [3]	1.0 g/L 0.6 g/L	44.9 bc	9.0 b
BLOOMTIME followed by STREPTOMYCIN [3]	0.5 g/L 0.6 g/L	42.5 c	10.4 b
STREPTOMYCIN [3]	0.6 g/L	37.2 c	16.7 b
ANOVA Pr > F		0.0103	0.0216

[1] These values are means of six replications of 'Pacific Gala' apple trees.
[2] Numbers in each column followed by the same letter are not significantly different at $p \leq 0.05$ as decided by Waller-Duncan *k*-ratio (k = 100) *t* test.
[3] Two applications of APOGEE followed the 25% and 100% bloom applications when shoots were 2.5-7.5 cm in length and 14 days later.

Table 2. Average shoot length (mm) of 5 shoots per tree measured on 12 June 2007.

Treatment	Rate	Shoot length [1]
Untreated		168.2 a [2]
BLOOMTIME [3]	0.5 g/L	161.5 a
APOGEE	0.3 g/L	169.0 a
BLIGHTBAN [3]	0.5 g/L	166.1 a
BLIGHTBAN	0.5 g/L	
followed by STREPTOMYCIN [3]	0.6 g/L	156.8 a
SERENADE MAX	1.0 g/L	
followed by STREPTOMYCIN [3]	0.6 g/L	158.3 a
BLOOMTIME	0.5 g/L	
followed by STREPTOMYCIN [3]	0.6 g/L	171.8 a
STREPTOMYCIN [3]	0.6 g/L	155.3 a
ANOVA Pr > F		0.998

[1] These values are means of six replications of 'Pacific Gala' apple trees.
[2] Numbers followed by the same letter are not significantly different at $p \leq 0.05$ as decided by Waller-Duncan *k*-ratio (k = 100) *t* test.
[3] Two applications of APOGEE followed the 25% and 100% bloom applications when shoots were 2.5-7.5 cm in length and 14 days later.

Table 3: Weather conditions as recorded by Agriculture Canada Weather Station, Agassiz, BC from 28 April to 12 June, 2007

Year	Month	Day	Rain (mm)	Max Air Temp (°C)	Min Air Temp (°C)	Mean Air Temp (°C)	
2007	4	28	0.4	15.9	5.4	10.6	
2007	4	29	0	16.3	7.2	11.8	
2007	4	30	1	15.6	5.3	10.5	
2007	5	1	2	14.1	7.8	11	25% bloom application
2007	5	2	1.6	14.8	8.8	11.8	
2007	5	3	0	13.6	6.6	10.1	
2007	5	4	0.8	11.8	6.5	9.1	
2007	5	5	0	13.2	7.1	10.1	
2007	5	6	2.2	14.4	7.9	11.1	
2007	5	7	0.4	20.2	10.5	15.4	100% bloom application
2007	5	8	0	22.3	9	15.6	Ea Inoculation
2007	5	9	0	17.7	4.7	11.2	
2007	5	10	0	19.2	3.4	11.3	3h Wetness period
2007	5	11	0	20.5	4.6	12.6	
2007	5	12	0.4	19.7	4.5	12.1	
2007	5	13	0	13.2	9.6	11.4	
2007	5	14	0	22.2	5.2	13.7	
2007	5	15	0	28.9	12.2	20.5	First Apogee
2007	5	16	0	19.4	9.3	14.4	
2007	5	17	0	19.5	10.9	15.2	
2007	5	18	5.4	20.9	4.6	12.8	
2007	5	19	5.2	13.7	9.3	11.5	
2007	5	20	13.8	14.4	7.6	11	
2007	5	21	0	14.4	6.4	10.4	

2007	5	22	0	19.6	8.8	14.2	
2007	5	23	0	20.4	6.9	13.6	
2007	5	24	0	25	7.9	16.5	
2007	5	25	0	24.1	11.8	18	
2007	5	26	4.2	19	12.8	15.9	
2007	5	27	0.6	14.5	10.3	12.4	
2007	5	28	0	18.3	9.4	13.8	
2007	5	29	0	28.1	9.7	18.9	Second Apogee
2007	5	30	0	29.1	13.9	21.5	
2007	5	31	0	27.7	13.5	20.6	
2007	6	1	0	27.4	10.5	19	
2007	6	2	0	29.4	11.7	20.5	
2007	6	3	3.4	31.4	16.5	24	
2007	6	4	12.3	21.4	16.1	18.8	
2007	6	5	21.8	13.5	12	12.8	
2007	6	6	0.8	13.9	9.2	11.5	
2007	6	7	0	14.7	10.4	12.5	
2007	6	8	0	19.1	8.8	14	
2007	6	9	7.6	17.3	11.8	14.5	
2007	6	10	12.2	15.9	12.5	14.2	
2007	6	11	0.6	15.7	8.7	12.2	
2007	6	12	1.8	19.5	9.4	14.4	Final evaluation

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2007 PMR REPORT# 55 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples cv. Jonagold
PEST: Gray mold, *Botrytis cinerea* Pers., blue mold, *Penicillium expansum* Link

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TITLE: EFFECT OF CALCIUM ON PRE-HARVEST AND POST-HARVEST APPLICATIONS OF FUNGICIDES ON THE CONTROL OF GRAY AND BLUE MOLD DECAY ON JONAGOLD APPLES IN 2005

MATERIALS: CALCIUM CHLORIDE (Dow Flake Process Grade 77-80%), MERTECT 45% flowable (thiabendazole), SCALA SC (pyrimethanil), PRISTINE WG (pyraclostrobin 12.8% and boscalid 25.2%), SENATOR 70 WP (thiophanate-methyl)

METHODS: Fungicide treatments were applied to Jonagold apple trees arranged in a randomized complete block design with six replicate blocks for each treatment. Each block consisted of four cv. Jonagold trees with guard cv. Gala trees on either side. Treatments were an unsprayed check, SCALA (800 g ai/ha) two weeks pre-harvest, SCALA (800 g ai/ha) one week pre-harvest, SCALA (800 g ai/ha) two weeks pre-harvest plus a CALCIUM treatment (12 kg/ha or 500 g/100 L water applied to runoff) one week before harvest, SCALA (800 g ai/ha) one week pre-harvest plus a CALCIUM treatment (12 kg/ha or 500 g/100 L applied to runoff) one week before harvest and PRISTINE (420g/ha) one week pre-harvest. Pre-harvest sprays were applied before harvest on 6 and 13 September, respectively. Spray applications were made using a hand operated gun sprayer (345 Kpa) to run off in volumes of 225 L water/ha. The apple fruit were harvested on 20 September, 2005 when the fruit were at commercial maturity. These apples were placed into mesh bags in samples of 10 apples per replicate and treated by dipping for 30 seconds in MERTECT (0.45 ml ai/L) or SENATOR (2.25g/L) fungicide suspension. After the fruit dried, each apple was wounded with a sterile nail (3.0 mm in diameter). The fruit was then inoculated by dipping into a spore suspension of 10^4 conidia/ml of *Botrytis cinerea* or *Penicillium expansum*, and kept at 1°C for 3 months when lesion diameter was measured using an electronic caliper. Each lesion was measured twice and the two readings were averaged. After 6 months storage the fruit were again wounded and dip inoculated as above but kept at 20°C until measurable lesions occurred. Lesion diameter was measured as above. Data were analyzed using the General Linear Model (SAS Institute, Cary, NC) and means were separated using the Duncan's Multiple Range comparative test (p =

0.05).

RESULTS AND DISCUSSION: After the 'Jonagold' apples had been stored for 3 months, the least decay for both *B. cinerea* and *P. expansum* was shown by all the SCALA treatments. The MERTECT and PRISTINE treatments showed significantly less decay than the untreated check with the exception of the isolate 1790 (R) known to be resistant to Benomyl (Table 1). Similar observations were made for decay incidence at 3 months storage with the exception of isolate B-27 (S) with the MERTECT treatment. In this case, disease incidence was significantly more than the control (Table 2). After 6 months storage all the SCALA treatments for all pathogens showed significantly less decay than the untreated check, MERTECT or SENATOR post harvest treatments. The PRISTINE showed significantly less decay than the MERTECT or the control but more decay than SCALA. For the *Botrytis* isolate B-104, the CALCIUM applications significantly reduced decay (Table 3). SCALA was effective at significantly reducing the incidence of decay for all the pathogens tested (Table 4). It was observed that the MERTECT treatments were not effective against the TBZ sensitive isolates in this study. It is possible that there has been some cross contamination with the TBZ resistant isolates. The isolates should be rechecked for TBZ sensitivity.

CONCLUSION: SCALA is an effective fungicide for reducing post harvest decay whether it is applied 14 or 7 days before harvest for control of both *P. expansum* and *B. cinerea.* It is possible that the CALCIUM treatments could enhance the effectiveness of SCALA. In this trial post-harvest application of SENATOR was ineffective against both fungi.

Table 1. Mean severity of post harvest decay for 'Jonagold' apples treated with preharvest fungicides, wounded and inoculated after harvest and kept for 3 months in air storage at 1°C.

Treatment[1] (g ai/ha)	Days applied before harvest	Lesion diameter[1] (mm)			
		Penicillium expansum		*Botrytis cinerea*	
		986-2W(S)	1790 (R)	B-27 (S)	B-104 (R)
Control	--	20.8 a[2]	16.2 b	46.4 a	10.3 a
MERTECT (0.45 ml)	0	14.9 b	21.7 a	24.9 b	5.5 b
SCALA (800)	14	4.2 c	3.0 d	3.0 d	3.0 b
SCALA (800)	7	3.4 c	3.0 d	3.0 d	.0 b
SCALA (800) + CA[3] (12,000)	14	3.9 c	4.7 d	3.1 d	3.0 b
SCALA (800) + CA (12,000)	7	3.7 c	3.1 d	3.9 d	3.0 b
PRISTINE (420)	7	13.6 b	11.1 c	19.4 c	4.7 b

[1] Mean of six replicates of 10 apples per replicate. Each apple was wounded once, and then inoculated with *Botrytis cinerea* or *Penicillium expansum* isolates that were either thiabendazole sensitive (S) or thiabendazole resistant (R). Wound diameter 3.0 mm.
[2] Numbers followed by the same letter in each column are not statistically different at the $p = 0.05$ level.
[3] CA - Calcium chloride applied.

Table 2. Mean incidence of post harvest decay for 'Jonagold' apples treated with pre-harvest fungicides, wounded and inoculated after harvest and kept for 3 months air storage at 1°C.

Treatment[1] (g ai/ha)	Days applied before harvest	% Decay incidence[1]			
		Penicillium expansum		*Botrytis cinerea*	
		986-2W (S)	1790 (R)	B-27 (S)	B-104 (R)
Control	--	90.9 a[2]	76.3 a	61.7 b	31.7 a
MERTECT (0.45 ml)	0	60.0 b	68.9 ab	97.2 a	9.5 b
SCALA (800)	14	0.0 d	3.3 c	0.0 c	0.0 c
SCALA (800)	7	0.0 d	1.7 c	0.0 c	0.0 c
SCALA (800) + CA[3] (12,000)	14	8.3 d	3.3 c	1.7 c	0.0 c
SCALA (800) + CA (12,000)	7	1.7 d	3.3 c	1.7 c	0.0 c
PRISTINE (420)	7	31.7 c	53.5 b	56.7 b	6.7

[1] Mean of six replicates of 10 apples per replicate. Each apple was wounded once, and then inoculated with *Botrytis cinerea* or *Penicillium expansum* isolates that were either thiabendazole sensitive (S) or thiabendazole resistant (R).
[2] Numbers followed by the same letter in each column are not statistically different at the $p = 0.05$ level.
[3] CA - Calcium chloride applied.

