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2005 Pest Management Research Report (PMRR)
2005 Growing Season

2005 Rapport de recherches sur la lutte dirigée (RRLD)
pour le saison 2005

Canada

2005 Pest Management Research Report (PMRR)
2005 Growing Season

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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 seen by the ECIPM as an integral part in the formulation of sound pest management strategies. If in doubt about the registration status of a particular product, consult the Pest Management Regulatory Agency, Health Canada at 1-800-267-6315.

This year there were 103 reports. The Expert Committee on Integrated Pest Management is indebted to the researchers from provincial and federal departments, universities, and industry who submitted reports, for without their involvement there would be no report. Special thanks is also extended to the section editors for reviewing the scientific content and merit of each report, and 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.**

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. 2005. Pest Management Research Report - 2005 Growing Season. Expert Committee on Integrated Pest Management. February, 2005. Report No. x. 44: pp-pp.

2005 PEST MANAGEMENT RESEARCH REPORT INDEX

2005 PMR REPORT # 01

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

CROP: Apple cv. McIntosh
PESTS: Codling Moth, *Cydia pomonella* (L.); Oblique Banded Leafroller, *Choristoneura rosaceana* (Harris); Oriental Fruit Moth, *Grapholita molesta* (Busck); Plum Curculio, *Conotrachelus nenuphar* (Herbst); Spotted Tentiform Leafminer, *Phyllonorycter blancardella* (Fabr.)

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TITLE: **ASSESSMENT OF INSECTICIDES AGAINST CODLING MOTH, OBLIQUE BANDED LEAFROLLER, ORIENTAL FRUIT MOTH, PLUM CURCULIO AND SPOTTED TENTIFORM LEAFMINER. 2005**

MATERIALS: DPX-E2Y45 35 WG, ASSAIL 70 WP (acetamiprid), INTREPID 2F (methoxyfenozide)

METHODS: The trial was conducted in a ten-year-old 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 four rates of DPX-E2Y45 35 WG (25 g a.i./ha, 50 g a.i./ha, 75 g a.i./ha and 100 g a.i./ha) to single rates of ASSAIL (168 g a.i./ha), INTREPID (240 g a.i./ha) and an unsprayed control. There were two applications of each insecticide. Insecticides were applied 9 June (132.9 DD_{10} after first trap catch of first generation Codling Moth (CM) (26 May)) and 28 July (33.9 DD_{10} after first trap catch of second generation Codling Moth (25 July)). 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. Approximately 6-7 L of spray mix were used per plot; pressure was set at 2000 kPa. On 22 June, fifty apples per plot (twenty-five apples per tree) were visually assessed for internal Lepidoptera (a mixed population of Codling Moth (CM) and Oriental Fruit Moth (OFM)) and Plum Curculio (PC) damage. Efficacy was expressed as percent fruit damaged by each pest. On 8 July, fifty apples per plot were harvested, weighed and examined for internal Lepidoptera and PC damage. Efficacy was expressed as percent fruit damaged by each pest. On 17 August, fifty leaves per plot were harvested and examined for Spotted Tentiform Leafminer (STLM) mines. On 18 August, fifty apples per plot were harvested, weighed and examined for damage by CM, OFM and Oblique Banded Leafroller (OBLR). Apples with internal feeding damage were cut open and live larvae were assessed for presence or lack of an anal comb (OFM has an anal comb) to determine species. If no live larvae were found, pest species was assessed by location of feeding injury. Efficacy was expressed as percent fruit damaged by each pest. Data were analyzed using analysis of variance and means were separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Tables 1, 2, 3, 4, 5 and 6. No phytotoxic effects were observed in any plots at any evaluation date (assessed 15 June, 21 June, 4 August and 10 August). Forty live larvae were found in the 18 August sample, of which 10% (4/40) were OFM.

CONCLUSIONS: In both the 22 June and 8 July samples, all treatments significantly reduced internal Lepidoptera damage as compared to the control (Table 1). There were no significant differences in PC damage by any of the treatments in the 22 June and 8 July sample (Table 2). There were no significant differences in OFM damage in any of the treatments in the 18 August sample (Table 3). In the 18 August sample, only the two highest rates of DPX-E2Y45 significantly reduced CM damage as compared to the control (Table 3). There were no significant differences in OBLR damage in any of the treatments in the 18 August sample (Table 4). In the 17 August sample for STLM mines, all treatments except for INTREPID significantly reduced the number of mines compared to the control (Table 5). ASSAIL and the two highest rates of DPX-E2Y45 had significantly fewer mines per sample as compared to INTREPID (Table 5). There

were no significant differences in the number of STLM mines per sample between ASSAIL and any of the rates of DPX-E2Y45 (Table 5). There were no weight differences in the total weight of the apples in any of the treatments at either harvest date (Table 6).

Table 1. Percent fruit damage by internal Lepidoptera.

Treatment[1]	Rate (g a.i./ha)	% fruit damage (22 June)	% fruit damage (8 July)
DPX-E2Y45 35 WG	25	2.0 b[2]	8.5 b
DPX-E2Y45 35 WG	50	1.5 b	6.0 b
DPX-E2Y45 35 WG	75	1.5 b	4.0 b
DPX-E2Y45 35 WG	100	0.5 b	2.5 b
INTREPID 2F	240	3.0 b	11.0 b
ASSAIL 70 WP	168	2.0 b	9.5 b
CONTROL	-	12.0 a	22.5 a

[1] Applied 9 June, reapplied 28 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent fruit damage by Plum Curculio.

Treatment[1]	Rate (g a.i./ha)	% fruit damage (22 June)	% fruit damage (8 July)
DPX-E2Y45 35 WG	25	3.0 a[2]	6.5 a
DPX-E2Y45 35 WG	50	4.0 a	2.5 a
DPX-E2Y45 35 WG	75	6.0 a	7.0 a
DPX-E2Y45 35 WG	100	4.5 a	3.5 a
INTREPID 2F	240	2.0 a	3.0 a
ASSAIL 70 WP	168	6.5 a	8.5 a
CONTROL	-	5.5 a	6.5 a

[1] Applied 9 June, reapplied 28 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 3. Percent fruit damage by Codling Moth (second generation) and Oriental Fruit Moth.

Treatment[1]	Rate (g a.i./ha)	% CM fruit damage (18 August)	% OFM fruit damage (18 August)
DPX-E2Y45 35 WG	25	17.0 ab[2]	3.5 a
DPX-E2Y45 35 WG	50	17.0 ab	5.0 a
DPX-E2Y45 35 WG	75	9.5 b	0.0 a
DPX-E2Y45 35 WG	100	4.0 b	0.0 a
INTREPID 2F	240	18.5 ab	1.0 a
ASSAIL 70 WP	168	12.5 ab	3.5 a
CONTROL	-	29.5 a	1.5 a

[1] Applied 9 June, reapplied 28 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 4. Percent fruit damage by Oblique Banded Leafroller.

Treatment[1]	Rate (g a.i./ha)	% OBLR fruit damage (18 August)
DPX-E2Y45 35 WG	25	7.0 a[2]
DPX-E2Y45 35 WG	50	10.0 a
DPX-E2Y45 35 WG	75	2.0 a
DPX-E2Y45 35 WG	100	5.0 a
INTREPID 2F	240	5.5 a
ASSAIL 70 WP	168	5.5 a
CONTROL	-	2.0 a

[1] Applied 9 June, reapplied 28 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 5. Number of Spotted Tentiform Leafminer mines per fifty leaves.

Treatment[1]	Rate (g a.i./ha)	# STLM mines/50 leaves (17 August)
DPX-E2Y45 35 WG	25	8.0 bc[2]
DPX-E2Y45 35 WG	50	13.0 bc
DPX-E2Y45 35 WG	75	1.8 c
DPX-E2Y45 35 WG	100	2.3 c
INTREPID 2F	240	21.5 ab
ASSAIL 70 WP	168	0.0 c
CONTROL	-	32.3 a

[1] Applied 9 June, reapplied 28 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 6. Total weight of fifty fruit.

Treatment[1]	Rate (g a.i./ha)	Weight (g) (8 July)	Weight (g) (18 August)
DPX-E2Y45 35 WG	25	1235.6 a[2]	3375.0 a
DPX-E2Y45 35 WG	50	1131.2 a	3329.5 a
DPX-E2Y45 35 WG	75	1145.1 a	3262.8 a
DPX-E2Y45 35 WG	100	1207.9 a	3294.0 a
INTREPID 2F	240	1197.1 a	3188.3 a
ASSAIL 70 WP	168	1227.3 a	3307.8 a
CONTROL	-	1095.3 a	3313.3 a

[1] Applied 9 June, reapplied 28 July.
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2005 PMR REPORT # 02

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 INSECTICIDES; 2005**

MATERIALS: DPX-E2Y45 35 WG, 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. On 4 July, insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Plots were sampled 14 July (10 days after 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 14 July for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). A sample was taken 2 September to examine the effects of treatments on yield; 20 bunches were collected per plot, and average bunch weight was 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 and 2. No phytotoxic effects were observed in any plots.

CONCLUSIONS: All treatments reduced grape berry moth damage, GBM damage was observed to decline with increasing rate of E2Y45, but these rate effects were not statistically different. The addition of HASTEN (0.25% v/v) did not significantly increase efficacy of E2Y45 at 75 g a.i./ha. No effects on yield were observed in any of the treated plots.

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

Treatment	Rate (a.i./ha)	% Infested Bunches 10 Days after Application (14 July)
GUTHION 240 SC[1]	1.8 kg	9.0 B[3]
E2Y45 35 WG	100 g	9.5 B
E2Y45 35 WG[2]	75 g	15.0 B
E2Y45 35 WG	75 g	18.0 B
E2Y45 35 WG	50 g	26.0 B
CONTROL	-	57.0 A

[1] Applied 4 July
[2] Applied 4 July, HASTEN 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 and yield data.

Treatment	Rate (a.i./ha)	Phytotoxicity Rating (0-100) 10 Days after Application (14 July)	Average Bunch Weight (g) (2 September)
GUTHION 240 SC[1]	1.8 kg	0.0 A	49.0 A[3]
E2Y45 35 WG	100 g	0.0 A	54.1 A
E2Y45 35 WG[2]	75 g	0.0 A	54.8 A
E2Y45 35 WG	75 g	0.0 A	48.4 A
E2Y45 35 WG	50 g	0.0 A	46.1 A
CONTROL	-	0.0 A	52.5 A

[1] Applied 4 July
[2] Applied 4 July, HASTEN added at 0.25% v/v
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2005 PMR REPORT # 03

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

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

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TITLE: **CONTROL OF GRAPE BERRY MOTH WITH INSECTICIDES; 2005**

MATERIALS: DPX-E2Y45 35 WG, 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. Foch 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 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. On 4 August, insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Plots were sampled 16 August (12 days after 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 16 August for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). A sample was taken 2 September to examine the effects of treatments on yield; 20 bunches were collected per plot, and average bunch weight was 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 and 2. No phytotoxic effects were observed in any plots.

CONCLUSIONS: All treatments reduced grape berry moth damage, GBM damage was observed to decline with increasing rate of E2Y45, but no difference was observed between the 75 g a.i./ha and 100 g a.i./ha rates. The addition of HASTEN (0.25% v/v) to the 75 g a.i./ha rate of E2Y45 resulted in less GBM damage than the 50 g a.i./ha rate of E2Y45, but this treatment was not different from the 75 g a.i./ha of E2Y45 alone. No effects on yield were observed in any of the treated plots.

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

Treatment	Rate (a.i./ha)	% Infested Bunches 12 Days after Application (16 August)
E2Y45 35 WG[1]	100 g	9.0 C
E2Y45 35 WG[2]	75 g	9.0 C
GUTHION 240 SC	1.8 kg	13.0 BC
E2Y45 35 WG	75 g	13.0 BC
E2Y45 35 WG	50 g	17.0 B
CONTROL	-	53.0 A

[1] Applied 4 August
[2] Applied 4 August, HASTEN added at 0.25% v/v
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent grape bunches infested by grape berry moth; yield data.

Treatment	Rate (a.i./ha)	Phytotoxicity Rating (0-100) 12 Days after Application (16 August)	Average Bunch Weight (g) (2 September)
E2Y45 35 WG[1]	100 g	0.0 A	51.3 A[3]
E2Y45 35 WG[2]	75 g	0.0 A	52.2 A
GUTHION 240 SC	1.8 kg	0.0 A	51.5 A
E2Y45 35 WG	75 g	0.0 A	48.2 A
E2Y45 35 WG	50 g	0.0 A	49.2 A
CONTROL	-	0.0 A	51.3 A

[1] Applied 4 August
[2] Applied 4 August, HASTEN added at 0.25% v/v
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2005 PMR REPORT # 04

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

CROP: Grapes cv. Baco Noir
PEST: Grape Berry Moth, *Endopiza viteana* (Clemens); Japanese Beetle, *Popillia japonica* Newman

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TITLE: **CONTROL OF GRAPE BERRY MOTH AND JAPANESE BEETLE WITH ASSAIL; 2005**

MATERIALS: ASSAIL 70 WP (acetamiprid), GUTHION 240 SC (azinphos-methyl)

METHODS: This study was part of AAFC Pesticide Minor Use project AAFC05-061E. 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 randomized complete block design. Application timing was based on first significant increase in pheromone trap catch of male grape berry moths (GBM). Two rates of ASSAIL (56 and 112.36 g a.i./ha) were compared to a GUTHION standard and an unsprayed control. On 4 July, insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Plots were sampled 14 July (10 days after application); 50 grape bunches per plot were examined on the vine for GBM damage; results were expressed as percent damaged bunches (0-100%). Numbers of live Japanese beetle per plot were also recorded. Plots were also examined 14 July for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). A sample was taken 2 September to examine the effects of treatments on yield; 20 bunches were collected per plot, and average bunch weight was 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, and 3. No phytotoxic effects were observed in any plots.

CONCLUSIONS: In the 14 July sample, all treated plots contained less GBM damage than the control plots. All treatments reduced numbers of Japanese Beetle. Differences between insecticide treatments were not significant. No phytotoxic or yield effects were observed.

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

Treatment[1]	Rate (a.i./ha)	% Infested Bunches 10 Days after Application (14 July)
GUTHION 240 SC	1.8 kg	7.0 B[2]
ASSAIL 70 WP	112.36 g	8.0 B
ASSAIL 70 WP	56 g	18.0 B
CONTROL	-	52.0 A

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

Table 2. Number of Japanese beetles per plot.

Treatment[1]	Rate (a.i./ha)	Number of Japanese Beetles per plot 10 Days after Application (14 July)
GUTHION 240 SC	1.8 kg	1.0 B[2]
ASSAIL 70 WP	112.36 g	1.0 B
ASSAIL 70 WP	56 g	1.8 B
CONTROL	-	8.8 A

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

Table 3. Phytotoxicity ratings and yield data.

Treatment[1]	Rate (a.i./ha)	Phytotoxicity Rating (0-100) 10 Days after Application (14 July)	Average Bunch Weight (g) (2 September)
GUTHION 240 SC	1.8 kg	0.0 A	51.3 A
ASSAIL 70 WP	112.36 g	0.0 A	49.3 A
ASSAIL 70 WP	56 g	0.0 A	48.0 A
CONTROL	-	0.0 A	45.0 A

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

2005 PMR REPORT # 05

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

CROP: Grapes cv. Chardonnay
PEST: Japanese Beetle, *Popillia japonica* Newman

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TITLE: **CONTROL OF JAPANESE BEETLE ON GRAPE WITH ASSAIL; 2005**

MATERIALS: ASSAIL 70 WP (acetamiprid), SEVIN XLR PLUS (carbaryl)

METHODS: This study was part of AAFC Pesticide Minor Use project AAFC05-061E. The trial was conducted in a mature vineyard in the Jordan, Ontario area; vines cv. Chardonnay 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. Treatments were applied as a cover spray versus adult Japanese beetles (JB); two rates of ASSAIL (56 and 112.36 g a.i./ha) were compared to a SEVIN XLR PLUS standard and an unsprayed control. On 4 August, insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Plots were sampled 4 August (pre-spray), 5 August (1 day after application), 8 August (4 days after application), and 16 August (12 days after application); numbers of live Japanese beetle were counted; results were expressed as number of Japanese beetles per plot. Plots were examined 5 August and 16 August for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). Data were transformed (log (x+1)) where necessary, and analysed using analysis of variance with means separated by a Tukey test at the 0.05 significance level.

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

CONCLUSIONS: Pre-spray numbers of Japanese beetles (JB) were high, and were similar in all plots (averages ranged from 93-134 per plot). In the samples taken 5 August (1 DAT) and 8 August (4 DAT), all treated plots contained fewer JB than the control; plots treated with SEVIN XLR PLUS contained fewer JB than those treated with the low (56 g a.i./ha) rate of ASSAIL. No differences were observed between the two rates of ASSAIL. Numbers of JB in treated plots were not different from the control in the 16 August sample (12 days after application). No phytotoxic effects were observed.

Table 1. Number of Japanese beetles per plot.

Treatment[1]	Rate (a.i./ha)	Days After Application			
		Pre-spray (4 Aug.)	1 Day (5 Aug.)	4 Days (8 Aug.)	12 Days (16 Aug.)
SEVIN XLR PLUS	2.45 kg	127.0 A	1.8 C	2.0 C	4.8 A[2]
ASSAIL 70 WP	112.36 g	93.3 A	4.3 BC	4.8 BC	7.5 A
ASSAIL 70 WP	56 g	134.5 A	11.8 B	9.5 B	7.3 A
CONTROL	-	111.5 A	44.3 A	53.3 A	15.5 A

[1] Applied 4 August
[2] 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) 1 Day after Application (5 August)	Phytotoxicity Rating (0-100) 12 Days after Application (16 August)
SEVIN XLR PLUS	2.45 kg	0.0 A	0.0 A[2]
ASSAIL 70 WP	112.36 g	0.0 A	0.0 A
ASSAIL 70 WP	56 g	0.0 A	0.0 A
CONTROL	-	0.0 A	0.0 A

[1] Applied 4 August

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

2005 PMR REPORT # 06

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

CROP: Grapes cv. Baco Noir
PEST: Grape Phylloxera, *Daktulosphaira vitifoliae* (Fitch)

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TITLE: **CONTROL OF GRAPE PHYLLOXERA WITH ASSAIL; 2005**

MATERIALS: ASSAIL 70 WP (acetamiprid), THIODAN 50 WP (endosulfan)

METHODS: This study was part of AAFC Pesticide Minor Use project AAFC05-061E. 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. Treatments were applied as a cover spray versus grape phylloxera (GP); two rates of ASSAIL (56 and 112.36 g a.i./ha) were compared to a THIODAN standard and an unsprayed control. On 6 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 22 June (16 days after application); 50 grape leaves per plot were examined on the vine for the presence of GP galls; results were expressed as percent damaged leaves. Plots were also examined 22 June for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). Data were analysed using analysis of variance and means separated with a Tukey test at the 0.05 significance level.

RESULTS: Data are presented in Table 1.

CONCLUSIONS: In the 16 June sample, all treated plots contained fewer % GP-damaged leaves than the control plots. No differences were observed between insecticide treatments. Plots treated with THIODAN exhibited a slight (10%) phytotoxic effect (leaf burn); this is a well-documented phytotoxic response by this variety of grape when sprayed with THIODAN. No phytotoxic effects were observed in any plots treated with ASSAIL.

Table 1. Percent of leaves damaged by grape phylloxera, and phytotoxicity ratings.

Treatment[1]	Rate (a.i./ha)	% Damaged Leaves per Plot 16 Days after Application (22 June)	Phytotoxicity Rating (0-100) 16 Days after Application (22 June)
THIODAN 50 WP	1.5 kg	1.0 B	10.0 A[2]
ASSAIL 70 WP	112.36 g	2.5 B	0.0 A
ASSAIL 70 WP	56 g	3.0 B	0.0 A
CONTROL	-	38.0 A	0.0 A

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

2005 PMR REPORT # 07

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

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

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TITLE: **EFFICACY OF ACETAMIPRID, CYPERMETHRIN, AND MALATHION FOR CONTROL OF MULTICOLOURED ASIAN LADY BEETLE ON GRAPE; 2005**

MATERIALS: ASSAIL 70 WP (acetamiprid), MALATHION 500 E (Malathion), RIPCORD 400 EC (cypermethrin)

METHODS: The trial was conducted in a 2 year old vineyard in the Jordan Station, Ontario area; vines cv. Concord were spaced 3.0 m by 2.0 m. Treatments were replicated three times, assigned to three-vine plots measuring 3.0 m by 8.0 m, and arranged according to a randomised complete block design. The registered rates of RIPCORD (60 g a.i./ha) and MALATHION (900 g a.i./ha) were compared to ASSAIL treatments at 56 g a.i./ha and 112 g a.i./ha, and to an unsprayed control. On 6 October treatments were diluted to a rate comparable to 3000 L per ha and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Plots were sampled 1 day (7 October), 5 days (11 October), 7 days (13 October), 13 days (19 October), 25 days (31 October), and 29 days (4 November) after treatment; total numbers of multicoloured Asian lady beetle (MALB) in bunches and on leaves were recorded for each plot. Data were transformed (log (x + 1)) where necessary, and analysed using analysis of variance; means were separated with a Tukey test at the 0.05 significance level.

RESULTS: Data are presented in Table 1. No phytotoxic effects were observed.

CONCLUSIONS: All treated plots had fewer MALB than the control (Table 1) when sampled within 7 days of application. Only the RIPCORD treatment continued to be effective for control of MALB beyond 7 days after application.

Table 1. Mean numbers of MALB per plot.

Treatment[1]	Rate a.i./ha	Days After Treatment					
		1 DAT 7 Oct.	5 DAT 11 Oct.	7 DAT 13 Oct.	13 DAT 19 Oct.	25 DAT 31 Oct.	29 DAT 4 Nov.
RIPCORD 400 EC	60 g	0.0 B[2]	0.0 B	0.3 B[2]	0.0 B	0.7 B[2]	1.7 B[3]
ASSAIL 70 WP	112 g	0.0 B	1.0 B	1.3 B	10.3 AB	34.3 A	63.7 A
ASSAIL 70 WP	56 g	0.3 B	1.7 B	1.3 B	33.0 AB	54.0 A	49.0 A
MALATHION 500 E	900 g	0.3 B	0.0 B	6.0 B	45.3 A	102.3 A	52.0 A
CONTROL	-	30.7 A	29.3 A	69.3 A	44.0 A	67.3 A	78.7 A

[1] Applied 6 October
[2] Data were transformed (log(x+1))
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2005 PMR REPORT # 08

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

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

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TITLE: **CONTROL OF FIRST-GENERATION ORIENTAL FRUIT MOTH ON PEACH; 2005**

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

METHODS: This study was part of AAFC Pesticide Minor Use Project AAFC05-060E. The trial was conducted in a four-year-old orchard in the Jordan Station, Ontario area; trees cv. Elberta were spaced 4.6 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application was timed for egg hatch of the first generation Oriental fruit moth (OFM), determined from pheromone trap catches of male moths. 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 30 May, 115 DD (base 7.2 C) after first male moth catch (May 9). 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 15 June (16 days after application); all infested terminals and fruit were removed and counted. Plots were also examined 15 June for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). A sample was taken 21 June to examine the effects of treatments on yield; 25 peaches were collected per plot and average peach weight was calculated. 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 and 2. No phytotoxic effects were observed in any plots.

CONCLUSIONS: In the 15 June sample (Table 1), all treated plots contained significantly less damaged twigs and fruit than the control. Differences between rates of E2Y45 were not statistically significant, and the addition of HASTEN did not increase efficacy. The plots treated with MATADOR contained less OFM damage than those treated with the 50 g a.i./ha rate of E2Y45, but were not different from other treatments. No phytotoxic or yield effects were observed (Table 2).

Table 1. OFM damage per plot.

Treatment[1]	Rate (a.i./ha)	Infested Terminals per Plot 15 June	Damaged Fruit per Plot 15 June	Total OFM Damage 15 June
MATADOR 120 EC	12.7 g	12.0 C	1.3 B	13.3 C
E2Y45 35 WG[2]	75 g	21.0 BC	6.0 B	27.0 BC
E2Y45 35 WG	100 g	25.3 BC	2.3 B	27.5 BC
E2Y45 35 WG	75 g	26.8 BC	2.8 B	29.5 BC
E2Y45 35 WG	50 g	43.3 B	5.5 B	48.8 B
CONTROL	-	83.8 A	14.8 A	98.5 A

[1] Applied 30 May
[2] Applied 30 May, HASTEN 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 and yield data.

Treatment[1]	Rate (a.i./ha)	Phytotoxicity Rating (0-100) 15 June	Average Peach Weight (g) 21 June
MATADOR 120 EC	12.7 g	0.0 A	7.2 A[3]
E2Y45 35 WG[2]	75 g	0.0 A	7.2 A
E2Y45 35 WG	100 g	0.0 A	7.3 A
E2Y45 35 WG	75 g	0.0 A	7.9 A
E2Y45 35 WG	50 g	0.0 A	7.5 A
CONTROL	-	0.0 A	7.3 A

[1] Applied 30 May
[2] Applied 30 May, HASTEN added at 0.25% v/v
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2005 PMR REPORT # 09

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

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

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TITLE: **CONTROL OF SECOND-GENERATION ORIENTAL FRUIT MOTH ON PEACH; 2005**
MATERIALS: DPX-E2Y45 35 WG, MATADOR 120 EC (lambda cyhalothrin)

METHODS: This study was part of AAFC Pesticide Minor Use Project AAFC05-060E. The trial was conducted in a two-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 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 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 5 July, 635 DD (base 7.2 C) after first male moth catch (May 9). 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 18 July (13 days after application); all infested terminals and fruit were removed and counted. Plots were also examined 18 July for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). The trial orchard had been planted only two years before, and numbers of peaches were insufficient to analyse for damage or yield. 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 and 2. No phytotoxic effects were observed.

CONCLUSIONS: In the 18 July sample, all treated plots contained significantly less OFM terminal damage than the control; numbers of damaged peaches were very low due to scarcity of fruit. The plots treated with the 100 g a.i./ha rate of E2Y45, and the 75 g a.i./ha rate plus HASTEN, contained less OFM damage than those treated with the 50 g a.i/ha rate of E2Y45, but these treatments were not different from the 75 g a.i/ha rate alone or the MATADOR standard.

Table 1. OFM damage per plot.

Treatment[1]	Rate (a.i./ha)	Infested Terminals per Plot 18 July
E2Y45 35 WG[2]	75 g	5.5 C[3]
E2Y45 35 WG	100 g	6.8 C
MATADOR 120 EC	12.7 g	18.0 BC
E2Y45 35 WG	75 g	14.5 BC
E2Y45 35 WG	50 g	31.5 B
CONTROL	-	76.5 A

[1] Applied 5 July
[2] Applied 5 July, HASTEN 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) 18 July
E2Y45 35 WG[2]	75 g	0.0 A[3]
E2Y45 35 WG	100 g	0.0 A
E2Y45 35 WG	75 g	0.0 A
E2Y45 35 WG	50 g	0.0 A
MATADOR 120 EC	12.7 g	0.0 A
CONTROL	-	0.0 A

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

2005 PMR REPORT # 10

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

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

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TITLE: **EFFICACY OF NOVALURON FOR CONTROL OF FIRST-GENERATION ORIENTAL FRUIT MOTH ON PEACH; 2005**

MATERIALS: RIMON 10 EC (novaluron), MATADOR 120 EC (lambda cyhalothrin)

METHODS: This study was part of AAFC Pesticide Minor Use Project AAFC05-059E. The trial was conducted in a four-year-old orchard in the Jordan Station, Ontario area; trees cv. Elberta were spaced 4.6 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application was timed for egg hatch of the first generation Oriental fruit moth (OFM), determined from pheromone trap catches of male moths. Two rates of RIMON (15 g a.i./100 L and 30 g a.i./100 L) were compared to a MATADOR standard and an unsprayed control. Treatments were applied 30 May, 115 DD (base 7.2 C) after first male moth catch (May 9). Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate; pressure was set at 2000 kPa. Plots were sampled post-treatment 16 June (17 days after application); all infested terminals and fruit were removed and counted. Plots were also examined 16 June for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). A sample was taken 21 June to examine the effects of treatments on yield; 25 peaches were collected per plot and average peach weight was calculated. Data were transformed (square root (x +½)) where necessary, 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 and 2. No phytotoxic effects were observed.

CONCLUSIONS: In the 17 June sample, all treated plots contained fewer damaged twigs, fruit, and total OFM damage than the control plots. Differences between insecticide treatments were not significant. No phytotoxic or yield effects were observed.

Table 1. OFM damage per plot.

Treatment[1]	Rate (a.i./ha)	Infested Terminals per Plot 16 June	Damaged Fruit per Plot 16 June	Total OFM Damage 16 June
RIMON 10 EC	30 g	7.3 B[2, 3]	0.8 B[2, 3]	8.1 B[2, 3]
MATADOR 120 EC	12.7 g	7.8 B	0.8 B	8.6 B
RIMON 10 EC	15 g	13.0 B	2.8 B	15.8 B
CONTROL	-	76.0 A	12.3 A	88.3 A

[1] Applied 30 May
[2] Data were transformed (square root (x+½))
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Phytotoxicity ratings and yield data.

Treatment[1]	Rate (a.i./ha)	Phytotoxicity Rating (0-100) 16 June	Average Peach Weight (g) 21 June
RIMON 10 EC	30 g	0.0 A	8.0 A[3]
MATADOR 120 EC	12.7 g	0.0 A	7.8 A
RIMON 10 EC	15 g	0.0 A	7.1 A
CONTROL	-	0.0 A	7.6 A

[1] Applied 30 May

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

2005 PMR REPORT # 11

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

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

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TITLE: **EFFICACY OF NOVALURON FOR CONTROL OF SECOND-GENERATION ORIENTAL FRUIT MOTH ON PEACH; 2005**

MATERIALS: RIMON 10 EC (novaluron), MATADOR 120 EC (lambda cyhalothrin)

METHODS: This study was part of AAFC Pesticide Minor Use Project AAFC05-059E. The trial was conducted in a four-year-old orchard in the Jordan Station, Ontario area; trees cv. Elberta were spaced 4.6 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application was timed for egg hatch of the first generation Oriental fruit moth (OFM), determined from pheromone trap catches of male moths. Two rates of RIMON (15 g a.i./100 L and 30 g a.i./100 L) were compared to a MATADOR standard and an unsprayed control. Treatments were applied 5 July, 635 DD (base 7.2 C) after first male moth catch (May 9). 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 18 July (13 days after application); all infested terminals and fruit were removed and counted. Plots were also examined 18 July for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). A sample was taken 1 September to examine the effects of treatments on yield; 25 peaches were collected per plot and average peach weight was calculated. Data were 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 and 2. No phytotoxic effects were observed.

CONCLUSIONS: In the 18 July sample, all treated plots contained fewer damaged terminals, fruit, and total OFM damage than the control plots. No differences in fruit damage were observed between insecticide treatments; however, the plots treated with the high (30 g a.i./100 L) rate of RIMON contained fewer damaged terminals and less total OFM damage than those treated with the low (15 g a.i./100 L) rate of RIMON. The high rate of RIMON was not statistically different from the MATADOR standard. No phytotoxic or yield effects were observed.

Table 1. OFM damage per plot.

Treatment[1]	Rate (a.i./ha)	Infested Terminals per Plot 18 July	Damaged Fruit per Plot 18 July	Total OFM Damage 18 July
RIMON 10 EC	30 g	15.3 C	5.8 B	21.1 C[2]
MATADOR 120 EC	12.7 g	23.8 BC	5.8 B	29.6 BC
RIMON 10 EC	15 g	55.8 B	11.0 B	66.8 B
CONTROL	-	160.0 A	31.0 A	191.0 A

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

Table 2. Phytotoxicity ratings and yield data.

Treatment[1]	Rate (a.i./ha)	Phytotoxicity Rating (0-100) 18 July	Average Peach Weight (g) 1 September
RIMON 10 EC	30 g	0.0 A	117.9 A[3]
MATADOR 120 EC	12.7 g	0.0 A	114.5 A
RIMON 10 EC	15 g	0.0 A	116.3 A
CONTROL	-	0.0 A	111.3 A

[1] Applied 5 July

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

2005 PMR REPORT # 12

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

CROP: Peach cv. Loring
PEST: Tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois)

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TITLE: **EFFICACY OF CLOTHIANIDIN FOR CONTROL OF TARNISHED PLANT BUG ON PEACH; 2005**

MATERIALS: CLUTCH 50 WDG (clothianidin), RIPCORD 400 EC (cypermethrin)

METHODS: This study was part of AAFC Pesticide Minor Use Project AAFC04-074E. The trial was conducted in a mature orchard in the Niagara-on-the-Lake, Ontario area; trees cv. Loring were spaced 5.5 m by 4.6 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Applications were timed for first appearance of tarnished plant bug (TPB), and were applied 10 June. Three rates of CLUTCH (112 g a.i./ha, 168 g a.i./ha, and 224 g a.i./ha) were compared to a RIPCORD standard and an unsprayed control. 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 21 June (11 days after application); 25 peaches per plot were sampled, examined for TPB damage, and results were expressed as percent fruit damage (0-100%). Plots were also examined 21 June for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). A sample was taken 6 July to examine the effects of treatments on yield; 25 peaches were collected per plot and average peach weight was calculated. Data were 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 and 2. No phytotoxic effects were observed.

CONCLUSIONS: All treated plots contained less TPB-damaged fruit than the control; differences between treatments were not statistically different. No phytotoxic or yield effects were observed.

Table 1. Percent Tarnished Plant Bug-damaged fruit per plot

Treatment[1]	Rate (a.i./ha)	% Fruit Damaged by TPB 21 June
CLUTCH 50 WDG	224 g	1.0 B[2]
CLUTCH 50 WDG	168 g	1.0 B
CLUTCH 50 WDG	112 g	4.0 B
RIPCORD 400 EC	70 g	4.0 B
CONTROL	-	15.0 A

[1] Applied 10 June
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Phytotoxicity ratings and yield data.

Treatment[1]	Rate (a.i./ha)	Phytotoxicity Rating (0-100) 21 June	Average Peach Weight (g) 6 July
CLUTCH 50 WDG	224 g	0.0 A	18.7 A[3]
CLUTCH 50 WDG	168 g	0.0 A	18.1 A
CLUTCH 50 WDG	112 g	0.0 A	19.4 A
RIPCORD 400 EC	70 g	0.0 A	20.7 A
CONTROL	-	0.0 A	19.0 A

[1] Applied 10 June
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

2005 PMR REPORT # 13

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

CROP: Plum cv. Early Golden
PEST: Plum curculio, *Conotrachelus nenuphar* (Herbst)

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TITLE: **EFFICACY OF CLOTHIANIDIN FOR CONTROL OF PLUM CURCULIO ON PLUM; 2005**

MATERIALS: CLUTCH 50 WDG (clothianidin), GUTHION 50 WP (azinphos-methyl)

METHODS: This study was part of AAFC Pesticide Minor Use Project AAFC04-075E. The trial was conducted in a mature orchard in the Beamsville, Ontario area; trees cv. Early Golden were spaced 5.5 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Applications were timed for first appearance of plum curculio (PC) damage, and were applied at shuck (26 May). Three rates of CLUTCH (112 g a.i./ha, 168 g a.i./ha, and 224 g a.i./ha) were compared to a GUTHION standard and an unsprayed control. 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 17 June (22 days after application); 50 plums per plot were sampled, examined for PC damage, and results were expressed as percent fruit damage (0-100%). Fruit were then dissected and numbers of live PC larvae were counted; results were expressed as number of live larvae per plot. Plots were also examined 17 June for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). A sample was taken 1 July to examine the effects of treatments on yield; 25 plums were collected per plot and average plum weight was calculated. Data were transformed (log (x+1)) where necessary, 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 and 2. No phytotoxic effects were observed.

CONCLUSIONS: All treated plots contained less % PC damaged fruit and fewer live PC larvae than the control; differences between treatments were not statistically different. No phytotoxic or yield effects were observed.

Table 1. Percent damaged fruit and number of live larvae per plot.

Treatment[1]	Rate (a.i./ha)	% Damaged Fruit 17 June	Number of Live Larvae 17 June
CLUTCH 50 WDG	224 g	2.0 B[2]	1.3 B[2, 3]
CLUTCH 50 WDG	168 g	4.0 B	0.8 B
CLUTCH 50 WDG	112 g	2.0 B	0.5 B
GUTHION 50 WP	1.25 kg	9.0 B	4.0 B
CONTROL	-	46.0 A	16.8 A

[1] Applied 26 May
[2] Data were transformed (log(x+1))
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Yield data and phytotoxicity ratings.

Treatment[1]	Rate (a.i./ha)	Average Plum Weight (g) 1 July	Phytotoxicity Rating (0-100) 22 days after application (17 June)
CLUTCH 50 WDG	224 g	6.8 A	0.0 A[2]
CLUTCH 50 WDG	168 g	7.0 A	0.0 A
CLUTCH 50 WDG	112 g	6.7 A	0.0 A
GUTHION 50 WP	1.25 kg	6.5 A	0.0 A
CONTROL	-	6.3 A	0.0 A

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

2005 PMR REPORT # 14

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

CROP: Plum cv. Early Golden
PEST: Plum curculio, *Conotrachelus nenuphar* (Herbst)

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TITLE: **CONTROL OF PLUM CURCULIO ON PLUM; 2005**

MATERIALS: CLUTCH 50 WDG (clothianidin), GUTHION 50 WP (azinphos-methyl)

METHODS: This study was part of AAFC Pesticide Minor Use Project AAFC04-075E. The trial was conducted in a mature orchard in the Niagara-on-the-Lake, Ontario area; trees cv. Early Golden were spaced 5.5 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Applications were timed for first appearance of plum curculio (PC) damage, and were applied at shuck (26 May). Three rates of CLUTCH (112 g a.i./ha, 168 g a.i./ha, and 224 g a.i./ha) were compared to a GUTHION standard and an unsprayed control. 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 17 June (22 days after application); 50 plums per plot were sampled, examined for PC damage, and results were expressed as percent fruit damage (0-100%). Fruit were then dissected and numbers of live PC larvae were counted; results were expressed as number of live larvae per plot. Plots were also examined 17 June for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). A sample was taken 7 July to examine the effects of treatments on yield; 25 plums were collected per plot and average plum weight was calculated. Data were 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 and 2. No phytotoxic effects were observed.

CONCLUSIONS: All treated plots contained less % PC damaged fruit and fewer live PC larvae than the control; differences between treatments were not statistically different. No phytotoxic or yield effects were observed.

Table 1. Percent damaged fruit and number of live larvae per plot.

Treatment[1]	Rate (a.i./ha)	% Damaged Fruit 17 June	Number of Live Larvae 17 June
CLUTCH 50 WDG	224 g	1.0 B	0.0 B[2]
CLUTCH 50 WDG	168 g	1.0 B	0.5 B
CLUTCH 50 WDG	112 g	1.5 B	0.0 B
GUTHION 50 WP	1.25 kg	2.5 B	2.0 B
CONTROL	-	20.0 A	17.5 A

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

Table 2. Yield data and phytotoxicity ratings.

Treatment[1]	Rate (a.i./ha)	Average Plum Weight (g) 7 July	Phytotoxicity Rating (0-100) 22 days after application (17 June)
CLUTCH 50 WDG	224 g	21.9 A	0.0 A[2]
CLUTCH 50 WDG	168 g	17.5 A	0.0 A
CLUTCH 50 WDG	112 g	21.5 A	0.0 A
GUTHION 50 WP	1.25 kg	19.1 A	0.0 A
CONTROL	-	19.8 A	0.0 A

[1] Applied 26 May

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

2005 PMR REPORT # 15

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

CROP: Plum cv. Valor
PEST: Oriental Fruit Moth, *Grapholita molesta* (Busck)

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TITLE: **CONTROL OF ORIENTAL FRUIT MOTH ON PLUM; 2005**

MATERIALS: CLUTCH 50 WDG (clothianidin), MATADOR 120 EC (lambda cyhalothrin)

METHODS: This study was part of AAFC Pesticide Minor Use Project AAFC04-075E. The trial was conducted in a two-year-old orchard in the Jordan Station, Ontario area; trees cv. Valor were spaced 5.5 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 first generation Oriental fruit moth (OFM), determined from pheromone trap catches of male moths. Three rates of CLUTCH (112 g a.i./ha, 168 g a.i./ha, and 224 g a.i./ha) were compared to a MATADOR standard and an unsprayed control. Treatments were applied 30 May, 115 DD (base 7.2 C) after first male moth catch (May 9). 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 17 June (18 days after application); all infested terminals and fruit were removed and counted; results were expressed as percent damaged terminals (0 – 100%). Plots were also examined 17 June for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). The trial orchard had been planted only two years before, and numbers of plums were insufficient to analyse for damage or yield. Data were analysed using analysis of variance and mean separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Table 1. No phytotoxic effects were observed.

CONCLUSIONS: In the 17 June sample, all treated plots contained fewer damaged terminals than the control plots. Differences between insecticide treatments were not significant.

Table 1. Percent terminals damaged by OFM, and phytoxicity ratings per plot.

Treatment[1]	Rate (a.i./ha)	% Damaged Terminals 17 June	Phytotoxicity Rating (0-100) 17 June
CLUTCH 50 WDG	224 g	0.0 B	0.0 A[2]
CLUTCH 50 WDG	168 g	0.0 B	0.0 A
CLUTCH 50 WDG	112 g	1.0 B	0.0 A
MATADOR 120 EC	12.7 g	2.0 B	0.0 A
CONTROL	-	11.0 A	0.0 A

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

2005 PMR REPORT # 16

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

CROP: Plum cv. Stanley
PEST: Oriental Fruit Moth, *Grapholita molesta* (Busck)

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TITLE: **EFFICACY OF CLOTHIANIDIN FOR CONTROL OF ORIENTAL FRUIT MOTH ON PLUM; 2005**

MATERIALS: CLUTCH 50 WDG (clothianidin), MATADOR 120 EC (lambda cyhalothrin)

METHODS: This study was part of AAFC Pesticide Minor Use Project AAFC04-075E. The trial was conducted in a two-year-old orchard in the Jordan Station, Ontario area; trees cv. Stanley were spaced 5.5 m by 5.5 m. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application was timed for egg hatch of the first generation Oriental fruit moth (OFM), determined from pheromone trap catches of male moths. Three rates of CLUTCH (112 g a.i./ha, 168 g a.i./ha, and 224 g a.i./ha) were compared to a MATADOR standard and an unsprayed control. Treatments were applied 30 May, 115 DD (base 7.2 C) after first male moth catch (May 9). 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 17 June (18 days after application); all infested terminals and fruit were removed and counted; results were expressed as percent damaged terminals (0 – 100%). Plots were also examined 17 June for phytotoxic effects, and assigned a rating from 0 (no damage) to 100 (mortality). The trial orchard had been planted only two years before, and numbers of plums were insufficient to analyse for damage or yield. Data were transformed (log (x+1)) and analysed using analysis of variance with means separated by a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Table 1. No phytotoxic effects were observed.

CONCLUSIONS: In the 17 June sample, all treated plots contained fewer damaged terminals than the control plots. Differences between insecticide treatments were not significant.

Table 1. Percent terminals damaged by OFM, and phytoxicity ratings per plot.

Treatment[1]	Rate (a.i./ha)	% Damaged Terminals 17 June	Phytotoxicity Rating (0-100) 17 June
CLUTCH 50 WDG	224 g	0.0 B	0.0 A[2]
CLUTCH 50 WDG	168 g	0.0 B	0.0 A
CLUTCH 50 WDG	112 g	1.0 B	0.0 A
MATADOR 120 EC	12.7 g	2.0 B	0.0 A
CONTROL	-	16.0 A	0.0 A

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

2005 PMR REPORT #17 **SECTION A: BERRIES - Insect Pests**
STUDY DATA BASE: 160.3

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

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TITLE: **SMALL PLOT FIELD EVALUATION OF ENTOMOPATHOGENIC NEMATODES FOR CONTROL OF BLACK VINE WEEVIL IN STRAWBERRY, 2005**

MATERIALS: HETERORHABDITIS-SYSTEM (*Heterorhabditis megidis* sp. n. [Heterorhabditidae: Rhabditida] nematodes 525,000 nematodes/g)

METHODS: Single row plots were established on 07 June in a block of strawberries planted near Waterdown, ON in 2002 on Lot 1, Concession IV, Town of Flamborough. Plots were established down the length of 4 adjacent rows of strawberries. Individual plots measured 9 m long, separated by a 1 m buffer between plots. All treatments (Table 1) were replicated 4x in a Randomized Complete Block Design with the 4 plots in each experimental row comprising a replicate block. Treatments were applied in 10 L/100 m row at 135 kPa in a 0.4 m band centred on the row, using a hand-held, CO_2-pressurized R&D field-plot sprayer fitted with a single XR11008VS flat spray tip. To ensure that entomopathogenic nematodes (EPN) were applied to moist soil, sprinkler irrigation was operational during application; 10-15 mm water was subsequently applied immediately after application.
Immediately prior to application, a single 12 x 15 cm soil core, centred on a wilting strawberry plant, was collected from each plot and carefully checked for the presence of BVW larvae, pupae or adults. Collected BVW were returned to the laboratory for inspection and dissection. Larvae or pupae showing the reddish, orange colour characteristic of infection by *H. megidis* were considered to have been infected by EPN. Subsequent dissection in the laboratory verified the presence of EPN in coloured BVW larvae or pupae. No EPN were identified in larvae or pupae of the white colour associated with healthy BVW larvae or pupae. On 21 June, 14 days after treatment (DAT), a total of 3 soil cores was collected and examined from each plot as described above.

OBSERVATIONS: In addition to 10-15 mm water from sprinkler irrigation, a total of 25 mm rainfall accumulated on the experimental block by 7 DAT. The maximum air temperature reached 30.9°C on Day 0 (07 June); the average daily maximum air temperature over the first 7 DAT was 29.5°C. The average maximum 5 cm soil temperature during the same time period was 23.7°C. No phytotoxicity was observed following any treatment.

RESULTS: BVW were not evenly distributed throughout the study block. Indeed, effective statistical analysis of collected data was not possible. Trends, however, were noted in the summarized data (Table 1).

By the time EPN were applied on 07 June, 25 of 61 BVW collected from the experimental block had pupated while 36 of 61 BVW were late instar larvae. No adults were extracted from soil cores collected prior to application of EPN (Table 1a). BVW development proceeded rapidly during the hot weather that followed application. By the time the next series of soils cores was collected 14 DAT, only 30 of 120 BVW remained in the larval stage. Forty five pupae and 45 recently eclosed adults were also extracted (Table 1b). No BVW infected with EPN were identified either in any soil core collected prior to treatment (Table 1a) or in soil cores from CONTROL plots 14 DAT (Table 1b). BVW infected with EPN were extracted only from soil cores removed from plots treated with HETERORHABDITIS-SYSTEM (Table 1b). Indeed, 12 of 25 larvae extracted from those plots 14 DAT were infected with EPN. Only 1 of 25 pupae from treated plots showed the reddish, orange colour associated with infection by EPN while all collected adults appeared to be healthy and were thus not dissected (Table 1b).

CONCLUSIONS: Under the conditions of this trial, application of HETERORHABDITIS-SYSTEM resulted in infection of BVW larvae by 14 DAT. Due to uneven distribution of BVW throughout the experimental block, no conclusions were possible about the relationship of rate of application and level of resulting infection by EPN. Higher levels of infection would likely have been achieved had HETERORHABDITIS-SYSTEM been applied earlier in the season when BVW larvae were at an earlier stage of development.

Table 1. Infection of black vine weevil, *Otiorhynchus sulcatus* by entomopathogenic nematodes, *Heterorhabditis megidis*, following field application to strawberry, Waterdown, ON, 2005.

Tmt. No.	Treatment (M/m^2)[1]	Number Black Vine Weevils Collected for Indicated Life Stage					
		Larvae		Pupae		Adults	
		n	# / % Inf.[2]	n	# / % Inf.	n	# / % Inf.
a) - Pre-Treatment							
1	1.00 M	10	0 / 0.0	2	0 / 0.0	0	0 / 0.0
2	0.50 M	12	0 / 0.0	6	0 / 0.0	0	0 / 0.0
3	0.25 M	11	0 / 0.0	17	0 / 0.0	0	0 / 0.0
4	control	3	0 / 0.0	0	0 / 0.0	0	0 / 0.0
Totals		36	0 / 0.0	25	0 / 0.0	0	0 / 0.0
b) - 14 Days Post Treatment							
1	1.00 M	11	6 / 54.5	4	0 / 0.0	10	0 / 0.0
2	0.50 M	4	1 / 25.0	9	1 / 11.0	15	0 / 0.0
3	0.25 M	10	5 / 50.0	12	0 / 0.0	7	0 / 0.0
4	control	5	0 / 0.0	20	0 / 0.0	13	0 / 0.0
Totals		30	12 / 40.0	45	1 / 2.2	45	0 / 0.0

[1] million entomopathogenic nematodes/m^2.
[2] number / % BVW infected with entomopathogenic nematodes.

2005 PMR Report # 18

SECTION B: VEGETABLE AND SPECIAL CROPS - Insect Pests
ICAR: 33331596

CROP: Garlic (*Allium sativum* L.)
Green onions (*Allium cepa* L.) var. Parade
PEST: Leek moth, *Acrolepiopsis assectella* Zeller (Lepidoptera: Acrolepiopidae)

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TITLE: **EFFECTS OF BACILLUS THURINGIENSIS AND SPINOSAD ON LEEK MOTH IN GARLIC AND ONION**

MATERIALS: In 2004 the treatments applied to garlic in Almonte and Osgoode were as shown in Tables 1 and 2, respectively. In 2004 the treatments applied to onion in Almonte and Osgoode were as shown in Tables 3 and 4, respectively. In 2005 the treatments applied to garlic in Almonte and Osgoode were as shown in Tables 5 and 6, respectively. In 2005 the treatments applied to onion in Almonte and Osgoode were as shown in Tables 7 and 8, respectively.

METHODS: Two field trials were conducted in organic garlic and onion naturally infested with leek moth at locations near Almonte and Osgoode. At both sites, plots were located in areas where growers had experienced problems since 1999. A randomized complete block design with 3 blocks per treatment was used. Each replicate consisted of 2 spaced garlic rows interspaced with 2 onion rows, 5 m in length. Plants were sprayed using a CO_2 powered GS sprayer (R&D Sprayers, Opeloosas, Louisiana) with flat spray tip 110-03VP nozzles. After each of the three sprays, samples were taken weekly for up to 2 weeks. A scale of 0-5 was used to assess damage: 0, no damage seen; 1, entrance holes; 2, entrance holes and leaf mines; 3, entrance holes, leaf mines and frass; 4, entrance holes, multiple mines and frass; and 5, plant destroyed. At Almonte, garlic was planted at a density of 5 plants/m and green onions were planted at a density of 40 plants/m. In 2004, the treatments were: a) ENTRUST applied at 3 different rates, 84, 140, and 168 g ai/ha; b) BIOPROTEC applied at 3 different rates, 18, 27 and 36 BIU/ha; c) DIPEL applied at 3 different rates, 17.6, 26.8 and 36 BIU/ha; and d) a water control. In 2005, the treatments were: a) ENTRUST applied at 3 different rates, 105, 175, and 210 g ai/ha; b) BIOPROTEC applied at 3 different rates, 1.4, 2.1, 2.8 L/ha; c) DIPEL applied at 3 different rates, 550, 837, 1125 g ai/ha; d) a water control; e) a row greenhouse cover; and f) a row cover. At Osgoode, garlic was planted at a density of 4 plants/m and green onions were planted at a density of 40 plants/m. In 2004, the treatments were: a) SUCCESS applied at 3 different rates, 182, 300, 350 mL/ha; b) BIOPROTEC applied at 2 different rates, 18 and 36 BIU/ha; c) DIPEL applied at 2 different rates, 17.6 and 36 BIU/ha; and d) a water control. In 2005, the treatments were: a) SUCCESS applied at 3 different rates, 87.4, 144, and 168 g/ha; b) BIOPROTEC applied at 3 different rates, 1.4, 2.1, 2.8 L/ha; c) DIPEL applied at 3 different rates, 550, 837, 1125 g ai/ha; d) a water control; e) a greenhouse-

type cover; and f) a row cover. Air temperatures during the experiments ranged from 10 ^{O}C to 20 ^{O}C. Data were normalized using a y=LOG(X+1) transformation and then analyzed using the General Linear Models function of SAS V8.2. Means separation was obtained using Duncan's multiple range test at P=0.05 level of significance. Untransformed means are presented in the tables.

RESULTS: As outlined in Tables 1-8. Since numbers of eggs/plant and pupae/plant over the entire experiment were very low in all treatments, these parameters do not appear to be suitable for assessing efficacy.

For garlic, while mean numbers of larvae and damage ratings were lowest for ENTRUST treatments at all doses at Almonte in 2004, these were not however, significantly different than mean numbers of larvae and damage in the control (Table 1). At Osgoode, mean numbers of larvae and damage ratings were lowest for SUCCESS treatments at all doses. These were significantly different than mean damage in the control but only numbers of larvae at the highest dose applied were significantly different than the control (Table 2). Weekly results supported the overall results that SUCCESS treatments resulted in fewer larvae and less damage than other treatments and the control although these data trends were not consistent (data not shown).

In 2005, at Almonte mean numbers of larvae were lower than controls for all treatments of ENTRUST, BIOPROTEC and DIPEL although they were not significantly so for the highest ENTRUST dose and the DIPEL applied at 550 and 837 g ai/ha (Table 5). Damage ratings were significantly lower than the control only for ENTRUST treatments, although ratings for BIOPROTEC and DIPEL were numerically lower. The greenhouse and row covers had significantly fewer larvae and less damage than the control and the row cover was superior to any other treatment. At Osgoode, mean numbers of larvae were highly variable and no consistent trends were observed (Table 6). Damage was lower in SUCCESS and BIOPROTEC treatments than in the control but not significantly so. The effectiveness of the row covers may be due to their tight fit over the crop canopy that would prevent free movement of any ovipositing females that may have penetrated the edges. In contrast, the greenhouse covers allow any females that found a way in to fly freely between plants.

For onion in 2004, mean numbers of larvae were lowest for ENTRUST treatments at 84 g ai/ha and 168 g ai/ha at Almonte, however, only the ENTRUST 168 g ai/ha treatment was significantly different than the control (Table 3). Damage levels for ENTRUST treatments at 84 g ai/ha and 168 g ai/ha, and BIOPROTEC 27 BIU/ha were significantly lower than the control, BIOPROTEC 18 BIU/ha and 36 BIU/ha and all DIPEL treatments. At Osgoode in 2004, mean numbers of larvae were lowest for SUCCESS treatments at 144 g ai/ha and 168 g ai/ha and were significantly different than mean numbers of larvae in the control (Table 4). Similarly, damage ratings for SUCCESS treatments at 144 g ai/ha and 168 g ai/ha were significantly different than damage ratings in the control plots. Weekly results supported the overall results that ENTRUST treatments resulted in fewer larvae and less damage that other treatments and the control although these data trends were not consistent (data not shown).

In 2005, at Almonte results from onion were inconsistent, although significantly fewer larvae occurred in the two highest dose ENTRUST treatments and the lowest BIOPROTEC dose than in the control (Table 7). No treatment produced significantly lower damage than the control. At Osgoode, results were also inconsistent and although mean numbers of larvae were lowest for SUCCESS treatments these were not significantly different than the control (Table 8). Only application of SUCCESS at the two highest doses resulted in damage that was significantly lower than in the control.

The greenhouse covers had significantly fewer larvae and less damage than the control only in garlic at Almonte (Tables 5-8). The row cover was superior to any other treatment. Significantly fewer larvae and lower damage than the control was found at both locations for garlic and onion in all treatments except for the mean number of larvae on garlic at Osgoode.

CONCLUSIONS: The data suggest that spinosad products (ENTRUST and SUCCESS) provide some protection of garlic and onion from leek moth damage while *Bacillus thuringiensis kurstaki* (Btk) products (DIPEL and BIOPROTEC) do not. However, the biology of leek moth must be considered. Upon hatching, larvae mine into the leaf of host plants and thus are only exposed to Btk for a very brief period during which they must consume a lethal dose. In contrast spinosad acts as both a contact and stomach poison and a lethal dose is more likely to be encountered by newly hatched larvae. This suggests that timing of Btk applications (i.e. at the beginning of egg hatch) will be critical to the effectiveness of these products. Row covers showed consistent results and are clearly a good option for protection of garlic and onion from leek moth.

Table 1. Mean numbers (±SE) of eggs, larvae and pupae, and plant damage rating for leek moth (*Acrolepiopsis assectella* Zeller [Lepidoptera: Acrolepiidae]) on garlic treated with ENTRUST, BIOPROTEC and DIPEL at Almonte, ON, 2004.

