Agriculture and Agri Food Canada | Agriculture et Agroalimentaire Canada

2006 Pest Management Research Report (PMRR)
2006 Growing Season

2006 Rapport de recherches sur la lutte dirigée (RRLD)
pour le saison 2006

Canada

2006 Pest Management Research Report (PMRR)
2006 Growing Season

Prepared by

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[1] **Volume numbers have been assigned to the Report, starting with Volume 39 in 2000. It is based on the number of years that it has been published**

Background Information and Acknowledgments

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 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 61 reports. Appreciation is expressed 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 Andrea Labaj and Bruce Bowman for editorial and computer compilation services.

Suggestions for improving this publication are always welcome.

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Pest Management Research Report History.

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

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

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

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

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

2006 **Agriculture and Agri-Food Canada discontinued their funding support for CARC (Canadian Agri-Food Research Council), consequently resulting in the disbanding of all of its expert committees, including The *Expert Committee on Integrated Pest Management* (ECIPM), for which this annual report was compiled.**

Beginning with the Report for the 2000 growing season, volume numbers have been assigned, starting with Volume 39, based on the number of years this report has been published in total. Although there was a name change since it was first published, the purpose and format of the publication remains the same.

An individual report will be cited as follows:

Author(s). Title. 2006. Pest Management Research Report - 2006 Growing Season. Expert Committee on Integrated Pest Management. May, 2006. Report No. x. 45: pp-pp.

2006 PEST MANAGEMENT RESEARCH REPORT INDEX

2006 PMR REPORT # 001

SECTION A: FRUIT - Insect Pests
STUDY DATA BASE: 280-1261-9341

CROP: Apple cv. McIntosh
PEST: Plum Curculio, *Conotrachelus nenuphar* (Herbst)

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TITLE: ASSESSMENT OF INSECTICIDES AGAINST PLUM CURCULIO ON APPLE; 2006

MATERIALS: ASSAIL 70 WP (acetamiprid), GUTHION SOLUPAK (azinphos-methyl), MATADOR 120 EC (lambda-cyhalothrin), MATADOR 120 variant F (lambda-cyhalothrin))

METHODS: Note: The acetamiprid and azinphos-methyl data in this report have been submitted to the AAFC Pesticide Minor Use Program as trial AAFC06-024E-064. The trial was conducted in an eight-year-old orchard in the Jordan Station, Ontario area; trees cv. McIntosh were spaced 3.7 m by 2.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomized complete block design; two rates of ASSAIL (168 and 84 g a.i./ha) were compared to two formulations of MATADOR (120 EC and 120 variant F), a GUTHION SOLUPAK standard and an unsprayed control. Treatments were applied at petal fall (25 May), and were repeated 12 days later (5 June); 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 5 June (12 days after treatment), 20 June, and 14 August; 50 apples per plot were examined on the tree for plum curculio (PC) damage, and results expressed as percent fruit damage. Plots were also examined 1 June and 20 June for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). To assess yield, all apples were harvested from each plot on 14 August; the total weight of fruit per plot and average weight per fruit were recorded. Data were analyzed using analysis of variance; means were separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1-3 below. PC infestations were considered heavy.

CONCLUSIONS: In each of the first two samples taken to assess efficacy, all treated plots contained significantly less PC damage than the control, but were not different from each other. No differences were observed between formulations of MATADOR.
A rate effect was observed with ASSAIL in the 20 June and 14 August samples, plots treated with 84 g a.i./ha of ASSAIL contained more PC damage than those treated with the 168 g a.i./ha of ASSAIL; however, these differences were not statistically significant. Damage levels in plots treated with 84 g a.i./ha of ASSAIL were not different from the control in the 14 August sample; no significant differences in levels of PC damage were observed between the 168 g a.i./ha rate of ASSAIL, the MATADOR treatments, and the GUTHION standard.
No phytotoxic effects were observed in any plots. Total weight of fruit per plot was slightly lower in the untreated control plots, but this was likely due to fruit drop due to pest infestation. No differences in average weight per apple were observed between treatments.

Table 1. Percent fruit damaged by plum curculio.

Treatment[1]	Rate (a.i./ha)	Sample 1 5 June[2,3]	Sample 2 20 June[3]	Sample 3 14 August[3]
GUTHION SOLUPAK	1.05 kg	0.5 b	3.0 b	4.0 b
ASSAIL 70 WP	168 g	1.5 b	2.5 b	7.5 b
MATADOR 120 EC	12.5 g	0.5 b	2.5 b	7.0 b
MATADOR 120 "F"	12.5 g	0.0 b	3.5 b	8.0 b
ASSAIL 70 WP	84 g	1.0 b	8.0 b	11.0 ab
CONTROL	-	8.0 a	37.0 a	21.5 a

[1] Applied 24 May, 5 June.
[2] Samples were taken before the second application of treatments.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Phytotoxicity.

Treatment[1]	Rate (a.i./ha)	Phytotoxicity 0 - 100 1 June[2]	Phytotoxicity 0 - 100 20 June[2]
GUTHION SOLUPAK	1.05 kg	0.0 a	0.0 a
ASSAIL 70 WP	168 g	0.0 a	0.0 a
MATADOR 120 EC	12.5 g	0.0 a	0.0 a
MATADOR 120 "F"	12.5 g	0.0 a	0.0 a
ASSAIL 70 WP	84 g	0.0 a	0.0 a
CONTROL	-	0.0 a	0.0 a

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

Table 3. Yield.

Treatment[1]	Rate (a.i./ha)	Average Yield per Plot (kg) 14 August[2]	Average Weight per Apple (g) 20 June[2]
GUTHION SOLUPAK	1.05 kg	65.5 ab	69.5 a
ASSAIL 70 WP	168 g	54.5 ab	68.2 a
MATADOR 120 EC	12.5 g	65.4 ab	69.5 a
MATADOR 120 "F"	12.5 g	64.6 ab	64.4 a
ASSAIL 70 WP	84 g	72.3 a	69.9 a
CONTROL	-	43.7 b	66.1 a

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

2006 PMR REPORT # 002

SECTION A: FRUIT - Insect Pests
STUDY DATA BASE: 280-1261-9341

CROP: Apple cv. Idared
PEST: European apple sawfly, *Hoplocampa testudinea* (Klug), Plum curculio *Conotrachelus nenuphar* (Herbst)

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TITLE: CONTROL OF EUROPEAN APPLE SAWFLY ON APPLE; 2006

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

METHODS: Note: The acetamiprid, azinphos-methyl and phosmet data in this report have been submitted to the AAFC Pesticide Minor Use Program as trial AAFC06-024E-065. The trial was conducted in a mature orchard in the Picton, Ontario area; trees cv. Idared were spaced 6.0 m by 4.2 m. Treatments were replicated four times, assigned to one-tree plots, and arranged according to a randomised complete block design; two rates of ASSAIL (168 and 84 g a.i./ha) were compared to two rates of CALYPSO 480 SC (105 g a.i./ha and 210 g a.i./ha), single rates of GUTHION and IMIDAN, and an unsprayed control. Treatments were applied at petal fall (30 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 post-treatment 7 June (8 days after treatment), 21 June, and 20 September: 50 apples per plot were examined for damage caused by European apple sawfly and plum curculio (PC) with results expressed as percent fruit damage. EAS data were sorted by type of damage: primary, secondary, and total damage. Plots were also examined 7 June for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). To assess yield, 50 apples were harvested from each plot on 20 September; the average weight per fruit were recorded. Data were analysed using analysis of variance; means were transformed (log(x+1)) where necessary and separated with a Tukey Test at the 0.05 level.

RESULTS: Data are presented in Tables 1-5 below.

CONCLUSIONS: Note: Primary EAS damage is caused by a short period of feeding by first-instar larvae, and is characterised by a spiral scar on mature fruit; fruit exhibiting primary EAS damage may fall before harvest, depending on the severity of the damage. Secondary EAS damage is characterised by an exit hole near the primary damage spiral scar, and is caused by extensive feeding by the developing larva; due to the extent of the damage, fruit exhibiting secondary EAS damage usually drop before harvest.
No significant reduction in percentage of apples with primary EAS damage were observed in any of the 7 June,

21 June or 20 September samples (Table 1). Higher levels of damage in some treated plots than in the controls in the 7 June sample could indicate that treatments were applied after primary damage had occurred. Applications were delayed by an extended bloom; applications earlier in the season may have resulted in more significant reduction of primary EAS damage. The incidence of primary EAS damage was lower in the controls than in the treated plots in the 21 June and 20 September samples; this was likely due to increased fruit drop from more extensive feeding damage, as most of the primary EAS damage in the controls had advanced to secondary EAS damage. This was not the case in the treated plots, as the larvae were killed before they could develop and cause extensive damage, and consequently less fruit drop.

While no differences were observed in the incidence of primary EAS damage, the extent of secondary EAS damage was lower in the treated plots than in the controls, possibly due to the larvae being killed by the insecticide treatments before secondary damage could occur (Table 2). This conclusion was supported by the data from the 7 June and 21 June samples; all treatments significantly reduced secondary EAS damage compared to the control. In the 20 September sample, no secondary EAS damage was found in any plots; all damaged fruit had probably dropped to the ground by this time.

Primary EAS damage was added to secondary EAS damage to give the percentage of fruit containing any EAS damage (called total EAS damage, Table 3). In the 7 June sample, all treatments significantly reduced the percentage of apples with EAS damage; a rate effect was observed with ASSAIL, but the difference was not statistically significant. In the 21 June sample, no statistical differences were observed between insecticide treatments, but EAS damage levels were lower than the control in plots treated with IMIDAN, 168 g a.i./ha of ASSAIL, and 105 g a.i./ha of CALYPSO. No differences in total EAS damage were observed in any plots in the 20 September sample. Total EAS damage levels in the control plots were observed to decline sharply as the season progressed, due to fruit drop caused by EAS damage.

In the 21 June sample, all treated plots contained less PC damage than the control, but differences were not statistically different (Table 4). At harvest (20 September), only the plots treated with IMIDAN or the 168 g a.i./ha rate of ASSAIL had significantly less PC damage than the control; however, no differences were observed between insecticide treatments.

No phytotoxic effects were observed in any plots (Table 5). No differences in average weight per apple were observed between treatments.

Table 1. Percent primary damage by European apple sawfly.

Treatment[1]	Rate	Percent Primary Damage[2]		
	(a.i./ha)	7 June	21 June	20 Sept
CALYPSO 480 SC	105 g	4.50 a	8.50 a	10.00 a
CALYPSO 480 SC	210 g	3.50 a	10.50 a	13.50 a
ASSAIL 70 WP	84 g	12.00 a	10.00 a	11.00 a
ASSAIL 70 WP	168 g	6.00 a	7.50 a	8.00 a
GUTHION 50 WP	1100 g	10.50 a	8.50 a	14.00 a
IMIDAN 50 WP	1875 g	5.00 a	10.50 a	11.50 a
CONTROL	-	9.50 a	3.50 a	2.50 a

[1] Applied 30 May.

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

Table 2. Percent secondary damage by European apple sawfly.

Treatment[1]	Rate (a.i./ha)	Percent Secondary Damage[2] 7 June	21 June	20 Sept
CALYPSO 480 SC	105 g	0.00 b	0.00 b	0.00 a
CALYPSO 480 SC	210 g	2.50 b	0.00 b	0.00 a
ASSAIL 70 WP	84 g	0.00 b	0.00 b	0.00 a
ASSAIL 70 WP	168 g	0.00 b	0.00 b	0.00 a
GUTHION 50 WP	1100 g	0.50 b	0.00 b	0.00 a
IMIDAN 50 WP	1875 g	0.00 b	0.00 b	0.00 a
CONTROL	-	21.50 a	14.50 a	0.00 a

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

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

Treatment[1]	Rate (a.i./ha)	Percent Total Damage[2] 7 June	21 June	20 Septr
CALYPSO 480 SC	105 g	4.50 b	8.50 b	10.00 a
CALYPSO 480 SC	210 g	6.00 b	10.50 ab	13.50 a
ASSAIL 70 WP	84 g	12.00 b	10.00 ab	11.00 a
ASSAIL 70 WP	168 g	6.00 b	7.50 b	8.00 a
GUTHION 50 WP	1100 g	11.00 b	8.50 b	14.00 a
IMIDAN 50 WP	1875 g	5.00 b	10.50 ab	11.50 a
CONTROL	-	31.00 a	18.00 a	2.50 a

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

Table 4. Percent plum curculio damage per plot.

Treatment[1]	Rate (a.i./ha)	21 June[2]	20 Sept[2]
CALYPSO 480 SC	105 g	3.00 a	1.00 ab
CALYPSO 480 SC	210 g	0.50 a	2.00 ab
ASSAIL 70 WP	84 g	8.00 a	6.00 ab
ASSAIL 70 WP	168 g	1.50 a	0.00 b
GUTHION 50 WP	1100 g	2.00 a	0.50 ab
IMIDAN 50 WP	1875 g	0.00 a	0.00 b
CONTROL	-	11.50 a	16.50 a

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

Table 5. Weight of fifty apples per plot.

Treatment[1]	Rate (a.i./ha)	Weight (g) 20 September[2]
CALYPSO 480 SC	105 g	6611 a
CALYPSO 480 SC	210 g	6698 a
ASSAIL 70 WP	84 g	6579 a
ASSAIL 70 WP	168 g	6326 a
GUTHION 50 WP	1100 g	7006 a
IMIDAN 50 WP	1875 g	7047 a
CONTROL	-	7175 a

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

2006 PMR REPORT # 003 **SECTION A: TREE FRUIT - Insect Pests**

CROP: Apple (*Malus domestica* Borkh.), cv. Empire
PEST: Rosy Apple Aphid, *Dysaphis plantaginea* (Passerini)

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TITLE: CONTROL OF ROSY APPLE APHID ON APPLE WITH CALYPSO; 2006

MATERIALS: CALYPSO 480 SC (thiacloprid), ASSAIL 70 WP (acetamiprid)

METHODS: The trial was conducted in a mature apple orchard in Vittoria, Ontario; apples cv. Empire, were spaced 4.6 m by 2.4 m. Three rates of CALYPSO 480 SC (35 g a.i./ha, 70 g a.i./ha and 140 g a.i./ha) were compared to a single rate of ASSAIL 70 WP (70 g a.i./ha) and an unsprayed control. Treatments were replicated four times, assigned to single tree plots and arranged according to a randomized complete block design. Application was timed to target an elevated population of rosy apple aphid (RAA). On 21 June, insecticides were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Individual plots were sampled 23 June and 28 June, two and seven days after treatment. For each assessment, ten random terminals with RAA symptoms per plot were removed, examined and rated for presence of live RAA using a 0-5 scale as follows: 0 RAA per terminal = 0, 1-10 RAA per terminal = 1; 11-25 RAA per terminal = 2; 26-50 RAA per terminal = 3; 51-100 RAA per terminal = 4 and >100 RAA per terminal = 5. The ten ratings per plot were averaged to get a mean value per plot. On 7 September, all apples per plot were harvested and weighed. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables1 and 2. There were no phytotoxic effects observed at two, seven days or fourteen days after treatment. Frost damage affected fruit set which resulted in poor yield in the entire block.

CONCLUSIONS: All treatments significantly reduced numbers of RAA two days and seven days post-treatment compared to the control; at seven days post-treatment, all aphids were killed with ASSAIL and the two highest rates of CALYPSO (Table 1). There were no significant differences in average fruit weight in any of the treatments compared to the control (Table 2).

Table 1. Average rating of rosy apple aphids per sample.

Treatment[1]	Rate (g a.i./ha)	Average RAA rating[2] 23 June	28 June 28
CALYPSO 480 SC	35	0.25 b	0.03 b
CALYPSO 480 SC	70	0.60 b	0.00 b
CALYPSO 480 SC	140	0.70 b	0.00 b
ASSAIL 70 WP	1630	0.30 b	0.00 b
CONTROL	-	2.18 a	1.50 a

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

Table 2. Average weight per apple per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g)[2] 7 September
CALYPSO 480 SC	35	140.9 a
CALYPSO 480 SC	70	135.1 a
CALYPSO 480 SC	140	117.8 a
ASSAIL 70 WP	1630	158.0 a
CONTROL	-	137.6 a

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

2006 PMR REPORT # 004 **SECTION A: FRUIT-Insect Pests**

CROP: Apple (*Malus domestica* Borkh.), cv. Empire
PESTS: Plum curculio, *Conotrachelus nenuphar* (Herbst)

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TITLE: ASSESSMENT OF INSECTICIDES AGAINST FIRST GENERATION INTERNAL LEPIDOPTERA AND PLUM CURCULIO; 2005

MATERIALS: CALYPSO 480 SC (thiacloprid), GUTHION 50 WP (azinphos-methyl)

METHODS: The trial was conducted in a five-year-old apple orchard in Jordan Station, Ontario; trees cv. Empire, on M9 rootstock, were spaced 4.6 m by 2.4 m. Treatments were replicated four times, assigned to two-tree plots and arranged according to a randomized complete block design. The trial compared three rates of CALYPSO 480 SC (70 g a.i./ha, 140 g a.i./ha and 210 g a.i./ha) to a single rate of GUTHION 50 WP (1100 g a.i./ha) and an unsprayed control. Insecticides were applied 9 June (132.9 DD_{10} after peak codling moth (CM) flight) and 23 June (280.5 DD_{10} after peak CM flight). Insecticides were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 3-4 L of spray mix were used per plot; pressure was set at 2000 kPa. On 21 June, fifty apples per plot were harvested and examined for damage by plum curculio (PC) and internal Lepidoptera. Efficacy was expressed as percent fruit damaged by pest. On 5 July, fifty apples per plot were harvested, weighed and examined for damage by PC and internal Lepidoptera. Efficacy was expressed as percent fruit damaged by pest. Apples with internal feeding damage were cut open to identify any living larvae but larvae were too small and so were identified as internal Lepidoptera. Data were analyzed using analysis of variance and means were separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2 and 3. No phytotoxic effects were observed in any plots at any of the observation dates (15 June, 21 June, 30 June and 5 July). Although not significant in either case, there was a rate effect with the CALYPSO for control of internal Lepidoptera in the 5 July assessment and for both assessments for PC control.

CONCLUSIONS: There were no significant differences in fruit damage caused by internal Lepidoptera between any of the treatments and the control in the 21 June sample (Table 1). In the 5 July sample, all treated plots had significantly fewer apples with damage caused by internal Lepidoptera compared to the control (Table 1).
There were no significant differences in fruit damage caused by PC between any of the treatments and the control at either sample date (Table 2). Although, there were no significant differences in total apple weight in any of the treatments compared to the control, all treated plots had higher total weights than the control (Table 3).

Table 1. Percent fruit damaged by internal Lepidoptera per plot.

Treatment[1]	Rate	Sample date[2]	
	(g a.i./ha)	21 June	5 July
CALYPSO 480 SC	35	2.5 a	9.5 b
CALYPSO 480 SC	70	0.0 a	3.5 b
CALYPSO 480 SC	140	0.5 a	1.0 b
GUTHION 50 WP	1100	2.0 a	2.5 a
CONTROL	-	2.5 a	23.0 a

[1] Applied 9 June and 23 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent fruit damaged by plum curculio per plot.

Treatment[1]	Rate	Sample date[2]	
	(g a.i./ha)	21 June	5 July
CALYPSO 480 SC	35	8.5 a	12.0 a
CALYPSO 480 SC	70	4.0 a	6.5 a
CALYPSO 480 SC	140	0.5 a	4.5 a
GUTHION 50 WP	1100	4.5 a	8.5 a
CONTROL	-	9.5 a	19.5 a

[1] Applied 9 June and 23 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 3. Weight of fifty apples per plot.

Treatment[1]	Rate	Weight (g)[2]
	(g a.i./ha)	5 July
CALYPSO 480 SC	35	1015.5 a
CALYPSO 480 SC	70	1044.0 a
CALYPSO 480 SC	140	1037.0 a
GUTHION 50 WP	1100	1041.0 a
CONTROL	-	918.3 a

[1] Applied 9 June and 23 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2006 PMR REPORT # 005 **SECTION A: FRUIT - Insect Pests**

CROP: Apple (*Malus domestica* Borkh.), cv. Empire
PESTS: Codling moth, *Cydia pomonella* (L.)

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TITLE: ASSESSMENT OF ALTACOR AGAINST CODLING MOTH; 2006

MATERIALS: ASSAIL 70 WP (acetamiprid), ALTACOR 35 WG (rynaxypyr), INTREPID 2F (methoxyfenozide)

METHODS: The trial was conducted in a seven-year-old apple orchard in Jordan Station, Ontario. Empire trees on M9 rootstock, were spaced 4.6 m by 2.4 m apart. Treatments were replicated four times, assigned to two tree plots and arranged according to a randomized complete block design. The trial compared four rates of ALTACOR 35 WG (25 g a.i./ha, 50 g a.i./ha, 75 g a.i./ha and 100 g a.i./ha) to a single rate of ASSAIL 70 WP (168 g a.i./ha), a single rate of INTREPID 2F (240 g a.i./ha) and an unsprayed control. Insecticides were applied 1 June (101 DD_{10} after Biofix) and 24 July (666 DD_{10} after Biofix). Insecticides were diluted to a rate comparable to 2000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 6 L of spray mix were applied per plot; pressure was set at 2000 kPa. On 15 June, forty apples per plot were harvested and examined for damage by codling moth (CM). Efficacy is expressed as per cent fruit damaged by pest. On 14 August, fifty apples per plot were harvested, weighed and examined for damage by CM. Damaged apples were cut open and live larvae were identified. Results are expressed as per cent fruit damaged by pest. Data were analyzed using analysis of variance and means were separated with a Tukey Test at P=0.05 significance level.

RESULTS: Data are presented in Tables 1 and 2. No phytotoxic effects were observed in any plots when examined seven or fourteen days after either application. CM data on 14 August were not normally distributed and were transformed using $\log_{10}(x+1)$; CM data presented are non-transformed data.

CONCLUSIONS: In both assessments, all treatments significantly reduced damage by CM compared to the control; insecticide treatments were not different from each other (Table 1). There were no significant differences in yield between any of the treatments and the control on the 14 August harvest assessment (Table 2).
Live larvae collected from the control plots of the 14 August harvest assessment were identified to be 100% CM larvae (11/11); 85.7% (6/7) of live larvae in the treated plots were identified as CM larvae (57.1% (4/7) of live larvae from treated plots were found in plots treated with the lowest rate of ALTACOR (25 g a.i./ha)); 14.3% (1/7) of live larvae in the treated plots were identified as Oriental fruit moth larvae.

Table 1. Percent apples damaged by codling moth per plot.

Treatment[1]	Rate (g a.i./ha)	Percent CM damaged apples[2] 15 June	14 August
ALTACOR 35 WG	25	0.63 b	3.50 b
ALTACOR 35 WG	50	0.63 b	1.00 b
ALTACOR 35 WG	75	1.88 b	0.00 b
ALTACOR 35 WG	100	0.63 b	0.00 b
ASSAIL 70 WP	168	0.00 b	1.00 b
INTREPID 2F	240	0.63 b	4.00 b
CONTROL	-	6.88 a	15.50 a

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

Table 2. Weight of fifty apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g)[2] 14 August
ALTACOR 35 WG	25	5692 a
ALTACOR 35 WG	50	5802 a
ALTACOR 35 WG	75	5533 a
ALTACOR 35 WG	100	5605 a
ASSAIL 70 WP	168	5123 a
INTREPID 2F	240	5495 a
CONTROL	-	5609 a

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

2006 PMR REPORT # 006 **SECTION A: TREE FRUIT - Insect Pests**

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

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TITLE: CONTROL OF SUMMER GENERATION OBLIQUE BANDED LEAFROLLER ON APPLE WITH INSECTICIDES; 2006

MATERIALS: CALYPSO 480 SC (thiacloprid), INTREPID 248 SC (methoxyfenozide)

METHODS: The trial was conducted in a mature apple orchard in Renton, Ontario; trees cv. Empire were spaced 5.4 m by 4.0 m. Three rates of CALYPSO 480 SC (70 g a.i./ha, 140 g a.i./ha and 210 g a.i./ha) were compared to an INTREPID standard (180 g a.i./ha) and an unsprayed control. Treatments were replicated four times, assigned to single-tree plots and arranged according to a randomized complete block design. Applications were targeted for egg hatch (110-170 DD_{10} after first adult oblique banded leafroller (OBLR) trap catch). On 21 June (132 DD_{10} after Biofix) and 4 July, insecticides were diluted to a rate comparable to 3000 L/ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. On 25 July, one hundred terminals per plot were visually assessed for OBLR feeding damage and live OBLR larvae. Efficacy is expressed as per cent damaged terminals and number of live larvae. On 27 July, fifty apples per plot were harvested, weighed and assessed for damage by OBLR. Efficacy is expressed as per cent damage. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, 3 and 4. There were no phytotoxic effects observed in any of the treated plots at either 7 days or 14 days after either application.

CONCLUSIONS: In the 25 July terminal and live larvae assessment, INTREPID had significantly fewer damaged terminals than the low rate of CALYPSO (70 g a.i./ha) and the control (Table 1). The middle rate of CALYPSO (140 g a.i./ha) and INTREPID had significantly fewer live larvae than the control (Table 2).
In the 27 July fruit assessment, there was no significant difference in the amount of fruit damage by OBLR or fruit weight among any of the treatments and the control (Tables 3 and 4).

Table 1. Percentage terminals with OBLR feeding damage per plot

Treatment[1]	Rate (g a.i./ha)	Percentage terminals with damage[2] 25 July
CALYPSO 480 SC	70	15.75 ab
CALYPSO 480 SC	140	11.25 bc
CALYPSO 480 SC	210	13.25 abc
INTREPID 248 SC	180	9.50 c
CONTROL	-	18.25 a

[1] Applied 21 June and 4 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Number of live OBLR larvae per sample.

Treatment[1]	Rate (g a.i./ha)	Number of live OBLR larvae[2] 25 July
CALYPSO 480 SC	70	5.50 ab
CALYPSO 480 SC	140	3.00 b
CALYPSO 480 SC	210	5.25 ab
INTREPID 248 SC	180	3.50 b
CONTROL	-	9.25 a

[1] Applied 21 June and 4 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 3. Percentage apples with OBLR feeding damage per plot.

Treatment[1]	Rate (g a.i./ha)	Percentage apples with damage[2] 27 July
CALYPSO 480 SC	70	2.50 a
CALYPSO 480 SC	140	7.50 a
CALYPSO 480 SC	210	8.00 a
INTREPID 248 SC	180	2.50 a
CONTROL	-	6.00 a

[1] Applied 21 June and 4 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 4. Weight of fifty apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g)[2] 27 July
CALYPSO 480 SC	70	2886 a
CALYPSO 480 SC	140	3080 a
CALYPSO 480 SC	210	3118 a
INTREPID 248 SC	180	3173 a
CONTROL	-	3030 a

[1] Applied 21 June and 4 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2006 PMR REPORT # 007 **SECTION A: TREE FRUIT - Insect Pests**

CROP: Apple (*Malus domestica* Borkh.) cv. Empire
PEST: Codling moth, *Cydia pomonella* (L.), Mullein bug, *Campylomma verbasci* (Meyer), Oriental fruit moth, *Grapholita molesta* (Busck), White apple leafhopper, *Typhlocyba pomaria* (McAtee)

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TITLE: CONTROL OF INSECT PESTS ON APPLE WITH SEASON-LONG APPLICATIONS OF INSECTICIDES; 2006

MATERIALS: CALYPSO 480 SC (thiacloprid), DECIS 5 EC (deltamethrin), DIAZINON 50 W diazinon), GUTHION 50 WP (azinphos methyl), IMIDAN 50 WP (phosmet), INTREPID 2F (methoxyfenozide), MATADOR 120 EC (cyhalothrin-lambda), SUCCESS 480 SC (spinosad)

METHODS: The season long trial was conducted in a twelve-year-old apple orchard in Jordan Station, Ontario; trees cv. Empire, on M9 rootstock, were spaced 4.6 m by 2.4 m. An early season CALYPSO regime was compared to a late season CALYPSO regime, an Organophosphate/Pyrethroid (OP/PYR) regime and an unsprayed control (see Tables 1a, 1b and 1c for products, rates and application dates). Applications were timed as follows: petal fall (PF) - May 25; first generation CM (June 2 ((CM1-1) 108 DD_{10} from Biofix) and June 15 (CM1-2)); second generation CM (July 24 ((CM2-1) 666 DD_{10} from Biofix) and August 4 (CM2-2)) and a pre-harvest application (PH) - August 18. Treatments were replicated four times, assigned to four-tree plots and arranged according to a randomized complete block design. For all products, insecticides were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 15-17 L of spray mix were used per plot; pressure was set at 2000 kPa. Plots were sampled for mullein bug (MB) and white apple leafhopper nymphs (WALH) on 31 May (six days after PF treatment) and 6 June (four days after CM1-1); three limbs per tree were tapped three times (nine total) over 45 cm x 45 cm tapping trays and all MB, and WALH nymphs were counted. Total numbers of MB, and WALH nymphs per sample were recorded. On 29 June (fourteen days after CM1-2), fifty apples were harvested, weighed and examined for damage by CM and Oriental fruit moth (OFM). Damaged apples were cut open and live larvae were identified. On 11 September (twenty-four days after PH application), fifty apples were harvested, weighed and examined for damage by CM and OFM. Damaged apples were cut open and live larvae were identified. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 2, 3, 4, 5, 6 and 7. This trial was conducted in a 0.58 ha block of apples that had not been sprayed with insecticides for nine years and was adjacent to a 0.52 ha seventeen-year-old block of Red Delicious apples that had not been sprayed with insecticides for seven years. The lack of insecticide applications have allowed the level of insect pressure to increase beyond what would normally occur in a commercial orchard. This block is considered to be heavily infested with most apple pests. WALH counts of 31 May were analyzed with transformed data ($\log_{10}(x+1)$) although non-transformed values are given in Table 3. There were no phytotoxic effects observed at any time through the growing season (ratings were taken 1 June, 9 June, 22 June, 29 June, 31 July, 8 August, 25 August and 5 September).

CONCLUSIONS: While numbers of MB were reduced in all treated plots six days after PF treatment, differences were not significantly different; all regimes significantly reduced MB counts compared to the control four days after CM1-1 application (Table 2).

In the 31 May sample, both Calypso regimes significantly reduced WALH nymph counts compared to the control while the standard OP/PYR regime was not significantly different from the control (Table 3). All regimes significantly reduced WALH nymph counts compared to the control four days after CM1-1 application (Table 3).

All treatments were equally effective in controlling CM throughout the season. In the 11 September harvest, although not significantly different, the late season CALYPSO regime had less CM damage than the early season CALYPSO regime and the OP/PYR regime (Table 4).

No significant differences in OFM damage were observed with any regimes compared to the control fourteen days after CM1-2 treatment (Table 5). Twenty-four days after PH treatment, the late season Calypso regime and the OP/PYR regime had significantly lower OFM damage than the control; OFM damage in plots treated with the early season Calypso regime were not significantly different from the control or any other regimes (Table 5). Applications were not timed for OFM emergence but there appeared to be enough residual product to partially control early second generation OFM populations.

At harvest, there was a significantly higher percentage of marketable fruit in all regimes as compared to the control (Table 6). While there were no significant differences in total weight of fifty apples with any regimes compared to the control at either sampling date, all regimes had greater total weights than the control at both sampling dates (Table 7).

Live larvae collected from the control plots of the 29 June harvest assessment were identified to be 94.7% CM larvae (18/19) and 5.3% OFM larvae (1/19); only one live larva (OFM) was found in the treated plots. Live larvae collected from the control plots of the 11 September harvest assessment were identified to be 69.2% CM larvae (18/26) and 30.8% OFM larvae (8/26); 87.5% (7/8) of live larvae collected in the treated plots were identified as CM larvae and 12.5% (1/8) were OFM larvae.

It should be noted that treatments for control of second generation OFM could have been applied between CM1-2 and CM2-1; this may have reduced the amount of OFM damage and increased the percentage of marketable apples in the test plots at harvest. There may have been a residual amount of insecticide remaining after CM1-2 (June 15) that reduced early second generation OFM damage but residues were likely not persistent enough to control the later second generation OFM before CM2-1 was applied (July 24).

Table 1a. Application dates, products and rates for Calypso Early Season regime.

Regime - Calypso (early)	Product	Rate	App. Date
Petal Fall	Calypso 480 SC	140 g ai/ha	May 25
First generation Codling moth-1st app	Calypso 480 SC	210 g ai/ha	June 2
First generation Codling moth-2nd app	Calypso 480 SC	210 g ai/ha	June 15
Second generation Codling moth-1st app	Success 480 SC	87.4 ml ai/ha	July 24
Second generation Codling moth-2nd app	Success 480 SC	87.4 ml ai/ha	August 4
Pre-harvest	Intrepid 2F	248 g ai/ha	August 18

Table 1b. Application dates, products and rates used for Calypso Late Season regime.

Regime - Calypso (late)	Product	Rate	App. Date
Petal Fall	Calypso 480 SC	140 g ai/ha	May 25
First generation Codling moth-1st app	Success 480 SC	87.4 ml ai/ha	June 2
First generation Codling moth-2nd app	Success 480 SC	87.4 ml ai/ha	June 15
Second generation Codling moth-1st app	Calypso 480 SC	210 g ai/ha	July 24
Second generation Codling moth-2nd app	Calypso 480 SC	210 g ai/ha	August 4
Pre-harvest	Intrepid 2F	248 g ai/ha	August 18

Table 1c. Application dates, products and rates used for Organophosphate/Pyrethroid regime.

Regime - OP/PYR	Product	Rate	App. Date
Petal Fall	Diazinon 50W	1630 g ai/ha	May 25
First generation Codling moth-1st app	Guthion 50 WP	1100 g ai/ha	June 2
First generation Codling moth-2nd app	Guthion 50 WP	1100 g ai/ha	June 15
Second generation Codling moth-1st app	Decis 5 EC	12.5 g ai/ha	July 24
Second generation Codling moth-2nd app	Matador 120 EC	10 ml ai/ha	August 4
Pre-harvest	Imidan 50 WP	1875 g ai/ha	August 18

Table 2. Number of mullein bugs per sample.

Treatment	Sample Date	
	31 May[1,3]	6 June[2]
CALYPSO (early) regime	0.25 a	0.00 b
CALYPSO (late) regime	0.75 a	0.00 b
OP/PYR regime	1.50 a	0.00 b
CONTROL	6.00 a	5.25 a

[1] Sample taken six days after petal fall treatment.
[2] Sample taken four days after first application of first generation Codling moth treatment.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 3. Number of white apple leafhopper nymphs per sample.

Treatment	Sample Date	
	31 May[1,3]	6 June[2]
CALYPSO (early) regime	1.25 c	1.00 b
CALYPSO (late) regime	3.00 bc	0.50 b
OP/PYR regime	14.25 ab	5.00 b
CONTROL	28.25 a	28.00 a

[1] Sample taken six days after petal fall treatment.
[2] Sample taken four days after first application of first generation Codling moth treatment.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 4. Percentage of apples with codling moth damage.

Treatment	Sample Date	
	29 June[1,3]	11 September[2]
CALYPSO (early) regime	0.50 b	9.50 b
CALYPSO (late) regime	1.00 b	5.50 b
OP/PYR regime	0.50 b	6.00 b
CONTROL	20.50 a	36.50 a

[1] Sample taken fourteen days after second application of first generation Codling moth treatment.
[2] Sample taken twenty-four days after pre-harvest treatment.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 5. Percentage of apples with Oriental fruit moth damage.

Treatment	Sample Date	
	29 June[1,3]	11 September[2]
CALYPSO (early) regime	0.00 a	8.50 ab
CALYPSO (late) regime	0.50 a	5.00 b
OP/PYR regime	1.00 a	4.50 b
CONTROL	1.50 a	19.00 a

[1] Sample taken fourteen days after second application of first generation Codling moth treatment.
[2] Sample taken twenty-four days after pre-harvest treatment.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 6. Percentage of marketable apples (apples free of insect damage).

Treatment	Sample Date[1]
	11 September[2]
CALYPSO (early) regime	66.0 a
CALYPSO (late) regime	72.0 a
OP/PYR regime	77.0 a
CONTROL	33.5 a

[1] Sample taken twenty-four days after pre-harvest treatment.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 7. Weight of fifty apples per plot.

Treatment	Weight (g)	
	29 June[1,3]	11 September[2]
CALYPSO (early) regime	1127 a	7475 a
CALYPSO (late) regime	1149 a	7233 a
OP/PYR regime	1185 a	7226 a
CONTROL	1071 a	6906 a

[1] Sample taken fourteen days after second application of first generation Codling moth treatment.
[2] Sample taken twenty-four days after pre-harvest treatment.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2006 PMR REPORT #008 **SECTION A: TREE FRUIT - Insect Pests**

CROP: Apple (*Malus domestica* Borkh.), cv. Golden delicious (Smoothie)
PEST: Mullein Bug, *Campylomma verbasci* (Meyer)

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TITLE: CONTROL OF MULLEIN BUG ON APPLE WITH CALYPSO; 2005

MATERIALS: CALYPSO 480 SC (thiacloprid), DIAZINON 50 W (diazinon)

METHODS: The trial was conducted in an eleven-year-old apple orchard in Beamsville, Ontario; apples cv. Golden delicious, on 1-11 rootstock, were spaced 6.3 m by 4.8 m. Three rates of CALYPSO 480 SC (35 g a.i./ha, 70 g a.i./ha and 140 g a.i./ha) were compared to a single rate of DIAZINON 50 W (1630 g a.i./ha) and an unsprayed control. Treatments were replicated four times, assigned to two-tree plots and arranged according to a randomized complete block design. Application of insecticides were timed to target an elevated population of mullein bug (MB). On 8 June, insecticides were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 10-12 L of spray mix were used per plot; pressure was set at 2000 kPa. Individual plots were sampled two days and seven days after treatment. Six limbs per plot were struck three times each over a tapping tray and numbers of MB were recorded. On 15 July, fifty apples per plot were harvested, weighed and examined for damage by MB. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2 and 3. There were no phytotoxic effects observed at two, seven days or thirteen days after treatment.

CONCLUSIONS: All treatments significantly reduced numbers of MB two days after treatments were applied compared to the control; after seven days, there were no longer any significant differences in numbers of MB between any of the treatments and the control (Table 1). Although the differences between rates of CALYPSO was not significant, there appeared to be a rate effect for the control of MB on both sample dates (Table 1).
On 15 July, there were no significant differences in fruit damage caused by MB between any of the treatments and the control (Table 2). Fruit damage by MB may have occurred prior to the application of insecticides, an earlier application may have reduced the fruit damage. On 15 July, there were no significant differences in total weight of fifty apples between any of the treatments and the control (Table 3).

Table 1. Numbers of mullein bug per sample.

Treatment[1]	Rate (g a.i./ha)	Sample Date 10 June[2]	15 June[2]
CALYPSO 480 SC	35	21.0 b	5.8 a
CALYPSO 480 SC	70	12.5 b	5.5 a
CALYPSO 480 SC	140	10.3 b	1.3 a
DIAZINON 50 W	1630	14.5 b	4.8 a
CONTROL	-	46.3 a	7.5 a

[1] Applied 8 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent fruit damage by mullein bug per plot.

Treatment[1]	Rate (g a.i./ha)	Sample Date 15 July[2]
CALYPSO 480 SC	35	9.8 a
CALYPSO 480 SC	70	11.8 a
CALYPSO 480 SC	140	7.0 a
DIAZINON 50 W	1630	9.8 a
CONTROL	-	11.3 a

[1] Applied 8 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 3. Weight of fifty apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g) 15 July[2]
CALYPSO 480 SC	35	979.3 a
CALYPSO 480 SC	70	906.3 a
CALYPSO 480 SC	140	928.8 a
DIAZINON 50 W	1630	939.6 a
CONTROL	-	939.7 a

[1] Applied 8 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2006 PMR REPORT #009 **SECTION A: TREE FRUIT - Insect Pests**

CROP: Apple (*Malus domestica* Borkh.), cv. Empire
PEST: Mullein bug, *Campylomma verbasci* (Meyer)

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TITLE: CONTROL OF MULLEIN BUG AND INTERNAL LEPIDOPTERA ON APPLE WITH CALYPSO; 2005

MATERIALS: CALYPSO 480 SC (thiacloprid), DIAZINON 50 W (diazinon)

METHODS: The trial was conducted in an eleven-year-old apple orchard in Jordan Station, Ontario; apples cv. Empire, on M9 rootstock, were spaced 4.6 m by 2.4 m. Three rates of CALYPSO 480 SC (35 g a.i./ha, 70 g a.i./ha and 140 g a.i./ha) were compared to a single rate of DIAZINON 50 W (1630 g a.i./ha) and an unsprayed control. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomized complete block design. On 8 June, insecticides were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 6 L of spray mix were used per plot; pressure was set at 2000 kPa. Individual plots were sampled two days and seven days after treatment; six limbs per plot were struck three times each over a tapping tray and counts of mullein bug (MB) were recorded. On 13 July, fifty apples were harvested, weighed and examined for MB and internal Lepidoptera damage. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables1, 2 and 3. MB populations were considered to be low and no fruit damage was recorded. There were no phytotoxic effects observed at two, seven days or thirteen days after treatment.

CONCLUSIONS: There were no significant differences in numbers of MB with any treatments compared to the control at either two or seven days post-treatment (Table 1). There were no significant differences in damage caused by internal Lepidoptera with any treatments compared to the control thirty-five days post-treatment; although not significantly different, there appeared to be a rate effect with CALYPSO for control of internal Lepidoptera (Table 2). There were no significant differences in total weight of fifty apples with any treatments compared to the control (Table 3).

Table 1. Numbers of mullein bug per sample.

Treatment[1]	Rate (g a.i./ha)	Sample Date 10 June[2]	15 June[2]
CALYPSO 480 SC	35	3.0 a	0.5 a
CALYPSO 480 SC	70	1.8 a	1.0 a
CALYPSO 480 SC	140	1.0 a	1.0 a
DIAZINON 50 W	1630	1.3 a	1.3 a
CONTROL	-	6.5 a	1.8 a

[1] Applied 8 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent fruit damage by internal Lepidoptera per plot.

Treatment[1]	Rate (g a.i./ha)	Sample Date 13 July[2]
CALYPSO 480 SC	35	12.0 a
CALYPSO 480 SC	70	8.5 a
CALYPSO 480 SC	140	8.0 a
DIAZINON 50 W	1630	2.5 a
CONTROL	-	10.0 a

[1] Applied 8 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 3. Weight of fifty apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g) 13 July[2]
CALYPSO 480 SC	35	1095 a
CALYPSO 480 SC	70	1114 a
CALYPSO 480 SC	140	1235 a
DIAZINON 50 W	1630	1128 a
CONTROL	-	1053 a

[1] Applied 8 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2006 PMR REPORT #010 **SECTION A: FRUIT-Insect Pests**

CROP: Apple (*Malus domestica* Borkh.), cv. McIntosh
PESTS: Plum curculio, *Conotrachelus nenuphar* (Herbst)

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TITLE: ASSESSMENT OF CALYPSO FOR CONTROL OF EARLY INTERNAL LEPIDOPTERA AND PLUM CURCULIO; 2005

MATERIALS: CALYPSO 480 SC (thiacloprid), GUTHION 50 WP (azinphos-methyl)

METHODS: The trial was conducted in an eleven-year-old apple orchard in Jordan Station, Ontario; trees cv. McIntosh, on M26 rootstock, were spaced 4.8 m by 3.0 m. Treatments were replicated four times, assigned to two-tree plots and arranged according to a randomized complete block design. The trial compared three rates of CALYPSO 480 SC (70 g a.i./ha, 140 g a.i./ha and 210 g a.i./ha) to a single rate of GUTHION 50 WP (1100 g a.i./ha) and an unsprayed control. Two applications of insecticides, timed to target peak egg hatch of codling moth and fourteen days later, were applied 7 June (103.6 DD_{10} after Biofix) and 23 June (280.5 DD_{10} after Biofix). Insecticides were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 10-12 L of spray mix were used per plot; pressure was set at 2000 kPa. On 21 June, fifty apples per plot were harvested and examined for damage by plum curculio (PC) and internal Lepidoptera. Efficacy was expressed as percent fruit damaged by pest. On 6 July, fifty apples per plot were harvested, weighed and examined for damage by PC and internal Lepidoptera. Efficacy was expressed as percent fruit damaged by pest. Data were analyzed using analysis of variance and means were separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2 and 3. No phytotoxic effects were observed in any plots at any of the observation dates (15 June, 21 June, 30 June and 6 July). PC populations were considered to be low.

CONCLUSIONS: There were no significant differences in fruit damage caused by internal Lepidoptera between any of the treatments and the control in the 21 June sample; in the 6 July sample, all treated plots had significantly fewer apples with internal Lepidoptera damage compared to the control, there were no differences between treatments (Table 1). There were no significant differences in fruit damage caused by PC between any of the treatments and the control at either sample date (Table 2). There were no significant differences in weight of fifty apples between any of the treatments or the control (Table 3).

Table 1. Percent fruit damaged by internal Lepidoptera per plot.

Treatment[1]	Rate (g a.i./ha)	Sample date 21 June[2]	6 July
CALYPSO 480 SC	70	1.5 a	2.5 b
CALYPSO 480 SC	140	0.5 a	1.5 b
CALYPSO 480 SC	210	0.0 a	2.0 b
GUTHION 50 WP	1100	0.0 a	0.0 b
CONTROL	-	3.0 a	12.0 a

[1] Applied 7 June and 23 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent fruit damaged by plum curculio per plot.

Treatment[1]	Rate (g a.i./ha)	Sample date 21 June[2]	6 July
CALYPSO 480 SC	70	1.5 a	2.5 a
CALYPSO 480 SC	140	0.0 a	1.5 a
CALYPSO 480 SC	210	1.5 a	3.0 a
GUTHION 50 WP	1100	1.5 a	1.0 a
CONTROL	-	2.0 a	1.0 a

[1] Applied 7 June and 23 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 3. Weight of fifty apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g) 6 July[2]
CALYPSO 480 SC	70	824.8 a
CALYPSO 480 SC	140	900.0 a
CALYPSO 480 SC	210	896.8 a
GUTHION 50 WP	1100	872.8 a
CONTROL	-	882.0 a

[1] Applied 7 June and 23 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

CROP: Apple *(Malus domestica* Borkh.), cv. Empire
PEST: White Apple Leafhopper, *Typhlocyba pomaria* McAtee
PREDATORS: *Amblyseius* sp., Assassin bug, *Acholla multispinosa* De Geer, *Zetzellia* sp.

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TITLE: CONTROL OF WHITE APPLE LEAFHOPPER ON APPLE WITH CALYPSO; 2005

MATERIALS: CALYPSO 480 SC (thiacloprid), DIAZINON 50 W (diazinon)

METHODS: The trial was conducted in an eleven-year-old apple orchard in Jordan Station, Ontario; apples cv. Empire, on M9 rootstock, were spaced 4.6 m by 2.4 m. Three rates of CALYPSO 480 SC (35 g a.i./ha, 70 g a.i./ha and 140 g a.i./ha) were compared to a single rate of DIAZINON 50 W (1630 g a.i./ha) and an unsprayed control. Treatments were replicated four times, assigned to two-tree plots and arranged according to a randomized complete block design. Application was timed to target an elevated population of white apple leafhopper (WALH). On 8 June, insecticides were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 6 L of spray mix were used per plot; pressure was set at 2000 kPa. On 10 June, six limbs per plot were struck three times each over a tapping tray and populations of WALH were recorded. On 13 June, fifty leaves per plot were harvested, examined using a stereo-microscope (leaves were brushed with a Henderson-McBurnie mite brushing machine) and numbers of predatory mites were recorded for each sample. On 15 June, six limbs per plot were struck three times each over a tapping tray and populations of WALH and assassin bugs were recorded. On 13 July, fifty apples per plot were harvested and weighed. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables1, 2, 3 and 4. There were no phytotoxic effects observed at two, seven days or thirteen days after treatment. The populations of WALH were not normally distributed in the two day sample, therefore the data were transformed (square root (x + 0.5)).

