Agriculture and Agri Food Canada | Agriculture et Agroalimentaire Canada

2004 Pest Management Research Report (PMRR)
2004 Growing Season

2004 Rapport de recherches sur la lutte dirigée (RRLD)
pour le saison 2004

Compiled for
The Expert Committee on Integrated Pest Management (ECIPM)

Compilé par
le Comité d'experts sur la lutte intégrée (CELI)

February, 2005 / Février, 2005

Canada

English

2004 PEST MANAGEMENT RESEARCH REPORT

Compiled for: **THE EXPERT COMMITTEE ON INTEGRATED PEST MANAGEMENT (ECIPM)**

Chairperson: **Hugh Berges**

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The Official Title of the Report

2004 Pest Management Research Report - 2004 Growing Season: Compiled for the Expert Committee on Integrated Pest Management, by Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre, London, Ontario, Canada N5V 4T3.
May, 2005.Volume 43[1]. 293 pp.
Published on the Internet at: http://www.carc-crac.ca/english/ECIPM/ecipm.htm

[1] This is the fifth 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 iii.

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 108 reports. The Expert Committee on Integrated Pest Management 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, to Andrea Labaj for editorial and computer compilation services and to Bruce Bowman as an excellent all-round resource and advisor.

Suggestions for improving this publication are always welcome.

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Procedures for the 2005 Annual PMR Report will be sent in Fall, 2005. They will also be published on the web site, or contact PMRR EDITOR, Andrea Labaj.

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.

The publication of the Report for the growing season 2004 has been assigned a Volume number for the fifth 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 44.

An individual report will be cited as follows:
Author(s). 2005. Title. 2004 Pest Management Research Report - 2004 Growing Season. Expert Committee on Integrated Pest Management. May, 2005. Report No. x. Vol. 43: pp-pp.

Français

Rapport de recherches sur la lutte dirigée - 2004

Préparé pour: **LE COMITÉ D'EXPERTS SUR LA LUTTE INTÉGRÉE**

Président: **Hugh Berges**

Préparé par: **Agriculture et Agroalimentaire Canada**
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Titre officiel du document
2004 Rapport de recherches sur la lutte dirigée - pour le saison 2004. Compilé par le Comité d'experts sur la lutte intégrée, par Agriculture et Agroalimentaire Canada, London (Ontario) Canada N5V 4T3.
Mai, 2005. 293 pp.
Publié sur l'Internet à http://www.carc-crac.ca/french/ECIPM/ecipmf.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 108 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, Andrea Labaj qui ont fourni les services d'édition et de compilation sur ordinateur et Bruce Bowman pour ses conseils d'un expert l'informatique. Vos suggestions en vue de l'amélioration de cette publication sont toujours très appréciées.

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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.

Il y a cinq ans, 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 2002 correspond au volume 42.

Modèle de référence :
[Nom de l'auteur ou des auteurs. Année de parution 2005. Titre (*2004 Rapport de recherche sur la lutte antiparasitaire*). Comité d'experts de la lutte anti-parasitaire intégrée. Mai. 2005. Rapport n^{o} x. 44:** pp-pp.]

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[1] enregistrement
[2] numéro de page

2004 PMRR REPORT # 01 **SECTION A: FRUIT-Insect Pests**
STUDY DATABASE: 280-1261-9341

CROP: Grapes cv. Baco Noir
PEST: Grape Berry Moth, *Endopiza viteana* (Clemens)

NAME AND AGENCY:
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TITLE: CONTROL OF SECOND GENERATION GRAPE BERRY MOTH WITH INSECTICIDES, 2004

MATERIALS: INTREPID 2F (methoxyfenozide), GUTHION 240 SC (azinphos-methyl)

METHODS: The trial was conducted in a mature vineyard in the Niagara-on-the-Lake, Ontario area; vines cv. Baco Noir were spaced 3.0 m by 1.5 m. Treatments were replicated four times, assigned to five-vine plots measuring 1.0 m by 8.0 m, and arranged according to a randomised complete block design. Application timing was based on peak pheromone trap catch of male grape berry moths (GBM). Three rates of INTREPID (144, 108, and 72 g a.i./ha) were compared to GUTHION and an unsprayed control; all treatments were applied twice and compared to a single application of INTREPID at 144 g a.i./ha. On 21 July and 5 August, insecticides 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 4 August (14 days after first application) and 18 August (13 days after second application); 50 grape bunches per plot were examined on the vine for GBM damage; results were expressed as percent damaged bunches (0-100%). 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 plots.

CONCLUSIONS: All treatments reduced grape berry moth damage when two applications were made. Both one and two applications of INTREPID at 144 g a.i./ha were as effective as GUTHION in reducing GBM damage. However, the 72 g a.i./ha rate of INTREPID was not effective in controlling GBM after one application, and plots treated with this rate of INTREPID contained significantly more GBM damage after the second application than those treated with two applications of GUTHION or the higher rates of INTREPID. Plots treated with 108 g a.i./ha INTREPID contained more GBM damage than those treated with GUTHION or 144 g a.i/ha INTREPID after one application, but no differences were observed after two applications.

Table 1. Percent grape bunches infested by grape berry moth.

Treatment	Rate (a.i./ha)	Days After Treatment	
		14 days (4 August)	27 days (18 August)
GUTHION 240 SC[2]	1.8 kg	3.0 D	11.0 C[3]
INTREPID 2F[2]	144 g	10.0 CD	5.5 C
INTREPID 2F[1]	144 g	12.0 BC	11.0 C
INTREPID 2F[2]	108 g	19.0 B	13.0 C
INTREPID 2F[2]	72 g	28.5 A	23.5 B
CONTROL	-	29.5 A	39.0 A

[1] Applied 21 July
[2] Applied 21 July, 5 August
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2004 PMRR REPORT # 02 **SECTION A: FRUIT-Insect Pests**
STUDY DATA BASE: 280-1261-9341

CROP: Grapes cv. Foch
PEST: Grape Berry Moth, *Endopiza viteana* (Clemens)

NAME AND AGENCY:
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TITLE: CONTROL OF SECOND GENERATION GRAPE BERRY MOTH WITH INSECTICIDES; 2004

MATERIALS: INTREPID 2F (methoxyfenozide), GUTHION 240 SC (azinphos-methyl)

METHODS: The trial was conducted in a mature vineyard in the Niagara-on-the-Lake, Ontario area; vines cv. Foch were spaced 3.0 m by 1.5 m. Treatments were replicated four times, assigned to five-vine plots measuring 1.0 m by 8.0 m, and arranged according to a randomised complete block design. Application timing was based on peak pheromone trap catch of male grape berry moths (GBM). Three rates of INTREPID (144, 108, and 72 g a.i./ha) were compared to GUTHION and an unsprayed control; all treatments were applied twice and compared to a single application of INTREPID at 144 g a.i./ha. On 21 July and 5 August, insecticides 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 4 August (14 days after first application) and 18 August (13 days after second application); 50 grape bunches per plot were examined on the vine for GBM damage; results were expressed as percent damaged bunches (0-100%). 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 plots.
CONCLUSIONS: All treatments reduced grape berry moth damage when whether one or two applications were made. Plots treated with one application of INTREPID at 144 g a.i./ha contained more GBM damage than those treated with two applications, but these differences were not statistically significant.

Table 1. Percent grape bunches infested by grape berry moth.

Treatment	Rate (a.i./ha)	Days After Treatment	
		14 days (4 August)	27 days (18 August)
INTREPID 2F[2]	144 g	2.5 B	1.5 B[3]
INTREPID 2F[1]	144 g	3.5 B	2.5 B
GUTHION 240 SC[2]	1.8 kg	6.0 B	1.5 B
INTREPID 2F[2]	108 g	6.5 B	1.5 B
INTREPID 2F[2]	72 g	7.5 B	5.0 B
CONTROL	-	18.0 A	13.0 A

[1] Applied 21 July
[2] Applied 21 July, 5 August
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2004 PMRR REPORT # 03 **SECTION A: FRUIT-Insect Pests**
STUDY DATABASE #: 280-1261-9341

CROP: Grapes cv. Foch
PEST: Grape Berry Moth, *Endopiza viteana* (Clemens)

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TITLE: CONTROL OF SECOND GENERATION GRAPE BERRY MOTH WITH INSECTICIDES, 2004

MATERIALS: INTREPID 2F (methoxyfenozide), GUTHION 240 SC (azinphos-methyl)

METHODS: The trial was conducted in a mature vineyard in the Grimsby, Ontario area; vines cv. Foch were spaced 3.0 m by 1.5 m. Treatments were replicated four times, assigned to five-vine plots measuring 1.0 m by 8.0 m, and arranged according to a randomised complete block design. Application timing was based on peak pheromone trap catch of male grape berry moths (GBM). Three rates of INTREPID (144, 108, and 72 g a.i./ha) were compared to GUTHION and an unsprayed control; all treatments were applied twice and compared to a single application of INTREPID at 144 g a.i./ha. On 26 July and 6 August, insecticides 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 5 August (10 days after first application) and 19 August (13 days after second application); 50 grape bunches per plot were examined on the vine for GBM damage; results were expressed as percent damaged bunches (0-100%). 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 plots.

CONCLUSIONS: All treatments reduced grape berry moth damage when either one or two applications were made. Plots treated with one application of INTREPID at 144 g a.i./ha contained more GBM damage than those treated with two applications, but these differences were not statistically significant.

Table 1. Percent grape bunches infested by grape berry moth.

Treatment	Rate (a.i./ha)	Days After Treatment	
		10 days (5 August)	24 days (19 August)
INTREPID 2F[1]	144 g	0.0 B	21.5 BC[3]
GUTHION 240 SC[2]	1.8 kg	0.5 B	12.5 C
INTREPID 2F[2]	144 g	0.5 B	12.0 C
INTREPID 2F[2]	108 g	0.5 B	20.0 BC
INTREPID 2F[2]	72 g	2.0 B	30.5 B
CONTROL	-	6.0 A	58.5 A

[1] Applied 26 July
[2] Applied 26 July, 6 August
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2004 PMRR REPORT # 04 **SECTION A: FRUIT - Insect Pests**
STUDY DATABASE: 280-1261-9341

CROP: Grapes cv. Baco Noir
PEST: Multicoloured Asian Lady Beetle, *Harmonia axyridis* (Pallas)

NAME AND AGENCY:
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TITLE: CONTROL OF MULTICOLOURED ASIAN LADY BEETLE ON GRAPE; 2004

MATERIALS: RIPCORD 400 EC (cypermethrin)

METHODS: The trial was conducted in a mature vineyard in the Vineland, Ontario area; vines cv. Baco Noir were spaced 2.5 m by 1.5 m. Treatments were replicated four times, assigned to five-vine plots measuring 1.0 m by 8.0 m, and arranged according to a randomised complete block design. The registered rate of RIPCORD (60 g a.i./ha) was compared to RIPCORD treatments at one half (30 g a.i./ha) and one quarter (15 g a.i./ha) of the full rate and to an unsprayed control. On 12 October 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. Approximately 8-10 L of spray mix were applied per plot; pressure was set at 2000 kPa. Plots were sampled 1 day (13 October), 2 days (14 October), 3 days (15 October), 7 days (19 October), 10 days (22 October), 14 days (October 26), and 22 days (November 3) after treatment; total numbers of multicoloured Asian lady beetle (MALB) in bunches and on leaves 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. Weather conditions at the time of sampling are presented in Table 2. No phytotoxic effects were observed.

CONCLUSIONS: In all samples, all plots treated with RIPCORD had fewer MALB than the control (Table 1), no differences were observed between rates. Higher numbers of MALB were present on calm, sunny days than on cold or rainy days.

Table 1. Mean numbers of MALB per plot.

Treatment[1]	Rate a.i./ha	Days After Treatment						
		1 DAT 13 Oct.	2 DAT 14 Oct.	3 DAT 15 Oct.	7 DAT 19 Oct.	10 DAT 22 Oct.	14 DAT 26 Oct.	22 DAT 3 Nov.
RIPCORD 400 EC	60 g	0.25 B	0.0 B	0.0 B	0.0 B	0.0 B	3.0 B	0.0 B[2]
RIPCORD 400 EC	30 g	0.5 B	0.0 B	0.0 B	0.0 B	0.0 B	4.25 B	0.25 B
RIPCORD 400 EC	15 g	0.5 B	0.0 B	0.0 B	0.0 B	0.0 B	9.5 B	4.0 B
CONTROL	-	12.0 A	6.0 A	3.5 A	3.25 A	5.75 A	21.0 A	78.5 A

[1] Applied 12 October
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Weather conditions at sampling.

Treatment	Days After Treatment						
	1 DAT 13 Oct.	2 DAT 14 Oct.	3 DAT 15 Oct.	7 DAT 19 Oct.	10 DAT 22 Oct.	14 DAT 26 Oct.	22 DAT 3 Nov.
Temperature (°C)	20	13	14	10	11	14	6
Sun/Cloud/Rain	Sun	Rain	Rain	Cloud	Cloud	Sun	Sun
Wind Speed (km/h)	Calm	5	5	~ 20	5	Calm	Calm

2004 PMRR REPORT # 05 **SECTION A: FRUIT-Insect Pests**
STUDY DATABASE: 280-1261-9341

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

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TITLE: CONTROL OF FIRST-GENERATION ORIENTAL FRUIT MOTH ON PEACH WITH INSECTICIDES; 2004

MATERIALS: ASSAIL 70 WP (acetamiprid), DECIS 5 EC (deltamethrin)

METHODS: The trial was conducted in a three-year-old orchard in the Jordan Station, Ontario area; trees cv. Elberta were spaced 4.6 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application was timed for egg hatch of the first generation Oriental fruit moth (OFM), determined from pheromone trap catches of male moths. Treatments were applied 21 May, 124 DD (base 7.2 C) after first male moth catch (May 3). Insecticides 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 post-treatment 9 June (19 days after application); all infested terminals and fruit were removed and counted. 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 plots.

CONCLUSIONS: In the 9 June sample, all treated plots contained significantly less damaged twigs and fruit than the control. The plots treated with DECIS and the 176 g a.i./ha rate of ASSAIL contained less OFM damage than all other plots, but these differences were not significant.

Table 1. OFM damage per plot.

Treatment[1]	Rate (a.i./ha)	Infested Terminals per Plot 9 June	Damaged Fruit per Plot 9 June	Total OFM Damage 9 June
DECIS 5 EC	10 g	1.0 B	0.0 B	1.0 B[2]
ASSAIL 70 WP	176 g	4.3 B	0.0 B	4.3 B
ASSAIL 70 WP	168.8 g	11.5 B	0.0 B	11.5 B
ASSAIL 70 WP	47.2 g	13.0 B	0.8 B	13.8 B
CONTROL	-	27.5 A	2.8 A	30.3 A

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

2004 PMRR REPORT # 06 **SECTION A: FRUIT-Insect Pests**
STUDY DATABASE: 280-1261-9341

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

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TITLE: ASSESSMENT OF CLOTHIANIDIN AGAINST FIRST-GENERATION ORIENTAL FRUIT MOTH ON PEACH; 2004

MATERIALS: CLUTCH 50 WDG (clothianidin), DECIS 5 EC (deltamethrin)

METHODS: The trial was conducted in a three-year-old orchard in the Jordan Station, Ontario area; trees cv. Elberta were spaced 4.6 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application was timed for egg hatch of the first generation Oriental fruit moth (OFM), determined from pheromone trap catches of male moths. Treatments were applied 21 May, 124 DD (base 7.2 C) after first male moth catch (May 3). Insecticides 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 post-treatment 9 June (19 days after application); all infested terminals and fruit were removed and counted. 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 plots.

CONCLUSIONS: In the 9 June sample, all treated plots contained significantly less damaged twigs, damaged fruit, and total damage than the control. The plots treated with DECIS contained less twig damage and total damage than those treated with the low (112 g a.i./ha) rate of CLUTCH; no differences were observed between the three rates of CLUTCH.

Table 1. OFM damage per plot.

Treatment[1]	Rate (a.i./ha)	Infested Terminals per Plot 9 June	Damaged Fruit per Plot 9 June	Total OFM Damage 9 June
DECIS 5 EC	10 g	1.0 C	0.0 B	1.0 C[2]
CLUTCH 50 WDG	224 g	7.5 BC	0.5 B	8.0 BC
CLUTCH 50 WDG	168 g	10.0 BC	0.3 B	10.3 BC
CLUTCH 50 WDG	112 g	11.0 B	0.5 B	11.5 B
CONTROL	-	21.3 A	2.5 A	23.8 A

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

2004 PMRR REPORT # 07 **SECTION A: FRUIT-Insect Pests**
STUDY DATABASE: 280-1261-9341

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

NAME AND AGENCY:
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TITLE: CONTROL OF SECOND-GENERATION ORIENTAL FRUIT MOTH ON PEACH WITH INSECTICIDES; 2004

MATERIALS: ASSAIL 70 WP (acetamiprid), DECIS 5 EC (deltamethrin)

METHODS: The trial was conducted in a three-year-old orchard in the Jordan Station, Ontario area; trees cv. Elberta were spaced 4.6 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application was timed for egg hatch of the first generation Oriental fruit moth (OFM), determined from pheromone trap catches of male moths. Treatments were applied 9 July, 617 DD (base 7.2 C) after first male moth catch (May 3). Insecticides 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 post-treatment 20 July (11 days after application); all infested terminals and fruit were removed and counted. 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 plots.

CONCLUSIONS: In the 20 July sample, all treated plots contained significantly lower totals for combined damaged twigs and fruit than the control. The plots treated with DECIS and the 176 g a.i./ha rate of ASSAIL contained less OFM damage than all other plots, but these differences were not significant.

Table 1. OFM damage per plot.

Treatment[1]	Rate (a.i./ha)	Infested Terminals per Plot 20 July	Damaged Fruit per Plot 20 July	Total OFM Damage 20 July
ASSAIL 70 WP	176 g	0.8 B	0.3 B	1.0 B[2]
DECIS 5 EC	10 g	1.5 B	1.3 B	2.8 B
ASSAIL 70 WP	168.8 g	4.3 B	0.8 B	5.0 B
ASSAIL 70 WP	47.2 g	9.3 B	3.5 AB	12.8 B
CONTROL	-	28.0 A	7.8 A	35.8 A

[1] Applied 9 July
[2] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

2004 PMRR REPORT # 08 **SECTION A: FRUIT-Insect Pests**
STUDY DATA BASE: 280-1261-9341

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

NAME AND AGENCY:
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TITLE: ASSESSMENT OF CLOTHIANIDIN AGAINST SECOND-GENERATION ORIENTAL FRUIT MOTH ON PEACH; 2004

MATERIALS: CLUTCH 50 WDG (clothianidin), DECIS 5 EC (deltamethrin)

METHODS: The trial was conducted in a three-year-old orchard in the Jordan Station, Ontario area; trees cv. Elberta were spaced 4.6 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application was timed for egg hatch of the second generation Oriental fruit moth (OFM), determined from pheromone trap catches of male moths. Treatments were applied 9 July, 617 DD (base 7.2 C) after first male moth catch (May 3). Insecticides 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 post-treatment 22 July (13 days after application); all infested terminals and fruit were removed and counted. 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 plots.

CONCLUSIONS: In the 22 July sample, all treated plots contained significantly less damaged twigs, damaged fruit, and total damage than the control, but no differences were observed between insecticide treatments.

Table 1. OFM damage per plot.

Treatment[1]	Rate (a.i./ha)	Infested Terminals per Plot 22 July	Damaged Fruit per Plot 22 July	Total OFM Damage 22 July
CLUTCH 50 WDG	224 g	1.0 B	1.5 B	2.5 B[2]
DECIS 5 EC	10 g	1.8 B	1.3 B	3.0 B
CLUTCH 50 WDG	168 g	2.8 B	1.8 B	4.5 B
CLUTCH 50 WDG	112 g	8.3 B	3.8 B	12.0 B
CONTROL	-	24.8 A	12.0 A	36.8 A

[1] Applied 9 July
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.2004

2004 PMRR REPORT # 09 **SECTION A: FRUIT-Insect Pests**
STUDY DATABASE: 280-1261-9341

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

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TITLE: CONTROL OF THIRD-GENERATION ORIENTAL FRUIT MOTH ON PEACH WITH ASSAIL; 2004

MATERIALS: ASSAIL 70 WP (acetamiprid), DECIS 5 EC (deltamethrin)

METHODS: The trial was conducted in a three-year-old orchard in the Jordan Station, Ontario area; trees cv. Elberta were spaced 4.6 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application was timed for egg hatch of the first generation Oriental fruit moth (OFM), determined from pheromone trap catches of male moths. Treatments were applied 6 August, 994 DD (base 7.2 C) after first male moth catch (May 3). Insecticides 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 post-treatment 16 August (10 days after application); all infested terminals and fruit were removed and counted. 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 plots.

CONCLUSIONS: In the 16 August sample, all treated plots contained significantly less OFM damage than the control, but no differences in fruit damage were observed between insecticide treatments. All treatments had less twig damage than the control; however, the 47.2 g a.i./ha rate of ASSAIL was not as effective as DECIS or the higher rates of ASSAIL. Plots treated with the 176 g a.i./ha rate of ASSAIL contained significantly less total damage than those treated with the 47.2 g a.i./ha rate of ASSAIL, but were not different from DECIS or the 168.8 g a.i./ha rate of ASSAIL.

Table 1. OFM damage per plot.

Treatment[1]	Rate (a.i./ha)	Infested Terminals per Plot 16 August	Damaged Fruit per Plot 16 August	Total OFM Damage 16 August
ASSAIL 70 WP	176 g	3.8 C	1.0 B	4.8 C[2]
DECIS 5 EC	10 g	5.5 C	0.5 B	6.0 BC
ASSAIL 70 WP	168.8 g	5.3 C	0.8 B	6.0 BC
ASSAIL 70 WP	47.2 g	10.8 B	1.0 B	11.8 B
CONTROL	-	19.5 A	7.0 A	26.5 A

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

2004 PMRR REPORT # 10 **SECTION A: FRUIT-Insect Pests**
STUDY DATA BASE #: 280-1261-9341

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

NAME AND AGENCY:
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TITLE: ASSESSMENT OF CLOTHIANIDIN AGAINST THIRD-GENERATION ORIENTAL FRUIT MOTH ON PEACH; 2004

MATERIALS: CLUTCH 50 WDG (clothianidin), DECIS 5 EC (deltamethrin)

METHODS: The trial was conducted in a three-year-old orchard in the Jordan Station, Ontario area; trees cv. Elberta were spaced 4.6 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application was timed for egg hatch of the third generation Oriental fruit moth (OFM), determined from pheromone trap catches of male moths. Treatments were applied 6 August, 994 DD (base 7.2 C) after first male moth catch (May 3). Insecticides 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 post-treatment 16 August (10 days after application); all infested terminals and fruit were removed and counted. 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 plots.

CONCLUSIONS: In the 16 August sample, all treated plots contained significantly less damaged twigs, damaged fruit, and total damage than the control, but no differences were observed between insecticide treatments.

Table 1. OFM damage per plot.

Treatment[1]	Rate (a.i./ha)	Infested Terminals per Plot 16 August	Damaged Fruit per Plot 16 August	Total OFM Damage 16 August
DECIS 5 EC	10 g	6.8 B	0.0 B	6.8 B[2]
CLUTCH 50 WDG	224 g	6.8 B	0.8 B	7.5 B
CLUTCH 50 WDG	168 g	7.3 B	0.8 B	8.0 B
CLUTCH 50 WDG	112 g	9.3 B	1.0 B	10.3 B
CONTROL	-	15.0 A	5.3 A	20.3 A

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

2004 PMRR REPORT # 11 **SECTION A: FRUIT-Insect Pests**
STUDY DATABASE: 280-1261-9341

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

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TITLE: **ASSESSMENT OF ACETAMIPRID AGAINST ORIENTAL FRUIT MOTH ON PEACH; 2004**

MATERIALS: ASSAIL 70 WP (acetamiprid), DECIS 5 EC (deltamethrin)

METHODS: The trial was conducted in a mature orchard in the Jordan Station, Ontario area; trees cv. Harrow Beauty were spaced 4.5 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application was timed for egg hatch of the first generation Oriental fruit moth (OFM), determined from pheromone trap catches of male moths. Treatments were applied 9 July, 617 DD (base 7.2 C) after first male moth catch (May 3). Insecticides 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 post-treatment 22 July (13 days after application); all infested terminals and fruit were removed and counted. 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 plots.

CONCLUSIONS: In the 22 July sample, all treated plots contained significantly less twig, fruit, and total OFM damage than the control, but no differences were observed between insecticide treatments.

Table 1. OFM damage per plot.

Treatment[1]	Rate (a.i./ha)	Infested Terminals per Plot 22 July	Damaged Fruit per Plot 22 July	Total OFM Damage 22 July
DECIS 5 EC	10 g	1.0 B	0.3 B	1.3 B[2]
ASSAIL 70 WP	176 g	1.5 B	0.0 B	1.5 B
ASSAIL 70 WP	168.8 g	1.5 B	0.3 B	1.8 B
ASSAIL 70 WP	47.2 g	2.8 B	0.3 B	3.0 B
CONTROL	-	7.5 A	2.3 A	9.8 A

[1] Applied 9 July
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2004 PMRR REPORT # 12 **SECTION A: FRUIT-Insect Pests**
STUDY DATABASE: 280-1261-9341

CROP: Plum cv. Early Golden
PESTS: Plum Curculio, *Conotrachelus nenuphar* (Herbst)

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TITLE: ASSESSMENT OF ACETAMIPRID AGAINST PLUM CURCULIO ON PLUM; 2004

MATERIALS: ASSAIL 70 WP (acetamiprid), GUTHION 50 WP (azinphos-methyl)

METHODS: The trial was conducted in a mature orchard in the Niagara-on-the-Lake, Ontario area; trees cv. Early Golden were spaced 3.0 m by 4.8 m. Treatments were replicated four times, assigned to one-tree plots, and arranged according to a randomised complete block design. Treatments, timed for first appearance of plum curculio (PC) damage, were applied at shuck (21 May). Insecticides 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 14 June (24 days after application); 50 plums per plot were examined for PC damage, and results were expressed as percent damaged fruit (0-100%). Fruit were then dissected and numbers of live PC larvae were counted; results were expressed as percent infested fruit. 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 below. No phytotoxic effects were observed in any plots.

CONCLUSIONS: The 47.2 g a.i./ha rate of ASSAIL was not effective for control of plum curculio on plum. Both the 168.8 and 176 g a.i./ha rates of ASSAIL were as effective as the GUTHION standard.

Table 1.

Treatment[1]	Rate (a.i./ha)	Percent Damaged Fruit 14 June (24 days after application)	Percent Infested Fruit 14 June (24 days after application)
ASSAIL 70 WP	168.8 g	30.5 B	12.5 B[3]
GUTHION 50 WP	1.05 kg	30.0 B	13.0 B
ASSAIL 70 WP	176 g	27.0 B	14.5 B
ASSAIL 70 WP	47.2 g	45.0 AB	38.5 A
CONTROL	-	61.0 A	45.0 A

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

2004 PMRR REPORT # 13 **SECTION A: FRUIT-Insect Pests**
STUDY DATABASE: 280-1261-9341

CROP: Plum cv. Italian
PESTS: Plum Curculio, *Conotrachelus nenuphar* (Herbst)

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TITLE: ASSESSMENT OF ACETAMIPRID AGAINST PLUM CURCULIO ON PLUM; 2004

MATERIALS: ASSAIL 70 WP (acetamiprid), GUTHION 50 WP (azinphos-methyl)

METHODS: The trial was conducted in a mature orchard in the Niagara-on-the-Lake, Ontario area; trees cv. Italian were spaced 3.0 m by 4.8 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Treatments, timed for first appearance of plum curculio (PC) damage, were applied at shuck (21 May). Insecticides 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 14 June (24 days after application); 50 plums per plot were examined for PC damage, and results were expressed as percent damaged fruit (0-100%). Fruit were then dissected and numbers of live PC larvae were counted; results were expressed as percent infested fruit. Data were transformed (square root (X+1/2)), and 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 below. No phytotoxic effects were observed in any plots.

CONCLUSIONS: All treatments were effective in reducing damage by plum curculio. However, the plots treated with the 47.2 g a.i./ha rate of ASSAIL contained more infested fruit than the plots treated with GUTHION or the 168.8 and 176 g a.i./ha rates of ASSAIL.

Table 1.

Treatment[1]	Rate (a.i./ha)	Percent Damaged Fruit 14 June (24 days after application)	Percent Infested Fruit 14 June (24 days after application)
GUTHION 50 WP	1.05 kg	3.0 C	0.5 B[3]
ASSAIL 70 WP	176 g	1.5 C	0.5 B
ASSAIL 70 WP	168.8 g	3.0 C	0.5 B
ASSAIL 70 WP	47.2 g	6.0 B	2.5 B
CONTROL	-	11.0 A	8.0 A

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

2004 PMRR REPORT # 14 **SECTION B: VEGETABLE and SPECIAL CROPS - Insect Pests**

STUDY DATABASE:

CROP: Broccoli cv. Paragon
PEST: Swede midge (SM), *Contarinia nasturtii* (Kieffer)

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TITLE: **CONTROL OF SWEDE MIDGE IN GREENHOUSE GROWN BROCCOLI TRANSPLANTS, SEEDED JUNE 10 2004**

MATERIALS: TRISTAR 70 WSP (acetamiprid 70%), INTERCEPT 60 WP (imidacloprid 60%), DIAMOND 10 EC (novaluron 100 g/L), ENDEAVOUR 50 WG (pymetrozine 50%), CLUTCH 50 WP (clothianidin 50%), BELAY 16 WG (clothianidin 16%), TRACER 480 SC (spinosad 480 g/L), GAUCHO (imidacloprid 600 g/L), PONCHO 600 (clothianidin 600 g/L).

METHODS: Broccoli was seeded into 200 cell plastic seedling trays in a commercial greenhouse on June 10. Broccoli seed was treated on May 19 in the laboratory at Ridgetown College by tumbling the seed treatment in a clean bag for 5 minutes until all seed was uniformly coated. The seed was then dried. Drench treatments were applied on July 12 at a rate of 200 ml per tray using a modified spray bottle with a fine mist, just prior to shipping transplants to the SM infested research site. All other treatments were applied to the foliage using a specialized, CO_2 sprayer with a two-nozzle, hand-held boom applying 100 ml per tray of spray mixture on the transplants on July 14, just prior to shipment. The trays were set out in a commercial field with known SM populations near Troy, south of Guelph, ON. All treatments were replicated 4 times in a randomized complete block design. Treated broccoli transplants were left in the field for 24 hours, exposed to the existing SM pressures (natural infestation period) and then placed into a greenhouse away from the insect pressure until assessment on July 17 and 21, 3 and 7 days after plants were removed from the field. Assessments were taken by counting the total number of plants per tray and calculating the percentage of plants in each SM Damage Rating on each assessment date. Percentage data results were transformed Log (x+1) and then analyzed using ANOVA and Duncan's Multiple Range Test ($P \leq 0.05$).

RESULTS: Data are presented in Table 1. None of the insecticides tested in this trial caused any damage to broccoli transplants.

CONCLUSIONS: At the first rating, 3 days after removal from the field, while trays treated in the greenhouse with TRISTAR, had the highest numbers of symptom-free broccoli seedlings, means for no treatment were significantly different from CONTROL. When trays were rated 4 days later, the number of symptom-free plants had declined in all treatments. The high rate of TRISTAR provided significantly

better control than DIAMOND. At least 33% of plants remained free of symptoms in trays treated with GAUCHO, PONCHO and TRACER as seed treatments or INTERCEPT and BELAY as drench treatments and TRISTAR and CLUTCH as foliar treatments.

Table 1. Control of swede midge in broccoli with greenhouse applied control agents – Seeded, June 10; Assessed – July 17 and 21 (3 and 7 days after application).

			Insect Damage Ratings (0-3) [1] % counts on indicated date			
			July 17		July 21	
Treatments	Rate Product/ha	Method	0	1	0	1
TRISTAR 70 WSP	86 g	Foliar	82.7 a[2]	15.1 b	48.6 a	48.9 b
TRISTAR 70 WSP	48 g	Foliar	82.4 a	15.4 b	41.6 ab	55.3 ab
INTERCEPT 60 WP	80 g	Foliar	71.9 ab	35.3 a	44.3 a	54.0 ab
INTERCEPT 60 WP	80 g	Drench	69.6 ab	28.6 ab	32.6 ab	67.3 ab
DIAMOND 10 EC	500 ml	Foliar	68.4 ab	25.2 ab	24.8 b	71.5 ab
ENDEAVOUR 50 WG	193 g	Foliar	55.1 b	33.3 a	38.2 ab	55.7 b
CLUTCH 50 WG	210 g	Foliar	72.1 ab	26.5 ab	37.7 ab	61.6 ab
BELAY 16 WG	1275 g	Drench	59.2 b	32.4 a	33.1 ab	60.2 ab
TRACER 480 SC	75 ml/kg	Seed Trt	65.3 ab	33.7 a	38.6 ab	61.0 ab
GAUCHO 600	13.3 ml / kg	Seed Trt	72.5 ab	26.3 ab	36.9 ab	61.4 ab
PONCHO 600	8 ml / kg	Seed Trt	66.9 ab	31.5 a	41.5 ab	54.4 ab
CONTROL	---[3]	---	72.7 ab	26.1 ab	47.5 a	49.6 b
ANOVA $P \leq 0.05$			s	s	s	s
Coefficient of Variation (%)			4.4	12.5	8.8	5.0

[1] Insect Damage Ratings (0-3); 0- no insect damage and good marketability; 1 – mild crumpling and/or twisting of leaves, 2 – severe crumpling and/or twisting of transplant, gall or scarring may be present, 3 – severe damage, with other symptoms previously listed plus insect damage due to "blind growth" (no potential for head formation and no marketable yield).
[2] Numbers within a column followed by the same letter are not significantly different according to a Duncan's Multiple Range Test ($P \leq 0.05$).
[3] No insecticide applied.

2004 PMRR REPORT # 15 **SECTION B: VEGETABLE and SPECIAL CROPS - Insect Pests**
STUDY DATABASE:

CROP: Broccoli cv. Paragon
PEST: Swede midge (SM), *Contarinia nasturtii* (Kieffer)

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TITLE: CONTROL OF SWEDE MIDGE IN GREENHOUSE GROWN BROCCOLI TRANSPLANTS, SEEDED JULY 12 2004

MATERIALS: TRISTAR 70 WSP (acetamiprid 70%), INTERCEPT 60 WP (imidacloprid 60%), DIAMOND 10 EC (novaluron 100 g/L), ENDEAVOUR 50 WG (pymetrozine 50%), CLUTCH 50 WP (clothianidin 50%), BELAY 16 WG (clothianidin 16%), TRACER 480 SC (spinosad 480 g/L), GAUCHO (imidacloprid 600 g/L), PONCHO 600 (clothianidin 600 g/L).

METHODS: Broccoli was seeded into 200 cell plastic seedling trays in a commercial greenhouse on July 12. Broccoli seed was treated on May 19, 54 days prior to seeding, in the laboratory at Ridgetown College by tumbling the seed treatment in a clean bag for 5 minutes until all seed was uniformly coated. The seed was then dried. Drench treatments were applied on August 19 at a rate of 200 ml per tray using a modified spray bottle with a fine mist, just prior to shipping transplants to the SM infested research site. All other treatments were applied to the foliage using a specialized, CO_2 sprayer with a two-nozzled, hand-held boom applying 100 ml per tray of spray mixture on the transplants on August 19, just prior to shipment. The trays were set out in a commercial field with known SM populations near Troy, located south of Guelph, ON. All treatments were replicated 4 times in a randomized complete block design. Treated broccoli transplants were left in the field for 24 hours, exposed to the existing SM pressures (natural infestation period) and then placed into a greenhouse away from the insect pressure for assessment on August 23 and 27, 3 and 7 days after plants were removed from the field. Assessments were taken by counting the total number of plants per tray and calculating the percentage of plants in each SM Damage Rating on each assessment date. Percentage data results were transformed Log (x+1) and then analyzed using ANOVA and Duncan's Multiple Range Test ($P \leq 0.05$).

RESULTS: Data are presented in Tables 1. None of the insecticides tested in this trial caused any damage to broccoli transplants.

CONCLUSIONS: At the first rating, 3 days after removal from the field, while trays treated in the greenhouse with INTERCEPT, DIAMOND, CLUTCH, BELAY, GAUCHO or PONCHO, had the highest numbers of symptom-free broccoli seedlings, numbers for no treatment were significantly different from those recorded in CONTROL trays. When trays were again rated 4 days later, the number

of symptom-free plants had declined in all treatments. At least 46% of plants remained free of symptoms in trays treated with GAUCHO or PONCHO as seed treatments or INTERCEPT as a drench and DIAMOND as a foliar treatment.

Table 1. Control of swede midge in broccoli with greenhouse applied control agents – Seeded, July 12; Assessed – August 23 and 27 (3 and 7 days after application).

Treatments	Rate Product/ha	Method	Insect Damage Ratings (0-3) [1] % counts on indicated date August 23		August 27	
			0	1	0	1
TRISTAR 70 WSP	86 g	Foliar	64.7 ab[2]	27.1 ab	32.2 b	52.4 ab
TRISTAR 70 WSP	48 g	Foliar	53.9 b	36.8 a	36.1 ab	54.4 ab
INTERCEPT 60 WP	80 g	Foliar	66.9 a	25.9 abc	42.8 ab	48.7 ab
INTERCEPT 60 WP	80 g	Drench	70.5 a	20.3 bc	46.1 ab	46.3 ab
DIAMOND 10 EC	500 ml	Foliar	77.2 a	15.0 c	55.9 a	36.5 b
ENDEAVOUR 50 WG	193 g	Foliar	64.8 ab	24.4 abc	38.8 ab	55.1 ab
CLUTCH 50 WG	210 g	Foliar	69.3 a	24.5 abc	43.5 ab	50.4 ab
BELAY 16 WG	1275 g	Drench	73.4 a	20.5 bc	40.7 ab	49.8 ab
TRACER 480 SC	75 ml / kg	Seed Trt	73.1 a	24.7 abc	40.5 ab	58.2 ab
GAUCHO 600	13.3 ml / kg	Seed Trt	77.9 a	21.0 bc	53.9 ab	45.5 ab
PONCHO 600	8 ml / kg	Seed Trt	69.4 a	29.4 ab	58.2 ab	39.3 ab
CONTROL	---[3]	---	65.0 ab	30.1 ab	43.8 ab	51.2 ab
ANOVA $P \leq 0.05$			s	s	s	s
Coefficient of Variation (%)			3.1	9.7	7.9	6.1

[1] Insect Damage Ratings (0-3); 0- no insect damage and good marketability; 1 – mild crumpling and/or twisting of leaves, 2 – severe crumpling and/or twisting of transplant, gall or scarring may be present, 3 – severe damage, with symptoms listed previously plus insect damage due to "blind growth" (no potential for head formation and no marketable yield).
severe insect damage due to "blind growth" and no head formation (no marketable yield).
[2] Numbers within a column followed by the same letter are not significantly different according to a Duncan's Multiple Range Test ($P \leq 0.05$).
[3] No insecticide applied.

2004 PMRR REPORT # 16 **SECTION B: VEGETABLE and SPECIAL CROPS - Insect Pests**
STUDY DATABASE:

CROP: Cabbage cv. Cheers
PEST: Swede midge (SM), *Contarinia nasturtii* (Kieffer)

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TITLE: **CONTROL OF SWEDE MIDGE IN GREENHOUSE GROWN CABBAGE TRANSPLANTS, SEEDED MAY 22 2004**

MATERIALS: TRISTAR 70 WSP (acetamiprid 70%), INTERCEPT 60 WP (imidacloprid 60%), DIAMOND 10 EC (novaluron 100 g/L), ENDEAVOUR 50 WG (pymetrozine 50%), CLUTCH 50 WP (clothianidin 50%), BELAY 16 WG (clothianidin 16%), TRACER 480 SC (spinosad 480 g/L), GAUCHO (imidacloprid 600 g/L), PONCHO 600 (clothianidin 600 g/L).

METHODS: Cabbage was seeded into 200 cell plastic seedling trays in a commercial greenhouse on May 22. Cabbage seed was treated on May 19 in the laboratory at Ridgetown College by tumbling the seed treatment in a clean bag for 5 minutes until all seed was uniformly coated. The seed was then dried. Drench treatments were applied on June 21 at a rate of 200 ml per tray using a modified spray bottle with a fine mist, just prior to shipping transplants to the SM infested research site. All other treatments were applied to the foliage using a specialized, CO_2 sprayer with a two-nozzle, hand-held boom applying 100 ml per tray of spray mixture on the transplants on June 21, just prior to shipment. The trays were set out in a commercial field with known SM populations near Troy, ON. All treatments were replicated 4 times in a randomized complete block design. Treated cabbage transplants were left in the field for 24 hours, exposed to the existing SM pressures (natural infestation period) and then placed into a greenhouse away from the insect pressure until assessment on June 26, 3 days after plants were removed from the field. Assessments were taken by counting the total number of plants per tray and calculating the percentage of plants in each SM Damage Rating on each assessment date. Percentage data results were transformed Log (x+1) and then analyzed using ANOVA and Duncan's Multiple Range Test ($P \leq 0.05$).

RESULTS: Data are presented in Tables 1. None of the insecticides tested in this trial caused any damage to broccoli transplants.

CONCLUSIONS: While trays treated with GAUCHO, TRISTAR or INTERCEPT had significantly more symptom-free cabbage seedlings, than ENDEAVOUR, means for no treatment were significantly different from CONTROL trays. At least 44% of plants remained free of symptoms in trays treated with GAUCHO, PONCHO and TRACER as seed treatments or BELAY as a drench treatment and TRISTAR, INTERCEPT or DIAMOND as foliar treatments.

Table 1. Control of swede midge in cabbage with greenhouse applied control agents – Seeded, May 22; Assessed – June 26 (3 days after application).

Treatments	Rate Product/ha	Method	Insect Damage Ratings (0-3) [1] % counts on indicated date June 26	
			0	1
TRISTAR 70 WSP	86 g	Foliar	34.3 ab[2]	40.6 ab
TRISTAR 70 WSP	48 g	Foliar	53.0 a	37.9 ab
INTERCEPT 60 WP	80 g	Foliar	54.9 a	42.9 ab
INTERCEPT 60 WP	80 g	Drench	30.4 ab	64.7 a
DIAMOND 10 EC	500 ml	Foliar	43.9 ab	52.7 ab
ENDEAVOUR 50 WG	193 g	Foliar	20.5 b	65.8 a
CLUTCH 50 WG	210 g	Foliar	27.7 ab	67.4 a
BELAY 16 WG	1275 g	Drench	48.8 ab	43.9 ab
TRACER 480 SC	75 ml / kg	Seed Trt	48.0 ab	45.0 ab
GAUCHO 600	13.3 ml / kg	Seed Trt	64.3 a	31.2 b
PONCHO 600	8 ml / kg	Seed Trt	48.6 ab	44.7 ab
CONTROL	---[3]	---	35.3 ab	54.9 a
ANOVA $P \leq 0.05$			s	s
Coefficient of Variation (%)			14.2	9.9

[1] Insect Damage Ratings (0-3); 0- no insect damage and good marketability; 1 – mild crumpling and/or twisting of leaves, 2 – severe crumpling and/or twisting of transplant, gall or scarring may be present, 3 – severe damage, with symptoms listed previously plus insect damage due to "blind growth" (no potential for head formation and no marketable yield).
[2] Numbers within a column followed by the same letter are not significantly different according to a Duncan's Multiple Range Test ($P \leq 0.05$).
[3] No insecticide applied.

2004 PMR REPORT# 17 **SECTION B: VEGETABLE and SPECIAL CROPS - Insect Pests**
STUDY DATABASE:

CROP: Cabbage cv. Cheers
PEST: Swede midge (SM), *Contarinia nasturtii* (Kieffer)

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TITLE: CONTROL OF SWEDE MIDGE IN GREENHOUSE GROWN CABBAGE TRANSPLANTS, SEEDED JULY 13 2004

MATERIALS: TRISTAR 70 WSP (acetamiprid 70%), INTERCEPT 60 WP (imidacloprid 60%), DIAMOND 10 EC (novaluron 100 g/L), ENDEAVOUR 50 WG (pymetrozine 50%), CLUTCH 50 WP (clothianidin 50%), BELAY 16 WG (clothianidin 16%), TRACER 480 SC (spinosad 480 g/L), GAUCHO (imidacloprid 600 g/L), PONCHO 600 (clothianidin 600 g/L).

METHODS: Cabbage was seeded into 200 cell plastic seedling trays in a commercial greenhouse on July 13. Cabbage seed was treated on May 19, 55 days prior to shipping, in the laboratory at Ridgetown College by tumbling the seed treatment in a clean bag for 5 minutes until all seed was uniformly coated. The seed was then dried. Drench treatments were applied on August 16 at a rate of 200 ml per tray using a modified spray bottle with a fine mist, just prior to shipping transplants to the SM infested research site. All other treatments were applied to the foliage using a specialized, CO_2 sprayer with a two-nozzled, hand-held boom applying 100 ml per tray of spray mixture on the transplants on August 16, just prior to shipment. The trays were set out in a commercial field with known SM populations near Troy, south of Guelph, ON. All treatments were replicated 4 times in a randomized complete block design. Treated cabbage transplants were left in the field for 24 hours, exposed to the existing SM pressures (natural infestation period) and then placed into a greenhouse away from the insect pressure until assessments on August 21 and 25, 3 and 7 days after plants were removed from the field. Assessments were taken by counting the total number of plants per tray and calculating the percentage of plants in each SM Damage Rating on each assessment date. Percentage data results were transformed Log (x+1) and then analyzed using ANOVA and Duncan's Multiple Range Test ($P \leq 0.05$).

RESULTS: Data are presented in Tables 1. None of the insecticides tested in this trial caused any damage to cabbage transplants.

CONCLUSIONS: TRISTAR (48 g / ha rate) and CLUTCH foliar applications were the most effective, having the most symptom-free cabbage seedlings 7 days post infestation. Numbers for no treatment were significantly different from CONTROL trays 3 days post infestation, except BELAY, which had significantly fewer symptom-free transplants.

Table 1. Control of swede midge in cabbage with greenhouse applied control agents – Seeded, May 22; Assessed – June 26 (3 days after application).

Treatments	Rate Product/ha	Method	Insect Damage Ratings (0-3) [1] % counts on indicated date			
			August 21		August 25	
			0	1	0	1
TRISTAR 70 WSP	86 g	Foliar	41.1 a[2]	48.2 a	25.9 ab	59.7 a
TRISTAR 70 WSP	48 g	Foliar	64.1 a	19.1 b	37.0 a	54.7 a
INTERCEPT 60 WP	80 g	Foliar	47.2 a	42.2 a	34.7 ab	57.6 a
INTERCEPT 60 WP	80 g	Drench	50.2 a	42.7 a	19.0 b	71.9 a
DIAMOND 10 EC	500 ml	Foliar	64.8 a	29.8 ab	23.0 ab	66.3 a
ENDEAVOUR 50 WG	193 g	Foliar	54.5 a	37.9 a	31.3 ab	60.2 a
CLUTCH 50 WG	210 g	Foliar	55.2 a	34.8 ab	37.1 a	57.2 a
BELAY 16 WG	1275 g	Drench	68.9 a	28.4 ab	33.6 ab	60.1 a
TRACER 480 SC	75 ml / kg	Seed Trt	45.2 a	43.9 a	27.2 ab	69.8 a
GAUCHO 600	13.3 ml / kg	Seed Trt	62.1 a	34.7 ab	30.4 ab	66.6 a
PONCHO 600	8 ml / kg	Seed Trt	45.8 a	45.2 a	31.4 ab	65.1 a
CONTROL	---[3]	---	61.6 a	35.3 ab	33.2 ab	61.3 a
ANOVA $P \leq 0.05$			s	s	s	s
Coefficient of Variation (%)			8.4	10.4	10.1	3.9

[1] Insect Damage Ratings (0-3); 0- no insect damage and good marketability; 1 – mild crumpling and/or twisting of leaves, 2 – severe crumpling and/or twisting of transplant, gall or scarring may be present, 3 – severe damage, with symptoms listed previously plus insect damage due to "blind growth" (no potential for head formation and no marketable yield).

[2] Numbers within a column followed by the same letter are not significantly different according to a Duncan's Multiple Range Test ($P \leq 0.05$).

[3] No insecticide applied.

2004 PMRR REPORT # 18 **SECTION B: VEGETABLE and SPECIAL CROPS-Insect Pests**
ICAR:

CROP: Yellow cooking onions (*Allium cepa* L.) cv. Millennium
PEST: Onion smut(OS), *Urocystis cepulae* (Frost)
Onion maggot(OM), *Delia antiqua* (Meigen)

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TITLE: **INTEGRATED MANAGEMENT OF ONION SMUT AND ONION MAGGOT WITH REDUCED RISK SEED TREATMENTS.**

MATERIALS: RAXIL 2.6F (tebuconazole 28.4%), THIRAM 42S(thiram 42%), APRON XL LS (mefenoxam 28.4%), MAXIM 4FS (fludioxinil 40.3%), DITHANE DG 75G(mancozeb 75%), PRO GRO 80D (carbathiin 30%, thiram 50%), GOVERNOR 75WP (cyromazine 75%), Tracer 4SC (spinosad 44.2%), REGENT 6.2FS (fipronil 56%), LORSBAN 15G (chlorpyrifos 15%).

METHODS: Several new reduced risk seed treatments, fungicides and insecticides alone and in combination, were evaluated for the control of onion smut and onion maggot in a field trial conducted at the Muck Crops Research Station, Holland Marsh, Ontario in 2004. Yellow cooking onions (cv. Millennium) were seeded (40 seeds/m) in muck soil (pH ≃6.4, organic matter ≃60%)on 8 May. Onion maggot (*Delia antiqua)* occurs naturally in this area and the muck soil is naturally infested with onion smut *Urocystis cepulae*. Treatments applied are outlined in Table 1. A Randomized Complete Block design with four replications was used for the experiment. The field plots for each treatment replicate consisted of four rows (42 cm apart) of onions 6 m in length. A push cone seeder was used to plant the seed treatments and a V-belt seeder was used for granular in furrow applications such as Dithane DG and Lorsban 15G. Six 2 m sections for each of three OS assessments, three OM assessments and one 2.32 m section for yield assessment were randomly selected within each treatment plot. To determine the initial stands, germination counts were recorded weekly in each 2 m length of a row before the first assessment. Dying onions, other than those in the sections selected for yield assessment, were rogued out and cause of death (OM, OS, OM + OS or other) recorded. Data were collected twice weekly to account for loss of onions from the original stand. Assessments for OS were done at the 1st (8 June), 3rd- 5th (25 June) true leaf stages, and at harvest (27 September), by harvesting one of the 2 m sections each time and evaluating leaves and bulbs for OS symptoms. OM damage was estimated by evaluating bulbs for maggot damage at the end of the 1st(28 June) and 2nd (18 August) generations and at harvest (27 September).Weight and bulb size were evaluated at harvest for the yield sections in each block. The air temperature in 2004 was below the 10 year mean for June (16.3° C), August (17.8° C), average for May (12.4° C), July (19.3° C) and above for September (16.6° C). Monthly rainfall was above the 10-year mean for May (108 mm), July (102 mm), August (103 mm), below the mean for June (50 mm) and

September (25 mm).Statistical significance of observed differences was determined using a modified 2×4 factorial analysis of variance (ANOVA) and Fisher's Protected LSD test ($P<0.05$) and analyzed using the General Analysis of Variance function of the Linear Models section of SAS V.8.2.

RESULTS: See Tables 2 and 3.

CONCLUSIONS: Overall there were significant differences among all treatments on all assessment dates. In 2004, both fungicide combination treatments, RAXIL + THIRAM + APRON +MAXIM and PRO GRO + DITHANE, significantly reduced onion smut incidence. However, while several insecticide/fungicide combinations gave substantially better OS control, such as: LORSBAN + GOVERNOR + PRO GRO, LORSBAN + GOVERNOR +PRO GRO + DITHANE, GOVERNOR + RAXIL + THIRAM + APRON + MAXIM, TRACER + RAXIL + THIRAM + APRON + MAXIM and REGENT+ PRO GRO, the difference was not statistically significant . Insecticide treatments reduced OM damage; however insecticide/fungicide combinations were the most effective. Best OM control was obtained with the combination of: REGENT +PRO GRO, LORSBAN + GOVERNOR +PRO GRO + DITHANE and LORSBAN + GOVERNOR + PRO GRO. In the yield evaluation, REGENT + RAXIL + THIRAM + APRON + MAXIM and LORSBAN +PRO GRO +DITHANE had the highest yield. The untreated check had the lowest yields, followed by treatments with inqecticides without fungicides: TRACER, GOVERNOR, LORSBAN + GOVERNOR along with the treatment combination RAXIL + THIRAM + APRON + MAXIM which contained fungicides but no insecticide.

Table 1. Treatments applied to cooking onion for control of onion maggot and onion smut at Muck Crops Research Station, Holland Marsh, ON, 2004.

Trt	Treatment(s) Applied	Method[1]	Rate Applied	
			ST mg a.i./100 g seed	GIF kg a.i/ha
1	Check	-------		
2	Governor	ST	5000	
3	Tracer	ST	2500	
4	Governor + Lorsban	ST+GIF	5000	4.8
5	Regent	ST	2500	
6	Raxil+Thiram+Apron+Maxim	ST+ST+ST+ST	250+188+15+5	
7	Pro Gro+ Dithane	ST+GIF	2000	6.6
8	Tracer+ Pro Gro	ST+ST	2500+2000	
9	Regent+Raxil+Thiram+Apron+Maxim	ST+ST+ST+ST+ST	2500+250+188+ 15+5	
10	Governor+Pro Gro	ST+ST	5000+2000	
11	Regent+Pro Gro	ST+ST	2500+2000	
12	Tracer+Raxil+Thiram+Apron+Maxim	ST+ST+ST+ST+ST	2500+250+188+ 15+5	
13	Governor+Raxil+Thiram+Apron+Maxim	ST+ST+ST+ST+ST	5000+250+188+15+5	
14	Governor+ Pro Gro+ Lorsban	ST+ST+GIF	5000+2000	4.8
15	Governor + Pro Gro + Dithane + Lorsban	ST+ST+GIF+ GIF	5000+2000	6.6+4.8
16	Pro Gro+ Dithane+ Lorsban	ST+GIF+GIF	2000	6.6+4.8

[1] Method of Application: ST- seed treatment; GIF- granular in-furrow.

Table 2. Evaluation of reduced risk seed treatments and granular fungicides for the control of onion smut at the Muck Crop Research Station, Holland Marsh, Ontario; 2004.

	Total incidence of smut (%)			Yield
Treatment	8 June	25 June	27 Sept	t/ha
1	58.1 c [1]	44.5 d	47.2 c	34.2 f
2	49.3 bc	45.1 d	35.7 c	54.5 d-f
3	49.1 bc	43.4 d	19.5 b	42.1 ef
4	26.8 a-c	10.0 c	5.2 ab	59.1 b-e
5	55.6 c	46.5 d	8.4 ab	81.4 a-c
6	4.1 a	9.0 ab	9.7 ab	57.6 c-f
7	19.8 ab	20.9 cd	4.5 ab	67.7 a-d
8	23.3 a-c	28.9 c	8.0 ab	76.7 a-d
9	28.9 a-c	30.9 c	6.9 ab	88.0 a
10	26.6 a-c	23.2 c	12.9 ab	81.2 a-c
11	3.1 a	4.1 a	3.1 ab	67.1 a-d
12	9.4 a	1.1 a	2.8 ab	67.2 a-d
13	4.2 a	1.6 a	1.8 a	67.3 a-d
14	0.9 a	4.9 a	1.8 a	82.8 ab
15	1.5 a	4.9 a	1.7 a	82.6 ab
16	2.5 a	24.4 c	1.1 a	83.9 a

[1] Values in a column followed by the same letter are not significantly different at P=0.05, Fisher's Protected LSD test.

Table 3. Evaluation of reduced risk seed treatments and granular insecticides for the control of onion maggot at the Muck Crops Research Station, Holland Marsh, Ontario, 2004.

	Total OM damage (%)			Yield
Treatment	28 June	18 Aug.	27 Sept	t/ha
1	15.4 c [1]	68.0 d	51.9 f	34.2 f
2	6.3 ab	33.3 c	50.0 f	54.5 d-f
3	1.9 a	34.2 c	29.6 de	42.1 ef
4	3.3 a	21.9 bc	16.6 a-d	59.1 b-e
5	1.9 a	10.4 ab	18.7 a-d	81.4 a-c
6	11.1 bc	32.7 c	42.5 ef	57.6 c-f
7	2.9 a	15.1 ab	12.8 a	67.7 a-d
8	0.7 a	10.3 ab	27.1 b-d	76.7 a-d
9	1.8 a	8.6 ab	15.9 a-d	88.0 a
10	4.9 ab	17.7 ab	29.4 cd	81.2 a-c
11	1.2 a	3.9 a	9.7 a	67.1 a-d
12	2.4 a	16.3 ab	15.1 a-c	67.2 a-d
13	1.4 a	11.5 ab	14.9 a-c	67.3 a-d
14	0.0 a	8.2 ab	6.8 a	82.8 ab
15	0.0 a	7.3 ab	8.3 a	82.6 ab
16	1.1 a	5.2 a	13.5 a-c	83.9 a

[1] Values in a column followed by the same letter are not significantly different at *P*=0.05, Fisher's Protected LSD test.

2004 PMRR REPORT # 19 **SECTION B: VEGETABLE and SPECIAL CROPS - Insect Pests**
STUDY DATABASE: 160.3

CROP: Dry yellow seed cooking onion (*Allium cepa* L.), cv. Frontier
Bunching (green) onion (*Allium cepa* L.), cv. Emerald Isle
PEST: Onion maggot (OM), *Delia antiqua* (Meigen)

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TITLE: EVALUATION OF PLANTING-TREATMENTS FOR CONTROL OF DAMAGE BY ONION MAGGOT TO DRY YELLOW SEED COOKING ONION AND BUNCHING (GREEN) ONION ON ORGANIC SOIL; 2004

MATERIALS: ICON 6.2 FS (fipronil 755 g/L), TRACER 480 SC (spinosad 480 g/L), ENTRUST 80 WP (spinosad 80%), GAUCHO 480 FL (imidacloprid 480 g/L), PONCHO 600 FS (clothianidin 600 g/L), RIMON 10 SC (novaluron 100 g/L), PRO-GRO 80 WP (carbathiin 30% + thiram 80%), PYRIFOS 15 G (chlorpyrifos 15%), sticker (HP-9 Acrylic Emulsion Polymer)

METHODS: On 11 May onion seed treatments (ST) (Table 1[cooking onion], Tmts. 1-3, 5, 6; Table 2 [bunching onion], Tmts. 1-5) were applied in the laboratory at SCPFRC-London by tumbling seed and sticker together in a clean 375 ml glass jar for 3-4 minutes until all seed was uniformly coated. Two glass marbles were tumbled with the mixture to separate clumped seed. To control onion smut, *Urocystis magica*, PRO GRO (25.0 g/kg seed) was then added to all treated batches and seed again tumbled for 1 minute. Cooking onion seed for Tmt. 4 (Table 1) was commercially treated by Dr. A. Taylor, Cornell University, Geneva, NY. Seed for all treatments (Table 1, 2) was planted at the SCPFRC-London Research Farm on 13 May in 4-row microplots (2.25 m long x 0.9 m wide) filled with insecticide residue-free organic soil; 2 rows of each onion type were planted in each microplot. In-furrow granular (IFG) treatments were hand-applied in a 2-3 cm band in the bottom of the furrow after the seed was planted but before the seed furrow was closed. In-furrow spray (IFS) treatments were applied in a 3-4 cm band over the seed in the seed furrow, at 125 kPa in 5 L/100 m row using a hand-held, CO_2-pressurized, R&D plot sprayer with a single 4004E flat spray tip. All treatments were replicated three times in a randomized complete block design. On 11 June a total of 250 OM eggs from an insecticide-susceptible strain, originally collected on the Thedford Marsh, were buried 1 cm deep beside one row of each onion type in each plot. The infested row length was delineated by stakes and the number of onion plants was counted. The second infestation was completed as described above on 14 June. Surviving onion plants were counted 4 weeks after each infestation and the percent loss calculated. 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 Least Significant Difference range test. Untransformed data are presented.

OBSERVATIONS: No phytotoxicity was observed following application of any treatment to either variety of onions. Although OM damage to seedlings of cooking onion was higher in untreated plots than damage to seedlings of bunching onion in the same plots, most treatments generally had more impact on damage in cooking onions than on damage to bunching onions.
RESULTS: Experimental results for cooking onion are outlined in Table 1. and those for bunching

onion are shown in Table 2.

Under the conditions of this trial, all treatments significantly reduced very high OM damage to cooking onion following both infestations. No onion seedlings were lost in plots treated with IFG- application of PYRIFOS, the method of OM control currently employed by most commercial onion growers. For both infestations, less than 5% of cooking onion seedlings were lost following ST-application of ICON, PONCHO or GAUCHO (Table 1). ST-application of both formulations of spinosad (TRACER, ENTRUST) and IFS-application of the chitin synthesis inhibitor, RIMON, also reduced loss of cooking onion seedlings (Table 1).

All treatments also significantly reduced OM damage to bunching onion seedlings following both infestations of OM eggs. Greatest reductions in both infestations (> 80%) followed ST-application of ICON, PONCHO or GAUCHO or following IFG-application of PYRIFOS (Table 2). While ST-application of TRACER and IFS-application of RIMON were less effective, the 50%-65% reduction in damage recorded was statistically significant (Table 2).

CONCLUSIONS: Application to onion seed of ICON, TRACER, ENTRUST, GAUCHO or PONCHO or IFS application of RIMON effectively reduced OM damage to seedlings of both cooking and bunching onion. Further research is warranted to determine the optimum rate of application and generate data to support a petition to either register (ICON, RIMON) or expand current registrations (TRACER, GAUCHO, PONCHO) to include OM control on both cooking and bunching onion.

Table 1. Effect of planting treatments on loss of seedlings due to onion maggot attacking dry yellow seed cooking onions on organic soil, London, ON; 2004.

Tmt. No.	Treatment Applied		Rate Applied (a.i./kg seed)	Method[1]	Mean % Onion Loss after Indicated Infestation	
	Insecticide	Formulation			I -11 Jun	II - 14 Jun
1	fipronil	ICON 6.2 FS	26.4 g	ST	2.9 bc	1.2 c
2	spinosad	TRACER 480 SC	24.0 g	ST	9.7 bc	8.0 bc
3	spinosad	TRACER 480 SC	36.0 g	ST	9.7 bc	2.7 c
4	spinosad	ENTRUST 80 WP	25.0 g	ST	14.7 bc	20.8 b
5	clothianidin	PONCHO 600 FS	39.0 g	ST	0.0 c	4.9 bc
6	imidacloprid	GAUCHO 480 FL	38.4 g	ST	0.0 c	1.1 c
7	novaluron	RIMON 10 SC	2.0 g[3]	IFS	18.5 b	10.0 bc
8	chlorpyrifos	PYRIFOS 15 G	9.6 g[3]	IFG	0.0 c	0.0 c
9	no insecticide	---[4]	---	---	98.3 a	81.2 a

[1] Method of Application: ST - Seed Treatment; IFS - In Furrow Spray Application; IFG - In Furrow Granular Application
[2] For each infestation, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined by ANOVA and a Least Significant Difference Test.
[3] g a.i./100 m row.
[4] No insecticide applied.

Table 2. Effect of planting treatments on loss of seedlings due to onion maggot attacking bunching (green) onions on organic soil, London, ON; 2004.

Tmt. No.	Treatment Applied		Rate Applied (a.i./kg seed)	Method [1]	Mean % Onion Loss after Indicated Infestation	
	Insecticide	Formulation			I -11 Jun	II - 14 Jun
1	fipronil	ICON 6.2 FS	26.4 g	ST	6.3 c	6.1 bc
2	spinosad	TRACER 480 SC	24.0 g	ST	39.1 b	26.6 b
3	spinosad	TRACER 480 SC	36.0 g	ST	34.0 b	25.8 b
4	clothianidin	PONCHO 600 FS	39.0 g	ST	5.3 c	0.0 c
5	imidacloprid	GAUCHO 480 FL	38.4 g	ST	8.5 c	12.4 bc
6	novaluron	RIMON 10 SC	2.0 g[3]	IFS	28.0 b	25.5 b
7	chlorpyrifos	PYRIFOS 15 G	9.6 g[3]	IFG	3.4 c	6.0 bc
8	no insecticide	---[4]	---	---	76.0 a	71.1 a

[1] Method of Application: ST - Seed Treatment; IFS - In Furrow Spray Application; IFG - In Furrow Granular Application

[2] For each infestation, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined by ANOVA and a Least Significant Difference Test.

[3] g a.i./100 m row.

[4] No insecticide applied.

2004 PMRR REPORT # 20 **SECTION C: VEGETABLE and SPECIAL CROPS - Insect Pests**
STUDY DATABASE: 160.3

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

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TITLE: EVALUATION OF TREATMENTS FOR CONTROL OF DAMAGE BY CABBAGE MAGGOT TO RADISH ON MINERAL SOIL; 2004

MATERIALS: TRACER 480 SC (spinosad 480 g/L), PONCHO 600 FS (clothianidin 600 g/L), RIMON 10 SC (novaluron 10% w/w), PYRINEX 480 EC (chlorpyrifos 480 g/L), sticker (HP-9 Acrylic Emulsion Polymer [Expt. 1]; 1% methyl cellulose [Expt. 2])

METHODS: On 11 May (Expt. 1) and 26 July (Expt. 2) radish seed (SD) treatments (Tmt. 1, 2) were applied in the laboratory at SCPFRC-London by tumbling seed and sticker for each treatment together in a clean 375 ml glass jar for 3-4 minutes until all seed was uniformly coated. Two or three glass marbles were tumbled with the mixture to separate clumped seed. Seed for all treatments (Table 1) was planted at the SCPFRC-London Research Farm on 17 May (Expt. 1) and 29 July (Expt. 2) in 3-row micro-plots (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 (Tmt. 3, 5-7) were applied in a 3-5 cm band at 150 kPa in 5 L/100 m row, using a hand-held, CO_2-pressurized, single-nozzled R&D plot sprayer fitted with a 4006E even flat spray tip, centred over the seed in the open seed furrow. Foliar (F) treatments were applied at 175 kPa in 900 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. F treatments were applied to Expt. 1 on 04 June at BBCH growth stage 12 (BBCH - 12) and to Expt. 2 on 05 Aug (BBCH - 10) and 13 Aug (BBCH - 12). On 07 June (Expt. 1; BBCH - 13-14) and 13 Aug (Expt. 2; 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 row in each plot. After infestation, plots were lightly watered to improve egg survival and hatch. On each date the infested row length was delineated by stakes and the number of radish plants was counted. All radishes from the infested rows were harvested on 17 June (Expt. 1) or 27 Aug (Expt. 2). Roots were washed, counted and the 20 largest roots in each plot 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 a Least Significant Difference Range Test. Untransformed data are presented.

OBSERVATIONS: No phytotoxicity to radish seedlings was observed following application of any treatment in either experiment.

RESULTS: Experimental results are outlined in Table 1. In both experiments, CM damage to radish in untreated plots exceeded 30% following infestation of CM eggs. In both experiments, CM damage to radish was significantly reduced by at least 80% following IFS application of chlorpyrifos (Tmt. 7), the current commercial standard of CM control in this crop. While no application of novaluron had a

significant impact on CM damage in Expt. 1, radish damage fell significantly by over 80% following IFS application of the growth regulator (Tmt. 5) in Expt. 2. Foliar application of novaluron (Tmt. 4) had no significant effect on CM damage in either experiment. CM damage was significantly reduced following IFS application of spinosad (Tmt. 3) in Expt. 1 and SD application of the same insecticide (Tmt.2) in Expt. 2. CM damage to radish was not significantly reduced following SD application of clothianidin (Tmt. 1) in either experiment.

CONCLUSIONS: IFS application of chlorpyrifos, currently registered and recommended for control of CM damage to radish, was the most effective management strategy for this pest in these experiments. F application of novaluron did not reduce CM damage to radish. IFS application of novaluron did reduce CM damage to radish in one experiment. More precisely targeted application of this growth regulator warrants further investigation. While CM damage following application of spinosad was variable, results were sufficiently encouraging to warrant further investigation of both SD and IFS application of this reduced risk insecticide. In contrast to 2003, SD application of clothianidin significantly reduced CM damage to radish in neither experiment.

Table 1. Effect of selected treatments on damage due to cabbage maggot attacking radishes on mineral soil, London, ON; 2004.

Tmt No.	Treatment Applied			Rate/kg Seed		Results for Indicated Experiment			
						Expt. 1 (17 May)		Expt. 2 (29 Jul)	
	Insecticide	Formulation	Method[1]	a.i.	Product	% Dam. Roots	% Dam. Reduction	% Dam. Roots	% Dam. Reduction
1	clothianidin	PONCHO 600 FS	SD	39.0 g	65.0 ml	24.3 ab	36.6	10.0 abc	68.5
2	spinosad	TRACER 480 SC	SD	36.0 g	75.0 ml	16.7 ab	56.4	6.7 bc	78.9
3	spinosad	TRACER 480 SC	IFS	1.4 g[2]	3.0 ml[2]	6.7 b	82.5	11.7 abc	63.1
4	novaluron	RIMON 10 SC	F	90.0 g[3]	900.0 ml[3]	31.7 a	17.2	21.7 ab	31.5
5	novaluron	RIMON 10 SC	IFS	0.25 g[2]	2.5 ml[2]	32.3 a	15.7	5.0 c	84.2
6	novaluron	RIMON 10 SC	IFS	1.0 g[2]	10.0 ml[2]	33.3 a	13.1	11.7 abc	63.1
7	chlorpyrifos	PYRINEX 480 EC	IFS	4.1 g[2]	8.5 ml[2]	6.0 b	84.3	3.3 c	89.6
8	untreated	----	---	---	---	38.3 a	---	31.7 a	---

[1] type 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 after seedling emergence.
[2] amount/100 m row; 0.25 m row spacing.
[3] amount/ha; 1 (Expt. 1) or 2 (Expt. 2) broadcast foliar applications post emergence.
[4] For each experiment, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and a Least Significant Difference Range Test.

2004 RAPPORT # 21 **SECTION C: INSECTES DES POMMES DE TERRE**
BASE DE DONNÉES DES ÉTUDES: 86000718

CULTURE: Pomme de terre, (*Solanum tuberosum*), cv. Goldrush
RAVAGEUR: Doryphore de la pomme de terre, *Leptinotarsa decemlineata* (Say)

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TITRE: **EFFICACITÉ DU CRUISER APPLIQUÉ SUR LE PLANTON CONTRE LE DORYPHORE DE LA POMME DE TERRE, SAISON 2004**

PRODUITS: CRUISER 5FS (thiamethoxam 47,6 %), GENESIS 240 SC (imidacloprid 240 g/L). MAXIM PSP (fludioxonil 0,5 %)

MÉTHODES: L'essai a été réalisé à Deschambault (Québec) selon un plan à blocs complets aléatoires avec 4 répétitions. Les pommes de terre cv. Goldrush ont été plantées le14 mai 2004 à 33 cm d'espacement. Les parcelles de 7,3 m de longueur comprenaient 4 rangs espacés de 0,9 m.

Les traitements étaient les suivants :
* CRUISER 5FS appliqué sur les plantons aux doses suivantes : 2,9 ml/100 kg de semence, 4,5 ml/100 kg de semence, 5,8 ml/100 kg de semence et 7,5 ml/100 kg de semence;
* GENESIS 240 SC appliqué sur les plantons à la dose de 26,0 ml/100 kg de semence;
* TÉMOIN non traité.

Le volume final de la solution à pulvériser a été fixé à 75 ml/100 kg de semence. Afin que le volume de solution soit le même pour chaque traitement, la semence a été calibrée. Pour chaque traitement, nous avons utilisé 352 plantons provenant de 176 tubercules tranchés en deux. Le poids de ces derniers était de 21,2 kg. Les traitements ont été réalisés avec un pulvérisateur manuel calibré pour vaporiser 75 ml de solution par 100 kg de semence. Après le traitement insecticide, une application de MAXIM PSP a été faite à raison de 500 g /100 kg de semence pour tous les traitements, incluant le témoin, qui lui a été vaporisé avec de l'eau avant le poudrage au MAXIM PSP. L'évaluation des densités du doryphore a été effectuée les 6, 12, 20 et 28 juillet, sur 10 plants pris au hasard dans les deux rangées du centre. Le dommage au feuillage a été évalué visuellement par une estimation en pourcentage de défoliation du plant les 6, 12, 21, 29 juillet et le 24 août avant le défanage. Les plants de pommes de terre ont été défanés une première fois le 24 août avec du RÉGLONE (diquat 2,5 L p.c./ha) et le 31 août avec le même produit (diquat 1,5L p.c./ha). Le rendement en tubercules a été déterminé à partir de la récolte des deux rangées du centre de chaque parcelle faite le 14 septembre 2004. Le rendement vendable se compose des tubercules dont le diamètre varie de 47 mm à 76 mm pour le calibre Canada No 1 et de 77 mm à 114 mm pour le calibre No1 grosse.

RÉSULTATS: Voir le tableau ci-dessous.

CONCLUSION: En 2004, cet essai a été réalisé en appliquant les insecticides sur les semences de pommes de terre avant la plantation. En ce qui concerne l'insecticide CRUISER 5FS, les résultats obtenus démontrent des différences d'efficacité entre les doses. Plus elles sont faibles et plus les populations larvaires deviennent importantes au fur et à mesure que nous avançons en juillet. Il en est de même pour

les dommages au feuillage. En août, avant le défanage, la même tendance se confirme au niveau du dommage au feuillage. Dans ces conditions, les rendements ont été affectés (tableau 1). On note également une différence entre le CRUISER 5FS et le GENESIS 240 SC. À la plus forte dose de CRUISER 5 FS, on obtient de meilleurs résultats qu'avec le GENESIS 240 SC. C'est le contraire pour la plus faible dose de CRUISER 5FS. En absence de traitement, les populations larvaires et les dommages sont élevés et les rendements chutent drastiquement.

Tableau 1. Nombre moyen de larves de doryphore/plant, dommage en % et rendement vendable, Deschambault, Québec; 2004.

Traitement	Dose	Population larvaire[1]				Dommage[1] (%)					Rendement
Insecticide	(p.c).	Juillet				Juillet				Août	T/ha
	/100 kg	6	12	20	28	06	12	21	29	24	
CRUISER	7,5 ml	0,2 b[2]	0,1 d	3,1 d	2,1 d	0,0 b	0,5 b	0,9 b	0,4 c	1,5 e	35,8 a
CRUISER	5,8 ml	0,0 b	0,2 d	5,7 c	10,2 c	0,0 b	0,5 b	1,6 b	3,3 c	7,0 de	31,7 ab
CRUISER	4,5 ml	0,0 b	0,6 cd	9,8 b	18,1 ab	0,3 b	0,5 b	4,8 b	9,5 bc	40,0 c	32,8 a
CRUISER	2,9 ml	0,5 b	4,4 b	48,0 a	26,8 a	0,6 b	1,0 b	10,3 b	19,5 b	61,7 b	27,8 b
GENESIS	26,0 ml	0,0 b	0,8 c	6,7 bc	9,4 bc	0,4 b	0,5 b	3,3 b	4,8 c	11,0 d	31,6 ab
Témoin	---	44,9 a	44,8 a	26,2 a	6,3 c	7,8 a	23,8 a	46,3 a	65,0 a	100,0 a	7,6 c
Valeur de F		2604	393,6	26,8	9,7	3.3	9,5	13.3	32,8	188.3	39,9

(1) Les données de population larvaire ont été transformées selon la formule log (x +1) avant l'analyse de la variance. Les données pour le dommage ont été transformées selon la formule arsin ($\sqrt{x}$ /100). Ces données sont présentées non transformées dans le tableau.
(2) Les résultats suivis d'une même lettre ne sont pas significativement différents, à un seuil de 0,05 (Waller-Duncan).

2004 PMRR REPORT # 22 **SECTION C: POTATOES – Insect Pests**
ICAR:

CROP: Potato, (*Solanum tuberosum* L.) cv. Superior.
PEST: Colorado potato beetle (CPB), (*Leptinotarsa decemlineata* (Say))

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TITLE: EFFICACY OF RIMON 10 EC AND ADMIRE 240 F IN ROTATION FOR CONTROL OF COLORADO POTATO BEETLE ON POTATO, 2004

MATERIALS: RIMON 10 EC (novaluron 100 g/L), ADMIRE 240 F (imidacloprid 240 g/L)

METHODS: Potato seed pieces were planted at the University of Guelph – Simcoe Research Farm (Simcoe, Ontario) on 23 April in four-row 13 x 4 m plots, each separated by 3 m spray lanes. A randomized complete block design with four blocks per treatment was used. To prevent premature defoliation, Colorado potato beetle (CPB) adults were removed from the plots up to 30 May and subsequently reintroduced at a rate of 175 adults per plot. RIMON and ADMIRE were applied to potato foliage at rates of 500 ml/ha and 200 ml/ha, respectively, using a tractor mounted, four-row boom sprayer delivering 800 L/ha. Treatments were: 1) CHECK; 2) ADMIRE + ADMIRE; 3) RIMON + RIMON; 4) ADMIRE + RIMON; and 5) RIMON + ADMIRE. Plots first treated with ADMIRE were sprayed the day after introduction of CPB adults into the plots. Plots first treated with RIMON were sprayed when 20% of pre-marked CPB egg masses became 2nd instar larvae. The second ADMIRE/RIMON application occurred when CPB populations exceeded the economic threshold in each treatment (0.2 adults per plant, 1.5 1st (L1)/2nd (L2) instar larvae per plant, or 0.5 3rd (L3)/4th (L4) instar larvae per plant). In addition, two applications of dimethoate (LAGON 480) were made to each plot to control potato leafhopper, and weeds and pathogens were controlled by conventional methods. Twice per week, the number of CPB adults, egg masses, L1, L2, L3 and L4 were recorded on eight randomly selected plants per plot. Percent defoliation was assessed on the same eight plants using a defoliation index (0 = no defoliation, 1 = up to 10% defoliation, 2 = up to 25% defoliation, 3 = up to 50% defoliation, 4 = up to 75% defoliation, 5 = 100% defoliation). The experiment was terminated on 15 July as large numbers of second-generation adults from CHECK plots, which were completely defoliated, immigrated into the other plots.