Treatment	**# leek moth eggs**	**# leek moth larvae**	**# leek moth pupae**	**damage rating**
control	0.08 ± 0.06ns	2.95 ± 0.72ab	0.05 ± 0.01ab	2.05 ± 0.25a
Entrust 84 g ai/ha	0.03 ± 0.03	1.47 ± 0.33ab	0.03 ± 0.03ab	2.14 ± 0.24a
Entrust 140 g ai/ha	0.08 ± 0.08	1.36 ± 0.30 b	0.00 b	1.31 ± 0.20 b
Entrust 168 g ai/ha	0	1.47 ± 0.27 ab	0.00 b	2.19 ± 0.24 a
Bioprotec 18 BIU/ha	0.07 ± 0.05	3.35 ± 0.68 a	0.15 ± 0.06a	2.66 ± 0.22 a
Bioprotec 27 BIU/ha	0.09 ± 0.05	3.21 ± 0.64 ab	0.06 ± 0.06 ab	2.65 ± 0.24 a
Bioprotec 36 BIU/ha	0	3.09 ± 0.60 ab	0.09 ± 0.05 ab	2.47 ± 0.25 a
Dipel 17.6 BIU/ha	0	2.57 ± 0.59 ab	0.05 ± 0.04 ab	2.84 ± 0.23 a
Dipel 26.8 BIU/ha	0	3.03 ± 0.67 ab	0.03 ± 0.03 ab	2.46 ± 0.27 a
Dipel 36 BIU/ha	0	2.16 ± 0.51 ab	0.05 ± 0.04 ab	2.32 ± 0.24 a

Analysis of variance of Log(x+1) transformed data, means separation using Duncan's multiple range test: ns = not significantly different (P>0.05); Eggs P = 0.3815, df = 9, 364 F = 1.07; Larvae P = 0.0662, df = 9, 363, F = 1.81; Pupae P = 0.2265, df = 9, 364, F = 1.32; Damage P = 0.0013, df = 9, 364, F = 3.11.

Table 2. Mean numbers (±SE) of eggs, larvae and pupae, and plant damage rating for leek moth (*Acrolepiopsis assectella* Zeller [Lepidoptera: Acrolepiidae]) on garlic treated with SUCCESS, BIOPROTEC and DIPEL at Osgoode, ON, 2004.

Treatment	# leek moth eggs	# leek moth larvae	# leek moth pupae	damage rating
control	0.00 ns	1.17 ± 0.28 abc	0.06 ± 0.04 ns	2.12 ± 0.27 a
Success 87.4 g/ha	0.08 ± 0.06	0.67 ± 0.17 cd	0	1.28 ± 0.21 b
Success 144 g/ha	0.05 ± 0.04	0.72 0.22 cd	0	1.13 ± 0.20 b
Success 168 g/ha	0	0.42 ± 0.17 d	0.07 ± 0.05	1.17 ± 0.18 b
Bioprotec 18 BIU/ha	0.03 ± 0.03	1.31 ± 0.3 abc	0.08 ± 0.06	1.69 ± 0.22 ab
Bioprotec 36 BIU/ha	0	1.81 ± 0.43 ab	0.03 ± 0.03	2.23 ± 0.26 a
Dipel 17.6 BIU/ha	0.03 ± 0.03	2.13 ± 0.43 a	0.03 ± 0.03	2.26 ± 0.26 a
Dipel 36 BIU/ha	0	1.08 ± 0.28 bc	0.05 ± 0.04	2.05 ± 0.24 a

Analysis of variance of Log(x+1) transformed data, means separation using Duncan's multiple range test: ns = not significantly different ($P>0.05$); Eggs P = 0.4192, df = 7, 304, F = 1.02; Larvae P = 0.0007, df = 7, 304, F = 3.74; Pupae P = 0.6378, df = 7, 304, F = 0.74; Damage P < 0.0011, df = 7, 298, F = 3.57.

Table 3. Mean numbers (±SE) of eggs, larvae and pupae, and plant damage rating for leek moth (*Acrolepiopsis assectella* Zeller [Lepidoptera: Acrolepiidae]) on onion treated with Entrust, BIOPROTEC and DIPEL at Almonte, ON, 2004.

Treatment	**# leek moth eggs**	**# leek moth larvae**	**# leek moth pupae**	**damage rating**
control	0.01 ± 0.01 b	0.14 ± 0.03 cd	0.01 ± 0.01 ns	0.85 ± 0.09 abc
Entrust 84 g ai/ha	0.00 b	0.07 ± 0.02 de	0.01 ± 0.01	0.39 ± 0.06 ef
Entrust 140 g ai/ha	0.00 b	0.20 ± 0.05 bc	0.01 ± 0.01	0.64 ± 0.09 cde
Entrust 168 g ai/ha	0.00 b	0.03 ± 0.01 e	0	0.32 ± 0.06 f
Bioprotec 18 BIU/ha	0.00 b	0.23 ± 0.04 bc	0	0.68 ± 0.09 cd
Bioprotec 27 BIU/ha	0.00 b	0.15 ± 0.03 cde	0	0.58 ± 0.09 def
Bioprotec 36 BIU/ha	0.00 b	0.36 ± 0.06 a	0	0.84 ± 0.09 abc
Dipel 17.6 BIU/ha	0.01 ± 0.01 b	0.31 ± 0.06 ab	0.01 ± 0.01	1.02 ± 0.10 ab
Dipel 26.8 BIU/ha	0.01 ± 0.01 b	0.29 ± 0.06 abc	0	0.83 ± 0.10 bcd
Dipel 36 BIU/ha	0.03 ± 0.01a	0.30 ± 0.06ab	0.01 ± 0.01	1.04 ± 0.10a

Analysis of variance of Log(x+1) transformed data, means separation using Duncan's multiple range test: ns = not significantly different ($P>0.05$); Eggs $P < 0.0001$, df = 9, 1961, $F = 4.01$; Larvae $P < 0.0001$, df = 9, 1961, $F = 6.73$; Pupae $P = 0.3796$, df = 9, 1961 $F = 1.07$; Damage $P < 0.0001$, df = 9, 1961, $F = 9.13$.

Table 4. Mean numbers (±SE) of eggs, larvae and pupae, and plant damage rating for leek moth (*Acrolepiopsis assectella* Zeller [Lepidoptera: Acrolepiidae]) on onion treated with SUCCESS, BIOPROTEC and DIPEL at Osgoode, ON, 2004.

Treatment	# leek moth eggs	# leek moth larvae	# leek moth pupae	damage rating
control	0.00 b	0.21 ± 0.04 ab	0.05 ± 0.02 a	0.81 ± 0.09 a
Success 87.4 g/ha	0.00 b	0.14 ± 0.03 bc	0.01 ± 0.01 b	0.56 ± 0.07 ab
Success 144 g/ha	0.00 b	0.03 ± 0.01 cd	0.00 b	0.25 ± 0.03 c
Success 168 g/ha	0.00 b	0.07 0.03 d	0.01 ± 0.01 b	0.40 ± 0.06 bc
Bioprotec 18 BIU/ha	0.00 b	0.13 ± 0.03 bc	0.00 b	0.73 ± 0.08 a
Bioprotec 36 BIU/ha	0.00 b	0.16 ± 0.03 ab	0.00 b	0.65 ± 0.08 ab
Dipel 17.6 BIU/ha	0.01 ± 0.01 a	0.25 ± 0.04 a	0.03 ± 0.01 ab	0.78 ± 0.09 a
Dipel 36 BIU/ha	0.00 b	0.18 ± 0.05 ab	0.01 ± 0.01 b	0.83 ± 0.11a

Analysis of variance of Log(x+1) transformed data, means separation using Duncan's multiple range test: Eggs $P = 0.0419$, df = 7, 1606, $F = 2.09$; Larvae $P < 0.0001$, df = 7, 1606, $F = 6.42$; Pupae $P = 0.0058$, df = 7, 1606, $F = 2.86$; Damage $P < 0.0001$, df = 7, 1606, $F = 6.37$.

Table 5. Mean numbers (±SE) of eggs, larvae and pupae, and plant damage rating for leek moth (*Acrolepiopsis assectella* Zeller [Lepidoptera: Acrolepiidae]) on garlic treated with ENTRUST, BIOPROTEC and DIPEL at Almonte, or covered with a row cover or row greenhouse, ON, 2005.

Treatment	**# leek moth eggs**	**# leek moth larvae**	**# leek moth pupae**	**damage rating**
Control	0.08 ± 0.04 a	0.71 ± 0.20 a	0.11 ± 0.07 a	1.55 ± 0.20 a
Entrust 105 g ai/ha	0.03 ± 0.03 ab	0.25 ± 0.08 bcd	0.03 ± 0.02 ab	0.58 ± 0.13 def
Entrust 175 g ai/ha	0.00 b	0.32 ± 0.13 bc	0.00 b	0.75 ± 0.15 bcde
Entrust 210 g ai/ha	0.02 ± 0.02 ab	0.47 ± 0.17 abc	0.07 ± 0.04 ab	0.73 ± 0.15 cde
Bioprotec 1.4 L/ha	0.02 ± 0.02 ab	0.23 ± 0.09 bcd	0.02 ± 0.02 ab	1.23 ± 0.18 ab
Bioprotec 2.1 L/ha	0.00 b	0.28 ± 0.11 bcd	0.02 ± 0.02 ab	1.05 ± 0.29 abcd
Bioprotec 2.8 L/ha	0.00 b	0.30 ± 0.09 bc	0.02 ± 0.02 ab	1.02 ± 0.17 abcd
Dipel 550 g ai/ha	0.03 ± 0.03 ab	0.30 ± 0.07 abc	0.02 ± 0.02 ab	1.20 ± 0.18 abc
Dipel 837 g ai/ha	0.02 ± 0.02 ab	0.55 ± 0.16 ab	0.03 ± 0.02 ab	1.38 ± 0.17 a
Dipel 1125 g ai/ha	0.03 ± 0.02 ab	0.28 ± 0.09 bc	0.03 ± 0.02 ab	1.17 ± 0.16 ab
Greenhouse cover	0.03 ± 0.03 ab	0.17 ± 0.09 cd	0.02 ± 0.02 ab	0.48 ± 0.14 ef
Row cover	0.00 b	0.00 d	0.00 b	0.23 ± 0.08 f

Analysis of variance of Log(x+1) transformed data, means separation using Duncan's multiple range test: ns = not significantly different (P>0.05); Eggs P = 0.0912, df = 50, 715 F = 1.29; Larvae P = 0.0190, df = 50, 715, F = 1.48; Pupae P = 0.2187, df = 50, 715, F = 1.16; Damage P < 0.0001, df = 50, 715, F = 2.81.

Table 6. Mean numbers (±SE) of eggs, larvae and pupae, and plant damage rating for leek moth (*Acrolepiopsis assectella* Zeller [Lepidoptera: Acrolepiidae]) on garlic treated with SUCCESS, BIOPROTEC and DIPEL at Osgoode, or covered with a row cover or row greenhouse, ON, 2005.

Treatment	**# leek moth eggs**	**# leek moth larvae**	**# leek moth pupae**	**damage rating**
control	0.10 ± 0.07 ns	0.25 ± 0.09 abc	0.10 ± 0.05 abc	1.27 ± 0.19 abcd
Bioprotec 1.4 L/ha	0.07 ± 0.04	0.37 ± 0.13 abc	0.02 ± 0.02 bc	1.12 ± 0.18 bcd
Bioprotec 2.1 L/ha	0.20 ± 0.13	0.32 0.11 abc	0.08 ± 0.06 abc	1.14 ± 0.18 bcd
Bioprotec 2.8 L/ha	0.07 ± 0.04	0.36 ± 0.09 abc	0.07 ± 0.03 abc	1.66 ± 0.18 a
Dipel 550 g ai/ha	0.10 ± 0.07	0.50 ± 0.14 ab	0.08 ± 0.04 abc	1.48 ± 0.20 abc
Dipel 837 g ai/ha	0.03 ± 0.02	0.70 ± 0.22 a	0.22 ± 0.14 ab	1.62 ± 0.19 ab
Dipel 1125 g ai/ha	0.03 ± 0.02	0.47 ± 0.13 ab	0.11 ± 0.05 abc	1.11 ± 0.17 bcd
Success 182 mL/ha	0.09 ± 0.04	0.48 ± 0.17 abc	0.02 ± 0.02 bc	0.85 ± 0.13 cd
Success 300 mL/ha	0.03 ± 0.02	0.15 ± 0.05 bc	0.03 ± 0.02 bc	0.82 ± 0.13 d
Success 350 mL/ha	0.02 ± 0.02	0.28 ± 0.15 abc	0.02 ± 0.02 bc	0.72 ± 0.14 de
Greenhouse cover	0.21 ± 0.18	0.49 ± 0.17 ab	0.24 ± 0.11 a	1.35 ± 0.22 abcd
Row cover	0.03 0.02	0.09 ± 0.05 c	0.00 c	0.40 ± 0.11 e

Analysis of variance of Log(x+1) transformed data, means separation using Duncan's multiple range test: ns = not significantly different (P>0.05); Eggs P = 0.2235, df = 51, 713, F = 1.15; Larvae P = 0.0692, df = 51, 713, F = 1.32; Pupae P = 0.0105, df = 51, 713, F = 1.54; Damage P < 0.0001, df = 51, 713, F = 3.13.

Table 7. Mean numbers (±SE) of eggs, larvae and pupae, and plant damage rating for leek moth (*Acrolepiopsis assectella* Zeller [Lepidoptera: Acrolepiidae]) on onion treated with ENTRUST, BIOPROTEC and DIPEL, or covered with a row cover or row greenhouse at Almonte, ON, 2005.

Treatment	# leek moth eggs	# leek moth larvae	# leek moth pupae	damage rating
control	0	0.59 ± 0.18 a	0.00 ns	0.88 ± 0.21 abcd
Entrust 105 g ai/ha	0	0.28 ± 0.10 abc	0	0.47 ± 0.15 cde
Entrust 175 g ai/ha	0	0.15 ± 0.07 bc	0	0.56 ± 0.15 bcde
Entrust 210 g ai/ha	0	0.13 ± 0.06 bc	0	0.41 ± 0.16 de
Bioprotec 1.4 L/ha	0	0.13 ± 0.06 bc	0	0.56 ± 0.18 bcde
Bioprotec 2.1 L/ha	0	0.33 ± 0.10 ab	0	0.80 ± 0.25 abcde
Bioprotec 2.8 L/ha	0	0.66 ± 0.15 a	0	1.28 ± 0.23 a
Dipel 550 g ai/ha	0	0.41 ± 0.13 ab	0	1.09 ± 0.23 abc
Dipel 837 g ai/ha	0	0.38 ± 0.13 ab	0.03 ± 0.03	1.13 ± 0.21 ab
Dipel 1125 g ai/ha	0	0.50 ± 0.16 ab	0.03 ± 0.03	1.00 ± 0.22 abcd
Greenhouse cover	0	0.88 ± 0.32 a	0	1.19 ± 0.26 abc
Row cover	0	0.00 c	0	0.22 ± 0.10 e

Analysis of variance of Log(x+1) transformed data, means separation using Duncan's multiple range test: ns = not significantly different (P>0.05); Eggs -; Larvae P = 0.0020, df = 48, 383, F = 1.78; Pupae P = 0.5606, df = 48, 383 F = 0.96; Damage P = 0.0060, df = 48, 383, F = 1.66.

Table 8. Mean numbers (±SE) of eggs, larvae and pupae, and plant damage rating for leek moth (*Acrolepiopsis assectella* Zeller [Lepidoptera: Acrolepiidae]) on onion treated with SUCCESS, BIOPROTEC and DIPEL, or covered with a row cover or row greenhouse at Osgoode, ON, 2005.

Treatment	# leek moth eggs	# leek moth larvae	# leek moth pupae	damage rating
Control	0.00 b	0.53 ± 0.19 abc	0.00 ns	1.16 ± 0.20 abc
Bioprotec 1.4 L/ha	0.00 b	0.31 ± 0.11 bcd	0.03 ± 0.03	1.03 ± 0.24 abcd
Bioprotec 2.1 L/ha	0.00 b	0.53 ± 0.18 abc	0	1.28 ± 0.20 ab
Bioprotec 2.8 L/ha	0.00 b	0.78 ± 0.19 a	0.06 ± 0.04	1.28 ± 0.23 abc
Dipel 550 g ai/ha	0.03 ± 0.03a	0.59 ± 0.16 ab	0	1.59 ± 0.22 a
Dipel 837 g ai/ha	0.00 b	0.59 ± 0.16 ab	0	1.28 ± 0.28 abc
Dipel 1125 g ai/ha	0.00 b	0.53 ± 0.20 abc	0.03 ± 0.03	1.19 ± 0.22 abc
Success 182 mL/ha	0.00 b	0.22 ± 0.09 bcd	0	0.78 ± 0.24 cde
Success 300 mL/ha	0.00 b	0.28 ± 0.09 bcd	0	0.38 ± 0.17 e
Success 350 mL/ha	0.00 b	0.19 ± 0.13 cd	0	0.47 ± 0.16 de
Greenhouse cover	0.00 b	0.59 ± 0.21 abc	0.06 ± 0.04	0.84 ± 0.20 bcde
Row cover	0.00 b	0.06 ± 0.04 d	0	0.38 ± 0.12 de

Analysis of variance of Log(x+1) transformed data, means separation using Duncan's multiple range test: ns = not significantly different (P>0.05); Eggs P = 0.4779, df = 47, 383, F = 1.00; Larvae P = 0.0003, df = 47, 383, F = 1.99; Pupae P = 0.0030, df = 47, 383 F = 1.74; Damage P < 0.0001, df = 47, 383, F = 2.68.

2005 PMR REPORT# 19

SECTION B: VEGETABLE and SPECIAL CROPS – Insect Pests
ICAR: 206003

CROP: Yellow cooking onions (*Allium cepa* L.)
PEST: Onion maggot (OM), *Delia antiqua* (Meigen)

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TITLE: **FIELD EVALUATION OF TRANSPLANTED COMMERCIAL YELLOW COOKING ONION CULTIVARS AND BREEDING LINES FOR RESISTANCE TO ONION MAGGOT, *DELIA ANTIQUA* (MEIGEN), 2005**

MATERIALS: Onion breeding lines obtained from Seminis Vegetable Seeds and the University of Wisconsin, and 5 commercial cultivars from various seed companies

METHODS: Yellow cooking onions were evaluated for resistance to OM in a field trial on organic soil (pH≈7.0, organic matter≈71.1%) naturally infested with *Delia antiqua* pupae at the Muck Crops Research Station, Holland Marsh, Ontario. Five onion cultivars and 3 breeding lines obtained from Seminis Vegetable Seeds and the University of Wisconsin were seeded into 288 plug trays on 21 April. Onions were hand-transplanted at 25 plants/meter on 8 June. Each cultivar was replicated four times in a randomized complete block design. Each replicate consisted of two rows (40 cm apart), 3 m in length. Recommended control procedures were followed to manage other insects, pathogens and weeds. Transplants were counted and visually examined weekly throughout June and July for onion maggot damage or damage caused by other pests. Damaged plants were rogued out and the cause recorded. Onion damage was recorded two weeks after the end of the first (7 July) and second (16 August) OM generation peaks and at harvest (29 August) (onion bulb maturity). Total damage was calculated as the cumulative damage caused by the first and second OM generations plus the damage recorded at harvest. Only first and total damage are presented. On 14 September, for yield assessment, total onion weights and the numbers of healthy bulbs were recorded. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistics 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: Significant differences in the incidence of OM damage among the cultivars and breeding lines were found both at first generation and at harvest assessments (Table 1). Fortress had significantly more OM damage than all other cultivars and breeding lines at first generation assessment. Fortress and breeding lines 1247B and 1416C had significantly more OM damage than Millennium, Cortland, Ricochet and 1247B in total onion maggot damage. Significant differences were observed in yield among cultivars and breeding lines. Hoopla had significantly higher yields than all other cultivars. Since Hoopla is phenotypically a larger onion than the other cultivars, yields at similar planting densities tend to be higher. Breeding lines 1416C and 1247B had the lowest yields at 17.7 and 15.0 t/ha, respectively.

Table 1. Percent onion maggot (OM) damage and yield of onions transplanted at the Muck Crops Research Station, Holland Marsh, Ontario, 2005.

Cultivar/Line	Source	% OM Damage[1]		Yield (t/ha)
		1st Generation	Total	
Ricochet	Seminis	2.2 a[2]	4.4 a	24.8 cd
Cortland	Bejo	2.7 a	5.6 ab	36.5 b
Millennium	Numhems	3.4 a	7.8 ab	36.5 b
1247B	Seminis	4.8 a	14.3 d	15.0 e
1598B (W461B)	UW[3]	5.2 a	9.4 bc	25.8 c
Hoopla	Seedworks	5.2 a	9.6 bc	56.8 a
1416C	Seminis	5.4 a	13.2 cd	17.7 de
Fortress	Seminis	9.3 b	15.7	40.2 b

[1] 1st Generation - OM damage from 21 April to 7 July, Total - Cumulative OM Damage for season

[2] Numbers in a column followed by a different letter were significantly different (P = 0.05), Fisher's Protected LSD test.

[3] UW = University of Wisconsin - Madison.

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SECTION B: VEGETABLE and SPECIAL CROPS – Insect Pests
ICAR: 206003

CROP: Yellow cooking onions (*Allium cepa* L.)
PEST: Onion maggot(OM), *Delia antiqua* (Meigen)

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TITLE: **FIELD EVALUATION OF SEEDED COMMERCIAL YELLOW COOKING ONION CULTIVARS AND BREEDING LINES FOR RESISTANCE TO THE ONION MAGGOT, *DELIA ANTIQUA* (MEIGEN), 2005**

MATERIALS: Onion breeding lines obtained from Seminis Vegetable Seeds and the University of Wisconsin and 5 commercial cultivars from various seed companies

METHODS: Yellow cooking onions were evaluated for their resistance to the OM in a field trial on organic soil (pH≈7.0, organic matter 71.1%), in a region where *Delia antiqua* occurs naturally at the Muck Crops Research Station, Holland Marsh, Ontario. Five onion cultivars and 3 breeding lines obtained from Seminis Vegetable Seeds and the University of Wisconsin were hand-seeded at 40 seeds/m on 16 May. Each cultivar and breeding line was replicated four times in a randomized complete block design. Each replicate consisted of two rows (40 cm apart), 3 m in length. Recommended control procedures to manage other insects, pathogens and weeds were followed. To determine initial stand count, plant emergence was determined. Plants were then counted and visually examined weekly throughout June and July for onion maggot or damage caused by other pests. Damaged plants were rogued out and the cause recorded. Onion damage was recorded two weeks after the end of the first (7 July) and second (16 August) OM generation peaks and at harvest (21 September) (onion bulb maturity). Total damage was calculated as the cumulative damage caused by the first and second OM generations and the damage recorded at harvest. Only first and total damage are presented. On 30 September, for yield assessment, onion total weight and number of healthy bulbs were recorded after harvest. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistics 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: Significant differences among the onion cultivars and breeding lines were found in first generation OM damage, total OM damage and yield (Table 1). At first generation assessment and in total OM damage, Ricochet and Fortress had significantly less damage than the breeding line 1247B, Cortland and Hoopla. Ricochet had significantly less OM damage at first generation and in total damage than all other cultivars except Fortress and University of Wisconsin breeding line 1598B. Total OM damage was extremely high in cultivar Hoopla in this trial. The similar trial grown from transplants had relatively low damage in cultivar Hoopla. Onions of cultivar Hoopla were seeded at a higher density to compensate for poor germination of this cultivar; the onions germinated unevenly may have contributed to the high damage found in cultivar Hoopla in this seeded trial. Overall stands were similar among all cultivars in the trial. Fortress had the highest yield at 53.1 t/ha while Hoopla and breeding line 1416C had the lowest yields at 9.8 and 11.9 t/ha respectively.

Table 1. Percent onion maggot (OM) damage and yield of onions seeded at the Muck Crops Research Station, Holland Marsh, Ontario, 2005.

Cultivar/Line	Source	% OM Damage[1]		Yield (t/ha)
		1st Generation	Total	
Ricochet	Seminis	5.0 a[2]	11.6 a	47.6 ab
Fortress	Seminis	14.8 ab	21.3 ab	53.1 a
1598B (W461B)	UW[3]	16.9 abc	26.1 abc	22.5 d
1416C	Seminis	17.4 abc	31.4 bcd	11.9 e
Millennium	Numhems	24.3 bcd	36.9 bcd	40.0 bc
1247B	Seminis	30.8 cd	40.2 cd	25.6 d
Cortland	Bejo	39.1 d	44.5 d	31.4 cd
Hoopla	Seedworks	83.4 e	90.5 e	9.8 e

[1] 1st Generation - OM damage from 16 May to 7 July, Total - Cumulative OM Damage for season

[2] Numbers in a column followed by a different letter were significantly different at $P = 0.05$, Fisher's Protected LSD test.

[3] UW = University of Wisconsin - Madison.

2005 PMR REPORT #21

SECTION B: VEGETABLE and SPECIAL CROPS-Insect Pests
ICAR: 206003

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

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

MATERIALS: RAXIL 2.6 F (tebuconazole 28.4%), APRON XL LS (mefenoxam 28.4%), MAXIM 4 FS (fludioxinil 40.3%), PRO GRO (carbathiin 30%, thiram 50%), GOVERNOR 75 WP (cyromazine 75%), SUCCESS 4 SC (spinosad 44.2%), REGENT 6.2 FS (fipronil 56%).

METHODS: Field trials were conducted at the Muck Crop Research Station (MCRS), Holland Marsh, Ontario in summer 2005 to evaluate several new reduced risk seed treatments, fungicides and insecticides alone and in combination for the control of OS and OM. Yellow cooking onions (cv. Millennium) were seeded (40 seeds/m) in muck soil (pH ≈ 6.4, organic matter ≈ 60%) on 9 May. Muck soil naturally infested with onion smut (*Urocystis cepulae*) and the natural onion maggot (*Delia antiqua)* population in this area was used. Treatments applied are as shown in Table 1 and 2. A randomized complete block design with four replications was used for the experiment. The field plots for each treatment replicate consisted of four rows (42 cm apart) of onions 6 m in length. A push cone seeder was used for planting the seed treatments. Six 2 m long sections of row for each of three OS assessments, three OM assessments and one 2.32 meter section for yield assessment were randomly selected within each treatment block. To determine the initial stands, germination counts were recorded weekly in each 2 m length of a row before the first assessment. Dying onions, other than those in the sections selected for yield assessment, were rogued out and cause of death (OM, OS, OM+OS or other) was recorded. Data were collected twice weekly to account for loss of onions from the original stand. Assessments for OS were done at the 1st (14 June), 3rd- 5th (4 July) true leaf stages, and at harvest (2 September), by harvesting one of the 2 m sections for each assessment and evaluating leaves and bulbs for OS symptoms. OM damage was examined by evaluating bulbs for the maggot symptoms at the end of the 1st (11 July) and 2nd (22 August) generations and at harvest (22 September). Weight and bulb size were measured at harvest for the yield sections in each block to determine marketable yield. The air temperatures in 2005 were below the long term (10 year) average for May (10.8º C), average for August (19.9º C), and above average for June (21.2º C), July (21.8º C), September (16.7º C) and October (10.0º C). Monthly rainfall was below the long term (10 year) average for May (14 mm), June (63 mm), July (33 mm), September (53 mm), and average for August (56 mm). Analysis of variance (ANOVA) and Fisher's Protected LSD test ($P<0.05$) using the General Analysis of Variance function of the Linear Models section of SAS V.8.2 were used to determine statistical significance of observed differences among treatments. Also an arcsine square root transformation was done on data.

RESULTS: As summarized in Tables 1 and 2.

CONCLUSIONS: In summer 2005 both OS and OM damage were very high. Significant differences among all treatments on three assessment dates were observed for both OS and OM. Both fungicide treatments alone, RAXIL + APRON + MAXIM and PRO GRO, initially significantly reduced OS incidence at different application rates. However, several insecticide/fungicide combinations gave substantially better

OS control, such as high rates of SUCCESS + RAXIL + APRON + MAXIM and REGENT+ RAXIL + APRON + MAXIM. Compared to the standard fungicide seed treatment, PRO GRO, either alone or in combination with GOVERNOR and the untreated check, new fungicide seed treatments particularly in combination with new reduced risk insecticides had stronger effect on OS. To control OM damage, insecticide treatments alone such as REGENT, SUCCESS and GOVERNOR showed an intermediate level of control and no significant difference was observed between the different rates of these insecticides application. Insecticide/fungicide combinations, however, were the most effective for OM control. Most efficacious combinations were: REGENT + RAXIL + APRON + MAXIM and SUCCESS + RAXIL + APRON + MAXIM. Although there were no significant differences between different rates of REGENT, significant differences were observed between different rates of SUCCESS in combination with new fungicides in the first and second OM generation assessment. The higher rates of SUCCESS were more effective than the lowest rate. However, in the third OM generation assessment there were no significant differences between different application rates of SUCESS. Moreover, results showed that new insecticide/fungicide combinations were as effective for OM as the industry standard seed treatment insecticide, Governor, either alone or in combination with the fungicide seed treatment PRO GRO.

Table 1. Evaluation of reduced risk seed treatment fungicides for the control of onion smut at the Muck Crop Research Station, Holland Marsh, Ontario, 2005.

Treatment	Application Rate mg ai/ 100 g seeds	Total incidence of smut %			
		14 June 2005	04 July 2005	02 Sept 2005	Yield T/h
Check	-------	61.0 f[1]	74.5 h	68.8 g	11.77 fg
Governor +Pro Gro	5000+2000	51.5 ef	38.8 b-f	56.4 e-g	38.30 b-e
Success	2500	48.1 d-f	51.6 fg	45.0 b-g	24.77 ef
Regent	500	43.6d-e	44.0 d-g	24.5 a-d	31.82 c-e
Success	5000	43.2d-e	54.1 fg	42.5 a-g	29.35 de
Regent	2500	38.5 d-e	45.9 e-g	52.0 d-g	43.87 a-c
Pro-Gro	2000	31.2 cd	52.4 fg	54.3 gf	6.67 g
Raxil+Apron+Maxim	125+15+5	31.1 cd	24.7 a-e	22.0 a-d	9.25 g
Governor	5000	30.5 b-d	39.8 c-f	37.8 a-f	27.60 de
Success+Raxil+Apron+Maxim	1000+150+15+5	14.8 a-c	27.8 a-e	28.4 a-d	37.90 b-e
Regent+Raxil+Apron+Maxim	500+125+15+5	14.0 a-c	22.8 a-d	27.0 a-d	49.60 ab
Raxil+Apron+Maxim	250+15+5	14.0 a-c	59.3 gh	65.3 g	8.12 g
Success+Raxil+Apron+Maxim	2500+125+15+5	10.6 a-c	20.0 a-c	46.0 c-g	27.40 de
Regent+Raxil+Apron+Maxim	500+250+15+5	10.1 ab	15.0 ab	10.1 ab	41.23 a-d
Regent+Raxil+Apron+Maxim	2500+250+15+5	10.0 ab	14.9 ab	8.4 a	46.90 ab
Regent+Raxil+Apron+Maxim	2500+150+15+5	9.3 a	28.6 a-e	24.1 a-d	47.40 ab
Success+Raxil+ Apron+Maxim	2500+250+15+5	5.6 a	12.2 a	18.3 a-c	54.60 a
Success+Raxil+Apron+Maxim	5000+125+15+5	4.3 a	17.3 a-c	15.2 a-c	44.70 a-c
Success+Raxil+Apron+Maxim	5000+250+15+5	4.3 a	6.3 a	9.7 ab	38.60 b-e
Success+Raxil+Apron+Maxim	1000+250+15+5	3.4 a	24.6 a-e	17.4 a-c	44.45 a-c

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

Table 2. Evaluation of reduced risk seed treatment insecticides for the control of onion maggot at the Muck Crop Research Station, Holland Marsh, Ontario, 2005.

Treatment	Application Rate mg ai/ 100 g seeds	Total incidence of maggot %			
		11 July 2005	22 Aug 2005	22 Sept 2005	Yield T/h
Check	-------	81.6 f[1]	87.7 ij	74.6 de	11.77 fg
Raxil+Apron+Maxim	125+15+5	73.9 ef	74.6 hi	85.4 e	9.25 g
Pro-Gro	2000	69.5 ef	88.5 j	79.9 de	6.67 g
Raxil+Apron+Maxim	250+15+5	59.7 de	69.5 gh	68.7 cd	8.12 g
Success+Raxil+Apron+Maxim	1000+250+15+5	40.6 cd	29.3 a-d	26.2 ab	44.45 a-c
Success+Raxil+Apron+Maxim	1000+150+15+5	39.4 bc	52.9 e-g	44.6 bc	37.90 b-e
Success	2500	25.8 a-c	57.2 fg	52.8 bc	24.77 ef
Success	5000	24.5 a-c	44.3 d-f	47.4 bc	29.35 de
Success+Raxil+Apron+Maxim	2500+125+15+5	19.0 a-c	32.5 b-e	39.6 ab	27.40 de
Regent	500	16.4 ab	35.7 c-e	40.3 ab	31.82 c-e
Governor	5000	16.0 ab	34.3 b-e	33.9 ab	27.60 de
Success+Raxil+ Apron+Maxim	2500+250+15+5	15.6 ab	18.7 a-c	24.8 ab	54.60 a
Regent	2500	9.8 a	35.4 c-e	34.8 ab	43.87 a-c
Regent+Raxil+Apron+Maxim	500+125+15+5	9.4 a	23.9 a-d	35.6 ab	49.60 ab
Governor +Pro Gro	5000+2000	8.9 a	26.3 a-d	42.5 ab	38.30 b-e
Success+Raxil+ Apron+Maxim	5000+125+15+5	7.5 a	26.1 a-d	24.8 ab	44.70 a-c
Success+Raxil+ Apron+Maxim	5000+250+15+5	5.6 a	16.8 a-c	30.6 ab	38.60 b-e
Regent+Raxil+Apron+Maxim	500+250+15+5	4.8 a	12.8 ab	23.7 ab	41.23 a-d
Regent+Raxil+Apron+Maxim	2500+150+15+5	4.2 a	16.0 a-c	13.3 a	47.40 ab
Regent+Raxil+Apron+Maxim	2500+250+15+5	2.8 a	7.7 a	13.3 a	46.90 ab

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

2005 PMR REPORT #22

SECTION C: 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, 2005**

MATERIALS: SUCCESS 480 SC (spinosad 480 g/L), PONCHO 600 FS (clothianidin 600 g/L), CRUISER 5 FS (thiamethoxam 600 g/L), novaluron technical (96% w/w), PYRINEX 480 EC (chlorpyrifos 480 g/L), 1% methyl cellulose (sticker - Tmt. 5), MATADOR 120 EC (lambda cyhalothrin 120 g/L)

METHODS: On 06 May, radish seed (ST) treatments (Tmt. 1-6) were applied in the laboratory at SCPFRC-London by tumbling seed, formulation and, if necessary, sticker for each treatment together in a clean 375 ml glass jar for 3-4 minutes until all seed was uniformly coated. Two or three glass marbles were tumbled with the mixture to separate clumped seed. Seed for all treatments (Table 1) was planted at the SCPFRC-London Research Farm on 18 May in 3-row micro-plots (2.25 m long x 0.9 m wide) filled with insecticide residue-free mineral soil (sandy loam - pH 6.5; 67% sand; 20% silt; 13% clay; 2.2% organic matter). All treatments were replicated three times in a randomized complete block design. The in-furrow spray (IFS) treatment (Tmt. 7) was applied in a 3-5 cm band at 100 kPa in 5 L/100 m row, using a hand-held, CO_2-pressurized, single-nozzled R&D plot sprayer fitted with a 4006E even flat spray tip, centred over the seed in the open seed furrow. To control feeding cutworms and crucifer flea beetles, at BBCH growth stage 10-11 (BBCH - 10-11) on 01 June, lambda-cyhalothrin was applied at 175 kPa in 500 L/ha using a hand-held CO_2-pressurized R&D plot sprayer with a 0.6 m boom fitted with three XR8002VS flat spray tips. During the morning of 06 June when radishes were at BBCH 13-14, a total of 250 CM eggs from an insecticide-susceptible strain were buried 1 cm deep beside a 1 m length of the row in each plot. After infestation, plots were lightly watered to improve egg survival and hatch. A second infestation was similarly completed during the afternoon of 06 June. For each infestation the infested row length was delineated by stakes and the number of radish plants was counted. All radishes from the infested rows were harvested on 13 June (BBCH 46-47) (Infestation 1) or 16 June (BBCH 48-49) (Infestation 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 Student-Neuman-Keul's Multiple Range Test. Untransformed data are presented.

OBSERVATIONS: Yellow margins were observed on cotyledons and first leaves of some seedlings growing from seed treated with either PONCHO or CRUISER. This early phytotoxicity gradually disappeared. Later leaves were not affected.

RESULTS: Experimental results are outlined in Table 1. In both infestations, CM damage to radish in untreated plots exceeded 50% following infestation of CM eggs. In both experiments, CM damage to radish was significantly reduced by at least 89% following IFS-application of chlorpyrifos (Tmt. 7), the current commercial standard of CM control in this crop. CM damage was significantly reduced following ST-application of the higher rate of clothianidin for both infestations (Tmt. 2). CM damage to radish was not significantly reduced following ST application of either rate of thiamethoxam (Tmt. 3, 4), the lower rate of clothianidin (Tmt. 1) or novaluron (Tmt. 5) in either infestation. Although ST application of

spinosad (Tmt. 6) reduced CM damage to radish by at least 60% for both infestations, the reduction was not statistically significant.

CONCLUSIONS: IFS-application of chlorpyrifos, currently registered and recommended for control of CM damage to radish, was the most effective management strategy for this pest in these experiments. In contrast to 2004, ST application of clothianidin significantly reduced CM damage to radish in both infestations in 2005; the rate of application in 2005 was higher than the rate tested in 2004.

Table 1. Effect of planting treatments on damage due to cabbage maggot attacking radishes on mineral soil, London, ON, 2005.

Tmt No.	Treatment Applied			Rate/kg Seed		Results for Indicated Infestation			
						Infestation [1]		Infestation [2]	
	Insecticide	Formulation	Method[1]	a.i.	Product	% Dam. Roots	% Dam. Reduction	% Dam. Roots	% Dam. Reduction
1	clothianidin	PONCHO 600 FS	ST	25.0 g	41.2 ml	33.7 ab[3]	37.9	16.4 ab	67.3
2	clothianidin	PONCHO 600 FS	ST	50.0 g	82.4 ml	14.3 bc	73.7	8.5 b	83.1
3	thiamethoxam	CRUISER 5 FS	ST	25.0 g	42.0 ml	35.5 ab	34.6	34.8 ab	30.7
4	thiamethoxam	CRUISER 5 FS	ST	50.0 g	84.0 ml	31.0 ab	42.9	20.4 ab	59.4
5	novaluron	novaluron technical	ST	25.0 g	26.0 g	42.5 ab	21.7	43.1 a	14.1
6	spinosad	SUCCESS 480 SC	ST	50.0 g	103.8 ml	20.5 abc	62.2	17.7 ab	64.7
7	chlorpyrifos	PYRINEX 480 EC	IFS	4.1 g[2]	8.5 ml[2]	4.6 c	91.5	5.1 b	89.8
8	untreated	----	---	---	---	54.3 a	---	50.2 a	---

[1] method of application: ST - 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 Student-Newman-Keul's Multiple Range Test.

2005 PMR REPORT #23 **SECTION C: POTATOES - Insect Pests**
STUDY DATA BASE: 160.3

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

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TITLE: **EVALUATION OF ENTRUST FOR CONTROL OF COLORADO POTATO BEETLE POPULATIONS IN ORGANIC POTATO PRODUCTION, 2005**

MATERIALS: ENTRUST (spinosad 80%), NOVODOR (*bacillus thuringiensis* subspecies *tenebrionis* 10%)

METHODS: The trial was conducted in the Lower Farm section of the Potato Research Centre of AAFC in Fredericton, NB. Although this section of the research farm is not Certified Organic, it is physically isolated from the main farm section and has been managed organically for at least five years, six at the site of the trial. Seed potatoes were planted on 10 June 2005. Plots were 4 rows wide and 7.62 m in length with 3 m of fallow ground around each plot. This minimized insect movement between plots or foliar treatment drift and allowed the use of tractor mounted equipment to apply treatments or maintain the area as weed free as possible. Plots were arranged in a randomized complete block design (three blocks) with two factors because of an expected gradient of beetle colonization from the previous year's organic potato field across from the 2005 field. The two factors were insecticide (Entrust, Novodor and water as control) and fertilizer (0 kg N, 150 kg N, 300 kg N) in the form of Nutriwave 4-1-2 organic fertilizer. The effect of the fertilizer level on crop health and yield will be reported elsewhere. A tractor mounted device was used to open two small furrows on either side of the seed furrow. Pre-measured amounts of fertilizer were then distributed by hand in the furrows of each row. Seed was placed by hand and the rows closed using the tractor. The insecticides Entrust and Novodor were applied on the 15, 22, 28 July, the 4, 12, and 19 August using a tractor mounted sprayer. Entrust was applied at the rate of 0.11 L/ha and Novodor at the rate of 6.0 L/ha at a pressure of 2.9 kPa. Novodor was applied on the control (water treatment) plots on the 26 of July to prevent excessive defoliation of the plots by the build up of the CPB population. The fungicide Parasol was applied at a rate of 1.80 L/ha on the 28 July, the 4, 11, 18, and 25 August to control blight. Weeds were controlled mechanically as much as possible. The abundance of adults and larvae of the CPB was assessed on five whole plants per plot on the 5, 11, 18, 25 July, the 2, 8, 15, 22 and 30 August. The experimental field was cultivated on 4 July and disked 4 August. The field was weeded on 29 July and harvested on 28 September. Defoliation in each plot was estimated according to an index of defoliation ranging from 1 to 8; where 1 represents minor defoliation along the edges of one foliole, on 1 or 2 plants in a plot, and 8 represents total defoliation of a plot. Significance of observed differences among treatments was determined using ANOVA (SAS) and Student's t tests.

RESULTS: The experimental field was colonized by adult CPB at plant emergence. Counts carried out on 18 July, after the first insecticide application, showed significantly fewer first instar larvae in the Entrust and Novodor treated plots than in the insecticide free plots (Table 1). Counts of third instar larvae were significantly lower in Entrust and Novodor treated plots than in the insecticide free plots on 25 July after the second insecticide application. In spite of an application of Novodor on the control plots on 26 July to prevent excessive defoliation, counts of fourth instar larvae were significantly lower in Entrust and Novodor treated plots than in the insecticide free plots on 8 and 15 August.

The defoliation index climbed up to become significantly higher than that in the insecticide treated plots on 25 July (Table 2). The abundance of CPB larvae in the control (water treatment) plots could not be allowed to build up beyond the commercially acceptable level of defoliation index 1.5 – 2.0 because of the near absence of organic CPB control measures against the summer adult population. The Novodor application on 22 July on control plots reduced the population for the remaining of the season but reduced defoliation only temporarily. Defoliation level climbed again to become significantly higher than in the insecticide treated plots on 15 August. However, there was consistently more defoliation on the unprotected plots than on the Novodor or Entrust treated plots.

The plots receiving insect control treatments did not have higher yields than control plots (Table 3).

CONCLUSIONS: Organic potato producers have access to a limited number of control options to manage the population of CPB in their crop. The bacterial insecticide Novodor has been a key product for many years but has been eliminated from the list of products suitable for use by Certified Organic producers. In this test, the application of the products at least once during peak abundance of each larval instar demonstrated that Entrust can provide a level of control similar to that provided by Novodor for each CPB instar. In commercial potato production, far fewer applications of either product would be required to protect the crop from economic yield loss. In fact, a single application of Novodor on 22 July on the control plots was sufficient to reduce the development of the CPB population and the corresponding defoliation to the extent that their yield was similar to that in the plots receiving multiple applications of Entrust and Novodor.

Table 1. Efficacy of two insecticides against Colorado potato beetles on organically grown potatoes planted in Fredericton, NB, 2005.

Treatment	Mean Number (±SE) of CPB/ 5plants				
	L1	L2	L3	L4	
	July 18	July 18	July 25	August 5	August 15
Control	17.00 ± 4.11a[1]	22.89 ± 12.22a	36.22 ± 7.19a	15.33 ± 5.58a	19.11 ± 5.85a
Novodor (6 l/ha)	6.44 ± 1.99b	0.11 ± 0.11a	10.89 ± 3.01b	2.89 ± 1.40b	2.00 ± 1.32b
Entrust (3.7 oz/ha)	0.89 ± 0.51b	0.00 ± 0.00a	2.56 ± 1.49b	3.89 ± 3.02b	0.11 ± 0.11b
	P < 0.01	P = 0.06	P < 0.01	P = 0.02	P < 0.01

[1] Numbers in a column followed by the same letter are not statistically different ($P \leq 0.05$, Student's t test)

Table 2 Efficacy of two insecticides at protecting organically grown potatoes against foliar damage by Colorado potato beetles in Fredericton, NB, 2005.

Treatment	Mean (±SE) defoliation index [2]					
	July 18	July 25	August 2	August 8	August 15	August 22
Control	1.11 ± 0.11 a[1]	1.44 ± 0.10 a	1.50 ± 0.08 a	1.83 ± 0.17 a	2.17 ± 0.17 a	2.39 ± 0.20 a
Novodor (6 L/ha)	1.00 ± 0.00 a	0.89 ± 0.11 b	1.11 ± 0.11 a	1.39 ± 0.11 a	1.56 ± 0.10 b	1.94 ± 0.15 a
Entrust (3.7 oz/ha)	1.00 ± 0.00 a	1.06 ± 0.06 b	1.17 ± 0.12 a	1.28 ± 0.15 a	1.44 ± 0.15 b	1.83 ± 0.26 a
	$P = 0.48$	$P = 0.05$	$P = 0.19$	$P = 0.19$	$P = 0.04$	$P = 0.22$

[1] Numbers in a column followed by the same letter are not statistically different ($P \leq 0.05$, Student's t test)

[2] The defoliation index was as follows: (0) no defoliation; (1) 2-60% of plants with leaflets lightly damaged; (1.5) > 60% of plants with leaflets lightly damaged; (2) 2% of plants with one or more compound leaves at least 50% defoliated; (3) 3-9% of plants with one or more stems at least 50% defoliated; (4) 10-24% of plants with one or more stems at least 50% defoliated; (5) 25-49% of plants with one or more stems at least 50% defoliated; (6) 50-74% of plants with one or more stems at least 50% defoliated; (7) 75-99% of plants with one or more stems at least 50% defoliated; (8) stems completely eaten on all plants.

Table 3. Effect of two insecticides on the average total and marketable yield of organically grown potatoes planted in Fredericton, NB, 2005.

Treatment	Marketable Yield Mean ± S.E T/ha	Total Yield Mean ± S.E T/ha
Control	4.47 ± 1.20 a[1]	14.37 ± 1.49 a
Novodor (6 L/ha)	4.97 ± 1.20 a	15.26 ± 1.69 a
Entrust (3.7 oz/ha)	4.85 ± 0.80 a	14.42 ± 1.26 a

[1] Numbers in a column followed by the same letter are not statistically different ($P \leq 0.05$, Student's t test)

2004 PMR REPORT #24 **SECTION C: POTATOES - Insect Pests**
STUDY DATA BASE: 160.3

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

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TITLE: **EVALUATION OF ENTRUST FOR CONTROL OF LOW DENSITY COLORADO POTATO BEETLE POPULATIONS IN ORGANIC POTATO PRODUCTION, 2004**

MATERIALS: ENTRUST (spinosad 80%), NOVODOR (*bacillus thuringiensis* subspecies *tenebrionis* 10%)

METHODS: The trial was conducted in the Lower Farm section of the Potato Research Centre of AAFC in Fredericton, NB. Although this section of the research farm is not Certified Organic, it is physically isolated from the main farm section and has been managed organically for at least four years, five at the site of the trial. Seed potatoes were planted on 31 May 2004. Plots were 4 rows wide and 7.62 m in length with 3 m of fallow ground around each plot. This minimized insect movement between plots or foliar treatment drift and allowed the use of tractor mounted equipment to apply treatments or maintain the area as weed free as possible. Plots were arranged in a randomized complete block design (three blocks) with two factors because of an expected gradient of beetle colonization from the previous year's organic potato field across from the 2004 field. The two factors were insecticide (Entrust, Novodor and water as control) and fertilizer (0 kg N, 150 kg N, 300 kg N) in the form of Nutriwave 4-1-2 organic fertilizer. The effect of the fertilizer level on crop health and yield will be reported elsewhere. A tractor mounted device was used to open two small furrows on either side of the seed furrow. Pre-measured amounts of fertilizer were then distributed by hand in the furrows of each row. Seed was placed by hand and the rows closed using the tractor. The insecticides Entrust and Novodor were applied on 21 July and 10 August using a tractor mounted sprayer. Entrust was applied at the rate of 1.50 oz/acre and Novodor at the rate of 6.0 L/ha at a pressure of 60 psi. The fungicide Parasol was applied at a rate of 1.80 L/ha on 21 July, the 12, 19 and 26 August to control blight. Weeds were controlled mechanically as much as possible. The abundance of adults and larvae of the CPB was assessed on five whole plants per plot on 29 June, the 5, 12, 19, 26 July, the 3, 9, 16, 23 and 31 August. The experimental field was cultivated on 5 July and disked on 3 August. The field was weeded on 6 August and harvested on 18 October. Defoliation in each plot was estimated according to an index of defoliation ranging from 1 to 8; where 1 represents minor defoliation along the edges of one foliole, on 1 or 2 plants in a plot, and 8 represents total defoliation of a plot. Significance of observed differences among treatments was determined using ANOVA (SAS) and Student's t tests.

RESULTS: The colonization of the experimental field by adult CPB was unusually late in 2004 with the peak abundance of adult colonizers taking place on 19 July. The field was isolated and the climate was unfavourable to beetle dispersal. As a result, the CPB were never abundant in the field. Insect control treatment was not required until 20 July. Counts carried out on 26 July, after the first insecticide application, showed significantly fewer adults in the Entrust and Novodor treated plots than in the insecticide free plots (Table 1). Counts of stage 3 larvae were also significantly lower in Entrust and Novodor treated plots than in the insecticide free plots on 26 July, 3 August and 16 August, after the

second insecticide application. Counts of larvae tended to be lower in plots treated with Entrust than in those treated with Novodor but not significantly so.

Because of the late colonization and the resulting low beetle density, crop defoliation was never high (Table 2). Significant differences in the level of defoliation between treatments were observed only on 26 July. However, there was consistently more defoliation on the unprotected plots than on the Entrust treated plots.

The plots receiving insect control treatments had consistently higher yields than plots with no insect control treatment but not significantly so (Table 3). The overall low yield value, regardless of treatment, can be attributed in part to the effect of the low soil fertility treatments on plant growth in many plots (reported elsewhere) and possibly, in part, to a high water table in the last third of the growing season.

CONCLUSIONS: Organic potato producers have access to a limited number of control options to manage the populations of CPB in their crop. The bacterial insecticide Novodor has been a key product for many years but was being eliminated from the lists of products suitable for use by Certified Organic producers when this project was undertaken. Results of the test confirm that Entrust can provide a level of control of low density CPB populations similar or better than that provided by Novodor under Maritime conditions.

Table 1. Efficacy of two insecticides against Colorado potato beetles on organically grown potatoes planted in Fredericton, NB, 2004.

Treatment	Mean Number (±SE) of CPB/ 5 plants					
	Adults		L3			L4
	July 19	July 26	July 26	August 3	August 16	August 16
Control	3.89 ± 1.03 a[1]	0.44 ± 0.18 a	10.22 ± 3.68 a	4.67 ± 2.75 a	1.33 ± 0.73 a	5.67 ± 2.81 a
Novodor (6 l/ha)	2.78 ± 0.70 a	0.22 ± 0.15 ab	2.67 ± 1.42 b	0.22 ± 0.15 b	0.11 ± 0.11 b	0.22 ± 0.22 b
Entrust (3.7 oz/ha)	3.44 ± 0.85 a	0.00 ± 0.00 b	0.00 ± 0.00 b	0.11 ± 0.11 b	0.00 ± 0.00 b	0.00 ± 0.00 b

[1] Numbers in a column followed by the same letter are not statistically different ($P \leq 0.05$, Student's t test)

Table 2 Efficacy of two insecticides at protecting organically grown potatoes against foliar damage by Colorado potato beetles in Fredericton, NB, 2004.

Treatment	Mean (±SE) defoliation index [2]			
	July 19	July 26	August 3	August 16
Control	0.89 ± 0.11 a[1]	0.89 ± 0.11 a	1.00 ± 0.00 a	1.00 ± 0.00 a
Novodor (6 L/ha)	0.89 ± 0.11 a	0.67 ± 0.17 a	0.78 ± 0.15 a	0.89 ± 0.11 a
Entrust (3.7 oz/ha)	0.78 ± 0.15 a	0.78 ± 0.15 a	0.89 ± 0.11 a	1.00 ± 0.00 a

[1] Numbers in a column followed by the same letter are not statistically different ($P \leq 0.05$, Student's t test)

[2] The defoliation index was as follows: (0) no defoliation; (1) 2-60% of plants with leaflets lightly damaged; (1.5) > 60% of plants with leaflets lightly damaged; (2) 2% of plants with one or more compound leaves at least 50% defoliated; (3) 3-9% of plants with one or more stems at least 50% defoliated; (4) 10-24% of plants with one or more stems at least 50% defoliated; (5) 25-49% of plants with one or more stems at least 50% defoliated; (6) 50-74% of plants with one or more stems at least 50% defoliated; (7) 75-99% of plants with one or more stems at least 50% defoliated; (8) stems completely eaten on all plants

Table 3. Effect of two insecticides on the average total and marketable yield of organically grown potatoes planted in Fredericton, NB, 2004.

Treatment	Marketable Yield Mean ± S.E T/ha	Total Yield Mean ± S.E T/ha
Control	1.71 ± 0.63 a[1]	8.70 ± 1.74 a
Novodor (6 L/ha)	3.69 ± 1.30a	13.10 ± 2.04 a
Entrust (3.7 oz/ha)	3.49 ± 1.15a	12.20 ± 1.74 a

[1] Numbers in a column followed by the same letter are not statistically different ($P \leq 0.05$, Student's t test)

2005 PMR REPORT #25 **SECTION C: POTATOES - Insect Pests**
STUDY DATA BASE: 160.3

CROP: Potato (*Solanum tuberosum*), cv. Hostess 1879
PEST: Colorado potato beetle (CPB), *Leptinotarsa decemlineata* (Say)

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TITLE: **FIELD EVALUATION OF PESTICIDE TREATMENTS ON COLORADO POTATO BEETLE POPULATIONS IN POTATO, 2004**

MATERIALS: THIMET 15G (phorate 15%), PYRIFOS 15G (chlorpyrifos 15%), PYRINEX 480EC (chlorpyrifos 480 g/L), GENESIS 240F (imidacloprid 240 g/L), PONCHO 600 (clothianidin 600 g/L), and TM-44403 WSG (clothianidin 16%)

METHODS: A field trial in Aylesford, Nova Scotia for testing insecticides against wireworm populations was used to test six different products for their effect on different life stages of Colorado potato beetle. The fungicide SENATOR (500 g/100 kg seed) was applied to seed for all treatments on 7 June, followed by insecticide applications. THIMET 15G, PYRIFOS 15G and TM-44403 WSG (Tables 1-4, treatments 2, 3 and 8) were applied as in furrow granular applications. A pre-measured amount of the product was manually applied to the bottom of a furrow in a 10 cm wide band before seeding. The PYRINEX 480EC (Tables 1-4, treatment 4) was applied as an in-furrow spray application using a handheld one nozzle, CO_2 propelled boom sprayer and, as with the granular treatments, the spray was applied to the bottom of a furrow in a 10 cm wide band before seeding. GENESIS 240F, and two concentrations of PONCHO 600 (Tables 1-4, treatments 5, 6 and 7) were applied as seed treatments on 9 June. Seed pieces were laid out flat in a plastic bag, and the product was sprayed on using an atomizer. The bag was then closed, and the seed pieces tumbled for 20 seconds. The process was repeated with the untreated side of the pieces (side without residue). All plots were planted on 9 June.
Eight treatments including a CONTROL (Tables 1-4, treatment 1) were organized in a randomized complete block design. Four blocks, each containing eight plots (5 m long, 2.8 m wide), were set up in a grower prepared section of a carrot field (potatoes the previous year) in Aylesford, Nova Scotia. Each plot contained five 5 m long rows with 0.7 m between them. The five rows consisted of a guard row followed by three treatment rows (A, B and C) and another guard row.
CPB counts for each life stage commenced on 5 July, and continued once a week until 14 September. For each week, 5 plants were randomly selected from the B treatment row in each plot, and the number of egg masses, first to second instar larvae, third to fourth instar larvae, and adults were recorded. No yield assessments were made on these plots.
For each sampling date, differences among treatments for each life-stage were analyzed using one way ANOVA of square root transformed counts (SAS Institute, Cary, NC). The Waller-Duncan K-ratio t-test was used to separate means.
Maintenance fungicide sprays (with either MANZATE or BRAVO) were made throughout the season. On 20 August, an application of SUCCESS 480 (Spinosad 480 g/l) insecticide was applied at a rate of 166 ml/ha in 400 L of water to all plots to protect the potato planting from CPB and thus, no further monitoring was done.