CONCLUSIONS: All treatments except DIAZINON significantly reduced numbers of WALH two days post-treatment compared to the control; all treatments significantly reduced numbers of WALH seven days post-treatment compared to the control (Table 1). There were no significant differences in numbers of predatory mites in any of the treatments five days after treatment compared to the control (Table 2). All treatments significantly reduced numbers of assassin bugs seven days post-treatment compared to the control (Table 3). There were no significant differences in total weight of fifty apples in any of the treatments compared to the control (Table 4).

Table 1. Numbers of white apple leafhoppers per sample.

Treatment[1]	Rate (g a.i./ha)	Sample Date 10 June[2]	15 June[2]
CALYPSO 480 SC	35	2.76 b	7.3 b
CALYPSO 480 SC	70	1.38 b	4.5 b
CALYPSO 480 SC	140	1.19 b	5.3 b
DIAZINON 50 W	1630	6.84 a	19.0 b
CONTROL	-	8.87 a	41.0 a

[1] Applied 8 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Numbers of predatory mites per sample.

Treatment[1]	Rate (g a.i./ha)	Sample Date 13 June[2]
CALYPSO 480 SC	35	4.3 a
CALYPSO 480 SC	70	2.5 a
CALYPSO 480 SC	140	5.5 a
DIAZINON 50 W	1630	3.5 a
CONTROL	-	0.5 a

[1] Applied 8 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 3. Numbers of assassin bugs per sample.

Treatment[1]	Rate (g a.i./ha)	Sample Date 15 June[2]
CALYPSO 480 SC	35	0.3 b
CALYPSO 480 SC	70	1.0 b
CALYPSO 480 SC	140	0.5 b
DIAZINON 50 W	1630	0.3 b
CONTROL	-	4.0 a

[1] Applied 8 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 4. Weight of fifty apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g) 13 July[2]
CALYPSO 480 SC	35	1095 a
CALYPSO 480 SC	70	1114 a
CALYPSO 480 SC	140	1235 a
DIAZINON 50 W	1630	1128 a
CONTROL	-	1053 a

[1] Applied 8 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2006 PMR REPORT #012 **SECTION A: TREE FRUIT - Insect Pests**

CROP: Apples (*Malus domestica* Borkh.) cv. Red delicious
PEST: European Red Mite, *Panonychus ulmi* (Koch)
PREDATOR: *Amblyseius* sp.

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TITLE: EARLY SEASON CONTROL OF EUROPEAN RED MITE ON APPLE WITH ACARICIDES; 2005

MATERIALS: ACRAMITE 50 WP (bifenazate), AGRI-MEK 1.9 EC (abamectin), ENVIDOR 240 SC (spirodiclofen)

METHODS: The trial was conducted in an eleven-year-old apple orchard in Jordan Station, Ontario; trees cv. Red delicious, on M9 rootstock, were spaced 4.3 m by 2.4 m. A single rate of ENVIDOR 240 SC (180 g a.i./ha) was compared to single rates of AGRI-MEK 1.9 EC (14.25 g a.i./ha) with Superior 70 Oil (0.25% v/v) added, ACRAMITE 50 WP (426 g a.i./ha), ENVIDOR 240 SC (180 g a.i./ha) with added Boron (0.1 kg SOLUBAR/100 L) and an unsprayed control. Treatments were replicated four times, assigned to two-tree plots and arranged according to a randomized complete block design. Applications were timed to target an elevated early season European Red Mite (ERM) population based on pre-spray counts. On 17 June, acaricides were diluted to a rate comparable to 3000 L/ha (except AGRI-MEK 1.9 EC which was diluted to a rate comparable to 3750 L/ha) and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 4-5 L of spray mix were used per plot; pressure was set at 2000 kPa. Plots were sampled pre-treatment (pre-spray counts were taken from twenty leaves) and 8, 24 and 46 days post-treatment. Samples consisted of counts made on fifty leaves per plot, picked randomly around the canopy. Samples were examined using a stereo-microscope (leaves were brushed with a Henderson-McBurnie mite brushing machine) and numbers of ERM eggs, nymphs and adults recorded. Total numbers of predatory mites observed were also recorded for each sample. Twenty-five apples per plot were harvested and weighed on October 6. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, 3, 4, 5 and 6. Pre-treatment samples taken 17 June showed similar numbers of ERM eggs (approximately 6 eggs per leaf) and ERM motiles (approximately 3.5 motiles per leaf) in all plots. There were no phytotoxic effects observed in any plots 7 days or 13 days after treatment. The adult ERM population of 11 July was not distributed normally so a transformation (square root (x + 0.5)) was done.

CONCLUSIONS: All treatments significantly reduced numbers of ERM eggs at all sampling dates compared to the control (Table 1) . Only AGRI-MEK (with Superior Oil) significantly reduced nymph populations after 8 days compared to the control; all treatments significantly reduced populations of ERM nymphs 24 and 46 days after application compared to the control (Table 2). After 8 days, there were significant reductions in adult ERM populations compared to the control in all treatments except ENVIDOR; after 24 days, all treatments caused significant reductions in adult ERM populations compared to the control (Table 3). After 46 days, none of the treatments showed any significant reduction in adult ERM populations (Table 3). When total populations of ERM motiles were considered, all treatments significantly reduced populations at all sampling dates (Table 4).

Populations of predatory mites were not affected by any of the treatments at any of the sampling dates (Table 5). There were no significant differences in weight of fifty apples in any of the treatments compared to the control (Table 6).

Table 1. Number of ERM eggs per sample.

Treatment[1]	Rate	Days After Treatment		
	(g a.i./ha)	8 days[2]	24 days[2]	46 days[2]
ENVIDOR 240 SC	180	27.0 b	8.3 b	7.3 b
AGRI-MEK 1.9 EC[3]	14.5	13.5 b	12.5 b	35.5 b
ACRAMITE WP 50	426	10.3 b	4.3 b	31.0 b
ENVIDOR 240 SC (+ BORON)	180	12.3 b	6.5 b	8.5 b
CONTROL	-	78.8 a	82.3 a	104.0 a

[1] Applied 17 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.
[3] Superior 70 Oil (0.25% v/v) was added to AGRI-MEK 1.9 EC prior to application.

Table 2. Number of ERM nymphs per sample.

Treatment[1]	Rate	Days After Treatment		
	(g a.i./ha)	8 days[2]	24 days[2]	46 days[2]
ENVIDOR 240 SC	180	1.8 ab	0.0 b	1.3 b
AGRI-MEK 1.9 EC[3]	14.5	0.5 b	1.3 b	4.5 b
ACRAMITE WP 50	426	2.0 ab	0.3 b	2.5 b
ENVIDOR 240 SC (+ BORON)	180	2.0 ab	0.0 b	0.5 b
CONTROL	-	11.5 a	9.8 a	30.3 a

[1] Applied 17 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.
[3] Superior 70 Oil (0.25% v/v) was added to AGRI-MEK 1.9 EC prior to application.

Table 3. Number of ERM adults per sample.

Treatment[1]	Rate	Days After Treatment		
	(g a.i./ha)	8 days[2]	24 days[2]	46 days[2]
ENVIDOR 240 SC	180	0.8 ab	0.7 b	1.0 a
AGRI-MEK 1.9 EC[3]	14.5	0.3 b	1.0 b	0.5 a
ACRAMITE WP 50	426	0.5 b	0.7 b	1.8 a
ENVIDOR 240 SC (+ BORON)	180	0.0 b	0.8 b	0.0 a
CONTROL	-	4.8 a	2.4 a	0.8 a

[1] Applied 17 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test
[3] Superior 70 Oil (0.25% v/v) was added to AGRI-MEK 1.9 EC prior to application.

Table 4. Total number of ERM motiles per sample.

Treatment[1]	Rate (g a.i./ha)	Days After Treatment 8 days[2]	24 days[2]	42 days[2]
ENVIDOR 240 SC	180	2.5 b	0.0 b	2.3 b
AGRI-MEK 1.9 EC[3]	14.5	0.8 b	2.0 b	5.0 b
ACRAMITE 50 WP	426	2.5 b	0.3 b	4.3 b
ENVIDOR 240 SC (+ BORON)	180	2.0 b	0.3 b	0.5 b
CONTROL	-	16.3 a	15.0 a	31.0 a

[1] Applied 17 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.
[3] Superior 70 Oil (0.25% v/v) was added to AGRI-MEK 1.9 EC prior to application.

Table 5. Number of predatory mites per sample.

Treatment[1]	Rate (g a.i./ha)	Days After Treatment 8 days[2]	24 days[2]	46 days[2]
ENVIDOR 240 SC	180	2.0 a	2.5 a	1.5 a
AGRI-MEK 1.9 EC[3]	14.5	2.0 a	1.0 a	3.5 a
ACRAMITE WP 50	426	3.0 a	1.5 a	1.0 a
ENVIDOR 240 SC (+ BORON)	180	6.3 a	1.8 a	1.0 a
CONTROL	-	6.0 a	2.8 a	5.3 a

[1] Applied 17 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.
[3] Superior 70 Oil (0.25% v/v) was added to AGRI-MEK 1.9 EC prior to application.

Table 6. Weight of fifty apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g) 6 October[2]
ENVIDOR 240 SC	180	4147.8 a
AGRI-MEK 1.9 EC[3]	14.5	4087.8 a
ACRAMITE 50 WP	426	4295.0 a
ENVIDOR 240 SC (+ BORON)	180	4229.0 a
CONTROL	-	4259.8 a

[1] Applied 17 June.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.
[3] Superior 70 Oil (0.25% v/v) was added to AGRI-MEK 1.9 EC prior to application.

2006 PMR REPORT #013 **SECTION A: TREE FRUIT - Insect Pests**

CROP: Apples (*Malus domestica* Borkh.), cv. Red delicious
PEST: Oblique Banded Leafroller, *Choristoneura rosaceana* (Harris)

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TITLE: EARLY SEASON CONTROL OF OBLIQUE BANDED LEAFROLLER ON APPLE WITH CALYPSO; 2005

MATERIALS: CALYPSO 480 SC (thiacloprid), INTREPID 2F (methoxyfenozide)

METHODS: The trial was conducted in a twenty-year-old orchard in Grimsby, Ontario; trees cv. Red delicious were spaced 5.0 m by 2.3 m. Three rates of CALYPSO 480 SC (70 g a.i./ha, 140 g a.i./ha, and 210 g a.i./ha) were compared to a single rate of INTREPID 2F (180 g a.i./ha) and an unsprayed control. Treatments were replicated four times, assigned to two-tree plots and arranged according to a randomized complete block design. Insecticides were timed to control over-wintering oblique banded leafroller (OBLR). On 29 June (179 $DD_{6.1}$ after Biofix) and fourteen days later (396.1 $DD_{6.1}$ after Biofix), insecticides were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 8-9 L of spray mix were used per plot; pressure was set at 2000 kPa.. Plots were sampled 5 August by visually assessing one hundred terminals per plot for evidence of OBLR feeding damage. On 5 August, one hundred apples per plot were harvested, weighed and examined for evidence of OBLR feeding damage. Data were analyzed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Table 1, 2 and 3. There were no phytotoxic effects observed in any of the treated plots on any of the observation dates (5 July, 13 July, 21 July and 3 Aug).

CONCLUSIONS: In the 5 August terminal assessment, all treatments significantly reduced terminal damage caused by OBLR compared to the control (Table 1). In the 5 August fruit sample, all treatments significantly reduced fruit damage caused by OBLR compared to the control; the highest rate of CALYPSO had significantly fewer damaged fruit per plot than the lowest rate of CALYPSO; a significant rate effect by CALYPSO for control of OBLR fruit damage is evident from the data (Table 2). There were no significant differences in apple weight between any of the treatments and the control (Table 3).

Table 1. Percent oblique banded leafroller infested terminals per plot.

Treatment[1]	Rate (g a.i./ha)	Percent infested terminals 5 August[2]
CALYPSO 480 SC	70	1.3 b
CALYPSO 480 SC	140	1.5 b
CALYPSO 480 SC	210	1.0 b
INTREPID 2F	180	1.0 b
CONTROL	-	5.8 a

[1] Applied 29 June and 13 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent oblique banded leafroller damaged apples per plot.

Treatment[1]	Rate (g a.i./ha)	Percent damaged apples 5 August[2]
CALYPSO 480 SC	70	5.3 b
CALYPSO 480 SC	140	3.0 bc
CALYPSO 480 SC	210	1.8 c
INTREPID 2F	180	4.0 bc
CONTROL	-	10.0 a

[1] Applied 29 June and 13 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 3. Weight of one hundred apples per plot.

Treatment[1]	Rate (g a.i./ha)	Weight (g) 5 August[2]
CALYPSO 480 SC	70	4773 a
CALYPSO 480 SC	140	4716 a
CALYPSO 480 SC	210	4429 a
INTREPID 2F	180	4640 a
CONTROL	-	4732 a

[1] Applied 29 June and 13 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2006 PMR REPORT #014 **SECTION A: FRUIT - Insect Pests**
STUDY DATA BASE: 280-1261-9341

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

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TITLE: CONTROL OF SECOND GENERATION GRAPE BERRY MOTH WITH RYNAXYPYR; 2006

MATERIALS: DPX-E2Y45 35 WG (rynaxypyr), GUTHION 240 SC (azinphos-methyl)

METHODS: This study was part of AAFC Pesticide Minor Use Project AAFC05-062E. 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 3.0 m by 8.0 m, and arranged according to a randomised complete block design. Application timing was based on first significant increase in pheromone trap catch of male grape berry moths (GBM). Three rates of E2Y45 (50, 75, and 100 g a.i./ha) were compared to a GUTHION standard and an unsprayed control; the effect of the addition of the surfactant HASTEN (modified vegetable oil) at 0.25% v/v was also studied. Treatments were applied 6 July, and reapplied 20 July; insecticides were diluted to a rate comparable to 2000 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 17 July (11 days after application) and 2 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%). Plots were also examined 17 July and 2 August for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). Data were transformed (log(x+1)), and analysed using analysis of variance and means separated with a Tukey test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1 and 2.

CONCLUSIONS: In both the 17 July and 2 August samples, all treated plots contained less GBM damage than the control plots. Differences between insecticide treatments were not significant. The addition of HASTEN did not increase efficacy of E2Y45.
It should be noted that timing of application 1 should have occurred 3-5 days earlier than in this trial. As a result, GBM damage levels of 10% were observed in all plots prior to application 1; levels of control could have been approximately 10% lower for all treatments.
No phytotoxic effects were observed in any plots.

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

Treatment[1]	Rate (a.i./ha)	% Infested Bunches 11 Days after Application 1 (17 July)[3]	% Infested Bunches 13 Days after Application 2 (2 August)[3]
GUTHION 240 SC	1.8 kg	20.5 b	21.0 b
E2Y45 35 WG	100 g	17.0 b	19.0 b
E2Y45 35 WG[2]	75 g	17.0 b	20.5 b
E2Y45 35 WG	75 g	19.0 b	22.0 b
E2Y45 35 WG	50 g	18.5 b	27.5 b
CONTROL	-	57.0 a	49.0 a

[1] Applied 6 July, repeated 20 July.
[2] HASTEN (adjuvant) added at 0.25% v/v.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Phytotoxicity ratings.

Treatment[1]	Rate (a.i./ha)	Phytotoxicity Rating (0-100) 11 Days after Application 1 (17 July)[3]	Phytotoxicity Rating (0-100) 13 Days after Application 2 (2 August)[3]
GUTHION 240 SC	1.8 kg	0.0 a	0.0 a
E2Y45 35 WG	100 g	0.0 a	0.0 a
E2Y45 35 WG[2]	75 g	0.0 a	0.0 a
E2Y45 35 WG	75 g	0.0 a	0.0 a
E2Y45 35 WG	50 g	0.0 a	0.0 a
CONTROL	-	0.0 a	0.0 a

[1] Applied 6 July, repeated 20 July
[2] HASTEN (adjuvant) added at 0.25% v/v
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2006 PMR REPORT #015 **SECTION A: TREE FRUIT - Insect Pests**

CROP: Grapes (*Vitis vivifera* L.), cv. Riesling
PEST: European Red Mite, *Panonychus ulmi* (Koch)
PREDATOR: *Amblyseius* sp.

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TITLE: LATE SEASON CONTROL OF EUROPEAN RED MITE ON GRAPE WITH ACARICIDES; 2005

MATERIALS: ENVIDOR 240 SC (spirodiclofen), FLORAMITE 50 WP (bifenazate), PYRAMITE 75 WP (pyridaben)

METHODS: The trial was conducted in an nine-year-old vineyard in Jordan Station, Ontario; grapes cv. Riesling, on SO4 rootstock, were spaced 2.5 m by 1.5 m. A single rate of ENVIDOR 240 SC (180 g a.i./ha) was compared to single rates of PYRAMITE 75 WP (180 g a.i./ha), FLORAMITE 50 WP (180 g a.i./ha) and an unsprayed control. Treatments were replicated four times, assigned to five-vines-per-panel plots and arranged according to a randomized complete block design. Application was timed to target an elevated late season European red mite (ERM) population based on pre-spray counts. On 24 August, acaricides were diluted to a rate comparable to 3000 L/ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 7 L of spray mix were used per plot; pressure was set at 2000 kPa. Plots were sampled pre-treatment and 7, 13 and 43 days post-treatment. Samples consisted of counts made on twenty leaves per plot, picked randomly around the canopy. Samples were examined using a stereo-microscope (leaves were brushed with a Henderson-McBurnie mite brushing machine) and numbers of ERM eggs, nymphs and adults recorded. Total numbers of predatory mites observed in each sample were also recorded. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, 3, 4 and 5. Pre-treatment samples taken 22 August showed similar numbers of ERM eggs (approximately 177 eggs per sample) and ERM motiles (approximately 58 motiles per sample) in all plots. Populations of predatory mites were considered to be low in all plots at all sampling dates. There were no phytotoxic effects observed on any leaves at either seven days or thirteen days after treatment.

CONCLUSIONS: All treatments showed significant reductions in numbers of ERM egg seven days post-treatment compared to the control (Table 1). Only ENVIDOR significantly reduced ERM egg populations after thirteen days compared the control (Table 1). At forty-three days post-treatment, there were no significant differences in ERM egg numbers between any of the treatments and the control (Table 1).
Only ENVIDOR significantly reduced numbers of ERM nymphs seven days post-treatment compared to the control (Table 2). ERM nymph numbers were reduced significantly by all treatments compared to the control thirteen days post-treatment (Table 2). At forty-three days post-treatment, PRYRAMITE had significantly higher numbers of ERM nymphs compared to the FLORAMITE and ACRAMITE treatments; there were no significant differences between the control and the ENVIDOR and FLORAMITE treatments (Table 2).

Only ENVIDOR significantly reduced adult ERM populations after seven days compared to the control (Table

3). There were significant reductions in adult ERM populations by all treatments after thirteen days compared to the control (Table 3). There were no significant reductions in adult ERM populations with any treatments forty-three days post-treatment (Table 3).

Only ENVIDOR significantly reduced total motile populations after seven days (Table 4). All treatments significantly reduced total motile populations after thirteen days (Table 4). At forty-three days post-treatment, PRYRAMITE had significantly higher populations of total motiles present compared to the other acaricide treatments (TABLE 4). Although there were not significant differences in total motile numbers between the control, the FLORAMITE and ENVIDOR treatments, the numbers of total motiles were reduced by the FLORAMITE and ENVIDOR treatments (Table 4). Populations of predatory mites were not affected by any of the treatments at any of the sampling dates (Table 5).

Table 1. Number of ERM eggs per sample.

Treatment[1]	Rate	Days After Treatment		
	(g a.i./ha)	7 days[2]	13 days[2]	43 days[2]
ENVIDOR 240 SC	180	87.5 b	86.0 b	25.0 a
PYRAMITE 75 WP	180	95.0 b	160.5 ab	28.3 a
FLORAMITE 50 WP	426	81.5 b	150.0 ab	27.5 a
CONTROL	-	181.0 a	454.8 a	28.0 a

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

Table 2. Number of ERM nymphs per sample.

Treatment[1]	Rate	Days After Treatment		
	(g a.i./ha)	7 days[2]	13 days[2]	43 days[2]
ENVIDOR 240 SC	180	2.0 b	30.5 b	11.0 b
PYRAMITE 75 WP	180	35.0 ab	40.8 b	67.8 a
FLORAMITE 50 WP	426	45.5 ab	80.3 b	3.0 b
CONTROL	-	77.5 a	225.5 a	37.5 ab

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

Table 3. Number of ERM adults per sample.

Treatment[1]	Rate	Days After Treatment		
	(g a.i./ha)	7 days[2]	13 days[2]	43 days[2]
ENVIDOR 240 SC	180	2.0 b	2.5 b	12.0 a
PYRAMITE 75 WP	180	8.0 ab	6.5 b	33.5 a
FLORAMITE 50 WP	426	8.0 ab	11.0 b	3.0 a
CONTROL	-	29.5 a	54.0 a	29.0 a

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

Table 4. Total number of ERM motiles per sample.

Treatment[1]	Rate	Days After Treatment		
	(g a.i./ha)	7 days[2]	13 days[2]	43 days[2]
ENVIDOR 240 SC	180	4.0 b	33.0 b	23.0 b
PYRAMITE 75 WP	180	43.0 ab	47.3 b	103.8 a
FLORAMITE 50 WP	426	53.5 ab	91.3 b	6.0 b
CONTROL	-	107.0 a	279.5 a	66.5 ab

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

Table 5. Number of predatory mites per sample.

Treatment[1]	Rate	Days After Treatment		
	(g a.i./ha)	7 days[2]	13 days[2]	43 days[2]
ENVIDOR 240 SC	180	0.0 a	0.5 a	1.0 a
PYRAMITE 75 WP	180	1.5 a	0.0 a	0.5 a
FLORAMITE 50 WP	426	0.5 a	0.0 a	0.3 a
CONTROL	-	2.5 a	0.8 a	1.0 a

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

2006 PMR REPORT # 016 **SECTION A: FRUIT - Insect Pests**
STUDY DATA BASE: 280-1261-9341

CROP: Peach cv. Vivid
PEST: Oriental Fruit Moth, *Grapholita molesta* (Busck), Tarnished Plant Bug, *Lygus lineolaris* (Palisot de Beauvois)

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TITLE: CONTROL OF FIRST-GENERATION ORIENTAL FRUIT MOTH ON PEACH; 2006

MATERIALS: DPX-E2Y45 35 WG (rynaxypyr), MATADOR 120 EC (lambda cyhalothrin)

METHODS: Note: This study has been submitted as part of AAFC Pesticide Minor Use Project AAFC05-060E. The trial was conducted in a three-year-old orchard in the Jordan Station, Ontario area; trees cv. Vivid 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. Three rates of E2Y45 (50, 75, and 100 g a.i./ha) were compared to a MATADOR standard and an unsprayed control; the effect of the addition of the surfactant HASTEN (modified vegetable oil) at 0.25% v/v was also studied. Treatments were applied 19 May, 99.2 DD (base 7.2 C) after first male moth catch (1 May), and were repeated 2 June (241.8 $DD_{7.2}$). Insecticides were diluted to a rate comparable to 2000 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 1 June (13 days after application) and 20 June; all infested terminals and fruit were removed and counted. On 20 June, 50 peaches per plot were examined for the presence of damage from tarnished plant bug (TPB); results were expressed as per cent damage fruit per plot. Plots were also examined 1 June and 20 June for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). To assess yield, peaches were harvested from each plot on 16 August; the total weight of fruit per plot and average weight per fruit were recorded. Data were transformed (log(x+1)) and analysed using analysis of variance; means were separated with a Tukey Test at the 0.05 significance level.

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

CONCLUSIONS: Damage levels were too low to assess in the 1 June sample. In the 20 June sample, all treated plots contained significantly less OFM terminal damage than the control (Table 1). A rate effect was observed; plots treated with 50 g a.i./ha of E2Y45 contained more OFM terminal damage than all other rates of E2Y45, only 100 g a.i./ha of E2Y45 was as effective as the MATADOR standard. The addition of HASTEN did not result in any difference in damage levels from the 75 g a.i./ha treatment of E2Y45 alone.
All treatments reduced fruit damage, but plots treated with 100 g a.i./ha of E2Y45 contained significantly less OFM-damaged fruit than those treated with the lowest (50 g a.i./ha) rate of E2Y45. The addition of HASTEN did not result in any difference in damage levels from the 75 g a.i./ha treatment of E2Y45 alone.
A rate effect was observed when total OFM damage (terminal damage plus fruit damage) per plot was examined. All treatments reduced total OFM compared to the control, but 50 g a.i./ha of E2Y45 was not as effective as all other treatments. No differences were observed between the MATADOR standard and the 75 or 100 g a.i./ha rates of E2Y45. The addition of HASTEN did not result in any difference in damage levels from the 75 g a.i./ha treatment of E2Y45 alone.

A rate effect was observed when TPB damage was assessed (Table 2). TPB damage levels in plots treated with the low (50 g a.i./ha) rate of E2Y45 were not different from the control. No differences were observed between the 75 g a.i./ha and 100 g a.i./ha rates of E2Y45, but only the 100 g a.i./ha rate was statistically similar to the MATADOR standard. The addition of HASTEN did not have any effect on efficacy at 75 g a.i./ha. No phytotoxic effects were observed in any plots.
No adverse effects on yield were observed in any plots (Table 3). There were no differences between treatments in either weight of fruit per plot or average weight per peach.

Table 1. OFM damage per plot.

Treatment[1]	Rate (a.i./ha)	Infested Terminals 20 June[3]	Damaged Fruit 20 June[3]	Total Damage 20 June[3]
MATADOR 120 EC	12.68 g	0.8 d	0.3 bc	1.0 c
DPX-E2Y45 35 WG	100 g	2.8 cd	0.0 c	2.8 c
DPX-E2Y45 35 WG	75 g	3.3 c	0.5 bc	3.8 c
DPX-E2Y45 35 WG[2]	75 g	3.5 c	0.5 bc	4.0 c
DPX-E2Y45 35 WG	50 g	11.8 b	3.0 b	14.8 b
CONTROL	-	59.3 a	14.5 a	73.8 a

1 Applied 19 May, 2 June
2 HASTEN adjuvant added at 0.25% v/v
3 Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Tarnished plant bug (TPB) damage and phytotoxicity ratings per plot.

Treatment[1]	Rate (a.i./ha)	% Fruit Damaged by TPB 20 June[3]	Phytoxicity (0-100) 20 June[3]
MATADOR 120 EC	12.68 g	2.5 d	0.0 a
DPX-E2Y45 35 WG	100 g	11.0 cd	0.0 a
DPX-E2Y45 35 WG	75 g	12.0 bc	0.0 a
DPX-E2Y45 35 WG[2]	75 g	13.0 bc	0.0 a
DPX-E2Y45 35 WG	50 g	21.0 ab	0.0 a
CONTROL	-	23.5 a	0.0 a

1 Applied 19 May, 2 June
2 HASTEN adjuvant added at 0.25% v/v
3 Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 3. Yield per plot.

Treatment[1]	Rate (a.i./ha)	Total Yield (kg peaches/plot)[3]	Average Fruit Size (g/peach)[3]
MATADOR 120 EC	12.68 g	16.6 a	10.8 a
DPX-E2Y45 35 WG	100 g	24.1 a	12.6 a
DPX-E2Y45 35 WG	75 g	20.2 a	11.9 a
DPX-E2Y45 35 WG[2]	75 g	17.0 a	11.0 a
DPX-E2Y45 35 WG	50 g	19.9 a	11.0 a
CONTROL	-	18.8 a	10.5 a

[1] Applied 19 May, 2 June
[2] HASTEN adjuvant added at 0.25% v/v
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2006 PMR REPORT # 017 **SECTION A: FRUIT - Insect Pests**
STUDY DATA BASE #: 280-1261-9341

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

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

MATERIALS: PX-E2Y45 35 WG (rynaxypyr), DECIS 5 EC (deltamethrin)

METHODS: Note: This study has been submitted as part of AAFC Pesticide Minor Use Project AAFC05-060E. The trial was conducted in a three-year-old orchard in the Jordan Station, Ontario area; trees cv. Loring were spaced 4.6 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomized 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. Three rates of E2Y45 (50, 75, and 100 g a.i./ha) were compared to a DECIS standard and an unsprayed control; the effect of the addition of the surfactant HASTEN (modified vegetable oil) at 0.25% v/v was also studied. Treatments were applied 5 July, 655.6 DD (base 7.2 C) after first male moth catch (1 May), and were repeated 19 July (867.8 $DD_{7.2}$). Insecticides were diluted to a rate comparable to 2000 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 18 July (13 days after application), 2 August (13 days after second application), and 17 August (28 days after second application); all infested terminals and fruit were removed and counted. Plots were also examined 18 July and 2 August for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). Data were transformed (log(x+1)) and analyzed using analysis of variance; means were separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, 3 and 4. No phytotoxic effects were observed.

CONCLUSIONS: In the 18 July sample, all treated plots contained significantly less OFM terminal damage than the control (Table 1). A rate effect was observed; plots treated with the 50 g a.i./ha rate of E2Y45 contained more OFM terminal damage than those treated with DECIS or 100 g a.i./ha of E2Y45. Comparing E2Y45 treatments, no differences were observed between 50 and 75 g a.i./ha, or between 75 and 100 g a.i./ha; only the 100 g a.i./ha rate of E2Y45 was as effective as the DECIS standard. The addition of HASTEN did not result in any difference in damage levels from the 75 g a.i./ha treatment of E2Y45 alone. All treatments reduced fruit damage, but no differences were observed between treatments. The addition of HASTEN did not result in any difference in damage levels from the 75 g a.i./ha treatment of E2Y45 alone. A rate effect was observed when total OFM damage (terminal damage plus fruit damage) per plot was examined. All treatments reduced total (damaged terminals plus damaged fruit) OFM damage, but plots treated with 100 g a.i./ha of E2Y45 contained significantly less total OFM damage than those treated with 50 g a.i./ha of E2Y45. The addition of HASTEN did not result in any difference in damage levels from the 75 g a.i./ha treatment of E2Y45 alone.
In the 2 August sample, all treatments reduced terminal, fruit, and total damage, and a rate effect was evident, but differences between treatments were not statistically significant (Table 2). The addition of HASTEN did not have

any effect on efficacy.

A third sample was taken 17 August to assess long-term effects (Table 3). While terminal damage and total damage were reduced by all treatments, only the 100 g a.i./ha rate of E2Y45 was statistically different from the control, but was not different from any other treatments. All treatments reduced fruit damage, but none were statistically different from the control. The addition of HASTEN did not have any effect on efficacy in this sample.

No phytotoxic effects were observed in any plots (Table 4).

Table 1. OFM damage per plot 13 days after first application.

Treatment[1]	Rate (a.i./ha)	Infested Terminals 18 July[3]	Damaged Fruit 18 July[3]	Total Damage 18 July[3]
DECIS 5 EC	10.0 g	6.3 d	4.3 b	10.5 d
DPX-E2Y45 35 WG	100 g	9.8 cd	1.5 b	11.3 cd
DPX-E2Y45 35 WG	75 g	16.3 bc	5.0 b	21.3 bc
DPX-E2Y45 35 WG[2]	75 g	16.8 bc	3.5 b	20.3 bcd
DPX-E2Y45 35 WG	50 g	23.0 b	4.0 b	27.0 b
CONTROL	-	73.5 a	11.3 a	84.8 a

[1] Applied 5 July, 19 July

[2] HASTEN adjuvant added at 0.25% v/v

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

Table 2. OFM damage per plot 14 days after second application.

Treatment[1]	Rate (a.i./ha)	Infested Terminals 2 August[3]	Damaged Fruit 2 August[3]	Total Damage 2 August[3]
DECIS 5 EC	10.0 g	8.5 b	1.0 b	9.5 b
DPX-E2Y45 35 WG	100 g	6.0 b	0.5 b	6.5 b
DPX-E2Y45 35 WG	75 g	11.8 b	2.3 b	14.0 b
DPX-E2Y45 35 WG[2]	75 g	12.5 b	1.0 b	13.5 b
DPX-E2Y45 35 WG	50 g	13.5 b	3.3 b	16.8 b
CONTROL	-	59.8 a	13.0 a	72.8 a

[1] Applied 5 July, 19 July

[2] HASTEN adjuvant added at 0.25% v/v

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

Table 3. OFM damage per plot 29 days after second application.

Treatment[1]	Rate (a.i./ha)	Infested Terminals 17 August[3]	Damaged Fruit 17 August[3]	Total Damage 17 August[3]
DECIS 5 EC	10.0 g	38.5 ab	1.0 a	39.5 ab
DPX-E2Y45 35 WG	100 g	29.2 b	1.8 a	31.0 b
DPX-E2Y45 35 WG	75 g	36.0 ab	3.0 a	39.0 ab
DPX-E2Y45 35 WG[2]	75 g	34.0 ab	1.5 a	35.5 ab
DPX-E2Y45 35 WG	50 g	34.0 ab	2.0 a	36.0 ab
CONTROL	-	72.0 a	6.8 a	78.8 a

[1] Applied 5 July, 19 July
[2] HASTEN adjuvant added at 0.25% v/v
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 4. Phytotoxicity ratings per plot.

Treatment[1]	Rate (a.i./ha)	Phytoxicity (0-100) 18 July[3]	Phytoxicity (0-100) 2 August[3]
DECIS 5 EC	10.0 g	0.0 a	0.0 a
DPX-E2Y45 35 WG	100 g	0.0 a	0.0 a
DPX-E2Y45 35 WG	75 g	0.0 a	0.0 a
DPX-E2Y45 35 WG[2]	75 g	0.0 a	0.0 a
DPX-E2Y45 35 WG	50 g	0.0 a	0.0 a
CONTROL	-	0.0 a	0.0 a

[1] Applied 19 May, 2 June
[2] HASTEN adjuvant added at 0.25% v/v
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2006 PMR REPORT # 018 **SECTION A: FRUIT - Insect Pests**
STUDY DATA BASE #: 280-1261-9341

CROP: Peach cv. Baby Gold 5
PEST: European red mite, *Panonychus ulmi* (Koch)
PREDATOR: *Amblyseius fallacis* (Garman)

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TITLE: ASSESSMENT OF ACARICIDES FOR CONTROL OF EUROPEAN RED MITE ON PEACH; 2006

MATERIALS: ACRAMITE 50 WS (bifenazate), ENVIDOR 240 SC (spirodiclofen), KANEMITE 15 SC (acequinocyl)

METHODS: Note: This study has been submitted as part of AAFC Pesticide Minor Use Project trial AAFC06-029E-109. The trial was conducted in a four-year-old orchard in the Jordan Station, Ontario area; trees cv. Baby Gold 5 were spaced 4.5 m by 3.6 m. Two rates of ACRAMITE, 283.75 g a.i./ha and 425.6 g a.i./ha (equivalent to 2 pouches/0.8 ha and 3 pouches/0.8 ha respectively), were compared to KANEMITE, an ENVIDOR standard, and an unsprayed control; treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomized complete block design. On 18 July, acaricides 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. Blocks were sampled pre-treatment (17 July), and individual plots sampled 7, 16, 22, and 35 days after treatment; samples consisted of counts made on 50 leaves per plot, picked randomly at arm's length into the canopy. Samples were examined using a stereo-microscope (leaves were brushed with a Henderson-McBurnie mite-brushing machine), and numbers of live European Red Mite (ERM) eggs and motiles (nymphs and adults) recorded. Total numbers of beneficial mites observed were also recorded for each plot. Data were transformed (log (x+1)) where necessary and analyzed using analysis of variance and means separated with a Tukey test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1 and 2.

CONCLUSIONS: Pre-treatment samples 17 July showed similar numbers of ERM motiles (approximately 4.1 motiles per leaf) in all plots. Mite numbers were observed to decrease naturally in August.
In the 25 July (7-day) sample, all treated plots contained significantly fewer ERM than the control; however, plots treated with ENVIDOR contained fewer ERM than those treated with the low (283.75 g a.i./ha) rate of ACRAMITE (Table 1). All treatments significantly reduced numbers of ERM compared to the control in each of the 16, 22 and 35-day samples, but no differences were observed between treatments.
Numbers of beneficial mites in all treated plots were not different from the control in the 7-day and 22-day samples, while numbers in the plots treated with ENVIDOR and KANEMITE were significantly lower than in control plots in the 16-day sample (Table 2). In the 35-day sample, only plots treated with ENVIDOR contained significantly fewer beneficial mites than the control. Whether these differences were due to toxic effects or a lack of prey was not determined. It should be noted that no statistical differences in numbers of beneficial mites per plot were observed between acaricide treatments in any samples.
No phytotoxic effects were observed in any plots.

Table 1. Numbers of ERM motiles per leaf.

Treatment[1]	Rate (a.i./ha)	Seven DAT[2] 25 July[3]	16 DAT 3 August[3]	22 DAT 9 August[3]	35 DAT 22 August[3]
ACRAMITE 50 WS	425.6 g	0.740 bc	0.560 b	0.220 b	0.200 b
ACRAMITE 50 WS	283.75 g	1.425 b	0.800 b	0.280 b	0.160 b
KANEMITE 15 SC	340 g	0.600 bc	0.240 b	0.120 b	0.160 b
ENVIDOR 240 SC	180 g	0.250 c	0.180 b	0.120 b	0.120 b
CONTROL	-	3.220 a	3.520 a	2.460 a	2.340 a

[1] Applied 18 July.
[2] DAT = Days After Treatment.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Numbers of beneficial mites per leaf.

Treatment[1]	Rate (a.i./ha)	Seven DAT[2] 25 July[3]	16 DAT 3 August[3]	22 DAT 9 August[3]	35 DAT 22 August[3]
ACRAMITE 50 WS	425.6 g	0.350 a	0.520 ab	0.280 a	0.740 ab
ACRAMITE 50 WS	283.75 g	0.355 a	0.440 ab	0.360 a	0.820 ab
KANEMITE 15 SC	340 g	0.470 a	0.320 b	0.300 a	0.620 ab
ENVIDOR 240 SC	180 g	0.210 a	0.080 b	0.080 a	0.240 a
CONTROL	-	0.440 a	1.440 a	0.500 a	1.120 a

[1] Applied 18 July.
[2] DAT = Days After Treatment.
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2006 PMR REPORT #019 **SECTION B: VEGETABLE AND SPECIAL CROPS – Insect Pests**

CROP: Broccoli, cv. Eureka;
Cabbage, cv. Blue Dynasty
PEST: Swede midge (SM), *Contarinia nasturtii* (Keiffer)

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TITLE: COMPARATIVE EFFICACY OF PRE-TRANSPLANT INSECTICIDES FOR CONTROL OF SWEDE MIDGE ON BROCCOLI AND CABBAGE SEEDLINGS, 2006

MATERIALS: TRISTAR 70 WSP (acetamiprid 70%), INTERCEPT 60 WP (imidacloprid 60%), CRUISER 5 FS (thiamethoxam 47.6%), PONCHO 600 S (clothianidin 48%)

METHODS: Broccoli (cv. Eureka) or cabbage (cv. Blue Dynasty) seeds were planted into 200 cell plug trays on 5 June (Trial 1) and 19 June (Trial 2) and placed in a greenhouse at Ridgetown College. Ten treatments (Table 1) were evaluated on broccoli and cabbage including seed treatments applied prior to seeding, foliar drenches (i.e. product applied in 1 ml water per plant; applied to leaves as spray with excess running into soil) applied on 3 and 17 July (i.e. 10 days before shipping, DBS) , and foliar sprays (i.e. product applied in 0.5 ml water per plant) applied on 12 and 26 July (i.e. 1 DBS). All treatments were replicated 4 times. On 12 July (Trial 1) and 26 July (Trial 2), 25 broccoli seedlings or 25 cabbage seedlings were transplanted into individual 30 x 30 cm trays (one tray per treatment per replicate). Seedlings were transplanted to trays prior to SM exposure in order to avoid crowding of plants over the duration of the trial and thus allow unrestricted expression of SM damage symptoms. On 13 July (Trial 1) and 27 July (Trial 2), broccoli and cabbage trays were transported from Ridgetown College to the University of Guelph - Elora Research Station. For both trials, cabbage and broccoli trays were set out as blocks according to replicate number with treatments randomly placed within each block in a row between spring canola plants for exposure to SM adults. Broccoli and cabbage plants were exposed for 5 and 4 days in Trials 1 and 2, respectively; trays were then transferred to a greenhouse at the University of Guelph on 17 and 31 July and placed inside finely screened enclosures. All 25 plants within a treatment replicate were assessed for SM damage symptoms at 16 and 14 days after first exposure to SM in Trial 1 and Trial 2, respectively, on a scale of 0 to 3 (0 = no damage; 1 = mild twisting of stem; 2 = severe twisting of stem and crumpling of leaves; 3 = death of meristem). Additionally, all plants from each replicate were examined for the presence of SM larvae on both

dates. Differences in damage ratings among treatments were determined using analysis of variance and Duncan's multiple range test.

OBSERVATIONS: The lack of larvae within obviously affected transplants was most likely due to accelerated development associated with high temperatures within the greenhouse environment in which plant material was held following field exposure. Several transplant plug trays with heavily damaged seedlings were kept aside and monitored for adult emergence. Large numbers of SM emerged from these trays, suggesting that the assessments were conducted after larvae had left the plants to pupate.

RESULTS: The results are summarized in Tables 1, 2 and 3. In the first broccoli trial, all treatments, with the exception of the low rate of CRUISER, had lower damage ratings than the CONTROL plots (Table 1). In the second broccoli trial, plants treated with either rate of INTERCEPT and either the mid or high rate of TRISTAR had the lowest damage ratings of all of the treatments tested. In the cabbage trials, plots treated with INTERCEPT or the high rate of TRISTAR had the lowest damage ratings compared to CONTROL plots in both Trial 1 and Trial 2 (Table 2). In Trial 1, a total of 9 living and 2 dead SM larvae were detected. Seven living larvae were detected on cabbage and two on broccoli. Due to low numbers, data were not analyzed. In Trial 2, a total of 64 living larvae were detected; 18 on broccoli and 46 on cabbage. Although no significant differences were observed among any of the treatments, no larvae were detected on cabbage or broccoli plants treated with either rate of INTERCEPT or the high rates of TRISTAR or PONCHO (Table 3).

CONCLUSIONS: Cabbage and broccoli treated with INTECEPT consistently had lower damage ratings than any of the other treatments tested.

Table 1. Mean damage rating of broccoli plants treated with seed treatments, foliar (1 day) or drench (10 days) insecticide applications following 4 day exposure to swede midge, Elora, ON, 2006.

Tmt. No.	Insecticide	Method[1]	Timing (DBS)[2]	Rate (ai)	Mean Damage Rating (± SEM)	
					Trial 1	Trial 2
1	TRISTAR	F	1	0.007 g/1000 plants	0.080±0.003 b[4]	0.168±0.006 bcd
2	TRISTAR	F	1	0.07 g/1000 plants	0.070±0.004 b	0.030±0.002 d
3	TRISTAR	F	1	0.7 g/1000 plants	0.060±0.002 b	0.010±0.001 d
4	INTERCEPT	DR	10	1.9 g/1000 plants	0.050±0.002 b	0.022±0.002 d
5	INTERCEPT	DR	10	2.5 g/1000 plants	0.110±0.003 ab	0.023±0.002 d
6	CRUISER	ST	-	0.4 g/100 g seeds	0.250±0.006 a	0.283±0.008 b
7	CRUISER	ST	-	4.5 g/100 g seeds	0.080±0.004 b	0.152±0.005 bcd
8	PONCHO	ST	-	0.4 g/100 g seeds	0.040±0.003 b	0.860±0.013 a
9	PONCHO	ST	-	4.5 g/100 g seeds	0.080±0.004 b	0.033±0.003 d
10	CONTROL	[3]	-	--	0.240±0.007 a	0.301±0.008 b

[1] Method of Application: ST- seed treatment; F – foliar spray; DR – drench

[2] DBS - Days before shipping

[3] No insecticide applied

[4] Damage ratings within a column followed by the same letter are not significantly different (P>0.05) as determined by ANOVA and Duncan's Multiple Range test

Table 2. Mean damage rating of cabbage plants treated with seed treatments, foliar (1 day) or drench (10 days)insecticide applications following 4 day exposure to swede midge, Elora, ON, 2006.

Tmt. No.	Insecticide	Method[1]	Timing (DBS)[2]	Rate (ai)	Mean Damage Rating (± SEM)	
					Trial 1	Trial 2
1	TRISTAR	F	1	0.007 g/1000 plants	0.500±0.009 bc[4]	0.500±0.009 ef
2	TRISTAR	F	1	0.07 g/1000 plants	0.340±0.007 c	0.317±0.009 fg
3	TRISTAR	F	1	0.7 g/1000 plants	0.000±0.000 d	0.042±0.002 g
4	INTERCEPT	DR	10	1.9 g/1000 plants	0.020±0.001 d	0.152±0.003 g
5	INTERCEPT	DR	10	2.5 g/1000 plants	0.000±0.000 d	0.041±0.002 g
6	CRUISER	ST	-	0.4 g/100 g seeds	0.880±0.015 a	1.190±0.012 bc
7	CRUISER	ST	-	4.5 g/100 g seeds	0.480±0.009 bc	1.041±0.012 c
8	PONCHO	ST	-	0.4 g/100 g seeds	0.890±0.010 a	0.750±0.011 de
9	PONCHO	ST	-	4.5 g/100 g seeds	0.500±0.008 bc	0.241±0.005 fg
10	CONTROL	-3	-	--	0.780±0.011 a	1.454±0.013 ab

[1] Method of Application: ST- seed treatment; F – foliar spray; DR – drench
[2] DBS - Days before shipping
[3] No insecticide applied
[4] Damage ratings within a column followed by the same letter are not significantly different (P>0.05) as determined by ANOVA and Duncan's Multiple Range test

Table 3. Number of swede midge larvae detected on cabbage and broccoli plants treated with seed treatments, foliar (1 day) or drench (10 days) insecticide applications following 4 day exposure to swede midge, Elora, ON, 2006

Tmt. No.	Insecticide	Method[1]	Timing (DBS)[2]	Rate (ai)	Mean No. Larvae/25 plants in Trial 2	
					Broccoli	Cabbage
1	TRISTAR	F	1	0.007 g/1000 plants	0.05 a[4]	0.01 a
2	TRISTAR	F	1	0.07 g/1000 plants	0.03 a	0.00 a
3	TRISTAR	F	1	0.7 g/1000 plants	0.00 a	0.00 a
4	INTERCEPT	DR	10	1.9 g/1000 plants	0.00 a	0.00 a
5	INTERCEPT	DR	10	2.5 g/1000 plants	0.00 a	0.00 a
6	CRUISER	ST	-	0.4 g/100 g seeds	0.01 a	0.05 a
7	CRUISER	ST	-	4.5 g/100 g seeds	0.15 a	0.01 a
8	PONCHO	ST	-	0.4 g/100 g seeds	0.04 a	0.06 a
9	PONCHO	ST	-	4.5 g/100 g seeds	0.00 a	0.00 a
10	CONTROL	-3	-	--	0.06 a	0.01 a

[1] Method of Application: ST- seed treatment; F – foliar spray; DR – drench
[2] DBS - Days before shipping
[3] No insecticide applied
[4] Damage ratings within a column followed by the same letter are not significantly different (P>0.05) as determined by ANOVA and Duncan's Multiple Range test

2006 PMR REPORT #020 **SECTION B: VEGETABLE AND SPECIAL CROPS - Insect Pests**

CROP: Broccoli (*Brassica oleracea*) cv. Everest
PEST: Swede midge, *Contarinia nasturtii* (Keiffer) (Diptera: Cecidomydiae)

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TITLE: EVALUATION OF INSECTICIDES FOR CONTROL OF SWEDE MIDGE ON COLE CROPS, 2006

MATERIALS: DPX-E2Y45 20 SC (rynaxypyr™ 200 g/L) MATADOR 120 EC (lambda-cyhalothrin 120 g/L), AVAUNT 30 WG (indoxacarb 30%), HASTEN™ NT (methyl and ethyl oleate 71.44%).