Table 3. Mean severity of post harvest decay for 'Jonagold' apples treated with preharvest fungicides, wounded and inoculated after 6 months air storage at 1°C, and incubated at 20°C for 5 days.

Treatment[1] (g ai/ha)	Days applied before harvest	Lesion diameter[1] (mm)			
		Penicillium expansum		*Botrytis cinerea*	
		986-2W (S)	1790 (R)	B-27 (S)	B-104 (R)
Control	--	29.2 a[2]	27.3 a	38.8 a	40.6 a
MERTECT (0.45 ml)	0	28.6 a	28.1 a	39.8 a	40.8 a
SCALA (800)	14	17.7 b	13.7 c	4.2 c	5.9 c
SCALA (800)	7	14.5 c	9.9 d	5.0 c	5.7 cd
SCALA (800) + CA[3] (12,000)	14	18.8 b	18.0 b	3.7 c	4.8 cd
SCALA (800) + CA (12,000)	7	11.6 c	12.3 cd	3.0 c	3.0 d
PRISTINE (420)	7	19.7 b	20.1 b	32.1 b	24.1 b
SENATOR (2.25 g/l)	0	29.5 a	27.2 a	39.8 a	42.7 a

[1] Mean of six replicates of 10 apples per replicate. Each apple was wounded once, and then inoculated with *Botrytis cinerea* or *Penicillium expansum* isolates that were either thiabendazole sensitive (S) or thiabendazole resistant (R). Wound diameter is 3.0 mm.
[2] Numbers followed by the same letter in each column are not statistically different at the $p = 0.05$ level.
[3] CA - Calcium chloride applied.

Table 4. Mean incidence of post harvest decay for 'Jonagold' apples treated with preharvest fungicides, wounded and inoculated after 6 months air storage at 1°C, and incubated at 20°C for 5 days.

Treatment[1](g ai/ha)	Days applied before harvest	% Decay incidence[1]			
		Penicillium expansum		*Botrytis cinerea*	
		986-2W (S)	1790 (R)	B-27 (S)	B-104 (R)
Control	--	100.0 a[2]	100.0 a	95.0 a	100.0 a
MERTECT (0.45 ml)	0	100.0 a	100.0 a	95.2 a	100.0 a
SCALA (800)	14	71.7 b	63.3 b	5.2 b	13.3 b
SCALA (800)	7	53.3 c	387.3 c	67. b	8.3 b
SCALA (800) + CA[3] (12,000)	14	68.3 bc	1.7 b	3.3 b	10.2 b
SCALA (800) + CA (12,000)	7	56.9 bc	55.0 bc	0.0 b	0.0 b
PRISTINE (420)	7	100.0 a	100.0 a	98.3 a	100.0 a
SENATOR (2.25 g/l)	0	100.0 a	100.0 a	6.7 a	100.0 a

[1] Mean of six replicates of 10 apples per replicate. Each apple was wounded once, and then inoculated with *Botrytis cinerea* or *Penicillium expansum* isolates that were either thiabendazole sensitive (S) or thiabendazole resistant (R).
[2] Numbers followed by the same letter in each column are not statistically different at the $p = 0.05$ level.
[3] CA - Calcium chloride applied.

2007 PMR REPORT# 56 **SECTION K: FRUIT Diseases**

CROP: GRAPE (*Vitis vinifera* L.) cv. Riesling
PEST: Bunch rot (*Botrytis cinerea* Pers.:Fr)

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TITLE: COMPARISON OF FUNGICIDE ALTERNATIVES AND CONVENTION FUNGICIDES FOR CONTROL OF BUNCH ROT IN GRAPEVINE, 2006-2007

MATERIALS: ROVRAL WDG (iprodione 50%), ELEVATE 50WDG (fenhexamid 50%), KELP (extract from *Ascophyllum nodosum*), PLANT WASH + KELP (extracts from thyme *Thymus vulgaris* L. 1%, sage *Salvia officinalis L.,*1%, cloves *Syzygium aromaticum* [L.] Merr. et Perry) 1% + extract from *Ascophyllum nodosum ecad mackaii* (Turner) S.M. Baker & M.H. Bohling), OLIGO-CA (chelated calcium, 6%), SERENADE MAX *B. subtilis* (Ehrenberg) Cohn QST 713 14.6%)

METHODS: The experiment was conducted on five- to six-vine plots (6 m long x 3 m wide) replicated four times in a randomised complete block design in a mature commercial vineyard in Beamsville, ON in 2006 and 2007. Sprays were applied with a hydraulic tunnel sprayer as a full canopy spray at 1380 kPa at a rate of 1000 L per ha at cluster close (13 July, 2006 & 2007), veraison (22 August, 2006 & 27 August, 2007) and 2 wk later (8 September, 2006 & 10 September, 2007). In the commercial standard, ROVRAL (1.5 kg/ha) was applied at cluster close and ELEVATE (1.12 kg/ha) was applied at veraison and 2 wk later. In 2006, KELP (1 kg/ha) and PLANT WASH PLUS KELP (10 L/ha) were applied at all 3 timings and in 2007, KELP (1 kg/ha), OLIGO-CA (5L/ha) and SERENADE MAX (1.5 kg/ha) were applied at all 3 timings. Incidence and severity of bunch rot were evaluated at harvest, 02 October 2006 and 03 October 2007, on 25 random clusters on the middle three vines per plot using the Barratt-Horsfall scale for severity. Severity values were arcsin sq root transformed and analysed using ANOVA (XLStat). In 2006, temperatures were above average in May (7.5°C), June (13.9°C), July (19.4°C) and August (21°C) and average in September (16.1°C); precipitation was above average in May (55.8 mm), June (96.2 mm), July (97.6 mm), August (36 mm) and September (106 mm). In 2007 the average monthly temperatures were slightly above average in May (12.7°C), June (20.4°C), July (20.9°C), August (21.9°C) and September (18.2°C) precipitation was well below average in May (42.4 mm), June (18 mm), July (36 mm), August (16.6 mm) and September (18 mm).

RESULTS: As shown in Table 1.

CONCLUSIONS: Bunch rot pressure was very high in 2006 and low in 2007. All treatments significantly reduced the severity of bunch rot in 2006 and all alternatives gave control comparable to the grower standard. In 2007, all the alternative treatments significantly reduced the severity of bunch rot compared to the untreated check and gave control comparable to the grower standard. No phytotoxicity was observed in any treatment.

Table 1: Efficacy of standard fungicide and alternative treatments for control of *Botrytis* bunch rot, 2006-2007

	02 Oct, 2006		03 Oct, 2007	
Treatment	Severity[1]	Incidence	Severity	Incidence
Check	17.4 b	75.0 b	2.8 a	7.2 a
STANDARD	2.2 a [87] [2]	16.0 a	1.7 ab [39]	3.5 a
KELP	4.6 a [74]	32.0 ab	0.6 b [79]	2.0 a
PLANT WASH + KELP	4.5 a [74]	30.0 ab	--	---
OLIGO-CA	--	--	1.1 b [61]	3.8 a
SERENADE MAX	--	--	0.5 b [82]	2.5 a

[1] Severity was rated using the Barratt-Horsfall scale. ANOVA were conducted on arcsin sq root transformed data. Values in table represent back-transformed means.
[2] Values in a column followed by the same letter are not significantly different according to the Tukey multiple range test ($\alpha = 0.05$). Disease severity expressed as per cent of the unsprayed control is shown in brackets [ ].

2007 PMR REPORT# 57 **SECTION K: FRUIT Diseases**

CROP: GRAPE (*Vitis vinifera* L.) cv.Cabernet sauvignon
PEST: Powdery mildew (*Erysiphe necator* Schwein.)

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TITLE: FUNGICIDES AND ALTERNATIVE TREATMENTS FOR CONTROL OF POWDERY MILDEW OF GRAPEVINE, 2006

MATERIALS: KUMULUS (sulphur 80%), NOVA 40W (myclobutanil 40%), LANCE (boscalid 70%), PRISTINE WG (boscalid 25.2% + pyraclostrobin 12.8%), SILMATRIX (potassium silicate 29%), VERAISON PHP (elemental bio-sulphur 45.3% + monopotassium phosphate 46.3%), PHORTRESS (monopotassium phosphate 7.8% + phosphorous acid 5.9%), K50 (potassium carbonate), + SW7 (silicon wetter, 7%), PLANT WASH (extracts from thyme *Thymus vulgaris* L. 1%, sage *Salvia officinalis* L.,1%, cloves *Syzygium aromaticum* [L.] Merr. et Perry) 1%, AGROGREEN (extract from Neem, *Azadirachta indica* A. Juss.).

METHODS: The experiment was conducted on five- to six-vine plots replicated four times in a randomised complete block design in mature research vineyard, cv. Cabernet sauvignon at Vineland Station, ON. Sprays were applied with a hydraulic tunnel sprayer at 1380 kPa at a rate of 500 L/ha pre-bloom and 1000 L/ha from immediate post-bloom through the rest of the season. Sprays were applied at: 15-20 cm shoots (07 June), immediate pre-bloom (14 June), immediate post-bloom (27 June), pea-sized berries (07 July), cluster close (14 July), veraison (31 July), 2 wk post-veraison (15 August) and 4 wk post-veraison (31 August). Incidence and severity of powdery mildew was evaluated on 25 random leaves and clusters on the middle three vines per plot using the Barratt-Horsfall scale for severity on 23 July. Incidence and severity of powdery mildew were determined on 25 fruit on 25 September and on the basal 5 internodes of canes on 09 October. Severity values were arcsin sq root transformed and analysed using ANOVA (XLStat). Temperatures were above average in May (7.5°C), June (13.9°C), July (19.4°C) and August (21°C) and average in September (16.1°C); precipitation was above average in May (55.8 mm), June (96.2 mm), July (97.6 mm), August (36 mm) and September (106 mm).

RESULTS: As presented in Tables 1 and 2.

CONCLUSIONS: The incidence and severity of powdery mildew on leaves and fruit were very low and there were no significant differences among treatments 23 July. By 25 September, many plots were defoliated with downy mildew therefore foliar powdery mildew was not evaluated. The commercial standard (KUMULUS, NOVA, LANCE), PRISTINE and full-season KUMULUS provided the best control of powdery mildew on fruit, although not significantly different from PHORTRESS, PLANT WASH, and AGROGREEN. VERAISON PHP and SILMATRIX did not significantly reduce severity of powdery mildew on fruit. There was no significant difference among treatments and the untreated check with respect to incidence of powdery mildew on fruit. The commercial standard, PRISTINE and KUMULUS also provided better control of cane infection than the other treatments and untreated check.

The other treatments, with the exceptions of K50+SW7 and PLANT WASH, significantly reduced the severity of cane lesions compared to the check. The fruit in the treatments containing plant wash exhibited a loss of waxy bloom after veraison. No phytotoxicity was observed on foliage in any treatment.