OBSERVATIONS: Plant wilting and chlorosis was noticed in plants in the first four plots on 20 July. This was attributed to a grower applied herbicide, LOROX. Many of the plants were dead the following week. These four plots were excluded from analyses. On 30 June, it was noted that emergence was variable throughout the planting. This was likely due to irregular hilling and planting and dry weather. No treatment effects could be seen. In general earlier and more intense defoliation was seen on the plots on the northeast end of the field than those on the southwest end of the field.

RESULTS: Results are presented in Tables 1-4.
There were more egg masses in the CONTROL, PYRIFOS and PYRINEX treatments than the other five treatments on 5 and 13 July (Table 1). The THIMET treatment had greater numbers of egg masses than did the GENESIS and PONCHO treatments on 5 July and than PONCHO at the higher rate on 13 July. On 20 July, the CONTROL had more egg masses than did GENESIS and the two PONCHO treatments, while TM-44403 had more egg masses than any other treatments on 3 August. There were essentially no egg masses, regardless of treatment, from 3 August onward.
On 13 July, fewer first and second instar larvae were found in the GENESIS, PONCHO and TM-44403 treatments than the CONTROL, PYRIFOS and PYRINEX treatments while the THIMET treatment had fewer than PYRIFOS and PYRINEX treatments (Table 2). Results were similar on 20 July, except that PYRINEX was now similar to the GENESIS, PONCHO and TM-44403 treatments. The higher rate of PONCHO and GENESIS had the fewest first and second instar larvae on 27 July. The number of first and second instar larvae remained low for the remainder of the study with few consistent differences among the treatments.
Third and fourth instar larvae were first observed on 20 July. GENESIS and PONCHO had the fewest third and fourth instar larvae while PYRINEX had the most and PYRIFOS and the CONTROL were intermediate (Table 3). THIMET had similar numbers of larvae to TM-44403 which was similar to GENESIS and PONCHO on that date. This pattern continued from 27 July to 10 August with GENESIS and PONCHO consistently having the fewest third and fourth instar larvae and PYRINEX and the CONTROL having the most and THIMET intermediate numbers. Low numbers of third and fourth instar larvae were seen for the remainder of the season.
The mean number of colonizing adults was low from 5 July onward (Table 4). The efficacy of treatments was not consistent. The TM-44403 treatment had more adults than the CONTROL on 13 July. Similar numbers of adults were seen in all treatments on 20 July. On 27 July, TM-44403 had similar numbers of adults to PYRIFOS and GENESIS, and greater numbers of adults than the other treatments. The abundance of summer adults in the PYRIFOS and PYRINEX treatments was similar to that in the CONTROL on 16 August.

CONCLUSIONS: PYRIFOX and PYRINEX were ineffective in reducing numbers of CPB larvae. GENESIS, PONCHO and, to some extent, TM-44403 were more effective than THIMET in reducing number of CPB larvae. Consequently, the abundance of summer adults was lowest with GENESIS and the high rate of PONCHO and intermediate with the low rate of PONCHO, THIMET and TM-44403.

Table 1. Mean counts of Colorado potato beetle (CPB) egg masses in different pesticide treatments on potato in Aylesford, Nova Scotia, 2004.

No.	Treatment[1]	July 5		July 13		Jul 20		Jul 27		Aug 3		Aug 10		Aug 16	
1	no insecticide	2	ab[3]	1.6	b	0.75	a	0.55	a	0	b	0.1	a	0	a
2	THIMET 15G	0.8	c	0.6	c	0.2	ab	0.1	a	0	b	0	a	0.1	a
3	PYRIFOS 15G	1.5	b	1.85	b	0.45	ab	0.1	a	0	b	0	a	0.1	a
4	PYRINEX 480EC	2.6	a	2.7	a	0.3	ab	0	a	0	b	0.15	a	0.1	a
5	GENESIS 240F	0	d	0.1	cd	0.1	b	0	a	0	b	0.1	a	0.1	a
6	PONCHO 600	0	d	0.1	cd	0.1	b	0.1	a	0	b	0.1	a	0.1	a
7	PONCHO 600	0	d	0	d	0	b	0	a	0	b	0	a	0	a
8	TM-44403 WSG	0.4	cd	0.55	cd	0.25	ab	0.2	a	0.1	a	0	a	0.1	a

[1] THIMET 15G at a rate of 215 g/100 row-m, PYRIFOS 15G at a rate of 100 g/100 row-m and TM-44403 WSG at a rate of 1400 g/ha were all applied as in furrow granular applications (IFG). PYRINEX 480EC was applied as an in furrow spray application (IFS) at a rate of 21.6 ml/100 row-m. GENESIS 240F at a rate of 52 ml/100kg, PONCHO 600 (no.6) at a rate of 6.25 g a.i./100 kg and PONCHO 600 (no.7) at a rate of 12.5 g a.i./100 kg were all applied as seed treatments (ST).

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

Table 2. Mean counts of first and second instar Colorado potato beetle (CPB) larvae in different pesticide treatments on potato in Aylesford, Nova Scotia, 2004.

No.	Treatment[1]	July 5		Jul 13		Jul 20		Jul 27		Aug 3		Aug 10		Aug 16	
1	no insecticide	0	a	7	ab	12.3	a	6.75	a	0.7	ab	0.4	bc	0.1	abc
2	THIMET 15G	0	a	4.15	bc	6.7	ab	2.8	bc	1	ab	1.1	a	0.5	ab
3	PYRIFOS 15G	0	a	9.65	a	9.85	a	2.5	bcd	1	ab	0.4	abc	0.4	abc
4	PYRINEX 480EC	0	a	8.1	a	2.5	bc	4.05	ab	1.8	a	0.3	bc	0	c
5	GENESIS 240F	0	a	0	c	0	c	0	e	0	b	0	c	0	bc
6	PONCHO 600	0	a	0	c	0	c	3.3	bc	0	b	0.1	bc	0	bc
7	PONCHO 600	0	a	0	c	0	c	0.1	de	0	b	0	c	0	c
8	TM-44403 WSG	0	a	2.15	c	0.35	c	0.35	cde	0.5	ab	0.65	ab	0.6	a

[1] THIMET 15G at a rate of 215 g/100 row-m, PYRIFOS 15G at a rate of 100 g/100 row-m and TM-44403 WSG at a rate of 1400 g/ha were all applied as in furrow granular applications (IFG). PYRINEX 480EC was applied as an in furrow spray application (IFS) at a rate of 21.6 ml/100 row-m. GENESIS 240F at a rate of 52 ml/100 kg, PONCHO 600 (no.6) at a rate of 6.25 g a.i./100 kg and PONCHO 600 (no.7) at a rate of 12.5 g a.i./100 kg were all applied as seed treatments (ST).

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

Table 3. Mean counts of third and fourth instar Colorado potato beetle (CPB) larvae in different pesticide treatments on potato in Aylesford, Nova Scotia, 2004.

No.	Treatment[1]	Jul 5		Jul 13		Jul 20		Jul 27		Aug 3		Aug 10		Aug 16	
1	no insecticide	0	a	0	a	13.8	b	15.6	a	6.05	a	1.7	ab	0.25	bc
2	THIMET 15G	0	a	0	a	4.6	c	5.7	b	3.55	b	0.6	cd	0.9	abc
3	PYRIFOS 15G	0	a	0	a	12.9	b	7	b	6.85	a	2.75	a	1.25	a
4	PYRINEX 480EC	0	a	0	a	22.2	a	14.8	a	6.65	a	1.75	ab	0.4	abc
5	GENESIS 240F	0	a	0	a	0.1	d	0	d	0	d	0	d	0.1	c
6	PONCHO 600	0	a	0	a	0		9.4	bc	0	d	0	d	0.45	bc
7	PONCHO 600	0	a	0	a	0	d	0.1	d	0	d	0	d	0	c
8	TM-44403 WSG	0	a	0	a	1.05	cd	1.5	cd	1.35	c	1.55	bc	1.05	ab

[1] THIMET 15G at a rate of 215 g/100 row-m, PYRIFOS 15G at a rate of 100 g/100 row-m and TM-44403 WSG at a rate of 1400 g/ha were all applied as in furrow granular applications (IFG). PYRINEX 480EC was applied as an in furrow spray application (IFS) at a rate of 21.6 ml/100 row-m. GENESIS 240F at a rate of 52 ml/100 kg, PONCHO 600 (no.6) at a rate of 6.25 g a.i./100 kg and PONCHO 600 (no.7) at a rate of 12.5 g a.i./100 kg were all applied as seed treatments (ST).

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

Table 4. Mean counts of adult Colorado potato beetles (CPB) in different pesticide treatments on potato in Aylesford, Nova Scotia, 2004.

No.	Treatment[1]	July 5		Jul 13		Jul 20		Jul 27		Aug 3		Aug 10		Aug 16	
1	no insecticide	0.25	b	0.1	b	0.1	a	0	b	0	a	0.5	a	5.75	a
2	THIMET 15G	0.35	b	0	b	0	a	0.1	b	0	a	0.1	a	1.75	b
3	PYRIFOS 15G	0.6	ab	0.2	ab	0.1	a	0.1	ab	0.1	a	0.55	a	4.8	a
4	PYRINEX 480EC	0.9	a	0.15	ab	0.1	a	0	b	0	a	0.25	a	4.25	a
5	GENESIS 240F	0.1	b	0	b	0	a	0.15	ab	0.1	a	0.1	a	0.5	c
6	PONCHO 600	0.1	b	0.15	ab	0	a	0.1	b	0.1	a	0.15	a	0.95	bc
7	PONCHO 600	0.1	b	0	b	0.1	a	0.1	b	0.1	a	0.1	a	0.35	c
8	TM-44403 WSG	0.35	ab	0.35	a	0.15	a	0.3	a	0	a	0.15	a	2.4	b

[1] THIMET 15G at a rate of 215g/100 row-m, PYRIFOS 15G at a rate of 100g/100 row-m and TM-44403 WSG at a rate of 1400 g/ha were all applied as in furrow granular applications (IFG). PYRINEX 480EC was applied as an in furrow spray application (IFS) at a rate of 21.6 ml/100 row-m. GENESIS 240F at a rate of 52 ml/100 kg, PONCHO 600 (no.6) at a rate of 6.25 g a.i./100 kg and PONCHO 600 (no.7) at a rate of 12.5g a.i./100 kg were all applied as seed treatments (ST).

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

2005 PMR REPORT #26 **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, 2005**

MATERIALS: ASSAIL 70 WP (acetamiprid 70%), DPX-E2Y45 35 WG (rynaxypyr 35%), BAS 320I 240 SC (metaflumizone 240 g/L), MERGE adjuvant (surfactant blend 50%), MAXIM PSP (fludioxonil 0.5%)

METHODS: Chitted seed potatoes were hand cut on 18 May; cut seed potatoes for each treatment was placed in separate 50 lb clear plastic bags. On 19 May MAXIM (500 g/100 kg seed) was sprinkled over the top of the treated seed pieces in the bag which was then closed and tumbled for 1 minute to ensure even coating of all seed pieces. Seed pieces for all treatments (Table 1, Tmts. 1-4) were then planted on the SCPFRC-London Research Farm in single-row (10 seed pieces/row) micro-plots (2.25 m long x 0.9 m wide) filled with insecticide residue-free mineral soil. All treatments were replicated 3 times in a randomized complete block design. To supplement scanty rainfall, micro-plots received 10-15 mm water via sprinkler-irrigation on 22, 27, 30 June, 05, 11, 15 July and 03 August.
On 24 June when plants were in early bud, 25 fully expanded compound leaves were tagged in each plot. On 27 June all treatments were applied at 250 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, a total of 6 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 6 leaves was harvested from each plot of each treatment and returned to the laboratory. If CPB numbers were sufficient, a total of 9 adult-bioassays (3 bioassays/plot x 3 plots/tmt.), each containing 1 tri-foliate leaflet and 5 CPB adults, and 9 larval-bioassays (3 bioassays/plot x 3 plots/tmt.), each containing a 12.0 cm^2 leaf disc and 5 early second instar larvae, was then established for each treatment. Bioassays were held at 22°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 area of 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 or consumption among treatments was determined using ANOVA and Tukey's HSD means separation test.

OBSERVATIONS: After foliar application on 27 June, no rain fell during the 24 hrs after treatment. A total of 0.3 mm of rainfall subsequently accumulated by 5 days after treatment (DAT), supplemented by 10 mm water by sprinkler irrigation. At total of 5.0 mm rainfall plus 33.0 mm irrigation water was reached by 14 DAT. The maximum temperature reached 32.9°C on Day 0 (27 June); the average daily maximum temperature over the first 5 DAT was 29.0°C. No phytotoxicity was noted following any treatment.

RESULTS: Nearly 90% of adult CPB died within 72 hrs after feeding in bioassay on leaves collected as soon as spray deposits of all 3 treatments dried (Table 2). While virtually no feeding was observed on leaves treated with either ASSAIL or rynaxypyr, adult CPB consumed an average of nearly 40% of the area of leaves treated at the same time with metaflumizone (Table 3). Reduced adult mortality was recorded in bioassays established 1 and 4 DAT; the observed variation in adult mortality among treatments was not statistically significant (Table 2). Again at both 1 and 4 DAT, adult CPB consumed significantly more foliage treated with metaflumizone than with either acetamiprid or rynaxypyr (Table 3). Due to lack of adults in the laboratory culture, no bioassays were possible from 5-14 DAT. At 14 DAT, <20% adult mortality was recorded in bioassays of leaves treated with either ASSAIL or metaflumizone. Adult mortality was significantly higher on leaves treated with rynaxypyr; 60% of exposed adults died within 72 hrs (Table 2). Minimal adult feeding was observed 14 DAT on leaves treated with rynaxypyr; application of ASSAIL or metaflumizone had no impact on adult feeding by that date (Table 3). Minimal adult mortality was observed on leaves treated with rynaxypyr in bioassays established 28 DAT (Table 2); no reduction in leaf consumption was recorded in the same bioassays (Table 3).
In bioassay, foliar application of all 3 treatments proved highly toxic to early second instar larvae for 2 DAT (Table 4). By 4 DAT mortality of early second instar larvae fell below 50% in bioassay of leaves treated with ASSAIL. Until 28 DAT average mortality of early second instar larvae was at least 50% in 8 of 9 bioassays of foliar toxicity of metaflumizone. As long as 36 DAT, foliar deposits of rynaxypyr proved lethal to over 75% of exposed early second instar larvae; over 50% of exposed larvae died within 72 hrs in bioassay 42 DAT (Table 4). In bioassay, leaf consumption by early second instar larvae was significantly reduced relative to damage in untreated CONTROL plots as follows: ASSAIL - 7 DAT; metaflumizone - 21 DAT; and, rynaxypyr at least until 42 DAT (Table 5).

CONCLUSIONS: Under the conditions of this trial foliar residues of all 3 insecticides were more effective against early second instar larvae than against CPB adults. The observed order of significant reduction of larval feeding by applied rates was: rynaxypyr (at least 42 days) > metaflumizone (21 days) > ASSAIL (7 days). Due to reported different and unique modes of action, both rynaxypyr and metaflumizone 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, 2005.

Tmt. No.	Insecticide	Formulation	Rate/ha	
			a.i.	product
1	acetamiprid	ASSAIL 70 WP	56.0 g	80.0 g
2	rynaxypyr	DPX-E2Y45 35 WG	75.0 g	214.3 g
3	metaflumizone[1]	BAS 3201 240 SC[1]	80.0 g	333.3 ml
4	no insecticide	CONTROL	---	---

[1] Applied in combination with MERGE surfactant.

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, 2005.

Tmt.[1] No.	Average % Corrected Adult CPB Mortality on Indicated DAT[3]					
	0	1	4	14	21	28
1	86.8 a[2]	62.0 a	93.9 a	18.7 a	13.3 a	---[4]
2	89.5 a	48.8 a	63.6 a	60.0 b	35.6 a	4.4
3	94.7 a	81.6 a	69.7 a	15.6 a	15.6 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] Days after Treatment.

[4] Bioassay not performed due to low mortality in preceding bioassay.

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, 2005.

Tmt.[1] No.	Average Damage Rating[3] due to Feeding by Adult CPB on Indicated DAT[4]					
	0	1	4	14	21	28
1	0.1 c[2]	0.2 c	0.1 b	7.4 a	9.7 a	---[5]
2	0.2 c	0.2 c	0.2 b	0.3 b	0.6 b	9.6 a
3	3.8 b	3.8 b	3.5 a	8.3 a	9.7 a	---
4	9.0 a	8.0 a	4.5 a	8.8 a	9.9 a	9.8 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.

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, 2005.

Tmt. No.	Average % Corrected Larval CPB Mortality on Indicated DAT[3]										
	0	1	2	4	7	10	14	21	28	36	42
1	95.2 a[2]	97.6 a	85.6 a	45.4 b	48.7 b	10.0 b	10.5 b	6.9 c	51.9 a	---[4]	---
2	85.7 a	97.6 a	95.2 a	97.6 a	100.0 a	100.0 a	95.3 a	97.7 a	88.9 a	78	51.3
3	97.6 a	63.5 b	88.4 a	88.9 a	84.2 ab	93.1 a	37.8 b	50.2 b	70.4 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] Days after Treatment.
[4] Bioassay not performed due to low mortality in preceding bioassay.

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, 2005.

Tmt.[1] No.	Average Leaf-Area[3] Consumed by Larval CPB on Indicated DAT[4]										
	0	1	2	4	7	10	14	21	28	36	42
1	0.3 b[2]	0.3 c	0.4 b	2.2 bc	1.0 bc	4.4 a	4.5 a	5.2 ab	5.9 a	---[5]	---
2	0.4 b	0.4 c	0.2 b	0.1 b	0.1 c	0.2 b	0.4 d	0.9 c	0.7 b	0.4 b	0.9 b
3	1.0 b	2.9 b	1.0 b	3.1 b	1.6 b	1.5 b	2.7 c	3.7 b	5.2 a	---	---
4	6.7 a	6.7 a	7.3 a	8.5 a	5.7 a	3.4 a	5.6 a	5.3 a	3.8 a	4.7 a	5.5 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.

2005 PMR REPORT #27

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 PLANTING TREATMENTS FOR CONTROL OF COLORADO POTATO BEETLE ON POTATO ON MINERAL SOIL, 2005**

MATERIALS: PONCHO 600 FS (clothianidin 48% [w/w]), THIMET 15 G (phorate 15% [w/w]), MAXIM PSP (fludioxonil 0.5% [w/w])

METHODS: Chitted seed potatoes were hand cut on 18 May; cut seed potatoes for each treatment was placed in separate 50 lb clear plastic bags. Using a hand-operated mist-applicator, seed treatments (ST) (Table 1, Tmts. 1-3) were uniformly applied in 0.625 L/100 kg seed on 19 May to cut seed potatoes. Each bag was then closed and seed potatoes tumbled for 1 minute to ensure even coating of all pieces. MAXIM PSP (500 g/100 kg seed) was then uniformly sprinkled over the top of the treated seed pieces in each bag which was then closed and again tumbled for 1 minute to ensure even coating of all seed pieces. Seed pieces for Tmt. 4-6 were tumbled with MAXIM PSP only. After tumbling, bags were opened and seed allowed to dry until planting. Seed potatoes for all treatments were planted on the SCPFRC-London Research Farm on 19 May in single-row (10 seed pieces/row) micro-plots (2.25 m long x 0.9 m wide) filled with insecticide residue-free, mineral soil. The in-furrow granular (IFG) treatments (Table 1, Tmt. 4-5) were hand applied in 7-10 cm band in the bottom of the seed furrow before placement of the seed potatoes. All treatments were replicated 3 times in a randomized complete block design. To supplement scanty rainfall, microplots received 10-15 mm water via sprinkler-irrigation on 22, 27, 30 June, 05, 11, 15 July and 03 August.
Once growing plants had developed at least 2 tri-foliate leaves, residual effectiveness of all treatments against both adult and larval insecticide-susceptible, laboratory-reared CPB was measured by bioassay. On each collection date (Tables 2-5) a total of 6 leaves was harvested from each plot of each treatment and returned to the laboratory. A total of 9 adult-bioassays (3 bioassays/plot x 3 plots/tmt.), each containing 1 tri-foliate leaflet and 5 CPB adults, and 9 larval-bioassays (3 bioassays/plot x 3 plots/tmt.), each containing a 12.0 cm^2 leaf disc and 5 early second instar larvae, was then established for each treatment. Bioassays were held at 22°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 area of 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 or consumption among treatments was determined using ANOVA and Tukey's HSD test.

RESULTS: At the time of the first bioassay, 31 days after treatment (DAT), mortality of adult CPB was significantly higher when feeding on foliage from plants treated with PONCHO than on foliage from plants treated with THIMET (Table 2). Almost all adult CPB died within 72 hrs in bioassays of PONCHO persistence while <10% of adult CPB died during the same time period after feeding on foliage treated with THIMET (Table 2). Because of minimal mortality on foliage treated with THIMET, no bioassay of impact

on adult CPB was undertaken after 53 DAT. Adult mortality exceeded 50% following ST application of PONCHO for at least 67 DAT. At 53 and 60 DAT, significantly less adult mortality was recorded on foliage from micro-plots treated with PONCHO for the first time in 2005 than on foliage from micro-plots treated with the insecticide for either 2 (53 DAT) or 3 (60 DAT) years (Table 2). In bioassays undertaken beyond 60 DAT, the number of applications of PONCHO had no significant effect on adult CPB mortality. ST application of PONCHO significantly reduced feeding by adult CPB in bioassay for at least 81 DAT (Table 3). While the number of applications of PONCHO had no significant impact on adult feeding damage in any bioassay, numerically less damage was observed in bioassays of foliage in micro-plots receiving at least 2 applications of the insecticide. Adult feeding damage to foliage from plots receiving IFG-application of THIMET was significantly reduced in bioassay only 31 DAT and only in plots treated with THIMET for the first time in 2005 (Table 3).

Until 60 DAT mortality of CPB larvae in bioassay was significantly higher on foliage from micro-plots treated with PONCHO than on foliage from plots receiving IFG-application of THIMET (Table 4). While larval mortality generally exceeded 75% in plots receiving ST-application of PONCHO until 60 DAT, larval mortality in plots treated with THIMET was always significantly lower (Table 4). The 50%+ mortality recorded 81 DAT in plots treated with THIMET for the first time in 2005 (Table 4) is regarded as an anomaly as increased mortality was not accompanied by significantly reduced larval feeding (Table 5). In the first bioassay, 31 DAT, significantly less larval mortality was recorded on foliage from plots treated 2x with THIMET than on foliage from plots treated with THIMET for the first time in 2005 (Table 4). CPB larvae consumed significantly less foliage from plants treated with PONCHO than from plants receiving IFG-application of THIMET until 60 DAT (Table 5). IFG-application of THIMET significantly reduced larval leaf consumption only in the first bioassay 31 DAT and only in plots treated with the insecticide for the first time in 2005 (Table 5). Repeat IFG-application of THIMET did not significantly reduce larval feeding damage relative to that recorded in bioassay of foliage from UNTREATED plots (Table 5).

CONCLUSIONS: Under the conditions of this trial sufficient systemic residues PONCHO, applied ST, remained in potato foliage to significantly reduce feeding by both adult and larval CPB several weeks beyond the period that those residues caused significant mortality of introduced insects. IFG-application of THIMET provided only limited, very short term protection of potato foliage. Repeat application of clothianidin to the same plots for a second and third year did not decrease protection of potato foliage in those plots. Indeed, there was some indication of increased foliage protection 53-60 DAT. Thus in this trial there was no evidence of enhanced degradation of clothianidin by soils subjected to repeated application of the insecticide. THIMET, on the other hand, in addition to providing only short term, limited protection of potato foliage also appeared to be subject to more rapid degradation in soils treated a second time with the insecticide. Reduced mortality and greater damage was observed in bioassays of foliage from plots treated with THIMET in both 2004 and 2005.

Table 1. Planting treatments evaluated in micro-plots for control of insect pests of potato on mineral soil, London, ON, 2005.

Tmt. No.	Insecticide	Formulation	Yr[1]	Method[2]	Rate/100 kg Seed	
					a.i.	product
1	clothianidin	PONCHO 600 FS	1	ST	9.35 g	15.6 ml
2	clothianidin	PONCHO 600 FS	2	ST	9.35 g	15.6 ml
3	clothianidin	PONCHO 600 FS	3	ST	9.35 g	15.6 ml
4	phorate	THIMET 15 G	1	IFG	32.25 g[3]	215.0 g[3]
5	phorate	THIMET 15 G	2	IFG	32.25 g[3]	215.0 g[3]
6	no insecticide	CONTROL	---	---[4]	---	---

[1] Number of years treatment applied to same plot.
[2] Method of application: IFG - in-furrow granular application; ST - seed treatment.
[3] Amount/100 m row.
[4] No insecticide applied.

Table 2. Effect of foliage of potatoes, protected by selected planting treatments, on mortality of Colorado potato beetle (CPB) adults after feeding for 72 hours in bioassay, London, ON, 2005.

Tmt.[1] No.	Average % Corrected Adult CPB Mortality on Indicated DAT[3]					
	31	53	60	67	75	81
1	95.6 a[2]	38.4 bc	45.9 b	51.1 a	44.4 a	40.0 a
2	100.0 a	82.9 a	64.4 ab	55.6 a	60.3 a	20.0 a
3	93.3 a	66.4 ab	84.4 a	66.7 a	48.9 a	28.9 a
4	6.7 b	5.1 c	---[4]	---	---	---
5	8.9 b	0.0 c	---	---	---	---

[1] Refer to Table 1 for full description of treatments.
[2] Within each DAT, means followed by the same letter are not significantly different ($P \leq 0.05$) as determined using ANOVA and Tukey's HSD means separation test.
[3] Days after Treatment.
[4] Bioassay not performed due to low mortality in preceding bioassay.

Table 3. Effect of foliage of potatoes, protected by selected planting treatments, on feeding damage by Colorado potato beetle (CPB) adults after 72 hours in bioassay, London, ON, 2005.

Tmt.[1] No.	Average Damage Rating[3] due to Feeding by Adult CPB on Indicated DAT[4]					
	31	53	60	67	75	81
1	0.2 c[2]	0.6 b	2.4 b	2.5 b	2.6 b	3.0 b
2	0.1 c	0.2 b	0.4 b	0.7 b	2.6 b	3.3 b
3	0.3 c	0.5 b	0.2 b	1.1 b	1.5 b	2.0 b
4	3.1 b	9.2 a	---[5]	---	---	---
5	6.2 a	9.4 a	---	---	---	---
6	7.5 a	8.8 a	9.9 a	9.8 a	9.9 a	9.5 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.

Table 4. Effect of foliage of potatoes, protected by selected planting treatments, on mortality of Colorado potato beetle (CPB) larvae after feeding for 72 hours in bioassay, London, ON, 2005.

Tmt.[1] No.	Average % Corrected Larval CPB Mortality on Indicated DAT[3]						
	31	42	53	60	67	75	81
1	100.0 a[2]	---[4]	64.4 b	79.8 a	57.1 a	46.0 a	39.4 ab
2	95.3 a	---	86.7 ab	84.4 a	61.8 a	30.0 a	23.8 ab
3	97.7 a	---	100.0 a	88.7 a	72.9 a	36.0 a	4.0 b
4	25.4 b	8.3 a	0.0 c	17.0 b	43.4 a	23.8 a	52.9 a
5	2.0 c	3.4 a	0.0 c	8.3 b	35.2 a	0.0 a	0.7 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 lack of insects for bioassay.

Table 5. Effect of foliage of potatoes, protected by selected planting treatments, on feeding damage by Colorado potato beetle (CPB) larvae after 72 hours in bioassay, London, ON, 2005.

Tmt.[1] No.	Average Leaf-Area[3] Consumed by Larval CPB on Indicated DAT[4]						
	31	42	53	60	67	75	81
1	0.3 c[2]	---[5]	2.0 b	1.8 cd	2.6 bc	3.6 b	3.1 a
2	0.1 c	---	0.2 b	1.3 d	1.0 c	4.2 b	3.7 a
3	0.3 c	---	0.3 b	1.1 d	0.5 c	2.2 b	4.6 a
4	2.8 b	5.8 a	5.6 a	3.3 bc	5.3 a	5.3 ab	3.4 a
5	5.3 a	6.3 a	5.6 a	4.8 ab	4.1 ab	8.1 a	5.5 a
6	6.4 a	5.7 a	5.1 a	5.3 a	3.8 ab	4.7 ab	5.5 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 insects for bioassay.

2005 PMR REPORT #28 **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, 2005**

MATERIALS: PONCHO 600 FS (clothianidin 48% [w/w]), CRUISER 5 FS (thiamethoxam 47.6% [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]), MAXIM PSP (fludioxonil 0.5% [w/w])

METHODS: Using a hand-operated mist-applicator, seed treatments (ST) (Table 1, Tmts. 1-5) were uniformly applied in 0.625 L/100 kg seed on 12 May to cut seed potatoes contained in separate 50 lb clear plastic bags. Each bag was then closed and seed potatoes tumbled for 1 minute to ensure even coating of all pieces. MAXIM PSP (500 g/100 kg seed) was then uniformly sprinkled over the top of the treated seed pieces in each bag which was then closed and again tumbled for 1 minute to again ensure even coating of all seed potatoes. Seed potatoes for Tmt. 6-9 were tumbled with MAXIM PSP only. After tumbling, bags were opened and seed allowed to dry until planting. Hard red, spring wheat for the trap and kill (TK) treatment (Tmt. 7) was treated on 11 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). The in-furrow spray (IFS) treatment (Tmt. 6) was applied in a 10-12 cm band in the bottom of the open seed furrow in 5 L/100 m row at 205 kPa, using a hand-held, CO_2-pressurized R&D field-plot sprayer fitted with a single 4004EVS flat spray tip. The in-furrow granular (IFG) treatment (Tmt. 8) was hand applied in 7-10 cm band in the bottom of the seed furrow. On 13 May, single row plots were established in sandy loam soil near Rodney, Ontario (42° 33' 33.77" N; 81° 38' 53.45" W). Rows were planted on 1 m spacing. Individual plots measured 5 m long. Replicate ranges were separated by 1 m fallow walkways which were also located at either end of the entire block. Seed pieces were hand planted at 20 cm spacing (25 seed pieces/plot) as specified; seed pieces for Tmts. 6-8 were placed on top of the applied experimental treatments. Seed pieces were covered with soil, hilled to a height of ca. 10 cm and lightly tamped to ensure good contact with soil. With the exception of Tmt. 9, all treatments were replicated 4x in a Randomized Complete Block design. To accommodate possible uneven WW distribution within the block, single untreated rows (Tmt. 9) were established so that every treated row was adjacent to an untreated row; each replicate range thus contained 4 untreated rows. Plots were subsequently hilled and weeds removed manually as required until harvest.
On 22 August, all potatoes from Plants 2-11 in each plot were carefully dug, placed in labelled jute bags and returned to the laboratory for grading. During grading, harvested potatoes were washed and all marketable tubers ≥ 51 mm diameter 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. Since WW were present throughout the block, a single untreated plot (Tmt. 9) was randomly selected from each replicate for purposes of comparison of treatment effect. The number of blemishes/tuber was square-root transformed prior to statistical analysis by Analysis of Variance using the General Linear Model in SAS Version 8.2. The significance of observed differences among treatment means was then determined using Tukey's

Studentized Range (HSD) test. Untransformed data are presented, expressed as the number of blemishes/100 tubers.

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 many occasions during the summer. By 15 July potato plants had been seriously affected. By 22 July "weather fleck" and leaf curling was observed throughout the block; all treatments were affected. Injury continued to increase masking any visible foliar impact of feeding by potato leafhopper.

RESULTS: Impact of planting treatments on WW-damage to harvested potato tubers is shown in Table 1. An average of 190 WW blemishes/100 tubers was recorded in plots to which no insecticide was applied. While fewer WW blemishes were counted in all tubers harvested from plants receiving ST application of either PONCHO or CRUISER, numbers were significantly reduced only in tubers from plants treated with PONCHO @ 20.8 ml/100 kg seed, the highest rate of application of the insecticide. Either IFS-application of REGENT or IFG-application of THIMET, the previous commercial standard method of WW control was highly effective, reducing WW feeding damage to harvested tubers by as much as 97.4%. Excellent protection of potato tubers was also recorded in plots receiving TK application of fipronil; tuber damage was significantly reduced by over 88% in those plots.

CONCLUSION: Under the conditions of this experiment, in-furrow application of either REGENT or THIMET reduced WW-damage to potato tubers more consistently than did ST application of tested rates of either PONCHO or CRUISER. WW are attracted to germinating wheat seeds. If those seeds are treated with fipronil, resulting mortality of feeding WW can result in significant reductions in WW damage to potato tubers growing in the same plots.

Table 1. Impact of planting treatments on damage to harvested potato tubers by wireworms, 2005.

Tmt No.	Insecticide Applied	Method[1] of Application	Rate Applied/100 kg		Mean Wireworm Damage[4]
			a.i.	Formulation	
1	PONCHO 600 FS	ST	6.25 g	10.4 ml	155.0 ab[5]
2	PONCHO 600 FS	ST	9.35 g	15.6 ml	72.5 abc
3	PONCHO 600 FS	ST	12.50 g	20.8 ml	40.0 bc
4	CRUISER 5 FS	ST	4.50 g	7.5 ml	165.0 ab
5	CRUISER 5 FS	ST	9.00 g	15.0 ml	112.5 abc
6	REGENT 4 SC	IFS	3.05 g[2]	6.25 ml[2]	5.0 c
7	ICON 6.2 FS	TK	1.6 g[2, 3]	2.1 ml[2, 3]	22.5 c
8	THIMET 15 G	IFG	32.25 g[2]	215.0 g[2]	7.5 c
9	no insecticide	-----	----	-----	190.0 a

1 Method of application: IFS - in-furrow spray treatment; IFG - in-furrow granular treatment; ST - seed treatment; TK - trap and kill treatment.
2 amount/100 m row.
3 based on application rate of 3.053 g a.i./48,000 wheat seeds (0.06 mg a.i./seed) planted at a density of 2.5 seeds/cm row (250 seeds/m row).
4 Blemishes/100 tubers.
5 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.

2005 PMR REPORT #29

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

CROP: Corn, *(Zea maize L.)*, cv D 73
PEST: Wireworm, *(Limonius* spp.)

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TITLE: **CONTROL OF WIREWORM IN CORN WITH SEED TREATMENTS**

MATERIALS: MAXIM XL 324 FS (fludioxonil + metalaxyl-M, 229.59 + 87.66 g ai/L); CRUISER 5 FS (thiamethoxam, 5 g ai/L); PONCHO 600 FS (clothianidin, 600 g ai/L); CRUISER 350 FS (thiamethoxam, 350 g ai/L); A9765N 600 g ai/L (Experimental).

METHODS: Seed was treated in 1 kg lots in individual plastic bags by applying seed treatment via a syringe to each bag. The seed was then mixed in the inflated bag for 1 min to ensure thorough seed coverage. Seed weight was 275 g/1000 seed. The corn was planted on 12 May, 2005 at Rodney, ON using a two-row cone-seeder mounted on a John Deere Max Emerge planter. Plots were 4 rows, spaced 0.76 m apart and 6 m in length placed in RCBD with 4 replications. The plots were fertilized and maintained according to provincial recommendations. Emergence was assessed on 1 June, 2005 and plant stand was determined on 8, 15, 22 and 29 June, 2005. Vigor assessments, using a scale of 0 -100 (100= most advanced plant and 0 = plants dead in the plot), were recorded on the same dates. The total number of plants and wireworm populations were estimated on 1 June, 2005 by digging up 1 m of row in a trench 15.2 cm deep and 10.16 cm wide in the check plots, sifting the soil and separating out the wireworms. Plant stand and plant height in 1 m of row were recorded on 29 June, 2005 and fresh weights on the leaves and roots of these plants were recorded on the same date. Plots were harvested on 18 Nov, 2005 and yields adjusted to 15.5% moisture. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at P= 0.05.

RESULTS: See Table 1-3. The mean counts for plants and wireworms per m in the check plots were 2.0 and 8.0, respectively.

CONCLUSIONS: Emergence and final stand improved in the fungicide-treated check relative to the non-treated check treatment. Stand and vigor were only marginally improved by the addition of insecticide seed treatment. Without insecticide alone treatments it is difficult to speculate whether insecticides and fungicides interacted to protect against the effects of wireworm. Wireworms clearly played a role in reducing the plant stands.

Table 1. Emergence and plant stand assessments in a corn trial evaluating seven insecticide treatments against wireworms at Rodney, ON, 2005.

Treatment	Rate g ai/100 kg or mg ai/seed*	Emergenc	Plant Stand Number plants per plot			
		1 June	8 June	15 June	22 June	29 June
UNTREATED CHECK		59 b[1]	66 b	69 c	68 c[2]	70 b
MAXIM XL FUNGICIDE CHECK	3.5	77 a	85 a	84 b	83 b	84 a
MAXIM XL +CRUISER 5	3.5 50	80 a	88 a	90 ab	89 ab	89 a
MAXIM XL +CRUISER 5	3.5 100	83 a	89 a	89 ab	89 ab	88 a
MAXIM XL +CRUISER 350	3.5 50	78 a	91 a	91 a	91 a	90 a
MAXIM XL +A9765N	3.5 50	82 a	90 a	90 ab	91 a	90 a
MAXIM XL +PONCHO 600 FS	3.5 0.25*	83 a	91 a	91 a	88 ab	89 a
CV		9.2	5.4	5.0	5.8	5.5

[1] Means within a column followed by same letter do not significantly differ, *P*= 0.05 LSD.
[2] Data transformed by arsine square root for means separation and CV calculation, means are de-transformed.

Table 2. Vigour assessments in a corn trial evaluating seven insecticide treatments against wireworms at Rodney, ON, 2005.

Treatment	Rate g ai/100 kg or mg ai/seed*	Vigour				
		1 June	8 June	15 June	22 June	29 June
UNTREATED CHECK		55	65	65	62.5 b[1]	60.0 c
MAXIM XL FUNGICIDE CHECK	3.5	85	90	90	85.0 a	77.5 b
MAXIM XL +CRUISER 5	3.5 50	75	82.5	85	90.0 a	92.5 a
MAXIM XL +CRUISER 5	3.5 100	80	87.5	87.5	87.5 a	87.5 ab
MAXIM XL +CRUISER 350	3.5 50	77.5	85	87.5	90.0 a	92.5 a
MAXIM XL +A9765N	3.5 50	77.5	82.5	80	85.0 a	87.5 ab
MAXIM XL +PONCHO 600 FS	3.5 0.25*	85	87.5	87.5	87.5 a	80.0 b
CV		20.2	13.4	12.7	11.8	8.7

[1] Means within a column followed by same or no letter do not significantly differ, *P*= 0.05 LSD.

Table 3. Plant height, plant stand, fresh weights and yield assessments in a corn trial evaluating seven insecticide treatments against wireworms at Rodney, ON, 2005.

Treatment	Rate g ai/100 kg or mg ai/seed*	Plant Height cm	Plant Stand # per m	Fresh Weight Leaves g	Fresh Weight Roots g	Test Weight kg/hl	Yield T/ha
		29 June				18 Nov	
UNTREATED CHECK		86.6[1]	7	666.7	133.2	73.8	9.9
MAXIM XL	3.5	88.8	9	741.8	171.4	73.4	9.6
FUNGICIDE CHECK							
MAXIM XL	3.5	90.0	9	785.4	160.3	74.2	10.1
+CRUISER 5	50						
MAXIM XL	3.5	91.6	8	662.3	147.3	73.6	10.1
+CRUISER 5	100						
MAXIM XL	3.5	90.2	9	838.6	148.5	73.9	10.3
+CRUISER 350	50						
MAXIM XL	3.5	91.3	8	755.8	142.8	73.9	11.2
+A9765N	50						
MAXIM XL	3.5	90.4	10	882	164.1	73.8	10.6
+PONCHO 600 FS	0.25*						
CV		4.9	22.3	25.3	24.4	1.0	14.1

[1] Means within a column followed by same or no letter do not significantly differ, *P*= 0.05 LSD.

2005 PMR REPORT #30

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

CROP: Corn, *(Zea maize L.)*, cv D73
PEST: Wireworm, *(Limonius* spp.)

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TITLE: CONTROL OF WIREWORM IN CORN WITH SEED TREATMENTS

MATERIALS: MAXIM XL 324 FS (fludioxonil + metalaxyl-M, 229.59 + 87.66 g ai/L); PONCHO 600 FS (clothianidin, 600 g ai/L); CRUISER 5 FS (thiamethoxam, 5 g ai/L); PRECISE FINISHER 1003 FS SEED COATING; PRO-IZED RED COLOURANT FS; TALC 100 WP.

METHODS: Corn seed was treated in 500 g lots in individual plastic bags by applying a slurry of material via a syringe to each bag (all treatments diluted in water to the same volume of 5.0 ml per kg). The seed was then mixed in the inflated bag for 1 min to ensure thorough seed coverage. Seed weight was 275 g/1000 seeds. Early and late plantings were on 4 and 12 May, 2005 at Rodney, ON using a two-row cone-seeder mounted on a John Deere Max Emerge planter. Plots were four rows spaced 0.76 m apart and 6 m in length placed in RCBD with 4 replications. The plots were fertilized and maintained according to provincial recommendations. Growth stage assessments were based on the BBCH scale where S1 (BBCH 10) = up to leaf or cotyledon development, S2 (BBCH 11-19) = 2-6 weeks after emergence, S3 (BBCH 20-59) = stem elongation/main shoot development, S4 (BBCH 60-69) =flowering, S5 (BBCH 70- 89) = dough stage, SM (BBCH 90)= maturity (BASF, Bayer, Ciba-Geigy and Hoechst). Emergence was assessed on 25 May and plant stand was assessed on 1, 8,15 June and 28 July, 2005 for both planting dates. Vigor assessments, using a scale of 0 -100% (100= most advanced plants and 0 = plants dead in the trial) were recorded on the same dates. Row fill was assessed on 25 May, 1, 8, 15 June and 28 July, 2005 for both locations using a scale of 0-100% (100= all plants equally spaced, 50= half plants missing, 0= all plants missing). Plant stand, number of damaged plants and fresh weights (g/m from one whole plot row) were recorded at both locations on 25 May, 2005. Wireworm populations were assessed on the same date in the same 1 m by digging a trench 15.2 cm deep and 10.16 cm wide, sifting the soil and separating out the wireworms. Plots of both planting dates were harvested on 18 Nov, 2005 and yields corrected to 15.5%. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at $P = 0.05$.

RESULTS: See Tables 1-8. No phytotoxicity was observed in the plots.

CONCLUSIONS: All treatments significantly improved plant stand (Table 1), vigour (Table 2), and row fill (Table 3) in early planted corn at the Rodney location, with no differences between treatments noted. Stand reductions were due to the protection against disease rather than wireworm as evidenced by the significant difference in stands observed between the fungicide and non-treated checks and the lack of difference between the fungicide check and the insecticide plus fungicide treatments. CRUISER at the 300 mg ai rate imparted slightly greater vigour measured on 1 June. No differences in yield were noted (Table 4). In the later planted trial there was a slight advantage to the insecticide application in plant stand, plant vigour, and row fill (Tables 5, 6, and 7). PONCHO at 1.25 mg ai/seed resulted in the greatest response.

Table 1. Emergence and plant stand assessments in a trial to evaluate six treatments for wireworm control in early planted corn at Rodney, ON, 2005.

Treatment	Rate g ai/100 kg or mg ai/seed* or ml/100 kg**	Emergence	Plant Stand Number plants per plot			
		25 May S1	1 June S2	8 June S2B	15 June S2C	28 July earshoot
UNTREATED CHECK	0	68 b[1]	80 b [2]	83 b[2]	82 d,[2]	82b[2]
MAXIM XL FUNGICIDE CHECK	3.5	87 a	94 a	93 a	95 a	94a
MAXIM XL	3.5	90 a	93 a	94 a	94 ab	93a
+ PONCHO 600 FS	0.25*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
MAXIM XL	3.5	86 a	91 a	90 a	91 bc	90a
+ PONCHO 600 FS	1.25*					
+ Precise S Finisher 1003	200**					
+ Pro-ized Red Colourant	35**					
+ Talc	200					
MAXIM XL	3.5	86 a	91 a	90 a	90 c	90a
+ CRUISER 5 FS	0.125*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
MAXIM XL	3.5	90 a	93 a	93 a	92 abc	92a
+ CRUISER 5 FS	0.25*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
CV		8.7	4.7	4.3	3.1	3.7

[1] Means within columns followed by same letter do not significantly differ, *P*= 0.05 LSD

[2] Data transformed by arsine square root to separate means and calculate CV, means are de-transformed.

Table 2. Vigour assessments in a trial to evaluate six treatments for wireworm control in early planted corn at Rodney, ON, 2005.

Treatment	Rate g ai or ml/100 kg or mg ai/seed* or ml/100 kg**	Vigour 0-100 %				
		25 May S1	1 June S2	8 June S2B	15 June S2C	28 July earshoot
UNTREATED CHECK	0	52.5	72.5 c[1]	70.0	72.5	40.6 b[2]
MAXIM XL FUNGICIDE CHECK	3.5	65.0	85.0 b	75.0	75.0	78.2 a
MAXIM XL	3.5	70.0	85.0 b	90.0	90.0	88.8 a
+ PONCHO 600 FS	0.25*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
MAXIM XL	3.5	70.0	80.0 bc	92.5	92.5	97.7 a
+ PONCHO 600 FS	1.25*					
+ Precise S Finisher 1003	200**					
+ Pro-ized Red Colourant	35**					
+ Talc	200					
MAXIM XL	3.5	67.5	82.5 bc	72.5	77.5	94.3 a
+ CRUISER 5 FS	0.125*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
MAXIM XL	3.5	67.5	97.5 a	87.5	90.0	87.8 a
+ CRUISER 5 FS	0.25*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
CV		23.2	9.1	15.0	13.3	20.9

[1] Means within a column followed by same or no letter do not significantly differ, *P*= 0.05 LSD.

[2] Data transformed by arsine square root to separate means and calculate CV, means are de-transformed.

Table 3. Row fill assessments in a trial to evaluate six treatments for wireworm control in early planted corn at Rodney, ON, 2005.

Treatment	Rate g ai/100 kg or mg ai/seed* or ml/100 kg**	Row fill 0-100 %				
		25 May S1	1 June S2	8 June S2B	15 June S2C	28 July earshoot
UNTREATED CHECK	0	67.5 b[1]	76.3 b	80.0	75.0	85.0
MAXIM XL FUNGICIDE CHECK	3.5	85.0 a	95.0 a	90.0	87.5	92.5
MAXIM XL	3.5	90.0 a	93.8 a	90.0	90.0	95.0
+ PONCHO 600 FS	0.25*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
MAXIM XL	3.5	85.0 a	91.3 a	92.5	92.5	92.5
+ PONCHO 600 FS	1.25*					
+ Precise S Finisher 1003	200**					
+ Pro-ized Red Colourant	35**					
+ Talc	200					
MAXIM XL	3.5	85.0 a	91.3 a	77.5	77.5	90.0
+ CRUISER 5 FS	0.125*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
MAXIM XL	3.5	87.5 a	96.3 a	90.0	90.0	92.5
+ CRUISER 5 FS	0.25*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
CV		10.5	6.4	10.7	11.5	7.0

[1] Means within a column followed by same or no letter do not significantly differ, *P*= 0.05 LSD

Table 4. Plant stand, damage, wireworm and fresh weight assessments in a trial to evaluate six treatments for wireworm control in early planted corn at Rodney, ON, 2005.

Treatment	Rate g ai/100 kg or mg ai/seed* or ml/100 kg**	Plant Stand	Damaged Plants	Wireworm	Fresh Wt Leaves g/m	Fresh Wt Roots g/m	Final Plant Stand Number/2 rows	Test Wt. kg/hl	Yield T/ha
		Number per m							
		5 May					18 Nov Harvest		
UNTREATED CHECK	0	7	5	1	184.6	57.3	90 a[1]	72.0	8.3
MAXIM XL FUNGICIDE CHECK	3.5	9	7	2	234.2	67.4	89 a	72.0	8.5
MAXIM XL	3.5	8	7	1	302.9	83.0	89 a	72.1	8.5
+ PONCHO 600 FS	0.25*								
+ Precise S Finisher 1003	125**								
+ Pro-ized Red Colourant	20**								
+ Talc	60								
MAXIM XL	3.5	9	7	0	261.3	74.5	87 a	72.1	7.9
+ PONCHO 600 FS	1.25*								
+ Precise S Finisher 1003	200**								
+ Pro-ized Red Colourant	35**								
+ Talc	200								
MAXIM XL	3.5	7	7	0	188.3	47.9	91 a	72.3	8.6
+ CRUISER 5 FS	0.125*								
+ Precise S Finisher 1003	125**								
+ Pro-ized Red Colourant	20**								
+ Talc	60								
MAXIM XL	3.5	7	8	0	165.9	52.0	81 b	72.5	8.6
+ CRUISER 5 FS	0.25*								
+ Precise S Finisher 1003	125**								
+ Pro-ized Red Colourant	20**								
+ Talc	60								
CV		21.3	14.2	217.1	37.2	41.5	4.5	1.6	19.0

[1] Means within a column followed by the same or no letter do not significantly differ, *P*= 0.05 LSD add period

Table 5. Emergence and plant stand assessments in a trial to evaluate six treatments for wireworm control in late planted corn at Rodney, ON, 2005.

Treatment	Rate g ai/100 kg or mg ai/seed* or ml/100 kg**	Emergence	Plant Stand			
		Number plants per plot				
		25 May S1	1 June S2	8 June S2B	15 June S2C	28 July earshoot
UNTREATED CHECK	0	80 c[1]	84 b	84 b	84 b	83 b[2]
MAXIM XL	3.5	81 bc	84 b	85 b	84 b	81 b
FUNGICIDE CHECK						
MAXIM XL	3.5	90 a	90 a	91 a	91 a	91 a
+ PONCHO 600 FS	0.25*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
MAXIM XL	3.5	93 a	95 a	94 a	93 a	92 a
+ PONCHO 600 FS	1.25*					
+ Precise S Finisher 1003	200**					
+ Pro-ized Red Colourant	35**					
+ Talc	200					
MAXIM XL	3.5	88 ab	92 a	91 a	91 a	91 a
+ CRUISER 5 FS	0.125*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
MAXIM XL	3.5	91 a	94 a	93 a	93 a	92 a
+ CRUISER 5 FS	0.25*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
CV		5.3	4.2	3.8	4.2	6.0

[1] Means within columns followed by same letter do not significantly differ, *P*= 0.05 LSD

[2] Data transformed by arsine square root to separate means and calculate CV, means are de-transformed.

Table 6. Vigour assessments in a trial to evaluate six treatments for wireworm control in late planted corn at Rodney, ON, 2005.

Treatment	Rate g ai/100 kg or mg ai/seed* or ml/100 kg**	Vigour 0-100 %				
		25 May S1	1 June S2	8 June S2B	15 June S2C	28 July earshoot
UNTREATED CHECK	0	62.5 c[1]	75.0 b	72.5 c	72.5 c	62.6 c[2]
MAXIM XL FUNGICIDE CHECK	3.5	62.5 c	72.5 b	75.0 bc	77.2 bc	78.2 bc
MAXIM XL	3.5	80.0 b	90.0 a	90.0 a	87.5 ab	88.8 ab
+ PONCHO 600 FS	0.25*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
MAXIM XL	3.5	92.5 a	95.0 a	95.0 a	95.0 a	97.4 a
+ PONCHO 600 FS	1.25*					
+ Precise S Finisher 1003	200**					
+ Pro-ized Red Colourant	35**					
+ Talc	200					
MAXIM XL	3.5	75.0 b	90.0 a	92.5 a	92.5 a	94.3 ab
+ CRUISER 5 FS	0.125*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
MAXIM XL	3.5	80.0 b	90.0 a	85.0 ab	85.0 ab	87.8 ab
+ CRUISER 5 FS	0.25*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
CV		10.2	10.6	8.1	8.1	13.9

[1] Means within columns followed by same letter do not significantly differ, *P*= 0.05 LSD
[2] Data transformed by arsine square root to separate means and calculate CV, means are de-transformed.

Table 7. Row fill assessments in a trial to evaluate six treatments for wireworm control in late planted corn at Rodney, ON, 2005.

Treatment	Rate g ai/100 kg or mg ai/seed* or ml/100 kg**	25 May S1	1 June S2	8 June S2B	15 June S2C	Row fill 0-100 % 28 July earshoot
UNTREATED CHECK	0	80.0 bc[1]	75.0 b	65.0 c	65.0 b	62.5 c2
MAXIM XL FUNGICIDE CHECK	3.5	77.5 c	75.0 b	82.5 b	87.5 a	81.0 bc
MAXIM XL	3.5	82.5 abc	87.5 ab	90.0 ab	87.5 a	88.8 ab
+ PONCHO 600 FS	0.25*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
MAXIM XL	3.5	92.5 a	97.5 a	95.0 a	95.0 a	97.4 a
+ PONCHO 600 FS	1.25*					
+ Precise S Finisher 1003	200**					
+ Pro-ized Red Colourant	35**					
+ Talc	200					
MAXIM XL	3.5	85.0 abc	95.0 a	92.5 ab	92.5 a	94.3 ab
+ CRUISER 5 FS	0.125*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
MAXIM XL	3.5	90.0 ab	97.5 a	87.5 ab	87.5 a	87.8 ab
+ CRUISER 5 FS	0.25*					
+ Precise S Finisher 1003	125**					
+ Pro-ized Red Colourant	20**					
+ Talc	60					
CV		8.0	10.5	9.5	9.6	14.0

[1] Means within columns followed by same letter do not significantly differ, *P*= 0.05 LSD

[2] Data transformed by arsine square root to separate means and calculate CV, means are de-transformed.

Table 8. Plant stand, damaged plants, wireworm, fresh weight and yield assessments in a trial to evaluate six treatments for wireworm control in late planted corn at Rodney, ON. 2005 no period after ON period at the end of the sentence.

Treatment	Rate	Plant	Damaged Wireworm		Fresh Wt	Fresh Wt	Final Plant	Test	Yield
	g ai/100 kg	Stand	Plants		Leaves	Roots	Stand	Weight	
	or mg ai/seed* or ml/100 kg**		Number per m	25 May	g	g	Number/2 row 18 Nov	kg/hl Harvest	T/ha
UNTREATED CHECK	0	9	5 c1	3.8	160.6	101.3	82	69.1	4.2
MAXIM XL FUNGICIDE CHECK	3.5	9	6 bc	3.3	171.0	128.9	88	69.7	4.8
MAXIM XL	3.5	9	7 ab	3.5	210.4	141.7	92	69.2	4.3
PONCHO 600 FS	0.25*								
Precise S Finisher 1003	125**								
Pro-ized Red Colourant	20**	9	8 ab	2.8	248.1	147.3	89	69.8	4.9
Talc	60								
MAXIM XL	3.5								
PONCHO 600 FS	1.25*								
Precise S Finisher 1003	200**								
Pro-ized Red Colourant	35**	12	8 a	2.3	221.1	138.2	88	69.5	4.5
Talc	200								
MAXIM XL	3.5								
CRUISER 5 FS	0.125*								
Precise S Finisher 1003	125**								
Pro-ized Red Colourant	20**								
	60								
MAXIM XL	3.5	8	8 a	2.0	163.5	111.9	85	69.2	4.5
CRUISER 5 FS	0.25*								
Precise S Finisher 1003	125**								
Pro-ized Red Colourant	20**								
	60								
CV		9.1	12.5	4.6	6.8	8.8	6.2	0.9	28.2

[1] Means within columns followed by same or no letter do not significantly differ, *P*= 0.05 LSD.

2005 PMR REPORT #31

SECTION E: CEREAL, FORAGE CROPS, and OILSEEDS - Insects
ICAR: 61006537

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

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TITLE: **CONTROL OF CORN ROOTWORM IN CORN WITH SEED TREATMENTS**

MATERIALS: MAXIM XL 324 FS (fludioxonil + metalaxyl-M, 229.59 + 87.66 g ai/L); CRUISER 5 FS (thiamethoxam, 5 g ai/L); PONCHO 600 FS (clothianidin, 600 g ai/L); A9765N 600 g ai/L (Experimental); FORCE 3 G (tefluthrin, 3 % v/v).