CPB data were subject to Analysis of the Variance and means were separated using the Tukey test at the α = 0.05 level. Ranked defoliation data were analyzed with the Kruskal-Wallis test and means were separated with the Nemenyi test (non-parametric test analogous to Tukey) at the α = 0.05 level. All analyses were done with JMP IN V.3.2.1 statistical software (SAS Institute).

RESULTS: As outlined in Tables 1-4. RIMON applications caused no significant reductions in adult CPB mortality (data not shown). This was expected, as it is selectively toxic against larval stages. It is unclear if RIMON elicits ovicidal activity when CPB adults feed on treated foliage. No reductions to the number of egg masses per plant due to RIMON were found, although egg mass production in the check also declined (data not shown). RIMON, whether applied first or after an initial RIMON/ADMIRE application, caused no reductions in the number of L1 (Table 1) but caused significant reductions in the number of L2 (Table 2), and almost completely suppressed L3 and L4 development throughout the trial (Table 3). ADMIRE applications initially caused significant adult mortality and reductions in the number of egg masses (data not shown). However, adults from adjacent plots immigrated to the plots initially

treated with ADMIRE, resulting in an increase in the number of L1 by 25 June (Table 1). Although the ADMIRE-ADMIRE treatment had significantly more L3 and L4 per plant at the end of the trial, the number of L3 and L4 in ADMIRE-RIMON treatment remained low (Table 3). CHECK plots were completely defoliated by the end of the experiment (Table 4). In contrast, none of the other treatments had more than 10% defoliation.

CONCLUSIONS: The results suggests that RIMON, alone or in rotation with ADMIRE, can provide excellent control of L2, L3 and L4, and has very good potential in future CPB management programs.

Table 1. Relative efficacy of RIMON 10EC and ADMIRE 240F rotations for control of 1st instar Colorado potato beetle larvae (L1) on potato.

Treatment [1,2]	Mean Number (±SEM) of L1/Plant				
	10 June	17 June	25 June	1 Jul	8 July
CHECK	5.5 (1.7) a[3]	20.6 (4.1) a	12.2 (2.4) a	12.8 (2.7) a	NA[4]
ADMIRE + ADMIRE	2.5 (1.0) a	0.1 (0.1) b	1.4 (0.8) b	31.4 (5.4) b	2.3 (0.7) a
RIMON + RIMON	7.1 (2.7) a	25.9 (4.6) a	12.6 (3.3) a	7.3 (2.1) a	1.3 (0.9) a
ADMIRE + RIMON	1.8 (0.9) a	1.3 (1.1) b	11.3 (2.6) a	29.5 (5.2) b	0.1 (0.04) a
RIMON + ADMIRE	2.9 (1.2) a	20.2 (3.3) a	8.4 (2.1) ab	4.4 (1.2) a	0.7 (0.7) a

[1] Plots first treated with ADMIRE were sprayed on 4 June, one day after introduction of CPB adults into the plots. Plots first treated with RIMON were sprayed on June 15 at 20% 2nd instar emergence. The second ADMIRE and RIMON applications occurred when CPB populations exceeded the economic threshold in that treatment.

[2] ADMIRE applied at 200 ml/ha (48 g a.i./ha); RIMON applied at 500 ml/ha (50 g a.i./ha).

Values within columns with different letters are significantly different from each other (Tukey test, $P < 0.05$).

Data not available due to complete defoliation of plants.

Table 2. Relative efficacy of RIMON 10EC and ADMIRE 240F rotations for control of 2nd instar Colorado potato beetle larvae (L2) on potato.

Treatment [1,2]	Mean Number (±SEM) of L2/Plant				
	10 June	17 June	25 June	1 July	8 July
CHECK	0	15.8 (2.7) a[3]	9.9 (1.7) a	8.9 (1.9) a	NA[4]
ADMIRE + ADMIRE	0	0.2 (0.1) b	0.03 (0.03) b	2.8 (1.0) b	2.0 (0.7) a
RIMON + RIMON	0	2.8 (1.0) b	1.3 (0.5) b	2.4 (1.1) b	0.03 (0.03) b
ADMIRE + RIMON	0	0.7 (0.3) b	0.5 (0.2) b	2.9 (1.2) b	0.03 (0.03) b
RIMON + ADMIRE	0	1.7 (0.6) b	2.2 (0.7) b	1.5 (0.4) b	0.01 (0.01) b

[1] Plots first treated with ADMIRE were sprayed on 4 June, one day after introduction of CPB adults into the plots. Plots first treated with RIMON were sprayed on June 15 at 20% 2nd instar emergence. The second ADMIRE and RIMON applications occurred when CPB populations exceeded the economic threshold in that treatment.
[2] ADMIRE applied at 200 ml/ha (48 g a.i./ha); RIMON applied at 500 ml/ha (50 g a.i./ha).
Values within columns with different letters are significantly different from each other (Tukey test, $P < 0.05$).
Data not available due to complete defoliation of plants.

Table 3. Relative efficacy of RIMON 10EC and ADMIRE 240F rotations for control of 3rd and 4th instar Colorado potato beetle (CPB) larvae (L3+L4) on potato.

Treatment [1,2]	Mean Number (±SEM) of L3+L4/Plant			
	17 June	25 June	1 July	8 July
CHECK	4.7 (1.5) a[3]	29.4 (2.3) a	34.2 (3.4) a	NA[4]
ADMIRE + ADMIRE	0.9 (0.1) b	0.1 (0.1) b	0.2 (0.1) b	8.84 (2.0) a
RIMON + RIMON	0.2 (0.1) b	0.3 (0.1) b	1.3 (0.5) b	0.2 (0.1) b
ADMIRE + RIMON	0.5 (0.3) b	0.1 (0.1) b	0.3 (0.1) b	0.5 (0.3) b
RIMON + ADMIRE	0.1 (0.1) b	0.4 (0.2) b	1.9 (0.8) b	0.03 (0.03) b

[1] Plots first treated with ADMIRE were sprayed on 4 June, one day after introduction of CPB adults into the plots. Plots first treated with RIMON were sprayed on June 15 at 20% 2nd instar emergence. The second ADMIRE and RIMON applications occurred when CPB populations exceeded the economic threshold in that treatment.
[2] ADMIRE applied at 200 ml/ha (48 g a.i./ha); RIMON applied at 500 ml/ha (50 g a.i./ha).
Values within columns with different letters are significantly different from each other (Tukey test, $P < 0.05$).
Data not available due to complete defoliation of plants.

Table 4. Potato defoliation due to Colorado potato beetle in plots receiving RIMON 10EC and/or ADMIRE 240F foliar treatments.

Treatment [2, 3]	Mean Defoliation (±SEM)/Plant [1]			
	14 June	21 June	28 July	5 July
CHECK	1.03 (0.03) a[4]	1.25 (0.09) a	3. 94 (0.35) a	5.00 (0.00) a
ADMIRE + ADMIRE	0.97 (0.03) a	1.03 (0.03) b	1.00 (0.00) b	1.00 (0.00) b
RIMON + RIMON	1.03 (0.03) a	1.00 (0.00) b	1.00 (0.00) b	1.00 (0.00) b
ADMIRE + RIMON	1.00 (0.00) a	1.03 (0.03) b	1.00 (0.00) b	1.06 (0.04) b
RIMON + ADMIRE	1.00 (0.00) a	1.00 (0.00) b	1.00 (0.00) b	1.03 (0.03) b

[1] Percent defoliation was assessed using a defoliation rank index: 0 = no defoliation; 1 = up to 10% defoliation; 2 = 1up to 25% defoliation; 3 = up to 50% defoliation; 4 = up to 75% defoliation; 5 = 100% defoliation.
[2] Plots first treated with ADMIRE were sprayed on 4 June, one day after introduction of CPB adults into the plots. Plots first treated with RIMON were sprayed on June 15 at 20% 2nd instar emergence. The second ADMIRE and RIMON applications occurred when CPB populations exceed the economic threshold in that treatment.
[3] ADMIRE applied at 200 ml/ha (48 g a.i./ha); RIMON applied at 500 ml/ha (50 g a.i./ha).
Values within columns with different letters are significantly different from each other (Nemenyi test, $P < 0.05$).

2004 PMRR REPORT # 23 **SECTION C: POTATOES – Insect Pests**
ICAR:

CROP: Potato, (*Solanum tuberosum* L.) cv. Kennebec.
PEST: Colorado potato beetle (CPB), (*Leptinotarsa decemlineata* (Say))

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TITLE: PERSISTENCE OF BIOLOGICAL ACTIVITY OF RIMON 10 EC AND ADMIRE 240 F ON POTATO FOLIAGE FOR CONTROL OF COLORADO POTATO BEETLE, 2004

MATERIALS: RIMON 10 EC (novaluron 100g/L), ADMIRE 240 F (imidacloprid 240 g/L)

METHODS: Potato seed pieces were planted 10 per row in 2.25 x 0.9 microplots at the Southern Crop Protection Food Research Centre, Agriculture and Agri-Food Canada, London, ON. One row of potato was planted per micro-plot. Each plot was treated with broadcast fertilizer (16-16-16) at a rate of 825 kg/ha (165 g/micro-plot) during planting. Experimental treatments were replicated three times in a randomized complete block design. The treatments were: 1) CHECK (untreated); 2) RIMON at 250 ml/ha (R250); 3) RIMON at 500 ml/ha (R500); and 4) ADMIRE at 200 ml/ha (A200). When plants were ca. 40 cm high, approximately 20 randomly selected trifoliate leaves were tagged per plot. Insecticide was then applied (900 L/ha) using a hand-held CO_2 pressurized R&D plot sprayer fitted with a single D-4 orifice disc and a #25 swirl plate. Insecticide was applied only once to each plot during the experiment. In addition, 16 days after application of the experimental treatments, LAGON 480E (dimethoate) applied to all plots (750 ml/ha) to control potato leafhopper. Tagged potato leaves were harvested at random from each micro-plot on various days (Table 1) and transferred promptly to the laboratory for bioassay. 4.0 cm diam. discs were cut from each leaf and placed individually in sterile microbiological dishes. Five 2nd instar laboratory-reared CPB larvae (L2) of an insecticide susceptible strain were placed onto each leaf disc. There were 5 L2/bioassay x 3 bioassays/plot x 3 plots/treatment = 45 L2 per treatment on each sample day. Bioassays were transferred to a 25° C incubator at 65% RH, under 16:8 [L:D] lighting. Insects were allowed to feed for 48 h and were then transferred to waxed paper cups containing untreated potato foliage. Percent mortality of larvae was recorded after 48 and 120 h. After the 48 h feeding period, the area remaining from each leaf disc was measured using a LI-COR portable area meter. Leaf consumption was determined by subtracting the measured area from a standard leaf disc area measured at the beginning of each bioassay.

Logistic regressions were conducted to determine the effect of exposure time of foliage in the field (days after treatment) on larval mortality for the different treatments. Differences in leaf consumption and L2 mortality on different days were compared by analysis of the variance and means separation by the Tukey test at $\alpha = 0.05$. Percent data were arcsine-transformed before analysis. Untransformed data are presented in tables. Changes in leaf consumption over time in the different treatments were analyzed using the General Linear Model platform. All analyses were done with JMP IN V.3.2.1 statistical software (SAS Institute).

RESULTS: Results of this study are summarized in Tables 1 and 2. L2 exposure to foliage treated with R250 or R500 resulted in approximately 100% mortality over the first 10 days of the experiment (Table 1). Although a significant decrease in L2 mortality after exposure to R500 was observed 15 days after treatment (DAT), there was no significant decrease in mortality 15-35 DAT, when mortality continued to be 80-92%. The biological activity of the R250 treatment was less persistent than the R500 treatment, but remained high several weeks into the experiment (Table 1). A significant decrease in percent L2 mortality for the R250 treatment was found only beyond 15 DAT, although almost one-quarter of L2 died 35 DAT after eating R250 treated foliage. The biological activity of the A200 treatment was far less persistent than that of either novaluron treatment. A significant decrease in mortality was found 3 DAT and after 5 DAT almost all L2 exposed to A200 foliage survived. L2 exposed to CHECK foliage experienced very low levels of mortality, with no significant change in percent mortality over the course of the experiment.

During the first 2 DAT, consumption of A200 foliage by L2 was significantly less than that of CHECK, R250 and R500 treated foliage. After 2 DAT, however, consumption of the A200 foliage increased significantly, and was not significantly different from consumption of CHECK foliage 5, 7 and 12 DAT. Although A200 had no significant impact on CPB mortality 9 and 15 DAT, leaf consumption by L2 on these days was significantly less than that in CHECK bioassays, suggesting that an antifeedant effect due to ADMIRE applications may persist beyond its lethal effects. Feeding in CHECK plots was found to decrease significantly over time. Thickening of foliage or physiological changes in the plants as they aged probably caused this effect in the CHECK treatment. The LAGON application 16 DAT may have also reduced feeding in the CHECK. In contrast, there was no significant change in consumption of R250 and R500 foliage throughout experiment, where consumption ranged from 1.0-3.1 cm^2, or approximately 8-25% of the total foliage available.

CONCLUSIONS: The biological activity of foliar applied RIMON was much more persistent than that of ADMIRE, with 84% mortality of L2 35 DAT when exposed to an application rate of 500 ml/ha, a medium rate on the proposed RIMON 10EC label. Although the persistence of RIMON would offer prolonged CPB control and possible flexibility in application timing, it could also increase selection pressure for novaluron-resistant CPB long after population densities have been reduced below an economic threshold level.

Table 1. Mean (± SE) percent mortality of laboratory reared 2nd instar Colorado potato beetle larvae 120 h after exposure to CHECK (untreated), ADMIRE 240F or RIMON 10EC treated potato foliage [1].

DAT [2]	Treatment % Mortality (± SE)			
	CHECK	ADMIRE 200ml/ha	RIMON 250 ml/ha	RIMON 500 ml/ha
0	0 (0) a[3]	97.8 (3.3) b	100 (0) b	100 (0) b
2	4.4 (3.0) a	80 (7.0) b	93.3 (6.2) bc	100 (0) c
5	0 (0) a	10 (6.0) a	100 (0) b	96.7 (5.0) b
7	0 (0) a	6.7 (4.5) a	100 (0) b	97.8 (3.3) b
9	2.2 (2.0) a	2.2 (2.0) a	100 (0) b	97.8 (3.3) b
12	2.2 (2.0) a	4.4 (2.0) a	86.7 (11.2) b	97.8 (3.3) b
15	0 (0) a	2.2 (2.0) a	46.7 (8.4) b	91.9 (5.7) c
20	2.2 (2.0) a	0 (0) a	71.1 (7.9) a	80 (7.8) a
29	4.4 (3.0) a	0 (0) a	42.2 (9.4) b	84.4 (8.7) c
35	2.2 (2.0) a	0 (0) a	24.4 (5.3) b	84.4 (8.7) c

[1] Insecticides were applied in the field and foliage was transferred to the laboratory for bioassay. Insects were exposed to treated foliage for 48 h and thereafter fed untreated foliage for 72 h.
[2] Days After Treatment.
[3] Percent data were arcsine transformed before analysis. Untransformed data are presented. Values within rows with the same letter not significantly different (Tukey test, $P < 0.05$).

Table 2. Mean leaf consumption (± SE) by five laboratory reared 2nd instar Colorado potato beetle larvae after 48 h exposed to CHECK (untreated), ADMIRE 240F or RIMON 10EC treated potato foliage [1].

DAT [2]	Leaf Consumption (cm^2) (± SE)			
	CHECK	ADMIRE 200ml/ha	RIMON 250 ml/ha	RIMON 500 ml/ha
0	6.1 (0.4) a[3]	0.001 (0.001) c	2.3 (0.2) b	1.6 (0.2) b
2	4.7 (0.4) a	0.2 (0.09) c	2.4 (0.1) b	2.1 (0.2) b
5	5.8 (2.1) a	2.8 (0.7) ab	2.3 (0.3) b	1.6 (0.2) b
7	4.2 (0.3) a	3.5 (0.5) ab	2.7 (0.3) bc	2.2 (0.2) c
9	5.1 (0.2) a	3.7 (0.2) b	3.1 (0.2) b	2.3 (0.1) c
12	2.8 (0.2) a	2.2 (0.1) ab	2.4 (0.1) ab	1.9 (0.1) b
15	4.3 (0.3) a	2.0 (0.4) b	2.5 (0.2) b	1.8 (0.2) b
20	2.7 (0.2) a	NA	1.4 (0.2) b	1.0 (0.2) b
29	3.2 (0.4) a	NA	2.4 (0.3) ab	2.0 (0.3) b

[1] Insecticides were applied in the field and foliage was transferred to the laboratory for bioassay.
[2] Days After Treatment.
[3] Values within rows with the same letter not significantly different (Tukey test, $P < 0.05$).

2004 PMRR REPORT # 24 **SECTION C: POTATOES - Insect Pests**
STUDY DATABASE: 160.3

CROP: Potato (*Solanum tuberosum*), cv. Kennebec
PEST: Colorado potato beetle (CPB), *Leptinotarsa decemlineata* (Say)
Potato leafhopper (PLH), *Empoasca fabae* (Harris)

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TITLE: MICROPLOT EVALUATION OF PLANTING TREATMENTS FOR CONTROL OF INSECT PESTS OF POTATO ON MINERAL SOIL; 2004

MATERIALS: ADMIRE 240 F (imidacloprid 240 g/L), GENESIS 240 F (imidacloprid 240 g/L), Z0601-00 (clothianidin 390 g/L + trifloyxstrobin 240 g/L), THIMET 15 G (phorate 15%), SENATOR PST (thiophanate methyl 10%)

METHODS: Using a hand-operated mist-applicator, seed treatments (ST) (Table 1, Tmts. 1-5) were uniformly applied in 0.875 L/100 kg seed on 08 June to freshly cut seed potatoes contained in separate 50 lb clear plastic bags. Each bag was then closed and seed potatoes tumbled for 1 minute to ensure even coating of all pieces. SENATOR PST (500 g/100 kg seed) was then sprinkled over the top of the treated seed pieces in the bag which was then closed and again tumbled for 1 minute to again ensure even coating of all seed potatoes. Seed potatoes for Tmt. 6-8 were tumbled with SENATOR PST only. After tumbling, bags were opened and seed allowed to dry until planting. Seed potatoes for all treatments were planted on the SCPFRC-London Research Farm on 08 June in single-row (10 seed pieces/row) microplots (2.25 m long x 0.9 m wide) filled with insecticide residue-free mineral soil. The in-furrow spray (IFS) treatment (Table 1, Tmt. 6) was applied in a 7-10 cm band in the bottom of the seed furrow before placement of seed potatoes, at 175 kPa in 5 L/100 m row using a hand-held, CO_2-pressurized, R&D plot sprayer with a single 4004E flat spray tip. The in-furrow granular (IFG) treatment (Table 1, Tmt. 7) was hand applied in 7-10 cm band in the bottom of the seed furrow before placement of the seed potatoes. All treatments were replicated 3 times in a randomized complete block design. To supplement scanty rainfall, microplots received 10-15 mm water via sprinkler-irrigation on 12 and 23 August.
The number of plants with stems breaking through the soil surface (BBCH growth stage - 09) was counted in each plot on 28 June and 07 July.
Once growing plants had developed at least 2 tri-foliate leaves, residual effectiveness of all treatments against both adult and larval insecticide-susceptible, laboratory-reared CPB was measured by bioassay. On each collection date (Tables 3-6) a total of 6 leaves was harvested from each plot of each treatment and returned to the laboratory. A total of 9 adult-bioassays (3 bioassays/plot x 3 plots/tmt.), each containing 1 tri-foliate leaflet and 5 CPB adults, and 9 larval-bioassays (3 bioassays/plot x 3 plots/tmt.), each containing a 12.5 cm^2 leaf disc and 5 first instar larvae, was then established for each treatment. Bioassays were held at 25°C, 55% RH, and 16:8 L:D photoperiod. For each set of bioassays, mortality

and leaf damage were recorded after 48 hrs. Adult-feeding damage was rated using a 0-10 scale where 0.0 represents no feeding damage, 5.0 represents 50% loss of leaf area, 10.0 represents 100% consumption of the leaf. Larval feeding damage was measured directly. Areas of leaf discs remaining after 48 hrs were read directly using a LI-COR® portable leaf-area meter; larval-leaf consumption was calculated by subtracting the disc-area at the end of each bioassay from the area of standard leaf discs collected at the beginning of each bioassay and held under the same conditions as the bioassays.
On 11 and 27 August, a total of 10 randomly selected, terminal leaflets in each plot was rated for PLH damage on a 0 - 2 scale assigned as follows: 0 - no symptoms of PLH feeding; 1 - leaf-curling only; 2 - leaf-curling + necrosis and/or brown leaf margins around at least part of the leaflet. A Cumulative PLH-Rating was then calculated for each plot by summing individual leaf-ratings for that plot.
Mortality was corrected using Abbott's factor and subjected to arcsin square root transformation prior to statistical analysis by analysis of variance (ANOVA). Fisher's Protected Least Significant Difference (LSD) test was then used to estimate significance of differences among treatment means. Untransformed data are presented in the tables. Significance of observed differences in plant emergence, leaf consumption (CPB) and leaf damage (PLH) among treatments was determined using ANOVA and an LSD means separation test.

OBSERVATIONS: Weather at SCPFRC-London during May and June was generally cool and wet. Plant emergence in an initial trial planted on 21 May was very uneven. When inspection revealed extensive decay and breakdown of seed pieces in the hills, the entire trial was replanted with fresh seed. By the final bioassay of the second trial on 08 Sept., 91 DAT, hopperburn due to PLH feeding in CONTROL plots was so severe that it was difficult to collect foliage from these plots for bioassay. Foliage in treated plots was also beginning to senesce on that date.

RESULTS: Plant emergence was generally delayed when insecticide was applied to the potato seed piece. With the exception of the lower rate of application of GENESIS, fewer potato plants had emerged on 28 June in plots receiving an insecticidal seed treatment than in plots with no insecticide directly applied to the seed piece (Table 2). The lowest numbers of emerged plants were counted in plots where seed pieces had been treated with Z0601-11. On 28 June there were no significant differences between the number of plants in plots where insecticide was applied in-furrow than in plots with no insecticide (Table 2). By 07 July plant emergence was complete. On that date significantly fewer plants were recorded in plots where Z0601-00 was applied to the seed piece prior to planting.
At the time of the first bioassay, 28 days after treatment (DAT), mortality of adult CPB was significantly higher when feeding on foliage from plants treated with Z0601-00 than on foliage from plants from any other treatment (Table 3); almost all adult CPB died within 48 hrs. On the same date planting treatment with imidacloprid also caused significant adult mortality; seed treatment with GENESIS or IFS-application of ADMIRE were equally effective (Table 3). Foliage harvested from plots treated with IFG-application of THIMET caused minimal mortality of adult CPB 28 DAT (Table 3). As long as 91 DAT, seed treatment with Z0601-00 resulted in significantly higher mortality of CPB adults, exceeding 80% when applied at 48.0 ml/100 kg seed (Table 3). By 63 DAT, significantly higher adult mortality was recorded on foliage from seed pieces treated with GENESIS than from foliage receiving IFS-application of ADMIRE, a trend which generally persisted until the end of the experiment (Table 3).
While all treatments significantly reduced feeding damage by adult CPB at the time of the first bioassay 28 DAT, IFG-application of THIMET was significantly less effective than any application of a neonicotinoid insecticide (Table 4). While the differential was not always statistically significant, throughout the experiment, seed treatment with Z0601-00 generally provided better protection of foliage than seed treatment with the equivalent rate of GENESIS (Table 4). On 6 of 9 sampling dates, treatment of seed with GENESIS provided better protection of foliage against feeding by adult CPB than IFS-application of ADMIRE, a different formulation of imidacloprid. Until 84 DAT IFS-application of ADMIRE provided better foliage protection against adult CPB than did IFG-application of THIMET (Table 4).
Due to relatively slow plant growth, leaves were not large enough for larval bioassay until 35 DAT. On

that date all late first instar feeding on foliage from plants treated with any rate of Z0601-00 died within 48 hrs (Table 5). Indeed, 48 hr mortality of first instar larvae feeding on foliage from plants treated with Z0601-00 was at least 80% until the end of the experimental, 91 DAT. There was no significant difference in mortality of larvae feeding on foliage from the plants treated with the high or low rate of Z0601-00 (Table 5). Until 77 DAT larval mortality was significantly higher in bioassay of foliage from plants treated with the higher rate of GENESIS that from plants receiving IFS-application of ADMIRE (Table 5). On 5 of 9 sampling dates, significantly higher larval mortality was recorded on foliage of plants treated with the higher rate of GENESIS than on foliage of plants treated with the lower rate of the insecticide (Table 5). On no sampling date did larval mortality reach 25% on foliage from plants receiving IFG-application of THIMET (Table 5).

With the sole exception of IFG-application of THIMET, all treatments significantly reduced foliage consumption by CPB larvae in the first bioassay 35 DAT (Table 6). Also on the date, all ST treatments were more effective than IFS-application of ADMIRE (Table 6). On 7 of 9 sampling dates CPB larvae consumed significantly less foliage of potatoes treated with the higher rate of GENESIS than of plants receiving IFS-application of ADMIRE (Table 6). Until 56 DAT, IFS-application of ADMIRE provided better protection of potato foliage than did IFG-application of THIMET. ST-application of Z0601-00 significantly reduced foliage consumption by first instar larvae until the final bioassay 91 DAT (Table 6).

Although often small differences were not all statistically significant in this trial, several relative performance trends were observed (Table 7). As measured by the parameters of this trial, ST-application of the higher rate of GENESIS or Z-0601-00 most often provided control of both CPB adults and larvae equal to or better than control provided by the lower rate of the same insecticides (Table 7). When equivalent rates of GENESIS or Z0601-00 were applied to the potato seed piece, control by Z0601-00 was always equal or superior to that provided by GENESIS (Table 7). Control of CPB larvae following application of Z0601-00 to the same plots for 2 consecutive years was not consistent; while higher mortality was observed in plots treated for the first time, less damage by CPB larvae was generally observed in plots treated for the 2nd time (Table 7).

When plots were first rated for PLH damage 64 DAT, many leaves in CONTROL plots were heavily damaged with significant leaf curling and some leaf death (Table 8). On that date significantly less hopperburn was recorded in all treated plots than in the CONTROL plots. Leaves from plots treated with either rate of Z0601-00 (Tmt. 3-5) were only slightly curled with no necrosis (Table 8). Slightly higher damage ratings were recorded for plots receiving either ST application of the higher rate of GENESIS (Tmt. 2) or IFG-application of THIMET (Tmt. 7). Leaves in plots treated with the lower rate of GENESIS (Tmt. 1) or IFS-application of ADMIRE (Tmt. 6) exhibited more leaf curling with slight marginal necrosis on some leaves (Table 8). By 80 DAT most leaves rated in CONTROL plots showed severe symptoms of hopperburn (Table 8). While damage symptoms had progressed in all treatments, most leaves in plots receiving ST-application of Z0601-00 (Tmts. 3-5) showed only minor leaf curling with no necrosis on that date (Table 8).

CONCLUSIONS: Under the conditions of this trial sufficient systemic residues of all planting treatments remained in potato foliage to significantly reduce feeding by both adult and larval CPB several weeks beyond the period that those residues caused significant mortality of introduced insects.

ST-application of Z0601-00 provided very effective protection of potato foliage against feeding damage by both adult and larval CPB as well as PLH. ST-application of Z0601-00 furnished better control of both CPB and PLH than similar application of the equivalent rate of GENESIS. Protection of potato foliage against both CPB and PLH lasted longer following ST-application of GENESIS than following IFS application of ADMIRE, a different formulation of the same active ingredient. While IFG-application of THIMET was the least effective treatment evaluated in this trial, it did provide a significant degree of early season protection of potato foliage against both CPB and PLH.

While repeat application of clothianidin (Z0601-00) to the same plots for a second year did not appear to significantly decrease insect control in the second year, further work is warranted to verify that this insecticide is not subject of enhanced degradation in soils receiving repeated treatments.

Under the growing conditions of this trial, ST-application of Z0601-00 significantly reduced potato

emergence. Further research is essential to determine whether the observed phytotoxicity is due to clothianidin or to the fungicide trifloxystrobin, added to the insecticide for control of fungal potato diseases.

Table 1. Planting treatments evaluated in micro-plots for control of insect pests of potato on mineral soil, London, ON; 2004.

Tmt. No.	Insecticide	Formulation	Method [1]	Rate/100 kg Seed	
				a.i.	product
1	imidacloprid	GENESIS 240 F	ST	6.24 g	26.0 ml
2	imidacloprid	GENESIS 240 F	ST	12.48 g	52.0 ml
3	clothianidin	Z0601-00	ST	12.48 g	32.0 ml
4	clothianidin	Z0601-00	ST	18.72 g	48.0 ml
5.2	clothianidin	Z0601-00	ST	12.48 g	32.0 ml
6	imidacloprid	ADMIRE 240 F	IFS	2.90 g[4]	12.0 ml[4]
7	phorate	THIMET 15 G	IFG	32.25 g[4]	215.0 g[4]
8	no insecticide	CONTROL	---[3]	---	---

[1] Method of application: IFS - in-furrow spray application; IFG - in-furrow granular application; ST - seed treatment.
[2] 2nd application on plots first treated in 2003.
[3] No insecticide applied.
[4] amount/100 m row.

Table 2. Effect of planting treatments on emergence of potato plants in micro plots filled with mineral soil, London, ON; 2004.

Tmt.[1] No.	Mean Number Plants/Micro plot for Indicated Date	
	38165	38172
1	7.7 abc[2]	8.3 a
2	6.7 bcd	7.3 a
3	4.3 de	4.3 b
4	3.3 e	4.7 b
5	5.0 cde	7.7 a
6	9.0 ab	9.3 a
7	8.7 ab	8.7 a
8	9.7 a	9.7 a

[1] Refer to Table 1 for full description of treatments.
[2] For each date, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and a Least Significant Difference means separation test.

Table 3. Effect of foliage of potatoes, protected by selected planting treatments, on mortality of Colorado potato beetle (CPB) adults after feeding for 48 hours in bioassay, London, ON; 2004.

Tmt.[1] No.	Average % Corrected Adult CPB Mortality on Indicated DAT[3]								
	28	35	42	49	56	63	70	84	91
1	50.1 b[2]	55.6 b	79.8 bc	77.3 b	82.1 bcd	68.9 c	68.1 b	51.1 b	46.7 b
2	58.8 b	57.8 b	75.3 bc	77.3 b	69.2 d	73.3 bc	80.0 ab	28.9 b	48.9 b
3	88.9 a	100.0 a	84.1 ab	97.7 a	94.9 ab	91.1 a	93.3 a	82.2 a	68.9 ab
4	100.0 a	100.0 a	100.0 a	97.7 a	100.0 a	100.0 a	95.6 a	91.1 a	84.4 a
5	100.0 a	97.8 a	93.2 ab	85.5 a	92.3 abc	88.9 ab	84.4 ab	86.7 a	68.9 ab
6	49.3 b	55.6 b	65.9 c	57.1 b	76.9 cd	28.9 d	51.1 c	28.9 b	0.0 c
7	12.8 c	25.9 c	4.0 d	57.3 b	40.2 e	26.7 d	17.8 d	4.4 c	2.9 c

[1] Refer to Table 1 for full description of treatments.
[2] Within each DAT, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and Fisher's Protected Least Significant Difference means separation test.
[3] Days after Treatment.

Table 4. Effect of foliage of potatoes, protected by selected planting treatments, on feeding damage by Colorado potato beetle (CPB) adults after 48 hours in bioassay, London, ON; 2004.

Tmt.[1] No.	Average Damage Rating [3] due to Feeding by Adult CPB on Indicated DAT[4]								
	28	35	42	49	56	63	70	84	91
1	0.4 c[2]	0.9 de	3.0 c	2.6 d	1.4 c	1.9 cd	1.7 cd	3.7 c	2.2 c
2	0.3 c	1.2 d	0.4 d	0.6 e	0.4 cd	0.5 de	0.8 de	3.1 c	1.6 d
3	0.2 c	0.1 e	0.2 d	0.4 e	0.2 d	0.3 e	0.3 e	0.7 d	0.7 d
4	0.3 c	0.1 e	0.1 d	0.2 e	0.1 d	0.2 e	0.3 e	0.3 d	0.6 d
5	0.1 c	0.2 de	0.2 d	0.2 e	0.1 d	0.2 e	0.3 e	0.6 d	0.6 d
6	0.7 c	3.3 c	4.8 b	4.4 c	2.2 c	2.2 c	2.0 c	6.7 b	6.9 b
7	3.6 b	6.6 b	6.5 a	5.9 b	4.7 b	4.7 b	4.5 b	8.5 a	7.8 b
8	8.7 a	7.9 a	7.4 a	9.3 a	7.0 a	8.9 a	8.5 a	8.4 a	9.7 a

[1] Refer to Table 1 for full description of treatments.
[2] Within each DAT, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and Fisher's Protected Least Significant Difference means separation test.
[3] Actual 72-hour leaf damage rating (0-10 scale where 0.0 represents no feeding damage, 5.0 represents 50% loss of leaf area, 10.0 represents 100% consumption of the leaf).
[4] Days after Treatment.

Table 5. Effect of foliage of potatoes, protected by selected planting treatments, on mortality of Colorado potato beetle (CPB) larvae after feeding for 48 hours in bioassay, London, ON; 2004.

Tmt.[1] No.	Average % Corrected Larval CPB Mortality on Indicated DAT [2]								
	35	42	49	56	63	70	77	84	91
1	64.4 b	27.8 d	36.1 bc	30.6 c	42.2 c	13.3 c	8.9 bc	13.9 b	20.0 bc
2	88.9 a	55.6 c	50.0 b	80.6 b	71.1 b	53.3 b	24.4 b	8.3 b	37.8 b
3	100.0 a	80.6 bc	97.2 a	100.0 a	97.8 a	84.4 a	93.3 a	97.8 a	86.7 a
4	100.0 a	100.0 a	100.0 a	97.2 ab	100.0 a	97.8 a	91.1 a	84.4 a	80.0 a
5	100.0 a	95.6 ab	97.2 a	80.6 b	93.3 ab	82.2 a	82.2 a	85.6 a	82.2 a
6	31.1 c	7.2 d	5.6 d	5.6 d	15.6 d	15.6 c	2.2 c	0.0 b	6.7 c
7	22.2 c	7.8 d	19.4 cd	8.3 d	11.1 d	4.4 c	0.0 c	0.0 b	0.0 c

[1] Refer to Table 1 for full description of treatments.
[2] Days after Treatment.
[3] Within each DAT, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and Fisher's Protected Least Significant Difference means separation test.

Table 6. Effect of foliage of potatoes, protected by selected planting treatments, on feeding damage by Colorado potato beetle (CPB) larvae after 48 hours in bioassay, London, ON; 2004.

Tmt.[1] No.	Average Leaf-Area[3] Consumed by Larval CPB on Indicated DAT[4]								
	35	42	49	56	63	70	77	84	91
1	0.8 c[2]	2.0 d	2.2 de	2.4 c	3.0 cd	2.5 c	4.6 b	3.1 b	2.0 cd
2	0.7 c	1.2 d	2.6 d	1.7 cd	1.7 de	1.3 cd	3.1 c	1.6 c	2.2 c
3	0.6 c	1.4 d	1.7 de	1.7 cd	1.3 e	0.9 d	1.2 d	0.6 c	1.5 cd
4	0.5 c	1.3 d	1.3 e	1.2 d	1.3 e	0.8 d	1.1 d	0.6 c	1.1 d
5	0.2 c	1.3 d	1.1 e	1.2 d	1.2 e	1.1 d	1.2 d	0.5 c	1.2 cd
6	3.3 b	3.3 c	3.8 c	2.3 c	4.3 bc	4.2 b	7.2 a	4.7 a	4.3 b
7	6.2 a	4.6 b	5.2 b	4.4 b	6.1 ab	4.9 b	7.8 a	4.8 a	4.9 b
8	6.2 a	6.4 a	6.6 a	6.0 a	7.5 a	7.2 a	7.6 a	4.9 a	8.5 a

[1] Refer to Table 1 for full description of treatments.
[2] Within each DAT, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and Fisher's Protected Least Significant Difference means separation test.
[3] Actual area (cm^2) of leaf-disc consumed during 48 hour feeding period.
[4] Days after Treatment.

Table 7. Comparison of relative performance of selected treatments for control of Colorado potato beetle (CPB) attacking potato on mineral soil, London, ON; 2004.

Treatments Compared	Relative Performance for Indicated Observation			
	CPB Adults		CPB Larvae	
	Mortality	Damage	Mortality	Damage
GENESIS - Hi Rate ≥ Lo Rate (Tmt. 2 ≥ Tmt. 1)	6 / 9	8 / 9	7 / 9	7 / 9
Z0601-00 - Hi Rate ≥ Lo Rate (Tmt. 4 ≥ Tmt. 3)	9 / 9	8 / 9	5 / 9	9 / 9
Z0601-00 - Yr. 1 ≥ Yr. 2 (Tmt. 3 ≥ Tmt. 5)	6 / 9	8 / 9	8 / 9	1 / 9
ST-Application - clothianidin ≥ imidacloprid (Tmt. 3 ≥ Tmt. 2)	9 / 9	9 / 9	9 / 9	8 / 9

Table 8. Impact of planting treatments on damage to potato foliage by the potato leafhopper (PLH), *Empoasca fabae*, London, ON; 2004.

Tmt.[1] No.	Mean Cumulative PLH Rating[3] for Indicated Date	
	11 August (64 DAT)	27 August (80 DAT)
1	9.7 b[2]	14.0 b
2	4.3 cd	9.3 c
3	1.7 d	5.3 de
4	1.3 d	4.7 de
5	2.0 d	3.0 e
6	10.3 b	15.0 ab
7	6.0 c	8.3 cd
8	15.3 a	18.3 a

[1] Refer to Table 1 for full description of treatments.
[2] For each date, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and a Least Significant Difference means separation test.
[3] 0 - 2 scale assigned as follows: 0 = no symptoms of PLH feeding; 1 = leaf-curling only; 2 = leaf-curling + necrosis and/or brown leaf margins around at least part of the leaflet. Cumulative rating is sum of ratings for all 10 leaves selected from each plot.

2004 PMRR REPORT # 25 **SECTION C: POTATOES - Insect Pests**
STUDY DATABASE: 160.3

CROP: Potato (*Solanum tuberosum*), cv. Kennebec
PEST: Colorado potato beetle (CPB), *Leptinotarsa decemlineata* (Say)
Potato leafhopper (PLH), *Empoasca fabae* (Harris)

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TITLE: **FIELD EVALUATION OF PLANTING TREATMENTS FOR CONTROL OF INSECT PESTS OF POTATO ON MINERAL SOIL; 2004**

MATERIALS: GENESIS 240 F (imidacloprid 240 g/L), Z0601-00 (clothianidin 390 g/L + trifloyxstrobin 240 g/L), BELAY 16 WSG (clothianidin 16%), TRACER 480 SC (spinosad 480 g/L), REGENT 4 SC (fipronil 488 g/L), ICON 6.2 FS (fipronil 743 g/L), PYRINEX 480 E (chlorpyrifos 480 g/L), PYRIFOS 15 G (chlorpyrifos 15%), SENATOR PST (thiophanate methyl 10%)

METHODS: Using a hand-operated mist-applicator, seed treatments (ST) (Table 1, Tmts. 1-3, 5) were uniformly applied in 0.875 L/100 kg seed on 18 May to freshly cut seed potatoes contained in separate 50 lb clear plastic bags. Each bag was then closed and seed potatoes tumbled for 1 minute to ensure even coating of all pieces. SENATOR PST (500 g/100 kg seed) was then sprinkled over the top of the treated seed pieces in the bag which was then closed and again tumbled for 1 minute to again ensure even coating of all seed potatoes. Seed potatoes for Tmt. 4, 6-10 were tumbled with SENATOR PST only. After tumbling, bags were opened and seed allowed to dry until planting. Hard red spring wheat for the TKR treatment (Table 1, Tmt.7) was treated on 18 May by distributing the wheat over the seed treatment spread on the inner surface of a clear 5 lb plastic bag, closing the bag and then tumbling the seed for 1 minute until all seed was uniformly treated. On 19 May seed potatoes for all treatments were planted at 20 cm spacing in single row plots in mineral soil on the farm of Mark Murphy (44° 10' 05.34" N, 79° 49' 31.47" W) near Alliston, ON. Plot rows were 1 m apart and 4 m long. All treatments were replicated 4x in a Randomized Complete Block design. Blocks were separated by 1.5 m cultivated walkways.
The in-furrow spray (IFS) treatments (Table 1, Tmts. 4, 8) were applied in a 7-10 cm band in the bottom of the seed furrow before placement of seed potatoes, at 175 kPa in 5 L/100 m row using a hand-held, CO_2-pressurized, R&D plot sprayer with a single 4004E flat spray tip. The in-furrow granular (IFG) treatment (Table 1, Tmt. 9) was hand applied in 7-10 cm band in the bottom of the seed furrow before placement of the seed potatoes. Treated wheat seed for the trap-and-kill (TKR) treatment (Table 1, Tmt. 7) was sprinkled in a uniform 7-10 cm band in the bottom of the seed furrow before placement of the seed potatoes. Weeds were controlled throughout the season by cultivation and hand weeding. All plots were hilled on 02 July.
On 09 July, CPB-feeding damage was rated for 5 randomly selected compound leaves/plot using a 0-10 scale where 0.0 represents no feeding damage, 5.0 represents 50% loss of leaf area, 10.0 represents 100%

consumption of the leaf. On 06 and 20 August, a total of 10 randomly selected, terminal leaflets in each plot was rated for PLH damage on a 0 - 2 scale assigned as follows: 0 - no symptoms of PLH feeding; 1 - leaf-curling only; 2 - leaf-curling + necrosis and/or brown leaf margins around at least part of the leaflet. A Cumulative PLH-Rating was then calculated for each plot by summing individual leaf-ratings for that plot. Significance of observed differences in leaf damage due to CPB and PLH among treatments was determined using Analysis of Variance (ANOVA). A Least Significant Difference (LSD) test was then used to ascertain significance of differences among treatment means.

OBSERVATIONS: Emergence of potatoes from seed pieces treated with Z0601-00 (Tmt. 2, 3) was generally delayed relative to emergence of potatoes in other treatments. No wheat seedlings were observed in plots receiving the TKR treatment (Tmt. 7). Due to IFS-application of ADMIRE by the grower in the adjacent commercial field of potatoes (cv. Snowden), the CPB population in the experimental block was very low throughout the season. PLH were not distributed uniformly throughout the experimental block. On both rating dates, damage was significantly higher at the east end of the block than at the west, upwind end of the block.

RESULTS: Results are presented in Table 1. On 09 July less than 20% leaf damage by feeding CPB was recorded in CONTROL plots (Table 1). No CPB damage was recorded in plots treated with a neonicotinoid insecticide either as a ST (Tmts. 1-3) or IFS application (Tmt. 4)(Table 1). Minimal CPB damage was recorded in all other treatments on that date.
On 06 August, even though PLH damage was not uniformly distributed across the block, cumulative PLH damage ratings were significantly higher in CONTROL plots and plots receiving ST application of TRACER than in plots receiving other treatments (Table 1). Leaf curling due to developing hopperburn was general in CONTROL plots; marginal leaf necrosis was also observed on a few leaves in those plots. On 06 August significantly less hopperburn was seen in plots treated with either neonicotinoid insecticide (Tmts. 1-4). Only minor leaf curling was observed in those plots. By 20 August, while hopperburn had progressed in all treatments the pattern of protection persisted; least hopperburn was recorded in plots treated with either neonicotinoid insecticide (Table 1). On that date, marginal leaf necrosis was observed on virtually all leaves in CONTROL plots and plots receiving any treatment other than a neonicotinoid insecticide. On both 06 and 20 August, the cumulative PLH damage rating was significantly lower in plots receiving ST-application of Z0601-00 (Tmt. 3) than in plots treated with the same effective rate of GENESIS (Tmt. 1)(Table 1).

CONCLUSIONS: Under the conditions of this trial, ST- (Z0601-00, GENESIS) or IFS-application (BELAY) of neonicotinoid insecticides effectively delayed development of hopperburn due to PLH feeding on treated potatoes. ST-application of Z0601-00 proved more effective than similar application of the same rate of GENESIS.

Table 1. Planting treatments evaluated in one-row field plots for control of insect pests of potato on mineral soil, Alliston, ON; 2004.

Tmt. No.	Insecticide	Formulation	Method [1]	Rate/100 m Row		Mean CPB Leaf Damage Rating [5]	Mean Cumulative PLH Rating [7] for Indicated Date	
				a.i.	product		38204	38218
1	imidacloprid	GENESIS 240 F	ST	12.50 g[2]	52.0 ml[2]	0.0 b[6]	4.3 d	12.3 c
2	clothianidin	Z0601-00 390 F	ST	6.24 g[2]	16.0 ml[2]	0.0 b	2.3 de	10.8 cd
3	clothianidin	Z0601-00 390 F	ST	12.48 g[2]	32.0 ml[2]	0.0 b	1.8 e	9.3 d
4	clothianidin	BELAY 16 WSG	IFS	2.24 g	14.0 g	0.0 b	2.5 de	10.8 cd
5	spinosad	TRACER 480SC	ST	8.00 g[2]	16.7 ml[2]	0.1 b	11.8 a	18.0 a
6	fipronil	REGENT 4 SC	IFS	3.05 g	6.25 ml	0.1 b	7.0 c	15.3 b
7	fipronil	ICON 6.2 FS	TKR	1.6 g[3]	2.1 ml[3]	0.8 ab	8.8 bc	18.8 a
8	chlorpyrifos	PYRINEX 480 EC	IFS	10.37 g	21.6 ml	0.9 ab	8.3 bc	16.5 ab
9	chlorpyrifos	PYRIFOS 15 G	IFG	30.0 g	200.0 g	0.4 b	9.8 ab	18.3 a
10	no insecticide	CONTROL	---[4]	---	---	1.8 a	12.0 a	16.8 ab

[1] method of application: IFS - in-furrow spray application; IFG - in-furrow granular application; ST - seed treatment; TKR - trap & kill row.
[2] amt/100 kg seed.
[3] based on application rate of 3.053 g a.i./48,000 wheat seeds (0.06 mg a.i./seed) planted at a density of 2.5 seeds/cm row (250 seeds/m row).
[4] No insecticide applied.
[5] Actual leaf damage rating (0-10 scale where 0.0 represents no feeding damage, 5.0 represents 50% loss of leaf area, 10.0 represents 100% consumption of the leaf).
[6] Within each column, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and a Least Significant Difference means separation test.
[7] 0 - 2 scale assigned as follows: 0 = no symptoms of PLH feeding; 1 = leaf-curling only; 2 = leaf-curling + necrosis and/or brown leaf margins around at least part of the leaflet. Cumulative rating is sum of ratings for all 10 leaves selected from each plot.

2004 PMRR REPORT # 26 **SECTION E: CEREAL, FORAGE, AND OILSEED CROPS -insects**
ICAR: 61006537

CROP: White bean, (*Phaseolus vulgaris* L.), cv OAC Thunder
PEST: Seedcorn maggot, *Delia platura* (Meigen)

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TITLE: CONTROL OF SEED CORN MAGGOT IN DRY EDIBLE BEANS WITH SEED TREATMENTS

MATERIALS: CRUISER 5 FS (thiamethoxam 5 g ai/L); CRUISER 350 FS (thiamethoxam 350 g ai/L); APRON MAXX RTA 19.05 FS (fludioxonil + metalaxyl-M, 7.69 + 11.54 g ai/L); DCT diazinon + captan + thiophanate methyl, 18 + 6 + 14 % v/v).

METHODS: Seed was treated on 26 Apr, 2004 in 500 g lots in individual plastic bags by applying the treatment or slurry via a syringe to each bag (all treatments diluted to the same volume of 5.0 ml/kg seed using water). The seed was then mixed in the inflated bag for 1 min to ensure thorough seed coverage. Cattle manure was broadcast on the plots 2 weeks before planting and the soil was disced shortly after the manure application. The experiment was planted at two locations on 6 May, 2004 (Ridgetown and Highgate, ON), using a 2-row cone seeder at a seeding rate of 20 seeds/m. after yellow sticky traps captured some adult seed corn maggots 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. Total plot emergence was evaluated on 17 and 20 May, 2004 at Highgate and Ridgetown, respectively. Plant stand was assessed on 25, 31 May, 7 and 14 June, 2004 at Highgate and 27 May, 2, 11 and 18 June, 2004 at Ridgetown. Vigor was assessed on the same dates using a scale of 0-100% (100 = furthest developed plant in the trial and 0 = plant dead). Seed corn maggot damage and number of maggots were assessed in one row of the check plots on 17 and 20 May, 2004 at Highgate and Ridgetown, respectively, by exhuming all plants and seed remains from a 1 m length of row. Fresh plant weights in 4 m were assessed on 15 July, 2004. Plots were harvested on 3 and 17 Sept, 2004 at Ridgetown and Highgate, respectively, and yields converted to 14.5% moisture. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at the P= 0.05.

RESULTS: See Tables 1-6. Mean damaged plants recovered/m was 0 and 1.2 at Ridgetown and Highgate, respectively. Mean number of seed corn maggots/m recovered from the check plots was 0 at both Ridgetown and Highgate. No phytotoxicity due to treatments was noted in any of the plots. The spring was cool and wet. By the time damaged plants were assessed, dead seedlings had decomposed and could not be found. Seed corn maggot flies were captured on yellow sticky cards in the plot areas at both locations before planting. Plant loss and decomposition were clearly due to a combination of plant pathogens and seed corn maggot injury. There was also evidence of seed corn maggot in neighbouring soybean trials.

CONCLUSIONS: At the Ridgetown location no plants survived in the untreated checks, about 40 % survived in the fungicide-treated plots and nearly 66 % survived in all the insecticide plus fungicide-treated plots, with the exception of DCT treated plots. In DCT treated plots there was no difference in survival between these and fungicide treatment. The highest rate of Cruiser yielded the highest amount of

seed. At the Highgate location plant survival was very low in the untreated check plots. The best stand (76% of planted seed) was obtained with the fungicide/Cruiser treatment, with Cruiser at 50 g ai/100 kg seed. A similar pattern followed for yield. A combination of fungicide and insecticide clearly mitigated the effects of the cool wet spring where seed rots and seed corn maggot prevailed. DCT was inferior to the combination of Apron Maxx RTA plus Cruiser.

Table 1. Emergence and plant stand assessments in dry edible beans at Ridgetown, Ontario; 2004

Treatment	Rate	Emerg	Plant Stand			
	g ai/100 kg	Number of plants per plot				
		20 May	27 May	2 June	11 June	18 June
UNTREATED CHECK		1 c *	0 c **	1 c *	1 c *	0 c **
FUNGICIDE CHECK-APRON MAXX RTA	6.25	49 b	75 b	72 b	64 b	60 b
APRON MAXX RTA +CRUISER 5 FS	6.25 15	81 a	100 a	105 a	100 a	98 a
APRON MAXX RTA +CRUISER 5 FS	6.25 30	90 a	99 a	105 a	105 a	97 a
APRON MAXX RTA +CRUISER 5 FS	6.25 50	85 a	100 a	110 a	105	99 a
APRON MAXX RTA +CRUISER 5 FS	6.25 100	81 a	100 a	110 a	105 a	99 a
DCT	197.6	49 b	65 b	64 b	64 b	67 b
APRON MAXX RTA +CRUISER 350 FS	6.25 50	85 a	100 a	110 a	100 a	100 a
CV		6.9	8.4	7.8	6.7	9.4

* Means followed by same letter do not significantly differ (*P*=.05, LSD), data transformed by square root for means separation and CV, means not de-transformed.
** Means followed by same letter do not significantly differ (*P*=.05, LSD), data transformed by arsine square root for means separation and CV, means not de-transformed

Table 2. Vigor assessments in dry edible beans at Ridgetown, Ontario; 2004

Treatment	Rate g ai/100 kg	Vigor 0-100%				
		20 May	27 May	2 June	11 June	18 June
UNTREATED CHECK		0 c	0.2 c *	0.1 d **	0 c	2.5 d
FUNGICIDE CHECK - APRON MAXX RTA	6.25	45.0 b	62.7 b	65.4 c	57.5 b	61.3 c
APRON MAXX RTA +CRUISER 5 FS	6.25 15	75.0 a	87.4 a	83.3 b	90.0 a	80.0 b
APRON MAXX RTA +CRUISER 5 FS	6.25 30	90.0 a	89.8 a	85.4 b	87.5 a	87.5 ab
APRON MAXX RTA +CRUISER 5 FS	6.25 50	85.0 a	87.4 a	92.5 b	82.5 a	92.5 a
APRON MAXX RTA +CRUISER 5 FS	6.25 100	85.0 a	92.1 a	99.4 a	85.0 a	85.0 ab
DCT	197.6	37.5 b	62.3 b	67.6 c	60.0 b	62.5 c
APRON MAXX RTA +CRUISER 350 FS	6.25 50	90.0 a	82.8 a	87.8 b	90.0 a	90.0 ab
CV		18.3	5	11.1	12.4	10.4

* Means followed by same letter do not significantly differ (*P*=.05 LSD), data transformed by square root for means separation and CV, means not de-transformed.
** Means followed by same letter do not significantly differ (*P*=.05 LSD), data transformed by arsine square root for means separation and CV, means not de-transformed

Table 3. Fresh plant weight and yield assessments in dry edible beans at Ridgetown, Ontario; 2004

Treatment	Rate g ai/100 kg	Fresh Weight g 15 July	Yield T/ha
UNTREATED CHECK		0.05 e *	0.05 d
FUNGICIDE CHECK-APRON MAXX RTA	6.25	3.6 d	2.1 c
APRON MAXX RTA +CRUISER 5 FS	6.25 15	5.2 ab	2.2 bc
APRON MAXX RTA +CRUISER 5 FS	6.25 30	4.7 bc	2.6 ab
APRON MAXX RTA +CRUISER 5 FS	6.25 50	5.6 a	2.6 ab
APRON MAXX RTA +CRUISER 5 FS	6.25 100	5.4 ab	2.9 a
DCT	197.6	4.1 cd	2.5 ab
APRON MAXX RTA +CRUISER 350 FS	6.25 50	5.4 a	2.5 ab
CV		10.8	11.9

* Means followed by same letter do not significantly differ (*P*=.05 LSD).

Table 4. Emergence and plant stand assessments in dry edible beans at Highgate, Ontario; 2004

Treatment	Rate g ai/100 kg	Emergence	Plant Stand Number of plants per plot			
		17 May	25 May	31 May	7 June	14 June
UNTREATED CHECK		7 c *	17 d	20 d	21 d	20 c
FUNGICIDE CHECK-APRON MAXX RTA	6.25	60 b	104 bc	106 c	108 bc	99 b
APRON MAXX RTA +CRUISER 5 FS	6.25 15	74 ab	112 abc	111 abc	114 abc	113 ab
APRON MAXX RTA +CRUISER 5 FS	6.25 30	64 b	105 bc	108 bc	109 bc	101 b
APRON MAXX RTA +CRUISER 5 FS	6.25 50	75 ab	117 ab	121 ab	119 ab	121 a
APRON MAXX RTA +CRUISER 5 FS	6.25 100	77 ab	116 ab	118 abc	118 abc	114 ab
DCT	197.6	64 b	98 c	103 c	105 c	99 b
APRON MAXX RTA +CRUISER 350 FS	6.25 50	87 a	124 a	126 a	124 a	112 ab
CV		22.2	10.4	10.3	9.2	10.9

* Means followed by same letter do not significantly differ (*P*=.05 LSD).

Table 5. Vigor assessments in dry edible beans at Highgate, Ontario; 2004

Treatment	Rate g ai/100 kg	Vigor 0-100%				
		17 May	25 May	31 May	7 June	14 June
UNTREATED CHECK		1.7 c **	8.3 d *	12.5 d	15.0 c	10.8 c
FUNGICIDE CHECK-APRON MAXX RTA	6.25	59.0 b	67.5 c	70.0 c	82.5 ab	82.5 ab
APRON MAXX RTA +CRUISER 5 FS	6.25 15	74.1 b	77.5 abc	77.5 bc	82.5 ab	85.0 ab
APRON MAXX RTA +CRUISER 5 FS	6.25 30	65.5 b	77.5 abc	77.5 bc	85.0 ab	85.0 ab
APRON MAXX RTA +CRUISER 5 FS	6.25 50	86.9 ab	95.0 a	95.0 a	92.5 a	92.5 a
APRON MAXX RTA +CRUISER 5 FS	6.25 100	76.0 b	87.5 ab	90.0 ab	90.0 a	90.0 ab
DCT	197.6	70.5 b	72.5 bc	75.0 c	77.5 b	77.5 b
APRON MAXX RTA +CRUISER 350 FS	6.25 50	97.4 a	92.5 a	92.5 a	90.0 a	92.5 a
CV		25	17.5	13.6	10.1	11.7

* Means followed by same letter do not significantly differ (*P*=.05 LSD).
** Means followed by same letter do not significantly differ (*P*=.05 LSD), data transformed by arsine square root for means separation and CV, means not de-transformed

Table 6. Fresh plant weight and yield assessments in dry edible beans at Highgate, Ontario; 2004

Treatment	Rate g ai/100 kg	Fresh Weight g 15 July	Yield T/ha
UNTREATED CHECK		0.99	0.29 c *
FUNGICIDE CHECK - APRON MAXX RTA	6.25	2.37	0.63 b
APRON MAXX RTA +CRUISER 5 FS	6.25 15	2.48	0.81 ab
APRON MAXX RTA +CRUISER 5 FS	6.25 30	2.71	0.71 ab
APRON MAXX RTA +CRUISER 5 FS	6.25 50	2.46	0.87 a
APRON MAXX RTA +CRUISER 5 FS	6.25 100	2.31	0.73 ab
DCT	197.6	2.56	0.69 ab
APRON MAXX RTA +CRUISER 350 FS	6.25 50	2.56	0.87 ab
CV		43.9	23.6

* Means followed by same letter do not significantly differ (*P*=.05 LSD).

2004 PMRR REPORT # 27 **SECTION E: CEREALS, FORAGE CROPS AND OILSEEDS**
ICAR: 61006537

CROP: Corn (*Zea mays* L.) Pioneer 38P04 (Herculex) Transgenic and Pioneer 38P05 Near-Isoline
PEST: Black cutworm *(Agrotis ipsilon*, Hufnagel)

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TITLE: EFFECTIVENESS OF A BT HYBRID AND CLOTHIANIDIN IN PROTECTING CORN SEEDLINGS FROM BLACK CUTWORM

MATERIALS: PIONEER HI-BRED 38P04 (HERCULEX I Cry 1F Bt), PIONEER HI-BRED 38P05 (non-Bt isoline of 38P04), PONCHO 1250 (clothianidin, 600 g ai/L^{-1}), and PONCHO 250 (clothianidin, 600 g ai/L^{-1}).

METHODS: Four farm fields were selected from across southern Ontario before corn planting in the spring of 2003. All of these fields had a history of heavy cutworm infestations in the past four years. Approximately two weeks before planting, seeds were treated using a gasoline-powered portable cement mixer and $C0_2$-powered spray atomizer. All seed was pre-treated commercially with a fungicide. Each treatment was planted in strips that were 6-rows wide (4.56 m) and at least 800-m long. All treatments were planted by the growers or co-operators using their own planting equipment and at their target plant populations. Treatments included an untreated check of Pioneer Hi-Bred 38P05 (non-Bt) with no insecticide seed treatment, Pioneer Hi-Bred 38P05 treated with PONCHO 250 (0.25 mg a.i. $kernel^{-1}$), Pioneer Hi-Bred 38P05 treated with PONCHO 1250 (1.25 mg a.i. $kernel^{-1}$), Pioneer Hi-Bred 38P04 (Herculex I Bt) treated with no insecticide, and Pioneer Hi-Bred 38P04 treated with PONCHO 250. All treatments were replicated four times in a randomized complete block design, for a total of 20 plots per site.

All sites were monitored throughout the season for insect damage and plant stand. If there where no visual differences apparent among the treatments during early growth, and if there were no apparent cutworm infestations, then the sites were abandoned and no grain yields were recorded. At approximately the eighth leaf stage of crop development, plant spacing variability uas assessed by measuring the distance between plants in six, 10-m row segments of each treatment. Data was collected from the two center rows only.

RESULTS: See Tables 1-4.

CONCLUSIONS: Five farm fields were selected in southern Ontario on the northern side of Lake Erie, before corn planting in the spring of 2004. All of these fields had a history of heavy cutworm infestations in the past four years. Treatments included an untreated check of Pioneer Hi-Bred 38P05 (non-Bt isoline) with no insecticide seed treatment, Pioneer Hi-Bred 38P05 treated with PONCHO 250 (0.25 mg a.i. $kernel^{-1}$), Pioneer Hi-Bred 38P05 treated with PONCHO 1250 (1.25 mg a.i. $kernel^{-1}$), Pioneer Hi-Bred 38P04 (Herculex I Bt) treated with no insecticide, and Pioneer Hi-Bred 38P04 treated with PONCHO 250. Approximately two weeks before planting, seeds were treated with Poncho™ using a gasoline-powered portable cement mixer and $C0_2$-powered spray atomizer. Each treatment was planted in strips

that were 6-rows wide (4.56 m) and at least 800-m long. The trials were planted by the growers, using their planting equipment, and their target plant populations. All treatments were replicated four times in a randomized complete block design, for a total of 20 plots per site.
All sites were monitored throughout the season for insect damage and plant stand. If there were no apparent cutworm infestations, then the site was abandoned and grain yields were not recorded. At approximately the eighth leaf stage of crop development, plant spacing variability and populations were assessed by measuring the distance between plants in six 10-m row segments of each treatment. Data were collected from the two center rows only. Grain yield and moisture content were determined by harvesting the entire plot using the harvesting equipment of the respective farmer/co-operator, and weighing the corn with a weigh wagon (Long Point) or with the use of a yield monitor on the combine (Dunnville).

Table 1: The effect of clothianidin seed treatments and Cry 1F Bt corn on plant establishment, yield and plant populations in a field infested with black cutworm in Woodstock, Ontario 2004.

Treatment	Plants ha^{-1}		% of Check	Yield t / ha^{-1}		% of Check	Harvest Grain Moisture
	Avg.	SD		Avg.	SD		
ISOLINE CHECK	59637 c*	±5327	100 %	10.4	±0.4	100 %	24.7
ISOLINE +CLOTHIANIDIN Low	63351 b	±4066	106 %	10.9	±0.6	104 %	25.0
ISOLINE +CLOTHIANIDIN High	63515 b	±3922	106 %	10.9	±0.3	104 %	25.3
Herculex I Cry 1F Bt	65809 a	±7271	110 %	11.5	±0.4	110 %	26.2
Herculex I +CLOTHIANIDIN Low	69358 a	±4319	116 %	11.7	±1.7	112 %	26.0

* Means followed by the same letter are not significantly different (*P*=0.05 Tukey)

Table 2: The effect of clothianidin seed treatments and Cry 1F Bt corn on plant establishment, yield and plant populations in one of two fields (1) infested with black cutworm Dunnville, Ontario; 2004.

Treatment	Plants ha^{-1}		% of Check	Yield t / ha^{-1}		% of Check	Harvest Grain Moisture
	Avg.	SD		Avg.	SD		
ISOLINE CHECK	74056 a *	±9562	100 %	6.2	±1.3	100 %	21.7
ISOLINE +CLOTHIANIDIN Low	69413 b	±7450	93 %	6.6	±0.2	106 %	21.7
ISOLINE +CLOTHIANIDIN High	68321 b	±4786	92 %	6.6	±0.1	106 %	21.7
Herculex I Cry 1F Bt	67229 b	±4277	91 %	6.7	±0.3	108 %	21.7
Herculex I +CLOTHIANIDIN Low	67502 b	±4090	90 %	7.0	±0.2	112 %	21.7

* Means followed by the same letter are not significantly different (*P*=0.05 Tukey)

Table 3: The effect of clothianidin seed treatments and Cry 1F Bt corn on plant establishment, yield and plant populations in one of two fields (2) infested with black cutworm in Dunnville, Ontario; 2004.

Treatment	Plants ha^{-1}		% of Check	Yield t / ha^{-1}		% of Check	Harvest Grain Moisture
	Avg.	SD		Avg.	SD		
ISOLINE CHECK	70615	±5618	100 %	7.1	±3.2	100 %	21.8
ISOLINE +CLOTHIANIDIN Low	69522	±7745	98 %	7.0	±2.8	99 %	21.8
ISOLINE +CLOTHIANIDIN High	69522	±5634	98%	7.1	±2.8	100 %	21.8
Herculex I Cry 1F Bt	70614	±6841	99 %	8.6	±2.8	121 %	21.8
Herculex I +CLOTHIANIDIN Low	69796	±7694	98 %	6.6	±0.5	92 %	21.8

Table 4: The effect of clothianidin seed treatments and Cry 1F Bt corn on plant establishment, yield and plant populations in a field infested with black cutworm in Long Point, Ontario; 2004.

Treatment	Plants ha-1		% of Check	Yield t / ha^{-1}		% of Check	Harvest Grain Moisture
	Avg.	SD		Avg.	SD		
ISOLINE CHECK	69795	±3889	100 %	-		-	-
ISOLINE +CLOTHIANIDIN Low	71762	±2712	102 %	-		-	-
ISOLINE +CLOTHIANIDIN High	69686	±2712	100 %	-		-	-
Herculex I Cry 1F Bt	68703	±3254	98 %	-		-	-
Herculex I +CLOTHIANIDIN Low	69631	±3549	100 %	-		-	-

2004 PMRR REPORT # 28 **SECTION E: CEREAL, FORAGE CROPS, and OILSEEDS**
ICAR: 61006537

CROP: Corn (*Zea maize* L.), Pioneer 38P04 Transgenic (Herculex) and Pioneer 38P05 Near-Isoline
PEST: Black Cutworm, *Agrotis ipsilon*, Hufnagel

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TITLE: CONTROL OF BLACK CUTWORM IN CORN WITH SEED TREATMENTS

MATERIALS: MAXIM XL 324 FS (fludioxonil + metalaxyl-M, 229.59 + 87.66 g ai/L); PONCHO 250 FS (clothianidin, 250 g ai/L); PONCHO 1250 FL (clothianidin, 1250 g ai/L); Lorsban 4E (chlorpyrifos, 480 g ai/L).

METHODS: Seed was treated at a rate of 1.15 L ai/ha in 22 kg lots by spraying treatments into a modified cement mixer with a hand held precision CO_2 sprayer. Treatments were evenly applied as the seed rotated in the mixer and the seed was allowed to mix for an additional 1.5 min to ensure thorough coverage. The crop was planted on 13 and 21 May, 2004 at Ridgetown at a seeding rate of 10 seeds per m using a two-row cone-seeder mounted on a John Deere Max Emerge planter. Plots were 4 rows, 4 m in length and spaced 0.76 m apart arranged in a RCBD with 4 replications. Round galvanized metal enclosures 7.32 m X 40 cm high were installed in each plot to enclose two rows prior to the third leaf stage. The number of plants in each enclosure was thinned to 24 in the early planting and to 15 in the late planting before infestation. Lorsban spray was applied one day before infestation using a SOLO® backpack sprayer at a rate of 1.15 L ai/ha. Lorsban was applied to plots designated for infestation with 3rd instars on 31 May, 2004 and to plots designated for infestation with 1st - 2nd instars on 1 June, 2004. Early planted plots were infested at dusk with 3rd instars (1.0 cm average length) at a rate of 1 larva per plant on 31 May, 2004 when the corn had reached the 4 leaf stage. Plants were infested with 1st - 2nd instars in the plant whorl on 1 June, 2004 when plants had reached the 2 leaf stage. The enclosed plots were covered with a thin layer of wheat straw to provide protection from birds and heat. Late planted plots were sprayed with Lorsban on 4 June, 2004. Late planted plots were infested with 3rd and 1st instars at 2 leaf stage on 3 June, 2004 in the same manner as above. The number of individual missing/damaged/cut plants were counted and rated using the Guthrie scale (1-10), (Tseng *et al.*, 1984, J Econ Ent: 77) until feeding stopped. Final plant stands and fresh weights were assessed on 18 June, 2004.

RESULTS: See Tables 1-4.

CONCLUSIONS: The higher rate of Poncho was needed to significantly reduce cutworm plant damage. In most cases Poncho 1250 provided the same protection as a LORSBAN spray applied before infestation. The Herculex + Poncho 250 combination provided the best protection against cutworm.

Table 1. Control of black cutworm with seed treatments in early planting with 1st-2nd stage instars at Ridgetown, Ontario; 2004

Treatment	Rate g ai/100 kg or mg/seed* or L ai/ha	Early Planting Damage Guthrie 1-10 9 June 6 leaf stage	Early Planting Stand % Survival	Fresh Weight kg 18 June
FUNGICIDE CHECK	3.5	2.3 a **	99	1.03
MAXIM XL	3.5	2.3 a	100	1.17
+PONCHO 250 FL	0.25 *			
MAXIM XL	3.5	2.3 a	100	0.99
+PONCHO 1250 FL	1.25 *			
MAXIM XL	3.5	1.5 c	100	1.03
+LORSBAN SPRAY	1.15 L			
MAXIM XL	3.5	1.6 bc	98	1.04
+HERCULEX LINE ***				
MAXIM XL	3.5	2.0 ab	100	1.17
+ HERCULEX LINE				
+PONCHO 250 FL	0.25 *			
CV		14.3	1.8	9.9

** Means followed by same letter do not significantly differ (*P*=0.05 LSD)

*** Herculex - The non-transgenic, near-isoline version of Herculex was used for all treatments with the exception of the last two.

Table 2. Control of black cutworm with seed treatments in early planting with 3rd stage instars at Ridgetown, Ontario; 2004

Treatment	Rate	Early Planting		
	g ai/100 kg or mg/seed* or L ai/ha	Damage Guthrie 1-10 9 June 6 leaf stage	Stand % Survival	Fresh Weight kg 18 June
FUNGICIDE CHECK	3.5	2.6	85	0.72 c **
MAXIM XL	3.5	2.3	93	1.09 ab
+PONCHO 250 FL	0.25 *			
MAXIM XL	3.5	2.2	92	0.86 bc
+PONCHO 1250 FL	1.25 *			
MAXIM XL	3.5	1.6	98	0.96 abc
+LORSBAN SPRAY	1.15 L			
MAXIM XL	3.5	1.2	99	0.97 abc
+HERCULEX LINE ***				
MAXIM XL	3.5	1.4	99	1.16 a
+ HERCULEX LINE				
+PONCHO 250 FL	0.25 *			
CV		39.6	8.8	17.9

** Means followed by same letter do not significantly differ (*P*=0.05 LSD)
*** Herculex - The non-transgenic, near-isoline version of Herculex was used for all treatments with the exception of the last two.

Table 3. Control of black cutworm with seed treatments in late planting with 1st -2nd stage instars at Ridgetown, Ontario; 2001

Treatment	Rate g ai/100 kg or mg/seed * or L ai/ha	Late Planting Damage Guthrie 1-10 11 June 6 leaf stage	Late Planting Stand % Survival	Late Planting Fresh Weight kg 18 June
FUNGICIDE CHECK	3.5	3.8 a **	106	0.14
MAXIM XL	3.5	3.3 ab	98	0.19
+PONCHO 250 FL	0.25 *			
MAXIM XL	3.5	2.0 c	100	0.21
+PONCHO 1250 FL	1.25 *			
MAXIM XL	3.5	2.3 bc	100	0.18
+LORSBAN SPRAY	1.15 L			
MAXIM XL	3.5	2.3 bc	100	0.18
+HERCULEX LINE				
MAXIM XL	3.5	1.9 c	102	0.18
+ HERCULEX LINE				
+PONCHO 250 FL	0.25 *			
CV		30	5	19.2

** Means followed by same letter do not significantly differ (P=.05 LSD)

*** Herculex - The non-transgenic, near-isoline version of Herculex was used for all treatments with the exception of the last two.

Table 4. Control of black cutworm with seed treatments in late planting with 3rd stage instars at Ridgetown, Ontario; 2004

Treatment	Rate g ai/100 kg or mg/seed * or L ai/ha	Late Planting Damage Guthrie 1-10 11 June 6 leaf stage	Late Planting Stand % Survival	Late Planting Fresh Weight kg 18 June
FUNGICIDE CHECK	3.5	4.7 a **	94 ab	0.14
MAXIM XL	3.5	3.8 ab	87 b	0.16
+PONCHO 250 FL	0.25 *			
MAXIM XL	3.5	2.5 bc	97 a	0.18
+PONCHO 1250 FL	1.25 *			
MAXIM XL	3.5	2.8 bc	97 a	0.18
+LORSBAN SPRAY	1.15 L			
MAXIM XL	3.5	2.2 bc	100 a	0.14
+HERCULEX LINE ***				
MAXIM XL	3.5	1.6 c	97 a	0.17
+ HERCULEX LINE				
+PONCHO 250 FL	0.25 *			
CV		39.9	5.3	31.1

** Means followed by same letter do not significantly differ (*P*=.05 LSD)

*** Herculex - The non-transgenic, near-isoline version of Herculex was used for all treatments with the exception of the last two.

2004 PMRR REPORT # 29 **SECTION E: CEREAL, FORAGE CROPS, and OILSEEDS - Insects**
ICAR: 61006537

CROP: Corn, (*Zea maize* L.), Hybrid Dekalb 73
PEST: Western corn rootworm, *Diabrotica virgifera virgifera* LeConte

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TITLE: CONTROL OF CORN ROOTWORM IN CORN WITH SEED TREATMENTS

MATERIALS: MAXIM XL 324 FS (fludioxonil + metalaxyl-M, 229.59 + 87.66 g ai/L); PONCHO 600 FS (clothianidin, 600 g ai/L); L1116-A1 (Experimental); G7065-00 (Experimental); FORCE 3G (tefluthrin, 3% v/v).

METHODS: Seed was treated on 5 May, 2004 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 seed was then mixed for 1 min in the inflated bag to ensure thorough seed coverage. Seed weight was 277 g/1000 seeds. Inoculations with corn rootworm eggs were made at two Ridgetown locations, one on-campus and one off-campus, 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). Corn was planted in 1 row plots on 3 June, 2004 at both locations using a two-row cone-seeder at a seeding rate of 8 seeds/m. FORCE 3G was applied in-furrow at planting using a Noble® plot scale applicator. Plots were 1 row spaced 0.76 m apart and were 10 m long in a RCBD with 4 replications. The plots were fertilized and maintained according to provincial recommendations. Plant emergence was recorded on 14 June, 2004 and plant stand was assessed on 21 June, 2004 at both locations. Vigour was recorded on the same dates using a scale of 0-100% (100= furthest developed plant and 0 = dead plants). Root damage assessments at both locations were recorded on 21 June, 2004. Ten plants per plot were dug up, washed and rated for root worm damage using the Iowa 1-6 scale where ‘1'= no damage and ‘6' = three or more nodes severely pruned. Plots were harvested on 11 Nov, 2004 at the on-campus site and hand harvested on 19 Nov, 2004 at the off-campus site and yields converted to 15.5% moisture. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at P= 0.05.

RESULTS: See Tables 1-3. Only 2 replications were harvested at the off-campus location due to water damage to plots in the other two replications from an extremely wet spring. Water damage was noted on 21 June, 2004 when plant stand and vigour assessments were recorded.

CONCLUSIONS: Similar levels of rootworm damage protection was obtained from all treatments compared to the untreated control. Yields were variable due to wet spring conditions and no differences were noted.

Table 1. Emergence, plant stand, vigor and damage assessments in on-campus site at Ridgetown, Ontario; 2004

Treatment	Rate	Emergence	Plant Stand	Vigor		Damage
	g ai/100 kg	Number plants per plot		0-100 %		1-6 Iowa
	or mg/seed *	14 June	21 June	14 June	21 June	
FUNGICIDE CHECK MAXIM XL	3.5	52	73	60	82.5	3.7 a **
MAXIM XL +PONCHO 600 FS	3.5 1.3	58	75	90	92.5	1.5 b
MAXIM XL +G7065 Exp	3.5 1.3 *	49	73	60	75	2.0 b
MAXIM XL +L1116-A1 Exp	3.5 1.3 *	50	73	67.5	80	1.3 b
MAXIM XL +FORCE 3G kg/ha	3.5 0.13	56	73	82.5	90	1.3 b
CV		17.7	5.1	28.9	17.4	17.7

** Means followed by same letter do not significantly differ (*P*=.05 LSD), data transformed by arsine square root for means separation and CV, means not de-transformed.

Table 2. Emergence, plant stand, vigor and damage assessments in off-campus site at Ridgetown, Ontario; 2004

Treatment	Rate	Emergence	Plant Stand	Vigor		Damage
		Number plants/plot		0-100 %		1-6 Iowa
		14 June	21 June	14 June	21 June	
FUNGICIDE CHECK MAXIM XL	3.5	56	67	62.5	73.8	3.7 a *
MAXIM XL +PONCHO 600 FS	3.5 1.3	63	69	72.5	83.8	1.6 b
MAXIM XL +G7065 Exp mg/seed	3.5 1.3	63	75	82.5	78.8	2.0 b
MAXIM XL +L1116-A1 Exp mg/seed	3.5 1.3	51	66	60	77.5	1.2 b
MAXIM XL +FORCE 3G kg/ha	3.5 0.13	62	73	77.5	85	1.4 b
CV		25.8	12.7	39.2	19.8	17.2

* Means followed by same letter do not significantly differ (*P*=0.05 LSD), data transformed by arsine square root for means separation and CV, means not de-transformed

Table 3. Test weights and yields in corn at two sites in Ridgetown, Ontario; 2004

		On-campus Site		Off-campus Site	
Treatment	Rate	Test Wt	Yield	Test Wt	Yield
	g ai/100 kg	kg/hl	T/ha	kg/hl	T/ha
	or mg/seed *	11 Nov			
FUNGICIDE CHECK	3.5	63.98	5.54	67.38	1.11
MAXIM XL					
MAXIM XL	3.5	65.25	7.01	69.42	1.52
+PONCHO 600 FS	1.3				
MAXIM XL	3.5	65.36	6.22	66.85	0.75
+G7065 Exp	1.3 *				
MAXIM XL	3.5	64.78	6.59	69.4	1.08
+L1116-A1 Exp	1.3 *				
MAXIM XL	3.5	65.25	6.5	66.52	0.56
+FORCE 3G kg/ha	0.13				
CV		1.5	15.9	1	15.6

* Means followed by same letter do not significantly differ (*P*=0.05 LSD), data transformed by arsine square root for means separation and CV, means not de-transformed

2004 PMRR REPORT # 30 **SECTION E: CEREAL, FORAGE CROPS, and OILSEEDS - Insects**
ICAR: 61006537

CROP: Corn, (*Zea maize* L.), cv DAS-59122-7 Transgenic and its Isoline
PEST: Western corn rootworm, *Diabrotica virgifera virgifera* LeConte

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TITLE: CONTROL OF CORN ROOTWORM IN CORN WITH SEED TREATMENTS

MATERIALS: PONCHO 250 FS (clothianidin, 250 g ai/L); PONCHO 1250 FS (clothianidin, 1250 g ai/L); FORCE 3G (tefluthrin, 3%).