METHODS: Two rows of broccoli seedlings were transplanted (27 plants/row) into 8 m x 2 m plots in a field in Breslau, ON on 21 July 2006. All treatments were replicated 4 times in a randomized complete block design. On 5 August all treatments were applied in 200 L/ha, at 275 kPa, using a hand-held, CO_2-pressurized R&D field-plot sprayer fitted with a 1.1 m boom equipped with four ceramic hollow disc-core cone nozzles(AGDCER4/AG25CER). On 23 August all treatments were again applied using the same equipment in 300 L/ha at 275 kPa. On 31 July, 9, 14, 23, 29 August and 4 September, damage assessments were made on 10 plants per plot using a rating scale 0 to 3 (0 = no damage; 1 = mild twisting of stem; 2 = severe twisting of stem and crumpling of leaves; 3 = death of meristem). The percentage of plants in each damage rating was calculated and transformed using log (x +1). Significance of observed differences was analyzed using ANOVA and Fisher's Protected LSD test. Untransformed data are presented herein.

RESULTS: Experimental results are outlined in Table 1. Since on the first three assessment dates only 3 plants had observable swede midge damage analyses were not performed. On 23 August, no damage was observed on broccoli plants treated with the low rate of DPX-E2Y45 (with or without HASTEN) and the high rate of DPX-E2Y45 + HASTEN. On 29 August, 6 days following the second application, plots treated with all rates of DPX-E2Y45, except the mid-rate (without HASTEN), had no observable swede midge damage. On 4 September, only two treatments, the low rate of DPX-E2Y45+ HASTEN and AVAUNT, had significantly more plants with no observable damage than the CONTROL plots.

CONCLUSIONS: Foliar application of DPX-E2Y45 reduced the amount of swede midge damage observed on broccoli plants in this trial. The combination of HASTEN with the low rate of DPX-E2Y45 provided best protection of broccoli plants relative to CONTROL plots.

Table 1. Impact of foliar treatments on swede midge damage to broccoli, Breslau, ON, 2006.

Treatments	Rate g ai/ha	% of Plants in Each Damage Category on each Assessment Date								
		August 23			August 29			September 4		
		0	2	3	0	2	3	0	2	3
DPX-E2Y45 + HASTEN	25 + 0.25	100.0 a[1]	0.0 a	0.0 a	100.0 a	0.0 a	0.0 a	80.0 a	17.5 b	2.5 bc
DPX-E2Y45	25	100.0 a	0.0 a	0.0 a	100.0 a	0.0 a	0.0 a	60.0 abc	40.0 a	0.0 c
DPX-E2Y45 + HASTEN	50 + 0.25	77.5 b	22.5 b	0.0 a	100.0 a	0.0 a	0.0 a	65.0 abc	32.5 ab	2.5 bc
DPX-E2Y45	50	95.0 a	2.5 a	2.5 a	95.0 a	5.0a	0.0 a	62.5 abc	25 ab	12.5 a
DPX-E2Y45 + HASTEN	75 + 0.25	100.0 a	0.0 a	0.0 a	100.0 a	0.0 a	0.0 a	67.5 abc	30 ab	2.5 bc
DPX-E2Y45	75	97.5 a	2.5 a	0.0 a	92.5 a	5.0 a	2.5 a	57.5 bc	32.5 ab	10 ab
AVAUNT	75 + 0.25	97.5 a	0.0 a	2.5 a	97.5 a	0.0 a	2.5 a	77.5 ab	17.5 b	5.0 abc
MATADOR	9.96	95.0 a	2.5	2.5 a	97.5 a	0.0 a	2.5 a	75.0 abc	22.5 ab	2.5 bc
CONTROL	-2	95.0 a	2.5 a	2.5 a	92.5 a	5.0 a	2.5 a	55.0 c	37.5 a	7.5 abc

[1] Percentages within a column followed by the same letter are not significantly different ($P>0.05$) as determined by ANOVA and Fisher's Protected LSD.

[2] No insecticide applied.

2006 PMR REPORT #021

SECTION B: VEGETABLES and SPECIAL CROPS - Insect Pests
STUDY DATA BASE: 160.3

CROP: Cantaloupe (*Cucumis melo*, Reticulatus Group), cv. Aphrodite
PEST: Common armyworm (CAW), *Pseudoletia unipuncta* (Haworth)

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TITLE: FIELD PLOT EVALUATION OF FOLIAR INSECTICIDES FOR CONTROL OF COMMON ARMYWORM ON CANTALOUPE ON MINERAL SOIL, 2006

MATERIALS: AVAUNT 300 WG (indoxacarb 30%), DPX-E2Y45 35 WG (chlorantraniliprole 35%)

METHODS: Aphrodite cantaloupe seed was planted using a cone seeder on 30 May in Fox sandy loam on the SCPFRC-Delhi Research Farm in 3-row plots (8 m long) with 1 m row spacing. All treatments (Table 1) were replicated 4 x in a Randomized Complete Block design. On 19-20 June plants were blocked to a final spacing of 60 cm. To supplement erratic rainfall, plots received 13 mm water via sprinkler-irrigation on 13 June.
On 18 July, when plants had largely filled in the rows and begun to flower, a total of 20 leaves, near the growing point but measuring 8-10 cm diameter, were tagged on the center row of each plot. On 19 July, all treatments were applied at 200 kPa in 300 L/ha using a tractor borne, CO_2-pressurized sprayer with a side boom fitted with 6 TeeJet 11002 flat spray tips at 50 cm spacing. Residual effectiveness of foliar deposits against both 3rd and 5th instar laboratory-reared CAW larvae was measured by bioassay. The CAW culture originated from CAW moths collected using a black light trap on the SCPFRC-London Research Farm in May 2006. As soon as spray deposits had dried on the foliage, 7 leaves were collected from the center row of each plot, placed in appropriately labeled plastic bags which were then placed on "blue ice" in a plastic cooler and transported to the laboratory at SCPFRC-London. Tagged leaves were similarly collected on Day 2 and Day 6 after treatment.
On each collection date a total of 12, 5th instar-bioassays (3 bioassays/plot x 4 plots/tmt.), each containing 1 complete leaf and 3, 5th instar larvae, and 12, 3rd instar-bioassays (3 bioassays/plot x 4 plots/tmt.), each containing a 12.0 cm^2 leaf disc and 5, 3rd instar larvae, was established for each treatment. Bioassays were then held in a

growth cabinet at 22°C, 55% RH, and 16:8 L:D photo-period. For each set of bioassays, mortality and leaf damage were recorded after 72 hrs. Larvae were considered dead if unresponsive when prodded with a small brush, affected if twitching or responsive only after prodding and alive if capable of directed movement. For convenience, numbers of dead and affected larvae in each bioassay were pooled for statistical analysis. 5th instar-feeding damage was rated using a 0-10 scale where 0.0 represents no feeding damage, 5.0 represents 50% loss of leaf area, and 10.0 represents 100% consumption of the leaf. 3rd instar-feeding damage was measured directly. Areas of leaf discs remaining after 72 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.

"Mortality" (dead + affected larvae) for both 3rd and 5th instar larvae was corrected using Abbott's factor and subjected to arcsin square root transformation prior to statistical analysis by analysis of variance (ANOVA). Tukey's HSD means separation test was then used to estimate significance of differences among treatment means. Untransformed data are presented in the tables.

To accommodate heterogeneous variance of leaf areas consumed by 3rd instar larvae, data for consumption of untreated CONTROL leaf discs were excluded from analysis and data for treated leaf discs were subjected to log (X+1) transformation prior to ANOVA. Tukey's HSD means separation test was then used to estimate significance of differences among means for the 4 insecticide treatments. Untransformed data are presented in the tables. Significance of observed differences in 5th instar leaf damage among all treatments was determined using ANOVA and Tukey's HSD means separation test.

OBSERVATIONS: After foliar application on 19 July, a total of 16 mm rainfall accumulated during the 24 hrs after treatment. An additional 36.1 mm of rain fell by 6 DAT when the final leaf samples were collected for bioassay. A total of 52.1 mm rainfall was thus recorded during the sampling period. The maximum temperature reached 29.8°C on Day 0 (19 July); the average daily maximum temperature over the first 5 DAT was 26.8°C. No phytotoxicity was noted following any treatment.

3rd instar CAW were much more active and responsive to stimulation than 5th instar larvae. While larvae exposed to deposits of chlorantraniliprole often did not die rapidly they did quickly cease feeding.

RESULTS: All 3rd instar larvae, placed on cantaloupe leaf discs treated with all rates of indoxacarb and harvested as soon as spray deposits dried, died within 72 hrs (Table 1). Although significantly fewer 3rd instar larvae died within 72 hrs after being placed on leaf discs harvested as soon as deposits of chlorantraniliprole had dried (Table 1), there was no significant difference in the amount of damage to leaves harvested from any insecticide treatment on Day 0 (Table 2). 3rd instar larvae consumed less leaf area in bioassay of all insecticide treatments than in bioassays of untreated leaves (Table 2). While mortality of 3rd instar larvae declined in all insecticide treatments by 2 DAT, the same pattern of mortality was observed as on Day 0. Mortality was significantly higher in bioassay of leaves treated with indoxacarb than bioassay of leaves treated with chlorantraniliprole (Table 1) but all insecticide treatments resulted in less consumption of leaf area relative to consumption of untreated leaf discs (Table 2). Application of chlorantraniliprole reduced leaf consumption by just over 90% 2 DAT (Table 2). By 6 DAT, mortality of 3rd instar larvae in bioassays of leaves treated with 123.0 g ai/ha indoxacarb, remained above 90% (Table 1). On 6 DAT, consumption of leaves treated with 50.0 g ai/ha indoxacarb by 3rd instar larvae was equal to that recorded for untreated leaves (Table 2). Leaf consumption for all other insecticide treatments was significantly reduced; the reduction approached 95% for leaves treated with chlorantraniliprole (Table 2).

At both 0 and 2 DAT, 100% mortality of 5th instar larvae placed on leaves treated with all insecticides was observed after 72 hrs in bioassay (Table 3). All treatments significantly reduced feeding by 5th instar larvae in bioassay relative to leaf damage recorded on untreated leaves harvested at the same time (Table 4). Lower mortality of 5th instar larvae was recorded by 6 DAT; on that date, significantly higher mortality was recorded in bioassays of leaves treated with 50.0 g ai/ha chlorantraniliprole than of leaves treated with 90.0 g ai/ha indoxacarb (Table 3). At 6 DAT, a significant reduction in leaf damage by 5th instar larvae was only recorded on leaves treated with chlorantraniliprole; the damage rating was reduced by over 66% in those bioassays (Table 4).

CONCLUSIONS/DISCUSSION: Under the conditions of this trial, application of chlorantraniliprole and all rates of indoxacarb significantly reduced feeding damage to cantaloupe by both 3rd and 5th instar CAW larvae for 2 DAT. The highest rate of application of indoxacarb and application of chlorantraniliprole reduced feeding damage by 3rd instar larvae by over 80% 6 DAT. Less protection against 5th instar larvae was provided at 6 DAT; no application of indoxacarb reduced damage by more than 40% while just over 65% less damage was recorded in bioassay of leaves treated with chlorantraniliprole.
The apparent higher toxicity of chlorantraniliprole and the lowest rate of indoxacarb to 5th instar larvae at 6 DAT (Tables 1, 3) could be an artefact of the observed greater sensitivity of 3rd instar larvae to physical stimulation. Additional trials are recommended to verify differential instar response to insecticide application.

Table 1. Effect of foliage of cantaloupe, treated with selected foliar insecticides, on mortality of 3rd instar larvae of common armyworm (CAW), *Pseudoletia unipuncta*, after feeding for 72 hours in bioassay, Delhi/London, ON, 2006.

Tmt. No.	Insecticide	Formulation	Rate/ha		Average Corrected % "Affected"[1] Larvae on Indicated DAT[2]		
			a.i.	product	0	2	6
1	indoxacarb	AVAUNT 300WG	123.0 g	410.0 g	100.0 a[3]	98.0 a	91.7 a
2	indoxacarb	AVAUNT 300WG	90.0 g	300.0 g	100.0 a	89.4 a	51.7 ab
3	indoxacarb	AVAUNT 300WG	50.0 g	166.7 g	100.0 a	87.9 ab	20.0 b
4	chlorantraniliprole	DPX-E2Y45 35 WG	50.0 g	142.9 g	86.3 b	61.7 b	31.7 b

[1] "Affected" = Dead + immobile but twitching or responding when prodded with a brush.
[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 Tukey's HSD means separation test.

Table 2. Effect of foliage of cantaloupe, treated with selected foliar insecticides, on feeding damage by 3rd instar larvae of common armyworm (CAW), *Pseudoletia unipuncta*, after feeding for 72 hours in bioassay, Delhi/London, ON, 2006.

Tmt. No.	Insecticide	Formulation	Rate/ha		Ave. Leaf Area[1] Consumed by Larvae on Indicated DAT[2]			% Reduction[3] in Area Consumed on Indicated DAT		
			a.i.	product	0	2	6	0	2	6
1	indoxacarb	AVAUNT 300WG	123.0 g	410.0 g	0.5 a[4]	0.5 a	0.6 bc	76.2	84.8	84.2
2	indoxacarb	AVAUNT 300WG	90.0 g	300.0 g	0.5 a	0.4 a	1.2 b	76.2	87.9	68.4
3	indoxacarb	AVAUNT 300WG	50.0 g	166.7 g	0.4 a	1.1 a	3.9 a	81	66.7	0
4	chlorantraniliprole	DPX-E2Y45 35 WG	50.0 g	142.9 g	0.3 a	0.3 a	0.2 c	85.7	90.9	94.7
5	no insecticide	CONTROL	---	---	2.1	3.3	3.8			

[1] Actual area (cm^2) of leaf-disc consumed during 72 hour feeding period.
[2] Days after Treatment.
[3] Relative to area consumed in untreated CONTROL plots.
[4] Within each DAT, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and Tukey's HSD means separation test.

Table 3. Effect of foliage of cantaloupe, treated with selected foliar insecticides, on mortality of 5th instar larvae of common armyworm (CAW), *Pseudoletia unipuncta*, after feeding for 72 hours in bioassay, Delhi/London, ON, 2006.

Tmt. No.	Insecticide	Formulation	Rate/ha		Average Corrected % "Affected"[1] Larvae on Indicated DAT[2]		
			a.i.	product	0	2	6
1	indoxacarb	AVAUNT 300WG	123.0 g	410.0 g	100.0 a[3]	100.0 a	74.5 ab
2	indoxacarb	AVAUNT 300WG	90.0 g	300.0 g	100.0 a	100.0 a	57.4 b
3	indoxacarb	AVAUNT 300WG	50.0 g	166.7 g	100.0 a	100.0 a	65.2 ab
4	chlorantraniliprole	DPX-E2Y45 35 WG	50.0 g	142.9 g	100.0 a	100.0 a	97.1 a

[1] "Affected" = Dead + immobile but twitching or responding when prodded with a brush.

[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 Tukey's HSD means separation test.

Table 4. Effect of foliage of cantaloupe, treated with selected foliar insecticides, on feeding damage by 5th instar larvae of common armyworm (CAW), *Pseudoletia unipuncta*, after feeding for 72 hours in bioassay, Delhi/London, ON, 2006.

Tmt. No.	Insecticide	Formulation	Rate/ha		Average Damage Rating[1] on Indicated DAT[2]			% Reduction in Damage Rating on Indicated DAT		
			a.i.	product	0	2	6	0	2	6
1	indoxacarb	AVAUNT 300WG	123.0 g	410.0 g	0.1 b[4]	0.2 b	2.0 ab	83.3	94.6	16.7
2	indoxacarb	AVAUNT 300WG	90.0 g	300.0 g	0.3 b	0.3 b	2.4 a	50	91.9	0
3	indoxacarb	AVAUNT 300WG	50.0 g	166.7 g	0.3 b	0.4 b	1.5 ab	50	89.2	37.5
4	chlorantraniliprole	DPX-E2Y45 35 WG	50.0 g	142.9 g	0.2 b	0.1 b	0.8 b	66.7	97.3	66.7
5	no insecticide	CONTROL	---	---	0.6 a	3.7 a	2.4 a			

[1] 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).

[2] Days after Treatment.

[3] Relative to Damage Rating in untreated CONTROL plots.

[4] Within each DAT, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and Tukey's HSD means separation test.

2006 PMR REPORT #022 **SECTION B: VEGETABLE AND SPECIAL CROPS - Insect Pests**

CROP: Garlic (*Allium sativum* L.)
Onion sets (*Allium cepa* L.)
Dry bulb cooking onions, (*Allium cepa* L.) cv. Norstar
PEST: Leek moth, *Acrolepiopsis assectella* Zeller (Lepidoptera: Acrolepiopidae)

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TITLE: EVALUATION OF ORGANIC AND CONVENTIONAL INSECTICIDES FOR CONTROL OF LEEK MOTH ON GARLIC AND ONION, 2006

MATERIALS: SUCCESS 480 SC (spinosad 480 g/L), ENTRUST 80W (spinosad 80%), ASSAIL 70 WP (acetamiprid 70%), MATADOR 120 EC (lambda-cyhalothrin 120 g/L), BIOPROTEC CAF (*Bacillus thuringiensis* subsp. *Kurstaki* strain HD-1 127 BIU/L) DIPEL 2X (*Bacillus thuringiensis* subsp. *Kurstaki* strain HD-1. 32 BIU/kg), RYNAXPYR SC (rynaxpyr 200 g/L), METAFLUMIZONE SC (metaflumizone 240 g/L)

METHODS: Three field trials were conducted in garlic and onion plantings naturally infested with leek moth at locations near Osgoode, ON (Site 1), Almonte, ON (Site 2), and Carp, ON (Site 3). At Sites 1 and 2, garlic cloves were planted on 27 and 28 October 2005. Plots (6 m long x 2 m wide) were planted with two rows of garlic, 20 cloves per row. Rows were 0.30 m apart. At Site 3, garlic was planted by the grower in the fall of 2005. Plots were 3 m long and 1 m wide and consisted of a single row of garlic plants spaced 7 cm apart. At Sites 1 and 2, two rows of onion sets (40 bulbs/row) were planted between the garlic rows in each plot on 18 May. At Site 3, yellow cooking onion transplants were planted by the grower the first week of May in a separate field. Onion plots (3 m long x 1 m wide) consisted of two rows of onion plants spaced 10 cm apart. Rows were 0.30 m apart.
All treatments were replicated 4 times in a randomized complete block design. Insecticide applications were made on 6 June (garlic) and 5 July (onion), 7-10 days following a peak flight recorded using pheromone traps. All treatments were applied in 300 L/ha, at 276 kPa, using a hand-held, CO_2-pressurized R&D field-plot sprayer fitted with a 1.1 m boom equipped with four flat fan (110-03VP) nozzles. On 13 June, ten garlic plants were randomly selected and harvested from each plot, individually bagged, packed on ice and delivered to the lab for inspection. On 12 July, ten onion plants were harvested, individually bagged, packed on ice and delivered to the lab for inspection. The day following each harvest, individual plants were assessed for

damage, number of leek moth larvae and pupae. Damage assessments on garlic were made using a rating scale of 0 – no damage, 1 – surface feeding, 2 – leaf mines, 3 – leaf and scape mines. On onion, damage assessments were made using a rating scale of 0 – no damage, 1 – leaf feeding, 2 – entrance/exit holes. Damage indices for each site were calculated using DI=[(0xA)+(1xB)+(2xC)+(3xD)] /[(A+B+C+D)x3] x 100, where numbers are damage classes and letters are number of plants in each class. Data were analyzed and significance of observed differences among treatment means were determined using ANOVA and Fisher's Protected LSD test.

RESULTS: Experimental results are outlined in Tables 1, 2 and 3. At Site 1, garlic plants treated with ASSAIL and BIOPROTEC CAF had no observable damage; damage was significantly different from that recorded in the CONTROL plots (Table 1). While damage in no other treatment was significantly different from the CONTROL plots, garlic treated with RYNAXPYR, MATADOR or DIPEL had four-fold less damage than the CONTROL plots. At this site, onion plants treated with RYNAXPYR and MATADOR had significantly less damage than the CONTROL plots. At Site 3, garlic and onion plants treated with any of the five treatments had significantly less damage than the CONTROL plots (Table 1). Numbers of larvae on garlic plants was very low at Site 1 and 3 and analyses were not performed. Larvae data were analyzed for the onion trials. At Site 1, onion plants in plots treated with any of the treatments except ASSAIL had significantly fewer larvae than the CONTROL plots (Table 2). At Site 3, onion plants in all treatments had significantly fewer larvae than onions the CONTROL plots (Table 2). At Site 2, all treatments applied to garlic had significantly lower damage ratings and number of larvae than the CONTROL plots (Table 3). Garlic plots treated with the highest rate of ENTRUST had the lowest amount of damage and number of larvae. On onions, no treatment was significantly different from the CONTROL plots for either damage rating or number of larvae; however, plots treated with the low or mid rate of ENTRUST had the lowest damage ratings of any of the treatments tested. The fewest number of larvae were recorded on onions treated with ENTRUST, the high rate of BIOPROTEC or the low rate of DIPEL. Interestingly, at this site, onion plants treated with the low rate of BIOPROTEC CAF or the mid or high rate of DIPEL had numerically more leek moth damage and more leek moth larvae than onion plants in the CONTROL plots.

CONCLUSIONS: Garlic and onion plants treated with RYNAXPYR and MATADOR consistently had less damage and fewer larvae that untreated plots. At the organic site, the low rate of ENTRUST consistently had less damage and fewer larvae than CONTROL plots. Further investigations of the potential of RYNAXPYR, MATADOR and ENTRUST are warranted.

Table 1. Impact of foliar application of conventional insecticides on damage caused by leek moth, Osgoode, ON and Carp, ON, 2006.

Treatment	Rate/ha	Damage Rating			
		Site 1 (Osgoode)		Site 3 (Carp)	
		Garlic	Onions	Garlic	Onions
RYNAXPYR	0.75 L	0.08±0.03 ab[1]	0.06±0.03 c	0.33±0.16 b	0.10±0.08 b
METAFLUMIZONE	1.6 L	0.24±0.14 ab	0.22±0.05 bc	0.08±0.07 b	0.10±0.04 b
SUCCESS	300 ml	0.33±0.16 a	0.16±0.05 bc	0.24±0.14 b	0.18±0.11 b
ASSAIL	120 ml	0.00±0.00 b	0.66±0.17 a	0.27±0.20 b	0.12±0.04 b
MATADOR	188 ml	0.08±0.04 ab	0.10±0.04 c	0.00±0.00 b	0.14±0.08 b
BIOPROTEC CAF	1.4 L	0.00±0.00 b	0.12±0.04 bc	--	--
DIPEL	1.1 kg	0.08±0.02 ab	0.66±0.20 a	--	--
CONTROL	-2	0.33±0.15 a	0.38±0.07 b	1.04±0.31 a	0.54±0.15 a

[1] Means within a column followed by the same letter are not significantly different (P>0.05) as determined by ANOVA and Fisher's Protected LSD.

[2] No insecticide applied.

Table 2. Impact of foliar application of conventional insecticides on leek moth larvae on onion, Osgoode, ON and Carp, ON, 2006.

Treatment	Rate/ha	# Larvae	
		Site 1 (Osgoode)	Site 3 (Carp)
RYNAXPYR	0.75 L	0.00±0.00 c[1]	0.02±0.02 a
METAFLUMIZONE	1.6 L	0.02±0.02 bc	0.00±0.00 a
SUCCESS	300 ml	0.02±0.02 bc	0.00±0.05 a
ASSAIL	120 ml	0.12±0.06 ab	0.00±0.17 a
MATADOR	188 ml	0.02±0.02 bc	0.00±0.04 a
BIOPROTEC CAF	1.4 L	0.02±0.02 bc	--
DIPEL	1.1 kg	0.07±0.05 bc	--
CONTROL	-2	0.22±0.07 a	1.12±0.46 b

[1] Means within a column followed by the same letter are not significantly different (P>0.05) as determined by ANOVA and Fisher's Protected LSD.

[2] No insecticide applied.

Table 3. Impact of foliar application of organic insecticides on leek moth damage and populations in Almonte, ON, 2006.

Treatment	Rate/ha	Site 2			
		Garlic		Onion	
		Damage Rating	# Larvae	Damage Rating	# Larvae
ENTRUST	105 g	1.29±0.24 c[1]	0.25±0.11 cde	0.04±0.02 d	0.00±0.00 c
ENTRUST	175 g	1.62±0.26 c	0.15±0.06 de	0.04±0.02 d	0.07±0.04 bc
ENTRUST	210 g	1.22±0.24 c	0.07±0.05 e	0.12±0.04 cd	0.05±0.03 c
BIOPROTEC CAF	1.4 L	1.95±0.25 bc	0.55±0.11 bcd	0.33±0.09 abc	0.32±0.13 a
BIOPROTEC CAF	2.1 L	1.26±0.25 c	0.35±0.09 bcde	0.20±0.09 bcd	0.10±0.13 bc
BIOPROTEC CAF	2.8 L	1.95±0.25 bc	0.70±0.20 b	0.10±0.04 cd	0.07±0.05 bc
DIPEL	0.55 kg	2.45±0.30 b	0.62±0.17 bc	0.10±0.04 cd	0.02±0.04 c
DIPEL	0.83 kg	1.91±0.35 bc	0.47±0.14 bcde	0.41±0.17 ab	0.27±0.02 ab
DIPEL	1.12 kg	1.62±0.08 c	0.52±0.19 bcd	0.49±0.12 a	0.35±0.08 a
CONTROL	-2	3.20±0.26 a	1.42±0.21 a	0.29±0.09 abcd	0.17±0.12 abc

[1] Means within a column followed by the same letter are not significantly different ($P>0.05$) as determined by ANOVA and Fisher's Protected LSD.

[2] 0 insecticide applied.

2006 PMR REPORT #023

SECTION B : VEGETABLE and SPECIAL CROPS - Insect Pests
STUDY DATA BASE: 160.3

CROP: Dry yellow seed cooking onion (*Allium cepa* L.), cvs. Frontier, Yellow Ebenezer
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 ON ORGANIC SOIL, 2006

MATERIALS: REGENT TS (fipronil 56% [w/w]), PONCHO 600 FS (clothianidin 48% [w/w]), SUCCESS 480 SC (spinosad 44.2% [w/w]), PRO-GRO 80 WP (carbathiin 30% + thiram 80%), APRON XL LS (mefenoxam 33% [w/w]), MAXIM (fludioxinil 0.5% [w/w]), PYRIFOS 15 G (chlorpyrifos 15%)

METHODS: On 9 May seed dressings (SD) (Table 1, Tmts. 2-4) were applied in the laboratory at SCPFRC-London by tumbling seed and insecticides 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. Onion seed for Tmt. 1 (Table 1), treated by E.I. du Pont de Nemours & Co., Wilmington, DE, USA, was also coated with a mixture of MAXIM + APRON XL to control onion smut. Seed for all treatments (Table 1) was planted at the SCPFRC-London Research Farm on 10 May in 3-row microplots (2.25 m long x 0.9 m wide) filled with insecticide residue-free organic soil. The in-furrow granular (IFG) treatment was 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. All treatments were replicated three times in a randomized complete block design. On 16 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 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 19 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 Tukey's HSD means separation test. Untransformed data are presented.

OBSERVATIONS: Reduced seedling emergence was recorded in plots planted with seed treated with REGENT TS

RESULTS: Experimental results are outlined in Table 1. Under the conditions of this trial, for both infestations, less than 5% of onion seedlings were lost following IFG-application of PYRIFOS (Tmt. 8), the method of OM control currently employed by most commercial onion growers. Similar results followed SD application of both rates of clothianidin (Tmts. 3, 4). SD-application of fipronil (Tmt. 1) and spinosad (Tmt. 2) was evaluated only for the first infestation; seedling loss due to OM fell below 10% for both treatments.

CONCLUSIONS: Application to onion seed of fipronil, spinosad and clothianidin effectively reduced OM

damage to onion seedlings. Further research is warranted to determine the optimum rate of application and generate data to support a petition to either register (fipronil) or expand current registrations (spinosad, clothianidin) to include OM control on cooking 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, 2006.

Tmt. No.	Treatment Applied		Rate Applied (a.i./kg seed)	Method[1]	Mean % Onion Loss after Indicated Infestation	
	Insecticide	Formulation			I -16 Jun	II - 19 Jun
1	fipronil	REGENT TS	50.0 g	SD	4.8 b[2]	xx[3]
2	spinosad	SUCCESS 480 SC	50.0 g	SD	9.2 b	xx
3	clothianidin	PONCHO 600 FS	25.0 g	SD	0.0 b	3.0 b
4	clothianidin	PONCHO 600 FS	50.0 g	SD	5.0 b	0.0 b
5	chlorpyrifos	PYRIFOS 15 G	9.6 g[4]	IFG	1.5 b	4.5 b
6	no insecticide	—[5]	---	---	73.7 a	69.4 a

[1] Method of Application: SD - seed dressing applied to seed at least 48 h prior to planting; 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 Tukey's HSD means separation test.

[3] Infestation not possible due to lack of seedlings.

[4] g a.i./100 m row; 0.4 m row spacing.

[5] No insecticide applied.

2006 PMR REPORT #024

SECTION B : VEGETABLE and SPECIAL CROPS - Insect Pests
STUDY DATA BASE: 160.3

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

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TITLE: EVALUATION OF PLANTING TREATMENTS FOR CONTROL OF DAMAGE BY CABBAGE MAGGOT TO RADISH ON MINERAL SOIL, 2006

MATERIALS: PONCHO 600 FS (clothianidin 48% [w/w]), BAS 320I 240 SC (metaflumizone 22% [w/w]), DPX-E2Y45 35 WG (chlorantraniliprole 35% [w/w]), Dow Exp (Dow Exp 25% [w/w]), SUCCESS 480 SC (spinosad 44.2% [w/w]/L), PYRINEX 480 EC (chlorpyrifos 480 g/L), DECIS 5 F (deltamethrin 4.85% [w/w])

METHODS: On 09 May, radish seed (SD) treatments (Tmts. 1-2) were applied in the laboratory at SCPFRC-London by tumbling seed and insecticide formulation for each treatment together in a clean 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 15 May in 3-row microplots (2.25 m long x 0.9 m wide) filled with insecticide residue-free mineral soil (sandy loam - pH 6.5; 67% sand; 20% silt; 13% clay; 2.2% organic matter). All treatments were replicated three times in a randomized complete block design. In-furrow spray (IFS) treatments (Tmts. 3-8) were applied in a 3-5 cm band at 135 kPa in 5 L/100 m row, using a hand-held, CO_2-pressurized, single-nozzled R&D plot sprayer fitted with a 4004E even flat spray tip, centered over the seed in the open seed furrow. To control feeding cutworms and crucifer flea beetles, at BBCH growth stage 10-11 (BBCH - 10-11) on 24 May, deltamethrin was applied at 140 kPa in 500 L/ha using a hand-held CO_2-pressurized R&D plot sprayer with a 0.6 m boom fitted with three XR11002VS flat spray tips. During the morning of 02 June when radishes were at BBCH 12, 41, a total of 250 CM eggs from an insecticide-susceptible strain were buried 1 cm deep beside a 1 m length of both the north (N) and south (S) rows in each plot. The infested row length was delineated by stakes and the number of radish plants was counted. All radishes from the infested portions of rows were harvested on 12 June (BBCH 46-47) (S row - Harvest 1) or 16 June (BBCH 48-49) (N row - Harvest 2). Roots were washed, counted and inspected for CM damage. The percent roots showing any feeding damage was calculated for each plot. Data were subjected to arcsin square root transformation prior to statistical analysis by analysis of variance (ANOVA); significance of differences among treatments means was determined using Tukey's HSD means separation test. Untransformed data are presented.

OBSERVATIONS: No phytotoxicity was observed following any treatment.

RESULTS: Experimental results are outlined in Table 1. On both harvest dates, CM damage to radish in untreated plots exceeded 60% following infestation of CM eggs. On both dates, CM damage to radish was significantly reduced by at least 95% following IFS-application of chlorpyrifos (Tmt. 7), the current commercial standard for CM control in this crop. CM damage was significantly reduced by at least 85%

following SD-application of both rates of clothianidin on both harvest dates (Tmts. 1, 2). On both harvest dates IFS-application of metaflumizone was the only IFS treatment that did not significantly decrease CM damage to radish relative to damage recorded in untreated CONTROL plots. Significant damage reduction following remaining IFS-application of non-registered insecticides ranged from 49% (chlorantraniliprole (Tmt. 4) - Harvest 1) to 77% (Dow Exp [Tmt. 5] - Harvest 1); differences among these experimental IFS treatments were not, however, statistically significant. The observed order of effectiveness of IFS treatments in this trial was: chlorpyrifos (95%+ reduction) > Dow Exp > spinosad > chlorantraniliprole > metaflumizone (12% reduction).

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 this experiment. Further evaluation of SD-application of clothianidin is warranted to finalize application rates and determine possible residues in harvested radish following treatment. IFS-application of Dow Exp, spinosad and chlorantraniliprole demonstrated sufficient activity against CM to justify further investigation.

Table 1. Effect of planting treatments on damage due to cabbage maggot attacking radishes on mineral soil, London, ON, 2006.

Tmt No.	Treatment Applied			Rate/kg Seed		Results for Indicated Infestation			
						Harvest 1		Harvest 2	
	Insecticide	Formulation	Method[1]	a.i.	Product	% Dam. Roots	% Dam. Reduction	% Dam. Roots	% Dam. Reduction
1	clothianidin	PONCHO 600 FS	SD	30.0 g[3]	49.5 ml[3]	6.8 de	89.3	7.9 de	87.6
2	clothianidin	PONCHO 600 FS	SD	50.0 g[3]	82.5 ml[3]	6.7 de	89.5	5.6 de	91.2
3	metaflumizone	BAS 320I 240 SC	IFS	2.0 g	8.3 ml	56.1 ab	11.8	47.8 ab	25.2
4	chlorantraniliprole	DPX-E2Y45 35 WG	IFS	2.0 g	5.7 g	32.5 bc	48.9	31.6 bc	50.5
5	Dow Exp	Dow Exp 25 WG	IFS	2.0 g	8.0 g	14.7 cd	76.9	17.8 cd	72.1
6	spinosad	SUCCESS 480 SC	IFS	2.0 g	4.1 ml	24.6 c	61.3	18.6 cd	70.9
7	chlorpyrifos	PYRINEX 480 EC	IFS	4.1 g	8.5 ml	2.7 e	95.8	0.0 e	100
8	untreated	----	---	---	---	63.6 a	---	63.9 a	---

[1] method of application: SD - seed dressing applied to seed at least 48 h prior to planting; IFS - in seed-furrow spray over seed.

[2] amount/100 m row; 0.25 m row spacing.

[3] For each infestation, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and Tukey's HSD means separation test.

2006 PMR REPORT #025 **SECTION C: POTATOES - Insect Pests**
STUDY DATABASE:

CROP: Potato (*Solanum tuberosum*), cv. Chieftain
PEST: Wireworm (click beetle larvae), genus *Agriotes*

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TITLE: NOVA SCOTIA FIELD TRIAL TO EVALUATE EFFICACY OF VARIOUS INSECTICIDES FOR CONTROL OF WIREWORMS IN POTATO, 2005

MATERIALS: THIMET 15G (phorate 15%), PONCHO 600 (clothianidin 600 g/L) and CRUISER 5FS (thiamethoxan 47.6%)

METHODS: A field trial was conducted at the Agriculture and Agri-Food Canada, Atlantic Food and Horticulture Research Centre (AFHRC) in Kentville, Nova Scotia to evaluate 2 candidate insecticides at three rates alongside a previously registered insecticide for wireworm control. The seed potatoes for this trial consisted of two seed lots of cv. Chieftain, certified and elite, received 25 and 26 April, 2005; 113.4 kg from Scotian Gold Cooperative and 113.4 kg from Avery Farms. The seed potatoes were placed in a 10ºC storage room at 95% humidity until seed pieces were cut on 9 June. Once cut, seed pieces were placed in a 20ºC growth cabinet at 60-70% humidity with 14 hours of light to green sprout to promote good eye formation. 20 June, prior to seeding, the seed pieces were removed for seed treatment applications. Fifty-one seed pieces per plot were then laid out on plastic on a table and were treated with the various insecticide treatments. A glass hospital atomizer was used to apply the spray treatments. A higher rate of water carrier was used for all CRUISER 5FS and PONCHO 600 treatments to ensure uniform coverage on both sides of the seed pieces. Product plus water equaled 100 ml of solution per treatment. After one side was sprayed with half the solution, then dried, the seed pieces were flipped and the other side was sprayed with the other half of the solution. After the insecticide application had dried, the treated seed pieces were placed in large plastic bags, rolled and dusted with the fungicide MAXIM PSP (fludioxonil.15%) at 250 g/50 kg seed. This procedure was repeated for each insecticide plot treatment. Three rates of CRUISER 5FS and PONCHO 600 were tested. For CRUISER 5FS, 4.2 g a.i., 9.0 g a.i. and 12.5 g a.i. per 100 kg seed rates were used. For PONCHO 600, 6.2 g a.i., 9.5 g a.i. and 12.5 g. a.i. per 100 kg seed rates were used. The CONTROL and THIMET 15G seed pieces received the MAXIM PSP fungicide treatment prior to seeding. THIMET 15G was applied at the rate of 215 g/100 row-m, as an in furrow granular application. Seed pieces treated with MAXIM PSP were placed by hand in the row furrow then a pre-measured amount of THIMET 15G was manually applied in a 15 cm band along the bottom of the furrow.

The test was carried out in a field section of coarse loamy soil till that had been in permanent sod since 1985

but renovated and re-seeded with a clover/timothy/fescue mix in 1999. In preparation for the test, the field received an application of 3% Roundup herbicide on 26 April, was disked on 26 May, plowed on 8 June, limed (1 T/ha), disked and harrowed on 9 June 2005. Finally, 130 kg N/ha of 15-15-18 fertilizer blend was broadcast applied then harrowed on 13 June. The plot was hilled on 14 June, prior to hand seeding on 20 June. There were no green material/sod clumps visible by that time. A second hilling, post seeding, was done by hand hoeing on 5 August.

The trial was sprayed 22 June, according to label, with LEXONE (metribuzin) and maintained weed free by hand weeding throughout the growing season. Foliar insects were monitored weekly July throughout August. Little to no foliar insect pressure was noted. Supplemental irrigation was supplied 4 times throughout August. Trial was sprayed weekly, according to label, alternately with fungicides BRAVO 500 (chlorothalonil) and MANZATE 200 (mancozeb) for foliar diseases (e.g. late blight) from mid July throughout August.

Replicate 1 was harvested at 102 days after seeding and replicates 2, 3, 4 were harvested 106 days after seeding. Most plant material had died back at this time. The first 3 and last 3 plants in each row were avoided. Six consecutive plants, with no missing plants on either side, from the center of row 3 of each treatment were gently dug up using a pitch fork. All potatoes over 1 cm diameter from each plant were gently brushed off and put in large paper bags and labeled by plant, rep, treatment, row and date . The paper bags were folded and placed into a large potato mesh bag and labeled by rep, treatment, row, date. After each harvest, the large potato bags were placed in cold storage at 5ºC.

Potatoes were washed and allowed to dry prior to grading. Each potato was measured at the widest point using a digital electronic caliper (Ultra Pro 83070) and weighed using a Mettler Toledo scale (PG802S). The potatoes were packaged and sent to the person responsible for grading wireworm damage for all locations with the same efficacy trial. Tubers with two or more wireworm blemishes were considered culls. Only tubers greater than 5.1 cm in diameter were included in the final analysis of wireworm damage The data was analyzed using ANOVA (SAS Institute, Cary, NC) and means separated by Tukey's Standardized Range HSD test at P=0.05.

Pheromone traps for *Agriotes sputator*, *A. obscurus* and *A. lineatus* were also placed and inspected weekly at this site. The most abundant species was *A. sputator* with some 600 specimens collected in November 2005 from the outside guard rows of the trial.

OBSERVATIONS: There was severe wireworm pressure at this site. As the potatoes were dug, wireworms were evident in the tubers. Plant emergence was uniform with only 1 or 2 skips noted in a few rows. Cool weather early in the growing season slowed growth, and dry conditions in mid summer during tuber bulking may have contributed to lower tuber set and smaller tuber size for the whole trial. Blight and wilt lesions were evident at harvest. A few tubers with early blight lesions and rhizoctonia were noted at grading.

RESULTS: Results are presented in Table 1.

Only THIMET 15G showed a significant reduction in wireworm damage over the CONTROL and over the two candidate insecticides at the three application rates.

CONCLUSIONS: The two candidate insecticides, PONCHO 600 and CRUISER 5FS did not control wireworm damage any better than the CONTROL under the high wireworm pressure at this site. There was no reduction of wireworm damage or % culls even at the higher rates of the two candidate insecticides. THIMET 15G provided some control but culls were still relatively high at 50.3%.

Table 1. Mean blemishes per tuber (≥ 5.1 cm diameter) in plots treated with various insecticides in potato efficacy trials conducted in Kentville, Nova Scotia in 2005.

Treatment	Application Rate/100 kg Seed	n	X Tubers /Rep	X wt (kg) /Rep	X wt (kg) /Tuber	Wireworm x blemishes (SEM) /Tuber/Rep	% Culls
Control		4	30	2.67	0.088	16.59 (0.84) a[1]	98.5
Thimet 15G	215 g/100 row-m	4	25	2.55	0.1	3.42 (0.71) b[1]	50.3
Poncho 600	6.2 g a.i	4	30	2.63	0.089	19.73 (1.13) a[1]	99.0
Poncho 600	9.5 g a.i.	4	29	2.94	0.106	14.26 (2.32) a[1]	92.2
Poncho 600	12.5 g a.i.	4	25	2.16	0.087	11.30 (0.42) a[1]	93.4
Cruiser 5FS	4.2 g a.i.	4	29	2.73	0.094	18.00 (3.76) a[1]	96.5
Cruiser 5FS	9.0 g a.i.	4	24	2.17	0.091	17.96 (2.16) a[1]	97.1
Cruiser 5FS	12.5 g a.i.	4	24	2.98	0.119	18.62 (2.22) a[1]	97.5

[1] Letters following means denote significant differences (p=0.05) within columns.

2006 PMR REPORT #026 **SECTION C: POTATOES - Insect Pests**
STUDY DATABASE: 303-1251-9601

CROP: Potato (*Solanum tuberosum*), cv. Russet Burbank
PEST: European corn borer (ECB), *Ostrinia nubilalis* (Hübner) (Lepidoptera: Crambidae)

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TITLE: CHEMICAL CONTROL OF THE EUROPEAN CORN BORER ON POTATOES, 2006

MATERIALS: AVAUNT 30WG (Indoxacarb), RIMON 10EC (Novaluron), SUCCESS 480 SC (Spinosad), DIPEL 2X DF (*Bacillius thrungensis* subsp. *kurstaki*)

METHODS: Cut seed potato pieces were planted at Harrington, PEI, on 16 May 2006, in four-row plots with plant spacing of 0.4 m within rows, and 0.9 m between rows. Plots were arranged in a randomized complete block design, with four replicates per treatments. All plots were treated with ADMIRE in furrow to prevent damage by the Colorado potato beetle. The plots measured 7.6 m in length and 3.7 m in width, and were separated from each other by a six-foot width of bare soil within each replicate. Treatments were as follows: 1) Unsprayed check, 2) AVAUNT one foliar spray at 50 g AI/ha on 6 July, 3) AVAUNT two foliar sprays at 50 g AI /ha on 6 and 12 July, 4) RIMON one foliar spray at 50 ml AI on 1 July, 5) RIMON two foliar sprays at 50 g AI on 1 and 7 July, 6) SUCCESS two foliar sprays at 58 ml AI /ha on 6 and 12 July and 7) DIPEL two foliar sprays at 840 ml product /ha applied on 6 and 12 July.
In mid June ECB pheromone traps were set up to determine moth flight. First moths were recorded on 20 June in 2006 and counts of egg masses began 21 June. Ten plants per row on the two center rows of each plot were checked for egg masses. Counts were conducted twice a week until a threshold of 2 egg masses per ten plants was reached. On 1 July the RIMON treatment plots (treatment 4 and 5) were sprayed. On 7 July, treatment five received a second application of RIMON. In the rest of the plots, eggs masses were flagged and continued to be checked. On 6 July, when 50% of the egg masses had reached the black -head stage, treatment 1, 2, 3, and 6 were applied. On 12 July, treatment 1, 3 and 6 received a second treatment application. Throughout the summer, the plots received the recommended applications of CHLOROTHALONIL at 1.25 kg AI/ha for late blight control. On 27 September, the tops from 10 randomly selected plants from the two center rows per plot per treatment, were cut and taken to the lab. The stems of each plant was examined for holes and tunnels. DIQUAT was applied at the rate of 370 g AI/ha on 29 September for top desiccation. Tubers from the two center rows were harvested on 11 October. Total and marketable (wt.>33 g) yields were recorded. Analyses of variance (ANOVA) were performed on the data and Least Significant Differences (LSD) were calculated. Counts were transformed to Ln(x+1) before analysis. Untransformed means are presented.

RESULTS: All insecticide treatments were significantly more effective in reducing the number of holes per plant when compared to the check (Table 1). Two spray applications of AVAUNT and RIMON gave significantly better control than one spray, but they were not significantly different form each other. Two sprays of SUCCESS and DIPEL were effective in controlling borer damage but were not significantly different from each other or from one spray application of AVAUNT and RIMON. There were no significant differences between the one application treatment of AVAUNT and RIMON. No significant differences

were found between the number of stems per plants per treatment. RIMON sprayed at the egg stage was just as effective in controlling ECB damage as AVAUNT sprayed at the black head stage. Yield was significantly higher in the treatment plots when compared to the control plots in the Canada number 1 tuber range only (Table 2). Within this range, there were no significant differences in yield between AVAUNT and RIMON irrespective of the number of sprays. There were no significant differences between treatments in total and marketable yield.

CONCLUSIONS: AVAUNT, RIMON, SUCCESS and DIPEL were all effective in reducing ECB larval damage, however, two applications of AVAUNT and RIMON gave significantly better control than one application. RIMON reduced damage when applied at the egg stage which suggests that it can be applied before black head stage is reached. Thus, it could provide farmers with a longer window of opportunity to control this pest, and more flexibility to deal with inclement weather. All treatments were effective in increasing yield of Canada number 1 tubers.

Table 1. The efficacy of different insecticide treatments in reducing the number of holes per plant caused by European corn borer larval feeding in potatoes.

Treatment	Rate AI/ha	No. of applications	Stems/plant	Holes/plant
CONTROL	-	0	35.00	75.25a[1]
AVAUNT	50 g	1	36.00	24.50b
AVAUNT	50 g	2	38.75	10.00cd
RIMON	50 ml	1	35.50	15.75bc
RIMON	50 ml	2	32.25	6.00d
SUCCESS	58 g	2	37.00	15.50bc
DIPEL	840 ml product	2	34.75	23.00b

[1] Numbers in a column followed by the same letter are not statistically different ($P \leq 0.05$, Protected LSD Test).

Table 2. Effects of different insecticide treatments used to control the European corn borer on the total and marketable potato tuber yield per hectare.

Treatment	Rate AI/ha	No. of applications	Canada #1 t/ha	Market t/ha	Total Yield t/ha
CONTROL	-	0	42.21d [1]	57.97	58.48
AVAUNT	50 g	1	47.85abc	59.11	59.53
AVAUNT	50 g	2	47.87abc	58.91	59.2
RIMON	50 ml	1	49.90a	60.41	60.82
RIMON	50 ml	2	49.64ab	59.92	60.23
SUCCESS	58 g	2	46.72bc	57.53	57.93
DIPEL	840 ml product/ha	2	46.43c	58.21	58.51

[1] Numbers in a column followed by the same letter are not statistically different ($P \leq 0.05$, Protected LSD Test).