Table 1. Incidence and severity of powdery mildew on leaves and fruit, July 23, 2006

		Leaf		Fruit	
Treatment, rate/ha	Timing[z]	Severity[y]	Incidence	Severity	Incidence
Check	--	0.7 bc[x]	18 ab	0.2 a	0.20833333333
KUMULUS, 12.6 kg	178				
NOVA 40W, 200g	235				
LANCE, 315 g	46	0.2 c	14 ab	0 a	0 a
PRISTINE, 675 g	39454	0.0 c	13 ba	0	0
SILMATRIX, 400 mL	1-3				
SILMATRIX, 800 mL	39545	2.2 a	47 ab	0 a	3a
VERAISON PHP, 5 L	39454	4.6 a	33 ab	0.1 a	0.125
PHORTRESS, 4.94 L	39454	0.6 bc	24 ab	0.1 a	0
KUMULUS, 12.6 kg	39454	0.1 c	14 ba	0	0
K50, 3 L	1-3				
K50, 5 L	4-8				
+ SW7, 250 mL	1-8	0.7 bc	36 ab	0.1 a	2 a
PLANT WASH, 3.9 L	39454	0.7 bc	19 ab	0	0
PLANT WASH, 3.9 L	39450				
PLANT WASH + KELP, 10 L	39575	0.6 bc	23 ab	0	0
AGROGREEN, 5 L	39449				
AGROGREEN, 10 L	39545	0.5 bc	25 ab	0	0.125

[z] Sprays were applied at 1 = 15-20 cm shoots (07 June); 2 = immediate pre-bloom (14 June); 3 = immediate post-bloom (27 June); 4 = pea-sized berries (07 July); 5 = cluster close (14 July); 6 = veraison (31 July); 7 = 2-wk post-veraison (15 August); 8 = 4-wk post-veraison (31 August)

[y] Severity was rated using the Barratt-Horsfall scale. ANOVA were conducted on arcsin sq root transformed data. Values in table represent back-transformed means.

[x] Values in a column followed by the same letter are not significantly different according to the Tukey multiple range test ($\alpha = 0.05$).

Table 2: Incidence and Severity of powdery mildew on fruit and canes, 25 September and 09 October, respectively.

		39715 Fruit		09 October Cane	
Treatment, rate/ha	Timing[z]	Severity[y]	Incidence	Severity	Incidence
Check	--	12.2 ab[x]	33 ab	66.6 ab	100 a
KUMULUS, 12.6 kg	178				
NOVA 40W,200g	235				
LANCE, 315 g	46	0.1 d	1 b	5.6 g	51 c
PRISTINE, 675 g	39454	0 d	0 b	8.7 g	29 d
SILMATRIX, 400 mL	39449				
SILMATRIX 800 mL	4-8	16.3 a	57 a	52.8 cd	99 a
VERAISON PHP, 5 L	39454	7.7 bc	29 ab	55.1 cd	100 a
PHORTRESS, 4.94 L	39454	4.4 cd	28 ab	23.1 f	96 ab
KUMULUS, 12.6 kg	39454	0.2 d	3 ab	11.2 g	76 b
K50, 3 L	1-3				
K50, 5 L	4-8				
+ SW7, 250 mL	1-8	4.1 cd	20 ab	61.0 bc	99 a
PLANT WASH, 3.9 L	39454	1.0 d	10 ab	71.3 a	100 a
PLANT WASH, 3.9 L	1-4				
PLANT WASH + KELP, 10L	5-8	5.1 cd	19 ab	66.4 ab	100 a
AGROGREEN, 5L	1-3				
AGROGREEN, 10 L	4-8	3.7 cd	16 ab	46.9 de	100 a

[z] Sprays were applied at 1 = 15-20 cm shoots (07 June); 2 = immediate pre-bloom (14 June); 3 = immediate post-bloom (27 June); 4 = pea-sized berries (07 July); 5 = cluster close (14 July); 6 = veraison (31 July); 7 = 2-wk post-veraison (15 August); 8 = 4-wk post-veraison (31 August)

[y] Severity was rated using the Barratt-Horsfall scale. ANOVA were conducted on arcsin sq root transformed data. Values in table represent back-transformed means.

[x] Values in a column followed by the same letter are not significantly different according to the Tukey multiple range test ($\alpha = 0.05$).

2007 PMR REPORT# 58 **SECTION K: FRUIT Diseases**

CROP: Grape (*Vitis vinifera* L.) cv. Cabernet sauvignon
PEST: Powdery mildew (*Erysiphe necator* Schwein.)

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TITLE: FUNGICIDES AND ALTERNATIVE TREATMENTS FOR CONTROL OF DOWNY MILDEW OF GRAPEVINE, 2006

MATERIALS: MAESTRO (captan, 80%), PRISTINE WG (boscalid 25.2% + pyraclostrobin 12.8%), UPTAKE PLUS (phosphorous acid 18%), SILMATRIX (potassium silicate 29%), VERAISON PHP (elemental bio-sulphur 45.3% + monopotassium phosphate 46.3%, PHORTRESS (monopotassium phosphate 7.8% + phosphorous acid 5.9%), K50 (potassium carbonate) + SW7 (silicon wetter, 7%), PLANT WASH (extracts from thyme *Thymus vulgaris* L. 1%, sage *Salvia officinalis* L.,1%, cloves *Syzygium aromaticum* [L.] Merr. et Perry) 1%, AGROGREEN (extract from Neem, *Azadirachta indica* A. Juss.).

METHODS: The experiment was conducted on five- to six-vine plots replicated four times in a randomised complete block design in mature research vineyard, cv. Cabernet sauvignon at Vineland Station, ON. Sprays were applied with a hydraulic tunnel sprayer at 1380 kPa at a rate of 500 L/ha pre-bloom and 1000 L/ha from immediate post-bloom through the rest of the season. Sprays were applied at 15-20 cm shoots (07 June), immediate pre-bloom (14 June), immediate post-bloom (27 June), pea-sized berries (07 July), cluster close (14 July), veraison (31 July), 2 wk post-veraison (15 August) and 4 wk post-veraison (31 August). Incidence and severity of downy mildew were evaluated on 23 July and 25 September in 2006 on 25 random leaves on the middle three vines per plot using the Barratt-Horsfall scale for severity. Severity values were arcsin sq root transformed and analysed using ANOVA (XLStat). Temperatures were above average in May (7.5°C), June (13.9°C), July (19.4°C) and August (21°C) and average in September (16.1°C); precipitation was above average in May (55.8 mm), June (96.2 mm), July (97.6 mm), August (36 mm) and September (106 mm).

RESULTS: As shown in Table 1.

CONCLUSIONS: Disease pressure was very high in 2006. MAESTRO, PRISTINE, SILMATRIX PHORTRESS, UPTAKE PLUS AND AGROGREEN significantly reduced the severity of downy mildew 23 July; there was no difference in incidence among treatments and the untreated check. All treatments significantly reduced the severity of downy mildew on 25 September compared to the untreated check. The commercial standard, MAESTRO, provided the best control of downy mildew. PRISTINE and UPTAKE PLUS provided superior control compared to the other treatments; only MAESTRO significantly reduced the incidence of downy mildew. Fruit treated with PLANT WASH exhibited a loss of waxy bloom after veraison. No phytotoxicity was observed on foliage in any treatment.

Table 1. Severity and Incidence of downy mildew on foliage of grapevine, 2006

		39651		25 September	
Treatment, rate/ha	Timing[z]	Severity[y]	Incidence	Severity	Incidence
Check	--	1.7 a[x]	18 ab	98.6 a	100 a
MAESTRO, 2 kg	39454	0.1 c	14 ab	2.4 e	39 d
PRISTINE, 675 g	39454	0.2 bc	3 b	11.0 de	77 abcd
SILMATRIX, 400 mL	39454	0.4 bc	47 ab	67.6 c	97 a
VERAISON PHP, 5 L +					
MAESTRO, 1 kg	39454	2.0 a	33 ab	83.1 b	99 a
PHORTRESS, 4.94 L	39454	0.1 c	24 ab	20.3 d	84 abcd
UPTAKE PLUS, 2.47 L	39454	0.1 c	4 b	14.2 de	87 abc
K50, 3 L + SW7, 250 mL	39454	0.9 abc	36 ab	56.4 c	95 ab
PLANT WASH. 3.9 L	39454	1.6 a	19 ab	84.3 b	99 ab
PLANT WASH, 3.9 L	1-3				
PLANT WASH + KELP, 10 L	4-8	0.2 ab	23 ab	84.5 b	99 a
AGROGREEN, 5 L	1-3				
AGROGREEN, 10 L	4-8	0.5 bc	25 ab	64.4 c	97 a

[z] Sprays were applied at 1 = 15-20 cm shoots (07 June); 2 = immediate pre-bloom (14 June); 3 = immediate post-bloom (27 June); 4 = pea-sized berries (07 July); 5 = cluster close (14 July); 6 = veraison (31 July); 7 = 2-wk post-veraison (15 August); 8 = 4-wk post-veraison (31 August)

[y] Severity was rated using the Barratt-Horsfall scale. ANOVA were conducted on arcsin sq root transformed data. Values in table represent back-transformed means.

[x] Values in a column followed by the same letter are not significantly different according to the Tukey multiple range test ($\alpha = 0.05$).

CROP: Grape (*Vitis vinifera* L.) cv.Cabernet sauvignon
PEST: Powdery mildew (*Erysiphe necator* Schwein.)

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TITLE: FUNGICIDES AND ALTERNATIVE TREATMENTS FOR CONTROL OF POWDERY MILDEW OF GRAPEVINE, 2007

MATERIALS: FLINT, KUMULUS (sulphur 80%), NOVA 40W (myclobutanil 40%), LANCE (boscalid 70%), QUINTEC (quinoxyfen 25%), VERAISON PHP (elemental bio-sulphur 45.3% + monopotassium phosphate 46.3%), SERENADE MAX (*B. subtilis* (Ehrenberg) Cohn QST 713 14.6%), PHORTRESS (monopotassium phosphate 7.8% + phosphorous acid 5.9%), K50 (potassium carbonate), + SW7 (silicon wetter, 7%), PLANT WASH (extracts from thyme *Thymus vulgaris* L. 1%, sage *Salvia officinalis* L.,1%, cloves *Syzygium aromaticum* [L.] Merr. et Perry) 1%), EVERGREEN FISH EMULSION, EVERGRO LIQUID PLANT FOOD (0-0.6-0), EVERGREEN 8-16-8, GARLIC OIL, LIQUID CARBON (carbon % + *Bacillus chitinosporous*, *B. licheniformis*, *B. latersporus*, *B. cereus*) EVERGREEN MOLASSES

METHODS: The experiment was conducted on five- to six-vine plots replicated four times in a randomised complete block design in mature research vineyard, cv. Cabernet sauvignon at Vineland Station, ON. Sprays were applied with a hydraulic tunnel sprayer at 1380 kPa at a rate of 500 L/ha pre-bloom and 1000 L/ha from immediate post-bloom through the rest of the season. Sprays were applied at: 15-20 cm shoots (30 May), immediate pre-bloom (18 June), immediate post-bloom (25 June), pea-sized berries (03 July), cluster close (13 July), veraison (01 August), 2 wk post-veraison (16 August) and 4 wk post-veraison (31 August). Incidence and severity of powdery mildew were evaluated on 25 random leaves and clusters on the middle three vines per plot using the Barratt-Horsfall scale for severity on 23 July. Incidence and severity of powdery mildew were determined on 25 fruit 25 September and on the basal 5 internodes of canes on 09 October. Severity values were arcsin sq root transformed and analyzed using ANOVA (XLStat). The average monthly temperatures were slightly above average in May (12.7°C), June (20.4°C), July (20.9°C), August (21.9°C) and September (18.2°C) precipitation was well below average in May (42.4 mm), June (18 mm), July (36 mm), August (16.6 mm) and September (18 mm).