METHODS: Seed was pre-treated by Dow Agrosciences. Inoculations with corn rootworm eggs were made at two sites prior to planting using a two-row cultivator modified to apply a 4 cm band of eggs, 5 cm deep and 9 cm to each side of the corn row. Eggs were suspended uniformly in a 0.15% agar solution at a concentration of 30 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). Corn was planted in 1 row plots on 20 May and 4 June, 2004 at Ridgetown and St. Mary's, ON respectively, using a two-row cone-seeder at a seeding rate of 8 seeds/m. FORCE 3G was applied in-furrow at planting at a rate of 34 g product/100 m row using a Noble® plot scale applicator. Plots were spaced 0.76 m apart and were 10 m long arranged in a RCBD with 4 replications. The plots were fertilized and maintained according to provincial recommendations. Plant emergence was assessed on 4 June, 2004 at Ridgetown. Vigor was recorded on the same date using a scale of 0-100% (100= furthest advance healthy plant and 0 = dead plants). Final plant stand was assessed on 30 June, 2004 at Ridgetown. Root damage assessments were recorded on 27 July, 2004 at Ridgetown and St. Mary's. Six plants per plot were dug up, washed and rated for rootworm damage using the New Iowa 0-3 scale where '0' = no damage and '3' = three or more nodes severely pruned. Plots were not taken to harvest. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at P= 0.05.

RESULTS: See Table1.

CONCLUSIONS: No difference in emergence, vigor or final stand were noted at the Ridgetown site. Transgenic DAS59122-7 under high rootworm pressure was very effective in protecting roots from damage. PONCHO 250 seed treatment alone resulted in some rootworm damage suppression as did PONCHO 1250 but neither reduced damage to below the threshold of 1.0, whereas the commercial standard treatment with of FORCE 3G did.

Table 1. Emergence, vigor, final stand assessments at Ridgetown and damage assessments in corn at Ridgetown and St. Mary's, Ontario; 2004

Treatment	Rate g ai/100 kg or mg/seed* or g/100 m row **	Emergence #/2row 4 June	Vigor 0-100% 4 June	Final Stand #/2row 30 June	Average Damage New Iowa Scale 0-3 Ridgetown	St. Mary's
DAS 59122-7	0	152	92.5	155	0 d ****	0.05 d ***
DAS 59122-7	0	151	95	156	0.1 cd	0.05 d
+PONCHO 250 FS	0.25 *					
ISOLINE	0	153	85	157	0.5 b	2.9 a
ISOLINE	0	155	85	153	1.4 a	1.5 b
+PONCHO 250 FS	0.25*					
ISOLINE	0	146	87.5	150	0.4 bc	1.1 c
+PONCHO1250 FS	1.25*					
ISOLINE	0	150	85	154	0.3 bcd	0.3 d
+FORCE 3G IF	34**					
CV		4	7.6	4	15.1	20.2

*** Means followed by same letter do not significantly differ (*P*=0.05 LSD)
**** Means on transformed data followed by same letter do not significantly differ (*P*=0.05 LSD), data transformed by square root for means separation and CV, means not de-transformed.

2004 PMRR REPORT # 31 **SECTION E: CEREAL, FORAGE CROPS, and OILSEEDS - Insects**
ICAR: 61006537

CROP: Corn, (*Zea maize* L.), cv Maizex MZ 500
PEST: Corn flea beetle (*Chaetocnema pulicaria*, Melsheimer)

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TITLE: CONTROL OF CORN FLEA BEETLE WITH SEED TREATMENTS.

MATERIALS: MAXIM XL 324 FS (fludioxonil + metalaxyl-M, 229.59 + 87.66 g ai/L); CRUISER 5 FS (thiamethoxam, 5 g ai/L); PONCHO 600 FL (clothianidin, 600 g ai/L); CRUISER 350 FS (thiamethoxam, 350 g ai/L).

METHODS: Seed was treated on 30 April, 2004 in 500 g lots in individual plastic bags by applying a slurry (all treatments diluted in water to the same volume of 1.0 ml per kg) of the material via a syringe to each inflated bag. The seed was then mixed for 1 minute in an inflated bag to ensure thorough seed coverage. Seed weight was 270 g/1000 seeds. Corn was planted 28 May, 2004 at Ridgetown, ON using a two-row cone-seeder mounted on a John Deere Max Emerge planter. Plots were four rows 4 m in length and spaced 0.76 m apart arranged in a RCBD with 4 replications at a seeding rate of 8 seeds/m. Plant emergence was recorded on 8 June, 2004 and plant stand was assessed on 15 and 22 June, 2004. Vigor was assessed on the same dates using a scale of 0-100% (100 = most advance plant and 0 = dead plants). Two rows of each plot were harvested on 15 Nov, 2004 and corrected to 15.5 % moisture. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at $P = 0.05$.

RESULTS: See Table 1. No flea beetles were observed at the Ridgetown location in 2004.

CONCLUSIONS: A combination of seed treatment fungicides and insecticides was needed to maximize emergence and plant vigour, with significantly higher vigor provided by PONCHO at 0.25 mg/seed. This effect was not carried through to yields.

Table 1. Emergence, plant stand, vigor and yield assessments in corn at Ridgetown, Ontario; 2004

Treatment	Rate	Emergence	Plant Stand		Vigour (100 %)		
	g ai/100 kg	Number plants/plot					
	or mg/seed *	8 June	15 June	22 June	8 June	15 June	22 June
UNTREATED CHECK		47 c **	52 b	52 c	62.5 c	70.0 d	70.0 d
FUNGICIDE CHECK	3.5	50 bc	53 b	53 bc	75.0 bc	77.5 cd	77.5 cd
MAXIM XL	3.5	52 ab	57 a	58 a	82.5 b	85.0 bc	85.0 bc
+CRUISER 5 FS	25						
MAXIM XL	3.5	52 abc	57 a	56 ab	75.0 bc	77.5 cd	77.5 cd
+CRUISER 5 FS	50						
MAXIM XL	3.5	52 abc	60 a	60 a	85.0 b	85.0 bc	87.5 b
+CRUISER 5 FS	100						
MAXIM XL	3.5	56 a	59 a	59 a	100 a	100 a	100 a
+PONCHO 600 FL	0.25 *						
MAXIM XL	3.5	54 ab	57 a	58 a	87.5 ab	90.0 b	90 b
+CRUISER 350 FS	50						
CV		6.8	4.2	4.1	11.3	7.2	7.4

** Means followed by same letter do not significantly differ (*P*=0.05 LSD)

Table 2. Yields and test weight assessments in corn at Ridgetown, Ontario; 2004

Treatment	Rate	Yield	Test Weight
	g ai/100 kg	T/ha	kg/hl
	or mg/seed *	15 Nov	
UNTREATED CHECK		6.4	76.9
FUNGICIDE CHECK	3.5	8.0	76.4
MAXIM XL	3.5	7.5	76.9
+CRUISER 5 FS	25		
MAXIM XL	3.5	7.1	77.2
+CRUISER 5 FS	50		
MAXIM XL	3.5	8.0	76.5
+CRUISER 5 FS	100		
MAXIM XL	3.5	8.9	76.9
+PONCHO 600 FL	0.25 *		
MAXIM XL	3.5	7.4	76.9
+CRUISER 350 FS	50		
CV		18.5	0.7

2004 PMRR REPORT # 32

SECTION E: CEREAL, FORAGE, AND OILSEED CROPS - Insects
ICAR: 61006537

CROP: Soybean, (*Glycine max* (L.) Merrill), cv. Renoun (Round-up Ready)
PEST: Seedcorn maggot, *Delia platura* (Meigen)

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TITLE: CONTROL OF SEED CORN MAGGOT IN SOYBEANS WITH SEED TREATMENTS

MATERIALS: CRUISER 5 FS (thiamethoxam, 5 g ai/L); CRUISER 350 FS (thiamethoxam, 350 g ai/L); APRON MAXX RTA 19.05 FS (fludioxonil + metalaxyl-M, 7.69 + 11.54 g ai/L); AGROX DL PLUS (captan + diazinon + lindane, 150 + 150 + 250 g ai/L).

METHODS: Seed was treated on 26 April, 2004 in 500 g lots in individual plastic bags by applying the treatment or slurry via a syringe to each bag (all treatments diluted to the same volume of 2.5 ml/kg seed using water). The seed was then mixed in the inflated bag for 1 min to ensure thorough seed coverage. Cattle manure was broadcast on the plots 2 weeks before planting and the soil was disced shortly after the manure application. The crop was planted on 6 May, 2004 at Ridgetown and Highgate, ON, using a 2-row cone seeder at a seeding rate of 8 seeds/m. after yellow sticky traps captured some adult seed corn maggots. 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. Total plot emergence was evaluated on 17 and 20 May, 2004 at Highgate and Ridgetown, respectively. Plant stand was assessed on 25, 31 May, 7 and 14 June, 2004 at Highgate and 27 May, 2, 11 and 18 June, 2004 at Ridgetown. Vigour was assessed on the same dates using a scale of 0-100% (100 = furthest developed and most healthy plant in the trial and 0 = plant dead). Seed corn maggot damage and number of maggots were assessed in the check plots on 17 and 20 May, 2004 at Highgate and Ridgetown, respectively, by exhuming all plants and seed remains from a 1 m length of row. Plant fresh weights in 1 m were assessed on 15 July, 2004 at both locations. Plots were harvested on 27 and 28 Oct, 2004 at Ridgetown and Highgate, respectively and corrected to 14.5% moisture. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at the $P = 0.05$.

RESULTS: See Tables 1-4. Mean damaged plants/m in the check plots was 1.5 and 1.8 at Ridgetown and Highgate, respectively. Mean number of seed corn maggots/m recovered from the check plots was 0.2 and 0 at Ridgetown and Highgate, respectively. No phytotoxicity due to treatment effects was noted in the plots. Data from plots 107, 207 and 307 at Ridgetown are missing due to mechanical problems.

CONCLUSIONS: There were no significant differences in the final plant stands taken on 18 June between insecticide seed treatments. Eighty-seven percent of the seeds that were planted survived under protection of insecticide/fungicide seed treatment combination. Sixty-eight percent of the seed planted survived with only fungicide treatment and only 34 % with no seed treatment. While there was a rate response with CRUISER in emergence and vigour with 100 g ai/100 kg providing almost 100 % emergence, CRUISER at the 15 g ai/100 kg rate had a similar stand and yield. The highest yield was obtained at the 30 and 50 g ai/100 kg rates. CRUISER plus APRON MAXX at the lowest rates of CRUISER still resulted in significantly greater yield than AGROX DL PLUS at the recommended rate.

Table 1. Emergence, plant stand and fresh weight assessments in soybeans at Ridgetown, Ontario. 2004

Treatment	Rate g ai/100 kg	Emergence	Plant Stand Number plants/plot				Fresh Wt g
		20 May	27 May	2 June	11 June	18 June	15 July
UNTREATED CHECK		37 d *	47 f	50 e	46 d	44 d	1.29 b
FUNGICIDE CHECK		67 bc	91 e	90 d	89 c	87 c	2.40 ab
APRON MAXX RTA	6.25						
APRON MAXX RTA +CRUISER 5 FS	6.25 15	79 abc	110 cd	116 bc	109 ab	107 ab	3.11 a
APRON MAXX RTA +CRUISER 5 FS	6.25 30	68 bc	112 bcd	112 c	106 b	102 bc	3.45 a
APRON MAXX RTA +CRUISER 5 FS	6.25 50	97 a	124 ab	126 ab	121 a	117 ab	3.62 a
APRON MAXX RTA CRUISER 5 FS	6.25 100	97 a	127 a	127 a	122 a	119 a	3.02 a
AGROX DL PLUS	197.6	61 c	109 d	116 abc	108 b	105 ab	2.77 a
APRON MAXX RTA +CRUISER 350 FS	6.25 50	85 ab	122 abc	119 abc	113 ab	114 ab	2.55 a
CV		21.5	7.9	6.8	9	11.1	29.8

*Means followed by same letter do not significantly differ (*P*=0.05 LSD)

Table 2. Vigor and yield assessments in soybeans at Ridgetown, Ontario.;2004

Treatment	Rate g ai/100 kg	Vigor 0-100%					Yield T/ha
		20 May	27 May	2 June	11 June	18 June	27 Oct
UNTREATED CHECK		22.5 d *	32.5 d	52.5 d	50.0 b	47.5 b	1.7 d
FUNGICIDE CHECK		62.5 bc	65.0 c	75.0 c	77.5 a	72.5 a	2.8 abc
APRON MAXX RTA	6.25						
APRON MAXX RTA	6.25	75.0 abc	77.5 bc	80.0 bc	80.0 a	77.5 a	2.9 ab
+CRUISER 5 FS	15						
APRON MAXX RTA	6.25	60.0 bc	77.5 bc	85.0 abc	77.5 a	77.5 a	3.0 a
+CRUISER 5 FS	30						
APRON MAXX RTA	6.25	90.0 a	87.5 ab	90.0 ab	87.5 a	90.0 a	3.1 a
+CRUISER 5 FS	50						
APRON MAXX RTA	6.25	92.5 a	95.0 a	92.5 a	90.0 a	87.5 a	2.6 abc
CRUISER 5 FS	100						
AGROX DL PLUS	197.6	55.0 c	82.5 ab	85.0 abc	77.5 a	80.0 a	2.0 cd
APRON MAXX RTA	6.25	82.5 ab	82.5 ab	87.5 ab	80.0 a	75.0 a	2.1 bcd
+CRUISER 350 FS	50						
CV		26.2	15.2	10.2	16.5	18.6	23.6

* Means followed by same letter do not significantly differ (*P*=.05 LSD)

Table 3. Emergence, plant stand and fresh weight assessments in soybeans at Highgate, Ontario; 2004

Treatment	Rate g ai/100 kg	Emergence	Plant Stand Number plants per row				Fresh Wt g
		17 May	25 May	31 May	7 June	14 June	15 July
UNTREATED CHECK		66	100 c *	101 c	100 c **	96 c	2.44
FUNGICIDE CHECK		87	125 ab	130 ab	121 b	127 ab	3.35
APRON MAXX RTA	6.25						
APRON MAXX RTA	6.25	101	129 ab	129 ab	121 b	130 ab	4.35
+CRUISER 5 FS	15						
APRON MAXX RTA	6.25	79	124 b	122 b	121 b	123 b	3.64
+CRUISER 5 FS	30						
APRON MAXX RTA	6.25	86	131 ab	132 ab	126 b	135 ab	3.51
+CRUISER 5 FS	50						
APRON MAXX RTA	6.25	100	136 a	138 a	144 a	140 a	4.82
CRUISER 5 FS	100						
AGROX DL PLUS	197.6	87	129 ab	129 ab	126 b	129 ab	3.28
APRON MAXX RTA	6.25	93	123 b	127 ab	126 b	125 b	3.96
+CRUISER 350 FS	50						
CV		20.9	6.2	7.5	3.5	7.1	4

* Means followed by same letter do not significantly differ (*P*=.05 LSD)
** Means followed by same letter do not significantly differ (*P*=.05, LSD), data transformed by square root for means separation and CV, means not de-transformed.

Table 4. Vigor and yield assessments in soybeans at Highgate, Ontario; 2004

Treatment	Rate g ai/100 kg	Vigor 0-100%					Yield T/ha
		17 May	25 May	31 May	7 June	14 June	28 Oct
UNTREATED CHECK		65	65.0 d *	62.5 c	67.5 c	70	2.21
FUNGICIDE CHECK		72.5	77.5 bcd	82.5 b	82.5 ab	82.5	2.14
APRON MAXX RTA	6.25						
APRON MAXX RTA	6.25	87.5	92.5 ab	85.0 ab	85.0 ab	85	2.56
+CRUISER 5 FS	15						
APRON MAXX RTA	6.25	72.5	75.0 cd	77.5 b	82.5 ab	85	2.39
+CRUISER 5 FS	30						
APRON MAXX RTA	6.25	80	82.5 abc	82.5 b	85.0 ab	85	2.66
+CRUISER 5 FS	50						
APRON MAXX RTA	6.25	87.5	95.0 a	97.5 a	92.5 a	92.5	2.61
CRUISER 5 FS	100						
AGROX DL PLUS	197.6	80	80.0 a-d	77.5 b	77.5 bc	82.5	2.22
APRON MAXX RTA	6.25	92.5	90.0 abc	90.0 ab	92.5 a	92.5	2.16
+CRUISER 350 FS	50						
CV		18	12.4	12.3	10.5	10.9	16.4

* Means followed by same letter do not significantly differ (P=.05 LSD)

2004 PMRR REPORT # 33 **SECTION E: CEREAL, FORAGE, AND OILSEED CROPS - Insects**
ICAR: 61006537

CROP: Soybean, (*Glycine max* (L.) Merrill), cv Pioneer 91B33
PEST: Soybean aphid (*Aphis glycines*, Matsumura)

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TITLE: CONTROL OF SOYBEAN APHIDS WITH SEED TREATMENT IN CAGED PLOTS

MATERIALS: APRON MAXX RTA 19.05 FS (fludioxonil + metalaxyl-M, 7.69 + 11.54 g ai/L); CRUISER 5 FS (thiamethoxam, 50 g ai/ 100 kg seed); GAUCHO 350 FS (imidacloprid, 62 g ai/100 kg seed); GAUCHO 350 FS (imidacloprid, 100 g ai/100 kg seed).

METHODS: Seed was treated on 13 April, 2004 in 20 kg lots by spraying treatments into a modified cement mixer with a hand-held precision CO_2 sprayer. Insecticide was evenly applied as the seed rotated in the mixer and the seed was allowed to mix for an additional 1 minute to ensure even coverage. The crop was planted on 3 and 1 of June, 2004 at Site 1 and 2, respectively outside of Ridgetown, ON, using a John Deere 750 no-till drill at a seeding rate of 500,000 seeds / ha. Plots were 3 m wide by 10 m long with 3 replications. The plots were maintained according to provincial recommendations. Soybean aphid did not occur naturally at either location in 2004, therefore individual plants were enclosed at each site in nylon mesh caging and infested with aphids reared from laboratory colonies. At site 1, 1 plant at two equidistant points within each plot was enclosed. At site 2, 3 plants at two equidistant points within each plot were enclosed. Enclosure of plants took place on 22 and 23 June, 2004 at Site 1 and 2, respectively, and 200 soybean aphids were introduced to each cage on those dates. Further infestations of 200 aphids to the same enclosures took place at sites 1 and 2 on 30 July and on 5 and 6 Aug at sites 1 and 2, respectively. Ratings of aphid numbers were conducted at site 1 on 30 July, and 5, 12 Aug and at site 2 on 30 July and 6, 12 Aug. Ratings were on a 0-4 scale (‘0'=no aphids, ‘1'=1-10 aphids, ‘2'=11-25 aphids, ‘3'=26-99 aphids, ‘4'=100 + aphids. Four ratings were taken per plant on each observation date (on the stem, and on a top, middle and bottom trifoliate) giving a total plant score out of 16. Destructive sampling, in which total per plant aphid populations were assessed, occurred 4 weeks after enclosure of plants. Ratings and aphid counts per plant were analysed using ANOVA and means were separated using least significant difference (LSD) at $P = 0.05$. Yields could not be assessed due to destructive sampling of plant material.

RESULTS: See Tables 1 and 2.

CONCLUSIONS: Aphid populations on plants treated with the high rate of GAUCHO (100 g ai/100 kg) had significantly lower populations of aphids, as assessed by per plant counts, compared to untreated plants; up to 10 weeks after planting (12 Aug).

Table 1. Aphid populations and final counts in soybeans at Site 1 in Ridgetown, Ontario; 2004

Weeks after planting		Week 8	Week 9	Week 10	Week 10
	Rate (g ai/100 kg)	Total Plant Score (0-16)			Per Plant Counts
Treatment		30 July	5 Aug	12 Aug	12 Aug
FUNGICIDE CHECK-MAXIM XL		4.7 **	6.3	8.32 b*	1471.8 ab ***
APRON MAXX RTA +CRUISER	6.255	5.5	4.5	8.1 b	690.3 bc
APRON MAXX RTA +GAUCHO	6.2562	5.3	5.9	11.3 a	2063.3 a
APRON MAXX RTA +GAUCHO	6.251	5.5	4.6	6.2 b	489.1 c
CV		26.4	13.5	31.1	41.8

* Means followed by the same letter do not significantly differ (*P*=0.05 LSD);
** Week two aphid rating data transformed by square root * for means separation and CV, means de-transformed.
*** Week 4 per plant count data transformed by square root ** transformation for means separation and CV, means de-transformed.
All other data homogeneous and not transformed.

Table 2. Aphid populations and final counts in soybeans at Site 2 in Ridgetown, Ontario; 2004

Weeks after planting		Week 8	Week 9	Week 10	Week 10
	Rate: g ai/100 kg	Rating (0-16)			Per plant aphid counts
Treatment		30 July	5 Aug	12 Aug	12 Aug
FUNGICIDE CHECK-MAXIM XL		0.9 **	4	7.2 a *	677.1 a **
APRON MAXX RTA +CRUISER	6.255	0.7	3.5	4.6 b	322.3 ab
APRON MAXX RTA +GAUCHO	6.2562	1.2	3.4	4.3 b	169.5 b
APRON MAXX RTA +GAUCHO	6.251	0.77	2.4	3.7 b	74.7 b
CV		53.4	51.7	38.6	18.9

* Means followed by same letter do not significantly differ, (*P*=0.05 LSD)
** Means on transformed data followed by the same letter do not significantly differ (*P*=0.05 LSD), data transformed by square root for means separation and CV, means de-transformed.
All other data homogeneous and not transformed.

2004 PMRR REPORT # 34 **SECTION E: CEREAL, FORAGE, and OILSEED CROPS - Insects**
ICAR: 61006537

CROP: Soybean, (*Glycine max* (L.) Merrill), cv Hyland Revenge
PEST: Soybean aphid (*Aphis glycines*, Matsumura)

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TITLE: CONTROL OF SOYBEAN APHIDS WITH FOLIAR TREATMENT

MATERIALS: MATADOR 120 EC (cyhalothrin-lambda, 15 g ai/Ha); MATADOR 120 EC (cyhalothrin-lambda, 10 g ai/Ha); CYGON 480 E (dimethoate, 480 g ai/Ha); ASSAIL (acetamiprid, 60.2 g ai/Ha); ASANA (esfenvalerate, 56.7 g ai/Ha).

METHODS: One site with aphid populations was identified for spraying at Ridgetown College, University of Guelph, ON in early September, 2004. Seed was planted in rows spaced 0.76 m apart on 21 June, 2004 at a seeding rate of 20 seeds/m. Plots were 1.5 m by 25 m, in RCBD with 4 replications. On 16 Sept, 2004 pre-spray aphid populations were assessed by rating. All ratings followed a scale of 0-4 (‘0'=no aphids, ‘1'=1-10 aphids, ‘2'=11-25 aphids, ‘3'=26-99 aphids, ‘4'=100 + aphids). Three ratings were taken per plant , of a top, middle and bottom trifoliate, and the mean of those three ratings was calculated for each plant. Five plants from each of the two central plot rows were assessed at 4 metre intervals. By multiplying the trifoliate number per plant by the aphid number equivalent to a given rating (0-4), pre-spray aphid numbers were estimated to equal approximately 70 aphids/plant across the site. Insecticide was applied on 17 Sept., 2004, when the crop was at R4. Insecticide was applied using a High-Boy machine sprayer with 3 nozzles at 50 cm spacing. Nozzle type was XR Teejet flat-fan. Insecticide was prepared in two litre plastic pop bottles according to assigned rates with distilled water at an application rate of 233 L/ha. In all plots, insecticide was applied during one pass down the plot centre, on the morning of 17 Sept., 2004 at a height of 0.5 m above the crop, and at a speed of 1.5 m/s. Insecticide application took place from 7 – 9 AM during periods with no wind turbulence and at a temperature of approximately 14 C. No precipitation fell on the day of application. Following spraying, the number of aphids per plant was assessed by rating on 20 and 27 of Sept, 2004. Plots were harvested on 22 (Blocks 1-3) and 25 (Block 4), Oct., 2004 by hand. Five plants from each of the two central rows in each plot were harvested at 4 metre intervals, to give a total of 50 plants harvested per plot. Data were analysed using ANOVA and means were separated using least significant difference (LSD) at P=0.05.

RESULTS: See Table 1.

CONCLUSIONS: ASSAIL and CYGON decreased aphid numbers relative to other treatments. Four days after insecticide application (20 Sept), plots treated with CYGON had fewer aphids than plots treated with ASSAIL. No differences among treatments were observed 10 days after spraying (27 Sept). No differences in yield were observed among any treatment groups.

Table 1: Aphid ratings and yield assessments in soybeans at Ridgetown, Ontario; 2004.

Treatment	Rate g ai/ha	Aphids Rating (0-4 scale)		Yield T/ha
		20 Sept R5-R6	27 Sept R6	
CHECK	0	0.78 a *	0.61	5.4
Check + Water	0	0.74 a	0.48	5.8
MATADOR 120 EC FOLIAR	15	0.76 a	0.49	5.9
MATADOR 120 EC FOLIAR	10	0.69 a	0.47	6.4
ASSAIL	60.2	0.43 b	0.14	6.9
ASANA	56.7	0.73 a	0.48	5.8
CYGON 480 FOLIAR	480	0.18 c	0.29	5.6
CV		22.6	44.5	26.5

* Means followed by the same letter do not significantly differ, (*P*=0.05 LSD).

2004 PMR REPORT # 35 **SECTION E: CEREAL, FORAGE, AND OILSEED CROPS - Insects**
ICAR : 61006537

CROP: Spring wheat, (*Triticum* spp. L.), cv AC Taber
PEST: Wireworm, (*Limonius*, spp)

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TITLE: CONTROL OF WIREWORM IN SPRING WHEAT WITH SEED TREATMENTS

MATERIALS: RAXIL 250 FL (tebuconazole, 250 g ai/L); GAUCHO 480 FS (imidacloprid, 480 g ai/L); PONCHO 600 FL (clothianidin, 600 g ai/L)

METHODS: Treated seed was supplied by Gustafson on 28 Apr, 2004. The seed was planted on 7 May, 2004 at Rodney, ON using a two-row cone-seeder mounted on a John Deere Max Emerge planter at a seeding rate of 75 seeds/m. Plots were 2 rows spaced 0.18 cm apart and 4 m in length placed in RCBD with 4 replications. The plots were fertilized and maintained according to provincial recommendations. Emergence counts were taken on 17 May, 2004. Plant stand was determined on 25, 31 May and 7 June, 2004 and vigor assessments, using a scale of 0 -10, (10= most advanced healthy plant and 0 = dead plants dead in the trial) were recorded on 25, 31 May and 7 June, 2004. The total number of plants, number of damaged plants and wireworm populations per metre were recorded on 25 May and 7 June, 2004. Wireworm populations were estimated by digging up 1 m of row in a trench 15 cm deep and 10 cm wide in the plots, sifting the soil and separating out the wireworms. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at P= 0.05.

RESULTS: See Tables 1and 2. Plots were not harvested.

CONCLUSIONS: It is difficult to draw conclusions about wireworm populations and plant damage data except that wireworms were present at economically damaging levels in the trial. When plant stand and vigour are considered clearly PONCHO and GAUCHO provided protection against their effects, with GAUCHO providing the longest protection. Only 35% of the seeds planted survived in the fungicide check, while 55 and 72% of the seeds planted survived in the PONCHO and GAUCHO treatments, respectively.

Table 1. Emergence, plant stand and vigor assessments in spring wheat at Rodney, Ontario; 2004

Treatment	Rate	Emerge	Plant Stand		Vigor		Plant Stand	
	g ai/100 kg	Number plants/row			0-100 %		Number per metre	
		17 May	25 May	25 May	31 May	7 June	31 May	7 June
RAXIL 250 FL	1.5	648 b *	406 b	72.5 b	50.0 c	65.0	36 b	26 b
RAXIL 250 FL	1.5	742 a	510 b	80.0 b	75.0 b	75.0	64 a	41 ab
+PONCHO 600 FL	10							
RAXIL 250 FL	1.5	691 ab	687 a	100.0 a	100.0 a	97.5	65 a	54 a
+GAUCHO 480 FS	10							
CV		4.9	14.8	6.6	9.9	30.0	23.8	21.6

* Means with same letter do not significantly differ (*P*=0.05 LSD), data homogeneous and not transformed.

Table 2. Damaged plants and wireworm assessments at Rodney, Ontario; 2004

Treatment	Rate	Damaged Plants		Wireworm	
	g ai/100 kg	Number per metre		Number per metre	
		25 May	7 June	25 May	7 June
RAXIL 250 FL	1.5	11	8	1 b *	3
RAXIL 250 FL	1.5	11	11	6 a	3
+PONCHO 600 FL	10				
RAXIL 250 FL	1.5	10	15	6 a	2
+GAUCHO 480 FS	10				
CV		42.4	50.4	31.3	72.1

* Means with same letter do not significantly differ (*P*=0.05 LSD), data homogeneous and not transformed

2004 PMRR REPORT # 36 **SECTION E: CEREAL, FORAGE and OILSEED CROPS - Insects**
ICAR: 61006537

CROP: Winter wheat, (*Triticum* spp. L.), cv Wisdom
PEST: European chafer, *Rhizotrogus (Amphimallon) majalis*, Razoumowsky

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TITLE: **EUROPEAN CHAFER CONTROL IN WINTER WHEAT WITH SEED TREATMENTS**

MATERIALS: GAUCHO 480 FL (imidacloprid, 480 g ai/L); PONCHO 600 FL (clothianidin, 600 g ai/L); CRUISER 350 FS (thiamethoxam, 350 g ai/L)

METHOD: Seed was treated on 26 Sept, 2003 at a rate of 50 g ai/100 kg seed in 25 kg lots by spraying treatments into a modified cement mixer with a hand held precision CO_2 sprayer. Insecticide was evenly applied as the seed rotated in the mixer and the seed was allowed to mix for an additional 1.5 minutes to ensure thorough coverage. Seed weight was 36 g/1000 seed. Wheat was planted at Delaware, ON on 7 Oct, 2004 using a Great Plains No-till planter. Plots were 24 rows, 50 m in length and spaced 19 cm apart using a RCBD with 4 replications at a seeding rate of 168 kg seed/ha. Plant stand, grub counts, tiller counts and fresh weights were assessed on 3 May, 2004 in 33 cm of row in 2 transects for each plot. Plots were harvested on 26 July, 2004 and yields were corrected to 14.5% moisture. Thousand kernel weights were assessed on the same date.

RESULTS: See Table 1.

CONCLUSIONS: All three treatments improved plant stand, plant growth and yield similarly.

Table 1. Plant stand, grub counts, tiller counts, fresh weights, thousand kernel weights and yields in wheat at Delaware, Ontario; 2004

Treatment	Rate	Plant Stand	Grubs	Tillers	Fresh Wt	Yield	Kernel Wt
	g ai/100 kg	#/33cm		#/plant	g	T/ha	g
			3 May			26 July	
UNTREATED CHECK		4.1 b *	0.2	3.5	9.0 b	1.9 b	54.19
GAUCHO 480 FL	50	7.2 a	0.1	3.0	14.2 a	2.5 a	47.38
PONCHO 600 FL	50	6.1 a	0.4	3.0	13.2 a	2.5 a	51.95
CRUISER 350 FS	50	7.1 a	0.2	3.3	16.2 a	2.8 a	49.84
CV		20.5	71.8	10.5	15.7	15.6	11.7

* Means followed by same letter do not significantly differ (*P*=0.05 LSD)

2004 PMRR REPORT # 37 **SECTION G: BASIC STUDIES - Insect Pests**
STUDY DATABASE: 160.3

CROP: Canola (*Brassica napus*), cv. Dynamite, various breeding lines
Rutabaga (*Brassica napus* L. subspecies *rapifera* Metzg.), cv. Laurentian
White mustard (*Sinapus alba),* cv. Kirby
PEST: Cabbage maggot (CM), *Delia radicum* (Linnaeus)

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TITLE: EVALUATION OF RELATIVE SUSCEPTIBILITY TO FEEDING DAMAGE BY CABBAGE MAGGOT OF EXPERIMENTAL LINES OF CANOLA GROWN ON MINERAL SOIL IN SOUTHWESTERN ONTARIO; 2004

METHODS: Using a 4-row, Alma™ conet seeder, canola seed was planted at a density of 25 seeds/m row in single row plots in mineral soil on the SCPFRC-London Research Farm on 07 June. A single guard row (OAC-SCC990158 standard canola) was planted between each experimental line; 2 guard rows were planted on either side of the entire experimental block. Rows measured 5 m long and were separated by 0.75 m cultivated walkways. Five replicates of each canola line, of white mustard and of commercial rutabaga (Table 1) were planted in a randomized complete block design. Blocks were separated by 2.0 m cultivated walkways. Weeds were controlled throughout the growing season by cultivation and manual weeding. On 22 June, the total number of emerged seedlings were counted in a 4 m length of each plot. On 7-8 September, taproots of 15 randomly selected plants from each plot of Tmt. 1-7 were dug, washed and the damage caused by feeding CM subsequently assessed for each root using a semi quantitative rating scale where 0 = no root damage, 1 = less than 10% of the root surface with root maggot feeding channels, 2 = 11-25%, 3 = 26-50%, 4 = 51-75%, and 5 = 76-100% of the taproot surface area damaged. (Dosdall, L. M., M. J. Herbut, and N. T. Cowle. 1994). On the same date 15 roots were randomly selected from each plot of rutabagas (Tmt. 8) and subsequently graded using a semi-quantitative scale (clean, light, moderate, severe)(King, K.M. and A.R. Forbes. 1954). For each plot, the % roots in each damage category was then calculated. Significance of emergence data for all treatments was determined by analysis of variance (ANOVA); significance of differences among treatments means was determined using a Least Significant Difference (LSD) Range Test. Damage data for Tmt. 1-7 were subjected to arcsin square root transformation prior to statistical analysis by ANOVA; significance of differences among treatments means was again determined using a LSD Range Test. Untransformed data are presented. Damage data for rutabagas (Tmt. 8) are presented for comparative purposes.

OBSERVATIONS: Seedlings of all experimental lines and of the commercial standard as well as rutabagas were heavily damaged by a very high population of the crucifer flea beetle, *Phyllotreta cruciferae* (Goeze). Affected plants ultimately "grew through" the feeding damage. Towards the end of flowering on 10 August the experimental line RM01-700 was approximately 25% shorter than the other experimental lines and the standard commercial canola.

RESULTS: On 22 June when seedlings were at BBCH growth stage 10, the number of seedlings was significantly lower in plots seeded with Kirby® white mustard than in plots seeded with any commercial or experimental canola line or with rutabaga (Table 1).
Results of ratings of CM damage to roots are presented in Table 2. Significant differences in root damage ratings were recorded among lines. The percentage of plants with less than 10% of the root surface damaged by CM feeding (i.e. Damage Rating 1) was significantly lower in plots seeded with Line RM01-700, Line 45A65 or Kirby® white mustard than in plots seeded with Dynamite® canola, a commercial cultivar. Similarly, the percentage of plants with greater than 26% of the root surface damaged by CM (i.e. Damage Rating 3) was significantly lower in plots seeded with these lines than in plots seeded with Dynamite® canola. At least 70% of plants in plots seeded with Line RM99-200, Line RM01-700, Line 45A65 or Kirby® white mustard had a root damage rating of 0 or 1 (Table 2). No roots from plots seeded with Line RM01-700 or Line 45A65 suffered CM damage to more than 50% of the surface of the tap root (ie. Damage Rating 4). Roots of rutabagas seeded at the same time as the canola/mustard plots were heavily infested by CM when harvested. The mean infestation index of harvested rutabaga roots was 81.8; over 70% of rutabaga roots were rated as severely damaged (Table 2).

CONCLUSION: In this trial Line RM01-700 and Line 45A65 were as resistant to CM feeding as Kirby® white mustard, the weedy source of CM resistance. These lines could prove useful parents for introduction of CM resistance in rutabaga breeding lines.

REFERENCES:
Dosdall, L.M., M.J. Herbut, and N.T. Cowle. 1994. Susceptibilities of species and cultivars of canola and mustard to infestation by root maggots (Delia spp.) (Diptera: Anthomyiidae). The Canadian Entomologist 126: 251-260.

King, K.M. and A.R. Forbes. 1954. Control of root maggots in rutabagas. Journal of Economic Entomology 47: 607-615.

Table 1. Emergence of seedlings (BBCH - 10) in experimental field plots, London, ON; 2004-Jun-22.

Tmt. No.	Line Identity	Mean # Seedlings / 4 m Row
1.	RM99-200	32.2 a[1]
2.	RM00-229	43.8 a
3.	RM01-700	33.2 a
4.	268-09	38.4 a
5.	Dynamite® (Standard)	40.4 a
6.	45A65	41.4 a
7.	Kirby® (White Mustard)	15.0 b
8.	Laurentian® (Rutabaga)	39.0 a

[1] means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and a Least Significant Difference Range Test.

Table 2. Root damage caused by root maggots, *Delia* spp. feeding on selected lines of crucifers in field plots, London, ON; 2004.

Tmt. No.	Line Identity	Mean Percent of Canola/Mustard Roots with Indicated Damage Rating[1]							
		0	1	2	3	4	5	0 + 1	3 + 4 + 5
1.	RM99-200	15.6 a[2]	55.3 a	16.7 a	5.5 bc	6.9 a	0.0 a	70.9 abcd	12.4 ab
2.	RM00-229	19.1 a	42.0 a	20.6 a	11.1 ab	7.3 a	0.0 a	61.0 bcd	18.4 ab
3.	RM01-700	21.3 a	58.7 a	17.3 a	2.7 bc	0.0 a	0.0 a	80.0 ab	2.7 bc
4.	268-09	12.0 a	48.0 a	25.3 a	13.3 ab	1.3 a	0.0 a	60.0 cd	14.7 ab
5.	Dynamite® (Standard)	12.2 a	41.0 a	24.2 a	15.1 a	4.4 a	3.1 a	53.2 d	22.6 a
6.	45A65	18.7 a	62.7 a	14.7 a	4.0 bc	0.0 a	0.0 a	81.3 a	4.0 bc
7.	Kirby® (White Mustard)	18.5 a	60.7 a	18.8 a	0.0 c	2.0 a	0.0 a	79.2 abc	2.0 c

Tmt. No.	Line Identity	Mean Percent of Rutabaga Roots with Indicated Rating[3]				Infestation Index[4]
		Clean	Light	Moderate	Severe	
8.	Laurentian ® (Rutabaga)	9.3	4.0	10.7	73.3	81.8

[1] **Canola/Mustard Rating Scale:** 0 = no root damage, 1 = less than 10% of the root surface with root maggot feeding channels, 2 = 11-25%, 3 = 26-50%, 4 = 51-75%, and 5 = 76-100% of the taproot surface area damaged (Dosdall *et al.*, 1994).
[2] For each canola/mustard damage rating category, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and a Least Significant Difference Range Test.
[3] **Rutabaga Rating Scale: clean** = factor of 0; no damage; **light** = factor of 1; slight, superficial early feeding but fully healed; **moderate** = factor of 2; marketable as Grade 2 after single trim just above tap root to remove single deep penetration or, moderate, healed surface injury affecting < 20% of surface that could be removed by peeling; **severe** = factor of 4; unmarketable for table use; injury not removable by practical trimming; any extensive unhealed surface injury; maggot in root (King and Forbes, 1954).
[4] calculated for each plot by multiplying appropriate factor by % of roots in each category, adding products and dividing sum by 4 (King and Forbes, 1954).

2004 RAPPORT # 38 **SECTION I: ENQUÊTES PHYTOSANITAIRES ET INFESTATIONS**
IRAC: 87000242

CULTURE: Pommes
RAVAGEURS: Charançon de la prune, *Conotrachelus nenuphar* (Herbst), mouche de la pomme, *Rhagoletis pomonella* (Walsh), carpocapse de la pomme, *Cydia pomonella* (L.), tordeuse à bandes obliques, *Choristoneura rosaceana* (Harris), hoplocampe des pommes, *Hoplocampa testudinea* Klug, punaise terne, *Lygus lineolaris* P. de B., mineuse marbrée, *Phyllonorycter blancardella* (F.), noctuelle du fruit vert, *Orthosia hibisci* (Gn.).

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TITRE: **LES RAVAGEURS DES VERGERS DE POMMIERS DU QUÉBEC EN 2003 ET 2004**

MÉTHODES: Dans un verger non traité aux insecticides (Frelighsburg, seulement en 2003) et dix vergers de pommiers commerciaux dont un à régie biologique, une parcelle de 1-2 ha a été mise à la disposition du Réseau d'avertissements phytosanitaires du Québec pour dépister les insectes et acariens nuisibles aux pommiers et évaluer leur importance. Dans chacun de ces vergers-pilotes, le dépistage des lépidoptères a été réalisé à l'aide de pièges à phéromone sexuelle Phérocon ou Multi-pher. Pour chaque lépidoptère, deux pièges ont été disposés de part et d'autre du centre de la parcelle. Pour dépister la punaise terne et l'hoplocampe des pommes, deux cartons blancs englués (15 x 20 cm) ont été placés dans les pommiers, respectivement à 70 et 150 cm au-dessus du sol à chacun des coins de la parcelle. Le charançon de la prune a été dépisté grâce à quatre pièges pyramidaux (Tedders, 1994) (122 cm x 55 cm à la base) par verger disposés au pied du premier arbre de chaque extrémité des rangées extérieures de la parcelle. Une pièce collectrice en entonnoir surmontée d'un cylindre collecteur en plastique transparent était installée au sommet du piège pour capturer les insectes. La mouche de la pomme a été dépistée à l'aide de sphères rouges engluées et placées dans un pommier à chacun des coins de la parcelle. Les pièges ont été installés avant le début de la période d'activité des insectes concernés soit entre le 2 avril et le 9 juin 2003 et entre le 5 avril et le 9 juin 2004. La présence et le nombre d'insectes capturés ont été relevés à toutes les semaines jusqu'à la fin de la période d'activités des insectes, le dernier relevé ayant été effectué le 15 septembre 2003 et le 7 septembre 2004. Au besoin, les pièges collants ont été nettoyés ou remplacés et les diffuseurs à phéromone ont été remplacés à toutes les 4 ou 5 semaines. Les dommages à la récolte ont été évalués dans chacune des parcelles à la fin août ou au début de septembre en échantillonnant 500 pommes récoltées aléatoirement dans 50 à 100 arbres. Ce bilan reflète la situation générale des ravageurs observés dans l'ensemble des régions pomicoles.

RÉSULTATS: Voir les tableaux ci-dessous.

CONCLUSIONS: Les captures de tordeuses à bandes obliques ont dépassé un cumul de 180 papillons par piège à St-Paul d'Abbotsford, Rougemont, Dunham et Franklin en 2003 et à Hemmingford et Saint-

Paul d'Abbotsford en 2004. Dans les vergers commerciaux, les dégâts occasionnés par les tordeuses et autres chenilles étaient élevés en 2003 et 2004, soit respectivement 41 et 46% du total des dégâts occasionnés par les insectes. Des captures de noctuelles du fruit vert très élevées dans les vergers commerciaux atteignaient une moyenne de 342 et 297 papillons pour 2003 et 2004 soit respectivement 3,6 et 2,2 fois les captures normales enregistrées au cours des 12 dernières années. Les captures de carpocapses ont été abondantes en 2003 (1,7 fois la normale) et légèrement sous la normale en 2004 (0,8 fois la normale). Les dégâts (0,20%) ont été importants pour les deux années avec le niveau le plus élevé depuis 1991. Les dégâts (0,84%) du charançon de la prune ont été plus abondants que la normale (2ièmes plus élevés des treize dernières années) en 2003 et sous la normale (0,18%) en 2004. Les captures de mineuses marbrées ont été particulièrement élevées dans quelques vergers. Elles ont dépassé 20 000 papillons dans les vergers de Dunham, Rougemont et Saint-Paul d'Abbotsford en 2003 et 2004 et dans le verger de Franklin en 2004. Les dégâts de la mouche de la pomme et de l'hoplocampe des pommes étaient plus faibles que la normale dans la majorité des vergers (2003 et 2004). Les dégâts totaux d'insectes dans les vergers commerciaux ont été plus élevés (6,60%) que la normale en 2003 mais plus faible (4,91%) que la normale en 2004 (moyenne de 13 années: 5,07 %).

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Tableau 1. Total des captures d'adultes par piège dans les vergers-pilotes du Québec en 2003.

	Ravageurs*								
Vergers	CARPO	HOP	MIN	MOU	NFV	PUN	SEC	TBO	TBR
Compton	121	143	4622	85	84	68	27	56	761
Dunham	31	95	22684	23	429	68	19	215	681
Ste-Famille (I.O.)	67	173	2455	10	33	35	1	123	56
Franklin	64	10	18624	45	348	28	41	194	239
Hemmingford	24	180	19530	83	499	60	49	164	757
Oka	4	25	8880	18	340	30	37	102	153
Rougemont	154	0	76979	23	342	15	16	283	234
Saint-Joseph-du-lac	10	8	3403	8	345	45	73	74	72
St-Paul d'Abbotsford	67	10	37500	28	660	15	33	365	239
verger non traité aux insecticides**	303	290	18517	6723	147	23	0	103	393
verger biologique***	152	368	5936	423	285	30	6	176	785
Cumul Moyen (v. commerciaux)	60	71	21631	36	342	40	33	175	354
Normale moyenne (v. commerciaux)****	35	117	21263	66	96	48	42	138	298
Période de dépistage	28 avril -22 sep	28 avril-23 juin	14 avril-22 sep	9 juin22 sep	2 avril-9 juin	2 avril-16 juin	20 mai-22 sep	20 mai-22 sep	7 avril-22 sep
Type de piège*****	MP-1	C B E	MP-2	S R E	MP-1	C B E	MP-3	PH-1C	MP-3
Phéromone	Trécé		Trécé		Scentry		Scentry	Trécé	Trécé

Tableau 2. Total des captures d'adultes par piège dans les vergers-pilotes du Québec en 2004.

	Ravageurs*									
Vergers	CARPO	CHAR	HOP	MIN	MOU	NFV	PUN	SEC	TBO	TBR
Compton	54		298	3813	140	145	13	7	16	668
Dunham	20		78	25499	8	169	33	6	41	365
Ste-Famille (I.O.)	19		23	1418	0	48	28	4	32	78
Franklin	27	0	70	31060	35	506	38	15	156	253
Hemmingford	15	2	405	14806	95	242	53	14	254	701
Oka	1		60	4068	35	216	43	33	75	139
Rougemont	114	3	3	75742	5	594	13	2	103	123
Saint-Joseph-du-lac	7		3	10497	3	161	20	182	89	65
St-Paul d'Abbotsford	44	0	13	47749	20	593	40	25	183	281
Verger biologique***	47	5	280	8669	105	346	18	3	167	327
Cumul Moyen (v. commerciaux)	33	5	106	23850	38	297	31	32	105	297
Normale moyenne (v. commerciaux)****	39	nd	108	20226	58	133	44	43	123	422
Période de dépistage	26 avril -	26 avril -	26 avril	13 avril	7 juin	5 avril 7	5 avril -	17 mai	17 mai 7	5 avril -7
Type de piège***** MP-1	7 sept	12 juillet	21 juin	7 sept	7 sept	juin	14 juin	7 sept	sept PH-	sept MP-
Trécé	MP-1	PyrN	C B E	MP-2	S R E	MP-1	C B E	MP-3	1C Trécé	3 Trécé
Phéromone	Trécé					Scentry		Scentry		

Tableau 3. Dommages à la récolte (%) dans les vergers-pilotes du Québec durant les saisons 2003 et 2004.

	Ravageurs*								
Année	CARPO	HOP	MOU	CHE	TBO 2e gen.	CHA	PUN	APP	Pression totale
VERGERS COMMERCIAUX (9 sites)									
1991	0	20	0	80	10	20	190	90	470
1992	4	11	13	111	7	93	422	24	731
1993	0	4	7	118	0	7	164	27	338
1994	2	0	0	67	7	19	122	52	287
1995	0	60	4	114	4	33	204	60	498
1996	0	16	4	94	12	27	86	35	280
1997	0	18	0	122	13	4	77	11	267
1998	0	198	0	16	84	0	222	22	607
1999	4	151	0	100	53	18	93	27	462
2000	0	76	24	76	71	40	151	29	477
2001	4	98	7	139	147	16	316	51	798
2002	0	227	24	218	31	49	98	44	711
2003	20	27	2	168	102	84	162	53	660
2004	20	49	0	203	22	18	102	69	491
1991-2003	3	70	7	109	42	32	177	40	507
VERGER BIOLOGIQUE***									
2004	28	34	32	144	4	60	86	76	470
VERGER NON TRAITÉ AUX INSECTICIDES**									
1991	230	14	460	512	32	216	52	118	1640
1992	166	10	282	326	56	362	126	618	1950
1993	584	26	490	156	204	808	46	196	2510
1994	432	12	558	234	44	860	34	200	2370
1995	380	10	984	506	48	882	32	420	3260
1996	102	14	900	468	6	394	36	218	2140
1997	152	18	968	636	10	862	30	146	2820
1998	168	72	946	304	10	480	62	58	2100
1999	ND	ND	ND	ND	ND	ND	ND	ND	ND
2000	272	78	868	572	48	888	112	192	3030
2001	222	94	898	570	126	896	94	150	3050
2002	390		932	466	94	822	48	136	2936
2003	738	6	996	376	72	912	8	94	3276
2004	ND	ND	ND	ND	ND	ND	ND	ND	ND
1991-2002	282	36	753	432	62	679	61	223	2528

* CARPO: Carpocapse de la pomme; CHAR: Charançon de la prune; HOP: Hoplocampe des pommes; MIN: Mineuse marbrée; MOU: Mouche de la pomme; NFV: Noctuelle du fruit vert; PUN: Punaise terne; SEC: Sésie du cornouiller; TBO: Tordeuse à bandes obliques; TBR: Tordeuse à bandes rouges; CHE: Chenilles; CHA: Charançon de la prune; APP : Autres punaises phytophages. ** Verger situé à Frelighsburg; *** Verger situé à Henryville. **** Normales basées sur 10 ans en date du 15 septembre 2003 et du 13 septembre 2004. *****PH-1C= Phérocon 1C; C B E= Carton blanc englué; MP - 1., 2 ou 3= Multi-pher (1, 2 ou 3); S R E= sphère rouge engluée; PyrN: piège pyramidal noir en bois.

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IRAC: 87000242

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RÉSULTATS: Voir les tableaux ci-dessous.
CONCLUSIONS: Les captures de tordeuses à bandes obliques ont dépassé un cumul de 180 papillons par

piège à St-Paul d'Abbotsford, Rougemont, Dunham et Franklin en 2003 et à Hemmingford et Saint-Paul d'Abbotsford en 2004. Dans les vergers commerciaux, les dégâts occasionnés par les tordeuses et autres chenilles étaient élevés en 2003 et 2004, soit respectivement 41 et 46% du total des dégâts occasionnés par les insectes. Des captures de noctuelles du fruit vert très élevées dans les vergers commerciaux atteignaient une moyenne de 342 et 297 papillons pour 2003 et 2004 soit respectivement 3,6 et 2,2 fois les captures normales enregistrées au cours des 12 dernières années. Les captures de carpocapses ont été abondantes en 2003 (1,7 fois la normale) et légèrement sous la normale en 2004 (0,8 fois la normale). Les dégâts (0,20%) ont été importants pour les deux années avec le niveau le plus élevé depuis 1991. Les dégâts (0,84%) du charançon de la prune ont été plus abondants que la normale (2ièmes plus élevés des treize dernières années) en 2003 et sous la normale (0,18%) en 2004. Les captures de mineuses marbrées ont été particulièrement élevées dans quelques vergers. Elles ont dépassé 20 000 papillons dans les vergers de Dunham, Rougemont et Saint-Paul d'Abbotsford en 2003 et 2004 et dans le verger de Franklin en 2004. Les dégâts de la mouche de la pomme et de l'hoplocampe des pommes étaient plus faibles que la normale dans la majorité des vergers (2003 et 2004). Les dégâts totaux d'insectes dans les vergers commerciaux ont été plus élevés (6,60%) que la normale en 2003 mais plus faible (4,91%) que la normale en 2004 (moyenne de 13 années: 5,07 %).

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Franklin	64	1.0	18624	4.5	348	2.8	41	194	239
Hemmingford	24	18	19530	8.3	499	6.0	49	164	757
Oka	4	2.5	8880	1.8	340	3.0	37	102	153
Rougemont	154	0	76979	2.3	342	1.5	16	283	234
Saint-Joseph-du-lac	10	0.8	3403	0.8	345	4.5	73	74	72
St-Paul d'Abbotsford	67	1	37500	2.8	660	1.5	33	365	239
verger non traité aux insecticides**	303	29	18517	672.3	147	2.3	0	103	393
verger biologique***	152	36.8	5936	42.3	285	3.0	6	176	785
Cumul Moyen (v. commerciaux)	60	7.1	21631	3.6	342	4	33	175	354
Normale moyenne (v. commerciaux)****	35	11.7	21263	6.6	96	4.8	42	138	298
Période de dépistage	28 avril - 22 sep	28 avril - 23 juin	14 avril - 22 sep	9 juin - 22 sep	2 avril - 9 juin	2 avril - 16 juin	20 mai - 22 sep	20 mai - 22 sep	7 avril - 22 sep
Type de piège*****	MP-1	C B E	MP-2	S R E	MP-1	C B E	MP-3	PH-1C	MP-3
Phéromone	Trécé		Trécé		Scentry		Scentry	MP-1	CBE

Tableau 2. Total des captures d'adultes par piège dans les vergers-pilotes du Québec en 2004.

	Ravageurs*									
Vergers	CARPO	CHA	HOP	MIN	MOU	NFV	PUN	SEC	TBO	TBR
Compton	54		29.8	3813	14.0	145	1.3	7	16	668
Dunham	20		7.8	25499	0.8	169	3.3	6	41	365
Ste-Famille (I.O.)	19		2.3	1418	0.0	48	2.8	4	32	78
Franklin	27	0	7.0	31060	3.5	506	3.8	15	156	253
Hemmingford	15	2	40.5	14806	9.5	242	5.3	14	254	701
Oka	1		6	4068	3.5	216	4.3	33	75	139
Rougemont	114	0.3	0.3	75742	0.5	594	1.3	2	103	123
Saint-Joseph-du-lac	7		0.3	10497	0.3	161	2	182	89	65
St-Paul d'Abbotsford	44	0	1.3	47749	2	593	4	25	183	281
Verger biologique***	47	5	28.0	8669	10.5	346	1.8	3	167	327
Cumul Moyen (v. commerciaux)	33	0.5	10.6	23850	3.8	297	3.1	32	105	297
Normale moyenne (v. commerciaux) ****	39	nd	10.8	20226	5.8	133	4.4	43	123	422
Période de dépistage	26 avril - 7 sept	26 avril -12 juillet	26 avril - 21 juin	13 avril - 7 sept	7 juin - 7 sept	5 avril - 7 juin	5 avril - 14 juin	17 mai - 7 sept	17 mai - 7 sept	5 avril - 7 sept
Type de piège *****	MP-1	PyrN	C B E	MP-2	S R E	MP-1	C B E	MP-3	PH-1C	MP-3
Phéromone	Trécé			Trécé		Scentry		Scentry	Trécé	Trécé

Tableau 3. Dommages à la récolte (%) dans les vergers-pilotes du Québec durant les saisons 2003 et 2004.

Année	Ravageurs*								
	CARPO	HOP	MOU	CHE	TBO 2e gen.	CHA	PUN	APP	Pression totale
VERGERS COMMERCIAUX (9 sites)									
1991	0	0.2	0	0.8	0.1	0.2	1.9	0.9	4.7
1992	0.04	0.11	0.13	1.11	0.07	0.93	4.22	0.24	7.31
1993	0	0.04	0.07	1.18	0	0.07	1.64	0.27	3.38
1994	0.02	0	0	0.67	0.07	0.19	1.22	0.52	2.87
1995	0	0.6	0.04	1.14	0.04	0.33	2.04	0.6	4.98
1996	0	0.16	0.04	0.94	0.12	0.27	0.86	0.35	2.8
1997	0	0.18	0	1.22	0.13	0.04	0.77	0.11	2.67
1998	0	1.98	0	0.16	0.84	0	2.22	0.22	6.07
1999	0.04	1.51	0	1	0.53	0.18	0.93	0.27	4.62
2000	0	0.76	0.24	0.76	0.71	0.4	1.51	0.29	4.77
2001	0.04	0.98	0.07	1.39	1.47	0.16	3.16	0.51	7.98
2002	0	2.27	0.24	2.18	0.31	0.49	0.98	0.44	7.11
2003	0.2	0.27	0.02	1.68	1.02	0.84	1.62	0.53	6.6
2004	0.2	0.49	0	2.03	0.22	0.18	1.02	0.69	4.91
1991-2003	0.03	0.7	0.07	1.09	0.42	0.32	1.77	0.4	5.07
VERGER BIOLOGIQUE***									
2004	2.8	3.4	3.2	14.4	0.4	6	8.6	7.6	47
VERGER NON TRAITÉ AUX INSECTICIDES**									
1991	23	1.4	46	51.2	3.2	21.6	5.2	11.8	164
1992	16.6	1	28.2	32.6	5.6	36.2	12.6	61.8	195
1993	58.4	2.6	49	15.6	20.4	80.8	4.6	19.6	251
1994	43.2	1.2	55.8	23.4	4.4	86	3.4	20	237
1995	38	1	98.4	50.6	4.8	88.2	3.2	42	326
1996	10.2	1.4	90	46.8	0.6	39.4	3.6	21.8	214
1997	15.2	1.8	96.8	63.6	1	86.2	3	14.6	282
1998	16.8	7.2	94.6	30.4	1	48	6.2	5.8	210
1999	ND	ND	ND	ND	ND	ND	ND	ND	ND
2000	27.2	7.8	86.8	57.2	4.8	88.8	11.2	19.2	303
2001	22.2	9.4	89.8	57	12.6	89.6	9.4	15	305
2002	39	4.8	93.2	46.6	9.4	82.2	4.8	13.6	293.6
2003	73.8	0.6	99.6	37.6	7.2	91.2	8	9.4	327.6
2004	ND	ND	ND	ND	ND	ND	ND	ND	ND

* CARPO: Carpocapse de la pomme; CHA: Charançon de la prune; HOP: Hoplocampe des pommes;

MIN: Mineuse marbrée; MOU: Mouche de la pomme; NFV: Noctuelle du fruit vert; PUN: Punaise terne; SEC: Sésie du cornouiller; TBO: Tordeuse à bandes obliques; TBR: Tordeuse à bandes rouges; CHE: Chenilles; APP: Autres punaises phytophages. ** Verger expérimental de la ferme d'Agriculture et Agro-alimentaire Canada à Frelighsburg; *** Verger situé à Henryville. **** Normales basées sur 10 ans en date du 15 septembre 2003 et du 13 septembre 2004. *****PH-1C= Phérocon 1C; C B E= Carton blanc englué; MP - 1., 2 ou 3= Multi-pher (1, 2 ou 3); S R E= sphère rouge engluée; PyrN: piège pyramidal noir en bois.

2004 PMRR REPORT # 40 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: 402-1531-8605

CROP: Apples cv. Jonagold
PEST: Gray mold, *Botrytis cinerea* Pers., blue mold, *Penicillium expansum* Link

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TITLE: EVALUATION OF PETAL FALL AND PRE-HARVEST SPRAYS FOR THE CONTROL OF POST-HARVEST BLUE AND GRAY MOLD DECAY OF APPLES; 2003

MATERIALS: VANGARD 75WG (cyprodinil 75%), SCALA (pyrimethanil 400G/L), SCALA 60SC (pyrimethanil 606g/L)

METHODS: Fungicide treatments were applied to Jonagold apple trees arranged in a randomized complete block design with three 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), VANGARD (281 g ai/ha) at petal fall; SCALA (800 g ai/ha), SCALA 60SC (800 g ai/ha), VANGARD (281 g ai/ha) at two weeks pre-harvest and SCALA (800 g ai/ha) at petal fall and two weeks pre-harvest. Petal fall sprays were applied on May 9, 2003 and pre-harvest sprays were applied on August 22, 2003. Spray applications were made using a hand operated gun sprayer (345 Kpa) to run off in volumes of 225 L water/ha. Apple fruit were harvested on September 8, 2003. Harvested fruit were stored for four months in air storage at 1±0.2°C. Upon removal from storage, replicate fruit samples of 10 apples each were wounded in triplicate, inoculated with 20 Fl of a *Botrytis* or *Penicillium* spore suspension (10^4 conidia/ml) or sterile distilled water as a control, and incubated at 20 EC for five to seven days. Two diameters of developing rot lesions were measured and wound decay data was analyzed using the General Linear Model of SAS. Means were separated using the Duncan's Multiple Range comparative test.

RESULTS: As outlined in Tables 1 and 2.

CONCLUSIONS: After four months the severity of storage decay by *Botrytis* was significantly decreased by SCALA and VANGARD applied as pre-harvest treatments and by SCALA applied at petal fall and pre-harvest. Petal fall treatments alone of SCALA or VANGARD did not reduce post-harvest decay as compared to the control. The only effective treatment for the control of *Penicillium* decay after four months storage in this trial was SCALA applied at petal fall and pre-harvest (Table 1).

The incidence of *Botrytis* and *Penicillium* as measured by the percentage of wounds that decayed show that the SCALA petal fall and pre-harvest treatment was the most effective in reducing decay. The incidence of *Penicillium* decay was significantly reduced by this treatment over the control and all other treatments used. The control of *Botrytis* by this treatment was significantly better than the control and equally as effective as the other effective treatments, SCALA pre-harvest and VANGARD pre-harvest. The SCALA 60 SC formulation significantly reduced the incidence of *Botrytis* decay as compared to the control but was significantly less effective than the VANGARD pre-harvest, SCALA petal fall and pre-harvest and SCALA pre-harvest treatments (Table 2).

Table 1. Mean severity of post-harvest decay for wounded inoculated Jonagold apples treated at petal fall or pre-harvest with fungicides after four months air storage at 1°C.

Treatment	Timing	Rate	Mean diameter of decay mm[1]		
		g ai/ha	Control	Botrytis	Penicillium
Control	N/A		3.0 a[2]	18.3 a[2]	11.9 ab[2]
SCALA	petal fall	800	3.0 a	19.6 a	12.9 a
VANGARD	petal fall	281	3.0 a	17.1 a	12.5 ab
SCALA	pre-harvest	800	3.0 a	5.7 c	11.3 b
SCALA 60SC	pre-harvest	800	3.0 a	11.2 b	11.5 ab
VANGARD	pre-harvest	281	3.0 a	8.1 c	11.5 ab
SCALA	petal fall and pre-harvest	800	3.0 a	6.3 c	8.3 c

[1] Mean of three replicates of 10 apples per replicate. Each apple was wounded in triplicate, and then inoculated with *Botrytis cinerea* or *Penicillium expansum*.
[2] Numbers followed by the same letter are not statistically different at the $P = 0.05$ level.

Table 2. Mean percent of wounds with gray or blue mold decay for Jonagold apples treated at petal fall or pre-harvest with fungicides after four months air storage at 1°C.

Treatment	Timing	Rate	Mean % of wounds with decay[1]		
		g ai/ha	Control	Botrytis	Penicillium
Control	N/A		0.0 a[2]	97.8 a[2]	98.9 ab[2]
Scala	petal fall	800	2.2 a	100.0 a	97.8 ab
Vangard	petal fall	281	0.0 a	96.7 a	100.0 a
Scala	pre-harvest	800	1.1 a	30.0 d	88.9 b
Scala 60 SC	pre-harvest	800	3.3 a	67.8 b	93.3 ab
Vangard	pre-harvest	281	0.0 a	54.4 bc	94.4 ab
Scala	petal fall and pre-harvest	800	1.1 a	43.3 cd	65.6 c

[1] Mean of three replicates of 10 apples per replicate. Each apple was wounded in triplicate, and then inoculated with *Botrytis cinerea* or *Penicillium expansum*.
[2] Numbers followed by the same letter are not statistically diffepent at the $P = 0.05$ level.

2004 PMRR REPORT # 41 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.23

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

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TITLE: STORAGE EVALUATION OF POST-HARVEST FUNGICIDES SCHOLAR (FLUDIOXONIL), MERTECT (THIABENDAZOLE) AND DIPHENYLAMINE (DPA) FOR CONTROL OF BLUE MOLD IN APPLE CV. EMPIRE, 2003-04.

MATERIALS: SCHOLAR 50 WG (50% fludioxonil), No Scald DIPHENYLAMINE EC 283 (DPA), and MERTECT 500 SC (45% thiabendazole; TBZ)

METHODS: A trial was conducted to determine the effect of DIPHENYLAMINE (DPA), an anti-scalding agent, on the effectiveness of SCHOLAR (fludioxonil) against blue mold of apple caused by *Penicillium expansum*. The treatments were compared with MERTECT (TBZ) for efficacy against blue mold. Commercially ripe apple cv. Empire were obtained from a AAFC research orchard in Jordan Station, ON. All fruits were stored in cold storage at 2°C until used in the experimental treatments. Apples 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 apples were placed on a plastic packing insert (24 fruit master) contained in a plastic box. Each box represented a treatment replication. Three replicate trays with 12 apples per replicate were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20µl drop of TBZ-resistant *P. expansum* isolate PS-1R at a concentration of 1 x 10^5 conidia/ml and incubated at 13°C for 18-24 hours and then treated with fungicide treatments. The drench application consisted of mixing appropriate amount of fludioxonil concentration in water and pouring it on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. Half of the apples was treated with DPA 3.86 g/L and fludioxonil and the other half was treated with fungicides only. Untreated check had no fungicides or DPA. The treatments were randomized completely. Treatments were applied on 28 January, 2003 and the treated apples were stored at 2°C for 98 days. Efficacy of fungicides and DPA against TBZ-resistant (TBZ-R) *P. expansum* were evaluated for blue mold incidence (percent infected apples) at monthly intervals. 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 (fludioxonil) and DPA were tested for their efficacy against blue mold on apple cv. 'Empire' for 3 months at 2°C in a cold storage. Apples were evaluated after 98 days after the treatment and disease incidence was recorded. At lower concentrations of SCHOLAR, higher disease incidence of blue mold was observed in DPA treated apples. At higher concentrations (600 µg/ml), fludioxonil gave 100% control of blue mold for 3 months. As expected, a higher disease incidence was observed in the shelf-life study. Apples treated with DPA showed higher disease incidence than the apples that were not treated with DPA. At a concentration of 600 µg/ml of fludioxonil, DPA neither negatively

nor positively interacted with higher concentrations of post-harvest fungicide in the cold storage. TBZ was not effective against blue mold caused by TBZ-resistant isolate.

Table 1. Evaluation of post-harvest drench treatment of fludioxonil and diphenylamine (DPA) for control of blue mold, caused by *Penicillium expansum*, in 'Empire' apples, 2003-04.

	% Blue mold incidence [a,b]			
	98 days at 2°C		98 days at 2°C + 6 days at 20°C	
	DPA[c]	No DPA	DPA[c]	No DPA
Inoculated control	88.8 d[d]	91.6 d[d]	100.0 e[d]	100.0f[d]
SCHOLAR @ 0.01 g/L	61.1 c	47.2 c	97.2 e	94.4 e
SCHOLAR @ 0.05 g/L	2.8 b	5.5 b	88.8 d	58.3 d
SCHOLAR @ 0.15 g/L	0.0 a	0.0 a	30.5 c	58.3 d
SCHOLAR @ 0.3 g/L	0.0 a	0.0 a	16.6 b	33.3 c
SCHOLAR @ 0.6 g/L	0.0 a	0.0 a	0.0 a	11.1 b
SCHOLAR @ 1.2 g/L	0.0 a	0.0 a	0.0 a	8.3 b
MERTECT @ 1.15 g/L	100.0 e	100.0 e	100.0 e	100.0 f
Non-inoculated non-treated control	0.0 a	0.0 a	0.0 a	0.0 a

[a] A TBZ-resistant isolate, PS-1R was used in inoculations.
[b] In post-inoculation treatment, the wounded apples were inoculated with the fungal inoculum and incubated at 13°C. After 18-20 h the inoculated apples were treated with fungicides and incubated at 2°C for 98 days.
[c] Apples were treated with 3.86 g/L of DPA.
[d] Values are mean of disease incidence of three replicates within a treatment and the means of treatments within the same column followed by different letters are significantly ($P<0.05$) different according to the Tukey Test.

2004 PMRR REPORT # 42 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.23

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

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TITLE: **EVALUATION OF BIOSAVE, SCHOLAR (FLUDIOXONIL) AND MERTECT FOR CONTROL OF BLUE MOLD IN APPLES UNDER CONTROLLED ATMOSPHERE (CA) STORAGE CONDITIONS, 2003-04.**

MATERIALS: SCHOLAR (50% fludioxonil) and MERTECT 500SC (thiabendazole 45%)

METHODS: BIOSAVE (*Pseudomonas syringae*) and SCHOLAR 50WP (fludioxonil) were compared with MERTECT (thiabendazole; TBZ) for efficacy against blue mold of apples caused by *Penicillium expansum*. Commercially ripe apples cv. Empire were obtained from an orchard in Jordan Station, Ontario. The trial was conducted at SCPFRC, AAFC, Vineland. All fruits were stored at 2°C until used the in experimental treatments. Apples were harvested on October 2, 2003 and experiment was initiated on November 4, 2003. Apples 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, 12 apples were placed on a plastic mesh bag. Each bag represented a treatment replication. Three replicates, with 12 apples per replicate, were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20µl drop of TBZ-resistant *Penicillium expansum* isolate PS-1R at a concentration of 1 x 10^5 conidia/ml and incubated at 12°C for 18-24 hours and then treated with fungicide treatments. The drench application consisted of mixing appropriate amount of fludioxonil concentration in water and pouring on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. Untreated check had no fungicides. The treatments were completely randomized. Treated apples were incubated in controlled atmosphere storage (CA))at 1.5°C, 2.0% O_2 and 2.5 % CO_2) for 99 days. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation in CA the fruits were moved to 20°C, 85% RH and incubated for 6 days. The fruits were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion is developed on the fruit. The data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means were separated by the Tukey test.

RESULTS: As outlined in Table 1.

CONCLUSIONS: The efficacy of SCHOLAR (fludioxonil) as a post-inoculation treatment (curative) was evaluated on blue mold (*P. expansum*) of apples in CA storage conditions for 99 days after treatment. The post-inoculation treatment was used to simulate the "pre-storage" treatment intervals where the infection may have occurred at the time of harvest in the field or in transit prior to the treatment at storage. The concentrations, 0.15, 0.3, 0.6 and 1.2 g/L of SCHOLAR were effective against blue mold in CA storage, but higher disease incidence was observed in the shelf-life study. Fludioxonil was effective as drench application. As expected, MERTECT was ineffective against blue mold caused by the TBZ-resistant *P. expansum*.

Acknowledgments: This work was supported in part by the Ontario Ministry of Agriculture and Food under the program, 2002 New Directions in Agri-Food and Rural Research Program, Guelph, Ontario.

Table 1. Effect of fludioxonil on blue mold, caused by *Penicillium expansum*, of apple in a post-inoculation treatment on apple cv Empire in controlled atmosphere (CA storage); 2003-04.

Treatment	% blue mold incidence [a]	
	After 99 days in CA	After 99 days in CA + 6 days at 20 °C
Inoculated control	86.1 c [b]	86.1 d [b]
BIOSAVE @ 0.795 g/L	100.0 f	100.0 f
BIOSAVE @ 1.59 g/L	97.2 e	100.0 f
BIOSAVE @ 3.18 g/L	91.7 d	94.4 e
SCHOLAR @ 0.15 g/L	2.8 b	38.9 c
SCHOLAR @ 0.30 g/L	0.0 a	19.4 a
SCHOLAR @ 0.60 g/L	5.6 b	33.3 b
SCHOLAR @ 1.20 g/L	0.0 a	38.9 c
MERTECT @ 1.15 g/L	100.0 f	100.0 f

[a] Disease incidence was assessed after 99 days at 1.5 °C in CA storage, and after subsequent shelf-life at 20°C for 6 days.
[b] Means of treatments within the same column followed by different letters are significantly ($P<0.05$) different according to the Tukey Test.

2004 PMRR REPORT # 43 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.23

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

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TITLE: EFFICACY OF BIOSAVE, SCHOLAR (FLUDIOXONIL) AND MERTECT FOR CONTROL OF GRAY MOLD IN APPLES UNDER CONTROLLED ATMOSPHERE (CA) STORAGE CONDITIONS; 2003-04.

MATERIALS: BIOSAVE (*Pseudomonas syringae*); SCHOLAR (50 WG ; 50% fludioxonil) and MERTECT 500SC (thiabendazole 45%)

METHODS: BIOSAVE (*Pseudomonas syringae*) and SCHOLAR 50WP (fludioxonil) were compared with MERTECT (thiabendazole; TBZ) for efficacy against gray mold of apples caused by *Botrytis cinerea*. Commercially ripe Apples (*Malus domestica*) cv. Empire were obtained from an experimental orchard at Jordan Station, Ontario. All fruits were stored at 4 ˚C until used in the experimental treatments. Apples were harvested on October 3, 2003 and the experiment was initiated on November 4, 2003. Apples 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, 12 apples were placed on a plastic mesh bags. Each bag represented a treatment replication. Three replicates, with 12 apples per replicate, were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-sensitive *B. cinerea* isolate BC-8AS at a concentration of 1 x 10^5 conidia/ml and incubated at 12°C for 18-24 hours and then treated with fungicide treatments. In the drench application, appropriate amount of fludioxonil concentration was mixed in water and poured on to wounded and inoculated fruit for 20 seconds or until the fruits were completely drenched. Untreated check had no fungicides. The treatments were completely randomized. Treated apples were incubated in a controlled atmosphere storage (CA; 1.5 °C, 2.5% O_2 and 2.5 % CO_2) for 99 days. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation in CA storage, the fruits were moved to 20 °C, 85% RH and incubated for 6 days. The fruit were again evaluated for gray mold incidence (percent infected apples). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means were separated by the Tukey test.

RESULTS: As outlined in Table 1.

CONCLUSIONS: The efficacy of BIOSAVE (*Pseudomonas syringae*) and SCHOLAR (fludioxonil), as post-inoculation treatments (curative) were evaluated on gray mold (*B. cinerea*) of apples in CA storage for 99 days after treatment. The post-inoculation treatment was used to simulate the "pre-storage" treatment intervals where the infection may have occurred at the time of harvest in the field or in transit prior to the treatment at storage. BIOSAVE was not effective as a post inoculation treatment and disease incidence of over 88% was observed in the concentrations tested. The pathogen *B. cinerea was* completely controlled by SCHOLAR at a concentrations of 0.15 g/L and higher, in CA storage, however, up to 5.6% of gray mold disease was observed in the shelf-life study. As expected, MERTECT was effective against TBZ-sensitive isolate of *B. cinerea*.

Table 1. Evaluation of post-harvest treatment of BIOSAVE, SCHOLAR and MERTECT for control of gray mold in apple cv. Empire in controlled atmosphere (CA) storage, 2003-04.

Treatment	Incidence of gray mold (%)	
	After 99 days in CA	After 99 days in CA + 6 days at 20°C
Inoculum only	80.5 b[1]	86.1 e[1]
BIOSAVE @ 0.795 g/L	97.2 d	100.0 f
BIOSAVE @ 1.59 g/L	91.7 c	100.0 f
BIOSAVE @ 3.18 g/L	88.9 c	100.0 f
SCHOLAR @ 0.15 g/L	0.0 a	5.6 b
SCHOLAR @ 0.30 g/L	0.0 a	41.7 d
SCHOLAR @ 0.60 g/L	0.0 a	5.6 b
SCHOLAR @ 1.20 g/L	0.0 a	0.0 a
MERTECT @ 1.15 g/L	0.0 a	13.3 c

[1] Values represent mean of disease incidence of three replicates within a treatment and the means of treatments within the same column followed by different letters are significantly ($P<0.05$) different according to the Tukey Test.

2004 PMRR REPORT # 44 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.21

CROP: Apples (*Malus domestica* Borkh.) cv. Gala
PEST: Blue mold (*Penicillium expansum*)and gray mold (*Botrytis cinerea* Pers.)

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TITLE: EVALUATION OF POST-HARVEST FUNGICIDES SCHOLAR (FLUDIOXONIL) AND THIABENDAZOLE FOR CONTROL OF BLUE MOLD AND GRAY MOLD IN 'GALA' APPLES IN COLD STORAGE; 2003-04.

MATERIALS: SCHOLAR (50% fludioxonil) and MERTECT 500SC (thiabendazole 45%)

METHODS: SCHOLAR 50WP (fludioxonil) was compared with MERTECT (thiabendazole; TBZ) for efficacy against blue mold of apples caused by *Penicillium expansum* and gray mold of apples caused by *Botrytis cinerea*. Commercially ripe apples cv. Gala were obtained from an orchard in Jordan Station, Ontario. The trial was conducted at SCPFRC, AAFC, Vineland. All fruits were stored at 4°C until used in the experimental treatments. Apples were harvested on September 20, 2003 and the experiments were initiated on November 13 (blue mold) and on November 18 (gray mold). Apples 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 apples were placed on a plastic packing insert (fruit master) contained in a plastic box. Three replicate trays were prepared for each treatment and each replicate had 12 apples. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-resistant *B. cinerea* isolate BC-8DR or TBZ-resistant *P. expansum* isolate PS-1R at a concentration of 1×10^5 conidia/ml and incubated at 13°C for 18-24 hours and then treated with fungicide treatments. The drench application consisted of mixing appropriate amount of fludioxonil concentration in water and pouring on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. Untreated check had no fungicides. The treatments were completely randomized. Treated apples were incubated at 2 °C for 3 months. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation at 2°C, the fruits were moved to 20°C, 85% RH and incubated for 6 days. The fruit were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means were separated by the Tukey tests.

RESULTS: As outlined in Tables 1 and 2.