2006 PMR REPORT #027

SECTION C: POTATOES - Insect Pests
STUDY DATABASE: 303-1251-9601

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

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TITLE: EFFICACY OF SEED-PIECE OR IN-FURROW INSECTICIDE TREATMENTS AGAINST WIREWORM IN POTATOES, 2006

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

METHODS: A field trial was conducted in Kinross, Prince Edward Island, on land belonging to a farmer with previous wireworm problems in a potato crop. From early spring until planting time, the land was lightly cultivated to prevent establishment of weeds which would act as an alternative food source for the insects. The experiment was set up in a randomized complete block design, with six treatments and four replications. Each plot consisted of four treated rows spaced at 0.9 metres apart, with in-row seed-piece spacing of 0.3 metres. Two ADMIRE-treated buffer rows were planted between plots and on the outside edges of each replication. A two-metre bare soil pathway was left between replications, and a three-metre buffer zone of bare soil surrounded the entire plot area. Tubers were cut into seed pieces containing at least two eyes on 6 June. CRUISER at 4.2 g ai (Treatment 3) or 9.0 g ai (Treatment 4) per 100 kg of seed, and PONCHO at 6.2 g ai (Treatment 5) or 12.5 g ai (Treatment 6) per 100 kg of seed, were applied to pre-counted cut seed pieces. MAXIM fungicide at 2.5 g ai/100 kg seed was applied to the seed pieces for all treatments. Planting was done on 7 June using a two-row planter which dropped seed pieces into fertilized open rows, enabling the number and positioning of seed pieces in each row to be checked before being covered with soil. Prior to covering, THIMET at 32 g ai per 100 m of row was applied over the seed pieces in Treatment 2 using a hand shaker. The CHECK plots, Treatment 1, received only the MAXIM fungicide. On 22 June, SENCOR 75DF was applied to the entire plot area for control of annual grasses and broadleaf weeds. On 6 July, emergence counts were done on all plots, and on 14 July, all rows were hilled. Throughout the summer, applications of chlorothalonil were made on a regular spray schedule for late-blight prevention, and plants were periodically examined for signs of insecticide phytotoxicity. Weeds were removed by hand as required, as were Colorado potato beetle adults early in the season. To control Colorado potato beetle larvae in the Check plots, it was necessary to spot-spray ADMIRE on 20 July. In mid-August, late blight was discovered on several plants in a buffer row, and on 28 August, it was found on a few plants in plot rows in Rep 1. Subsequently, REGLONE top-killer was applied to the entire experiment on 29 August, and again on 7 September. On 11 October, tubers from 12 plants per plot, were collected and bagged on an individual plant basis. Subsequently, all tubers from each bag were washed, counted, and measured, and wireworm damage was rated as either scars

(old damage) or holes (fresh damage) as per the protocol. Analyses of variance (ANOVA) were performed on the data. Differences in means was calculated using Least Significant Differences (LSD). Counts of blemishes were transformed to Ln(x+1) before analysis. Untransformed means are presented.

RESULTS: There was a significant decrease in the number of scars and the percent damaged tubers in the plots treated with CRUISER and PONCHO when compared to the untreated CHECK (Table 1). There was no significant difference between the high and low rate of either CRUISER or PONCHO. No significant difference was recorded in the number of scars between the in-furrow application of THIMET and the untreated CHECK. The percent damaged tubers at the end of the season was significantly lower in the plots treated with an in-furrow application of THIMET when compared to the CHECK, however, it was significantly higher when compared to the two rates of CRUISER and PONCHO. No significant phytotoxicity was observed in any treatment.

CONCLUSION: Under the conditions of this experiment, the seed piece treatments of CRUISER and PONCHO at the high and low rates were significantly better in controlling wireworm damage. The in-furrow treatment of THIMET was less effective than CRUISER and PONCHO but was significantly better than the untreated CHECK. All insecticide treatments significantly reduced the percentage of damaged tubers.

Table 1. Effectiveness of seed-piece or in-furrow insecticide treatments in controlling wireworm damage to Chieftain potato tubers, Kinross, PEI, 2006.

Trt. No.	Insecticide Applied	Rate (g ai)	Method[3]	Mean Number of W W Scars/Plot	Mean % Damaged Tubers/Plot
1	CHECK - none	-	-	23.00 a[4]	18.45 a
2	THIMET 15 G	32.3 g[1]	IFG	9.75 a	7.93 b
3	CRUISER 5FS	4.2 g[2]	SPT	0.75 b	0.65 c
4	CRUISER 5FS	9.0 g[2]	SPT	1.50 b	1.35 c
5	PONCHO 600	6.2 g[2]	SPT	1.00 b	0.95 c
6	PONCHO 600	12.5 g[2]	SPT	1.75 b	1.53 c
	ANOVA $P \leq 0.05$			s	s

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

2006 PMR REPORT #028 **SECTION C: POTATOES - Insect Pests**
STUDY DATA BASE: 160.3

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

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TITLE: MICROPLOT EVALUATION OF PERSISTENCE OF FOLIAR INSECTICIDES FOR CONTROL OF COLORADO POTATO BEETLE ON POTATO ON MINERAL SOIL, 2006

MATERIALS: ASSAIL 70 WP (acetamiprid 70% [w/w]), DPX-E2Y45 35 WG (chlorantraniliprole 35% [w/w]), Dow Exp 25 WG (Dow Exp 25% [w/w]), SUCCESS 480 SC (spinosad 480 g/L), BAS 320I 240 SC (metaflumizone 240 g/L), MERGE adjuvant (surfactant blend 50%)

METHODS: Seed potatoes were hand cut on 17 May and planted within 2 hours on the SCPFRC-London Research Farm in single-row (11 seed pieces/row) microplots (2.25 m long x 0.9 m wide) filled with insecticide residue-free mineral soil. All treatments (Table 1) were replicated 3 times in a randomized complete block design. To supplement erratic rainfall, microplots received 10-15 mm water via sprinkler-irrigation on 15, 16 June and 07 July.
On 26 June when plants were in early bud, 25 fully expanded compound leaves were tagged in each plot. Later the same day all treatments were applied at 220 kPa in 900 L/ha using a hand-held, CO_2-pressurized, R&D plot sprayer with a single disc-core (D4-25) hollow cone spray tip. Residual effectiveness of foliar deposits against both adult and larval insecticide-susceptible, laboratory-reared CPB was measured by bioassay. As soon as spray deposits had dried on the foliage, compound leaves were harvested from each plot of each treatment and returned to the laboratory. Compound leaves were thereafter collected at regular intervals for further bioassay (Tables 2-5); tagged leaves were collected after Day 4.
On each collection date a total of 9 adult-bioassays (3 bioassays/plot x 3 plots/tmt.), each containing 1 tri-foliate leaflet + 5 CPB adults, and 9 larval-bioassays (3 bioassays/plot x 3 plots/tmt.), each containing a 12.0 cm^2 leaf disc + 5 early second instar larvae, was established for each treatment. Bioassays were held at 24°C, 55% RH, and 16:8 L:D photoperiod. For each set of bioassays, mortality and leaf damage were recorded after 72 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, and 10.0 represents 100% consumption of the leaf. Larval feeding damage was measured directly. Areas of leaf discs remaining after 72 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 mean area of 2 standard leaf discs collected at the beginning of each bioassay and held under the same conditions as the bioassays.
Mortality was corrected using Abbott's factor and subjected to arcsin square root transformation prior to statistical analysis by analysis of variance (ANOVA). Tukey's HSD means separation test was then used to estimate significance of differences among treatment means. Untransformed data are presented in the tables. Significance of observed differences in leaf damage (adults) or consumption (larvae) among treatments was determined using ANOVA and Tukey's HSD means separation test.

OBSERVATIONS: Beginning 13 hrs after completion of foliar application on 26 June, 1.5 mm rain fell

during the 24 hrs after treatment. A total of 15.0 mm of rainfall subsequently accumulated by 5 days after treatment (DAT). The maximum temperature reached 24.0°C on Day 0 (26 June); the average daily maximum temperature over the first 5 DAT was 24.4°C. No phytotoxicity was noted following any treatment. Deteriorating leaf quality due to "hopperburn" in untreated CONTROL plots prevented effective bioassay of efficacy beyond 28 DAT.
In bioassay on Day 0, while both adult and larval CPB did not die as quickly following exposure to deposits of metaflumizone or chlorantraniliprole as to deposits of other insecticides, feeding rapidly ceased and damage was minimal.

RESULTS: At least 80% of adult CPB died within 72 hrs after feeding in bioassay on leaves collected as soon as spray deposits of all treatments dried (Table 2). Adult CPB in the Day 0 bioassay consumed an average of 25% of the area of leaves treated with metaflumizone, significantly more than was observed for any other treatment; all foliar treatments, however, significantly reduced leaf consumption relative to that observed in untreated CONTROL plots (Table 3). By 2 DAT, adult mortality in bioassay of plots treated with spinosad had fallen below 30%, significantly lower than adult mortality in plots treated with metaflumizone, Dow Exp, or the higher rate of chlorantraniliprole (Table 2). On Day 2 leaf consumption by adults in plots treated with spinosad was not significantly different than consumption by adults in untreated CONTROL plots (Table 3). On the same day, less than 20% of the leaf area was lost due to adult feeding in plots treated with acetamiprid or either rate of chlorantraniliprole (Table 3). By 4 DAT, deposits of Dow Exp or acetamiprid on harvested leaves no longer caused significant mortality of adult CPB; metaflumizone and both rates of chlorantraniliprole remained effective against adults on that date (Table 2) as evidenced both by mortality (Table 2) and reduced feeding damage (Table 3). Similar relationships of treatment efficacy against adult CPB were observed in bioassays completed 7 and 10 DAT (Table 2, 3). By 14 DAT, deposits of metaflumizone had no significant impact on adult CPB mortality (Table 2). In bioassays completed 21 DAT over 90% of adult CPB died within 72 hours of exposure to deposits of the higher rate of application of chlorantraniliprole (Table 2). By 28 DAT adult mortality did not exceed 60% in bioassay of any treatment (Table 2). While adult CPB did not die within 72 hours of exposure, feeding damage was significantly reduced in bioassay 28 DAT of both rates of application of chlorantraniliprole (Table 3).
With minor exceptions, the pattern of response by early 2nd instar CPB larvae exposed in bioassay to foliar deposits of tested insecticides was similar to that described above for adult CPB (Table 4 - mortality; Table 5 - leaf consumption). In bioassay, larval leaf consumption was significantly reduced relative to damage in untreated CONTROL plots as follows: spinosad - 2 DAT; acetamiprid, Dow Exp - 7 DAT; metaflumizone - at least 14 DAT; chlorantraniliprole (25.0, 50.0 g a.i./ha) - at least 28 DAT (Table 5).

CONCLUSIONS: Under the conditions of this trial while foliar residues of all tested insecticides initially proved effective against both adult and early 2nd instar larvae, pronounced differences in residual activity were recorded. The observed order of significant reduction in adult feeding damage by applied rates was: chlorantraniliprole (25.0, 50.0 g a.i./ha)(at least 28 days) > metaflumizone (80 g a.i./ha)(at least 14 days) > acetamiprid (14 days) > Dow Exp (80.0 g a.i./ha)(4 days) > spinosad (79.7 g a.i./ha)(2 days). The observed order of significant reduction in larval leaf consumption by applied rates was: chlorantraniliprole (25.0, 50.0 g a.i./ha)(at least 28 days) > metaflumizone (80 g a.i./ha)(at least 14 days) > acetamiprid (7 days) = Dow Exp (80.0 g a.i./ha)(7 days) > spinosad (79.7 g a.i./ha)(2 days).
Due to reported different and unique modes of action, metaflumizone and chlorantraniliprole would be effective additions to current Canadian IPM and resistance management programs for CPB.

Table 1. Foliar treatments evaluated in microplots for control of insect pests of potato on mineral soil, London, ON, 2006.

Tmt. No.	Insecticide	Formulation	Rate/ha	
			a.i.	product
1	acetamiprid	ASSAIL 70 WP	56.0 g	80.0 g
2	chlorantraniliprole	DPX-E2Y45 35 WG	25.0 g	71.4 g
3	chlorantraniliprole	DPX-E2Y45 35 WG	50.0 g	142.9 g
4	Dow Exp	Dow Exp 25 WG	80.0 g	320.0 g
5	spinosad	SUCCESS 480 SC	79.7 g	166.0 ml
6	metaflumizone[1]	BAS 3201 240 SC[1]	80.0 g	333.3 ml
7	no insecticide	CONTROL	---	---

[1] Applied in combination with MERGE surfactant (0.5% [v/v]).

Table 2. Effect of foliage of potatoes, treated with selected foliar insecticides, on mortality of Colorado potato beetle (CPB) adults after feeding for 72 hours in bioassay, London, ON, 2006.

Tmt.[1] No.	Average % Corrected Adult CPB Mortality on Indicated DAT[3]							
	0	2	4	7	10	14	21	28
1	82.2 a[2]	53.5 bc	18.1 b	39.1 b	35.6 b	3.6 b	---	---
2	86.7 a	56.3 bc	75.0 a	89.6 a	69.0 a	65.1 a	57.1 b	34.9 a
3	86.7 a	69.8 ab	94.4 a	93.1 a	97.8 a	88.4 a	93.2 a	32.8 a
4	97.8 a	79.6 ab	27.8 b	3.0 c	15.6 b	—[4]	---	---
5	100.0 a	27.9 c	8.3 b	12.6 bc	17.8 b	---	---	---
6	93.3 a	100.0 a	97.2 a	100.0 a	95.6 a	23.0 b	---	---

[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 Tukey's HSD means separation test.
[3] Days after Treatment.
[4] Bioassay not performed due to low mortality in preceding bioassay of the same treatment.

Table 3. Effect of foliage of potatoes, treated with selected foliar insecticides, on feeding damage by Colorado potato beetle (CPB) adults after 72 hours in bioassay, London, ON, 2006.

Tmt.[1] No.	Average Damage Rating[3] due to Feeding by Adult CPB on Indicated DAT[4]							
	0	2	4	7	10	14	21	28
1	0.1 c[2]	0.6 c	2.8 b	2.0 c	4.4 b	7.4 a	—[5]	—
2	0.4 c	1.7 c	1.0 cd	0.5 c	0.7 c	0.8 c	1.8 b	2.0 b
3	0.4 c	0.7 c	0.5 d	0.5 c	0.3 c	0.5 c	0.7 c	2.9 b
4	0.2 c	4.9 b	5.3 a	7.0 a	6.9 a	---	---	---
5	0.2 c	7.6 a	6.2 a	6.5 a	6.8 a	---	---	---
6	2.5 b	4.2 b	2.6 bc	1.8 c	1.6 c	5.8 b	---	---
7	7.7 a	8.1 a	6.3 a	4.3 b	7.6 a	8.0 a	8.0 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 Tukey's HSD 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.
5 Bioassay not performed due to lack of activity in preceding bioassay of the same treatment.

Table 4. Effect of foliage of potatoes, treated with selected foliar insecticides, on mortality of Colorado potato beetle (CPB) larvae after feeding for 72 hours in bioassay, London, ON, 2006.

Tmt.[1] No.	Average % Corrected Larval CPB Mortality on Indicated DAT[3]							
	0	2	4	7	10	14	21	28
1	97.5 a[2]	25.2 bc	32.3 b	0.3 c	2.2 c	0.0 b	—[4]	---
2	75.0 ab	67.7 a	61.5 ab	81.1 a	53.3 b	51.1 a	32.5 a	40.0 a
3	73.9 ab	60.6 ab	100.0 a	78.4 a	77.8 ab	75.6 a	64.1 a	28.9 a
4	100.0 a	82.8 a	25.3 b	11.7 bc	11.1 c	---	---	---
5	100.0 a	11.7 c	24.3 b	2.1 c	4.4 c	---	---	---
6	66.4 b	61.6 ab	83.7 a	45.6 ab	53.3 b	6.7 b	---	---

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 Tukey's HSD means separation test.
3 Days after Treatment.
4 Bioassay not performed due to low mortality in preceding bioassay of the same treatment.

Table 5. Effect of foliage of potatoes, treated with selected foliar insecticides, on feeding damage by Colorado potato beetle (CPB) larvae after 72 hours in bioassay, London, ON, 2006.

Tmt.[1] No.	Average Leaf-Area[3] Consumed by Larval CPB on Indicated DAT[4]							
	0	2	4	7	10	14	21	28
1	0.0 b[2]	0.6 b	2.1 bc	3.9 a	4.3 a	7.1 a	---	---
2	0.0 b	0.3 b	0.3 d	0.1 c	0.1 c	0.1 d	0.7 b	0.7 b
3	0.1 b	0.2 b	0.1 d	0.1 c	0.1 c	0.1 d	0.9 b	0.5 b
4	0.0 b	1.0 b	2.7 b	2.9 ab	3.3 ab	—[5]	---	---
5	0.0 b	5.5 a	2.7 b	2.4 b	2.4 b	---	---	---
6	0.6 b	1.0 b	0.7 cd	0.5 c	0.6 c	2.2 c	---	---
7	5.9 a	6.4 a	5.8 a	2.5 ab	3.7 ab	4.2 b	4.7 a	4.5 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 Tukey's HSD means separation test.

3 Actual area (cm^2) of leaf-disc consumed during 72 hour feeding period.

4 Days after Treatment.

5 Bioassay not performed due to lack of activity in preceding bioassay of the same treatment.

2006 PMR REPORT #029

SECTION C: POTATOES - Insect Pests
STUDY DATA BASE: 160.3

CROP: Potato (*Solanum tuberosum*), cv. Chieftain
PEST: Wireworm (WW), *Melanotus* spp.

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TITLE: PLANTING TREATMENTS FOR CONTROL OF DAMAGE TO POTATO TUBERS BY FIELD WIREWORMS, 2006

MATERIALS: Dow Exp (Dow Exp 25% [w/w]), DPX-E2Y45 35 WG (chlorantraniliprole 35% [w/w]), BAS 320I 240 SC (metaflumizone 22% [w/w]), REGENT 4 SC (fipronil 39.4% [w/w]), ICON 6.2 FS (fipronil 56% [w/w]), THIMET 15 G (phorate 15% [w/w])

METHODS: Hard red, spring wheat for the trap and kill (T&K) treatment (Tmt. 6) was treated on 9 May by tumbling in a clean 6 lb plastic bag with seed treatment for 1 minute to ensure even coating of seed; treated wheat was sprinkled uniformly down the length of the open seed furrow (250 seeds/m). Seed potatoes were hand cut on 10 May. On 11 May, single row plots were established in sandy loam soil near Rodney, Ontario (42° 33' 38.02" N; 81° 38' 47.58" W). Rows were planted on 1 m spacing. Individual plots measured 5 m long. With the exception of Tmt. 8, all treatments were replicated 4x in a Randomized Complete Block design. To accommodate possible uneven WW distribution within the block, single untreated rows (Tmt. 8) were established so that every treated row was adjacent to an untreated row; each replicate range thus contained 5 untreated rows. Replicate ranges were separated by 1 m fallow walkways which were also located at either end of the entire block.
The in-furrow granular (IFG)(Tmt. 7) and trap and kill (T&K)(Tmt. 6) were hand applied in a 7-10 cm band in the bottom of the seed furrow before placement of seed pieces. Seed pieces were then hand planted at 20 cm spacing (25 seed pieces/plot) in all plots. In-furrow spray (IFS) treatments (Tmts. 1-5) were applied in a 10-12 cm band over the seed pieces in the open seed furrow in 5 L/100 m row at 175 kPa, using a hand-held, CO_2-pressurized R&D field-plot sprayer fitted with a single 8004 EVS flat spray tip. Seed pieces were covered with soil, hilled to a height of ca. 10 cm and lightly tamped to ensure good contact with soil. Plots were subsequently hilled and weeds removed manually as required until harvest.
On 15 August, all potatoes from Plants 2-11 in each plot were carefully dug, placed in labeled jute bags and returned to the laboratory. All tubers were washed and allowed to dry prior to grading. During grading, all harvested tubers ≥ 30 mm diameter were measured, weighed and checked for WW feeding damage. Damage was determined by counting numbers of blemishes (fresh WW feeding holes + healed WW feeding scars) on each tuber and then calculating the number of blemishes/tuber for each plot. The % tubers WW-damaged tubers was also calculated for each plot. Since WW were present throughout the block, the mean number of

blemishes/tuber and the mean % WW damaged tubers for all untreated rows in each replicate were calculated and utilized for purposes of comparison of treatment effect. The observed impact of treatments on the number of blemishes/tuber was analyzed by Analysis of Variance (ANOVA); significance of observed differences among treatment means was then determined using Tukey's HSD means separation test. Results are presented as the number of WW blemishes/10 tubers. The % WW-damaged tubers were subjected to arcsine square root transformation prior to determination of statistical significance by ANOVA and Tukey's HSD means separation test. Untransformed data are presented.

OBSERVATIONS: No significant phytotoxicity was observed following any planting treatment. Wheat plants growing from treated seed planted beneath potato seed pieces were quite spindly and did not compete with growing potato plants. Air quality in southwestern Ontario was very poor on several occasions during the summer. By 18 July potato plants had been affected. By 07 August "weather fleck" and leaf curling due to feeding by potato leafhopper was observed throughout the block; all treatments were affected.

RESULTS: Impact of planting treatments on WW-damage to harvested potato tubers is shown in Table 1. While WW-damage was significantly higher in Replicate 1 than in Replicate 4, across the entire block an average of more than 37 WW blemishes/10 tubers was recorded in plots to which no insecticide was applied. IFS-application of Dow Exp, chlorantraniliprole or metaflumizone had no impact on either WW-damage to harvested potato tubers or the % of harvested tubers attacked by WW. IFS-application of fipronil was the most effective treatment, significantly reducing the mean number of WW-blemishes by over 95% and the % WW-damaged tubers by nearly 80%. Both T&K application of fipronil and IFG-application of phorate (THIMET 15 G), the previous commercial standard were also very effective, significantly reducing both the number of WW-blemishes/tuber and the % WW-damaged tubers at harvest.

CONCLUSION: Under the conditions of this experiment, in-furrow application of either fipronil or phorate effectively reduced WW-damage to potato tubers. WW are attracted to germinating wheat seeds. If those seeds are treated with fipronil, resulting mortality of feeding WW can significantly reduce WW damage to potato tubers growing in the same plots. Dow Exp, chlorantraniliprole and metaflumizone did not control the WW present in this trial.

Table 1. Impact of planting treatments on damage to harvested potato tubers by wireworms, Rodney, ON, 2006.

Tmt No.	Insecticide Applied	Method [1]	Rate /100 m row (a.i.)	Mean WW- Damage		Damaged Tubers	
				Blemish [3]	% Red'n [5]	% Dam.	% Red'n [5]
1	Dow Exp	IFS	3.0 g	39.8 ab[4]	xx[6]	68.4 a	0.3
2	chlorantraniliprole	IFS	3.0 g	41.2 a	xx	71.3 a	xx
3	HGW86	IFS	2.0 g	42.9 a	xx	69.1 a	xx
4	metafumizone	IFS	3.0 g	38.2 abc	xx	67.4 a	1.7
5	fipronil	IFS	3.05 g	1.8 d	95.2	13.8 b	79.9
6	fipronil	T&K	1.5 g[2]	5.0 cd	86.8	22.4 b	67.3
7	phorate	IFG	32.25 g	6.4 bcd	82.9	31.6 b	53.9
8	no insecticide	-----	----	37.4 abc		68.6 a	

[1] Method of application: IFS - in-furrow spray treatment; IFG - in-furrow granular treatment; T&K - trap ad kill treatment.

[2] 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).

[3] Number of WW-blemishes/10 tubers.

[4] Means within a column followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and Tukey's Studentized Range (HSD) test.

[5] Relative to values recorded in absence of insecticide.

[6] No reduction recorded.

2006 PMR REPORT #030

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

CROP: Corn, (*Zea maize* L.), cv ELITE 46T07
PEST: Wireworm, (*Limonius* spp.)

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TITLE: CONTROL OF WIREWORM IN CORN WITH SEED TREATMENTS

MATERIALS: MAXIM XL 324 LS (fludioxonil + metalaxyl-M, 229.59 + 87.66 g ai/L); VORTEX FL (ipconazole, 448.2 g ai/L); ALLEGIANCE 318 FL (metalaxyl, 318 g ai/L); PONCHO 600 FS (clothianidin, 600 g ai/L); CRUISER 5 FS (thiamethoxam, 5 g ai/L); FORCE 3 G (tefluthrin, 3 % v/v); PRECISE FINISHER 1006 FS SEED COATING; PRECISE FINISHER 1007 FS SEED COATING PRO-IZED RED COLOURANT FS; PRO-IZED PURPLE COLOURANT FS; TALC 100 WP.

METHODS: Seed was treated by Bayer CropScience and weighed 202.96 g/1000 seeds. The trial was planted on 9 May 2006 at Rodney, ON using a two-row cone-seeder mounted on a John Deere Max Emerge planter at a rate of 8 seeds/m. Plots were 1 row, spaced 0.76 m apart and 10 m in length placed in a RCBD with 4 replications. The plots were fertilized and maintained according to provincial recommendations. Plot emergence and vigour were assessed on 25 May. Plant stand was determined on 9 June, 22, and 29 June. Vigour was assessed on the same dates using a scale of 0 -100%, (100 = most advanced plot and 0 = plants dead in plot) and with a Bayer CropScience scale of 1-9 (1 = excellent, 2= very good, 3 = good, 4 = normal, 5 = marginally acceptable, 6 = marginally unacceptable, 7 = poor, 8 = very poor, and 9 = little or no growth). Plant stand, plant height, fresh weight, and wireworm damage were assessed on 16 June using a rating scale of 0-3 (0 = no damage, 1 = feeding damage, but alive, 2 = plant died after emergence from insect damage, 3 = non emerged seed) by exhuming all plants and seed remains from a 2 m length of row. Wireworm populations were estimated by sifting the soil in a 10 by 10 cm trench surrounding the plants and separating out the insects. Fresh weight was also measured on 7 July from 20 plants. Data were analyzed using analysis of variance and means were separated using Fisher's protected least significant differences test (LSD) at $P \leq 0.05$.

RESULTS: No differences in emergence or plant stand were observed among seed treatments, but emergence was lowest with Force 3 G applied in-furrow (Table 1). Vigour was improved in corn treated with fungicide and fungicide + insecticide, except with Force 3 G applied in-furrow (Table 2). No differences were found in wireworm feeding damage or number of wireworm among treatments (Table 3) although slightly less wireworm damage was measured with Cruiser 5 FS (0.25 mg ai/seed)(Tables 3 and 4). Plant biomass was decreased with in-furrow application of Force 3 G (Table 5).

CONCLUSIONS: Seed treatments provided better protection of corn seed from wireworm damage than application of Force 3 G in furrow. No differences were detected among seed treatments.

Table 1. Emergence and plant stand assessments in corn at Rodney, Ontario, 2006.

Treatment	Rate g ai/100 kg or mg ai/seed * or g ai/100 m row **	Emergence	Plant Stand Mean per m^2		
		25 May VE	29 May V1	22 June V8	29 June V10
UNTREATED CHECK		7.11 ab***	8.03 ab	8.18 ab	8.06 a
MAXIM XL	3.5	7.86 a	8.75 a	9.00 ab	8.88 a
VORTEX FL	2.5	7.27 ab	8.72 a	9.05 ab	8.92 a
+ALLEGIANCE FL	2				
VORTEX FL	2.5	7.20 ab	8.72 a	9.21 a	9.09 a
+ALLEGIANCE FL	2				
+PONCHO 600 FS	0.25*				
MAXIM XL	3.5	6.38 ab	7.73 ab	8.22 ab	7.89 a
+PONCHO 600 FS	0.25*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	6.22 ab	8.26 a	8.76 ab	8.51 a
+PONCHO 600 FS	0.50*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	6.45 ab	7.76 ab	8.51 ab	8.59 a
+PONCHO 600 FS	1.25*				
+Precise S Finisher 1007	3.9				
+Pro-ized Purple Colourant	32.7				
+Precise S Finisher 1006	326				
+ Talc	62.5				
MAXIM XL	3.5	7.73 a	8.68 a	9.00 ab	8.59 a
+CRUISER 5 FS	0.25*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	6.68 ab	7.76 ab	7.48 ab	7.15 a
+CRUISER 5 FS	0.125*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	5.36 b	6.71 b	7.15 b	7.07 a
+FORCE 3 G In-Furrow	37.5 **				
CV		12.6	8.3	9.5	10.5

*** Means followed by the same letter do not significantly differ, $P \geq 0.05$ LSD.

Table 2. Vigour assessments of whole corn row plots at Rodney, Ontario, 2006.

Treatment	Rate	Vigour 1- 100%*** (1-9****)			
	g ai/100 kg or mg ai/seed * or g ai/100 m row **	25 May	29 May	22 June	29 June
		VE	V1	V8	V10
UNTREATED CHECK		67.5 bc ***** (4.5)	77.5 ab (4.0)	85.0 abc (4.0)	80.0 abc (4.0)
MAXIM XL	3.5	87.5 a (3.8)	92.5 a (3.8)	90.0 abc (3.5)	82.5 abc (4.0)
VORTEX FL	2.5	82.5 ab (4.0)	92.5 a (4.0)	97.5 a (3.3)	87.5 a (4.0)
+ALLEGIANCE FL	2				
VORTEX FL	2.5	83.8 ab (4.0)	93.8 a (4.0)	92.5 abc (3.3)	95.0 a (3.5)
+ALLEGIANCE FL	2				
+PONCHO 600 FS	0.25*				
MAXIM XL	3.5	73.8 ab (4.3)	83.8 a (4.0)	95.0 ab (3.5)	82.5 abc (3.8)
+PONCHO 600 FS	0.25*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	77.5 ab (4.3)	87.5 a (4.0)	85.0 abc (3.8)	82.5 abc (4.0)
+PONCHO 600 FS	0.50*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	78.8 ab (4.0)	83.8 ab (4.0)	85.0 abc (3.8)	82.5 abc (4.0)
+PONCHO 600 FS	1.25*				
+Precise S Finisher 1007	3.9				
+Pro-ized Purple Colourant	32.7				
+Precise S Finisher 1006	326				
+ Talc	62.5				
MAXIM XL	3.5	85.0 ab (4.0)	91.3 a (4.0)	92.5 abc (4.0)	87.5 ab (3.8)
+CRUISER 5 FS	0.25*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	72.5 ab (5.0)	80.0 ab (4.0)	75.0 c (4.0)	70.0 bc (4.0)
+CRUISER 5 FS	0.125*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	57.5 c (5.0)	68.8 b (4.0)	77.5 bc (4.0)	67.5 c (4.0)
+FORCE 3 G In-Furrow	37.5 **				
CV		10.4 (13.0)	8.4 (4.0)	9.3 (11.3)	9.5 (7.5)

*** 100 = most advanced plot and 0 = plants dead in plot.

**** 1 = excellent, 2= very good, 3 = good, 4 = normal, 5 = marginally acceptable, 6 = marginally unacceptable, 7 = poor, 8 = very poor, and 9 = little or no growth.

***** Means followed by the same letter do not significantly differ, $P \geq 0.05$ LSD.

Table 3. Mean plant stand, plant height, number of damaged plants and wireworm per metre in corn at Rodney, Ontario, 2006.

Treatment	Rate g ai/100 kg or mg ai/seed * or g ai/100 m row **	Plant Height (cm)	Plant Stand	Damaged Plants	Wireworm
				Mean per m^2 16 June (V6)	
UNTREATED CHECK		51.9 a	9.05 ab***	2.26 a	2.14 a
MAXIM XL	3.5	54.8 a	10.53 ab	2.59 a	2.30 a
VORTEX FL	2.5	53.6 a	9.54 ab	2.38 a	2.96 a
+ALLEGIANCE FL	2				
VORTEX FL	2.5	55.7 a	8.88 ab	2.22 a	2.30 a
+ALLEGIANCE FL	2				
+PONCHO 600 FS	0.25*				
MAXIM XL	3.5	53.1 a	8.39 ab	2.10 a	0.82 a
+PONCHO 600 FS	0.25*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	52.9 a	8.72 ab	2.10 a	1.32 a
+PONCHO 600 FS	0.50*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	48.2 a	9.38 ab	2.34 a	1.32 a
+PONCHO 600 FS	1.25*				
+Precise S Finisher 1007	3.9				
+Pro-ized Purple Colourant	32.7				
+Precise S Finisher 1006	326				
+ Talc	62.5				
MAXIM XL	3.5	55.4 a	7.40 b	1.85 a	1.32 a
+CRUISER 5 FS	0.25*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	48.6 a	11.18 a	2.80 a	3.13 a
+CRUISER 5 FS	0.125*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	42.5 a	7.40 b	1.93 a	1.64 a
+FORCE 3 G In-Furrow	37.5 **				
CV		6.2	16.5	17.4	81

***Means followed by the same letter do not significantly differ, $P \geq 0.05$ LSD.

Table 4. Wireworm damage assessments in corn at Rodney, Ontario, 2006.

Treatment	Rate g ai/100 kg or mg ai/seed * or g ai/100 m row **	Damage Category*** 0	1	2	3
		Mean plants per m^2 16 June (V6)			
UNTREATED CHECK		5.92 ab****	3.12 a	0	0
MAXIM XL	3.5	8.22 a	2.14 a	0	0
VORTEX FL	2.5	7.73 ab	1.81 a	0	0
+ALLEGIANCE FL	2				
VORTEX FL	2.5	6.91 ab	1.97 a	0	0
+ALLEGIANCE FL	2				
+PONCHO 600 FS	0.25*				
MAXIM XL	3.5	6.09 ab	2.30 a	0	0
+PONCHO 600 FS	0.25*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	6.09 ab	2.30 a	0	0
+PONCHO 600 FS	0.50*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	7.40 ab	1.97 a	0	0
+PONCHO 600 FS	1.25*				
+Precise S Finisher 1007	3.9				
+Pro-ized Purple Colourant	32.7				
+Precise S Finisher 1006	326				
+ Talc	62.5				
MAXIM XL	3.5	5.10 b	2.30 a	0	0
+CRUISER 5 FS	0.25*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	7.73 ab	3.45 a	0	0
+CRUISER 5 FS	0.125*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	5.76 ab	1.97 a	0	0
+FORCE 3 G In-Furrow	37.5 **				
CV		17.6	49.3	0	0

*** 0 = no damage, 1 = feeding damage, but alive, 2 = plant died from insect damage after emergence, 3 = non-emerged seed

**** Means followed by the same letter do not significantly differ, $P \geq 0.05$ LSD.

Table 5. Fresh weight measurements in corn at Rodney, Ontario, 2006.

Treatment	Rate	Fresh Weight			
	g ai/100 kg or	Total (g)	Mean (g)	Total (kg)	Mean (kg)
	mg ai/seed * or	per m^2		per 20 plants	
	g ai/100 m row **	16 June (V6)		7 July (V10)	
UNTREATED CHECK		250.8 a***	22.3 ab	11.6 a	0.58 a
MAXIM XL	3.5	336.7 a	21.4 ab	12.4 a	0.62 a
VORTEX FL	2.5	306.3 a	21.0 ab	11.4 a	0.57 a
+ALLEGIANCE FL	2				
VORTEX FL	2.5	287.4 a	24.5 a	11.7 a	0.59 a
+ALLEGIANCE FL	2				
+PONCHO 600 FS	0.25*				
MAXIM XL	3.5	251.4 a	20.8 ab	12.2 a	0.61 a
+PONCHO 600 FS	0.25*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	269.8 a	21.2 ab	11.5 a	0.58 a
+PONCHO 600 FS	0.50*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	230.2 a	16.7 ab	10.1 a	0.50 a
+PONCHO 600 FS	1.25*				
+Precise S Finisher 1007	3.9				
+Pro-ized Purple Colourant	32.7				
+Precise S Finisher 1006	326				
+ Talc	62.5				
MAXIM XL	3.5	270.6 a	24.9 a	11.8 a	0.59 a
+CRUISER 5 FS	0.25*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	284.5 a	16.8 ab	10.3 a	0.51 a
+CRUISER 5 FS	0.125*				
+Precise S Finisher 1006	130				
+Pro-ized Red Colourant	19.6				
+Talc	62.5				
MAXIM XL	3.5	137.7 b	13.1 b	9.7 a	0.48 a
+FORCE 3 G In-Furrow	37.5 **				
CV		21.8	23.6	12.5	12.5

*** Means followed by the same letter do not significantly differ, $P \geq 0.05$ LSD.

2006 PMR REPORT #031

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

CROP: Soybean, (*Glycine max* (L.) Merrill), cv Dekalb Monsanto 2702R
PEST: Wireworm, (*Limonius*, spp)

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TITLE: CONTROL OF WIREWORM IN SOYBEAN WITH SEED TREATMENTS

MATERIALS: GAUCHO 480 FS (imidacloprid, 480 g ai/L); GAUCHO 600 FS (imidacloprid, 600 g ai/L); CRUISER 5 FS (thiamethoxam, 5 g ai/L); APRON MAXX RTA 19.05 FS (fludioxonil + metalaxyl-M, 7.69 + 11.54 g ai/L).

METHODS: Seed was treated by Bayer CropScience. All seed was treated with the fungicide Apron Maxx RTA 19.05 FS at a rate of 6.25 g ai/100 kg seed. Seed weight was 162.6 g/1000 seeds. Seed was planted on 9 May 2006 at Rodney, Ontario using a two-row cone-seeder mounted on a John Deere Max Emerge planter. Plots were 2 rows, spaced 0.76 m apart and 10 m in length placed in RCBD with 4 replications at a seeding rate of 20 seeds/m. The plots were fertilized and maintained according to provincial recommendations. Plot emergence and vigour were assessed on 26 May. Plant stand was determined on 9, 22, and 29 June. Vigour was recorded on the same dates using a scale of 0 -100 %, (100= most advanced plot and 0 = plants dead in the plot) and using a Bayer CropScience 1-9 rating scale (1 = excellent, 2 = very good, 3 = good, 4 = normal, 5 = marginally acceptable, 6 = marginally unacceptable, 7 = poor, 8 = very poor, and 9 = little or no growth). Plant stand, plant height, fresh weight, and wireworm damage were assessed on 16 June using a rating scale of 0-3 (0 = no damage, 1 = feeding damage, but alive, 2 = plant died after emergence from insect damage, 3 = non emerged seed) by exhuming all plants and seed remains from a 2 m length of row. Wireworm populations were estimated by sifting the soil and separating out the insects. The trial was harvested on 30 October and yields were converted to 14.5 % moisture. Data were analyzed using analysis of variance and means were separated using Fisher's protected least significant differences test (LSD) at $P \leq 0.05$.

RESULTS: Emergence and plant stand were improved with all insecticide treatments although no differences in emergence were measured among treatments (Table 1). Plant stand counts were highest in soybeans treated with either rate of Cruiser 5 FS and Gaucho 480 FS (62.5 g ai/100 kg seed) (Table 1). Vigour was improved with all insecticide treatments, rated highest in the high rate plots of all three insecticide products (Table 2). Soybeans treated with Gaucho 600 FS (125 g ai/100 kg seed) were found to have the least wireworm feeding damage and highest plant growth characteristics including height, fresh weight, and yield (Tables 3-4).

CONCLUSIONS: No differences were detected among seed treatments although Gaucho 600 FS (125 g ai/100 kg seed) tended to provide the most effective protection against wireworm feeding damage in soybeans.

Table 1. Emergence and plant stand assessments in soybeans at Rodney, Ontario 2006.

Treatment	Rate	Emergence	Plant Stand per m^2		
	g ai/100 kg	26 May	9 June	22 June	29 June
		VE	V1	V5	V6
UNTREATED CHECK		5.2 b*	20.6 b	22.0 b	20.0 b
GAUCHO 480 FS	31.25	7.8 ab	33.8 a	33.2 ab	33.2 ab
GAUCHO 480 FS	62.5	12.0 a	34.9 a	41.5 a	40.8 a
GAUCHO 480 FS	125	7.6 ab	30.8 ab	36.5 ab	35.6 ab
GAUCHO 600 FS	31.25	7.1 ab	28.7 ab	34.7 ab	34.4 ab
GAUCHO 600 FS	62.5	7.3 ab	29.4 ab	40.1 a	39.2 a
GAUCHO 600 FS	125	9.5 ab	36.1 a	40.1 a	39.6 a
CRUISER 5 FS	30	8.6 ab	36.5 a	43.1 a	42.9 a
CRUISER 5 FS	50	7.8 ab	29.3 ab	43.3 a	42.7 a
CV		29.0	18.4	20.8	22.1

* Means followed by the same letter do not significantly differ, $P \geq 0.05$ LSD.

Table 2. Vigour assessments of whole soybean plots at Rodney, Ontario 2006.

Treatment	Rate	Vigour							
	g ai/100 kg	1-100%*	1-9**	0-100%	1-9	1-100%	1-9	1-100%	1-9
		26 May		9 June		22 June		29 June	
		VE		V1		V5		V6	
UNTREATED CHECK		50 b***	5 a	53 b	5 a	55 a	5	53 b	5
GAUCHO 480 FS	31.25	71 a	4 b	83 a	4 b	65 a	5	68 ab	5
GAUCHO 480 FS	62.5	83 a	4 b	89 a	4 b	85 a	4	85 a	4
GAUCHO 480 FS	125	76 a	4 b	86 a	4 b	83 a	4	90 a	4
GAUCHO 600 FS	31.25	73 a	4 b	78 a	4 b	75 a	4	78 ab	4
GAUCHO 600 FS	62.5	68 a	4 b	76 a	4 b	73 a	4	78 ab	4
GAUCHO 600 FS	125	85 a	4 b	95 a	4 b	93 a	4	88 a	4
CRUISER 5 FS	30	88 a	4 b	94 a	4 b	78 a	4	80 ab	4
CRUISER 5 FS	50	81 a	4 b	88 a	4 b	85 a	4	88 a	4
CV		12.7	5.3	12.2	8.4	19.9	12.3	17.8	10.6

* 100= most advanced plot and 0 = plants dead in the plot.

** 1 = excellent, 2 = very good, 3 = good, 4 = normal, 5 = marginally acceptable, 6 = marginally unacceptable, 7 = poor, 8 = very poor, and 9 = little or no growth.

*** Means followed by the same letter do not significantly differ, $P \geq 0.05$ LSD.

Table 3. Plant height and wireworm damage assessments of soybeans at Rodney, Ontario 2006.

Treatment	Rate g ai/100 kg	Plant Height (cm)	Plant Stand (plants per m^2)	Wireworm Damage*				Wireworm (per m^2)
				0	1	2	3	
				19 June (V3)				
UNTREATED CHECK		12.5 b*	8.1 b	4.9 b	3.1 a	0 a	0 a	3.95***
GAUCHO 480 FS	31.25	13.8 ab	13.8 a	9.9 ab	4.0 a	0 a	0 a	13.8
GAUCHO 480 FS	62.5	17.5 ab	16.5 a	13.3 a	2.8 a	0 a	0 a	0.38
GAUCHO 480 FS	125	16.7 ab	18.9 a	15.3 a	3.6 a	0 a	0 a	4.37
GAUCHO 600 FS	31.25	16.4 ab	13.8 a	10.9 ab	3.0 a	0 a	0 a	0.65
GAUCHO 600 FS	62.5	14.0 ab	15.3 a	12.8 a	2.5 a	0 a	0 a	0.89
GAUCHO 600 FS	125	18.8 a	17.4 a	13.7 a	3.8 a	0 a	0 a	1.35
CRUISER 5 FS	30	16.1 ab	15.8 a	12.3 a	3.5 a	0 a	0 a	2.57
CRUISER 5 FS	50	16.1 ab	16.9 a	13.2 a	3.8 a	0 a	0 a	3.95
CV		13.9	20.9	29.0	40.6	0	0	125.4

* 0 = no damage, 1 = feeding damage, but alive, 2 = plant died from insect damage after emergence, 3 = non-emerged seed.

** Means followed by the same letter do not significantly differ, $P \geq 0.05$ LSD.

*** Data transformed to $\log_{10}$ to meet assumptions of ANOVA, data reported are back transformed.

Table 4. Fresh weights and yield of soybeans at Rodney, Ontario 2006.

Treatment	Rate	Fresh Weight				Yield
	g ai/100 kg	Total (g)	Mean (g)	Total (kg)	Mean (kg)	T per ha
		19 June (per m^2) V3		10 July (20 plants) V8		30 Oct R8
UNTREATED CHECK		26.6 b*	3.1 a	0.31 b	0.02 b	0.6 a
GAUCHO 480 FS	31.25	48.9 ab	3.4 a	0.41 ab	0.02 ab	1.0 a
GAUCHO 480 FS	62.5	81.7 ab	4.9 a	0.67 ab	0.03 ab	1.2 a
GAUCHO 480 FS	125	81.7 ab	4.3 a	0.65 ab	0.03 ab	1.3 a
GAUCHO 600 FS	31.25	66.9 ab	4.8 a	0.53 ab	0.03 ab	1.1 a
GAUCHO 600 FS	62.5	53.8 ab	3.2 a	0.50 ab	0.03 ab	1.3 a
GAUCHO 600 FS	125	134.9 a	7.7 a	0.71 a	0.04 a	1.6 a
CRUISER 5 FS	30	77.5 ab	5.0 a	0.52 ab	0.03 ab	1.2 a
CRUISER 5 FS	50	87.8 ab	5.2 a	0.59 ab	0.03 ab	1.5 a
CV		50.9	44.4	29.4	29.4	34.5

* Means followed by the same letter do not significantly differ, $P \geq 0.05$ LSD.

2006 PMR REPORT #032

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

CROP: Soybean, (*Glycine max* (L.) Merrill), cvs. 90B11 (Small seed) and 2702R (Large seed)
PEST: Seed corn maggot, *Delia platura* (Meigen)

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TITLE: CONTROL OF SEED CORN MAGGOT IN LARGE AND SMALL SOYBEANS WITH SEED TREATMENTS

MATERIALS: APRON MAXX RTA 19.05 FS (fludioxonil + metalaxyl-M, 7.69 + 11.54 g ai/L); CRUISER 5 FS (thiamethoxam, 5 g ai/L).

METHODS: Seed was separated into large and small sizes and treated on 1 May 2006 in 1 kg lots in individual plastic bags by applying the treatment or slurry via a syringe to each bag. The bag was inflated, and the seed was mixed for 1 min to ensure thorough seed coverage. Seed weights were 146 g/1000 seed and 168 g/1000 seed for 90B11 and 2702R, respectively. 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 4 May at Ridgetown, ON using a 2-row cone seeder at a seeding rate of 20 seeds/metre. Plots were 4 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 and vigour were evaluated on 26 May. Plant stand was evaluated on 6, 21, and 28 June. Vigour was assessed on the same dates using a scale of 0-100% (100 = furthest developed plant in the trial and 0 = plant dead). Plant stand and seed corn maggot damage were assessed on 6 June using a rating scale of 0-4 (0 = no damage, 1 = some damage on cotyledons, 2 = bald head, no true leaves, 3 = seed emerged but feeding evident, and 4 = damaged and rotted seed) by exhuming all plants and seed remains from a 1 m length of row. Plant fresh weights in 4 m were assessed on 17 August. Plots were harvested on 16 October and yields were corrected to 14.5% moisture. Data were analysed using analysis of variance and means were separated using Fisher's protected least significant differences test (LSD) at $P \leq 0.05$.

RESULTS: All insecticide treatments significantly improved emergence, plant stand, vigour and yield over fungicide treatments alone, yet no differences existed between application rates (Tables 1-3). Insecticide treatments provided early protection of seed improving plant stand throughout the duration of the trial, although seed corn maggot feeding damage was present on insecticide treated plants on 6 June (Table 3). No differences were measured among treatments in fresh weight or yield (Table 3).