METHODS: Seed was treated on 17 May, 2005 in 500g lots in individual plastic bags by applying the chemical via syringe to each bag. The seed was then mixed for 1 min in the inflated bag to ensure thorough seed coverage. Seed weight was 275 g/1000 seeds. Two experiments were planted on campus at Ridgetown. Experiment 1 was inoculated artificially and Experiment 2 was planted in a second year corn field with natural infestation. Exp 1 was planted on 18 May, 2005 and Exp 2 was planted on 13 June, 2005 using a two-row cone-seeder at a seeding rate of 8 seeds/m. Inoculations with corn rootworm eggs were made on 29 June, 2005 at Exp 1 using a two-row cultivator modified to apply a 4 cm band of eggs, 5 cm deep and 9 cm on each side of the corn row. Eggs were suspended uniformly in a 0.15% agar solution and delivered through tubes from a holding tank at a rate of 2460 eggs/m by a ground driven metering pump (Demco mode1 MP-466). FORCE 3 G was applied in-furrow at planting using a Noble® plot scale applicator. Plots were 2 row spaced 0.76 m apart and were 6 m long in a RCBD with 4 replications. The plots were fertilized and maintained according to provincial recommendations. Plant emergence was assessed on 1 Jun, 2005 and plant stand on 8, 15 and 22 June, 2005 at Exp 1. Plant emergence was assessed on 27 June and plant stand on 4, 11 and 18 July, 2005 at Exp 2. Vigour was recorded on the same dates using a scale of 0-100% (100= furthest developed plant and 0 = dead plants). Root damage was assessed on 19 July and 10 Aug, 2005 at Exp 1 and 2, respectively. Five plants per plot were dug up, washed and rated for root worm damage using the Iowa 1-6 scale (1= no damage and 6= 3 or more nodes severely pruned). Plots from both experiments were harvested on 17 Nov, 2005 and yields converted to 15.5% moisture. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at P= 0.05. Means were pooled for damage, moisture and yields using Proc Mixes where Experiment and replications were random effects.

RESULTS: See Tables 1-7.

CONCLUSIONS: No differences were noted in plant stand at either experiment location. A higher test weight was achieved at Exp 1 with CRUISER. Plants treated with fungicide plus insecticide or fungicide alone had significantly higher vigour throughout the early growing season at Exp 2. The earliest maturity occurred with the three seed treatments at the recommended or highest rates. Only PONCHO and A9765N at the high rate resulted in an over all increase in yield, despite the different outcomes in rootworm damage protection.

Table 1. Emergence and plant stand assessments in Exp 1 corn with rootworm egg inoculations at Ridgetown, ON. 2005

Treatment	Rate g ai/100 kg or mg/seed* or g ai/100 m row**	Emergence	Plant Stand		
		Number plants per plot			
		June 1 2005	June 8 2005	June 15 2005	June 22 2005
UNTREATED CHECK	0	140	152	151	149
MAXIM XL FUNGICIDE CHECK	3.5	146	151	152	150
MAXIM XL + A9765N 600 FS (Exp)	3.5 250	150	157	158	155
MAXIM XL + A9765N 600 FS (Exp)	3.5 500	149	155	156	155
MAXIM XL + CRUISER 5 FS	3.5 500	147	154	156	152
MAXIM XL + PONCHO 600 FS	3.5 1.25*	147	152	152	153
FORCE (In-Furrow)	37.5**	148	155	155	154
CV		3.4	2.6	2.3	2.9

Table 2. Vigour assessments in Exp 1 corn with rootworm egg inoculations at Ridgetown, ON. 2005

Treatment	Rate g ai/100 kg or mg/seed* or g ai/100 m row**	Vigour 0-100 %			
		June 1 2005	June 8 2005	June 15 2005	June 22 2005
UNTREATED CHECK	0	70	75	77.5	77.5
MAXIM XL FUNGICIDE CHECK	3.5	77.5	80	82.5	80
MAXIM XL + A9765N 600 FS (Exp)	3.5 250	90	95	95	87.5
MAXIM XL + A9765N 600 FS (Exp)	3.5 500	85	82.5	85	90
MAXIM XL + CRUISER 5 FS	3.5 500	82.5	85	85	85
MAXIM XL + PONCHO 600 FS	3.5 1.25*	80	85	90	92.5
FORCE (In-Furrow)	37.5**	77.5	82.5	85	87.5
CV		16.7	11.7	10.5	12

Table 3. Damage, moisture and yield assessments at Exp 1 corn with rootworm egg inoculations , Ridgetown, ON. 2005

Treatment	Rate g ai/100 kg or mg/seed* or g ai/100 m row**	Damage Iowa 0-6 July 19 2005	Yield T/ha	Test Weight kg/hl
UNTREATED CHECK	0	4.8 a ***	4.9	70.1 bc***
MAXIM XL FUNGICIDE CHECK	3.5	3.7 ab	5.9	70.4 bc
MAXIM XL + A9765N 600 FS (Exp)	3.5 250	2.6 b	5.8	70.7 ab
MAXIM XL + A9765N 600 FS (Exp)	3.5 500	2.0 b	6.2	70.6 abc
MAXIM XL + CRUISER 5 FS	3.5 500	2.3 b	5.7	71.5 a
MAXIM XL + PONCHO 600 FS	3.5 1.25*	2.6 b	6.4	70.8 ab
FORCE (In-Furrow)	37.5**	2.7 b	5.4	67.7 c
CV		39	15.4	1

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

Table 4. Emergence and plant stand assessments in corn with no rootworm egg inoculations at Exp 2, Ridgetown, ON. 2005

Treatment	Rate g ai/100 kg or mg/seed* or g ai/100 m row**	Emergence	Plant Stand		
		Number plants per plot			
		June 27 2005	July 4 2005	July 11 2005	July 18 2005
UNTREATED CHECK	0	113	114	115	115
MAXIM XL FUNGICIDE CHECK	3.5	123	123	125	125
MAXIM XL + A9765N 600 FS (Exp)	3.5 250	125	127	128	128
MAXIM XL + A9765N 600 FS (Exp)	3.5 500	124	126	128	128
MAXIM XL + CRUISER 5 FS	3.5 500	117	118	120	120
MAXIM XL + PONCHO 600 FS	3.5 1.25*	126	127	130	129
FORCE (In-Furrow)	37.5**	113	114	115	115
CV		9.3	9.5	9.1	9.1

Table 5. Vigour assessments in corn with no rootworm egg inoculations at Exp 2, Ridgetown, ON. 2005

Treatment	Rate g ai/100 kg or mg/seed* or g ai/100 m row**	Vigour 0-100 %			
		June 27 2005	July 4 2005	July 11 2005	July 18 2005
UNTREATED CHECK	0	62.5	60.0 c***	60.0 c	60.0 c
MAXIM XL FUNGICIDE CHECK	3.5	80	85.0 ab	82.5 ab	82.5 ab
MAXIM XL + A9765N 600 FS (Exp)	3.5 250	82.5	87.5 a	90.0 a	90.0 a
MAXIM XL + A9765N 600 FS (Exp)	3.5 500	85	85.0 ab	85.0 a	85.0 a
MAXIM XL + CRUISER 5 FS	3.5 500	67.5	80.0 ab	82.5 ab	82.5 ab
MAXIM XL + PONCHO 600 FS	3.5 1.25*	87.5	87.5 a	87.5 a	87.5 a
FORCE (Untreated seed) IF	37.5**	70	67.5 bc	65.0 bc	65.0 bc
CV		14.091	9.3	5.6	5.6

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

Table 6. Damage and yield assessments in corn with no rootworm egg inoculations at Exp 2, Ridgetown, ON. 2005

Treatment	Rate g ai/100 kg or mg/seed* or g ai/100 m row**	Damage Iowa 0-6	Test Weight kg/hl	Yield T/ha
		10 Aug 2005		17 Nov 2005
UNTREATED CHECK	0	4.9 a***	73.1	4.1
MAXIM XL FUNGICIDE CHECK	3.5	3.8 ab	73.2	4.6
MAXIM XL + A9765N 600 FS (Exp)	3.5 250	3.2 bc	73.9	5
MAXIM XL + A9765N 600 FS (Exp)	3.5 500	2.0 cd	73.9	5.6
MAXIM XL + CRUISER 5 FS	3.5 500	2.2 cd	72.6	4.2
MAXIM XL + PONCHO 600 FS	3.5 1.25*	3.2 bc	74.1	6
FORCE (Untreated seed) IF	37.5**	1.2 d	74.1	5.3
CV		26.6	1.8	19.8

*** Means followed by same letter do not significantly differ, *P*= 0.05 LSD, data transformed by log for means separation and CV calculations, means were de-transformed.

Table 7. Rootworm damage, moisture and yield assessements in corn pooled across Exp 1 and 2, Ridgetown, ON. 2005

Treatment	Rate g ai/100 kg or mg/seed* or g ai/100 m row**	Damage Iowa 0-6 July 19 2005	Moisture % 17 Nov 2005	Yield T/ha
UNTREATED CHECK	0	4.9 a***	22.8 ab***	4.9 a***
MAXIM XL FUNGICIDE CHECK	3.5	3.8 b	22.6 ab	5.5 ab
MAXIM XL	3.5	2.6 c	22.5 abc	5.8 abc
+ A9765N 600 FS (Exp)	250			
MAXIM XL	3.5	2.0 c	22.4 c	6.3 bc
+ A9765N 600 FS (Exp)	500			
MAXIM XL	3.5	2.3 c	22.4 c	5.4 ab
+ CRUISER 5 FS	500			
MAXIM XL	3.5	2.7 bc	22.5 abc	6.6 c
+ PONCHO 600 FS	1.25*			
FORCE (In-Furrow)	37.5**	1.9 c	22.9 a	5.8 abc

* * * Means pooled using Proc mixed.

2005 PMR REPORT #32

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

CROP: Soybean, *(Glycine max (L.)* Merrill), cv Pioneer 92738
PEST: Soybean aphid *(Aphis glycine* Matsumura)

NAME AND AGENCY:
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TITLE: CONTROL OF SOYBEAN APHIDS WITH SEED TREATMENT AND FOLIAR INSECTICIDE APPLICATIONS

MATERIALS: CRUISER 5 FS (thiamethoxam, 5 g ai/L); APRON MAXX RTA 19.05 FS (fludioxonil + metalaxylM, 7.69 + 11.54 g ai/L); A9765N (Experimental, 600 g ai/L); A14379B (Experimental, 288 g ai/L); MATADOR Foliar, (cyhalothrin-lambda, 120 g ai/L).

METHODS: Seed was treated in 3.5 kg lots in individual new plastic bags by applying the treatment via a syringe to each bag. The seed was then mixed in the inflated bags for 1 min to ensure thorough seed coverage. The crop was planted on 7, 9 and 10 June, 2005 at Morpeth, Delaware and Ridgetown, ON, respectively, using a 4-row cone seeder. Plots were 4 rows 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. Total plot emergence was assessed on 17, 21 and 27 Jun, 2005 at Morpeth, Delaware and Ridgetown, respectively. 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 vigour were recorded on 24 and 30 Jun, 2005 at Morpeth, on 28 Jun and 5 Jul, 2005 at Delaware and on 4 and 11 Jul, 2005 at Ridgetown. When aphids were detected in the plots, counts were recorded by assessing 3 plants/plot. Aphids were counted on the stem, the middle leaflet of the top uppermost fully unfolded trifoliate, the middle leaflet of a trifoliate half-way up the plant and a trifoliate at the bottom of the plant using a scale of 0-4 where (0= no aphids, 1= 1-10 aphids, 2= 11-25 aphids, 3= 26-99 aphids and 4= 100+ aphids per leaflet or stem). The average mean score for each plot was calculated to give a rating from 0-16 (Dr. C. Difonzo, Michigan State University). Aphid counts were recorded on 28 Jul, 2005 at Delaware, and on 22, 29 Jul, 2005 at Morpeth. When aphid thresholds were reached pre-spray aphid counts were recorded on 4, 5 and 10 Aug, 2005 at Delaware, Morpeth and Ridgetown, ON, respectively. MATADOR foliar treatment was sprayed at all locations using a Solo® backpack sprayer with a 1.5 m boom, 3 TeeJet TJ60 (#1 1003VS) nozzles spaced 0.4 m apart using a volume of 1.3 L/plot (83 ml/ha) and walking at a speed of 0.25 m/sec. Morpeth plots were sprayed on 6 Aug, 2005 at the early pod fill stage, at 22ºC and calm wind conditions. Delaware plots were sprayed on 8 Aug, 2005 at the full flower/early pod stage, at 28ºC and calm wind conditions. Ridgetown plots were sprayed on 10 Aug, 2005 at the early pod stage, at 22ºC and calm wind conditions. Post-spray counts were assessed on 17 and 24 Aug, 2005 at Ridgetown, on 11, 18 and 25 Aug, 2005 at Delaware and on 12, 19 and 26 Aug at Morpeth. Plant height (cm) and canopy coverage using a scale of 1-5 (1= 20% coverage, 2= 40% coverage, 3= 60% coverage, 4= 80% coverage and 5= 100% coverage) were assessed at the R5-R6 stage on 24, 25 and 26 Aug, 2005 at Ridgetown, Delaware and Morpeth, respectively. Plots were harvested on 17, 19 and 31 Oct, 2005 at Delaware, Morpeth and Ridgetown, respectively, and yields converted to 14.5% moisture. Data were analysed using analysis of variance and means were separated using least significant difference (LSD) at $P = 0.05$.

RESULTS: See Tables 1-6. The Ridgetown plots just reached the aphid spray threshold of 250/plant and the conditions were very dry. At Ridgetown the soil was extremely dry when planted and minimal preciptation arrived afterward. Emergence continued sporadically through the season. A trace of precipitation on 5 July, 2005 resulted in a jump in the number of emerged plants. The plots at Delaware just reached threshold levels, the ground was very dry on a light sandy knoll and there was a lot of deer feeding and ground hog damage. Morpeth had a good stand, normal precipitation and good insect pressure.

CONCLUSIONS: There was no yield response to any treatment at Ridgetown or Delaware due to masking effects of drought and animal damage. At Delaware CRUISER FS at 50 g ai/100 kg reduced aphid populations significantly for up to 8 weeks after planting. At Morpeth there was a yield response to the fungicide seed treatment component of most treatments. Aphids did not impact yield at this location, but CRUISER FS at 50 g ai/100 kg seemed to reduce aphid populations up to 7 weeks after planting.

Table 1. Emergence, plant stand and vigour assessments in a trial to evaluate treatments for control of soybean aphid in soybeans at Ridgetown, ON, 2005.

Treatment	Rate g ai/100 kg or g ai/ha*	Emergence Number plants per plot 27 June	Plant Stand 4 July	Plant Stand 11 July	Vigour 0-100 % 27 June	Vigour 0-100 % 4 July	Vigour 0-100 % 11 July
UNTREATED CHECK	0	84 ab[1]	89	140	67.5	67.5	75
APRON MAXX RTA	6.25	71 b	83	104	55.0	55.0	62.5
APRON MAXX RTA	6.25	40 b	45	75	32.5	32.5	50.0
+ CRUISER 5 FS	50						
APRON MAXX RTA	6.25	100 a	100	185	95.0	95.0	85.0
+ A9765N 600 FS	50						
A14379B 288 FS	56.25	45 b	50	84	47.5	36.3	50.0
A14379B	56.25	82 ab	83	141	55.0	57.5	67.5
+ CRUISER 5 FS	50						
APRON MAXX RTA	6.25	63 b	68	79	47.5	50.0	42.5
+ MATADOR 120 EC	10 *						
Foliar							
CV		31.7	33.1	51.9	44.9	46.6	50.1

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

Table 2. Pre-spray aphid assessments, post-spray aphid and plant assessments in a trial to evaluate treatments for control of soybean aphid in soybeans planted on 10 June, 2005 at Ridgetown, ON.

Treatment	Rate g ai/100 kg or g ai/ha *	Plant Stand Number plants per plot 10 Aug	Aphid Counts per 3 plants 0-16 Scale			Avg Plant Height cm	Canopy 1-5 scale	Yield T/ha
			10 Aug Pre Spray	17 Aug	24 Aug Post Spray	24 Aug		31 Oct
UNTREATED CHECK		178	4.2	2.3	1.2	72.6	2.5	2.4
APRON MAXX RTA	6.25	200	3.8	2.3	0.8	73.4	2.3	2.2
APRON MAXX RTA	6.25	193	2.8	1.4	0.4	60.8	1.5	2.3
+ CRUISER 5 FS	50							
APRON MAXX RTA	6.25	219	3.7	2.3	0.6	74.1	3	2.5
+ A9765N 600 FS	50							
A14379B 288 FS	56.25	207	2.8	2.2	0.5	64.2	1.5	2.2
A14379B	56.25	202	3.1	1.8	0.6	75.7	2.5	2.3
+ CRUISER 5 FS	50							
APRON MAXX RTA	6.25	184	3.4	2	0.6	68.2	1.8	2.4
+ MATADOR 120 EC	10 *							
Foliar								
CV		10.9	19.8	29.3	68.8	18.7	42.1	15.5

Table 3. Emergence, plant stand and vigour assessments in a trial to evaluate treatments for control of soybean aphid in soybeans at Delaware, ON, 2005.

Treatment	Rate g ai/100 kg or g ai/ha *	Emergence Number plants/plot 21 June	Plant Stand Number plants/plot 28 June	Plant Stand Number plants/plot 5 July	Vigour 0-100 % 21 June	Vigour 0-100 % 28 June	Vigour 0-100 % 5 July
UNTREATED CHECK	0	334	333	336	80	80	80.0 ab1
APRON MAXX RTA	6.25	328	315	303	72.5	72.5	70.0 bc
APRON MAXX RTA	6.25	327	310	309	80	75	70.0 bc
+ CRUISER 5 FS	50						
APRON MAXX RTA	6.25	330	322	326	92.5	92.5	92.5 a
+ A9765N 600 FS	50						
A14379B 288 FS	56.25	321	306	312	72.5	75	67.5 bc
A14379B	56.25	287	300	329	65	70	62.5 c
+ CRUISER 5 FS	50						
APRON MAXX RTA	6.25	332	328	326	87.5	87.5	87.5 a
+ MATADOR 120 EC	10 *						
Foliar							
CV		9.3	12.2	7.5	15.6	15.7	13.5

[1] Means within a column followed by the same letter do not significantly differ (P=0.05, LSD).

Table 4. Pre-spray aphid assessments, post-spray aphid, plant and yield assessments in a trial to evaluate treatments for control of soybean aphid in soybeans planted on 9 June, 2005 at Delaware, ON.

Treatment	Rate g ai/100 kg or g ai/ha*	Aphids per 3 plants 0-16 Scale					Avg Plant Height cm	Canopy 1-5 Scale	Yield T/ha
		28 Jul	4 Aug	11 Aug	18 Aug	25 Aug	25 Aug		16 Oct
		Pre-Spray		Post-Spray					
UNTREATED CHECK	0	2.7 a[1]	5.8 a	4.9 a	3.5 a	1.2	73.4	4	1
APRON MAXX RTA	6.25	2.1 ab	4.9 abc	5.0 a	2.8 ab	1.5	68.6	3	0.8
APRON MAXX RTA	6.25	1.4 bc	3.9 cd	3.1 bc	2.8 ab	1.1	79.4	4	0.8
+ CRUISER 5 FS	50								
APRON MAXX RTA	6.25	1.3 bc	5.3 ab	3.6 abc	3.5 a	1.4	79.9	4	1.1
+ A9765N 600 FS	50								
A14379B 288 FS	56.25	1.4 bc	4.4 bcd	3.8 ab	2.9 ab	1.2	77.5	3	0.7
A14379B	56.25	0.9 c	3.6 d	2.2 cd	2.3 bc	1.8	84.5	4	0.8
+ CRUISER 5 FS	50								
APRON MAXX RTA	6.25	2.7 a	4.8 abc	1.5 d	1.8 c	1.5	77.5	3	0.8
+ MATADOR 120 EC	10 *								
CV		35.7	16.4	30.4	23.5	25.6	15	25.7	29.2

[1] Means within a column followed by the same letter do not significantly differ (P=0.05, LSD).

Table 5. Emergence, plant stand and vigour assessments in a trial to evaluate treatments for control of soybean aphid in soybeans at Morpeth, ON, 2005.

Treatment	Rate g ai/100 kg or g ai/ha *	Emergence Number plants per plot	Plant Stand Number plants per plot		Vigour 0-100 %		
		June 17	June 24	June 30	June 17	June 24	June 30
UNTREATED CHECK	0	334	345	347	67.5	72.5	75
APRON MAXX RTA	6.25	350	357	354	82.5	85	87.5
APRON MAXX RTA	6.25	341	349	353	80	85	92.5
+ CRUISER 5 FS	50						
APRON MAXX RTA	6.25	321	353	360	77.5	87.5	90
+ A9765N 600 FS	50						
A14379B 288 FS	56.25	344	354	353	77.5	82.5	85
A14379B	56.25	326	335	337	72.5	80	90
+ CRUISER 5 FS	50						
APRON MAXX RTA	6.25	356	362	345	70	77.5	80
+ MATADOR 120 EC	10 *						
Foliar							
CV		7.4	3.7	4.9	19.8	14.3	9.3

Table 6. Pre-spray aphid assessments, post-spray aphid, plant and yield assessments in a trial to evaluate treatments for control of soybean aphid in soybeans planted on 7 June, 2005 at Morpeth, ON.

Treatment	Rate g ai/100kg or g ai/ha *	Aphids per 3 plants 0-16 Scale						Avg Plant Height cm	Canopy 1-5 Scale	Yield T/ha
		22 Jul	29 Jul	5 Aug	12 Aug	19 Aug	26 Aug	26 Aug		19 Oct
		Pre-Spray			Post-Spray					
UNTREATED CHECK	0	2.3 ab[1]	4.1 ab	7.2 ab	7.0 a	6.9	1.5	111.2	4.72	3.0 b
APRON MAXX RTA	6.25	2.5 a	5.0 a	7.1 ab	6.9 a	7	1.1	110.9	4.7	3.7 a
APRON MAXX RTA	6.25	1.1 c	4.3 ab	6.7 ab	4.3 b	4.2	1.3	115.8	4.7	3.4 ab
+ CRUISER 5 FS	50									
APRON MAXX RTA	6.25	1.6 bc	3.7 bc	5.5 bc	4.4 b	6.6	1.2	118.6	5	3.8 a
+ A9765N 600 FS	50									
A14379B 288 FS	56.25	1.9 abc	3.3 bc	5.7 bc	4.9 b	5.4	0.7	113.1	4.7	3.1 b
A14379B	56.25	1.8 abc	2.8 c	4.0 c	3.5 b	4.2	0.6	115.9	5	3.5 ab
+ CRUISER 5 FS	50									
APRON MAXX RTA	6.25	2.3 ab	4.4 ab	8.0 a	5.1 ab	4.9	1.9	112.4	4.7	3.7 a
+ MATADOR 120 EC	10 *									
Foliar										
CV		27.5	11.8	19.7	24.7	52.5	56.1	4.2	4.5	10.9

[1] Means within columns followed by the same letter do not significantly differ (P=0.05, LSD).
[2] Data transformed by log to separate means and CV calculations, means de-transformed.

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

CROP: Soybean, *(Glycine max (L.)* Merrill), cv Crown, 92M72
PEST: Soybean aphid *(Aphis glycine* Matsumura)

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TITLE: CONTROL OF SOYBEAN APHIDS WITH FOLIAR INSECTICIDE TREATMENTS

MATERIALS: MATADOR 120 E (cyhalothrin-lambda, 120 g ai/L); LAYGON 480 E (dimethoate, 480 g ai/L); ASSAIL 70 WG (acetamiprid, 70 g ai/L); ASANA 80 XL (esfenvalerate, 80 g ai/L); ADJUST (pH ammendment); BAYER Product X (Experimental).

METHODS: On-farm trials were conducted in pre-planted soybean fields located at Chatham and Fletcher, ON. The variety Crown was planted on 20 May, 2005 at Chatham, ON and 92M72 was planted on 18 May, 2005 at Fletcher, ON. Plots 3 m wide and 20 m long were sprayed after a threshold of 250 aphids/plant was reached. Plots were sprayed at both locations using a CO_2 precision sprayer mounted on a self-propelled highboy sprayer modified to apply foliar treatments to small plots. Spraying at Chatham was on 2 Aug between 9 and 11 am, when the soybeans were at the R3-R4 stage, with 10 km southerly winds, 25ºC temp and clear skies. The sprayer had a 3.1 m boom, TJ-60 twin jet nozzles (# 11003VS) spaced 50.8 cm apart, traveling at a ground speed of 6.4 kph and using a water volume 200 L/ha at 45 psi. Spraying at Fletcher was on 4 Aug, 2005 between 6:30 and 8:30 pm, with soybeans at R3 stage, wind speeds from southwest at 5-10 km, 25ºC temp and sunny conditions. The sprayer had a 3.1 m boom, TJ-60 twin jet nozzles (#1 1003VS) spaced 50.8 cm apart, traveling at 6.4 kph and using a water volume of 210 L/ha at 47 psi. Post spray aphid counts were recorded at both locations on 18 and 22 Aug, 2005 by assessing the stem, the middle leaflet of the top uppermost fully unfolded trifoliate, the middle leaflet of a trifoliate half-way up the plant and a trifoliate at the bottom of the plant using a scale of 0-4 where 0= no aphids, 1= 1-10 aphids, 2= 11-25 aphids, 3= 26-99 aphids and 4= 100+ aphids per leaflet or stem. The average mean score for each plot was calculated to give a rating from 0- 16 (Dr. C. Difonzo, Michigan State University). Subplots (1.5 m wide by 8 m long) were harvested on 28 Sept, 2005 at Fletcher and on 18 Oct, 2005 at Chatham and yields corrected to 14.5% moisture. Data were analysed using analysis of variance and means were separated using least significant difference (LSD) at P= 0.05.

RESULTS: See Tables 1 and 2.

CONCLUSIONS: All treatments controlled aphids; however populations were on the decline. There were no significant yield benefits to spraying at the R6 stage for any treatment. ASSAIL and BAYER Product X at the higher rate provided the best control. The addition of ADJUST did not affect the performance of LAYGON or MATADOR.

Table 1. Post-spray aphid assessments and yields of soybeans at Chatham, ON, 2005.

Treatment	Rate g ai/ha or % v/v * or L/ha * *	Aphid Count Average per 4 plants Scale 0-16		Yield T/ha
		18 Aug	22 Aug	18 Oct
UNTREATED CHECK		12.2 a [1]	5.2 a	3
MATADOR CHECK	10	4.5 bc	2.1 b	3.1
MATADOR	15	2.6 cd	1.2 b	2.9
LAYGON	480	3.9 bcd	1.5 b	3.2
ASSAIL 70 WG	60.2	2.5 cd	0.6 b	3.3
ASANA 70 WP	56.7	5.3 b	1.7 b	3.5
LAYGON	480	3.9 bcd	2.1 b	2.2
+ ADJUST	0.25 *			
MATADOR	10	3.7 bcd	1.8 b	2.9
+ ADJUST	0.25 *			
BAYER PRODUCT X	0.50 **	3.1 cd	1.2 b	2.9
BAYER PRODUCT X	0.65 * *	2.3 d	1.0 b	2.9
CV		32.5	64.2	20.6

[1] Means within a column followed by the same letter do not significantly differ (*P*=.05, LSD). All data homogeneous and not transformed.

Table 2. Post-spray aphid assessments and yields in soybeans at Fletcher, ON, 2005.

Treatment	Rate g ai/ha or % v/v * or L/ha **	Aphid Count Average per 4 plants Scale 0-16		Yield T/ha
		18 Au g	22 Aug	28 Sept
UNTREATED CHECK		10.9 a [1]	4.8 a	2.6
MATADOR CHECK	10	1.7 bc	0 c	3.3
MATADOR	15	1.6 bc	0.4 bc	2.9
LAYGON	480	1.9 bc	0.2 c	3.1
ASSAIL 70 WG	60.2	1.1 c	0 c	3
ASANA 70 WP	56.7	3.3 b	1.1 b	2.9
LAYGON	480	1.5 bc	0.1 c	2.8
+ ADJUST	0.25 *			
MATADOR	10	1.4 bc	0.2 bc	3
+ ADJUST	0.25 *			
BAYER PRODUCT X	0.50 **	2.2 bc	0.3 bc	2.8
BAYER PRODUCT X	0.65 * *	0.7 c	0 c	2.7
CV		20.6	35.5	13.7

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

2005 PMR REPORT #34

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

CROP: Soybean, *(Glycine max (L.)* Merrill), cv Crown, 92M72
PEST: Soybean aphid *(Aphis glycine* Matsumura)

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TITLE: CONTROL OF SOYBEAN APHIDS AND DISEASES WITH FOLIAR INSECTICIDE TREATMENTS

MATERIALS: MATADOR 120 EC (cyhalothrin, 120 g ai/L); QUADRIS 250 SC (azoxystrobin, 250 g ai/L); QUADRIS Xtra 280 SC (azoxystrobin, 280 g ai/L); QUILT 200 SC (azoxystrobin + propiconazole, 7% + 11.7%); TILT 250 EC (propiconazole, 250 g ai/L); A9901A (Experimental)

METHODS: Established soybean fields were located at Chatham and Fletcher, ON. Crown variety was planted on 20 May, 2005 at Chatham, ON and 92M72 variety was planted on 18 May, 2005 at Fletcher, ON. Plots were staked at 1.5 m wide and 8 m long. Plots were sprayed after a threshold of 250 aphids/plant was reached. Plots were sprayed at both locations using a CO_2 precision sprayer mounted on a self-propelled highboy sprayer modified to apply foliar treatments to small plots. Spraying at Chatham was on 2 Aug between 9 and 11 am, at R3-R4 stage, wind speed from south at 10 km, 25ºC temp and clear skies. Sprayer had a 3.1 m boom, TJ-60 twin jet nozzles (# 11003VS) spaced 50.8 cm apart, traveling at a ground speed of 6.4 kph and using a water volume 200 L/ha at 45 psi. Spraying at Fletcher was on 4 Aug, 2005 between 6:30 and 8:30 pm, at R3 stage, wind speed from southwest at 5-10 km, 25ºC temp and sunny conditions. Sprayer had a 3.1 m boom, TJ-60 twin jet nozzles (#11003VS) spaced 50.8 cm apart, traveling at 6.4 kph and using a water volume of 210 L/ha at 47 psi. Post spray aphid counts were recorded on 4 plants/plot at both locations on 18 and 22 Aug, 2005 by assessing the stem, the middle leaflet of the top uppermost fully unfolded trifoliate, the middle leaflet of a trifoliate half-way up the plant and a trifoliate at the bottom of the plant using a scale of 0-4 where (0= no aphids, 1= 1-10 aphids, 2= 11-25 aphids, 3= 26-99 aphids and 4= 100+ aphids per leaflet or stem) to obtain a score out of 16. The average mean score for each plot was calculated to give a rating from 0-16 (Dr. C. Difonzo, Michigan State University). Plots were also monitored weekly for foliar disease symptoms. Subplots (1.5 m wide by 8 m long) were harvested on 28 Sept, 2005 at Fletcher and on 18 Oct, 2005 at Chatham and yields corrected to 14.5% moisture. Data were analysed using analysis of variance and means were separated using least significant difference (LSD) at $P = 0.05$.

RESULTS: See Tables 1 and 2. No foliar disease symptoms were observed. There was evidence of green seed, *Cercospora,* and a low incidence of *Phomopsis* in the harvested seed from the Fletcher location, but no obvious differences between treatments.

CONCLUSIONS: There was no significant yield response to foliar applications of MATADOR alone or in combination with fungicide at the Chatham location, even when above threshold populations of aphids were controlled. MATADOR alone, while providing good control of aphids, did not result in a significant yield improvement at the Fletcher location. However, the addition of certain fungicides, including QUADRIS, and QUILT in combination with MATADOR did result in a significant yield increase. This phenomenon was most pronounced with the MATADOR plus QUADRIS treatment. There were no obvious disease problems in the plots at the Chatham location.

Table 1. Post-spray aphid counts and yield assessments in soybeans at Chatham, ON, 2005.

Treatment	Rate g ai/100 kg or g ai/L *	Aphid Counts 4 Plants/plot 0-16 Scale		Yield t/ha
		18 Aug R5-R6	22 Aug R6	18 Oct
UNTREATED CHECK		9.9 a[1]	6.4 a	3
MATADOR 120 EC	10	2.9 c	1.0 b	3.3
QUADRIS 250 SC	125	2.9 c	0.4 b	3.4
+ MATADOR 120 EC	10			
QUADRIS XTRA 280 SC	82	3.1 c	0.8 b	3.4
+ MATADOR 120 EC	10			
QUILT 200 SC	300	4.4 bc	1.9 b	2.9
+ MATADOR 120 EC	10			
QUILT 200 SC	200 *	3.6 bc	0.9 b	3.4
+ MATADOR	10			
TILT 250 EC	125	5.4 b	0.9 b	3
+ MATADOR 120 EC	10			
A9901A	30	3.5 bc	0.7 b	3.1
+ MATADOR 120 EC	10			
A12910C	82	3.0 c	2.8 b	3.5
+ MATADOR 120 EC	10			
CV		35	116.1	11.4

[1] Means followed by same letter do not significantly differ (P= 0.05, LSD)

Table 2. Post-spray aphid counts and yield assessments in soybeans at Fletcher, ON, 2005.

Treatment	Rate g ai/ 100 kg or g ai/L *	Aphid counts 4 Plants/plot 0-16 Scale		Yield t/ha
		18 Aug	22 Aug	29 Sept
UNTREATED CHECK		9.3 a [1]	3.7 a [2]	3
MATADOR 120 EC	10	1.4 cd	0.1 b	3.2
QUADRIS 250 SC	125	1.4 cd	0.3 b	3.7
+ MATADOR 120 EC	10			
QUADRIS XTRA 280 SC	82	0.5 e	0.5 b	3.7
+ MATADOR 120 EC	10			
QUILT 200 SC	300	2.4 bc	0.4 b	3.7
+ MATADOR 120 EC	10			
QUILT 200 SC	200*	0.8 de	0.7 b	3.6
+ MATADOR	10			
TILT 250 EC	125	1.0 de	0.4 b	3.2
+ MATADOR 120 EC	10			
A9901A	30	0.8 de	0.1 b	3.4
+ MATADOR 120 EC	10			
A12910C	82	3.0 b	2.1 a	3.3
+ MATADOR 120 EC	10			
CV		25	61.7	10.7

[1] Means followed by the same letter do not significantly differ (P= 0.05, LSD), data transformed by arsine square for means separation and CV calculations, means de-transformed.

[2] Means followed by the same letter do not significantly differ (P= 0.05, LSD), data transformed by log for means separation and CV calculations, means de-transformed.

2005 PMR REPORT # 35

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

CROP: Soybean, *(Glycine max (L.)* Merrill), cv Crown, 92M72
PEST: Soybean aphid *(Aphis glycine,* Matsumura)

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TITLE: CONTROL OF SOYBEAN APHIDS AND DISEASES WITH FOLIAR INSECTICIDE TREATMENTS

MATERIALS: MATADOR 120 EC (cyhalothrin, 120 g ai/L); MATADOR 120 EC (cyhalothrin, 120 g ai/L); QUADRIS 250 SC (azoxystrobin, 250 g ai/L); QUADRIS Xtra 280 SC (azoxystrobin, 280 g ai/L); QUILT 200 SC (azoxystrobin + propiconazole, 7% + 11.7%); TILT 250 EC (propiconazole, 250 g ai/L); A9901A (Experimental) HEADLINE 250 EC (pyraclostrobin, 250 g ai/L); PROLINE 480 (pyrethrin + piperonyl butoxide, 0.5% + 4.0 %); FOLICUR 432 F (tebuconazole, 432 g ai/L).

METHODS: Established soybean fields were located at Chatham and Fletcher, ON. Crown variety was planted on 20 May, 2005 at Chatham, ON and 92M72 variety was planted on 18 May, 2005 at Fletcher, ON. Plots were staked 3 m wide and 20 m long and sprayed after a threshold of 250 aphids/plant was reached. Plots were sprayed at both locations using a CO_2 precision sprayer mounted on a self-propelled highboy sprayer modified to apply foliar treatments to small plots. Spraying at Chatham was on 2 Aug between 9 and 11 am, at R3-R4 stage, wind speed from south at 10 km, 25ºC temp and clear skies. Sprayer had a 3.1 m boom, TJ-60 twin jet nozzles (# 1 1003VS) spaced 50.8 cm apart, traveling at a ground speed of 6.4 kph and using a water volume 200 L/ha at 45 psi. Spraying at Fletcher was on 4 Aug, 2005 between 6:30 and 8:30 pm, at R3 stage, wind speed from southwest at 5-10 km, 25ºC temp and sunny conditions. Sprayer had a 3.1 m boom, TJ-60 twin jet nozzles (#11003VS) spaced 50.8 cm apart, traveling at 6.4 kph and using a water volume of 210 L/ha at 47 psi. Post spray aphid counts were recorded on 4 plants/plot at both locations on 18 and 22 Aug, 2005 by assessing the stem, the middle leaflet of the top uppermost fully unfolded trifoliate, the middle leaflet of a trifoliate half-way up the plant and a trifoliate at the bottom of the plant using a scale of 0-4 where (0= no aphids, 1= 1-10 aphids, 2= 11-25 aphids, 3= 26-99 aphids and 4= 100+ aphids per leaflet or stem) to obtain a score out of 16. The average mean score for each plot was calculated to give a rating from 0-16 (Dr. C. Difonzo, Michigan State University). Plots were also monitored weekly for foliar disease symptoms. Subplots (1.5 m wide by 8 m long) were harvested on 28 Sept, 2005 at Fletcher and on 18 Oct, 2005 at Chatham and yields corrected to 14.5% moisture. Data were analysed using analysis of variance and means were separated using least significant difference (LSD) at $P = 0.05$.

RESULTS: See Tables 1 and 2. No foliar disease symptoms were observed. There was evidence of green seed, *Cercospora,* and a low incidence of *Phomopsis* in the harvested seed from the Fletcher location.

CONCLUSIONS: There was no significant yield response to foliar applications of MATADOR alone or in combination with fungicide at the Chatham location, even when above threshold populations of aphids were controlled. MATADOR alone, while providing good control of aphids, did not result in a significant yield improvement at the Fletcher location. However, the addition of certain fungicides, including QUADRIS, QUILT, HEADLINE and PROLINE in combination with MATADOR did result in a significant yield increase. This phenomenon was most pronounced with the MATADOR plus QUADRIS treatment. There were no obvious disease problems in the plots at the Chatham location. At the Fletcher location no significant differences in seed lots between the highest and lowest yields were demonstrated due to presence of seed diseases and green seed.

Table 1. Post-spray aphid counts and yields in soybeans at Chatham, ON. 2005

Treatment	Rate g ai/100 kg or g ai/L * or g ai/ha**	Aphid Counts 4 plants/plot 0-16 scale		Yield T/ha 19 Oct
		18 Aug R5-R6	22 Aug R6	
UNTREATED CHECK		9.9 a ***	6.4 a	3.0 ****
MATADOR 120 EC	10	2.9 cd	1.0 b	3.3
QUADRIS 250 SC	125	2.9 cd	0.4 b	3.4
+ MATADOR 120 EC	10			
QUADRIS XTRA 280 SC	82	3.1 cd	0.8 b	3.4
+ MATADOR 120 EC	10			
QUILT 200 SC	300	4.4 bc	1.9 b	2.9
+ MATADOR 120 EC	10			
QUILT	200 *	3.6 bcd	0.9 b	3.4
+ MATADOR	10			
TILT 250 EC	125	5.4 b	0.9 b	3
+ MATADOR 120 EC	10			
A9901A	30	3.5 bcd	0.7 b	3.1
+ MATADOR 120 EC	10			
A12910C	82	3.0 cd	2.8 b	3.5
+ MATADOR 120 EC	10			
HEADLINE EC	150**	4.7 bc	1.4 b	3
+ MATADOR120 EC	10			
HEADLINE EC	100**	2.3 c	2.8 b	3.3
+ MATADOR 120 EC	10			
PROLINE 480	150**	1.7 c	0.7 b	3.4
+ MATADOR 120 EC	10			
PROLINE 480	100**	3.4 cd	1.0 b	2.6
+ MATADOR 120 EC	10			
FOLICUR 432 F	126**	3.0 cd	0.7 b	3.3
+ MATADOR 120 EC	10			
CV		36.3	116.3	12.7

* * * Means followed by same or no letter do not significantly differ (P= 0.05, LSD).

Table 2. Post-spray aphid counts and yield assessments in soybeans at Fletcher, ON. 2005

Treatment	Rate g ai/100 kg or g ai/L * or g ai/ha**	Aphid counts 4 plants/plot 0-16 scale		Yield T/ha
		18 Aug R5-R6	22 Aug R6	29 Sept
UNTREATED CHECK		9.3 a ***	3.7 a ****	3.0 d
MATADOR 120 EC	10	1.4 cde	0.1 bc	3.2 bcd
QUADRIS 250 SC	125	1.4 de	0.3 bc	3.7 a
+ MATADOR 120 EC	10			
QUADRIS XTRA 280 SC	82	0.5 f	0.5 bc	3.7 a
+ MATADOR 120 EC	10			
QUILT 200 SC	300	2.4 bcd	0.4 bc	3.6 ab
+ MATADOR 120 EC	10			
QUILT	200 *	0.8 ef	0.7 b	3.6 ab
+ MATADOR	10			
TILT 250 EC	125	1.0 ef	0.4 bc	3.2 bcd
+ MATADOR 120 EC	10			
A9901A	30	0.8 ef	0.1 c	3.4 a-d
+ MATADOR 120 EC	10			
A12910C	82	3.0 b	2.1 a	3.3 a-d
+ MATADOR 120 EC	10			
HEADLINE EC	150**	2.6 bc	0.3 bc	3.3 a-d
+ MATADOR120 EC	10			
HEADLINE EC	100**	1.4 de	0.6 bc	3.5 abc
+ MATADOR 120 EC	10			
PROLINE 480	150**	1.0 ef	0.4 bc	3.5 abc
+ MATADOR 120 EC	10			
PROLINE 480	100**	1.2 ef	0.2 bc	3.5 abc
+ MATADOR 120 EC	10			
FOLICUR 432 F	126**	1.5 cde	0.2 bc	3.1 cd
+ MATADOR 120 EC	10			
CV		23.9	65.9	9

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

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

2005 PMR REPORT #36

SECTION E: CEREAL, FORAGE CROPS, and OILSEEDS - Insects
ICAR: 61006537

CROP: Soybean, (*Glycine max* (L.) Merrill), cv P92B38, P91B33
PEST: Soybean apid (*Aphis glycine* Matsumura)

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TITLE: SOYBEAN YIELD RESPONSE TO SEED TREATMENTS AND FOLIAR SPRAYS IN ON-FARM STRIP TRIALS ACROSS SOUTHERN ONTARIO IN 2005

MATERIALS: MAXIM APRON (fludioxonil + metalaxyl-m, 231 + 93 g ai/L); CRUISER 600 FS (thiamethoxam, 600 g ai/L); GAUCHO 480 (imidacloprid, 600 g ai/L); MATADOR 120 E Foliar (cyhalothrin-lambda, 120 g ai/L); FOLICUR 432 SC Foliar (imidacloprid, 432 g ai/L); QUADRIS 280 SC Foliar (azoxystrobin, 280 g ai/L); LAGON 480 E Foliar (dimethoate, 480 g ai/L).

SEED TREATMENTS:
1- UNTREATED CHECK (no fungicide or insecticide seed treatment)2- MAXIM-APRON
3- MAXIM APRON + CRUISER @ 50 g/100 kg of seed
4- MAXIM APRON + GAUCHO @ 62 g/100 kg of seed, described herein as "GAUCHO low rate"
5- MAXIM APRON + GAUCHO @ 120 g/100 kg of seed, described herein as "GAUCHO high rate"

FOLIAR INSECTICIDE SPRAY TREATMENTS:
1- No spray treatment
2- MATADOR at 83 mL/ha
3- MATADOR at 83 mL/ha plus either FOLICUR at 292 mL/ha or QUADRIS at 455 mL/ ha, or LAGON at 1000 mL/ha

METHODS: Experiments were established on 10 fields across southern Ontario in the spring of 2005 (Table 1). Multiple locations across a wide geographical area were necessary to increase the potential for fields with varied aphid populations or levels of infestations, and to obtain fields with soybeans at varied levels of stress as dictated by spatial variability in weather and other sources of stress. Multiple locations are also desired to gain better precision on any treatment differences. All insecticide seed treatments were applied in a gasoline-powered portable cement mixer using a $C0_2$-powered spray atomizer. Treatments were arranged in a strip plot design, 3 m wide by 125 m long with 3 replications per treatment. Five strips of seed treatments were randomized within each replication, and three foliar insecticide treatments were planned for application across the seed treatments, for a total of 15 treatment combinations per replication (see treatment lists above). Filler strips were designed into the experiment to allow access for a sprayer during glyphosate application for weed control. Check plots were monitored twice a week from soybean emergence to the V2 stage for the presence of root disease and soil pest insects such as European chafer, wireworm, and seed corn maggot. Plant populations were determined in all seed treatment strips approximately 3 wk after emergence from 4-m segments of the two centre rows in three areas within each plot. Vigour ratings were determined subjectively on a scale of 0-100% (values were estimated visually in
each plot by comparing plots within the same replicate exhibiting the most uniform emergence, colour and growth). The plots were monitored weekly from late-June until mid-August for additional insect pests such as bean leaf beetle, potato leafhopper, and soybean aphid. Ratings of *Rhizoctonia* damage were conducted on a 1-7 scale (1= no lesions, 2= slight, 3= <1.0 cm lesion not encircling, 4= <1.0 cm lesion but encircling, 5= >1.0 cm lesion encircling, 6= girdled, 7= dead) at two locations, Thamesville-Kramer and Thamesville-McLeod. When aphids were detected in the plots, counts were recorded by assessing 4 plants/plot. Aphids were counted on the stem, the middle leaflet of the top uppermost fully unfolded trifoliate, the middle leaflet of a trifoliate half-way up the plant and a trifoliate at the bottom of the plant using a scale of 0-4, where 0= no aphids, 1= 1-

10 aphids, 2= 11-25 aphids, 3= 26-99 aphids and 4= 100+ aphids per leaflet or stem, to obtain a total score out of 16. The average mean score for each plot was calculated to give a rating from 0-16 (Dr. C. Difonzo, Michigan State University). The main foliar insecticide spray treatments were applied when aphid thresholds reached 250 aphids/plant. Plots were sprayed using a CO_2 precision sprayer mounted on a self-propelled highboy sprayer modified to apply foliar treatments to small plots. The sprayer had a 3.1 m boom, TJ-60 twin jet nozzles (# 11003VS) spaced 50.8 cm apart, traveling at a ground speed of approx 6.4 kph and using a water volume 200 L/ha at 45 psi. Post-spray counts were assessed in the same manner as above. A second application of MATADOR was applied to the front half of plots if thresholds of 250 aphids/plant were exceeded in check seed treatment plots. In this regard, only one field was sprayed twice. Seed yield and harvest moisture were determined on most fields with visible differences across the seed or foliar spray treatments. Subplots in the selected fields were harvested in a 2m by 10 m strip in each plot and yields were converted to 14.5% moisture. PROC UNIVARIATE (SAS) was used to test the plausibility of assumptions for ANOVA. Transformations of data were performed to satisfy assumptions of ANOVA and normality; means were detransformed for presentation purposes. All data were analyzed using the SAS procedure PROC MIXED. The effects of location, and location by treatment interactions, were fixed variables, and rep within location was the random effect in the mixed model.

RESULTS: See Tables 1 to 11. Significant differences in soybean plant populations were observed at locations 'Thamesville-Kramer', 'Thamesville-McLeod' and 'Rondeau-Rose' approximately 21 days after planting. Treatment with Fungicide + CRUISER significantly increased soybean plant populations relative to untreated check populations (Table 2). Not at Thamesville/McLeod. Significant differences in plant vigour were observed at locations 'Thamesville-Kramer' and 'Rondeau-Rose'. Plants treated with Fungicide + CRUISER and Fungicide + GAUCHO exhibited significantly higher vigour compared to untreated check populations (Table 3). Significant differences in bean leaf beetle populations were observed at locations 'Shetland-Elliot' and 'Thamesville-McLeod'. Plant populations treated with Fungicide + CRUISER and Fungicide + GAUCHO (high rate) exhibited significantly lower bean leaf beetle populations compared to untreated plants (Table 4). Of the ten locations monitored, one location, 'Rondeau-Rose' was affected by wireworm (*Limonius spp.*) populations. As affected by seed treatments, significant differences in the proportion of plants with visual wireworm damage was observed. Plant populations treated with Fungicide + GAUCHO exhibited the lowest levels of visual wireworm damage (Table 5). Plants treated with Fungicide + CRUISER and Fungicide + GAUCHO at 100 g exhibited significantly less *Rhizoctonia* damage as assessed on a 0-7 scale (Table 6). No significant differences in yield were observed among the five locations which received only seed treatments (Table 7). Furthermore, when the seed treatment data were extracted from all 11 locations and a mixed model was used across locations, no yield differences were noted. As affected by seed treatments and assessed by visual ratings, soybean aphid populations were significantly lower in Fungicide + CRUISER treated plots by sampling point 2 (Table 8). Foliar applications of MATADOR and LAGON significantly reduced soybean aphid populations as assessed by visual ratings (0-16 scale) (Table 9). At two locations, 'Ridgetown-Fisher' and 'Shetland-Elliot', aphid populations continued to be suppressed two weeks after application of MATADOR. At locations 'Bayfield-Armstrong' and 'Lucan-Jaramel', the lowest aphid populations were observed in plots sprayed with LAGON (Table 9). An application of a foliar insecticide increased soybean seed yields from 0.26 to 0.47 t/ha at 3 of 5 field locations ($p < 0.05$), with an average response of 0.25 t/ha ($p < 0.05$) averaged across the 5 locations (Table 10). Soybean yields did not respond to fungicides applied as a foliar spray with an insecticide (Table 10). There were no interactions among seed treatments and foliar insecticide treatments. Multiple foliar insecticide/fungicide applications occurred at the 'Ridgetown-Rose' location. Although all treatment combinations significantly increased seed yield relative to untreated plant populations, no significant yield gains were derived from a second foliar insecticide/fungicide application (Table 11).

CONCLUSIONS: Only three locations showed a response to seed treatment in plant stand and plant vigour. Two could be attributed to fungicide control of *Rhizoctonia* and the third to protection against wireworm with the best wireworm protection coming from GAUCHO. However, when data were pooled over all locations the best plant stand was obtained using the CRUISER/fungicide combination. Three locations had sufficient bean leaf beetle populations to score seed treatment effects. Bean leaf beetles were not completely eliminated from treated plots and there was some feeding damage evident. However, populations were significantly reduced with CRUISER and GAUCHO at the high rate. Only three locations showed a positive response to seed treatments in soybean aphid control. It seems that CRUISER consistently kept aphid populations low for more than 60 days after planting. The data for GAUCHO were less conclusive. No yield benefits were noted with any of the seed treatments at any location, nor when data were pooled across locations. At both locations where LAGON and MATADOR were directly compared, LAGON provided better aphid control. However, this did not carry through to yield where there were no differences. There was no advantage in yield to adding a fungicide when spraying the insecticide for aphid control at any of the locations.

Table 1. Planting dates and agronomic characteristics of soybean fields across southern Ontario used in a trial to evaluate insecticides for soybean aphid control, 2005.

Field Location	Grower	County	Previous Crop	Soil Type	Tillage	Planting Date
Bayfield	Armstrong	Huron	Corn	Clay Loam	No-till	May 12
Ridgetown	Bauman	Kent	Wheat	Clay	No-till	May 13
Shetland	Elliot	Lambton	Corn	Loam	No-till	May 17
Ridgetown	Fisher	Kent	Soybeans	Clay	No-till	May 12
Alvinston	Griffiths	Lambton	Corn	Gravel Loam	No-till	May 17
Thamesville	Kramer	Kent	Corn	Sandy Loam	No-till	May 13
Oil Springs	McKinley	Lambton	Wheat	Clay Loam	No-till	May 16
Thamesville	Mcleod	Kent	Corn	Sandy Loam	No-till	May 13
Thamesville	Tyhurst	Kent	Corn	Silt Loam	No-till	May 18
Rondeau	Rose	Kent	Seed Corn	Sandy Loam	No-till	May 11

Table 2. Soybean plant populations approximately 21 days after planting as affected by seed treatments in soybean aphid strip trials on farm fields across southern Ontario, 2005.

Field Location/ Grower	Check	Fungicide Only	Fungicide + CRUISER	Fungicide + GAUCHO Low rate	Fungicide + GAUCHO High rate
			Number of plants per m		
Ridgetown/Bauman	35.0	34.5	33.8	33.2	33.2
Ridgetown/Fisher	30.1	31.6	29.6	29.9	30.3
Alvinston/Griffith	31.6	33.8	33.2	33.0	32.8
Oil Springs/McKinlay	36.2	36.6	38.5	35.8	36.0
Thamesville/Kramer	27.6 a[1]	31.4 b	34.0 b	31.9 b	31.7 b
Thamesville/McLeod	30.1 a	31.2 a	31.1 a	32.5 ab	35.8 b
Thamesville/Tyhurst	33.1	30.5	35.8	32.7	31.5
Rondeau/Rose	32.8 a	37.0 b	39.7 b	36.7 b	34.9 a
Mean	32.1 a	33.4 ab	34.1 b	33.2 ab	33.3 ab

[1] Means followed by the same letter within each field do not significantly differ according to a Fisher's protected LSD test at a significant level of P=0.05.

Table 3. Soybean vigour ratings approximately 21 days after planting as affected by seed treatments in soybean aphid strip trials on farm fields across southern Ontario, 2005.

Field Location/ Grower	Check	Fungicide Only	Fungicide + CRUISER	Fungicide + GAUCHO Low rate	Fungicide + GAUCHO High rate
			% [1]		
Ridgetown/Bauman	90	90	86	86	87
Ridgetown/Fisher	87	90	80	97	100
Alvinston/Griffith	97	93	97	100	97
Thamesville/Kramer	66 a[2]	83 b	97 c	100 c	100 c
Oil Springs/McKinlay	93	90	100	100	97
Thamesville/McLeod	93	100	100	100	100
Thamesville/Tyhurst	92	90	97	97	100
Rondeau/Rose	77 a	87 a	93 b	97 b	81 a
Mean	86 a	90 ab	93 b	95 b	92 b

[1] Mean vigour rated on a scale from 0 to 100, expressed as the mean percentage of growth and visual appearance of the best plot per replicate.

[2] Means followed by the same letter within each field do not significantly differ according to Fisher's protected LSD test at a significant level of P=0.05.

Table 4. Populations of bean leaf beetle as affected by seed treatments on 3 farm fields across southern Ontario, 2005.

Field Location/ Grower	Check	Fungicide Only	Fungicide + CRUISER	Fungicide + GAUCHO Low rate	Fungicide + GAUCHO High rate
			Number of beetles per plant[1]		
Shetland/Elliot	5.3 a [2]	0.5 b	1.1 b	3.1 a	1.0 b
Thamesville/McLeod	3.4 ab	4.2 a	0.8 c	1.1 bc	0.9 bc
Rondeau/Rose	0.9	0.8	0.6	1.1	0.2
Mean	2.6 a	1.3 ab	0.8 b	1.6 a	0.6 b

[1] Data were transformed using ln (x + 0.2) to satisfy assumptions of ANOVA. Transformed means were de-transformed for presentation purposes.

[2] Means followed by the same letter within each location are not significantly different according to Fisher's Protected LSD Test at a significance level of P=0.05.

Table 5. Proportion of plants with visual damage caused primarily by wireworm as affected by seed treatments on one field in southern Ontario, 2005.

Field Location/ Grower	Check	Fungicide Only	Fungicide + CRUISER	Fungicide+ GAUCHO Low rate	Fungicide + GAUCHO High rate
			%[1]		
Rondeau-Rose	49 a[2]	19 b	13 b	1 c	1 c

[1] Data were transformed using ln (x + 0.5) to satisfy assumptions of ANOVA. Transformed means were detransformed for presentation purposes.

[2] Means followed by the same letter are not significantly different according to Fisher's Protected LSD Test at a significance level of P =0.05.

Table 6. Ratings of plants with visual damage caused by *Rhizoctonia* as affected by seed treatments on two fields in southern Ontario, 2005.

Field Location/ Grower	No Seed Treatment	Fungicide Only	Fungicide + CRUISER	Fungicide + GAUCHO Low rate	Fungicide + GAUCHO High rate
			Rating scale 0-7		
Thamesville/Kramer	1.89	1.93	1.60	1.77	1.89
Thamesville/McLeod	2.87	2.45	1.99	2.37	2.19
Mean	2.38 a[1]	2.19 ab	1.79 c	2.07 ab	2.01 bc

[1] Means followed by the same letter are not significantly different according to Fisher's Protected LSD Test at a significance level of P=0.05.

Table 7. Effects of seed treatments on soybeans yields in on-farm strip trials across southern Ontario, 2005.

Field Location	Grower	No Seed Treatment	Fungicide Only	Fungicide + CRUISER	Fungicide + GAUCHO Low Rate	Fungicide + GAUCHO High Rate
				t/ha		
Thamesville	McLeod	2.43	2.34	2.38	2.33	2.27
Thamesville	Tyhurst	3.05	3.11	3.18	3.16	3.31
Ridgetown	Bauman	2.25	2.19	2.31	2.39	2.37
Oil Springs	McKinley	3.90	3.85	3.91	3.99	4.14
Alvinston	Griffiths	2.98	2.89	2.90	2.82	2.83
Mean		2.85	2.78	2.84	2.84	2.85

Table 8. Effects of seed treatment on soybean aphid populations as assessed by visual ratings (0-16) in on-farm strip trials across southern Ontario, 2005. Only those locations in which treatment difference were detected are displayed.