CONCLUSIONS: Seven concentrations of SCHOLAR and one concentration of MERTECT were evaluated for blue mold control on 'Gala' apples. SCHOLAR at concentrations of 0.6 and 1.2 g/L was effective against blue mold in cold storage and also in the subsequent shelf-life study at 20 °C for 6 days. SCHOLAR was effective as drench application. Higher concentrations (SCHOLAR 0.15 to 0.6 g/L) of fludioxonil gave 97.8% control of gray mold (Table 2). As expected, MERTECT was ineffective against blue mold and gray mold caused by the TBZ-resistant *P. expansum* and *B. cinerea*, respectively.

Table 1. Effect of SCHOLAR on blue mold, caused by *Penicillium expansum*, on apple cv. Gala in cold storage; 2003-04.

Treatments	% Blue mold incidence [a]	
	90 days at 2°C	90 days at 2°C + 6 days at 20°C in a Shelf-life study
Inoculated control	100.0 f [b]	100.0 f [b]
SCHOLAR @ 0.010 g/L	12.5 d	33.3 e
SCHOLAR @ 0.020 g/L	14.6 d	22.9 d
SCHOLAR @ 0.035 g/L	4.2 c	10.4 c
SCHOLAR @ 0.15 g/L	0.0 a	0.0 a
SCHOLAR @ 0.3 g/L	2.1 b	2.1 b
SCHOLAR @ 0.6 g/L	0.0 a	2.1 b
SCHOLAR @ 1.2 g/L	0.0 a	0.0 a
MERTECT @ 1.15 g/L	95.8 e	100.0 f
Non-inoculate, non-treated	0.0 a	0.0 a

[a] Disease incidence was assessed after 90 days at 2°C, and after subsequent shelf-life at 20°C for 6 days.
[b] Values represent mean of disease incidence of three replicates within a treatment and the means of treatments within the same column followed by different letters are significantly ($P<0.05$) different according to the Tukey test.

Table 2. Effect of SCHOLAR on gray mold, caused by *Botrytis cinerea*, of apple in a post-inoculation treatment on apple cv. Gala in cold storage; 2003-04.

Treatments (g/l)	% gray mold incidence [a]	
	90 days at 2°C	90 days at 2°C + 6 days at 20°C in Shelf-life study
Inoculated control	100.0 f [b]	100.0 e
SCHOLAR @ 0.010	35.4 e	41.7 d
SCHOLAR @ 0.020	14.6 d	16.7 c
SCHOLAR @ 0.035	12.5 c	14.6 c
SCHOLAR @ 0.15	2.1 b	2.1 g
SCHOLAR @ 0.3	2.1 b	2.1 b
SCHOLAR @ 0.6	2.1 b	2.1 b
SCHOLAR @ 1.2	2.1 b	2.1 b
MERTECT @ 1.15	100.0 f	100.0 e
Non-inoculate, non-treated control	0.0 a	0.0 a

[a] Disease incidence was assessed after 90 days at 2°C, and for shelf-life 20°C for 6 days
[b] Means of treatments within the same column followed by different letters are significantly ($P<0.05$) different according to Tukey Test.

2004 PMRR REPORT # 45 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.23

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

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TITLE: EVALUATION OF BIOLOGICAL CONTROL ACTIVITY OF *METSCHNIKOWIA PULCHERRIMA* FOR CONTROL OF BLUE MOLD IN 'MCINTOSH' APPLES IN COLD STORAGE; 2003-04.

MATERIALS: *Metschnikowia pulcherrima*
METHODS: A yeast antagonist, *Metschnikowia pulcherrima*, was tested for efficacy against blue mold caused by *Penicillium expansum* on 'McIntosh' apples. The trial was conducted at SCPFRC, AAFC, Vineland. Commercially ripe apples cv. McIntosh were obtained from an orchard in Jordan Station, Ontario. All fruits that were stored in controlled atmosphere (CA) storage for 3 months were used in experimental treatments. Apples 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 apples were placed on a plastic packing insert (fruit master) contained in a plastic box. Each treatment had three replicates and each replicate had 12 apples. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop consisting of one of the three concentrations of *M. pulcherrima* with *P. expansum* isolate PS-1R. The treatments were completely randomized. Treated apples were incubated at 4°C for 3 months. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of the bio-control agent on the shelf-life of the fruit, after first fruit decay evaluations following incubation at 4°C, the fruits were moved to 20°C, 85% RH and incubated for 6 days. The fruit were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means were separated by the Tukey test.

RESULTS: As outlined in Table 1.

CONCLUSIONS: Results from the test on the efficacy of *M. pulcherrima* on the control of blue mold show that initial low decay incidence increased with time. After 28 days of incubation, 28% blue mold infection was observed in the inoculum only treatment, while the treatments with combination of *M. pulcherrima* and the pathogen ranged between 0 to 8%. Better control was achieved with the lower concentrations of the pathogen inoculum. The combinations of *M. pulcherrima* at 1.6×10^7 CFU/ml and 1×10^4 conidia/ml of *P. expansum* resulted in no decay and only 2.8% decay after 28 and 58 days of storage, respectively. Control declined to 39% of blue mold after storing for 86 days.

Table 1. Effect of *M. pulcherrima* on the control of blue mold, caused by *Penicillium expansum* in 'McIntosh' apple in cold storage; 2003-04.

Treatment		Blue mold incidence (%)				
		Storage time at 4°C (days)			Storage time at 20°C after storing for 86 days at 4°C	
		28	58	86	7	14
M. pulcherrima + CFU/ml	*P. expansum* conidia/ml					
-	1×10^4	27.8 e[a]	91.7 g[a]	100.0 f[a]	100.0 d[a]	100.0 b[a]
1.6×10^5	1×10^4	5.6 c	41.7 d	97.2 e	100.0 d	100.0 b
1.6×10^6	1×10^4	5.6 c	16.7 b	72.2 c	97.2 c	100.0 b
1.6×10^7	1×10^4	0.0 a	2.8 a	38.9 a	91.7 a	97.2 a
1.6×10^5	5×10^4	5.6 c	88.9 f	97.2 e	100.0 d	100.0 b
1.6×10^6	5×10^4	8.3 d	58.3 e	83.3 d	97.2 c	100.0 b
1.6×10^7	5×10^4	2.8 b	22.2 c	52.8 b	94.4 b	97.2 a

[a] Values are mean of disease incidence of three replicates within a treatment and the means of treatments within the same column followed by different letters are significantly ($P<0.05$) different according to the Tukey Test.

2004 PMRR REPORT # 46 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cvs. Empire and McIntosh
PEST: Blue mold (*Penicillum expansum* Link) and gray mold (*Botrytis cinerea* Pers.)

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TITLE: **EFFECT OF SMARTFRESH™ (1-METHYCYCLOPROPENE; 1-MCP) ON DECAYS IN 'EMPIRE' AND 'MCINTOSH' APPLES, 2003-04.**

MATERIALS: SMARTFRESH™ (1-methycyclopropene)

METHODS: A trial was conducted to determine the effect of SMARTFRESH™ (1-methylcyclopropene; 1-MCP) on the post-harvest decays in wounded apples. Optimum harvest time for long term storage for the apples was determined by the internal ethylene concentration and starch staining. 'McIntosh' and 'Empire' apple fruits were harvested on 16 September, 2003 and 30 September, 2003, respectively. 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 2 hours of harvest, the apples were wounded. Apples in the control treatments were not wounded. There were 4 treatments; 1) no wound, 2) no wound + 1-MCP, 3) wound only, and 4) wound + 1-MCP. Each treatment had 4 replications with 12 fruits per replication. Following the wounding, the apples were cooled to 1 ± 1°C overnight and then the treatments 2 and 4 received 1 µl/ml of 1-MCP for 24 h at 0°C. Fruit were then stored either in air at 0-1°C for up to 120 days, or in standard controlled atmosphere (CA; 2.5-3°C, 2.5% O_2 and 4.5% CO_2 for McIntosh and 2.0 -3 °C, 2.5% O_2 and 2.5% CO_2 for Empire) at the Horticultural Products Laboratory, University of Guelph, Guelph Ontario. Decay incidence was recorded after 30, 60, 90, and 120 days after treatment for apples that were kept in air. For the apples that were stored in CA storage, disease incidence was recorded after 240 days after treatment. Apples were evaluated for decay after each of the incubation periods and the apples moved to a shelf-life storage (20°C) for 6 days. Fruits were considered decayed when a lesion developed on the fruit. When appropriate and necessary, the data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results on the effect of 1-MCP on decays are presented in Tables 1-4.

CONCLUSIONS: Decay incidence in 'McIntosh' after cold storage and the shelf-life after each incubation period are presented in Tables 1 and 2. Decay incidence in 'Empire' after cold storage and the shelf- life after each incubation period are presented in Tables 2 and 4. The analysis of results after incubation in air at different intervals show that no decay was observed at 30 and 60 days after treatment in both cultivars held in air. A higher incidence of decay was observed in wounded plus 1-MCP treated 'McIntosh' apples than in wounded only apples after 90 and 120 days in air and in CA storage. 1-MCP had a variable effect on decay in 'Empire' apples, where higher decay incidence was observed in wounded plus 1-MCP treated apples than in wounded only apples at 90 days, but the reverse trend was found at 120 days after treatment. In summary, 1-MCP had a variable effect on decay incidence in different apple cultivars, and this variability in response to deacy is an important consideration in any program utilizing 1-MCP treatment.

Table 1. Effect of 1-MCP on decay incidence at different intervals in 'McIntosh' apples; 2003-04.

Treatment	% apples with decay					
	Incubation at 0°C					CA
	30 days	60 days	90 days	120 days	215 days	164 days
No Wound; No 1-MCP	0.0 a [a,b]	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Wound Only	0.0 a	0.0 a	8.3 b	25.0 c	39.0 c	6.1 c
No Wound; 1-MCP	0.0 a	0.0 a	0.0 a	3.0 b	0.0 a	3.0 b
Wound; 1-MCP	0.0 a	0.0 a	19.3 c	50.0 d	17.0 b	25.0 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.

Table 2. Effect of 1-MCP on the decay incidence in shelf-life study after incubation at different intervals in 'McIntosh' apples; 2003-04.

Treatment	% apples with decay					
	Incubation at 0°C					CA
	30 days + shelf-life	60 days + shelf-life	90 days + shelf-life	120 days + shelf-life	215 days + shelf-life	164 days + shelf-life
No Wound; No 1-MCP	0.0 a [a,b]	0.0 a	11.1 b	0.0 a	0.0 a	0.0 a
Wound Only	3.4 b	27.0 b	64.0 c	75.0 c	42.6 d	8.3 b
No Wound; 1-MCP	0.0 a	0.0 a	3.4 a	3.0 a	8.3 b	3.0 b
Wound; 1-MCP	33.3 c	48.4 c	44.4 d	69.6 b	19.0 c	56.9 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.

Table 3. Effect of 1-MCP on decay incidence at different intervals in 'Empire' apples; 2003-04.

Treatment	% apples with decay					
	Incubation at 0°C					CA
	30 days	60 days	90 days	120 days	215 days	164 days
No Wound; No 1-MCP	0.0 a [a,b]	0.0 a	6.2 b	0.0 a	11.1 b	0.0 a
Wound Only	0.0 a	3.7 b	33.3 d	8.0 b	31.4 c	8.0 c
No Wound; 1-MCP	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	3.2 b
Wound; 1-MCP	0.0 a	0.0 a	25.0 c	33.3 c	42.7 d	22.2 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 represents the mean of four replicates.

Table 4. Effect of 1-MCP on the decay in shelf-life study after incubation at different intervals 'Empire' apples; 2003-04.

Treatment	% apples with decay					
	Incubation at 0°C					CA
	30 days + shelf-life	60 days + shelf-life	90 days + shelf-life	120 days + shelf-life	215 days + shelf-life	164 days + shelf-life
No Wound; No 1-MCP	0.0 a [a,b]	0.0 a	6.0 b	0.0 a	11.1 b	0.0 a
Wound Only	31.3 c	19.2 c	50.0 d	8.4 b	47.2 b	11.1 c
No Wound; 1-MCP	0.0 a	0.0 a	0.0 a	0.0 a	8.0 a	3.3 b
Wound; 1-MCP	11.1 b	17.0 b	28.3 c	44.6 c	44.6 b	22.2 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.

2004 PMRR REPORT # 47 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cvs. Empire and McIntosh
PEST: Blue mold (*Penicillum expansum* Link) and gray mold (*Botrytis cinerea* Pers.)

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TITLE: **EFFECT OF SMARTFRESH™ (1-METHYLCYCLOPROPENE; 1-MCP) ON BLUE MOLD AND GRAY MOLD IN ‘‘MCINTOSH’ AND ‘EMPIRE’ APPLES, 2003-04.**

MATERIALS: SmartFresh™ (1-methycyclopropene)

METHODS: A trial was conducted to determine the effect of SMARTFRESH™ (1-methylcyclopropene; 1-MCP) on post-harvest 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. ‘McIntosh’ and ‘Empire’ apple fruits were harvested on 16 September, 2003 and 30 September, 2003, respectively. 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 wounded and drop inoculated with the pathogen. TBZ-resistant *B. cinerea* isolate BC-8D or TBZ-resistant *P. expansum* PS-1R at a concentration of 1 x 10^5 conidia/ml were used. There were 6 treatments; 1) no wound, 2) no wound + 1-MCP, 3) wound only, 4) wound + MCP, 5) wound + *P. expansum/ B. cinerea*, and 5) wound + *P. expansum/ B. cinerea* + 1-MCP. Each treatment had 4 replications with 12 fruit per replication. Following the wounding and inoculations, the apples were cooled to 1 ± 1°C overnight and then the treatments 2, 4 and 6 received 1 µl/ml of 1-MCP for 24 h at 0°C. ‘McIntosh’ apples were incubated in standard CA storage (3°C, 2.5% O_2, 4.5% CO_2) for 157 days and in air at 3°C for 232 days. ‘Empire’ apples were incubated in standard controlled atmosphere (CA) storage (1.5°C, 2.5% O_2, 2.5% CO_2) for 171 days and in air at 0 °C for 157 days. Apples in the experiment were evaluated for disease incidence after respective incubation periods. After CA or cold storage incubation, the fruit was moved to 20 ºC, 85% RH and incubated for 6 days. After the shelf-life study, the fruit was again evaluated for blue mold and 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 1-4.

CONCLUSIONS: A higher incidence of blue mold was observed in wounded + 1-MCP treated 'McIntosh' apples in air and in CA storage, whereas lower incidence was observed in the wounded + 1-MCP-treated 'Empire' apples in air and in CA storage. A low incidence of gray mold was observed in the wounded + 1-MCP-treated apples of both cultivars. The effect of 1-MCP on blue mold and gray mold are presented in Tables 1-4; blue mold (Table 1) and gray mold (Table 2) in 'McIntosh' apples, and blue mold (Table 3) and gray mold (Table 4) in 'Empire' apples are presented. A high incidence (97-100%) of blue mold and gray mold was observed in 1-MCP-treated and non-treated 'McIntosh' and 'Empire' apples in CA and air storage. The results show that 1-MCP had neither a positive nor negative effect on storage rots in apples.

Table 1. Effect of 1-MCP on post-harvest blue mold in 'McIntosh' apples, 2003-04.

Treatment	% apples with blue mold				
	CA storage for 153 days	CA + 6 days at 20°C	CA + 14 days at 20°C	Air at 0°C for 153 days	Air at 0°C +7 days at 20°C
No Wound; No 1-MCP	3.2 b [ab]	5.3 a	8.6 a	8.6 a	11.1 a
Wound Only	8.6 c	11.1 b	11.1 b	25.2 c	28.3 b
No Wound; 1-MCP	0.0 a	5.3 a	6.3 a	14.5 b	31.5 c
Wound + 1-MCP	17.2 d	17.2 c	17.1 c	30.4 d	44.4 d
Wound + *P. expansum*	100.0 e	100.0 d	100.0 d	100.0 e	100.0 e
Wound + *P. expansum* + 1-MCP	100.0 e	100.0 d	100.0 d	100.0 e	100.0 e

[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.

Table 2. Effect of 1-MCP on post-harvest gray mold in 'McIntosh' apples; 2003-04.

Treatment	% apples with blue mold				
	CA storage for 153 days	CA + 7 days at 20°C	CA + 14 days at 20°C	Air 0°C for 153 days	Air at 0°C for 153 days + 6 days at 20°C
No Wound; No 1-MCP	0.0 a [a,b]	0.0 a	0.0 a	0.0 a	19.2 a
Wound Only	11.1 d	17.2 d	17.2 c	50.0 d	67.5 c
No Wound; 1-MCP	3.2 b	3 .4 b	3.2 b	11.1 b	17.1 a
Wound + 1-MCP	6.4 c	11.1 c	19.7 c	25.0 c	31.3 b
Wound + *B. cinerea*	100.0 e	100.0 e	100.0 d	100.0 e	100.0 d
Wound + *B. cinerea* + 1-MCP	100.0 e	100.0 e	100.0 d	100.0 e	100.0 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.

Table 3. Effect of 1-MCP on post-harvest blue mold in 'Empire' apples, 2003-04.

Treatment	% apples with blue mold			
	CA storage for 171 days	CA + 7 days at 20°C	Air 0°C for 168 days	Air at 0°C for 168 days + 7 days a t 20°C
No Wound; No 1-MCP	0.0 a [a,b]	5.0 a	0.0 a	6.2 b
Wound Only	22.2 c	36.2 b	22.1 c	36.4 d
No Wound; 1-MCP	0.0 a	3.2 a	0.0 a	3.2 a
Wound + 1-MCP	20.0 d	28.3 c	19.2 b	28.4 c
Wound + *P. expansum*	97.2 e	100.0 e	97 .2 d	100.0 e
Wound + *P. expansum* + 1-MCP	97.2 e	97.2 d	97.2 d	97.2 e

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

Table 4. Effect of 1-MCP on post-harvest gray mold in 'Empire' apples; 2003-04.

Treatment	% apples with blue mold			
	CA storage for 171 days	CA + 7 days at 20°C	Air 0°C for 168 days	Air at 0°C for 168 days + 7 days at 20°C
No Wound; No 1-MCP	0.0 a[a,b]	0.0 a	0.0 a	0.0 a
Wound Only	25.0 c	33.3 c	25.0 c	33.3 c
No Wound; 1-MCP	0.0 a	0.0 a	0.0 a	0.0 a
Wound + 1-MCP	11.1 b	17.2 b	11.1 b	17.2 b
Wound + *B. cinerea*	100.0 d	100.0 d	100.0 d	100.0 d
Wound + *B. cinerea* + 1-MCP	100.0 d	100.0 d	100.0 d	100.0 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.

2004 PMRR REPORT # 48 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Empire
PEST: Blue mold (*Penicillum expansum* Link) and gray mold (*Botrytis cinerea* Pers.)

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TITLE: **EVALUATION OF BIOLOGICAL CONTROL AGENT BIOSAVE (*PSEUDOMONAS SYRINGAE*) FOR CONTROL OF BLUE MOLD AND GRAY MOLD ON SMARTFRESH™ (1-MCP)-TREATED 'EMPIRE' APPLES; 2003-04.**

MATERIALS: BIOSAVE (*Pseudomonas syringae*) SMARTFRESH™ (1-methylcyclopropene; 1-MCP)

METHODS: BIOSAVE (*Pseudomonas syringae*) was tested for efficacy against blue mold caused by thiabendazole-resistant and -sensitive *Penicillium expansum* and gray mold caused by thiabendazole-resistant *Botrytis cinerea* on 'Empire' apples treated with SMARTFRESH™ (1-methylcyclopropene; 1-MCP). Within 24 hours of harvest 'Empire' apples were treated with 1 µl/ml of 1-MCP and stored in a controlled atmosphere storage A (1.0% O_2 and 1.5% CO_2, 0°C) and in Storage B (2.5% O_2 and 2.0% CO_2, 0°C) for 120 days at the University Guelph. The trial on the efficacy of biological control agent on blue mold in 1-MCP treated and untreated 'Empire' apples from storage A and storage B was conducted at SCPFRC, AAFC, Vineland Station. The treatments were: 1) thiabendazole-resistant *P. expansum*, 2) thiabendazole-sensitive *P. expansum*, 3) thiabendazole-resistant *B. cinerea*, 4) thiabendazole-resistant *P. expansum* + BIOSAVE 1 x 10^9 CFU/ml (1.59 g/L), 5) thiabendazole-sensitive *P. expansum* +BIOSAVE 1 x 10^9 CFU/ml (1.59 g/L) and 6) thiabendazole-resistant *B. cinerea* + BIOSAVE 1 x 10^9 CFU/ml (1.59 g/L). TBZ-resistant *B. cinerea* isolate BC-8DR or TBZ-resistant *P. expansum* isolate PS-1R or TBZ-sensitive *P. expansum* P24-7AS at a concentration of 1 x 10^5 conidia/ml. Apples were placed on a plastic packing insert (24 fruit master) contained in a plastic box. Each box represented a treatment replication. Three replicate trays of 6 apples per replicate were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated or co-treated with pathogen inoculum and BIOSAVE. The drench application consisted of mixing appropriate amount pathogen inoculum with or without BIOSAVE concentration in

water and pouring it on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. The treatments were randomized completely. Apples were incubated at 4°C for 17 days. Apples in each of the experiments were evaluated for decay. To determine the efficacy of fungicide treatments on the shelf-life of the fruit, after first fruit decay evaluations following incubation at 4°C, the fruits were moved to 20 °C and 85% RH and incubated for an additional 6 days. The apples were again evaluated for blue mold/gray mold incidence (percent infected apples). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: As outlined in Table 1.

CONCLUSIONS: In apples from storage A (kept at 1.0% O_2 and 1.5% CO_2, 0°C for 120 days), diseases were completely controlled in cold storage for 17 days when the BIOSAVE was applied together with the pathogen(s). High disease incidence was observed in control treatments with pathogen only. In apples from Storage B (kept at 2.5% O_2 and 2.0% CO_2; 0°C for 120 days), complete control of blue mold was achieved in BIOSAVE treated apples but gray mold disease was observed in 1-MCP-treated- and non-treated apples. BIOSAVE was not effective in the shelf-life study in apples from both storage treatments. There was no difference in response to disease or disease control with BIOSAVE between the 1-MCP-treated and non-treated apples. The results suggest that storage conditions may play a role in disease suppression in stored apples.

Table 1. Mean percentage incidence of blue mold and gray mold after post-harvest treatment of BioSave in 'Empire' apples that have been treated with 1-MCP and stored for 120 days in CA storage.

Treatments [1]	Disease incidence (%)			
	Storage A (1.2% O_2 and 1.2 % CO_2, 0°C for 120 days)		Storage B (2.5% O_2 and 2.5 % CO_2, 0°C for 120 days)	
	4°C for 17 days	4°C for 17 days + 20°C for 6 days	4°C for 17 days	4°C for 17 days+ 20 °C for 6 days 4°C for 17 days + 20°C for 6 days
Without 1-MCP				
TBZ-R *P. expansum*[2]	94.4 c [3,4]	100.0 c	100.0 e	100.0 a
TBZ-S *P. expansum*[5]	100.0 d	100.0 c	88.9 c	100.0 a
TBZ-S *B. cinerea*[6]	100.0 d	100.0 c	100.0 e	100.0 a
TBZ-R *P. expansum* + BIOSAVE @ 1.59 g/L	0.0 a	66.6 b	0.0 a	100.0 a
TBZ-S *P. expansum* + BIOSAVE @ 1.59 g/L	0.0 a	50.0 a	0.0 a	100.0 a
TBZ-S *B. cinerea* + BIOSAVE @ 1.59 g/L	0.0 a	100.0 c	16.7 b	100.0 a
With 1-MCP				
TBZ-R *P. expansum*	88.8 b	100.0 c	88.9 c	100.0 a
TBZ-S *P. expansum*	100 d	100.0 c	94.4 d	100.0 a
TBZ-S *B. cinerea*	94.4 c	100.0 c	100.0 e	100.0 a
TBZ-R *P. expansum* + BIOSAVE @ 1.59 g/L	0.0 a	100.0 c	0.0 a	100.0 a
TBZ-S *P. expansum* + BIOSAVE @ 1.59 g/L	0.0 a	100.0 c	0.0 a	72.2 b
TBZ-S *B. cinerea* + BIOSAVE @ 1.59 g/L	0.0 a	100.0 c	0.0 a	100.0 a

[1] one half of the apples were treated with 1 ppm of 1-MCP and stored at 0°C and >95% RH for 120 days prior to the test.
[2] TBZ-R = thiabendazole resistant.
[3] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.
[4] Data represent the mean of 3 replicates of 6 apples per replicate. Each apple was wounded and inoculated with pathogen inoculum with or without BIOSAVE.
[5] TBZ-S = thiabendazole sensitive
[6] TBZ-R = thiabendazole resistant

2004 PMRR REPORT # 49 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. McIntosh
PEST: Blue mold (*Penicillum expansum* Link) and gray mold (*Botrytis cinerea* Pers.)

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TITLE: EVALUATION OF BIOLOGICAL CONTROL AGENT BIOSAVE (*PSEUDOMONAS SYRINGAE*) FOR CONTROL OF BLUE MOLD AND GRAY MOLD ON SMARTFRESH™ (1-MCP)-TREATED 'MCINTOSH' APPLES; 2003-04.

MATERIALS: BIOSAVE (*Pseudomnas syringae*) SMARTFRESH™ (1-methylcyclopropene; 1-MCP)

METHODS: BIOSAVE (*Pseudomonas syringae*) was tested for efficacy against blue mold caused by thiabendazole-resistant and -sensitive *Penicillium expansum* and gray mold caused by thiabendazole-resistant *Botrytis cinerea* on 'McIntosh' apples treated with SMARTFRESH™ (1-methylcyclopropene; 1-MCP). Within 24 hours of harvest 'McIntosh' apples were treated with 1-MCP and stored in air at 0°C for 135 days at the University Guelph. The trial on the efficacy of biological control agent on blue mold in 1-MCP treated and untreated 'McIntosh' apples was conducted at SCPFRC, AAFC, Vineland Station. The treatments were: 1) thiabendazole-resistant *P. expansum*, 2) thiabendazole-sensitive *P. expansum*, 3) thiabendazole-resistant *B. cinerea*, 4) thiabendazole-resistant *P. expansum* +BIOSAVE 1 x 10^9 CFU/ml (1.59 g/L), 5) thiabendazole-sensitive *P. expansum* +BIOSAVE 1 x 10^9 CFU/ml (1.59 g/L) and 6) thiabendazole-resistant *B. cinerea* +BIOSAVE 1 x 10^9 CFU/ml (1.59 g/L). TBZ-resistant *B. cinerea* isolate BC-8DR or TBZ-resistant *P. expansum* isolate PS-1R or TBZ-sensitive *P. expansum* P24-7AS at a concentration of 1 x 10^5 conidia/ml were used in the treatments. Apples were placed on a plastic packing insert (24 fruit master) contained in a plastic box. Each box represented a treatment replication. Three replicate trays of 6 apples per replicate were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated or co-treated with pathogen inoculum and BIOSAVE. The drench application consisted of mixing appropriate amount of pathogen inoculum with or without BIOSAVE concentration in water and

pouring it on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. The treatments were randomized completely. Apples were incubated at 4°C for 17 days. Apples in each of the experiments were evaluated for decay. To determine the efficacy of fungicide treatments on the shelf-life of the fruit, after first fruit decay evaluations following incubation at 4°C , the fruits were moved to 20°C and 85% RH and incubated for an additional 6 days. The apples were again evaluated for blue mold/gray mold incidence (percent infected apples). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: As outlined in Table 1.

CONCLUSIONS: Following inoculation and incubation for 17 days in cold storage, low blue mold incidence (0 to 5.5%) and very high gray mold incidence (88.8 - 100%) was observed in BIOSAVE treated apples, that had been previously treated with 1-MCP after harvest. Higher incidence of blue mold and gray mold was observed in non-1-MCP treated apples. BIOSAVE was not effective in the shelf-life study..

Table 1. Mean percentage incidence of blue mold and gray mold after post-harvest treatment of BIOSAVE on 'McIntosh' apples that have been treated with 1-MCP and stored for 135 days in controlled atmosphere (CA) storage [1]; 2003-04.

Treatment [1]	Disease incidence (%)	
	4°C for 17 days	4°C for 17 days + Shelf-life at 20°C for 6 days
Without 1-MCP		
TBZ-R *P. expansum*[2]	100.0 i[3,4]	100.0 a
TBZ-S *P. expansum*[5]	100.0 i	100.0 a
TBZ-S *B. cinerea* [6]	100.0 i	100.0 a
TBZ-R *P. expansum* + BIOSAVE @ 1.59 g/L	22.2 c	100.0 a
TBZ-S *P. expansum* + BIOSAVE @ 1.59 g/L	27.8 d	100.0 a
TBZ-S *B. cinerea* + BIOSAVE @ 1.59 g/L	88.9 g	100.0 a
With 1-MCP		
TBZ-R *P. expansum*	94.4 h	100.0 a
TBZ-S *P. expansum*	55.5 e	100.0 a
TBZ-S *B. cinerea*	100.0 i	100.0 a
TBZ-R *P. expansum* + BIOSAVE @ 1.59 g/L	5.5 b	100.0 a
TBZ-S *P. expansum* + BIOSAVE @ 1.59 g/L	0.0 a	100.0 a
TBZ-S *B. cinerea* + BIOSAVE @ 1.59 g/L	72.2 f	100.0 a

[1] one half of the apples were treated with 1 ppm 1-MCP and stored at 0°C and >95% RH for 135 days prior to the test.
[2] TBZ-R = thiabendazole resistant *P. expansum*.
[3] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.
[4] Data represent the mean of 3 replicates of 6 apples per replicate. Each apple was wounded and inoculated with pathogen inoculum with or without BIOSAVE.
[5] TBZ-S = thiabendazole sensitive *P. expansum*.
[6] TBZ-R = thiabendazole resistant *B. cinerea*.

2004 PMRR REPORT # 50 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Gala
PEST: Blue mold (*Penicillum expansum* Link) and gray mold (*Botrytis cinerea* Pers.)

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TITLE: EVALUATION OF FUNGICIDES FOR POST-HARVEST CONTROL OF BLUE MOLD IN SMARTFRESH™ (1-MCP)-TREATED 'GALA' APPLES; 2003-04.

MATERIALS: BIOSAVE (*Pseudomonas syringae*), MERTECT 500SC (thiabendazole 45%), SCALA (pyrimethanil), SCHOLAR (50% fludioxonil), SMARTFRESH (1-methylcyclopropene; 1-MCP), and VANGARD (cyprodinil)

METHODS: A trial was conducted to test the efficacy of post-harvest fungicides, BIOSAVE (JET Harvest Solutions), MERTECT 500SC (thiabendazole 45%), SCALA (pyrimethanil), SCHOLAR (50% fludioxonil) and VANGARD (cyprodinil) to control blue mold in SMARTFRESH (1-methylcyclopropene; 1-MCP)- treated 'Gala' apples. Within 24 hours of harvest 'Gala' apples were treated with 1 µl/ml of 1-MCP and stored in air for 100 days at the University Guelph. Both 1-MCP-treated and non-treated apples were used and the trial was conducted at SCPFRC, AAFC, Vineland Station. Apples were placed on a plastic packing insert (fruit master) contained in a plastic box. Each box represents a treatment replication and three replicate trays were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-resistant *Penicillium expansum* isolate PS-1R at a concentration of 1 x 10^5 conidia/ml and incubated at 12°C for 18-24 hours and then treated with fungicide treatments. The drench application consisting of mixing appropriate amount of fungicides concentration in water and poured on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. Untreated check had no fungicides. The treatments were completely randomized. Treated apples were incubated at 4°C for 3 months. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after the first fruit decay evaluations following incubation at 4°C, the fruits were moved to 20

°C, 85% RH and incubated for 6 days. The fruits were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means were separated by the Tukey test.

RESULTS: As outlined in Table 1.

CONCLUSIONS: SCALA (pyrimethanil), SCHOLAR (50% fludioxonil) and VANGARD (cyprodinil) gave complete control of blue mold in 1-MCP- treated and non-treated apples. BIOSAVE was not effective as a post-inoculation treatment. As expected, MERTECT was ineffective against blue mold caused by the TBZ-resistant *P. expansum*.

Table 1. Effect of fungicides on blue mold, caused by *Penicillium expansum*, in a post-inoculation treatment on 'Gala' apples that have been treated with 1-MCP and stored for 120 days in controlled atmosphere (CA) storage [1].

Treatment	% blue mold incidence			
	30 days at 4°C	60 days at 4°C	90 days at 4°C	90 days at 4°C+ shelf-life at 20°C for 6 days
Without 1-MCP				
Inoculum only	91.6 d [2,3]	100.0 d	100.0 c	100.0 c
BIOSAVE @ 1.59 g/L (9 X 10^9 CFU/ml)	61.1 b	77.8 b	83.3 b	83.3 b
MERTECT @ 1.15 g/L	88.9 d	100.0 d	100.0 c	100.0 c
SCHOLAR @ 1.2 g/L	0.0 a	0.0 a	0.0 a	0.0 a
SCALA @ 2 ml/L	0.0 a	0.0 a	0.0 a	0.0 a
VANGARD @ 0.8 g/L	0.0 a	0.0 a	0.0 a	0.0 a
With 1-MCP				
Inoculum only	100.0 e	100.0 d	100.0 c	100.0 c
BIOSAVE @ 1.59 g/L (9 X 10^9 CFU/ml)	77.8 c	88.9 c	100.0 c	100.0 c
MERTECT @ 1.15 g/L	100.0 e	100.0 d	100.0 c	100.0 c
SCHOLAR @ 1.2 g/L	0.0 a	0.0 a	0.0 a	0.0 a
SCALA @ 2 ml/L	0.0 a	0.0 a	0.0 a	0.0 a
VANGARD @ 0.8 g/L	0.0 a	0.0 a	0.0 a	0.0 a

[1] Apples were treated with 1 µg/ml of 1-MCP and stored at 0°C and >95% RH for 100 days prior to the test.
[2] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.
[3] Data represent the mean of 3 replicate of 12 apples per replicate. Each apple was wounded and inoculated with pathogen inoculum with or without BIOSAVE.

2004 PMRR REPORT # 51 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.61

CROP: Apples (*Malus domestica* Borkh.) cv. Delicious
PEST: Blue mold (*Penicillum expansum* Link) and gray mold (*Botrytis cinerea* Pers.)

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TITLE: EVALUATION OF POST-HARVEST FUNGICIDES FOR CONTROL OF BLUE MOLD IN SMARTFRESH ™(1-MCP)-TREATED 'DELICIOUS' APPLES UNDER THREE, CONTROLLED ATMOSPHERE, STORAGE ENVIRONMENTS; 2003-04.

MATERIALS: SCHOLAR (50% fludioxonil) and MERTECT 500SC (thiabendazole 45%).

METHODS: SCHOLAR 50WP (fludioxonil) was compared with the thiabendazole (TBZ) for efficacy against blue mold of apples caused by *Penicillium expansum*. Within 24 hours of harvest 'Delicious' apples were treated with 1-MCP and stored in 3 different controlled atmosphere (CA) storage environments: CA storage A, 0.6% O_2 and 0.6% CO_2; CA storage B, 1.2% O_2 and 1.2% CO_2; CA storage C, 2.5% O_2 and 2.5% CO_2; for 100 days at the University Guelph. Both 1-MCP treated and non-treated apples were used and the trial was conducted at SCPFRC, AAFC, Vineland Station. Apples were placed on a plastic packing insert (fruit master) contained in a plastic box. Each treatment had 3 replicates and each replicate had 4 apples. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-resistant *Penicillium expansum* isolate PS-1R at a concentration of 1 x 10^5 conidia/ml and incubated at 12°C for 18-24 hours and then treated with fungicide treatments. The drench application consisted of mixing appropriate amount of fludioxonil concentration in water and pouring on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. Untreated check had no fungicides. The treatments were completely randomized. Treated apples were incubated at 4°C for 3 months. Apples in each of the experiments were evaluated for blue mold incidence after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation at 4°C, the fruits were moved to 20°C, 85% RH and incubated for

6 days. The fruits were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed with SigmaStat statistical package.

RESULTS: As outlined in Table 1.

CONCLUSIONS: SCHOLAR at a concentration of 1.2 g/L gave complete control of blue mold in apples that had been stored at three different CA storage environments. SCHOLAR was effective as drench application. In the control treatment, higher disease incidence was observed in apples treated with 1-MCP and stored in CA storage A, (at 0.6% O_2 and 0.6% $CO_{2)}$ while lower disease incidence was observed in apples that were stored in CA storage environments B (CA storage B, 1.2% O_2 and 1.2% CO_2) and CA storage C (CA storage C, 2.5% O_2 and 2.5% CO_2). Disease incidence in control and MERTECT treatment increased with time. As expected MERTECT was ineffective against blue mold caused by the TBZ-resistant *P. expansum*.

Table 1. Effect of SCHOLAR on blue mold, caused by *Penicillium expansum* in 'Delicious' apples that were treated with 1-MCP and stored under three controlled atmosphere storage conditions for 100 days, 2003-04 [1].

Treatment	Controlled Atmosphere Storage		% Blue mold incidence							
			30 days at 4°C		60 days at 4°C		90 days at 4°C		90 days at 4°C + shelf-life for 6 days at 20°C	
	% O_2	% CO_2	No 1-MCP	1-MCP	No 1-MCP	1-MCP	No 1-MCP	1-MCP	No 1-MCP	1-MCP
CA storage A										
Inoculum only	0.6	0.6	16.7 b [2,3]	25.0 c	50.0 a	83.3 c	66.7 b	83.3 c	91.7 c	100.0 d
SCHOLAR @ 1.2 g/L	0.6	0.6	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	8.3 b	0.0 a
MERTECT @ 1.15 g/L	0.6	0.6	33.3 c	41.7 d	75.0 b	91.7 d	91.7 d	91.7 d	100.0 d	91.7 c
CA storage B										
Inoculum only	1.2	1.2	66.7 d	25.0 c	83.3 c	58.3 b	83.3 b	58.3 b	91.7 c	75.0 b
SCHOLAR @ 1.2 g/L	1.2	1.2	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
MERTECT @ 1.15 g/L	1.2	1.2	33.3 b	18.3 b	75.0 b	91.7 d	91.7	91.7 d	100.0 d	91.7 c
CA storage C										
Inoculum only	2.5	2.5	75.0 e	25.0 c	83.3 c	58.3 b	91.7 d	58.3 b	100.0 d	75.0 b
SCHOLAR @ 1.2 g/L	2.5	2.5	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
MERTECT @ 1.15 g/L	2.5	2.5	58.3 c	25.0 c	91.6 d	91.7 d	100.0 e	100.0 e	100.0 d	100.0 d

[1] Apples were treated with 1 ppm 1-MCP and stored at 0°C and >95% RH for 100 days prior to the test.
[2] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.
[3] Data represent the mean of 3 replicates, with 4 apples per replicate.

2004 PMRR REPORT # 52 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. 'Empire'
PEST: Blue mold (*Penicillum expansum* Link)

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TITLE: EVALUATION OF BIOLOGICAL CONTROL ACTIVITY OF *METSCHNIKOWIA PULCHERRIMA* FOR CONTROL OF BLUE MOLD ON 'EMPIRE' APPLES IN COLD STORAGE; 2003-2004.

MATERIALS: *Metschnikowia pulcherrima*

METHODS: A yeast antagonist, *Metschnikowia pulcherrima*, was tested for efficacy against blue mold caused by *Penicillium expansum* on 'Empire' apples. The trial was conducted at SCPFRC, AAFC, Vineland. Commercially ripe apples were obtained from an orchard in Jordan Station, Ontario. Fruits that had been stored for 3 months in controlled atmosphere (CA) storage were used in the experimental treatments. Apples 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 apples were placed on a plastic packing insert (fruit master) contained in a plastic box. Each treatment had three replicates and each replicate had 12 apples. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop consisting of one of the three concentrations of *M. pulcherrima* with *P. expansum* isolate PS-1R. The treatments were completely randomized. Treated apples were incubated at 4°C for 3 months. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine efficacy of the bio-control agent on the shelf-life of the fruit, after decay evaluations following incubation at 4°C, the fruits were moved to 20°C, 85% RH and incubated for 6 days. The fruits were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means were separated by the Tukey test.

RESULTS: As outlined in Table 1.

CONCLUSIONS: Results from the test on the efficacy of *M. pulcherrima* on the control of blue mold show that initial low decay incidence increased with time. After 28 days of incubation, 88% blue mold infection was observed in the inoculum only treatment, while the treatments with combination of *M. pulcherrima* and the pathogen ranged between 0 to 61%, depending on antagonist/pathogen ratio. Better

control was achieved with the lower concentrations of the pathogen inoculum. The combinations of *M. pulcherrima* at 1.6 x 10^7 CFU/ml and 1 x 10^4 conidia/ml of *P. expansum* resulted in the lowest incidence of blue mold. Two combinations, 1.6 x 10^7 CFU/ml of *M. pulcherrima* and 1 x 10^4 and 5 x 10^4 conidia/ml of *P. expansum* gave initially complete control of blue mold, but by day 86 all fruit had decay. Additional antagonist applications may be needed to achieve long lasting control on this cultivar.

Table 1. Effect of *M. pulcherrima* on the control of blue mold, caused by *Penicillium expansum*, on 'Empire' apple in cold storage; 2003-2004.

Treatments		Blue Mold incidence(%)				
		Storage time at 4°C (days)			Storage time at 20°C after storage for 86 days at 4°C (days)	
M. pulcherrima + CFU/ml	*P. expansum* conidia/ml	28	58	86	7	14
--	1 x 10^4	88.8 f [a]	100.0 b	100.00 a	100.00 a	100.00 a
1.6 x 10^5	1 x 10^4	5.6 c	100.00 b	100.00 a	100.00 a	100.00 a
1.6 x 10^6	1 x 10^4	2.8 b	100.00 b	100.00 a	100.00 a	100.00 a
1.6 x 10^7	1 x 10^4	0.0 a	86.1 a	100.00 a	100.00 a	100.00 a
1.6 x 10^5	5 x 10^4	61.1 e	100.00 b	100.00 a	100.00 a	100.00 a
1.6 x 10^6	5 x 10^4	19.4 d	100.00 b	100.00 a	100.00 a	100.00 a
1.6 x 10^7	5 x 10^4	0.0 a	100.00 b	100.00 a	100.00 a	100.00 a

[a] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.

2004 PMRR REPORT # 53 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.21

CROP: Apples (*Malus domestica* Borkh.) cv. Empire
PEST: Blue mold (*Penicillum expansum* Link) and gray mold (*Botrytis cinerea* Pers.)

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TITLE: EVALUATION OF PENBOTEC™ 400 SC (LAG 2002 259) FOR POSTHARVEST CONTROL OF BLUE MOLD AND GRAY MOLD IN 'EMPIRE' APPLES; 2003-04.

MATERIALS: PENBOTEC 400 SC (pyrimethanil)and MERTECT (thiabendazole).

METHODS: PENBOTEC 400 SC (pyrimethanil) was compared with thiabendazole (TBZ) for efficacy against gray mold of apple caused by *Botrytis cinerea* and blue mold of apple caused by *Penicillium expansum*. Experiments were conducted at the research Centre in Vineland, Ontario. All fruits were stored at 1– 4°C until used in experimental treatments. Apples were harvested on October 10 and the experiment was conducted on October 24, 2004. Apples 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 apples were placed on a plastic packing insert (24 fruit master) contained in a plastic box. 4 replicates, with 12 fruits for each replicate were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-resistant *B. cinerea* isolate BC-8D and TBZ-resistant *P. expansum* isolate PS-2R at a concentration of 1 x 10^5 conidia/ml and incubate at 12ºC for 18-24 hours and then treated with fungicide treatments. Drench treatment included mixing appropriate amount of PENBOTEC 400 SC concentration in water and pouring on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. The treatments were completely randomized. Treated apples were incubated at 2 (± 2)ºC for 3 and 6 months. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation at 2 (± 2)°C, the fruits were moved to 20ºC, 85% RH and incubated for 6 days. The fruits were again evaluated for blue/gray mold incidence (percent infected apples). 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 Tables 1 and 2.

Conclusions: The reduced risk fungicide, PENBOTEC 400 SC, at concentrations of 0.29 g/L or higher effectively controlled blue mold in 'Empire' apples after 3 months in cold storage and an increase of disease incidence was observed after 6 months (Table 1). Higher disease was observed in the treatments incubated in the shelf-life study than in the cold storage. High blue mold disease incidence (100%) was observed in the untreated and inoculated control. As expected, MERTECT did not control blue mold caused by thiabendazole-resistant *P. expansum*.

PENBOTEC was also effective against gray mold in 'Empire' apples (Table 2). The concentration of 0.15

g/L and higher completely controlled the disease after 3 months in cold storage and an increase of disease incidence was observed after 6 months. Concentrations of 1.16 and 2.34 g/l gave 98 % control of gray mold in cold storage and in the shelf-life study. In summary, PENBOTEC 400 SC at concentrations of 1.16 g/L or higher gave control of blue mold and gray mold in 'Empire' apples.

Table 1. Mean percentage incidence of blue mold (*Penicillium expansum*) after post-harvest treatment of PENBOTEC™ 400 SC on apple cv. Empire; 2003-04.

Treatment	% Disease incidence [a]		
	in cold storage at 2 (± 2)°C		
	3 months	6 months	6 months + 6 days at 20°C
No inoculum	0.0 a[b]	0.0 a	0.0 a
Inoculum only	100.0 e	100.0 f	100.0 h
PENBOTEC @ 0.035 g/L	87.5 d	97.9 e	97.9 g
PENBOTEC @ 0.072 g/L	58.3 c	87.5 d	87.5 f
PENBOTEC @ 0.15 g/L	2.1 b	27.0 c	37.5 d
PENBOTEC @ 0.29 g/L	0.0 a	25.0 c	41.7 e
PENBOTEC @ 0.58 g/L	0.0 a	4.2 b	31.3 c
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	22.9 b
PENBOTEC @ 2.32 g/L	0.0 a	4.2 b	41.7 e
MERTECT @ 1.15 g/L	100.0 e	100.0 f	100.0 h

[a] Data represent the mean of 4 replicates of 12 apples/replicate.
[b] Means within columns followed by the same letter are not significantly different using the Tukey test at P=0.05.

Table 2. Mean percentage incidence of gray mold (*Botrytis cinerea*) after post-harvest treatment of PENBOTEC™ 400 SC on apple cv. Empire; 2003-04.

Treatment (g/L)	% Disease incidence [a]		
	in cold storage at 2 (± 2)ºC		
	3 months	6 months	6 months + 6 days at 20°C
Inoculum only	100 d [b]	100 e	100 f
PENBOTEC @ 0.035 g/L	37.5 c	68.8 d	68.8 e
PENBOTEC @ 0.072 g/L	4.2 b	10.4 c	18.8 d
PENBOTEC @ 0.15 g/L	0.0 a	2.1 a	8.3 c
PENBOTEC @ 0.29 g/L	0.0 a	4.2 b	4.2 b
PENBOTEC @ 0.58 g/L	0.0 a	4.2 b	4.2 b
PENBOTEC @ 1.16 g/L	0.0 a	2.1 a	2.1 a
PENBOTEC @ 2.32 g/L	0.0 a	2.1 a	2.1 a
MERTECT @ 1.15 g/L	97.9 d	100 e	100 f

[a] Data represent the mean of 4 replicates of 12 apples/replicate.
[b] Means within columns followed by the same letter are not significantly different using the Tukey test at P=0.05.

2004 PMRR REPORT # 54 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.21

CROP: Apples (*Malus domestica* Borkh.) cv. Gala
PEST: Blue mold (*Penicillum expansum* Link) and gray mold (*Botrytis cinerea* Pers.)

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TITLE: EVALUATION OF PENBOTEC™ 400 SC (LAG 2002 259) FOR POST-HARVEST CONTROL OF BLUE MOLD AND GRAY MOLD IN APPLE CV. GALA; 2003-04.

MATERIALS: PENBOTEC™ 400 SC (pyrimethanil) and MERTECT (thiabendazole)

METHODS: The post-harvest fungicide, PENBOTEC™ 400 SC (Janssen formulation code LAg 2002 259) was compared with MERTECT (thiabendazole; TBZ) for efficacy against gray mold of apple caused by *Botrytis cinerea* and blue mold of apple caused by *Penicillium expansum*. All fruits were stored at 1–4ºC until used in experimental treatments. Apples were harvested on October 10 and the experiment was conducted on October 24, 2004. Apples 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 apples were placed on a plastic packing insert (24 fruit master) contained in a plastic box. 4 replicates, with 12 fruit for each replicate were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-resistant *B. cinerea* isolate BC-8D and TBZ-resistant *P. expansum* isolate PS-2R at a concentration of 1 x 10^5 conidia/ml and incubate at 12°C for 18-24 hours and then treated with fungicide treatments. Details of the treatments are presented in Table 1. Drench treatment included mixing appropriate amount of PENBOTEC™ 400 SC concentration in water and poured on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. The treatments were completely randomized. Treated apples were incubated at 1.5°C for 3-6 months. Apples in each of the experiments were evaluated for disease incidence after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations, the fruits were moved to 20°C, 85% RH and incubated for 6 days. The fruit were again evaluated for blue mold and gray mold incidence (percent infected apples). 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 were separated by Tukey test.

RESULTS: As outlined in Tables 1 and 2.

CONCLUSIONS: The post-harvest fungicide, PENBOTEC™ 400 SC at concentrations of 0.58 g/L or higher effectively controlled blue mold in 'Gala' apples in cold storage. Slightly higher disease (>3.0%) than that was present in treatments incubated in the cold storage was observed in the apples that were treated with 500 µg/ml or higher concentrations of the fungicides in the shelf-life study. High blue mold disease incidence (100%) was observed in the untreated and inoculated control. As expected, MERTECT did not control blue mold caused by thiabendazole-resistant *P.expansum*. PENBOTEC™ 400 SC was also effective against gray mold in 'Gala' apples. The concentration of 0.01 g/L had higher disease and the remaining concentrations had 0-3.0% of gray mold. Concentrations of 1.16, 2.32 and 3.48 g/L gave 100%

control of gray mold in cold storage and in the subsequent shelf-life study. In summary, PENBOTEC™ 400 SC at concentrations of 1.16 g/L or higher gave control of blue mold and gray mold in 'Gala' apples.

Table 1. Mean Percentage incidence of blue mold (*Penicillium expansum*) after post-harvest treatment of PENBOTEC™ 400 SC on apple cv Gala; 2003-04.

Treatment	% Blue mold incidence [a]	
	3 months at 1.5ºC	3 months at 1.5ºC + 6 days at 20°C
No inoculum	0.0 a [b]	0.0 a
Inoculum only	97.2 f	97.2 g
PENBOTEC @ 0.01 g/L	75.0 d	91.6 f
PENBOTEC @ 0.02 g/L	91.7 e	100.0 h
PENBOTEC @ 0.17 g/L	13.9 c	25.0 e
PENBOTEC @ 0.29 g/L	8.3 b	11.1 d
PENBOTEC @ 0.58 g/L	0.0 a	5.6 c
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a
PENBOTEC @ 2.32 g/L	0.0 a	2.8 b
PENBOTEC @ 3.48 g/L	0.0 a	2.8 b
MERTEC @ 1.15 g/L	97.2 f	97.2 g

[a] Data represent the mean of 4 replicates of 12 apples/replicate.
[b] Means within columns followed by the same letter are not significantly different using the Tukey test at P=0.05.

Table 2. Mean percentage incidence of gray mold (*Botrytis cinerea*) after post-harvest treatment of PENBOTEC™ 400 SC on apple cv. Gala; 2003-04.

Treatment	% Gray mold incidence [a]	
	After 3 months at 1.5°C	3 months at 1.5°C+ 6 days at 20°C
No inoculum	0.0 a[b]	0.0 a
Inoculum only	97.2 e	97.2 e
PENBOTEC @ 0.01 g/L	30.6 c	44.4 c
PENBOTEC @ 0.02 g/L	2.8 b	2.8 b
PENBOTEC @ 0.17 g/L	0.0 a	0.0 a
PENBOTEC @ 0.29 g/L	0.0 a	2.8 b
PENBOTEC @ 0.58 g/L	2.8 b	2.8 b
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a
PENBOTEC @ 2.32 g/L	0.0 a	0.0 a
PENBOTEC @ 3.48 g/L	0.0 a	0.0 a
MERTECT @ 1.15 g/L	94.4 d	94.4 d

[a] Data represent the mean of 4 replicates of 12 apples/replicate.
[b] Means within columns followed by the same letter are not significantly different using the Tukey test at P=0.05.

2004 PMRR REPORT # 55 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.21

CROP: Apples (*Malus domestica* Borkh.) cvs. Empire, Jonagold and Red Delicious
PEST: Gray mold (*Botrytis cinerea* Pers.) and Blue mold (*Penicillium expansum* Link)

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TITLE: EVALUATION OF PENBOTEC™ 400 SC (LAG 2002 259) FOR POST-HARVEST CONTROL OF GRAY MOLD AND BLUE MOLD IN APPLE CV. EMPIRE, JONAGOLD AND RED DELICIOUS; 2003-04.

MATERIALS: PENBOTEC™ 400 SC (pyrimethanil) and MERTECT (thiabendazole)

METHODS: PENBOTEC™ 400 SC (pyrimethanil) was compared with thiabendazole (TBZ) for efficacy against gray mold of apples caused by *Botrytis cinerea* and blue mold of apple caused by *Penicillium expansum*. Experiments were conducted at the research Centre in Vineland, Ontario. All fruits were stored at 1– 4ºC until used in the experimental treatments. Apples were harvested on October 10 and the experiment was conducted on October 24, 2004. Empire, Gala, Jonagold and Red Delicious apples were drenched with 2 X (1000 ppm) and 3X (1500 ppm) of PENBOTEC™ 400 SC and kept in the cold storage for three months. Each treatment had 4 replicates, with 12 fruit in each replicate. After three months apples were evaluated for phytotoxicity, blemishes on the skin of the fruit, to the fungicide. Following the incubation for three months, apples from three cultivars, Empire, Jonagold and Red Delicious, were tested for the post-treatment efficacy of PENBOTEC™. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-resistant *B. cinerea* isolate BC-8D and TBZ-resistant *P. expansum* isolate PS-2R at a concentration of 1 x 10^5 conidia/ml and incubate at 20ºC for 6 days. Each treatment had 4 replicates, with 6 fruit in each replicate. Apples were evaluated for blue and gray mold incidence (percent infected apples). 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 Tables 1.

CONCLUSIONS: There was no phytotoxicity in any of the four apple cvs. Empire, Gala, Jonagold and Red Delicious that were treated with 2.32 and 3.48 g/L of the reduced risk fungicide, PENBOTEC ™400 SC. Variable levels of control of blue mold and gray mold was observed in the apples that had been treated with PENBOTEC™ 400 SC and incubated for 3 months in cold storage. Similar blue mold disease incidence was observed in Empire and Jonagold, while no disease was observed in Red Delicious. High, low and no gray mold incidence was observed in Jonagold, Empire and Red Delicious, respectively.

Table 1. Mean percentage incidence of blue mold (*Penicillium expansum*) and gray mold (*Botrytis cinerea*) in apples that were treated with PENBOTEC™ 400 SC and incubated for three months in cold storage; 2003-04.

Treatment	Empire		Jonagold		Red Delicious	
	% Blue mold [a]	% Gray mold [a]	% Blue mold [a]	% Gray mold [a]	% Blue mold [a]	% Gray mold [a]
Inoculum only	94.4 c[b]	66.6 c	94.4 c	83.3 c	94.4 b	94.4 b
PENBOTEC @ 2.32 g/L	61.1 b	5.56 a	16.7 b	66.6 b	0.0 a	0.0 a
PENBOTEC @ 2.32 g/L	37.5 a	11.1 b	11.1 a	50.0 a	0.0 a	0.0 a

[a] Data represents the mean of 4 replicates with 6 apples/replicate.
[b] Means within columns followed by the same letter are not significantly different using the Tukey test at P=0.05.

2004 PMRR REPORT # 56 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Empire
PEST: Blue mold (*Penicillum expansum* Link) and gray mold (*Botrytis cinerea* Pers.)

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TITLE: **EFFECT OF SMARTFRESH™ (1-METHYCYCLOPROPENE) AND PENBOTEC™ ON POST-HARVEST CONTROL OF BLUE MOLD AND GRAY MOLD IN APPLE; 2003-04.**

MATERIALS: PENBOTEC™ (*pyrimethanil*) SMARTFRESH™ (1-methylcyclopropene; 1-MCP).

METHODS: Post-harvest fungicide, PENBOTEC™ 400 SC (Janssen formulation code LAg 2002 259) was compared with the thiabendazole (TBZ) for efficacy against gray mold of apples caused by *Botrytis cinerea* and blue mold of apple caused by *Penicillium expansum*. Apples were harvested on October 2, 2004. Experiments were conducted at the University of Guelph storage facility in Guelph, Ontario. 'Empire' apple fruits had been wounded immediately after optimum harvest for long-term storage (as determined by internal ethylene and starch staining) and were co-treated with the pathogen and PENBOTEC™ 400 SC. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-resistant *B. cinerea* isolate BC-8D and TBZ-resistant *P. expansum* isolate PS-2R at a concentration of 1×10^5 conidia/ml and different concentrations of PENBOTEC™. Then the apples were treated with/without 1 µl L^{-1} of 1-MCP for 24 h at 0°C. Fruit were then stored in air at 0-1°C for up to 120 days. The treatments were completely randomized. Treated apples were incubated at 0-1ºC for 126 days (4.2 months). Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation at 0-1°C, the fruits were moved to 20°C, 85% RH and incubated for 6 days. The fruit were again evaluated for blue and gray mold incidence (percent infected apples). 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 Tables 1 and 2.

CONCLUSIONS: The post-harvest fungicide, PENBOTEC™ 400 SC at concentrations of 1.16 g/L and higher effectively controlled blue mold (Table 1) and gray mold (Table 2) of apples in cold storage. Higher disease incidence was present in the treatments incubated in the shelf-life study than in the cold storage. High blue mold disease incidence (100%) was observed in the untreated and inoculated control. As expected, MERTECT did not control blue mold caused by thiabendazole-resistant *P. expansum* or gray mold caused by *B. cinerea*. There was no interaction between 1-MCP and higher concentrations (1.16 and 2.32 g/L)of PENBOTEC™ 400 SC in regards to the control of blue mold or gray mold of apple in 2003-04.

Table 1. Effect of 1-MCP on the control of blue mold with post-harvest treatment of PENBOTEC ™400 SC in 'Empire' apples, 2003-04.

Treatment	% Disease incidence	
	126 days at 0°C	126 days at 0°C + 6 days at 20°C
Without 1-MCP		
P.e. only [a]	100 e [bc]	100.0 g
P.e. + PENBOTEC @ 0.29 g/L	5.6 b	38.9 f
P.e. + PENBOTEC @ 0.58 g/L	8.3 c	22.2 d
P.e. + PENBOTEC @ 1.16 g/L	0.0 a	5.6 c
P.e. + PENBOTEC @ 2.32 g/L	0.0 a	0.0 a
P.e. + MERTECT @ 1.15 g/L	97.2 d	97.2
With 1-MCP		
P.e. only	100.0 e	100 g
P.e. + PENBOTEC @ 0.29 g/L	0.0 a	19.4 d
P.e. + PENBOTEC @ 0.58 g/L	0.0 a	25.0 e
P.e. + PENBOTEC @ 1.16 g/L	0.0 a	2.8 b
P.e. + PENBOTEC @ 2.32 g/L	0.0 a	0.0 a
P.e. + MERTECT @ 1.15 g/L	100.0 e	100.0 g

[a] Pe+ *Penicillium expansum* at 1 x 10^5 conidia/ml
[b] Data represents mean of 4 replicates, and 12 apples/replicate.
[c] Means within columns followed by the same letter are not significantly different using the Tukey test at P=0.05.

Table 2. Effect of 1-MCP on the control of gray mold with post-harvest treatment of PENBOTEC™ 400 SC in 'Empire' apples; 2003-04.

Treatment (g/L)	% Disease incidence	
	126 days at 0°C	126 days at 0°C + 6 days at 20°C
Without 1-MCP		
B.c.. only [a]	100.0 e [bc]	100.0 g
B.c. + PENBOTEC @ 0.29	2.8 b	38.9 f
B.c. + PENBOTEC @ 0.58	2.8 c	22.2 d
B.c. + PENBOTEC @ 1.16	0.0 a	5.6 c
B.c. + PENBOTEC @ 2.32	0.0 a	0.0 a
B.c. + MERTECT @ 1.15	91.6 d	97.2
With 1-MCP		
B.c. only	100.0 e	100.0 g
B.c. + PENBOTEC @ 0.29	0.0 a	19.4 d
B.c. + PENBOTEC @ 0.58	0.0 a	25.0 e
B.c. + PENBOTEC @ 1.16	0.0 a	2.8 b
B.c. + PENBOTEC @ 2.32	0.0 a	0.0 a
B.c. + MERTECT @ 1.15	100.0 e	100.0 g

[a] B.c.+ *Botrytis cinerea* at 1 x 10^5 conidia/ml
[b] Data represents mean of 4 replicates, and 12 apples/replicate.
[c] Means within columns followed by the same letter are not significantly different using the Tukey test at P=0.05.

2004 PMRR REPORT # 57 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.63

CROP: Apples (*Malus domestica* Borkh.) cvs. Gingergold and Honeycrisp
PEST: Blue mold (*Penicillium expansum* Link) and gray mold (*Botrytis cinerea* Pers.)

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TITLE: EVALUATION OF FUNGICIDES FOR POST-HARVEST CONTROL OF BLUE MOLD AND GRAY MOLD IN 'GINGERGOLD' AND 'HONEYCRISP' APPLES; 2003-04.

MATERIALS: BIOSAVE (*Pseudomonas syringae*), MERTECT 500SC (thiabendazole 45%), and SCHOLAR (50% fludioxonil)

METHODS: A trial was conducted to test the efficacy of post-harvest fungicides, BIOSAVE (*Pseudomonas syringae*), MERTECT 500SC (thiabendazole 45%), and SCHOLAR (50% fludioxonil) to control blue mold and gray mold in 'Gingergold' and 'Honeycrisp' apples. The trial was conducted at SCPFRC, AAFC, Vineland Station. Apples were placed on a plastic packing insert (fruit master) contained in a plastic box. Each box represents a treatment replication and three replicate trays were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-resistant *Penicillium expansum* isolate PS-1R or TBZ-resistant *B cinerea* isolate BC-8D at a concentration of 1 x 10^5 conidia/ml and incubated at 12°C for 18-24 hours and then treated with fungicide treatments. The drench application consisted of mixing appropriate amount of fungicides concentration in water and poured on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. Untreated check had no fungicides. The treatments were completely randomized. Treated apples were incubated at 4°C for 3 months. Apples in each of the experiments were evaluated for decay after the respective incubation period. To determine the efficacy of fungicides on the shelf-life of the fruit, following incubation at 4°C, the fruits were moved to 20°C, 85% RH and incubated for 6 days. The fruits were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion developed on the fruit. The data obtained was analyzed with SigmaStat statistical package. Analysis of variance were determined by using appropriate transformations and significance between means were separated by the Tukey test.

RESULTS: As outlined in Tables 1, 2, 3, 4.

CONCLUSIONS: In a time course study, SCHOLAR (fludioxonil) gave complete control of blue mold up to 64 days and the disease incidence increased up to 3% after 93 days in cold storage in 'Gingergold' and apples. In cold storage + shelf-life study, 6% disease was observed. BIOSAVE was not effective as a post-inoculation treatment.
In 'Honeycrisp' apples SCHOLAR (fludioxonil) gave 96% control of blue mold up to 64 days and disease increased afterwards (Table 3). Complete control of gray mold was observed up to 64 days after inoculation and an increase was observed after 93 days and in the subsequent shelf-life study. As expected, MERTECT was ineffective against blue mold caused by the TBZ-resistant *P. expansum* (Tables 1,3) and gray mold caused by *B. cinerea* in both cultivars. (Tables 2,4).

Table 1. Effect of fungicides on blue mold, caused by *Penicillium expansum*, in a post-inoculation treatment on 'Gingergold' apples; 2003-04.

Treatment	% blue mold incidence			
	44 days at 4°C	64 days at 4°C	93 days at 4°C	93 days at 4°C + 6 days at 20°C
Inoculum only	100.0 c[1,2]	100.0 b	100.0 b	100.0 b
BIOSAVE @ 1.59 g/L (9×10^9 CFU/ml)	80.6 b	100.0 b	100.0 b	100.0 b
MERTECT @ 1.15 g/L	100.0 c	100.0 b	100.0 b	100.0 b
SCHOLAR @ 1.2 g/L	0.0 a	0.0 a	2.8 a	5.6 a

[1] Data represent the mean of 3 replicate of 12 apples per replicate. Each apple was wounded and inoculated with pathogen inoculum and/or with fungicides.
[2] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.

Table 2. Effect of fungicides on gray mold, caused by *Botrytis cinerea*, in a post-inoculation treatment on 'Gingergold' apples; 2003-04.

Treatment	% blue mold incidence			
	44 days at 4°C	64 days at 4°C	93 days at 4°C	93 days at 4°C + 6 days at 20°C
Inoculum only	94.4 c[1,2]	94.4 b	100.0 c	100.0 b
BIOSAVE @ 1.59 g/L (1×10^9 CFU/ml)	77.8 b	94.4 b	94.4 b	100.0 b
MERTECT @ 1.15 g/L	100.0 d	100.0 c	100.0 c	100.0 b
SCHOLAR @ 1.2 g/L	0.0 a	0.0 a	0.0 a	16.7 a

[1] Data represent the mean of 3 replicate of 12 apples per replicate. Each apple was wounded and inoculated with pathogen inoculum and/or with fungicides.
[2] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.

Table 3. Effect of fungicides on blue mold, caused by *Penicillium expansum*, in a post-inoculation treatment on 'Honeycrisp' apples; 2003-04.

Treatment	% blue mold incidence			
	44 days at 4°C	64 days at 4°C	93 days at 4°C	93 days at 4°C + 6 days at 20°C
Inoculum only	100.0 c[1,2]	100.0 c	100.0 c	100.0 b
BIOSAVE @ 1.59 g/L (1×10^9 CFU/ml)	29.2 b	87.5 b	95.8 b	100.0 b
MERTECT @ 1.15 g/L	100.0 c	100.0 c	100.0 c	100.0 b
SCHOLAR @ 1.2 g/L	4.1 a	4.1 a	16.7 a	45.8 a

[1] Data represent the mean of 3 replicate of 12 apples per replicate. Each apple was wounded and inoculated with pathogen inoculum and/or with fungicides.
[2] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.

Table 4. Effect of fungicides on gray mold, caused by *Botrytis cinerea*, in a post-inoculation treatment on 'Honeycrisp' apples, 2003-04.

Treatment	% blue mold incidence			
	44 days at 4°C	64 days at 4°C	93 days at 4°C	93 days at 4°C + 6 days at 20°C
Inoculum only	97.4 c[1,2]	97.4 c	97.4 c	97.4 c
BIOSAVE @ 1.59 g/L (1×10^9 CFU/ml)	33.3 b	62.5 b	83.3 b	91.7 b
MERTECT @ 1.15 g/L	100.0 d	100.0 d	100.0 d	100.0 d
SCHOLAR @ 1.2 g/L	0.0 a	0.0 a	4.2 a	16.7 a

[1] Data represent the mean of 3 replicate of 12 apples per replicate. Each apple was wounded and inoculated with pathogen inoculum and/or with fungicides.
[2] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.

2004 PMRR REPORT # 58 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.21

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

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TITLE: EVALUATION OF POST-HARVEST FUNGICIDES FOR CONTROL OF GRAY MOLD IN 'GALA' APPLES IN COLD STORAGE; 2003-04.

MATERIALS: SCHOLAR (50% fludioxonil) and MERTECT 500SC (thiabendazole 45%)

METHODS: SCHOLAR 50WP (fludioxonil) was compared with MERTECT (thiabendazole; TBZ) for efficacy against gray mold of apples caused by *Botrytis cinerea*. Commercially ripe Apples cv. Gala were obtained from an orchard in Jordan Station, Ontario. The trial was conducted at SCPFRC, AAFC, Vineland. All fruits were stored at 4°C until used in the experimental treatments. Apples were harvested September 20, 2003 and the experiments were initiated on October 2, 2004. Apples 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 apples were placed on a plastic packing insert (fruit master) contained in a plastic box. Three replicate trays were prepared for each treatment and each replicate had 12 apples. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-sensitive and TBZ-resistant *B. cinerea* isolate at a concentration of 1×10^5 conidia/ml and incubated at 13 °C for 18-24 hours and then treated with fungicide treatments. The drench application consisted of mixing appropriate amount of fludioxonil concentration in water and poured on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. Untreated check had no fungicides. The treatments were completely randomized. Treated apples were incubated at 2°C for 3 months. Apples in each of the experiments were evaluated for decay after the respective incubation period. After the first fruit decay evaluation following incubation at 2°C, the fruits were moved to 20°C, 85% RH and incubated for 6 days to determine the efficacy of fungicides on the shelf-life of the fruit. The fruit were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means were separated by the Tukey tests.

RESULTS: As outlined in Tables 1 and 2.

CONCLUSIONS: Seven concentrations of SCHOLAR and one concentration of MERTECT were evaluated for gray mold control on Gala and the results show that SCHOLAR at concentrations of 0.3, 0.6, and 1.2 g/L was effective against gray mold caused by TBZ-resistant and -sensitive isolates of *B. cinerea* in cold storage for 99 days and also in the subsequent shelf-life study at 20°C for 6 days. SCHOLAR was effective as drench application. Higher concentrations (SCHOLAR 0.15 to 0.6 g/L) of fludioxonil gave 96% control of gray mold (Table 2). As expected, MERTECT was ineffective against blue mold and gray mold caused by the TBZ-resistant *B. cinerea*.

Table 1. Effect of SCHOLAR on gray mold caused by TBZ-sensitive *B. cinerea* in a post-inoculation treatment on apple cv. Gala in cold storage, 2003-04.

Treatments	% gray mold incidence [a]	
	99 days at 2°C	99 days at 2°C + 6 days at 20°C in Shelf-life study
Inoculated control	39.6 e [b]	47.9 e
SCHOLAR @ 0.010 g/L	4.2 c	8.3 c
SCHOLAR @ 0.020 g/L	0.0 a	0.0 d
SCHOLAR @ 0.035 g/L	0.0 a	2.0 b
SCHOLAR @ 0.15 g/L	2.0 b	2.0 b
SCHOLAR @ 0.3 g/L	0.0 a	0.0 a
SCHOLAR @ 0.6 g/L	0.0 a	0.0 a
SCHOLAR @ 1.2 g/L	0.0 a	0.0 a
MERTECT @ 1.15 g/L	12.5 d	12.5 d
Non-inoculated and untreated control	0.0 a	0.0 a

[a] Disease incidence was assessed after 3 months at 2°C and after subsequent shelf-life at 20°C for 6 days
[b] Means of treatments within the same column followed by different letters are significantly ($P<0.05$) different according to Tukey Test.

Table 2. Effect of SCHOLAR on gray mold, caused by TBZ-resistant *Botrytis cinerea*, of apple in a post-inoculation treatment on apple cv. Gala in cold storage; 2003-04.

Treatments	% gray mold incidence [a]	
	99 days at 2°C	99 days at 2°C + 6 days at 20°C in Shelf-life study
Inoculated control	100.0 d [b]	100.0 e
SCHOLAR @ 0.010 g/L	2.1 b	45.8 d
SCHOLAR @ 0.020 g/L	0.0 a	18.7 c
SCHOLAR @ 0.035 g/L	2.1 b	16.6 c
SCHOLAR @ 0.15 g/L	0.0 a	4.2 b
SCHOLAR @ 0.3 g/L	4.2 b	2.1 b
SCHOLAR @ 0.6 g/L	2.1 b	4.2 b
SCHOLAR @ 1.2 g/L	0.0 a	0.0 a
MERTECT @ 1.15 g/L	89.5 c	100.0 e
Non-inoculated, untreated control	0.0 a	0.0 a

[a] Disease incidence was assessed after 90 days at 2°C , and for shelf-life 20°C for 6 days
[b] Means of treatments within the same column followed by different letters are significantly ($P<0.05$) different according to Tukey Test.

2004 PMRR REPORT # 59 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.21

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

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TITLE: EVALUATION OF PRE-HARVEST FUNGICIDE, SCALA, FOR CONTROL OF POST-HARVEST BLUE MOLD IN 'EMPIRE' APPLES.

MATERIALS: SCALA (pyrimethanil 400g/L)

METHODS: Pre-harvest fungicide treatments were applied to 'Empire' apple trees arranged in a randomized complete block design with 4 replicate blocks in an experimental orchard in Jordan Station, Ontario. Each block consisted of three cv. Empire trees with guard (unsprayed) trees on either side. The apples treatments were an unsprayed check and SCALA at 1.5 L/ha. Spray applications were made using a hand operated gun sprayer to run off.. Pre-harvest treatments were applied on September 12, 2003 (4 weeks prior to harvest) and Sept 26, 2003 (2 weeks prior to harvest). Apples were harvested on October 12, 2003. Fruit were stored for three or six months in air storage at 3 ± 1°C. Upon removal from storage, replicate fruit samples of 10-16 apples were wounded. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm and inoculated with either 20 µl of sterile distilled water, or a conidial suspension of *Penicillum expansum*, isolate PS-1R (1 x 10^5 conidia/ml). After inoculation, 24 apples were placed on a plastic packing insert (fruit master) contained in a plastic box. Three replicate trays were prepared for each treatment and each replicate had 12-16 apples and incubated at 20°C for 7 days. The diameter of developing rot lesions and disease incidence were measured. Data were analysed using the General Linear Model of SigmaStat. Statistical package. Means were separated using the Tukey test.

RESULTS: As shown in Table 1.

CONCLUSIONS: There was no disease or decay in the non- wounded and non- inoculated treatment in apples after three and six months cold storage. In the wounded and inoculated with *P. expansum* treatment, blue mold was observed and there was no significant difference in decay or disease incidence among the replicates. SCALA did not reduce decay or disease incidence in apples that had been treated with pre-harvest application of SCALA and stored for three and six months in cold storage.

Table 1. Effect of pre-harvest field application of SCALA on post-harvest blue mold caused by TBZ-resistant *P. expansum* in wounded and inoculated 'Empire' apple fruit; 2003-04.

Treatments	Replicate	Time of SCALA application prior to harvest	Pre-harvest treatment of SCALA + 3 months in cold storage			Pre-harvest treatment of SCALA + 6 months in cold storage		
			No wound and no inoculaton	at 20°C for 7 days after wounding and inoculation		No wound and no inoculaton	at 20°C for 7 days after wounding and inoculation	
			Disease incidence [a] (%)	Decay Diameter [a] (cm)	Disease incidence [a] (%)	Disease incidence [a] (%)	Decay Diameter [a] (cm)	Disease incidence [a] (%)
Control (water)			0.0 a[b]	2.91 a	100.0 a	0.0 a [b]	2.86 a	100.0 a
SCALA @ 2 ml/L	1	4 weeks	0.0 a	2.63 a	100.0 a	0.0 a	2.49 a	100.0 a
SCALA @ 2 ml/L	2	4 weeks	0.0 a	2.43 a	100.0 a	0.0 a	2.52 a	96.8 b
SCALA @ 2 ml/L	3	4 weeks	0.0 a	2.95 a	100.0 a	0.0 a	2.82 a	100.0 a
SCALA @ 2 ml/L	4	4 weeks	0.0 a	2.28 a	100.0 a	0.0 a	2.84 a	100.0 a
SCALA @ 2 ml/L	1	2 weeks	0.0 a	2.89 a	100.0 a	0.0 a	2.78 a	100.0 a
SCALA @ 2 ml/L	2	2 weeks	0.0 a	2.88 a	100.0 a	0.0 a	2.99 a	100.0 a
SCALA @ 2 ml/L	3	2 weeks	0.0 a	2.78 a	100.0 a	0.0 a	2.61 a	100.0 a
SCALA @ 2 ml/L	4	2 weeks	0.0 a	2.88 a	100.0 a	0.0 a	3.02 a	100.0 a

[a] Disease incidence was assessed, after the incubation for 7 days at 20°C on apples that had been treated with pre-harvest application of SCALA and incubated for either 3 months or 6 months in cold storage.
[b] Means of treatments within the same column followed by different letters are significantly ($P<0.05$) different according to the Tukey Test.

2004 PMRR REPORT # 60 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.21

CROP: Apples (*Malus domestica* Borkh.) cv. McIntosh
PEST: Blue mold (*Penicillum expansum* Link) and gray mold (*Botrytis cinerea* Pers.)

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TITLE: EVALUATION OF PENBOTEC™ 400 SC (LAG 2002 259) FOR POST-HARVEST CONTROL OF BLUE MOLD AND GRAY MOLD IN 'MCINTOSH' APPLES; 2003-04.

MATERIALS: PENBOTEC™ 400 SC (pyrimethanil), MERTECT (thiabendazole)

METHODS: PENBOTEC™ 400 SC (pyrimethanil) was compared with MERTEC (thiabendazole; TBZ) for efficacy against gray mold of apples caused by *Botrytis cinerea* and blue mold of apple caused by *Penicillium expansum*. Experiments were conducted at the research Centre in Vineland, Ontario. All fruits were stored at 1– 4°C until used in the experimental treatments. McIntosh apples were harvested on October 10 and the experiment was conducted on October 24, 2004. Apples 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 apples were placed on a plastic packing insert (24 fruit master) contained in a plastic box. 4 replicates, with 12 fruits for each replicate were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-resistant *B. cinerea* isolate BC-8D and TBZ-resistant *P. expansum* isolate PS-2R at a concentration of 1 x 10^5 conidia/ml and incubate at 12°C for 18-24 hours and then treated with fungicide treatments. Drench treatment included mixing appropriate amount of PENBOTEC™ 400 SC concentration in water and poured on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. The treatments were completely randomized. Treated apples were incubated at 2 (± 2)°C for 3 and 6 months. The fruit were evaluated for blue and gray mold incidence (percent infected apples). 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 Tables 1 and 2.

CONCLUSIONS: The reduced risk fungicide, PENBOTEC™ 400 SC at concentrations of 2.32 and 1.16 g/l effectively controlled (96% control) blue mold in 'McIntosh' apples after 3 months in cold storage and an increase of disease incidence was observed after 6 months (Table 1). High blue mold disease incidence (100%) was observed in the untreated and inoculated control. As expected, MERTECT did not control blue mold caused by thiabendazole-resistant *P. expansum*. PENBOTEC™ was also controlled gray mold in 'McIntosh' apples (Table 2). The concentration of 2.32 and 1.16 g/l controlled 97% of the disease after 3 months in cold storage and an increase of disease incidence was observed after 6 months. In summary, PENBOTEC™ 400 SC at concentrations of 1.16 g/L or higher gave 96% control of blue mold and gray mold in 'McIntosh' apples.