CONCLUSIONS: Cruiser 5 FS was effective in protecting both large and small seed soybeans from seed corn maggot damage. No differences were observed among 50 g ai/100 kg seed and 0.0757 mg ai/seed rates of Cruiser 5 FS or among small and large seed sizes.

Table 1. Emergence and plant stand assessments in soybeans planted on 4 May, 2006 at Ridgetown, Ontario.

Treatment	Rate g ai/100 kg or mg ai/seed*	Emergence	Plant Stand Plants per m^2		
		26 May	6 June	21 June	28 June
APRON MAXX RTA (Sm seed)	6.25	3 b**	5 b	4 b	5 b
APRON MAXX RTA (Lg seed)	6.25	3 b	8 ab	3 b	3 b
APRON MAXX RTA (Sm seed) +CRUISER 5 FS	6.25 50	0.333333333	0.1666667	0.25	0.3333333
APRON MAXX RTA (Sm seed) +CRUISER 5 FS	6.25 0.0757*	0.166666667	0.1666667	0.25	0.2916667
APRON MAXX RTA (Lg seed) +CRUISER 5 FS	6.25 50	0.291666667	0.1666667	0.375	0.4166667
APRON MAXX RTA (Lg seed) +CRUISER 5 FS	6.25 0.0757*	0.333333333	0.083333	0.1666667	0.1666667
CV		46.4	31.2	37.3	40

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

Table 2. Vigour assessments of soybean plots planted on 4 May, 2006 at Ridgetown, Ontario.

Treatment	Rate g ai/100 kg or mg ai/seed*	Vigour 0-100%			
		26 May	6 June	21 June	28 June
APRON MAXX RTA (Sm seed)	6.25	20 b**	33 b	30 b	63 a
APRON MAXX RTA (Lg seed)	6.25	25 b	33 b	23 b	38 b
APRON MAXX RTA (Sm seed) +CRUISER 5 FS	6.25 50	65 a	79 a	68 a	78 a
APRON MAXX RTA (Sm seed) +CRUISER 5 FS	6.25 0.0757*	65 a	79 a	83 a	83 a
APRON MAXX RTA (Lg seed) +CRUISER 5 FS	6.25 50	78 a	93 a	88 a	78 a
APRON MAXX RTA (Lg seed) +CRUISER 5 FS	6.25 0.0757*	73 a	75 a	73 a	75 a
CV		29.5	23.7	26	22.4

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

Table 3. Seed corn maggot damage, plant stand, fresh weight, and yield of soybeans planted on 4 May, 2006 at Ridgetown, Ontario.

Treatment	Rate	SCM Damage					Plant Stand	Fresh Wt (kg)	Yield
	g ai/100 kg	Plants per Damage Category** - 6 June					per m row		T per ha
	or mg ai/seed*	0	1	2	3	4	17 Aug	17 Aug	16 Oct
APRON MAXX RTA (Sm seed)	6.25	0 a***	0.0416667	0.0416667	0 b	0.125	0.1666666667	1.7 a	1.1 bc
APRON MAXX RTA (Lg seed)	6.25	0	0.0833333	0	1 ab	0.20833333	0.1666666667	1.0 a	0.5 c
APRON MAXX RTA (Sm seed)	6.25								
+CRUISER 5 FS	50	0.041667	0.20833333	0.0833333	2 ab	0.29166667	0.4583333333	3.1 a	2.2 ab
APRON MAXX RTA (Sm seed)	6.25								
+CRUISER 5 FS	0.0757*	0.041667	0.20833333	0	4 ab	0.29166667	0	3.8 a	2.9 a
APRON MAXX RTA (Lg seed)	6.25								
+CRUISER 5 FS	50	0	0.25	0	0.16666667	0.20833333	0.125	4.4 a	3.0 a
APRON MAXX RTA (Lg seed)	6.25								
+CRUISER 5 FS	0.0757*	0	0.20833333	0.0416667	4 ab	0.20833333	0.1666666667	5.0 a	2.3 ab
CV		198.7	66.9	278.9	77.1	57.3	53.7	58.8	41.1

** 0 = no damage, 1 = some damage on cotelydons, 2 = bald head, no true leaves, 3 = seed emerged but feeding evident, and 4 = damaged and rotted seed.

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

2006 PMR REPORT #033

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

CROP: Soybean, (*Glycine max* (L.) Merrill), cvs. Pioneer 90B11(small seed), Dekalb Monsanto 2702R (large seed)
PEST: Seed corn maggot, *Delia platura* (Meigen)

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TITLE: CONTROL OF SEED CORN MAGGOT IN LARGE AND SMALL SIZE SOYBEANS WITH SEED TREATMENTS

MATERIALS: GAUCHO 480 FS (imidacloprid, 480 g ai/L); GAUCHO 600 FS (imidacloprid, 600 g ai/L); CRUISER 5 FS (thiamethoxam, 5 g ai/L).

METHODS: Seed was treated by Bayer CropScience after pre-treatment with the fungicide Apron Maxx RTA at a rate of 6.25 g ai/100 kg seed. Seed weights for Pioneer 90B11 and Dekalb Monsanto 2702R were 146 and 162.6 g/1000 seed, respectively. Cattle manure was broadcast on the plots 2 weeks before planting and the soil was disked shortly after the manure application. The crop was planted on 4 May, 2006 at Ridgetown ON at a seeding rate of 20 seeds/m using a 2-row cone seeder. Plots were 2 rows spaced 0.76 m apart and 4 m in length placed in a RCBD with 4 replications. The plots were fertilized and maintained according to provincial recommendations. Total plot emergence and vigour were evaluated on 26 May at VE stage. Plant stand per plot was evaluated at V1 stage on 5 June and plant stand per 4 m row on 21 (V2 stage), and 28 (V3 stage) June. Vigour was assessed on the same dates using a scale of 0-100% (100 = furthest developed plants in the trial and 0 = plants dead in trial) and a 1-9 Bayer CropScience scale (1 = excellent, 2 = very good, 3 = good, 4 = normal, 5 = marginally acceptable, 6 = marginally unacceptable, 7 = poor, 8 = very poor, and 9 = little or no growth). Plant stand and seed corn maggot damage were assessed on 6 June, 2006 at V1 stage, using a rating scale of 0-4 (0 = no damage, 1 = some damage on cotyledons, 2 = bald head, no true leaves, 3 = seed emerged but feeding evident, and 4 = damaged and rotted seed) by exhuming all plants and seed remains from a 1 m length of row. Fresh weights in a 3 m row section were assessed on 17 August. Small and large seed plots were harvested on 22 and 23 October, respectively, and yields were corrected to 14.5% moisture. Data were analyzed using analysis of variance and means were separated using Fisher's protected least significant differences test (LSD) at $P \leq 0.05$.

RESULTS: None of the seed treatments improved soybean populations over 40% of the seeding rate (Tables 1 and 5). Despite the poor control, there was a trend for emergence and plant stand in both small and large seed trials to be highest with Cruiser 5 FS (50 g ai/100 kg seed) followed by Cruiser 5 FS (30 g ai/100 kg seed) (Tables 1 and 4). Vigour ratings were also best with Cruiser 5 FS at the high and low rates, followed by Gaucho 480 FS at 125 g ai/100 kg seed in both size seed trials (Tables 2 and 5). No differences in fresh weight or yield were observed in the small seed trial (Table 4). A significant yield increase was measured on large seed treated with Cruiser 5 FS at both the high and low rate (Table 8). No differences were observed among Gaucho 480 FS and Gaucho 600 FS treatments, although a trend of increased efficacy with rate was present with both seed sizes.

CONCLUSIONS: Cruiser 5 FS (50 g ai/100 kg seed) was most effective in protecting both large and small soybean seed from seedcorn maggot damage.

Table 1. Emergence and plant stand assessments in small seed soybeans at Ridgetown, Ontario, 2006.

Treatment	Rate	Emergence	Plant Stand per m^2		
	g ai/100 kg	26 May	5 June	21 June	28 June
		VE	V1	V3	V5
UNTREATED CHECK		0.7 b*	1.0 b	1.1 a	0.9 a
GAUCHO 480 FS	31.25	0.9 b	1.3 b	2.2 a	2.1 a
GAUCHO 480 FS	62.5	1.5 b	2.0 ab	2.3 a	2.2 a
GAUCHO 480 FS	125	1.4 b	2.2 ab	3.0 a	3.4 a
GAUCHO 600 FS	31.25	1.3 b	1.8 b	2.0 a	2.3 a
GAUCHO 600 FS	62.5	1.1 b	2.1 ab	3.0 a	3.0 a
GAUCHO 600 FS	125	1.6 b	2.4 ab	2.2 a	2.6 a
CRUISER 5 FS	30	2.2 b	2.8 ab	3.0 a	3.5 a
CRUISER 5 FS	50	3.5 a	4.5 a	4.4 a	4.8 a
CV		53.2	50.6	50.3	54.4

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

Table 2 . Vigour assessments in small seed soybean plots at Ridgetown, Ontario, 2006.

Treatment	Rate	Vigour							
	g ai/	0-100%*	1-9**	0-100%	1-9	0-100%	1-9	0-100%	1-9
	100 kg	26 May		5 June		21 June		28 June	
		VE		V1		V3		V5	
UNTREATED CHECK		15.0 b***	0.333333	36.3 b	0.25	17.5 c	0.291667	37.5 b	0.3
GAUCHO 480 FS	31.25	20.0 b	8 ab	47.5 b	5 ab	35.0 bc	5 ab	47.5 ab	0.2
GAUCHO 480 FS	62.5	32.5 b	6 ab	56.3 b	5 ab	37.5 bc	5 ab	57.5 ab	0.2
GAUCHO 480 FS	125	37.5 b	5 ab	58.8 b	5 ab	55.0 b	5 ab	62.5 ab	0.2
GAUCHO 600 FS	31.25	30.0 b	7 ab	52.5 b	5 ab	37.5 bc	6 ab	57.5 ab	0.2
GAUCHO 600 FS	62.5	27.5 b	7 ab	63.8 b	4 ab	57.5 b	5 ab	52.5 ab	0.2
GAUCHO 600 FS	125	32.5 b	7 ab	61.3 b	5 ab	50.0 bc	5 ab	72.5 a	0.2
CRUISER 5 FS	30	50.0 ab	5 ab	65.0 b	5 ab	65.0 b	4 b	70.0 a	0.2
CRUISER 5 FS	50	67.5 a	4 b	100.0 a	3 b	90.0 a	4 b	75.0 a	0.2
CV		46.62	28	27.1	18.2	33.3	24	22.9	20

* 100 = furthest developed plants in the trial and 0 = plants dead in trial.

** 1 = excellent, 2 = very good, 3 = good, 4 = normal, 5 = marginally acceptable, 6 = marginally unacceptable, 7 = poor, 8 = very poor, and 9 = little or no growth.

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

Table 3. Plant stand and seedcorn maggot damage assessments in small seed soybeans at Ridgetown, Ontario on 6 June, 2006.

Treatment	Rate	Plant Stand	Seedcorn Maggot Damage*				
	g ai/100 kg	plants per m^2	0	1	2	3	4
			V2				
UNTREATED CHECK		11.8 a	0.0 a	1.0 b**	1.6 a	4.6 a	3.8 a
GAUCHO 480 FS	31.25	13	0.0 a	2.3 b	1.0 a	7.2 a	6.0 a
GAUCHO 480 FS	62.5	14	0.3 a	3.6 b	0.3 a	6.9 a	6.5 a
GAUCHO 480 FS	125	15	0.7 a	1.3 b	0.3 a	7.9 a	7.8 a
GAUCHO 600 FS	31.25	16	0.0 a	3.6 b	0.7 a	10.2 a	5.3 a
GAUCHO 600 FS	62.5	13	0.0 a	2.3 b	2.3 a	10.2 a	2.8 a
GAUCHO 600 FS	125	20	0.0 a	4.3 b	1.3 a	7.2 a	10.5 a
CRUISER 5 FS	30	17	1.3 a	6.3 ab	0.0 a	8.9 a	4.8 a
CRUISER 5 FS	50	26.3 a	0.7 a	9.5 a	0.3 a	9.9 a	5.3 a
CV		43.2	234.1	69.6	163.1	60.9	76.1

* 0 = no damage, 1 = some damage on cotelydons, 2 = bald head, no true leaves, 3 = seed emerged but feeding evident, and 4 = damaged and rotted seed

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

Table 4. Plant stand, fresh weight and yield assessments in small seed soybeans at Ridgetown, Ontario, 2006.

Treatment	Rate	Plant Stand	Total Fresh Wt	Mean Fresh Wt	Yield
	g ai/100 kg	per m^2	kg per m^2		T per ha
			17 Aug		22 Oct
UNTREATED CHECK		3.5	0.3 a	0.16 a	0.17 a
GAUCHO 480 FS	31.25	0.8 b	0.08 a	0.07 a	0.27 a
GAUCHO 480 FS	62.5	1.3 b	0.14 a	0.1 a	0.22 a
GAUCHO 480 FS	125	1.5 b	0.24 a	0.16 a	0.31 a
GAUCHO 600 FS	31.25	2.0 b	0.27 a	0.13 a	0.42 a
GAUCHO 600 FS	60.5	1.2 b	0.28 a	0.14 a	0.36 a
GAUCHO 600 FS	125	2.2 b	0.53 a	0.25 a	0.57 a
CRUISER 5 FS	30	3.0 ab	0.64 a	0.2 a	0.75 a
CRUISER 5 FS	50	4.2 a	0.6 a	0.13 a	1.1 a
CV		54.6	100	62.3	95.6

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

Table 5. Emergence and plant stand assessments in large seed soybeans at Ridgetown, Ontario, 2006.

Treatment	Rate	Emergence	Plant Stand per m^2		
	g ai/100 kg	26 May	5 June	21 June	28 June
		VE	V1	V3	V5
UNTREATED CHECK		0.7 c*	1.1 b	0.7 b	0.7 b
GAUCHO 480 FS	31.25	1.3 bc	2.0 b	1.6 ab	1.8 b
GAUCHO 480 FS	62.5	1.1 bc	1.9 b	1.8 ab	2.0 b
GAUCHO 480 FS	125	2.3 bc	2.8 b	2.9 ab	2.8 ab
GAUCHO 600 FS	31.25	0.7 c	1.2 b	1.4 ab	1.5 b
GAUCHO 600 FS	62.5	1.4 bc	2.1 b	1.5 ab	1.5 b
GAUCHO 600 FS	125	1.4 bc	2.0 b	2.1 ab	2.3 ab
CRUISER 5 FS	30	2.3 b	2.8 b	3.0 ab	3.2 ab
CRUISER 5 FS	50	5.0 a	5.6 a	4.4 a	4.9 a
CV		37.1	36.3	59.3	59

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

Table 6. Vigour assessments in large seed soybean plots at Ridgetown, Ontario, 2006.

Treatment	Rate	Vigour							
	g ai/100 kg	0-100%*	1-9**	0-100%	1-9	0-100%	1-9	0-100%	1-9
		26 May		5 June		21 June		28 June	
		VE		V1		V3		V5	
UNTREATED CHECK		17.5 cd***	6	33.8 b	5	12.5 c	6	35.0 b	0.2917
GAUCHO 480 FS	31.25	32.5 bcd	5	47.5 b	5	27.5 bc	5	62.5 ab	4 ab
GAUCHO 480 FS	62.5	22.5 bcd	5	52.5 b	5	27.5 bc	6	52.5 ab	3 b
GAUCHO 480 FS	125	50.0 b	5	62.5 b	5	42.5 bc	5	70.0 ab	4 ab
GAUCHO 600 FS	31.25	15.0 d	6	47.5 b	5	17.5 bc	5	62.5 ab	4 ab
GAUCHO 600 FS	62.5	32.5 bcd	5	50.0 b	5	27.5 bc	5	67.5 ab	4 ab
GAUCHO 600 FS	125	25.0 bcd	7	58.8 b	5	30.0 bc	5	67.5 ab	4 ab
CRUISER 5 FS	30	45.0 bc	5	60.0 b	5	50.0 b	5	82.5 a	4 ab
CRUISER 5 FS	50	77.5 a	4	100.0 a	4	80.0 a	4	87.5 a	4 ab
CV		46.62	23.9	24.6	15.3	44.1	20.1	27.9	29

* 100 = furthest developed plants in the trial and 0 = plants dead in trial.

** 1 = excellent, 2 = very good, 3 = good, 4 = normal, 5 = marginally acceptable, 6 = marginally unacceptable, 7 = poor, 8 = very poor, and 9 = little or no growth.

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

Table 7. Plant stand and seedcorn maggot damage assessments in large seed soybeans at Ridgetown, Ontario on 6 June, 2006.

Treatment	Rate	Plant Stand	Seedcorn Maggot Damage*				
	g ai/100 kg	plants per m^2	0	1	2	3	4
			V2				
UNTREATED CHECK		4.6 a	0.0 a	1.0 b**	0.7 a	0.7 a	2.3 a
GAUCHO 480 FS	31.25	13	0.3 a	3.0 b	1.0 a	4.3 a	5.3 a
GAUCHO 480 FS	62.5	14	0.0 a	2.3 b	1.0 a	6.3 a	6.9 a
GAUCHO 480 FS	125	15	0.7 a	4.3 b	0.3 a	4.6 a	6.9 a
GAUCHO 600 FS	31.25	16	0.0 a	1.3 b	0.3 a	5.3 a	9.2 a
GAUCHO 600 FS	62.5	13	0.7 a	3.0 b	1.6 a	1.3 a	13.2 a
GAUCHO 600 FS	125	20	0.0 a	3.6 b	2.0 a	1.0 a	12.5 a
CRUISER 5 FS	30	17	0.3 a	3.6 b	1.0 a	4.9 a	11.2 a
CRUISER 5 FS	50	25.7 a	0.7 a	11.5 a	1.3 a	4 .6 a	7.6 a
CV		51.4	230.2	54.2	166.6	123.5	71

* 0 = no damage, 1 = some damage on cotelydons, 2 = bald head, no true leaves, 3 = seed emerged but feeding evident, and 4 = damaged and rotted seed

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

Table 8. Plant stand, fresh weight and yield assessments in large seed soybeans at Ridgetown, Ontario, 2006.

Treatment	Rate	Plant Stand	Total Fresh Wt	Mean Fresh Wt	Yield
	g ai/100 kg	plants per m^2	kg per m^2		T per ha
			17 Aug		22 Oct
UNTREATED CHECK		3.5	0.21 bc	0.01 b	0.17 b
GAUCHO 480 FS	31.25	1.4 b	0.24 bc	0.01 b	0.23 b
GAUCHO 480 FS	62.5	1.1 b	0.26 bc	0.01 ab	0.44 b
GAUCHO 480 FS	125	2.4 b	0.38 bc	0.02 ab	0.65 b
GAUCHO 600 FS	31.25	0.6 b	0.09 c	0.02 ab	0.21 b
GAUCHO 600 FS	60.5	1.9 b	0.25 bc	0.03 ab	0.27 b
GAUCHO 600 FS	125	1.4 b	0.20 bc	0.03 ab	0.39 b
CRUISER 5 FS	30	2.9 b	0.69 b	0.03 ab	0.95 ab
CRUISER 5 FS	50	6.0 a	1.1 a	0.04 a	1.4 a
CV		58.5	64.3	62.6	65

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

2006 PMR REPORT #034

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

CROP: Soybean, (*Glycine max* (L.) Merrill), cv 2702R Dekalb Monsanto
PEST: Seedcorn maggot, *Delia platura* (Meigen)

NAME AND AGENCY:
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TITLE: CONTROL OF SEED CORN MAGGOT IN SOYBEANS WITH SEED TREATMENTS

MATERIALS: GAUCHO 480 FS (imidacloprid, 480 g ai/L); GAUCHO 600 FS (imidacloprid, 600 g ai/L); CRUISER 5 FS (thiamethoxam, 5 g ai/L).

METHODS: Seed was treated by Bayer Cropscience after pretreatment with the fungicide Apron Maxx RTA (fludioxonil + metalaxyl-M, 7.69 + 11.54 g ai/L) at a rate of 6.25 g ai/100 kg seed. Seed weight was 162.6 g/1000 seed. Cattle manure was broadcast on the plots 2 weeks before planting and the soil was disked shortly after the manure application. The crop was planted on 10 May, 2006 at Ridgetown and Highgate, ON, using a 2-row cone seeder at a seeding rate of 20 seeds/m. 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 and vigour were evaluated on 26 May at VE stage. Plant stand was evaluated on 5 (V1), 20 (V3), and 28 (V5) June at Ridgetown and on 1 (V1), 22 (V3), and 29 (V5) June at Highgate. Vigour was assessed on the same dates using a scale of 0-100% (100 = furthest developed plants in the trial and 0 = plants dead in plot) and using a Bayer CropScience 1-9 rating scale (1 = excellent, 2 = very good, 3 = good, 4 = normal, 5 = marginally acceptable, 6 = marginally unacceptable, 7 = poor, 8 = very poor, and 9 = little or no growth). Plant stand and seedcorn maggot damage were assessed on 6 June at V1 stage, using a rating scale of 0-4 (0 = no damage, 1 = some damage on cotyledons, 2 = bald head, no true leaves, 3 = seed emerged but feeding evident, and 4 = damaged and rotted seed) by exhuming all plants and seed remains from a 1 m length of row. The fresh weight of plants within 2 m was assessed on 17 August at Highgate and from two replications only at Ridgetown due to poor plant survival. Plots at Ridgetown were harvested on 10 Oct and yields were corrected to 14.5% moisture. Plots at Highgate were not harvested as no differences were observed in fresh weight assessments. Data were analysed using analysis of variance and means were separated using Fisher's protected least significant difference test (LSD) at $P \leq 0.05$.

RESULTS: No differences were measured in emergence among treatments at Ridgetown, although later assessments of plant stand, vigour, and yield found both rates of Cruiser to be most effective, followed by the high rate of Gaucho 480 FS (125 g ai/100 kg seed) (Tables 1-4). No differences were observed among Gaucho 480 FS and Gaucho 600 FS in any measured parameter (Tables 1-4). At the Highgate location, no differences were observed among treatments for any parameter measured and very little seed corn maggot damage was observed (Tables 5-8).

CONCLUSIONS: All treatments showed improved plant emergence and stand under high seedcorn maggot pressure at the Ridgetown location, although no significant differences were measured among treatments.

Table 1. Emergence and plant stand assessments in soybean at Ridgetown, Ontario, 2006.

Treatment	Rate g ai/100 kg	Emergence	Plant Stand per m^2		
		26 May VE	5 June V1	20 June V3	28 June V5
UNTREATED CHECK		1.6 a	6.1 b*	6.7 b	7.0 b
GAUCHO 480 FS	31.25	1.8 a	6.8 ab	9.2 ab	8.9 ab
GAUCHO 480 FS	62.5	2.3 a	7.4 ab	9.6 ab	10.0 ab
GAUCHO 480 FS	125	3.3 a	9.4 ab	10.7 ab	12.7 a
GAUCHO 600 FS	31.25	2.4 a	8.8 ab	11.7 ab	11.8 a
GAUCHO 600 FS	62.5	1.7 a	8.4 ab	11.2 ab	11.1 ab
GAUCHO 600 FS	125	2.5 a	8.2 ab	11.5 ab	12.3 a
CRUISER 5 FS	30	3.1 a	9.9 ab	12.8 a	13.7 a
CRUISER 5 FS	50	3.2 a	10.8 a	12.9 a	13.2 a
CV		46	21.3	20.5	19.9

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

Table 2. Vigour assessments in soybean plots at Ridgetown, Ontario, 2006.

Treatment	Rate	Vigour					
	g ai/100 kg	0-100%*	1-9**	0-100%	1-9	0-100%	1-9
		26 May VE		20 June V3		28 June V5	
UNTREATED CHECK		30	5	63	4	67.5	4
GAUCHO 480 FS	31.25	42.5	4	73	4	75	4
GAUCHO 480 FS	62.5	42.5	5	75	4	77.5	4
GAUCHO 480 FS	125	57.5	4	78	4	77.5	4
GAUCHO 600 FS	31.25	55	4	73	4	72.5	4
GAUCHO 600 FS	62.5	47.5	4	75	4	72.5	4
GAUCHO 600 FS	125	52.5	5	78	4	77.5	4
CRUISER 5 FS	30	70	4	80	4	80	4
CRUISER 5 FS	50	62.5	4	85	4	85	4
CV		36.15	7.6	16.5	4.6	13.4	7.7

* 100 = furthest developed plants in the trial and 0 = plants dead in plot.

** 1 = excellent, 2 = very good, 3 = good, 4 = normal, 5 = marginally acceptable, 6 = marginally unacceptable, 7 = poor, 8 = very poor, and 9 = little or no growth.

Table 3. Plant stand and seed corn maggot damage assessments in soybeans at Ridgetown, Ontario, 2006.

Treatment	Rate g ai/100 kg	Plant Stand plants per m^2	Seed corn Maggot Damage* 0	1	2	3	4
				6 June V2			
UNTREATED CHECK		17	0.5	4.1	0.8	3.3	2.1
GAUCHO 480 FS	31.25	19	1.2	2.3	1.5	5.6	1.6
GAUCHO 480 FS	62.5	18	1	3.1	0.8	2.5	4.1
GAUCHO 480 FS	125	13.8	1.6	3.6	1.3	4	3.3
GAUCHO 600 FS	31.25	11.2	2.5	4.1	0.8	3.1	0.7
GAUCHO 600 FS	62.5	20	1	3.8	0.7	5.8	2.1
GAUCHO 600 FS	125	11.2	1.8	3.8	0.8	3.5	1.3
CRUISER 5 FS	30	19	1.8	5.8	0.2	3.6	1
CRUISER 5 FS	50	21	1.8	5.4	1	4.4	0.8
CV		29	76.6	36.8	119.8	54.2	94

* Maggot damage scale: 0= no damage, 1=some damage on cotyledons, 2=bald head, no true leaves, 3=seed emerged but feeding evident, 4=damaged and rotted seed.

Table 4. Plant stand, fresh weight and yield assessments in soybeans at Ridgetown, Ontario, 2006.

Treatment	Rate g ai/100 kg	Plant Stand per m^2	Total Fresh Wt kg per m^2	Mean Fresh Wt	Yield T per ha
			17 Aug R2		10 Oct R8
UNTREATED CHECK		24	2.4	0.15	0.46
GAUCHO 480 FS	31.25	12.8	1.7	0.12	0.36
GAUCHO 480 FS	62.5	15.5	2.5	0.16	0.58
GAUCHO 480 FS	125	15.5	2.1	0.14	0.64
GAUCHO 600 FS	31.25	13.2	2.1	0.16	0.48
GAUCHO 600 FS	62.5	10.9	1.8	0.16	0.42
GAUCHO 600 FS	125	13.8	1.8	0.14	0.52
CRUISER 5 FS	30	17.4	2.3	0.13	0.6
CRUISER 5 FS	50	13.5	1.6	0.12	0.51
CV		30.83	34.1	14.3	31.9

Table 5. Emergence and plant stand assessments in soybean at Highgate, Ontario, 2006.

Treatment	Rate	Emergence	Plant Stand per m^2		
	g ai/100 kg	26 May	1 June	22 June	29 June
		VE	V1	V3	V5
UNTREATED CHECK		13.9	17.5	16.3	15.4
GAUCHO 480 FS	31.25	10.4	12.7	12.4	13.2
GAUCHO 480 FS	62.5	13.6	17.2	16.6	16.4
GAUCHO 480 FS	125	15.1	19.5	18.3	17.6
GAUCHO 600 FS	31.25	7.3	10.1	8.7	8.7
GAUCHO 600 FS	62.5	11.3	14.1	14	12.8
GAUCHO 600 FS	125	9.3	12.6	11.8	11.4
CRUISER 5 FS	30	10.8	14.8	13.7	14.2
CRUISER 5 FS	50	11.8	14.2	15.9	15
CV		39	32.9	40	39.1

Table 6. Vigour assessments in soybean plots at Highgate, Ontario, 2006.

Treatment	Rate	Vigour							
	g ai/100 kg	0-100%*	1-9**	0-100%	39090	0-100%	1-9	0-100%	1-9
		26 May		1 June		22 June		29 June	
		VE		V1		V3		V5	
UNTREATED CHECK		30	4	80	3.8	80	3.8	75	4
GAUCHO 480 FS	31.25	60	4.3	72.5	4.3	62.5	30	72.5	3.8
GAUCHO 480 FS	62.5	80	4	85	3.8	70	4.3	75	4
GAUCHO 480 FS	125	77.5	3.8	85	3.5	75	4	80	4
GAUCHO 600 FS	31.25	55	4.8	60	4.5	52.5	4.5	60	4.3
GAUCHO 600 FS	62.5	65	4.3	72.5	4	65	4.3	75	4
GAUCHO 600 FS	125	52.5	4.3	62.5	4.3	62.5	4.3	70	4
CRUISER 5 FS	30	70	4.3	75	4	65	4.3	75	4
CRUISER 5 FS	50	62.5	4.3	80	4	70	4	75	4
CV		36.15	15.1	23.5	14.7	32.8	15.2	19	5.8

* 100 = furthest developed plants in the trial and 0 = plants dead in plot.

** 1 = excellent, 2 = very good, 3 = good, 4 = normal, 5 = marginally acceptable, 6 = marginally unacceptable, 7 = poor, 8 = very poor, and 9 = little or no growth.

Table 7. Plant stand and seedcorn maggot damage assessments in soybeans at Highgate, Ontario, 2006.

Treatment	Rate	Plant Stand	Seed corn Maggot Damage*				
	g ai/100 kg	plants per m^2	0	1	2	3	4
				6 June			
				V2			
UNTREATED CHECK		17	4.3	5.6	0.8	0.5	2.3
GAUCHO 480 FS	31.25	19	3.6	5.3	0.8	0.7	3
GAUCHO 480 FS	62.5	18	4	5.6	0.3	0.5	2.3
GAUCHO 480 FS	125	12.7	4.6	4.9	0.7	1	1.5
GAUCHO 600 FS	31.25	12	1.5	4.4	0.8	2.3	3
GAUCHO 600 FS	62.5	20	4.4	4.3	0.8	0	1.3
GAUCHO 600 FS	125	11.7	1.8	5.1	0.5	1	3.3
CRUISER 5 FS	30	19	4.3	3.3	0.3	0.3	2.6
CRUISER 5 FS	50	21	4.9	3.8	0.2	0	2.5
CV		29	78.9	42	103.4	136.2	81.9

* Maggot damage scale: 0=no damage, 1=some damage on cotyledons, 2=bald head, no true leaves, 3=seed emerged but feeding evident, 4=damaged and rotting seed.

Table 8. Plant stand and fresh weight assessments in soybeans at Highgate, Ontario, 2006.

Treatment	Rate	Plant Stand	Total Fresh Wt	Mean Fresh Wt
	g ai/100 kg	plants per m^2	kg per m^2	
			17 Aug	
			R2	
UNTREATED CHECK		24	1.2	0.05
GAUCHO 480 FS	31.25	19.7	1	0.05
GAUCHO 480 FS	62.5	22.7	1.1	0.05
GAUCHO 480 FS	125	25.8	1.3	0.05
GAUCHO 600 FS	31.25	16.1	0.7	0.04
GAUCHO 600 FS	62.5	20.4	1.1	0.05
GAUCHO 600 FS	125	16.8	0.6	0.04
CRUISER 5 FS	30	23.4	0.9	0.04
CRUISER 5 FS	50	18.4	0.8	0.04
CV		30.83	48.6	26.1

2006 PMR REPORT #035

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

CROP: Soybean, (*Glycine max* (L.) Merrill), cvs. Envoy (white) and Red Kanner (kidney)
PEST: Seedcorn maggot, *Delia platura* (Meigen)

NAME AND AGENCY:
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TITLE: CONTROL OF SEEDCORN MAGGOT IN EDIBLE BEANS WITH SEED TREATMENTS

MATERIALS: APRON MAXX RTA 19.05 FS (fludioxonil + metalaxyl-M, 7.69 + 11.54 g ai/L); GAUCHO 480 FS (imidacloprid, 480 g ai/L); CRUISER 5 FS (thiamethoxam, 5 g ai/L); DCT (diazinon + captan + thiophanate methyl, 18% + 6% + 14% v/v).

METHODS: All seed was treated by Bayer CropScience after pre-treatment with the fungicide Apron Maxx RTA at a rate of 6.25 g ai/100 kg seed. White and kidney bean seed weights were 203.68 and 480.24 g/1000 seed, respectively. Cattle manure was broadcast on the plots 2 weeks before planting and the soil was disked shortly after manure application. The crop was planted on 4 May, 2006 at a seeding rate of 20 seeds/m at Ridgetown, ON using a 2-row cone seeder. Plots were 2 rows, spaced 0.76 m apart and 4 m in length placed in a RCBD with 4 replications. The plots were fertilized and maintained according to provincial recommendations. Total plot emergence and vigour were evaluated on 25 May. Plant stand was evaluated on 30 May and 20, 28 June. Vigour was assessed on the same dates using a scale of 0-100% (100 = furthest developed plants in the trial and 0 = plants dead in plot) and with an alternate Bayer CropScience scale of 1-9 (1 = excellent, 2 = very good, 3 = good, 4 = normal, 5 = marginally acceptable, 6 = marginally unacceptable, 7 = poor, 8 = very poor, and 9 = little or no growth). Plant stand and seed corn maggot damage were assessed on 6 June using a rating scale of 0-4 (0 = no damage, 1 = some damage on cotyledons 2 = bald head, no true leaves, 3 = seed emerged but feeding evident, and 4 = damaged and rotted seed) by exhuming all plants and seed remains from a 1 m length of row. Bean leaf beetle feeding was also rated on 6 June by calculating the average percent defoliation on these plants. Plots were harvested on 13 Sept and yields were corrected to 14.5% moisture. Data were analysed using analysis of variance and means were separated using Fisher's protected least significant differences test (LSD) at $P \leq 0.05$.

RESULTS: DCT was more effective in protecting edible beans from seedcorn maggot damage before emergence than other treatments (Tables 1 and 4). Exposed to high populations of seedcorn maggot, there were no differences among entries treated with DCT, DCT + Gaucho, and Cruiser in plant stand, vigour, and yield (Tables 1-6). Gaucho alone was not effective for seedcorn maggot control at either the low or high rate (Tables 1-6). In white beans, GAUCHO was most effective in reducing bean leaf beetle feeding (Table 3) that was observed in all edible bean trials, although damage was not measured in kidney beans.

CONCLUSIONS: In combination with DCT, Gaucho is slightly more effective for control of seedcorn maggot damage. Protection against seedcorn maggot was not achieved with either the low or high rate of Gaucho alone.

Table 1. Emergence and plant stand assessments in white beans at Ridgetown, Ontario, 2006.

Treatment	Rate g ai/100 kg	Emergence	Plant Stand per m^2		
		25 May	30 May	20 June	28 June
		VE	V1	V3	V5
UNTREATED CHECK		0.7 c*	1.6 b	0.4 b	0.2 a
GAUCHO 480 FS	62.5	1.7 bc	1.4 b	0.3 b	0.3 a
GAUCHO 480 FS	125	1.4 bc	1.1 b	1.6 b	1.7 a
DCT	198	9.8 a	6.0 a	8.1 a	7.2 a
GAUCHO 480 FS	62.5				
+DCT	198	7.5 ab	6.4 a	6.7 a	6.4 a
CRUISER 5 FS	30	6.2 abc	4.9 a	5.7 a	6.9 a
CV		66.3	41.5	68.6	81.6

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

Table 2. Vigour assessments in white bean plots at Ridgetown, Ontario, 2006.

Treatment	Rate	Vigour							
	g ai/100 kg	0-100%*	1-9**	0-100 %	1-9	0-100%	1-9	0-100%	1-9
		25 May		30 May		20 June		28 June	
		VE		V1		V3		V5	
UNTREATED CHECK		10.0 c***	9 a	40.0 bc	9	10.0 b	6	10.0 c	4
GAUCHO 480 FS	62.5	20.0 bc	8 ab	27.5 c	8	7.5 b	4	12.5 bc	1
GAUCHO 480 FS	125	22.5 bc	8 ab	30.0 c	8	35.0 ab	7	42.5 b	4
DCT	198	82.5 a	4 c	65.0 ab	6	67.5 a	5	75.0 a	4
GAUCHO 480 FS	62.5	80.0 a	5 c	80.0 a	6	67.5 a	5	92.5 a	3
+DCT	198								
CRUISER 5 FS	30	47.5 b	6 bc	67.5 a	5	65.0 a	5	80.0 a	4
CV		44.48	28.8	33.9	30.5	55.8	56.6	41.3	80.1

* 100 = furthest developed plants in the trial and 0 = plants dead in plot.

** 1 = excellent, 2 = very good, 3 = good, 4 = normal, 5 = marginally acceptable, 6 = marginally unacceptable, 7 = poor, 8 = very poor, and 9 = little or no growth.

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

Table 3. Seed corn maggot and bean leaf beetle damage assessments and yield of white beans at Ridgetown, Ontario, 2006.

Treatment	Rate g ai/100 kg	Plant Stand plants per m^2	Seed Corn Maggot Damage* 0	1	2	3	4	Bean Leaf Beetle Damage % per m row	Yield T per ha
					6 June V2				13 Sept R8
UNTREATED CHECK		1 c**	0 b	0 b	0	0 b	0	40 b	0 b
GAUCHO 480 FS	62.5	1 c	0 b	0 b	0	0 b	0	4 c	0.1 b
GAUCHO 480 FS	125	1 c	0 b	0 b	0	0 b	0	1 c	0.5 b
DCT	198	0.083333333	6 a	8 a	0	1 b	0	74 a	1.5 a
GAUCHO 480 FS +DCT	62.5	0.083333333	5 a	4 b	0	5 a	0	11 c	1.8 a
CRUISER 5 FS	30	10 b	2 ab	5 b	0	3 ab	0	13 bc	1.7 a
CV		31.7	96.28	46	276.5	106.3	357.8	79.8	54.8

* 0 = no damage, 1 = some damage on cotelydons, 2 = bald head, no true leaves, 3 = seed emerged but feeding evident, and 4 = damaged and rotted seed.

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

Table 4. Emergence and plant stand assessments in kidney beans at Ridgetown, Ontario, 2006.

Treatment	Rate g ai/100 kg	Emergence	Plant Stand per m^2		
		25 May VE	30 May V1	20 June V3	28 June V5
UNTREATED CHECK		0.9 b*	1.2 c	0.6 b	0.6 a
GAUCHO 480 FS	62.5	1.0 b	1.4 c	1.4 b	2.1 a
GAUCHO 480 FS	125	0.8 b	2.2 c	1.0 b	2.6 a
DCT	198	4.3 a	11.3 a	6.0 a	4.9 a
GAUCHO 480 FS +DCT	62.5 198	3.0 a	7.8 ab	5.8 a	4.9 a
CRUISER 5 FS	30	2.7 ab	6.0 bc	4.1 ab	4.5 a
CV		45.4	49.8	63.3	60.7

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

Table 5. Vigour assessments in kidney bean plots at Ridgetown, Ontario, 2006.

Treatment	Rate	Vigour							
	g ai/100 kg	0-100%*	1-9**	0-100%	1-9	0-100%	1-9	0-100%	1-9
		25 May		30 May		20 June		28 June	
		VE		V1		V3		V5	
UNTREATED CHECK		17.5 bc ***	9 a	47.5 bc	5	5.0 b	3	32.5 b	2
GAUCHO 480 FS	62.5	13.8 bc	8 a	35.0 c	5	25.0 b	5	57.5 ab	5
GAUCHO 480 FS	125	10.0 c	7 a	45.0 bc	5	17.5 b	5	80.0 a	4
DCT	198	40.0 a	3 b	62.5 ab	5	80.0 a	4	80.0 a	4
GAUCHO 480 FS	62.5	27.5 ab	4 b	82.5 a	4	87.5 a	4	90.0 a	4
+DCT	198								
CRUISER 5 FS	30	32.5 a	4 b	72.5 a	4	65.0 a	4	77.5 a	4
CV		38.9	24.0	24.1	9.1	42.9	29.7	32.9	34.6

* 100 = furthest developed plants in the trial and 0 = plants dead in plot.

** 1 = excellent, 2 = very good, 3 = good, 4 = normal, 5 = marginally acceptable, 6 = marginally unacceptable, 7 = poor, 8 = very poor, and 9 = little or no growth.

*** Means followed by the same letter do not significantly differ ($P \geq 0.05$, LSD)

Table 6. Seed corn maggot damage and yield assessments in kidney beans at Ridgetown, Ontario, 2006.

Treatment	Rate	Plant Stand	Seed Corn Maggot Damage*					Yield
	g ai/100 kg	plants per m^2	0	1	2	3	4	T per ha
				6 June				13 Sept
				V2				R8
UNTREATED CHECK		4 b**	0	0 b	0.041667	2 b	0.083	0 c
GAUCHO 480FS	62.5	7 b	0	1 ab	0.041667	2 b	0.125	0.1 bc
GAUCHO 480 FS	125	0.125	0	2 ab	0.041667	7 a	0.2083	0.1 bc
DCT	198	0.25	0.166667	4 a	0.1666667	4 b	0.083	0.4 ab
GAUCHO 480 FS	62.5	0.45833333	0.08333	4 ab	0.1666667	2 b	11a	0.9 a
+DCT	198							
CRUISER 5 FS	30	0.20833333	0.125	3 ab	0.125	2 b	0.2917	0.7 a
CV		39	105	77.4	82.7	67.9	76.7	46.5

* 0 = no damage, 1 = some damage on cotelydons, 2 = bald head, no true leaves, 3 = seed emerged but feeding evident, and 4 = damaged and rotted seed.

** Means followed by the same letter do not significantly differ ($P \geq 0.05$, LSD)

2006 PMR REPORT #036

SECTION F: ORNAMENTALS and GREENHOUSE – Insect Pests
ICAR: 33332126

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

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TITLE: EVALUATION OF CHEMICAL AND BIOLOGICAL INSECTICIDES FOR CONTROL OF ROSE MDGE, 2006.

MATERIALS: AVID 1.9% EC (abamectin, 19 g/L); DOKTOR DOOM (0.25% permethrin RTU); DOKTOR DOOM (0.50% permethrin RTU); *Steinernema feltiae* (Filipjev) (Rhabditida: Steinernematidae) predatory nematode (50 million per package); *Hypoaspis* sp. (Acari: Laelapidae) predatory mite (25,000/L); MATADOR 120 EC (lambda-cyhalothrin, 120 g/L).

METHODS: The trial was conducted at a commercial nursery in Langley, British Columbia, Canada on outdoor, container-grown roses cv. 'Orange Blossom Special'. Roses were produced from cuttings rooted in the greenhouse in March and transplanted into a standard sand/bark/peat mix pH 6.0 in one-gallon pots which were placed outdoors on May 31st. Treatments were separated into four replicates in a randomized complete block (RCB) design. Each plot consisted of four pots (surface area 0.16 m^2) for a total area of 0.64 m^2 per treatment. Plants were overhead irrigated, fertilized and pruned once by the grower in late July as per commercial practice. Subdue MAXX (metalaxyl-m) was applied at 0.08 mL/L on Aug. 29 to control downy mildew. To ensure insect pressure within the trial, midge-infested buds picked from neighbouring plants were placed in extra pots spaced between reps I and II and reps III and IV. These were replaced every two weeks starting June 20 and adult midge emergence was monitored weekly with two yellow sticky cards placed among the four replicates. Blooms and infested buds were removed each week before treatments were applied. Treatments were applied on a 14-day interval starting June 6 and ending Sept. 26, with the exception of the DOKTOR DOOM 0.50% soil treatment which was applied monthly on June 6, July 4, August 1 and Aug. 29. AVID, MATADOR and DOKTOR DOOM 0.25% were applied as foliar sprays in a solution volume of 160 mL per 16 one-gallon pots (64 m^2), using a CO_2 backpack sprayer at 40 psi (276 kPa) and a single adjustable nozzle. AVID 1.9% EC (abamectin) (Syngenta Crop Protection) was applied at 0.6 mL product/L after the solution was adjusted with phosphoric acid to pH 5.0. MATADOR 120 EC (pH 7.2-7.4) (Syngenta Crop Protection) was applied at 83 and 104 mL product/L. DOKTOR DOOM 0.25% "ready-to-use" (RTU) concentration (Ultrasol Industries) was applied as a fine mist 30-40 cm above the plants and allowed to settle onto the foliage. DOKTOR DOOM 0.50% RTU was applied to the soil surface in a total application volume of 60 mL per pot in a split application of 30 mL sprayed onto the soil surface and worked in lightly, followed by a second surface spray of 30 mL within one to two hours. One 50 million package of *Steinernema feltiae* predatory nematodes (Becker Underwood) was divided in half (25 million) and mixed in 10 L of water; 250 mL (one cup) per pot was poured onto the soil surface and 20 mL per plant was sprayed onto foliage with a hand-spray bottle. *Hypoaspis* sp. (unidentified species) predatory mites (25,000/L) (Applied Bionomics) were applied to the soil surface at half a teaspoon (15 mL) per pot.

RESULTS: Results are presented in Table 1. Pest pressure was low (thrips) to moderate (rose midge and aphids). From one to six adult midges were caught on yellow sticky traps in the trial area each week (data not shown). Weather was generally hot and dry with only six days of rain (34.2 mm) from June 13 to Sept. 12 and an average daily maximum temperature of 23.6ºC.

CONCLUSIONS: Monthly soil applications of DOKTOR DOOM 0.50% RTU solution reduced rose midge and aphid damage by over 90% compared to the untreated check and suppressed thrips damage by approximately 50%. DOKTOR DOOM 0.25% RTU solution applied as a foliar mist every 14 days was equally effective on aphids and thrips and reduced midge damage by 70%. Both AVID 1.9% EC (solution acidified to pH 5.0) and MATADOR 120 EC at 83 mL/L reduced rose midge damage by 70% and aphids by 55%. AVID suppressed thrips somewhat too, but MATADOR had no effect on thrips. MATADOR 120 EC was phytotoxic to roses when applied as a foliar spray at 104 mL/L, but caused no plant injury at 83 mL/L. Phytotoxicity was zero or negligible (rating less than 1) in all other treatments (data not shown).

Table 1: Cumulative sum of leaf and flower buds produced, mean percent reduction in buds damaged or infested with rose midge compared to the untreated check, and mean cumulative sum of buds or shoots infested with midge, thrips and aphids, 2006.[1]

Treatment	Application Interval (Days)	Application Method and Product Rate	Mean No. Leaf and Flower Buds[2]	Mean No. Midge Infested/ Damaged Buds[2]	Mean % Midge Damage Reduc. wrt UTC[2]	Mean of Buds with Thrips[3]	Mean of Shoots with Aphids[2]
UTC	-	-	454.0 a	10.5 a	0	5.2 a	63.5 b
Avid 1.9% EC (abamectin)	14	Foliar Spray: 10 mL per pot @ 0.6 mL/L	438.2 a	3.2 bc	69.5 bc	2.2 ab	28.5 cd
Doktor Doom (0.25% permethrin)	14	Foliar Mist: 10 mL per pot: RTU	439.2 a	3.2 bc	69.5 bc	1.2 b	3.2 d
Doktor Doom (0.50% permethrin)	28	Soil: 60 mL per pot: 30 mL per split application: RTU	428.5 a	0.75 c	92.9 c	2.0 ab	6.5 d
Steinernema feltiae predatory nematode	14	Foliar 20 mL + Soil Drench 250 mL/pot: 2.5 x 10^6/L	385.8 ab	7.0 ab	33.3 ab	4.2 ab	56.2 bc
Hypoaspis sp. predatory mite	14	½ tsp (15 mL) per pot: 25,000/L	459.2 a	6.0 abc	42.9 ab	2.2 ab	93.8 a
Matador 120 EC (lambda-cyhalothrin)	14	Foliar Spray: 10 mL per pot @ 83 mL/L	405.5 ab	3.0 bc	71.4 bc	4.8 ab	28.5 cd
Matador 120 EC (lambda-cyhalothrin)	14	Foliar Spray: 10 mL per pot @ 104 mL/L	295.5 b	2.2 bc	79.0 bc	2.0 ab	12.0 d

[1] Mean of four plants per replicate; four replicates per treatment; RCB design.