Location-Grower	Sampling Point/Rating Date			
Seed Treatment	1 McLeod: 21 July Bauman: 21 July McKinlay: 22 July	2 McLeod: 27 July Bauman: 28 July McKinlay: 8 Aug	3 McLeod: 10 Aug Bauman: 10 Aug McKinlay: 12 Aug	Mean
	Visual Rating 0-16			
Thamesville - McLeod				
Check	0.87	3.77 a[1]	2.83	2.49 a
Fungicide Only	0.83	0.00 b	2.87	1.23 bc
Fungicide+ CRUISER	0.73	0.00 b	1.87	0.87 b
Fungicide + GAUCHO Low	0.77	0.00 b	2.73	0.16 bc
Fungicide + GAUCHO High	0.73	3.23 a	2.13	2.03 ac
Mean	0.79 a	1.40 b	2.48 c	
Ridgetown - Bauman				
Check	0.60	0.80 ab	2.60	1.33
Fungicide Only	0.57	2.90 a	2.93	2.13
Fungicide+ CRUISER	0.53	0.00 c	4.27	1.60
Fungicide + GAUCHO Low	0.07	1.50 bc	4.30	2.16
Fungicide + GAUCHO High	0.50	0.70 abc	3.78	1.66
Mean	0.57 a	1.18 a	3.57 b	
Oil Springs - McKinlay				
Check	0.87	1.33 ab	5.50	2.56
Fungicide Only	0.73	2.57 a	6.93	3.41
Fungicide+ CRUISER	0.83	0.00 b	7.17	2.67
Fungicide + GAUCHO Low	1.60	2.40 ab	7.10	3.70
Fungicide + GAUCHO High	0.77	1.24 ab	7.40	3.13
Mean	0.96 a	1.50 a	6.81 b	

[1] Means followed by the same letter within each location and column or row do not significantly differ according to a Fisher's protected LSD test at a significance level of P=0.05.

Table 9. Effects of foliar treatments on soybean aphid populations as assessed by visual ratings (0-16 scale) in on-farm strip trials across southern Ontario, 2005.

Location	Grower- Spray Date	Foliar Spray Treatment		
	Sampling Date	Check	MATADOR 83 mL/ha	LAGON 1000 mL/ha
			Rating scale 0-16	
Bayfield	Armstrong - 15 August			
	17 August	9.12 a [1]	6.00 b	3.75 c
	23 August	5.93 a	1.02 b	0.28 c
	Mean	7.45 a	3.08 b	1.66 c
Ridgetown	Fisher - 09 August			
	12 August	4.56 a	2.09 b	
	19 August	5.55 a	0.99 b	
	25 August	1.46 a	0.09 b	
	Mean	3.66 a	0.94 b	
Shetland	Elliot - 11 August			
	12 August	5.12 a	2.10 b	
	18 August	3.00 a	1.79 b	
	25 August	3.94 a	0.38 b	
	Mean	3.98 a	1.32 b	
Thamesville	Kramer - 15 August			
	17 August	1.78 a	1.79 a	
	24 August	2.89 a	0.30 b	
	Mean	2.31 a	0.95 b	
Thamesville	Tyhurst - 16 August			
	18 August	2.97 a	2.63 a	
	24 August	5.68 a	0.30 b	
	Mean	4.23 a	1.27 b	
Lucan[2]	Jaramel Farms - 15 August			
	17 August	5.06 a	2.62 b	1.33 c
	23 August	4.02 a	0.40 b	0.04 c
	Mean	4.53 a	1.34 b	0.59 c

[1] Means followed by the same letter within each location and row do not significantly differ according to a Fisher's protected LSD test at a significance level of P=0.05.

[2] Yield data not analyzed for this location.

Table 10. Effects of seed treatment and foliar insecticides and fungicides on soybean yields in on-farm strip trials across southern Ontario, 2005.

Location-Grower	Seed Treatment	Foliar Spray Treatment			
		CHECK	MATADOR	LAGON alone or MATADOR + [fungicide]	Means Across Seed Treatment
		t/ha			
Bayfield-Armstrong				LAGON	
	No seed treatment	3.23	3.49	3.31	3.34 a
	Fungicide Only	3.20	3.50	3.42	3.37 a
	Fungicide+CRUISER	3.52	3.72	3.67	3.63 b
	Fungicide+GAUCHO Low	3.36	3.77	3.55	3.56 b
	Fungicide+GAUCHO High	3.56	3.67	3.71	3.65 b
	Mean	3.37 a[1]	3.63 b	3.53 b	
Ridgetown-Fisher				[FOLICUR]	
	No seed treatment	1.85	2.37	2.21	2.14
	Fungicide Only	1.78	2.19	2.13	2.03
	Fungicide+CRUISER	1.88	2.30	2.24	2.14
	Fungicide+GAUCHO Low	1.72	2.29	2.33	2.12
	Fungicide+GAUCHO High	1.76	2.19	2.20	2.05
	Mean	1.80 a	2.27 b	2.22 b	
Shetland-Elliot				[QUADRIS]	
	No seed treatment	3.10	3.26	3.08	3.23
	Fungicide Only	3.07	3.18	3.22	3.15
	Fungicide+CRUISER	3.05	3.36	3.27	3.22
	Fungicide+GAUCHO Low	3.08	3.25	3.17	3.17
	Fungicide+GAUCHO High	3.20	3.37	3.31	3.29
	Mean	3.10	3.28	3.26	
Thamesville-Kramer				[QUADRIS]	
	No seed treatment	2.43	2.90	2.61	2.65
	Fungicide Only	2.79	2.69	2.63	2.70
	Fungicide+CRUISER	2.92	2.73	2.59	2.78
	Fungicide+GAUCHO Low	3.01	2.91	2.71	2.88
	Fungicide+GAUCHO High	2.92	3.07	2.65	2.88
	Mean	2.81	2.88	2.64	
Thamesville-Tyhurst				[FOLICUR]	
	No seed treatment	2.93	3.21	3.33	3.16
	Fungicide Only	3.01	3.28	3.37	3.22
	Fungicide+CRUISER	3.06	3.39	3.45	3.30
	Fungicide+GAUCHO Low	3.12	3.23	3.46	3.27
	Fungicide+GAUCHO High	3.20	3.52	3.58	3.43
	Mean	3.06 a	3.32 b	3.44 b	3.28
Means Across Spray Treatments		2.83 a	3.08 b	3.02 b	

[1] Means followed by the same letter within each location do not significantly differ according to a Fisher's protected LSD test at a significance level of P=0.05.

Table 11. Effects of seed treatment and multiple applications of foliar insecticides/fungicides on soybean yields in an on-farm strip trial (farm co-operator, "Rose") near Ridgetown, ON, 2005.

Seed Treatment	CHECK	MATADOR Sprayed Once	MATADOR + FOLICUR Sprayed Once	MATADOR Sprayed Twice	MATADOR + FOLICUR; then MATADOR Only	Means Across Spray Treatments
			t/ha			
No Seed Treatment	3.27	3.99	3.40	3.92	3.95	3.64
Fungicide Only	3.26	3.92	3.61	4.00	4.09	3.69
Fungicide + CRUISER	3.15	3.53	3.70	3.90	4.14	3.66
Fungicide + GAUCHO Low	2.95	3.89	3.34	3.79	4.14	3.59
Fungicide + GAUCHO High	2.98	3.88	3.61	3.73	4.05	3.61
Mean	3.12 a[1]	3.88 b	3.53 b	3.87 b	4.07 b	

[1] Means followed by the same letter do not significantly differ according to a Tukey-Kramer means separation test at a significance level of P=0.05.

2005 PMR REPORT #37

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

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

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TITLE: CONTROL OF WIREWORM IN SPRING WHEAT WITH SEED TREATMENTS

MATERIALS: RAXIL MD (tebuconazole + metalaxyl, 5 + 6.2 g ai/L); RAXIL T FS (tebuconazole + thiram, 6.6 + 222 g ai/L); GAUCHO 480 FL (imidacloprid, 480 g ai/L); GAUCHO XT (imidacloprid + metalaxyl + tebuconazole, 139 + 6.2 + 6.7 g ai/L); L1397-A1 (tebuconazole + metalaxyl + prothioconazole, 3.1 + 6.2 + 15.4 g ai/L); DIVIDEND XL RTA (difenoconazole + metalaxyl-M, 3.37 + 0.27 g ai/L); CRUISER 5 FS (thiamethoxam, 600 g ai/L)); G2106-04 (carboxin + lindane, 180 + 165 g ai/L); VITAFLOW 280 FS (carboxin + thiram, 169.6 + 150.6 g ai/L).

METHODS: Treated seed was supplied by Bayer CropScience. The wheat was planted on 12 May, 2005 in a grower's field at Rodney, ON at a seeding rate of 75 seeds/m using a two-row cone-seeder mounted on a John Deere Max Emerge planter. Plots were 4 rows, spaced 0.76 cm apart and 6 m in length placed in a RCBD with 4 replications. The plots were fertilized and maintained according to provincial recommendations. Emergence and plant stand in 2 center plot rows were assessed on 1 and 8 June, 2005, respectively. Vigour assessments, using a scale of 0 -100 %, (100= most advanced plants and 0 = plants dead in the plot) were recorded on the same dates. The number of plants and wireworm populations per m were estimated in the check plots on 1 and 8 June, 2005 by digging up 1 m of row in a trench 15.2 cm deep and 10.16 cm wide, sifting the soil and separating out the wireworms. Row population was estimated on 8 June and 6 July, 2005 using a scale of 0-100 % (100= all plants equally spaced, 50= half plants missing, 0= all plants missing). Plots were hand harvested. Data were analyzed using analysis of variance and means were separated using least significant differences (LSD) at **P**= 0.05.

RESULTS: See Table 1. The mean average for plants and wireworms per m in check plots on 1 June, 2005 were 66 and 2.0 respectively, and on 8 June, 2005, 51 and 1.8 respectively. Drift from a spray application in an adjacent field caused much damage in 3 or of 4 reps in the wheat trial. Yields are not reported due to differences in plot weights.

CONCLUSIONS: No differences were noted in any of the treatments. The wireworm population was much lower than anticipated.

Table 1. Emergence, plant stand and row fill assessments in a trial to evaluate control of wireworms in spring wheat at Rodney, ON, 2005.

Treatment	Rate	Emergence	Plant Stand	Vigour		Row Fill	
	g ai/100 kg	Number plants/2 rows		0-100 %		1-100 %	
		June 1	June 8	June 1	June 8	June 8	July 6
RAXIL MD	300	679	663	80	77.5	75	45
RAXIL T FS	51.4	648	620	67.5	77.5	72.5	37.5
RAXIL T FS	51.4	703	682	77.5	82.5	77.5	30
+GAUCHO 480	10.1						
RAXIL MD	300	653	687	67.5	77.5	72.5	35
+GAUCHO 480	10.1						
GAUCHO XT	38.7	709	681	82.5	92.5	90	48.8
L1397-A1	8	705	651	82.5	77.5	72.5	45
L1397-A1	8	704	687	80	75	75	35
+GAUCHO 480	10.1						
DIVIDEND XL	13	713	676	82.5	75	75	30
+CRUISER 5 FS	19.8						
G2106-04	104	693	674	85	85	80	35
VITAFLO 280 FS	106	677	668	72.5	75	62.5	37.5
VITAFLO 280 FS	106	707	676	87.5	87.5	82.5	62.5
+CRUISER 5 FS	19.8						
RAXIL T FS	51.4	718	668	85	82.5	82.5	40
+CRUISER 5 FS	19.8						
CV		6.7	8.4	14.6	13.5	19.3	65.5

2005 PMR REPORT #38

SECTION E: CEREAL, FORAGE CROPS, and OILSEEDS - Insects
ICAR: 61006537

CROP: Winter wheat, (*Triticum* spp. L.), cv P25R47
PEST: European chafer, *Rhizotrogus (Amphimallon) majalis*, Razoumowsky

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

MATERIALS: DIVIDEND RTA 36 FS (difenoconazole, 36 g ai/L); GAUCHO 600 FL (imidacloprid, 600 g ai/L); CRUISER 350 FS (thiamethoxam, 350 g ai/L).

METHODS: All seed was pre-treated with DIVIDEND RTA fungicide at a rate of 13 g ai/100 kg. The additional insecticide seed treatments were applied separately by treating 25 kg lots in a modified cement mixer fitted with a CO_2 precision sprayer. After the chemical was applied, the seed continued to mix for 2 min to ensure uniform coverage. Treated seed was planted on 6 Oct, 2004 at Delaware, ON. Strip plots were 4.5 m wide and 92 m long , with rows spaced 17.5 cm apart. Seed weight was 37 g/1000 seeds. Wheat was planted using a conventional grain drill. Plant emergence was assessed in 2 m lengths of 1 row at the front and back of each plot on 4 Dec, 2004. Chafers were counted in the front and back of each plot by removing a golf-cup changer core sample. Plant stand and vigor ratings using a scale of 0-100% (100 = most advance plants and 0 = dead plants) were assessed on 15 Apr, 2005. Chafer counts were recorded in the check plots on the same date by removing a 1 m trench of soil 15 cm wide and 10 cm deep and sifting them out of the soil. On 2 May, 2005 chafer counts were assessed again by taking 3 golf-cup changer core samples, approximately 25 m apart, from each plot in 4 tiers. The cores were sampled in the zone of transition between damaged and healthy plants. Plots were harvested on 18 July, 2005 and yields corrected to 14.5% moisture. Data were analyzed using analysis of variance and means were separated using least significant differences (LSD) at $P = 0.05$.

RESULTS: See Table 1. No grubs were found in the check plot of the first replication and plant emergence and final stand were high in this plot. Therefore plots from the first replicate were discarded.

CONCLUSIONS: European chafers resulted in at least 50% yield loss. The chafer populations were significantly lower in the treated plots and yields were doubled in the presence of both CRUISER and GAUCHO.

Table 1. Emergence, plant stands and yield assessments in a trial to evaluate European chafer cntrol in winter wheat at Delaware, ON, 2005.

Treatment	Rate g ai/100 kg	Emergence Avg/4m 4 Dec 2004	Plant Stand Avg/4m 15 Apr 2005	Vigor 0-100 % 15 Apr 2005	Chafers Avg/12 cores 2 May 2005	Yield T/ha 18 July 2005
CHECK	0	36 b[1]	31 b[1]	31.2 b[2]	1	1.4 b[1]
GAUCHO 480 FS	50	81 a	104 a	98.9 a	0	3.1 a
CRUISER 350 FS	50	89 a	115 a	95.5 a	0	3.2 a
CV		15.6	18.7	24.2	51.5	16.5

[1] Means within a column followed by same letter do not significantly differ ($P = .05$, LSD).
[2] Data transformed by arsine square root for means separation and CV calculations, means were de-transformed.

2005 PMR REPORT #39

SECTION E: CEREAL, FORAGE CROPS, and OILSEEDS - Insects
ICAR: 61006537

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

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

MATERIALS: DIVIDEND XL RTA 36 FS (difenoconazole, 36 g ai/L); CRUISER 350 FS (thiamethoxam, 350 g ai/L); GAUCHO 480 FL (imidacloprid, 480 g ai/L); PONCHO 600 FL (clothianidin, 600 g ai/L).

METHODS: Seed was treated in 500 g lots in individual plastic bags by applying a slurry (all treatments diluted in water to the same volume of 0.72 ml per 500 g) of the material via a syringe to each bag. The seed was then mixed for 1 min in the inflated bag to ensure thorough seed coverage. Wheat was planted at Ridgetown 25 Oct, 2004 using a twelve-row Wintersteiger cone seeding drill. Plots were 6 rows 4 m in length and spaced 15 cm apart and arranged in a RCBD with 4 replications. Galvinized steel sheet enclosures, 25 X 25 cm square and 25 cm high, were placed at the front and back of each plot around the 2 planted rows to a depth of 10 cm. European chafers were released into enclosures on 25 Oct, 2004 at a rate of 6 chafers per enclosure. Plant emergence inside enclosures was assessed on 22 Nov, 2004. Plant stand was assessed on 11 Apr, 2005. Vigour was assessed on 11 Apr, 2005 using a scale of 0-100% (100 = furthest developed plant in the trial and 0 = plant dead). Wheat in enclosures was hand harvested on 8 Aug, 2005 and whole plant weights recorded. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at $P = 0.05$.

RESULTS: See Table 1.

CONCLUSIONS: The greatest winter survival of plants occurred with GAUCHO and CRUISER. The best winter survival occurred with GAUCHO at the high rate. Only GAUCHO at high rate significantly improved yield. There was a trend towards greater fresh weight yields with higher rates of GAUCHO and CRUISER, suggesting that the higher rates would be more efficacious.

Table 1. Emergence, plant stand, vigour, winter survival and whole plant fresh weight assessments from 2 enclosures at Ridgetown, Ontario.

Treatment	Rate g ai/100 kg	Emergence Avg number plants/enclosure 22 Nov, 2004	Plant Stand 11 Apr, 2005	Vigour 0-100 %	Winter Survival %	Fresh Weight Avg g/ enclosure 8 Aug, 2005
TREATED CHECK -DIVIDEND XL RTA		33 abc	19 b	57	57 c	12.6 b
PONCHO 600 FL	30	41 a	30 a	82	71 bc	19.5 ab
GAUCHO 480 FL	30	38 abc	31 a	78	83 ab	16.4 ab
GAUCHO 480 FL	50	28 c	26 ab	65	91a	24.5 a
CRUISER 350 FS	30	30 bc	23 ab	58	75 abc	12.4 b
CRUISER 350 FS	50	35 abc	28 ab	75	80 ab	16.8 ab
CV		14.3	19.5	22.4	13.1	29.5

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

2005 PMR REPORT #40

SECTION F: ORNAMENTALS and GREENHOUSE – Insect Pests
ICAR: 33331975

CROP: Rose (*Rosa* L. *x hybrida)* cv. 'Fellowship' aka 'Warm Wishes'
PEST: Rose midge, *Dasineura rhodophaga* (Coquillett)

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TITLE: **EVALUATION OF INSECTICIDES AND A PREDATORY NEMATODE FOR CONTROL OF ROSE MIDGE, 2005**

MATERIALS: DOKTOR DOOM® aerosol (permethrin 0.25%); INTERCEPT 60 WP (imidacloprid); MERIT 0.5 G (imidacloprid 0.5%); NEMASYS H predatory nematode (*Heterorhabditis megidis* 50 million/pkg.); ORTHENE T & O (acephate 75%).

METHODS: The trial was conducted at a commercial nursery in Langley, BC in 2005. Cuttings of *Rosa x hybrida* cv. 'Fellowship' were rooted in a greenhouse mist chamber and transplanted to one gallon (15 x 15 cm square) pots. The potting medium was a 50:50 mixture of peat and bark, with 5% compost and Osmocote slow-release fertilizer; pH approximately 6.0. Pots were placed outdoors on ground cover in a designated area of the nursery on June 3. The first midge-damaged buds were observed on the plants on June 7 and the first treatments were applied on June 9. Yellow sticky cards were replaced weekly in two of the untreated check plots to record the presence of adult midges. The trial was a randomized complete block design with four replicates per treatment, four pots (0.1 m^2) per plot, for a total of 16 pots per treatment. Each replicate consisted of one row of 12 treatment plots, with 60 cm between each plot along the row and 1.2 m between each row/replicate. The trial was hand-watered, pruned and fertilized by the grower as per commercial practice. Subdue MAXX (metalaxyl-m) fungicide was applied on June 28 to control rose downy mildew (*Peronospora sparsa*). DOKTOR DOOM aerosol was applied as a 10 second spray per 0.1 m^2 plot area (mean measured delivery rate was approximately 25 mL product per 10 sec) = 250 mL/m^2. The first foliar spray on June 9 was applied with the aerosol can held 10-20 cm from the plant and the nozzle directed toward the leaves. Subsequent foliar sprays were applied in a slow sweeping motion with the aerosol can held 30-45 cm from the plant and the spray allowed to settle onto the foliage as a light mist. For soil application, the DOKTOR DOOM aerosol was sprayed onto the dry surface of the potting mix, worked in to 2-3 cm depth, then re-applied to the surface; no rain or irrigation was allowed on the pots for 24 hours after soil application. ORTHENE T & O was applied at 125 mL solution per plot as a foliar spray with a CO_2 backpack sprayer at 40 psi (276 kPa) and a hand-held boom with a single adjustable nozzle. INTERCEPT 60 WP was applied at 0.5 g/16 pots as a liquid soil drench in 100 mL of solution per pot, poured onto the surface of the potting mix. MERIT 0.5 G was sprinkled on the surface of the potting mix at 0.67 g/plot with a hand-applicator/shaker and watered after application. NEMASYS H (*H. megidis*) was applied as a 1:400 dilution. One package was dissolved in 10 L of water to make a stock solution which was then diluted 40 times before pouring on the surface of the potting mix at 80 mL solution per pot (320 mL solution per 0.1 m^2). The second application of NEMASYS H scheduled for July 5 was delayed for two weeks until July 19 (42 days after the initial application) because the product was unavailable earlier. The final applications in Treatments 3, 10 and 11 were then made 28 days later on Aug 16; two weeks later than the other products were applied. The presence of live nematodes in the 1:400 dilution was confirmed under the microscope on Aug 16. The number of leaf and flower buds with midge damage or maggots was counted pre-treatment and weekly thereafter. Damaged/infested buds were removed at each weekly assessment, so only newly-affected buds were counted each week. Phytotoxicity (stunting, chlorosis, necrosis, leaf distortion, bud abortion) was rated on a visual scale of 0 to 10, where 0 = no damage; 1 = negligible (1-2 buds/leaves affected with minor chlorosis/distortion); and 10 = more than 80% of foliage affected with severe symptoms. Starting on July 19, the number of buds, flowers and shoots infested with thrips or aphids was counted weekly. At the end of the trial, on Aug 30, the total number of leaf and flower buds per plant was counted in each treatment. Statistical

analysis (ANOVA) was performed using CoStat Version 6.204, 2003, CoHort Software, Monterey, California, USA, Copyright © 1998-2003.

RESULTS: Rose midge causes swollen, distorted leaf and flower buds that fail to open, then blacken and drop. Cumulative weekly rose midge damage per treatment is presented in Table 1. Both midge-damaged and maggot-infested buds were counted weekly since midge damage was often evident although live maggots were not always found in dissected buds. DOKTOR DOOM® foliar mist reduced rose midge damage when applied every two weeks but not when applied monthly (Figure 1). Thrips were often found in conjunction with rose midge maggots in the buds. Thrips feeding results in distorted buds and leaves also, but the rasping injury from thrips feeding was distinct from midge damage. A summary of midge, thrips and aphid counts over the course of the trial is presented in Table 2. Roses flush out new leaf and flower buds continuously throughout the growing season. Although the DOKTOR DOOM treatments had among the highest total leaf and flower buds at the end of the trial (Aug 30) and the untreated check among the lowest, the mean number of total leaf and flower buds per treatment was not significantly different in Duncan's Multiple Range Test at $P < 0.05$ (Table 2). The first foliar spray of DOKTOR DOOM on June 9 was applied with the aerosol can held 10-20 cm from the plant, resulting in large droplets on the leaves and chlorotic and curled leaves on young shoots. Negligible or no phytotoxicity was observed when subsequent foliar sprays were applied in a slow sweeping motion with the aerosol can held 30-45 cm from the plant and the spray allowed to settle onto the plant foliage as a light mist. No spray injury was observed on flower petals in the DOKTOR DOOM aerosol mist treatments. High numbers of two-spotted spider mites were present in the trial in July-August but no difference in mite infestation levels was observed among any treatments.

CONCLUSIONS: DOKTOR DOOM® aerosol (0.25% permethrin) applied every two weeks as a light mist over the plant foliage resulted in a 70% reduction in buds damaged by rose midge compared to the untreated check, with negligible phytotoxicity. The number of damaged/infested buds was significantly less than in the untreated check or the ORTHENE T & O standard. Since the plots were not enclosed with screens, some damage could have been due to adult midges migrating into the trial area and between plots within the trial however a similar influx may occur in landscape gardens and nurseries during the growing season. The 14-day aerosol mist treatment with DOKTOR DOOM provided excellent control of aphids and thrips also. Monthly mist applications of DOKTOR DOOM were less effective than the 14-day schedule, but still reduced midge damage by approximately 30%. Monthly soil applications of DOKTOR DOOM suppressed midge damage by 50% compared to the check and provided effective control of aphids. Soil applications of DOKTOR DOOM suppressed thrips by about 50% also, but were less effective than foliar mist treatments in controlling thrips, again possibly due to influx of adults from nearby plants. Pest resistance is a concern with repeated applications of permethrin and other insecticides. Combination treatments consisting of an initial soil application of NEMASYS H or imidacloprid (MERIT 0.5 G) in June followed by a monthly soil or foliar mist treatment with DOKTOR DOOM in July and August reduced midge damage by approximately 40% compared to the check. However, the effect appeared to be primarily due to the DOKTOR DOOM treatments. Neither NEMASYS H nor imidacloprid were effective alone. Imidacloprid is absorbed by roots and translocated to the foliage and growing points. The soil-applied granular formulation of imidacloprid (MERIT 0.5 G) which demonstrated good control of rose midge in 2003 and 2004 trials was not effective in 2005.

Table 1: Mean cumulative sum of midge-damaged/infested buds per treatment per week, 2005.[1]

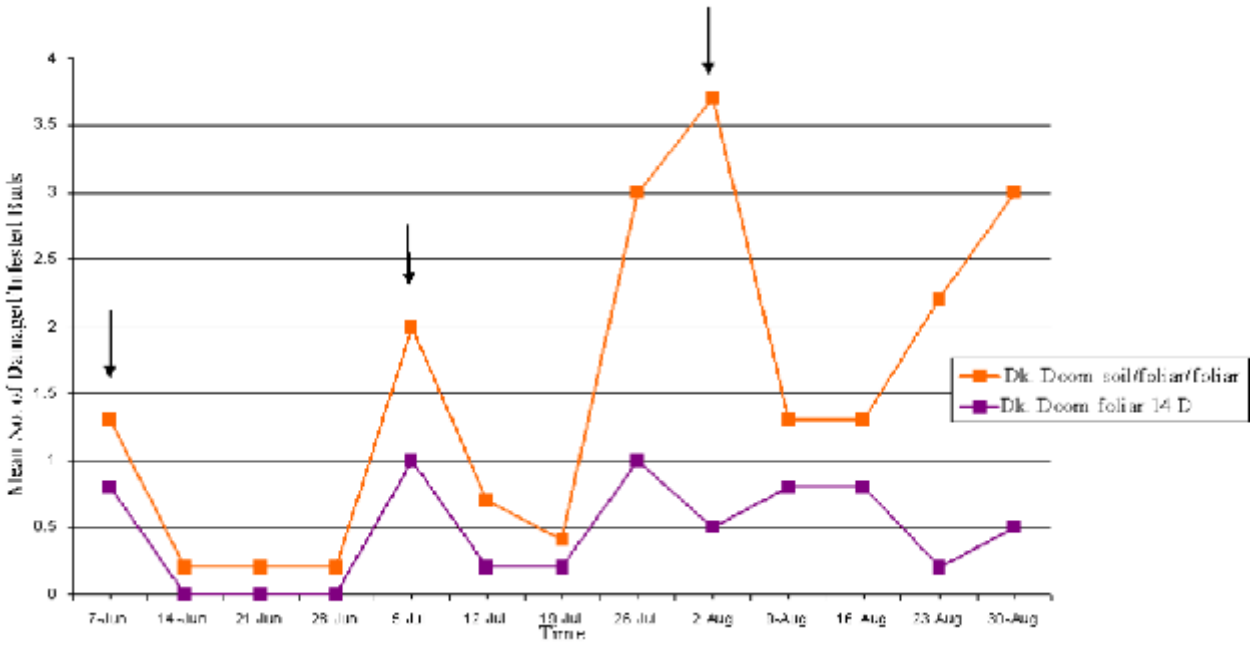
Treatment	Appl. Interval (days)	Product Rate	June 7	June 14	June 21	June 28	July 5	July 12	July 19	July 26	Aug 2	Aug 9	Aug 16	Aug 23	Aug 30
Check	-	-	0.2ab	0.8a	1.0ab	1.8ab	3.8ab	5.5ab	6.0ab	9.0ab	10.8abc	11.8ab	13.8ab	17.2a	20.2a
ORTHENE T & O	28	0.85g/L	0b	0a	0b	0.2b	2.2b	2.5b	2.8b	4.2bc	9.2abc	12.0ab	14.8ab	16.5a	19.0a
NEMASYS H	42/28	1:400	0b	0a	0.2ab	0.8b	3.2ab	4.2ab	4.2ab	6.8abc	11.0abc	11.5ab	13.2abc	14.5ab	15.0ab
DK. DOOM Foliar	14	250ml/ m^2	0.8ab	0.8a	0.8ab	0.8b	1.8b	2.0b	2.2b	3.2c	3.8c	4.5b	5.2c	5.5b	6.0b
DK. DOOM Soil	28	250ml/ m^2	0.2ab	1.0a	1.2ab	1.2b	2.5b	2.5b	2.8b	3.5bc	6.0bc	6.8ab	7.0bc	8.8ab	10.2ab
DK. DOOM Soil/Foliar/Foliar	28	250ml/ m^2	0.5ab	0.8a	1.0ab	1.2b	2.2b	2.8b	3.0b	5.0abc	8.2abc	8.8ab	9.2abc	11.2ab	13.8ab
MERIT 0.5 G	28	67g/10 m^2	0.5ab	0.8a	0.8ab	1.8ab	3.8ab	4.8ab	5.2ab	8.2abc	11.8ab	12.0ab	14.2ab	18.0a	19.0a
INTERCEPT 60 WP	28	10g/325 pot	0.8ab	1.5a	1.8ab	1.8ab	2.5b	4.2ab	4.2ab	7.2abc	9.8abc	11.2ab	12.2abc	13.2ab	14.2ab
NEMASYS H/DK. DOOM Soil/DK. DOOM Foliar	28	as above	0.8ab	1.8a	1.8ab	1.8ab	3.5ab	4.0ab	4.2ab	5.5abc	6.2bc	8.5ab	10.2abc	10.2ab	11.0ab
MERIT G/ NEMASYS H/ NEMASYS H	42/28	as above	1.5a	2.2a	2.8a	4.5a	7.0a	8.0a	8.2a	10.2a	12.8ab	13.8a	14.5ab	16.2a	17.8a
INTERCEPT 60 WP/ NEMASYS H/ NEMASYS H	42/28	as above	1.0ab	2.0a	2.2ab	2.5ab	4.5ab	5.5ab	5.8ab	10.5a	14.2a	14.2a	16.2a	16.5a	17.5a
MERIT G/DK. DOOM Soil/DK. DOOM Foliar	28	as above	0.2ab	0.5a	0.5ab	1.2b	3.2ab	3.8ab	3.8b	6.2abc	7.8abc	7.8ab	9.0abc	10.2ab	11.5ab

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

Table 2: Mean total number leaf and flower buds at end of trial, mean percent reduction in rose midge-damaged buds compared to the untreated check; mean cumulative sum of thrips-infested buds and shoots infested with aphids, per treatment, 2005.[1]

Treatment	Application Interval	Rate Product	Mean Total Leaf and	Mean Cumulative Sum Midge-	Mean % Midge Damage Reduction	Mean Cumulative	Mean Cumulative Sum of Shoots
Check	-	-	25.5a	20.2a	0a	20.8a	10.5a
ORTHENE T & O	28	0.85g/L	27.8a	19.0a	5.9a	5.5de	0b
NEMASYS H	42/28	1:400	28.8a	15.0ab	25.7ab	17.0ab	7.8a
DK. DOOM Foliar	14	250ml/m²	28.2a	6.0b	70.3b	4.5	0b
DK. DOOM Soil	28	250ml/m²	32.2a	10.2ab	49.5ab	11.2bcd	0.2b
DK. DOOM Soil/Foliar/Foliar	28	250ml/m²	30.0a	13.8ab	31.7ab	7.0de	0.2b
MERIT 0.5 G	28	67g/10 m²	25.5a	19.0a	5.9a	15.2abc	3.2b
INTERCEPT 60 WP	28	10g/325 pots	30.0a	14.2ab	29.7ab	9.5cde	0b
NEMASYS H/ DK. DOOM Soil/	28	as above	26.2a	11.0ab	45.5ab	9.8bcd	1.2b
MERIT G/ NEMASYS	42/28	as above	25.8a	17.8a	11.9a	18.2a	2.8b
INTERCEPT 60 WP/ NEMASYS	42/28	as above	24.5a	17.5a	13.4a	15.2abc	0.5b
MERIT G/DK. DOOM Soil/DK.	28	as above	26.8a	11.5ab	43.1ab	9.2cde	1.0b

Figure 1. Dk. Doom: Comparison of Monthly vs. Bi-Weekly Foliar Applications



2005 PMR REPORT #41

SECTION H: PEST MANAGEMENT METHODS – BIOLOGICAL CONTROL
ICAR: 33331596

CROP: Alfalfa (*Medicago sativa* L.), Apple (*Malus domestica* Borkhausen), Canola (*Brassica napus* L. and *B. rapa* L.), Strawberry (*Fragaria ananassa* Duchesne)
PEST: Plant bugs, *Lygus* spp. (Hahn)
PARASITOID: *Peristenus digoneutis* Loan

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TITLE: COLD-HARDINESS OF PERISTENUS DIGONEUTIS, 2005

MATERIALS: Cocoons containing overwintering adults of the parasitoids *P. digoneutis* Loan (Hymenoptera: Braconidae) were obtained from the second nymphal generation of *Lygus rugulipennis* (Hemiptera: Miridae) collected in northern Germany, in August 2002. Overwintering cocoons were stored in an insectary (in northern Germany), in which the temperature never dropped below + 2 °C, even when the temperature outside the building was below 0 °C. Parasitoid cocoons were not exposed to freezing temperatures before the experiments were started.

METHODS: The super-cooling point (SCP) of insects is defined as the temperature at which body water spontaneously freezes during the process of continuous cooling. The survival potential of a species can be assessed by comparing the measured SCP (as an indicator of the lower lethal limit) to minimum winter temperatures. In January 2003, *P. digoneutis* cocoons which were kept in the insectary at temperatures above 0°C, were cooled down at a rate of 2°C/min until they froze spontaneously. The SCP was indicated by the sudden increase of temperature, caused by the release of heat of fusion from freezing water. The lowest temperature recorded before this temperature increase was taken as the SCP. The change of the parasitoid's body temperature was measured with a NiCr-NiAL thermocouple. In a second experiment, cocoons of *P. digoneutis* that were previously stored at temperatures above 0°C, were chilled for 4 days at –5°C, followed by 4 days at –10°C and 4 days at –15°C prior to conducting the experiment. Afterwards, the SCP of *P. digoneutis* was measured and compared to the SCP of individuals kept at temperatures above 0°C prior to the experiment. In March 2003, the SCP of *P. digoneutis* stored in the insectary was measured again and compared to the SCP measured in January to determine if increasing temperatures in the insectary influenced parasitoid SCP. To estimate whether *P. digoneutis* can also adapt its SCP to high temperatures, a sample of cocoons was warmed-up for four days at +10°C followed by four days at +15°C. The SCP of the warmed parasitoids were compared to the parasitoid SCP measured in March.
It has also been demonstrated that exposure to temperatures above the SCP can cause high mortality in diapausing insects, the effect of prolonged exposure to low temperatures on parasitoid survival was studied. Overwintering *P. digoneutis* cocoons were transferred to a cryostat and acclimatized at 0°C for three days before exposure to subzero temperatures. The cocoons were acclimatized to -5°C (cooling rate: 2°C / h), then they were divided into four experimental groups, each containing five to ten samples of 50 to 150 parasitoid cocoons. Each group was kept at different sub-zero temperatures (-5°C,-10°C, -15°C, -20°C) for a period of one to four weeks. Cocoons selected for exposure to temperatures below –5°C were chilled down in 5°C steps every three days until the desired storage temperature was achieved. When the period of exposure to subzero temperatures was finished, the cocoons were warmed up in 5°C steps (lasting three days each) until they reached –5°C. All cocoons used in the experiments were incubated

simultaneously at +20°C until emergence or death of the parasitoids. To estimate the effect of freezing temperatures on *Lygus* parasitoids, the survival of individuals exposed to subzero temperatures was compared with the survival of individuals in control samples which were stored inside the subterranean insectary. To investigate parasitoid survival when exposed to natural winter temperatures in the area of origin (Germany) *P. digoneutis* cocoons were kept in an outdoor open wooden shelter until parasitoid emergence in spring.

RESULTS: As outlined in Table 1 and 2.

CONCLUSIONS: The survival of overwintering *P. digoneutis* is crucial to the successful establishment of the biological control agent in Canada. The low mean SCP of overwintering *P. digoneutis* which were not cold-acclimated, and at the time of measurement (January) most likely in a period of thermal quiescence, indicate that *P. digoneutis* is probably freeze-intolerant. Furthermore, *P. digoneutis* is able to acclimatize to changing temperatures with an increase/decrease of its SCP. Mortality of *P. digoneutis* increases as temperature decreases and as exposure to low temperatures lengthens. However, the low survival of *P. digoneutis* following exposure to –5°C for four weeks was unexpected and contradicts the higher survival of *P. digoneutis* exposed to –10°C for the same period. In the field, *P. digoneutis* overwinters as adult in a cocoon formed by their larvae at a soil depth of 1 to 5 cm and the majority of overwintering *P. digoneutis* would most likely die if exposed to temperatures of –15°C or lower for prolonged periods. However, the insulation effect of snow cover would likely protect the overwintering parasitoids from harmful exposure to low temperatures. The exposure of *P. digoneutis* to natural winter temperatures of northern Germany did not negatively affect the overwintering parasitoids. However, outside temperatures rarely dropped below –5°C and the longest period of continuous subzero temperatures was only nine days. The successful survival of *Peristenus* under natural winter temperature conditions corresponds greatly with results from laboratory studies which show that *P. digoneutis* suffers little mortality at –5°C exposure for as long as three weeks. Before releasing *P. digoneutis* into Canada, the overwintering survival of *P. digoneutis* under natural winter temperatures in the area of potential introduction should be analysed.

Table 1. Mean (±SE) super-cooling points (SCP) of *P. digoneutis* in January and March 2003 after storage at temperatures above 2°C (in the insectary) and SCPs after the parasitoids were cooled down to –15°C or warmed up to +15°C (n = no. of measurements; One way ANOVA followed by a Bonferroni post hoc test for multiple comparisons; $P > 0.05$).

Date of measurement	Temperature treatment	n	SCP of *P. digoneutis* (°C)
January 2003		30	-25.2 ± 0.2a
January 2003	cooled to –15°C	32	-26.8 ± 0.2b
March 2003		37	-23.7 ± 0.2c
March 2003	warmed to + 15°C	32	-22.5 ± 0.2d

Table 2. Survival of *P. digoneutis* following exposure to different low temperatures of variable duration (n = total numbers of individuals; * at Kiel, northern Germany).

Duration of exposure (weeks)	% survival at					
	-5°C	-10°C	-15°C	-20°C	<+2°C in the insectary	Outside temperatures*
1	99 (97)	78 (72)	25 (146)	17 (121)		
2	92 (36)	-	29 (164)	0 (151)		
3	98 (46)	53 (40)	18 (118)	0 (88)		
4	0 (48)	28 (72)	14 (131)	0 (141)		
<4					99.2 (696)	73.2 (312)

2005 PMR REPORT #42

SECTION H: PEST MANAGEMENT METHODS - BIOLOGICAL CONTROL - insects, mites, nematodes
ICAR: 33331596

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

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TITLE: RELEASE OF TWO NATIVE OBLIQUE-BANDED LEAFROLLER PARASITOIDS IN APPLE ORCHARDS

MATERIALS: Oblique-banded leafroller, *Choristoneura rosaceana* (Harris) neonates, adult *Apophua simplicipes* (Cresson) (Hymenoptera: Ichneumonidae) and *Apanteles polychrosidis* Viereck (Hymenoptera: Braconidae) all reared from laboratory colonies. Meridic pinto bean based diet. Two-year-old potted Royal Gala apple trees.

METHODS: Six hundred *Apanteles polychrosidis* and five hundred *Apophua simplicipes* females were released over a 2 week period beginning April 19, 2004 in each of two (*A. polychrosidis*) or one (*A. simplicipes*) organically managed orchards where the released species had not been previously recorded. Three potted apple trees that had been manually infested with oblique-banded leafroller neonates were placed in the release area for two weeks following release. An additional three infested trees were placed outside the release area in the first two weeks of the release. All leafrollers from potted trees were collected one week post release. Wild leafroller larvae were collected from orchard trees in the third week of the study. Leafroller larvae were placed on a meridic diet and held at 20°C under a 16:8 h L:D photoperiod until larval death, host pupation or parasitoid emergence.

RESULTS: Six to 25 % of the sentinel leafroller hosts and 0 to 7 % of the wild leafroller hosts were found to be parasitized by the *A. polychrosidis*. Ten to 31% of the sentinel hosts and 21 % of the wild hosts were found to be parasitized by *A. simplicipes*. Both species were able to move out of the release area as 4 to 26% of the sentinel leafroller hosts and 0 to 3% of the wild leafroller hosts on control trees outside the release area were parasitized by *A. polychrosidis* in the *A. polychrosidis* release orchards. Zero to 10 % of the sentinel leafroller hosts and 3 % of the wild leafroller hosts on control trees outside the release area were parasitized by *A. simplicipes* in the *A. simplicipes* release orchard.

CONCLUSION: Spring release of two native parasitoid species in orchards before adults would normally be found resulted in parasitism of both introduced and wild hosts.

2005 PMR REPORT #43

SECTION H: PEST MANAGEMENT METHODS - BIOLOGICAL CONTROL - insects, mites, nematodes
ICAR: 33331596

CROP: Apples
PESTS: Oblique-banded leafroller, *Choristoneura rosaceana* (Harris), three-lined leafroller, *Pandemis limitata* (Robinson), fruit tree leafroller, *Archips argrospilus* (Walker) and European leafroller, *Archips rosanus* (Linnaeus)

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TITLE: **PARASITISM OF APPLE LEAFROLLER COMPLEX IN ORGANICALLY MANAGED ORCHARDS IN THE NORTH OKANAGAN VALLEY OF BRITISH COLUMBIA**

MATERIALS: A meridic pinto bean based diet.

METHODS: Collections of leafrollers were made for seven weeks from the second week of Mayto the end of June in eight (2001) and six (2002) organically managed orchards in the north Okanagan Valley of British Columbia. Each week during the study, 50 leaf clusters on each of five trees within five areas of the orchard were inspected for leafroller larvae and/or pupae. Leafroller larvae were placed on a meridic diet and held at 20°C under a 16:8 h L:D photoperiod until larval death, host pupation or parasitoid emergence. Collections were repeated weekly. Percent parasitism was adjusted for mortality by using only hosts from which a parasitoid emerged or which developed to at least the pupal stage.

RESULTS: Mean leafroller densities for all orchards (2001: 12.4 ± 3.3; 2002: 11.0 ± 2.7 leafrollers/250 leaf clusters) were high. Mean percent parasitism of the spring leafroller complex ranged 0 to 34 % within individual orchards from April to June and the mean percent spring leafroller parasitism over all orchards was 10.4 ± 2.1 in 2001 and 13.8 ± 3.6 in 2002. Nineteen parasitoid species were recorded emerging from the leafroller complex in the spring. *Enytus eureka* (Ashmead) (Hymenoptera: Ichneumonidae), *Meteorus trachynotus,* Viereck*, Microgaster epagoges* Gahan and *Apanteles polychrosidis* Viereck (all Hymenoptera: Braconidae) were the most commonly found parasitoids in this survey.

CONCLUSION: Parasitism of the spring leafroller complex was relatively low in the organic orchards in the northern Okanagan valley where this survey was conducted. This study indicates that there may be potential to enhance parasitoid populations through augmentation of indigenous species.

2005 PMR REPORT #44

SECTION H: PEST MANAGEMENT METHODS - BIOLOGICAL CONTROL - insects, mites, nematodes
ICAR: 33331596

CROP: Apples
PEST: Oblique-banded leafroller, *Choristoneura rosaceana* (Harris)

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TITLE: PARASITISM OF OBLIQUE-BANDED LEAFROLLERS BY FOUR NATIVE PARASITOIDS IN AN ORCHARD RELEASE TRIAL

MATERIALS: Oblique-banded leafroller, *Choristoneura rosaceana* (Harris) neonates, adult *Apophua simplicipes* (Cresson), *Glypta variegata* Dasch (Hymenoptera: Ichneumonidae), *Apanteles polychrosidis* Viereck and *Macrocentrus linearis* Nees (Hymenoptera: Braconidae) all from laboratory colonies. Meridic pinto bean based diet. Two year-old potted Royal Gala apple trees.

METHODS: Nine potted apple trees, each infested with approximately 20 obliquebanded leafroller larvae, were placed in each of three screen cages with zippered doors. Three groups of nine infested trees were also placed uncaged in an adjacent orchard. Zero, 5 or 50 parasitoid females of the same species were released on the centre caged and uncaged trees. One week later, all leaves on the potted trees within each treatment were inspected and those with evidence of leafrollers were removed. The trees were replaced by different infested potted trees; additional parasitoids were not released. Seven days later, all leaves with evidence of leafrollers were removed. All living larvae within the leaves were placed on diet and held at 25°C until host or parasitoid pupation. The trial was replicated twice over time for each of four parasitoid species (*Apophua simplicipes*, *Glypta variegata*, *Apanteles polychrosidis* and *Macrocentrus linearis*) and specific test dates were based on when they would naturally be expected to encounter early instar wild hosts. Percentages were transformed using an arcsin transformation before the effects of the parasitoid release treatments were determined using an analysis of variance for each parasitoid species. Means were compared using Tukey's Studentized range test. Parasitism within cages in the second week were not recorded as there was evidence of parasitoids moving into the control cage.

RESULTS: Mean percent parasitism of oblique-banded leafroller hosts is recorded in Table 1. The two larger parasitoid species, *A. simplicipes* and *G. variegata* moved into and parasitized hosts in the uncaged control trees. Parasitoid releases had a significant effect on the percent parasitism occurring in the caged and uncaged trees in all but the *M. linearis* release trials.

CONCLUSION: Released *A. simplicipes*, *G. variegata* and *A. polychrosidis* caused significant parasitism in sentinel host larvae under caged and uncaged conditions.

Table 1. Mean percent of oblique-banded leafrollers (± SE) parasitized post-release of *A. simplicipes, G. variegata, A. polychrosidis or M. linearis* females onto caged and uncaged infested potted apple tree (N=9 trees; 2 replications).

Parasitoid	Mean percent of collected leafroller parasitized					
	Caged treatments			Uncaged treatments		
	0 (control)	5 females	50 females	0 (control)	5 females	50 females
Apophua simplicipes						
week 1	0 ± 0 a[1]	75 ± 3 b	71 ± 7 b	32 ± 8 a	65± 8 b	74± 7 b
week 2	na	na	na	8 ± 3 a	4 ± 2 a	23 ± 6 b
Glypta variegata						
week 1	0 ± 0 a	41 ±9 b	29 ± 9 b	29 ± 7 a	7 ± 4 b	15 ± 4 ab
week 2	na	na	na	10 ± 7 a	8 ± 6 a	19 ± 8 a
Macrocentrus linearis						
week 1	0 ± 0 a	0 ± 0 a	12 ± 8 a	0 ± 0 a	0 ± 0 a	2 ± 2 a
week 2	na	na	na	0 ± 0 a	0 ± 0 a	0 ± 0 a
Apanteles polychrosidis						
week 1	0 ± 0 a	6 ± 2 ab	14 ± 3 b	0.2 ± 0.2 a	1 ± 1 ab	4 ± 1 b
week 2	na	na	na	0 ± 0 a	1 ± 1 ab	3 ± 1 b

[1] Means within row and caged and uncaged classification followed by the same letter are not significantly (P>0.05) different as determined by Tukey's Studentized range test.

2005 PMR REPORT #45

SECTION H: PEST MANAGEMENT METHODS - BIOLOGICAL CONTROL - INSECTS, MITES, NEMATODES
ICAR: 33331596

CROP: Apples
PEST: Codling moth, *Cydia pomonella* (Linnaeus)

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TITLE: **IMPACT OF VIROSOFT CP4® IN COMBINATION WITH OILS ON CODLING MOTH**

MATERIALS: VIROSOFT CP4® (*Cydia pomonella* granulovirus; BioTepp Inc., Mont-St-Hilaire, QC), mineral oil (Superior 70 oil, United Agri Products, Dorchester, ON), fish oil (Crocker's Fish Oil, Inc., Quincy, WA) and once descummed soybean oil; *Cydia pomonella* (L.), (Lepidoptera: Tortricidae), codling moth (Okanagan-Kootenay Sterile Insect Release Program, Osoyoos, BC).

METHODS: Four blocks of four rows of high density MacIntosh apple trees at the Pacific Agri-Food Research Centre, Summerland, BC were each treated with Virosoft CP4® alone at 239 ml/ha (original preparation: $4x10^{13}$ occlusion bodies/946.34 ml), Virosoft CP4® 239 ml/ha + mineral oil at 2L/ha, Virosoft CP4® 239 ml/ha + fish oil at 2L /ha or Virosoft CP4® 239 ml/ha + once descummed soybean oil at 2.5 L/ha, 17 June, 2004 using an air-blast sprayer set to deliver a volume of 1,553.6 L/ha. A block of untreated trees separated by >10 trees in the same orchard was used as the control. Ten apples were randomly collected from each treatment and the control at least two hours after application of treatments on day 0, as well as 1, 2, 5, 7, and 10 days post-treatment. The entire trial was replicated on 28 June on different blocks of trees within the same orchard. Five neonate codling moth were placed on each collected apple. The apples were confined within plastic cups and incubated at 24°C for seven days before codling moth mortality was assessed by cutting open the fruit. Percent mortalities were arcsine transformed before an analysis of variance of the data and comparison of the means using Tukey's Studentized range test for each day of collection.

RESULTS: The virus treatments had a significant effect on survival of codling moth larvae ($F_{4, 25} = 32.2$, $P < 0.001$). Significantly fewer living codling moth larvae were found in apples collected two hours, one day, and five days post-treatment from trees treated with Virosoft CP4® alone, or in combination with any of the oils, than in the control apples. In apples collected two, seven and ten days post-treatment, this difference was not significant (Table 1). Although the mean numbers of live codling moth larvae per apple in Virosoft CP4® treatments in combination with an oil was lower on days 0 and 1, the numbers were not significantly lower than those in the Virosoft CP4® treatment alone.

CONCLUSION: The addition of fish, soybean or mineral oils to Virosoft CP4® treatments did not significantly increase the efficacy or persistence of the viral insecticide on apples in this study.

Table 1. Mean (± SE) number of live codling moth larvae per apple after 7 days when neonates were placed on fruit treated with Virosoft CP4® combined with one of three oils, or nothing. Replicated twice; n = 10 apples; 5 codling moth larvae per apple.

Days post treatment	Mean (± SE) number of live codling moth larvae per apple per treatment				
	Virosoft CP4®	Virosoft CP4®+ Superior 70 oil	Virosoft CP4®+ Fish oil	Virosoft CP4®+ Soybean oil	Control
0 (2h)	1.1 ± 0.4 a[1]	0.6 ± 0.1 a	0.3 ± 0.2 a	0.3 ± 0.2 a	3.9 ± 0.5 b
1	1.2 ± 0.3 a	0.7 ± 0.1 a	1.1 ± 0.3 a	0.7 ± 0.2 a	3.7 ± 0.5 b
2	1.8 ± 0.5 a	1.8 ± 0.5 a	1.1 ± 0.1 a	1.6 ± 1.0 a	3.5 ± 0.1 a
5	2.0 ± 0.7 a	1.6 ± 0 a	2.0 ± 0.2 a	1.9 ± 0.2 a	3.9 ± 0.4 b
7	2.4 ± 0.7 a	1.9 ± 0.5 a	2.2 ± 0.7 a	2.0 ± 0.1 a	3.1 ± 0.9 a
10	2.0 ± 0.2 a	1.9 ± 0 a	2.3 ± 0.4 a	2.0 ± 0.5 a	3.1 ± 0.4 a

[1] means within rows followed by the same letter are not significantly different ($P > 0.05$) as determined with Tukey's studentized range test.

2005 PMR REPORT #46

SECTION H: PEST MANAGEMENT METHODS – BIOLOGICAL CONTROL – Insects
ICAR: 33331596

LIVESTOCK: Dairy cattle
PEST: House fly, *Musca domestica* L.; Stable fly, *Stomoxys calcitrans* (L.)

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TITLE: **WASPS PARASITIC ON FLIES AFFECTING DAIRY CATTLE IN PRINCE EDWARD ISLAND**

MATERIALS: Field-collected pupae of *M. domestica*

METHODS: House fly and stable fly are pests that breed in rotting organic material associated with dairy cattle. Both species of flies share a common guild of parasitic wasps, including species that have been, or could be, commercialized as bio-control agents. Surveys in Alberta, Manitoba and Ontario/Quebec show regional differences in the species composition of this parasitoid guild (Floate et al. 2002; Gibson and Floate 2004). These differences identify species that potentially could be introduced into different geographical regions of the country to improve levels of parasitism. However, there is virtually no information on the parasitoid species affecting these pest flies in Atlantic Canada.

To identify endemic species of wasps parasitic on pupae of house fly and stable fly, a two-year survey was performed on dairies in Prince Edward Island. Fly pupae were collected from July through October, inside and outside of barns from areas of spilled feed, calf pens, and moist areas adjacent to water troughs. Pupae were placed individually in containers and held at room temperature for six to eight weeks for the emergence of parasitic wasps. Emerged wasps were identified by GAP Gibson.

RESULTS: A total of 10 060 fly pupae from six farms were collected in 2003, and 36 992 pupae from five farms in 2004 (Tables 1-2). Of these totals, 510 and 377 pupae were parasitized giving an overall 5% and 1% parasitism rate in 2003 and 2004 respectively. *Phygadeuon fumator* were most common, representing 48 and 47 percent of the total number of individuals recovered in 2003 and 2004 respectively. *Muscidifurax raptor* were next most common, comprising 22 and 21 percent of the individuals recovered in 2003 and 2004, respectively. *Spalangia cameroni* and *A. pallipes* were recovered only in 2003. Dissection of fly pupae from which neither flies nor wasps had emerged after six to eight weeks identified an additional 160 cases of parasitism in 2003, and 207 cases in 2004. The majority of these unemerged wasps were *P. fumator*.

CONCLUSIONS: Results of the current survey identify low levels of parasitism and species diversity for the guild of wasps parasitic on house fly and stable fly on dairies in PEI. Parasitism was less than 1 percent on most farms with only six species of wasps recovered. By comparison, 14 species were recovered in Ontario/Quebec, ten species in Manitoba, and 13 species in Alberta, in previous surveys using similar methods (Floate et al. 2002; Gibson and Floate 2004). *Trichomalopsis sarcophagae* (Gahan) and *Muscidifurax zaraptor* Kogan & Legner are relatively common in Alberta and *Spalangia nigra* Latreille and

S. nigroaenea Curtis are relatively common in Ontario/Quebec, but were absent in PEI. These combined results suggest the possible introduction of species common in other regions of Canada into PEI to increase overall levels of fly parasitism.

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Gibson, G.A.P. and K.D. Floate. 2004. Filth fly parasitoids on dairy farms in Ontario and Quebec, Canada. Canadian Entomologist 136:407-417.31.

Table 1. Recovery of wasps from fly pupae collected on six dairy farms in Prince Edward Island in 2003. Numbers without brackets identify specimens emerging from fly pupae. Numbers in brackets identify specimens dissected from fly pupae.

Species	MacPhail	MacBeath	McIsaac	Weeks	Wood	Wyand	Total
Spalangia cameroni.	-	5	-1	-	61 (32)	3 (1)	69 (34)
Urolepis rufipes	-	-	80	-	-	3 (10)	83 (10)
Muscidifurax raptor	-	1	105 (8)	-	1	4	111 (8)
Phygadeuon fumator	-	29	171 (36)	25 (20)	7 (10)	12	244
Aphaereta pallipes	-	-	1	-	-	-	1
Trichomalopsis sp.	-	-	3	-	-	-	3
Species unknown	-	-5	1 (37)	-	-	-	3 (42)
Total	-	35 (5)	361 (82)	25 (20)	69 (42)	22 (11)	514
Parasitism (%)		1.6	14	4.3	4.7	3.6	6.7

Table 2. Recovery of wasps from fly pupae collected on five dairy farms in Prince Edward Island in 2004. Numbers without brackets identify specimens emerging from fly pupae. Numbers in brackets identify specimens dissected from fly pupae.