RESULTS: As shown in Table 1.

CONCLUSIONS: Powdery mildew was not observed until mid-July. The severity was moderate on the upper and lower leaf surfaces but lower severity on the fruit in the untreated check. This is likely the result of non-conducive conditions for infection during most of the period of berry susceptibility. All treatments significantly reduced the severity of powdery mildew on all tissues. When placed at various times in the spray schedule, QUINTEC performed comparably to FLINT, NOVA or LANCE. SERENADE MAX controlled powdery mildew whether applied full season either alone or in combination with a half-rate of KUMULUS, or when applied only in the latter part of the season only. The EVERGREEN combinations also significantly reduced the severity of powdery mildew; however, fruit in this treatment lost their waxy bloom at veraison. No foliar phytotoxicity was observed.

Table 1: Severity of powdery mildew on leaves and fruit, 2007

Treatment, rate/ha	Timing[z]	Upper Leaf Surface	Lower Leaf Surface	Fruit
Check	--	20.5	18.5 a	12.4 a
FLINT, 105 g	39721	0.3 b	1.9 b	0 b
PHORTRESS, 4.94 L	39721	0 b	0 b	0 b
PHORTRESS, 4.94 L				
+ KUMULUS, 6.3 kg	39721	0 b	0 b	0 b
KUMULUS, 6.3 kg	39721	0 b	0 b	0 b
KUMULUS, 12.6 kg	39721	0 b	0 b	0 b
K50, 3 L + SW7, 250 mL	39721	0 b	0.4 b	0 b
VERAISON PHP,				
+ KUMULUS, 6.3 kg	39721	0 b	0 b	0 b
SERENADE MAX, 1.5 kg	39721	0.7 b	2.0 b	0 b
KUMULUS, 12. 6 kg	39478			
FLINT, 105 g	3			
NOVA, 200 g	4			
SERENADE MAX, 1.5 kg	39725	0.4 b	2.2 b	0 b
SERENADE MAX, 750 g				
+ KUMULUS, 6.3 kg	39456	0.1 b	0.1 b	0 b
KUMULUS, 12.6 kg	1,2, 8-10			
FLINT, 105 g	34			
NOVA, 200 g	5			
LANCE, 315 g	67	0 b	0 b	0 b
KUMULUS, 12.6 kg	1,2, 8-10			
QUINTEC, 300 mL	34			
NOVA, 200 g	5			
LANCE, 315 g	67	0 b	0 b	0 b
KUMULUS, 12.6 kg	1,2,8-10			
FLINT, 105 g	34			
QUINTEC, 300 mL	56			
LANCE, 315 g	7	0 b	0 b	0 b
KUMULUS, 12.6 kg	1,2,8-10			
FLINT, 105 g	34			
NOVA, 200 g	5			
QUINTEC, 300 mL	67	0.1 b	0 b	0 b
EVERGRO, 625 mL				
+ 8-16-8, 626 mL				
+ FISH EMULSION, 11.23 L				
+ GARLIC OIL, 500 mL				
+ MOLASSES, 625 mL				
+ KUMULUS, 6.3 kg	13579			
EVERGRO, 625 mL				
+ 8-16-8, 626 mL				
+ FISH EMULSION, 22.46 L				
+ GARLIC OIL, 500 mL				
+ MOLASSES, 625 mL	246810	0 b	0.1 b	0 b

[z] Sprays were applied at 1 = 15 cm shoot (30 May); 2 = 25 cm shoot (07 June); 3 = immediate pre-bloom

(18 June); 4 = immediate post-bloom (25 June); 5 = fruit set (03 July); 6 = pea-sized berries (13 July); 7 = cluster close (21 July); 8 = veraison (01 August); 9 = 2 wk post-veraison (16 August); 10 = 4 wk post-veraison (31 August).

[y] Severity was rated using the Barratt-Horsfall scale. ANOVA were conducted on arcsin sq root transformed data. Values in table represent back-transformed means.

[x] Values in a column followed by the same letter are not significantly different according to the Tukey multiple range test ($\alpha = 0.05$).

2007 PMR REPORT# 60 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E0104.07

CROP: Grape *(Vitis vinifera)* cv. 'Pinot noir'
PEST: Powdery mildew, *Uncinula necator* Pers.Fr.

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TITLE: EFFICACY OF IBR LIQUID AND PALMOLIVE FOR POWDERY MILDEW AND POST-HARVEST ROT CONTROL ON GRAPES, 2006

MATERIALS: INTERNATIONAL BIO-RECOVERY Liquid Fertilizer (3-1-1), NOVA (myclobutanil 40%), PALMOLIVE (dishwashing detergent).

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 21 year old 'Pinot noir'. Spacing was 1.4 x 3.6 m per panel containing five vines.The cordon trained, spur pruned vines (ca. 20 nodes/m row) on vertical trained canopies were shoot thinned/suckered at 30 cm shoot length and hedged around lag phase of berry development. The experimental design was a randomized complete block with 5 replicates. Each replicate had the first and last vines as guards for disease evaluation, thus treatments were separated by buffer vines. The treatments were applied until run-off with a handgun operated at approximately 700 kPa at a rate of 1500 L water/ha. Treatments on 'Pinot noir' were applied on 25 May (Inflorescence swelling), 9 June (Inflorescence fully developed), 21 June (Bloom), 30 June (Post-bloom), 13 July (Pea size), 25 July (Berry touch), 8 August (Bunch closure), 23 August (Veraison), and 12 September (Post Veraison) 2006. PALMOLIVE was applied at 1% rate on 25 May, 9 June, 21 June and 30 June and at 0.5 % on 13 July, 25 July, 8 August, 23 August and 12 September 2006. Percent incidence and severity of leaf powdery mildew were evaluated on 3 August and 18 September by examining 10 leaves on each of five shoots in the three middle vines. Percent incidence and severity of cluster powdery mildew were evaluated on 3 August and 3 October by examining 10 berry clusters per three middle vines. The average weight of ten clusters and the presence of post-harvest rots were recorded on the same day. On 4 October, ten grape clusters from each treatment were harvested and incubated at 13°C for10 days to determine infection incidence and severity of *Botrytis* spp (grey mold), *Penicillium* spp (blue mold) and *Alternaria* rot. Clusters were considered infected if fungal growth was observed among the berries. Values were converted to percent infected per replicate, and subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan Multiple Range Test was used to separate means (K = 100).

RESULTS and DISCUSSION: IBR significantly reduced severity of powdery mildew on foliage and symptoms were significantly less than the untreated control on fruit (Table 1). PALMOLIVE achieved good control on both foliage and fruit except for incidence on foliage in September. This can possibly be attributed to the reduction of the application rate from 1% to 0.5% starting at 'pea size' stage. This change was triggered by the phytotoxicity observed on the berries following the 30 June application of PALMOLIVE (rough circular markings at the surface of the young berries). No phytotoxicity was

observed for other treatments.
There was no significant difference in berry weight between treatments (Table 2). There was low incidence of grey mold, blue mold and *Alternaria* rot at harvest. The occurrence of grey mold on the clusters was the highest on the berries treated with NOVA. After incubation, the severity of grey mold was highest on the IBR treated grapes and NOVA (Table 3). Both PALMOLIVE and IBR reduced the severity of blue mold and *Alternaria* rot compared to untreated grapes.

CONCLUSIONS: IBR reduced the severity of grape powdery mildew on foliage and fruit. PALMOLIVE is a promising material for the control of foliar powdery mildew. The russetting on the berries could possibly be avoided by reducing the rate of PALMOLIVE starting at 'pea-size' stage. Both IBR and PALMOLIVE reduced the severity of blue mold and *Alternaria* rot but were not effective for the control of grey mold on grapes.

Table 1. Percent powdery mildew severity and incidence on 'Pinot noir' foliage and fruit.

Treatment and Rate/100 L	3 Aug Foliage		18 Sept Foliage		3 Aug Fruit		3 October Fruit	
	Incidence	Severity	Incidence	Severity	Incidence	Severity	Incidence	Severity
Untreated Control	73.2 a	8.4 a [2]	98.8 a	36.76 a	96.0 a	44.6 a	100.0 a	73.0 a
IBR - 4%	59.6 a	5.16 b	95.2 a	23.34 b	31.2 c	3.4 b	72.0 b	19.5 b
PALMOLIVE 1% / 0.5%[1]	25.6 b	1.92 c	84.4 a	12.50c	60.0 b	6.9 b	70.0 b	16.8 b
NOVA - 13.3 g	9.2 c	0.58 cd	46.4 b	4.30 d	16.0 cd	1.5 b	22.0 c	4.2 c
ANOVA Pr ȼ F	ȼ 0.0001	ȼ 0.0001	ȼ 0.0001	ȼ 0.0001	ȼ 0.0001	ȼ 0.0001	ȼ 0.0001	ȼ 0.0001

[1] PALMOLIVE was applied at 1% rate on 25 May, 9 June, 21 June and 30 June and at 0.5 % on 13 July, 25 July, 8 August, 23 August and 12 September 2006.
[2] These values are means of five replications. Numbers in each column followed by the same letter are not significantly different at $p \leq 0.05$ as decided by Waller-Duncan k-ratio (k = 100) test.

Table 2. Average weight of ten clusters, severity and incidence of grey mold on 'Pinot noir' evaluated at harvest on 3 October, 2006.

Treatment and Rate per 100 L	Weight 10 clusters (kg)	Grey Mold Incidence	Grey Mold Severity
Untreated Control	1.2 b	0.0 b [2]	0.0 b
IBR - 4%	1.6 ab	0.0 b	0.0 b
PALMOLIVE- 1% / 0.5% [1]	1.0 b	2.0 b	0.6 b
NOVA - 13.3 g	1.4 ab	12.0 a	3.0 a
ANOVA Pr ȼ F	0.005	0.0041	0.0049

[1] PALMOLIVE was applied at 1% rate on 25 May, 9 June, 21 June and 30 June and at 0.5 % on 13 July, 25 July, 8 August, 23 August and 12 September 2006.
[2] These values are means of five replications. Numbers in each column followed by the same letter are not significantly different at $p \leq 0.05$ as decided by Waller-Duncan k-ratio (k = 100) test.

Table 3. Severity and incidence of grey mold, blue mold and *Alternaria* rot on 'Pinot noir' fruit incubated at 13°C for 10 days evaluated on 13 October, 2006.