[2] Numbers followed by the same letter are not significantly different in Duncan's Multiple Range Test at $P < 0.05$.

[3] Numbers followed by the same letter are not significantly different in LSD at $P < 0.05$.

2006 PMR REPORT #037

SECTION H: PEST MANAGEMENT METHODS - BIOLOGICAL CONTROL - Insects, Mites, Nematodes

CROP: Apples
PESTS: Obliquebanded leafroller, *Choristoneura rosaceana* (Harris)

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TITLE: IMPACT OF SPINOSAD ON A SOLITARY ENDOPARASITOID OF THE OBLIQUE-BANDED LEAFROLLER

MATERIALS: SUCCESS® 480 SC (spinosad); *Choristoneura rosaceana* (Harris) (Lepidoptera: Tortricidae); *Apophua simplicipes* Cresson (Hymenoptera: Ichneumonidae)

METHODS: Neonate leafroller larvae were placed in 29.6 ml plastic cups containing pinto bean-based meridic diet. Larvae were parasitized as second instars by female *Apophua simplicipes.* Parasitism was confirmed by observing parasitoid eggs through the host's integument. Parasitized and non-parasitized larvae were treated with spinosad insecticide (Dow AgroSciences) as fourth instar larvae, either by topical application with a microsyringe or by feeding them spinosad-treated apple leaf discs. Treatment rates were 25, 50, 100, 500 and 1000 ppm *a.i.* for topical treatments, and 0.05, 0.5, 2.5 and 5.0 ppm *a.i.* for feeding experiments. Larvae were kept individually in plastic solo cups at 20° C under a 16 h L: 8 h D photoperiod and fed untreated apple leaf material until they either emerged successfully as adults, or died from a combination of the insecticide treatment and parasitism. The length of the assessment period lasted approximately 6 weeks.

RESULTS: Both the host and the parasitoid were more susceptible (ca. 59-fold) to spinosad when hosts fed on spinosad-treated leaf material. Fourth instar larvae treated topically had an LD_{50} of 52 ppm *a.i.* (95% C.I. = 36-71); slope (SE) = 0.64 (0.09) whereas a feeding exposure produced an LC_{50} of 0.88 ppm *a.i.* (0.66 – 1.11); slope (SE) = 1.07 (0.12). At all doses, a portion of the parasitoids were able to complete development and emerge successfully to pupate when hosts were treated topically with spinosad although only 7 % of the parasitoids emerged successfully when hosts were topically treated with the top level of 500 ppm. No parasitoids or hosts survived when hosts were exposed to the two top oral exposures. At lower doses, which may be typical of residues encountered by leafroller larvae in the field, parasitoid survival was greater than host survival, and did not differ significantly from controls.

CONCLUSION: Our results suggest that spinosad-based insecticides can be used in combination with the beneficial parasitoid *A. simplicipes* when the parasitized hosts are in their fourth instar without causing excessive parasitoid mortality, provided that other factors such as adult mortality and host immigration are suitable for parasitoid survival.

2006 PMR Report #038 **SECTION H: PEST MANAGEMENT METHODS - BIOLOGICAL CONTROL**

CROP: Potato, *Solanum tuberosum*, cv Russet Burbank
PEST: European corn borer *(ECB), Ostrinia nubilalis* (Hübner)

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TITLE: ***TRICHOGRAMMA* WASPS: A POTENTIAL BIO-CONTROL AGENT OF EUROPEAN CORN BORER IN POTATOES**

MATERIALS: *Trichogramma brassicae* Bezdenko, *Trichogramma pretiosum* Westwood, *Trichogramma minutum* Riley, *(Hymenoptera: Trichogrammitidae); Ephestia kuehniella* Zeller (Lepidoptera: Pyralidae) eggs, European corn borer egg masses

METHODS: In part 1 of this two-part study, twelve 4m x 2m x 2m caged test plots were established in a commercial-sized potato field at AAFC's research farm in Harrington, P.E.I. Each cage contained two rows of 10 plants. Plots were separated from each other by 80m buffer zones. Potato seed pieces were treated at planting with imidacloprid (Admire ©) in-furrow, and the field was sprayed with chlorothalonil (Bravo ©) every 7-10 days throughout the growing season to prevent late blight, however no pesticides were sprayed during the test period. ECB egg masses laid on waxed paper, collected from lab-reared moths, were pinned to every second potato plant in both rows in every plot for a total of 10 egg masses per plot. Each of the three commercially reared *Trichogramma* species was released into four test plots at the rate of ca. 4,000 wasps per plot. After two days, all ECB egg masses were removed and incubated to assess the parasitism rate.
The second part of this study was carried out to try to identify why there was so little egg parasitism in the field cages. Mated females from the above three *Trichogramma* species were offered a choice between ECB eggs and eggs of *Ephestia kuehniella*, the host used by commercial insectaries to rear *Trichogramma* wasps. This test was carried out twice for each species, once with 30 repetitions and once with 20 repetitions using females from the same commercial shipment. Female *Trichogramma* wasps were introduced into individual containers with both an ECB egg mass and an equivalent mass of *E. kuehniella* eggs. The location of the female was recorded every 45 minutes over a period of eight hours. The females were recorded as being either in contact with the ECB egg mass, in contact with the *E. kuehniella* egg mass, or not in contact with any egg mass. The egg masses were then incubated and the parasitism rate for each type of egg mass was recorded.

RESULTS: The results for the *Trichogramma* release in caged potato plots were inconclusive. Only one egg mass in one plot was parasitized by a *T. brassicae* wasp, which was still on the egg mass when it was removed from the cage.
In the lab study, when given a choice between eggs from the rearing host, *E. kuehniella*, and ECB eggs, all three *Trichogramma* species showed an overwhelming preference for *E. kuehniella* eggs (Table 1). *T. brassicae* was observed to be in contact with and parasitized ECB eggs more frequently than the other two *Trichogramma* species, but it still preferred *E. kuehniella* eggs two to one. *T. pretiosum* and *T. minutum* were rarely, if ever, observed to be in contact with ECB eggs and the parasitism rates reflected that. Commercial rearing of *Trichogramma* wasps can potentially affect the ability of the females to accept target eggs as hosts. This is as a

result of a learned response to the rearing host. However, this is more likely to be observed in lower-ranked hosts than in higher-ranked hosts (Bjorksten and Hoffman, 1998). It is not clear from this study if the low parasitism rate of these ECB eggs was a result of a learned response or because the ECB eggs were unsuitable hosts for some reason.

CONCLUSIONS: When given a choice in this study, the overwhelming preference of *T. minutum* and *T. pretiosum* was for *E. kuehniella* eggs over ECB eggs. Parasitism by *T. brassicae* of one-third of the ECB eggs in the lab indicates that this species holds the most potential as a biological control agent for ECB in potatoes, but further study needs to be done on all three species.

REFERENCES:

Bjorksten, T.A., and A.A. Hoffmann. 1998. Persistence experience effects in the parasitoid *Trichogramma* nr. brassicae. Ecological Entomology 23: 110-117.

Table 1: Preference of three species of *Trichogramma* females for eggs of European corn borer (ECB) versus *Ephestia kuehniella* (*Ek*) eggs.

Trichogramma species	Observations of Positions of Females			No. of Parasitized Eggs	
	ECB (%)	*Ek* (%)	Off Egg (%)	ECB (%)	*Ek* (%)
brassicae	69 (12.1)	199 (34.9)	302 (53.0)	97 (34.4)	185 (65.6)
minutum	20 (3.8)	102 (19.2)	410 (77.1)	51 (5.2)	932 (94.8)
pretiosum	6 (1.1)	242 (42.6)	320 (56.3)	0 (0)	1446 (100)

2006 PMR Report #039

SECTION K: FRUIT - Diseases
STUDY DATA BASE: 280-2127-9912

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

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TITLE: **EVALUATION OF A COMBINATION OF SCHOLAR (FLUDIOXONIL) AND PENBOTEC (PYRIMETHANIL) FOR THE CONTROL OF POST-HARVEST BLUE MOLD AND GRAY MOLD ON APPLES CV. EMPIRE, 2005-06.**

MATERIALS: SCHOLAR 50 WG (50% fludioxonil), PENBOTEC 400 SC (37.5% Pyrimethanil).

METHODS: A trial was conducted to determine the effectiveness of a combination of SCHOLAR (fludioxonil) and PENBOTEC (pyrimethanil) against blue mold of apple caused by *Penicillium expansum* and gray mold caused by *Botrytis cinerea.* 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 harvested October 5, 2005 and experiment was initiated on March 17, 2006. 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 and three replicate trays with 12 apples per replicate were prepared for each treatment. Post-inoculation treatment, which was used to simulate the Apre-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 of SCHOLAR was evaluated. 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 ml drop of TBZ-resistant *P. expansum* isolate PS-1R 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 fungicide treatments were: inoculum only; SCHOLAR @ 0.45, 0.60, 1.20 g/L; PENBOTEC @ 0.58 0.87, 1.16 g/L; SCHOLAR @ 0.45 + PENBOTEC @ 0.58, SCHOLAR @ 0.45 + PENBOTEC @ 0.87, SCHOLAR @ 0.45 + PENBOTEC @ 1.16 g/L, SCHOLAR @ 0.60 + PENBOTEC @, 0.58, SCHOLAR @ 0.60 + PENBOTEC @ 0.87, SCHOLAR @ 0.60 + PENBOTEC @ 1.16 g/L; and MERTECT @ 1.15 g/L. The drench application consisted of mixing appropriate amount of SCHOLAR in water and pouring it on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. The fruit were drained on the wire mesh before placing them on the fruit inserts. Untreated check had no fungicides. The treatments were completely randomized. Apples in each of the experiments were evaluated for blue mold and gray mold incidence (percent infected apples) for decay after 30 and 60 days of incubation periods. Untreated check had no fungicides. The treatments were randomized completely. Efficacy of fungicides against TBZ-resistant (TBZ-R) *P. expansum* were evaluated after both incubation periods. 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 LSD comparative tests.

RESULTS: Incidence of blue mold is outlined in Table 1.

CONCLUSIONS: All the concentration of of SCHOLAR and PENBOTEC gave less than 10% disease incidence after 30 days of treatments. The combination of SCHOLAR @ 300 g/L and the three PENBOTEC concentrations gave less than 5.6% of blue mold and gray mold after 60 days of incubation. High disease incidence was observed in MERTECT treatments in which TBZ-resistant inoculum was used. Since both these fungicides, SCHOLAR and PENBOTEC, belong to different classes of fungicides and have different modes of action, these fungicides can be considered for incorporation into fungicide resistance management strategies for the control of storage diseases of apple.

Table 1. Mean percentage incidence of blue mold (*Penicillium expansum*) and gray mold (*Botrytis cinerea*) after post-harvest treatment of a combination of SCHOLAR and PENBOTEC on apple cv. Empire, 2005-06.

Treatment	cold storage at 2 (± 2) ºC [a]			
	% blue mold incidence		% gray mold incidence	
	30 days	60 days	30 days	60 days
Inoculum only	100.0 d[b]	100.0 f	100.0 c	100.0 d
SCHOLAR @ 0.45 g/L	5.7 b	5.7 b	0.0 a	0.0 a
SCHOLAR @ 0.60 g/L	2.8 b	2.8 b	0.0 a	0.0 a
SCHOLAR @ 1.12 g/L	0.0 a	5.7 b	0.0 a	0.0 a
PENBOTEC @ 0.58 g/L	8.8 c	25.0 e	2.8 b	5.6 bc
PENBOTEC @ 0.87 g/L	8.3 c	25.0 e	2.8 b	5.6 bc
PENBOTEC @ 1.16 g/L	8.3 c	19.4 d	2.8 b	5.6 bc
SCHOLAR @ 0.45 g/L + PENBOTEC @ 0.58 g/L	2.8 b	13.8 c	5.7 b	8.3 c
SCHOLAR @ 0.45 g/L + PENBOTEC @ 0.87g/L	2.8 b	2.8 b	0.0 a	2.8 b
SCHOLAR @ 0.45 g/L + PENBOTEC @ 1.17 g/L	0.0 a	2.8 b	0.0 a	0.0 a
SCHOLAR @ 0.60 g/L + PENBOTEC @ 0.58 g/L	2.8 b	5.6 b	2.8 b	2.8 b
SCHOLAR @ 0.60 g/L + PENBOTEC @ 0.87 g/L	2.8 b	5.6 b	2.8 b	2.8 b
SCHOLAR @ 0.60 g/L + PENBOTEC @ 1.16 g/L	0.0 a	2.8 b	0.0 a	0.0 a
MERTECT @ 1.15 g/L	100.0 d	100.0 f	100.0 c	100.0 d

[a] Data represent the mean of 3 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.

2006 PMR Report #040

SECTION K: FRUIT - Diseases
STUDY DATA BASE: 280-2127-9912

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

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TITLE: **EVALUATION OF SCHOLAR (FLUDIOXONIL) AND PENBOTEC (PYRIMETHANIL) FOR THE CONTROL OF POSTHARVEST BLUE MOLD AND GRAY MOLD ON APPLES CV. MCINTOSH, 2005-06.**

MATERIALS: SCHOLAR 50 WG (50% fludioxonil) and PENBOTEC 400 SC (37.5% Pyrimethanil).

METHODS: A trial was conducted to determine the effectiveness of a combination of SCHOLAR (fludioxonil) and PENBOTEC (pyrimethanil) against blue mold of apple caused by *Penicillium expansum* and gray mold caused by *Botrytis cinerea*.The treatments were compared with MERTECT (TBZ) for efficacy against blue mold. Commercially ripe apple cv. McIntosh 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 harvested October 5, 2005 and experiment was initiated on January 15, 2006. 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 and three replicate trays with 12 apples per replicate were prepared for each treatment. Post-inoculation treatment, which was used to simulate the Apre-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 of SCHOLAR was evaluated. 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 ml drop of TBZ-resistant *P. 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 fungicide treatments were: inoculum only; SCHOLAR @ 0.45, 0.60, 1.20 g/L; PENBOTEC @ 0.58, 0.87, 1.16 g/L; SCHOLAR @ 0.45 + PENBOTEC @ 0.58, SCHOLAR @ 0.45 + PENBOTEC @ 0.87, SCHOLAR @ 0.45 + PENBOTEC @ 1.16 g/L, SCHOLAR @ 0.60 + PENBOTEC @ 0.58, SCHOLAR @ 0.60 + PENBOTEC @ 0.87, SCHOLAR @ 0.60 + PENBOTEC @ 1.16 g/L; and MERTECT @ 1.15 g/L. The drench application consisted of mixing appropriate amount of SCHOLAR in water and pouring it on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. The fruit were drained on the wire mesh before placing them on the fruit inserts. Untreated check had no fungicides. The treatments were completely randomized. Apples in each of the experiments were evaluated for blue mold and gray mold incidence (percent infected apples) for decay after 30, 60, and 90 days of incubation periods. Untreated check had no fungicides. The treatments were randomized completely. Efficacy of fungicides against TBZ-resistant (TBZ-R) *P. expansum* were evaluated after both incubation periods. Fruits were considered decayed when a lesion developed on the fruit. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation at 2 (± 2) ºC, the fruits were moved to 20 ºC, 85% RH and incubated for 6 days. The fruits were again evaluated for blue/gray mold incidence (percent infected apples). 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 LSD comparative tests.

RESULTS: Incidence of blue mold is outlined in Table 1 and gray mold is outlines in Table 2.

CONCLUSIONS: All the concentrations of SCHOLAR and PENBOTEC gave less than 10% disease incidence after 60 days of treatments. The combination of SCHOLAR @ 300 g/L and the three PENBOTEC concentrations gave less than 7.4 % of blue mold and gray mold after 90 days of incubation. Higher disease incidence was observed in the shelf-life study foloowing 90 days of incubation. High disease incidence was observed in MERTECT treatments in which TBZ-resistant inoculum was used. Since both these fungicides, SCHOLAR and PENBOTEC, belong to different classes of fungicides and have different modes of action, these fungicides can be considered for incorporation into fungicide resistance management strategies for the control of storage diseases of apple.

Table 1. Mean percentage incidence of blue mold (*Penicillium expansum*) after post harvest treatment of a combination of SCHOLAR and PENBOTEC on apple cv. McIntosh, 2005-06.

Treatment	% blue mold incidence at 2 (± 2) ºC after [a]			
	30 days	60 days	90 days	90 days + shelf-life
Inoculum only	100.0 d[b]	100.0 d	100.0 e	100.0 f
SCHOLAR @ 0.45 g/L	0.0 a	0.0 a	0.0 a	11.1 d
SCHOLAR @ 0.60 g/L	0.0 a	0.0 a	0.0 a	0.0 a
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a
PENBOTEC @ 0.58 g/L	3.7 b	7.4 c	11.1 d	29.6 e
PENBOTEC @ 0.87 g/L	7.4 c	7.4 c	11.1 d	14.8 d
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	3.7 b	3.7 b
SCHOLAR @ 0.45 g/L + PENBOTEC @ 0.58 g/L	0.0 a	0.0 a	0.0 a	11.1 d
SCHOLAR @ 0.45 g/L + PENBOTEC @ 0.87g/L	0.0 a	0.0 a	0.0 a	7.4 c
SCHOLAR @ 0.45 g/L + PENBOTEC @ 1.17 g/L	0.0 a	3.7 b	7.4 c	7.4 c
SCHOLAR @ 0.60 g/L + PENBOTEC @ 0.58 g/L	0.0 a	0.0 a	0.0 a	11.1 d
SCHOLAR @ 0.60 g/L + PENBOTEC @ 0.87 g/L	0.0 a	0.0 a	7.4 c	7.4 c
SCHOLAR @ 0.60 g/L + PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	3.7 b
MERTECT @ 1.15 g/L	100.0 d	100.0 d	100	100.0 d

[a] Data represent the mean of 3 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 a combination of SCHOLAR and PENBOTEC on apple cv. McIntosh, 2005-06.

Treatment	% blue mold incidence at 2 (± 2) ºC after [a]			
	30 days	60 days	90 days	90 days + shelf-life
Inoculum only	100.0 d[b]	100.0 d	100.0 e	100.0 f
SCHOLAR @ 0.45 g/L	0.0 a	0.0 a	0.0 a	0.0 a
SCHOLAR @ 0.60 g/L	0.0 a	0.0 a	7.4 c	7.4 c
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	3.7 b	3.7 b
PENBOTEC @ 0.58 g/L	7.4 c	10.1 c	14.8 d	14.8 e
PENBOTEC @ 0.87 g/L	3.7 b	3.7 b	3.7 b	7.4 c
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	3.7 b
SCHOLAR @ 0.45 g/L + PENBOTEC @ 0.58 g/L	0.0 a	3.7 b	7.4 c	11.1 d
SCHOLAR @ 0.45 g/L + PENBOTEC @ 0.87g/L	0.0 a	0.0 a	3.7 b	3.7 b
SCHOLAR @ 0.45 g/L + PENBOTEC @ 1.17 g/L	0.0 a	3.7 b	3.7 b	7.4 c
SCHOLAR @ 0.60 g/L + PENBOTEC @ 0.58 g/L	0.0 a	0.0 a	0.0 a	11.1 d
SCHOLAR @ 0.60 g/L + PENBOTEC @ 0.87 g/L	0.0 a	0.0 a	7.1 c	11.1 d
SCHOLAR @ 0.60 g/L + PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	0.0 a
MERTECT @ 1.15 g/L	100.0 d	100.0 d	100	100.0 f

[a] Data represent the mean of 3 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.

2006 PMR Report #041

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.23

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

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TITLE: **EFFECT OF SMARTFRESH™ (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF BLUE MOLD WITH POST-HARVEST FUNGICIDES IN 'MCINTOSH' APPLES, 2005-06.**

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

METHODS: A trial was conducted to determine the effect of SMARTFRESH™ (1-methylcyclopropene; 1-MCP) on the control of postharvest blue mold with postharvest fungicides, SCHOLAR 50 WGand PENBOTEC 400 SC, VANGARD 75 WG, BIOSAVE (*Pseudomonas syringae*, ESC10), and MERTECT in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'McIntosh' apple fruits were harvested on 19 September, 2005. There were three main treatments: 1. Fruit were co- treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); 2. Fruit were co-treated and cooled overnight and then 1-MCP treated; 3. Fruit were cooled overnight, 1-MCP treated for 24 hours and then apples were wounded, co-treated with fungicides and inoculum. In each of the main treatments, 5 fungicide subtreatments (SCHOLAR @ 1.12 g/L, PENBOTEC @ 1.16 g/L, Vangard @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. For inoculum, TBZ-resistant *P. expansum*

PS-1R at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 4 replicates with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0°C. 'McIntosh' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit was moved to 20ºC, 85% RH and incubated for 6 days. After the shelf-life study, the fruit was again evaluated for blue mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest blue mold incidence. The test fungicide treatments (SCHOLAR @ 1.12 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L) gave complete control with or without 1-MCP treatments. As Expected MERTECT was not effective against TBZ-resistant isolates of *Penicillium*. In case of BIOSAVE, higher disease incidence was observed in the fruit that co-treated and then treated with 1-MCP, as compared to the treatments that were 1-MCP treated and then co-treated with fungicides and the inoculum for up to 89 days. After this time the incidence reached 100%. The results show that the 1-MCP had neither a positive nor negative effect on the control of postharvest diseases of apples with SCHOLAR @1.12 g/L, PENBOTEC @1.16 G/L, VANGARD @ 0.8 g/L in 'McIntosh' apples for up to 6 months and in the subsequent shelf-life after 6 months of storage in air at 0°C.

Table 1. Effect of 1-MCP on the control of post-harvest blue mold (*Penicillium expansum*) with fungicides in 'McIntosh' apples, 2005-06.

Treatment	% Blue mold incidence in cold storage at 0°C after						
	28 days	61 days	89 days	110 days	138 days	166 days	166 days +shelf-life
Fruit co-inoculated and fungicide treated only but no 1-MCP							
Inoculum only	61.1 e [a]	100.0 e	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	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	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	11.1 b	100.0 e	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
MERTECT @ 1.15 g/L	77.8 f	100.0 e	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
Fruit co-inoculated and fungicide treated and then treated with 1-MCP							
Inoculum only	39.9 c	61.1 b	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	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	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	55.6 d	77.8 c	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
MERTECT @ 1.15 g/L	0.0 a	0.0 a	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
Fruit treated with 1-MCP and then co-inoculated and fungicide treated							
Inoculum only	100.0 g	100.0	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	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	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	0.0 a	94.4 d	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
MERTECT @ 1.15 g/L	100.0 g	100.0 e	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b

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

[b] Data represent the mean of four replicates.

2006 PMR Report #042

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.23

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

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TITLE: **EFFECT OF SMARTFRESH™ (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF GRAY MOLD WITH POST-HARVEST FUNGICIDES IN 'MCINTOSH' APPLES, 2005-06.**

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

METHODS: A trial was conducted to determine the effect of SMARTFRESH™ (1-methylcyclopropene; 1-MCP) on the control of post-harvest gray mold with post-harvest fungicides, SCHOLAR 50 WG (50% fludioxonil) and PENBOTEC 400 SC (37.5% pyrimethanil), VANGARD 75 WG (75% Cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), and MERTECT (45 % thiabendazole)
in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'McIntosh' apple fruits were harvested on 19 September, 2005. There were two main treatments: 1. Fruit were co- treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); and 2. Fruit were treated and cooled overnight and then 1-MCP treated. In each of the main treatments, 5 fungicide treatments (SCHOLAR @ 1.12 g/L, PENBOTEC @ 1.16 g/L, vangard @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. TBZ-resistant *B. cinerea* isolate BC-8D

at a concentration of 1 x 10^4 conidia/ml were used. Each treatment had 4 replications with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0°C. 'McIntosh' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit was moved to 20 ºC, 85% RH and incubated for 6 days. After the shelf-life study, the fruit was again evaluated for gray mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest gray mold incidence. The test fungicide treatments (SCHOLAR @ 1.12 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L) gave complete control with or without 1-MCP treatments. As expected MERTECT was not effective against TBZ-resistant isolates of *Botrytis*. In case of BIOSAVE, higher disease incidence was observed in the fruit that co-treated and then treated with 1-MCP, as compared to the no 1-MCP treated apples for up to 28 days. After this time the incidence reached 100%. The results suggests that the 1-MCP had neither a positive nor negative effect on the control of postharvest gray mold of apples with SCHOLAR @ 1.12 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L in 'McIntosh' apples for up to 6 months and in the subsequent shelf-life after 6 months of storage in air at 0°C

Table 1. Effect of 1-MCP on the control of post-harvest gray mold (*Botrytis cinerea*) with fungicides in 'McIntosh' apples, 2005-06.

Treatment	% Gray mold incidence in cold storage at 0°C after						
	28 days	61 days	89 days	110 days	138 days	166 days	166 days +shelf-life
Fruit co-inoculated and fungicide treated only but no 1-MCP							
Inoculum only	94.4 c [ab]	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	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	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	44.4 b	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
MERTECT @ 1.15 g/L	100.0 d	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
Fruit co-inoculated and fungicide treated and then treated with 1-MCP							
Inoculum only	100.0 d	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	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	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	100.0 d	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
MERTECT @ 1.15 g/L	100.0 d	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b

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

[b] Data represent the mean of four replicates.

2006 PMR Report #043

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.23

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

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TITLE: **EFFECT OF SMARTFRESH™ (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF BLUE MOLD WITH POST-HARVEST FUNGICIDES IN 'EMPIRE' APPLES, 2005-06.**

MATERIALS: SMARTFRESH™ (1-methycyclopropene), SCHOLAR 50 WG (50% fludioxonil) and PENBOTEC 400 SC (37.5% pyrimethanil), VANGARD 75 WG (75% cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45 % thiabendazole).

METHODS: A trial was conducted to determine the effect of SMARTFRESH™ (1-methylcyclopropene; 1-MCP) on the control of post-harvest blue mold with post-harvest fungicides, SCHOLAR 50 WG (50% fludioxonil) and PENBOTEC 400 SC (37.5% pyrimethanil), VANGARD 75 WG (75% cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), and MERTECT (45 % thiabendazole)
in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Empire' apple fruits were harvested on 26 September, 2005. There were three main treatments: 1. Fruit were co- treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); 2. Fruit were co-treated and cooled overnight and then 1-MCP treated; 3. Fruit were cooled overnight, 1-MCP treated for 24 hours and then apples were wounded, co-treated with fungicides and inoculum. In each of the main treatments, 5 fungicide sub-treatments (SCHOLAR @ 1.12 g/L, PENBOTEC @ 1.16 g/L, Vangard @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within

4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. For inoculum, TBZ-resistant *P. expansum* PS-1R at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 4 replications with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0 °C. 'Empire' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit was moved to 20ºC, 85% RH and incubated for 6 days. After the shelf-life study, the fruit was again evaluated for blue mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest blue mold incidence. The test fungicide treatments (SCHOLAR @ 1.12 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L) gave complete control with or without 1-MCP treatments. As Expected MERTECT was not effective against TBZ-resistant isolates of *Penicillium*. In two treatments a slight disease increase was observed in the subsequent shelf-life study. In case of BIOSAVE, higher disease incidence was observed in the fruit that were co-treated and then treated with 1-MCP, as compared to the treatments that were 1-MCP treated and then co-treated with fungicides and the inoculum for up to 168 days. The results show that the 1-MCP had neither a positive nor negative effect on the control of post-harvest diseases of apples with SCHOLAR @ 1.12 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L in 'Empire' apples for up to 6 months.

Table 1. Effect of 1-MCP on the control of post-harvest blue mold (*Penicillium expansum*) with fungicides in 'Empire' apples, 2005-06.

Treatment	% Blue mold incidence in cold storage at 0°C after						
	28 days	56 days	84 days	112 days	140 days	186 days	166 days + shelf-life
Fruit co-inoculated and fungicide treated only but no 1-MCP							
Inoculum only	61.1 c [ab]	100.0 e	100.0 e	100.0 e	100.0 e	100.0 d	100.0 c
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	5.6 b	11.1 b
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	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	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	0.0 a	11.1 b	88.9 d	94.4 d	94.4 d	100.0 d	100.0 d
MERTECT @ 1.15 g/L	83.3 d	100.0 e	100.0 b	100.0 b	100.0 e	100.0 d	100.0 d
Fruit co-inoculated and fungicide treated and then treated with 1-MCP							
Inoculum only	66.7 c	94.4 d	94.4 e	100.0 e	100.0 e	100.0 c	100.0 e
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	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	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	0.0 a	50.0 c	72.2 c	83.3 c	83.3 c	88.9 d	94.4 d
MERTECT @ 1.15 g/L	83.3 c	100.0 a	100.0 e	100.0 e	100.0 e	100.0 e	100.0 e
Fruit treated with 1-MCP and then co-inoculated and fungicide treated							
Inoculum only	50.0 b	100.0	100.0 e	100.0 e	100.0 e	100.0 e	100.0 e
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	11.1 a
VANGARD @ 0.8 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	0.0 a	11.1 b	61.1 b	72.2 b	77.8 b	83.3 c	83.3 c
MERTECT @ 1.15 g/L	61.1 c	100.0 e	100.0 e	100.0 e	100.0 e	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.

2006 PMR Report #044

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.23

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

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TITLE: **EFFECT OF SMARTFRESH™ (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF GRAY MOLD WITH POST-HARVEST FUNGICIDES IN 'EMPIRE' APPLES, 2005-06.**

MATERIALS: SMARTFRESH™ (1-methycyclopropene), SCHOLAR 50 WG (50% fludioxonil) and PENBOTEC 400 SC (37.5% pyrimethanil), VANGARD 75 WG (75% cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45 % thiabendazole).

METHODS: A trial was conducted to determine the effect of SMARTFRESH™ (1-methylcyclopropene; 1-MCP) on the control of post-harvest gray mold with post-harvest fungicides, SCHOLAR 50 WG (50% fludioxonil) and PENBOTEC 400 SC (37.5% pyrimethanil), VANGARD 75 WG (75% cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), and MERTECT (45 % thiabendazole)
in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Empire' apple fruits were harvested on 26 September, 2005. There were two main treatments: 1. Fruit were co- treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); and 2. Fruit were treated and cooled overnight and then 1-MCP treated. In each of the main treatments, 5 fungicide treatments (SCHOLAR @ 1.12 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides.

TBZ-resistant *B. cinerea* isolate BC-8D at a concentration of 1 x 10^4 conidia/ml were used. Each treatment had 4 replications with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0 °C. 'Empire' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit was moved to 20 ºC, 85% RH and incubated for 6 days. After the shelf-life study, the fruit was again evaluated for gray mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest gray mold incidence. The test fungicide treatments (SCHOLAR @ 1.12 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L) gave complete control with or without 1-MCP treatments for up to 166 days. As expected, MERTECT was not effective against TBZ-resistant isolates of *Botrytis*. In the case of BIOSAVE, higher disease incidence was observed in the fruit that was co-treated and then treated with 1-MCP, as compared to the no 1-MCP treated apples for up to 61 days. After this time the incidence reached 100%. The results suggests that the 1-MCP had neither a positive nor negative effect on the control of postharvest gray mold of apples with SCHOLAR @ 1.12 g/L, PENBOTEC @ 1.16 g/L, VANGARD @ 0.8 g/L in 'Empire' apples for up to 6 months of storage in air at 0°C.

Table 1. Effect of 1-MCP on the control of post-harvest gray mold (*Botrytis cinerea*) with fungicides in 'Empire' apples, 2005-06.

	% Gray mold incidence in cold storage at 0°C after						
Treatment	33 days	61 days	89 days	110 days	138 days	166 days	166 days + shelf-life
Fruit co-inoculated and fungicide treated only but no 1-MCP							
Inoculum only	27.8 d[ab]	55.6 b	66.7 b	77.8 b	83.3 b	83.3 b	88.9 b
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	5.6 a
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	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	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	11.1 b	72.2 c	100.0 c	100.0 c	100.0 c	100.0 c	100.0 c
MERTECT @ 1.15 g/L	100.0 f	100.0 d	100.0 c	100.0 c	100.0 c	100.0 c	100.0 c
Fruit co-inoculated and fungicide treated and then treated with 1-MCP							
Inoculum only	100.0 f	100.0 d	100.0 c	100.0 c	100.0 c	100.0 c	100.0 c
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	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	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	22.2 c	100.0 d	100.0 c	100.0 c	100.0 c	100.0 c	100.0 c
MERTECT @ 1.15 g/L	100.0 f	100.0 d	100.0 c	100.0 c	100.0 c	100.0 c	100.0 c
Fruit treated with 1-MCP and then co-inoculated and fungicide treated							
Inoculum only	100.0 f	100.0 d	100.0 c	100.0 c	100.0 c	100.0 c	100.0 c
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	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	0.0 a	0.0 a	5.6 a
BIOSAVE @ 1.59 g/L	33.3 e	100.0 d	100.0 c	100.0 c	100.0 c	100.0 c	100.0 c
MERTECT @ 1.15 g/L	100.0 f	100.0 d	100.0 c	100.0 c	100.0 c	100.0 c	100.0 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.

2006 PMR Report #045

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.23

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

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TITLE: **EFFECT OF SMARTFRESH™ (1-METHYLCYCLOPROPENE; 1-MCP) ON THE CONTROL OF BLUE MOLD WITH POST-HARVEST FUNGICIDES IN 'GALA' APPLES, 2005-06.**

MATERIALS: SMARTFRESH™ (1-methycyclopropene), SCHOLAR 50 WG (50% fludioxonil) and PENBOTEC 400 SC (37.5% pyrimethanil), VANGARD 75 WG (75% cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), MERTECT (45 % thiabendazole)

METHODS: A trial was conducted to determine the effect of SMARTFRESH™ (1-methylcyclopropene; 1-MCP) on the control of post-harvest blue mold with post-harvest fungicides, SCHOLAR 50 WG (50% fludioxonil) and PENBOTEC 400 SC (37.5% pyrimethanil), VANGARD 75 WG (75% cyprodinil), BIOSAVE (*Pseudomonas syringae*, ESC10), and MERTECT (45 % thiabendazole)
in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Gala' apple fruits were harvested on 26 September, 2005. There were three main treatments: 1. Fruit were co- treated (co-treatment consists of co-treatment of fungicides along with the pathogen inoculum on the detached fruit); 2. Fruit were co-treated and cooled overnight and then 1-MCP treated; 3. Fruit were cooled overnight, 1-MCP treated for 24 hours and then apples were wounded, co-treated with fungicides and inoculum. In each of the main treatments, 5 fungicide subtreatments (SCHOLAR @ 1.12 g/L, PENBOTEC @ 1.16 g/L, Vangard @ 0.8 g/L, BIOSAVE @ 1.59 g/L, MERTECT @ 1.15 g/L) and a control without fungicide treatment were included. For the main treatments 1 and 2, apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth

of 4 mm. Within 4 hours of harvest, the apples were drop inoculated with the pathogen and the fungicides. For inoculum, TBZ-resistant *P. expansum* PS-1R at a concentration of 1 x 10^4 conidia/ml was used. Each treatment had 4 replications with 6 fruit per replicate. For 1-MCP treatment, 1 µl/ml of 1-MCP was used for 24 h at 0 °C. 'Empire' apples were incubated in cold storage. Apples in the experiment were evaluated for disease incidence at monthly intervals. After cold storage incubation, the fruit was moved to 20ºC, 85% RH and incubated for 6 days. After the shelf-life study, the fruit was again evaluated for blue mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest blue mold incidence. The test fungicide treatments (SCHOLAR @ 1.12 g/L and PENBOTEC @ 1.16 g/L gave complete control with or without 1-MCP treatments, while Vangard shoed diseases incidence at 166 days and in th subsequent shelf-life study. As expected, MERTECT was not effective against TBZ-resistant isolates of *Penicillium*. In case of BIOSAVE, higher disease incidence was observed in the fruit that were co-treated and then treated with 1-MCP, as compared to the treatments that were 1-MCP treated and then co-treated with fungicides and the inoculum for up to 166 days. The results show that the 1-MCP had neither a positive nor negative effect on the control of post-harvest diseases of apples with SCHOLAR @ 1.12 g/L and PENBOTEC @ 1.16 G/L in 'Gala' apples for up to 6 months and in the subsequent shelf-life after 6 months of storage in air at 0 °C.

Table 1. Effect of 1-MCP on the control of post-harvest blue mold (*Penicillium expansum*) with fungicides in 'Gala' apples, 2005-06**.**

Treatment	% Blue mold incidence in cold storage at 0°C after						
	33 days	61 days	89 days	110 days	138 days	166 days	166 days + shelf-life
Fruit co-inoculated and fungicide treated only but no 1-MCP							
Penicillium only	72.2 d	100.0 e	100.0 d	100.0 c	100.0 b	100.0 c	100.0 c
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	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	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	0.0 a	44.4 c	83.3 c	88.9 b	100.0 b	100.0 c	100.0 c
MERTECT @ 1.15 g/L	61.1 c	100.0 e	100.0 d	100.0 c	100.0 b	100.0 c	100.0 c
Fruit co-inoculated and fungicide treated and then treated with 1-MCP							
Penicillium only	100.0 d	100.0 e	100.0 d	100.0 c	100.0 b	100.0 c	100.0 c
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	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	0.0 a	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	22.2 c	83.3 d	100.0 d	100.0 c	100.0 b	100.0 c	100.0 c
MERTECT @ 1.15 g/L	100.0 e	100.0	100.0 d	100.0 c	100.0 b	100.0 c	100.0 c
Fruit treated with 1-MCP and then co-inoculated and fungicide treated							
Penicillium only	16.7 b	100.0 e	100.0 d	100.0 c	100.0 b	100.0 c	100.0 c
SCHOLAR @ 1.12 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	0.0 a	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	0.0 a	38.9 b	38.9 b
BIOSAVE @ 1.59 g/L	0.0 a	11.1 b	61.1 b	100.0	100.0 b	100.0 c	100.0 c
MERTECT @ 1.15 g/L	16.7 b	100.0 e	100.0 d	100.0 c	100.0 b	100.0 c	100.0 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.

2006 PMR REPORT #046

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (Malus domestica Borkh.) cv. Empire
PEST: Blue mold (*Penicillium expansum* Link.), Gray mold (*Botrytis cinerea* Pers.)

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TITLE: EFFECT OF POST-HARVEST APPLICATION OF BioSave® 10 LP AND DPA (DIPHENYLAMINE) ON POSTHARVEST BLUE MOLD AND GRAY MOLD DISEASES IN 'EMPIRE' APPLES, 2005-06.

MATERIALS: BioSave® 10LP (*Pseudomonas syringae*-1x 10^9 CFU/g), DPA (Diphenylamine), MERTECT (45% Thiabendazole).

METHODS: In the 2005 growing season, commercially ripe 'Empire' apples were harvested (September 24) from commercial orchards in Ontario and stored at 0°C. Apples were placed in mesh bags and placed into the creates. On October 5, 2005 apples were inoculated using single spore isolates of *Penicillium expansum*-TBZ-S (thiabendazole sensitive) and TBZ-R (thiabendazole resistant) and *Botrytis cinerea* (TBZ-S and TBZ-R). Each apple was punctured once with a nail-like tapered probe 5 mm deep and 4 mm wide at its base with a 12 mm diameter collar to limit the depth of the wound. Apples were drench inoculated with the pathogens ($1x10^4$ CFU/mL) at the time of DPA, BioSave® 10 LP (JetHarvest Solutions, FL) at rate: 0.79 g/L, 1.59 g/L (company recommendation), 2.38 g/L or BioSave® 10 LP + DPA (1000 µ l^{-1}) applications (co-treatment). Following treatment, apples were placed in plastic crates then stored for 168 days at 1°C. Apples were

evaluated for disease incidence at 4 week intervals until 24 weeks (168 days) and then were placed at 20°C (85% RH) for 6 days and evaluated again. The general linear model (GLM) procedures were used for the analysis of variance (ANOVA); SigmaStat 2.0 for Windows, SPSS Science, Chicago, IL) Percentage data were subjected to square-root transformation before the ANOVA. All pair-wise multiple comparison procedures were determined with the Tukey test.

RESULTS: Results are presented in Tables 1 - 2.

CONCLUSIONS: The evaluation of disease incidence after every 4-weeks in cold storage indicated that apples treated with the three concentrations of BioSave® 10 LP alone or in combination DPA resulted in significantly lower disease incidence of *P. expansum* than the control treatment. Lower blue mold was observed for 8 weeks in storage while, lower gray mold was observed for up to 12 weeks. The half rate of BioSave® 10 LP (0.79 g/L) showed best control in comparison with the full and double rate of this product against blue and gray mold. There was no effect in any application of BioSave® 10 LP on gray mold incidence on apples treated with TBZ sensitive isolates, BioSave® 10 LP showed some control on gray mold on apples inoculated with the TBZ resistant isolate. Apples in the shelf-life study at 20ºC (85 % RH) for 6 days resulted in an increase of blue and gray mold incidence. It could be concluded that treating apples with BioSave® 10 LP provided a significant control of apple decays. In long term storage, BioSave® 10 LP is more efficacious against blue mold than gray mold.

Table 1. Effect of BioSave® 10 LP alone or in combination with DPA (diphenylamine) on the % incidence of blue mold (*Penicillium expansum*) on 'Empire' apples, 2005-2006.

Treatment	Concentration	DPA 1000 ppm/L	% Blue mold incidence in cold storage at 0°C after						
			4 weeks	8 week	12 week	16 weeks	20 weeks	24 weeks	24 weeks + 6 days at 20°C **
Water		No	0.0 a*	0.0 a	0.0 a	2.1 a	6.3 a	12.5 a	27.1 a
Inoculum only		No	83.3 c	100.0 b	100.0 d	100	100.0 d	100.0 c	100.0 c
DPA		Yes	39.6 b	93.8 b	97.9 d	97.9 de	97.9 d	97.9 c	100.0 c
BioSave® LP	0.79 g/L	No	0.0a	0.0a	27.1bc	37.5b	41.7b	73.8ab	43.8a
BioSave® LP	1.59 g/L	No	0.0a	4.2a	25.0bc	35.4b	45.8bc	47.9b	56.3ab
BioSave® LP	2.38 g/L	No	0.0 a	4.2 a	39.6 bc	50.0 bc	52.1 bc	52.1 b	54.2 a
BioSave® LP	0.79 g/L	Yes	0.0 a	2.1 a	54.2 bc	81.3 cd	87.5 cd	91.7 c	91.7 c
BioSave® LP	1.59 g/ L	Yes	0.0 a	18.8 a	56.3 c	77.1 cde	83.3 cd	85.4 c	87.5 bc
BioSave® LP	2.38 g/L	Yes	0.0 a	0.0 a	33.3 bc	62.5 bc	75.0 bcd	85.4 c	89.6 c
MERTECT (Post-harvest treatment)	1.15 g/L	No	83.3 c	97.9 b	97.9 d	97.9 de	97.9 d	97.9 c	97.9 c

* Means within the column followed by the same letter(s) are not significantly different according to the Tukey test at P=0.05.

** After the 24 weeks of (168 days) observation, apples were moved to a growth chamber at 20°C and 85 % RH for 6 days before the final observation was recorded.

Table 2. Effect of BioSave® 10 LP alone or in combination with DPA (diphenylamine) on the % incidence* of gray mold (*Botrytis cinerea*) on 'Empire' apples, 2005-2006

Treatment	Concentration	% Gray mold incidence in cold storage at 0°C after							
		DPA 1000 ppm /L	4 weeks	8 week	12 week	16 weeks	20 weeks	24 weeks	24 weeks + 6 days at 20°C **
Water		No	0.0 a*	0.0 a	2.1 a	2.1 a	2.1 a	2.1 a	8.3 a
Inoculum only		No	95.8 c	100.0 d	100.0 b	100.0 c	100.0 c	100.0 c	100.0 c
DPA		Yes	0.0 a	0.0 a	4.2 a	4.2 ab	6.3 ab	10.4 ab	18.8 ab
BioSave® LP	0.79 g/L	No	0.0 a	4.2 ab	4.2 a	4.2 ab	4.2 a	6.3 ab	8.3 a
BioSave® LP	1.59 g/L	No	8.3 a	12.5 b	18.8 a	25. 0 b	25.0 b	29.2 b	29.2 ab
BioSave® LP	2.38 g/L	No	0.0 a	0.0 a	2.1 a	4.2 ab	6.3 ab	12.5 ab	22.9 ab
BioSave® LP	0.79 g/L	Yes	0.0 a	0.0 a	6.3 a	10.4 ab	12.5 ab	22.9 ab	39.6 b
BioSave® LP	1.59 g/L	Yes	0.0 a	2.1 ab	2.1 a	8.3 ab	10.4 ab	16.7 ab	33.3 b
BioSave® LP	2.38 g/L	Yes	0.0 a	0.0 a	0.0 a	2.1 a	6.3 ab	10.4 ab	25.0 ab
Post-harvest TBZ	1.15 g/L	No	54.2 b	87.5 c	87.5 b	87.5 c	87.5 c	87.5 c	91.7 c

* Means within the column followed by the same letter(s) are not significantly different according to the Tukey test at P=0.05.

** After the 24 week (168 days) observation, apples were moved to a growth chamber at 20°C and 85 % RH for 6 days before the final observation was recorded.

2006 PMR Report #047

SECTION K: FRUIT – Diseases
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. McIntosh
PEST: Blue mold (*Penicillium expansum* Link.), Gray mold (*Botrytis cinerea* Pers.)

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TITLE: EFFECT OF POST-HARVEST APPLICATION OF BioSave® 10 LP AND DPA (DIPHENYLAMINE) ON THE POST-HARVEST BLUE MOLD AND GRAY MOLD DISEASES IN 'MCINTOSH''APPLES, 2005-06

MATERIALS: BioSave® 10 LP (*Pseudomonas syringae*-1 x 10^9 CFU/g), DPA (diphenylamine).

METHODS: Commercially ripe 'McIntosh' apples were harvested on September 26, 2005 from a commercial orchard in Simcoe, Ontario and stored at 1°C. Randomly selected 12 apples were dropped in high density polythene inserts placed in plastic totes and considered as a replication of a treatment. One tote contained 24 apples (2 sets of 12). Each apple was wounded once with a nail-like tapered probe 5 mm deep and 4 mm wide at its base with a 12 mm diameter collar to limit the depth of the wound. On October 3, 2005 wounds were inoculated with $1x10^4$ CFU/ml of thiabendazole resistant isolates of *Penicillium expansum* and *Botrytis cinerea*. There were 10 treatments for each of blue mold and gray mold (Table 1 and 2). Apples were drench inoculated with the pathogen ($1x10^4$ CFU/mL), one level of DPA (1.2g a.i./L) and 3 levels of BioSave® 10 LP (0.79 g/L, 1.59 g/L and 2.38 g/L). Supplier recommended dose of BioSave® 10 LP for citrus

fruits is 1.59 g/L. Following treatments, apples were stored at 1°C. Incidence of diseases were observed at 4 week interval and ended at 24 weeks (168 days) after inoculation. For shelf-life test, the remaining healthy apples were moved to a Conviron (20ºC and 85% RH). After 6 days, the incidence of diseases were evaluated again.

The general linear model (GLM) procedures were used for the analysis of variance (ANOVA) using SigmaStat 2.03 for Windows (SPSS Science, Chicago, Ill). Percentage data were subjected to square-root transformation before the ANOVA were performed. All pair-wise multiple comparison procedures were determined with the Tukey test.

RESULTS: Data are presented in Table 1 (blue mold) and Table 2 (gray mold).