Table 1. Mean percentage incidence of blue mold (*Penicillium expansum*) after post-harvest treatment of PENBOTEC™ 400 SC on apple cv. McIntosh; 2003-04.

Treatment	% Disease incidence [a]	
	in cold storage at 2 (± 2)°C	
	3 months	6 months
No inoculum	0.0 a[b]	0.0 a
Inoculum only	97.2 d	97.2 e
PENBOTEC @ 0.29 g/L	27.1 c	79.2 d
PENBOTEC @ 0.58 g/L	8.3 b	66.7 c
PENBOTEC @ 1.16 g/L	4.3 a	30.8 b
PENBOTEC @ 2.32 g/L	4.2 a	18.8 a
MERTECT @ 1.15 g/L	100.0 d	100.0 e

[a] Data represent the mean of 4 replicates, and 12 apples/replicate.
[b] Means within columns followed by the same letter are not significantly different using the Tukey test at P=0.05.

Table 2. Mean percentage incidence of gray mold (*Botrytis cinerea*) after post-harvest treatment of PENBOTEC™ 400 SC on apple cv. McIntosh , 2003-04.

Treatment (g/L)	% Disease incidence [a]	
	in cold storage at 2 (± 2)ºC	
	3 months	6 months
No inoculum	0.0 a[b]	0.0 a
Inoculum only	100.0 e	100.0 f
PENBOTEC @ 0.29	37.8 d	54.2 e
PENBOTEC @ 0.58	16.7 c	41.7 d
PENBOTEC @ 1.16	3.4 b	17.5 c
PENBOTEC @ 2.32	2.5 b	4.2 b
MERTECT @ 1.15	100.0 e	100.0 f

[a] Data represent the mean of 4 replicates, with 12 apples/replicate.
[b] Means within columns followed by the same letter are not significantly different using the Tukey test at P=0.05.

2004 PMRR REPORT # 61 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: 402-1531-8605

CROP: Apples cv. Jonagold
PEST: Fire blight, *Erwinia amylovora* (Burrill) Winslow et al.

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TITLE: EFFICACY OF APOGEE FOR GROWTH CONTROL ON APPLE SHOOTS, 2003

MATERIALS: APOGEE 27.5WG (Prohexadione-calcium), AMMONIUM SULFATE SG, AGRAL 90 (Nonylphenoxy polyethoxy ethanal 90%).

METHODS: APOGEE trials were conducted at the Pacific Agri-Food Research Centre in Summerland, BC in two 'Jonagold' orchard blocks designated A for high density planting and B for conventional planting. The trial in orchard block A was on 10-year-old 'Jonagold' apple trees on M9 rootstocks spaced at 1.0 m x 3.0 m and the trial in orchard block B was on 16-year-old Jonagold apple trees on M7a rootstocks spaced at 3.0 m x 6.0 m. The statistical design of both trials was the randomized complete block with five treatments replicated four times. In orchard block A each replicate consisted of four trees separated by an unsprayed buffer tree and in orchard block B each replicate consisted of a single tree also separated by an unsprayed buffer tree. Treatments were applied until run-off with a handgun operated at approximately 400 kPa. Average volume of water applied per replicate was 8 litres in orchard block A and 6 litres per single tree in orchard block B. The treatments were applied in orchard block A on 13 May (petal fall), 27 May (fruit set) and 10 June (first cover) and in orchard block B on 13 May (petal fall), 27 May (fruit set), 3 June (first cover) and 10 June (second cover). Shoot growth for both orchard blocks was assessed on 22 May, 12 June and 10 July. Five newly developed shoots per tree were measured for a total of 20 measurements per replicate for orchard block A and 20 newly developed shoots per tree were measured in orchard block B. Measurements were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan k-ratio t test (k = 100) was used for multiple comparison of means.

RESULTS and DISCUSSION: APOGEE did not have any effect on 'Jonagold' shoot length in a high density planting until the second reading on 12 June (Table 1). Shoot length was reduced by an average of 20% on 12 June and 25% on 10 July compared to the control. The use of AGRAL 90 surfactant or high or low rate of APOGEE did not appear to have any effect on control of shoot growth. APOGEE did not have any effect on 'Jonagold' shoot length in a conventional planting until the second reading on 12 June (Table 2). In this trial shoot length was reduced by an average of 41% on 12 June and 51% on 10 July compared to the control. Apparently APOGEE reduces shoot length an additional 15% on larger more vigorous trees as used in Orchard block B. The high or low rate of APOGEE or two or three applications of the high rate of APOGEE had no additional effect on reducing shoot length of 'Jonagold'.

CONCLUSIONS: APOGEE at a concentration of 27.3 g per 100 L of water applied two or three times is an effective material for reducing shoot length of apple trees in either high density or conventional planting. Use of surfactant does not appear to improve the growth reducing effect of APOGEE.

Table 1. Shoot length (mm) of 'Jonagold' apple trees after treatment with APOGEE in orchard block A (high density planting).

Treatment and Rate/100 L	Shoot length (mm)		
	22 May	12 June	10 July
Control	107.4 a[1]	165.0 a	202.2 a
APOGEE 27.3 g (0.82 kg/ha) with Ammonium sulfate 45.5 g (1.4 kg/ha) Applied 13 and 27 May; 10 June	105.5 a	132.4 b	149.0 b
APOGEE 27.3 g (0.82 kg/ha) with Ammonium sulfate 45.5 g (1.4 kg/ha) and AGRAL 90 50.0 ml (1.5 L/ha) Applied 13 and 27 May; 10 June	101.6 a	130.3 b	150.0 b
APOGEE 45.5 g (1.4 kg/ha) with Ammonium sulfate 45.5 g (1.4 kg/ha) Applied 13 and 27 May; 10 June	110.1 a	125.7 b	152.8 b
APOGEE 45.5 (1.4 kg/ha) with Ammonium sulfate 45.5 g (1.4 kg/ha) and AGRAL 90 50 ml (1.5 L/ha) Applied 13 and 27 May; 10 June	105.0 a	138.1 b	151.9 b
ANOVA *P*r>F	0.8962	0.0402	0.0063

[1] Numbers followed by the same letter are not significantly different as decided by the Waller-Duncan k-ratio t Test (k = 100). Treatments were analyzed with four replications.

Table 2. Shoot length (mm) of 'Jonagold' apple trees after treatment with APOGEE in orchard block B (Conventional planting).

Treatment and Rate/L	Shoot length (mm)		
	22 May	12 June	10 July
Control	86.3 a[1]	234.4 a	389.7 a
APOGEE 27.3 g (0.82 kg/ha) with Ammonium sulfate 45.5 g (1.4 kg/ha) Applied 13 and 27 May; 10 June	85.4 a	141.4 b	200.7 b
APOGEE 45.5 g (1.4 kg/ha) with Ammonium sulfate 45.5 g (1.4 kg/ha) Applied 13 May; 3 June	82.7 a	136.9 b	190.6 b
APOGEE 45.5 (1.4 kg/ha) with Ammonium sulfate 45.5 g (1.4 kg/ha) and AGRAL 90 50 ml (1.5 L/ha) Applied 13 and 27 May; 10 June	87.4 a	137.4 b	183.8 b
ANOVA *P*r>F	0.7158	<.0001	<.0001

[1] Numbers followed by the same letter are not significantly different as decided by the Waller-Duncan k-ratio t Test (k = 100). Treatments were analyzed with four replications.

2004 PMRR REPORT # 62 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: 402-1531-8605

CROP: Apples cv. McIntosh
PEST: Powdery mildew, *Podosphaera leucotricha* (Ell. and Ev.) Salm.

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TITLE: GREENHOUSE SCREENING OF COMMERCIAL MATERIALS FOR CONTROL OF APPLE POWDERY MILDEW IN 2003

MATERIALS: AGROGREEN (Pine oil fertilizer 4-1-1), Autoclaved (121°C for 20 min) sea buckthorn (SBT) juice *(H. sinensis)*, Centrifuged (7,000 rpm, 30 sec, 4°C) SBT juice (Supernatant) (*Hippophae rhamnoides* cv. Indian Summer and *H. sinensis*), Cinnamon oil, Filtered (0.2µ) SBT juice (*H. sinensis*), FUNGINEEM (Potassium salts of fatty acids 40%), Garlic extract, Jojoba oil, KUMULUS 80 DF (sulphur), Lysozyme, Homogenized Milk, Peppermint oil, NOVA 40W (myclobutanil), Potassium phosphate, Potato flour, Pumpkin seed oil, SBT juice (*Hippophae rhamnoides* cv. Indian Summer and *H. sinensis*), SBT leaf extract, SBT leaf tea, SBT pulp oil, SBT seed oil, Soybean oil, Tween 80, UPTAKE PLUS (DP 114: inorganic fertilizer containing P, K, Zn, Cu and Mn) and Vitamin C.

METHODS: McIntosh apple seeds were disinfested for 5 minutes in 5% sodium hypochlorite, triple rinsed and soaked for 12 hours in distilled water. The seeds were stratified in a 1°C cold room in a moist soilless mix made of half perlite and half vermiculite for a minimum of four weeks and then moved to the greenhouse to germinate and grow at 22°C with 16 hours of light per day under a clear plastic domes to insure high relative humidity. At the two-leaf stage, the plants were potted in peat moss growth medium in 85 mm diameter pots, and fertilized with 10-52-10 at 5 g/L and a week later fertilized with 15-15-18 at 2 g/L and weekly there after. The seedlings were grown in solid trays (265 x 530 mm) and spaced to six per tray in a random block design. Each treatment consisted of five replicate apple seedlings in individual pots. The seedlings from trials 1 and 3 represented in Table 1 were grown under a plastic chamber with mist on for 3 seconds, four times an hour (22°C with 69.1% rh). The trees from the trial represented by Table 2 were grown on the greenhouse bench (27.8°C with 54.7% rh). The treatments were applied until drip with a hand atomizer using 20 ml per plant at 7-10 day intervals for a total of three applications. Powdery mildew was assessed by rating each leaf as follows: over 50% of leaf surface covered with powdery mildew was considered “severe” with an leaf index value of 3; less than 50% of leaf surface covered with powdery mildew was considered “light” with an index value of 1; and no leaf powdery mildew symptoms was considered “clean” with an index value of 0. The total value for all leaves on the apple seedling were recorded as the index for that plant. For the trials represented in Tables 1 and 2, the seedlings were inoculated with conidia of *Podosphaera leucotricha*. Conidia were vacuumed off infected foliage into a 0.1% sterile agar solution containing 0.0025% Tween-20. A suspension of 2.5×10^5 conidia/ml was sprayed with a airbrush on the foliage within 20 minutes. Seedlings were rated once a week. Index values were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan k-ratio t test (k = 100) was used for multiple comparison of means.

RESULTS and DISCUSSION: In the first trial initiated on 21 January 2003, 18 treatments were screened for control of powdery mildew (Table 1). Thirteen of the eighteen materials provided some control. Milk and AGROGREEN were ineffective at the rates used in this trial. Sea buckthorn juice,

residue and centrifuged pulp oil from the 'Indian Summer' cultivar showed that these components of sea buckthorn juice were not active against powdery mildew. Conversely sea buckthorn juice and oil were very active and provided levels of control near to that of NOVA and KUMULUS. Cinnamin, jojoba, and pumpkin seed oils reduced powdery mildew but only the pumpkin seed oil did not damage leaves. The neem product, FUNGINEEM and the fertilizer, potassium phosphate, were relatively effective but the fertilizer caused some leaf damage.

In the second trial initiated on 29 January, 2003, 10 treatments were screened with six treatments different from the previous trial (Table 2). In this trial extracts of sea buckthorn leaves were shown to be ineffective. Likely the substance active against powdery mildew is found only in the sea buckthorn berries and seed. Soybean oil was found to be very effective against powdery mildew and was as effective as NOVA. Interestingly potato flour showed that it was relatively effective against powdery mildew and was almost as effective as sea buckthorn supernatant. Both products indicated that they have the ability to eradicate powdery mildew because index levels for each material were lower after the first, second and third readings.

In the third trial initiated on 4 April, 2003, 11 treatments were screened to retest some of the components of sea buckthorn juice and to evaluate some new materials (Table 3). In this trial NOVA and sea buckthorn supernatant were the most effective materials. Lysozyme although appearing very effective after the first reading was more phytotoxic than NOVA or sea buckthorn supernatant. However, conditions in the greenhouse were very conducive to leaf damage due to very warm temperatures and even some control leaves were damaged.

CONCLUSIONS: The greenhouse trials identified several new products for further testing for control of apple powdery mildew. The most interesting were pumpkin seed oil, soybean oil, potato powder, and the supernatant of sea buckthorn that was centrifuged to remove pulp. It appears that the sea buckthorn components that are active against powdery mildew can only be found in the juice, juice supernatant, or oil.

Table 1. Powdery mildew index of McIntosh apple seedlings treated with commercial materials on 21 January, 2003.

Treatment and Rate/L[1]	Powdery mildew index[2]		
	5 Feb.	13 Feb.	19 Feb.
Distilled water	2.6 abcd[3]	9.2 a	14.8 a
SBT Juice residue 1.5% v/v	3.2 abcd	4.8 abcd	9.8 ab
2% Milk 50% v/v	4.0 abc	2.4 cd	9.6 abc
SBT centrifuged pulp oil 1.5% v/v	5.8 a	7.5 ab	9.2 abcd
AGROGREEN 2% v/v	4.8 ab	6.2 abc	8.4 abcde
Jojoba oil 1% v/v[1]	0.5 d	0.5 d	6.0 bcdef
SBT juice cv. *H. sinensis* pure	1.5 bcd	1.8 cd	3.8 bcdef
SBT juice cv. Indian summer pure	0.8 cd	3.5 bcd	2.5 bcdef
Potassium phosphate 0.15 g/L[1]	0.8 cd	2.0 cd	2.2 bcdef
FUNGINEEM 5.0% v/v	1.2 cd	1.2 d	2.2 bcdef
Pumpkin oil 1.0% v/v[1]	0.0 d	0.6 d	1.8 cdef
SBT 'Indian summer' 50.0% v/v	0.8 cd	0.2 d	1.5 def
SBT seed oil 1.5% v/v[1]	0.0 d	0.3 d	1.3 ef
SBT juice and seed oil 1.5% v/v	1.0 cd	0.2 d	1.0 ef
KUMULUS 2.0 g/L	0.0 d	1.0 d	0.8 ef
SBT pulp oil 1.5% v/v[1]	0.0 d	0.0 d	0.2 f
Cinnamon oil 1.0 v/v[1]	0.0 d	0.0 d	0.2 f
NOVA 0.1 g/L	1.0 cd	0.0 d	0.2 f
ANOVA *P*r>F	0.0011	0.0002	0.0003

[1] Tween 80 (0.05%) was added to these treatments.
[2] Powdery mildew was assessed by rating infection on each leaf as follows: over 50% of leaf surface covered with powdery mildew was considered severe with an leaf index value of 3; less than 50% of leaf surface covered with powdery mildew was considered light with an index value of 1; and no leaf powdery mildew symptoms was considered clean with an index value of 0. These values for each plant were totaled and recorded as the index.
[3] These values are means of 5 replications of McIntosh potted seedlings except where the plant died due to phytotoxicity. The Waller-Duncan k-ratio t test (k = 100) was used for multiple comparison of means.

Table 2. Powdery mildew index of McIntosh apple seedlings treated with commercial materials on 29 January; 2003.

Treatment and Rate/L[1]	Powdery mildew index [2]		
	5 Feb	13 Feb	19 Feb
Distilled water	7.0 abc[3]	12.2 a	11.4 a
SBT 'Indian Summer' Tea 50% v/v[1]	9.8 ab	11.2 ab	10.2 ab
Monopotassium phosphate 10 g/L[1]	6.2 bcd	8.2 abc	9.8 abc
SBT 'Indian Summer' Leaf Extract 2% v/v[1]	6.4 abc	7.8 abc	8.2 abcd
Distilled water + Tween 80 0.05% v/v	0.8 de	7.6 abc	7.6 abcde
Peppermint oil 1.5% v/v[1]	3.5 cde	6.2 abcd	7.5 abcde
SBT 'Indian Summer' supernatant	3.2 cde	4.5 bdc	2.5 de
NOVA 40W 0.1 g/ L	4.2 cde	4.2 dc	4.2 bcde
Potato flour 33 g/L	11.8 a	3.2 dc	3.0 cde
Soybean oil 1.5% v/v[1]	0.2 e	0.5 d	0.5 e
ANOVA *P*r>F	0.0029	0.0153	0.0214

[1] Tween 80 (0.05%) was added to these treatments.
[2] Powdery mildew was assessed by rating infection on each leaf as follows: over 50% of leaf surface covered with powdery mildew was considered severe with an leaf index value of 3; less than 50% of leaf surface covered with powdery mildew was considered light with an index value of 1; and no leaf powdery mildew symptoms was considered clean with an index value of 0. These values for each plant were totaled and recorded as the index.
[3] These values are means of 5 replications of McIntosh potted seedlings except where the plant died due to phytotoxicity. The Waller-Duncan k-ratio t test (k = 100) was used for multiple comparison of means.

Table 3. Powdery mildew index of McIntosh apple seedlings treated with commercial materials on 4 April; 2003.

Treatment and Rate/L	Powdery mildew index [1]		
	9 April	16 April	24 April
Vitamin C 1.6 g/L	12.2 abc[2]	23.6 a	28.6 ab
Distilled Water	13.6 ab	21.8 a	33.0 a
Garlic Extract 2% v/v	11.4 abcd	19.6 ab	24.8 bc
Garlic Juice 1% v/v	10.2 bcd	19.4 abc	22.2 cd
UPTAKE PLUS 1% v/v	7.4 d	15.6 bcd	19.4 d
Autoclaved SBT supernatant 'Sinensis'	15.6 a	14.2 cd	11.6 ef
Supernatant SBT 'Sinensis'	7.6 cd	13.8 d	7.6 fg
Filtered SBT supernatant 'Sinensis'	11.0 abcd	13.4 d	no data
Supernatant SBT 'Sinensis' 50% v/v	7.8 cd	13.2 d	12.0 ef
Lysozyme 1.0 g/L	8.2 cd	11.8 d	13.2 e
NOVA 40W 0.1 g/L	6.8 d	6.0 e	4.4 g
ANOVA *P*r>F	0.0022	<.0001	<.0001

[1] Powdery mildew was assessed by rating infection on each leaf as follows: over 50% of leaf surface covered with powdery mildew was considered severe with an leaf index value of 3; less than 50% of leaf surface covered with powdery mildew was considered light with an index value of 1; and no leaf powdery mildew symptoms was considered clean with an index value of 0. These values for each plant were totaled and recorded as the index.

[2] These values are means of 5 replications of McIntosh potted seedlings except where the plant died due to phytotoxicity. The Waller-Duncan k-ratio t test (k = 100) was used for multiple comparison of means.

2004 PMRR REPORT # 63 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: 402-1531-8605

CROP: Apples cvs. McIntosh and Spartan
PEST: Apple scab, *Venturia inaequalis* (Cook) G. Wint.

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TITLE: EFFECT OF TREATMENTS FOR CONTROL OF APPLE SCAB in 2003

MATERIALS: BAS 51604F 38WG (boscalid + pyraclostrobin), KUMULUS 80 DF (sulphur), MAESTRO 75DF (captan), NOVA 40W (myclobutanil), POLYRAM 80WDG (metiram), SOVRAN 50 WG (kresoxim-methyl).

METHODS: The trial was conducted at 19402 Garnett Valley road in Summerland, BC on 16-year-old McIntosh and Spartan apple trees on semi-dwarfing rootstocks spaced at 4.7 m x 4.7 m. Seven treatments were applied to single tree replicates in five blocks following the complete block statistical design. The trial was setup so that each treatment consisted of three 'McIntosh' and two 'Spartan' apple trees with each tree separated by a non-sprayed buffer tree. The treatments were applied until run-off with a Solo backpack sprayer. Average volume of water applied per tree was 3 liters. All treatments were applied on 23 April (Green tip), 28 May (Petal fall), 5 June (Fruit set), and 17 June (First cover). The two organic treatments consisted of consecutive applications of KUMULUS used at 2g/L and 4g/L. The two BASF programs to test the ability of SOVRAN or BAS 516 to eradicate scab consisted of MAESTRO applied at green tip, BAS 516 or SOVRAN applied 78 hours after a major apple scab infection period, BAS 516 or SOVRAN seven to ten days later and MAESTRO at first cover. A data logger (Model 450 Watchdog, Spectrum Technologies, Inc., Plainfield, IL) was used to record temperature, leaf wetness and humidity every 30 min starting on 14 April and ending on 26 August, 2003. The data logger was downloaded weekly or more often in the event that the local weather forecast predicted rain. This data was used with SpecWare 6.0 and the Apple Scab disease model software (Spectrum Technologies, Inc., Plainfield, IL) to identify when an infection period occurred in the orchard. The MAESTRO program consisted of two applications: green tip and first cover. The standard program consisted of MAESTRO at green tip, NOVA at petal fall, NOVA/POLYRAM at fruit set and SOVRAN at first cover. The control treatment was left unsprayed. Foliar apple scab incidence and severity were evaluated on 26 June and 26 August by rating 50 leaves per tree for percent area covered by apple scab lesions. Fruit scab incidence and severity was determined on 20 apples on 26 August in the same way. These counts were converted to percent infected leaves per tree, mean severity per leaf, and percent incidence and severity scabbed fruit. Percent values were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan k-ratio t test (k = 100) was used for multiple comparison of means.

RESULTS and DISCUSSION: The apple scab disease model indicated that a moderate infection period occurred on May 25 starting at 4:30 AM that became a heavy infection period on May 26. Ascospore maturity at that time was predicted to be 96% and leaves were wet for a total of 27 hours over the two days with temperatures ranging from approximately 10 to 20°C. In order to apply the materials before 96 hrs elapsed from the start of the infection period, BAS 516 and SOVRAN were applied at 11:00 AM on May 28. It was determined later that this was 78 hours after the start of the infection period. The 26 June apple scab evaluation showed that both SOVRAN and BAS 516 reduced the incidence of apple scab on the leaves to about half that found on the control (Table 1). None of the other treatments were significantly

better than the control. The disease severity was similar with SOVRAN and BAS 516 with the lowest severity ratings of 1.2 and 1.1%, respectively. Foliage infection increased after 26 June and was 76.0% in the control on 26 August. Fungicides were not applied after 17 June and it is presumed that the primary lesions allowed secondary spread of apple scab especially in this orchard were overhead irrigation occurred for long periods of time. Fruit with apple scab was less in the treatments that contained SOVRAN, BAS 516, NOVA, or MAESTRO. The 'McIntosh' trees were separated out of the trial and analyzed separately but no significant differences were found between the treatments (Table 2) although generally the numerical values were similar to those in Table 1.

CONCLUSIONS: BAS 516 appears to have eradicant properties similar to SOVRAN and is able to eradicate scab infections 78 hours after they have been established.

Table 1. Percent apple scab after treatment with BASF products 78 hours after start of a major infection period on combined McIntosh and Spartan apples.

Treatment and Rate/100 L[1]	26 June Foliage		26 August Foliage		26 August Fruit	
	Incid.	Sev.	Incid.	Sev.	Incid	Sev.
Non-treated control	34.0 a[2]	3.9 a	76.0 a	13.2 a	10.4 a	6.2 a
KUMULUS 200 g (6.0 kg/ha) Applied 23 April, 28 May, 5 June, and 17 June	26.4 ab	2.3 abc	82.4 a	20.3 a	7.0 ab	3.9 a
KUMULUS 400 g (12.0 kg/ha) Applied 23 April, 28 May, 5 June, and 17 June	29.6 ab	3.2 ab	66.2 a	8.9 a	5.8 ab	3.2 a
MAESTRO 130 g (3.9 kg/ha) Applied 23 April and 17 June	27.6 ab	2.3 abc	62.8 a	8.8 a	5.2 b	2.9 a
MAESTRO 130 g (3.9 kg/ha) applied 23 April; NOVA 11.3 g (0.339 kg/ha) applied 28 May; NOVA 11.3 g + POLYRAM 200 g (0.339 + 6.0 kg/ha); SOVRAN 8.0 g (0.240 kg/ha)	23.6 ab	1.7 bc	59.6 a	10.6 a	3.2 b	1.4 a
MAESTRO 130 g (3.9 kg/ha) applied 23 April; SOVRAN 8.0 g (0.240 kg/ha) applied 28 May and 5 June; MAESTRO 130 g (3.9 kg/ha) applied 17 June	17.6 b	1.2 c	54.8 a	7.5 a	4.0 b	2.5 a
MAESTRO 130 g (3.9 kg/ha) applied 23 April; BAS 516 30.7 g (0.921 kg/ha) applied 28 May and 5 June; MAESTRO 130 g (3.9 kg/ha) applied 17 June	17.2 b	1.1 c	64.6 a	14.4 a	4.4 b	2.4 a
ANOVA *P*r>F	0.0882	0.01	0.4801	0.8317	0.0425	0.2204

[1] Each treatment contained five replicates composed of three ‘McIntosh’ and two ‘Spartan’ trees.
[2] Means are not significantly different with the same letter by the Waller-Duncan k-ratio t Test (k = 100).

Table 2. Percent apple scab after treatment with BASF products 78 hours after start of a major infection period on ‘McIntosh’ apples.

Treatment and Rate/100 L	26 June Foliage		26 August Foliage		26 August Fruit	
	Incid.	Sev.	Incid.	Sev.	Incid	Sev.
Non-treated control	35.3 a	3.6 a	74.7 a	13.5 a	53.3 a	7.3 a
KUMULUS 200 g (6.0 kg/ha) Applied 23 April, 28 May, 5 June, and 17 June	26.0 a	2.2 a	77.3 a	16.2 a	38.3 a	5.1 a
KUMULUS 400 g (12.0 kg/ha) Applied 23 April, 28 May, 5 June, and 17 June	30.7 a	3.2 a	74.7 a	9.5 a	33.3 a	3.4 a
MAESTRO 130 g (3.9 kg/ha) Applied 23 April and 17 June	23.3 a	1.6 a	63.3 a	8.3 a	36.7 a	4.4 a
MAESTRO 130 g (3.9 kg/ha) applied 23 April; NOVA 11.3 g (0.339 kg/ha) applied 28 May; NOVA 11.3 g + POLYRAM 200 g (0.339 + 6.0 kg/ha); SOVRAN 8.0 g (0.240 kg/ha)	26.0 a	1.7 a	73.3 a	15.1 a	25.0 a	2.2 a
MAESTRO 130 g (3.9 kg/ha) applied 23 April; SOVRAN 8.0 g (0.240 kg/ha) applied 28 May and 5 June; MAESTRO 130 g (3.9 kg/ha) applied 17 June	18.7 a	1.3 a	62.7 a	10.5 a	23.3 a	3.4 a
MAESTRO 130 g (3.9 kg/ha) applied 23 April; BAS 516 30.7 g (0.921 kg/ha) applied 28 May and 5 June; MAESTRO 130 g (3.9 kg/ha) applied 17 June	16.7 a	1.0 a	70.7 a	19.2 a	25.0 a	3.3 a
ANOVA *P*r>F	0.4838	0.1862	0.9861	0.8317	0.4461	0.5757

[1] Each treatment consisted of three ‘McIntosh’ apple tree replicates.
[2] Means are not significantly different with the same letter by the Waller-Duncan k-ratio t Test (k = 100).

2004 PMRR REPORT # 64 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: 402-1531-8605

CROP: Apple cv. Jonagold
PEST: Powdery Mildew, *Podosphaera leucotrica* (Ell.and Ev.) Salm.

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TITLE: EFFICACY OF DIFFERENT MATERIALS USED AS ERADICANTS FOR POWDERY MILDEW CONTROL ON APPLES; 2003

MATERIALS: ARMICARB (Potassium bicarbonate 85%), JMS STYLET OIL (paraffinic oil 97.1%), KUMULUS 80DF (sulphur), SYLGARD surfactant (siloxylated polyether 76%) , Sea buckthorn seed oil and LIME SULPHUR (sulphide sulphur 22%).

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre in Summerland, BC on 16-year-old apple trees cv Jonagold on M7a rootstocks spaced at 3.0 m x 6.0 m. The statistical design of the trial was the randomized complete block with six treatments replicated four times on single tree replicates. The early treatments (Armicarb, JMS STYLET OIL, SYLGARD, Sea buckthorn seed oil and LIME SULPHUR) were applied with a Solo backpack sprayer on 27 March (dormant) and 4 April (green tip). The cover sprays (KUMULUS) were applied until run-off with a handgun operated at approximately 400 kPa on 13 May (petal fall), 30 May (first cover), 10 June (second cover), 24 June (third cover) and 16 July (fourth cover). Average volume of water applied per tree was 4.6 litres with the backpack sprayer and 19 L with the handgun sprayer. Primary powdery mildew was assessed by counting the number of shoots with white tips on each single tree replicate on 29 April (late pink). Secondary foliage powdery mildew incidence and severity were evaluated on 10 July and 22 August by rating 10 leaves on 5 shoots per tree for percent area covered by powdery mildew. Fruit mildew was determined 3 October on 25 harvested apples from each single tree replicate by evaluating each fruit for netlike russetting, symptomatic for powdery mildew damage. The fruit was also evaluated for bitter pit by recording fruit with depressions and dark spots coincident with lenticels and sunburn by recording fruit with brown discoloration over the fruit surface.

RESULTS AND DISCUSSION: Five percent SYLGARD was the best material for reducing primary powdery mildew (Table 1). Five percent STYLET OIL also was effective for eradicating primary powdery mildew reducing it by almost one half to what it was in the control. The other materials were not significantly effective although the trees treated with ARMICARB and lime sulphur had lower values for primary powdery mildew than the control. The reduction of primary powdery mildew had no significant effect on secondary powdery mildew evaluated on two dates. It is possible that less secondary foliar powdery mildew would have occurred if the mildew pressure had been lower. The number of russetted fruit due to powdery mildew was not affected by any of the treatments (Table 2). The treatments had no effect on sunburn or bitter pit, either. However 5% SYLGARD appeared to have damaged the buds of trees that had been sprayed with it and fruit yield was considerably lower on these trees than in the other treatments. STYLET oil did not have this damaging effect on the fruit buds.

CONCLUSIONS: SYLGARD was very effective in reducing primary powdery mildew but caused severe damage to fruit buds. STYLET OIL reduced primary powdery mildew and did not appear to damage fruit buds.

Table 1. Percent primary powdery mildew and subsequent foliar powdery mildew on 'Jonagold' apple trees.

Treatment and rate [1]	%Primary mildew (white tips)	%Foliar powdery mildew			
		10 July Incidence	10 July Severity	22 August Incidence	22 August Severity
Control	33.7 a[2]	58.0 a	13.0 a	65.0 ab	20.0 ab
SBT oil 3/1.4%	32.1 a	76.0 a	16.6 a	80.5 a	24.0 a
STYLET OIL 5%	18.4 b	70.0 a	13.6 a	70.0 ab	16.8 ab
ARMICARB 30 g/L	26.3 ab	61.5 a	13.9 a	59.0 ab	16.9 ab
LIME SULPHUR 10%	29.7 ab	56.0 a	12.1 a	58.5 ab	15.4 ab
SYLGARD 5%	04.4 c	59.0 a	09.2 a	54.5 b	10.4 b
ANOVA *P*r>F	0.0004	0.5834	0.7302	0.1154	0.0828

[1] Cover sprays of KUMULUS (200 g/100L water) were applied to all treatments at approximately 2 week intervals beginning on 13 May at petal fall and ending on 16 July.
[2] These values are means of four replications. Raw data were arcsin transformed before ANOVA and the de-transformed means are presented here. Numbers within a column followed by the same letter are not significantly different according to the Waller-Duncan k-ratio t test (k = 100).

Table 2. Percent powdery mildew , bitter pit and sunburn of 'Jonagold' fruit harvested on 3 October.

Treatment and rate [1]	Available fruit	%PM incidence	%PM severity	%Bitter pit	%Sunburn
Control	100	3.0 a[2]	0.80 a	0.2 a	0.2 a
SBT oil 3/1.4%	95	3.0 a	0.68 a	0.0 a	0.2 a
STYLET OIL 5%	100	0.5 a	0.10 a	0.0 a	3.8 a
ARMICARB 30 g/L	62	1.5 a	0.50 a	0.0 a	0.5 a
LIME SULPHUR 10%	95	0.5 a	0.38 a	0.5 a	0.5 a
SYLGARD 5%	203	1.0 a	0.85 a	0.2 a	0.5 a
ANOVA *P*r>F		0.2292	0.6858	0.3485	0.3019

[1] Cover sprays of KUMULUS (200 g/100 L water) were applied to all treatments at approximately 2 week intervals beginning on 13 May at petal fall and ending on 16 July.
[2] These values are means of four replications. Raw data were arcsin transformed before ANOVA and the de-transformed means are presented here. Numbers within a column followed by the same letter are not significantly different according to the Waller-Duncan k-ratio t test (k = 100).
[3] Trees sprayed with 5% Sylgard had very little fruit due to bud damage.

2004 PMRR REPORT # 65 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: 402-1531-8605

CROP: Apple (*Malus domestica*) cvs. Pacific Gala and Jonagold
PEST: Fire blight, *Erwinia amylovora* (Burrill) Winslow et al

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TITLE: SCREENING GWN-9250 FOR CONTROL OF FIRE BLIGHT CAUSED BY STREPTOMYCIN-SENSITIVE BACTERIA IN 2003

MATERIALS: GOWAN-9200 (gentamycin 10%), GOWAN-9350 (gentamycin 10%), MYCOSHIELD (oxytetracycline hydrochloride 21.6%), 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. The first and second trials included apple trees cv Pacific Gala on NIC29 rootstocks (Holdover). The second trial also included 30 Jonagold apple trees on M9 rootstocks. On 22 April, sixty dormant bare root trees cv Pacific Gala/NIC 29 were planted in 5-gallon pots containing Premier Pro-Mix growing media (Premier Horticulture Ltee, Riviere-du-Loup, Quebec). The roots were trimmed. The rest of the trees were stored in a cold room (1°C) in wet saw dust and planted on 8 July. The Jonagold trees were planted on 15 July. The trees were irrigated as needed and fertilized with 10-52-10 (5 g/L) and Nutricote 14-14-14 (40 g/tree) at planting and with 15-15-18 (3 g/L) weekly 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 6 rows for the first trial and 9 rows for the second, within the screenhouse. The treatments were applied with a spray bottle (100 ml/tree) on 26 May/21 July (25-50% bloom) and 28 May/25 July (50%-100% bloom). The Gowan materials, MYCOSHIELD and AGRIMYCIN were applied with REGULAID (3 ml/L) in a sodium phosphate buffer at pH 6.0. Blossoms were inoculated with a cell suspension of *Erwinia amylovora* (8.4 x 10 6 CFU/ml for 29 May application and 1.0 x 107 for 26 July application) 24 hours later at first petal fall. The suspension was a mixture of two different isolates of *E. amylovora* grown in nutrient broth for 24 hours. The isolates S1477-1 and S1584 were know to be virulent to apple and sensitive to STREPTOMYCIN. The suspension was sprayed with a backpack sprayer (Solo) (80 and 120 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 6 June (8 days after inoculation) and 6 August (10 days after inoculation). Shoots displaying symptoms of fire blight indicated by blackening and wilting were recorded on June 24 and 6 -13 August. Number of infected clusters and shoot values were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan k-ratio t test (k = 100) was used for multiple comparison of means.

RESULTS and DISCUSSION: The trees used in the first trial averaged only eight blossoms per treatment and several trees did not have any flowers. Statistical analysis of the data of the trees with flowers did not show any significant differences (Table 1). The shoots of these trees were evaluated on 24 June and some differences in treatments were noted but none differed significantly from the control. The trial was repeated in late July even though eight ‘Pacific Gala’ trees died before the blossom clusters were evaluated for fire blight. In this trial an average of 35 clusters were evaluated for each treatment. Variability was very high and the combined results from ‘Pacific Gala’ and ‘Jonagold’ trees were not

significant (Table 2). Numerically the combined GWN-9350 and MYCOSHIELD and MYCOSHIELD alone treatments provided the best control of infected blossoms. The number of infected shoots were evaluated on 13 August and again there were no significant differences between treatments although the GWN-9350 treatment at a rate of 100 ppm had the lowest number of infected shoots. The 'Jonagold' trees were evaluated by themselves because they produced a much higher number of flowers than the 'Pacific Gala'. The highest number of infected blossoms were found on the GWN-9350 treatment at a rate of 50 ppm (Table 3). None of the other treatments differed significantly from the control. The results for shoots were similar with the most infected shoots in GWN-9350 at 50 ppm. The combination of GWN-9350 and MYCOSHIELD were significantly more effective than GWN-9350 at the 50 ppm rate.

CONCLUSIONS: The first trial did not provide any useful information on the various treatments because of the absence of flower clusters. The second trial had a sufficient number of flower clusters but the results were extremely variable in the trial which combined both 'Gala' and 'Jonagold' trees. The second trial with 'Jonagold' trees only showed that GWN9350 at the 50 ppm rate was likely not effective and higher rates should be used.

Table 1. Percent Pacific Gala apple flower clusters and shoots blighted by *Erwinia amylovora* in the first trial.

Treatment [1] and Rate	% Fire blight incidence			
	Flower clusters [2] 6 June	Number of replicates	Shoots 24 June	Number of replicates
Control	80.0 a[3]	5	4.8 ab	4
AGRIMYCIN 100 ppm	100.0 a	4	5.0 ab	4
GWN-9200 150 ppm	66.7 a	3	14.3 a	4
GWN-9350 50 ppm	100.0 a	3	8.2 ab	4
GWN-9350 75 ppm	No flowers			
GWN-9350 100 ppm	75.0 a	4	3.0 ab	4
GWN-9350 50 ppm + MYCOSHIELD 150 ppm	87.5 a	4	0.0 b	4
MYCOSHIELD 200 ppm	100.0 a	4	0.0 b	4
ANOVA *P*r>F	0.2202		0.1056	

[1] All treatments except the control were combined with Regulaid surfactant (3 ml/L) and adjusted to pH 6 with phosphate buffer.
[2] These values are based on the number of replicates of Pacific Gala potted apple trees that produced flowers.
[3] 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. Raw data were arcsin transformed before ANOVA and the de-transformed values are reported here.

Table 2. Percent combined 'Gala' and 'Jonagold' apple flower clusters and shoots blighted by *Erwinia amylovora* in the second trial.

Treatment [1] and Rate	% Fire blight incidence [2]			
	Flower clusters 6 August	Number of replicates	Shoots 13 August	Number of Replicates
Control	36.4a[3]	3	26.3 a	4
AGRIMYCIN 100 ppm	42.4 a	3	34.4 a	4
GWN-9200 150 ppm	32.4 a	2	23.7 a	3
GWN-9350 50 ppm	65.5 a	4	34.1 a	4
GWN-9350 75 ppm	19.4 a	3	24.9 a	4
GWN-9350 100 ppm	48.8 a	4	20.2 a	4
GWN-9350 50 ppm + MYCOSHIELD 150 ppm	12.5 a	3	30.1 a	5
MYCOSHIELD 200 ppm	10.0 a	3	25.7 a	5
ANOVA *P*r>F	0.2261		0.9644	

[1] All treatments except the control were combined with Regulaid surfactant (3 ml/L) and adjusted to pH 6 with phosphate buffer.
[2] These values are based on the number of replicates of 'Pacific Gala' and 'Jonagold' potted apple trees that produced flowers.
[3] 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. Raw data were arcsin transformed before ANOVA and the de-transformed values are reported here.

Table 3. Percent 'Jonagold' apple flower clusters and shoots blighted by *Erwinia amylovora* in the second trial.

Treatment [1] and Rate	% Fire blight incidence [2]			
	Flower clusters 6 August	Number of Replicates	Shoots 13 August	Number of Replicates
Control	30.9 bcd[3]	2	18.5 ab	2
AGRIMYCIN 100 ppm	46.0 bc	2	36.3 a	2
GWN-9200 150 ppm	30.2 bcd	2	24.5 ab	2
GWN-9350 50 ppm	78.2 a	2	36.6 a	2
GWN-9350 75 ppm	23.5 bcd	3	17.1 ab	3
GWN-9350 100 ppm	76.6 b	3	21.6 ab	3
GWN-9350 50 ppm + MYCOSHIELD 150 ppm	13.7 d	2	14.8 ab	2
MYCOSHIELD 200 ppm	8.3 cd	2	7.0 b	2
ANOVA *P*r>F	0.0673		0.0633	

[1] All treatments except the control were combined with Regulaid surfactant (3 ml/L) and adjusted to pH 6 with phosphate buffer.
[2] These values are based on the number of replicates of 'Jonagold' potted apple trees that produced flowers.
[3] 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. Raw data were arcsin transformed before ANOVA and the de-transformed values are reported here.

2004 PMRR REPORT # 66 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: 402-1531-8605

CROP: Apple cv. Jonagold
PEST: Powdery Mildew, *Podosphaera leucotrica* (Ell. and Ev.) Salm.

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TITLE: EFFICACY OF DIFFERENT MATERIALS FOR POWDERY MILDEW CONTROL ON APPLES; 2003

MATERIALS: INTERNATIONAL BIO-RECOVERY Liquid, FUNG-AID (chitosan 5%), FUNGINEEM (potassium salts of fatty acids 40%), KUMULUS (sulphur 80%), MINERALL CLAY (glacial marine clay), NOVA 40 WP (myclobutanil), Sea buckthorn cv sinensis juice, SBT cv sinensis supernatant, Sodium bicarbonate, STYLET OIL (paraffinic oil 97.1%).

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre in Summerland, BC on 16-year-old apple trees cv Jonagold on M7a rootstocks spaced at 3.0 m x 6.0 m. The statistical design of the trial was the randomized complete block with fourteen treatments replicated five times on single tree replicates. All the treatments except sea buckthorn (SBT) juice were applied until run-off with a handgun operated at approximately 400 kPa. Average volume of water applied per tree was 4 litres. The SBT treatments were applied with a Solo backpack sprayer with an average volume per tree of 1 to 2 litres. All treatments were applied on 15-17 April (green tip), 25-28-29 April (pink), 6 May (full bloom), 14-15 May (petal fall), 4 June (first cover), 19-24 June (second cover) and 17-23 July (third cover). The Chitosan treatment was applied on 17 July, 24 June, 24 July and 7 August. Secondary foliage powdery mildew incidence and severity were evaluated on 10 July and 22 August by rating 10 leaves on 5 shoots per tree for percent area covered by powdery mildew. Fruit mildew was determined 25 September on 25 harvested apples from each single tree replicate and evaluating each fruit for net russetting, sunburn and bitter pit. These counts were converted to percent infected leaves per tree, mean severity per leaf, percent russetted fruit, percent sunburned fruit, and percent bitter pit. Values were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan K ratio t Test at K = 100 was used for multiple comparison of means.

RESULTS: Powdery mildew was well established on 'Jonagold' apple foliage by the time the first reading was taken on 10 July. The treatments that reduced the incidence and severity of powdery mildew the most after the first reading were NOVA, Sodium bicarbonate + STYLET OIL, FUNGINEEM, KUMULUS and the higher rate of the IBR liquid (Table 1). The best materials for control of foliar powdery mildew incidence after the second reading on 22 August were NOVA, FUNGINEEM, high rate of KUMULUS, and Sodium bicarbonate + Stylet oil. Although the IBR liquid did not reduce the incidence of foliar powdery mildew it did reduce the severity of powdery mildew at the higher 4% rate. Incidence of fruit powdery mildew was reduced the most by both the high and low rate of KUMULUS (Table 2). Sodium bicarbonate + STYLET OIL, MINERALL CLAY, and FUNG-AID were slightly less effective but as effective as NOVA for control of fruit powdery mildew. FUNGINEEM, the IBR liquid, and sea buckthorn juice were no better than the control in preventing fruit powdery mildew. It should be noted that the frost period of 17 May (-2.4°C) caused some fruit russetting that could be confused with powdery mildew damage. The low rate of KUMULUS increased sunburn over the level found in the control apples. None of the other treatments significantly increased sunburn in the apples. Bitter pit was a severe problem

in 2003 especially in the apples treated with sodium bicarbonate + STYLET OIL. Compared to the control apples this treatment increased bitter pit by 28%.

CONCLUSIONS: In general, the best treatments for control of foliar powdery mildew were NOVA, followed by KUMULUS, FUNGINEEM, Sodium bicarbonate + STYLET OIL and the IBR liquid at the 4% rate. The best treatments for control of fruit russetting were KUMULUS, NOVA, and Sodium bicarbonate + STYLET OIL. However sodium bicarbonate + STYLET OIL significantly increased the incidence of bitter pit in 'Jonagold' apples. It should be noted that both sea buckthorn treatments, juice and supernatant, caused chlorotic spots on leaves after three applications and the Sodium bicarbonate + STYLET OIL treatment caused burning of leaf margins around the same time. However, in both cases, the damage disappeared later in the growing season.

Table 1. Percent powdery mildew incidence and severity of Jonagold foliage treated with various spray materials.

Treatment and rate per 100 L	10 July		22 August	
	Incidence	Severity	Incidence	Severity
FUNG-AID	----	----	89.2 ab	26.8 ab
SBT juice supernatant	96.0 a[1]	26.5 a	93.2 a	25.0 abc
Control	94.0 ab	28.3 a	86.0 ab	28.6 a
MINERALL CLAY 4.0 kg	90.0 ab	22.9 abc	93.2 a	25.4 abc
SBT juice	88.4 abc	24.5 ab	87.2 ab	23.2 abc
IBR 2.0%	86.0 abc	22.1 abc	80.0 abc	21.4 abcd
IBR 4.0%/ KUMULUS 200 g	82.8 bc	17.3 bcd	87.2 ab	21.7 abcd
IBR 2.0%/ KUMULUS 200 g	77.2 cd	16.6 cd	80.8 ab	17.4 cdef
IBR 4.0%	76.8 cd	16.2 cd	78.0 abc	20.4 bcde
KUMULUS 200 g	68.8 de	11.3 de	84.4 ab	18.8 bcdef
KUMULUS 400 g	62.4 ef	9.9 de	64.6 cd	12.5 ef
FUNGINEEM	58.0 ef	7.9 ef	61.6 d	11.0 fg
Sodium bicarbonate 1 kg + STYLET OIL 1%	55.6 f	7.1 ef	76.8 bcd	13.7 def
NOVA 11.3 g	7.2 g	0.5 f	31.6 e	3.0 g
Anova *P*r>F	<.0001	<.0001	<.0001	<.0001

[1] These data were arcsin transformed prior to analysis of variance. The actual means are presented here. Means followed by the same letter are not significantly different according to the Waller-Duncan k-ration t Test (k = 100).

Table 2. Percent powdery mildew, sunburn and bitter pit of 'Jonagold' apples on 25 September.

Treatment and rate per 100 L	% Fruit Powdery Mildew		% Fruit	
	Incidence	Severity	Sunburn	Bitter pit
FUNG-AID 4.0%	16.0 bcde[1]	1.44 ab	2.4 b	1.6 b
SBT juice supernatant	30.0 abc	3.92 ab	1.6 b	2.4 b
Control	33.6 ab	4.72 a	0.0 b	0.8 b
MINERALL CLAY 4.0 kg	9.6 cde	0.76 ab	7.2 ab	4.0 b
SBT juice	37.6 a	3.44 ab	4.0 ab	3.2 b
IBR 2.0%	20.0 abcde	2.20 ab	5.6 ab	4.0 b
IBR 4.0%/ KUMULUS 200 g	0.8 e	0.04 b	8.0 ab	1.6 b
IBR 2.0%/ KUMULUS 200 g	7.2 de	0.52 b	6.2 ab	0.0 b
IBR 4.0%	22.4 abcd	2.16 ab	5.6 ab	0.0 b
KUMULUS 200 g	1.6 e	0.12 b	14.4 a	1.6 b
KUMULUS 400 g	0.8 e	0.04 b	10.4 ab	1.6 b
FUNGINEEM	31.2 ab	3.32 ab	3.2 b	1.6 b
Sodium bicarbonate 1 kg + STYLET OIL 1%	7.2 de	0.72 b	4.8 ab	28.8 a
NOVA 11.3 g	4.8 de	0.32 b	9.6 ab	0.0 b
Anova *P*r>F	0.0003	0.0288	0.0562	<.0001

[1] These data were arcsin transformed prior to analysis of variance. The actual means are presented here. Means followed by the same letter are not significantly different according to the Waller-Duncan k-ration t Test (k = 100).

2004 PMRR REPORT # 67 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: 402-1531-8605

CROP: Cherry cv. Lapin
PEST: Brown rot, *Monilinia fructicola* (Wint.) Honey

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TITLE: EFFICACY OF BASF 516 FOR BROWN ROT CONTROL ON CHERRIES; 2003

MATERIALS: BASF 516 04F 38WG (boscalid + pyraclostrobin), TOPAS 240EC (propiconazole 250g/L), Sodium Bicarbonate, STYLET OIL (paraffinic Oil 97.1%) and ARMICARB (potassium bicarbonate 85%)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre in Summerland, BC on 5-year-old cherry trees cv Lapin on Mazzard rootstocks spaced at 3.6 m x 6.0 m. The statistical design of the trial was the randomized complete block with five treatments replicated four times on single tree replicates. Treatments were applied until run-off with a handgun operated at approximately 400 kPa. Average volume of water applied per tree was 5 litres. The BAS 516 and TOPAS treatments were applied on 17 April (Bloom), 2 May (Late bloom), 15 May (Husk fall), 19 June (first cover) and 16 July (7 days pre-harvest). The Sodium Bicarbonate/Stylet Oil and ARMICARB treatments were applied on the same dates except that the late bloom spray (2 May) was omitted. Fruits were picked on 24 July and were inoculated with *Monilinia fructicola* (Isolate #1179). The spore suspension (2.8×10^5 CFU/ml) was applied on the cherries with a hand atomizer. The cherries were stored in plastic bags in ventilated plastic containers at 13°C. The number of fruits with rot (brown soft tissue, with or without sporulation) was assessed on 6 August. Secondary powdery mildew incidence and severity were evaluated on 30 July by rating 10 leaves on 5 shoots per tree for percent area covered by powdery mildew. Fruit powdery mildew was assessed on the fruit picked on 24 July. Percent values were arcsin-transformed and all values were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan k-ratio t test (k = 100) was used for multiple comparison of means.

RESULTS: There was no cherry decay in the orchard so fruit had to be inoculated with *M. fructicola* to evaluate fruit brown rot. Cherry fruit rot was most effectively controlled by BASF 516 which reduced brown rot decay from 96% to 11% in inoculated fruit (Table 1). ARMICARB and TOPAS were also somewhat effective significantly reducing decay of cherries incubated for 13 days at 13°C. Sodium bicarbonate and Stylet oil were ineffective in this trial. Very few cherries were infected by *Penicillium* spp. or *Rhizopus* spp. and decay caused by these pathogens was not evaluated. No powdery mildew was observed on the cherry fruit although there was heavy leaf infection. There were no significant differences between the treatments in control of powdery mildew incidence or severity (Table 2). The treatments did appear to reduce incidence and severity of powdery mildew but were extremely variable from one replicate to the other.

CONCLUSIONS: BASF 516 is an effective fungicide for the control of cherry brown rot. TOPAS and the organic product, ARMICARB are also effective materials. Evaluation of powdery mildew will not be possible until there is a more even distribution of the disease in the orchard.

Table 1. Percent brown rot after inoculating cherries with *Monilinia fructicola*.

Treatment and Rate/100 L water	%Flower clusters with brown rot
Control	95.7 a[1]
Sodium bicarbonate 1 kg (30.0 kg/ha) + STYLET OIL 1 L (30.0 L/ha)	87.2 a
ARMICARB 0.6 kg (18 kg/ha)	50.0 b
TOPAS 17 ml (0.51 L/ha)	37.6 b
BAS 516 24.6 g (0.74 kg/ha)	10.7 c
ANOVA *P*r>F	<.0001

[1] These values are means of four replications. Raw data were arcsin transformed before ANOVA and the de-transformed means are presented here. Numbers within a column followed by the same letter are not significantly different according to the Waller-Duncan k-ratio t test (k = 100).

Table 2. Percent foliar powdery mildew on cherries evaluated on July 30.

Treatment and Rate/100 L water	Incidence	Severity
Control	52.0 a[1]	21.6 a
TOPAS 17 ml (0.51 L/ha)	32.0 a	7.5 a
Sodium bicarbonate 1 kg (30.0 kg/ha) + STYLET OIL 1 L (30.0 L/ha)	27.0 a	4.2 a
ARMICARB 0.6 kg (18 kg/ha)	42.0 a	7.6 a
BAS 516 24.6 g (0.737 kg/ha)	35.5 a	8.1 a
ANOVA *P*r>	0.4833	0.4613

[1] These values are means of four replications. Raw data were arcsin transformed before ANOVA and the de-transformed means are presented here. Numbers within a column followed by the same letter are not significantly different according to the Waller-Duncan k-ratio t test (k = 100).

2004 PMRR REPORT # 68 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: 402-1531-8605

CROP: Grape, *Vitis vinifera* cv. Pinot noir
PEST: Powdery mildew, *Uncinula necator* Pers.:Fr.

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TITLE: EFFICACY OF OILS AND IBR LIQUID AGAINST POWDERY MILDEW OF GRAPE; 2003

MATERIALS: AGRAL 90 (nonionic surfactant), ELEVATE 50 WDG (fenheximide), FUNGINEEM (neem product), IBR LIQUID (vegetable waste liquid), NOVA 40W (Myclobutanil), ROVRAL 50 W (iprodione), VANGARD 75 WG (cyprodinil), Sea buckthorn juice, Sodium bicarbonate, Soybean oil, SYLGARD (nonionic surfactant), STYLET OIL (light mineral oil), SUPERIOR OIL (light mineral oil)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 16 year old 'Pinot noir' (5 replicates) vines. Spacing was 1.4 x 3.6 m for a panel of five Pinot noir vines. The cordon trained, spur pruned vines (ca. 20 nodes/m row) on vertical trained canopies were hedged around lag phase of berry development. The experimental design was a randomized complete block. 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 500 kPa at a rate of 1000 L water/ha. The grower standard and the UC Davis powdery mildew model programs consisted of NOVA for control of powdery mildew and various fungicides for control of bunch rot. See below for application times and fungicides that were used in these programs. The remaining treatments consisting of FUNGINEEM, IBR liquid + SYLGARD, Sea buckthorn juice, Soybean oil, STYLET OIL + Sodium bicarbonate, and SUPERIOR OIL were applied on each application date until harvest. All treatments were applied to 'Pinot noir' grapes on 29 May (Pre-bloom), 18 June (Pre-bloom), 3 July (Post bloom), 24 July (Fruit set), 14 August (Bunch closure), 28 August (Veraison), 16 September (Post Veraison). Percent incidence and severity of leaf and cluster powdery mildew were evaluated on 15 July, and 3 September by examining 10 leaves on each of five shoots per three middle vines; and 10 berry clusters per three middle vines. Fifty clusters were examined for powdery mildew and bunch rot at harvest on September 23. Clusters were considered to have bunch rot if gray mold was observed growing among the berries. At harvest weight and number of clusters per replicate panel were recorded. A sample of 100 berries from randomly selected clusters in each replicate were collected and weighted. From this sample a 50 g sub-sample was subjected to a nonvolatile acid extraction procedure and titratable acidity was determined on the obtained extracts using a Brinkmann Titroprocessor ensemble. The rest of the sample was juiced, and soluble solids concentration (°Brix), and pH were measured on settled juice using an Abbé refractometer and a pH meter, respectively. Five Pinot noir grape clusters from each replicate were incubated at 13°C for 10 days to determine if they were infected by *Botrytis* spp. and other fungi. Counts of cluster, and leaf powdery mildew incidence and severity and bunch rot incidence and severity were converted to the percent infected per replicate and subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan's Multiple Range Test was used to separate means (K = 100).

GROWER Program consisted of NOVA (13.3 g/100 L or 133 g/ha) on 29 May, VANGARD 75 WG (50 g/100 L or 0.5 kg/ha) tank mixed with NOVA (13.3 g/100 L or 133 g/ha) on 18 June, NOVA (13.3 g/100

L or 133 g/ha) on 3 July, ROVRAL 50W (100 g/100 L or 1.0 kg/ha) tank mixed with NOVA (13.3 g/100 L or 133 g/ha) on 24 July, VANGARD 75 WG (50 g/100 L or 0.5 kg/ha) tank mixed with NOVA (13.3 g/100 L or 133 g/ha) on 28 August, and ELEVATE 50WG (75 g/100 L or 0.75 kg/ha) tank mixed with NOVA (13.3 g/100 L or 133 g/ha) on 16 September. Harvest was on 23 September.

PM MODEL Program consisted of NOVA (13.3 g/100 L or 133 g/ha) on 29 May, VANGARD 75 WG (50 g/100 L or 0.5 kg/ha) tank mixed with NOVA (13.3 g/100 L or 133 g/ha) on 18 June, NOVA (13.3 g/100 L or 133 g/ha) on 3 July, ROVRAL 50W (100 g/100 L or 1.0 kg/ha) tank mixed with NOVA (13.3 g/100 L or 133 g/ha) on 24 July, VANGARD 75 WG (50 g/100 L or 0.5 kg/ha) tank mixed with NOVA (13.3 g/100 L or 133 g/ha) on 28 August, and ELEVATE 50WG (75 g/100 L or 0.75 kg/ha) tank mixed with NOVA (13.3 g/100 L or 133 g/ha) on 16 September. Harvest was on 23 September.

RESULTS and DISCUSSION: Powdery mildew was first observed on grape berries on the 26 June. The only treatments that significantly reduced foliar powdery mildew early in the season were the standard grower program and the powdery mildew model program which are based on NOVA for control of powdery mildew (Table 1). The other materials all successfully reduced the severity of foliar powdery mildew and the IBR LIQUID and SUPERIOR OIL were not significantly different than the standard grower program. None of the materials including NOVA were significantly different in controlling cluster powdery mildew on 15 July (Table 1). The materials successfully reduced the severity of cluster powdery mildew and STYLET OIL + sodium bicarbonate, FUNGINEEM, IBR LIQUID and SUPERIOR OIL as effectively as NOVA used in the powdery mildew program. Later in the season on 3 September only the powdery mildew model program was effective in significantly reducing foliar powdery mildew although it was not significantly different from the standard program, IBR LIQUID, or SUPERIOR OIL (Table 2). All the materials except Soybean oil maintained their effectiveness in reducing the severity of foliar powdery mildew especially the IBR LIQUID, FUNGINEEM, STYLET OIL + sodium bicarbonate, and SUPERIOR OIL which did not differ significantly from the grower standard. Only the grower standard was effective in reducing the incidence of cluster powdery mildew on 3 September when compared to the control and other treatments (Table 2). All of the treatments were effective in reducing severity of cluster powdery mildew with the best treatments being the Grower standard, followed by the Powdery mildew model, IBR LIQUID, STYLET OIL + sodium bicarbonate, and SUPERIOR OIL in order of decreasing effectiveness (Table 2). At harvest when yield weight and number of clusters were considered there was no significant difference in the number of clusters although the average cluster weight and total cluster weight were higher in the treatments than the control (Table 3). Quality of grapes indicated by berry weight, pH, soluble solids, and titratable acidity did not differ significantly from grapes treated with the grower standard program (Table 4). The bunch rot study was inconclusive although after 8 days the lowest incidence and severity of bunch rot was in the grower standard program and after 15 days the lowest incidence and severity was in the SBT juice treatment (Table 5). FUNGINEEM corresponded to the highest levels of bunch rot for both dates. *Penicillium* spp. grew on the bunches and probably inhibited the growth of *Botrytis* spp. making some treatments look more effective.

CONCLUSIONS: The grower standard and powdery mildew model treatments which depend on NOVA for their effectiveness against powdery mildew were generally the most effective treatments. However some of the novel treatments showed promise especially for reducing the severity of powdery mildew. The IBR LIQUID, STYLET OIL + sodium bicarbonate, and FUNGINEEM provided adequate control of foliar and cluster powdery mildew. None of these products appeared to compromise grape quality as indicated by pH, soluble solids, and titratable acidity. It was not clear if any of these materials were effective against bunch rot.

Table 1. Percent powdery mildew incidence and severity on Pinot Noir grapes treated with various materials and evaluated on 15 July; 2003.

Treatment	Leaf Powdery Mildew		Cluster Powdery Mildew	
	Incidence	Severity	Incidence	Severity
Control	99.6 a[1]	51.8 a	100.0 a	46.3 a
50% SBT juice	98.8 a	24.2 bc	98.0 a	23.5 bc
1% Soybean oil + 25 ml/100 L AGRAL 90	96.0 a	18.5 bcd	96.0 a	24.2 b
1% STYLET OIL + 0.5 kg/100 L Sodium Bicarbonate	95.6 a	26.5 b	92.0 a	12.9 bcd
2.5% FUNGINEEM	92.0 a	19.1 bcd	94.0 a	12.1 bcd
2% IBR LIQUID + 10 ml/100L SYLGARD	84.0 ab	12.4 cde	88.0 ab	11.2 bcd
1% SUPERIOR OIL	83.2 ab	9.8 de	94.0 a	9.4 bcd
Grower (15 July)	64.0 c	8.0 de	78.0 ab	8.4 cd
PM Model (15 July)	61.6 c	4.9 e	86.0 ab	10.8 bcd
*P*r> F	<.0001	<.0001	0.198	<.0001

[1] Numbers followed by the same letter are not significantly different as decided by the Waller-Duncan's K-ratio t Test (K=100). Treatments were analyzed with five replications.

Table 2. Percent powdery mildew incidence and severity on Pinot Noir grapes treated with various materials and evaluated on 3 September; 2003.

Treatment	Leaf Powdery Mildew		Cluster Powdery Mildew	
	Incidence	Severity	Incidence	Severity
Control	99.2 a[1]	74.7 a	100.0 a	90.8 a
50% SBT juice	100.0 a	49.8 bcd	100.0 a	41.8 bc
1% Soybean oil + 25 ml/100 L AGRAL 90	100.0 a	59.6 abc	100.0 a	40.0 bc
1% STYLET OIL + 0.5 kg/100 L Sodium Bicarbonate	99.3 a	34.6 def	98.0 a	31.8 bcd
2.5% FUNGINEEM	99.6 a	34.5 def	100.0 a	38.0 bc
2% IBR LIQUID + 10 ml/100 L SYLGARD	98.8 ab	31.9 def	82.0 ab	25.6 cde
1% SUPERIOR OIL	86.8 ab	42.9 cde	94.0 ab	33.4 bcd
Grower (15 July)	87.2 ab	20.3 efg	68.0 bc	13.4 de
PM Model (15 July)	81.1 b	18.4 gf	78.0 ab	20.6 cde
*P*r> F	<.0001	<.0001	0.0006	<.0001

[1] Numbers followed by the same letter are not significantly different as decided by the Waller-Duncan's K-ratio t Test (K=100). Treatments were analyzed with five replications.

Table 3. Effect of various materials on number of clusters and weight (kg) of 'Pinot noir' grapes at harvest.

Treatment	No. Of Clusters	Avg. Cluster wt.	Total Cluster wt.
Control	157.6 b[1]	0.052 d	8.1 c
50% SBT juice	198.2 ab	0.067 bcd	13.2 bc
1% Soybean oil + 25 ml/100 L AGRAL 90	211.0 ab	0.065 bcd	13.6 abc
1% STYLET OIL + 0.5 kg/100 L Sodium Bicarbonate	187.4 ab	0.086 b	16.5 ab
2.5% FUNGINEEM	193.4 ab	0.080 bc	15.5 ab
2% IBR LIQUID + 10 ml/100 L SYLGARD	193.8 ab	0.063 bcd	12.3 bc
1% SUPERIOR OIL	187.6 ab	0.066 bcd	12.2 bc
Grower (15 July)	217.8 ab	0.074 bcd	16.4 ab
PM Model (15 July)	199.0 ab	0.086 b	16.6 ab
*P*r> F	0.4044	<.0001	0.0225

[1] Numbers followed by the same letter are not significantly different as decided by the Waller- Duncan K-ratio t Test (K=100). Treatments were analyzed with four replications.

Table 4. Effect of various treatments on quality of Pinot noir grapes at harvest on 23 September.

Treatment	Berry weight (g)	pH	Soluble solids (%)	Titratable acidity (g/L)
Soybean oil	84.9 a[1]	3.5 b	19.1 a	15.5 a
1% STYLET OIL + 0.5 kg/100 L Sodium Bicarbonate	84.2 a	3.6 ab	17.7 a	15.7 a
2.5% FUNGINEEM	85.9 a	3.8 a	18.6 a	16.1 a
2% IBR LIQUID + 10 ml/100 L SYLGARD	75.2 a	3.6 ab	17.5 a	15.2 a
1% SUPERIOR OIL	87.4 a	3.6 ab	16.5 a	14.5 a
Grower (15 July)	90.1 a	3.6 ab	18.5 a	14.2 a
*P*r> F	0.6381	0.273	0.9582	0.6921

[1] Numbers followed by the same letter are not significantly different as decided by the Waller- Duncan K-ratio t Test (K=100).

Table 5. Effect of various treatments on percent bunch rot of Pinot noir grapes incubated at 10°C for 8 and 15 days.

Treatment	After 8 days		After 15 days	
	Incidence	Severity	Incidence	Severity
Control	32.0 abc[1]	1.6 b	32.0 bc	2.4 bc
50% SBT juice	44.0 abc	2.4 b	4.0 cd	0.2 c
1% STYLET OIL + 0.5 kg/100 L Sodium Bicarbonate	56.0 ab	3.2 ab	60.0 ab	3.8 b
2.5% FUNGINEEM	64.0 a	5.6 a	72.0 a	8.8 a
2% IBR LIQUID + 10 ml/100 L SYLGARD	40.0 abc	2.2 b	44.0 ab	3.2 bc
1% SUPERIOR OIL	40.0 abc	2.6 b	52.0 ab	3.4 bc
Grower (15 July)	16.0 c	0.8 b	32.0 bc	1.8 bc
*P*r> F	0.0385	0.0057	<.0001	<.0001

[1]Numbers followed by the same letter are not significantly different as decided by the Waller- Duncan K-ratio t Test (K=100).

2004 PMRR REPORT # 69 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: 402-1531-8605

CROP: Grape, *Vitis vinifera* cv. Pinot noir
PEST: Powdery mildew, *Uncinula necator* Pers.:Fr.

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TITLE: EFFICACY OF BAS 516 AGAINST POWDERY MILDEW OF GRAPE; 2003

MATERIALS: BAS 516F 38 WG (boscalid + pyraclostrobin), ELEVATE 50 WDG (fenheximide), NOVA 40W (myclobutanil), ROVRAL 50 W (iprodione), VANGARD 75 WG (cyprodinil)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 16 year old 'Pinot noir' (5 replicates) vines. Spacing was 1.4 x 3.6 m for a panel of five Pinot noir vines. The cordon trained, spur pruned vines (ca. 20 nodes/m row) on vertical trained canopies were hedged around lag phase of berry development. The experimental design was a randomized complete block. 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 500 kPa at a rate of 1000 L water/ha. The grower standard treatment, the UC Davis powdery mildew model treatment, and the BAS 516 treatment were applied to 'Pinot noir' grapes on 29 May (Pre-bloom), 18 June (Pre-bloom), 3 July (Post bloom), 24 July (Fruit set), 14 August (Bunch closure), 28 August (Veraison), 16 September (Post Veraison). See below for application times and fungicides that were used in each treatment. Percent incidence and severity of leaf and cluster powdery mildew were evaluated on 15 July, and 3 September by examining 10 leaves on each of five shoots per three middle vines; and 10 berry clusters per three middle vines. Fifty clusters were examined for powdery mildew and bunch rot at harvest on September 23. Clusters were considered to have bunch rot if gray mold was observed growing among the berries. At harvest, weight and number of clusters per replicate panel were also recorded. Five Pinot noir grape clusters from each replicate were incubated at 13°C for 10 days to determine if they were infected by *Botrytis* spp. and other fungi. Counts of cluster, and leaf powdery mildew incidence and severity and bunch rot incidence and severity were converted to the percent infected per replicate and subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan's Multiple Range Test was used to separate means (K = 100).

GROWER Program consisted of NOVA (13.3 g/100 L or 200 g/ha) on 29 May, VANGARD 75 WG (50 g/100 L or 0.5 kg/ha) tank mixed with NOVA (13.3 g/100 L or 200 g/ha) on 18 June, NOVA (13.3 g/100 L or 200 g/ha) on 3 July, ROVRAL 50W (150 g/100 L or 1.5 kg/ha) tank mixed with NOVA (13.3 g/100 L or 200 g/ha) on 24 July, NOVA (13.3 g/100 L or 200 g/ha) on 14 August, VANGARD 75 WG (50 g/100 L or 0.5 kg/ha) tank mixed with NOVA (13.3 g/100 L or 200 g/ha) on 28 August, and ELEVATE 50WG (75 g/100 L or 0.75 kg/ha) tank mixed with NOVA (13.3 g/100 L or 200 g/ha) on 16 September. Harvest was on 23 September.

PM MODEL Program consisted of NOVA (13.3 g/100 L or 200 g/ha) on 29 May, VANGARD 75 WG (50 g/100 L or 0.5 kg/ha) tank mixed with NOVA (13.3 g/100 L or 200 g/ha) on 18 June, NOVA (13.3 g/100 L or 200 g/ha) on 3 July, ROVRAL 50W (150 g/100 L or 1.5 kg/ha) tank mixed with NOVA (13.3 g/100 L or 200 g/ha) on 24 July, NOVA (13.3 g/100 L or 200 g/ha) on 14 August, VANGARD 75 WG (50 g/100 L or 0.5 kg/ha) tank mixed with NOVA (13.3 g/100 L or 200 g/ha) on 28 August, and ELEVATE

50WG (75 g/100 L or 0.75 kg/ha) tank mixed with NOVA (13.3 g/100 L or 200 g/ha) on 16 September. Harvest was on 23 September.

BAS 516 Program consisted of BAS 516 38 WG (49.1 g/100 L or 0.491 kg/ha) on 29 May, 18 June, 3 July, 24 July, 14 August, 28 August, and 16 September. Harvest was on 23 September.

RESULTS and DISCUSSION: Powdery mildew was first observed on grape berries on the 26 June. BAS 516 was very effective in controlling powdery mildew on 'Pinot noir' grape foliage throughout the growing season (Table 1). It was the best material after the first reading on 15 July and as powdery mildew increased over the summer BAS 516 maintained its relative effectiveness over the Grower standard and PM Model treatments. BAS 516 provided the best control of cluster powdery mildew in a year when the disease infected 100% of the control bunches as early as 15 July (Table 1). The severity of cluster powdery mildew near harvest on 3 September was only 4% in the BAS 516 grapes compared to 13% in the Grower treatment. BAS 516 had the highest total cluster weight and average cluster weight at harvest on September 23 (Table 2). Bunch rot did not occur in the vineyard in this extremely dry year and had to be induced by incubating the grape bunches for 8 and 15 days in humid chambers at 13°C. BAS 516 completely prevented bunch rot from occurring in the 'Pinot noir' bunches after incubation for 15 days (Table 3). Fungi such as *Alternaria* spp. and *Penicillium* spp. did appear on some of the bunches but appeared to be absent from the BAS 516 bunches. Significant leaf wetness (> 10 hrs) only occurred on 25 May ,13 June, and 9 August during the growing season and likely explains the early development of powdery mildew and the lack of bunch rot in this trial.

CONCLUSIONS: BAS 516 is a very effective fungicide for the control of powdery mildew in grape and may also provide addition benefits such as the reduction of bunch rot incidence and severity.

Table 1. Percent powdery mildew incidence and severity of Pinot Noir grapes treated with BAS 516.

Treatment/Program (Evaluated)	Leaf Powdery Mildew		Cluster Powdery Mildew	
	Incidence	Severity	Incidence	Severity
Control (15 July)	99.6 a[1]	51.8 a	100.0 a	46.3 a
Grower (15 July)	64.0 b	8.0 bc	78.0 ab	8.4 cd
PM Model (15 July)	61.6 b	4.9 c	86.0 ab	10.8 bcd
BAS 516 (15 July)	18.0 c	1.6 c	56.0 b	3.9 d
*P*r> F	<.0001	<.0001	0.198	<.0001
Control (3 Sep.)	99.2 a	74.7 a	100.0 a	90.8 a
Grower (3 Sep.)	87.2 ab	20.3 bcd	68.0 bc	13.4 cd
PM Model (3 Sep.)	81.1 b	18.4 cd	78.0 ab	20.6 bcd
BAS 516 (3 Sep)	54.5 c	7.6 d	44.0 c	4.4 d
*P*r> F	<.0001	<.0001	0.0006	<.0001

[1] Numbers followed by the same letter are not significantly different as decided by the Waller-Duncan's K-ratio t Test (K=100). Treatments were analyzed with five replications.

Table 2. Effect of BAS 516 on number of clusters and weight (kg) of 'Pinot noir' grapes at harvest.

Treatment/ Program	No. of Clusters	Avg. Cluster wt.	Total Cluster wt.
Control	157.6 a[1]	0.052 a	8.1 a
Grower	217.8 ab	0.074 bcd	16.4 bc
PM Model	199.0 ab	0.086 c	16.6 bc
BAS 516	164.4 ab	0.120 d	19.8 c
*P*r> F	0.4044	<.0001	0.0225

[1] Numbers followed by the same letter are not significantly different as decided by the Waller- Duncan K-ratio t Test (K=100). Treatments were analyzed with four replications.

Table 3. Effect of BAS 516 on percent bunch rot of Pinot noir grapes incubated at 13°C for 8 and 15 days.

Treatment/ Program	After 8 days		After 15 days	
	Incidence	Severity	Incidence	Severity
Control	32.0 abc[1]	1.6 a	32.0 a	2.4 a
Grower	16.0 c	1.0 a	32.0 a	1.8 a
BAS 516	8.0 c	0.4 a	0.0 b	0.0 b
*P*r> F	0.0385	0.0057	<.0001	<.0001

[1] Numbers followed by the same letter are not significantly different as decided by the Waller- Duncan K-ratio t Test (K=100).

2004 PMRR REPORT # 70 **SECTION K: FRUIT – Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Peaches (Prunus persica) cv. Loring
PEST: Brown Rot (*Monilinia fructicola*)

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TITLE: EVALUATION OF BIOSAVE, SCHOLAR AND MERTECT FOR POST-HARVEST CONTROL OF BROWN ROT IN 'LORING' PEACHES IN COLD STORAGE; 2004.

MATERIALS: BIOSAVE (*Pseudomonas syringae*), SCHOLAR (50% fludioxonil) and MERTECT 500SC (45% thiabendazole, TBZ)

METHODS: SCHOLAR 50wp (fludioxonil) and BIOSAVE (*Pseudomonas syringae*) were compared with MERTECT (thiabendazole, TBZ) for efficacy against brown rot of peaches caused by *Monilinia fructicola*. Commercially ripe peaches were obtained from an orchard at Jordan Station, Ontario. All fruits were stored at 4°C until used in the experimental treatments. 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 6 or 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 *M. fructicola* isolate MF-6 at a concentration of 1×10^5 conidia/ml and appropriate concentrations of fungicides. Treatments were: control, 0.02, 0.10, 0.3, 0.6 and 1.2 g/L of SCHOLAR , 1.59, 0.795, and 0.397 g /L of BIOSAVE 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 were evaluated for disease incidence after 3 weeks of incubation at 4°C on September 23. To determine the efficacy of fungicides on the shelf-life of the fruit, the fruits were then moved to 20°C, 85% RH and incubated for an additional 4 days and then evaluated for brown rot incidence on September 27. 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 tests.

RESULTS: As outlined in Table 1.

CONCLUSIONS: SCHOLAR at concentrations, 0.02, 0.3, 0.6 and 1.2 g/L gave 100% of control of brown rot after three weeks of storage at 4°C and an increase of brown rot was observed after the shelf-life storage. Very high incidence of brown rot was observed in BIOSAVE treatments. Due to wet weather conditions during the spring, latent brown rot symptoms were observed on the fruit. MERTECT gave 17% and 0% control of brown rot after cold storage and shelf-life storage, respectively. In summary, after three weeks of storage at 4°C, SCHOLAR significantly reduced brown rot.

Table 1. Mean percentage incidence of brown rot after post-harvest treatment of SCHOLAR (fludioxonil) on Peaches, cv. Loring; 2004.

Treatment	Incidence of brown rot (%)	
	at 4°C for 3 weeks	at 4°C for 3 weeks + 20°C for 4 days
Inoculum only	100.0 e [1,2]	100.0 f
SCHOLAR @ 0.02 g/L	0.0 a	77.8 d
SCHOLAR @ 0.10 g/L	5.6 b	61.1 c
SCHOLAR @ 0.3 g/L	0.0 a	33.0 a
SCHOLAR @ 0.6 g/L	0.0 a	44.4 b
SCHOLAR @ 1.2 g/L	0.0 a	33.0 a
BIOSAVE @ 0.397 g/L	94.4 e	94.5 e
BIOSAVE @ 0.795 g/L	88.9 d	100.0 f
BIOSAVE @ 1.59 g/L	77.8 c	100.0 f
MERTECT @ 1.15 g/L	83.3 d	100.0 f

[1] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.

[2] Data represent the mean of four replicates of 12 peaches per replicate. Each peach was wounded and inoculated with thiabendazole-resistant *M. fructicola* before treatment.

2004 PMRR REPORT # 71 **SECTION K: FRUIT – Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Peaches (Prunus persica) cv Loring
PEST: Gray mold (*Botrytis cinerea* Pers.:Fr.)

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TITLE: EVALUATION OF FUNGICIDES AND BIOSAVE SCHOLAR FOR POST-HARVEST CONTROL OF GRAY MOLD IN 'LORING' PEACHES IN COLD STORAGE; 2004.