Species Name	MacBeath	McIsaac	Weeks	Wood	Wyand	Total
Spalangia cameroni	-	-	-	-	-	0
Urolepis rufipes	-	8 (1)	-	-	1	9 (1)
Muscidifurax raptor	-	26 (3)	1	-	32 (22)	59 (25)
Phygadeuon fumator	1 (17)	90 (71)	2 (2)	-	-	93 (91)
Aphaereta pallipes	-	-	-	-	-	-
Trichomalopsis	1	6 (1)	-	-	-	7 (1)
Unidentified	-	-11	-1	-	-24	-36
Unidentified larvae	-7	-44	-	-	-2	-53
Total	2 (24)	130 (131)	3 (3)	-	33 (48)	168 (207)
Parasitism (%)	0.5	3	0.07	-	0.08	1

RAPPORT #47 **SECTION I: ENQUÊTES PHYTOSANITAIRES ET INFESTATIONS**
IRAC: 87000242

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

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TITRE: **LES RAVAGEURS DES VERGERS DE POMMIERS DU QUÉBEC EN 2003 ET 2004/2005**

MÉTHODES: Dans dix vergers de pommiers commerciaux et un verger à régie biologique, une parcelle de 1-2 ha a été mise à la disposition du Réseau d'avertissements phytosanitaires du Québec pour dépister les insectes et acariens nuisibles aux pommiers et évaluer leur importance. Dans chacun de ces vergers pilotes, le dépistage des lépidoptères a été réalisé à l'aide de pièges à phéromones sexuelles Phérocon ou Multi-pher. Pour chaque lépidoptère, deux pièges ont été disposés de part et d'autre du centre de la parcelle. Pour dépister la punaise terne et l'hoplocampe des pommes, deux cartons blancs englués (15 x 20 cm) ont été placés dans les pommiers, respectivement à 70 et 150 cm au-dessus du sol à chacun des coins de la parcelle. Le charançon de la prune a été dépisté grâce à quatre pièges pyramidaux (Tedders, 1994) (122 cm x 55 cm à la base) par verger disposés à chacun des coins de la parcelle, au pied du premier arbre de chaque extrémité des rangées extérieures. Une pièce collectrice en entonnoir surmontée d'un cylindre collecteur en plastique transparent était installée au sommet du piège pour capturer les adultes de cette espèce. La mouche de la pomme a été dépistée à l'aide de sphères rouges engluées et placées dans un pommier à chacun des coins de la parcelle. Les pièges ont été installés avant le début de la période d'activité des insectes concernés soit entre le 4 avril et le 6 juin 2005. La présence et le nombre d'insectes capturés ont été relevés à toutes les semaines jusqu'à la fin de la période d'activité des insectes, le dernier relevé ayant été effectué le 28 septembre 2005. Les pièges collants ont été nettoyés ou remplacés au besoin et les diffuseurs à phéromone ont été remplacés à toutes les 4 ou 5 semaines. Les dommages à la récolte ont été évalués dans chacune des parcelles à la fin août ou au début de septembre en échantillonnant 500 pommes récoltées aléatoirement dans 50 à 100 arbres. Ce bilan reflète la situation générale des ravageurs observés dans l'ensemble des régions pomicoles du Québec.

RÉSULTATS: Voir les tableaux ci-dessous.

CONCLUSIONS: Les captures de carpocapse de la pomme dépassaient de 2 fois à 3 fois la normale (moyenne de 40 captures) dans les vergers de Franklin, Saint-Bruno de Montarville et Saint-Paul d'Abbotsford, et dépassaient de 6 fois les captures normales pour le verger de Rougemont. Pour l'ensemble des vergers pilotes les captures moyennes de 2005 dépassaient de 1,8 fois les captures normales. Ces captures élevées se sont reflétées sur les dommages qui ont atteint 0.3%, le niveau le plus élevé depuis 1991. Les captures de tordeuses à bandes obliques ont dépassé de 1,6 fois les captures normales dans le verger de Saint-Paul d'Abbotsford (237 captures) mais ont été sous la normale dans les autres vergers. Les dégâts occasionnés par les tordeuses et autres chenilles dans les vergers commerciaux correspondaient à 30 % du total des dégâts d'insectes, elles demeurent des ravageurs importants de la pomme au les dégâts (0,5%) du charançon de la prune ont été plus abondants que la normale dans les

vergers commerciaux et ont constitué le principal problème dans le verger biologique avec 24% du total des dégâts d'insectes. Les captures de mineuses marbrées , de noctuelles du fruit vert, de punaises ternes, de sésies du cornouiller et de tordeuses à bandes rouges et les dégâts des punaises étaient en moyenne égaux ou inférieurs à la normale. Les dégâts de mouches de la pomme et d'hoplocampes des pommes étaient plus élevés que la normale malgré des captures proches de la normale. Les dégâts totaux d'insectes dans les vergers commerciaux (5.0%) ont été équivalents à la normale (moyenne des 14 dernières années).

RÉFÉRENCE: Tedders, W. L. et B. W. Wood. 1994. A new technique for monitoring pecan weevil emergence (Coleoptera: Curculionidae). J. Entomol. Sci. 29(1):18-30.

Tableau 1. Total des captures d'adultes par piège dans les vergers-pilotes du Québec en 2005.

	Ravageurs[1]									
Vergers	CARPO	CHA	HOP	MIN	MOU	NFV	PUN	SEC	TBO	TBR
Compton	27		16.5	3178	9.3	22	2.5	6	11	520
Dunham	20		10.8	13952	3.0	17	4.6	6	34	290
Franklin	105	0.0	3.3	13056	1.5	410	2.0	26	123	235
Hemmingford	18	0.8	55.3	13780	2.5	200	3.0	4	86	366
Oka	12		0.3	3628	1.8	42	10.8	32	21	82
Rougemont	274	0.3	0.0	43349	1.3	113	3.5	3	79	93
Saint-Bruno de Montarville	131	2.0	19.3	4804	40.0	144	5.0	5	140	160
Sainte-Famille (I.O.)	3		6.5	2540	0.0	2	3.0	0	20	51
Saint-Joseph-du-lac	11		2.0	4188	0.5	25	3.3	14	30	53
Saint-Paul d'Abbotsford	120	0.3	0.8	30497	0.8	110	6.5	40	237	238
Verger biologique[2]	49	2.8	77.3	19931	5.5	93	1.5	2	38	278
Cumul Moyen (v. commerciaux)	72	0.7	11.5	13297	6.1	108	4.4	13	78	209
Normale moyenne (v. commerciaux)	40	0.5	11.1	20202	5.9	150	4.4	41	147	389
Période de dépistage	25 avril - 28 sept	18 avril - 18 juillet	25 avril - 20 juin	11 avril - 28 sept	6 juin - 28 sept	4 avril - 6 juin	4 avril - 13 juin	16 mai - 28 sept	16 mai - 28 sept	4 avril - 28 sept
Type de piège[4]	MP-1	PyrN	C B E	MP-2	S R E	MP-1	C B E	MP-3	PH-1C	MP-3
Phéromone	Trécé			Trécé		Scentry		Scentry	Trécé	Trécé

Tableau 2. ommages à la récolte (%) dans les vergers-pilotes du Québec en 2005.

	Ravageurs[1]							
Vergers	CARPO	CHA	HOP	MIN	MOU	NFV	PUN	SEC
Compton	27		16.5	3178	9.3	22	2.5	6
Dunham	20		10.8	13952	3.0	17	4.6	6
Franklin	105	0.0	3.3	13056	1.5	410	2.0	26
Hemmingford	18	0.8	55.3	13780	2.5	200	3.0	4
Oka	12		0.3	3628	1.8	42	10.8	32
Rougemont	274	0.3	0.0	43349	1.3	113	3.5	3
Saint-Bruno de Monta	131	2.0	19.3	4804	40.0	144	5.0	5
Sainte-Famille (I.O.)	3		6.5	2540	0.0	2	3.0	0
Saint-Joseph-du-lac	11		2.0	4188	0.5	25	3.3	14
Saint-Paul d'Abbotsfo	120	0.3	0.8	30497	0.8	110	6.5	40
Verger biologique[2]	49	2.8	77.3	19931	5.5	93	1.5	2
Cumul Moyen (v. com	72	0.7	11.5	13297	6.1	108	4.4	13
(± E.S.)	(82)	(0.7)	(16.0)	(12909)	(11.6)	(118)	(2.5)	(13)
Normale moyenne (v.	40	0.5	11.1	20202	5.9	150	4.4	41
(± E.S.)	(37)	(0.7)	(12.5)	(18626)	(4.5)	(54)	(1.5)	(36)
Période de dépistage	25 avril -	18 avril -	25 avril -	11 avril -	6 juin -	4 avril -	4 avril -	16 mai -
	28 sept	18 juillet	20 juin	28 sept	28 sept	6 juin	13 juin	28 sept
Type de piège[4]	MP-1	PyrN	C B E	MP-2	S R E	MP-1	C B E	MP-3
Phéromone	Trécé			Trécé		Scentry		Scentry

1 CARPO: Carpocapse de la pomme; CHA: Charançon de la prune; HOP: Hoplocampe des pommes; MIN: Mineuse marbrée; MOU: Mouche de la pomme; NFV: Noctuelle du fruit vert; PUN: Punaise terne; SEC: Sésie du cornouiller; TBO: Tordeuse à bandes obliques; TBR: Tordeuse à bandes rouges; CHE: Chenilles; APP: Autres punaises phytophages;

2 Verger situé à Henryville.

3 Normales basées sur 10 ans en date du 28 septembre 2005

4 PH-1C= Phérocon 1C; C B E= Carton blanc englué; MP - 1., 2 ou 3= Multi-pher (1, 2 ou 3); S R E= sphère rouge engluée; PyrN: piège pyramidal noir en bois.

5 Dégâts observés dans 9 vergers, les dégâts du verger de Saint-Bruno de Montarville ne font pas partie de la compilation.

2005 PMR REPORT # 48

SECTION I: SURVEYS and OUTBREAKS - Insects and mites
ICAR: 44010309

CROP: Canola (*Brassica napus* and *B. rapa*), oats, wheat and barley
PEST: *Candidatus Phytoplasma asteris* (Aster yellows phytoplasma)

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TITLE: SURVEY OF ASTER YELLOWS DISEASE IN CANOLA AND CEREAL CROPS IN SASKATCHEWAN, CANADA, 2001-2005.

MATERIALS: An average of 40 canola fields (*Brassica napus* L. and *B. rapa* L.) and 20 barley, oats and wheat fields located throughout Saskatchewan were visited and sampled each year. Universal phytoplasma-specific primer pairs R16R2/R16F2 (Lee *et al*. 1993; Phytopathology 83:834–842) and P1/P6 (Schneider *etal*. 1995; In Molecular and diagnostic procedures in mycoplasmology. Vol. 1. S. Razin and J.G. Tully, eds. Academic Press, San Diego. pp. 369–380) were used for PCR analysis.

METHODS: Twice a month, 20 sweeps were taken at the field edge and at 5, 10, 20 and 50 m from the field edge in each field. Leafhoppers were identified, counted and stored at -20ºC. In mid-August, a visual assessment of Aster Yellows (AY) incidence (% of plants showing AY symptoms) was made for each field and 20 asymptomatic plants were harvested randomly at each sampling site. PCR tests were performed on leaf and stem tissues and on leafhoppers to detect the presence of phytoplasma. Leafhoppers known to be phytoplasma vectors or carriers were tested individually while the other species were tested in groups of 5 to 10 specimens. DNA sequencing was performed on twenty canola plants that tested positive for phytoplasma each year in 2003-2005.

RESULTS: (Table 1 and 2). Out of 42 leafhopper species trapped in the sweeps, individuals from 15 species tested positive for the presence of phytoplasmas at least once during the past five years. *Macrosteles quadrilineatus* F., considered to be the main vector of AY phytoplasma, was found in high numbers with frequency of infection decreasing from 2001 to 2005. *Ceratagalia humilis* O., known to be a phytoplasma carrier, and *Amplicephalus inimicus* S., known to be a phytoplasma vector, were found in low numbers with frequency of infection also decreasing from 2001 to 2005. *Neokolla hieroglyphica* S., *Scaphytopius acutus* S., *Balclutha* spp., *Gyponana* spp. and *Psammotettix* spp., known to be phytoplasma carriers or vectors, and *Euscelis maculipennis* D&D., *Chlorotettix* spp, *Diplocolenus configuratus* U., *Extrusus extrusanus* Van D., *Sorhoanus ulheri* O. and *Verdanus evansi* A., which are not known to be phytoplasma carriers or vectors, showed only 1-3 infected specimens per species in the past five years. During 2001–2005, the frequency of canola plants showing AY symptoms was less than 1%, and no oats, barley or wheat plants showed AY symptoms. However, PCR tests performed on canola and cereal plants showed high percentages of phytoplasma infected plants. DNA sequencing confirmed the presence of AY phytoplasma, strain 16SrI-A and B in canola plants.

CONCLUSIONS: The results of the field surveys revealed that the AY phytoplasma is present in a large proportion of asymptomatic plants in canola and cereal fields in Saskatchewan. Among the potential vector/carrier leafhopper species, *M. quadrilineatus* was most commonly found in Saskatchewan and had the largest proportion of infected individuals.

Table 1: Frequency of infection in each species/genus of leafhoppers trapped in the field and at the field edge, which tested positive for phytoplasma at least once in 2001-2005.

Leafhopper species	No. of infected leafhopper / Total no. of tested leafhoppers				
	2001	2002	2003	2004	2005
Macrosteles quadrilineatus	305/3625	78/1752	43/2228	30/693	10/445
Athysanus argentarius	0/83	0/132	0/193	2/55	0/51
Balclutha spp	0/266	0/168	0/254	2/146	0/104
Ceratagalia humilis	6/61	1/282	6/335	1/42	0/21
Chlorotettix spp	0/34	0/7	0/31	2/2	0/6
Diplocolenus configuratus	1/14	1/27	2/16	1/21	0/9
Endria inimica	2/50	1/61	1/99	6/80	(-)[1]
Euscelis maculipennis	3/10	0/2	(-)	(-)	(-)
Extrusanus extrusus	0%	(-)	(-)	1/1	(-)
Gyponana spp	1/2	(-)	(-)	(-)	(-)
Neokolla hieroglyphica	1/3	(-)	(-)	(-)	(-)
Psammotettix spp	1/80	2/60	0/24	0/44	0/43
Scaphytopius acutus	0/15	1/5	0/1	0/2	(-)
Sorhoanus ulheri	0/81	1/37	0/23	0/25	0/39
Verdanus evansi	0/683	0/631	0/106	1/76	0/61

(-)[1]: No leafhopper trapped

Table 2: Frequency of phytoplasma infection in canola, oats, barley and wheat assessed with PCR.

	No. of infected plants/Total no. of tested plants			
	2002	2003	2004	2005
Canola	4/20	1/120	12/161	25/539
Barley	ND[1]	ND	5/26	12/231
Wheat	ND	ND	12/20	16/149
Oats	ND	ND	1/25	7/98

ND[1]: Not Done

2003 PMR REPORT # 49

SECTION K: FRUIT - Diseases
STUDY DATA BASE 402-1531-8605

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

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TITLE: **EVALUATION OF PYRIMETHANIL FOR CONTROL OF POST-HARVEST BLUE AND GRAY MOLD DECAY OF APPLES, 2002**

MATERIALS: MERTECT (thiabendazole 45%), PENBOTEC (pyrimethanil 40% w/v)

METHODS: Gala apples harvested from a commercial orchard were stored in air storage at 1± 0.2°C until December 18, 2002. Apples were removed from air storage, wounded in triplicate using an alcohol sterilized 3 mm diameter nail embedded in cork, so that wounds of uniform width and depth would be made in each apple. Wounded apples were dipped for two minutes in spore suspensions amended with 0.5% Tween 20: *Penicillium expansum* isolate 1790 (thiabendazole-resistant) 3 x 10^4 conidia /ml, *Botrytis cinerea* isolate B-27 2 x 10^4 conidia/ml, or a sterile distilled water control. Wounded and dipped apples were allowed to dry. Five replicate samples of ten apples each were placed in mesh bags for subsequent fungicide treatment. Treatments were applied twelve hours after wounding and dip inoculation. The various fungicide treatment rates (Tables 1 and 2) were prepared in 10 L volumes in 20 L plastic tubs with lids. Apples were dipped for sixty seconds in the fungicide solutions, allowed to drain, and returned to cold air storage. On February 11, 2003, treated apples were removed from storage for a two-month storage examination. Apples were assessed for number of wounds and number of fruit with decay. Data were analyzed statistically using the SAS GLM, LSMeans procedures.

RESULTS: As outlined in Tables 1 and 2.

CONCLUSIONS: PENBOTEC is a very effective post-harvest fungicide for the control of both gray and blue mold of apples. In this trial PENBOTEC at the rate of 250 ppm a.i. completely controlled both gray and blue mold and was more effective than MERTECT for the control of blue mold caused by a thiabendazole-resistant isolate of *P. expansum*.

Table 1. Mean percentage of wounds showing gray or blue mold decay for wounded inoculated apple fruit treated with MERTECT or PENBOTEC dip after two months air storage at 1 °C.

Treatment		% wounds with decay[1]	
	Rate ppm a.i.	Gray mold	Blue mold
Untreated Control		35.7 b[2]	16.3 b
MERTECT	450	7.0 a	19.3 b
PENBOTEC	250	0.0 a	0.0 a
PENBOTEC	750	0.0 a	0.0 a
PENBOTEC	1500	0.0 a	0.0 a
Standard error *p*= 0.05		± 6.4	± 4.1

[1] Mean of five replicates of 10 apples per replicate. Each apple was wounded in triplicate, then dip inoculated with *Botrytis cinerea* or *Penicillium expansum*.

[2] Numbers followed by the same letter are not statistically different at the *p*=.05 level.

Table 2. Mean percent of fruit with gray or blue mold decay for Gala apples treated with MERTECT or PENBOTEC dip and stored for two months in air storage at 1 °C.

Treatment		% fruit with decay[1]	
	Rate ppm a.i.	Gray mold	Blue mold
Untreated Control		48.0 b[2]	35.0 b
MERTECT	450	18.0 a	32.0 b
PENBOTEC	250	0.0 a	0.0 a
PENBOTEC	750	0.0 a	0.0 a
PENBOTEC	1500	0.0 a	0.0 a
Standard error *p*= 0.05		± 8.6	± 7.6

[1] Mean of five replicates of 10 apples per replicate. Each apple was wounded in triplicate, then dip inoculated with *Botrytis cinerea* or *Penicillium expansum*.

[2] Numbers followed by the same letter are not statistically different at the *p*=.05 level.

2005 PMR Report #50

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.21

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

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TITLE: **EVALUATION OF PENBOTEC™ 400 SC (LAG 2002 259) FOR THE POST-HARVEST CONTROL OF BLUE MOLD AND GRAY MOLD IN 'EMPIRE' APPLES, 2004-05.**

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

METHODS: PENBOTEC 400 SC (pyrimethanil) was compared with thiabendazole (TBZ) for efficacy against gray mold of apple caused by *Botrytis cinerea* and blue mold of apple caused by *Penicillium expansum*. Experiments were conducted at the research Centre in Vineland, Ontario. All fruits were stored at 1– 4 ºC until used in experimental treatments. Apples were harvested on October 10 and the experiment was conducted on December 17, 2004. Apples were disinfested in 10% household bleach (5% sodium hypochlorite) and 0.01% Tween 20 (Fisher Scientific) for 4 min and rinsed in reverse osmosis water for 4 min. After disinfestation, 24 apples were placed on a plastic packing insert (24 fruit master) contained in a plastic box. 4 replicates, with 12 fruits for each replicate were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-sensitive *B. cinerea* isolate BC-2A, TBZ-resistant *B. cinerea* isolate BC-8D, TBZ-sensitive *P. expansum* P24-7AS and TBZ-resistant *P. expansum* isolate PS-2R at a concentration of 1 x 10^5 conidia/ml and incubate at 12 ºC for 18-24 hours and then treated with fungicide treatments. Drench treatment included mixing appropriate amount of PENBOTEC 400 SC concentration in water and pouring on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. The treatments were completely randomized. Treated apples were incubated at 2 (± 2) ºC for 3 and 6 months. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation at 2 (± 2) 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). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

Results: As outlined in Tables 1 and 2.

Conclusions: The reduced risk fungicide, PENBOTEC 400 SC, at concentrations of 0.29 g/L or higher effectively controlled blue mold in 'Empire' apples after 3 months in cold storage and an increase of disease incidence was observed after 6 months (Table 1). Higher disease was observed in the treatments incubated in the shelf-life study than in the cold storage. High blue mold disease incidence (100%) was observed in the untreated and inoculated control. As expected, MERTECT did not control blue mold caused by thiabendazole-resistant *P. expansum*.
PENBOTEC was also effective against gray mold in 'Empire' apples (Table 2). The concentration of 0.15 g/L controlled the disease after 3 months in cold storage and an increase of disease incidence was observed after 3 months. Concentrations of 1.16 gave 98 % control of gray mold in cold storage. In summary, PENBOTEC 400 SC at concentrations of 1.16 g/L gave control of blue mold and gray mold in 'Empire' apples.

Table 1. Mean percentage incidence of blue mold (*Penicillium expansum*) after post-harvest treatment of PENBOTEC 400 SC on apple cv. Empire, 2004-05.

Treatment	% blue mold incidence in cold storage at 2 (± 2) ºC [a]									
	3 months		4 months		5 months		6 months		6 months + 6 days at 20°C	
	TBZ-S	TBZ-R	TBZ-S	TBZ-R	TBZ-S	TBZ-R	TBZ-S	TBZ-R	TBZ-S	TBZ-R
Inoculum only	100.0 c[b]	100.0 d	100.0 e	100.0 d	100.0 e	100.0 e	100.0 f	100.0 e	100.0 e	100.0 e
PENBOTEC @ 0.04 g/L	100.0 c	100.0 d	100.0 e	100.0 d	100.0 e	100.0 e	100.0 f	100.0 e	100.0 e	100.0 e
PENBOTEC @ 0.08g/L	100.0 c	100.0 d	100.0 e	100.0 d	100.0 e	100.0 e	100.0 f	100.0 e	100.0 e	100.0 e
PENBOTEC @ 0.15 g/L	29.2 c	20.8 c	50.0 d	37.5 c	66.7 d	70.8 d	87.5 e	70.8 d	95.8 d	83.3 c
PENBOTEC @ 0.29 g/L	8.3 b	12.5 b	29.2 c	37.5 c	66.7 d	66.7 c	83.3 d	87.5 b	91.7 c	95.8 d
PENBOTEC @ 0.58 g/L	0.0 a	0.0 a	16.7 b	16.7 b	54.2 c	54.2 b	75.0 c	62.5 c	95.8 d	79.2 b
PENBOTEC @ 1.16 g/L	0.0 a	0.0 a	2.8 a	8.3 a	7.5 b	8.3 a	12.5 b	12.5 a	49.2 b	41.7 a
MERTECT @ 1.15 g/L	0.0 a	100.0 d	0.0 a	100.0 d	0.0 a	100.0 e	0.0 a	100.0 e	0.0 a	100

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

Table 2. Mean percentage incidence of gray mold (*Botrytis cinerea*) after post-harvest treatment of PENBOTEC 400 SC on apple cv. Empire, 2004-05.

Treatment	% gray mold incidence in cold storage at 2 (± 2) ºC [a]									
	3 months		4 months		5 months		6 months		6 months + 6 days at 20 °C	
	TBZ-S	TBZ-R	TBZ-S	TBZ-R	TBZ-S	TBZ-R	TBZ-S	TBZ-R	TBZ-S	TBZ-R
Inoculum only	100.0 e [b]	100.0 f	100.0 e	100.0 e	100.0 d	100.0 e	100.0 f	100.0 e	100.0 f	100.0 e
PENBOTEC @ 0.04 g/L	100.0 e	100.0 f	100.0 e	100.0 e	100.0 d	100.0 e	100.0 f	100.0 e	100.0 f	100.0 e
PENBOTEC @ 0.08 g/L	95.8 e	92.0 e	100.0 e	92.0 d	100.0 d	95.8 e	100.0 f	95.8 e	100.0 f	95.8 e
PENBOTEC @ 0.15 g/L	16.7 c	66.7 d	50.0 d	70.5 c	45.8 b	83.3 d	54.2 e	91.7 d	62.5 d	91.2 d
PENBOTEC @ 0.29 g/L	0.0 a	58.3 c	29.2 c	62.5 b	4.2 a	65.5 c	29.2 d	75.0 c	41.7 c	75.8 b
PENBOTEC @ 0.58 g/L	4.2 b	37.5 b	16.7 b	45.8 a	4.2 a	58.3 b	16.7 c	62.5 b	29.2 b	83.3 c
PENBOTEC @ 1.16 g/L	0.0 a	4.8 a	4.8 a	4.8 a	4.2 a	5.2 a	12.5 b	24.2 a	66.7 e	54.2 a
MERTECT @ 1.15 g/L	0.0 a	100.0 f	0.0 a	100.0 e	0.0 a	100.0 e	0.0 a	100.0 e	0.0 a	100

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

2005 PMR Report #51

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.21

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

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TITLE: **EVALUATION OF PENBOTEC™ 400 SC (LAG 2002 259) FOR THE POST-HARVEST CONTROL OF BLUE MOLD AND GRAY MOLD IN 'MCINTOSH' APPLES, 2004-05.**

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

METHODS: PENBOTEC 400 SC (pyrimethanil) was compared with MERTEC (thiabendazole; TBZ) for efficacy against gray mold of apples caused by *Botrytis cinerea* and blue mold of apple caused by *Penicillium expansum*. Experiments were conducted at the research Centre in Vineland, Ontario. All fruits were stored at 1– 4 ºC until used in the experimental treatments. McIntosh apples were harvested on October 1, 2004 and the experiment was conducted on March 10, 2005. Apples were disinfested in 10% household bleach (5% sodium hypochlorite) and 0.01% Tween 20 (Fisher Scientific) for 4 min and rinsed in reverse osmosis water for 4 min. After disinfestation, 24 apples were placed on a plastic packing insert (24 fruit master) contained in a plastic box. 4 replicates, with 12 fruits for each replicate were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-resistant *B. cinerea* isolate BC-8D and TBZ-resistant *P. expansum* isolate PS-2R at a concentration of 1 x 10^5 conidia/ml and incubate at 12 ºC for 18-24 hours and then treated with fungicide treatments. Drench treatment included mixing appropriate amount of PENBOTEC 400 SC concentration in water and poured on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. The treatments were completely randomized. Treated apples were incubated at 2 (± 2) ºC for 3 months. The fruit were evaluated for blue and gray mold incidence (percent infected apples). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: As outlined in Tables 1 and 2.

CONCLUSIONS: The reduced risk fungicide, PENBOTEC 400 SC at concentrations of 1.16 g/l effectively controlled blue mold in 'McIntosh' apples after 3 months in cold storage and an increase of disease incidence was in Shelf-life (Table 1). High blue mold disease incidence (100%) was observed in the untreated and inoculated control. As expected, MERTECT did not control blue mold caused by thiabendazole-resistant *P. expansum*. PENBOTEC was also controlled gray mold in 'McIntosh' apples (Table 2). The concentration of 1.16 g/l controlled 95% of the disease after 3 months in cold storage and an increase of disease incidence was observed in shelf-life. In summary, PENBOTEC 400 SC at concentrations of 1.16 g/L control of blue mold and gray mold in 'McIntosh' apples.

Table 1. Mean percentage incidence of blue mold (*Penicillium expansum*) after post-harvest treatment of PENBOTEC 400 SC on apple cv. McIntosh, 2004-05.

Treatment	% blue mold incidence in cold storage at 2 (± 2) ºC [a]	
	3 months	3 months + shelf-life
Inoculum only	100.0 d [b]	100.0 c
PENBOTEC @ 0.04 g/L	100.0 c	100.0 c
PENBOTEC @ 0.07 g/L	100.0 c	100.0 c
PENBOTEC @ 0.15 g/L	100.0 c	100.0 c
PENBOTEC @ 0.29 g/L	100.0 b	100.0 c
PENBOTEC @ 0.58 g/L	90.8 a	100.0 c
PENBOTEC @ 1.16 g/L	13.3 a	85.8 a
MERTECT @ 1.15 g/L	100.0 d	100

[a] Data represent the mean of 4 replicates, and 12 apples/replicate.

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

Table 2. Mean percentage incidence of gray mold (*Botrytis cinerea*) after post-harvest treatment of PENBOTEC 400 SC on apple cv. McIntosh , 2004-05.

Treatment	% gray mold incidence in cold storage at 2 (± 2) ºC [a]	
	3 months	3 months + shelf-life
Inoculum only	100.0 e[b]	100.0 e[b]
PENBOTEC @ 0.04 g/L	100.0 e	100.0 e
PENBOTEC @ 0.07 g/L	100.0 e	100.0 e
PENBOTEC @ 0.15 g/L	47.6 d	61.9 d
PENBOTEC @ 0.29 g/L	33.3 c	47.6 c
PENBOTEC @ 0.58 g/L	9.5 b	29.5 b
PENBOTEC @ 1.16 g/L	4.8 a	23.8 a
MERTECT @ 1.15	100.0 e	100.0 e

[a] Data represent the mean of 4 replicates, with 12 apples/replicate.

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

2005 PMR Report #52

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.63

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

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TITLE: EVALUATION OF FUNGICIDES FOR THE POST-HARVEST CONTROL OF BLUE MOLD AND GRAY MOLD IN 'GINGERGOLD' AND 'HONEYCRISP' APPLES, 2004-05.

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

METHODS: A trial was conducted to test the efficacy of post-harvest fungicides, BIOSAVE (*Pseudomonas syringae*), MERTECT 500SC (thiabendazole 45%), and SCHOLAR (50% fludioxonil) to control blue mold and gray mold in'Gingergold' and 'Honeycrisp' apples. The trial was conducted at SCPFRC, AAFC, Vineland Station. Apples were harvested on September 25, 2004 and treated on October 8, 2004. Apples were placed on a plastic packing insert (fruit master) contained in a plastic box. Each box represents a treatment replication and three replicate trays were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-resistant *Penicillium expansum* isolate PS-1R or TBZ-resistant *B cinerea* isolate BC-8D at a concentration of 1 x 10^5 conidia/ml and incubated at 12°C for 18-24 hours and then treated with fungicide treatments. The drench application consisted of mixing appropriate amount of fungicides concentration in water and poured on to wounded and inoculated fruit for 20 seconds or until the fruit was completely drenched. Untreated check had no fungicides. The treatments were completely randomized. Treated apples were incubated at 4°C for 3 months. Apples in each of the experiments were evaluated for decay after the respective incubation period. To determine the efficacy of fungicides on the shelf-life of the fruit, following incubation at 4°C, the fruits were moved to 20°C, 85% RH and incubated for 6 days. The fruits were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion developed on the fruit. The data obtained was analyzed with SigmaStat statistical package. Analysis of variance were determined by using appropriate transformations and significance between means were separated by the Tukey test.

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

CONCLUSIONS: In a time course study, SCHOLAR (fludioxonil) gave 90% control of blue mold up to 90 days in cold storage in 'Gingergold' apples. In cold storage + shelf-life study, 34.4 % disease was observed. Control of gray mold was observed up to 62 days. BIOSAVE was not effective as a post-inoculation treatment. In 'Honeycrisp' apples SCHOLAR (fludioxonil) gave 100% control of blue mold up to 62 days and disease increased afterwards (Table 3). Complete control of gray mold was observed upto 62 days after inoculation and a slight increase was observed after 93 days and in the subsequent shelf-life study. As expected, MERTECT was ineffective against blue mold caused by the TBZ-resistant *P. expansum* (Tables 1, 3) and gray mold caused by *B. cinerea* in both cultivars (Tables 2,4).

Table 1. Effect of fungicides on blue mold, caused by *Penicillium expansum*, in a post-inoculation treatment on 'Gingergold' apples, 2004-05.

Treatment	% blue mold incidence			
	42 days at 4°C	62 days at 4°C	90 days at 4°C	90 days at 4°C + 6 days at 20 °C
Inoculum only	100.0 c[1,2]	100.0 b	100.0 b	100.0 b
BIOSAVE @ 1.59 g/L (9×10^9 CFU/ml)	87.5 b	96.9 b	100.0 b	100.0 b
MERTECT @ 1.15 G/l	96.9 c	96.9 b	100.0 b	100.0 b
SCHOLAR @ 1.2 G/L	9.4 a	9.4 a a	9.4 a	34.4 a

[1] Data represent the mean of 3 replicates of 12 apples per replicate. Each apple was wounded and inoculated with pathogen inoculum and/or with fungicides.

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

Table 2. Effect of fungicides on gray mold, caused by *Botrytis cinerea*, in a post-inoculation treatment on 'Gingergold' apples, 2004-05.

Treatment	% Gray mold incidence			
	42 days at 4°C	62 days at 4°C	90 days at 4°C	90 days at 4°C + 6 days at 20°C
Inoculum only	96.4 c[1,2]	100.0 c	100.0 b	100.0 b
BIOSAVE @ 1.59 g/L (1×10^9 CFU/ml)	77.8 b	94.4 b	94.4 b	100.0 b
MERTECT @ 1.15G/l	96.9 c	96.9 c	100.0 b	100.0 b
SCHOLAR @ 1.2 G/L	0.0 a	0.0 a	18.8 a	25.0 a

[1] Data represent the mean of 3 replicates of 12 apples per replicate. Each apple was wounded and inoculated with pathogen inoculum and/or with fungicides.

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

Table 3. Effect of fungicides on blue mold, caused by *Penicillium expansum*, in a post-inoculation treatment on 'Honeycrisp' apples, 2004-05.

Treatment	% blue mold incidence			
	42 days at 4°C	62 days at 4°C	90 days at 4°C	90 days at 4°C + 7 days at 20°C
Inoculum only	88.9 b[1,2]	94.4 b	100.0 b	100.0 b
BIOSAVE @ 1.59 g/L (1×10^9 CFU/ml)	97.2 c	100.0 c	100.0 b	100.0 b
MERTECT @ 1.15 G/l	97.2 c	100.0 c	100.0 b	100.0 b
SCHOLAR @ 1.2 G/L	0.0 a	0.0 a	6.7 a	12.5 a

[1] Data represent the mean of 3 replicates of 12 apples per replicate. Each apple was wounded and inoculated with pathogen inoculum and/or with fungicides.

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

Table 4. Effect of fungicides on gray mold, caused by *Botrytis cinerea*, in a post-inoculation treatment on 'Honeycrisp' apples, 2004-05.

Treatment	% gray mold incidence			
	42 days at 4°C	62 days at 4°C	90 days at 4°C	90 days at 4°C + 6 days at 20°C
Inoculum only	97.4 cb[1,2]	97.4 b	97.4 b	97.4 b
BIOSAVE @ 1.59 g/L (1×10^9 CFU/ml)	100.0 b	100.0 b	100.0 b	100.0 b
MERTECT @ 1.15G/l	97.2 b	97.2 b	97.2 b	97.2 b
SCHOLAR @ 1.2 G/L	0.0 a	0.0 a	2.8 a	13.9 a

[1] Data represent the mean of 3 replicates of 12 apples per replicate. Each apple was wounded and inoculated with pathogen inoculum and/or with fungicides.

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

2005 PMR Report #53

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

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

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TITLE: **EVALUATION OF POSTHARVEST FUNGICIDES SCHOLAR (FLUDIOXONIL) AND MERTECT (THIABENDAZOLE) FOR THE CONTROL OF BLUE MOLD OF APPLES CV. EMPIRE, 2004-05.**

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

METHODS: A trial was conducted to determine the effectiveness of SCHOLAR (fludioxonil) against blue mold of apple caused by *Penicillium expansum*. The treatments were compared with MERTECT (TBZ) for efficacy against blue mold. Commercially ripe apple cv. Empire were obtained from a AAFC research orchard in Jordan Station, ON. All fruits were stored in cold storage at 2 °C until used in the experimental treatments. Apples were harvested October 10, 2004 and experiment was initiated on March 7, 2005. 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 "pre-storage" treatment intervals where the infection may have occurred at the time of harvest in the field or in transit prior to the treatment at storage 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 µl 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 @ 0.01,0.03, 0.05, 0.15, 0.30, 0.60, 1.20 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. In the dip application, the wounded and inoculated fruit were placed in fungicide solution for 30 ± 5 seconds and then 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 decay after both incubation periods. Untreated check had no fungicides. The treatments were randomized completely. To determine the efficacy of fungicides on the shelf-life of the fruit, the fruits were moved to 20°C, 85% RH and incubated for 6 additional days. The fruit were again evaluated for blue mold incidence (percent infected apples). 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 was 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.

CONCLUSIONS: The concentration 1.2 g/L of SCHOLAR gave 100% of control of blue mold in drench and dip treated apples for up to 60 days in cold storage. Higher disease incidence was observed in the shelf-life study. In conclusion both application methods, dip and drench treatments were effective in delivering SCHOLAR. SCHOLAR, at 1.2 g/L concentration, was effective (100.0 % control of blue mold) as a curative treatment against TBZ -resistant *P. expansum* on apples under controlled atmosphere (CA) storage conditions and shelf-life conditions. High disease incidence was observed in MERTECT treatments in which TBZ-resistant inoculum was used.

Table 1. Mean percentage incidence of blue mold (caused by *Penicillium expansum*) after post-harvest treatment of SCHOLAR (fludioxonil) on apple, cv. Empire, 2004-05.

Treatment	% blue mold incidence after incubation at 2°C							
	31 days		45 days		59 days		9 days + 6 days at 20°C	
	Drench	Dip	Drench	Dip	Drench	Dip	Drench	Dip
Inoculum only	100.0 de[12]	100.0 f	97.2 g	100.0 h	100.0 h	100.0 h	100.0 d	100.0 f
SCHOLAR @ 0.005 g/L	25.0 d	30.6 d	66.7 f	77.8 f	86.1 g	91.7 f	100.0 d	100.0 f
SCHOLAR @ 0.01 g/L	27.8 d	13.9 c	41.7 e	66.7 e	58.3 f	77.8 e	97.2 d	100.0 f
SCHOLAR @ 0.03 g/L	8.3 c	5.6 b	22.2 d	25.0 d	33.3 e	61.1 d	80.6 d	41.7 d
SCHOLAR @ 0.05 g/L	8.3 c	5.6 b	16.7 c	11.1 c	27.8 d	13.8 c	75.0 c	41.7 d
SCHOLAR @ 0.150 g/L	2.7 b	0.0 a	2.8c	5.6 b	5.6 c	5.6 b	22.2 b	22.2 c
SCHOLAR @ 0.300 g/L	2.7 b	5.6 b	5.6 b	11.1 c	5.1 c	11.1 c	18.3 b	19.4 c
SCHOLAR @ 0.600 g/L	0.0 a	5.6 b	0.0 a	8.3 b	2.8 b	11.1 c	19.1 b	11.1 b
SCHOLAR @ 1.200 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
MERTECT @ 1.15 g/L	100.0 e	86.1 e	100.0 g	86.1 g	100.0 h	86.1 g	100.0 d	91.7 e

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

[2] Data is the mean of three replicates of 12 apples per replicate. Each apple was wounded and inoculated with thiabendazole-resistant *P. expansum* before treatment.

2005 PMR Report #54

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: **EVALUATION OF POSTHARVEST FUNGICIDES SCHOLAR (FLUDIOXONIL) AND MERTECT (THIABENDAZOLE) FOR THE CONTROL OF GRAY MOLD IN 'EMPIRE' APPLES, 2004-05.**

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

METHODS: A trial was conducted to determine the effectiveness of SCHOLAR (fludioxonil) against gray mold of apple caused by *Botrytis cinerea*. The treatments were compared with MERTECT (TBZ) for efficacy against gray 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 experimental treatments. Apples were harvested October 10, 2004 and experiment was initiated on March 7, 2005. 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 fruit per replicate were prepared for each treatment. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of thiabendazole-resistant *B. cinerea* isolate Bc-8DR 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 @ 0.01, 0.06, 0.125, 0.15, 0.30, 0.60, 1.20 g/L; 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. In the dip application, the wounded and inoculated fruit were placed in fungicide solution for 30 ± 5 seconds and then the fruit were drained on the wire mesh before placing them on the packing inserts. Untreated check had no fungicides. The treatments were completely randomized. Apples in each of the experiments were evaluated for decay after the respective incubation periods. Untreated check had no fungicides. The treatments were randomized completely. Efficacy of fungicides against thiabendazole-resistant (TBZ-R) *B. cinerea* were evaluated for gray mold incidence (percent infected apples). To determine the efficacy of fungicides on the shelf-life of the fruit, the fruits were moved to 20°C, 85% RH and incubated for 6 additional days. Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means was separated by LSD comparative tests.

RESULTS: Incidence of gray mold is outlined in Table 1.
CONCLUSIONS: The concentration 1.2g/L of SCHOLAR gave 90% of control of gray mold in drench and dip treated apples for up to 60 days in cold storage. Higher disease incidence was observed in the shelf-life study. In conclusion both application methods, dip and drench treatments were effective in delivering SCHOLAR.

Table 1. Mean percentage incidence of gray mold (caused by *Botrytis cinerea*) after post-harvest treatment of SCHOLAR (fludioxonil) on apple, cv. Empire, 2004-05.

Treatment	% gray mold incidence after incubation at 2°C							
	31 days		45 days		59 days		59 days + 6 days at 20°C	
	Drench	Dip	Drench	Dip	Drench	Dip	Drench	Dip
Inoculum only	100.0 d[1,2]	100.0 f	100.0 f	100.0 i	100.0 f	100.0 h	100.0 f	100.0 g
SCHOLAR @ 0.005 g/L	72.2 c	61.1 d	75.0 e	77.8 g	77.8 e	77.8 f	91.7 e	88.9 f
SCHOLAR @ 0.01 g/L	19.4 b	25.0 c	38.9 d	38.9 f	44.4 d	44.4 e	75.00 d	63.9 e
SCHOLAR @ 0.06 g/L	0.0 a	2.8 b	2.8 b	16.7 e	5.6 b	25.0 d	25.0 c	41.7 d
SCHOLAR @ 0.125 g/L	0.0 a	0.0 a	8.3 c	2.8 a	8.3 b	5.6 b	16.7 b	16.7 b
SCHOLAR @ 0.150 g/L	0.0 a	0.0 a	5.6 c	5.6 b	5.6 b	5.6 b	13.9 b	13.9 b
SCHOLAR @ 0.300 g/L	0.0 a	0.0 a	5.6 c	2.8 a	11.1 c	2.8 a	16.7 b	5.6 a
SCHOLAR @ 0.600 g/L	0.0 a	2.8 b	0.0 a	11.1 d	5.6 b	11.1 c	11.1 a	19.4 c
SCHOLAR @ 1.200 g/L	0.0 a	0.0 a	0.0 a	8.3 c	0.0 a	8.3 b	8.33 a	16.6 b
MERTECT @ 1.15 g/L	100.0 d	86.11 e	100.0 f	86.1 h	100.0 f	86.1 g	100.0 f	91.7 g

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

[2] Data is the mean of three replicate of 12 apples per replicate. Each apple was wounded and inoculated with thiabendazole-resistant *B. cinerea* before treatment.

2005 PMR Report #55

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

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

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TITLE: **EFFECT OF SMARTFRESH (1-METHYCYCLOPROPENE; 1-MCP) ON DECAYS IN 'EMPIRE' AND 'MCINTOSH' APPLES, 2004-05.**

MATERIALS: SMARTFRESH™ (1-methycyclopropene)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) on the post-harvest decays in wounded apples. Optimum harvest time for long term storage for the apples was determined by the internal ethylene concentration and starch staining. 'McIntosh' and 'Empire' apple fruits were harvested on 3 September, 2004 and 22 September, 2004, respectively. Apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 2 hours of harvest, the apples were wounded. Apples in the control treatments were not wounded. There were 4 treatments; 1) no wound, 2) no wound + 1-MCP, 3) wound only, and 4) wound + 1-MCP. Each treatment had 4 replications with 12 fruits per replication. Following the wounding, the apples were cooled to 1 ± 1°C overnight and then the treatments 2 and 4 received 1 µl/ml of 1-MCP for 24 h at 0°C. Fruit were then stored either in air at 0-1°C for up to 120 days, or in standard controlled atmosphere (CA; 2.5-3°C, 2.5% O_2 and 4.5% CO_2 for McIntosh and 2.0 -3°C, 2.5% O_2 and 2.5% CO_2 for Empire) at the Horticultural Products Laboratory, University of Guelph, Guelph. Decay incidence was recorded after 30, 60, 90, and 120 days after treatment for apples that were kept in air. For the apples that were stored in CA storage, disease incidence was recorded at 150 and 240 days after treatment for McIntosh' and 'Empire' apple, respectively. Apples were evaluated for decay after each of the incubation periods and the apples moved to a shelf-life storage (20°C) for 6 days. Fruits were considered decayed when a lesion developed on the fruit. When appropriate and necessary, the data obtained were analyzed with SigmaStat statistical package. Analysis of variance was determined by using appropriate transformations and significance between means was separated by the Tukey test.

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

CONCLUSIONS: Decay incidence in 'McIntosh' after cold storage and the shelf-life after each incubation period are presented in Tables 1 and 2. Decay incidence in 'Empire' after cold storage and the shelf- life after each incubation period are presented in Tables 2 and 4. The analysis of results after incubation in air at

different intervals show that no decay was observed at 30 days after treatment in both cultivars held in air. A higher incidence of decay was observed in wounded plus 1-MCP treated 'McIntosh' apples than in wounded only apples after 90 and 120 days in air storage. 1-MCP had a variable effect on decay in 'Empire' apples, where higher disease incidence was observed in wounded plus 1-MCP treated apples than in wounded only apples at 60 days, but similar decay incidence was found at 90 and 120 days after treatment. In CA storage, disease incidence was observed in the treatment, with 1-MCP treated apples had highest disease incidence. *Botrytis cinerea* was observed in decayed apples. Higher disease incidence was observed in the shelf-life study than after cold and CA storage. In summary, 1-MCP had a variable effect on decay incidence in different apple cultivars, and this variability in response to deacy is an important consideration in any program utilizing 1-MCP treatment.

Table 1. Effect of 1-MCP on decay incidence at different intervals in 'McIntosh' apples, 2004-05.

Treatment	% apples with decay				
	Incubation at 0°C				Controlled atmosphere (CA)
	30 days	60 days	90 days	120 days	150 days
No Wound; No 1-MCP	0.0 a [a,b]	0.0 a	0.0 a	0.0 a	0.0 a
Wound Only	0.0 a	0.0 a	11.1 b	25.0 c	13.9 b
No Wound; 1-MCP	0.0 a	0.0 a	0.0 a	5.6 b	0.0 a
Wound; 1-MCP	0.0 a	8.3 b	27.8 c	33.3 d	0.0 a

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

Table 2. Effect of 1-MCP on the decay incidence in shelf-life study after incubation at different intervals in 'McIntosh' apples, 2004-05.

Treatment	% apples with decay				
	Incubation at 0°C				CA
	30 days + shelf-life	60 days + shelf-life	90 days + shelf-life	120 days + shelf-life	150 days + shelf-life
No Wound; No 1-MCP	0.0 a [a,b]	0.0 a	0.0 a	0.0 a	0.0 a
Wound Only	13.4 b	0.0 a	13.9 b	41.7 c	13.9 b
No Wound; 1-MCP	0.0 a	0.0 a	0.0 a	5.6 b	0.0 a
Wound; 1-MCP	16.7 b	22.2 b	52.8 c	41.7 c	0.0 a

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

Table 3. Effect of 1-MCP on decay incidence at different intervals in 'Empire' apples, 2004-05.

Treatment	% apples with decay				
	Incubation at 0°C				Controlled atmosphere (CA)
	30 days	60 days	90 days	120 days	244 days
No Wound; No 1-MCP	0.0 a [a,b]	0.0 a	0.0 a	2.8 a	22.2 a
Wound Only	0.0 a	25.0 b	52.8 c	44.4 c	33.3 b
No Wound; 1-MCP	0.0 a	0.0 a	0.0 a	5.7 b	38.9 c
Wound; 1-MCP	0.0 a	0.0 a	55.8 c	41.7 c	52.8 d

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

Table 4. Effect of 1-MCP on the decay in shelf-life study after incubation at different intervals 'Empire' apples, 2004-05.

Treatment	% apples with decay			
	Incubation at 0°C			
	30 days + shelf-life	60 days + shelf-life	90 days + shelf-life	120 days + shelf-life
No Wound; No 1-MCP	0.0 a [a,b]	0.0 a	0.0 a	8.4 a
Wound Only	44.4 c	58.3 c	58.3 b	52.8 c
No Wound; 1-MCP	0.0 a	0.0 a	0.0 a	5.6 a
Wound; 1-MCP	52.8 b	75.0 b	61.1 b	44.4 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.

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

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

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TITLE: **EFFECT OF SMARTFRESH (1-METHYLCYCLOPROPENE; 1-MCP) ON BLUE MOLD AND GRAY MOLD IN ‘‘MCINTOSH’ AND ‘EMPIRE’ APPLES, 2004-05.**

MATERIALS: SmartFresh™ (1-methycyclopropene)

METHODS: A trial was conducted to determine the effect of SMARTFRESH (1-methylcyclopropene; 1-MCP) on post-harvest blue mold and gray mold in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. ‘McIntosh’ and ‘Empire’ apple fruits were harvested on 3 September, 2004 and 22 September, 2004, respectively. Apples were placed in plastic mesh bags and wounded by puncturing the apple once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 4 hours of harvest, the apples were wounded and drop inoculated with the pathogen. TBZ-resistant *B. cinerea* isolate BC-8D or TBZ-resistant *P. expansum* PS-1R at a concentration of 1 x 10^5 conidia/ml were used. There were 6 treatments; 1) no wound, 2) no wound + 1-MCP, 3) wound only, 4) wound + 1-MCP, 5) wound + *P. expansum/B. cinerea,* and 6) wound + *P. expansum/B. cinerea* + 1-MCP. Both pathogens were used at two concentrations, 1 x 10^3 and 1 x 10^4 CFU/ml. Each treatment had 4 replications with 12 fruit per replication. Following the wounding and inoculations, the apples were cooled to 1 ± 1°C overnight and then the treatments 2, 4 and 6 received 1 µl/ml of 1-MCP for 24 h at 0°C. ‘McIntosh’ apples were incubated in standard CA storage (3°C, 2.5% O_2, 4.5% CO_2) for 152 days and in air at 3°C for 232 days. ‘Empire’ apples were incubated in standard controlled atmosphere (CA) storage (1.5°C, 2.5% O_2, 2.5% CO_2) for 171 days and in air at 0 °C for 157 days. Apples in the experiment were evaluated for disease incidence after respective incubation periods. After CA or cold storage incubation, the fruit was moved to 20ºC, 85% RH and incubated for 6 days. After the shelf-life study, the fruit was again evaluated for blue mold and gray mold incidence (percent infected apples). Fruit was considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: Results are presented in Tables 1-4.

CONCLUSIONS: A higher incidence of blue mold was observed in wounded + 1-MCP treated 'McIntosh' apples in air than in CA storage (Table 1). A very low incidence (0 - 2.8%) was observed in uninoculated treatments. In uninoculated treatments, more disease was observed in air as compared to CA storage, where very little disease (2.8%) was observed. Of the two concentrations of inoculum tested in CA storage, 1 x 10^3 CFU/ml of *P. expansum* gave approximately, 50 % less diseases than the treatment with 1 x 10^4 CFU/ml. Incidence of 97.2 to 100.0% blue mold was observed in inoculated apples that were stored air. 1-MCP has no effect on the diseases. A comparison between the air and CA storage suggests that blue mold. With the exception of wound only treatment, very little increase in blue mold was observed in the shelf-life study. In the case of gray mold, low disease (8.3%)disease was observed in the uninoculated treatment both in air and CA storage (Table 2). Lower gray mold incidence was observed in CA storage than in Air in the apples that were treated with 1 x 10^3 CFU/ml of *B. cinerea*. At higher inoculum levels 97% of disease was observed. In 'Empire' apples, the observations were recorded after 244 days. High gray mold incidence was observed in the uninoculated treatments in both air and CA storage. All the inoculated (*P. expansum* or *B. cinerea*) treatments gave 100% disease (Tables 3 and 4). Based on the results, the observations should be recorded at 150 days. A high incidence (97-100%) of blue mold and gray mold was observed in 1-MCP-treated and non-treated 'McIntosh' and 'Empire' apples in CA and air storages. The results show that that 1-MCP had neither a positive nor negative effect on storage rots in apples.

Table 1. Effect of 1-MCP on post-harvest blue mold (*Penicillium expansum*) in 'McIntosh' apples, 2004-05**.**

Treatment	% apples with blue mold			
	CA storage for 153 days	CA + 7 days at 20°C	Air at 0°C for 153 days	Air at 0°C 7 days at 20°C
No Wound; No 1-MCP	2.8 b [ab]	2.8 b	2.8 a [ab]	2.8 a
Wound Only	2.8 b	2.8 b	13.9 d	19.4 b
No Wound; 1-MCP	0.0 a	0.0 a	5.7 a	5.6 a
Wound + 1-MCP	0.0 a	5.6 c	50.0 c	50.0 c
Wound + *P. expansum* 1 x 10^3 CFU/ml	55.6 d	55.6 d	100.0 d	100.0 d
Wound + *P. expansum* 1 x 10^3 CFU/ml + 1-MCP	50.0 c	50.0 e	97.2 d	97.2 d
Wound + *P. expansum*1 x 10^4 CFU/ml	97.2 f	100.0 f	100.0 d	100.0 d
Wound + *P. expansum* 1 x 10^4 CFU/ml+ 1-MCP	83.3 e	97.2 f	100.0 d	100.0 d

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

[b] Data represent the mean of four replicates.

Table 2. Effect of 1-MCP on post-harvest gray mold (*Botrytis cinerea*) in 'McIntosh' apples, 2004-05.

Treatment	% apples with blue mold			
	CA storage for 153 days	CA + 7 days at 20°C	Air 0°C for 153 days	Air at 0°C for 153 days + 6 days at 20°C
No Wound; No 1-MCP	5.6 a [a,b]	5.6 b	0.0 a	0.0 a
Wound Only	11.1 b	0.0 a	8.3 b	8.3 b
No Wound; 1-MCP	5.6 a	5.6 b	0.0 a	0.0 a
Wound + 1-MCP	8.3 a	8.3 b	8.3 b	27.8 c
Wound + *B. cinerea* 1 x 10^3 CFU/ml	61.1 c	61.1 c	97.2 c	100.0 d
Wound + *B. cinerea* 1 x 10^3 CFU/ml + 1-MCP	69.4 d	61.1 c	97.2 c	100.0 d
Wound + *B. cinerea* 1 x 10^4 CFU/ml	97.2 e	97.2 d	100.0 d	100.0 d
Wound + *B. cinerea* 1 x 10^4 CFU/ml + 1-MCP	100.0 e	97.2 d	100.0 d	100.0 d

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

Table 3. Effect of 1-MCP on post-harvest blue mold (*Penicillium expansum*) in 'Empire' apples, 2004-05.

Treatment	% apples with blue mold	
	CA storage for 171 days	Air 0°C for 168 days
No Wound; No 1-MCP	27.8 a [a,b*]	47.2 b*
Wound Only	50.0 c*	86.1 d*
No Wound; 1-MCP	25.0 a*	19.4 a *
Wound + 1-MCP	44.4 b*	55.6 c*
Wound + *P. expansum* 1 x 10^3 CFU/ml	100.0 d	100.0 e
Wound + *P. expansum* 1 x 10^3 CFU/ml + 1-MCP	100.0 d	100.0 e
Wound + *P. expansum*1 x 10^4 CFU/ml	100.0 d	100.0 e
Wound + *P. expansum* 1 x 10^4 CFU/ml+ 1-MCP	100.0 d	100.0 e

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test $P = 0.05$.
[b] Data represent the mean of four replicates.
* Sporulating Botrytis was present in apples in the treatments that were not inoculated. Botrytis contaminated adjacent fruit by nesting.

Table 4. Effect of 1-MCP on postharvest gray mold (*Botrytis cinerea*) in 'Empire' apples, 2004-05.

Treatment	% apples with gray mold	
	CA storage for 171 days	Air 0°C for 168 days
No Wound; No 1-MCP	11.1 a [a,b*]	27.2 a*
Wound Only	44.4 c*	50.0 c*
No Wound; 1-MCP	16.7 a*	13.9 a*
Wound + 1-MCP	41.7 d*	22.2 b*
Wound + *B. cinerea* 1 x 10^3 CFU/ml	100.0 d	100.0 d
Wound + *B. cinerea* 1 x 10^3 CFU/ml + 1-MCP	100.0 d	100.0 d
Wound + *B. cinerea* 1 x 10^4 CFU/ml	100.0 d	100.0 d
Wound + *B. cinerea* 1 x 10^4 CFU/ml + 1-MCP	100.0 d	100.0 d

[a] Means within the column followed by the same letter are not significantly different according to the Tukey test at $P = 0.05$.
[b] Data represent the mean of four replicates.
* Sporulating *Botrytis* was present in apples in the treatments that were not inoculated. Botrytis contaminated adjacent fruit by nesting.

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SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.61

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

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TITLE: **EVALUATION OF POSTHARVEST FUNGICIDES FOR THE CONTROL OF BLUE MOLD IN SMARTFRESH (1-MCP)-TREATED 'DELICIOUS' APPLES, 2004-05.**

MATERIALS: BioSave (*Pseudomonas syringae*) and MERTECT 500SC (thiabendazole 45%).