CONCLUSIONS: The data of percentage disease incidence indicated that the application of BioSave® 10 LP alone resulted good control of blue mold for up to 4 weeks (Table 1). The highest rate of application (2.38 g/L) gave the best control. This trend was unique across the six dates of observation and also during the shelf-life test at the end. Lower doses of BioSave® 10 LP consistently increased the incidence of disease. From sixteen weeks after inoculation, the rate of incidence went higher to the unacceptable commercial level. Combining DPA with BioSave® 10 LP in the treatments showed higher rates of incidence of blue mold at all three levels of BioSave® 10 LP and DPA applications. From these data it appears that DPA significantly reduced the efficiency of the biocontrol agent (*Pseudomonas syringae* ESC-10) in BioSave® 10 LP over the pathogenic fungus *Penicillium expansum*.

Post-harvest application of BioSave® 10 LP alone at the rate of 2.38 g/L significantly reduced the incidence of gray mold in 'McIntosh' apples up to 12 weeks of storage compared to control and the other doses of BioSave® (Table 2). DPA gave very good control of gray mold throughout the period of observation. Unlike blue mold, combination of BioSave® and DPA in the treatments showed better control of the disease compared to any level of BioSave® 10 LP alone. As expected, during the shelf-life test after 24 weeks of inoculation, the disease further increased in all the treatments.

Table 1. Effect of BioSave® 10 LP alone or in combination with DPA (diphenylamine) on the % incidence* of blue mold (*Penicillium expansum*) on 'McIntosh' apples, 2005-2006.

			Percentage incidence of blue mold (*Penicillium expansum*- TBZ-S) Days of evaluation						
Treatment	Concentration	DPA 1000 ppm /L	4 weeks	8 weeks	12 weeks	16 weeks	20 weeks	24 weeks	6 days at 20°C **
Water		No	0.0 a*	2.1 a	4.2 a	4.2 a	8.3 a	10.4 a	16.7 a
Inoculum only		No	91.7 c	100	100	100	100.0 d	100.0 c	100
DPA		Yes	100.0 c	100	100	100	100.0 d	100.0 c	100
BioSave® LP	0.79 g/L	No	6.3 a	66.7 d	72.9 cd	79.2 d	83.3 c	85.4 c	87.5 cd
BioSave® LP	1.59 g/L	No	6.3 a	27.1 b	45.8 b	54.2 c	62.5 b	64.6 ab	81.3 bc
BioSave® LP	2.38 g/L	No	0.0 a	6.3 b	14.6 a	25.0 b	50.0 b	66.7 b	72.9 bc
BioSave® LP	0.79 g/L	Yes	47.9 b	93.8 d	100	100	100.0 d	100.0 c	100
BioSave® LP	1.59 g/L	Yes	4.2 a	66.7 cd	93.8 de	93.8 de	97.9 cd	97.9 c	100
BioSave® LP	2.38 g/L	Yes	8.3 a	35.4 bc	70.8 bc	85.4 de	89.6 cd	91.7 c	95.8 de
Post-harvest MERTECT	1.15 g/L	No	79.2 c	100	100	100	100.0 d	100.0 c	100

* Means within the column followed by the same letter(s) are not significantly different according to the Tukey test at $P = 0.05$.

** After the 24 week (168 days) observation, apples were moved to 20ºC chamber (85 % RH) for 6 days before final observation was recorded.

Table 2. Effect of BioSave® 10 LP alone or in combination with DPA (diphenylamine) on the % incidence* of gray mold (*Botrytis cinerea*) on 'McIntosh' apples, 2005-2006.

			Percentage incidence of blue mold (*Penicillium expansum*- TBZ-S) Days of evaluation						
Treatment	Concentration	DPA 1000 ppm/L	4 week	8 week	12 week	16 week	20 week	24 week	6 days at 20°C**
Water		No	0.0 a*	2.1 ab	8.3 a	14.6 ab	18.8 ab	20.8 a	39.6 ab
Inoculum only		No	93.8 d	93.8	97.9 d	97.9 d	100	100.0 c	100.0 d
DPA		Yes	0.0 a	4.2 ab	6.3 a	12.5 ab	14.6 ab	18.8 a	29.2 ab
BioSave® LP	0.79 g/L	No	10.4 c	45.8 d	50.0 c	54.2 c	54.2 d	58.3 b	79.2 c
BioSave® LP	1.59 g/L	No	4.2 b	18.8 c	25.0 b	37.5 bc	50.0 cd	56.3 b	62.5 bc
BioSave® LP	2.38 g/L	No	0.0 a	8.3 bc	10.4 ab	25.0 abc	39.6 bcd	52.1 b	60.4 bc
BioSave® LP	0.79 g/L	Yes	0.0 a	0.0 a	6.3 a	18.8 ab	25.0 abcd	33.3 ab	50.0 abc
BioSave® LP	1.59 g/L	Yes	0.0 a	2.1 ab	6.3 a	12.5 ab	18.8 abcd	29.2 ab	47.9 abc
BioSave® LP	2.38 g/L	Yes	0.0 a	0.0 a	2.1 a	14.6 ab	29.2 abcd	33.3 ab	47.9 abc
post-harvest MERTECT	1.15 g/L	No	100	100	100.0 d	100.0 d	100	100.0 c	100.0 d

* Means within the column followed by the same letter(s) are not significantly different according to the Tukey test at $P = 0.05$.

** After the 24 week (168 days) observation, apples were moved to 20ºC chamber (85 % RH) for 6 days before final observation was recorded.

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SECTION K: FRUIT – Diseases
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Empire
PEST: Blue mold (*Penicillium expansum* Link.), Gray mold (*Botrytis cinerea* Pers.)

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TITLE: EFFECT OF PREHARVEST PYRIMETHANIL (SCALA SC, BAYER CROP SCIENCE LTD) APPLICATION FOR THE CONTROL OF POST-HARVEST GRAY AND BLUE MOLD IN 'EMPIRE' APPLES, 2005-06

MATERIALS: SCALA SC (pyrimethanil 400 g ai/L), MERTECT 45 % flowable (thiabendazole), CALCIUM CHLORIDE (28 % Ca)

METHODS: During the 2005 growing season a field trial was conducted at the Jordan Farm-AAFC, Jordan Station, ON. Apple cultivar 'EMPIRE' was maintained according to standard orchard practices at Jordan Farm, ON. Treatments were an unsprayed control, SCALA (pyrimethanil 800 g ai/ha) applied either 14 days or 7 days pre-harvest, SCALA (pyrimethanil 800 g ai/ha) 14 days pre-harvest plus a Calcium ($CaCl_2$) treatment at 12 kg/ha one week before harvest or SCALA (pyrimethanil 800 g ai/ha) one week preharvest plus a Calcium ($CaCl_2$) treatment at 12 kg/ha, one week before harvest. Treatments were replicated 4 times, two trees per replicate, allocated in a completely randomized block design. The apple trees were sprayed with

hand-operated gun sprayer at a pressure of 1034.25 kPa, 2.8-3 L of water per tree until runoff. Apples were harvested on October 4, 2005. On October 12, 2005, apples were punctured once with a nail-tapered probe 5 mm deep and 4 mm wide at its base placed in mesh bags and placed in plastic crates. Wounded fruits were then inoculated with 20 µl conidial suspension ($1x10^4$ conidia/ml of water) of either thiabendazole sensitive (TBZ – S) *P. expansum*; PS-28AS isolate, thiabendazole resistant (TBZ – R) *P. expansum* isolate PS-2R, thiabendazole sensitive (TBZ – S) *B. cinerea* isolate Bc-2a-S, thiabendazole resistant (TBZ – R) *B. cinerea* isolate Bc-8d-R and placed in cold storage at 1ºC. Twelve fruits were used for each treatment and each treatment has four replicates. After inoculation apples were evaluated for disease incidence once every 4 weeks. After 168 days (24 weeks) fruits were removed from cold storage and were placed in additional storage at 20ºC (85 % RH) for 6 days. The general linear model (GLM) procedures were used for the analysis of variance (ANOVA; SigmaStat 2.0 for Windows, SPSS Science, Chicago, Ill). Data recorded as percentage were subjected to arcsine square-root transformation before the ANOVA. All pair-wise multiple comparison procedures were determined with the Tukey test.

RESULTS: As outlined in Tables 1- 4.

CONCLUSIONS: The treatments that received preharvest application of SCALA two weeks prior to harvest gave better results on disease control for up to 28 days in storage. The preharvest application of SCALA did not show a good level of control of postharvest blue mold caused by both TBZ -S and TBZ-R strains. Good control of gray mold caused by TBZ-S strains of *B. cinerea* was achieved when SCALA was applied with calcium one week prior to harvest. As expected, in the shelf-life test, data showed an increase of disease incidence in all treatments regardless of the strains and pathogens.

Table 1. Effect of preharvest application of SCALA alone or in combination with calcium chloride and postharvest TBZ on the development of blue mold (*Penicillium expansum*-TBZ-S) in 'Empire' apples 2005-2006.

Treatment	Time before harvest	$CaCl_2$ 6 g/L	Percentage incidence of blue mold (*Penicillium expansum*-TBZ-S) Days of evaluation**						
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20°C**
Wound only	N/A		0.0 a*	18.8 a	45.8 a	50.0 a	50.0 a	54.2 a	81.3 a
Inoculum only	N/A		72.9 c	97.9 c	97.9 c	97.9 c	100.0 b	100.0 b	100.0 a
Scala @ 800 g ai/ha	14 days	No	14.6 ab	58.3 b	79.2 b	81.3 b	87.5 b	87.5 b	91.7 a
Scala @ 800 g ai/ha	7 days	No	35.4 b	70.8 bc	83.3 bc	87.5 bc	89.6 b	95.8 b	95.8 a
Scala @ 800 g ai/ha	14 days	Yes	14.6 ab	58.3 b	68.8 b	70.8 ab	83.3 b	87.5 b	89.6 a
Scala @ 800 g ai/ha	7 days	Yes	29.2 b	70.8 bc	83.3 bc	85.4 bc	87.5 b	87.5 b	95.8 a
MERTECT @ 1.15 g/L	Post-harvest drench	No	0.0 a	60.4 b	81.3 bc	83.3 bc	87.5 b	87.5 b	91.7 a

* Means within the column followed by the same letter are not significantly different according to the Tukey test at P=0.05.

** Apples were inoculated with *P. expansum* immediately after harvest, stored at 0°C and evaluated for disease incidence at 28, 56, 84, 112, 140 and 168 days, then removed from cold storage and stored for 6 days at 20°C.

Table 2. Effect of preharvest applications of SCALA alone or in combination with calcium and MERTECT on the development of post-harvest blue mold (*Penicillium expansum*- TBZ-R) in 'Empire' apples, 2005-2006.

Treatment	Time before harvest	$CaCl_2$ 6 g/L	Percentage incidence of blue mold (*P. expansum* TBZ-R) in cold storage at 0°C						
			28 days	56 days	84 days	112 days	140 days	168 days	168 days + 6 days at 20°C**
Wound only	N/A		0.0 a*	29.2 a	43.8 a	45.8 a	54.2 a	58.3 a	83.3 a
Inoculum only	N/A		89.6 e	100.0 d	100.0 c	100.0 c	100.0 b	100.0 b	100.0 b
Scala @ 800 g ai/ha	14 days	No	14.6 b	47.9 ab	77.1 b	81.3 b	85.4 b	100.0 b	100.0 b
Scala @ 800 g ai/ha	7 days	No	54.2 d	72.9 c	81.3 b	83.3 b	89.6 b	91.7 b	93.8 b
Scala @ 800 g ai/ha	14 days	Yes	18.8 bc	60.4 bc	83.3 b	89.6 bc	93.8 b	93.8 b	97.9 b
Scala @ 800 g ai/ha	7 days	Yes	45.8 cd	72.9 bc	85.4 b	91.7 bc	93.8 b	93.8 b	93.8 b
MERTECT @ 1.15 g/L	Post-harvest drench	No	100 f	100.0 d	100.0 c	100.0 c	100.0 b	100.0 b	100.0 b

* Means within the column followed by the same letter are not significantly different according to the Tukey test at P=0.05.

** Apples were inoculated with *P. expansum* immediately after harvest, stored at 0°C and evaluated for disease incidence at 28, 56, 84, 112, 140 and 168 days, then removed from cold storage and stored for 6 days at 20°C.

Table 3. Effect of preharvest application of SCALA alone or in combination with calcium chloride and postharvest TBZ on the development of gray mold (*B. cinerea* - TBZ-S) in 'Empire' apples 2005-2006.

Treatment Product	Time before harvest	$CaCl_2$ 6 g/L	Percentage incidence of gray mold (*Botrytis cinerea* - TBZ-S) Days of evaluation**						
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20°C**
Wound only	N/A		0.0 a*	25.0 cd	43.8 b	45.8 b	47.9 b	54.2 b	81.3 b
Inoculum only	N/A		0.0 a	41.7 d	50.0 b	50.0 b	50.0 b	52.1 b	79.2 b
Scala @ 800 g ai/ha	14 days	No	0.0 a	2.1 a	6.3 a	14.6 a	16.7 a	16.7 a	33.3 a
Scala @ 800 g ai/ha	7 days	No	0.0 a	18.8 bc	24.0 ab	27.1 ab	31.3 ab	43.8 b	50.0 a
Scala @ 800 g ai/ha	14 days	Yes	0.0 a	2.1 ab	4.2 a	8.3 a	10.4 a	16.7 a	20.8 a
Scala @ 800 g ai/ha	7days	Yes	0.0 a	0.0 a	8.3 a	8.3 a	8.3 a	12.5 a	27.1 a
MERTECT @ 1.15 g/L	Post-harvest drench	No	0.0 a	75	85.4 c	85.4 c	87.5 c	87.5 c	93.8 b

* Means within the column followed by the same letter are not significantly different according to the Tukey test at P=0.05.

** Apples were inoculated with *B. cinerea* immediately after harvest, stored at 0°C and evaluated for disease incidence at 28, 56, 84, 112, 140 and 168 days, then removed from cold storage and stored for 6 days at 20°C.

Table 4. Effect of preharvest application of SCALA alone or in combination with calcium chloride and postharvest TBZ on the development of blue mold (*B. cinerea* - TBZ-R) in 'Empire' apples 2005-2006.

Treatment Product	Time before harvest	$CaCl_2$ 6 g/L	Percentage incidence of blue mold (*B. cinerea* - TBZ-R) Days of evaluation**						
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20°C**
Wound only	N/A		0.0 a*	16.7 a	39.6 a	39.6 a	39.6 a	43.8 a	75.0 a
Inoculum only	N/A		100.0 c	100.0 c	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
Scala @ 800 g ai/ha	14 days	No	20.8 b	27.1 ab	37.5 a	37.5 a	39.6 a	41.7 a	50.0 a
Scala @ 800 g ai/ha	7 days	No	45.8 b	52.1 b	58.3 a	58.3 a	60.4 a	60.4 a	62.5 a
Scala @ 800 g ai/ha	14 days	Yes	25.0 b	35.4 ab	43.8 a	50.0 a	52.1 a	52.1 a	62.5 a
Scala @ 800 g ai/ha	7 days	Yes	37.5 b	50.0 b	52.1 a	54.2 a	54.2 a	58.3 a	64.6 a
MERTECT @ 1.15 g/L	Post-harvest drench	No	100.0 c	100.0 c	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b

* Means within the column followed by the same letter are not significantly different according to the Tukey test at P=0.05.

** Apples were inoculated with *B. cinerea* immediately after harvest, stored at 0°C and evaluated for disease incidence at 28, 56, 84, 112, 140 and 168 days, then removed from cold storage and stored for 6 days at 20°C.

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SECTION K: FRUIT – Diseases
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. Empire
PEST: Blue mold (*Penicillium expansum* Link.), Gray mold (*Botrytis cinerea* Pers.)

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TITLE: EFFECT OF PREHARVEST PYRIMETHANIL (SCALA SC, BAYER CROP SCIENCE LTD) APPLICATION FOR THE CONTROL OF POST-HARVEST GRAY AND BLUE MOLD IN 'EMPIRE' APPLES, 2005-06

MATERIALS: SCALA SC (pyrimethanil 400 g ai/L), MERTECT 45 % flowable (thiabendazole), CALCIUM CHLORIDE (28 % Ca)

METHODS: During the 2005 growing season a field trial was conducted at the Jordan Farm-AAFC, Jordan Station, ON. Apple cultivar 'EMPIRE' was maintained according to standard orchard practices at Jordan Farm, ON. Treatments were an unsprayed control, SCALA (pyrimethanil 800 g ai/ha) applied either 14 days or 7 days pre-harvest, SCALA (pyrimethanil 800 g ai/ha) 14 days pre-harvest plus a Calcium ($CaCl_2$) treatment at 12 kg/ha one week before harvest or SCALA (pyrimethanil 800 g ai/ha) one week preharvest plus a Calcium ($CaCl_2$) treatment at 12 kg/ha, one week before harvest. Treatments were replicated 4 times, two trees per replicate, allocated in a completely randomized block design. The apple trees were sprayed with

hand-operated gun sprayer at a pressure of 1034.25 kPa, 2.8-3 L of water per tree until runoff. Apples were harvested on October 4, 2005. On October 12, 2005, apples were punctured once with a nail-tapered probe 5 mm deep and 4 mm wide at its base placed in mesh bags and placed in plastic crates. Wounded fruits were then inoculated with 20 µl conidial suspension ($1x10^4$ conidia/ml of water) of either thiabendazole sensitive (TBZ – S) *P. expansum*; PS-28AS isolate, thiabendazole resistant (TBZ – R) *P. expansum* isolate PS-2R, thiabendazole sensitive (TBZ – S) *B. cinerea* isolate Bc-2a-S, thiabendazole resistant (TBZ – R) *B. cinerea* isolate Bc-8d-R and placed in cold storage at 1ºC. Twelve fruits were used for each treatment and each treatment has four replicates. After inoculation apples were evaluated for disease incidence once every 4 weeks. After 168 days (24 weeks) fruits were removed from cold storage and were placed in additional storage at 20ºC (85 % RH) for 6 days. The general linear model (GLM) procedures were used for the analysis of variance (ANOVA; SigmaStat 2.0 for Windows, SPSS Science, Chicago, Ill). Data recorded as percentage were subjected to arcsine square-root transformation before the ANOVA. All pair-wise multiple comparison procedures were determined with the Tukey test.

RESULTS: As outlined in Tables 1- 4.

CONCLUSIONS: The treatments that received preharvest application of SCALA two weeks prior to harvest gave better results on disease control for up to 28 days in storage. The pre-harvest application of SCALA did not show a good level of control of post-harvest blue mold caused by both TBZ -S and TBZ-R strains. Good control of gray mold caused by TBZ-S strains of *B. cinerea* was achieved when SCALA was applied with calcium one week prior to harvest. As expected, in the shelf-life test, data showed an increase of disease incidence in all treatments regardless of the strains and pathogens.

Table 1. Effect of pre-harvest application of SCALA alone or in combination with calcium chloride and post-harvest TBZ on the development of blue mold (*Penicillium expansum*-TBZ-S) in 'Empire' apples 2005-2006.

Treatment	Time before harvest	$CaCl_2$ 6 g/L	Percentage incidence of blue mold (*Penicillium expansum*-TBZ-S) Days of evaluation**						
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20°C**
Wound only	N/A		0.0 a*	18.8 a	45.8 a	50.0 a	50.0 a	54.2 a	81.3 a
Inoculum only	N/A		72.9 c	97.9 c	97.9 c	97.9 c	100.0 b	100.0 b	100.0 a
Scala @ 800 g ai/ha	14 days	No	14.6 ab	58.3 b	79.2 b	81.3 b	87.5 b	87.5 b	91.7 a
Scala @ 800 g ai/ha	7 days	No	35.4 b	70.8 bc	83.3 bc	87.5 bc	89.6 b	95.8 b	95.8 a
Scala @ 800 g ai/ha	14 days	Yes	14.6 ab	58.3 b	68.8 b	70.8 ab	83.3 b	87.5 b	89.6 a
Scala @ 800 g ai/ha	7 days	Yes	29.2 b	70.8 bc	83.3 bc	85.4 bc	87.5 b	87.5 b	95.8 a
MERTECT @ 1.15 g/L	Post-harvest drench	No	0.0 a	60.4 b	81.3 bc	83.3 bc	87.5 b	87.5 b	91.7 a

* Means within the column followed by the same letter are not significantly different according to the Tukey test at P=0.05.

** Apples were inoculated with *P. expansum* immediately after harvest, stored at 0°C and evaluated for disease incidence at 28, 56, 84, 112, 140 and 168 days, then removed from cold storage and stored for 6 days at 20°C.

Table 2. Effect of pre-harvest applications of SCALA alone or in combination with calcium and MERTECT on the development of post-harvest blue mold (*Penicillium expansum*- TBZ-R) in 'Empire' apples, 2005-2006.

Treatment	Time before harvest	$CaCl_2$ 6 g/L	Percentage incidence of blue mold (*P. expansum* TBZ-R) in cold storage at 0°C						
			28 days	56 days	84 days	112 days	140 days	168 days	168 days + 6 days at 20°C**
Wound only	N/A		0.0 a*	29.2 a	43.8 a	45.8 a	54.2 a	58.3 a	83.3 a
Inoculum only	N/A		89.6 e	100.0 d	100.0 c	100.0 c	100.0 b	100.0 b	100.0 b
Scala @ 800 g ai/ha	14 days	No	14.6 b	47.9 ab	77.1 b	81.3 b	85.4 b	100.0 b	100.0 b
Scala @ 800 g ai/ha	7 days	No	54.2 d	72.9 c	81.3 b	83.3 b	89.6 b	91.7 b	93.8 b
Scala @ 800 g ai/ha	14 days	Yes	18.8 bc	60.4 bc	83.3 b	89.6 bc	93.8 b	93.8 b	97.9 b
Scala @ 800 g ai/ha	7 days	Yes	45.8 cd	72.9 bc	85.4 b	91.7 bc	93.8 b	93.8 b	93.8 b
MERTECT @ 1.15 g/L	Post-harvest drench	No	100 f	100.0 d	100.0 c	100.0 c	100.0 b	100.0 b	100.0 b

* Means within the column followed by the same letter are not significantly different according to the Tukey test at P=0.05.

** Apples were inoculated with *P. expansum* immediately after harvest, stored at 0°C and evaluated for disease incidence at 28, 56, 84, 112, 140 and 168 days, then removed from cold storage and stored for 6 days at 20°C.

Table 3. Effect of pre-harvest application of SCALA alone or in combination with calcium chloride and post-harvest TBZ on the development of gray mold (*B. cinerea* - TBZ-S) in 'Empire' apples 2005-2006

Treatment Product	Time before harvest	$CaCl_2$ 6 g/L	Percentage incidence of gray mold (*Botrytis cinerea* - TBZ-S) Days of evaluation**						
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20°C**
Wound only	N/A		0.0 a*	25.0 cd	43.8 b	45.8 b	47.9 b	54.2 b	81.3 b
Inoculum only	N/A		0.0 a	41.7 d	50.0 b	50.0 b	50.0 b	52.1 b	79.2 b
Scala @ 800 g ai/ha	14 days	No	0.0 a	2.1 a	6.3 a	14.6 a	16.7 a	16.7 a	33.3 a
Scala @ 800 g ai/ha	7 days	No	0.0 a	18.8 bc	24.0 ab	27.1 ab	31.3 ab	43.8 b	50.0 a
Scala @ 800 g ai/ha	14 days	Yes	0.0 a	2.1 ab	4.2 a	8.3 a	10.4 a	16.7 a	20.8 a
Scala @ 800 g ai/ha	7 days	Yes	0.0 a	0.0 a	8.3 a	8.3 a	8.3 a	12.5 a	27.1 a
MERTECT @ 1.15 g/L	Post-harvest drench	No	0.0 a	75	85.4 c	85.4 c	87.5 c	87.5 c	93.8 b

* Means within the column followed by the same letter are not significantly different according to the Tukey test at P=0.05.

** Apples were inoculated with *B. cinerea* immediately after harvest, stored at 0°C and evaluated for disease incidence at 28, 56, 84, 112, 140 and 168 days, then removed from cold storage and stored for 6 days at 20°C.

Table 4. Effect of preharvest application of SCALA alone or in combination with calcium chloride and post-harvest TBZ on the development of blue mold (*B. cinerea* - TBZ-R) in 'Empire' apples 2005-2006.

Treatment	Time before harvest	$CaCl_2$ 6 g/L	Percentage incidence of blue mold (*B. cinerea* - TBZ-R) Days of evaluation**						
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20°C**
Wound only	N/A		0.0 a*	16.7 a	39.6 a	39.6 a	39.6 a	43.8 a	75.0 a
Inoculum only	N/A		100.0 c	100.0 c	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b
Scala @ 800 g ai/ha	14 days	No	20.8 b	27.1 ab	37.5 a	37.5 a	39.6 a	41.7 a	50.0 a
Scala @ 800 g ai/ha	7 days	No	45.8 b	52.1 b	58.3 a	58.3 a	60.4 a	60.4 a	62.5 a
Scala @ 800 g ai/ha	14 days	Yes	25.0 b	35.4 ab	43.8 a	50.0 a	52.1 a	52.1 a	62.5 a
Scala @ 800 g ai/ha	7 days	Yes	37.5 b	50.0 b	52.1 a	54.2 a	54.2 a	58.3 a	64.6 a
MERTECT @ 1.15 g/L	Post-harvest drench	No	100.0 c	100.0 c	100.0 b	100.0 b	100.0 b	100.0 b	100.0 b

* Means within the column followed by the same letter are not significantly different according to the Tukey test at P=0.05.

** Apples were inoculated with *B. cinerea* immediately after harvest, stored at 0°C and evaluated for disease incidence at 28, 56, 84, 112, 140 and 168 days, then removed from cold storage and stored for 6 days at 20°C.

2006 PMR Report #050

SECTION K: FRUIT – Diseases
STUDY DATA BASE: WBSE-E.0104.23

CROP: Apples (*Malus domestica* Borkh.) cv. McIntosh
PEST: Blue mold (*Penicillium expansum* Link.), Gray mold (*Botrytis cinerea* Pers.)

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TITLE: EFFECT OF PREHARVEST SCALA (PYRIMETHANIL) APPLICATION FOR THE CONTROL OF POST-HARVEST GRAY AND BLUE MOLD IN 'MCINTOSH' APPLES, 2005-06

MATERIALS: SCALA SC (pyrimethanil 400 g ai/L), MERTECT 45 % flowable (thiabendazole), CALCIUM CHLORIDE (28 % Ca)

METHODS: In 2005, a field trial was carried out at the AAFC Jordan Farm in Ontario. Apple cultivar 'McIntosh' was maintained according to standard orchard practices. Treatments were an unsprayed control; SCALA (Bayer Crop science Ltd., pyrimethanil 800 g ai/ha) applied either 2 weeks or 1 week preharvest; SCALA (pyrimethanil 800 g ai/ha) 2 weeks preharvest plus a CALCIUM ($CaCl_2$) application at 12 kg/ha one week before harvest ;or SCALA (pyrimethanil 800 g ai/ha) one week preharvest plus a CALCIUM ($CaCl_2$) treatment at 12 kg/ha, one week before harvest. Treatments were replicated 4 times, two trees per replicate, allocated in a completely randomized block design. The apple trees were sprayed with hand-operated gun

sprayer at a pressure of 1034.25 kPa, 2.8-3 L of water per tree until runoff. Apples were harvested on September 27, 2005 and stored at 1ºC until inoculation. On October 12, 2005 apples were removed from 1ºC storage punctured once with a nail-tapered probe 5 mm deep and 4 mm wide at its base placed in mesh bags and placed in plastic crates. Wounded fruits were then inoculated with 20µl conidial suspension ($1x10^4$ conidia/ml of water) of either thiabendazole sensitive (TBZ – S) *P. expansum*; PS-28AS isolate, thiabendazole resistant (TBZ – R) *P. expansum* isolate PS-2R, thiabendazole sensitive (TBZ – S) *B. cinerea* isolate Bc-2a-S, thiabendazole resistant (TBZ – R) *B. cinerea* isolate Bc-8d-R and placed back in cold storage at 1ºC. Twelve fruits were used for each treatment and each treatment has four replicates. After inoculation apples were evaluated for disease incidence every 4 weeks. After 24 weeks, fruits were removed from cold storage and were placed in additional storage at 20ºC (85 % RH) for 6 days. The general linear model (GLM) procedures were used for the analysis of variance (ANOVA; SigmaStat 2.0 for Windows, SPSS Science, Chicago, Ill). Data recorded as percentage were subjected to arcsine square-root transformation before the ANOVA. All pair-wise multiple comparison procedures were determined with Tukey's test.

RESULTS: Results are shown in Tables 1, 2, 3 and 4.

CONCLUSION: The treatments that received pre-harvest application of SCALA two weeks prior to harvest gave better results on disease control for up to 28 days in storage. Up to 16 weeks, percentage of incidence was low by TBZ susceptible strains of *P. expansum* and *B. cinerea*. However, as the storage period increased , higher disease incidence was observed. Application of SCALA one week prior to harvest without additional Calcium also showed good control of *B. cinerea* up to 16 weeks. Preharvest application of SCALA resulted in better control of postharvest molds of apples in 2004-2005, as compared to 2005-2006.

Table 1. Effect of pre-harvest application of SCALA alone or in combination with calcium chloride and MERTECT on the development of post-harvest blue mold (*Penicillium expansum*- TBZ-S) in McIntosh' apples, 2005-2006.

Treatment	Time of application	$CaCl_2$ 6 g/L	Percentage incidence of blue mold (*Penicillium expansum*- TBZ-S) Days of evaluation						
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20°C**
Wound only	N/A		0.0 a*	18.8 a	35.4 a	47.9 a	64.6 a	70.8 a	83.3 ab
Inoculum only	N/A		93.8	100.0 d	100.0 c	100.0 d	100.0 b	100.0 b	100.0 c
Scala @ 800 g ai/ha	2 week	No	31.3 b	60.2 b	77.1 b	83.3 b	89.6 b	93.8 b	97.9 c
Scala @ 800 g ai/ha	1 week	No	56.3 c	87.5 c	91.7 bc	91.7 cd	93.8 b	93.8 b	95.8 c
Scala @ 800 g ai/ha	2 week	Yes	50.0 c	70.8 bc	81.3 b	83.3 b	87.5 b	91.7 b	91.7 bc
Scala @ 800 g ai/ha	1 week	Yes	75.0 d	87.5 bc	95.8 bc	100.0 d	100.0 b	100.0 b	100.0 c
MERTECT @ 1.15 g/L	Post-harvest drench	No	0.0 a	12.5 a	16.7 a	25.0 a	41.7 a	52.1 a	79.2 a

* Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.

** Apples were inoculated with *Penicillium expansum* immediately after harvest, stored at 0°C and evaluated for disease incidence at 28, 56, 84, 112, 140 and 168 days, then removed from cold storage and stored for 6 days at 20°C.

Table 2. Effect of pre-harvest application of SCALA alone or in combination with calcium chloride and MERTECT on the development of post-harvest blue mold (*P. expansum* - TBZ-R) in 'McIntosh' apples, 2005-2006.

Treatment	Time before harvest	$CaCl_2$ 6 g/L	Percentage incidence of gray mold (*P. expansum* - TBZ-R) Days of evaluation **						
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20°C**
Wound only	N/A		0.0 a*	16.7 a	18.8 a	22.9 a	33.3 a	45.8 a	50.0 a
Inoculum only	N/A		95.8	100.0 c	100.0 c	100.0 d	100.0 c	100.0 c	100.0 c
Scala @ 800 g ai/ha	2 weeks	No	54.2 bc	66.7 b	77.1 b	83.3 bc	98.6 bc	91.7 bc	97.9 bc
Scala @ 800 g ai/ha	1 week	No	35.4 b	50.0 b	64.6 b	70.8 b	75.0 b	77.1 b	83.3 b
Scala @ 800 g ai/ha	2 weeks	Yes	56.3 bc	66.7 b	79.2 bc	87.5 bcd	91.7 bc	91.7 bc	97.9 c
Scala @ 800 g ai/ha	1 week	Yes	66.7 cd	75.0 b	83.3 bc	91.7 cd	93.8 bc	95.8 bc	97.9 c
MERTECT @ 1.15 g/L	Post-harvest drench	No	91.7 de	100.0 c	100.0 c	100.0 d	100.0 c	100.0 c	100.0 c

* Means within the column followed by the same letter are not significantly different according to the Tukey test at $P= 0.05$.

** Apples were inoculated with *B. cinerea* immediately after harvest, stored at 0°C and evaluated for disease incidence at 28, 56, 84, 112, 140 and 168 days, then removed from cold storage and stored for 6 days at 20°C.

Table 3. Effect of pre-harvest application of SCALA alone or in combination with calcium chloride and MERTECT on the development of post-harvest gray mold (*B. cinerea*-TBZ-S) in 'McIntosh' apples, 2005-2006.

Treatment	Time before harvest	$CaCl_2$ 6 g/L	Percentage incidence of gray mold (*B. cinerea*-TBZ-S) Days of evaluation **						
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20°C**
Wound only	N/A		0.0 a*	22.9 a	37.5 bcd	54.2 c	60.4 bc	66.7 b	89.6 a
Inoculum only	N/A		0.0 a	25.0 a	41.7 cd	47.9 bc	56.3 bc	64.6 b	81.3 a
Scala @ 800 g ai/ha	14 days	No	0.0 a	12.5 a	18.8 abc	25.0 ab	33.3 ab	41.7 a	77.1 a
Scala @ 800 g ai/ha	7 days	No	0.0 a	10.4 a	12.5 a	14.6 a	20.8 a	33.3 a	60.4 a
Scala @ 800 g ai/ha	14 days	Yes	0.0 a	12.5 a	14.6 ab	18.8 a	33.3 ab	43.8 a	70.8 a
Scala @ 800 g ai/ha	7 days	Yes	0.0 a	16.7 a	25.0 abc	27.1 ab	37.5 ab	41.7 a	72.9 a
MERTECT @ 1.15 g/L	Post-harvest drench	No	4.2 b	31.3 a	47.9 d	54.2 c	66.7 c	81.3 b	97.9 a

* Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.

** Apples were inoculated with *B. cinerea* immediately after harvest, stored at 0°C and evaluated for disease incidence at 28, 56, 84, 112, 140 and 168 days, then removed from cold storage and stored for 6 days at 20°C.

Table 4. Effect of pre-harvest application of SCALA alone or in combination with calcium chloride and MERTECT on the development of post-harvest gray mold in 'McIntosh' apples, 2005-2006.

Treatment	Time before harvest	$CaCl_2$ 6 g/L	Percentage incidence of gray mold (*B. cinerea*-TBZ-R) Days of evaluation **						
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20°C**
Wound only	N/A		0.0 a*	29.2 a	37.5 a	41.7 a	60.4 ab	70.8 a	85.4 a
Inoculum only	N/A		100.0 d	100.0 d	100.0 d	100.0 d	100.0 c	100.0 b	100.0 b
Scala @ 800 g ai/ha	2 weeks	No	62.5 c	66.7 bc	68.8 bc	72.9 bc	72.9 ab	77.1 a	81.3 a
Scala @ 800 g ai/ha	1 week	No	58.3 c	58.3 bc	62.5 abc	64.6 abc	64.6 ab	66.7 a	77.1 a
Scala @ 800 g ai/ha	2 weeks	Yes	33.3 b	52.1 ab	52.1 abc	52.1 abc	54.2 a	58.3 a	77.1 a
Scala @ 800 g ai/ha	1 week	Yes	72.9 c	79.2 c	79.2 c	79.2 c	79.2 b	79.2 a	89.6 ab
MERTECT @ 1.15 g/L	Post-harvest drench	No	100.0 d	100.0 d	100.0 d	100.0 d	100.0 c	100.0 b	100.0 b

* Means within the column followed by the same letter are not significantly different according to the Tukey test at $P= 0.05$.

** Apples were inoculated with *B. cinerea* immediately after harvest, stored at 0°C and evaluated for disease incidence at 28, 56, 84, 112, 140 and 168 days, then removed from cold storage and stored for 6 days at 20°C.

2006 PMR REPORT #051 **SECTION L: VEGETABLES and SPECIAL CROPS - Diseases**

CROP: Celery (*Apium graveolens*), cv. Sabroso and cv. Florida 683
PEST: Septoria late blight (*Septoria apiicola*)

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TITLE: EVALUATION OF DISEASE FORECASTING SYSTEMS FOR CONTROL OF SEPTORIA LATE BLIGHT ON CELERY IN ONTARIO, 2006

MATERIALS: BRAVO 500 (chlorothalonil 50%), PRISTINE WG (pyraclostrobin 12.8%, boscalid 25.2%), CHAMP 2FL (copper hydroxide 37.5%)

METHODS: The trial was conducted on organic soil (pH ≃ 6.8, organic matter ~40%) near the Muck Crops Research Station, Holland Marsh, Ontario. Celery cultivars Sabroso and Florida 683 were seeded into 288-cell Plastomer plug trays on 27 March. Celery was hand transplanted into the field on 19 May with in row plant spacing of 15 cm for Florida 683 and 18 cm for Sabroso. Treatments were arranged in a split-plot design with spray timing as the main plot factor and cultivar as subplot factor. Each subplot consisted of three rows, 55 cm apart and 5 m in length. The disease forecasting systems were based on leaf wetness and temperature data collected from within the trial site. For the Septoria Predictor, sprays were initiated after a leaf wetness period ≥ 12 hours, if the treatment had not been sprayed within the past 7 days and the canopy was not closed. For the Tomcast treatments, disease severity values (DSVs) were accumulated based on leaf wetness and temperature. Sprays were initiated when treatments reached the designated threshold (10, 15, or 20 DSVs). The trial was inoculated with diseased foliage from celery plants with actively growing *Septoria apiicola* lesions on 3 August. The diseased tissue was hand chopped, mixed with water and soaked for 2 hours. The tissue and water suspension was poured as evenly as possible over the middle two rows of each main plot. Treatments (rates are in Table 1) were applied using a pull-type plot sprayer with TeeJet D-3 hollow cone nozzles at 690 kPa (boom) in 500 L/ha of water.
Disease progress was assessed every 3 to 7 days. Twelve plants from each subplot were harvested on 18 and 20 September Sabroso was trimmed to 55 cm and Florida 683 was trimmed to 40 cm. One hundred twenty outer petioles from the 12 harvested plants were removed and rated from 0 - 5, where: 0 = 0%, 1 <10%, 2 = 10 - 24%, 3 = 25 - 49%, 4 = 50 - 74%, 5 >75% petiole area diseased. After trimming, leaves were rated from 0 - 3, where: 0 = no lesions on leaves, 1 <10% of leaves diseased, 2 = 10 - 49% diseased,

3 >50% diseased. The leaf blight index (LBI) and petiole disease severity index (DSI) were calculated using the following equation:

$$\text{DSI or LBI} = \frac{\sum [(\text{class no.})(\text{no. of petioles in each class})]}{(\text{total no. petioles per sample})(\text{no. classes } -1)} \times 100$$

Marketable weight was determined by stripping plants of any additional diseased petioles and weighing the disease-free portion of the plant plus any '0' rated petioles. The percent weight loss was determined by dividing weight loss (the difference between marketable weight and trimmed weight) by trimmed weight and multiplying by 100.

The air temperatures in 2006 were below the long term (10 year) average for September (14.3°C), average for June (18.4°C) and August (19.2°C), and above average for May (13.7°C) and July (21.9°C. The long term (10 year) average temperatures were: May 12.4°C, June 18.3°C, July 20.3°C , August 19.1°C, and September 15.6°C. Monthly rainfall was below the long term (10 year) average for May (64 mm), June (64 mm) and August (41 mm) and above average for July (72 mm) and September (174 mm) The long term (10 year) rainfall averages were: May 82 mm, June 81 mm, July 65 mm, August 59 mm, and September 82 mm. All statistical analysis was performed using the proc univariate and proc glm, procedures of SAS version 8.02. Analysis of variance was conducted on all response variables, and means were separated using least square means with Tukey's adjustment with P = 0.05 level of significance.

RESULTS: As presented in Table 1.

CONCLUSIONS: DSI and LBI were significantly lower for all fungicide treatments when compared to the non-sprayed control (Table 1). For LBI, forecasting treatments using PRISTINE WG/CHAMP 2FL provided disease control as good as the calendar spray program using PRISTINE WG/CHAMP 2FL. Tomcast DSV 10 and the Septoria Predictor treatments using BRAVO 500/CHAMP 2FL were also as good as the standard calendar spray program using BRAVO 500/CHAMP 2FL for LBI. Marketable weight was lowest, and weight loss to disease was highest, in the non-sprayed control. Treatment Tomcast DSV 15 using BRAVO 500/CHAMP 2FL had higher weight loss than the Septoria Predictor using BRAVO 500/CHAMP 2FL and all PRISTINE WG/CHAMP 2FL treatments except Tomcast DSV 10.

The number of fungicide applications was reduced by 1 for the Septoria Predictor, by 2 for Tomcast DSV 10, by 3 for Tomcast DSV 15, and by 4 for Tomcast DSV 20. The cost of using PRISTINE WG was approximately 2.4 times higher than using BRAVO 500, however treatments that received PRISTINE WG had lower levels of disease, higher marketable weight, and a lower percentage of weight loss than treatments receiving BRAVO 500.

Table 1. Treatment application rate, date, number of applications, estimated fungicide spray program cost, disease indices, and yield for fungicide timing and spray rotation for management of septoria late blight of celery at the Holland-Bradford Marsh, ON, 2006.

Treatment and rate (ha^{-1})	Application Date (DAFA)[1]	No. Sprays	Cost ($\$ ha^{-1}$)[2]	DSI[3]	LBI[3]	Market Wt. ($kg\ plant^{-1}$)	% Wt. Loss
Non-sprayed control	-	0	0	22.3 b[4]	93.8 c	0.43 a	63 c
Calendar							
PRISTINE WG 1.0 kg alt. CHAMP 2FL 4.0 kg	0, 8, 15, 22, 29, 6	6	552	0.0 a	2.1 a	1.49 c	0.041667
BRAVO 500 3.0 L alt. CHAMP 2FL 4.0 kg			245	0.0 a	17.4 ab	1.41 bc	4 ab
Tomcast DSV 10							
PRISTINE WG 1.0 kg alt. CHAMP 2FL 4.0 kg	0, 8, 21, 28	4	368	0.0 a	9.0 ab	1.38 bc	2 ab
BRAVO 500 3.0 L alt. CHAMP 2FL 4.0 kg			163	0.0 a	14.6 ab	1.29 bc	3 ab
Tomcast DSV 15							
PRISTINE WG 1.0 kg alt. CHAMP 2FL 4.0 kg	0, 17, 28	3	324	0.0 a	10.4 ab	1.43 bc	0.042
BRAVO 500 3.0 L alt. CHAMP 2FL 4.0 kg			119	0.3 a	34.6 b	1.10 b	15 b
Tomcast DSV 20							
PRISTINE WG 1.0 kg alt. CHAMP 2FL 4.0 kg	0, 21	2	184	0.0 a	14.4 ab	1.43 bc	0.042
BRAVO 500 3.0 L alt. CHAMP 2FL 4.0 kg			82	0.0 a	40.6 b	1.28 bc	10 ab
Septoria Predictor							
PRISTINE WG 1.0 kg alt. CHAMP 2FL 4.0 kg	0, 15[5], 22, 29, 36	5	508	0.0 a	2.4 a	1.38 bc	0
BRAVO 500 3.0 L alt. CHAMP 2FL 4.0 kg			201	0.0 a	14.4 ab	1.39 bc	0.042
Contrasts							
PRISTINE WG 1.0 kg alt. CHAMP 2FL 4.0 kg	-	-	-	0.0 ns	7.7 a	1.42 b	0.042
BRAVO 500 3.0 L alt. CHAMP 2FL 4.0 kg	-	-	-	0	24.3 b	1.29 a	7 b

[1] DAFA = days after first spray; first fungicide applications was on 1 Aug (first application = 0 days)

[2] Estimated cost based on the following fungicide prices: Bravo 500 = $\$12.50\ L^{-1}$, Champ 2FL = $\$11.00\ L^{-1}$, Pristine WG = $\$140.00\ kg^{-1}$

[3] DSI = petiole disease severity index, LBI = leaf blight index

[4] Numbers in a column followed by the same letter are not significantly different at $P = 0.05$, based on Tukey's adjustment; ns = not significant

[5] Canopy fully closed and regular calendar spray program began for remainder of study period

2006 PMR REPORT #052

SECTION L: VEGETABLE and SPECIAL CROPS -Diseases
ICAR: 206003

CROP: Iceberg head lettuce (*Lactuca sativa* L.) cv. Skyline
PEST: Sclerotinia drop, (*Sclerotinia sclerotiorum* (Lib.) de Bary); *Sclerotinia minor* Jagger)

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TITLE: EVALUATION OF FUNGICIDES FOR CONTROL OF SCLEROTINIA DROP ON INOCULATED LETTUCE, 2006

MATERIALS: PRISTINE (pyraclostrobin 12.8%, boscalid 25.2%), ROVRAL (iprodione 50%)

METHODS: Lettuce was seeded into 128-cell plug trays on 23 June and hand-transplanted (14 plants/m) into organic soil (pH ≃ 6.3, organic matter ≃ 71.8%) on 25 July at the Muck Crops Research Station, Holland Marsh Ontario. A randomized complete block design with four replicates per treatment was used. Each replicate consisted of four 5.5 m long rows, 42 cm apart. Treatments were: PRISTINE at 1.7 kg/ha on lettuce inoculated with *Sclerotinia minor*, *Sclerotinia sclerotiorum* or both species (*S. minor* and *S. sclerotiorum*) and ROVRAL at 1.5 kg/ha on lettuce inoculated with *Sclerotinia minor, Sclerotinia sclerotiorum* or both species were also included. An untreated, non-inoculated check and checks inoculated with *S. sclerotiorum, S. minor,* and both species were also included. Fungicide treatments were applied on 9, 17, and 24 August and 1, 5 September using a CO_2 backpack sprayer equipped with four TeeJet D-2 hollow cone nozzles spaced 40 cm apart and calibrated to deliver 250 L/ha at 240 kPa. Inoculum of *S. sclerotiorum* and *S. minor* was prepared using PDA-soaked filter paper inoculated with either pathogen, allowed to grow, then cut into strips 0.5 cm by 3.0 cm. On 10 August, 100 g of *S. sclerotiorum*-inoculated strips or 170 g of *S. minor*-inoculated strips were placed on the soil, in between plant rows, evenly over the treatment. The trial was monitored weekly for disease and infected plants were counted and removed. On 11 September, all heads were harvested and examined for disease. Fifteen heads from each replicate were weighed for a yield sample. The air temperatures in 2006 were below the long term (10 year) average for September (14.3°C), average for August (19.2°C), and above average for July (21.9°C). The long term (10 year) average temperatures were: July 20.3°C, August 19.1°C and September 15.6°C. Monthly rainfall was below the long term (10 year) average for August (41 mm) and above average for July (72 mm) and September (174 mm). The long term (10 year) rainfall averages were: July 65 mm, August 59 mm and September 82 mm. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.7. Means separation was obtained using Fisher's Protected LSD test at $P = 0.05$ level of significance.

RESULTS: As presented in Table 1

CONCLUSIONS: *S. minor* was the most prevalent sclerotinia disease in the plot. Incidence of disease caused by *S. sclerotiorum* was not significantly higher in treatments inoculated with *S. sclerotiorum* than non-inoculated treatments, indicating that inoculation with mycelium from *S. sclerotiorum* did not increase infection levels in the field. Lettuce inoculated with *S. minor* or both species of sclerotinia and treated with

either PRISTINE or ROVRAL had significantly lower disease incidence than the untreated checks inoculated with *S. minor* or both species of sclerotinia. The use of PRISTINE on disease caused by *S. minor* resulted in significant yield increase over the *S. minor*-inoculated check. Untreated lettuce inoculated with *S. minor* had an approximately six-fold increase in disease compared to the non-inoculated naturally infested treatment. Results of this trial indicate that the use of this inoculum technique improves the potential of sclerotinia drop developing in a trial and establishes a uniform distribution of the disease. All treatments containing PRISTINE had very little lettuce downy mildew. PRISTINE was effective in controlling downy mildew and sclerotinia drop. No phytotoxicity was found among the treatments.