MATERIALS: BIOSAVE (*Pseudomonas syringae*) and SCHOLAR (50% fludioxonil)

METHODS: SCHOLAR 50wp (fludioxonil) and BIOSAVE (*Pseudomonas syringae*) were tested for efficacy against gray mold of peaches caused by *Botrytis cinerea*. Commercially ripe peaches were obtained from an orchard at Jordan Station, Ontario. All fruits were stored at 4°C until used in experimental treatments. The peaches were placed on a plastic packing insert contained in a plastic box. Each box represents a treatment replication and four replicate trays with 6 or 12 fruits /replicate were prepared for each treatment. 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* isolate BC-8DR and TBZ-sensitive *B. cinerea* BC-2ES at a concentration of 1 x 10^5 conidia/ml and appropriate concentrations of fungicides. Treatments were: control, 0.02, 0.10, 0.3, 0.6, and 1.2 g/L of SCHOLAR, 1.59, 0.795, and 0.397 g /L of BIOSAVE 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 were evaluated for disease incidence after 3 weeks of incubation at 4°C on September 23. To determine the efficacy of fungicides on the shelf-life of the fruit, the fruits were then moved to 20°C , 85% RH and incubated for an additional 4 days and then evaluated on September 27. Fruits were considered decayed when a lesion developed on the fruit. The data obtained was 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 0.02, 0.3, 0.6 and 1.2 g/L gave 100% of control of gray mold after three weeks of storage at 4 °C and an increase of gray mold was observed after the shelf-life storage. Very high incidence of gray mold was observed in BIOSAVE treatments. Due to wet weather conditions during the spring, a high incidence of brown rot was observed on fruits. In summary, after three weeks of storage at 4°C and after shelf-life storage, SCHOLAR significantly reduced gray mold.

Table 1. Mean percentage incidence of gray mold after post-harvest treatment of SCHOLAR (fludioxonil) and BIOSAVE in peach, cv. Loring under cold and shelf-life storage conditions; 2004.

Treatment and rate (g/L)	Incidence of gray mold (%)			
	at 4°C for 3 weeks		at 4°C for 3 weeks + 20°C for 4 days	
	TBZ-S[1]	TBZ-R[2]	TBZ-S[1]	TBZ-R[2]
Inoculum only	94.4 d[3,4]	94.4 d	100.0 f	100.0 f
SCHOLAR @ 0.02	5.6 b	0.0 a	72.2 e	88.9 e
SCHOLAR @ 0.10	0.0 a	0.0 a	55.6 d	66.7 d
SCHOLAR @ 0.3	0.0 a	5.6 b	22.2 a	50.0 c
SCHOLAR @ 0.6	0.0 a	5.6 b	33.0 b	33.3 b
SCHOLAR @ 1.2	0.0 a	0.0 a	38.9 c	11.1 a
BIOSAVE @ 0.397	23.3 c	77.8 c	100.0 f	100.0 f
BIOSAVE @ 0.795	83.3 b	89.0 d	100.0 f	100.0 f
BIOSAVE @ 1.59	100.0 e	94.4 d	100.0 f	100.0 f

[1] TBZ-S = thiabendazole sensitive
[2] TBZ-R = thiabendazole resistant.
[3] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.
[4] Data represent the mean of four replicate of 12 peaches per replicate. Each peach was wounded and inoculated with thiabendazole-resistant *B. cinerea* before treatment.

2004 PMRR REPORT # 72 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Pears (*Pyrus communis*) cv. Bosc
PEST: Gray mold (*Botrytis cinerea* Pers.)

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TITLE: EVALUATION OF FUNGICIDES FOR CONTROL OF POST-HARVEST GRAY MOLD IN PEARS CV. BOSC; 2003-04.

MATERIALS: SCHOLAR (50% fludioxonil), ELEVATE (fenhexamid), BIOSAVE *(Pseudomonas syringae*) and MERTECT 500SC (45% thiabendazole)

METHODS: SCHOLAR 50WP (fludioxonil), ELEVATE (fenhexamid), and BIOSAVE were compared with MERTECT (thiabendazole; TBZ) for efficacy against gray mold of pears caused by *Botrytis cinerea*. The trial was conducted at SCPFRC, AAFC, Vineland. Commercially ripe pears (*Pyrus communis*) cv. Bosc were obtained from an orchard at Jordan Station, Ontario. All fruits were stored at 4°C until used in the experimental treatments. The pears were harvested on October 5, 2002 and experiment was initiated on October 15, 2003. Pears 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 pears were placed on a plastic packing insert (fruit master) contained in a plastic box. Each box represents a treatment replication. Five replicate trays were prepared for each treatment. The pears were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, pears were inoculated with a 20 µl drop of TBZ-resistant *B. cinerea* isolate BC-8D at a concentration of 1 x 10^5 conidia/ml and incubate at 12°C for 18-24 hours and then treated with fungicide treatments. The treatments are, control, SCHOLAR at 0.005, 0.01, 0.02, 0.04, 0.08, 0.15, 0.30, 0.60 and 1.2 g/L, BIOSAVE at 1.59 g/L, ELEVATE at 0.02 g/L and MERTECT at 1.15 g/L concentrations (Table 1). In the drench application appropriate amount of fungicides were mixed in water and pouring it on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. Untreated check had no fungicides. The treatments were randomized completely . Treated pears were incubated at 0°C for 103 days. Pears in each of the experiments were evaluated for decay after 56, 90, and 103 days after treatment. To determine the efficacy of fungicides on the shelf-life of the fruit, the fruits were moved to 20°C and 85% RH and incubated for 6 days. The fruits were again evaluated for gray mold incidence (percent infected pears). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: As outlined in Table 1.

CONCLUSIONS: In a time course study, the efficacy of fungicides, SCHOLAR 50WP (fludioxonil), FEHEXAMID, BIOSAVE were compared with MERTECT (thiabendazole; TBZ), as post-inoculation treatments (curative) for control of gray mold in pears in cold storage. The post-inoculation treatment was used to simulate the pre-storage treatment intervals where the infection may have occurred at the time of harvest in the field or in transit prior to the treatment at storage. Gray mold was observed at lower concentrations of SCHOLAR. At the highest concentration tested in this study, SCHOLAR at 1.2 g /L concentration gave 0%, 97%, and 89% control of gray mold after 56 days, 90 days and 103 days, respectively, in cold storage. BIOSAVE was ineffective as a post-inoculation treatment. ELEVATE gave 100% control of gray mold in pears. At recommended concentrations, MERTECT at 1.15 g/L, was not effective against TBZ-resistant *B. cinerea* inoculum, as the gray mold incidence was 100.0 % in METERCT-treated pears. In summary, SCHOLAR at 1.20 g/L concentration was effective up to 90 days against TBZ -resistant *B. cinerea* on pears, while high disease incidence was observed in MERTECT treatments in which TBZ-resistant inoculum was used.

Table 1. Evaluation of fungicides for control of gray mold in pear cv. Bosc; 2003-04.

Treatment	Incidence of gray mold (%)			
	56 days at 0°C	93 days at 0°C	103 days at 0°C	103 days at 0°C + 6 days at 20°C
Inoculum only	100.0 i[1]	100 h	100.0 h	100.0 i
SCHOLAR @ 0.005 g/L	41.7 h	52.7 g	69.4 g	86.1 h
SCHOLAR @ 0.01 g/L	27.7 g	33.3 f	33.3 f	58.3 g
SCHOLAR @ 0.02 g/L	16.7 f	19.4 e	22.2 e	27.8 f
SCHOLAR @ 0.04 g/L	13.9 e	19.4 e	22.2 e	27.8 f
SCHOLAR @ 0.08 g/L	2.8 b	2.8 b	2.8 b	2.8 b
SCHOLAR @ 0.15 g/L	8.3 d	11.1 d	11.1 d	11.1 d
SCHOLAR @ 0.30 g/L	5.6 c	5.6 c	5.6 c	8.3 c
SCHOLAR @ 0.60 g/L	3.8 bc	3.8 bc	13.9 d	19.4 e
SCHOLAR @ 1.20 g/L	0.0 a	2.8 b	11.1 d	11.1 c
ELEVATE@ 0.02 g/L	0.0 a	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	100.0 i	100.0 h	100.0 h	100.0 i
MERTECT @ 1.15 g/L	100.0 i	100.0 h	100.0 h	100.0 i

[1] Means within the column followed by the same letter are not significantly different according to Tukey test at (P = 0.05).

2004 PMRR REPORT # 73 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.23

CROP: Pears (*Pyrus communis*) cv. Bosc
PEST: Blue mold (*Penicillium expansum* Link) and Gray mold *Botrytis Cinerea* Pers.

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TITLE: EVALUATION OF FUNGICIDES FOR CONTROL OF POST-HARVEST BLUE MOLD AND GRAY MOLD IN PEARS cv. BOSC; 2003-04.

MATERIALS: SCHOLAR (50% fludioxonil), ELEVATE (fenhexamid), BIOSAVE *(Pseudomonas syringae*) and MERTECT 500SC (45% thiabendazole).

METHODS: SCHOLAR 50WP (fludioxonil), ELEVATE, BIOSAVE was compared with MERTECT (thiabendazole; TBZ) for efficacy against MERTECT (thiabendazole, TBZ) for efficacy against blue mold of pears caused by *Penicillium expansum* and gray mold of pears caused by *Botrytis cinerea*. The trial was conducted at SCPFRC, AAFC, Vineland and apples were stored at University of Guelph's cold storage. Commercially ripe Pears (*Pyrus communis*) cv. Bosc were obtained from an orchard at Jordan Station, Ontario. All fruits were stored at 4°C until used in experimental treatments. The pears were harvested on October 5, 2002 and experiment was initiated on October 15, 2003. Pears 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 pears were placed on a plastic packing insert (fruit master) contained in a plastic box. Each box represents a treatment replication. Five replicate trays were prepared for each treatment. The pears were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, pears were inoculated with a 20 µl drop of TBZ-resistant *P. expansum* isolate PS-1R or TBZ-resistant *B. cinerea* isolate BC-8D at a concentration of 1×10^5 conidia/ml and incubated at 12°C for 18-24 hours and then treated with fungicide treatments. The treatments are, control, SCHOLAR at .005, 0.01, 0.02, 0.04, 0.08, 0.15, 0.30, 0.60 and 1.2 g/L, BIOSAVE at 1.59 g/L, ELEVATE at 0.02 g/L and MERTECT at 1.15 g/L concentrations (Table 1). In the drench application appropriate amount of fludioxonil was mixed in water and pouring it on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. Untreated check had no fungicides. The treatments were randomized completely . Treated pears were incubated at 0°C for 103 days. Pears were evaluated for decay after 56, 90, and 103 days after treatment. To determine the efficacy of the fungicides on the shelf-life of the fruit, the fruits were moved to 20°C and 85% RH and incubated for 7 days. The fruit were again evaluated for blue mold and gray mold incidence (percent infected pears). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: As outlined in Tables 1 and 2.

CONCLUSIONS: In a time course study, the efficacy of fungicides, SCHOLAR 50WP (fludioxonil), FEHEXAMID, BIOSAVE were compared with MERTECT (thiabendazole; TBZ) as post-inoculation treatments (curative) for control of blue mold or gray mold in pears in cold storage. The post-inoculation treatment was used to simulate the "pre-storage" @ treatment intervals where the infection may have occurred at the time of harvest in the field or in transit prior to the treatment at storage. Blue mold and gray mold were observed at lower concentrations of SCHOLAR. At the highest concentration tested in this study, SCHOLAR at 1.2 g /L concentration gave 99% control of blue mold for up to 100 days in cold storage and 83% control of blue mold in the subsequent shelf-life study. As to the control of gray mold, SCHOLAR at 1.2 g /L concentration gave 100% control for 54 days and 97% for up to 100 days in storage. BIOSAVE was ineffective as a post-inoculation treatment. ELEVATE gave 0% control of blue mold and 100 % control of gray mold in pears. At recommended concentrations, MERTECT at 1.15 g/L, was not effective against TBZ-resistant *B. cinerea*, as the gray mold incidence was 100% in METERCT-treated pears. In summary, SCHOLAR at 1.2 g/L concentration was effective against TBZ -resistant *P. expansum* and *B. cinerea* on pears, while high disease incidence was observed in MERTECT treatments in which TBZ-resistant was used.

Table 1. Evaluation of fungicides for control of blue mold caused by (*Penicillium expansum*) in pear cv. Bosc; 2003-04.

Treatment	Incidence of blue mold (%)			
	54 days at 0°C	91 days at 0°C	100 days at 0°C	100 days at 0°C + 7 days at 20°C
Inoculum only	100.0 h[1]	100.0 i	100.0 g	100.0 i
SCHOLAR @ 0.005 g/L	33.3 f	58.3 g	63.9 gf	100.0 i
SCHOLAR @ 0.01 g/L	19.4 e	30.1 f	38.9 e	72.2 h
SCHOLAR @ 0.02 g/L	11.1 c	22.2 d	27.8 d	69.4 g
SCHOLAR @ 0.04 g/L	13.9 d	13.9 c	22.2 c	55.6 f
SCHOLAR @ 0.08 g/L	13.9 d	19.4 d	19.4 c	22.2 d
SCHOLAR @ 0.15 g/L	16.8 c	25.0 e	27.8 d	33.2 e
SCHOLAR @ 0.30 g/L	2.8 b	2.8 b	2.8 b	2.8 b
SCHOLAR @ 0.60 g/L	17.7 e	19.4 d	19.4 c	22.2 d
SCHOLAR @ 1.20 g/L	1.1 b	1.1 b	1.1 b	16.7 c
ELEVATE @ 0.02 g/L	100.0 h	100.0 i	100.0 g	100.0 i
BIOSAVE @ 1.59 g/L	100.0 h	100.0 i	100.0 g	100.0 i
MERTECT @ 1.15 g/L	94.4 g	94.4 h	97.2 g	100.0 i

[1] Means within the column followed by the same letter are not significantly different according to the Tukey test at ($P = 0.05$).

Table 2. Evaluation of fungicides for control of gray mold caused by (*Botrytis cinerea*) in pear cv. Bosc; 2003-04.

Treatment	Incidence of gray mold (%)			
	54 days at 0°C	91 days at 0°C	100 days at 0°C	100 days at 0°C + 7 days at 20 °C
Inoculum only	100.0 f[1]	100.0 g	100.0 h	100.0 i
SCHOLAR @ 0.005 g/L	17.7 e	38.9 f	69.4 g	100.0 i
SCHOLAR @ 0.01 g/L	8.3 c	33.3 e	44.4 f	88.9 h
SCHOLAR @ 0.02 g/L	8.3 c	11.1 d	19.4 e	55.5 g
SCHOLAR @ 0.04 g/L	8.3 c	11.1 d	11.1 d	30.6 f
SCHOLAR @ 0.08 g/L	5.6 b	8.3 c	8.3 c	16.7 d
SCHOLAR @ 0.15 g/L	8.3 c	11.1 d	13.8 d	22.2 e
SCHOLAR @ 0.30 g/L	11.1 d	13.9 d	13.9 d	13.9 c
SCHOLAR @ 0.60 g/L	16.7 e	16.7 f	16.7 e	19.4 d
SCHOLAR @ 1.20 g/L	0.0 a	2.8 b	2.8 b	2.8 b
ELEVATE @ 0.2 g/L	0.0 a	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	100.0 f	100.0 g	100.0 h	100.0 i
MERTECT @ 1.15 g/L	100.0 f	100.0 g	100.0 h	100.0 i

[1] Means within the column followed by the same letter are not significantly different according to theTukey test at ($P = 0.05$).

2004 PMRR REPORT # 74 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: 402-1531-8605

CROP: Peach cv. Harbrite
PEST: Brown rot, *Monilinia fructicola* (Wint.) Honey

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TITLE: EFFICACY OF BASF 516 FOR BROWN ROT CONTROL ON PEACHES; 2003

MATERIALS: BASF 51604F 38WG (boscalid + pyraclostrobin), TOPAS 250E (propiconazole 250 g/L), Sodium Bicarbonate, STYLET OIL (paraffinic Oil 97.1%) and ARMICARB (potassium Bicarbonate 85%)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre in Summerland, BC on mature peach trees cv Harbrite spaced at 3.6 m x 4.8 m. The statistical design of the trial was the randomized complete block with five treatments replicated five times on single tree replicates. Treatments were applied until run-off with a handgun operated at approximately 400 kPa. Average volume of water applied per tree was 8 litres. The BAS 516 and TOPAS treatments were applied on 17 April (Bloom), 2 May (Late bloom), 15 May (Husk fall), 19 June (first cover), 16 July (second cover) and 7 August (5 days pre-harvest). The Sodium Bicarbonate/STYLET OIL and ARMICARB treatments were applied on the same dates except that the late bloom spray (2 May) was omitted. To evaluate the efficacy of the different materials for blossom blight control, three shoots per replicate were collected on 24 April, a week after the bloom spray. They were inoculated with a mixture of four isolates of *Monilinia fructicola* designated as #1179, #1960-9, #1963-1 and #1953-7. The spore suspension (7.4×10^4 CFU/ml) was applied with a hand atomizer. The shoots with flowers were kept in water in a mist chamber (mist on every 10 minutes for 45 seconds, average temperature 18 C and 85 RH). Blossom blight/brown rot of the flowers was assessed on 29 April by counting the number of blighted flowers. One hundred fruits per tree were picked on 12 August and 50 were inoculated with isolate #1683 of *M. fructicola*. The spore suspension (1.0×10^5 CFU/ml) was applied on the fruits with a hand atomizer. All fruits were stored in plastic lugs at 13°C. The number of fruits with rot (brown soft tissue, with or without sporulation) was assessed on 20 August. Percent values were arcsin-transformed and all values were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan k-ratio t test (k = 100) was used for multiple comparison of means.

RESULTS: The blossom blight trial showed that BAS 516 was the most effective material for control of the blossom phase of brown rot (Table 1). TOPAS was also effective at controlling blossom brown rot. There were only a few brown rotted fruit in the orchard in this extremely dry year. All the treatments that were tested for control of fruit brown rot were not significantly different from the control (Table 2). Even when the fruit were inoculated with *M. fructicola* none of the treatments were effective although the lowest number of infected fruit was with BAS 516 (Table 2). We also observed that lesions on fruit treated with BAS 516 were smaller than those on fruit from the other treatments. An explanation for the poor control of fruit brown rot could be latent infections that developed after the fruit were incubated at 13°C on 12 August. The only time when significant rain fall occurred over the growing period for the fruit to become infected by *M. fructicola* was on 24-25 May, and has been documented as an apple scab infection period for the Summerland area. It is possible that applications of TOPAS and BAS 516 applied on 15 May did not protect the fruit from infection on 25 May. The next spray application was not made until the 19 June.

The presence of latent infections could also explain why inoculating the fruit with conidia of *M. fructicola* did not change the percentage of rot very much. In past years when fruit was incubated at 13°C significant amounts of decay caused by *Penicillium* spp., *Rhizopus* spp., and *Alternaria* spp. were observed and recorded. In this trial very little infection by any of these fungi were recorded. This is likely because of the extremely dry conditions that did not foster any contamination of peaches with spores of these fungi.

CONCLUSIONS: BAS 516 is very effective for the control of blossom brown rot. Latent infections of peaches are very difficult to eradicate and can not be controlled by BAS 516 or TOPAS.

Table 1. Percent flowers with brown rot after inoculating with *Monilinia fructicola* and misting with water.

Treatment and Rate/100 L water	%Flower clusters with brown rot
Sodium bicarbonate 1 kg (30.0 kg/ha) + STYLET OIL 1L (30.0 L/ha)	64.7 a[1]
ARMICARB 0.6 kg (18 kg/ha)	63.9 a
Control	56.6 a
TOPAS 17 ml (0.51 L/ha)	25.8 b
BAS 516 24.6 g (0.74 kg/ha)	4.7 c
ANOVA *P*r>F	<.0001

[1] These values are means of four replications. Raw data were arcsin transformed before ANOVA and the de-transformed means are presented here. Numbers within a column followed by the same letter are not significantly different according to the Waller-Duncan k-ratio t test (k = 100).

Table 2. Percent brown rot at harvest and after storage at 13°C for 8 days.

Treatment and Rate/100 L water	Harvest	Not Inoculated	Inoculated
Control	0	65.6 a[1]	57.6 a
TOPAS 17 ml (0.51 L/ha)	0	46.3 a	51.0 a
Sodium bicarbonate 1 kg (30.0 kg/ha) + STYLET OIL 1L (30.0 L/ha)	0	45.6 a	45.1 a
ARMICARB 0.6 kg (18 kg/ha)	0	41.9 a	41.0 a
BAS 516 24.6 g (0.737 kg/ha)	0	60.0 a	39.8 a
ANOVA *P*r>		0.2049	0..4890

[1] These values are means of four replications. Raw data were arcsin transformed before ANOVA and the de-transformed means are presented here. Numbers within a column followed by the same letter are not significantly different according to the Waller-Duncan k-ratio t test (k = 100).

2004 PMRR REPORT # 75 **SECTION K: FRUIT - Diseases**
STUDY DATABASE: WBSE-E.0104.61

CROP: Plum (Prunus domestica) cv. Shiro
PEST: Gray mold (*Botrytis cinerea* Pers.:Fr).

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TITLE: EVALUATION OF POST-HARVEST FUNGICIDES SCHOLAR (FLUDIOXONIL) AND MERTECT (THIABENDAZOLE) FOR CONTROL OF GRAY MOLD OF PLUM CV. SHIRO; 2004.

MATERIALS: BIOSAVE (*Pseudomonas syringae*), SCHOLAR (50% fludioxonil) and MERTECT 500SC (45% thiabendazole, TBZ)

METHODS: SCHOLAR 50wp (fludioxonil) and BIOSAVE (*Pseudomonas syringae*) were compared with the MERTECT (thiabendazole; TBZ) for efficacy against gray mold of plum caused by *Botrytis cinerea*. Commercially ripe plum was obtained from an orchard at Jordan Station, Ontario. All fruits were stored at 4°C until used in experimental treatments. 24 plums were arranged on a plastic packing insert in a plastic box. Each box represents a treatment replication. Four replicate trays with 12 fruit s/replicate were prepared for each treatment. Plums were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, plum was co-inoculated with a 20 µl drop of TBZ-resistant *B. cinerea* isolate BC-8D at a concentration of 1 x 10^5 conidia/ml and appropriate concentration of fungicide or Biological control agent and incubate at 20°C for 5 or 7 days. Treatments were: control, 0.01, 0.02, 0.05 and 0.10 g/L and thiabendazole at 1.15 g/L. The plums were drop treated. Drop treatment consisted of placing a drop of fungicide suspension on the wounded and inoculated fruits. The inoculated fruits were placed on the fruit inserts. Untreated check had no fungicides. The treatments were completely randomized. The plums, which were treated on August 12, 2004 were incubated at 20°C for 5 or 7 days. Plums in each of the experiments were evaluated on August 17 (5 days) and Aug 19 (7 days) for gray mold incidence (percent infected plums). Fruits were considered decayed when a lesion developed on the fruit. The data obtained was analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey tests.

RESULTS: Percent disease incidence is presented in Table 1.

CONCLUSIONS: SCHOLAR at concentrations of 0.05, and 0.1 g/L gave 92, and 97.0% of control of gray mold after 5 and 7 days, respectively. BIOSAVE, at the concentrations tested gave less control than SCHOLAR. MERTECT gave 28 and 19 % of control after 5 and 7 days, respectively.

Table 1. Mean percentage incidence of gray mold after post-harvest treatment of SCHOLAR (fludioxonil) on Plums, cv. Shiro; 2004.

Treatment	Incidence of gray mold (%)	
	at 20°C for 5 days	at 20°C for 7 days
Inoculum only	55.6 e [1,2]	75.0 g
SCHOLAR @ 0.01 g/L	27.8 c	36.1 f d
SCHOLAR @ 0.02 g/L	5.6 b	22.2 c
SCHOLAR @ 0.50 g/L	5.6 b	16.7 b
SCHOLAR @ 0.10 g/L	2.8 a	8.3 a
BIOSAVE @ 1 x 10^2 CFU/ml	79.4 h	80.5 f
BIOSAVE @ 1 x 10^3 CFU/ml	50.0 d	55.6 e
BIOSAVE @ 1 x 10^4 CFU/ml	55.6 e	75.0 g
BIOSAVE @ 1 x 10^6 CFU/ml	63.9 f	75.0 g
MERTECT @ 1.15 g/L	72.2 g	80.8 h

[1] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$.

[2] Data represent the mean of three replicate of 12 plums per replicate. Each plum was wounded and inoculated with thiabendazole-resistant *B. cinerea* before treatment.

2004 PMRR REPORT # 76 **SECTION K: FRUIT - Diseases**
ICAR: 306001

CROP: June-bearing strawberry (*Fragaria* x *ananassa* L.), cv. Honeoye
PEST: Red stele root rot (*Phytophthora fragariae* var. *fragariae*)

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TITLE: **CONTROLLED ENVIRONMENT EVALUATION OF RIDOMIL GOLD 480EC AND RIDOMIL GOLD 480SL TO PROTECT STRAWBERRY AGAINST RED STELE ROOT ROT, CAUSED BY *PHYTOPHTHORA FRAGARIAE* VAR. *FRAGARIAE*.**

MATERIALS: RIDOMIL GOLD 480EC (metalaxyl-M and S-isomer 480 g a.i./L), RIDOMIL GOLD 480SL (metalaxyl-M and S-isomer 480 g a.i./L).

METHODS: Strawberry plants, cultivar Honeoye, were obtained from Strawberry Tyme Farms Inc. (R.R. #2 Simcoe, Ontario, N3Y 4K1) and were maintained under greenhouse conditions. Plants were watered as necessary and fertilized periodically with soluble fertilizer. Young daughter plants, produced on runners, were rooted into soil-less compost (Promix BX, Plant Products, Brampton, ON) in 15-cm-diameter plastic pots, watered daily and grown under greenhouse conditions prior to inoculation. An isolate of *P. fragariae* (DAOM 229207) was obtained from the Canadian Collection of Fungal Cultures (CCFC) and grown on lima bean agar. A mycelial slurry was produced by homogenizing five lima bean agar cultures of *P. fragariae* with 500 ml of cold (4°C) distilled water for 10 seconds in a blender. After 17 days growth, under greenhouse conditions, young daughter plants were washed free of compost and roots were dipped in the mycelial slurry for 10 seconds followed by replanting in fresh compost. Immediately after inoculation and replanting, RIDOMIL GOLD 480EC or RIDOMIL GOLD 480SL was applied in 50 ml water per pot, at the equivalent of the recommended field rates. The label application rate of 1 L/ha was mimicked in pots with a soil surface area of 176.7 cm^2 by applying the equivalent label rate plus 6% (0.0018 mL) per pot. The additional 6% was added to compensate for loss of product, e.g., on walls of pipettes, during preparation and dispensation. Untreated, infested plants, with 50 ml of distilled water applied, and untreated, non-infested plants, with 50 ml distilled water applied, served as the two control treatments. Following treatment, plants were moved to a controlled environment and grown at 18-20°C under a 16/8 h light regime for 21 days. The experimental design was a completely randomized block design (CRBD). A block consisted of one replication per treatment. A replication consisted of one 15-cm-diam pot planted with one strawberry plant. There were five blocks per treatment. Disease severity was measured at harvest (21 days after inoculation). Disease severity was rated as the percentage of the roots affected by *P. fragariae* on a scale of 0 to 5; where 0 = 0%, 1 = 1 to 10%, 2 = 11 to 25%, 3 = 26 to 50%, 4 = 51 to 75% and 5 = 76 to 100%. Treatment effects on disease severity were compared using an ANOVA analysis and a REGWQ means comparison test ($P = 0.05$).

RESULTS: As outlined in Table 1.

CONCLUSIONS: Inoculation of strawberry roots by *P. fragariae* significantly increased disease severity compared to the non-infested check. Treatment with RIDOMIL GOLD 480EC or RIDOMIL GOLD 480SL significantly decreased disease severity compared to the infested check. RIDOMIL GOLD 480EC and RIDOMIL GOLD 480SL were effective and were equally effective for the control of red stele root rot of strawberry.

Table 1. Effect of RIDOMIL GOLD 480EC and RIDOMIL GOLD 480SL on disease severity on strawberry roots, infested with *Phytophthora fragariae* var. *fragariae*, averaged over five replications per treatment.

Treatment	Rate (L/ha)	Disease severity (0-5)[1]
NON-INFESTED CHECK		0.0 a[2]
INFESTED CHECK		4.0 c
RIDOMIL GOLD 480EC	1	1.4 b
RIDOMIL GOLD 480SL	1	1.0 b

[1] Disease severity was rated as the percentage of the roots affected by *P. fragariae* on a scale of 0 to 5; where 0 = 0%, 1 = 1 to 10%, 2 = 11 to 25%, 3 = 26 to 50%, 4 = 51 to 75% and 5 = 76 to 100%.
[2] Means followed by the same letter are not significantly different at $P = 0.05$ (REGWQ).

2004 PMRR REPORT # 77

SECTION L: VEGETABLE and SPECIAL CROPS - Diseases
ICAR: 206003

CROP: Carrot (*Daucus carota*), cv. Enterprise
PEST: Sclerotinia Rot of Carrot, *Sclerotium sclerotiorum* (Lib.) De Bary

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TITLE: VALIDATION OF A FIELD DISEASE FORECAST SYSTEM FOR MANAGEMENT OF SCLEROTINIA ROT OF CARROT; 2004

MATERIALS: LANCE WDG (Boscalid 70%), CABRIO EG (pyraclostrobin 20%)

METHODS: The trial was conducted at the Muck Crops Research Station, Holland Marsh, Ontario. Carrots (cv. Enterprise) were seeded May 17 at 82 seeds/m in organic muck soil (pH 6.4, organic matter 60%) that is naturally infested with *Sclerotinia sclerotiorum*. Fungicides used in the trial were LANCE at 0.315 kg/ha rotated with CABRIO 1.100 kg/ha. A randomized complete block design was used with 6 blocks and 4 treatments. Each experimental unit consisted of 2 carrot rows 10 meters in length separated by a 0.86 m furrow. Treatments were: I) an unsprayed check, II) spray based on the theoretical threshold of the forecast model, III) spray based on inoculum levels reaching a threshold of 10 cmlony forming units per plate, IV) and spray based on set calendar dates. CABRIO was only applied to avoid resistance from forming in fungal populations, and were only applied following 3 consecutive sprays with LANCE. Level of airborne inoculum was scouted for using petri dish plates filled with sclerotinia semi-selectable media (Steadman et al. 1994). On a weekly basis throughout the growing season, dishes were placed in the furrows between carrot rows, with 1 plate per experimental unit per week. Apothecia were scouted for weekly between carrot rows. Soil moisture, soil temperature, degree of canopy closure and degree of foliar senescence were recorded for determining the disease severity level for the forecast model. Assessment of disease initiated on June 9, sclerotinia rot was first observed three weeks later (Aug 3). Data was analyzed using the *Proc GLM* (General Linear Models) procedure in SAS v8.2. Means separation was obtained using Fisher's Protected LSD test at $P = 0.05$ level of significance.
Epidemiology plots were established in five commercial carrot fields. Inoculum levels, environmental data and crop data were scouted weekly. Scouting was initiated on August 3. Measured inoculum levels were compared with the calculated disease severity from the forecast model to determine the accuracy in disease prediction.

RESULTS: Table 1

CONCLUSIONS: Airborne inoculum was first detected on 20 July, however apothecia were not observed until 3 August. The airborne inoculum levels detected prior to appearance of apothecia were very low and most likely were produced form apothecia that had developed in the surrounding area. Sclerotinia rot was first observed on August 3, one week after the threshold level was reached for the forecast model. None of the treatments applied had a significant effect on the percent infection at harvest, the area under the disease progress curve or the yield at harvest when compared with each other or the check. Disease pressure was high throughout the growing season. The disease incidence became very high in August, and may have contributed to the lack of efficacy of the treatments.

Table 1. Evaluation of the effect of fungicide timing on control of sclerotinia rot of carrot at the Muck Crops Research Station, Holland Marsh, Ontario; 2004.

Treatment [1]	Number of Applications	% Infection [2]	AUDP [3]	Yield (Kg/m)
Scouting	3	64.13 a	2108.13 a	6.61 a
Forecast	3	64.53 a	2076.47 a	6.38 a
Calendar	7	69.40 a	2138.73 a	6.84 a
Check	0	74.93 a	2484.13 a	6.78 a

[1] Scouting = spray based on airborne inoculum reaching threshold; Forecast = spray based on theoretical threshold value of the forecast model; Calendar = spray based on set calendar dates. Scouting and Forecast received 3 treatments of LANCE at 0.315 kg/ha. Calendar received 6 sprays of LANCE at 0.315 kg/ha and 1 sprays of CABRIO at 1.100 kg/ha.
[2] % Infection = percent of carrots showing symptoms of sclerotinia rot at harvest
[3] AUDPC = area under the disease progress curve
[4] numbers in a column followed by the same letter are not significantly different at $P = 0.05$, Fisher's Protected LSD test

References

Steadman, J. R., J. Marcinkowska and S. Rutledge. 1994. A semi-selective medium for isolation of *Sclerotinia sclerotiorum*. Can. J. Plant Pathology 16:68-70.

2004 PMRR REPORT # 78

SECTION L: VEGETABLES and SPECIAL CROPS - Diseases
ICAR: 206003

CROP: Carrot (*Daucus carota* subsp. *sativus* (Hoffm.) Arkang.) cvs. Fontana and Idaho
PEST: Alternaria (*Alternaria dauci* (Kühn) Groves & Skolko) leaf blight, Cercospora (*Cercospora carotae* (Pass.) Solheim) leaf blight

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TITLE: EFFECT OF FOLIAR NITROGEN APPLICATION AND NITROGEN TIMING ON YIELD, QUALITY, AND LEAF BLIGHT SEVERITY OF CARROTS GROWN ON ORGANIC AND MINERAL SOIL IN 2004

MATERIALS: AMMONIUM NITRATE (nitrogen 34%), UREA (nitrogen 46%), AGRAL 90 surfactant.

METHODS: Carrots were seeded into organic soil (pH 6.0, organic matter 75%) at the Muck Crops Research Station, Holland Marsh, Ontario, and into mineral soil (pH 8.1, organic matter 2.6%) at an off-station site adjacent to the Holland Marsh. Cultivars Fontana and Idaho were seeded on 26 May into organic soil and 1 Jun into mineral soil. Each experimental unit in both plots consisted of 4 hills (2 hills/cultivar), 5 m in length, 20 cm high, spaced 86 cm apart, and with a seeding rate of 80 seeds/m. The mineral soil plot was re-hilled twice during the season. Eight treatments were applied in each plot and these are summarized in Table 1. Granular N was applied as ammonium nitrate. Once leaf blight symptoms developed, control and foliar spray treatments and both cultivars were visually rated bi-weekly for the damage caused by *Alternaria* and *Cercospora* separately. The treatments were rated on a scale of 0 to 10 (0 - no symptoms, 2 - some lesions mainly on leaves, 4 - many lesions on leaves and some on petioles, 6 - numerous lesions on leaves and petioles, 8 - half of leaves destroyed, and 10 - all leaves destroyed). Biweekly disease ratings were used to calculate the area under the disease progress curve (AUDPC) for each treatment. A final leaf blight assessment was conducted at harvest by counting the number of leaves not destroyed by leaf blight on 10 carrots per treatment and cultivar. Carrots were harvested from a 2.32 m section of the middle row of each cultivar and treatment on 20 Oct for organic soil and 22 Oct for mineral soil and assessed for total and marketable yield and weight per root. The air temperatures in 2004 were below the 10 year mean for June (16.3°C), August (17.8°C), average for May (12.4°C), July (19.3°C) and October (9.1°C) and above for September (16.6°C). The 10 year mean temperatures were: May 12.3°C, June 18.0°C, July 19.9°C, August 19.2°C, September 15.4°C and October 8.9°C. Monthly rainfall was above the 10-year mean for May (108), July (102 mm), August (103 mm), below the mean for June (50 mm), September (25 mm) and October (26 mm). The 10-year rainfall means were: May 89 mm, June 87 mm, July 73 mm, August 62 mm, September 77 mm and October 65 mm. The experiments were arranged as a split-plot design with N rate as the main plot and cultivar as the sub-plot with four replications. Data were analyzed using the linear models sections of Statistix V.4.1.

RESULTS: The results are summarized in Tables 2 to 4.

CONCLUSIONS: For all assessments, Idaho and Fontana carrots had a similar response to N treatment and the results were combined. However, leaf blight damage was consistently higher for Fontana carrots than for Idaho carrots (Table 2). The minor effects of treatment on disease severity that were present can

mostly be explained by differences in total N rate rather than foliar N application. However, Alternaria leaf blight damage on organic soil and Cercospora leaf blight damage on mineral soil were lower in the foliar spray with surfactant treatment given no pre-plant N than the control treatment based on season-long AUDPC, which suggests a small benefit to foliar N application (Table 2). However, the Cercospora damage on organic soil based on AUDPC was higher in the foliar spray treatment than the no N control (Table 2). There were no differences in the number of lesions per leaf between the foliar spray treatment and the no N control (Table 2). The number of leaves that survived to harvest was unaffected by treatment on mineral soil, but was higher at the 50% of recommended pre-plant N rate on organic soil (Table 3). Consequently, there is little evidence to support the idea that foliar N application consistently decreases the severity of carrot leaf blight. Total and marketable yield were unaffected by N rate, N timing, or foliar N application on mineral soil (Table 4). Weight per root on mineral soil was maximized in the treatment receiving the recommended N rate pre-plant in addition to biweekly foliar sprays. On organic soil, the treatments receiving the most overall N application had higher total yield, marketable yield, and weight per root (Table 4). Foliar N with surfactant increased yield on organic soil. Except for Cercospora leaf blight AUDPC on mineral soil, foliar sprays with surfactant did not decrease leaf blight severity or increase yield over foliar spays without surfactant. Overall, this data suggests that there can be a minor benefit to foliar N application. Pre-plant N in combination with foliar sprays performed better than foliar sprays alone in most cases, which suggests that pre-plant N also has an effect in determining leaf blight susceptibility.

Table 1. Summary of treatments applied to carrots grown on organic and mineral soil in 2004.

Treatment [1]	Granular Ammonium Nitrate (kg/ha)		Foliar Applications [2]	
	Pre-plant	Side-dress	Number	Surfactant
0	0	0	0	--
0 + Foliar	0	0	4	Agral 90
50 + Foliar	37.5	17.5	4	Agral 90
100 + Foliar	75	35	4	Agral 90
0 + Foliar-S	0	0	4	none
50 + 50	55	55	0	--
0 + 100	0	110	0	--
0 + 200	0	220	0	--

[1] Numbers indicate percent of recommended nitrogen rate.
[2] Applied as 2 kg/ha N as urea biweekly from near canopy closure.

Table 2. Effect of foliar nitrogen (N) application on Alternaria and Cercospora leaf blight area under the disease progress curve (AUDPC) and lesions per leaf in mid-September of carrots grown on organic and mineral soil.

Treatments (% of Recommended N)[1]	Mid-Season AUDPC [2]				Lesions per Leaf [2]			
	Organic		Mineral		Organic		Mineral	
	Alt.	Cerc.	Alt.	Cerc.	Alt.	Cerc.	Alt.	Cerc.
0	349.5 d	367.3 bc	380.6 b	347.6 d	6.53 a	25.2 a	6.5 a	46.0 a
0 + Foliar	312.9 bc	387.9 d	391.9 b	300.8 b	4.84 a	24.4 a	5.7 a	39.3 a
50 + Foliar	286.8 a	354.0 ab	373.0 b	268.5 a	--	--	--	--
100 + Foliar	294.3 ab	348.1 a	346.3 a	295.4 b	--	--	--	--
0 + Foliar-S	325.3 c	380.8 cd	381.3 b	325.1 c	--	--	--	--

[1] Foliar = biweekly foliar sprays of 2 kg/ha N once tops filled 75% of the inter-row space.

Table 3. Effect of foliar nitrogen (N) application on leaf survival at harvest of carrots grown on organic and mineral soil.

N Application Rate (% of Recommended)[1]	Number of Live Leaves per Plant [2]	
	Organic	Mineral
0	3.5 a	2.5 a
0 + Foliar	4.6 bc	2.5 a
50 + Foliar	4.8 c	2.6 a
100 + Foliar	3.9 ab	2.6 a
0 + Foliar-S	3.8 ab	2.4 a

[1] Foliar = biweekly foliar sprays of 2 kg/ha N once tops filled 75% of the inter-row space.
[2] Numbers in a column followed by the same letter are not significantly different at *P*=0.05, Fisher's Protected LSD Test.

Table 4. Effect of foliar nitrogen (N) application and N timing on total and marketable yield and weight per root of carrots grown on organic and mineral soil.

Treatments (% of Recommended N)[1]	Total Yield (t/ha)		Marketable Yield (t/ha)		Weight per Root (g)	
	Organic	Mineral	Organic	Mineral	Organic	Mineral
0	81.1 a	47.4 a	72.0 a	44.1 a	124.8 ab	90.5 ab
0 + Foliar	95.0 cd	44.2 a	88.3 b	41.2 a	138.3 bc	91.6 a-c
50 + Foliar	102.4 d	45.5 a	89.7 b	42.8 a	159.4 d	99.0 b-d
100 + Foliar	92.0 bc	46.4 a	79.9 ab	43.1 a	141.3 c	104.4 d
0 + Foliar-S	87.1 a-c	47.0 a	79.8 ab	44.3 a	124.1 a	91.4 a-c
50 + 50	85.9 ab	43.7 a	76.3 a	42.3 a	119.4 a	99.7 cd
0 + 100	87.6 a-c	44.8 a	77.9 a	42.4 a	138.5 bc	87.6 a
0 + 200	86.7 a-c	43.6 a	75.9 a	41.6 a	127.1 ab	84.3 a

[1] Foliar = biweekly foliar sprays of 2 kg/ha N once tops filled 75% of the inter-row space; numbers following a (+) indicate side-dress N at four weeks after seeding.
[2] Numbers in a column within the same soil type followed by the same letter are not significantly different at *P*=0.05, Fisher's Protected LSD Test.

2004 PMRR REPORT # 79

SECTION L: VEGETABLES and SPECIAL CROPS - Diseases
ICAR: 206003

CROP: Carrot (*Daucus carota* subsp. *sativus* (Hoffm.) Arkang.) cvs. Fontana and Idaho
PEST: Alternaria (*Alternaria dauci* (Kühn) Groves & Skolko) leaf blight, Cercospora (*Cercospora carotae* (Pass.) Solheim) leaf blight

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TITLE: EFFECT OF NITROGEN RATE ON YIELD AND LEAF BLIGHT SEVERITY IN CARROTS GROWN ON ORGANIC AND MINERAL SOIL IN 2004

MATERIALS: AMMONIUM NITRATE (nitrogen 34%)

METHODS: Carrots were seeded in 2004 into organic soil (pH 6.0, organic matter 75%) at the Muck Crops Research Station, Holland Marsh, Ontario, and into mineral soil (pH 8.1, organic matter 2.6%) at an off-station site adjacent to the Holland Marsh for the third of three consecutive years on this location. Cultivars Fontana and Idaho were seeded on 21 May into organic soil and 20 May into mineral soil. Each experimental unit in the organic soil plot consisted of 4 hills (2 hills/cultivar), 5 m in length, 20 cm high, spaced 86 cm apart, and with a seeding rate of 80 seeds/m. Each experimental unit in the mineral soil plot consisted of 8 hills (4 hills/cultivar), 10 m in length , 20 cm high, spaced 86 cm apart, and with a seeding rate of 80 seeds/m. Mineral soil plots were re-hilled twice during the season. Nitrogen (N) was applied at 0%, 50%, 100%, 150%, and 200% of the rates recommended by the Ontario Ministry of Agriculture and Food (OMAF) using ammonium nitrate for all applications. The same rates were applied in each of the three years of this trial. Once leaf blight symptoms developed, all treatments and cultivars were visually rated bi-weekly for the damage caused by Alternaria and Cercospora leaf blight separately. The treatments were rated on a scale of 0 to 10 (0 - no symptoms, 2 - some lesions mainly on leaves, 4 - many lesions on leaves and some on petioles, 6 - numerous lesions on leaves and petioles, 8 - half of leaves destroyed, and 10 - all leaves destroyed). The rating data was used to calculate the area under the disease progress curve (AUDPC) for each cultivar and soil type. In mid-September the number of lesions per leaf of both diseases was estimated on each live leaf of three plants per experimental unit. A final leaf blight assessment was conducted at harvest by counting the number of live leaves on 10 carrots per treatment and cultivar. Carrots were harvested from two 2.32 m sections (mineral soil) and one 2.32 m section (organic soil) of the middle rows of each cultivar and treatment on 21 Oct on organic soil and 26 Oct on mineral soil, and assessed for total and marketable yield and weight per root. One experimental unit in the recommended rate treatment on mineral soil flooded during the trial and this data point was removed in statistical analysis. The air temperatures in 2004 were below the 10 year mean for June (16.3°C), August (17.8°C), average for May (12.4°C), July (19.3°OC) and October (9.1°C) and above for September (16.6°C). The 10 year mean temperatures were: May 12.3°C, June 18.0°C, July 19.9°C, August 19.2°C, September 15.4°C and October 8.9°C. Monthly rainfall was above the 10-year mean for May (108), July (102 mm), August (103 mm), below the mean for June (50 mm), September (25 mm) and October (26 mm). The 10-year rainfall means were: May 89 mm, June 87 mm, July 73 mm, August 62 mm, September 77 mm and October 65 mm. The experiments were arranged as a split-plot design with N rate as the main plot and cultivar as the sub-plot with four replications. Data were analyzed using the GLM and Univariate procedures of SAS version 8.0 (SAS Institute, Cary NC).

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

CONCLUSIONS: For all assessments, Idaho and Fontana carrots had a similar response to N rate and the results were combined. However, leaf blight damage was consistently higher for Fontana carrots than for Idaho carrots. Leaf blight severity, as indicated by season-long AUDPC, lesions per leaf in mid-Sept, and live leaf assessment, decreased with increasing N rate in all cases except for the number of live leaves per plant at harvest on organic soil (Tables 1 and 2). Total yield, marketable yield, and weight per root were unaffected by N rate or leaf blight severity on organic soil (Table 3). On mineral soil, yield increased with increasing N rate up to the recommended N rate and decreased dramatically at higher N rates (Table 3). The decline in yield at high rates was mainly due to severe seedling death in these treatments. Weight per root increased with increasing N rate up to the maximum rate tested (Table 3). This was also mainly due to thinner stands as the rate of N increased. The effect of low N in increasing leaf blight severity would have caused problems for mechanical harvest of the crop. Weakened tops would break off during harvest leaving many carrots unharvested as a result. This is the first report of any effect of plant nutrition on Cercospora leaf blight in the field, and the first conclusive report of any effect of N nutrition alone on Alternaria leaf blight in the field. The data suggest that a balance between fungicide and N application is necessary to maintain yields, reduce leaf blight severity, and reduce environmental contamination. Nitrogen management should be considered in the integrated crop management program for the control of carrot leaf blight.

Table 1. Effect of nitrogen (N) application rate on season long Alternaria and Cercospora leaf blight area under the disease progress curve (AUDPC) and late-season lesions per leaf on carrots grown on organic and mineral soil for the third of three consecutive years. Nitrogen rates were applied in each of the three years.

N Application Rate (% of Recommended)	AUDPC				Lesions per Leaf			
	Organic		Mineral		Organic		Mineral	
	Alt. [1]	Cerc. [1]	Alt.	Cerc.	Alt. [1]	Cerc.	Alt.	Cerc.
0	383.92	398.83	416.84	369.35	3.06	41.17	9.58	26.29
50	349.9	367.8	402.5	374.5	3.6	36.5	6	26.8
100	320.5	367.3	357.5	316.3	2.5	32.2	4.7	19.3
150	307.5	344.5	338.8	322.9	2.1	39.4	5.6	19.4
200	294.4	311.5	331.1	276.1	1.5	39.2	4	14.1

[1] Cultivar Idaho only.
[2] Regression: $P<0.0001$, $R^2=0.79$, Equation: AUDPC=379 - 0.443(Nrate).
[3] Regression: $P<0.0001$, $R^2=0.62$, Equation: AUDPC=398 - 0.396(Nrate).
[4] Regression: $P<0.0001$, $R^2=0.42$, Equation: AUDPC=416 - 0.470(Nrate).
[5] Regression: $P<0.0001$, $R^2=0.26$, Equation: AUDPC=379 - 0.476(Nrate).
[6] Regression: $P=0.0105$, $R^2=0.31$, Equation: lesions per leaf=3.42 - 0.0086(Nrate).
[7] Linear and quadratic regression analysis not significant.
[8] Regression: $P=0.0184$, $R^2=0.14$, Equation: lesions per leaf=7.24 - 0.016(Nrate).
[9] Regression: $P=0.0135$, $R^2=0.15$, Equation: lesions per leaf=27.5 - 0.063(Nrate).

Table 2. Effect of nitrogen (N) application rate on the number of live leaves per plant at harvest for carrots grown on mineral and organic soil for the third of three consecutive years. Nitrogen rates were applied in each of the three years.

N rate (% of recommended)	Live Leaves per Plant	
	Organic Soil	Mineral Soil
0	5.41	3.02
50	5.2	3.5
100	4.9	4.5
150	5.8	5.3
200	4.8	6.1

[1] Linear and quadratic regression analysis not significant
[2] Regression: $P<0.0001$, $R^2=0.66$, Equation: lesions per leaf=2.87 - 0.016(Nrate).

Table 3. Effect of nitrogen (N) application rate on total and marketable yield and weight per root of carrots grown on mineral and organic soil for the third of three consecutive years. Nitrogen rates were applied in each of the three years.

N Application Rate	Total Yield (t/ha)		Marketable Yield (t/ha)		Weight per Root (g)	
(% of Recommended)	Organic	Mineral	Organic	Mineral	Organic	Mineral
0	71.71	38.82	62.31	36.53	133.51	69.54
50	72.7	47.1	63.2	43.4	138.8	89.6
100	69.5	50.9	61.1	39.4	142.4	151.9
150	72.1	47	61.7	42	135.6	145.2
200	71.7	31.6	61.9	28.3	133.4	195.5

[1] Linear and quadratic regression analysis not significant.
[2] Regression: $P=0.0010$, $R^2=0.58$, Equation: total yield=38.1 + 0.286(Nrate) - 0.0016(Nrate)^2.
[3] Regression: $P=0.0007$, $R^2=0.60$, Equation: marketable yield=35.9 + 0.241(Nrate) - 0.0014(Nrate)^2.
[4] Regression: $P<0.0001$, $R^2=0.79$, Equation: weight per root=69.8 - 0.065(Nrate).

2004 PMRR REPORT # 80 **SECTION L: VEGETABLE and SPECIAL CROPS-Diseases**
ICAR: 11110762

CROP: Celery (*Apium graveolens*), cvs. Sabroso and Florida 683
PEST: Septoria late blight, (*Septoria apiicola*)

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TITLE: EVALUATION OF NEW CHEMISTRY FUNGICIDES FOR THE CONTROL OF SEPTORIA LATE BLIGHT ON CELERY; 2004

MATERIALS: BRAVO 500 (chlorothalonil 50%), CUPROFIX (copper 40%) QUADRIS (azoxystrobin 23%), CABRIO (pyraclostrobin 20%), ALEXIN (potash 8%, calcium 2.4%), BAS 516 (pyraclostrobin 12.8%, boscalid 25.2%), CALCIUM CHLORIDE (calcium 36%)

METHODS: The trial was conducted on organic soil (pH ≃ 6.4, organic matter ~60%) at the Muck Crops Research Station, Holland Marsh, Ontario. Celery cultivars, Sabroso and Florida 683, were seeded into 288 cell plug trays on 26 April. Celery was hand transplanted into the field on 29 June (three rows/cultivar/treatment) with in row plant spacing of 15 cm and 18 cm for Florida 683 and Sobroso respectively. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of six rows, 55 cm apart and 5 m in length. Treatments were: BRAVO at 3.0 L/ha, CUPROFIX at 1.4 kg/ha, QUADRIS at 1.5 L ha, CABRIO at 1.0 kg/ha, BAS 516 at 1.0 kg/ha, ALEXIN at 4.0 L/ha, CALCIUM CHLORIDE at 1.9 kg/ha. An untreated check was also included. Treatments were applied on 17, 31 August and, 13, 21, 30 September using a pull type plot sprayer with TeeJet D-2 hollow cone nozzles at 690 kPa (boom) in 500 L/ha of water. On 20 August, the trial was inoculated with diseased foliage from celery plants with actively growing *S. apiicola* lesions. The diseased tissue was hand chopped and mixed with water. The wet, diseased debris was then spread evenly by hand over plants in row numbers three and four, the middle two rows of each treatment. A sample of 12 plants was harvested from each replicate on 13 and 14 October. The average weight was recorded for both cultivars, and average height was recorded for the Sabroso cultivar. The Sabroso cultivar was then trimmed to 55 cm and the trimmed weight was recorded. For the Florida 683 cultivar, plants were not graded, and height and weight were not recorded because a Fusarium yellows infection severely stunted the plants. For both cultivars, 120 outer stalks from the 12 harvested plants were removed and the petioles were rated for Septoria late blight from 0-5: 0 = no disease; 1 = < 10% petiole area diseased; 2 = 10-25% diseased; 3 = 25-50% diseased; 4 = 50-75% diseased; 5 = >75% diseased. The leaves were also assessed for Septoria leaf blight (after trimming) and rated on a scale from 0-3: 0 = no lesions on leaves; 1 = < 10% leaves diseased; 2 = 10-50% diseased; 3 = > 51% diseased. The disease severity index (DSI) was determined using the following equation:

$$DSI = \frac{\sum [(\text{class no.})(\text{no. of petioles in each class})]}{(\text{total no. petioles per sample})(\text{no. classes } -1)} \times 100$$

The air temperatures in 2004 were below the 10 year mean for June (16.3°C), August (17.8°C), average for May (12.4°C), July (19.3°C) and October (9.1°C) and above for September (16.6°C). The 10 year mean

temperatures were: May 12.3°C, June 18.0°C, July 19.9°C, August 19.2°C, September 15.4°C and October 8.9°C. Monthly rainfall was above the 10-year mean for May (108 mm), July (102 mm), August (103 mm), below the mean for June (50 mm), September (25 mm), and October (26 mm). The 10-year rainfall means were: May 89 mm, June 87 mm, July 73 mm, August 62 mm, September 77 mm, and October 65 mm.

All 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 with P=0.05 level of significance.

RESULTS: As presented in Table 1 and 2.

CONCLUSIONS: Petiole DSI was significantly lower for BAS 516, CABRIO, QUADRIS, and BRAVO compared to all other treatments (Table 1). ALEXIN and CUPROFIX were significantly lower than the CHECK. BAS 516, CABRIO and QUADRIS had significantly lower % petiole disease than all other treatments except BRAVO. BRAVO and ALEXIN were significantly lower than CUPROFIX, CALCIUM CHLORIDE, and the CHECK for % petiole disease. For leaf blight rating, BAS 516 was significantly lower for all treatments except CABRIO. CABRIO and QUADRIS were significantly lower than BRAVO, ALEXIN, CUPROFIX, CALCIUM CHLORIDE, and the CHECK. BRAVO was significantly lower for leaf blight rating than ALEXIN, CALCIUM CHLORIDE, CUPROFIX and the CHECK.

There were no significant differences in harvest weight for cv. Florida 683 and harvest height between treatments (Table 2). For the Sabroso cultivar, CABRIO had significantly greater harvest weights than all other treatments except BAS 516 and CALCIUM CHLORIDE. Harvest weight for BAS 516 was significantly greater than all treatments except ALEXIN, CALCIUM CHLORIDE and CABRIO. For trimmed weight, CABRIO was significantly greater than all other treatments except BAS 516. BAS 516 was significantly greater than BRAVO, CUPROFIX and the CHECK. Florida was severely affected by fusarium yellows, therefore data in the trimmed weight and harvest height are from the Sabroso only.

Table 1. Petiole DSI, % petioles diseased, and leaf blight rating of two celery cultivars treated with fungicides for the control of Septoria late blight, grown at the Muck Crops Research Station, Holland Marsh, Ontario; 2004.

Treatment	Rate	Petiole DSI[1]	% Petioles Disease[2]	Leaf Blight Rating
BAS 516	1.0 kg/ha	1.5 a[3]	6.8 a	0.7 a
CABRIO	1.0 kg/ha	2.3 a	10.3 a	1.0 ab
QUADRIS	1.5 L/ha	3.7 a	16.8 a	1.1 b
BRAVO	3.0 L/ha	4.9 a	19.7 ab	1.7 c
ALEXIN	4.0 L/ha	8.1 b	29.4 b	2.0 d
CUPROFIX	1.4 kg/ha	19.6 b	70.6 c	2.6 d
CALCIUM CHLORIDE	1.9 kg/ha	24.3 bc	76.2 c	2.9 d
CHECK	—	29.9 c	83.1 c	2.8 d

[1] petioles rated for % area diseased, where 0 = no disease; 1 = >0-10%; 2 = >10-25%; 3 = >25-50%; 4 = >50-75%; 5 = >75%

[2] % leaves diseased, where 0 = no disease; 1 = >0-10%, 2 = >10-50%; 3 = >50%

[3] numbers in a column followed by the same number are not significantly different at $P = 0.05$, Fisher's Protected LSD test

Table 2. Harvest weight, trimmed weight, and harvest height of two celery cultivars treated with fungicides for the control of Septoria late blight, grown at the Muck Crops Research Station, Holland Marsh, Ontario; 2004.

Treatment	Rate	Harvest Weight (kg)		Trimmed Weight[1] (kg) (Sabroso only)	Harvest Height (cm) (Sabroso only)
		Sabroso	Florida		
CABRIO	1.0 kg/ha	18.5 a[2]	8.9 ns[3]	17.1 a	68.7 ns
BAS 516	1.0 kg/ha	18.5 ab	9.3	16.8 ab	71.1
QUADRIS	1.5 L/ha	15.1 c	8.1	15.1 bc	73.7
ALEXIN	4.0 L/ha	16.3 bc	10	15.1 bc	68.4
CALCIUM CHLORIDE	1.9 kg/ha	16.5 abc	8.3	15.1 bc	70.6
BRAVO	3.0 L/ha	15.7 c	9.8	14.3 c	70.2
CUPROFIX	1.4 kg/ha	15.4 c	8	14.0 c	70.3
CHECK	—	14.3 c	6.2	14.0 c	67

[1] Sabroso trimmed to 55 cm
[2] numbers in a column followed by the same number are not significantly different at $P = 0.05$, Fisher's Protected LSD test
[3] ns = no significant difference between treatments

2004 PMRR REPORT # 81 **SECTION L: VEGETABLE and SPECIAL CROPS-Diseases**
ICAR: 11110762

CROP: Celery (*Apium graveolens*), cvs. Sabroso and Florida 683
PEST: Septoria late blight, (*Septoria apiicola*)

NAME AND AGENCY:
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TITLE: EVALUATION OF NEW CHEMISTRY FUNGICIDES FOR THE CONTROL OF SEPTORIA LATE BLIGHT ON CELERY; 2004

MATERIALS: BRAVO 500 (chlorothalonil 50%), CUPROFIX (copper 40%) QUADRIS (azoxystrobin 23%), CABRIO (pyraclostrobin 20%), ALEXIN (potash 8%, calcium 2.4%), BAS 516 (pyraclostrobin 12.8%, boscalid 25.2%), CALCIUM CHLORIDE (calcium 36%)

METHODS: The trial was conducted on organic soil (pH ≃ 6.4, organic matter ~60%) at the Muck Crops Research Station, Holland Marsh, Ontario. Celery cultivars, Sabroso and Florida 683, were seeded into 288 cell plug trays on 26 April. Celery was hand transplanted into the field on 29 June (three rows/cultivar/treatment) with in row plant spacing of 15 cm and 18 cm for Florida 683 and Sobroso respectively. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of six rows, 55 cm apart and 5 m in length. Treatments were: BRAVO at 3.0 L/ha, CUPROFIX at 1.4 kg/ha, QUADRIS at 1.5 L ha, CABRIO at 1.0 kg/ha, BAS 516 at 1.0 kg/ha, ALEXIN at 4.0 L/ha, CALCIUM CHLORIDE at 1.9 kg/ha. An untreated check was also included. Treatments were applied on 17, 31 August and, 13, 21, 30 September using a pull type plot sprayer with TeeJet D-2 hollow cone nozzles at 690 kPa (boom) in 500 L/ha of water. On 20 August, the trial was inoculated with diseased foliage from celery plants with actively growing *S. apiicola* lesions. The diseased tissue was hand chopped and mixed with water. The tissue and water suspension was then spread evenly by hand over plants in row numbers three and four, the middle two rows of each treatment. A sample of 12 plants was harvested from each replicate on 13 and 14 October. The average weight was recorded for both cultivars, and average height was recorded for the Sabroso cultivar. The Sabroso cultivar was then trimmed to 55 cm and the trimmed weight was recorded. For the Florida 683 cultivar, plants were not graded, and height and weight were not recorded because a Fusarium yellows infection severely stunted the plants. For both cultivars, 120 outer stalks from the 12 harvested plants were removed and the petioles were rated for Septoria late blight from 0-5: 0 = no disease; 1 = < 10% petiole area diseased; 2 = 10-25% diseased; 3 = 25-50% diseased; 4 = 50-75% diseased; 5 = >75% diseased. The leaves were also assessed for Septoria leaf blight (after trimming) and rated on a scale from 0-3: 0 = no lesions on leaves; 1 = < 10% leaves diseased; 2 = 10-50% diseased; 3 = > 51% diseased. The disease severity index (DSI) was determined using the following equation:

$$\text{DSI} = \frac{\sum [(\text{class no.})(\text{no. of petioles in each class})]}{(\text{total no. petioles per sample})(\text{no. classes} - 1)} \times 100$$

The air temperatures in 2004 were below the 10 year mean for June (16.3°C), August (17.8°C), average for May (12.4°C), July (19.3°C) and October (9.1°C) and above for September (16.6°C). The 10 year mean

temperatures were: May 12.3°C, June 18.0°C, July 19.9°C, August 19.2°C, September 15.4°C and October 8.9°C. Monthly rainfall was above the 10-year mean for May (108 mm), July (102 mm), August (103 mm), below the mean for June (50 mm), September (25 mm), and October (26 mm). The 10-year rainfall means were: May 89 mm, June 87 mm, July 73 mm, August 62 mm, September 77 mm, and October 65 mm.

All 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 with P=0.05 level of significance.

RESULTS: As presented in Table 1 and 2.

CONCLUSIONS: Petiole DSI was significantly lower for BAS 516, CABRIO, QUADRIS, and BRAVO compared to all other treatments (Table 1). ALEXIN and CUPROFIX were significantly lower than the CHECK. BAS 516, CABRIO and QUADRIS had significantly lower % petiole disease than all other treatments except BRAVO. BRAVO and ALEXIN were significantly lower than CUPROFIX, CALCIUM CHLORIDE, and the CHECK for % petiole disease. For leaf blight rating, BAS 516 was significantly lower for all treatments except CABRIO. CABRIO and QUADRIS were significantly lower than BRAVO, ALEXIN, CUPROFIX, CALCIUM CHLORIDE, and the CHECK. BRAVO was significantly lower for leaf blight rating than ALEXIN, CALCIUM CHLORIDE, CUPROFIX and the CHECK.
There were no significant differences in harvest weight for cv. Florida 683 and harvest height between treatments (Table 2). For the Sabroso cultivar, CABRIO had significantly greater harvest weights than all other treatments except BAS 516 and CALCIUM CHLORIDE. Harvest weight for BAS 516 was significantly greater than all treatments except ALEXIN, CALCIUM CHLORIDE and CABRIO. For trimmed weight, CABRIO was significantly greater than all other treatments except BAS 516. BAS 516 was significantly greater than BRAVO, CUPROFIX and the CHECK. Florida was severely affected by fusarium yellows, therefore data in the trimmed weight and harvest height are from the Sabroso only.

Table 1. Petiole DSI, % petioles diseased, and leaf blight rating of two celery cultivars treated with fungicides for the control of Septoria late blight, grown at the Muck Crops Research Station, Holland Marsh, Ontario; 2004.

Treatment	Rate	Petiole DSI [1]	% Petioles Disease [2]	Leaf Blight Rating
BAS 516	1.0 kg/ha	1.5 a[3]	6.8 a	0.7 a
CABRIO	1.0 kg/ha	2.3 a	10.3 a	1.0 ab
QUADRIS	1.5 L/ha	3.7 a	16.8 a	1.1 b
BRAVO	3.0 L/ha	4.9 a	19.7 ab	1.7 c
ALEXIN	4.0 L/ha	8.1 b	29.4 b	2.0 d
CUPROFIX	1.4 kg/ha	19.6 b	70.6 c	2.6 d
CALCIUM CHLORIDE	1.9 kg/ha	24.3 bc	76.2 c	2.9 d
CHECK	—	29.9 c	83.1 c	2.8 d

[1] petioles rated for % area diseased, where 0 = no disease; 1 = >0-10%; 2 = >10-25%; 3 = >25-50%; 4 = >50-75%; 5 = >75%

[2] % leaves diseased, where 0 = no disease; 1 = >0-10%, 2 = >10-50%; 3 = >50%

[3] numbers in a column followed by the same number are not significantly different at $P = 0.05$, Fisher's Protected LSD test

Table 2. Harvest weight, trimmed weight, and harvest height of two celery cultivars treated with fungicides for the control of Septoria late blight, grown at the Muck Crops Research Station, Holland Marsh, Ontario; 2004.

Treatment	Rate	Harvest Weight (kg)		Trimmed Weight [1] (kg) (Sabroso only)	Harvest Height (cm) (Sabroso only)
		Sabroso	Florida		
CABRIO	1.0 kg/ha	18.5 a[2]	8.9 ns[3]	17.1 a	68.7 ns
BAS 516	1.0 kg/ha	18.5 ab	9.3	16.8 ab	71.1
QUADRIS	1.5 L/ha	15.1 c	8.1	15.1 bc	73.7
ALEXIN	4.0 L/ha	16.3 bc	10	15.1 bc	68.4
CALCIUM CHLORIDE	1.9 kg/ha	16.5 abc	8.3	15.1 bc	70.6
BRAVO	3.0 L/ha	15.7 c	9.8	14.3 c	70.2
CUPROFIX	1.4 kg/ha	15.4 c	8	14.0 c	70.3
CHECK	—	14.3 c	6.2	14.0 c	67

[1] Sabroso trimmed to 55 cm
[2] numbers in a column followed by the same number are not significantly different at $P = 0.05$, Fisher's Protected LSD test
[3] ns = no significant difference between treatments

2004 PMRR REPORT # 82 **SECTION L: VEGETABLE and SPECIAL CROPS-Diseases**
ICAR: 11110762

CROP: Celery (*Apium graveolens*), cvs. Sabroso and Florida 683
PEST: Septoria late blight, (*Septoria apiicola*)

NAME AND AGENCY:
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TITLE: EVALUATION OF DISEASE FORECASTING SYSTEMS FOR CONTROL OF SEPTORIA LATE BLIGHT ON CELERY IN ONTARIO; 2004

MATERIALS: BRAVO 500 (chlorothalonil 50%), BAS 516 (pyraclostrobin 12.8%, boscalid 25.2%), CHAMP 2 (copper hydroxide 37.5%)

METHODS: The trial was conducted on organic soil (pH ≃ 6.4, organic matter ~60%) at the Muck Crops Research Station, Holland Marsh, Ontario. Celery cultivars, Sabroso and Florida 683, were seeded into 288 cell plug trays on 26 April. Celery was hand transplanted into the field on 29 June (three rows/ cultivar/ treatment) with in row plant spacing of 15 cm and 18 cm for Florida 683 and Sabroso respectively. A randomized complete block arrangement with three replicates per treatment was used. Each replicate consisted of six rows, 55 cm apart and 5 m in length. Treatments were: calendar-based spray using BRAVO at 3.0 L/ha alternated with CHAMP 2 at 4.0 kg/ha, symptom-based spray using BRAVO at 3.0 L/ha alternated with CHAMP 2 at 4.0 kg/ha, and an untreated check. The final three treatments were based on the Tomcast disease forecasting system. Disease severity values (DSVs) were accumulated using leaf wetness and temperature data collected from the trial site. The three treatments were: Tomcast DSV 20 using BRAVO at 3.0 L/ha alternated with CHAMP 2 at 4.0 kg/ha, Tomcast DSV 10 using BRAVO at 3.0 L/ha alternated with CHAMP 2 at 4.0 kg/ha, and Tomcast DSV 10 using BAS 516 at 1.0 kg/ha. Treatments were applied when the DSVs reached the treatment threshold, +/- 1 DSV.

BRAVO was applied to all treatment except the unsprayed check on 31 August. Calendar-based spray and symptom-based spray treatments were applied 13, 21, 30 September and 10 October. Tomcast DSV 20 treatments were applied 13 September., TOMCAST DSV 10- BRAVO and TOMCAST DSV 10 using BAS 516 were applied 13 September and 8 October. All treatments were applied using a pull type plot sprayer with TeeJet D-2 hollow cone nozzles at 690 kPa (boom) in 500 L/ha of water. On 1 September, the trial was inoculated with diseased foliage from celery plants with actively growing *S. apiicola* lesions. The diseased tissue was hand chopped and mixed with water. The wet, diseased debris was then spread evenly by hand over plants in row numbers three and four, the middle two rows of each treatment. A sample of 12 plants was harvested from each replicate on 18 October. For cultivar Sabroso, weight and average height were recorded. The harvested celery was trimmed to 55 cm and the trimmed weight was recorded. For cultivar Florida 683, the weight and average height were recorded, and the celery was trimmed to 40 cm. The celery was graded into 24's, 30's, and 48's, counted and weighed. For both cultivars, 120 outer stalks from the 12 harvested plants were removed and the petioles were rated for Septoria late blight from 0-5: 0 = no disease; 1 = < 10% petiole area diseased; 2 = 10-25% diseased; 3 = 25-50% diseased; 4 = 50-75% diseased; 5 = >75% diseased. The leaves were also assessed for Septoria leaf blight (after trimming for

Sabroso) and rated on a scale from 0-3: 0 = no lesions on leaves; 1 = < 10% of leaves diseased; 2 = 10-51% diseased; 3 = > 51% diseased. The disease severity index (DSI) was determined using the following equation:

$$DSI = \frac{\sum [(\text{class no.})(\text{no. of petioles in each class})]}{(\text{total no. petioles per sample})(\text{no. classes } -1)} \times 100$$

The air temperatures in 2004 were below the 10 year mean for June (16.3°C), August (17.8°C), average for May (12.4°C), July (19.3°C) and October (9.1°C) and above for September (16.6°C). The 10 year mean temperatures were: May 12.3°C, June 18.0°C, July 19.9°C, August 19.2°C, September 15.4°C and October 8.9°C. Monthly rainfall was above the 10-year mean for May (108 mm), July (102 mm), August (103 mm), below the mean for June (50 mm), September (25 mm), and October (26 mm). The 10-year rainfall means were: May 89 mm, June 87 mm, July 73 mm, August 62 mm, September 77 mm, and October 65 mm.

All 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 with *P*=0.05 level of significance.

RESULTS: As presented in Table 1 and 2.

CONCLUSIONS: Tomcast DSV 10-BAS 516 was significantly lower for % petioles diseased than Tomcast DSV 20, calendar and check treatments (Table 1). The symptom-based spray and Tomcast DSV 10 treatments had significantly fewer petioles diseased than the calendar-based spray and check treatments. For leaf blight rating, Tomcast DSV 10-BAS 516 was significantly lower than all treatments except the symptom-based spray treatment. The symptom-based spray treatment was significantly lower than treatments Tomcast DSV 20, calendar spray and check, while Tomcast DSV 10-BRAVO was significantly lower than the check. There were no significant differences between treatments for petiole DSI for either cultivar. Harvest weight, trimmed weight, and harvest height were not significantly different between treatments (Table 2).

Table 1. Disease Severity Index (DSI), % petioles diseased, and leaf blight rating of Septoria late blight treated with different fungicide spray programs, grown at the Muck Crops Research Station, Holland Marsh, Ontario; 2004.

Treatment	Product	Rate	Petiole DSI [1]		% Petioles Disease [2]	Leaf Blight Rating [2,3]
			Sabroso	Florida		
TOMCAST DSV 10	BAS 516	1.0 kg/ha	14.0 ns[4]	24.7 ns	66.2 a[5]	1.9 a
SYMPTOM	Bravo/ Champ	1.5 L/ha	22.6	22.7	76.5 ab	2.2 ab
TOMCAST DSV 10	Bravo/ Champ	4.0 L/ha	26.1	31.2	71.0 ab	2.4 bc
TOMCAST DSV 20	Bravo/ Champ	3.0 L/ha	28.9	37.6	83.1 bc	2.5 cd
CALENDAR	Bravo/ Champ	1.0 kg/ha	36.8	45.9	91.3 c	2.6 dc
CHECK	—	—	33.6	44.6	92.5 c	2.8 d

[1] petioles rated for % area diseased, where 0 = no disease; 1 = >0-10%; 2 = >10-25%; 3 = >25-50%; 4 = >50-75%; 5=>75%
[2] pooled data from both cultivars because ANOVA indicated no interaction
[3] % leaves diseased, where 0 = no disease; 1 = >0-10%, 2 = >10-50%; 3 = >50%
[4] ns = no significant difference between treatments
[5] numbers in a column followed by the same number are not significantly different at $P = 0.05$, Fisher's Protected LSD test

Table 2. Harvest weight, trimmed weight, and harvest height of two celery cultivars treated with different fungicide spray programs, grown at the Muck Crops Research Station, Holland Marsh, Ontario; 2004.

Treatment	Prod.	Rate	Harvest Weight (kg)		Trimmed Weight (kg)[1]		Harvest Height (cm)	
			Sabroso	Florida	Sabroso	Florida	Sabroso	Florida
TOMCAST DSV 10	BAS 516	1.4 kg/ha	19.5 ns[2]	13.3 ns	17.4 ns	11.1 ns	70.9 ns	60.8 ns
SYMPTOM	Bravo/ Champ	1.5 L/ha	17.1	13.1	15.2	11.5	73.2	63.1
TOMCAST DSV 10	Bravo/ Champ	4.0 L/ha	17.4	14	15.3	12	70.7	63.2
TOMCAST DSV 20	Bravo/ Champ	3.0 L/ha	16.2	11.2	14.2	9.5	69.5	55
CALENDAR	Bravo/ Champ	1.0 kg/ha	16.3	10	14.5	8.7	68.2	57.2
CHECK	—	—	17.7	11.7	15.8	8.7	70.4	58.9

[1] Sabroso trimmed to 55 cm, Florida to 40 cm
[2] ns = no significant difference between treatments

2004 PMRR REPORT # 83

SECTION L: VEGETABLES and SPECIAL CROPS - Diseases
STUDY DATABASE: 52326

CROP: Ginseng (*Panax quinquefolius*)
PEST: Damping-off, *Rhizoctonia solani*

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TITLE: EFFICACY OF QUADRIS, BAS 500 (CABRIO), AND SENATOR 70 WP FOR THE CONTROL OF RHIZOCTONIA DAMPING-OFF IN GINSENG; 2002-2004.

MATERIALS: QUADRIS (azoxystrobin; 229 g ai /L); BAS 500 (pyraclostrobin; 200 g ai /kg); SENATOR 70 WP (70 % thiophanate methyl); NUTRI-Q 0-0-5 (5 % quintozene)

METHODS: The trial (RS40/03) was established on a brunisolic grey-brown luvisol (Fox loamy sand; Delhi research farm) in Oct 2002. Plots (2.5 m long x 1.5 m wide), separated by 0.5 - m buffers, were laid out in a conventional cambered ginseng bed under plastic shade cloth using a randomized complete block design with four replications. The plot area was planted (210 seeds m^{-2}) on 29 Oct 2002. Each plot was subdivided into two 1- m^2 subplots, designed to receive pathogen inoculum either in the fall (29 Oct 2002), or the following spring (28 Mar 2003). Inoculum consisted of pieces of *R. solani*-colonized ginseng roots, prepared by slicing fresh roots into 5 mm thick sections then double-autoclaving in Erhlenmeyer flasks. Root pieces were inoculated with an agar culture of *R. solani* then incubated under ambient light in the laboratory for 4 wk. Five g (fresh wt) of colonized root, held in a cheesecloth bag, were placed in a shallow (2 cm) depression in the soil centrally located in each fall-infested subplot. Additional inoculum, prepared simultaneously, was stored at 8 C until 28 Mar 2003, when it was added to spring-infested subplots, as per the fall inoculum. Fall application of fungicide treatments was made to both subplots on 29 Oct 2002, prior to placement of an wheat straw mulch over the seeded beds. Spring fungicide applications (QUADRIS, SENATOR and BAS 500 only) to both subplots were made on 16 May 2003, over the existing straw mulch. Applications of QUADRIS and BAS 500 were made in the fall in 2000 L water ha^{-1} (TG-2 nozzle; 276 kPa) and, in the spring, in 4000 L water/ha (TG-3 nozzle; 234 kPa), using a CO_2 - powered backpack sprayer. Movable spray curtains were placed around each plot during application, in order to minimize spray drift. By contrast, the granular product NUTRI-Q 0-0-5 (quintozene) was applied only once (29 Oct 2002), using a spice shaker to uniformly distribute the material over the plot area. Check plots were untreated. Efficacy was evaluated during the 2003 and 2004 growing seasons but no further treatment applications were made after 16 May 2003. Ginseng stand counts for each 1.0 m^2 area subplot were recorded in June 2003 and July 2004. Data were analysed using ANOVA; Tukey's test was used to separate treatment means (XLSTAT Pro v. 7.5).

RESULTS: As outlined in Table 1. Plant emergence in 2003 was poor; approximately 31 % of intact seeds germinated in adjacent areas outside of the experimental area that were planted using the same seed lot. Approximately 20 % of the planted seeds had rotted by June 2003. No treatment differences were found in fall or spring-infested subplots (data not shown) in 2003. Plant populations were overall higher in 2004 (approx. 48 % of seeds now germinated), due to emergence of seed that was not completely stratified in 2003. In 2004, plant populations were found to be significantly affected by treatment in both fall-infested (P=0.0001) and spring-infested (P=0.0001) subplots. When treatments in fall-infested subplots

were compared, QUADRIS and NUTRI-Q were superior to both the untreated check and SENATOR. SENATOR was not significantly different from the check. BAS 500 was intermediate in efficacy. In spring-infested subplots, QUADRIS treatments were numerically superior to all others. SENATOR and BAS 500 failed to improve stand over that of the check, although BAS 500 was also not significantly different from QUADRIS.

CONCLUSIONS: Disease pressure and plant stand in 2004 were sufficient to allow treatments to be compared for efficacy. Higher populations in some treatments, when compared to the untreated check, are likely reflections of reductions in damping-off of both seedlings and two-year-old plants in these treatments. QUADRIS and NUTRI-Q resulted in 2004 stands that were significantly superior to those in the untreated check. QUADRIS, the product currently registered for this disease, appeared to be the superior treatment overall. NUTRI-Q is no longer available for this use and was included for historical purposes. BAS 500 was intermediate in efficacy and SENATOR failed to provide disease control.