METHODS: BioSave (*Pseudomonas syringae*) was compared with the thiabendazole (TBZ) for efficacy against blue mold of apples caused by *Penicillium expansum*. Within 24 hours of harvest 'Delicious' apples were treated with 1-MCP and stored in a controlled atmosphere (CA) storage (2.5% O_2 and 2.5% CO_2) for 100 days at the University Guelph. Both 1-MCP treated and non-treated apples were used and the trial was conducted at SCPFRC, AAFC, Vineland Station. Apples were placed on a plastic packing insert (fruit master) contained in a plastic box. Each treatment had 3 replicates and each replicate had 4 apples. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were drop inoculated with a 20 ul drop of TBZ-resistant *Penicillium expansum* isolate PS-1R at a concentration of 1 x 10^5 conidia/ml and bio-control agent or Mertect. Treated apples were incubated at 4°C for 2 months. Apples in each of the experiments were evaluated for blue mold incidence after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation at 4°C, the fruits were moved to 20°C, 85% RH and incubated for 6 days. The fruits were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed with SigmaStat statistical package.

RESULTS: As outlined in Table 1.

CONCLUSIONS: BioSave at a concentration of 1.59 g/L gave 100 % control of blue mold caused by TBZ-Resistant and TBZ-Sensitive isolates of *P. expansum* for 30 days in apples that had been stored in CA storage. Higher blue mold incidence was observed in 1-MCP treated apples than in the treatment where apples were not treated with 1-MCP. BioSave at a concentration of 1.59 g/L gave 100 % control of gray mold caused by TBZ-Resistant and TBZ-Sensitive isolates of *B.cinerea*. for 30 days in apples that had been stored in CA storage. Lower gray mold incidence was observed in 1-MCP treated apples than in

the treatment where apples were not treated with 1-MCP. With the exception of MERTECT on TBZ-sensitive isolates, disease incidence in all the treatments increased with time. As expected MERTECT was ineffective against blue mold caused by the TBZ-resistant *P. expansum* or gray mold caused by TBZ-resistant *B.cinerea*. Variable disease incidences were observed in 1-MCP treated apples indicate that post-harvest disease control measures are needed in 1-MCP treated apples.

Table 1. Effect of SCHOLAR on blue mold, caused by *Penicillium expansum* in 'Delicious' apples that were treated with 1-MCP and stored under three controlled atmosphere storage conditions for 100 days, 2004-05[1].

Treatment[2]	% Blue mold incidence					
	30 days at 4°C		60 days at 4°C		60 days at 4°C + shelf-life for 6 days at 20°C	
	No 1-MCP	1-MCP	No 1-MCP	1-MCP	No 1-MCP	1-MCP
P. expansum - R + water	18.5 c [2,3]	33.3 d	70.4 e	81.5 f	92.6 e	96.3 f
P. expansum - S + water	44.4 d	66.7 e	96.3 g	85.2 g	100	96.3 f
P. expansum - R + BioSave @ 1.59 g/L	0.0 a	0.0 a	18.5 b	3.7 b	81.5 d	62.9 c
P. expansum - S + BioSave @ 1.59 g/L	0.0 a	0.0 a	22.2 b	14.8 c	96.3 f	88.9 e
P. expansum - R + MERTECT @ 1.15 g/L	7.4 b	11.1	44.4 d	81.4 g	100.0 g	92.6 f
P. expansum - S + MERTECT @ 1.15 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
B. cinerea- R + water	92.6 f	77.8 f	96.3 g	96.3 h	100	96.3 f
B. cinerea - S + water	44.4 d	29.6 c	92.6 g	59.3 e	92.6 f	59.3 c
B. cinerea- R + BioSave @ 1.59 g/L	0.0 a	0.0 a	29.3 c	29.6 d	77.8 c	62.9 c
B. cinerea - S + BioSave @ 1.59 g/L	0.0 a	0.0 a	29.6 c	11.1 c	66.7 b	51.8 b
B. cinerea- R + MERTECT @ 1.15 g/L	59.2 e	22.2 b	81.5 f	62.9 e	88.9 e	77.8 d
B. cinerea - S + MERTECT @ 1.15 g/L	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a

[1] Apples were treated with 1 ppm 1-MCP and stored at 0°C and >95% RH for 100 days prior to the test.

[2] R= Thiabnedazole-resistant; S = thiabendazole resistant

[3] Means within columns followed by the same letter are not significantly different using the Tukey test at $P = 0.05$. Data represent the mean of 3 replicates, with 12 apples per replicate.

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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 POST-HARVEST APPLICATION OF BioSave® 10 LP AND DPA (DIPHENYLAMINE) ON POST HARVEST DISEASES UNDER LONG TERM CONTROLLED ATMOSPHERE STORAGE IN 'MCINTOSH' APPLES, 2004-05**

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

METHODS: In the 2004 growing season, commercially ripe 'McIntosh' apples were harvested (September 13, 2004) from commercial orchards in Ontario and stored for 24 hours at 4 ºC. Prior to treatment, apples were disinfested in 10% household bleach (5% sodium hypochlorite) and 0.01% Tween 20 (Fisher Scientific, Nepean, ON) for 4 min and rinsed in tap water for 4 min. Apples were placed in mesh bags (12 apples per bag) and placed into plastic crates. Apples were then stored at 13ºC equilibrium temperature the night before the inoculation. On September 15, 2004 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 Soultions, FL) at rate: 0.79 g/L, 1.59 g/L (company recommendation), 2.38 g/L or BioSave® LP + DPA (1000 µl l^{-1}) applications (co-treatment). Following treatments apples were drained and placed in plastic crates then stored for 168 days in controlled atmosphere (CA) chambers adjusted to an average of 3ºC and 2.5 % O_2 and 4.5 % CO_2. Apples were evaluated for disease incidence immediately after removing from long storage (168 days) then they were placed at 20ºC (85 % RH) for 6 days (shelf-life study) 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, Ill). Percentage data were subjected to square-root transformation before the ANOVA. All pair-wise multiple comparison procedures were determined with Tukey's test.

RESULTS: Results are presented in Tables 1-2.

CONCLUSIONS: The evaluation of disease incidence after 168 days in CA 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. expansumthan* than those in the control treatment. Treating apples with 2.38 g/L of BioSave® 10 LP provided the highest blue mold disease reduction. Apples treated with BioSave® 10 LP and DPA had higher disease incidence than those treated with BioSave® 10 LP only. This suggests that mixing BioSave® 10 LP with DPA could have a detrimental effect on its efficacy. BioSave® 10 LP reduced significantly gray mold incidence in apples when compared to control treatment, however all treatments had more than 50 % disease incidence, which could be considered as disease suppression than disease control. Because *B. cinerea* is a nesting pathogen it could be suggested that in 168 days the pathogen has spread over the neighbouring fruits in the crates and masked the effect of BioSave® 10 LP application. Placing apples after CA storage at 20ºC (85 % RH) for 6 days resulted in an increase of blue and gray mold incidence.

Table 1. Effect of BioSave® 10 LP alone or in combination with DPA (diphenylamine) on blue (*Penicillium expansum*) mold incidence on 'McIntosh' apples, 2004-05.

Treatment	Concentration	DPA 1000 ppm/L	Percentage incidence of blue mold (*P. expansum*)			
			168 days in CA		6 days at 20°C**	
			TBZ-S	TBZ-R	TBZ-S	TBZ-R
Water		No	14.58 a*	14.58 a	16.66 a	16.66 a
Inoculum only		No	95.83 d	100.0 e	97.92 d	100.0 e
DPA		Yes	85.42 d	100.0 e	89.58 d	100.0 e
BioSave® LP	0.79 g/L	No	29.17 ab	58.33 cd	45.83 bc	60.42 c
BioSave® LP	1.59 g/L	No	37.5 0 b	33.33 b	47.92 bc	45.83 b
BioSave® LP	2.38 g/L	No	25.00 ab	29.17 b	37.50 c	39.58 b
BioSave® LP	0.79 g/L	Yes	62.50 c	75.00 d	85.42 d	83.33 d
BioSave® LP	1.59 g/L	Yes	41.67 b	68.75 d	54.17 b	70.83 d
BioSave® LP	2.38 g/L	Yes	27.08 ab	41.67 bc	33.33 c	54.17 c

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

** Apples were stored for 168 days in CA storage (3ºC; 2.5 % O_2, 4.5 % CO_2) with an additional storage at 20°C (85 % RH) for 6 days.

Table 2. Effect of BioSave® 10 LP alone or in combination with DPA (diphenylamine) on gray (*Botrytis cinerea*) mold incidence on 'McIntosh' apples, 2004-05.

Treatment	Concentration	DPA 1000 ppm/L	Percentage incidence of gray mold (*B. cinerea*)			
			168 days in CA storage**		6 days at 20°C**	
			TBZ-S	TBZ-R	TBZ-S	TBZ-R
Water		No	18.75 a	18.75 a	22.92 a	22.92 a
Inoculum		No	100.0 e	100.0 d	100.0 e	100.0 c
DPA		Yes	100.0 e	91.67 d	100.0 e	95.83 c
BioSave®	0.79 g/L	No	85.42 cd	79.17 c	87.50 cd	93.75 c
BioSave®	1.59 g/L	No	54.17 b	66.67 bc	62.50 b	85.42 bc
BioSave®	2.38 g/L	No	56.25 b	62.50 bc	64.58 b	77.08 b
BioSave®	0.79 g/L	Yes	100.0 e	79.17 c	100.0 de	89.58 bc
BioSave®	1.59 g/L	Yes	89.58 d	60.42 b	91.67 de	72.92 b
BioSave®	2.38 g/L	Yes	83.33 c	52.08 b	83.33 c	68.75 b

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

** Apples were stored for 168 days in CA storage (3ºC; 2.5 % O_2, 4.5 % CO_2) with an additional storage at 20°C (85 % RH) for 6 days.

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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 POST-HARVEST APPLICATION OF BioSave® 10 LP AND DPA (DIPHENYLAMINE) ON POST HARVEST DISEASES UNDER LONG TERM CONTROLLED ATMOSPHERE STORAGE IN 'EMPIRE' APPLES, 2004-05**

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

METHODS: In the 2004 growing season, commercially ripe 'Empire' apples were harvested (September 24, 2004) from commercial orchards in Ontario and stored for several days at 0ºC. Prior to treatment, apples were disinfested in 10% household bleach (5% sodium hypochlorite) and 0.01% Tween 20 (Fisher Scientific, Nepean, ON) for 4 min and rinsed in tap water for 4 min. Apples were placed in mesh bags and placed into the crates. Apples were stored at 13ºC equilibrium temperature the night before the inoculation. On September 29, 2004 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 µl l^{-1}) applications (co-treatment). Following treatments apples were drained and placed in plastic crates then stored for 168 days in controlled atmosphere (CA) chambers adjusted to an average of 1.5ºC and 2.5% O_2 and 2% CO_2. Apples were evaluated for disease incidence immediately after removing from long-term storage (168 days) then they were placed at 20ºC (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, Ill). Percentage data were subjected to square-root transformation before the ANOVA. All pair-wise multiple comparison procedures were determined with Tukey's test.

RESULTS: Results are presented in Tables 1-2.

CONCLUSIONS: The evaluation of disease incidence after 168 days in CA storage indicated that apple cultivars treated with the three concentrations of BioSave® 10 LP alone or in combination DPA resulted in significantly lower disease incidence of *P. expansumthan* than the control treatment. The half rate of BioSave® 10 LP (0.79 g/L) was least efficacious in comparison with the full and double rate of this product against blue and gray mold. Treating apples with 2.38 g/L of BioSave® 10 LP provided the highest blue mold disease reduction. There is some indication that mixing BioSave® 10 LP with DPA could have a detrimental effect on BioSave® 10 LP efficacy. 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. Because *B. cinerea* is a nesting pathogen it spread over the neighbouring fruits in the crates and masked the effect of BioSave® 10 LP treatment. In support with that it could be seen that water treated apples had high percentage gray mold incidence. 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. Increasing rate of BioSave® 10 LP provides better disease control. Using half rate of BioSave® 10 LP should not be done in future studies. In long term storage BioSave® 10 LP is more efficacious against blue mold than gray mold. Further studies are needed to investigate the efficacy of BioSave® 10 LP against gray mold in apples under 3-4 moths CA storage.

Table 1. Effect of BioSave® 10 LP alone or in combination with DPA (diphenylamine) on blue (*Penicillium expansum*) mold incidence on 'Empire' apples, 2004-05.

Treatment	Concentration	DPA 1000 ppm/L	Percentage incidence of blue mold (*P. expansum*)			
			168 days in CA storage**		6 days at 20°C**	
			TBZ-S	TBZ-R	TBZ-S	TBZ-R
Water		No	02.08 a*	02.08 a	10.42 a	10.42 a
Inoculum only		No	100.0 e	100.0 e	100.0 e	100.0 e
DPA		Yes	100.0 e	100.0 e	100.0 e	100.0 e
BioSave® 10 LP	0.79 g/L	No	45.83 c	25.00 c	66.67 c	45.83 bc
BioSave® 10 LP	1.59 g/L	No	22.97 b	20.83 c	52.08 bc	33.33 b
BioSave® 10 LP	2.38 g/L	No	29.17 b	22.92 c	37.50 b	43.75 bc
BioSave® 10 LP	0.79 g/L	Yes	77.08 d	56.25 d	83.33 d	77.08 d
BioSave® 10 LP	1.59 g/L	Yes	60.42 c	31.25 c	87.50 d	54.17 c
BioSave® 10 LP	2.38 g/L	Yes	25.00 b	14.58 b	47.92 bc	37.50 b

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

** Apples were stored for 168 days in CA storage (1.5ºC; 2.5% O_2; 2% CO_2) with an additional storage at 20ºC (85 % RH) for 6 days.

Table 2. Effect of BioSave® 10 LP alone or in combination with DPA(diphenylamine) on gray (*Botrytis cinerea*) mold incidence on 'Empire' apples, 2004-05.

Treatment	Concentration	DPA 1000 ppm/L	Percentage incidence of gray mold (*B. cinerea*)			
			168 days in CA storage**		6 days at 20°C**	
			TBZ-S	TBZ-R	TBZ-S	TBZ-R
Water		No	27.08 a*	27.08 a	43.75 a	43.75 ab
Inoculum only		No	100.0 c	100.0 e	100.0 c	100.0 e
DPA		Yes	100.0 c	70.83 d	100.0 c	85.42 d
BioSave® 10 LP	0.79 g/L	No	100.0 c	81.25 d	100.0 c	93.75 d
BioSave® 10 LP	1.59 g/L	No	95.83 c	79.17 d	97.92 c	89.58 d
BioSave® 10 LP	2.38 g/L	No	100.0 c	66.67 cd	100.0 c	66.67 c
BioSave® 10 LP	0.79 g/L	Yes	100.0 c	45.83 bc	100.0 c	54.17 b
BioSave® 10 LP	1.59 g/L	Yes	87.50 b	27.08 a	91.67 b	37.50 a
BioSave® 10 LP	2.38 g/L	Yes	100.0 c	35.83 ab	100.0 c	37.50 a

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

** Apples were stored for 168 days in CA storage (1.5ºC; 2.5% O_2; 2% CO_2) with an additional storage at 20ºC (85 % RH) for 6 days.

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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 PRE-HARVEST PYRIMETHANIL (SCALA SC, BAYER CROPSCIENCE LTD) APPLICATION FOR THE CONTROL OF POST-HARVEST GRAY AND BLUE MOLD IN 'MCINTOSH' APPLES, 2005-05**

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

METHODS: During the 2004 growing season a field trial was carried out at the site of Jordan Farm-AAFC, near Vineland, ON. Apple cultivar 'McIntosh' was maintained according to standard orchard practices at Jordan Farm, ON. Treatments were an unsprayed control, SCALA (pyrimethanil 800 g ai/ha) applied either 28 days (August 24, 04) or 10 days (September 10, 2004) pre-harvest, SCALA (pyrimethanil 800 g ai/ha) 28 days pre-harvest plus a CALCIUM ($CaCl_2$) treatment at 12 kg/ha one week before harvest (September 13, 2004) or SCALA (pyrimethanil 800 g ai/ha) two weeks pre-harvest plus a CALCIUM ($CaCl_2$) treatment at 12 kg/ha, one week before harvest (September 13, 2004). 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 20, 2004. In order to compare pre-harvest fungicide efficacy with post-harvest fungicide treatment 96 apples (12 apples per replicate/per batch) were drenched with MERTECT (thiabendazole –TBZ) 45 % flowable, at a rate of 1.59 g ai/L. Harvested fruits were divided into two batches, one was stored immediately in air at 0ºC for 6 months. The rest of the apples were stored at 4ºC for three days. On Sept 24, 2004 apples were removed from 4ºC 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 0ºC. Twelve fruits were used for each treatment and each treatment has four replicates. After inoculation apples were evaluated for disease incidence every 28 days. After 168 days fruits were removed from cold storage and were placed in additional storage at 20 ºC (85 % RH) for 6 days. The same inoculation procedure was repeated on the second half of the fruits after 6 months of storage, then the apples were incubated at 20ºC (85 % RH) for 6 days after which disease incidence was recorded. 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: As outlined in Tables 1-4.

CONCLUSION: With the exception of MERTECT all treatments significantly reduced blue and gray mold incidence. MERTECT was applied immediately after harvest as a drench treatment on unwounded apples. Apples were dusty and that probably deteriorated drenching quality, which may explain the lack of MERTECT control on both pathogens. It is difficult to make a detailed comments on what the effect of fungicides, time and calcium chloride had on blue and gray mold development, because during the storage disease development varied at each evaluation. However, with the progress of storage there was progress in disease development for both pathogens. In the beginning it could be noted that application of SCALA 10 days before harvest alone or in combination with calcium chloride resulted in significantly lower disease incidence when compared to fungicide application 28 days before harvest. 168 days after storage there was no significant difference between SCALA applied 10 days before harvest alone or in combination with calcium chloride in terms of disease incidence for both *P. expansum* and *B. cinerea*. Similar observations have been recorded on the time and fungicide efficacy against blue and gray mold on second half of apples which were stored for six moths in cold storage then removed, inoculated with the pathogens and stored at 20ºC (85 %RH) for 6 days. Generally *P. expansum* had more severe disease development than *B. cinerea* suggesting higher sensitivity of the second pathogen to the fungicide. This study demonstrated that SCALA is more effective in reducing decay incidence caused by both *P. expansum* and *B. cinerea* if it is used 10 days before harvest rather than 28 days before harvest. Combining SCALA application with an additional application of calcium chloride demonstrated synergistic effect resulting in increased post-harvest disease control. Further study is necessary to investigate SCALA efficacy for post-harvest apple disease control when applied three or one week before harvest.

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 in 'McIntosh' apples, 2004-05.

Treatments Product g ai/ha	Time of application	CaCl 6 g/L	Percentage incidence of blue mold (*P. expansum*-TBZ-S) Days of evaluation**							Apples were inoculated after 6 months of storage
			28	56	84	112	140	168	6 days at 20ºC **	6 days at 20ºC ***
			TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S
No wound	N/A		0	00.00 a*	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	02.08 a
Wounded only	N/A		0	00.00 a	02.08 a	06.25 a	06.25 a	06.25 b	08.33 b	08.33 a
Inoculum only	N/A		0	41.67 d	100.0 e	100.0 d	100.0 d	100.0 e	100.0 f	100.0 e
Scala @ 800	28 days	No	0	14.58 c	27.08 c	60.42 c	64.58 c	81.25 d	85.42 e	87.50 d
Scala @ 800	10 days	No	0	08.33 b	14.58 b	33.33 b	43.75 b	54.17 c	68.75 d	64.58 c
Scala @ 800	28 days	Yes	0	04.17 ab	16.67 b	37.50 b	64.50 c	68.75 d	79.17 de	37.50 b
Scala @ 800	10 days	Yes	0	00.00 a	04.17 a	12.50 a	29.17 b	39.58 c	43.75 c	39.58 b
TBZ @ 1.6 g/L	Post-harvest drench	No	0	45.83 d	87.50 d	0	0	100.0 e	100.0 f	100.0 e

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

** Apples were inoculated with *P. expansum* immediately after harvest, stored at 0ºC 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 20ºC.

*** Immediately after harvest one half of the apples were stored in cold storage at 0ºC for 6 months, then removed and inoculated with *P. expansum*, stored for 6 days at 20ºC and evaluated for disease incidence.

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 in 'McIntosh' apples, 2004-05.

Treatments Product g ai/ha	Time before harvest	CaCl 6 g/L	Percentage incidence of blue mold (*P. expansum*-TBZ-R) Days of evaluation**							Apples were inoculated after 6 months of storage
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20ºC **	6 days at 20ºC ***
			TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R
No wound	N/A		0	00.00 a*	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	02.08 a
Wounded only	N/A		0	00.00 a	02.08 a	06.25 ab	06.25 b	06.25 b	08.33 b	08.33 a
Inoculum only	N/A		0	33.33 c	95.83 d	100.0 d	100.0 f	100.0 e	100.0 e	91.67 ef
Scala @ 800	28 days	No	0	04.17 a	20.83 c	41.67 c	62.50 e	68.75 d	77.08 d	79.17 de
Scala @ 800	10 days	No	0	06.25 b	10.42 bc	20.83 b	29.17 cd	39.58 c	50.00 c	54.17 bc
Scala @ 800	28 days	Yes	0	00.00 a	04.17 ab	27.08 bc	39.58 d	47.92 c	60.42 c	70.83 cd
Scala @ 800	10 days	Yes	0	00.00 a	06.25 ab	14.58 b	22.91 c	33.33 c	47.92 c	39.58 b
TBZ @ 1.6 g/L	Post-harvest drench	No	0	58.33 d	100.0 d	0	0	100.0 e	100.0 e	100.0 f

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

** Apples were inoculated with *P. expansum* immediately after harvest, stored at 0ºC 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 20ºC.

*** Immediately after harvest one half of the apples were stored in cold storage at 0ºC for 6 months, then removed and inoculated with *P. expansum*, stored for 6 days at 20ºC and evaluated for disease incidence.

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 in 'McIntosh' apples, 2004-05.

Treatments Product g ai/ha	Time before harvest	CaCl 6 g/L	Percentage incidence of gray mold (*B. cinerea* -TBZ-S) Days of evaluation**							Apples were inoculated after 6 months of storage
			28 days	56 days	84 days	112 days	140	168 days	6 days at	6 days at
			TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S
No wound	N/A		00.00 a*	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	02.08 a
Wounded only	N/A		00.00 a	00.00 a	02.08 a	06.25 b	06.25 b	08.33 b	08.33 b	08.33 b
Inoculum only	N/A		00.00 a	81.25 c	100.0 d	100.0 d	100.0 e	100.0 f	100.0 e	97.92 e
Scala @ 800	28 days	No	00.00 a	14.58 b	22.92 c	35.42 c	37.50 d	47.92 e	58.33 d	60.41 d
Scala @ 800	10 days	No	00.00 a	08.33 b	12.50 bc	14.58 b	18.75 c	22.92 cd	31.25 c	25.00 c
Scala @ 800	28 days	Yes	00.00 a	10.42 b	12.50 bc	20.83 b	27.08 cd	29.17 d	35.42 c	27.08 c
Scala @ 800	10 days	Yes	00.00 a	02.08 a	04.17 ab	14.58 b	14.58 c	14.58 bc	27.08 c	20.83 c
TBZ @ 1.6 g/L	Post-harvest drench	No	0	93.75 d	97.92 d	0	0	100.0 f	100.0 e	0

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

** Apples were inoculated with *B. cinerea* immediately after harvest, stored at 0ºC 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 20ºC.

*** Immediately after harvest one half of the apples were stored in cold storage at 0ºC for 6 months, then removed and inoculated with *B. cinerea*, stored for 6 days at 20ºC and evaluated for disease incidence.

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, 2004-05.

Treatments Product g ai/ha	Time before harvest	CaCl 6 g/L	Percentage incidence of gray mold (*B. cinerea* -TBZ-R) Days of evaluation**							Apples were inoculated after 6 months of storage
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20ºC **	6 days at 20ºC ***
			TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R
No wound	N/A		00.00 a*	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a
Wounded only	N/A		00.00 a	00.00 a	02.08 a	06.25 b	06.25 b	08.33 b	08.33 b	08.33 b
Inoculum only	N/A		10.42 c	87.50 c	100.0 e	100.0 e	100.0 e	100.0 e	100.0 f	97.92 f
Scala @ 800	28 days	No	06.25 b	31.25 b	45.83 d	29.17 c	54.17 d	54.17 d	54.17 d	64.58 e
Scala @ 800	10 days	No	00.00 a	20.83 b	25.00 c	29.17 c	35.42 c	35.42 c	43.75 d	25.00 c
Scala @ 800	28 days	Yes	00.00 a	33.33 b	50.00 d	60.42 d	62.50 d	62.50 d	77.08 e	47.92 d
Scala @ 800	10 days	Yes	00.00 a	06.25 a	08.33 b	12.50 b	14.58 b	14.58 b	27.08 c	18.75 c
TBZ @ 1.6 g/L	Post-harvest drench	No	0	100.0 d	100.0 e	0	0	100.0 e	100.0 f	100.0 f

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

** Apples were inoculated with *B. cinerea* immediately after harvest, stored at 0ºC 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 20ºC.

*** Immediately after harvest one half of the apples were stored in cold storage at 0ºC for 6 months, then removed and inoculated with *B. cinerea*, stored for 6 days at 20ºC and evaluated for disease incidence.

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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 PRE-HARVEST PYRIMETHANIL (SCALA SC, BAYER CROPSCIENCE LTD) APPLICATION FOR THE CONTROL OF POST-HARVEST GRAY AND BLUE MOLD IN 'EMPIRE' APPLES, 2004-05**

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

METHODS: During the 2004 growing season a field trial was carried out at the site of Jordan Farm-AAFC, near Vineland, 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 28 days (August 31, 04) or 14 days (September 13, 2004) pre-harvest, SCALA (pyrimethanil 800 g ai/ha) 28 days pre-harvest plus a CALCIUM ($CaCl_2$) treatment at 12 kg/ha one week before harvest (September 23,2004) or SCALA (pyrimethanil 800 g ai/ha) two weeks pre-harvest plus a CALCIUM ($CaCl_2$) treatment at 12 kg/ha, one week before harvest (September 23, 2004). 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, 2004. In order to compare pre-harvest fungicide efficacy with post-harvest fungicide treatment 96 apples (12 apples per replicate/per batch) were drenched with MERTECT (thiabendazole –TBZ) 45 % flowable, at a rate of 1.59 g ai/L. Harvested fruits were divided into two batches, one was stored immediately in air at 0ºC for 6 months. The rest of the apples were stored at 4ºC for ten days. On October 7, 2004 apples were removed from 4ºC 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 0ºC. Twelve fruits were used for each treatment and each treatment has four replicates. After inoculation apples were evaluated for disease incidence every 28 days. After 168 days fruits were removed from cold storage and were placed in additional storage at 20ºC (85 % RH) for 6 days. The same inoculation procedure was repeated on the second half of the fruits after 6 months of storage, then the apples were incubated at 20ºC (85 % RH) for 6 days after which disease incidence was recorded.
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: As outlined in Tables 1-4.

CONCLUSIONS: During the 168 days of storage MERTECT was the only treatment not to provide blue and gray mold control. All other fungicide treatments significantly reduced post-harvest disease incidence on the apples when compared to the control treatment. Application of SCALA 14 days before harvest alone or in combination with calcium chloride resulted in significantly lower disease incidence when compared to fungicide application 28 days before harvest. Combination of SCALA application 28 days before harvest and calcium chloride also provided better blue and gray mold control in comparison with SCALA applied 28 days before harvest alone in some evaluations. After 84 days of storage blue and gray mold disease incidence increased. However, application of SCALA 14 days before harvest in combination with calcium chloride was consistently the most efficacious treatment. The same trend has been observed on the time and fungicide efficacy against blue and gray mold on second half of apples which were stored for six moths in cold storage then removed, inoculated with the pathogens and stored at 20ºC (85 %RH) for 6 days. *B. cinerea* isolates used in this study demonstrated higher sensitivity to SCALA in comparison with *P. expansum* isolates. SCALA is more effective in reducing decay incidence caused by both *P. expansum* and *B. cinerea* if it is used 14 days before harvest rather than 28 days before harvest. Combining SCALA application with an additional application of calcium chloride demonstrated synergistic effect resulting in increased post-harvest disease control. *B. cinerea* is more sensitive to SCALA than *P. expansum* Further study is necessary to investigate SCALA efficacy for post-harvest apple disease control when applied three or one week before harvest.

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 in 'Empire' apples, 2004-05.

Treatments Product g ai/ha	Time before harvest	CaCl 6 g/L	Percentage incidence of blue mold (*P. expansum*-TBZ-S) Days of evaluation**							Apples were inoculated after 6 months of cold storage
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20ºC **	6 days at 20ºC ***
			TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S
No wound	N/A		00.00 a*	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a
Wounded only	N/A		00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a
Inoculum only	N/A		04.17 a	75.00 c	100.0 d	100.0 d	100.0 c	100.0 e	100.0 e	100.0 d
Scala @ 800	28 days	No	00.00 a	14.58 b	41.67 c	62.50 c	66.67 b	72.92 d	79.17 d	91.67 cd
Scala @ 800	14 days	No	00.00 a	10.42 b	41.67 c	64.58 c	64.58 b	70.83 cd	77.08 cd	87.50 bc
Scala @ 800	28 days	Yes	00.00 a	00.00 a	35.42 c	52.08 bc	54.16 b	60.42 bc	64.58 b	91.67 b
Scala @ 800	14 days	Yes	00.00 a	00.00 a	25.00 b	47.92 b	56.25 b	58.33 b	68.75 bc	81.25 b
TBZ @ 1.6 g/L	Post-harvest drench	No	02.08 a	70.83 c	91.67 d	100.0 d	100.0 c	100.0 e	100.0 e	100.0 d

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

** Apples were inoculated with *P. expansum* immediately after harvest, stored at 0ºC 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 20ºC.

*** Immediately after harvest one half of the apples were stored in cold storage at 0ºC for 6 months, then removed and inoculated with *P. expansum*, stored for 6 days at 20ºC and evaluated for disease incidence.

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 in 'Empire' apples, 2004-05.

Treatments Product g ai/ha	Time before harvest	CaCl 6 g/L	Percentage incidence of blue mold (*P. expansum*-TBZ-R) Days of evaluation**							Apples were inoculated after 6 months of cold storage
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20ºC **	6 days at 20ºC ***
			TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R
No wound	N/A		00.00 a*	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a
Wounded only	N/A		00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a
Inoculum only	N/A		02.08 a	79.62 d	100.0 d	100.0 d	100.0 d	100.0 d	100.0 d	100.0 e
Scala @ 800	28 days	No	02.08 a	20.83 c	45.83 c	58.33 c	70.83 c	66.67 c	72.92 c	93.75 d
Scala @ 800	14 days	No	00.00 a	06.25 ab	31.25 b	41.67 b	52.08 b	54.17 b	54.17 b	83.33 cd
Scala @ 800	28 days	Yes	00.00 a	10.42 bc	37.50 bc	50.00 bc	52.08 b	58.33 b	62.50 bc	77.08 bc
Scala @ 800	14 days	Yes	02.08 a	08.33 ab	29.17 b	41.67 b	52.08 b	54.17 b	56.25 b	70.83 b
TBZ @ 1.6 g/L	Post-harvest drench	No	0	85.42 d	100.0 d	0	0	100.0 d	100.0 d	0

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

** Apples were inoculated with *P. expansum* immediately after harvest, stored at 0ºC 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 20ºC.

*** Immediately after harvest one half of the apples were stored in cold storage at 0ºC for 6 months, then removed and inoculated with *P. expansum*, stored for 6 days at 20ºC and evaluated for disease incidence.

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 in 'Empire' apples, 2004-05.

Treatments Product g ai/ha	Time before harvest	CaCl 6 g/L	Percentage incidence of gray mold (*B. cinerea* -TBZ-S) Days of evaluation**							Apples were inoculated after 6 months of cold storage
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20ºC **	6 days at 20ºC ***
			TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S	TBZ-S
No wound	N/A		00.00 a*	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a
Wounded only	N/A		00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a
Inoculum only	N/A		29.17 b	93.75 b	100.0 d	100.0 d	100.0 e	100.0 e	100.0 d	100.0 e
Scala @ 800	28 days	No	04.17 a	10.42 a	22.92 c	25.00 c	25.00 d	31.25 d	37.50 c	39.58 d
Scala @ 800	14 days	No	00.00 a	00.00 a	06.25 b	06.25 ab	06.25 b	06.25 b	16.67 b	22.92 c
Scala @ 800	28 days	Yes	00.00 a	00.00 a	08.33 b	10.42 b	12.50 cd	16.67 c	29.17 c	27.08 cd
Scala @ 800	14 days	Yes	06.25 a	06.25 a	08.33 b	08.33 b	08.33 bc	10.42 bc	14.58 b	06.25 b
TBZ @ 1.6 g/L	Post-harvest drench	No	0	97.02 b	100.0 d	0	0	100.0 d	100.0 d	0

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

** Apples were inoculated with *B. cinerea* immediately after harvest, stored at 0ºC 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 20ºC.

*** Immediately after harvest one half of the apples were stored in cold storage at 0ºC for 6 months, then removed and inoculated with *B. cinerea*, stored for 6 days at 20ºC and evaluated for disease incidence.

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 'Empire' apples, 2004-05.

Treatments Product g ai/ha	Time before harvest	CaCl 6 g/L	Percentage incidence of gray mold (*B. cinerea* -TBZ-R) Days of evaluation**							Apples were inoculated after 6 months of cold storage
			28 days	56 days	84 days	112 days	140 days	168 days	6 days at 20ºC **	6 days at 20ºC ***
			TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R	TBZ-R
No wound	N/A		00.00 a*	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a
Wounded only	N/A		00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a	00.00 a
Inoculum only	N/A		85.42 c	100.0 d	100.0 d	100.0 d	100.0 d	100.0 c	100.0 d	100.0 e
Scala @ 800	28 days	No	06.25 b	18.75 c	27.08 c	31.25 c	37.70 c	31.25 c	50.00 c	45.83 d
Scala @ 800	14 days	No	00.00 a	04.17 b	06.25 b	12.50 b	16.67 b	16.67 bc	25.00 b	29.17 c
Scala @ 800	28 days	Yes	02.08 a	04.17 b	06.25 b	16.67 b	18.75 b	20.83 bc	29.17 b	29.17 c
Scala @ 800	14 days	Yes	02.08 a	02.08 a	08.33 b	12.50 b	12.50 b	12.50 b	29.17 b	10.42 b
TBZ 1.6 g/L	Post-harvest drench	No	0	100.0 d	100.0 d	0	0	100.0 c	100.0 d	0

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

** Apples were inoculated with *B. cinerea* immediately after harvest, stored at 0 ºC 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 20ºC.

*** Immediately after harvest one half of the apples were stored in cold storage at 0ºC for 6 months, then removed and inoculated with *B. cinerea*, stored for 6 days at 20ºC and evaluated for disease incidence.

2005 PMR REPORT #62

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

CROP: Apples cvs. Gala, McIntosh
PEST: Gray mold, *Botrytis cinerea* Pers., blue mold, *Penicillium expansum* Link

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TITLE: **EFFECT OF POST-HARVEST APPLICATION OF BIO-SAVE FOR THE CONTROL OF POST-HARVEST BLUE AND GRAY MOLD DECAY ON APPLES, 2004**

MATERIALS: BIO-SAVE 10 LP (*Pseudomonas syringae*)

METHODS: 'McIntosh' and 'Gala' apples harvested at commercial maturity in September 2004 were placed in 1°C cold storage until 8 October, 2004 when they were used to compare BIO-SAVE at three rates (0.79 g/L, 1.59 g/L, and 2.38 g/L) for control of *Penicillium expansum* (blue mold) and *Botrytis cinerea* (gray mold). Four replicate sets of 8 apples each were wounded once using an ethanol sterilized nail embedded in cork. BIO-SAVE was prepared according to package directions in sterile distilled water (SDW). The fruit was co-dip inoculated with the three rates of BIO-SAVE and the post-harvest pathogens and allowed to air dry. *B. cinerea* (isolate B-104) and *P. expansum* (isolate 1790) resistant to thiabendazole (TBZ) and *B. cinerea* (isolate B-27) and *P. expansum* (isolate 986-2W) sensitive to TBZ were inoculated at a concentration of 1×10^4 CFU/mL. Apples were kept at 1°C for 3 months in the case of 'Gala', and 4 months for 'McIntosh', when they were rated for decay by measuring decay diameter (mean of two measurements per lesion), and percent incidence of wounds with decay. Results were analyzed using the SAS General Linear Model LS Means procedure.

RESULTS: The low rate of 0.79 g/L BIO-SAVE was ineffective against *P. expansum* and *B. cinerea* resistant to TBZ on 'McIntosh' apples (Table 1). The medium and high rates of BIO-SAVE reduced decay by TBZ resistant *P. expansum* by reducing the mean diameter of decay by 29, and 21% respectively. All three rates of BIO-SAVE reduced decay caused by *B. cinerea* sensitive to TBZ. On 'Gala' apples all three rates of BIO-SAVE reduced decay diameter caused by TBZ sensitive *P. expansum* and TBZ resistant *B. cinerea* (Table 2).

CONCLUSIONS: The application of BIO-SAVE reduced decay but there were some inconsistencies between the rates especially for the experiment using 'McIntosh' fruit. In the 'Gala' experiment the variability was not as high and BIO-SAVE gave good general control of both blue and gray mold.

Table 1. Use of BIO-SAVE to control blue and gray mold of 'McIntosh' apples stored for 4 months at 1°C

Treatment[1]	Rate (g/L)	Lesion diameter[2]		%Infected apples	
		Penicillium expansum		*Botrytis cinerea*	
		986-2W (S)	1790 (R)	B-27 (S)	B-104 (R)
Control	---	27.3 b[3]	34.6 ab	36.4 a	11.6 a
BIO-SAVE	0.79	49.4 a	41.0 a	15.6 b	11.6 a
BIO-SAVE	1.59	38.4 ab	24.5 b	10.0 b	11.7 a
BIO-SAVE	2.38	30.2 b	27.3 b	14.2 b	5.9 a

[1] Each treatment consisted of four replicates of eight fruit per replicate wounded once with a sterile nail.
[2] Lesion diameter was the average of two measurements taken with an electronic caliper.
[3] Numbers followed by the same letter are not statistically different at $p = 0.05$.

Table 2. Use of BIO-SAVE to control blue and gray mold of 'Gala' apples stored for 3 months at 1°C

Treatment[1]	Rate (g/L)	Lesion diameter[2]			
		Penicillium expansum		*Botrytis cinerea*	
		986-2W (S)	1790 (R)	B-27 (S)	B-104 (R)
Control	---	27.2 a[3]	22.3 a	33.7 a	41.0 a
BIO-SAVE	0.79	19.9 b	16.3 b	24.8 ab	22.0 b
BIO-SAVE	1.59	18.9 b	22.2 a	15.9 b	12.4 b
BIO-SAVE	2.38	18.1 b	17.0 b	21.3 ab	13.3 b

[1] Each treatment consisted of four replicates of eight fruit per replicate wounded once with a sterile nail.
[2] Lesion diameter was the average of two measurements taken with an electronic caliper.
[3] Numbers followed by the same letter are not statistically different at $p = 0.05$.

2005 PMR REPORT #63

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

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

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TITLE: **EFFECT OF PRE-HARVEST FUNGICIDES ON THE CONTROL OF GRAY AND BLUE MOLD DECAY ON 'JONAGOLD' APPLES IN 2004**

MATERIALS: CALCIUM CHLORIDE (Dow Flake Process Grade 77-80%), MERTECT 45% flowable (thiabendazole), SCALA SC (pyrimethanil), SENATOR 70 WP (thiophanate-methyl), VANGARD 75 WG (cyprodinil)

METHODS: Fungicide treatments were applied to Jonagold apple trees arranged in a randomized complete block design with five replicate blocks for each treatment. Each block consisted of four cv. Jonagold trees with guard cv. Gala trees on either side. Treatments were an unsprayed check, SCALA (800 g ai/ha) four weeks pre-harvest, SCALA (800 g ai/ha) two weeks pre-harvest, SCALA (800 g ai/ha) four weeks pre-harvest plus a CALCIUM treatment (12 kg/ha or 500 g/100 L water applied to runoff) one week before harvest, SCALA (800 g ai/ha) two weeks pre-harvest plus a CALCIUM treatment (12 kg/ha or 500 g/100 L applied to runoff) one week before harvest, SENATOR (1.6 kg ai/ha) two weeks pre-harvest, and SENATOR (800 g ai/ha) plus VANGARD (170 g ai/ha) at two weeks pre-harvest. Pre-harvest sprays were applied four and two weeks before harvest on 20 August and 3 September, respectively. Spray applications were made using a hand operated gun sprayer (345 Kpa) to run off in volumes of 225 L water/ha. Apple fruit were harvested on 20 September, 2004 and half the control fruit were treated by dipping for 30 seconds in MERTECT (0.45 mL ai/L). After the fruit dried they were divided into samples of 10 apples per replicate with six apples for the control treatments and each apple was wounded with a sterile nail (3.0 mm in diameter). The fruit was then inoculated by dipping into a spore suspension of 10^4 conidia/ml of *Botrytis cinerea* or *Penicillium expansum*, and kept at 1°C for 3 months when lesion diameter was measured using an electronic caliper. Each lesion was measured twice and the two readings were averaged. After 6 months storage the fruit were again wounded and dip inoculated as above but kept at 20°C until measurable lesions occurred. Lesion diameter was measured as above. Data were analyzed using the General Linear Model (SAS Institute, Cary, NC) and means were separated using the Duncan's Multiple Range comparative test ($p = 0.05$).

RESULTS: After the 'Jonagold' apples had been stored for 4 months the SCALA treatments showed less decay for both *B. cinerea* and *P. expansum* (Table 1). The length of the pre-harvest interval (PHI) did not improve SCALA effectiveness except when an extra application of CALCIUM was applied. In this case the 14 day PHI appeared to improve effectiveness. The results for decay incidence after 4 months was similar with SCALA treatments being the most effective (Table 2). SENATOR plus VANGARD was effective on *B. cinerea* reducing the incidence of decay to similar levels as SCALA. Likely it was the VANGARD component of the combination that reduced decay because SENATOR alone was ineffective.

After 6 months storage only SCALA plus CALCIUM significantly reduced decay in one *P. expansum* isolate (Table 3). Both SCALA with/without CALCIUM and VANGARD were effective in reducing decay by *B. cinerea.* None of the treatments were effective in reducing percent incidence of *P. expansum* infection (Table 4). Incidence of *B. cinerea* was reduced by SCALA with/without CALCIUM and VANGARD.

CONCLUSION: SCALA is an effective fungicide for reducing post-harvest decay whether it is applied 14 or 28 days before harvest for control of both *P. expansum* and *B. cinerea* although it is more effective on *B. cinerea*. CALCIUM could enhance the effectiveness of SCALA. VANGARD is not effective against *P. expansum* but is as effective as SCALA for control of *B. cinerea*. In this trial SENATOR was ineffective against both fungi.

Table 1. Mean severity of post-harvest decay for 'Jonagold' apples treated with pre-harvest fungicides, wounded and inoculated after harvest and kept for 3 months in air storage at 1°C

Treatment[1] (g ai/ha)	Days applied before harvest	Lesion diameter (mm)		% decay	
		Penicillium expansum		*Botrytis cinerea*	
		986-2W(S)	1790 (R)	B-27 (S)	B-104 (R)
Control	---	49.5 a	46.4 a	77.2 a	65.7 a
MERTECT (0.45 mL)	0	38.8 b	46.3 a	65.8 a	60.2 a
SCALA (800)	28	23.7 d	19.9 bc	26.1 b	22.4 b
SCALA (800)	14	26.5 cd	18.2 bc	27.8 b	17.1 bc
SCALA (800) + CA (12,000)	28	29.7 bcd	25.2 b	30.7 b	15.6 bc
SCALA (800) + CA (12,000)	14	21.0 d	14.7 c	26.3 b	10.3 c
SENATOR (1,600)		51.8 a	52.0 a	69.3 a	60.5 a
SENATOR (800) + VANGARD (170)	14	35.9 bc	45.2 a	40.0 b	25.7 b

[1] Mean of three replicates of 10 apples per replicate (6 for the control). Each apple was wounded once, and then inoculated with *Botrytis cinerea* or *Penicillium expansum* isolates that were either thiabendazole sensitive (S) or thiabendazole resistant (R).

[2] Numbers followed by the same letter are not statistically different at the $p = 0.05$ level.

Table 2. Mean incidence of post-harvest decay for 'Jonagold' apples treated with pre-harvest fungicides, wounded and inoculated after harvest and kept for 3 months air storage at 1°C

Treatment[1] (g ai/ha)	Days applied before harvest	% Decay incidence			
		Penicillium expansum		*Botrytis cinerea*	
		986-2W (S)	1790 (R)	B-27 (S)	B-104 (R)
Control	---	100.0 a[2]	100.0 a	96.7 a	96.7 a
MERTECT (0.45 mL)	0	100.0 a	76.7 abc	90.0 ab	100.0 a
SCALA (800)	28	48.2 bc	52.0 bcd	57.5 c	51.7 b
SCALA (800)	14	40.0 bc	48.7 cd	46.0 c	31.9 bc
SCALA (800) + CA (12,000)	28	54.9 b	66.0 bcd	45.3 c	38.0 bc
SCALA (800) + CA (12,000)	14	26.0 c	46.7 d	50.0 c	24.2 c
SENATOR (1,600)	14	100.0 a	100.0 a	96.0 a	100.0 a
SENATOR (800) + VANGARD (170)	14	90.0 a	79.8 ab	65.0 bc	56.5 b

[1] Mean of three replicates of 10 apples per replicate (6 for the control). Each apple was wounded once, and then inoculated with *Botrytis cinerea* or *Penicillium expansum* isolates that were either thiabendazole sensitive (S) or thiabendazole resistant (R).

[2] Numbers followed by the same letter are not statistically different at the $p = 0.05$ level.

Table 3. Mean severity of post-harvest decay for 'Jonagold' apples treated with pre-harvest fungicides, wounded and inoculated after 6 months air storage at 1°C, and incubated at 20°C for 5 days

Treatment[1] (g ai/ha)	Days applied before harvest	Lesion diameter (mm)			
		Penicillium expansum		*Botrytis cinerea*	
		986-2W (S)	1790 (R)	B-27 (S)	B-104 (R)
Control	---	28.3 a[2]	28.4 a	45.0 a	38.0 a
MERTECT (0.45 mL)	0	26.4 a	27.9 a	43.1 a	36.7 a
SCALA (800)	28	25.8 a	26.7 ab	20.1 bc	14.2 b
SCALA (800)	14	26.6 a	28.0 a	14.7 cd	8.3 c
SCALA (800) + CA (12,000)	28	28.0 a	25.1 bc	24.4 b	13.8 bc
SCALA (800) + CA (12,000)	14	26.8 a	24.0 c	9.6 d	9.6 bc
SENATOR (1,600)	14	28.0 a	29.0 a	42.1 a	38.1 a
SENATOR (800) + VANGARD (170)	14	26.5 a	28.3 a	14.1 cd	11.3 bc

[1] Mean of three replicates of 10 apples per replicate (6 for the control). Each apple was wounded once, and then inoculated with *Botrytis cinerea* or *Penicillium expansum* isolates that were either thiabendazole sensitive (S) or thiabendazole resistant (R).

[2] Numbers followed by the same letter are not statistically different at the $p = 0.05$ level.

Table 4. Mean incidence of post-harvest decay for 'Jonagold' apples treated with pre-harvest fungicides, wounded and inoculated after 6 months air storage at 1°C, and incubated at 20°C for 5 days

Treatment[1] (g ai/ha)	Days applied before harvest	% Decay incidence			
		Penicillium expansum		*Botrytis cinerea*	
		986-2W (S)	1790 (R)	B-27 (S)	B-104 (R)
Control	---	100.0 a[2]	100.0 a	100.0 a	100.0 a
MERTECT (0.45 mL)	0	100.0 a	100.0 a	100.0 a	100.0 a
SCALA (800)	28	95.0 a	97.5 a	47.5 bc	45.0 b
SCALA (800)	14	94.0 a	98.0 a	39.0 bc	22.0 b
SCALA (800) + CA (12,000)	28	100.0 a	94.7 a	60.0 b	32.3 b
SCALA (800) + CA (12,000)	14	96.0 a	86.5 b	24.4 c	25.2 b
SENATOR (1,600)	14	100.0 a	100.0 a	98.0 a	100.0 a
SENATOR (800) + VANGARD (170)	14	100.0 a	100.0 a	35.0 bc	27.5 b

[1] Mean of three replicates of 10 apples per replicate (6 for the control). Each apple was wounded once, and then inoculated with *Botrytis cinerea* or *Penicillium expansum* isolates that were either thiabendazole sensitive (S) or thiabendazole resistant (R).

[2] Numbers followed by the same letter are not statistically different at the $p = 0.05$ level.

2005 PMR REPORT #64

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

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

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TITLE: **EFFECT OF PRE-HARVEST PYRIMETHANIL ON THE CONTROL OF GRAY AND BLUE MOLD DECAY ON 'GALA' APPLES IN 2004**

MATERIALS: CALCIUM CHLORIDE (Dow Flake Process Grade 77-80%), MERTECT 45% flowable (thiabendazole), SCALA SC (pyrimethanil)

METHODS: Fungicide treatments were applied to 'Gala' apple trees arranged in a randomized complete block design with six replicate blocks for each treatment. Each block consisted of a row of four 'Gala' trees with 'Spartan' guard trees at each end. Treatments were an unsprayed check, SCALA (800 g ai/ha) four weeks pre-harvest, SCALA (800 g ai/ha) two weeks pre-harvest, SCALA (800 g ai/ha) four weeks pre-harvest plus a CALCIUM treatment (12 kg/ha or 500 g/100 L water applied to runoff) one week before harvest, SCALA (800 g ai/ha) two weeks pre-harvest plus a CALCIUM treatment (12 kg/ha or 500 g/100 L applied to runoff) one week before harvest. Pre-harvest sprays were applied four and two weeks before harvest on 6 and 20 August, 2004, respectively. Spray applications were made using a hand operated gun sprayer (345 Kpa) to run off in volumes of 225 L water/ha. Apple fruit were harvested on 8 September, 2004 and half the control fruit were treated by dipping for 30 seconds in MERTECT (0.45 mL ai/L). After the fruit dried they were divided into samples of 12 apples per replicate (8 fruit for control treatments) and each apple was wounded with a sterile nail (3.0 mm in diameter). The fruit was then inoculated by dipping into a spore suspension of 10^4 conidia/ml of *Botrytis cinerea* or *Penicillium expansum*, and kept at 1°C for 3 months when lesion diameter was measured using an electronic caliper. Each lesion was measured twice and the two readings were averaged. After 6 months storage the fruit were again wounded and dip inoculated as above but kept at 20°C until measurable lesions occurred. Lesion diameter was measured as above. Data were analyzed using the General Linear Model (SAS Insitute, Cary, NC) and means were separated using the Duncan's Multiple Range comparative test (p = 0.05).

RESULTS: After the 'Gala' apples had been stored for 4 months the SCALA treatments applied 14 days before harvest showed the least decay for both *B. cinerea* and *P. expansum* (Table 1). The application of an extra CALCIUM treatment 7 days before harvest improved decay control on apples treated 28 days before harvest with SCALA in two of the isolates. The results for decay incidence after 4 months was similar with the 14 day SCALA treatments being the most effective (Table 2). After 6 months storage the 14 day SCALA treatment was the most effective in reducing decay diameter (Table 3). The application of CALCIUM did not appear to have any effect on reducing lesion diameter after either 14 or 28 days. The results for SCALA were similar for reducing incidence of decay with the day treatment being the most effective (Table 4).

CONCLUSION: SCALA is more effective in reducing decay caused by both *P. expansum* and *B. cinerea* if it is used 14 days before harvest rather than 28 days before harvest. Generally it is more effective in controlling *B. cinerea* than *P. expansum* and works equally well on thiabendazole resistant isolates of either fungus.

Table 1. Mean severity of postharvest decay for 'Gala' apples treated with preharvest fungicides, wounded and inoculated after harvest and kept for 3 months in air storage at 1°C

Treatment[1] (g ai/ha)	Days applied before harvest	Lesion diameter (mm)		% decay	
		Penicillium expansum		*Botrytis cinerea*	
		986-2W (S)	1790 (R)	B-27 (S)	B-104 (R)
Control	---	31.0 a	31.6 a	83.6 a	62.1 a
MERTECT (0.45 mL/L)	0	17.0 b	30.5 a	87.2 a	61.9 a
SCALA (800)	28	15.9 b	11.9 b	41.0 b	20.8 b
SCALA (800)	14	7.0 cd	4.7 c	6.5 d	3.8 c
SCALA (800) + CA (12,000)	28	10.9 c	11.3 b	28.0 c	17.6 b
SCALA (800) + CA (12,000)	14	5.2 d	4.2 c	14.3 d	4.2 c

[1] Mean of three replicates of 12 apples per replicate (8 for the control). Each apple was wounded once, and then inoculated with *Botrytis cinerea* or *Penicillium expansum* isolates that were either thiabendazole sensitive (S) or thiabendazole resistant (R).

[2] Numbers followed by the same letter are not statistically different at the $p = 0.05$ level.

Table 2. Mean incidence of post-harvest decay for 'Gala' apples treated with pre-harvest fungicides, wounded and inoculated after harvest and kept for 3 months air storage at 1°C

Treatment[1] (g ai/ha)	Days applied before harvest	% Decay incidence			
		Penicillium expansum		*Botrytis cinerea*	
		986-2W (S)	1790 (R)	B-27 (S)	B-104 (R)
Control	---	95.8 a[2]	95.8 a	91.7 a	95.8 a
MERTECT (0.45 mL)	0	47.9 bc	91.1 a	97.9 a	91.4 a
SCALA (800)	28	55.0 b	33.3 b	62.5 b	34.7 b
SCALA (800)	14	20.8 de	9.7 c	19.7 d	8.3 c
SCALA (800) + CA (12,000)	28	32.3 cd	38.3 b	44.5 c	30.4 b
SCALA (800) + CA (12,000)	14	10.0 e	8.5 c	28.3 cd	10.2 c

[1] Mean of three replicates of 12 apples per replicate (8 for the control). Each apple was wounded once, and then inoculated with *Botrytis cinerea* or *Penicillium expansum* isolates that were either thiabendazole sensitive (S) or thiabendazole resistant (R).

[2] Numbers followed by the same letter are not statistically different at the $p = 0.05$ level.

Table 3. Mean severity of post-harvest decay for 'Gala' apples treated with pre-harvest fungicides, wounded and inoculated after 6 months air storage at 1°C, and incubated at 20°C for 5 days.

Treatment[1] (g ai/ha)	Days applied before harvest	Lesion diameter (mm)			
		Penicillium expansum		*Botrytis cinerea*	
		986-2W (S)	1790 (R)	B-27 (S)	B-104 (R)
Control	---	19.2 a[2]	19.5 a	38.0 a	14.3 a
SCALA (800)	28	13.6 b	13.5 b	10.0 b	5.5 bc
SCALA (800)	14	4.6 d	7.6 c	3.6 c	3.4 c
SCALA (800) + CA (12,000)	28	12.0 b	12.9 b	9.0 b	6.2 b
SCALA (800)+ CA (12,000)	14	7.7 c	9.0 c	4.5 c	3.0 c

[1] Mean of three replicates of 12 apples per replicate (8 for the control). Each apple was wounded once, and then inoculated with *Botrytis cinerea* or *Penicillium expansum* isolates that were either thiabendazole sensitive (S) or thiabendazole resistant (R).

[2] Numbers followed by the same letter are not statistically different at the $p = 0.05$ level.

Table 4. Mean incidence of post-harvest decay for 'Gala' apples treated with pre-harvest fungicides, wounded and inoculated after 6 months air storage at 1°C, and incubated at 20°C for 5 days

Treatment[1] (g ai/ha)	Days applied before harvest	% Decay incidence			
		Penicillium expansum		*Botrytis cinerea*	
		986-2W (S)	1790 (R)	B-27 (S)	B-104 (R)
Control	---	87.5 a[2]	100.0 a	100.0 a	53.0 a
SCALA (800)	28	60.7 b	69.2 b	23.6 b	11.3 b
SCALA (800)	14	12.0 c	30.6 c	2.8 c	1.4 b
SCALA (800) + CA (12,000)	28	54.2 b	65.3 b	18.1 bc	15.5 b
SCALA (800) + CA (12,000)	14	30.4 c	38.3 c	6.7 bc	0.0 b

[1] Mean of three replicates of 12 apples per replicate (8 for the control). Each apple was wounded once, and then inoculated with *Botrytis cinerea* or *Penicillium expansum* isolates that were either thiabendazole sensitive (S) or thiabendazole resistant (R).

[2] Numbers followed by the same letter are not statistically different at the $p = 0.05$ level.