Table 1. Percentage of sclerotinia rot in lettuce inoculated with *S. minor* and *S. sclerotiorum* strips and treated with two fungicides, grown at the Muck Crops Research Station, Holland Marsh, Ontario, 2006

Treatment	Inoculum	Rate (kg/ha)	% Plants with Sclerotinia			Yield/Head[1] (g)
			Minor	Sclerotiorum	Total	
PRISTINE	*S. sclerotiorum*	1.7	0.8 a[2]	1.9 ns[3]	2.1 a	830 a
Untreated	*S. sclerotiorum*	---	8.3 a	5.7	12.4 ab	777 a
Untreated	Non-inoculated	---	9.3 ab	2.6	11.0 ab	746 ab
PRISTINE	Both	1.7	24.5 bc	3.1	26.8 bc	812 a
PRISTINE	*S. minor*	1.7	32.2 c	0	32.2 c	764 ab
ROVRAL	Both	1.5	34.4 c	4.2	37.4 c	651 bc
Untreated	*S. minor*	---	54.3 d	1.5	55.3 d	607 c
Untreated	Both	---	54.6 d	3.7	57.1 d	718 abc

[1] Yield was based on a sample of 15 heads

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

[3] ns indicates no significant differences among treatments

2006 PMR REPORT #053

SECTION L: VEGETABLE and SPECIAL CROPS - Diseases
ICAR: 206003

CROP: Pea (*Pisum sativum)* cv. Utrillo
PEST: Ascochyta blight (*Mycosphaerella pinodes*, anamorph *Ascochyta pinodes)*
Powdery Mildew *(Erysiphe pisi)*

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TITLE: EVALUATION OF VARIOUS FUNGICIDES FOR CONTROL OF POWDERY MILDEW AND ASCOCHYTA BLIGHT IN SUCCULENT PEAS, 2006

MATERIALS: SCALA (pyrimethanil 37%), QUADRIS (azoxystrobin 23%), HEADLINE EC (pyraclostrobin 25%), LANCE WDG (boscalid 70%), FOLICUR (tebuconazole 38.7%), ALEXIN (potassium 8%, calcium 2.4%, magnesium 0.8%, boron 0.2%)

METHODS: A field trial was established on July 20, 2006 at a site near Bradford, Ontario in sandy loam soil with pea cultivar Utrillo. The trial was replicated four times in a randomized complete block design. Each experimental unit consisted of eight 6-m rows, spaced 20 cm apart. Treatments were: LANCE WDG at 420 g/ha, QUADRIS at 500 mL/ha, SCALA at 2.0 L/ha, HEADLINE at 600 mL/ha, FOLICUR at 525 g/ha and ALEXIN at 4.0 L/ha. An untreated check was also included. Fungicides were applied on 17 August, 1,7 and 19 September. Fungicides were applied with a CO_2 backpack sprayer equipped with four TeeJet D-2 hollow cone nozzles spaced 40 cm apart and calibrated to deliver 250 L/ha at 240 kPa. Disease was assessed on 14 and 25 September and 2 October. Ten plants from each experimental unit were assessed for disease severity including ascochyta blight and powdery mildew based on the rating scale developed by Xue et al. 1996 (Table 1). Area Under the Disease Progress Curve (AUDPC) was calculated to compare relative susceptibility to disease and efficacy of the fungicides. The air temperatures in 2006 were below the long-term (10 year) average for September (14.3°C), August (19.2°C) and October (7.9°C) and above average for July (21.9°C). The long term (10 year) average temperatures were: July 20.3°C, August 19.1°C, September 15.6°C and October 8.8°C. Monthly rainfall was below the long-term (10 year) average for August (41 mm) and above average for July (72 mm), September (174 mm) and October (102 mm). The long-term (10 year) rainfall averages were: July 65 mm, August 59 mm, September 82 mm and October 56 mm. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.7. Means separation was obtained using Fisher's Protected LSD test at $P = 0.05$ level of significance.

RESULTS: As presented in Tables 2 and 3

CONCLUSIONS: Weather conditions during the trial were favourable for disease development of both fungi. Control of both powdery mildew and ascochyta blight was significantly different among treatment (Tables 2,3) Ascochyta blight pressure was high throughout the trial. HEADLINE and SCALA provided better control of ascochyta blight on all assessment dates than all other treatments. QUADRIS and FOLICUR also provided better control than LANCE, ALEXIN or the check. All fungicides except LANCE significantly

reduced ascochyta blight severity as determined by AUDPC compared to the check (Table 2). Disease pressure from powdery mildew was moderate in the trial. All fungicides significantly reduced powdery mildew in total AUDPC compared to ALEXIN and the check. FOLICUR provided the best disease control of powdery mildew of any treatment. On the 2 October assessment all fungicides significantly reduced disease severity compared to ALEXIN and the check (Table 3).

REFERENCES: Xue, A.G.,T.D. Warkentin, M.T. Greeniaus, and R.C. Zimmer. 1996. Genotype variability in seedborne infection of field pea by Mycosphaerella pinodes and its relation to foliar disease severity. Can. J. Plant Pathol. 18:370-374.

Table 1. The 0-9 scale used to assess foliar disease severity, (Xue et.al. 1996).

Severity score[1]	Plant Canopy Position		
	Upper	Middle	Lower
0	F	F	F
1	F	F	L
2	F	F	M
3	F	L	M
4	L	L	M
5	L	M	M
6	L	M	S
7	M	M	S
8	M	S	S
9	S	S	S

[1] F = free of disease, 0% of leaf/stem area with symptoms; L = light infection, 1-20% leaf/stem area with symptoms; M = moderate infection, 21-50% leaf/stem area with symptoms; S = severe infection, 50-100% leaf/stem area with symptoms

Table 2. Ascochyta severity ratings and Area Under the Disease Progress Curve (AUDPC) for fresh peas treated with various fungicides, grown near the Muck Crops Research Station, Holland Marsh, 2006.

Treatment	Rate /ha	Ascochyta Disease Severity (0-9) [1]			AUDPC
		14 Sep	25 Sep	2 Oct	
HEADLINE	600 mL	2.9 a[2]	2.8 a	3.3 a	61.6 a
SCALA	2.0 L	2.1 a	3.5 a	3.6 a	55.0 a
QUADRIS	500 mL	3.9 b	5.9 b	6.4 b	96.8 b
FOLICUR	525 mL	4.2 bc	6.8 c	7.1 c	109.2 c
LANCE	420 g	4.9 cd	7.6 cd	7.8 d	122.1 d
ALEXIN	4.0 L	4.5 bcd	8.3 d	8.3 de	127.6 d
Check	---	5.2 d	7.8 d	8.5 e	128.1 d

[1] Disease severity scale refer to Table 1 (Xue et.al. 1996)
[2] Figures followed by the same letter within a column are not significantly different using a Protected LSD (P<0.05)

Table 3. Powdery mildew severity ratings and Area Under the Disease Progress Curve (AUDPC) for fresh peas treated with various fungicides, grown near the Muck Crops Research Station, Holland Marsh, 2006.

Treatment	Rate /ha	Powdery mildew Severity (0-9) [1]			AUDPC
		14 Sep	25 Sep	2 Oct	
HEADLINE	600 mL	0.1 a[2]	0.2 a	0.1 a	3.4 a
SCALA	2.0 L	0.4 a	0.5 a	0.5 a	12.9 ab
QUADRIS	500 mL	0.3 a	0.8 ab	0.2 a	10.4 a
FOLICUR	525 mL	0.0 a	0.1 a	0.1 a	1.1 a
LANCE	420 g	2.3 b	1.5 ab	1.2 a	34.8 b
ALEXIN	4.0 L	2.8 b	3.4 c	3.2 b	69.0 c
Check	---	4.5 c	2.3 bc	5.0 c	71.1 c

[1] Disease severity scale refer to Table 1 (Xue et.al. 1996)
[2] Figures followed by the same letter within a column are not significantly different using a Protected LSD (P<0.05)

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2006 PMR REPORT #054

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases

CROP: Barley, cv. Westford
PEST: Loose smut - *Ustilago nuda*
Net blotch - *Pyrenophora teres*

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TITLE: EFFICACY OF FUNGICIDE SEED TREATMENTS ON CONTROL OF LOOSE SMUT AND ON YIELD OF SPRING BARLEY, 2006

MATERIALS: VITAFLO 280 (carbathiin 169.6 g ai/L, thiram 150.6 g ai/L), BAYTAN 30 (triadimenol 317 g ai/L), RAXIL FL (tebuconazole 6 g ai/L), RAXIL-T (tebuconazole 6.67 g ai/L, thiram 222.2 g ai/L), RAXIL MD (tebuconazole 5 g ai/L, metalaxyl 6.6 g ai/L), DIVIDEND XL RTA (difenoconazole 3.64% w:w, metalaxyl 0.27% w:w), GEMINI (triticonazole 14 g ai/L, thiram 140 g ai/L) and CHARTER (triticonazole 25 g ai/L)

METHODS: Spring barley seed, cv Westford, was treated with the materials and at the rates listed in Table 1. Plots were established on May 8, 2006, at a seeding rate of 300 viable seeds per m^2. Each plot was 5 rows wide and five metres long, with 15.6 cm between each row. Between each treatment plot was an equal sized wheat guard plot. Treatments were replicated four times in a randomized complete block design. Plots received a herbicide application of MCPA 500 (1 L/ha) plus REFINE EXTRA (20 g/ha) on June 15. Emergence counts were taken on 2 x 1 m of row prior to tillering. Seedling blight was rated on June 23, using a 0 - 9 scale (0 = disease free). On July 17, at ZGS 74, net blotch was rated on the penultimate and 3rd leaves of ten randomly selected tillers per plot, using the Horsfall and Barratt Rating System. Loose smut reductions were determined as the percentage of smutted heads per plot. The entire plot area was harvested, on Aug 14, using a small plot combine, and yield and thousand kernel weight determined.

RESULTS: Results are contained in Table 1. There was no significant effect on emergence, nor were there any significant effect of seed treatment on seedling blight or net blotch. Net blotch in 2006 was very variable. Several of the seed treatments had a significant effect on loose smut development. Yield effects following seed treatment was limited to BAYTAN 30, in this trial.

CONCLUSIONS: Loose smut levels were significantly reduced by all treatments, with the exception of DIVIDEND XL RTA. The most effective material, BAYTAN 30, provided for 100% loose smut control. Triticonazole containing materials, CHARTER and GEMINI, were less effective than BAYTAN 30, providing moderate loose smut control at 60.1 and 67.7% respectively. Tebuconazole containing materials behaved in a similar manner to VITAFLO 280, with an average reduction of 30.0%. Loose smut and yield response was not correlated in this study, even though the smut level in the trial was high. Based on the results of this trial, only BAYTAN 30 expressed a satisfactory loose smut control combined with a positive yield benefit, of 56.4%.

Table 1: Influence of fungicide seed treatments on spring barley, cv. Westford, Charlottetown, PEI, 2006

Treatment	Rate*	Emergence	Seedling Blight ZGS 43	Net Blotch 3rd leaf ZGS 74	Smut ZGS 87	Yield	1000 kwt
		(plants/m)	(0-9)	(%)	(%)	(Kg/ha)	(g)
Untreated Control		21.9	2.5	24.3	39.1	2031	35.97
VITAFLO 280	3.3	23.9	1.8	25	23.9	2038	34.43
BAYTAN 30	5	25.9	2.5	12.3	0	3177	34.88
RAXIL FL	3.25	22.4	2.5	20.7	27.8	2097	35.32
RAXIL T	2.25	25	2	23.1	26.7	2201	34.62
RAXIL MD	3.25	24.6	2.3	15	27.6	2171	34.2
DIVIDEND XL RTA	3.25	25.6	2.3	13.8	31.7	1964	35.11
DIVIDEND XL RTA	6.5	23.5	1.5	21.1	35.7	2038	35.44
CHARTER	2	21.5	2.3	13.5	15.6	2439	34.17
GEMINI	3.6	29.6	1.5	30.5	12.6	2379	33.99
LSD (0.05)		ns	ns	ns	9.06	534.3	1.705
SEM		5.846	0.541	4.83	3.12	184.1	0.587

* ml product/kg seed
SEM standard error of mean

2006 PMR REPORT #055

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases

CROP: Barley, cv.AC Sterling
PEST: Scald - *Rhychosporium secalis*
Net blotch - *Pyrenophora teres*

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TITLE: CORRELATION BETWEEN SCALD AND YIELD IN SPRING BARLEY FOLLOWING FUNGICIDE SEED TREATMENT

MATERIALS: VITAFLO 280 (carbathiin 169.6 g ai/L, thiram 150.6 g ai/L), BAYTAN 30 (triadimenol 317 g ai/L), RAXIL FL (tebuconazole 6 g ai/L), RAXIL-T (tebuconazole 6.67 g ai/L, thiram 222.2 g ai/L), RAXIL MD (tebuconazole 5 g ai/L, metalaxyl 6.6 g ai/L), DIVIDEND XL RTA (difenoconazole 3.64% w:w, metalaxyl 0.27% w:w), GEMINI (triticonazole 14 g ai/L, thiram 140 g ai/L), CHARTER (triticonazole 25 g ai/L), and an EXPERIMENTAL

METHODS: Spring barley seed, cv AC Sterling, was treated with the materials and at the rates listed in Table 1, using a Hege small batch seed treater. Plots were established on May 10, 2006, at a seeding rate of 300 viable seeds per m^2. Each plot was 10 rows wide and five metres long, with 17.8 cm between each row. Between each treatment plot was an equal sized wheat guard plot. Treatments were replicated four times in a randomized complete block design. Plots received a herbicide application of MCPA 500 (1 L/ha) plus REFINE EXTRA (20 g/ha) on June 15.
Emergence counts were taken on 2 x 1m of row prior to tillering. Seedling blight, early scald and early net blotch were all rated on June 23, using a 0 - 9 scale (0 = disease free). On July 14, at ZGS 74, net blotch and scald were rated on the penultimate and 3rd leaves of ten randomly selected tillers per plot, using the Horsfall and Barratt Rating System. A second rating was done at ZGS 82, on July 21. The entire plot area was harvested, on Aug 3, using a small plot combine, and yield and thousand kernel weight determined.

RESULTS: A summary of some results are contained in Table 1. Emergence ranged between 24.4 and 34 plants per m^2, but there was no significance (P=0.05). Similarly there was no significant impact on seedling blight or early net blotch (P=0.05), where diseased ranged from 2.3 to 3.0 and 1.3 - 2.5 respectively. There was no significant effect on late season net blotch or late season scald (P=0.05), as such only a representative set of data is presented in Table 1. Several of the treatments had positive effects on yield, while only BAYTAN 30 resulted in a significant increase in thousand kernel weight when compared to the untreated control.

CONCLUSIONS: Overall the most effective material tested was BAYTAN 30, providing significant reductions in early scald, with a significant increase in yield (26.0%) and thousand kernel weight (4.4%). While not significant there was also a reduction in late season net blotch and scald. VITAFLO 280, CHARTER and GEMINI also had a positive effect in control of early scald. However, only VITAFLO 280 and GEMINI also had a positive effect on yield, with an increase of 25.2 and 26.9% respectively. There was

also a small yield benefit from the confidential EXPERIMENTAL material, at 15.5%.
Scald, which is not usually severe in the region, had a significant effect on crop development, with a significant correlation between early scald and yield (R=0.643) and scald on the 1st leaf at ZGS 82 and yield (R=0.785). This would indicate that seed treatments which have an effect on foliar disease can be an effective control strategy in not only disease reduction but also on yield components.

Table 1: Influence of fungicide seed treatments on spring barley, cv. AC Sterling, Charlottetown, PEI, 2006

Treatment	Rate*	Scald June 23	Net Blotch 2nd leaf ZGS 82	Scald 1st leaf ZGS 82	Yield	1000 kwt
		(0-9)	(%)	(%)	(Kg/ha)	(g)
Untreated Control		5.5	51.4	30.9	3236	41.23
VITAFLO 280	3.3	3.8	31.7	17.3	4052	40.93
BAYTAN 30	5	1.3	34.1	5.5	4077	43.05
RAXIL FL	3.25	5	48.8	20.2	3744	41.35
RAXIL T	2.25	5	52.2	10.8	3713	41.62
RAXIL MD	3.25	4.5	52.7	29.6	3559	41.83
DIVIDEND XL RTA	3.25	6	66.3	14.3	3651	42.25
DIVIDEND XL RTA	6.5	4.3	48.8	26	3566	42.27
CHARTER	2	4	65.9	22.3	3663	42.2
GEMINI	3.6	4	62.5	12.3	4108	41.8
EXPERIMENTAL	3.6	5	61.6	18.5	3738	40.62
LSD (0.05)		1.33	ns	ns	492.6	1.053
SEM		0.459	9.59	8.02	170.6	0.365

* ml product/kg seed
SEM standard error of mean

2006 PMR REPORT #056 **SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases**

CROP: Spring Wheat, various cultivars and lines
PEST: Fusarium head blight, *Fusarium graminearum Schwabe*

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TITLE: RESPONSE TO FUSARIUM HEAD BLIGHT IN THE ONTARIO SPRING WHEAT PERFORMANCE TRIAL IN ARTIFICIAL INOCULATION TRIALS, PEI 2005/2006.

MATERIALS: Cultivars as indicated in Table 1

METHODS: The Ontario spring wheat performance trials were seeded in 2005 and 2006 in an area which was artificially inoculated with *Fusarium graminearum* and provided with misting from before anthesis to near maturity. Each cultivar or line was seeded using a Hege cartridge seeder which provided individual plots approximately 45-50 cm long in rows, 17.8 cm apart. Separation between sets of rows was approximately 40 cm. Each line and cultivar was replicated three times in a randomized complete block experimental design.
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 bubbled vigorously through the media for approximately 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 of water. The field was misted for 2 minute bursts every half hour at a rate of 660 L/ha.
Levels of fusarium head blight resistance was assessed based on visual symptoms in the field (FHB Index) and fusarium damage kernels (FDK). FHB Index was determined based on the product of a whole plot incidence rating (0 - 10, where zero was no head infected and 10 where all heads had some level of infection) and an average severity rating on those heads showing some level of FHB infection (0 - 10, where 10 was all infected heads entirely covered in symptoms). Fusarium damaged kernels were determined from a subsample of the harvested plot and percent damaged kernels calculated on a weight to weight basis.

RESULTS: Results are contained in Table 1.

CONCLUSIONS: There was no significant correlation between FHB index and FDK in 2005, however there was a significant linear relationship in 2006 (R=0.665). Where the same entries were tested in both years there was no significant correlation between FHB Index ratings. However there was an excellent linear relationship for the FDK between years (R=0.891). This indicated that the response of the entries was similar in both years.

A number of the entries exhibited moderate resistance to fusarium head blight. Over the two years, AC Brio, AC Barrie, Orleans and Nass demonstrate the best levels of resistance. Nass and Winfield had the lowest levels of FHB in 2005, a year with good visual disease symptoms in the field. Of the named lines, AC Foremost, Superb and Roblin were the most susceptible lines in both years. The test line ACS98735 had very high levels of FDK in 2006. ACS98735 belongs to the durum class of wheat which is as a whole versy susceptible to fusarium head blight. This class should not be promoted for production in areas where FHB is a problem.

While DON was not measured in the trials, there tends to be a good relationship between FDK and DON in field trials in PEI. Thus lines with low FDK expression should be promoted.

Table 1: Response of spring wheat cultivars and lines to fusarium head blight, 2004 and 2005.

Entry	2006 Fusarium head blight Incidence	Severity	Index	FDK	2005 Fusarium head blight Incidence	Severity	Index	FDK
	(0-10)	(0-10)	(0-100)	(%)	(0-10)	(0-10)	(0-100)	(%)
Quantum	6.3	4	25.3	26.5	8.3	8	66.7	18.2
AC Brio	6.3	3.7	23.3	12.3	7.7	7.3	56	8
B89:6:28:883	6.3	4.3	27.7	20	8	7.3	58.7	17.5
AC Barrie	6.3	4	25.3	11.7	7.7	7	53.7	8.7
Superb	6	3.7	22	28.5	8.3	7.3	61.3	23.8
Nass	5.7	3.7	21	16.1	6.7	6.7	44.3	13.2
AC Foremost	7	4.7	33	53.6	8.3	7.7	64	31.8
Orleans	6	4	24	13.4	8	8	64	11.9
Winfield	5.7	4	22.7	21.8	6.3	6	38	13.8
CM606	7	4.3	30.3	22.1	8	7.3	58.7	17.7
Hoffman	6	3.7	22	20.4	6	6	36	13.9
Brookfield	6.3	5	30.3	28.1	6.7	7	46.7	17.6
Norwell	6	3	18	13.6	8.3	7.7	63.7	14.9
Sable	6	4	24	19.4	7.3	6.7	48	10.8
Hobson	7	4	28	24.2				
5602HR	5.7	4	22.7	22.2	6.3	6.3	40	11.5
CM790	6.3	3	19	20.9				
ACS98735	6.7	4.7	31.3	53.6				
SW124-003	6	3.7	22	20.6				
BS00-708	6	3.3	19.7	11				
CRGB-0-623.4	5.7	3.7	21	18.3				
Roblin	6.3	3.7	23.3	32				
AW571	5.7	3.7	20.7	19.6				
Celtic	6.7	3.7	24.7	25.7				

Table 1 (cont'd)

Snowbird	6.3	3.3	21.3	14.8				
Arion					7	7	49	16.2
W98095					8.7	7.7	66.7	14.2
Torka					6.7	6.3	42.3	20.2
SS Fundy					7.3	7	51.3	21.5
PT211					8.3	8	66.7	16.7
AC Helena*	5.3	3.3	17.7	19.8	7.3	7	51.3	18.4
LSD (0.05)	0.99	0.88	6.56	9.97	0.88	1.09	9.3	8.65

ns - not significant
FDK - fusarium damaged kernels
* AC Helena is a cultivar common in the Atlantic Region and is added to the trial as a regional check

2006 PMR REPORT #057

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS-Diseases

CROP: Winter wheat (*Triticum aestivum* L.), cv. several
PEST: Fusarium head blight**,** *Fusarium graminearum* Schwabe

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TITLE: SUSCEPTIBILITY OF WINTER WHEAT VARIETIES TO FUSARIUM HEAD BLIGHT (FHB), FUSARIUM DAMAGED KERNELS (FDK) AND DEOXYNIVALENOL (DON) ACCUMULATION IN INOCULATED AND MISTED PLOTS-ONTARIO PERFORMANCE TRIAL

METHODS: Winter wheat cultivars were planted on October 19, 2005 in Ridgetown, Ontario. The plots were planted in a randomized block design with four replications in 4-m long single rows, spaced 17.8 cm apart; fertilized and maintained using provincial recommendations. Each plot was inoculated with a combined suspension of macro conidia of four *Fusarium graminearum* isolates at 50,000 spores/ml, when primary wheat heads were at 50% anthesis for each variety (Zadoks growth stage, ZGS 65). The suspension was produced in liquid shake culture using modified Bilay medium. Plots were misted daily beginning after the first plots were inoculated. The mist system was engaged until three days after the last variety was inoculated. The overhead mister 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). Twenty wheat heads were selected at random out of each plot, and rated for disease incidence and severity using the scoring system developed by Stack and McMullen (1994). Disease levels were calculated as fusarium head blight index (FHBI), which was the product of the percent heads infected and the percent spikelets infected, divided 100. Deoxynivalenol (DON) content was estimated from the three replications with the highest mean FHB index using a quantitative fluorometric test-FluoroQuan (Romer Labs, Inc, Union MO). A twenty-five gram sub-sample was taken randomly from each sample. Fusarium damaged kernels (FDK) were removed, weighed and the percent of FDK was calculated for each line.

RESULTS: The results are given below.

CONCLUSIONS: Range for FHB index, FDK and DON values were 0.4-42.0%, 1.6-13.7% and 1.3-27.6 ppm, respectively. The highest correlation was between FDK and DON ($r=0.76$, $P<0.001$), while correlations between FHB index and FDK and between FHB index and DON were $r=0.55$ ($P<0.001$) and $r=0.45$ ($P<0.001$), respectively. Variety OAC99R:21P had lowest FHB index, OTF010:077 had lowest FDK level and TW98617 had lowest DON content.

Table 1: Fusarium head blight index (%), % of Fusarium damaged kernels (FDK) and deoxynivalenol (DON) content (ppm) in inoculated and misted plots-Winter Wheat Performance test. Ridgetown, Ontario. 2005-2006.

No.	Winter wheat cultivar	Severity %	Incidence %	FHB index %	FHBI Rank	FDK %	FDK Rank	DON ppm	DON Rank
1	AC RON	19.7	73.4	15.2	28	3.4	14	4.1	17
2	AC MORLEY	4.2	35.6	1.6	3	2.7	6	1.7	3
3	SUPERIOR	7.4	45.0	3.5	9	3.0	9	3.0	10
4	AC MACKINNON	22.5	85.0	19.5	36	4.8	28	12.8	37
5	AC MOUNTAIN	15.1	71.7	13.3	24	2.8	8	5.2	20
6	MAXINE	19.8	96.7	22.0	38	12.5	44	27.6	45
7	WISDOM	17.7	95.0	17.0	32	9.1	39	12.9	39
8	WARWICK	14.1	90.0	12.9	23	3.8	20	9.1	33
9	WARTHOG	5.7	41.7	2.9	6	3.3	12	2.9	7
10	25R23	7.1	53.3	5.2	13	6.1	35	7.1	25
11	HARVARD	33.1	100.0	33.1	44	13.7	45	14.7	41
12	CARLISLE	11.1	80.0	9.8	18	6.0	32	14.0	40
13	VIENNA	10.3	66.7	8.8	16	2.7	7	4.1	16
14	FT WONDER	5.6	47.9	7.4	15	1.9	2	3.0	9
15	AC SAMPSON	32.1	100.0	32.1	43	4.3	21	2.7	6
16	25R47	13.0	86.7	12.3	22	4.7	26	8.4	31
17	RC STRATEGY	17.8	91.7	16.5	31	4.7	27	7.8	28
18	TWF020:038	4.2	31.7	1.5	2	2.0	3	3.1	11
19	25W41	3.3	38.4	2.8	5	5.1	29	11.5	34
20	TRIBUTE	32.8	90.0	30.9	42	6.0	33	5.0	19
21	GENESIS-D8006W	29.2	96.7	28.3	40	9.5	41	17.8	44
22	EMMIT	18.2	80.0	16.3	29	4.3	22	3.6	13
23	GENESIS:D6234W	13.0	65.0	9.2	17	4.3	23	6.8	23
24	GENESIS:E1007R	6.3	56.7	4.6	12	3.2	11	8.3	29
25	GENESIS:R045	28.7	95.0	27.3	39	4.6	24	7.1	26
26	IL98:5258	16.2	83.4	14.4	27	9.5	42	12.8	38
27	ACS51043	14.4	80.0	10.8	19	7.3	38	4.0	15
28	CM708	42.9	96.7	42.0	45	6.0	34	15.7	42
29	W2:912	13.3	80.0	10.9	20	4.6	25	7.4	27
30	PRC0220	7.1	43.4	4.3	11	3.5	16	2.6	5
31	OTF010:077	17.8	65.0	14.4	25	1.6	1	1.4	2
32	95:056:186	20.6	88.4	19.4	35	2.2	5	4.0	14
33	TW122:001	9.3	61.7	6.2	14	3.5	17	3.2	12
34	HONDO	3.4	33.0	2.9	7	3.7	19	3.0	8
35	TW070:015	14.1	76.7	11.2	21	5.3	30	12.5	35
36	ADV0201SR	20.1	88.3	18.4	34	3.3	13	5.5	21
37	TW98617	5.3	26.7	1.7	4	2.1	4	1.3	1
38	KV12401	5.6	50.0	3.9	10	3.0	10	6.8	24
39	GENESIS:R055	15.8	91.7	14.4	26	9.2	40	16.1	43
40	GENESIS:E1009	5.3	54.9	3.2	8	3.6	18	4.8	18
41	XW04A	22.4	90.0	20.2	37	7.0	37	8.9	32
42	IL97:2422	16.7	96.7	16.3	30	6.2	36	8.4	30

Table 1 (cont'd)

43	IL00:1665	19.6	91.7	18.1	33	5.5	31	12.6	36
44	OAC99R:21P	2.0	18.3	0.4	1	3.4	15	2.0	4
45	SECANHR101	31.2	95.0	28.9	41	9.7	43	5.6	22
	Mean	15.2	71.8	13.5		5.0		7.6	
	LSD (*P*=.05)	10.8	24.4	11.4		4.0		8.6	
	CV	50.6	24.3	60.6		56.1		69.8	

2006 PMR REPORT #058

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS-Diseases

CROP: Winter wheat (*Triticum aestivum* L.), cv. several
PEST: Fusarium head blight, *Fusarium graminearum* Schwabe

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TITLE: SUSCEPTIBILITY OF WINTER WHEAT VARIETIES TO FUSARIUMHEAD BLIGHT (FHB) AND FUSARIUM DAMAGED KERNELS (FDK)IN INOCULATED AND MISTED PLOTS- ORTHOGONAL BREAD TRIAL

METHODS: Winter wheat cultivars were planted on October 19, 2005 in Ridgetown, Ontario. The plots were planted in a randomized block design with four replications in 4-m long single rows, spaced 17.8 cm apart; fertilized and maintained using provincial recommendations. Each plot was inoculated with a combined suspension of macro conidia of four *Fusarium graminearum* isolates at 50,000 spores/ml, when primary wheat heads were at 50% anthesis for each variety (Zadoks growth stage, ZGS 65). The suspension was produced in liquid shake culture using modified Bilay medium. Plots were misted daily beginning after the first plots were inoculated. The mist system was engaged until three days after the last variety was inoculated. The overhead mister delivered about 7.5 mm of water daily. Each variety was assessed for visual symptoms when the early dough stage was reached (ZGS 83). Twenty wheat heads were selected at random out of each plot, and rated for disease incidence and severity using the scoring system developed by Stack and McMullen (1994). Disease levels were calculated as fusarium head blight index (FHBI), which was the product of the percent heads infected and the percent spikelets infected, divided by 100. Plots were harvested in mid July, 2006. A twenty-five gram sub-sample was taken randomly from each sample. Fusarium damaged kernels (FDK) were removed, weighed and the percent of FDK was calculated for each line.

RESULTS: The results are given below.

CONCLUSIONS: Range for FHB index and FDK values were 3.0-67.2% and 0.5-14.3 %, respectively. The correlation between FHB index and FDK was r=0.69 (P<0.001). Variety SCN007-012 had lowest FHB index and FDK level.

Table 1: Fusarium head blight index (%) and % of Fusarium damaged kernels (FDK) in inoculated and misted plots. Ridgetown, Ontario. 2005-2006.

No.	Winter wheat cultivar	Severity (%)	Incidence (%)	FHB index (%)	FDK (%)
1	AC MORLEY	8	55.6	4.9	1.0
2	MAXINE	27.5	93.3	26.2	8.1
3	CARLISLE	21.5	91.7	20.3	8.1
4	ACS52012	42.4	100.0	42.4	6.0
5	ACS52062	11	60.4	10.0	3.1
6	BCG99-184	8.5	66.7	6.2	5.4
7	95-073-264	26.5	71.1	19.3	3.5
8	96-091-199	23.3	85.0	20.5	4.7
9	96-106-010	30.7	90.0	28.3	3.5
10	SCN003-023	6.7	66.7	4.5	1.5
11	SCN003-037	12.1	81.7	8.3	1.1
12	SCN007-012	5	51.1	3.0	0.5
13	NS 35/01	63.6	93.3	59.3	8.8
14	NS 75/01	39.6	100.0	39.6	8.8
15	NS 155/01	56.6	100.0	56.6	14.3
16	JEFIMIJA	33.7	97.8	33.3	5.5
17	CIPOVKA	49.1	100.0	49.1	10.0
18	ACS54037	19.3	78.3	15.1	4.9
19	ACS54047	67.2	100.0	67.2	4.2
20	CM191	58.6	100	58.6	7.5
21	CM192	15.3	90.0	14.0	5.1
22	TW063-039	28.9	91.1	26.5	4.7
23	W300-001	40.1	100.0	40.1	6.2
24	WF249-035	22.7	83.4	20.4	2.2
25	BC960048-1-3	54	100.0	54.0	6.2
26	RCAT-Akos 2234	10	48.9	6.4	2.0
	Mean	30.1	84.5	28.2	5.3
	LSD (*P*=.05)	13.6	21.1	14.5	3.0
	CV	31.9	17.6	36.4	40.6

2006 PMR REPORT #059

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS-Diseases

CROP: Winter wheat (*Triticum aestivum* L.), cv. several
PEST: Fusarium head blight, *Fusarium graminearum* Schwabe

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TITLE: SUSCEPTIBILITY OF WINTER WHEAT VARIETIES TO FUSARIUM HEAD BLIGHT (FHB) AND FUSARIUM DAMAGED KERNELS (FDK) IN INOCULATED AND MISTED PLOTS-ORTHOGONAL PASTRY TRIAL

METHODS: Winter wheat cultivars were planted on October 19, 2005 in Ridgetown, Ontario. The plots were planted in a randomized block design with four replications in 4-m long single rows, spaced 17.8 cm apart; fertilized and maintained using provincial recommendations. Each plot was inoculated with a combined suspension of macro conidia of four *Fusarium graminearum* isolates at 50,000 spores/ml, when primary wheat heads were at 50% anthesis for each variety (Zadoks growth stage, ZGS 65). The suspension was produced in liquid shake culture using modified Bilay medium. Plots were misted daily beginning after the first plots were inoculated. The mist system was engaged until three days after the last variety was inoculated. The overhead mister delivered about 7.5 mm of water daily. Each variety was assessed for visual symptoms when the early dough stage was reached (ZGS 83). Twenty wheat heads were selected at random out of each plot, and rated for disease incidence and severity using the scoring system developed by Stack and McMullen (1994). Disease levels were calculated as fusarium head blight index (FHBI), which was the product of the percent heads infected and the percent spikelets infected, divided by 100. Plots were harvested in mid July, 2006. A twenty-five gram sub-sample was taken randomly from each sample. Fusarium damaged kernels (FDK) were removed, weighed and the percent of FDK was calculated for each line.

RESULTS: The results are given below.

CONCLUSIONS: Range for FHB index and FDK values were 5.2-45.9% and 1.3-14.5%, respectively. The correlation between FHB index and FDK was r=0.46 (P<0.001). Variety RCAT-TF174 1/C had lowest FHB index and RCAT-23/1 had lowest FDK level.

Table 1: Fusarium head blight index (%) and % of Fusarium damaged kernels (FDK) in inoculated and misted plots. Ridgetown, Ontario. 2005-2006.

No.	Winter wheat cultivar	Severity (%)	Incidence (%)	FHB index (%)	FDK (%)
1	AUGUSTA	30.7	76.68	24.25	3.4
2	25R23	12.9	78.4	10.5	5.2
3	SUPERIOR	21.6	78.4	17.1	5.0
4	WISDOM	18.2	90.0	16.6	7.9
5	CM30013	23.3	96.7	22.4	5.4
6	GEN D8006R	25.9	93.3	24.5	6.6
7	GEN E0028	25.8	88.4	23.3	6.0
8	BRANSON (M00-3701)	26.5	91.7	24.2	7.0
9	TW110-062	45.9	100.0	45.9	5.9
10	ADV0301	16.1	93.3	15.0	4.6
11	ADV0305	27.6	98.3	27.0	4.4
12	ADV0406	24.6	91.7	22.9	7.1
13	ADV0411	23.6	86.7	21.5	9.7
14	ADV0414	15.8	71.7	14.6	7.4
15	CM0714	36.6	95.0	35.1	4.6
16	CM153	22.4	93.4	20.9	11.0
17	CM184	20.9	86.7	18.2	6.8
18	CM282	19.6	91.7	18.1	4.8
19	CM3534	30.1	65.9	28.8	6.8
20	FS636	16.9	96.7	16.4	3.9
21	FS646	19.8	93.3	18.4	4.9
22	95-055-199	31.8	83.3	25.6	4.8
23	96-052-007	43.4	96.7	42.0	5.1
24	SCN007-009	9.1	51.7	6.1	1.6
25	WF116-072	21.5	95.0	20.1	7.3
26	WF116-129	45.1	96.7	44.1	3.6
27	N030-049	24.9	96.7	24.1	4.9
28	GEN GB085R	14.4	96.7	14.0	4.3
29	GEN E2017	22.8	82.3	19.7	3.3
30	GEN 1007W	14.8	93.3	15.9	7.9
31	GEN GB062R	17.6	90.0	16.5	3.6
32	M01-4377	24.3	95.0	23.3	6.6
33	TW115-149	26.2	77.9	21.8	3.4
34	WF 182-051	9.9	75.0	7.6	3.1
35	WF 188-023	22.6	95.0	21.4	9.5
36	W960937D1	25.7	91.7	23.7	8.6
37	W960964N1	28.1	96.7	27.0	6.7
38	W960797E1	10.3	76.7	8.3	4.0
39	W961047T6	16.8	86.7	14.6	6.5
40	IL01-13,776	13.5	93.4	12.6	2.1
41	IL01-13,830	14	86.7	12.1	1.5
42	VA02W-713	17.1	86.7	14.6	5.8
43	VA03W-235	44.2	96.7	42.9	13.2
44	VA03W-409	45.5	98.3	44.7	14.5

Table 1 (cont'd)

45	VA03W-412	30.9	95.0	29.7	5.6
46	RCAT-TF 203/2	13.4	80.1	11.3	2.3
47	RCAT-TF 174/1C	11.4	42.5	5.2	3.1
48	RCAT-Akos 2290	16.1	88.4	14.0	2.8
49	RCAT-23/1	9.4	65.1	21.1	1.3
50	RCAT-13/18	18.5	91.7	16.9	3.6
	Mean	23	87.2	21.3	5.6
	LSD (*P*=.05)	13.2	20.8	14.0	3.0
	CV	41	17	47.0	39.0

2006 PMR REPORT # 060 **SECTION O: CEREALS, FORAGE CROPS and OILSEEDS-Diseases**

CROP: Winter wheat (*Triticum aestivum* L.), cv. several
PEST: Fusarium head blight, *Fusarium graminearum* Schwabe

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TITLE: NORTHERN UNIFORM WINTER WHEAT SCAB NURSERY (NUWWSN)-EVALUATION OF WINTER WHEAT CULTIVARS AND BREEDING LINES FOR RESISTANCE TO FUSARIUM HEAD BLIGHT (FHB) IN INOCULATED AND MISTED PLOTS

METHODS: Winter wheat lines were planted on October 19, 2005 in Ridgetown, Ontario. The plots were planted in a randomized block design with four replications in 4-m long single rows, spaced 17.8 cm apart; fertilized and maintained using provincial recommendations. The breeding lines represent Northern Uniform Winter Wheat Scab Nursery (NUWWSN) established across North America. Five lines from Canada (Ridgetown Campus, University of Guelph FHB breeding program) were entered to the test. The plots were fertilized and maintained using provincial recommendations. Heading date was recorded for each line. Each plot was inoculated with a combined suspension of macro conidia of four *Fusarium graminearum* isolates at 50,000 spores/ml, when primary wheat heads were at 50% anthesis for each variety (Zadoks growth stage, ZGS 65). The suspension was produced in liquid shake culture using modified Bilay medium. Plots were misted daily beginning after the first plots were inoculated. The mist system was engaged until three days after the last variety was inoculated. The overhead mister delivered about 7.5 mm of water daily. Each variety was assessed for visual symptoms when the early dough stage was reached (ZGS 83). Twenty wheat heads were selected at random out of each plot, and rated for disease incidence and severity using the scoring system developed by Stack and McMullen (1994). 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, divided by 100.

RESULTS: The results are given in the Table 1.

CONCLUSIONS: Range for FHB index was 1.6-48.9%. MSU line E2042 had the lowest, while line MV 6-82 had the highest FHB index. Heading date significantly negatively correlated with FHB index ($r=-0.44$, $P<0.001$).

Table 1: Fusarium head blight reaction of winter wheat breeding lines (NUWWSN test) in inoculated and misted plots at Ridgetown, Ontario. 2005-2006.

No.	Winter wheat lines	Heading date*	Severity (%)	Incidence (%)	FHB Index (%)
1	ERNIE	144	23.5	91.7	22.1
2	TRUMAN	148	8.1	48.3	4.5
3	FREEDOM	146	12.3	73.3	9.7
4	PIONEER 2545	145	48.9	100	48.9
5	IL00-8061	145	19.5	75	17.4
6	IL00-8109	144	30.5	96.7	30.1
7	IL00-8530	144	38.5	65.9	26.9
8	IL01-11445	144	13.9	73.4	10.5
9	IL01-11934	145	20.8	88.4	19.7
10	MSU Line E0001	149	10	68.3	8.4
11	MSU Line E2017	149	19.4	81.7	16.6
12	MSU Line E2041	146	31.4	79.2	27.6
13	MSU Line E2042	149	3.5	38.3	1.6
14	MV 6-82	146	49.6	93.3	48.9
15	NE02465	146	11.8	68.3	9.2
16	NE02584	146	10.4	56.7	8.6
17	NE03490	148	5.2	69.9	2.8
18	NH01046	147	9.2	48.4	5.2
19	NI02425	146	26.2	93.3	25
20	OH02-12678	146	19.7	90	18.3
21	OH02-12686	148	11.2	56.7	7.5
22	OH02-13567	146	17.5	73.4	15.6
23	OH02-7217	147	16	81.7	14.3
24	OH904	141	22.9	75	20.1
25	P.0128A1-36	143	13	65	8.7
26	P.0172A1-12	143	12.3	70	9.2
27	P.0175A1-44	146	11.3	75	8.5
28	P.01931A1-5	144	21.3	85	19
29	P.01946A1-16	143	47.5	87.5	37.5
30	RCAT 202D/ 1	146	10.5	76.7	8.5
31	RCAT 32/157	148	9.5	55	5.2
32	RCAT Akos 2234	148	11.2	61.7	8.8
33	RCAT TF 203/2	147	11.6	66.7	9.5
34	RCAT19/4c	149	14.5	61.7	10.4
35	VA04W-563	145	46	84.2	35.3
36	VA04W-592	144	24.2	96.7	23.6
37	VA05W-417	146	9.5	68.3	6.9
38	VA05W-421	146	8.6	61.7	5.4
39	VA05W-452	146	39.8	80.8	28.7
40	M01-4377	145	30.9	98.3	30.6
41	COKER 9553	143	32.9	100	32.9
42	KY97c-0554-4-6	146	27.7	96.7	27.2
43	KY97c-0540-1-2	146	33.3	93.3	32.7

Table 1 (cont'd)

44	KY 97c-0388-5-2	148	22.8	80	21.3
45	KY97c-0304-26-10	146	21.2	81.7	18.4
46	KY97c-0277-1-8	146	19.1	83.4	17.4
47	KS03HW12-6-5	146	15.2	88.3	14
48	KS970085-9-15	144	38.6	93.3	37.5
49	MO050101	146	24.4	85	22.2
50	MO050143	146	31.7	75.8	20
51	MO050132	146	18.3	88.3	16.8
52	MO050194	146	14.2	73.3	11.1
53	MO050207	146	19.5	83.3	17.6
54	NY93285-9161	149	7.5	46.7	4.3
55	NY92237-1-sp-9173	148	10.4	61.7	6.4
56	NY94022-9093	149	41.9	91.7	39.1
57	NY93285-9147	149	7.3	30	2.2
58	NY93285-9179	149	8.3	43.3	4.4
	Mean	146	20.6	75.5	18.1
	LSD (*P*=.05)	2.7	19.9	29.1	17.6
	CV	7.4	69.1	27.5	73.5

*(from January 1)

2006 PMR REPORT #061

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases

CROP: Winter wheat (*Triticum aestivum* L.), cv. several
PEST: Fusarium head blight, *Fusarium graminearum* Schwabe

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TITLE: PRELIMINARY NORTHERN UNIFORM WINTER WHEAT SCAB NURSERY (PNUWWSN)-EVALUATION OF WINTER WHEAT BREEDING LINES FOR RESISTANCE TO FUSARIUM HEAD BLIGHT (FHB) IN INOCULATED AND MISTED PLOTS

METHODS: Winter wheat lines were planted on October 19, 2005 in Ridgetown, Ontario. The plots were planted in a randomized block design with four replications in 4-m long single rows, spaced 17.8 cm apart; fertilized and maintained using provincial recommendations. The breeding lines represent Preliminary Northern Uniform Winter Wheat Scab Nursery (PNUWWSN)-established across North America. Four lines from Canada (Ridgetown Campus, University of Guelph FHB breeding program) were entered to the test. The plots were fertilized and maintained using provincial recommendations. Each plot was inoculated with a combined suspension of macro conidia of four *Fusarium graminearum* isolates at 50,000 spores/ml, when primary wheat heads were at 50% anthesis for each variety (Zadoks growth stage, ZGS 65). The suspension was produced in liquid shake culture using modified Bilay medium. Plots were misted daily beginning after the first plots were inoculated. The mist system was engaged until three days after the last variety was inoculated. The overhead mister delivered about 7.5 mm of water daily. Each variety was assessed for visual symptoms when the early dough stage was reached (ZGS 83). Twenty wheat heads were selected at random out of each plot, and rated for disease incidence and severity using the scoring system developed by Stack and McMullen (1994). 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, divided by 100.

RESULTS: The results are given in the Table 1.

CONCLUSIONS: Line KY98c-1164-04 had the lowest, while variety Pioneer 2545 had the highest FHB index. Correlation between FHB index and severity was r=0.99 ($P<0.001$) and between FHB index and incidence was r=0.77 ($P<0.001$).

Table 1: Fusarium head blight reaction of winter wheat breeding lines (PNUWWSN test) in inoculated and misted plots at Ridgetown, Ontario. 2005-2006.

No.	Winter wheat lines	Severity (%)	Incidence (%)	FHB Index (%)
1	ERNIE	14	75	12.2
2	TRUMAN	7.1	60	4.6
3	FREEDOM	9.9	70	6.7
4	PIONEER 2545	61.3	95	58.8
5	IL00-8641	19.3	90	17.9
6	IL01-16170	11.7	78.3	9.4
7	IL02-18146	23.3	80	22.2
8	IL02-19463	8.9	75	6.4
9	IL02-7735	20.1	68.3	15.8
10	MSU Line E1009	17.2	78.3	16.1
11	OH01-6167	11.8	58.3	7.8
12	OH01-7653	10.2	70	8.3
13	OH02-15978	32.4	98.3	32.1
14	OH02-5512	16.2	86.7	14.3
15	OH776	42.4	95	39.9
16	P.011034A1-3	29.4	90	28.2
17	P.011035A1-71	31	91.7	27.8
18	P.011050A1-13	27.5	93.3	26.9
19	P.011099A1-2	12.3	65	10.2
20	P.011151B1-93	26.9	93.3	26
22	RCAT 32/35B	22.4	98.3	22
23	RCAT Akos 2290	6.3	61.7	3.9
24	RCAT F13	12.4	71.7	9.7
25	RCAT TF174/1c	6.3	61.7	4.2
26	VA05W-464	34.3	100	34.3
27	VA05W-510	32.4	98.3	32.1
28	VA05W-517	19.1	91.7	18.1
29	VA05W-673	27.2	90	23.7
30	VA05W-681	29.9	93.3	29.3
31	M00-3904-9	18.1	93.3	17.1
32	M02-2152	28.8	93.3	27.8
33	M02*2518	15.6	85	13.7
34	M03-3002	14.2	81.7	12.3
35	KY98c-1161-03	21.7	91.7	20.4
36	KY98c-1305-02	10.2	71.7	7.2
37	KY98c-1169-06	19.8	91.7	18.5
38	KY98c-1164-04	4.2	36.7	2.3
39	KY98c-1470-02	34.8	86.7	29.2
	Mean	20.4	81.2	18.5
	LSD (*P*=.05)	14.9	24.3	15
	CV	52.1	21.3	58

*(from January 1)