Table 1. Effect of fungicides on ginseng plant population in *Rhizoctonia*-infested plots; 2004.

Treatment and rate a.i. ha^{-1}	Plant population (m^{-2}) July 2004 [4]			
	Fall-infested subplots[5]		Spring-infested subplots[5]	
Quadris; 280 g ai ha^{-1} (2X)[1]	44.2	a	53.2	a
Quadris; 560 g ai ha^{-1} (2X)[1]	47.2	a	44.2	a
BAS 500; 220 g ai ha^{-1} (2X)[1]	32.2	ab	33	abc
BAS 500; 440 g ha^{-1} (2X)[1]	31	ab	33	abc
Nutri-Q (0-0-5); 6.75 kg ai ha^{-1} (1X)[2]	47.2	a	36.8	ab
Senator 70 WP; 0.78 kg ai ha^{-1} (2X)[1]	16.8	b	13.5	c
Senator 70 WP; 1.75 kg ai ha^{-1} (2X)[1]	16	b	20.8	bc
Check [3]	19.2	b	15.8	c
P > F	0.0001		0.0001	

[1] Applications were made twice (29 Oct 2002 and 16 May 2003) to each plot, at the rate indicated.
[2] Nutri-Q (quintozene) was added to plots only once, on 29 Oct 2002.
[3] Untreated plots to which inoculum was added (positive control).
[4] Plant stand m^{-2}. Stands in 2004 were comprised of two-year old plants and seedlings.
[5] Fungal inoculum was added to fall-infested subplots on 29 Oct 2002, prior to treatment application, and was added to spring-infested subplots on 28 Mar 2003. Treatment values in a column followed by the same letter indicate that treatments are not significantly different according to Tukey's test (alpha=0.05).

2004 PMRR REPORT # 84 **SECTION L: VEGETABLES and SPECIAL CROPS - Diseases**
STUDY DATABASE: 52326

CROP: Ginseng (*Panax quinquefolius*)
PEST: Seed diseases; *Cylindrocarpon destructans*, *Fusarium* spp.

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TITLE: EFFECTS OF THE FUNGICIDE SEED TREATMENTS DIVIDEND XL, MAXIM XL, AND SENATOR PSPT ON EMERGENCE OF GINSENG; 2002-2004.

MATERIALS: DIVIDEND XL (difenoconazole + metalaxyl-M); MAXIM XL (fludioxonil + metalaxyl-M); SENATOR PSPT (thiophanate methyl)

METHODS: The trial (ST50/03) was designed to determine the effects of seed treatment on plant stand. Stratified ginseng seed supplied was treated with the fungicides Dividend XL (difenoconazole + metalaxyl-M), Maxim XL (fludioxonil + metalaxyl-M), or Senator PSPT (thiophanate-methyl). Treatment rates were selected from label rates for other crops or, in the case of Senator PSPT, based on preliminary tests to determine the maximum amount of product that would adhere to seed. See Table 1 for treatment information. The experiment was designed as a randomized complete block with four replications of each treatment. Treatments were applied to seed on 18-19 November 2002. Treated seeds and an untreated check were hand planted (21 November 2002) into 1 m^2 plots located on raised beds in fumigated soil (brunisolic grey-brown luvisol (Fox loamy sand; Delhi research farm)). The seeding rate was 240 seeds / m^2. Wheat straw was applied as a mulch within 2 hr of seeding and irrigation was applied to help retain mulch. Plant stands were determined in July 2003 and July 2004. Data were analysed using ANOVA; Dunnett's test (right-tailed; alpha=0.05) was used to separate fungicide seed treatments from the untreated control (XLSTAT-Pro v.7.5).

RESULTS: Seedling emergence was poor in 2003 (approx 38 % of planted seeds emerged); a portion of the supplied seed may not have been properly stratified. No treatment differences were apparent with respect to plant stand in 2003 (Table 1). None of the fungicide treatments appeared to have adverse effects on germination, when compared to the control. Total plant stands were higher in 2004 (approx 51% of planted seeds emerged) in all plots, due to germination of a portion of seed that failed to germinate in 2003. In the second year (2004), significant differences were apparent between some fungicide treatments and the untreated control. The Senator PSPT seed treatment was significantly higher than the untreated control for total stand as well for seedlings (Table 1). Two-year-old populations for this treatment were numerically but not significantly higher than the control. Other seed treatments were not significantly different from the untreated check, although both Dividend and Maxim were numerically higher than the control. The superior performance of Senator PSPT appears to be due to increased survival and/or germination in 2004 of seeds that failed to germinate in 2003.

CONCLUSIONS: Senator PSPT was the only fungicide treatment to provide significantly improved stands. Inoculum of *Rhizoctonia solani* was not added to this field trial. Typical symptoms of Rhizoctonia damping-off (patches of damped-off plants) were not observed in the experimental plots. Superior performance of Senator PSPT therefore is likely due to improved control of seed diseases caused by

Fusarium or *Cylindrocarpon* spp (Reeleder et al, 2002, Journal of Ginseng Research 26: 151-158) or to other effects on seed viability, rather than to suppression of *R. solani*.

Table 1. Effect of seed treatment on ginseng plant population, 2003 and 2004.

Treatment	product /100 kg seed	ai g / 100 kg seed	Plant population (m^2)[6]					
			July 2003	July 2004				
			Seedlings	Seedlings		Two-yr-old	Total	
Dividend XL	130 ml	21.5[1] + 1.8[2]	91.2	61		54.5	115	
Maxim XL	22 ml	4.6[3] + 1.8[2]	95	67		59	126.2	
Senator PSPT	394 g[4]	39.4	97.5	90	*	72.2	161.8	*
Control [5]	-	-	86.2	50		50.5	100	
P > F			0.482	0.006		0.087	0.003	

[1] Difenoconazole.
[2] Metalaxyl-M.
[3] Fludioxonil.
[4] Amount used was determined after preliminary tests showed this to be the maximum amount retained by surface-dried ginseng seed.
[5] Untreated seed.
[6] Plant stand / m^2. Stands in 2004 were comprised of two-year old plants and seedlings. Asterisk indicates that the treatment mean is significantly greater than that of the untreated control according to Dunnett's test (alpha=0.05).

2004 PMRR REPORT # 85

SECTION M: FIELD LEGUMES - Diseases (Beans, Peas)
ICAR: 306001

CROP: Dry bean (*Phaseolus vulgaris* L.), cv. unknown
PEST: Anthracnose *Colletotrichum lindemuthianum*

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TITLE: CONTROLLED ENVIRONMENT EVALUATION OF SEED TREATMENTS TO PROTECT DRY BEAN AGAINST *COLLETOTRICHUM LINDEMUTHIANUM*.

MATERIALS: APRON MAXX RTA (fludioxonil, 7.62 g a.i./L and metalaxyl-M, 11.43 g a.i./L), SENATOR 70WP (thiophanate-methyl, 700 g a.i./kg), APRON MAXX RTA + SENATOR 70WP (fludioxonil, 7.62 g a.i./L and metalaxyl-M, 11.43 g a.i./L + thiophanate-methyl, 700 g a.i./kg) , MERTECT 500SC (thiabendazole, 450 g a.i./L), APRON MAXX RTA + MERTECT 500SC (fludioxonil, 7.62 g a.i./L and metalaxyl-M, 11.43 g a.i./L + thiabendazole, 450 g a.i./L) or DCT (diazinon, 60 g a.i./kg, captan, 180 g a.i./kg and thiophanate-methyl 140 g a.i./kg).

METHODS: Dry bean seed, naturally infested with *C. lindemuthianum*, was treated with APRON MAXX RTA 325 ml/100 kg seed, SENATOR 70WP at 104 ml/100 kg seed, APRON MAXX RTA + SENATOR 70WP at 325 + 104 ml/100 kg seed, MERTECT 500SC at 40 ml/100kg seed, APRON MAXX RTA + MERTECT 500SC at 325 + 40 ml/100 kg seed or DCT at 520 g/100kg seed applied as a slurry. To treat seed, the recommended amount of product + 6% was added to the seed and shaken in an Erlenmeyer flask for approximately 3 min to ensure thorough coating of the seed. Flasks were primed by treating and discarding a quantity of seed prior to treating seed for experimental use. Untreated, naturally infested seed and untreated, uninfested seed served as the two control treatments. The experimental design was a completely randomized block design (CRBD). A block consisted of one replication per treatment. A replication consisted of one 20-cm-diam pot planted with 25 seeds. There were four blocks per treatment. Seed was planted 5 cm deep in Promix BX. Pots were placed in plastic flats and each pot covered with a plastic bag to maintain high humidity and induce germination. Bags were removed and plants were watered as needed once emergence was observed. Plants were grown in a growth room maintained at 19/18°C under a 16/8 h light regime for the 28 day duration of the experiment. Emergence (the number of plants produced per replication from 25 seeds) was determined 7 days after seeding and stand (the number of plants produced per replication from 25 seeds) was measured 2, 3 and 4 weeks after seeding. Disease incidence (%) and disease severity were measured at harvest (28 days after planting). Disease severity was rated as the percentage of the hypocotyl affected by *C. lindemuthianum* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%. Disease incidence was the number of diseased hypocotyls per replication expressed as a percentage of the total number of hypocotyls per replication. Treatment effects on emergence, stand, disease incidence (%) and disease severity were compared using an ANOVA analysis and a REGWQ means comparison test ($P = 0.05$).

RESULTS: As outlined in Table 1.

CONCLUSIONS: Natural infestation of seed by *C. lindemuthianum* significantly reduced stand at day 28 and significantly increased disease severity and disease incidence (%) compared to the uninfested check. Stand (day 28) was significantly increased by seed treatment with SENATOR 70WP compared to the

infested check. Disease severity and disease incidence were significantly decreased by seed treatment with APRON MAXX RTA, SENATOR 70WP, APRON MAXX RTA + SENATOR 70WP, APRON MAXX RTA + MERTECT 500SC or DCT compared to the infested check.

Table 1. Effect of seed treatment on emergence (day 7), stand, disease severity and disease incidence (%) of dry bean seedlings, naturally infested with *Colletotrichum lindemuthianum*, averaged over four replications per treatment.

Treatment	product rate (ml/kg seed)	emergence (day 7)[1]	stand (day 14)	stand (day 21)	stand (day 28)	disease severity (0-4)[2]	disease incidence (%)
NON-INFESTED CHECK		23.5 a [3]	23.5 a	23.5 a	23.5 a	0.0 a	0.0 a
INFESTED CHECK		21.0 ab	21.0 abc	21.0 abc	18.3 c	0.7 d	58.3 d
APRON MAXX RTA	3.3	17.8 b	17.8 c	17.8 c	16.8 c	0.2 ab	22.3 ab
SENATOR 70WP	1	21.8 ab	22.5 ab	22.5 ab	22.5 ab	0.0 a	0.0 a
APRON MAXX RTA + SENATOR 70WP	3.3 +1.0	18.8 b	19.5 abc	19.5 abc	19.3 bc	0.0 a	2.5 ab
MERTECT 500SC	0.4	19.5 ab	19.5 abc	19.5 abc	19.3 bc	0.5 cd	46.0 cd
APRON MAXX RTA + MERTECT 500SC	3.3 +0.4	19.3 b	19.8 abc	19.8 abc	19.8 bc	0.3 bc	26.7 bc
DCT	5.2	18.8 b	19.3 bc	19.3 bc	19.3 bc	0.1 a	2.7 ab

[1] Emergence and stand were determined as the number of plants produced per replication from 25 seeds.
[2] Disease severity was rated as the percentage of the hypocotyl affected by *C. lindemuthianum* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%.
[3] Within a column, means followed by the same letter are not significantly different at $P = 0.05$ (REGWQ).

2004 PMRR REPORT # 86 **SECTION M: FIELD LEGUMES - Diseases (Beans, Peas)**
ICAR: 306001

CROP: Chickpea (*Cicer arietinum* L.), cv. Sanford
PEST: Ascochyta, *Ascochyta rabiei*

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TITLE: CONTROLLED ENVIRONMENT EVALUATION OF SEED TREATMENTS TO PROTECT CHICKPEA, CULTIVAR SANFORD, AGAINST *ASCOCHYTA RABIEI.*

MATERIALS: APRON MAXX RTA (fludioxonil, 7.62 g a.i./L and metalaxyl-M, 11.43 g a.i./L) or CROWN(carbathiin 92 g a.i./L + thiabendazole, 58 g a.i./L).

METHODS: Chickpea seed (*Cicer arietinum*), cultivar Sanford, naturally infested with *A. rabiei* (28.5%), was treated with APRON MAXX RTA at 325 ml/100 kg seed, or CROWN at 600 ml/100 kg seed. To treat seed, the recommended amount of product + 6% was added to the seed and shaken in an Erlenmeyer flask for approximately 3 min to ensure thorough coating of the seed. Flasks were primed by treating and discarding a quantity of seed prior to treating seed for experimental use. Untreated, naturally infested seed and untreated, uninfested seed served as the two control treatments. The experimental design was a completely randomized block design (CRBD). A block consisted of one replication per treatment. A replication consisted of three 20-cm-diam pots each planted with 10 seeds, therefore 30 seeds were planted per replication. There were four blocks per treatment. Seeds were sown 5 cm deep in Promix BX. Pots were placed in plastic flats and each pot covered with a plastic bag to maintain high humidity and induce germination. Bags were removed and plants were watered as needed once emergence was observed. Plants were maintained under greenhouse conditions. Emergence (number of plants produced per replication from 30 seeds) was determined after 7 days and stand (number of plants produced per replication from 30 seeds) was measured at days 14, 21, 28 and 35. Disease incidence (%) and disease severity were measured at harvest (35 days after planting). Disease severity was rated as the percentage of the hypocotyl affected by *A. rabiei* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%. Disease incidence was the number of diseased hypocotyls per replication expressed as a percentage of the total number of hypocotyls per replication. Treatment effects on emergence, stand, disease incidence (%) and disease severity were compared using an ANOVA analysis and a REGWQ means comparison test ($P = 0.05$).

RESULTS: As outlined in Table 1.

CONCLUSIONS: Natural infestation of seed by *A rabiei* significantly reduced emergence and significantly increased disease severity and disease incidence, compared to the uninfested check. Seed treatment with APRON MAXX RTA or CROWN significantly decreased disease severity and disease incidence (%) compared to the infested check.

Table 1. Effect of APRON MAXX RTA and CROWN on emergence (day 7), stand, disease severity and disease incidence (%) of chickpea seedlings, cultivar Sanford, naturally infested with *Ascochyta rabiei*, averaged over four replications per treatment.

Treatment	product rate (ml/kg seed)	emergence (day 7)[1]	stand (day 14)	stand (day 21)	stand (day 28)	stand (day 35)	disease severity (0-4)[2]	disease incidence (%)
NON-INFESTED CHECK		30.0 a[3]	30.0 a	30.0 a	30.0 a	30.0 a	0.0 a	0.0 a
INFESTED CHECK		24.3 b	25.0 a	25.0 a	25.0 a	25.0 a	0.3 c	27.1 c
APRON MAXX RTA	3.3	25.0 b	25.0 a	25.0 a	25.0 a	25.0 a	0.1 b	8.9 b
CROWN	6	25.0 b	26.3 a	26.3 a	26.3 a	26.3 a	0.0 a	1.0 a

[1] Emergence and stand were determined as the number of plants produced per replication from 30 seeds.
[2] Disease severity was rated as the percentage of the hypocotyl affected by *A. rabiei* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%.
[3] Within a column, means followed by the same letter are not significantly different at $P = 0.05$ (REGWQ).

2004 PMRR REPORT # 87 **SECTION M: FIELD LEGUMES - Diseases (Beans, Peas)**
ICAR: 306001

CROP: Chickpea (*Cicer arietinum* L.), cvs. Chico, Xena
PEST: *Ascochyta rabiei*

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TITLE: CONTROLLED ENVIRONMENT EVALUATION OF SEED TREATMENTS TO PROTECT CHICKPEA AGAINST *ASCOCHYTA RABIEI.*

MATERIALS: APRON MAXX RTA (fludioxonil, 7.62 g a.i./L and metalaxyl-M, 11.43 g a.i./L) or CROWN(carbathiin 92 g a.i./L + thiabendazole, 58 g a.i./L).

METHODS: Chickpea seed (*Cicer arietinum*), cultivars Chico and Xena, naturally infested with *A. rabiei* (32.5% and 21.5% respectively), were treated with APRON MAXX RTA at 325 ml/100 kg seed, or CROWN at 600 ml/100 kg seed. To treat seed, the recommended amount of product + 6% was added to the seed and shaken in an Erlenmeyer flask for approximately 3 min to ensure thorough coating of the seed. Flasks were primed by treating and discarding a quantity of seed prior to treating seed for experimental use. Untreated, naturally infested seed and untreated, non-infested seed served as the two control treatments. The experimental design was a completely randomized block design (CRBD). A block consisted of one replication per treatment. A replication consisted of one 15-cm-diam pot planted with 10 seeds. There were four blocks per treatment. Seeds were sown 5 cm deep in Promix BX. Pots were placed in plastic flats and each pot covered with a plastic bag to maintain high humidity and induce germination. Bags were removed and plants were watered as needed once emergence was observed. Plants were maintained in a growth room maintained at 19/18°C under a 16/8 h light regime. Emergence (number of plants produced per replication from 10 seeds) was determined after 7 days and stand (number of plants produced per replication from 10 seeds) was measured every week for 3 weeks following emergence. Disease incidence (%) and disease severity were measured at harvest (28 days after planting). Disease severity was rated as the percentage of the hypocotyl affected by *A. rabiei* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%. Disease incidence was the number of diseased hypocotyls per replication expressed as a percentage of the total number of hypocotyls per replication. Treatment effects on emergence, stand, disease incidence (%) and disease severity were compared using an ANOVA analysis and a REGWQ means comparison test ($P = 0.05$).

RESULTS: As outlined in Tables 1 and 2.

CONCLUSIONS: Natural infestation of seed by *A rabiei* significantly reduced emergence from Chico seed and stand on day 14 from Xena seed and significantly increased disease severity and disease incidence, on both cultivars, compared to the non-infested check. For both cultivars, seed treatment with APRON MAXX RTA or CROWN significantly decreased disease severity and disease incidence (%) compared to the infested check.

Table 1. Effect of APRON MAXX RTA and CROWN on emergence (day 7), stand, disease severity and disease incidence (%) of chickpea seedlings, cultivar Chico, naturally infested with *Ascochyta rabiei*, averaged over four replications per treatment.

Treatment	product rate (ml/kg seed)	emergence (day 7)[1]	stand (day 14)	stand (day 21)	stand (day 28)	disease severity (0-4)[2]	disease incidence (%)
NON-INFESTED CHECK		10.0 a[3]	10.0 a	10.0 a	10.0 a	0.0 a	0.0 a
INFESTED CHECK		7.8 b	8.5 a	8.5 a	8.8 a	0.5 c	35.3 c
APRON MAXX RTA	3.3	7.3 b	8.0 a	8.3 a	9.0 a	0.2 b	19.5 b
CROWN	6	9.3 ab	9.3 a	9.3 a	9.3 a	0.1 ab	5.0 ab

[1] Emergence and stand were determined as the number of plants produced per replication from 10 seeds.
[2] Disease severity was rated as the percentage of the hypocotyl affected by *A. rabiei* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%.
[3] Within a column, means followed by the same letter are not significantly different at $P = 0.05$ (REGWQ).

Table 2. Effect of APRON MAXX RTA and CROWN on emergence (day 7), stand, disease severity and disease incidence (%) of chickpea seedlings, cultivar Xena, naturally infested with *Ascochyta rabiei*, averaged over four replications per treatment.

Treatment	product rate (ml/kg seed)	emergence (day 7)[1]	stand (day 14)	stand (day 21)	stand (day 28)	disease severity (0-4)[2]	disease incidence (%)
NON-INFESTED CHECK		9.5 a[3]	9.8 a	10.0 a	10.0 a	0.0 a	0.0 a
INFESTED CHECK		7.8 ab	8.3 bc	8.5 ab	8.8 a	0.4 c	31.5 c
APRON MAXX RTA	3.3	7.3 b	7.3 c	7.8 b	9.3 a	0.2 b	16.3 b
CROWN	6	8.0 ab	8.8 ab	9.0 ab	9.0 a	0.0 a	0.0 a

[1] Emergence and stand were determined as the number of plants produced per replication from 10 seeds.
[2] Disease severity was rated as the percentage of the hypocotyl affected by *A. rabiei* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%.
[3] Within a column, means followed by the same letter are not significantly different at $P = 0.05$ (REGWQ).

2004 PMRR REPORT # 88 **SECTION M: FIELD LEGUMES - Diseases**
ICAR: 61009653

CROP: Fababean (*Vicia faba* L.), cv. Snowbird
PEST: Root rot, *Rhizoctonia solani* Kühn; *Fusarium avenaceum* (Corda) Sacc.

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TITLE: **EVALUATION OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF RHIZOCTONIA AND FUSARIUM SEEDLING BLIGHT OF FABA BEAN IN ALBERTA IN 2004**

MATERIALS: VITAFLO 280 (carbathiin 14.9% + thiram 13.2% SU), THIRAM (thiram, 75% WP), APRON MAXX (metalaxyl-M 13.6% + fludioxonil 9.11% SU)

METHODS: Seed of the fababean cv. Snowbird was treated in a Hege small batch seed treater with APRON MAXX at 3.25 ml/kg seed, THIRAM at 1.2 g/kg seed, or with VITAFLO 280 at 3.3 ml/kg seed. An experimental plot was established on 13 May at Vegreville, AB, in a black chernozemic sandy loam soil and on 19 May at Lacombe AB in a black chernozemic clay loam soil. The plot was seeded in a

randomized split block design with four replications. Main plots consisted of inoculated treatments of *Fusarium avenaceum*, *Rhizoctonia solani*, or a non-inoculated control. Subplots consisted of the seed treatments listed above or a non-treated control and contained four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 5 cm deep at a rate of 20 g per row. *Rhizoctonia solani* and *Fusarium avenaceum* were grown on sterilized oat grains for 14 days, dried, ground, and incorporated at the time of seeding at the rate of 15 and 30 ml/row, respectively. Emerged seedlings were counted on 18 June at both sites. At maturity (4 October at Vegreville and 7 October at Lacombe), plants were harvested by small plot combine. Seeds were cleaned and weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Since there was a significant ($P \leq 0.05$) inoculum x treatment interaction for both emergence and yield at both sites, the results of each inoculum treatment are presented separately. Emergence was significantly ($P \leq 0.05$) greater than the inoculated control for VITAFLO 280 and APRON MAXX in all inoculated plots (Table 1). Emergence for THIRAM was significantly greater than the inoculated control only for plots inoculated with *Fusarium* at Vegreville. Emergence for VITAFLO 280 was significantly greater than APRON MAXX for plots inoculated with *Rhizoctonia* at Vegreville, but not at Lacombe. Seed yield was greater ($P \leq 0.05$) in *Fusarium*-inoculated plots treated with APRON MAXX or VITAFLO 280 than those treated with THIRAM or left untreated. Seed yield did not respond to treatment in *Rhizoctonia*-inoculated plots at either site. Non-inoculated plots treated with APRON MAXX showed greater ($P \leq 0.05$) yield than those treated with THIRAM or the control plots at Vegreville.

CONCLUSIONS: VITAFLO 280 and APRON MAXX consistently improved emergence compared to non-treated controls inoculated with either *Fusarium* or *Rhizoctonia*. VITAFLO 280 and APRON MAXX also improved yield in *Fusarium*-inoculated plots, but not in *Rhizoctonia*-inoculated plots. Yield was improved by APRON MAXX in non-inoculated plots at the Vegreville site, indicating an influence of indigenous plant pathogenic soil fungi on yield at this site.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of fababean cv. Snowbird grown in soil inoculated with *Rhizoctonia solani* or *Fusarium avenaceum* at Vegreville and Lacombe, Alberta in 2004.

Non-inoculated	Rate (ml/kg seed)	Emergence (plants/m ^{2})		Seed yield (t/ha)	
		Vegreville	Lacombe	Vegreville	Lacombe
Control	--	36.2 a[1]	39.1 a	1.14 b	2.38 a
APRON MAXX	3.25	40.0 a	40.5 a	1.34 a	2.58 a
THIRAM	1.2 g	38.6 a	40.3 a	1.18 b	2.35 a
VITAFLO 280	2.6	40.3 a	40.4 a	1.20 ab	2.38 a

Fusarium	Rate (ml/kg seed)	Emergence (plants/m ^{2})		Seed yield (t/ha)	
		Vegreville	Lacombe	Vegreville	Lacombe
Control	--	11.8 c[1]	16.6 b	0.56 b	1.74 b
APRON MAXX	3.25	28.5 a	31.6 a	1.05 a	2.30 a
THIRAM	1.2 g	16.1 b	20.1 b	0.68 b	1.92 b
VITAFLO 280	2.6	29.6 a	30.8 a	1.09 a	2.26 a

Rhizoctonia	Rate (ml/kg seed)	Emergence (plants/m^2)		Seed yield (t/ha)	
		Vegreville	Lacombe	Vegreville	Lacombe
Control	--	24.6 c[1]	28.3 b	0.94 a	2.26 a
APRON MAXX	3.25	33.6 b	35.1 a	0.97 a	2.24 a
THIRAM	1.2 g	28.6 c	29.0 b	0.96 a	2.16 a
VITAFLO 280	2.6	40.1 a	36.2 a	1.04 a	2.12 a

[1] Means within a column followed by the same letter are not significantly different within each inoculum treatment, using Duncan's New Multiple Range Test ($P \leq 0.05$).

2004 PMRR REPORT # 89

SECTION M: FIELD LEGUMES - Diseases Beans, Peas)
ICAR: 306001

CROP: Lentil (*Lens culinaris* L.), cvs. Grandora, Richlea
PEST: *Ascochyta lentis*

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TITLE: CONTROLLED ENVIRONMENT EVALUATION OF SEED TREATMENTS TO PROTECT LENTIL AGAINST *ASCOCHYTA LENTIS*.

MATERIALS: APRON MAXX RTA (fludioxonil, 7.62 g a.i./L and metalaxyl-M, 11.43 g a.i./L) or CROWN (carbathiin 92 g a.i./L + thiabendazole, 58 g a.i./L).

METHODS: Lentil seed (*Lens culinaris*), cultivars Grandora and Richlea, naturally infested with *A. lentis* (34% and 24% respectively), were treated with APRON MAXX RTA at 325 ml/100 kg seed, or CROWN at 600 ml/100 kg seed. To treat seed, the recommended amount of product + 6% was added to the seed and shaken in an Erlenmeyer flask for approximately 3 min to ensure thorough coating of the seed. Flasks were primed by treating and discarding a quantity of seed prior to treating seed for experimental use. Untreated, naturally infested seed and untreated, non-infested seed served as the two control treatments. The experimental design was a completely randomized block design (CRBD). A block consisted of one replication per treatment. A replication consisted of two 20-cm-diam pots each planted with 25 seeds, therefore 50 seeds were planted per replication. There were four blocks per treatment. Seed was planted 5 cm deep in Promix BX. Pots were placed in plastic flats and each pot covered with a plastic bag to maintain high humidity and induce germination. Pots were incubated at 8°C, in a growth cabinet, for the first 14 days and then grown in a growth room maintained at 19/18°C under a 16/8 h light regime for the following 21 day duration of the experiment. Bags were removed and plants were watered as needed once emergence was observed. Emergence (number of plants produced per replication from 50 seeds) was determined after 14 days and stand (number of plants produced per replication from 50 seeds) was measured every week for 3 weeks following emergence. Disease incidence (%) and disease severity were measured at harvest. Disease severity was rated as the percentage of the hypocotyl affected by *A. lentis* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%. Disease incidence was the number of diseased hypocotyls per replication expressed as a percentage of the total number of hypocotyls per replication. Treatment effects on emergence, stand, disease incidence (%) and disease severity were compared using an ANOVA analysis and a REGWQ means comparison test (P = 0.05).

RESULTS: As outlined in Tables 1 and 2.

CONCLUSIONS: Natural infestation of seed by *A. lentis* significantly reduced all measures of emergence and stand and increased disease severity and disease incidence (%) compared to the non-infested check. Seed treatment with CROWN or APRON MAXX RTA significantly reduced disease severity and disease incidence (%), on both cultivars, compared to the infested check. APRON MAXX RTA significantly increased stand of both cultivars and emergence of Grandora. CROWN significantly increased emergence and stand of cultivar Grandora.

Table 1. Effect of APRON MAXX RTA and CROWN on emergence (day 14), stand, disease severity and disease incidence (%) of lentil seedlings, cultivar Grandora, naturally infested with *Ascochyta lentis*, averaged over four replications per treatment.

Treatment	product rate (ml/kg seed)	emergence (day 14)[1]	stand (day 21)	stand (day 28)	stand (day 35)	disease severity (0-4)[2]	disease incidence (%)
NON-INFESTED CHECK		47.3 a[3]	49.5 a	49.5 a	49.5 a	0.0 a	0.0 a
INFESTED CHECK		20.3 c	28.0 d	28.0 d	28.0 d	0.2 b	16.8 b
APRON MAXX RTA	3.3	30.8 b	36.5 c	36.5 c	36.5 c	0.0 a	3.4 a
CROWN	6	33.5 b	42.5 b	42.5 b	42.5 b	0.0 a	0.0 a

[1] Emergence and stand were determined as the number of plants produced per replication from 50 seeds.
[2] Disease severity was rated as the percentage of the hypocotyl affected by *A. lentis* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%.
[3] Within a column, means followed by the same letter are not significantly different at $P = 0.05$ (REGWQ).

Table 2. Effect of APRON MAXX RTA and CROWN on emergence (day 14), stand, disease severity and disease incidence (%) of lentil seedlings, cultivar Richlea, naturally infested with *Ascochyta lentis*, averaged over four replications per treatment.

Treatment	product rate (ml/kg seed)	emergence (day 14)[1]	stand (day 21)	stand (day 28)	stand (day 35)	disease severity (0-4)[2]	disease incidence (%)
NON-INFESTED CHECK		46.5 a[3]	49.8 a	49.8 a	49.8 a	0.0 a	0.0 a
INFESTED CHECK		20.8 b	26.5 c	26.5 c	26.5 c	0.1 b	7.6 b
APRON MAXX RTA	3.3	27.3 b	33.8 b	33.8 b	33.8 b	0.0 a	1.6 a
CROWN	6	21.8 b	32.0 bc	32.0 bc	32.0 bc	0.0 a	0.0 a

[1] Emergence and stand were determined as the number of plants produced per replication from 50 seeds.
[2] Disease severity was rated as the percentage of the hypocotyl affected by *A. lentis* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%.
[3] Within a column, means followed by the same letter are not significantly different at $P = 0.05$ (REGWQ).

2004 PMRR REPORT # 90

SECTION M: FIELD LEGUMES - Diseases (Beans, Peas)
ICAR: 306001

CROP: Lentil (*Lens culinaris* L.), cv. Laird
PEST: *Ascochyta lentis*

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TITLE: CONTROLLED ENVIRONMENT EVALUATION OF SEED TREATMENTS TO PROTECT LENTIL, CULTIVAR LAIRD, AGAINST *ASCOCHYTA LENTIS*.

MATERIALS: APRON MAXX RTA (fludioxonil, 7.62 g a.i./L and metalaxyl-M, 11.43 g a.i./L) or CROWN(carbathiin 92 g a.i./L + thiabendazole, 58 g a.i./L).

METHODS: Lentil seed (*Lens culinaris*), cultivar Laird, naturally infested with *A. lentis* (66.5%), was treated with APRON MAXX RTA at 325 ml/100 kg seed, or CROWN at 600 ml/100 kg seed. To treat seed, the recommended amount of product + 6% was added to the seed and shaken in an Erlenmeyer flask for approximately 3 min to ensure thorough coating of the seed. Flasks were primed by treating and discarding a quantity of seed prior to treating seed for experimental use. Untreated, naturally infested seed and untreated, non-infested seed served as the two control treatments. The experimental design was a completely randomized block design (CRBD). A block consisted of one replication per treatment. A replication consisted of two 20-cm-diam pots each planted with 25 seeds, therefore 50 seeds were planted per replication. There were four blocks per treatment. Seed was planted 5 cm deep in Promix BX. Pots were placed in plastic flats and each pot covered with a plastic bag to maintain high humidity and induce germination. Pots were incubated at 8°C, in a growth cabinet, for the first 7 days and then grown under greenhouse conditions for the following 21 day duration of the experiment. Bags were removed and plants were watered as needed once emergence was observed. Emergence (number of plants produced per replication from 50 seeds) was determined after 14 days and stand (number of plants produced per replication from 50 seeds) was measured every week for 2 weeks following emergence. Disease incidence (%) and disease severity were measured at harvest. Disease severity was rated as the percentage of the hypocotyl affected by *A. lentis* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%. Disease incidence was the number of diseased hypocotyls per replication expressed as a percentage of the total number of hypocotyls per replication. Treatment effects on emergence, stand, disease incidence (%) and disease severity were compared using an ANOVA analysis and a REGWQ means comparison test ($P = 0.05$).

RESULTS: As outlined in Table 1.

CONCLUSIONS: Natural infestation of seed by *A. lentis* significantly reduced all measures of emergence and stand, and increased disease severity and disease incidence (%) compared to the non-infested check. Seed treatment with CROWN significantly increased emergence and stand and decreased disease severity. Seed treatment with CROWN or APRON MAXX RTA significantly reduced disease incidence (%) compared to the infested check.

Table 1. Effect of APRON MAXX RTA and CROWN on emergence (day 14), stand, disease severity and disease incidence (%) of lentil seedlings, cultivar Laird, naturally infested with *Ascochyta lentis*, averaged over four replications per treatment.

Treatment	product rate (ml/kg seed)	emergence (day 14)[1]	stand (day 21)	stand (day 28)	disease severity (0-4)[2]	disease incidence (%)
NON-INFESTED CHECK		49.5 a[3]	49.8 a	49.8 a	0.0 a	0.0 a
INFESTED CHECK		36.3 c	36.5 c	36.5 c	0.2 b	21.0 c
APRON MAXX RTA	3.3	39.0 bc	39.5 bc	39.5 bc	0.1 b	12.0 b
CROWN	6	42.5 b	43.0 b	43.0 b	0.0 a	0.0 a

[1] Emergence and stand were determined as the number of plants produced per replication from 50 seeds.
[2] Disease severity was rated as the percentage of the hypocotyl affected by *A. lenitis* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%.
[3] Within a column, means followed by the same letter are not significantly different at $P = 0.05$ (REGWQ).

2004 PMRR REPORT # 91 **SECTION M: FIELD LEGUMES - Diseases**
ICAR: 61009653

CROP: Lupin (*Lupinus angustifolius* L.), cv. Arabella
PEST: Root rot, *Rhizoctonia solani* Kühn; *Fusarium avenaceum* (Corda) Sacc.

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TITLE: **EVALUATION OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF RHIZOCTONIA AND FUSARIUM SEEDLING BLIGHT OF LUPIN IN ALBERTA IN 2004**

MATERIALS: VITAFLO 280 (carbathiin 14.9% + thiram 13.2% SU), THIRAM (thiram, 75% WP), APRON MAXX (metalaxyl-M 13.6% + fludioxonil 9.11% SU)

METHODS: Seed of the lupin cv. Arabella was treated in a Hege small batch seed treater with APRON MAXX at 3.25 ml/kg seed, THIRAM at 1.2 g/kg seed, or with VITAFLO 280 at 3.3 ml/kg seed. An experimental plot was established on 17 May at Vegreville, AB, in a black chernozemic sandy loam soil and on 19 May at Lacombe AB in a black chernozemic clay loam soil. The plot was seeded in a

randomized split-block design with four replications. Main plots consisted of inoculated treatments of *Fusarium avenaceum*, *Rhizoctonia solani*, or a noninoculated control. Subplots consisted of the seed treatments listed above or a nontreated control, and contained four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 5 cm deep at a rate of 20 g per row. *Rhizoctonia solani* and *Fusarium avenaceum* were grown on sterilized oat grains for 14 days, dried, ground, and incorporated at the time of seeding at the rate of 15 and 30 mL/row, respectively. Emerged seedlings were counted on 18 June at both sites. At maturity (24 September at Lacombe), plants were harvested by small plot combine. Plots at Vegreville produced insufficient seed for harvest, due to a runaway infestation of Canada thistle (*Cirsium arvense* (L.) Scop.) earlier in the season. Seeds from Lacombe were cleaned and weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Since there was a significant ($P \leq 0.05$) inoculum x treatment interaction for both emergence and yield, the results of each inoculum treatment are presented separately. Emergence was significantly ($P \leq 0.05$) greater than the inoculated control for VITAFLO 280 and APRON MAXX in *Fusarium*-inoculated soils at both trial locations (Table 1). Emergence was also greater than the inoculated control for plots treated with THIRAM at Vegreville. Plots treated with VITAFLO 280 or APRON MAXX had significantly greater emergence in *Rhizoctonia*-inoculated soils at Vegreville, but at Lacombe, only VITAFLO 280 had significantly greater emergence than the control inoculated with *Rhizoctonia*. Emergence and seed yield were similar for all treatments in the non-inoculated controls. Seed yield was greater ($P \leq 0.05$) than the *Fusarium*- and *Rhizoctonia*-inoculated controls for both APRON MAXX and VITAFLO 280 at Lacombe. The *Rhizoctonia*-inoculated control produced a significantly greater ($P \leq 0.05$) seed yield than the *Rhizoctonia*-inoculated THIRAM treatment.

CONCLUSIONS: Both VITAFLO 280 and APRON MAXX improved emergence over controls in soils inoculated with *Fusarium*. VITAFLO 280 improved emergence over controls in soils inoculated with *Rhizoctonia*, and APRON MAXX showed improvement over the inoculated control at Vegreville. Both VITAFLO 280 and APRON MAXX improved yield compared to the controls inoculated with *Fusarium* or *Rhizoctonia*.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of lupin cv. Arabella grown in soil inoculated with *Rhizoctonia solani* or *Fusarium avenaceum* at Vegreville and Lacombe, Alberta in 2004.

Non-inoculated	Rate (ml/kg seed)	Stand (plants/m^2)[1]		Seed yield (t/ha)[1]	
		Vegreville	Lacombe	Vegreville	Lacombe
Control	--	26.8 a[1]	31.0 a	-	1.23 a
APRON MAXX	3.25	27.7 a	30.5 a	-	1.20 a
THIRAM	1.2 g	29.2 a	30.7 a	-	1.23 a
VITAFLO	2.6	28.5 a	32.8 a	-	1.26 a

Fusarium	Rate (ml/kg seed)	Stand (plants/m^2)[1]		Seed yield (t/ha)[1]	
		Vegreville	Lacombe	Vegreville	Lacombe
Control	--	6.1 c	9.7 b	-	0.81 b
APRON MAXX	3.25	17.5 a	17.8 a	-	1.03 a
THIRAM	1.2 g	10.7 b	13.8 ab	-	0.95 ab
VITAFLO	2.6	14.9 a	17.4 a	-	1.06 a

Rhizoctonia	Rate (ml/kg seed)	Stand (plants/m^2)[1]		Seed yield (t/ha)[1]	
		Vegreville	Lacombe	Vegreville	Lacombe
Control	--	7.4 c	10.0 b	-	0.72 b
APRON MAXX	3.25	10.9 b	11.0 b	-	0.88 a
THIRAM	1.2 g	9.6 bc	9.0 b	-	0.62 c
VITAFLO	2.6	16.5 a	18.0 a	-	0.89 a

[1] Means within a column followed by the same letter are not significantly different within each inoculum treatment, using Duncan's New Multiple Range Test ($P \leq 0.05$).

2004 PMRR REPORT # 92 **SECTION M: FIELD LEGUMES - Diseases**
ICAR: 61009653

CROP: Field Pea (*Pisum sativum* L.), cv. Mozart
PEST: Root rot, *Rhizoctonia solani* Kühn

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TITLE: EVALUATION OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF RHIZOCTONIA SEEDLING BLIGHT OF FIELD PEA IN ALBERTA IN 2004

MATERIALS: G2051 (carbathiin 14.9% + thiram 13.2% SU), L0020 (metalaxyl, 320 g/L SU), L1269 (trifloxystrobin 15.4 g/L + metalaxyl 12.3 g/L FL), L1050 (metalaxyl-M 13.6% + fludioxonil 9.11% SU)

METHODS: Seed of the field pea cv. Mozart was treated in a Hege small batch seed treater with L1050 at 3.25 ml/kg seed, L1269 at 3.25 ml/kg seed, L0020 at 0.128 ml/kg seed, or with G2051 at 2.6 ml/kg seed, either alone or in combination with L0020 at 0.128 ml/kg seed. An experimental plot was established on 25 May at Vegreville, Alberta, in a black chernozemic sandy loam soil. The plot was seeded in a randomized split-block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 5 cm deep at a rate of 20 g per row. Non-treated seeds were planted as inoculated and non-inoculated controls. *Rhizoctonia solani* was grown on sterilized oat grains for 14 days, dried, ground, and incorporated at the time of seeding at either 15 or 30 ml/row. Emerged seedlings were counted on 19 June. At maturity (15 September), plants were harvested by small plot combine. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Emergence was significantly ($P \leq 0.05$) greater than the inoculated control for L1269 and G 2051 alone or combined with L0020, and for L1050 under the high inoculum concentration (Table 1). Yield was significantly ($P \leq 0.05$) greater than the inoculated control only for L1269 alone at the lower inoculum concentration, but for the higher inoculum concentration, yield of both treatments including G2051, L1269 and L1050, exceeded that of the inoculated control.
CONCLUSIONS: All treatments, except L1050 at the lower inoculum concentration, improved

emergence compared to the inoculated control. All treatments significantly improved yield compared to the control at the higher inoculum concentration, but only L1269 alone improved yield at the lower concentration.

Table 1. Effect of seed treatments on the number of emerged seedlings and seed yield of field pea cv. Mozart grown in soil inoculated with *Rhizoctonia solani* at Vegreville, Alberta in 2004.

	Rate	Emergence (seedlings/m^2)[1]		Seed Yield (t/ha) [1]	
Treatment	(ml/kg seed)	Low inoc.	High inoc.	Low inoc.	High inoc.
Non-inoculated Control	--	37.3 a	37.0 a	1.84 abc	1.98 a
Inoculated Control [2]	--	23.5 cd	12.5 c	1.46 bc	0.79 c
L1050	3.25	28.5 bc	22.3 b	1.70 abc	1.57 ab
L1269	3.7	38.5 a	34.5 a	2.10 a	1.85 a
G2051	2.6	37.5 a	39.0 a	1.88 ab	2.17 a
L0020 + G2051	0.128 + 2.6	35.0 ab	38.2 a	1.67 abc	2.09 a

[1] Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test ($P \leq 0.05$).
[2] This and all subsequent treatments were inoculated with *Rhizoctonia solani* at the time of seeding.

2004 PMRR REPORT # 93

SECTION M: FIELD LEGUMES - Diseases (Beans, Peas)
ICAR: 306001

CROP: Soybean (*Glycine max* (L.) Merr.), var. S14-M7
PEST: *Phomopsis longicolla*

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TITLE: CONTROLLED ENVIRONMENT EVALUATION OF SEED TREATMENTS TO PROTECT SOYBEAN AGAINST *PHOMOPSIS LONGICOLLA*.

MATERIALS: APRON XL LS (metalaxyl-M 369 g a.i./L), APRON MAXX RTA (fludioxonil, 7.62 g a.i./L and metalaxyl-M 11.43 g a.i./L), MAXIM 480FS (fludioxonil, 480 g a.i./L), VITAFLO 280 (carbathiin, 148.4 g a.i./L and thiram 131.6 g a.i./L).

METHODS: Soybean seed was infested with *Phomopsis longicolla*. To infest seed, inoculum was produced on low water potential agar plates. Nutrient agar amended with KCl (65.6 g/L) to produce a water potential of -41 bars was inoculated with *P. longicolla*. Inoculated plates were incubated at room temperature for 2 weeks to allow colony growth to approximately 6 cm diameter. Soybean seed was placed on the edge of the colony and incubated for 24 hours to infest seed. Seeds incubated on uninoculated amended agar for 24 hours served as a control treatment. Infested seed was treated with APRON XL LS at 10.1 ml/100 kg seed, APRON MAXX RTA at 328 ml/100 kg seed, MAXIM 480 FS at 5.2 ml/100 kg seed, or VITAFLO 280 at 260 ml/100 kg seed. To treat seed, the recommended amount of product + 6% was added to the seed and shaken in an Erlenmeyer flask for approximately 3 min to ensure thorough coating of the seed. Flasks were primed by treating and discarding a quantity of seed prior to treating seed for experimental use. Untreated, infested seed and untreated, non-infested seed served as the two control treatments. The experimental design was a completely randomized design (CRD). Seed was planted 2.5 cm deep in Promix BX at a rate of 20 seeds per 20-cm-diam pot. Four replicate pots of each treatment were used. Pots were covered with plastic bags to maintain high humidity and induce germination. Plastic bags were removed and plants were watered every other day once emergence was observed. Plants were grown at 10°C/10°C under a 16/8 h light regime for the first 7 days and were then maintained under growth room conditions (19/18°C under a 16/8 h light regime) for the following 21 days. Emergence (determined as the number of plants produced per replication from 20 seeds) was determined 14 days after seeding and stand (determined as the number of plants produced per replication from 20 seeds) was measured 3 and 4 weeks after seeding. Disease incidence (%) and disease severity were measured at harvest (28 days after planting). Disease severity was rated as the percentage of the stem affected by *P. longicolla* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%. Disease incidence was the number of diseased stems per replication expressed as a percentage of the total number of stems per replication. Treatment effects on emergence, stand, disease incidence (%) and disease severity were compared using an ANOVA analysis and a REGWQ means comparison test ($P = 0.05$).

RESULTS: As outlined in Table 1.

CONCLUSIONS: Infestation of seed by *P. longicolla* significantly decreased emergence and stand and increased disease severity and disease incidence (%) compared to the non-infested check. Treatment of seed with APRON MAXX RTA, MAXIM 480FS or VITAFLO 280 significantly increased emergence and

stand and significantly decreased disease incidence compared to the infested check. APRON XL LS did not improve plant performance or reduce disease.

Table 1. Effect of seed treatment on emergence (day 14), stand, disease severity and disease incidence (%) of soybean seedlings, infested with *Phomopsis longicolla*, averaged over four replications per treatment.

Treatment	product rate (ml/kg seed)	emergence (day 14)[1]	stand (day 21)	stand (day 28)	disease severity (0-4)[2]	disease incidence (%)
NON-INFESTED CHECK		13.5 a[3]	14.5 a	14.5 a	0.0 a	0.0 a
INFESTED CHECK		3.5 b	4.5 b	4.5 b	0.4 b	38.8 b
APRON XL LS	0.1	6.0 b	6.8 b	6.8 b	0.3 ab	30.7 ab
APRON MAXX RTA	3.28	12.0 a	14.0 a	14.0 a	0.1 ab	7.2 a
MAXIM 480FS	0.05	13.3 a	14.5 a	14.5 a	0.1 ab	6.5 a
VITAFLO 280	2.6	14.3 a	14.8 a	14.8 a	0.1 ab	6.1 a

[1] Emergence and stand were determined as the number of plants produced per replication from 20 seeds.
[2] Disease severity was rated as the percentage of the stem affected by *P. longicolla* on a scale of 0 to 4; where 0 = 0%, 1 = 1 to 24%, 2 = 25 to 49%, 3 = 50 to 74% and 4 = 75 to 100%.
[3] Within a column, means followed by the same letter are not significantly different at $P = 0.05$ (REGWQ).

2004 PMRR REPORT # 94 **SECTION N: POTATOES - Diseases**
ICAR: 61009653

CROP: Potato (*Solanum tuberosum* L.), cv. Yukon Gold
PEST: Fusarium seed piece decay (*Fusarium sambucinum* Fuckel)

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TITLE: EVALUATION OF SEED PIECE TREATMENTS FOR THE CONTROL OF FUSARIUM SEED PIECE DECAY OF POTATO IN ALBERTA IN 2004

MATERIALS: L1210-A1 (imidacloprid, thiophanate-methyl and mancozeb, 1.25, 3.0 and 6.0% wt./wt. DF), L1424-A1 (fenamidone, thiophanate-methyl and mancozeb, 1.0, 2.5 and 6.0% wt./wt. DF), L0275-A1 (fludioxonil 0.5% DF), L0289-A1 (imidacloprid and mancozeb, 1.25 and 6.0% wt./wt. DF), G7051 (mancozeb, 16.0% wt./wt. DF), L1425-A1 (fenamidone, thiophanate-methyl and trifloxystrobin, 1.0, 2.5 and 1.0% wt./wt. DF), and G7050 (thiophanate-methyl 10% DF)

METHODS: Efficacy of seed piece treatments in controlling fusarium seed piece decay of potato was evaluated in a black chernozemic sandy loam soil at Vegreville, Alberta in 2004. Cut seed-potato pieces of Yukon Gold (Elite III) were planted on June 1, 2004, in two-row plots with a plant spacing of 0.3 m within rows and 1.0 m between rows. Plots were arranged in a randomized complete block design and replicated four times. The plots measured 6.0 m in length and 2.0 m in width, and were separated by a 2.0 m buffer zone between replicates. Seed pieces for all inoculated treatments were sprayed with a spore suspension of *Fusarium sambucinum* at a rate of 500 ml/100 kg of cut seed, immediately after cutting, using a hand-held plant mister. The spore suspension was prepared by flooding the surface of 3-week-old agar cultures with sterile distilled water, gently scraping the colony with a glass rod, and filtering the suspension through two layers of cheesecloth. The concentration of spores was determined with a hemacytometer and adjusted to 1.9×10^7 spores/ml. The experiment included eleven treatments: (1) inoculated control; (2) L1210-A1 @ 750 g/100 kg seed; (3) L1210-A1 @ 500 g/100 kg seed; (4) L1424-A1 @ 500 g/100 kg seed; (5) L0275-A1 @ 500 g/100 kg seed; (6) L0289-A1 @ 750 g/100 kg seed; (7) L0289-A1 @ 500 g/100 kg seed; (8) G7051 @ 500 g/100 kg seed; (9) L1425-A1 @ 500 g/100 kg seed; (10) G7050 @ 500 g/100 kg seed; and (11) a non-inoculated control. The treatments were applied 2-3 h after inoculation. Seed pieces were planted 18-24 h after application of the treatments. Plant stand counts, stem counts and plant height measurements were made on July 30. All seedlings were dug on August 9 to examine the incidence of seed piece dry rot (percentage of seed pieces with fusarium dry rot symptoms). Tubers were collected at same time and yields were recorded. Data were subjected to analysis of variance using a General Linear Models Procedure from the Statistical Analysis System (SAS 8.01) and Tukey's honest significant difference test was performed for means comparison.

RESULTS: Plant stand counts were significantly ($P \leq 0.001$) greater in plots treated with all seed treatment products, except for G7050, compared to the *Fusarium*-inoculated control (Table 1). Treatment with L1210-A1 at the higher rate resulted in the greatest plant stand among all treatments; stand counts were significantly ($P \leq 0.05$) greater than the inoculated control, L0289 (lower rate) and G7050. Stand counts for all treatments, except for G7050, were significantly greater than the inoculated control. The seed piece treatments did not affect stem counts significantly ($P \leq 0.07$, *data not shown*). Plant heights were significantly ($P \leq 0.002$) greater for G7050 compared to the inoculated control. The non-inoculated control had the greatest plant height compared to the other treatments. All seed treatments significantly ($P \leq 0.0001$) reduced seed piece dry rot caused by *F. sambucinum*, but the effect was significantly less with treatment G7051. Tuber yield was also affected by seed treatments ($P \leq 0.03$). L1210-A1 (500 g) produced the highest yield of 6.5 t/ha, while L1425-A1 and G7051 produced the lowest yield among the seed treatments (4.9 t/ha), not significantly greater than the *Fusarium*-inoculated control (4.0 t/ha). There were no significant differences between the two rates of L1210-A1 and L0289-A1 in with regard to plant stands, plant heights, seed piece dry rot and tuber yield.

CONCLUSIONS: L1210-A1, L1424-A1, L0289-A1, L0275-A1, L1425-A1, and G7051 seed piece treatments significantly improved establishment of potato plants. G7050 treatment significantly increased plant height. All seed treatments suppressed fusarium dry rot, although G7051 was less effective than the other treatments. These same treatments, except for L1425-A1 and G7051, also improved tuber yield.

Table 1. Efficacy of seed piece treatments on fusarium seed piece decay of potato (*Fusarium sambucinum*) in a field experiment at Vegreville, Alberta in 2004

Treatment and rate (Product/100 kg seed)	Final stand (40 seed pieces)	Plant height (cm)	Seed piece dry rot (%)	Tuber yield (t/ha)
Fusarium-inoculated control	33.8 d[1]	60.3 cd	75.0 a	4.0 c
L1210-A1, 750 g[2]	38.0 a	62.3 bcd	2.6 c	5.3 ab
L1210-A1, 500 g	37.3 ab	63.0 bc	6.3 c	6.5 a
L1424-A1, 500 g	37.0 ab	61.4 bcd	6.7 c	5.4 ab
L0275-A1, 750 g	37.8 ab	61.7 bcd	1.4 c	5.8 ab
L0289-A1, 750 g	36.5 abc	61.2 bcd	4.8 c	5.5 ab
L0289-A1, 500 g	36.3 bc	62.9 bc	7.3 c	6.0 ab
G7051, 500 g	36.8 abc	61.6 bcd	18.3 b	4.9 bc
L1425-A1, 500 g	37.0 ab	59.0 d	0.7 c	4.9 bc
G7050, 500 g	35.3 cd	64.0 b	2.3 c	5.5 ab
Non-inoculated control	37.5 ab	67.6 a	0.7 c	5.8 ab

[1] Values are means of four replications in each treatment. Means in a column within each category followed by the same letter under same category are not significantly different according to Tukey's honest significant difference at $P \leq 0.05$.
[2] All treatments except the non-inoculated control were inoculated with *Fusarium sambucinum*.

2004 PMRR REPORT # 95

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
ICAR: 61009653

CROP: Alfalfa (*Medicago sativa* L.), cv. Algonquin
PEST: Seedling blight, *Rhizoctonia solani* Kühn, *Fusarium avenaceum* (Corda) Sacc.

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TITLE: EVALUATION OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF SEEDLING BLIGHT OF ALFALFA CAUSED BY *RHIZOCTONIA SOLANI* AND *FUSARIUM AVENACEUM* IN ALBERTA IN 2004

MATERIALS: DFC (difenconazole 360 g/L SU), TRIBUNE (difenconazole, 1.61%, metalaxyl M, 0.51%, fludioxonil, 0.17%), APRON XL (metalaxyl M 33.3% LS), MAXIM 480 (fludioxonil, 480g/L FS) APRON MAXX (fludioxonil, 0.73%; metalaxyl-M, 1.1%).

METHODS: Seed of the alfalfa cv. Algonquin was treated in a Hege II small batch seed treater with APRON XL at 0.225 or 0.45 ml/kg seed, either alone or combined with MAXIM 480 at 0.052 ml/kg seed, with MAXIM 480 at 0.052 or 0.104 ml/kg seed, TRIBUNE at 14.85 ml/kg seed, DFC at 0.24 g ai/kg seed, or with APRON MAXX at 2.13 or 4.25 ml/kg seed. Experimental plots were established on 4 June, 2004 at Vegreville, Alberta in a black chernozemic sandy loam soil and on 3 June at Edmonton, Alberta in a black chernozemic clay loam soil. Plots were seeded in a randomized complete block design with four replications. Each plot consisted of four, 4 m rows of plants spaced 25 cm apart. Seeds were planted 1 cm deep at a rate of 0.6 g of seeds per row. *Rhizoctonia solani* and *Fusarium avenaceum* were grown on sterilized oat grains for 14 days, dried, ground, and incorporated as inoculum at the time of seeding at the rate of 20 ml/row. Non-treated seeds were planted as inoculated and non-inoculated controls. Seedlings were counted for each plot on 29 June. Vigour was assessed visually and plots were harvested by hand-cutting the plants on 12 August at Edmonton and on 10 August at Vegreville. The material collected was dried and weighed to determine yield. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Emergence was significantly greater ($P \leq 0.05$) than the *Fusarium*-inoculated control for all treatments, except APRON XL and MAXIM applied separately at the Vegreville site (Table 1), but only for MAXIM at the lower rate at the Edmonton site (Table 2). Emergence was significantly greater than the *Rhizoctonia*-inoculated control for TRIBUNE, MAXIM, APRON XL + MAXIM, and both APRON MAXX treatments at the Vegreville site. All of the treatments, except DFC and APRON XL, also showed significantly greater emergence than the *Rhizoctonia*-inoculated control at the Edmonton site. Vigor in the

Fusarium-inoculated plots was greater in plots treated with TRIBUNE and APRON MAXX at both rates than in the non-treated, inoculated control at Vegreville, but none of the treatments were different from the non-treated control at Edmonton. Vigor in the *Rhizoctonia*- treated plots was greater than the inoculated control for all treatments except for DFC and APRON XL at the lower rate at Vegreville and for DFC and APRON XL at either rate at Edmonton. Yield exceeded that of the *Fusarium*-inoculated control for TRIBUNE and APRON MAXX at the higher rate at Vegreville and for APRON MAXX at the higher rate at Edmonton. Yield exceeded that of the *Rhizoctonia*-inoculated control for all treatments, except for DFC and APRON XL at both Vegreville and Edmonton.

CONCLUSIONS: In general, APRON MAXX and TRIBUNE showed the greatest improvement in emergence, vigor and yield compared to the inoculated control.

Table 1. Effects of fungicidal seed treatments on plant stand, vigor and forage yield of alfalfa cv. Algonquin grown in soil inoculated with *Rhizoctonia solani* or *Fusarium avenaceum* at Vegreville, Alberta in 2004.

Treatment	Rate (ml/kg seed)	Emergence (plants/m ^{2})			Vigor (Percent)			Forage yield (t/ha)		
		Control	*Fusarium*	Rhizoc.	Control	*Fusarium*	Rhizoc.	Control	*Fusarium*	Rhizoc.
Non-inoculated Control	--	83.2 abcd[1]	77.2 a	78.2 a	100 a	100 a	100 a	1.88 a	1.78 a	1.42 a
Control [2]	--	88.7 a	40.5 e	9.3 e	100 a	82.5 b	27.5 c	1.70 a	1.08 b	0.36 b
TRIBUNE	14.85	84.6 abcd	58.0 bc	63.6 b	100 a	100 a	97.5 a	1.88 a	1.72 a	1.24 a
DFC	0.67	79.6 cd	52.7 abc	15.6 e	100 a	92.5 ab	42.5 bc	1.72 a	1.36 ab	0.50 b
MAXIM	0.052	80.7 bcd	48.4 cde	44.0 d	100 a	90.0 ab	85.0 a	1.68 a	1.44 ab	1.34 a
MAXIM	0.104	87.3 ab	50.9 bcde	47.8 cd	100 a	92.5 ab	92.5 a	1.60 a	1.44 ab	1.24 a
APRON XL	0.225	87.8 ab	49.3 bcde	10.0 e	97.5 a	90.0 ab	37.5 bc	1.72 a	1.52 ab	0.30 b
APRON XL	0.45	90.4 a	41.5 de	10.2 e	100 a	90.0 ab	47.5 b	1.82 a	1.38 ab	0.56 b
APRON XL + MAXIM	0.45 + 0.025	86.8 abc	58.7 bc	45.7 d	97.5 a	92.5 ab	90.0 a	1.60 a	1.44 ab	1.24 a
APRON MAXX	2.13	78.6 d	60.8 b	40.7 d	97.5 a	100 a	82.5 a	1.44 a	1.50 ab	1.32 a
APRON MAXX	4.25	86.6 abc	60.2 bc	59.9 bc	100 a	95.0 a	97.5 a	1.64 a	1.82 a	1.56 a

[1] Means followed by the same letter within a column are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test

[2] This and subsequent treatments inoculated with *Rhizoctonia solani* or *Fusarium avenaceum*, or left without inoculum, according to the column heading.

Table 2. Effects of fungicidal seed treatments on plant stand, vigor and forage yield of alfalfa cv. Algonquin grown in soil inoculated with *Rhizoctonia solani* or *Fusarium avenaceum* at Edmonton, Alberta in 2004.

Treatment	Rate (ml/kg seed)	Emergence (plants/m ^{2})			Vigor (Percent)			Forage yield (t/ha)		
		Control	*Fusarium*	Rhizoc.	Control	*Fusarium*	Rhizoc.	Control	*Fusarium*	Rhizoc.
Non-inoculated Control	--	52.9 b [1]	73.5 a	65.0 a	87.5 a	90.0 a	90.0 a	0.67 a	0.86 a	0.87 a
Control [2]	--	63.7 ab	38.2 cd	3.7 d	95.0 a	72.5 ab	15.0 c	0.81 a	0.44 cd	0.11 d
TRIBUNE	14.85	73.9 ab	50.9 bc	42.6 b	92.5 a	77.5 ab	77.5 ab	0.83 a	0.55 abcd	0.52 b
DFC (g ai)	0.24	66.3 ab	39.7 cd	6.2 d	92.5 a	75.0 ab	20.0 c	0.78 a	0.41 cd	0.13 cd
MAXIM	0.052	69.0 ab	53.3 b	38.5 b	87.5 a	77.5 ab	75.0 ab	1.01 a	0.53 bcd	0.52 b
MAXIM	0.104	68.7 ab	48.7 bc	43.5 b	90.0 a	77.5 ab	77.5 ab	0.87 a	0.53 bcd	0.47 b
APRON XL	0.225	74.3 ab	33.0 d	2.7 d	90.0 a	67.5 b	12.5 c	0.74 a	0.63 abcd	0.07 d
APRON XL	0.45	75.0 ab	33.8 d	4.1 d	90.0 a	67.5 b	10.0 c	0.97 a	0.35 d	0.06 d
APRON XL + MAXIM	0.45 + 0.025	79.4 a	44.0 bcd	24.4 c	92.5 a	85.0 ab	67.5 b	0.77 a	0.70 abc	0.44 b
APRON MAXX	2.13	61.2 b	50.2 bc	25.8 c	85.0 a	82.5 ab	70.0 b	0.83 a	0.66 abcd	0.36 bc
APRON MAXX	4.25	72.1 ab	49.2 bc	41.7 b	92.5 a	80.0 ab	80.0 ab	0.87 a	0.84 ab	0.56 b

[1] Means followed by the same letter within a column are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test

[2] This and subsequent treatments inoculated with *Rhizoctonia solani* or *Fusarium avenaceum*, or left without inoculum, according to the column heading.

2004 PMRR REPORT # 96

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
ICAR: 61009653

CROP: Birdsfoot trefoil (*Lotus corniculatus* L.), cv. Leo
PEST: Seedling blight, *Rhizoctonia solani* Kühn, *Fusarium avenaceum* (Corda) Sacc.

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TITLE: EVALUATION OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF SEEDLING BLIGHT OF BIRDSFOOT TREFOIL CAUSED BY *RHIZOCTONIA SOLANI* AND *FUSARIUM AVENACEUM* IN ALBERTA IN 2004

MATERIALS: DFC (difenconazole 360 g/L SU), TRIBUNE (difenconazole, 1.61%, metalaxyl M, 0.51%, fludioxonil, 0.17%), APRON XL (metalaxyl M, 33.3% LS), MAXIM 480 (fludioxonil, 480g/L FS) APRON MAXX (fludioxonil, 0.73%; metalaxyl M, 1.1%).

METHODS: Seed of the birdsfoot trefoil cv. Leo was treated in a Hege II small batch seed treater with APRON XL at 0.225 or 0.45 ml/kg seed either alone or combined with MAXIM 480 at 0.052 ml/kg seed, with MAXIM 480 at 0.052 or 0.104 ml/kg seed, TRIBUNE at 14.85 ml/kg seed, DFC at 0.24 g ai/kg seed or with APRON MAXX at 2.13 or 4.25 ml/kg seed. Experimental plots were established on 21 May, 2004 at Vegreville, Alberta in a black chernozemic sandy loam soil. Plots were seeded in a randomized complete block design with four replications. Each plot consisted of four, 4 m rows of plants spaced 25 cm apart. Seeds were planted 1 cm deep at a rate of 0.6 g of seeds per row. *Rhizoctonia solani* and *Fusarium avenaceum* were grown on sterilized oat grains for 14 days, dried, ground, and incorporated as inoculum at the time of seeding at the rate of 20 ml/row. Non-treated seeds were planted as inoculated and non-inoculated controls. Seedlings were counted for each plot on 30 July. Vigor was assessed visually and plots were harvested by hand-cutting the plants on 16 August. The material collected was dried and weighed to determine yield. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Emergence was significantly greater ($P \leq 0.05$) than either the *Fusarium*- or *Rhizoctonia*-inoculated control only for APRON MAXX at the higher rate (Table 1). Vigor in the *Fusarium*-treated plots was greater in plots treated with TRIBUNE, MAXIM, APRON XL + MAXIM, APRON XL at the higher rate, and for APRON MAXX at either rate. Vigor in the *Rhizoctonia*- inoculated plots was greater than the inoculated control for TRIBUNE, MAXIM at the lower rate, and APRON MAXX at the higher rate. Yield was not different from that of either inoculated control for any of the treatments, probably due to some degree of compensation in areas with low plant densities in treatments with lower emergence.

CONCLUSIONS: Although final yield did not differ from the inoculated control for any of the treatments, emergence and vigour were greatest in plots inoculated with APRON MAXX at the higher rate.

Table 1. Effects of fungicidal seed treatments on plant stand, vigour and forage yield of birdsfoot trefoil cv. Leo grown in soil inoculated with *Rhizoctonia solani* or *Fusarium avenaceum* at Vegreville, Alberta in 2004.

Treatment	Rate (ml/kg seed)	Emergence (plants/m^2)			Vigor (Percent)			Forage yield (t/ha)		
		Control	*Fusarium*	Rhizoc.	Control	*Fusarium*	Rhizoc.	Control	*Fusarium*	Rhizoc.
Non-inoculated Control	--	44.8 a[1]	35.1 a	49.1 a	87.5 a	80.0 a	87.5 a	0.20 ab	0.15 a	0.41 a
Control[2]	--	36.3 a	18.0 cde	3.7 c	82.5 a	37.5 e	10.0 e	0.16 ab	0.14 a	0.02 b
TRIBUNE	14.85	46.5 a	23.5 bcde	6.5 c	87.5 a	65.0 abcd	35.0 bc	0.24 a	0.17 a	0.05 b
DFC	0.67	44.7 a	14.6 e	4.2 c	82.5 a	52.5 cde	15.0 cde	0.13 b	0.24 a	0.03 b
MAXIM	0.052	48.2 a	21.6 bcde	10.3 bc	85.0 a	60.0 bcd	32.5 bcd	0.25 a	0.14 a	0.05 b
MAXIM	0.104	48.9 a	21.1 bcde	11.1 bc	85.0 a	65.0 abcd	30.0 cde	0.20 ab	0.21 a	0.05 b
APRON XL	0.225	42.8 a	16.6 de	3.6 c	77.5 a	47.5 de	12.5 de	0.21 ab	0.14 a	0.02 b
APRON XL	0.45	41.7 a	19.3 cde	3.6 c	82.5 a	60.0 bcd	15.0 cde	0.25 a	0.15 a	0.02 b
APRON XL + MAXIM	0.45 + 0.025	38.3 a	25.4 bcd	5.9 c	80.0 a	60.0 bcd	27.5 cde	0.13 b	0.23 a	0.03 b
APRON MAXX	2.13	36.8 a	26.4 bc	9.5 bc	85.0 a	67.5 abc	25.0 cde	0.16 ab	0.27 a	0.05 b
APRON MAXX	4.25	39.6 a	30.0 ab	17.0 b	87.5 a	72.5 ab	52.5 b	0.23 ab	0.24 a	0.13 b

[1] Means followed by the same letter within a column are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test

[2] This and subsequent treatments inoculated with *Rhizoctonia solani* or *Fusarium avenaceum*, or left without inoculum, according to the column heading.

2004 PMRR REPORT # 97

SECTION O: CEREALS, FORAGE CROPS AND OILSEEDS - Diseases
ICAR: 61009653

CROP: Canola (*Brassica napus* L.), cv. DKL 3235
PEST: Root rot, *Rhizoctonia solani* Kühn

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TITLE: EFFICACY OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF RHIZOCTONIA SEEDLING BLIGHT OF CANOLA FOLLOWING DIFFERENT INOCULUM RATES; 2004

MATERIALS: G 7009 (clothianidin, 600 g/L SU), G 7070 (clothianidin, 150 g/L + carbathiin, 52.5 g/L + metalaxyl, 3.8 g/L + thiram, 112.5 g/L SU), G 7074 (clothianidin,143 g/L + carbathiin, 50 g/L + metalaxyl, 5.4 g/L + trifloxystrobin, 7 g/L SU), L 1100 (difenconazole, 16 g/L + fludioxonil, 1.7 g/L + metalaxyl-M, 5 g/L + thiamethoxam, 133 g/L SU)

METHODS: Seed of canola cv. DKL 3235 was treated in a Hege small batch seed treater at product rates shown in Table 1. An experimental plot was established on 26 May, 2004 at Vegreville, Alberta, in a black chernozemic sandy loam soil. The plot was seeded in a randomized split block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 1.5 cm deep at a rate of 1.0 g of seed per row. *Rhizoctonia solani* was grown on sterilized oat grains for 14 days, dried, ground, and incorporated at the time of seeding at the rate of 0, 15 or 30 ml/row as main plots. Each of the seed treatments was seeded as subplots and non-treated seeds were planted as inoculated controls. Emerged seedlings were counted on 18 June. At maturity (October 7), plants were harvested and seed was weighed to determine yield. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Each of the main plots is presented separately since there were significant inoculation x treatment interactions. Emergence was significantly ($P \leq 0.05$) higher for G 7074 compared all other treatments where inoculum was present, and G 7070 and L 1100 had significantly greater emergence compared to the untreated control and to G 7009 (Table 1). In the absence of inoculum, plots treated with L 1100 had significantly greater emergence compared to the untreated control and to G 7009. Where the high rate of inoculum (30 ml/row) was used, yield was significantly ($P \leq 0.05$) greater than the untreated control for all three fungicidal treatments. At the low inoculum rate, yield exceeded that of the untreated control for G 7074 and L 1100, but not for G 7070 or G 7009.

CONCLUSIONS: Treatment with G 7074 improved emergence compared to all other seed treatments. Treatment with G 7070 or L 1100 improved emergence compared to the untreated control or the treatment with clothianidin only. Treatment with G 7074 or L 1100 consistently improved yield over the untreated control, treatment with G 7070 improved yield at high inoculum rates, and treatment with G 7009 did not affect yield compared to the untreated control.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of the canola cv. DKL 3235 grown in a field plot inoculated with *Rhizoctonia solani* at Vegreville, Alberta in 2004.

Control

Treatment	Rate (ml/kg seed)	Stand (plants/m ^{2})	Yield (t/ha)
Untreated		27.9 b [1]	1.86 a
G 7009	3.33	29.4 b	3.11 a
G 7070	13.33	32.4 ab	2.55 a
G 7074	14	33.0 ab	2.15 a
L 1100	15	35.3 a	2.45 a

Rhizoctonia @ 15 ml/row

Treatment	Rate (ml/kg seed)	Stand (plants/m ^{2})	Yield (t/ha)
Untreated [2]		5.9 c [1]	1.73 b
G 7009	3.33	6.2 c	1.79 ab
G 7070	13.33	20.7 b	1.82 ab
G 7074	14	25.3 a	2.13 a
L 1100	15	19.6 b	2.08 a

Rhizoctonia @ 30 ml/row

Treatment	Rate (ml/kg seed)	Stand (plants/m ^{2})	Yield (t/ha)
Untreated [2]		2.6 d [1]	1.31 b
G 7009	3.33	2.9 d	1.57 ab
G 7070	13.33	17.1 b	1.83 a
G 7074	14	22.1 a	1.75 a
L 1100	15	15.1 c	1.64 a

[1] Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test ($P \leq 0.05$).
[2] All treatments were inoculated with *Rhizoctonia solani* at the time of seeding.

2004 PMRR REPORT # 98

SECTION O: CEREALS, FORAGE CROPS AND OILSEEDS - Diseases
ICAR: 61009653

CROP: Canola (*Brassica napus* L.), cv. DKL 3235
PEST: Root rot, *Rhizoctonia solani* Kühn

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TITLE: EFFECTS OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF RHIZOCTONIA SEEDLING BLIGHT OF CANOLA (cv. DKL 3235) IN ALBERTA IN 2004

MATERIALS: G 2787 (carbathiin, 80.4 g/L + thiram, 156 g/L), G 7009 (clothianidin, 600 g/L SU), G 7047 (clothianidin, 120 g/L + carbathiin, 56 g/L + metalaxyl, 4 g/L + thiram, 120 g/L) G 7061 (clothianidin, 143 g/L + trifloxystrobin, 7 g/L + metalaxyl, 5.4 g/L), G 7070 (clothianidin, 150 g/L + carbathiin, 52.5 g/L + metalaxyl, 3.8 g/L + thiram, 112.5 g/L SU), G 7073 (clothianidin, 143 g/L + metalaxyl, 5.4 g/L + trifloxystrobin, 7 g/L SU), G 7074 (clothianidin, 143 g/L + carbathiin, 50 g/L + metalaxyl, 5.4 g/L + trifloxystrobin, 7 g/L SU), G 7082 (clothianidin, 286 g/L + carbathiin, 50 g/L + metalaxyl, 5.4 g/L + trifloxystrobin, 7 g/L SU), L 0020 (metalaxyl, 320 g/L FL), L 0121 (triazolinthion, 100 g/L SU), L 1100 (difenconazole, 16 g/L + fludioxonil, 1.7 g/L + metalaxyl-M, 5 g/L + thiamethoxam, 133 g/L SU)

METHODS: Seed of the canola cv. DKL 3235 was treated in a Hege small batch seed treater at product rates shown in Table 1. An experimental plot was established on 25 May, 2004 at Vegreville, Alberta, in a black chernozemic sandy loam soil. The plot was seeded in a randomized, split-block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 1.5 cm deep at a rate of 1.0 g of seed per row. *Rhizoctonia solani* was grown on sterilized oat grains for 14 days, dried, ground, and incorporated at the time of seeding at the rate of 30 ml/row. Seeds treated with G7009 were planted as inoculated and non-inoculated controls, since every treatment except G 2787 + L 0020 contained an insecticidal component. Emerged seedlings were counted on 18 June. At maturity (October 7), plants were harvested and seed was weighed to determine yield. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Emergence was significantly ($P \leq 0.05$) greater for all inoculated fungicide treatments compared to the insecticide-treated control (G 7009) (Table 1). Emergence was significantly greater for plots treated with G 7073, G 7074 and G 7082 than for those treated with G 2787 + L 0020, G 7061 or G 7047. Yield was significantly ($P \leq 0.05$) greater than the insecticide-treated control for G 7070, G 7073, G 7074, G 7082 and L 1100.

CONCLUSIONS: All treatments improved emergence over the inoculated control. Treatment with G 7073, G 7074 and G 7082 resulted in greater emergence than treatment with G 2787, G 7061 G 7061 + L 0121, or G 7047. G 7070, G 7073, G 7074, G 7082 and L 1100 improved yield over that of the inoculated control.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of the canola cv. DKL 3235 grown in a field plot inoculated with *Rhizoctonia solani* at Vegreville, Alberta in 2004.

Treatment	Rate (ml/kg seed)	Stand (plants/m ^{2})	Yield (t/ha)
G 7009 (non-inoculated)	3.33	28.7 a[1]	2.99 a
G 7009 [2]	3.33	2.1 d	1.60 c
G 2787 + L 0020	8.33 + 0.16	9.3 c	1.88 bc
G 7061	14	8.9 c	1.88 bc
G 7061 + L 0121	14.0 + 0.5	10.3 c	1.85 bc
G 7047	16.67	11.2 c	1.84 bc
G 7070	13.33	13.3 bc	1.98 b
G 7073	14	17.5 b	2.06 b
G 7074	14	17.8 b	2.04 b
G 7082	14	17.9 b	2.18 b
L 1100	15	13.5 bc	1.98 b

[1] Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test ($P \leq 0.05$).
[2] This and all subsequent treatments were inoculated with *Rhizoctonia solani* at the time of seeding.

2004 PMRR REPORT # 99

SECTION O: CEREALS, FORAGE CROPS AND OILSEEDS - Diseases
ICAR: 61009653

CROP: Canola (*Brassica napus* L.), cv. DKL 3585
PEST: Root rot, *Rhizoctonia solani* Kühn

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TITLE: EFFECTS OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF RHIZOCTONIA SEEDLING BLIGHT OF CANOLA (cv. DKL 3585) IN ALBERTA IN 2004

MATERIALS: G 2787 (carbathiin, 80.4 g/L + thiram, 156 g/L SU), G 7009 (clothianidin, 600 g/L SU), G 7071 (carbathiin 42 g/L+ metalaxyl, 3 g/L + thiram, 90 g/L + clothianidin240 g/L SU), G 7078 (clothianidin, 286 g/L + trifloxystrobin, 7 g/L + metalaxyl, 5.4 g/L SU), G 7082 (clothianidin, 286 g/L + carbathiin, 50 g/L + metalaxyl, 5.4 g/L + trifloxystrobin, 7 g/L SU), G 7074 (clothianidin, 143 g/L + carbathiin, 50 g/L + metalaxyl, 5.4 g/L + trifloxystrobin, 7 g/L SU), L 0020 (metalaxyl, 320 g/L FL), L 0270 (difenconazole, 16 g/L + fludioxonil, 1.7 g/L + metalaxyl-M, 5 g/L + thiamethoxam, 266 g/L SU)

METHODS: Seed of canola cv. DKL 3585 was treated in a Hege small batch seed treater at product rates shown in Table 1. An experimental plot was established on 25 May, 2004 at Vegreville, Alberta, in a black chernozemic sandy loam soil. The plot was seeded in a randomized split block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 1.5 cm deep at a rate of 1.0 g of seed per row. *Rhizoctonia solani* was grown on sterilized oat grains for 14 days, dried, ground, and incorporated at the time of seeding at the rate of 30 ml/row. Seeds treated with G 7009 were planted as inoculated or non-inoculated controls, since every treatment except G 2787 + L 0020 contained an insecticidal component. Emerged seedlings were counted on 18 June. At maturity (October 7), plants were harvested and seed was weighed to determine yield. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Emergence was significantly greater for plots treated with G 7082 than for all remaining treatments except G 7009 + G 7074 (Table 1). Emergence for this latter treatment was significantly greater than for all remaining treatments, except L 0270. Emergence for L 0270 was significantly greater than for all remaining treatments except G 7078 + L 0121. Emergence for this treatment was significantly greater than for all remaining treatments, except G 7071. Emergence for G 7071 was not significantly different from G 7078 + L 0121, G 7078 or G 2787 + L 0020 but was significantly greater than the

inoculated insecticidal control (G 7009). Yield was significantly ($P \leq 0.05$) greater than the inoculated control for G 7009 + G 7074, G 7082 and L 0270.