Treatment and Rate per 100 L	Grey mold		Blue mold		*Alternaria* rot	
	Incidence	Severity	Incidence	Severity	Incidence	Severity
Untreated Control	8.0 ab	0.8 b[2]	92.0 a	55.0 a	82.0 a	43.2 a
IBR - 4%	20.0 a	3.3 a	92.0 a1	4.7 bc	78.0 ab	9.1 b
PALMOLIVE- 1% / 0.5% [1]	12.0 ab	0.9 b	88.0 a1	7.6 b	84.0 a1	4.5 b
NOVA - 13.3 g	14.0 ab	1.6 ab	36.0 bc	2.5 cd	66.0 abc	10.0 b
ANOVA Pr > F	0.1109	0.0248	< 0.0001	< 0.0001	0.0345	0

[1] PALMOLIVE was applied at 1% rate on 25 May, 9 June, 21 June and 30 June and at 0.5 % on 13 July, 25 July, 8 August, 23 August and 12 September 2006.
[2] These values are means of five replications. Numbers in each column followed by the same letter are not significantly different at $p \leq 0.05$ as decided by Waller-Duncan k-ratio (k = 100) test.

2007 PMRR REPORT# 61 **SECTION K: FRUIT – Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Peaches (*Prunus persica*) cv. Harrow Diamond
PEST: Gray mold (*Botrytis cinerea* Pers)

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TITLE: EVALUATION OF REDUCED RISK FUNGICIDES FOR THE POSTHARVEST CONTROL OF GRAY MOLD IN 'HARROW DIAMOND' PEACHES, 2006

MATERIALS: BIOSAVE (*Pseudomonas syringae*), SCHOLAR (50% Fludioxonil), PENBOTEC 400 SC (37.5% Pyrimethanil) and MERTECT 500SC (45% Thiabendazole, TBZ)

METHODS: SCHOLAR 50 WP (fludioxonil) and PENBOTEC (Pyrimethanil) were compared with MERTECT (thiabendazole, TBZ) for efficacy against gray mold caused by *Botrytis cinerea* Peaches at commercial maturity were harvested on July 21, 2006, from an orchard at Jordan Station, Ontario. All fruits were stored at 4˚C until used in the experimental treatments on 28 July, 2006. Peaches were disinfested in 10% household bleach (5% sodium hypochlorite) and 0.01% Tween 20 (Fisher Scientific) for 4 min and rinsed in reverse osmosis water for 4 min. After disinfestation, 24 peaches were placed on a plastic packing insert (24 fruit master) contained in a plastic box. Each box represents a treatment replication. Four replicate trays with 12 fruits/replicate were prepared for each treatment. The peaches were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, peaches were inoculated with a 20µl drop of TBZ-resistant *B. cinerea* BC-8dR at a concentration of 1 x 10^5 conidia/ml and fruit were incubated at 13°C for 6 hours. Then the fruit were treated with: control, 0.3, 0.6 and 1.2 g/L of SCHOLAR, 0.29, 0.58 and 1.16 g/L PENBOTEC 400 SC (37.5% pyrimethanil) and MERTECT at 1.15 g/L. The peaches were drop treated. The fruits were then placed on packing inserts. Untreated check had no fungicides. The treatments were completely randomized. Peaches, which were treated on September 2, 2006 were evaluated for disease incidence after 5 days of incubation at 20˚C. Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: As outlined in Table 1.

CONCLUSIONS: SCHOLAR at concentrations, 0.3, 0.6 and 1.2 g/L gave 100% of control of gray mold after 5 days of storage at 20˚C. A higher disease incidence was observed in experiment 1 than in experiment 2. As expected, MERTECT was not effective against gray mold caused by thiabendazole-resistant *Botrytis*. Latent brown rot (caused by *Monilinia fructicola*)symptoms were observed on the fruit. Higher concentrations of PENBOTEC alone gave 8.3% infection. The combination of SCHOLAR @ 0.6 g/L + PENBOTEC @ 0.58 g/L significantly reduced gray mold but had no effect on the latent brown rot infections.

Table 1. Mean percentage incidence of gray mold after postharvest treatment of SCHOLAR (fludioxonil) and PENBOTEC on Peaches, cv. 'Harrow Diamond' 2006.

	% Gray mold Incidence after 5 days at 20˚C	
Treatment	Experiment 1	Experiment 2
Inoculum only	100 e [ab]	100 c
SCHOLAR @ 0.3 g/L	0	0
SCHOLAR @ 0.6 g/L	0	0
SCHOLAR @ 1.2g/L	0	0
PENBOTEC @ 0.29 g/L	54.17 d	50 b
PENBOTEC @ 0.58 g/L	8.33 c	0
PENBOTEC @ 1.16 g/L	8.33 c	0
SCHOLAR @ 0.3 g/L + PENBOTEC @ 0.29 g/L	4.17 b	0
SCHOLAR @ 0.6 g/L + PENBOTEC @ 0.58 g/L	0	0
MERTECT @ 1.15 g/L	100 e	91.67 c

[a] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.

[b] Data represent the mean of four replicates of 12 peaches per replicate. Each peach was wounded and inoculated with thiabendazole-resistant *B. cinerea* before treatment.

2007 PMRR REPORT# 62 **SECTION K: FRUIT – Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Peaches (*Prunus persica*) cv. Redhaven
PEST: Gray mold (*Botrytis cinerea* Pers); Brown rot (*Monilinia fructicola* L);

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TITLE: EVALUATION OF REDUCED RISK FUNGICIDES FOR THE POSTHARVEST CONTROL OF GRAY MOLD AND BROWN ROT IN 'REDHAVEN' PEACHES, 2006

MATERIALS: SCHOLAR (50% Fludioxonil), PENBOTEC 400 SC (37.5% Pyrimethanil) and MERTECT 500SC (45% Thiabendazole, TBZ)

METHODS: SCHOLAR 50wp (fludioxonil) and PENBOTEC (Pyrimethanil) were compared with MERTECT (thiabendazole, TBZ) for efficacy against gray mold caused by *Botrytis cinerea* and brown rot caused by *Monilinia fructicola.* Peaches at commercial maturity were harvested on August 21, 2006 from an orchard at Jordan Station, Ontario. All fruits were stored at 4˚C until used in the experimental treatments on August 24, 2006. Peaches were disinfested in 10% household bleach (5% sodium hypochlorite) and 0.01% Tween 20 (Fisher Scientific) for 4 min and rinsed in reverse osmosis water for 4 min. After disinfestation, 24 peaches were placed on a plastic packing insert (24 fruit master) contained in a plastic box. Each box represents a treatment replication. Four replicate trays with 12 fruits /replicate were prepared for each treatment. The peaches were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, peaches were inoculated with a 20 µl drop of TBZ-resistant *B. cinerea* BC-8dR at a concentration of 1×10^5 conidia/ml and fruit were incubated at 13°C for 6 hours. Then the fruit were treated with: control, 0.3, 0.6 and 1.2 g/L of SCHOLAR, 0.29, 0.58 and 1.16 g/L of PENBOTEC and a combination of SCHOLAR and PENBOTEC,and MERTECT at 1.15 g/L. The peaches were drop treated. The fruits were then placed on packing inserts. Untreated check had no fungicides. The treatments were completely randomized. Peaches, which were treated on September 2, 2006 were evaluated for disease incidence after 5 days of incubation at 20˚C. Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: As outlined in Table 1.

CONCLUSIONS: SCHOLAR at concentrations, 0.3, 0.6 and 1.2 g/L, PENBOTEC at two higher concentrations and combination of SCHOLAR and PENBOTEC gave 100% of control of gray mold after 5 days of storage at 20˚C. A higher disease incidence was observed in experiment 1 than in the experiment 2. As expected, MERTECT was not effective against gray mold caused by thiabendazole-resistant *Botrytis*.
While SCHOLAR gave 100% control, PENBOTEC was not effective against brown rot. Some control was observed with MERTECT on brown rot caused by thiabendazole-sensitive *M. fructicola*. Latent

brown rot symptoms were observed on the fruit. SCHOLAR and PENBOTEC and the combination of the two fungicides significantly reduced gray mold but had no effect on the latent brown rot infections. There was no significant difference between the experiments.

Table 1. Mean percentage incidence of gray mold and brown rot after postharvest treatment of SCHOLAR (fludioxonil) and PENBOTEC on 'Redhaven' Peaches, 2006.

Treatment	% Disease incidence after 5 days @ 20˚C			
	Gray mold		Brown rot	
	Experiment 1	Experiment 2	Experiment 1	Experiment 2
Inoculum only	100.00 c	100.00 c	100.00 e	100.00 e
SCHOLAR @ 0.3 g/L	0.00 a	0.00 a	0.00 a	0.00 a
SCHOLAR @ 0.6 g/L	0.00 a	0.00 a	0.00 a	0.00 a
SCHOLAR @ 1.2g/L	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 0.29 g/L	58.33 b	25.00 b	100.00	100.00
PENBOTEC @ 0.58 g/L	0.00 a	0.00 a	91.67 d	91.67 d
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	42.50 b	41.67 b
SCHOLAR @ 0.3 g/L + PENBOTEC @ 0.29 g/L	0.00 a	0.00 a	0.00 a	0.00 a
SCHOLAR @ 0.6 g/L + PENBOTEC @ 0.58 g/L	0.00 a	0.00 a	0.00 a	0.00 a
MERTECT @ 1.15 g/L	100.00 c	100.00 c	25.00 c	28.33 c

[a] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.
[b] Data represent the mean of four replicates of 12 peaches per replicate. Each peach was wounded and inoculated with thiabendazole-sensitive *M. fructicola* and thiabendazole-resistant *B. cinerea* before treatment.

2007 PMRR REPORT# 63 **SECTION K: FRUIT – Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Peaches (*Prunus persica*) cv. Loring
PEST: Gray mold (*Botrytis cinerea* Pers) Brown rot (*Monilinia fructicola* L)

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TITLE: EVALUATION OF REDUCED RISK FUNGICIDES FOR THE POSTHARVEST CONTROL OF GRAY MOLD AND BROWN ROT IN 'LORING' PEACHES, 2006

MATERIALS: SCHOLAR (50% Fludioxonil), PENBOTEC 400 SC (37.5% Pyrimethanil) and MERTECT 500SC (45% Thiabendazole, TBZ)

METHODS: SCHOLAR 50wp (fludioxonil) and PENBOTEC (Pyrithmethanil) were compared with MERTECT (thiabendazole, TBZ) for efficacy against gray mold caused by *Botrytis cinerea* and brown rot caused by *Monilinia fructicola.* Peaches at commercial maturity were harvested on Sept 5, 2006 from an orchard at Jordan Station, Ontario. All fruits were stored at 4˚C until used in the experimental treatments on Sept 6, 2006. Peaches were disinfested in 10% household bleach (5% sodium hypochlorite) and 0.01% Tween 20 (Fisher Scientific) for 4 min and rinsed in reverse osmosis water for 4 min. After disinfestation, 24 peaches were placed on a plastic packing insert (24 fruit master) contained in a plastic box. Each box represents a treatment replication. Four replicate trays with 12 fruits /replicate were prepared for each treatment. The peaches were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, peaches were inoculated with a 20µl drop of TBZ-resistant *B. cinerea* BC-8dR or TBZ-sensitive *Monilinia fructicola* at a concentration of 1 x 10^5 conidia/ml and appropriate concentrations of fungicides and fruit were incubated at 13°C for 6 hours. Then the fruit were treated with: control, 0.3, 0.6 and 1.2 g/L of SCHOLAR, 0.29, 0.58 and 1.16 g/L PENBOTEC and a combination of SCHOLAR and PENBOTEC, and MERTECT at 1.15 g/L. The fruits were placed on packing inserts and then were drop treated.. Untreated check had no fungicides. The treatments were completely randomized. Peaches, which were treated on September 6, 2006 were evaluated for disease incidence after 5 days of incubation at 20˚C. Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: As outlined in Table 1.

CONCLUSIONS: SCHOLAR at concentrations, 0.3, 0.6 and 1.2 g/L, PENBOTEC at two higher concentrations and combinations of SCHOLAR and PENBOTEC gave 100% of control of gray mold after 5 days of storage at 20˚C. There was no significant difference between the experiments. As expected, MERTECT was not effective against gray mold caused by thiabendazole-resistant *Botrytis*. While SCHOLAR, and SCHOLAR and PENBOTEC combination gave 100% control, PENBOTEC alone was not effective against brown rot. Some control was observed with MERTECT on brown rot caused by thiabendazole-sensitive *M. fructicola*. Latent brown rot symptoms were observed on the fruit. SCHOLAR and PENBOTEC and the combination of the two fungicides significantly reduced gray mold but they had no effect on the latent brown rot infections. A higher disease incidence was observed in experiment 1 than in experiment 2.

Table 1. Mean percentage incidence of gray mold and brown rot after postharvest treatment of SCHOLAR (fludioxonil) and PENBOTEC on 'Loring' Peaches, 2006

	% Disease incidence after 5 days @ 20˚C			
	Gray mold		Brown rot	
Treatment	Experiment 1	Experiment 2	Experiment 1	Experiment 2
Inoculum only	100.00 c	100.00 c	100.00 c	100.00 f
SCHOLAR @ 0.3 g/L	0.00 a	0.00 a	0.00 a	0.00 a
SCHOLAR @ 0.6 g/L	0.00 a	0.00 a	0.00 a	0.00 a
SCHOLAR @ 1.2g/L	0.00 a	0.00 a	0.00 a	0.00 a
PENBOTEC @ 0.29 g/L	8.33 b	4.17 b	100.00 c	66.67 d
PENBOTEC @ 0.58 g/L	0.00 a	6.27 b	100.00 c	75.00 e
PENBOTEC @ 1.16 g/L	0.00 a	0.00 a	25.00 b	54.17 c
SCHOLAR @ 0.3 g/L + PENBOTEC @ 0.29 g/L	0.00 a	0.00 a	0.00 a	0.00 a
SCHOLAR @ 0.6 g/L + PENBOTEC @ 0.58 g/L	0.00 a	0.00 a	0.00 a	0.00 a
MERTECT @ 1.15 g/L	100.00 c	100.00 c	25.00 b	45.83 b

[a] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.
[b] Data represent the mean of four replicates of 12 peaches per replicate. Each peach was wounded and inoculated with thiabendazole-sensitive *M. fructicola* and thiabendazole-resistant *B. cinerea* before treatment.

2007 PMR REPORT# 64 **SECTION K: FRUIT Diseases**

CROP: PEACH (*Prunus persica* L.) c.v. Babygold 7
PEST: Brown rot (*Monilinia fructicola* (Winter) Honey)

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TITLE: CONTROL OF BROWN ROT OF PEACH WITH DPX-LEM17, 2007

MATERIALS: DPX-LEM17, MAESTRO 80 (captan 80%), INDAR (Fenbuconazole 75%)

METHODS: The trial was conducted in a mature commercial peach orchard in Vineland Station, ON, Canada. Treatments were replicated 4 times in a randomized complete design with single-tree plots at row spacing 6 m and tree spacing 4.3 m. At budswell, 4 net sacks, each containing 6 peach mummies, were suspended in the upper limbs of each tree to provide additional inoculum. Treatments were applied using a calibrated spray gun at 200 psi at 5040 L/ha. Tarps were erected around neighbouring trees to preclude off-target movement of treatments. Trees were sprayed with water to run-off by gun on 03 and 07 May in an attempt to produce conditions favourable for blossom blight infection. The incidence of blossom blight of 100 nodes was determined per tree in the orchard ON 23 May (shuck split). Latent blossom infections were assessed on 100 nodes per tree by incubating blossoms on galvanized metal screens in large plastic boxes lined with moist filter paper for 5 days. The incidence of latent fruit infections was determined by collecting 25 symptomless fruit per tree on 10 July, storing them in the freezer for 3 days and incubating them at room temperature in individual cells of panta paks for 1 wk. The incidence of fruit infections at harvest was assessed on 100 fruit per tree on 03 September. Symptomless fruit (50 per tree) were collected into individual cells of panta paks and enclosed in plastic boxes at room temperature and the incidence of brown rot was determined 1 and 2 weeks post-harvest. Fruit that were infected with *Rhizopus* or contaminated with fruit fly maggots were discarded. The average monthly temperatures were slightly above average in May (12.7°C), June (20.4°C), July (20.9°C), August (21.9°C) and September (18.2°C) precipitation was well below average in May (42.4 mm), June (18 mm), July (36 mm), August (16.6 mm) and September (18 mm).

RESULTS: As shown in Table 1.

CONCLUSIONS: All treatments except the Maestro (captan) treatment significantly reduced the incidence of blossom blight in the orchard. There were no significant differences among the two rates of LEM17 and Indar. There were no significant differences among treatments and the untreated check with respect to latent infections of blossoms, June-drop fruitlets, fruit infections in the orchard or fruits stored for 1 wk post-harvest. Only the LEM 17 treatments significantly reduced brown rot incidence compared to the untreated check. There was no difference between the two rates of LEM17. No phytotoxicity was observed in any treatment throughout the trial.

Table 1. Incidence of blossom blight and brown rot on peach, 2007

		Incidence					
		Blossom Blight		Brown Rot			
Product, rate/ha	Timing*	Orchard	Latent	Latent June-drop fruitlets	Orchard harvest	1 wk post-harvest	2 wk post-harvest
Untreated Check	--	10 a**	0.04167	0.5 a	0.5 a	9.6 a	38 a
DPX-LEM17 SC, 0.75 L	12						
MAESTRO 80, 3600 g	3-11						
DPX-LEM17 SC 1.0 L	12-13	3 c	0	0	0	3.1 a	3.6 b
LEM17 SC, 1.125 L	12						
MAESTRO 80, 3600 g	3-11						
DPX-LEM17 SC, 1.0 L	12-13	5.8 bc	0	0	0.3 a	2.6 a	6.6 b
DPX-LEM17 SC, 1.5 L	12						
MAESTRO 80, 3600	3-11						
DPX-LEM 17 SC, 1.0 L	12-13	3.3 c	0	0	0.3 a	5.7 a	10 b
INDAR 75 WSP, 140 g	12						
MAESTRO 80, 3600 g	3-13	4.3 bc	0.5 a	0.0 a	0.5 a	7.4 a	15.7 ab
MAESTRO 80, 3600	39813	8.0 ab	0.5 a	0.0 a	0.0 a	7.1 a	21.8 ab

* Dates and approximate phenological stages for designated spray applications: 1 = 30 April (5-10% pink); 2 = 04 May (75% bloom); 3 = 11 May (full bloom); 4 = 17 May (petal fall); 5 = 28 May (shuck split); 6 = 06 June (fruit set, 10 mm fruit); 7 = 13 June (20 mm fruit diameter), 8 = 27 June (30 mm diameter fruit), 9 = 12 July (June drop/pit hardening), 10 = 26 July (50 mm fruit); 11 = 10 August (50 mm fruit); 12 = 28 August (fruit changing colour); 13 = 04 September (1 day pre-harvest).
** Means followed by same letter do not significantly differ (P=0.05, Student-Newman-Keuls).

2007 PMR REPORT# 65 **SECTION K: FRUIT Diseases**

CROP: Strawberry (*Fragaria* x *ananassa* Duch.) c.v. Seascape
PEST: Botrytis grey mould (*Botrytis cinerea* Pers.:Fr.)

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TITLE: EFFICACY OF SERENADE MAX FOR CONTROL OF BOTRYTIS GREY MOULD OF STRAWBERRY

MATERIALS: SERENADE MAX (*B. subtilis* (Ehrenberg) Cohn QST 713 14.6%), ELEVATE 50WDG (fenhexamid 50%), MAESTRO (captan, 80%)

METHODS: The trial was conducted in a commercial planting of Seascape, at Vineland Station, ON, planted with 1.5 m row width. The plots were 4 m in length and 1.5 m in width, with an untreated guard row between plots. Treatments were applied using a hooded boom sprayer with hollow cone nozzles at 60 psi. Treatments were applied at bloom (24 May), thimble-sized fruit (31 May), first colour (7 June), 1 day pre-harvest, 1st pick (15 June), 1 day pre-harvest, 2nd pick (23 June), thimble-sized fruit (24 July), 1 day pre-harvest, 3rd pick (07 August) and 1 day pre-harvest, 4th pick (14 August). ELEVATE was applied at first bloom (24 May) and thimble-sized fruit (24 July) and MAESTRO was applied at the remaining growth stages in both the grower standard and in combination with SERENADE MAX, as listed in Table 1. All ripe fruit were harvested and the weights of diseased and healthy fruit were recorded to determine the % fruit with grey mould by weight at each harvest date (11, 14, 20 and 27 June, 7, 13 and 20 August). The average monthly temperatures were slightly above average in May (12.7°C), June (20.4°C), July (20.9°C), August (21.9°C) and September (18.2°C) and precipitation was well below average in May (42.4 mm), June (18 mm), July (36 mm), August (16.6 mm) and September (18 mm).

RESULTS: As shown in Table 1.

CONCLUSIONS: The summer of 2007 was extremely dry and hot. No significant rain occurred until mid-late August. No grey mould developed during the first 2 picks. During the second flush of harvest, there was a trace amount of grey mould but the incidence was extremely variable within treatments. Numerically, SERENADE MAX and SERENADE MAX in combination with conventional fungicides ELEVATE and MAESTRO reduced the incidence of grey mould. However, this difference was not statistically significant. No phytotoxicity was observed in any of the plots.

Table 1. Efficacy of Serenade alone and in combination with fungicides for control of grey mould of strawberry, August 13, 2007

Treatment, rate per ha	Timing[1]	% fruit with grey mould by wt 13 August	% fruit with grey mould by wt 20 August
Untreated Check		0.62 a[2]	0.24 a
SERENADE MAX, 1.5 kg	39456	0	0
ELEVATE, 1.5 kg MAESTRO , 2 kg	17 23458910	2.16 a	0.64 a
ELEVATE, 1.5 kg + SERENADE MAX, 1 kg	17		
MAESTRO, 2 kg + SERENADE MAX, 1 kg	23458910 23458910	19.17 a	0 a

[1] Treatments were applied at: 1 = bloom (24 May), 2 = thimble-sized fruit (31 May), 3 = first colour (7 June), 4 = 1 day pre-harvest, 5= 1st pick (15 June), 6 = 1 day pre-harvest, 7 = 2nd pick (23 June), 8 = thimble-sized fruit (24 July), 9 = 1 day pre-harvest, 3rd pick (07 August) and 10 = 1 day pre-harvest, 4th pick (14 August)

[2] Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls).