CONCLUSIONS: All treatments improved emergence over the inoculated control (G 7009) and G 7083. Order of efficacy (with respect to emergence counts) for the remaining fungicidal treatments was: G 7082 ,G 7009 + G 7074, L 0270, G 7078 + L 0121, G 7071, G 7078, and G 2787 + L 0020. G 7009 + G 7074, G 7082 and L 0270 improved yield over the inoculated, insecticide-treated control (G 7009).

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of the canola cv. DKL 3585 grown in a field plot inoculated with *Rhizoctonia solani* at Vegreville, Alberta in 2004.

Treatment	Rate (ml/kg seed)	Stand (plants/m ^{2})	Yield (t/ha)
G 7009 (non-inoculated)	6.67	28.7 a[1]	3.66 a
G 7009 [2]	6.67	4.3 g	2.32 de
G 7009 + G 7074	6.67 + 14.0	23.9 bc	3.31 ab
G 2787 + L 0020	8.33 + 0.16	12.4 f	2.77 bcd
G 7071	16.67	15.5 ef	2.64 cde
G 7078	14	15.1 f	2.66 cde
G 7078 + L 0121	14.0 + 0.5	19.0 de	2.60 cde
G 7082	14	25.5 ab	3.34 ab
L 0270	15	21.0 cd	3.10 abc

[1] Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test ($P \leq 0.05$).
[2] This and all subsequent treatments were inoculated with *Rhizoctonia solani* at the time of seeding.

2004 PMRR REPORT # 100

SECTION O: CEREALS, FORAGE CROPS AND OILSEEDS - Diseases
ICAR: 61009653

CROP: Canola (*Brassica napus* L.), cv. DKL 3235
PEST: Root rot, *Fusarium avenaceum* (Corda) Sacc.

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TITLE: EFFECTS OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF FUSARIUM SEEDLING BLIGHT OF CANOLA IN ALBERTA IN 2004

MATERIALS: G 2787 (carbathiin, 80.4 g/L + thiram, 156 g/L), G 7009 (clothianidin, 600 g/L SU), G 7047 (clothianidin, 120 g/L + carbathiin, 56 g/L + metalaxyl, 4 g/L + thiram, 120 g/L) G 7061 (clothianidin, 143 g/L + trifloxystrobin, 7 g/L + metalaxyl, 5.4 g/L), G 7070 (clothianidin, 150 g/L + carbathiin, 52.5 g/L + metalaxyl, 3.8 g/L + thiram, 112.5 g/L SU), G 7073 (clothianidin, 143 g/L + metalaxyl, 5.4 g/L + trifloxystrobin, 7 g/L SU), G 7074 (clothianidin, 143 g/L + carbathiin, 50 g/L + metalaxyl, 5.4 g/L + trifloxystrobin, 7 g/L SU), G 7082 (clothianidin, 286 g/L + carbathiin, 50 g/L + metalaxyl, 5.4 g/L + trifloxystrobin, 7 g/L SU), L 0020 (metalaxyl, 320 g/L FL), L 0121 (triazolinthion, 100 g/L SU), L 1100 (difenconazole, 16 g/L + fludioxonil, 1.7 g/L + metalaxyl-M, 5 g/L + thiamethoxam, 133 g/L SU)

METHODS: Seed of the canola cv. DKL 3235 was treated in a Hege small batch seed treater at product rates listed in Table 1. An experimental plot was established on 25 May, 2004 at Vegreville, Alberta, in a black chernozemic sandy loam soil. The plot was seeded in a randomized, split-block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 1.5 cm deep at a rate of 1.0 g of seed per row. *Fusarium avenaceum* was grown on sterilized oat grains for 14 days, dried, ground, and incorporated at the time of seeding at the rate of 30 ml/row. Since all treatments, except for G 2727 + L 0020, included an insecticidal component, seeds treated with G 7009 were planted as inoculated controls. Emerged seedlings were counted on 18 June. At maturity (October 7), plants were harvested and seed was weighed to determine yield. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Emergence was significantly ($P \leq 0.05$) greater for all of the inoculated fungicide treatments compared to G 7009, the insecticide-treated control (Table 1). Emergence was significantly greater for plots treated with L 1100 than for those treated with G 7061 (either alone or in addition to L 0121), G 7047, G 7070, or G 2787 + L 0020. Emergence was significantly greater for plots treated with G 7074 than for those treated with G 7061 (alone), G 7047, G 7070, or G 2787 + L 0020. Emergence was

significantly greater for plots treated with G 7082 than for those treated with G 7061 (alone), G 7070, or G 2787 + L 0020. Emergence was significantly greater for plots treated with G 7073 than for those treated with G 7061 (alone) or G 2787 + L 0020. Yield was significantly ($P \leq 0.05$) greater than the insecticide-treated, inoculated control (G 7009) for G 2787 + L 0020 and for G 7061 (alone).

CONCLUSIONS: All treatments improved emergence over the inoculated control. The order of efficacy with respect to emergence counts was: L1100, G 7074, G 7073, G 7082, G 7061 + L 0121, G 7047, G 7070, G 2787 + L 0020, and G 7061 (alone). Only G 2787 + L 0020 and G 7061 (alone) improved yield compared to the inoculated control.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of the canola cv. DKL 3235 grown in a field plot inoculated with *Fusarium avenaceum* at Vegreville, Alberta in 2004.

Treatment	Rate (ml/kg seed)	Stand (plants/m ^{2})	Yield (t/ha)
G 7009 (non-inoculated)	3.33	30.3 a[1]	3.55 a
G 7009 [2]	3.33	15.4 f	1.45 c
G 2787 + L 0020	8.33 + 0.16	23.2 e	2.63 b
G 7061	14	22.8 e	2.40 b
G 7061 + L 0121	14.0 + 0.5	26.3 bcde	1.90 bc
G 7047	16.67	25.0 cde	2.06 bc
G 7070	13.33	24.7 de	1.92 bc
G 7073	14	28.3 abcd	1.91 bc
G 7074	14	29.9 ab	2.00 bc
G 7082	14	28.2 abc	1.93 bc
L 1100	15	30.9 a	2.03 bc

[1] Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test ($P \leq 0.05$).
[2] This and all subsequent treatments were inoculated with *Fusarium avenaceum* at the time of seeding.

2004 PMRR REPORT # 101

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
ICAR: 61009653

CROP: Clover (*Melilotus officinalis* (L.) Lam.), cv. Carlton
PEST: Seedling blight, *Rhizoctonia solani* Kühn, *Fusarium avenaceum* (Corda) Sacc.

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TITLE: EVALUATION OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF SEEDLING BLIGHT OF SWEET CLOVER CAUSED BY *RHIZOCTONIA SOLANI* AND *FUSARIUM AVENACEUM* IN ALBERTA IN 2004

MATERIALS: DFC (difenconazole 360 g/L SU), TRIBUNE (difenconazole, 1.61%, metalaxyl M, 0.51%, fludioxonil, 0.17%), APRON XL (metalaxyl M, 33.3% LS), MAXIM 480 (fludioxonil, 480g/L FS) APRON MAXX (fludioxonil, 0.73%; metalaxyl M, 1.1%).

METHODS: Seed of the sweet clover cv. Carlton was treated in a Hege II small batch seed treater with APRON XL at 0.225 or 0.45 ml/kg seed, either alone or combined with MAXIM 480 at 0.052 ml/kg seed, with MAXIM 480 at 0.052 or 0.104 ml/kg seed, TRIBUNE at 14.85 ml/kg seed, DFC at 0.24 g ai/kg seed or with APRON MAXX at 2.13 or 4.25 ml/kg seed. Experimental plots were established on 17 May, 2004 at Vegreville, Alberta in a black chernozemic sandy loam soil and on 8 June at Edmonton, Alberta in a black chernozemic clay loam soil. Plots were seeded in a randomized complete block design with four replications. Each plot consisted of four, 4 m rows of plants spaced 25 cm apart. Seeds were planted 1 cm deep at a rate of 0.6 g of seeds per row. *Rhizoctonia solani* and *Fusarium avenaceum* were grown on sterilized oat grains for 14 days, dried, ground, and incorporated as inoculum at the time of seeding at the rate of 20 ml/row. Non-treated seeds were planted as inoculated and non-inoculated controls. Seedlings were counted for each plot on 22 July at Vegreville and on 5 August at Edmonton. Vigour was assessed visually and plots were harvested by hand-cutting the plants on 17 August at Edmonton and on 13 August at Vegreville. The material collected was dried and weighed to determine yield. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Emergence was significantly greater ($P \leq 0.05$) than the *Fusarium*-inoculated control for MAXIM and APRON MAXX, at the low rates at Vegreville (Table 1). Plots treated with APRON XL at the low rate or APRON XL+ MAXIM, TRIBUNE, or APRON MAXX at either rate showed significantly greater emergence than the inoculated control at Edmonton (Table 2). Emergence was significantly greater than the *Rhizoctonia*-inoculated control for TRIBUNE, MAXIM, APRON XL + MAXIM, and both APRON MAXX treatments at both sites. Vigour in the *Fusarium*-treated plots was significantly

greater than in the inoculated control in plots treated with TRIBUNE, MAXIM, APRON XL + MAXIM and APRON MAXX at Vegreville and for plots treated with TRIBUNE, MAXIM at the higher rate, APRON XL + MAXIM, and APRON MAXX at the higher rate at the Edmonton site. Vigour in the *Rhizoctonia*- inoculated plots was significantly greater than the inoculated control for all treatments except DFC and APRON XL at both sites. Yield was not different than that of the *Fusarium*-inoculated control for either site. Yield significantly exceeded that of the *Rhizoctonia*-inoculated control for TRIBUNE, both MAXIM treatments, and both APRON MAXX treatments at Vegreville, but only for TRIBUNE at Edmonton.

CONCLUSIONS: In general, plots treated with APRON MAXX and TRIBUNE showed the greatest improvement in emergence, vigour and yield compared to the inoculated control. In some cases, MAXIM showed improvement over the inoculated controls and in one case emergence of plots treated with APRON XL exceeded the control, but DFC showed no improvement over the inoculated controls.

Table 1. Effects of fungicidal seed treatments on plant stand, vigour and forage yield of clover cv. Carlton grown in soil inoculated with *Rhizoctonia solani* or *Fusarium avenaceum* at Vegreville, Alberta in 2004.

Treatment	Rate (mL/kg seed)	Emergence (plants/m^2)			Vigour (Percent)			Forage yield (t/ha)		
		Control	Fusarium	Rhizoc.	Control	Fusarium	Rhizoc.	Control	Fusarium	Rhizoc.
Non-inoculated Control	--	56.3 a[1]	47.4 a	45.2 a	90.0 a	85.0 a	85.0 a	0.99 a	0.98 a	1.01 a
Control[2]	--	47.0 a	16.7 de	12.4 d	87.5 ab	45.0 c	35.0 e	1.10 a	0.35 b	0.28 c
TRIBUNE	14.85	61.9 a	29.0 bcd	33.9 ab	87.5 ab	72.5 ab	60.0 bcd	0.97 a	0.46 b	0.64 b
DFC	0.67	59.0 a	17.6 de	18.9 cd	85.0 b	62.5 abc	57.5 cde	0.94 a	0.48 b	0.40 bc
MAXIM	0.052	51.8 a	35.4 b	30.8 bc	87.5 ab	75.0 ab	70.0 abc	1.19 a	0.61 ab	0.64 b
MAXIM	0.104	53.9 a	26.9 bcde	30.7 bc	92.5 ab	80.0 ab	82.5 ab	0.93 a	0.62 ab	0.67 b
APRON XL	0.225	54.3 a	15.1 e	15.1 d	95.0 ab	55.0 bc	40.0 de	1.09 a	0.37 b	0.29 c
APRON XL	0.45	58.1 a	17.7 de	15.9 d	92.5 ab	67.5 abc	52.5 cde	0.93 a	0.41 b	0.42 bc
APRON XL + MAXIM	0.45 + 0.025	62.2 a	21.4 cde	30.9 bc	92.5 ab	70.0 ab	75.0 abc	0.99 a	0.65 ab	0.58 bc
APRON MAXX	2.13	48.0 a	31.3 bc	30.0 bc	90.0 ab	87.5 a	82.5 ab	0.85 a	0.75 ab	0.70 b
APRON MAXX	4.25	60.5 a	28.9 bcd	40.0 ab	97.5 a	65.0 abc	82.5 ab	1.25 a	0.51 b	0.67 b

[1] Means followed by the same letter within a column are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test

[2] This and subsequent treatments inoculated with *Rhizoctonia solani* or *Fusarium avenaceum*, or left without inoculum, according to the column heading.

Table 2. Effects of fungicidal seed treatments on plant stand, vigour and forage yield of clover cv. Norlac grown in soil inoculated with *Rhizoctonia solani* or *Fusarium avenaceum* at Edmonton, Alberta in 2004.

Treatment	Rate	Emergence (plants/m^2)			Vigour (Percent)			Forage yield (t/ha)		
	(mL/kg seed)	Control	Fusarium	Rhizoc.	Control	Fusarium	Rhizoc.	Control	Fusarium	Rhizoc.
Non-inoculated Control	--	48.9 b[1]	49.6 a	51.4 a	90.0 a	82.5 a	85.0 a	0.52 a	0.66 a	0.59 a
Control[2]	--	55.9 ab	23.3 d	7.6 fg	87.5 a	57.5 b	15.0 d	0.63 a	0.35 bcd	0.06 c
TRIBUNE	14.85	56.2 ab	41.6 abc	35.3 b	85.0 a	82.5 a	72.5 ab	0.59 a	0.55 abcd	0.41 ab
DFC (g ai)	0.24	54.0 ab	31.9 bcd	12.2 f	82.5 a	72.5 ab	32.5 d	0.50 a	0.40 abcd	0.17 c
MAXIM	0.052	51.0 ab	33.0 bcd	19.3 e	85.0 a	67.5 ab	52.5 c	0.62 a	0.31 d	0.17 c
MAXIM	0.104	57.9 ab	38.1	24.8 d	85.0 a	82.5 a	65.0 bc	0.47 a	0.50 abcd	0.24 bc
APRON XL	0.225	57.9 ab	43.2 ab	6.8 g	82.5 a	70.0 ab	22.5 d	0.46 a	0.33 cd	0.08 c
APRON XL	0.45	58.3 ab	27.0 cd	8.3 fg	85.0 a	57.5 b	20.0 d	0.66 a	0.32 d	0.10 c
APRON XL + MAXIM	0.45 + 0.025	57.6 ab	40.1 abc	26.5 cd	85.0 a	86.7 a	65.0 bc	0.48 a	0.63 ab	0.26 bc
APRON MAXX	2.13	61.1 a	40.7 abc	26.6 cd	87.5 a	75.0 ab	55.0 bc	0.58 a	0.62 abc	0.23 bc
APRON MAXX	4.25	59.1 ab	46.0 ab	30.7 bc	85.0 a	80.0 a	67.5 bc	0.48 a	0.40 abcd	0.23 bc

[1] Means followed by the same letter within a column are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test

[2] This and subsequent treatments inoculated with *Rhizoctonia solani* or *Fusarium avenaceum*, or left without inoculum, according to the column heading.

2004 PMRR REPORT # 102

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
ICAR: 61006537

CROP: Corn, (*Zea maize* L.), cv D73
PEST: *Fusarium graminearum.* DAOM 212678, DAOM 180378

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TITLE: CONTROL OF SEEDLING DISEASE IN CORN WITH SEED TREATMENTS

MATERIALS: MAXIM XL 324 FS (fludioxonil + metalaxyl-M, 229.59 + 87.66 g ai/L); ALLEGIANCE 317 FL (metalaxyl-M, 317 g ai/L); JAU 6476 (triazolinthion, 100 g ai/L); L1028-C4 (Experimental); L1401-A1 (Experimental; L1226-C1 (Experimental).

METHODS: Seed was treated on 18 May, 2004 in 500 g lots in individual plastic bags by applying the treatment or slurry via a syringe to each bag (all treatments diluted to the same volume of 1.25 ml/kg seed using water). The seed was then mixed for 1 min in the inflated bag to ensure thorough seed coverage. Seed weight was 277 g/1000 seeds. The crop was planted on 28 May, 2004 at Ridgetown using a 2-row cone seeder at a seeding rate of 8 seeds/m. Plots were 4 rows spaced 0.76 m apart and 4 m in length placed in a RCBD with 4 replications. The centre 2 rows were inoculated at planting with *Fusarium graminearum* at a rate of 20 g/m. The inoculum was prepared by soaking 1 kg corn in 600 ml distilled water for 2 hours in plastic 4 L capped bottles, pouring off excess water and autoclaving the bottles for 30 min. A second autoclaving was done after 2 days. Corn was then inoculated with 4-5 small plugs of 2 strains *of Fusarium graminearum* growing on Potato Dextrose Agar (PDA) and incubated at Room Temperature under fluorescent light banks for 2 weeks, shaking the bottles every 2 days until corn was fully infected with the fungus. Infected corn was ground in a Romer Mill® and weighed into packages of 20 g each. The plots were fertilized and maintained according to provincial recommendations. Emergence was evaluated on 8 June and plant stand was assessed on 15 and 22 June, 2004. Vigor was assessed on the same dates using a scale of 0-100% (100 = furthest developed and healthiest plant in the trial and 0 = plant dead). Plots were harvested on 11 Nov, 2004 and yields corrected to 14.5% moisture. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at $P = 0.05$.

RESULTS: See Tables 1 and 2.

CONCLUSIONS: The quickest emergence in the presence of Fusarium inoculum was provided by the experimental compound L1226-C1. The last four treatments had significantly better seedling vigor tan the inoculated controls, but this was not reflected in yield, where there were no differences.

Table 1. Emergence and plant stand assessments in corn at Ridgetown, Ontario; 2004

Treatment	Rate	Emergence	Plant Stand	
	g ai/100 kg	Number plants/2 row		
		8 June	15 June	22 June
UNTREATED INOCULATED CHECK		51 c *	60	60
NON-INOCULATED CHECK	0	59 a	62	63
MAXIM XL 324 FS	3.5	55 abc	62	62
ALLEGIANCE FL	2	52 bc	61	61
ALLEGIANCE FL	2	51 c	61	62
+L1266-C1 (Experimental)	2			
ALLIGIANCE FL	2	55 abc	61	63
+L1266-C1 (Experimental)	2			
MAXIM XL 324 FS	3.5	59 a	63	63
+L1266-C1 (Experimental)	2			
ALLIGIANCE FL	2	57 ab	61	62
+L1028-C4 (Experimental)	1.5			
L1226-C1 (Experimental)	2	56 abc	61	61
+JAU 6476	15			
+ALLEGIANCE FL	2			
L1401-A1(Experimental)	5	55 abc	62	63
CV		6.9	3.7	3.6

* Means followed by same letter do not significantly differ (*P*=.05, LSD)

Table 2. Vigour, yield and test weight assessments in corn at Ridgetown, Ontario; 2004.

Treatment	Rate	Vigor			Yield	Test Wt
	g ai/100 kg	0-100 %			T/ha	kg/hl
		8 June	15 June	22 June	11 Nov	
UNTREATED INOCULATED CHECK		70	72.5	70.0 b *	6.21	68.74
NON-INOCULATED CHECK	0	87.5	90	92.5 a	6.56	67.84
MAXIM XL 324 FS	3.5	85	85	82.5 ab	6.39	68.99
ALLEGIANCE FL	2	77.5	80	80.0 ab	6.03	64.22
ALLEGIANCE FL	2	80	82.5	82.5 ab	6.23	67.67
+L1266-C1 (Experimental)	2					
ALLIGIANCE FL	2	80	82.5	82.5 ab	6.56	68.49
+L1266-C1 (Experimental)	2					
MAXIM XL 324 FS	3.5	85	82.5	87.5 a	6.63	68.16
+L1266-C1 (Experimental)	2					
ALLIGIANCE FL	2	85	87.5	90.0 a	6.15	68.94
+L1028-C4 (Experimental)	1.5					
L1226-C1 (Experimental)	2	85	85	92.5 a	5.81	68.58
+JAU 6476	15					
+ALLEGIANCE FL	2					
L1401-A1(Experimental)	5	80	80	85.0 a	5.99	68.16
CV		15.1	12.2	10.5	8.7	5

* Means followed by same letter do not significantly differ (*P*=.05 LSD)

2004 PMRR REPORT # 103

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
ICAR: 61006537

CROP: Soybean, (*Glycine max* (L.) Merrill), cv Revenge (Round-up Ready)
PEST: Fusarium root rot, *Fusarium solani* (Mart) Sacc. F. sp. *Phaseoli* (Burkholder)

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TITLE: SOYBEAN SEED TREATMENTS FOR SEEDLING DISEASES

MATERIALS: VITAFLO 280 (carbathiin + thiram, 169.90 + 150.60 g ai/L); TFS-METALAXYL RTU (metalaxyl + trifloxystrobin, 10.80 + 13.50 g ai/L); ALLEGIANCE 317 FL (metalaxyl-M, 317 g ai/L); APRON MAXX RTA 19.05 FS (fludioxonil + metalaxyl-M, 7.69 +11.54 g ai/L); YIELD SHIELD (*Bacillus pumulus).*

METHODS: Seed was treated on 25 May, 2004 in 1 kg lots in individual plastic bags by applying the treatment or slurry via a syringe to each bag (all treatments diluted to the same volume of 3.1 ml/kg seed using water). The seed was then mixed for 1 min in the inflated bag to ensure thorough seed coverage. Seed weight was 136 g/1000 seeds. The crop was planted on 8 June, 2004 at Ridgetown, ON using a 2-row cone seeder at a seeding rate of 20 seeds/m. Plots were 4 rows spaced 0.76 m apart and 4 m in length placed in a RCBD with 4 replications. The centre 2 rows were inoculated at planting with *Fusarium solani* sp. *phaseoli* at a rate of 20 g/m. The inoculum was prepared by soaking 500 g hulless oats in 20% V-8 Juice for 2 hours in plastic 4 L capped bottles, pouring off excess juice and autoclaving the bottles for 30 min. A second autoclaving was done after 2 days. Oats were then inoculated with 4-5 small plugs of *Fusarium solani* growing on Potato Dextrose Agar (PDA) and incubated at room temperature in the dark for 2 weeks, shaking the bottles every 2 days until oats were fully infected with the fungus. Infected oats were ground in a Romer Mill and weighed into packages of 80 g each. The plots were fertilized and maintained according to provincial recommendations. Emergence was evaluated on 21 June, 2004 and plant stand was assessed on 28 June, and 5 July, 2004. Vigour was assessed on the same dates using a scale of 0-100% (100 = furthest developed and most healthy plant in the trial and 0 = plant dead). Plots were harvested on 27 Oct, 2004 and yields corrected to 14.5% moisture. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at $P = 0.05$.

RESULTS: See Tables 1 and 2.

CONCLUSIONS: Inoculations with F. solani did not affect plant stand or plant vigor. TFS-METALAXYL RTU alone and ALLEGIANCE in combination with VITAFLO 280 slowed emergence significantly and reduced plant vigour. No significant differences in yield were noted at harvest.

Table 1. Emergence and plant stand assessments in soybeans at Ridgetown, Ontario; 2004

Treatment	Rate g ai/100 kg	Emergence	Plant Stand	
		Number plants/2 row		
		21 June	28 June	5 July
UNTREATED INOCULATED CHECK		109 abc *	116 a	114
UNTREATED NON-INOCULATED CHECK		119 ab	120 a	123
VITAFLO 280	83	124 a	124 a	118
TFS-METALAXYL RTU	9	95 bc	95 c	91
VITAFLO 280	83	87 c	95 bc	93
+ALLEGIANCE FL	4.1			
APRON MAXX RTA	6.3	123 a	125 a	123
YIELD SHIELD	6.5	119 ab	115 ab	115
YIELD SHIELD	6.5	109 abc	116 a	114
+TFS-METALAXYL RTU	9			
CV		15.3	12	14.7

* Means followed by same letter do not significantly differ (*P*=.05 LSD)

Table 2. Vigour and yield assessments in soybeans at Ridgetown, Ontario; 2004.

Treatment	Rate g ai/100 kg	Vigour 0-100 %			Yield T/ha
		21 July	28 July	5 July	
UNTREATED INOCULATED CHECK		75.0 ab *	77.5 ab	75.0 ab	4.12
UNTREATED NON-INOCULATED CHECK		85.0 a	85.0 a	87.5 a	4.49
VITAFLO 280	83	87.5 a	85.0 a	72.5 ab	4.29
TFS-METALAXYL RTU	9	62.5 b	62.5 b	60.0 bc	3.95
VITAFLO 280	83	60.0 b	60.0 b	50.0 c	3.83
+ALLEGIANCE FL	4.1				
APRON MAXX RTA	6.3	87.5 a	85.0 a	82.5 a	4.22
YIELD SHIELD	6.5	87.5 a	87.5 a	72.5 ab	3.96
YIELD SHIELD	6.5	75.0 ab	85.0 a	85.0 a	4.42
+TFS-METALAXYL RTU	9				
CV		17.8	16.8	19.5	8.2

* Means followed by same letter do not significantly differ (*P*=.05 LSD)

2004 PMRR REPORT # 104

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS -Diseases
ICAR: 61006537

CROP: Soybean, (*Glycine max* (L.) Merrill), cv Revenge (Round-up Ready)
PEST: Damping off, *Rhizoctonia solani* Kühn

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TITLE: SOYBEAN SEED TREATMENTS FOR RHIZOCTONIA DAMPING OFF

MATERIALS: VITAFLO 280 (carbathiin + thiram, 169.90 + 150.60 g ai/L); TFS-METALAXYL RTU (metalaxyl + trifloxystrobin, 10.80 + 13.50 g ai/L); ALLEGIANCE 317 FL (metalaxyl-M, 317 g ai/L); APRON MAXX RTA 19.05 FS (fludioxonil + metalaxyl-M, 7.69 + 11.54 g ai/L); YIELD SHIELD (*Bacillus pumulus).*

METHODS: Seed was treated on 25 May, 2004 in 1 kg lots in individual plastic bags by applying the treatment or slurry via a syringe to each bag (all treatments diluted to the same volume of 3.7 ml/kg seed using water). The seed was then mixed for 1 min in the inflated bag to ensure thorough seed coverage. Seed weight was 136 g/1000 seeds. The crop was planted on 8 June, 2004, at Ridgetown and on 1 June, 2004, at Huron Research Station using a 2-row cone seeder. Plots were 4 rows spaced 0.76 m apart and 4 m in length placed in a RCBD with 4 replications. The centre 2 rows were inoculated at planting with *Rhizoctonia solani* at a rate of 1 g inoculum/m. The inoculum was prepared by soaking 500 g hulless oats in 20% V-8 Juice for 2 hours in plastic 4 L capped bottles, pouring off excess juice and autoclaving the bottles for 30 min. A second autoclaving was done after 2 days. Oats were then inoculated with 4-5small plugs of *Rhizoctonia solani* growing on Potato Dextrose Agar (PDA) and incubated at room temperature in the dark for 2 weeks, shaking the bottles every 2 days until oats were fully infected with the fungus. Infected oats were ground in a Romer Mill® and weighed into packages of 24 g each (4 g inoculum + 20 g sterilized oats) for uniform spread of inoculum. The plots were fertilized and maintained according to provincial recommendations. Emergence was evaluated in two inoculated rows on 21 June at Ridgetown and on 14 June at Huron Research Station. Plant stand was assessed on 28 June and 5 July at Ridgetown and on 21 and 28 June at Huron Research Station. Vigor was assessed on the same dates using a scale of 0-100% (100 = furthest developed and most healthy plant in the trial and 0 = plant dead). Plots were harvested at Ridgetown on 27 Oct, 2004 and yields corrected to 14.5% moisture. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at P= 0.05.

RESULTS: See Table 1- 4. Plots at Huron Research Station were not harvested due to poor stand.

CONCLUSIONS: At the Ridgetown site emergence was significantly quicker with the combination of VITAFLO and ALLEGIANCE than the inoculated check. However, plant stands in all the treated plots were not significantly different from the untreated/inoculated plots by 28 June, suggesting that the protection was only effective in new seedlings. There were no late vigor or yield differences among treatments in inoculated plots at Ridgetown. Plant loss due to inoculation was severe at the Huron site but there was no effect on late plant stands or vigor measurements. Perhaps in some plots the inoculation was more severe than might occur in nature, and the test results may not reflect the performance of the treatments under natural conditions.

Table 1. Emergence and plant stand assessments in soybeans at Ridgetown, Ontario; 2004

Treatment	Rate	Emergence	Plant Stand	
	g ai/100 kg	Number plants/2 row		
		21 June	28 June	5 July
UNTREATED INOCULATED CHECK		77 c *	47 b	42 b
UNTREATED NON-INOCULATED CHECK		124 a	120 a	120 a
VITAFLO 280	83	83 bc	40 b	37 b
TFS-METALAXYL RTU	9	90 bc	41 b	38 b
VITAFLO 280	83	97 b	56 b	46 b
+ALLEGIANCE FL	4.1			
APRON MAXX RTA	6.3	95 bc	48 b	35 b
YIELD SHIELD	6.5	83 bc	54 b	49 b
YIELD SHIELD	6.5	93 bc	45 b	39 b
+TFS-METALXYL RTU	9			
CV		14.2	35.5	31.1

* Means with the same letter do not significantly differ (*P*=.05 LSD)

Table 2. Vigour and yield assessments in soybeans at Ridgetown, Ontario; 2004

Treatment	Rate	Vigor			Yield
	g ai/100 kg	0-100 %			T/ha
		21 June	28 June	5 July	27 Oct
UNTREATED INOCULATED CHECK		62.5 c *	47.5 b	32.5 b	0.94 b
UNTREATED NON-INOCULATED CHECK		95.0 a	100 a	100 a	1.75 a
VITAFLO 280	83	70.0 bc	45.0 b	35.0 b	1.00 b
TFS-METALAXYL RTU	9	75.0 bc	37.5 b	27.5 b	1.05 b
VITAFLO 280	83	80.0 abc	52.5 b	40.0 b	0.95 b
+ALLEGIANCE FL	4.1				
APRON MAXX RTA	6.3	85.0 ab	42.5 b	32.5 b	0.91 b
YIELD SHIELD	6.5	67.5 bc	55.0 b	42.5 b	1.01 b
YIELD SHIELD	6.5	77.5 abc	50.0 b	35.0 b	0.95 b
+TFS-METALXYL RTU	9				
CV		15.7	30	31.1	18.1

* Means with the same letter do not significantly differ (*P*=.05 LSD)

Table 3. Emergence and plant stand assessments in soybeans at Huron Research Station, Ontario; 2004

Treatment	Rate	Emergence	Plant Stand	
	g ai/100 kg	Number plants/2 row		
		14 June	21 June	28 June
UNTREATED INOCULATED CHECK		16 b **	7 b **	7 b **
UNTREATED NON-INOCULATED CHECK		100 a	100 a	100 a
VITAFLO 280	83	20 b	7 b	7 b
TFS-METALAXYL RTU	9	31 b	12 b	10 b
VITAFLO 280	83	20 b	9 b	9 b
+ALLEGIANCE FL	4.1			
APRON MAXX RTA	6.3	18 b	9 b	8 b
YIELD SHIELD	6.5	16 b	9 b	8 b
YIELD SHIELD	6.5	21 b	9 b	10 b
+TFS-METALXYL RTU	9			
CV		22.1	20.8	21.1

** Means with the same letter do not significantly differ (*P*=.05 LSD)
** Means with the same letter do not significantly differ (*P*=.05 LSD), data transformed by arsine square root for means separation and CV, means not de-transformed.

Table 4. Vigour assessments in soybeans at Huron Research Station, Ontario; 2004

Treatment	Rate	Vigour		
	g ai/100 kg	0-100 %		
		14 June	21 June	28 June
UNTREATED INOCULATED CHECK		27.5 bc *	32.5 b	32.5 b
UNTREATED NON-INOCULATED CHECK		88.8 a	97.5 a	97.5 a
VITAFLO 280	83	30.0 bc	32.5 b	32.5 b
TFS-METALAXYL RTU	9	35.0 b	30.0 b	30 b
VITAFLO 280	83	35.0 b	32.5 b	27.5 b
+ALLEGIANCE FL	4.1			
APRON MAXX RTA	6.3	32.5 bc	30.0 b	30 b
YIELD SHIELD	6.5	25.0 c	30.0 b	32.5 b
YIELD SHIELD	6.5	32.5 bc	27.5 b	27.5 b
+TFS-METALXYL RTU	9			
CV		15.7	16.2	19.3

* Means with the same letter do not significantly differ (*P*=.05 LSD)

2004 PMRR REPORT # 105

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS – Diseases
ICAR :

CROP: Winter wheat (*Triticum aestivum* L.), cv. several
PEST: Fusarium head blight, *Fusarium graminearum* Schwabe

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TITLE: NUWWSN TEST- EVALUATION OF WINTER WHEAT CULTIVARS AND BREEDING LINES FOR RESISTANCE TO FUSARIUM HEAD BLIGHT (FHB) IN ARTIFICIALLY INOCULATED, MISTED PLOTS

METHODS: The crop was planted on October 22, 2003 at Ridgetown, Ontario using a 8-row cone seeder at 270 seeds/plot. The cultivars and breeding lines represent Northern Uniform Winter Wheat Scab Nursery (NUWWSN) test established across North America. For the second time five lines from Ridgetown College FHB breeding program (RCAT) were entered to the test. Plots were one row, planted 4 m in length, and placed in a randomized block design with four replications. The plots were fertilized and maintained using provincial recommendations. Each plot was inoculated with a 50-ml suspension of macroconidia of *F. graminearum* 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's 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 produced one 8 s burst every minute from 10:00 to 16:00 h each day, delivering about 7.5 mm of water daily. Each variety was assessed for visual symptoms when the early dough stage was reached (ZGS 83). Fifty wheat heads were selected at random out of each plot, and rated in the field for disease incidence and severity using the scoring system developed by Stack and McMullen. A fusarium head blight index (FHBI) was applied to the data, which was the product of the percent heads infected and the percent spikelets infected/100.

RESULTS: The results are given in the Table 1.

CONCLUSIONS: Variety '981517A1-1-5-2' had lowest (0.9%), while variety 'KY97C-0151-1' had the highest (36.7%) FHB index. Correlation between FHB index and severity was r=0.99 and between FHB index and incidence was r=0.86. Both heading date (r=-0.24) and height (r=-0.36) significantly ($P<0.001$) negatively correlated with FHB index. For the second year in a row line RCATL33 was the most resistant line among lines from our breeding program.

Table 1: Fusarium head blight reaction of winter wheat varieties in artificially inoculated and misted plots at Ridgetown, Ontario. 2003-2004.

Variety	Heading date	Height (inches)	Severity (%)	Incidence (%)	FHB Index (%)
PIONEER 2545	147	34.5	35.88	90.0	32.28
ERNIE	144	33.3	10.13	82.5	8.59
FREEDOM	149	38.5	20.50	90.0	18.90
IL97-6755	145	43.0	2.50	42.5	1.08
PATTERSON	145	35.8	37.75	92.5	35.05
TRUMAN	149	38.8	5.00	50.0	2.50
97397J1-4-1-4-7	145	34.3	18.00	87.5	16.03
981238A1-1-44-1	142	35.5	6.88	70.0	5.10
981312A1-6-2-2	147	32.8	14.25	77.5	11.93
981517A1-1-5-2	155	35.3	2.25	40.0	0.90
992128A2-4-1	143	32.5	28.25	90.0	26.16
VAN98W-342	146	29.8	16.75	77.5	13.90
VA03W-630	154	36.0	12.75	67.5	8.85
VA03W-633	147	31.5	29.13	95.0	27.58
VA03W-644	142	31.0	18.50	90.0	16.98
VA03W-674	143	32.8	17.75	85.0	15.48
IL96-24851-1	147	32.3	16.50	87.5	14.90
IL99-27048	143	35.0	5.13	42.5	2.95
IL00-8061	145	37.8	9.25	67.5	6.43
IL00-1665	147	36.0	12.13	70.0	9.53
IL99-20756	141	36.5	4.38	60.0	3.19
KY97C-0151-1	145	36.5	38.50	95.0	36.68
KY96C-0895-1	158	40.0	15.25	60.0	9.28
KS00HW175-4	149	37.3	11.38	72.5	9.28
KS950409-P-4	148	36.5	21.38	97.5	20.95
MD27-37	143	36.0	15.50	87.5	14.35
MO010925	149	39.0	8.88	62.5	5.84
MO010789	150	41.5	6.75	55.0	3.96
MO010574	151	38.0	15.38	80.0	14.45
MO010719	146	42.8	8.75	60.0	6.28
MO011130	149	43.0	20.25	82.5	18.28
NY88046-8138	153	40.3	14.75	77.5	11.58
Caledonia Resel-T	154	38.5	16.00	85.0	13.70
NY91028-9073	154	39.5	12.38	72.5	9.28
NY91028SP-9245W	154	38.0	5.88	55.0	3.43
NY89025-9111W	154	39.5	10.88	67.5	7.58
OH743	149	39.5	23.75	87.5	21.18
OH751	148	38.3	19.75	87.5	17.30
OH776	146	35.3	29.50	95.0	27.76
OH788	144	37.8	8.63	65.0	6.16
OH790	147	37.8	23.50	90.0	21.38
X00-1051	148	33.8	15.00	77.5	11.88
X00-1058	148	34.3	15.00	80.0	12.25
Y00-3044	148	35.0	30.25	87.5	26.70
E2057	150	33.8	12.13	65.0	8.80

E2038	153	37.0	12.75	65.0	9.50
E2048	153	41.0	12.00	70.0	8.70
E2037	152	38.5	9.88	62.5	6.41
E0009	154	41.5	7.38	60.0	4.63
RCATL33	146	45.5	3.13	47.5	1.53
RCATL10	151	43.3	25.75	92.5	24.10
RCATL24	154	46.0	3.50	47.5	1.81
RCATL12	151	45.8	8.13	57.5	5.14
RCAT L2	153	44.3	12.25	95.0	11.68
WESLEY	148	35.3	30.50	92.5	28.58
NE98466	147	38.5	11.00	70.0	7.90
MEAN	148.5	37.5	15.4	74.3	13.0
LSD (0.05)	3.7	1.7	8.6	17.7	8.9
CV (%)	1.8	3.2	40.1	17.0	49.3

2004 PMRR REPORT # 106

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
ICAR:

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) IN ARTIFICIALLY INOCULATED, MISTED PLOTS-ONTARIO PERFORMANCE TRIAL

METHODS: The crop was planted on October 20, 2003 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 suspension of macroconidia of four *F. graminearum* isolates at 50,000 spores/ml, when primary wheat heads were at 50% anthesis for each variety (Zadoks growth stage 65). The suspension was produced in liquid shake culture using modified Bilay's 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 produced one 8 s burst every minute from 10:00 to 16:00 h each day, delivering about 7.5 mm of water daily. Each variety was assessed for visual symptoms when the early dough stage was reached (ZGS 83). Fifty 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. Disease levels were calculated as fusarium head blight index (FHBI), which was the product of the percent heads infected and the percent spikelets infected/100. Deoxynivalenol (DON) content was estimated with three replications with highest FHB index using a quantitative fluorometric test-FluoroQuan (Romer® Labs, Inc, Union MO). The number of healthy and Fusarium damaged kernels (FDK) were counted from the three replications with highest FHB index and % of FDK were calculated.

RESULTS: The results are given below.

CONCLUSIONS: The highest correlation was between FDK and DON (r=0.66), while correlations between FHB index and FDK and between FHB index and DON were r=0.49 and r=0.21, respectively. Range for FHB index, DON and FDK values were 1.2-47%; 1.5-35.0 ppm and 4.5-21.4%, respectively. Variety 'Platinum' had lowest FHB index, 'Wisdom' had lowest DON level and 'Genesis D8006' had lowest FDK. The most common commercial cultivars in ON are: 25R49, 25R23, 25R47, Vienna, Wisdom and Superior.

Table 1: Fusarium head blight reaction of winter wheat cultivars in *F.graminearum* artificially inoculated and misted plots at Ridgetown, Ontario. 2003-2004.

	Severity (%)	Incidence (%)	FHB (%)	Rank	DON (ppm)	Rank	FDK (%)	Rank
AC RON	28.3	90.0	26	26	13.2	32	12.7	28
AC MORLEY	24.3	82.5	20.3	19	6.2	13	6.7	6
SUPERIOR	17.1	77.5	13.4	14	19.7	37	13.5	30
AC MACKINNON	50.9	92.5	47.7	38	19.3	36	14.9	32
AC MOUNTAIN	30.6	87.5	27.1	27	9.5	22	9.7	17
AC ESSEX	30.3	92.5	28.7	29	12.1	29	13.4	29
MAXINE	26.3	92.5	24.9	22	7.4	16	11.8	27
CALEDONIA	42.6	87.5	37.7	36	13.0	31	10.2	19
WISDOM	8.8	75.0	6.7	6	1.5	1	4.6	2
PLATINUM	2.5	45.0	1.2	1	9.1	21	8.3	11
WHITBY	12.9	67.5	10.8	11	7.9	18	7.0	8
WEBSTER	34.1	95.0	32.4	32	7.4	17	14.8	31
WARWICK	26.8	95.0	25.8	25	10.8	26	8.1	9
WARTHOG	11.6	70.0	8.9	9	3.1	2	6.7	7
25R49	35.5	92.5	33.3	33	13.5	33	21.4	38
PRO 202	45.3	87.5	40.0	37	6.5	15	11.1	25
WHITNEY	39.5	92.5	36.5	35	14.7	34	16.8	35
SISSON	26.3	97.5	25.4	24	11.1	27	16.9	36
25R23	30.6	97.5	30.1	31	5.5	11	9.7	18
HARVARD	25.5	82.5	21.2	20	7.9	19	11.1	26
CARLISLE	8.9	77.5	7.5	7	3.8	4	6.1	4
VIENNA	11.5	80.0	9.5	10	5.3	10	4.9	3
KRISTY	15.1	80.0	13.5	15	4.7	6	8.2	10
WONDER	12.3	70.0	8.8	8	8.0	20	10.7	23
AC SAMSON	14.6	82.5	12.2	12	11.9	28	16.6	34
TW060:075	19.9	92.5	18.6	17	35.0	38	18.0	37
25R47	22.5	77.5	17.3	16	3.6	3	6.4	5
VA98W-586	36.9	92.5	35.4	34	6.2	12	10.5	22
OTFO13:081	8.8	62.5	6.1	5	10.5	24	9.0	13
TWF020:038	7	62.5	5.0	4	14.7	35	9.6	16
25W41	15.5	80.0	12.6	13	6.4	14	9.5	15
26R15	33.3	85.0	28.2	28	10.1	23	15.1	33
25R35	4.8	60.0	2.9	2	4.9	8	8.5	12
CM99058	6.4	72.5	4.7	3	12.2	30	10.9	24
VA98W-593	24.8	87.5	21.9	21	4.1	5	9.2	14
RICHLAND	31.5	92.5	29.9	30	10.7	25	10.4	21
GEN D8006	22.5	85.0	19.3	18	4.9	9	4.5	1
TWO44-094	27.5	90.0	24.9	23	4.7	7	10.3	20
Mean	23	82.4	20.4		9.5		10.7	
LSD (*P*=0.5)	12.5	14.8	13.2		7.3		4.9	
CV	38.9	12.8	46.3		46.7		28.4	

2004 PMRR REPORT # 107

SECTION P: GREENHOUSE CROPS, ORNAMENTALS, and TURF – Diseases
STUDY DATABASE:

CROP: Turf grass on golf courses
PEST: Silvery Thread Moss (*Bryum argenteum)*

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TITLE: EVALUATION OF KOCIDE DF FOR CONTROL OF SILVERY THREAD MOSS ON GOLF GREENS

MATERIALS: KOCIDE DF (copper hydroxide 61.4%)

METHODS: Evaluation of Kocide DF to control silvery thread moss, *Byrum argenteum*, on turf grasses was conducted in eight golf courses located in the Fraser Valley and Vancouver Island of British Columbia. Kocide DF was applied as spray application at the rate of 1.6 g/m^2 of turf green. Applications were made at three-week intervals to a maximum of five applications beginning in January 2003. After the first three applications, Kocide DF was alternated with iron application at the rate of 0.25 ml iron/m^2. Since copper is known to interfere with iron metabolism in plants iron was supplemented to compensate iron deficiency. At the beginning of each Kocide DF application, visual estimations of the amount of silvery thread moss infestation (coverage) and colour intensity of the turf grass, i.e. phytotoxicity of Kocide DF to turf grass, were made within designated 0.3 m^2 areas of Kocide DF-treated and untreated turf green plots. The percentage of silvery thread moss coverage was estimated using a scale of 0 - 100%, where 0% = no moss infestation, 50% = half of the area infested with moss, 100% = entire area infested with moss. The intensity of turf grass colour was estimated using a scale of 1 to 9, where 1 = entirely white/yellow leaf blades, 9 = healthy, dark green leaf blades. Of the eight golf courses, three (golf course 1, 2, and 3) were able to provide complete data on the efficacy of Kocide in controlling silvery thread moss. Golf course 1 had five applications of Kocide DF whereas golf course 2 and 3 had three and two applications of Kocide DF respectively. Statistical analysis (JMP IN, SAS Institute 1996) was done separately on each data set collected from the three golf courses.

RESULTS: Results are presented in Table 1. In golf course 1, high incidence of silvery thread moss infestation, 49%, was found at the time of first application of Kocide DF. The infestation was reduced to 17 (i.e. 66% control) and 0% (i.e. 100% control) after the 3rd and 5th application of Kocide DF, respectively. In golf course 2, the initial high level of infestation, 63%, of silvery thread moss was reduced to 45 (i.e. 29% control) and 25% (i.e. 61% control) after 2nd and 3rd application of Kocide DF respectively. Golf course 3 had low level, 16%, of initial silvery thread moss infestation. The infestation was reduced to 4% (i.e. 74% control) after 2nd application of Kocide DF. In general, in all three golf courses, intensity of green colour of turf grass remained either unchanged or increased with the duration of the trial and application of Kocide DF.

CONCLUSIONS: In general, Kocide DF treatment as spray application, during late winter to early spring, to golf course greens in south coastal British Columbia significantly reduced the percent coverage/infestation of silvery thread moss, *Byrum argenteum*. These results indicate that, in golf courses with high pressure of silvery thread moss infestation, minimum of five applications of Kocide DF is necessary for the total control of silvery thread moss infestation. However, golf courses with low levels of silvery thread moss infestation, three applications of Kocide DF may be sufficient to control silvery thread moss infestation completely. Based on visual observation, Kocide DF has no apparent phytotoxic effect on the tested golf course grasses.

Table 1. Effect of Kocide DF on percentage silvery thread moss (*Bryum argenteum*) coverage and turf colour of golf greens. Kocide DF (copper hydroxide 61.4%) was applied at the rate of 1.6 g/m^2 golf green at 3-week intervals from early January to March 2003.

Number of Kocide Application	Kocide-treated plots		Untreated plots	
	Mean % moss coverage*	Mean turf colour intensity**	Mean % moss coverage*	Mean turf colour intensity**
Golf course 1[1]				
0	49 a	4	40	4
1	44 a	5	37	5
2	32 b	7	40	5
3	17 c	8	45	4
4	3 d	9	45	3
5	0 d	9	50	5
Golf course 2[2]				
0	63 a	6	18	5
1	56 a	6	18	5
2	44 ab	6	18	5
3	25 b	6	18	5
Golf course 3[3]				
0	13 a	6	18	6
1	11 a	5	18	5
2	4 b	5	21	5

[1] In golf course 1, mean % moss coverage and turf colour intensity were made from 36 replicates of Kocide-treated and untreated plots
[2] In golf course 2, mean % moss coverage and turf colour intensity were made from 10 and 5 replicates of Kocide-treated and untreated plots respectively
[3] In golf course 3, mean % moss coverage and turf colour intensity were made from 16 and 4 replicates of Kocide-treated and untreated plots respectively

* percentage silvery thread moss coverage was estimated within 0.3 m^2 golf green areas using a scale of 0 to 100%, where 0% = no moss infestation, 50% = half of the area infested with moss, 100% = entire area infested with moss.
**Intensity of turf grass colour was estimated within 0.3 m^2 golf green areas using a scale of 1 to 9, where 1 = entirely white/yellow leaf blades, 9 = healthy, dark green leaf blades.

Note: Within each golf course, mean values of % moss coverage, in Kocide-treated column, followed by the same letter do not differ significantly ($p < 0.001$) according to Dunnett's mean comparison analysis. Dunnett's mean comparison test was intended to compare the differences among the various number of Kocide applications within Kocide-treated plot.

2004 PMRR REPORT # 108

SECTION P: GREENHOUSE CROPS, ORNAMENTALS, and TURF – Diseases
STUDY DATABASE:

CROP: Turf grass on golf courses
PEST: Silvery Thread Moss (*Bryum argenteum)*

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TITLE: EVALUATION OF KOCIDE DF FOR CONTROL OF SILVERY THREAD MOSS ON GOLF GREENS

MATERIALS: KOCIDE DF (copper hydroxide 61.4%)

METHODS: Evaluation of Kocide DF to control silvery thread moss, *Byrum argenteum*, on turf grasses was conducted in eight golf courses located in the Fraser Valley and Vancouver Island of British Columbia. Kocide DF was applied as spray application at the rate of 1.6 g/m ^{2} of turf green. Applications were made at three-week intervals to a maximum of five applications beginning in January 2003. After the first three applications, Kocide DF was alternated with iron application at the rate of 0.25 ml iron/m^2. Since copper is known to interfere with iron metabolism in plants iron was supplemented to compensate iron deficiency. At the beginning of each Kocide DF application, visual estimations of the amount of silvery thread moss infestation (coverage) and colour intensity of the turf grass, i.e. phytotoxicity of Kocide DF to turf grass, were made within designated 0.3 m ^{2} areas of Kocide DF-treated and untreated turf green plots. The percentage of silvery thread moss coverage was estimated using a scale of 0 - 100%, where 0% = no moss infestation, 50% = half of the area infested with moss, 100% = entire area infested with moss. The intensity of turf grass colour was estimated using a scale of 1 to 9, where 1 = entirely white/yellow leaf blades, 9 = healthy, dark green leaf blades. Of the eight golf courses, three (golf course 1, 2, and 3) were able to provide complete data on the efficacy of Kocide in controlling silvery thread moss. Golf course 1 had five applications of Kocide DF whereas golf course 2 and 3 had three and two applications of Kocide DF respectively. Statistical analysis (JMP IN, SAS Institute 1996) was done separately on each data set collected from the three golf courses.

RESULTS: Results are presented in Table 1. In golf course 1, high incidence of silvery thread moss infestation, 49%, was found at the time of first application of Kocide DF. The infestation was reduced to 17 (i.e. 66% control) and 0% (i.e. 100% control) after the 3rd and 5th application of Kocide DF, respectively. In golf course 2, the initial high level of infestation, 63%, of silvery thread moss was reduced to 45 (i.e. 29% control) and 25% (i.e. 61% control) after 2nd and 3rd application of Kocide DF respectively. Golf course 3 had low level, 16%, of initial silvery thread moss infestation. The infestation was reduced to 4% (i.e. 74% control) after 2nd application of Kocide DF. In general, in all three golf courses, intensity of green colour of turf grass remained either unchanged or increased with the duration of the trial and application of Kocide DF.

CONCLUSIONS: In general, Kocide DF treatment as spray application, during late winter to early

spring, to golf course greens in south coastal British Columbia significantly reduced the percentage coverage/infestation of silvery thread moss *Byrum argenteum*. These results indicate that, in golf courses with high pressure of silvery thread moss infestation, minimum of five applications of Kocide DF is necessary for the total control of silvery thread moss infestation. However, golf courses with low levels of silvery thread moss infestation, three applications of Kocide DF may be sufficient to control silvery thread moss infestation completely. Based on visual observation, Kocide DF has no apparent phytotoxic effect on the tested golf course grasses.

Table 1. Effect of Kocide DF on percentage silvery thread moss (*Bryum argenteum*) coverage and turf colour of golf greens. Kocide DF (copper hydroxide 61.4%) was applied at the rate of 1.6 g/m^2 golf green at 3-week intervals from early January to March 2003.

	Kocide-treated plots		Untreated plots	
Number of Kocide Application	Mean % moss coverage*	Mean turf colour intensity**	Mean % moss coverage*	Mean turf colour intensity**
Golf course 1[1]				
0	49 a	4	40	4
1	44 a	5	37	5
2	32 b	7	40	5
3	17 c	8	45	4
4	3 d	9	45	3
5	0 d	9	50	5
Golf course 2[2]				
0	63 a	6	18	5
1	56 a	6	18	5
2	44 ab	6	18	5
3	25 b	6	18	5
Golf course 3[3]				
0	13 a	6	18	6
1	11 a	5	18	5
2	4 b	5	21	5

[1] In golf course 1, mean % moss coverage and turf colour intensity were made from 36 replicates of Kocide-treated and untreated plots

[2] In golf course 2, mean % moss coverage and turf colour intensity were made from 10 and 5 replicates of Kocide-treated and untreated plots respectively

[3] In golf course 3, mean % moss coverage and turf colour intensity were made from 16 and 4 replicates of Kocide-treated and untreated plots respectively

* percentage silvery thread moss coverage was estimated within 0.3 m^2 golf green areas using a scale of 0 to 100%, where 0% = no moss infestation, 50% = half of the area infested with moss, 100% = entire area infested with moss.

** Intensity of turf grass colour was estimated within 0.3 m^2 golf green areas using a scale of 1 to 9, where 1 = entirely white/yellow leaf blades, 9 = healthy, dark green leaf blades.

Note: Within each golf course, mean values of % moss coverage, in Kocide-treated column, followed by the same letter do not differ significantly ($p < 0.001$) according to Dunnett's mean comparison analysis. Dunnett's mean comparison test was intended to compare the differences among the various number of Kocide applications within Kocide-treated plot.

2004 PMRR REPORT #

SECTION O: CEREALS, FORAGE CROPS AND OILSEEDS- Diseases
STUDY DATABASE: 221.2

CROP: Sunflower (*Helianthus annuus* L.) Hybrid 9338
Pest: Rust, *Puccinia helianthi* Schwein.

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TITLE: CONTROL OF SUNFLOWER RUST BY FOLIAR APPLICATIONS OF FUNGICIDES; 2004

MATERIALS: Fungicides used: BRAVO 500 (chlorothalonil 50%), DITHANE DG (mancozeb 75%), FOLICUR (tebuconazole 38.5%), HEADLINE (pyraclostrobin 25%), LANCE (boscalid 70%), STRATEGO (propiconazole 12.5% and trifloxystrobin 12.5%), TILT (propiconazole 25%), and JAU6474 (experimental from Bayer CropScience).

METHODS: One field trial was conducted at the Agriculture and Agri-Food Canada Research Station at Morden, Manitoba in 2004. A randomized complete block design was used with four replicates. Each replicate consisted of 3-row plots of 3 m long and .75 m apart. The trial was seeded on May 18 and harvested on October 1, 2004. Each fungicide was applied in three treatments, one at mid-flowering (August 10), one at end of flowering (Aug 24), and one with two applications (August 10 & 24). All fungicides were applied in a 200 ml of water per plot at the following rates of product applications: BRAVO 500 (at 2 kg/ha, DITHANE DG at 2.25 kg/ha, FOLICUR at 0.3 kg/ha, HEADLINE at 0.6 kg/ha, LANCE at 0.36 kg/ha, STRATEGO at 0.75 kg/ha, TILT at 0.5 kg/ha, and JAU6474 at 0.4 kg/ha. The trial included two additional treatment, one with four applications of TILT on August 10, August 24, September 8, and September 20, and an untreated control treatment. The fungicides were applied using a knap-sack sprayer with a hand held nozzle and manually operated. The central row of each plot was sprayed from both sides in a circular motion. Rust infections occurred naturally starting around flowering time and progressed slowly due to the abnormal cool and wet conditions prevailing during the whole growing season. Rust severity was assessed after each fungicide application, and at the end of the season prior to foliage dry-up, using the scale of 1 to 10; 0= no sign of infection, and 10= 100% leaf area affected by rust. The middle row of each plot was harvested for seed yield, measuring oil content, and kernel weight. Data was analyzed using the analyses of variance Linear Model (Statistical Analyses System, SAS). Means separation was obtained using the Least Significant Differences LSD at P=0.05% level of significance.

RESULTS: The late single application (August 24) of all fungicides reduced the rust severity but was not effective in improving yield or kernel density of harvested seed, and these results are not included in Table 1. All fungicides used in a single application (August 10) significantly reduced the rust severity presented as measured by the area under the disease progress curve (AUDPC). Only STRATEGO and HEADLINE further reduced the AUDPC of rust with a second application (Table 1). A single application of JAU4676, STRATEGO, FOLICUR, HEADLINE, and two applications of DITHANE DG

resulted in a significant increase in yield and kernel density of harvested seed. Single applications of DITHANE DG, FOLICUR, HEADLINE, JAU4676, and two applications of STRATEGo significantly increased the kernel density of harvested seed (Table 1).

CONCLUSIONS: A single application of the fungicides JAU4676, STRATEGO, FOLICUR, and HEADLINE resulted in significant reduction in rust severity in sunflower in 2004, and a significant improvement in yield and kernel density of harvested seed. Although one application of DITHANE DG significantly reduced rust severity and improved kernel density, only the two applications resulted in significant improvement in yield. Single and two applications of BRAVO, TILT, and LANCE significantly reduced the rust severity but had no significant effects on yield or kernel density.

Table 1: Effects of foliar applications of fungicides on rust and yield in sunflower; 2004.

Fungicide	No. of Applications*	AUDPC	Yield g/plot	Kernel Density g/l
Control		16.9	335	290
LANCE	1	13.6	369	294
LANCE	2	13.9	336	294
BRAVO 500	1	13.5	392	298
BRAVO 500	2	14.1	323	308
DITHANE DG	1	12.3	397	313
DITHANE DG	2	12.5	447	312
FOLICUR	1	10.6	473	338
FOLICUR	2	10.9	491	330
HEADLINE	1	10.8	503	323
HEADLINE	2	9.8	400	328
JAU4676	1	10.4	507	328
JAU4676	2	10.3	544	332
STRATEGO	1	13.6	446	302
STRATEGO	2	11.6	489	328
TILT	1	13.8	419	305
TILT	2	13.6	369	305
LSD (P= 0.05)		1.2	101	20

* 1= one application at mid flowering
* 2= one application at mid flowering plus another at end of flowering.

2004 PMRR REPORT #

SECTION O: CEREALS, FORAGE CROPS AND OILSEEDS- DISEASES
STUDY DATABASE: 221.2

CROP: Sunflower (*Helianthus annuus* L.) Hybrid 311
PEST: Head Rot, *Sclerotinia sclerotiorum* (Lib.) de Bary

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TITLE: CONTROL OF SCLEROTINIA HEAD ROT IN SUNFLOWER BY FOLIAR APPLICATIONS OF FUNGICIDES; 2004

MATERIALS: Fungicides used: BENLATE (benomyl 50%), FLUAZINAM (trifluoromethyl pyridinamine 50%), LANCE (boscalid 70%), MAXIM (fludioxonil 50%), QUADRIS (azoxystrobin 25%), RONILAN (viclozolin 50%), ROVRAL (iprodine 24%), TOPSIN (thiophanate methyl 70%), and JAU6474 (experimental from Bayer CropScience).

METHODS: One field trial was conducted at the Agriculture and Agri-Food Canada Research station at Morden, Manitoba in 2004. A randomized complete block design was used with four replicates. Each replicate consisted of 3-row plots of 3 m long and .75m apart. The trial was seeded on May 18,and harvested on September 30, 2004. Each fungicide was applied in three treatments, one at early-flowering (August 1), one at end of flowering (Aug 14), and one with two applications (August 1 & 14). All fungicides were applied in a 200 ml of water per plot at the following rates of product applications: BENLATE at 1.5 kg/ha, FLUAZINAM at 1 kg/ha, LANCE at 0.36 kg/ha, MAXIM at 0.52 kg/ha, Quadris at 1 kg/ha, RONILAN at 2 kg/ha, ROVRAL at 2 kg/ha, TOPSIN at 2.2 kg/ha, and JAU6474 at 0.4 kg/ha. The trial included an untreated control treatment. The fungicides were applied using a back-pack sprayer with a hand held nozzle and manually operated. The central row of each plot was sprayed from both sides in full circle. All sunflower heads in each plot were artificially inoculated with ascospore suspension ($1x10^5$ /ml) and with ground sclerotinia-infected millet seed dusted on the heads, 24 hr after each fungicide application. The trial was misted using a ground misting system at a frequency of 5 minutes/30 minutes for two weeks except during rainy periods in order to create favorable conditions for infections and disease development. Sclerotinia head rot was assessed on each sunflower head after each fungicide application, and at the end of the season prior to maturity of the crop, using the scale of 0 to 10; 0= no sign of infection, and 10= 100% head rot and total collapse of the head. The middle row of each plot was harvested for seed yield, and visually estimating the percentage of sclerotia in seed sample, measuring oil content, and kernel weight. Data were analyzed using the analyses of variance Linear Model (Statistical Analyses System, SAS). Means separation was obtained using the Least Significant Differences LSD at P=0.05 level of significance.

RESULTS: The artificial inoculation with ascospores and ground sclerotinia-infected millet seed under the misting system resulted in high head rot incidence of 77%, and a disease index of 7.3 in the untreated control treatment (Table 1). All fungicides except for MAXIM, the early application of FLUAZINAM and the late application of TOPSIN, significantly reduced the head rot index. All fungicides except for the late application of BENLATE and the early application of MAXIM , significantly improved the yield

(Table 1). One early application of JAU6476 and LANCE resulted in 34% and 38% reduction in disease index, 368% and 345% improvement in yield, and 70% and 28% reduction in sclerotia in harvested seed, respectively. One early application of BENLATE, QUADRIS, and RONILAN reduced the disease index by 23%,improved yield by 281-338%, but only BENLATE had significant reduction in sclerotia in harvested seed (43%). FLUAZINAM, ROVRAL, and TOPSIN were less effective than the other fungicides, MAXIM was the least effective in reducing the disease and improving yield.

CONCLUSIONS: The fungicides JAU4676 and LANCE were very effective; BENLATE, RONILAN and QUADRIS were effective; and FLUAZINAM, ROVRAL and TOPSIN were moderately effective in reducing the sclerotinia head rot and improving the yield in sunflower. However, these results are based on one year data, and are not conclusive due to the high incidence of head rot in the trial due to the prolonged unusual cool and wet conditions towards the end of the season, favoring head rot infections and development.

Table 1: Effects of foliar applications of fungicides on rust and yield in sunflower; 2004.

Fungicide	No of Applications	Head Rot Index	Yield g/Plot	% Sclerotia in seed
Control		7.3	48	54
BENLATE	Early	5.5	135	31
BENLATE	Early & Late	4.9	165	34
BENLATE	Late	6.5	55	46
FLUAZINAM,	Early	7.1	83	63
FLUAZINAM	Early & Late	5.8	150	30
FLUAZINAM	Late	6.3	131	43
JAU 4676	Early	4.5	177	16
JAU 4676	Early & Late	5.2	154	38
JAU 4676	Late	6.6	92	48
LANCE	Early	4.8	166	39
LANCE	Early & Late	6.1	100	31
LANCE	Late	6.4	101	43
MAXIM	Early	6.9	60	56
MAXIM	Early & Late	6.9	96	51
MAXIM	Late	7.3	91	50
QUADRIS	Early	5.6	162	50
QUADRIS	Early & Late	6.4	129	41
QUADRIS	Late	6.5	89	50
RONILAN	Early	5.6	149	48
RONILAN	Early & Late	6.5	107	34
RONILAN	Late	6.3	104	33
ROVRAL	Early	6.2	102	46
ROVRAL	Early & Late	6	94	45
ROVRAL	Late	5.5	139	43
TOPSIN	Early	5.4	116	36
TOPSIN	Early & Late	5.8	97	43
TOPSIN	Late	6.9	91	51
LSD (P=0.05)		0.5	18	14

2004 PMRR REPORT #

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
STUDY DATABASE: 303-1212-8907

CROP: Barley cv. Harrington
PEST: False Loose Smut, *Ustilago nigra*
Scald, *Rhynchosporium secalis*

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TITLE: EFFICACY OF FUNGICIDE SEED TREATMENTS ON CONTROL OF FALSE LOOSE SMUT AND FOLIAR DISEASES, AND ON YIELD OF BARLEY; 2004

MATERIALS: VITAFLO 280 (carbathiin 169.7 g ai/L, thiram 151.5 g ai/L), RAXIL-T (tebuconazole 6.67 g ai/L thiram 222.2 g ai/L), L1397-A1 (metalaxyl 6.2 g ai/L, tebuconazole 3.1 g ai/L, triazolinthion 15.4 g ai/L)

METHODS: Barley seed was inoculated with spores via the vacuum method, and subsequently treated with the materials listed above, in a Hege treater by Gustafson lab personnel prior to shipping seed to PEI. Plots were established on May 13, 2004, at a seeding rate of 300 viable seeds per m^2. Each plot was 5 rows wide, five metres long and 17.8 cm between rows. Between each treatment plot was an equal sized wheat guard plot. Plots received a herbicide application of MCPA 500 (1 L/ha) plus REFINE EXTRA (20 g/ha) at Zadok's Growth Stage (ZGS) 16. Treatments were replicated four times in a randomized complete block design.

Emergence was taken on 1m of row prior to tillering. Scald was rated on July 27, ZGS 68, on the penultimate and 3rd leaves on ten randomly selected tillers per plot, using the Horsfall and Barratt Rating system. The number of smutted head per plot and the total number of healthy heads in one row was determined. Yield and thousand kernel weight were determined from the harvest of the entire plot area, on August 25, using a small plot combine.

RESULTS: Results are contained in Table 1. Seed treatment had no significant effect on emergence. There was no significant effect on scald at ZGS 68 with mean disease levels at that time of 39 and 72% on the 2nd and 3rd leaves respectively.

CONCLUSIONS: All treatments significantly ($p=0.05$) reduced the level of false loose smut to zero, from 10.6%. All treatments increased yield significantly ($p=0.05$). Yield increases ranged from 19% with VITAFLO 280 at 3.3 ml product/kg, to 36% with VITAFLO 280 at 2.3 ml product/kg.

Table 1: Influence of fungicide seed treatments on false loose smut of barley; 2004

Treatment	Rate*	Smut per Plot (%)	Yield (Kgha)	1000 kwt (g)
Untreated Control	0	10.6	2223	32.7
VITAFLO 280	2.3	0	3033	33.94
VITAFLO 280	3.3	0	2651	34.28
RAXIL-T	2.25	0	2740	37.2
L1397-A1	3.25	0	2785	33.3
LSD (0.05)		2.08	231	3.403
SEM		0.676	73.5	1.08

* ml product/kg seed
ns = no significant difference at $p = 0.05$

2004 PMRR REPORT #

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
STUDY DATABASE: 303-1212-8907

CROP: Spring wheat, AC Walton
PEST: Septoria leaf blotch, *Stagonospora nodorum* (syn. *Septoria nodorum*)
Fusarium head blight, *Fusarium graminearum*

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TITLE: EFFICACY OF FUNGICIDE SEED TREATMENTS ON CONTROL OF FUSARIUM HEAD BLIGHT, AND ON YIELD OF WHEAT; 2004

MATERIALS: VITAFLO 280 (carbathiin 169.7 g ai/L, thiram 151.5 g ai/L), RAXIL-T (tebuconazole 6.67 g ai/L thiram 222.2 g ai/L), RAXIL 250 (tebuconazole 6 g ai/L), CHARTER (triticonazole, 25 g ai/L), DIVIDEND XL RTA (difenoconazole 36.9 g ai/L, metalaxyl-m 3.11 g ai/L), RAXIL MD (metalaxyl 6.7 g ai/L, tebuconazole 4.9 g ai/L), L1397-A1 (metalaxyl 6.2 g ai/L, tebuconazole 3.1 g ai/L, triazolinthion 15.4 g ai/L)

METHODS: Wheat seed, cv. AC Walton, was treated in a small batch Hege seed treater. Plots were established on May 17, 2004, at a seeding rate of 350 viable seeds per m^2. Each plot was 10 rows wide, five metres long and 17.8 cm between rows. Between each treatment plot was an equal sized wheat guard plot. Plots received a herbicide application of MCPA 500 (1 L/ha) plus REFINE EXTRA (20 g/ha) at Zadok's Growth Stage (ZGS) 16. Treatments were replicated four times in a randomized complete block design.
Emergence was taken on 1m of row prior to tillering. Septoria leaf blotch was rated on August 13 at ZGS 85, on the flag and penultimate leaves of ten randomly selected tillers per plot, using the Horsfall and Barratt Rating system. Fusarium head blight was assessed at the same time as septoria leaf blotch. The incidence of fusarium head blight was assessed on the entire plot on a 0 - 10 scale (0 = no disease, 10 = every head infected). Severity was assessed on a 0 - 10 scale, but only on infected heads. Fusarium head blight index was calculated as the sum of these two ratings (0 - 100). Yield and thousand kernel weight were determined from the harvest of the entire plot area, on September 6, using a small plot combine.

RESULTS: Results are contained in Table 1. Seed treatment had no significant effect on emergence. There was no significant effect on septoria leaf blotch, where the disease severity level on the flag leave at time of assessment averaged 34%..

CONCLUSIONS: While there was no significant effect on fusarium head blight, several of the seed treatments did have a significant impact on yield response in this trial. VITAFLO 280 was consistently effective, resulting in a yield benefit of 16.0 to 17.5%, low to high rate respectively. L1397-A1 also resulted in a yield benefit of 16.0%.

Table 1: Influence of fungicide seed treatments on fusarium head blight and yield in spring wheat; 2004.

Treatment	Rate*	FHB** Incidence (0-10)	FHB Severity (0-10)	FHB Index (0-100)	FDK*** (%)	Yield (kg/ha)	1000 kwt (g)
Untreated Control	0	2.3	6	13.3	20.1	3063	33.98
VITAFLO 280	2.3	2.3	5.5	12.3	24.8	3552	34.93
VITAFLO 280	3.3	3.3	5	16.3	26.3	3599	35.6
RAXIL FL	2.5	3	6.3	19.3	22.6	3240	33.73
RAXIL-T	2.25	1.8	5	10.5	23.7	3251	34.65
RAXIL MD	3.25	2.3	6.5	13.8	21.2	3245	35.38
L1397-A1	3.25	2.5	6.3	14	25.3	3557	35.43
DIVIDEND XL RTA	3.25	2.3	7.8	17	19.9	3239	34.48
CHARTER	1	2	6.3	12.3	24.4	3160	34
LSD (0.05)		ns	ns	ns	ns	342	ns
SEM		0.341	0.796	2.401	2.418	117.2	0.603

* ml product/kg seed
** FHB - fusarium head blight
*** FDK - fusarium damaged kernels
ns = no significant difference at p=0.05

2004 PMRR REPORT #

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
STUDY DATABASE: 303-1212-8907

CROP: Spring Wheat, various cultivars and lines
PEST: Fusarium head blight, *Fusarium graminearum Schwabe*

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TITLE: **SPRING WHEAT CULTIVAR RESPONSE TO FUSARIUM HEAD BLIGHT AND RESULTING DON LEVELS IN ARTIFICIAL INOCULATION TRIALS, PEI; 2002/2003.**

MATERIALS:

METHODS: The Atlantic Registration Recommendation Coop Trial was seeded in 2002 and 2003 in an area which was artificially inoculated with *Fusarium graminearum* and provided with misting from before anthesis to near harvest. Each cultivar or line was seed using a Hege cartridge seeder which provided individual plots which were approximately 45-50 cm long in rows which were 17.8 cm apart. Within row separation was approximately 40 cm. The plot area was surrounded by a single set of guard plots of Roblin wheat, a highly susceptible cultivar. The plots were treated following conventional fertility and herbicide programs for the region.
Conidia spores of *Fusarium graminearum* were produced in a liquid medium. 100 gm/L of cubed tomatoes were soaked for 2 hours at which point the tomato cubes were strained out and 15 g/L NaCl added. The medium was then autoclaved and inoculated with one of five isolates of *F. graminearum* and filtered air was vigorously bubbled thru the medium for about one week, or until spore production reached satisfactory levels. Starting when approximately 50-75% of the heads had reached anthesis, 75,000 spores per ml were applied on a weekly basis, three times, using a standard pesticide sprayer delivering 200 l/ha water. The field was misted for 2 minute bursts at a rate of 660 L/ha; misting was done every half hour from 7am to 10:30 am, at 15 minute intervals thru to 7 pm, half hour intervals to 9 pm and then on an hourly basis until 7 am.
Levels of fusarium head blight was assessed based on visual symptoms in the field (FHB Index) , fusarium damaged kernels (FDK) and deoxynivalenol (DON) analysis. FHB Index was determined based on the product of a whole plot incidence rating (0 - 10, where zero was no head was infected to 10 where all heads had some level of infection) and an average severity rating on heads with some level of FHB symptom (0 - 10, where 10 was all infected heads were entirely covered in symptoms). FDK levels were determined, on a sub-sample of the hand-harvested and carefully cleaned plots, by the percent by weight

of fusarium damaged kernels compared to the total weight of the sub-sample. DON levels were determined via competitive direct enzyme-linked immunosorbent assay (CD-ELISA); performed at the DON lab, AAFC-Eastern Cereal and Oilseed Research Centre in Ottawa.

RESULTS: Results are contained in Table 1.

CONCLUSIONS: Head blight symptoms were not taken in the field in 2002, due to a very low level of visual symptoms. While the FDK levels in 2002 were relatively low, the DON levels were significant. This is an indication that while there was good infection as measured by DON, the yield impact, as measured by FDK, was minor. A late growth of *F. graminearum* may have contributed to increased DON with low FDK. Based on the 2002 DON levels, there were a number of lines with good levels of FHB resistance, notably AW488, AC Helena, Sandro, BRS177 and CB92.16.18.86. Each of these had levels below 10 ppm and this is significant when compared to Belvedere at 28.8 ppm and a standard commercial cultivar in the Atlantic Region. The FHB check cultivars behaved as expected for the most part with low DON and FDK from the resistant checks NuyBay, Sumai-3 and WUHAN#2, while the susceptible checks Max and Roblin were high in DON and FDK.

While DON levels were much higher in 2003, there were still a number of lines which demonstrated a fair to intermediate resistance level to FHB. Sandro in particular demonstrated low levels of FHB index, FDK and DON. A number of lines fell in the intermediate to poor level of resistance. Most notable would be Torka and AC Hartland which were very poor in both 2002 and 2003.

Roblin would appear to have been intermediate in its resistance level based on FDK and particularly DON. However this may be misleading, since it was very susceptible based on both early and late FHB index readings (63.3% and 82.5%). This difference between FHB index and FDK and DON response can be explained by the fact that Roblin was so susceptible that many of the contaminated seeds were so badly affected that they disintegrated or disappeared on cleaning. Thus many of the potentially highly DON contaminated kernels were lost, and others were very light which influenced the FDK percentage.

There was no significant correlations between FHB index ratings and either FDK or DON levels in 2003. There was a significant correlation between FDK and DON in both 2002 and 2003. Where cultivars and lines were produced in both years there was a significant correlation between DON but not FDK, between years.

Table 1: Cultivar response to fusarium head blight, PEI; 2002 and 2003.

Cultivar / Line	2002		2003 Aug 7	Aug 11		
	FDK	DON	FHB Index	FHB Index	FDK	DON
	(%)	(mg/kg)	(0-100)	(0-100)	(%)	(mg/kg)
AC Cora (I*)			15.8	48.0	38.9	23.4
AC Barrie	5.4	13.4				
AC Hartland	9.4	32.2	14.0	57.0	38.2	41.7
AC Helena	3.0	5.3	14.5	36.3	35.8	22.1
AC Norboro	10.2	16.3	22.5	63.3	34.1	22.2
AC Walton	5	12.5	16.8	43.5	39.3	26.6
AC Wilmot	9.3	22.7	14.8	42.8	33.4	21.2
AW 466	7.3	17.4	18.8	55.5	31.8	35.1
AW 488	3.2	8.0				
AW 494	6.9	13.8				
AW 516	7.5	16.3	24.3	50.0	21.5	15.7
AW 525	4.0	12.9				
AW 532	4.9	13.0				
AW 542	7.3	18.9				
AW543			21.0	54.0	38.2	29.0
AW547			14.5	38.0	34.3	24.6
AW548			18.8	44.5	48.2	36.8
AW554			19.8	43.3	43.2	27.7
AW558			14.5	35.3	36.7	26.1
Belvedere	11.3	28.8	17.3	41.0	34.3	22.7
BRS177	1.5	6.9				
CB 92.16.18.87	5.7	15.4				
CB92.16.18.86	3.0	6.5				
CB92-38*39-33			10.3	50.8	31.9	49.3
CFB 97626	4.2	10.7	12.8	38.0	47.2	21.8
CFT99306 **			23.5	58.0	92.0	55.6
CM2032			16.5	39.8	24.1	19.4
CM606 (CM2023)			17.5	51.0	40.0	28.1
FHB37 (R*)			12.5	43	42.8	25.3
HY644 (R*)			20.5	35.5	68.5	26.9
Max (S*)	8.1	22.1				
NuyBay (R*)	3.3	8.0				
QW628.5	4.3	10.1	18.3	50.0	38.8	31.3
Roblin (S*)	8.2	13.9	63.3	82.5	45.4	20.2
Sandro	2.4	7.7	3.3	28.0	29.9	9.8
SS Maestro	7.8	22.6	13.0	47.8	45.5	36.5
Sumia-3 (R*)	0.8	5.8				
Superb			16.8	46.3	35.7	23.5
Torka	5.6	25.3	12.3	56.5	51.1	58.9
WUHAN#2 (R*)	1.0	6.6				
LSD (0.05)	3.79	10.78	13.3	18.5	18.6	17.2

* FHB reported susceptibility (R = resistant, I = intermediate, S = susceptible)

** Triticale