2007 PMR REPORT# 66 **SECTION L: VEGETABLE AND SPECIAL CROPS – Diseases**

CROP: Cabbage (*Brassica oleracea* L. var. *capitata)* cv. Atlantis
PEST: Black leaf spot (*Alternaria brassicicola* (Schwein.) Wiltshire

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TITLE: EVALUATION OF FUNGICIDES FOR CONTROL OF BLACK LEAF SPOT OF CABBAGE, 2007

MATERIALS: BRAVO 500 (chlorothalonil 50%), PRISTINE WG (boscalid 25.2%, pyraclostrobin 12.8%), ALIETTE WDG (aluminum tris (O-ethyl phosphonate) 80%), SWITCH 62.5 WG (cyprodinil 37.5%, fludioxinil 25%), ALEXIN (potash 8%, calcium 2.4%), PHITAK (46% P_2O_5; 11% K_2O)

METHODS: A field trial was conducted at the Simcoe Research Station – University of Guelph in 2007. Atlantis cabbage were seeded on 4 July into 200 cell plastic plug trays filled with a commercial soil-less mix. Plants were grown in a greenhouse under ambient light and temperature conditions. Fertilizers were applied according to Ontario recommendations. Soil type was a Wattford sand (pH = 6.7). Cabbage were transplanted on 30 July using a mechanical transplanter. Plots were 7 m long and 3 m wide. Rows were spaced 0.75 m apart and plants were spaced 0.45 m apart in the row. Plots were inoculated on 10 September with a conidial suspension of *Alternaria brassicicola* at a concentration of 10,000 spores/mL using distilled water. Plots were irrigated with approximately 6 mm of water following inoculation on 31 August. Treatments were: BRAVO (4.8 L/ha), ALEXIN (6.0 L/ha), SWITCH (975 g/ha), ALIETTE (3.12 kg/ha), PRISTINE (735 g/ha), PHITAK (2.0 L/ha) plus an untreated control and were arranged in a randomized complete block design with four replications. Products were applied using a CO_2 backpack sprayer equipped with three TeeJet XR8002 nozzles spaced 50 cm apart and calibrated to deliver 200 L/ha water (1000 L/ha for the ALEXIN treatment) at 220 kPa on 7, 17, and 28 September. The trial was irrigated (approx. 19 mm) on 1, 17 August, 5 September. Weeds were controlled with a preplant application of trifluralin at 0.6 kg/ha and hand hoeing. Insect pests were controlled with a rotation of cypermethrin (87.5 mL/ha), endosulfan(1.5 L/ha) and carbaryl (2.5 L/ha). At harvest, the number of lesions per leaf was assessed by counting the lesions on all of the leaves on fifteen plants. The inside 5 m of a middle row of each plot was harvested on 17 October and total and marketable yield were recorded. The air temperatures in 2007 were above the 30-year normals for August (21.1 °C), September (17.3 °C), and October (14.1 °C) and normal for July (20.3 °C). The 30-year normal mean temperatures were: July 20.4 °C, August 19.5 °C, September 15.5 °C, and October 9.6 °C. Monthly rainfall was below the 30-year normals for July (49 mm), August (60 mm), September (73 mm), and October (60 mm). The 30-year normal rainfalls were: July 77 mm, August 80 mm, September 89 mm, and October 73 mm. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.7. Means separation was obtained using Fisher's Protected LSD test at P=0.05 level of significance.

RESULTS: As presented in Table 1.

CONCLUSIONS: Due to the hot and dry conditions during the trial, no disease developed after inoculation. It is likely that the minor disease that developed near harvest was from natural infection. The fungicides SWITCH and PRISTINE reduced the number of black leaf spot lesions per plant compared to the untreated control. Disease control in the SWITCH and PRISTINE treatments was comparable to the industry standard BRAVO. However, there was no difference in the number of lesions per plant among the SWITCH, PRISTINE, PHITAK, ALIETTE, and BRAVO treatments. Cabbage treated with ALIETTE exhibited phytotoxicity symptoms late in the season. Cabbage treated with ALEXIN had more lesions per plant than the untreated cabbage. The treatments had no effect on total or marketable yield. Black leaf spot was not severe enough to affect the marketability of the heads. The reduced-risk fungicides SWITCH and PRISTINE have potential for control of black leaf spot on cabbage, but further research under higher disease pressure is required.

Table 1. Effect of fungicides and foliar fertilizers on black leaf spot lesions per plant, total yield, and marketable yield for Atlantis cabbage grown at the Simcoe Research Station in 2007.

Treatment	Rate/ha	Black leaf spot lesions per plant	Total yield (t/ha)	Marketable yield (t/ha)
CONTROL	--	0.6 b[1]	15.2 ns	15.1 ns
ALEXIN	6.0 L	1.2 a	15.8	15.6
PHITAK	2.0 L	0.3 bc	15.7	15.1
ALIETTE	3.12 kg	0.3 bc	12.7	12.1
BRAVO	4.8 L	0.2 bc	13.9	13.2
SWITCH	975 g	0.0 c	14.7	13.8
PRISTINE	735 g	0.0 c	15.0	14.6

[1] Numbers in a column followed by the same letter are not significantly different at *P*=0.05, Fisher's Protected LSD Test; ns = not significant

CROP: Cauliflower (*Brassica oleracea* L. var. *botrytis)* cv. Apex
PEST: Black leaf spot (*Alternaria brassicicola* (Schwein.) Wiltshire

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TITLE: EVALUATION OF FUNGICIDES FOR CONTROL OF BLACK LEAF SPOT OF CAULIFLOWER, 2007

MATERIALS: BRAVO 500 (chlorothalonil 50%), PRISTINE WG (boscalid 25.2%, pyraclostrobin 12.8%), ALIETTE WDG (aluminum tris (O-ethyl phosphonate) 80%), SWITCH 62.5 WG (cyprodinil 37.5%, fludioxinil 25%), ALEXIN (potash 8%, calcium 2.4%), PHITAK (46% P_2O_5; 11% K_2O)

METHODS: A field trial was conducted at the Simcoe Research Station – University of Guelph in 2007. Apex cauliflower were seeded on 29 June into 200 cell plastic plug trays filled with a commercial soil-less mix. Plants were grown in a greenhouse under ambient light and temperature conditions. Fertilizers were applied according to Ontario recommendations. Soil type was a Wattford sand (pH = 6.7). Cauliflower were transplanted on 27 July using a mechanical transplanter. Plots were 7 m long and 3 m wide. Rows were spaced 1.0 m apart and plants were spaced 0.45 m apart in the row. Plots were inoculated on 31 August with a conidial suspension of *Alternaria brassicicola* at a concentration of 8,000 spores/mL and on 10 September with 10,000 spores/mL using distilled water. Plots were irrigated with approximately 6 mm of water following inoculation on 31 August. Treatments were: BRAVO (4.8 L/ha), ALEXIN (6.0 L/ha), SWITCH (975 g/ha), ALIETTE (3.12 kg/ha), PRISTINE (735 g/ha), PHITAK (2.0 L/ha) plus an untreated control and were arranged in a randomized complete block design with four replications. Products were applied using a CO_2 backpack sprayer equipped with three TeeJet XR8002 nozzles spaced 50 cm apart and calibrated to deliver 200 L/ha water (1000 L/ha for the ALEXIN treatment) at 220 kPa on 31 August, 10, 21 September. The trial was irrigated (approx. 19 mm) on 1, 17 August, 5 September. Weeds were controlled with a preplant application of trifluralin at 0.6 kg/ha and hand hoeing. Insect pests were controlled with a rotation of cypermethrin (87.5 mL/ha), endosulfan(1.5 L/ha) and carbaryl (2.5 L/ha). At harvest, the number of lesions per leaf was assessed by counting the lesions on all of the leaves on five plants. In addition, the heads were graded based on black leaf spot severity into mild (marketable as No. 2 grade) and severe (unmarketable). The inside 5 m of the middle row of each plot was harvested on 22 October and graded according to industry standards into grades No. 1, No. 2, and culls. The air temperatures in 2007 were above the 30-year normals for August (21.1 °C), September (17.3 °C), and October (14.1 °C) and normal for July (20.3 °C). The 30-year normal mean temperatures were: July 20.4 °C, August 19.5 °C, September 15.5 °C, and October 9.6 °C. Monthly rainfall was below the 30-year normals for July (49 mm), August (60 mm), September (73 mm), and October (60 mm). The 30-year normal rainfalls were: July 77 mm, August 80 mm, September 89 mm, and October 73 mm. Data were analyzed using the General Analysis of Variance function of the Linear

Models section of Statistix V.7. Means separation was obtained using Fisher's Protected LSD test at P=0.05 level of significance.

RESULTS: As presented in Table 1.

CONCLUSIONS: Cauliflower treated with the fungicides SWITCH and PRISTINE had the fewest lesions per plant and lowest disease severity on the heads. Disease control in these treatments was comparable to the grower standard BRAVO. The foliar fertilizer products ALEXIN and PHITAK did not reduce disease severity compared to the untreated control. Treatment with ALIETTE caused phytotoxicity on the leaves late in the season and did not reduce disease compared to the control. Due to the hot and dry conditions, neither inoculation was successful in initiating disease symptoms. It is likely that infection occurred naturally in late September. The treatments had no effect on total yield. Despite visual differences among treatments in the proportion of heads in the no. 1 grade, no significant differences could be identified due to variability in the plot. The reduced-risk fungicides SWITCH and PRISTINE have potential for the control of black leaf spot of cauliflower.

Table 1. Effect of fungicides and foliar fertilizers on black leaf spot lesions per plant and disease severity index (DSI), total yield, and percentage of heads in no. 1 grade for cauliflower grown at the Simcoe Research Station in 2007.

Treatment	Rate/ha	Black leaf spot		Total yield (t/ha)	No. 1 grade (%)
		Lesions per plant	Head DSI[1]		
CONTROL	--	77.1 a[2]	35.5 a	30.9 ns	38.2 ns
ALEXIN	6.0 L	69.3 a	21.2 ab	30.5	64.5
PHITAK	2.0 L	60.8 a	35.6 a	30.5	50.1
ALIETTE	3.12 kg	57.8 a	29.5 a	29.3	52.9
BRAVO	4.8 L	15.5 b	16.3 ab	26.0	65.8
SWITCH	975 g	11.7 b	4.7 b	28.4	82.2
PRISTINE	735 g	9.2 b	6.0 b	29.5	85.6

[1] DSI = ((Σ(class no.)(no. of heads in each class))/(total no. of heads per sample)(no. classes - 1))*100; classes: 0 = no lesions, 1 < 5 lesions per head, 2 ≥ 5 lesions per head (unmarketable).
[2] Numbers in a column followed by the same letter are not significantly different at *P*=0.05, Fisher's Protected LSD Test; ns = not significant.

2007 PMR REPORT# 68 **SECTION O: CEREALS, FORAGE CROPS and OILSEEDS-Diseases**

CROP: Winter barley (*Hordeum vulgare* L.), cv. several
PEST: Fusarium head blight, *Fusarium graminearum* Schwabe

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TITLE: CONTROL OF FUSARIUM HEAD BLIGHT (FHB) AND DEOXYNIVALENOL (DON) ACCUMULATION IN WINTER BARLEY WITH PROLINE APPLICATION IN INOCULATED, MISTED PLOTS

MATERIALS: PROLINE 480 SC (480 g ai/L prothiconazole)

METHODS: Winter barley cultivars and experimental lines were planted on October 31, 2006 in Ridgetown, Ontario. The plots were planted in a randomized block design with four replications in 4-m long single rows, spaced 17.8 cm apart; fertilized and maintained using provincial recommendations. Half of each plot was sprayed with PROLINE 480 SC when the barley heads were fully emerged (Feeks Growth Stage 10.5) for each variety using a back pack precision sprayer with a boom fitted with 2 twin jet nozzles spaced at 50 cm delivering 240 l/ha of water. The plots were inoculated with a 100-mL suspension of macroconidia of four *Fusarium graminearum* isolates at 50,000 spores/ml two days following the fungicide application. The suspension was produced in liquid shake culture using modified Bilay medium. Plots were misted daily beginning after the first plots were inoculated. The mist system was engaged until three days after the last line was inoculated. The overhead mister delivered about 7.5 mm of water daily. Each variety was assessed for visual symptoms three weeks after *Fusarium* inoculation. Twenty barley heads were selected at random out of each half of the plot, and rated for disease incidence and severity. Disease levels were calculated as fusarium head blight index (FHBI), which was the product of the percent heads infected (incidence) and the percent spikelets infected (severity), divided by 100. Plots were harvested in mid July, 2007. Deoxynivalenol (DON) content was estimated from the three replications with the highest mean FHB index using a quantitative fluorometric test-FluoroQuan (Romer Labs, Inc, Union MO).

RESULTS: The results are given below.

CONCLUSIONS: Mean FHB indices (5.5 % versus 9.2 %) and DON content (1.5 ppm versus 2.1 ppm) across barley cultivars and experimental lines tended to be lower when PROLINE 480 SC application was made. Correlation coefficient between DON content and FHB index with/without PROLINE 480 SC was r=0.94 (P<0.001) and r=0.76 (P<0.001), respectively.

Table 1. Fusarium head blight (FHB) index and deoxynivalenol (DON) content (ppm) in winter barley with/without PROLINE 480 SC application. Ridgetown, 2007.

PROLINE 480 SC			no PROLINE 480 SC	
Barley Cultivar/Line	FHB index %	DON (ppm)	FHB index %	DON (ppm)
OAC Elmira	0.4	0.4	0.9	0.4
McGregor	8.5	2.0	12.4	4.7
Experimental line 1	4.6	1.1	6.8	1.6
Experimental line 2	9.5	2.3	10.7	4.0
Experimental line 3	11.4	2.9	21.1	3.9
Experimental line 4	2.8	1.0	8.3	1.7
Experimental line 5	2.8	0.7	3.7	1.0
Experimental line 6	6.3	1.6	14.6	2.2
Experimental line 7	4.2	1.0	7.1	1.3
Experimental line 8	8.8	1.8	11.3	2.2
Experimental line 9	3.7	1.7	7.3	2.0
Experimental line 10	3.2	1.1	5.8	1.7
Mean	5.5	1.5	9.2	2.1
LSD (0.05)	5.4	1.1	9.1	1.5

2007 PMR REPORT# 69 **SECTION O: CEREALS, FORAGE CROPS and OILSEEDS-Diseases**

CROP: Oat (*Avena sativa*), cv. several
PEST: Fusarium head blight, *Fusarium graminearum* Schwabe

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TITLE: SUSCEPTIBILITY OF OAT VARIETIES TO FUSARIUM HEAD BLIGHT (FHB) AND DEOXYNIVALENOL (DON) ACCUMULATION IN INOCULATED, MISTED PLOTS

METHODS: Oat varieties were planted on May 4, 2007 in Ridgetown, Ontario. The plots were planted in a randomized block design with four replications in 4-m long single rows, spaced 17.8 cm apart; fertilized and maintained using provincial recommendations. Each plot was spray-inoculated with a 100-mL suspension of macroconidia of four *Fusarium graminearum* isolates at 50,000 spores/ml at Zadoks growth stage 65. The suspension was produced in liquid shake culture using modified Bilay medium. Plots were misted daily beginning after the first plots were inoculated. The mist system was engaged until three days after the last line was inoculated. The overhead mister delivered about 7.5 mm of water daily. Each cultivar was assessed for visual symptoms three weeks after *Fusarium* inoculation. Twenty heads were selected at random out of each plot and rated for disease incidence and severity. Disease levels were calculated as fusarium head blight index (FHBI), which was the product of the percent heads infected (incidence) and the percent spikelets infected (severity), divided by 100. Deoxynivalenol (DON) content was estimated from the three replications with the highest mean FHB index using a quantitative fluorometric test-FluoroQuan (Romer Labs, Inc, Union MO).

RESULTS: The results are given below.

CONCLUSIONS: FHB index in oat varieties ranged from 3.5% (Navan) to 37.0% (Lafayette). DON level ranged from 0.1 ppm to 1.1 ppm. P973A 38.9.27 had the highest DON content.

Table 1: Fusarium head blight index (FHB) index (%) and deoxynivalenol (DON) level (ppm) in oat varieties in inoculated and misted plots at Ridgetown, Ontario in 2007.

Variety	FHB index (%)	DON (ppm)
AC Alymer	35.7 ab*	0.3 c-g*
Goslin	32.6 abc	0.1 g
AC Rigodon	8.0 efg	0.6 a-d
Ida	18.7 c-f	0.3 c-g
Irish	11.6 efg	0.3 c-g
OAC Markdale	12.1 efg	0.2 d-g
Manotick	28.5 a-d	0.2 d-g
Lafayette	37.0 a	1.0 ab
Sherwood	33.2 abc	0.2 d-g
Prescott	21.9 b-e	0.4 c-f
Jay	29.4 a-d	0.7 abc
OA1036-9	12.1 efg	0.2 d-g
OA 1046-3	8.4 efg	0.1 g
SW Exactor	4.7 fg	0.1 g
Navan	3.5 g	0.1 g
Nice	4.4 fg	0.1 g
QC:685-48	5.2 fg	0.2 d-g
P973A 38.9.27	17.4 d-g	1.1 a
PD741A41-4-6-7	20.8 cde	0.6 a-d
Mean	18.2	0.4

* Means followed by the same letter are not different according to Fisher protected least significant difference test (*P*= 0.05).

2007 PMR REPORT# 70 **SECTION O: CEREALS, FORAGE CROPS and OILSEEDS-Diseases**

CROP: Winter wheat (*Triticum aestivum* L.), cv. several
PEST: Fusarium head blight, *Fusarium graminearum* Schwabe

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TITLE: SUSCEPTIBILITY OF WINTER WHEAT VARIETIES TO FUSARIUM HEAD BLIGHT (FHB), FUSARIUM DAMAGED KERNELS (FDK) AND DEOXYNIVALENOL (DON) ACCUMULATION IN INOCULATED AND MISTED PLOTS-ONTARIO PERFORMANCE TRIAL

METHODS: The crop was planted on October 16, 2006 at Ridgetown, Ontario using a 8-row cone seeder at 270 seeds/plot, 4 m in length, placed in a randomized block design with four replications. The plots were fertilized and maintained using provincial recommendations. Each plot was inoculated with a combined suspension of macroconidia of four *Fusarium graminearum* isolates at 50,000 spores/ml, when primary wheat heads were at 50% anthesis for each variety (Zadoks growth stage, ZGS 65). The suspension was produced in liquid shake culture using modified Bilay medium. Plots were misted daily beginning after the first plots were inoculated. The mist system was engaged until three days after the last variety was inoculated. The overhead mister delivered about 7.5 mm of water daily. Each variety was assessed for visual symptoms when the early dough stage was reached (ZGS 83). Twenty wheat heads were selected at random out of each plot, and rated for disease incidence and severity using the scoring system developed by Stack and McMullen (1994). Disease levels were calculated as fusarium head blight index (FHBI), which was the product of the percent heads infected and the percent spikelets infected, divided by 100. Deoxynivalenol (DON) content was estimated from the three replications with the highest mean FHB index using a quantitative fluorometric test-FluoroQuan (Romer Labs, Inc, Union MO). A twenty-five gram sub-sample was taken randomly from each sample. Fusarium damaged kernels (FDK) were removed, weighed and the percent of FDK was calculated for each line.

RESULTS: The results are given below.

CONCLUSIONS: The highest correlation was between FDK and DON (r=0.76, $P<0.001$), while correlations between FHB index and FDK and between FHB index and DON were r=0.48 ($P<0.001$) and r=0.65 ($P<0.001$), respectively. Variety Ashley had lowest FHB index, variety OTF13-81 had lowest FDK level and DON content.

Table 1: Fusarium head blight index (%), % of Fusarium damaged kernels (FDK) and deoxynivalenol (DON) content (ppm) in inoculated and misted plots-Winter Wheat Performance test. Ridgetown, Ontario. 2006-2007.

Winter wheat cultivar	FHB index (%)	FDK (%)	DON (ppm)
AC Morley	6.3	1.3	1.7
Superior	32.9	1.1	1.5
AC Mackinnon	35	3.2	4.0
AC Mountain	27.8	1.3	3.0
Maxine	31.2	2.0	3.0
Wisdom	18.6	3.2	1.9
Warwick	30	2.8	4.0
Warthog	16.7	1.7	1.8
Harvard	39.7	7.0	4.0
Carlisle	8.3	2.8	2.5
Vienna	11.6	1.6	1.9
FT Wonder	6.4	1.1	0.7
AC Sampson	21.9	4.2	4.5
25R47	8.1	2.7	2.9
Ashley	3.8	2.7	1.1
25W41	30.8	1.2	1.9
Tribute	12	3.1	1.5
D8006W	12.9	2.9	2.8
Emmit	25.1	4.7	3.0
E1007R	25.7	1.6	2.7
R045	36	4.5	3.5
Huntley	18	3.3	3.2
CM708	58.4	2.0	3.0
95:056:187	14.1	1.5	2.7
TW122:001	9.9	1.3	1.0
TW070:015	59.6	3.9	4.4
ADV Dyno	6.5	1.1	1.2
FTHP Redeemer	12.3	1.2	2.1
Genesis:R055	22.3	1.9	1.8
Genesis:E1009	17.1	2.5	3.6
25R56	35.3	3.9	3.9
IL97:2422	23	2.5	2.9
IL00:1665	21.9	2.1	2.1
BCG99-184	16.6	5.1	2.3
Branson	17.5	5.1	1.7
OTF13-81	5.6	0.7	0.7
95-094-197	13.2	1.9	1.9
ACS51012	45.3	8.7	8.1
ACS52062	8.1	1.9	2.0
E0028W	23.9	4.7	3.7
ADV0406	38.3	3.2	1.7
ADV0411	40	6.9	4.5
ADV0414	25.4	4.1	4.4
VA03W-409	30.2	7.7	4.4
IL01-13,830	12.5	1.2	1.4
25R51	5.8	1.3	1.0
Mean	23	3.0	2.7
LSD (P=0.05)	22.1	2.7	1.2