2003 PMR REPORT #65

SECTION K: DISEASES OF FRUIT
STUDY DATA BASE: 402-1531-8605

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

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TITLE: EVALUATION OF ORGANIC PRODUCTS FOR CONTROL OF POWDERY MILDEW ON GALA APPLE, 2002

MATERIALS: NOVA 40 W (myclobutanil), IBR (INTERNATIONAL BIO-RECOVERY) liquid + AGRAL spreader (Nonylphenoxy polyethoxy ethanol 90%), TRILOGY (Neem oil 70%)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 9-year-old Gala apple trees on M9 rootstocks spaced at 2.0 x 5.0 m. Average volume of water applied per tree was 4 litres for a total of 3000 litres per hectare. Treatments and rates were IBR (2 L) + AGRAL (0.025 L), NOVA (11.3 g), and TRILOGY (1 L) per 100 litres of water. Twenty trees were separated into 5 blocks of 4 random single tree replicates per block. The treatments were applied until run-off with a Solo backpack sprayer. Treatments were applied on 3 May (Pink), 16 May (Full bloom), 30 May (First cover), 13 June (Second cover), 27 June (Third cover), 11 July (Fourth cover), and 1 August (Fifth cover). Secondary powdery mildew incidence and severity were evaluated on 9 July, 23 August and 17 September by rating 10 leaves on 5 shoots per tree for percent area covered by powdery mildew. Fruit mildew was determined 17 September on 30 harvested apples from each single tree replicate by evaluating each fruit for net russetting. These values were converted to percent infected leaves per tree, mean severity per leaf, and percent russetted fruit. Values as proportions, were arcsin-transformed and subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller Duncan's k-ratio t-test (k=100) was used for multiple comparison of means.

RESULTS and DISCUSSION: Incidence of powdery mildew on apple foliage was relatively high in this trial and was found on 94% of the leaves by 23 August (Table 1). Early in the growing season TRILOGY provided control that was as effective as NOVA. The IBR liquid plus AGRAL spreader reduced the severity of powdery mildew after the first and second readings. NOVA was the only material to reduce incidence and severity of foliar powdery mildew in September. Powdery mildew fruit russetting did not occur on any of the control apples (Table 2). Apparently TRILOGY will increase the incidence of fruit russetting on Gala apples although the severity of the russetting is very low at 1.6%.

CONCLUSIONS: TRILOGY and the IBR liquid plus AGRAL spreader reduced severity of powdery mildew on Gala apple but were not as effective as NOVA. TRILOGY may be slightly phytotoxic to apple fruit and cause increased russetting on mature apple fruit.

Table. 1. Percent powdery mildew on foliage of Gala apple trees after treatment with TRILOGY, IBR, NOVA

Treatment[1] rate per 100 L or (kg/ha)	%Foliage Powdery Mildew					
	July 9		August 23		September 17	
	Incidence	Severity	Incidence	Severity	Incidence	Severity
Control	79.2 a[2]	17.7 a	94.0 a	31.5 a	46.4 a	9.3 a
TRILOGY 1 L (30 L/ha)	51.6 b	6.0 b	73.6 a	10.7 b	47.6 a	6.4 a
IBR 2 L (60 L/ha) + AGRAL 0.025 L (0.75 L/ha)	61.6 ab	7.2 b	76.8 a	11.8 b	37.6 a	7.0 a
NOVA 11.3 (0.34 kg/ha)	44.8 b	4.3 b	81.2 a	8.4 b	5.6 b	0.3 b
ANOVA Pr>F	0.0204	0.0132	0.1169	0.0047	0.0131	0.0067

[1] Control was non-sprayed, TRILOGY, IBR + AGRAL, and NOVA were applied with a backpack sprayer on 3, 16, 30 May, 13 and 27 June, 11 July and 1 August, 2002.

[2] Powdery mildew data were arcsin transformed prior to analysis of variance. The actual means are presented here. Numbers followed by the same letter are not significantly different (k= 100) as decided by the Waller Duncan k-ratio t-test.

Table 2 . Percent Gala apples russetted at harvest after treatment with IBR liquid, NOVA, or TRILOGY

Treatment[1] rate per 100 L or (kg/ha)	Powdery mildew fruit russetting	
	Incidence	Severity
Control	0.0 b[2]	0.0 b
TRILOGY 1 L (30 L/ha)	18.0 a	1.6 a
IBR 2 L (60 L/ha) + AGRAL 0.025 L (0.75 L/ha)	1.3 ab	0.2 ab
NOVA 11.3 (0.34 kg/ha)	1.3 ab	0.1 b
Pr>F	0.0589	0.0533

[1] Control was non-sprayed, TRILOGY, IBR + AGRAL, and NOVA were applied with a backpack sprayer on 3, 16, 30 May, 13 and 27 June, 11 July and 1 August, 2002.

[2] Powdery mildew data were arcsin transformed prior to analysis of variance. The actual means are presented here. Numbers followed by the same letter are not significantly different (k= 100) as decided by the Waller Duncan k-ratio t-test.

2003 PMR REPORT #66

SECTION K: DISEASES OF FRUIT
STUDY DATA BASE: 402-1531-8605

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

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TITLE: EFFICACY OF GWC (GROWING WITH CARE) PRODUCTS AGAINST POWDERY MILDEW ON APPLE, 2002

MATERIALS: FLINT 50 WG (trifloxystrobin), NOVA 40 WP (myclobutanil) SOVRAN 50 WG (kresoxim methyl), POLYRAM 80 DF (metiram), KUMULUS S (sulphur 80%), SODIUM BICARBONATE + STYLET OIL 1%, MINERAL CLAY + SYLGARD (glacial marine clay + siloxylated polyesther 76%), SEA BUCKTHORN (SBT) juice (cv. Indian Summer); SBT pulp oil.

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 15-year-old Jonagold apple trees on M7a rootstocks spaced at 3.0 x 6.0 m. The statistical design of the trial was the randomized complete block with 10 treatments replicated five times on single tree replicates. Average volume of water applied per tree was 4 L for a total of 3000 L per hectare. Treatment quantities for each 100 L of water were based on these water volumes. Fifty trees were separated into five blocks of 10 random single tree replicates per block. All nine treatments except SBT were applied until run-off with a handgun operated at approximately 400 kPa. The GWC-1, GWC-2, MINERAL CLAY and SBT program treatment rates and application dates were as follows: GWC-1 program consisted of POLYRAM (200g/100 L) applied on 24 April (Tight cluster), POLYRAM (200 g/100 L) tank mixed with NOVA (11.3 g/100 L) on 7 May (Pink), VANGARD (12.3 g/100 L) on 14 May (Late bloom), POLYRAM (200 g/100 L) tank mixed with NOVA (11.3 g/100 L) on 23 May (Petal fall); GWC-2 program consisted of POLYRAM (200g/100 L) applied on 24 April, POLYRAM (200 g/100 L) tank mixed with NOVA (11.3 g/100 L) on 7 May, VANGARD (12.3 g/100L) on 14 May, POLYRAM (200 g/100 L) tank mixed with NOVA (11.3 g/100 L) on 23 May, KUMULUS (200 g/100 L) on 31 May, 11, 20, 26 June, 3,17 July; MINERAL CLAY program consisted of NOVA (11.3 g/100 L) applied on 24 April, and 7 May, MINERAL CLAY (4 kg/100 L) tank mixed with SYLGARD (0.25%) on 24, 31 May, 11, 20, 26 June, 3,17 July; and the SBT Program consisted of SBT pulp oil (1%) applied with a Solo backpack sprayer on 3 May, followed by undiluted Indian Summer SBT juice on 17, 30 May, 13, 27 June, 11 July, and 1 August. The other six treatments consisted of the unsprayed control, KUMULUS S (200 g/ 100 L), SODIUM BICARBONATE (1 kg/ 100 L) + STYLET OIL (1%), SOVRAN (8.0 g/100 L), FLINT (5.0 g/100 L), and NOVA (11.3 g/100 L) applied on 24 April, 7, 15, 23, 31 May, 11, 20, 26 June, and 3, 17 July. Primary powdery mildew was assessed on 10 May by counting the total number of primary branch terminals with white tips on each single tree replicate. Secondary foliage powdery mildew incidence and severity were evaluated on 3 July and 9 August by rating 10 leaves on 5 shoots per tree for percent area covered by powdery mildew. Fruit mildew was determined 24 September on 25 harvested apples from each single tree replicate by evaluating each fruit for net russetting and sunburn. These values were converted to percent infected leaves per tree, mean severity per leaf, and percent russetted or sunburned fruit. Values were arcsin-transformed and subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan k-ratio t test (k = 100) was used for multiple comparison of means.

RESULTS and DISCUSSION: Treatment with NOVA, FLINT and SOVRAN reduced the number of white tips which are the source of primary powdery mildew in apple (Table 1). Growing with Care (GWC) programs 1 and 2 both reduced powdery mildew after the first reading in July. GWC-2 remained effective after the second reading in August along with SODIUM BICARBONATE tank mixed with STYLET OIL. However as previously noted with Stylet oil there was some burning and yellowing of the foliage. It was also observed that a higher percentage of the Sodium bicarbonate treated fruit had bitter

pit. KUMULUS was not effective after the August rating. The MINERAL CLAY program was very effective in controlling foliar powdery mildew but caused damage to fruit. In this case the lenticels were damaged and appeared black. It appears that SYLGARD in combination with MINERAL CLAY damages fruit and they should not be used together. As expected, the fungicide standard treatments, SOVRAN and NOVA and the new FLINT treatment were very effective. SBT juice was generally ineffective although it did reduce disease severity on one occasion in August. SBT juice may have been ineffective because the first application was missed in April and treatments were applied every two weeks rather than weekly. The material effectively controlled powdery mildew in the greenhouse when applied weekly even when used at one half the rate that was used in this trial. SBT juice caused a serious specific type of russetting on Jonagold apples. Further research will be required in order to use SBT juice without damage to fruit. Possibly a lower rate or the exclusive use of the pulp oil fraction would not have damaged the fruit surface.

CONCLUSIONS: GWC-2 program provides slighltly better control of powdery mildew than the use of consecutive applications of KUMULUS. GWC-1 program which involves only four applications of fungicides is not effective for the control of powdery mildew. SODIUM BICARBONATE with STYLET OIL proved to be very effective in this trial and should be tested again. Apparently natural russetting caused by powdery mildew or sunburn did not occur in this trial (Table 2).

Table 1. Number of branch terminals with white tips and percent foliar powdery mildew on 15-year-old Jonagold apple trees treated with various spray materials

Treatment[1] and rate per 100 L	White tips	3 July		9 August	
		Incidence	Severity	Incidence	Severity
Control	20.4 a[2]	82.8 a	17.0 a	74.0 a	16.7 a
KUMULUS 200 g	20.4 a	51.6 b	6.9 c	36.8 b	4.7 c
SBT juice	18.5 a	78.5 a	15.1 ab	63.0 a	7.9 b
GWC-1 program	11.8 abc	51.2 b	11.8 b	62.4 a	14.0 a
GWC-2 program	16.6 ab	37.6 b	3.2 d	32.0 b	4.2 c
SODIUM BICARBONATE 1 kg + STYLET OIL 1%	10.2 abc	40.0 b	3.6 d	33.6 b	3.1 cd
SOVRAN 8.0 g	7.4 bc	14.8 cd	0.9 e	15.2 c	1.0 e
FLINT 5.0 g	6.2 bc	22.0 c	1.5 de	22.0 bc	2.5 cde
CLAY program	5.4 c	8.0 d	0.8 e	16.4 c	1.4 de
NOVA 11.3 g	3.8 c	6.8 d	0.4 e	10.4 c	0.7 e
Anova Pr>F	0.0042	<.0001	<.0001	<.0001	<.0001

[1] The GWC-1, GWC-2, MINERAL CLAY and SBT program treatment rates and application dates were as follows: GWC-1 program consisted of POLYRAM (200g/100 L) applied on 24 April (Tight cluster), POLYRAM (200 g/100 L) tank mixed with NOVA (11.3 g/100 L) on 7 May (Pink), VANGARD (12.3 g/100 L) on 14 May (Late bloom), POLYRAM (200 g/100 L) tank mixed with NOVA (11.3 g/100 L) on 23 May (Petal fall); GWC-2 program consisted of POLYRAM (200g/100 L) applied on 24 April, POLYRAM (200 g/100 L) tank mixed with NOVA (11.3 g/100 L) on 7 May, VANGARD (12.3 g/100L) on 14 May, POLYRAM (200 g/100 L) tank mixed with NOVA (11.3 g/100 L) on 23 May, KUMULUS (200 g/100 L) on 31 May, 11, 20, 26 June, 3,17 July; MINERAL CLAY program consisted of NOVA (11.3 g/100 L) applied on 24 April, and 7 May, MINERAL CLAY (4 kg/100 L) tank mixed with SYLGARD (0.25%) on 24, 31 May, 11, 20, 26 June, 3,17 July; and the SBT Program consisted of SBT pulp oil (1%) applied with a Solo backpack sprayer on 3 May, followed by undiluted Indian Summer SBT juice on 17, 30 May, 13, 27 June, 11 July, and 1 August. The other six treatments consisted of the unsprayed control, KUMULUS S (200 g/ 100 L), SODIUM BICARBONATE (1 kg/ 100 L) + STYLET OIL (1%), SOVRAN (8.0 g/100 L), FLINT (5.0 g/100 L), and NOVA (11.3 g/100 L) applied on 24 April, 7, 15, 23, 31 May, 11, 20, 26 June, and 3, 17 July

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[2] These data were arcsin transformed prior to analysis of variance. The actual means are presented here. Means followed by the same letter are not significantly different according to the Waller-Duncan k-ration t test (k = 100).

Table 2. Percent of Jonagold apples with powdery mildew fruit russetting and sunburn after pre and post bloom fungicidal treatments

Treatment[1] and rate per 100 L	%Powdery mildew fruit russetting		%Sunburn
	Incidence	Severity	Incidence
Control	1.6 b[2]	0.2 b	3.4 a
KUMULUS 200 g	4.0 b	0.5 b	5.0 a
SBT juice	61.5 a	6.7 a	1.8 a
GWC-1 program	0.0 b	0.0 b	3.2 a
GWC-2 program	2.4 b	0.4 b	4.0 a
SODIUM BICARBONATE 1 kg + STYLET OIL 1%	0.0 b	0.0 b	3.6 a
SOVRAN 8.0 g	0.0 b	0.0 b	0.8 a
FLINT 5.0 g	0.0 b	0.0 b	4.0 a
CLAY program	3.2 b	0.2 b	1.6 a
NOVA 11.3 g	0.8 b	0.1 b	3.4 a
Anova Pr>F	<.0001	<.0001	0.3683

[1] The GWC-1, GWC-2, MINERAL CLAY and SBT program treatment rates and application dates were as follows: GWC-1 program consisted of POLYRAM (200g/100 L) applied on 24 April (Tight cluster), POLYRAM (200 g/100 L) tank mixed with NOVA (11.3 g/100 L) on 7 May (Pink), VANGARD (12.3 g/100 L) on 14 May (Late bloom), POLYRAM (200 g/100 L) tank mixed with NOVA (11.3 g/100 L) on 23 May (Petal fall); GWC-2 program consisted of POLYRAM (200g/100 L) applied on 24 April, POLYRAM (200 g/100 L) tank mixed with NOVA (11.3 g/100 L) on 7 May, VANGARD (12.3 g/100L) on 14 May, POLYRAM (200 g/100 L) tank mixed with NOVA (11.3 g/100 L) on 23 May, KUMULUS (200 g/100 L) on 31 May, 11, 20, 26 June, 3,17 July; MINERAL CLAY program consisted of NOVA (11.3 g/100 L) applied on 24 April, and 7 May, MINERAL CLAY (4 kg/100 L) tank mixed with SYLGARD (0.25%) on 24, 31 May, 11, 20, 26 June, 3,17 July; and the SBT Program consisted of SBT pulp oil (1%) applied with a Solo backpack sprayer on 3 May, followed by undiluted Indian Summer SBT juice on 17, 30 May, 13, 27 June, 11 July, and 1 August. The other six treatments consisted of the unsprayed control, KUMULUS S (200 g/ 100 L), SODIUM BICARBONATE (1 kg/ 100 L) + STYLET OIL (1%), SOVRAN (8.0 g/100 L), FLINT (5.0 g/100 L), and NOVA (11.3 g/100 L) applied on 24 April, 7, 15, 23, 31 May, 11, 20, 26 June, and 3, 17 July.

[2] These data were arcsin transformed prior to analysis of variance. The actual means are presented here. Means followed by the same letter are not significantly different according to the Waller-Duncan k-ration t test (k = 100).

2005 PMR REPORT #67

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WSBE E.0086.61

CROP: Apple cv. 'Aurora Golden Gala'
PEST: Fire Blight, *Erwinia amylovora* (Burrill) Winslow et al.

NAME AND AGENCY:
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TITLE: EFFICACY OF TANOS FOR THE CONTROL OF FIRE BLIGHT ON APPLE, 2005.

MATERIALS: KOCIDE 2000 (copper hydroxide 53.8%), UAP STREPTOMYCIN 17 (streptomycin sulfate 22.5%) and TANOS 50 DF (famoxadone 25%/cymoxanil 25%).

METHODS: The trial was conducted in a screen-house at the Pacific Agri-Food Research Centre in Summerland, BC. It included one year-old 'Aurora Golden Gala' apple trees on B9 rootstocks. On 2 and 28 June 2005, 25 bare root trees were planted in 5-gallon pots containing Premier Pro-Mix growing media (Premier Horticulture Ltd, Riviere-du-Loup, Quebec). The roots were trimmed. The second group of 25 trees, planted on 28 June 2005, were kept in a cold room at 3°C until 20 July and used for the second trial. The trees were irrigated as needed and fertilized with 10-52-10 (5 g/L) and Evercote 13-13-13 at 100 g/tree (Greenhouse & Nursery Acer Professional Fertilizer manufactured for WestGro Sales, Delta, BC) at planting. Each tree was a single replicate and each treatment was replicated 4 times according to the randomized block design. Trees were separated from one another by one meter on all sides and were arranged in 5 rows within the screen-house. For the first trial, the treatments were applied with a spray bottle (75 ml/tree) on 21 June (20% bloom) and 23 June (Full bloom). Blossoms were inoculated on 24 June with a cell suspension of *Erwinia amylovora* (Ea2325) of 1.4 x 10^7 CFU/ml grown in nutrient broth for 24 hours. In the second trial, the surfactant REGULAID (3 ml/L) was added to TANOS, TANOS/KOCIDE, STREPTOMYCIN and sprayed alone on the control trees. The treatments were applied with a spray bottle (75 ml/tree) on 31 July (25% bloom) and 2 August (Full bloom). Blossoms were inoculated on 3 August with a mixture of two isolates (98-1033 & 1594) of *Erwinia amylovora* of 1.2 x 10^7 CFU/ml. In both trials, the isolates were know to be virulent to apple and sensitive to streptomycin. The suspension was sprayed with a "Solo" backpack sprayer (180 ml/tree). Forty-eight hours after the blossoms were inoculated, the trees were wetted for 3 hours with overhead sprinklers. Clusters displaying symptoms of fire blight indicated by blackening of flowers were recorded on 30 June (first trial) and 10 August (second trial) 2005. Shoots displaying symptoms of fire blight indicated by blackening and wilting were recorded on 11 July (first trial) and 15 August (second trial) 2005. Measurements were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NJ). The Waller-Duncan k-ratio t test (k = 100) was used for multiple comparison of means.

RESULTS and DISCUSSION: TANOS used alone or with REGULAID did not significantly reduce the incidence of apple fire blight on flowers or shoots (Table 1 & 2). The mix TANOS / KOCIDE was more effective and numerically reduced the incidence of fire blight on the shoots in the first trial. In the second trial, the addition of the surfactant REGULAID did not improve the efficacy of TANOS as it did for the standard antibiotic STREPTOMYCIN. There was no phytotoxicity observed in either trial.

CONCLUSION: TANOS when combined with KOCIDE is a potential material for the control of shoot blight.

Table 1. Percent 'Aurora Golden Gala' apple flower clusters and shoots blighted by *Erwinia amylovora* for the first trial

Treatment and Rate	Percent Fire Blight Incidence[1]	
	Flowers 30 June	Shoots 11 July
Untreated	59.4 a	45.0 a
TANOS 0.4 g/L	46.8 ab	52.2 a
TANOS 0.4 g/L & KOCIDE 2000 0.2 g/L	40.0 ab	27.7 a
STREPTOMYCIN 0.6 g/L	28.3 b	46.9 a
ANOVA Pr > F	0.0651	0.6449

[1] These values are means of three replications of 'Aurora Golden Gala' potted apple trees.
[2] Number followed by the same letter are not significantly different at p ≤0.05 as decided by Waller-Duncan k-ratio (k = 100) test.

Table 2. Percent 'Aurora Golden Apple' apple flower clusters and shoots blighted by *Erwinia amylovora* for the second trial.

Treatment and Rate	Percent Fire Blight Incidence [1]	
	Flowers 10 Aug	Shoots 15 Aug
Control REGULAID 0.3% only	69.0 ab[2]	53.5
TANOS 0.4 g/L & REGULAID 0.3%	76.8 a	31.3
TANOS 0.4 g/L & KOCIDE 2000 0.2 g/L & REGULAID 0.3%	64.3 ab	34.7
STREPTOMYCIN 0.6 g/L & REGULAID 0.3%	18.6 c	16.3
ANOVA Pr > F	0.0027	0.0945

[1] These values are means of four replications of 'Aurora Golden Gala' potted apple trees.
[2] Number followed by the same letter are not significantly different at p ≤0.05 as decided by Waller-Duncan k-ratio (k = 100) test.

2005 PMR REPORT #67

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WSBE E.0086.61

CROP: Apple cv. 'Aurora Golden Gala'
PEST: Fire Blight, *Erwinia amylovora* (Burrill) Winslow et al.

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TITLE: EFFICACY OF TANOS FOR THE CONTROL OF FIRE BLIGHT ON APPLE, 2005.

MATERIALS: KOCIDE 2000 (copper hydroxide 53.8%), UAP STREPTOMYCIN 17 (streptomycin sulfate 22.5%) and TANOS 50 DF (famoxadone 25%/cymoxanil 25%).

METHODS: The trial was conducted in a screen-house at the Pacific Agri-Food Research Centre in Summerland, BC. It included one year-old 'Aurora Golden Gala' apple trees on B9 rootstocks. On 2 and 28 June 2005, 25 bare root trees were planted in 5-gallon pots containing Premier Pro-Mix growing media (Premier Horticulture Ltd, Riviere-du-Loup, Quebec). The roots were trimmed. The second group of 25 trees, planted on 28 June 2005, were kept in a cold room at 3°C until 20 July and used for the second trial. The trees were irrigated as needed and fertilized with 10-52-10 (5 g/L) and Evercote 13-13-13 at 100 g/tree (Greenhouse & Nursery Acer Professional Fertilizer manufactured for WestGro Sales, Delta, BC) at planting. Each tree was a single replicate and each treatment was replicated 4 times according to the randomized block design. Trees were separated from one another by one meter on all sides and were arranged in 5 rows within the screen-house. For the first trial, the treatments were applied with a spray bottle (75 ml/tree) on 21 June (20% bloom) and 23 June (Full bloom). Blossoms were inoculated on 24 June with a cell suspension of *Erwinia amylovora* (Ea2325) of 1.4 x 10^7 CFU/ml grown in nutrient broth for 24 hours. In the second trial, the surfactant REGULAID (3 ml/L) was added to TANOS, TANOS/KOCIDE, STREPTOMYCIN and sprayed alone on the control trees. The treatments were applied with a spray bottle (75 ml/tree) on 31 July (25% bloom) and 2 August (Full bloom). Blossoms were inoculated on 3 August with a mixture of two isolates (98-1033 & 1594) of *Erwinia amylovora* of 1.2 x 10^7 CFU/ml. In both trials, the isolates were know to be virulent to apple and sensitive to streptomycin. The suspension was sprayed with a "Solo" backpack sprayer (180 ml/tree). Forty-eight hours after the blossoms were inoculated, the trees were wetted for 3 hours with overhead sprinklers. Clusters displaying symptoms of fire blight indicated by blackening of flowers were recorded on 30 June (first trial) and 10 August (second trial) 2005. Shoots displaying symptoms of fire blight indicated by blackening and wilting were recorded on 11 July (first trial) and 15 August (second trial) 2005. Measurements were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NJ). The Waller-Duncan k-ratio t test (k = 100) was used for multiple comparison of means.

RESULTS and DISCUSSION: TANOS used alone or with REGULAID did not significantly reduce the incidence of apple fire blight on flowers or shoots (Table 1 & 2). The mix TANOS / KOCIDE was more effective and numerically reduced the incidence of fire blight on the shoots in the first trial. In the second trial, the addition of the surfactant REGULAID did not improve the efficacy of TANOS as it did for the standard antibiotic STREPTOMYCIN. There was no phytotoxicity observed in either trial.

CONCLUSION: TANOS when combined with KOCIDE is a potential material for the control of shoot blight.

Table 1. Percent 'Aurora Golden Gala' apple flower clusters and shoots blighted by *Erwinia amylovora* for the first trial

Treatment and Rate	Percent Fire Blight Incidence[1]	
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STREPTOMYCIN 0.6 g/L	28.3 b	46.9 a
ANOVA Pr > F	0.0651	0.6449

[1] These values are means of three replications of 'Aurora Golden Gala' potted apple trees.
[2] Number followed by the same letter are not significantly different at p ≤0.05 as decided by Waller-Duncan k-ratio (k = 100) test.

Table 2. Percent 'Aurora Golden Apple' apple flower clusters and shoots blighted by *Erwinia amylovora* for the second trial.

Treatment and Rate	Percent Fire Blight Incidence [1]	
	Flowers 10 Aug	Shoots 15 Aug
Control REGULAID 0.3% only	69.0 ab[2]	53.5
TANOS 0.4 g/L & REGULAID 0.3%	76.8 a	31.3
TANOS 0.4 g/L & KOCIDE 2000 0.2 g/L & REGULAID 0.3%	64.3 ab	34.7
STREPTOMYCIN 0.6 g/L & REGULAID 0.3%	18.6 c	16.3
ANOVA Pr > F	0.0027	0.0945

[1] These values are means of four replications of 'Aurora Golden Gala' potted apple trees.
[2] Number followed by the same letter are not significantly different at p ≤0.05 as decided by Waller-Duncan k-ratio (k = 100) test.

2005 PMR REPORT #68

SECTION K: FRUIT – Diseases
STUDY DATA BASE: WBSE E.0104.08

CROP: Sweet Cherry (*Prunus avium*) cv. Lapins
PEST: Powdery mildew, *Podosphaera clandestina*

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TITLE: **EVALUATION OF TRIFLOXYSTROBIN FOR THE CONTROL OF POWDERY MILDEW OF CHERRIES IN 2005**

MATERIALS: FLINT 50 WG (trifloxystrobin 50% ai) and NOVA 40 WP (myclobutanil 40% ai)

METHODS: The trial was established in a seven year old planting (1998) of Lapins cherries at PARC-Summerland. Experimental design was a randomized complete block design with 4 single tree replicates. Treatments were trifloxystrobin applied at 70 g ai/ha, 87.5 g ai/ha, or 105 g ai/ha, myclobutanil as a standard applied at 136 g ai/ha and an untreated control. Four applications were made beginning at petal fall and continuing on an approximately 14 day schedule. Spray applications were made May 5 (BBCH 69), May 20 (BBCH 71), June 2 (BBCH 73) and 20 (BBCH 81), 2005 using a truck mounted 100 L conical tank gun sprayer operated at approximately 700 kPa calibrated for delivery of a timed volume per tree equivalent to 1000 L/ha (May 5, 2005) or 2000 L/ha (subsequent applications). Detailed descriptions of the individual application parameters are attached. Plants were examined for phytotoxicity after each application on May 11, May 25, June 8 and June 28, 2005. On each occasion, twenty-five leaves of each replicate tree were examined for chlorosis and necrosis expressed as a percentage of leaf area. Disease ratings for powdery mildew were conducted for foliage on May 25, June 8 and, post-harvest on August 3, 2005. Ten leaves on each of five branches per tree were examined for the percentage of area covered with powdery mildew. On July 19, 2005, one hundred cherries were harvested in a representative manner from each of the treatment trees. The weight of the cherries harvested was recorded. Cherries were individually inspected for powdery mildew. Collected data was analyzed using the SAS (Cary, North Carolina) General Linear Means LSMEANS procedure.

RESULTS: No phytotoxicity due to pesticide application was found for any of the treatments on any sampling occasion. On the first sampling occasion no phytotoxicity symptoms were observed. On subsequent monitoring occasions, some chlorosis or necrosis was observed on individual leaves of the experimental trees but no differences were found between the untreated control and treated trees (Table 1). The powdery mildew in the field was late developing, and only the harvest rating of fruit and foliage provided any analyzable data. All sprayed treatments were effective as compared to the untreated control for reduction in mildew on foliage and fruit (Table 2). The trifloxystrobin treatments were equally as effective as the myclobutanil standard. As measured by the weight of 100 cherries, no differences were found in yield between the untreated control and treated trees.

CONCLUSIONS: Trifloxystrobin is a highly effective product for the control of powdery mildew in Sweet cherries.

Table 1. Percent incidence of phytotoxicity symptoms on Lapins cherry leaves treated with various fungicides.

Treatment	Rate	Incidence of Phytotoxicity expressed as a percentage* of leaves exhibiting chlorosis or necrosis		
		38496	38510	38530
Untreated control		26.25 a	11.00 a	25.00 a
Trifloxystrobin	70 g ai/ha	24.00 a	11.00 a	39.00 a
Trifloxystrobin	87.5 g ai/ha	21.00 a	11.00 a	35.00 a
Trifloxystrobin	105 g ai/ha	14.00 a	14.00 a	31.00 a
Myclobutanil	136 g ai/ha	21.00 a	10.00 a	25.00 a
Standard error		±4.23	±2.81	±5.14
ANOVA Pr > F		0.3652	0.8781	0.2805

* Means of four replicates of 25 leaves per replicate. Numbers followed by the same letter are not significantly different.

Table 2. Percent incidence of powdery mildew on foliage and fruit and relative yield of Lapins cherries treated with various fungicides.

Treatment	Rate	Mean* weight of 100 fruit, g	Mean* percentage of fruit with mildew July 19, 2005	Mean* percentage of leaves with mildew August 3, 2005
Untreated control		1230.35 a	25.46 a	13.00 a
Trifloxystrobin	70 g ai/ha	1222.07 a	4.25 b	4.00 b
Trifloxystrobin	87.5 g ai/ha	1179.39 a	2.75 b	0.50 b
Trifloxystrobin	105 g ai/ha	1265.80 a	3.25 b	1.00 b
Myclobutanil	136 g ai/ha	1266.62 a	0.00 b	2.5 b
Standard error		±50.28	±3.73	±2.24
ANOVA Pr > F		0.7264	0.0026	0.0115

* Means of four replicate samples. Numbers followed by the same letter are not significantly different.

2005 PMR REPORT #69

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.08

CROP: Cherry (*Prunus avium)* cv. Lapin
PEST: Powdery Mildew, *Podosphaera clandestina*

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TITLE: **EFFICACY OF FLINT FOR THE CONTROL OF POWDERY MILDEW OF CHERRY, 2005.**

MATERIALS: FLINT 50 WG (trifloxystrobin) and NOVA 40 WP (myclobutanil).

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre in Summerland, BC on 7-year-old cherry trees cv Lapin on Mazzard rootstocks spaced at 3.6 m x 6.0 m. The statistical design of the trial was the randomized complete block with five treatments replicated five times on single tree replicates. Treatments were applied until run-off with a handgun operated at approximately 700 kPa. Average volume of water applied per tree was 6.7 litres. The treatments were applied on 4 May (petal fall), 17 May (15-20 mm fruit), 30 May (pit hardening), 9 June (straw color), 21 June (first cover) and 30 June (second cover). Foliage powdery mildew incidence and severity were evaluated on 15 July and 3 August by rating 10 leaves on 5 shoots per tree for percent area covered by powdery mildew. Powdery mildew was evaluated on 3 August by rating 25 fruits for percent area covered by powdery mildew. The values were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan K ratio t test was used for multiple comparison of means.

RESULTS and DISCUSSION: All three rates of FLINT achieved good control of powdery mildew on foliage and fruit (Table 1). It compared very well with the commercial standard NOVA. There were no other diseases present to evaluate. There was no phytotoxicity on foliage or fruit.

CONCLUSION: FLINT was very effective in the control of cherry powdery mildew.

Table 1. Percent powdery mildew incidence and severity on foliage and fruit of Lapin cherry trees treated with various materials.

Treatment and Rate per 100 L	15 July - Leaf		3 August - Leaf		3 August - Fruit	
	Incidence	Severity	Incidence	Severity	Incidence	Severity
Untreated Control	46.8 a*	6.0 a	57.2 a	18.0 a	19.5 a	1.2 a
Nova 11.3 g	4.8 b	0.4 b	35.6 ab	4.1 bc	0.0 b	0.0 a
Flint 5.8 g	3.2 b	0.2 b	15.6 b	1.6 bc	0.0 b	0.0 a
Flint 4.6 g	0.8 b	0.04 b	10.4 b	0.6 c	0.0 b	0.0 a
Flint 7.0 g	0.0 b	0.0 b	11.2 b	1.0 c	0.0 b	0.0 a
ANOVA Pr > F	< 0.0001	0	0.0185	0.0006	0.0735	0.3575

* These values are means of five replications. Number followed by the same letter are not significantly different at $p \leq 0.05$ as decided by Waller-Duncan k-ratio (k = 100) test.

2005 PMR REPORT #70

SECTION K: FRUIT - Diseases
STUDY DATA BASE: WBSE-E.0104.07

CROP: Grape (*Vitis vinifera)* cvs. 'Pinot noir' and 'Riesling'
PEST: Powdery mildew, *Uncinula necator* Pers.Fr.

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TITLE: EFFICACY OF CORESS, IBR GENICA, PALMOLIVE and SPRAY OIL 13E FOR POWDERY MILDEW CONTROL ON GRAPES, 2005.

MATERIALS: CORESS (liquid sulfur), GENICA BP 300 (International Bio-Recovery liquid fertilizer), NOVA 40 WP (myclobutanil), PALMOLIVE (dishwashing detergent), PRISTINE (pyraclostrobin 12.8% /boscalid 25.2%) and SPRAY OIL 13E (petroleum oil 98%).

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 20 year old 'Pinot noir' and 'Riesling' vines (5 replicates). Spacing was 1.4 x 3.6 m per panel containing five vines. The cordon trained, spur pruned vines (ca. 20 nodes/m row) on vertical trained canopies were shoot thinned/suckered at 30 cm shoot length and hedged around lag phase of berry development. The experimental design was a randomized complete block. Each replicate had the first and last vines as guards for disease evaluation, thus treatments were separated by buffer vines. The treatments were applied until run-off with a handgun operated at approximately 700 kPa at a rate of 1500 L water/ha. Treatments on 'Pinot noir' were applied on 6 June (inflorescence fully developed), 17 June (bloom), 28 June (post-bloom), 12 July (pea size), 25 July (berry touch), 8 August (bunch closure), 25 August (veraison), and 6 September (post veraison) 2005. Due to lack of availability of CORESS, only 3 applications were done: 6 June, 17 June and 28 June. Treatments with GENICA on 'Riesling' were applied on 19 July (pea size), 25 July (berry touch), 8 August (bunch closure), 25 August (veraison), and 6 September (post veraison). Percent incidence and severity of leaf and cluster powdery mildew were evaluated on 3 August and 27 September by examining 10 leaves on each of five shoots and 10 berry clusters per three middle vines. At harvest on 29 September (Pinot noir) and 7 October (Riesling), ten grape clusters from each treatment were incubated at 14°C for 15 days (Pinot noir) and 24 days (Riesling) to determine if they were infected by *Botrytis spp*. Clusters were considered to have bunch rot if gray mold was observed growing among the berries. Bird damage reduced yield in 'Pinot noir', therefore, less than five replicates were evaluated. Values were converted to percent infected per replicate, and subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan Multiple Range Test was used to separate means (K = 100).

RESULTS: PALMOLIVE and SPRAY OIL 13E achieved good control of foliar powdery mildew after the first reading and compared well with PRISTINE and NOVA (Table 1). On fruit, CORESS, PALMOLIVE and SPRAY OIL 13E reduced the severity of the symptoms. At harvest, PALMOLIVE and SPRAY OIL 13E were effective at reducing foliar powdery mildew severity but only SPRAY OIL 13E compared well with PRISTINE and NOVA for the control of powdery mildew up to fruit maturity. PALMOLIVE was effective in controlling powdery mildew on the foliage early in the season but the repeated applications caused a russetting on the berries making it difficult to differentiate powdery mildew damage with spray damage. CORESS, applied 3 times early in the season, did not control foliar powdery mildew. Overall, the GENICA treatments did not reduced the incidence and severity of foliar or fruit powdery mildew on 'Riesling' (Table 2). The efficacy could likely be improved by starting the applications pre-bloom. Even though there was an insufficient number of 'Pinot noir' grape clusters to analyse the incidence of *Botrytis cinerea* infection, SPRAY OIL 13 showed a numerical reduction when compared with the untreated control (Table 3). The GENICA treatments on 'Reisling' did not reduced the incidence of bunch rot.

CONCLUSIONS: SPRAY OIL 13E is an effective fungicide for the control of grape foliar and fruit powdery mildew. PALMOLIVE is a promising material and the russetting on the berries could be diminished by a reduction in the rate and/or frequency of applications.

Table 1. Percent powdery mildew severity and incidence on 'Pinot noir' foliage and fruit.

Treatment and Rate per 100 L	3 Aug.		27 Sept.		3 Aug.		27 Sept.	
	Foliage		Foliage		Fruit		Fruit	
	Incidence	Severity	Incidence	Severity	Incidence	Severity	Incidence	Severity
Untreated Control	68.8 a	9.6 a [1]	96.0 a	57.1 a	96.0 a	36.3 a	100.0 (5) a	81.1 (5) a[2]
CORESS - 1%	67.2 a	9.2 a	96.8 a	65.1 a	66.0 b	9.2 b	80.0 (4) ab	70.3 (4) a
PALMOLIVE -1%	30.4 c	2.3 c	95.6 a	44.7 b	84.0 a	9.1 b	53.3 (3) ab	31.8 (3) ab
Spray Oil 13E - 1%	34.4 c	3.6 bc	43.2 bc	6.8 c	4.0 cd	0.2 c	12.9 (3) bc	4.5 (3) b
PRISTINE - 28 g	41.6 bc	4.4 bc	19.6 e	1.9 c	0.0 d	0.0 c	0.0 (2) c	0.0 (2) b
NOVA - 13.3 g	33.2 c	2.6 c	24.0 de	2.3 c	10.0 cd	0.5 c	n/a	n/a
ANOVA Pr > F	< 0.0001	< 0.0001	< 0.0001	<0.0001	< 0.0001	< 0.0001	0.007	0.0041

[1] These values are means of five replications. Number followed by the same letter are not significantly different at p ≤0.05 as decided by Waller-Duncan k-ratio (k = 100) test.

[2] As a result of bird damage, the fruit evaluation was done on less than 5 replicates. The number in parentheses indicates the number of replicates included.

Table 2. Percent powdery mildew severity and incidence on 'Riesling' foliage and fruit treated with GENICA.

Treatment Rate	3 Aug		27 Sept		3 Aug		27 Sept	
	Foliage		Foliage		Fruit		Fruit	
	Incidence	Severity	Incidence	Severity	Incidence	Severity	Incidence	Severity
GENICA 2%	81.2 [1]	14.9	82.8	28.6	40	2.7	70	9.2
Control	75.2	15.1	95.2	54.7	52	5.6	84	15.3
Level of Significance [2]	Ns	Ns	Ns	0	Ns	Ns	Ns	Ns

[1] These values are means of five replications.

[2] Ns: non-significant, * significant at p ≤0.05 as decided by Waller-Duncan k-ratio (k = 100) test.

Table 3. Incidence of *B. Cinerea* on 'Pinot noir' fruit incubated at 14°C for 15 days.

Treatment and Rate per 100 L	Botrytis Incidence
PALMOLIVE - 1%	50.0 (3)[1]
Untreated Control	44.8 (4)
CORESS - 1%	41.7 (3)
Spray Oil 13E - 1%	27.8 (3)
PRISTINE - 28 g	5.0 (2)
NOVA - 13.3 g	n/a
ANOVA Pr > F	0.6951

[1] As a result of bird damage, the fruit evaluation was done on less than 5 replicates. The number in parentheses indicates the number of replicates included.

2003 PMR REPORT #71

SECTION K: DISEASES OF FRUIT
STUDY DATA BASE: 402-1531-8605

CROP: Grape, *Vitis vinifera* cv. Riesling
PEST: Powdery mildew, *Uncinula necator* (Schwein.) Burrill
Bunch rot, *Botrytis cinerea* Pers.:Fr.

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TITLE: EFFICACY OF QRD (SERENADE) FORMULATIONS AGAINST POWDERY MILDEW OF GRAPE, 2002

MATERIALS: NOVA 40W (myclobutanil), ROVRAL 50W, QRD 286 (SERENADE) (liquid formulation of *Bacillus subtilis*), and QRD137 (SERENADE) (dried formulation of *Bacillus subtilis*)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 17 year-old Riesling grape vines. Spacing was 1.4 x 3.6 m for a panel of 5 grape vines. The cordon trained, spur pruned.
[1] Treatments were the Grower program of NOVA + ROVRAL alternated with NOVA; the QRD program consisted of 286 or 137 alternated with NOVA.
[2] Percent PM was visually estimated on leaves (adaxial side) by examining 10 leaves on each of five shoots per three middle vines, and on 10 berry clusters per three middle vines.
[3] Numbers followed by the same letter are not significantly different according to the Waller-Duncan k-ratio T test (k=100). Treatments were analyzed with four replications. Data was arcsin-transformed for analysis although the actual mean values are reported in this table. ed vines (ca. 20 nodes/m row) on vertical trained canopies were pruned 17 June and hedged 30 July near lag phase of berry development. The experimental design was a randomized complete block with four replicates. Each 5-vine replicate had vines 1 and 5 as guards for disease evaluation, thus treatments were separated by 2 buffer vines. The grower and QRD programs as described below were applied until run-off with a handgun operated at approximately 350 kPa at a rate of 1000 L water/ha. The grower (standard) program was applied on 4 June (3-8 cm shoot), 14 June (Bloom), 25 June (Post bloom),10 July (cover), 18 July (0.5 cm berry), 1 August (Bunch closure), 8 August (Post bunch closure), 22 August (Veraison), 28 August (Post veraison) and 24 September (Pre-harvest). QRD 286 and 137 treatments were applied on 14 June (Bloom), 10 July (Post-bloom), 1 August (Bunch closure), 22 August (Veraison), 24 September (Pre-harvest). Percent incidence and severity of powdery mildew were evaluated by visually estimating the amount of surface area of leaves (adaxial side) and clusters covered by mildew on 6 August, 2 September, and 7 October by examining ten leaves on each of five shoots per three middle vines, and on 10 berry clusters per three middle vines. Fifty clusters were examined for powdery mildew at harvest on October 9, 2002. At harvest, yield, and number of clusters with bunch rot per 50 clusters were also recorded. Clusters were considered to have bunch rot if gray mold was observed growing among the berries. Five clusters from each replicate were incubated at 13°C to determine if they were infected with *Botrytis cinerea*. Counts of cluster, and leaf powdery mildew and bunch rot incidence and severity were converted to the percent infected per replicate and arcsin-transformed. The transformed data for leaf and cluster mildew were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan k-ratio t Test was used to separate means (k=100).

GROWER Program consisted of NOVA 40 W (20 g/100 L or 0.2 kg/ha) applied on 4 June, ROVRAL 50W (150 g/100 L or 1.5 kg/ha) tank mixed with NOVA 40W (20 g/100 L or 200 g/ha) on 14 June, NOVA 40 W (20 g/100 L or 0.2 kg/ha) on 25 June, 10 July, 18 July, ROVRAL 50W (150 g/100 L or 1.5 kg/ha) tank mixed with NOVA 40W (20 g/100 L or 200 g/ha) on 1 August. NOVA 40 W (20 g/100 L or 0.2 kg/ha) on 8 August, ROVRAL 50W (150 g/100 L or 1.5 kg/ha) tank mixed with NOVA 40W (20 g/100 L or 200 g/ha) on 22 August, NOVA 40W (20 g/100 L or 200 g/ha) on 28 August and ROVRAL

50W (150 g/100 L or 1.5 kg/ha) tank mixed with NOVA 40W (20 g/100 L or 200 g/ha) on 24 September. Harvest was on 9 October.

QRD Program consisted of QRD 286 (930 mL/100 L or 9.3 L/ha = Low rate, and 2800 mL /100 L or 28 L/ha = High rate); and QRD 137 (420 g/100 L or 4.2 kg/ha = Low rate, and 670 g/100 L or 6.7 kg/ha = High rate), applied on 14 June, 10 July, 1 August, 22 August and 24 September. Cover sprays of the QRD treated plants consisted of NOVA 40 W (20 g/100 L or 0.2 kg/ha) applied on 4 June, 25 June, 18 July, 8 August, and 28 August. Harvest was on 9 October.

RESULTS and DISCUSSION: Powdery mildew was first observed on grape foliage in early July. Incidence of foliar powdery mildew was 100% in the control by August in this trial. Incidence of foliar powdery mildew was controlled by the high rate of QRD286 after the first reading in August (Table 1). All treatments except the control reduced diseases severity. After the second reading in September QRD 137 at the high rate was the only material that again reduced foliar powdery mildew. QRD 137 also reduced levels of disease severity to levels found in the NOVA grower program. After the final reading in October the high rate of QRD 286 was the only material that once more reduced powdery mildew. Disease severity levels were the same for all treatments except for the control. The control was not rated because the leaves were all dried out, due to powdery mildew infection. Incidence of cluster powdery mildew was extremely high in 2002 (Table 1). All the untreated clusters were infected. The high rate of QRD 286 reduced both incidence and severity of cluster powdery mildew after the second and third readings in September and October. QRD 137 at the high rate was as effective as the Grower standard treatment after the final reading in October. Fruit harvested on October 9 had an average berry weight and number of clusters higher than the control in the QRD treatments (Table 2). The QRD treatments and the Grower program consisting of ROVRAL plus NOVA did not reduce bunch rot in the vineyard (Table 3). The high rate of powdery mildew in the clusters made it very difficult to clearly separate the causal agent. It was possible to show that QRD 137 would reduce bunch rot by incubating naturally contaminated grape clusters in a 13ºC room for 12 days (Table 4).

CONCLUSIONS: QRD used in place of NOVA + ROVRAL four times during the growing season, alternated with NOVA provided the same level of control as the NOVA + ROVRAL/NOVA grower program. Bunch rot was not controlled by the QRD treatments or the NOVA + ROVRAL grower program in the field, however QRD 137 controlled bunch rot in grape clusters incubated at 13ºC for 12 days.

Table 1. Percent powdery mildew incidence and severity of Riesling grapes treated with high (H) or low (L) rates of QRD 286, and 137 as rated on 6 August, 2 September and 7 October.

QRD and Grower Treatments[1] Rate L or kg/100L	Leaf Powdery Mildew[2]		Cluster Powdery Mildew[2]	
	Incidence	Severity	Incidence	Severity
August 6				
Control	100 a[3]	47 a	100 a	57 a
QRD 286 0.9 L	93 ab	16 b	95 a	18 b
QRD 286 2.8 L	86 ab	16 b	68 a	11 bc
QRD 137 0.4 kg	88 ab	12 b	83 a	14 bc
QRD137 0.7 kg	92 ab	13 b	80 a	9 bc
Grower (NOVA 20 g; ROVRAL 150 g)	85 ab	12 b	68 a	5 c
Pr> F	0.1208	<.0001	0.2634	<.0001
September 2				
Control	100 a	59 a	100 a	70 a
QRD 286 0.9 L	95 ab	20 b	100 a	12 b
QRD 286 2.8 L	86 ab	13 bc	53 b	8 b
QRD 137 0.4 kg	84 ab	14 bc	58 b	8 b
QRD137 0.7 kg	83 b	9 c	60 ab	10 b
Grower (NOVA 20 g; ROVRAL 150 g)	92 ab	11 c	75 ab	6 b
Pr> F	0.1658	<.0001	0.0389	<.0001
October 7				
Control	---	---	100 a	78 a
QRD 286 0.9 L	99 a	25 a	70 bc	8 b
QRD 286 2.8 L	92 b	19 a	53 bc	7 b
QRD 137 0.4 kg	98 a	21 a	73 ab	10 b
QRD 137 0.7 kg	100 a	19 a	38 c	10 b
Grower (NOVA 20 g; ROVRAL 150 g)	100 a	19 a	35 c	3 b
Pr > F	0.0076	0.8421	0.0038	<.0001

Table 2. Effect of QRD (SERENADE) as compared to the grower program on mean berry weight and number of clusters

Treatment and rate L or kg/ 100 L	Berry weight (g)[1]	Number of clusters/Rep[2]
QRD286 0.9 L	59.23 a	187 a
QRD286 2.8 L	62.94 a	197 a
QRD137 0.4 kg	56.55 a	168 ab
QRD137 0.7 kg	58.65 a	160 ab
Grower (NOVA 20 g; ROVRAL 150 g)	59.60 a	140 ab
Control	41.77 b	87 b
Pr> F	0.0109	0.1222

[1] Each treatment consisted of the mean number of four replicates. The berry weight was based on a random sample of 50 berries from each replicate. The number of clusters was based on total counts per replicate.

[2] Numbers followed by the same letter are not significantly different according to the Waller-Duncan k-ratio T test (k=100).

Table 3. Percent bunch rot incidence and severity on Riesling grapes one month before harvest and at harvest.

Treatment[1] and rate L or kg/100L	September 2		October 9
	Field Incidence	Field Severity	Harvest Incidence[2]
CONTROL	65 a[3]	0.33333	8 b
QRD 286 0.9 L	58 a	14 a	30 a
QRD 286 2.8 L	60 a	0.375	11 ab
QRD 137 0.4 kg	60 a	10 a	15 ab
QRD 137 0.7 kg	45 a	0.25	22 ab
Grower (NOVA 20 g; ROVRAL 150 g)	45 a	0.29167	24 ab
Pr>F	0.8328	0.7917	0.0959

[1] Treatments were the Grower program of NOVA + ROVRAL alternated with NOVA; the QRD program consisted of 286 or 137 alternated with NOVA.

[2] Bunch rot was determined by visually examining 10 berry clusters on each replicate in the field and again at harvest by examining 50 clusters from each treatment for incidence and severity of bunch rot.

[3] Numbers followed by the same letter are not significantly different according to the Waller-Duncan k-ratio T test (k=100). Treatments were analyzed with four replications. Data was arcsin-transformed for analysis although the actual mean values are reported in this table.

Table 4: Percent incidence and severity of bunch rot on Riesling grapes incubated at 13ºC for 7 and 12 days

Treatment[1] and rate L or kg/100L	Incidence after 7 days	Severity after 7 days	Incidence after 12 days	Severity after[2] 12 days
Grower (NOVA 20 g; ROVRAL 150 g)	45 a[3]	8.0 a	60 ab	7.5 a
QRD286 0.9 L	40 a	5.3 a	80 ab	12.0 a
QRD286 2.8 L	30 a	2.8 a	80 ab	7.0 a
QRD137 0.4 kg	0.33333	1.8 a	42 b	6.5 a
QRD137 0.7 kg	40 a	11.8 a	42 b	16.8 a
Control	80 a	7.2 a	95 a	28.5 a
P>F	0.3004	0.3154	0.0586	0.2510

1 Treatments were the Grower program of NOVA + ROVRAL alternated with NOVA; the QRD program consisted of 286 or 137 alternated with NOVA .

2 Five clusters from each replicate were incubated at 13°C to determine if they were infected with *Botrytis cinerea*. Clusters were considered to have bunch rot if gray mold was observed growing among the berries.

3 Numbers followed by the same letter are not significantly different according to the Waller-Duncan k-ratio T test (k=100). Treatments were analyzed with four replications. Data was arcsin-transformed for analysis although the actual mean values are reported in this table.

2003 PMR REPORT #72

SECTION K: DISEASES OF FRUIT
STUDY DATA BASE: 402-1531-8605

CROP: Grape, *Vitis vinifera* cv. Pinot Noir
PEST: Powdery mildew, *Uncinula necator* (Schwein.) Burrill
Bunch rot, *Botrytis cinerea* Pers.:Fr.

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TITLE: EFFICACY OF PRONATEX (NEEM) AGAINST POWDERY MILDEW OF GRAPE, 2002

MATERIALS: NOVA 40W (myclobutanil), PRONATEX (neem), SOVRAN 50 WDG (kresoxim methyl)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 17 year old Pinot Noir grape vines. Spacing was 1.4 x 3.6 m for each panel of five grape vines. The cordon trained, spur pruned vines (ca. 20 nodes/m row) on vertical trained canopies were hedged around lag phase of berry development. The experimental design was a randomized complete block with five replicates. Each 5-vine replicate had vines 1 and 5 as guards for disease evaluation, thus the treatments were separated by 2 buffer vines. The treatments were applied until run-off with a handgun operated at approximately 400 kPa at a rate of 1500 L water/ha treatments as outlined below. The treatments were applied on 4 June (10-15 cm shoot), 14 June (Bloom), 27 June (Post-bloom), 11 July (Post bloom),29 July (Cluster closure), 15 August (Veraison), 29 August (Post veraison), 25 September (14 days pre-harvest). NOVA (0.2 kg/1500 L) , SOVRAN (0.24 kg/1500 L) and PRONATEX (1%) were applied consecutively on dates indicated above. Upon agitation in the spray tank PRONATEX produced excessive foam and a foam inhibitor with the brand name of HALT was used to reduce foaming. In the trials conducted from August to harvest the use of reduced agitation also helped to reduce foaming. Percent incidence and severity of powdery mildew was evaluated by visually estimating the amount of surface area of leaves (adaxial side) and clusters covered by powdery mildew on 30 July, 11 September, and 7 October by examining ten leaves on each of five shoots per three middle vines, and on 10 berry clusters per three middle vines. On the same dates leaves and clusters were evaluated for any signs of damage such as a typical leaf browning or fruit coloring. At harvest on 9 October weight of a random sample of 50 berries and number of clusters per replicate panel were recorded and 50 clusters were examined for powdery mildew and Botrytis bunch rot. Clusters were considered to have bunch rot if gray mold was observed growing among the berries. Five clusters from each replicate were incubated at 13°C for 12 days to determine if they were infected by *Botrytis* spp. Counts of cluster, and leaf powdery mildew incidence and severity and bunch rot incidence and severity were converted to the percent infected per replicate and arcsin-transformed. The transformed data for leaf and cluster mildew and untransformed yield and quality data were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan k ratio t Test (k=100) was used to separate means.

RESULTS: Powdery mildew was first observed on grape foliage on 2 July and by 30 July the incidence of both foliar and cluster powdery mildew was 100% in the untreated Control (Table 1a). PRONATEX reduced severity of foliar and cluster powdery mildew after the first reading on 30 July second reading on 11 September (Table 1b) and third reading on 7 October as compared to the control (Table 1c). Relatively large numbers of clusters had bunch rot at harvest but the treatments did not differ significantly (Table 2). Treatment clusters varied significantly for powdery mildew and PRONATEX again reduced severity of powdery mildew compared to the control treatment but did not reduce its incidence (Table 2). The number of grape clusters that were harvested per treatment or berry weight were not significantly different from the control (Table 3). Because the bunch rot analysis at harvest could not separate differences, sound grape clusters were incubated at 13ºC for up to 12 days. PRONATEX was not an

effective treatment for reducing decay caused by *Botrytis cinerea* (Table 4). There were no signs of phytotoxicity in any of the treatments on clusters or leaves throughout the entire study.

CONCLUSIONS and COMMENTS: PRONATEX appears to be a relatively effective material for the control of powdery mildew on grapes. However it did not show any indication that it would be effective against *B. cinerea* and likely should not be used for bunch rot control. Because powdery mildew disease pressure was extremely high in this trial and early PRONATEX treatments were poorly applied due to excessive foaming and lack of product it is possible that improved powdery mildew disease control could be obtained in future trials. It would be helpful if a more user friendly formulation of this material were developed for use in commercial vineyards. Specifically, a formulation that didn't foam excessively upon normal agitation used by agricultural sprayers.

Table 1a. Percent incidence and severity of leaf and berry cluster powdery mildew on Pinot Noir grapes treated with PRONATEX after the first evaluation on 30 July, 2002

Treatment[1] and Rate (Product/1500 L)	Leaf Powdery Mildew		Cluster Powdery Mildew[2]	
	Incidence	%Severity	%Incidence	%Severity
CONTROL	100 a[3]	47 a	100 a	40 a
PRONATEX (1.0%)	94 ab	27 b	82 ab	21 b
SOVRAN (0.24 kg)	86 b	17 b	70 b	4 c
NOVA (0.2 kg)	94 ab	26 b	94 ab	17 b
Pr>F	0.0422	0.0037	0.0644	0.0036

1 Treatments were applied consecutively staring on 4 June and ending on 25 September, 14 days before harvest. The control was unsprayed.

2 Percent incidence and severity of powdery mildew was evaluated by visually estimating the amount of surface area of leaves (adaxial side) and clusters covered by powdery mildew. Treatments consisted of 50 leaves on five shoots for leaf powdery mildew and 10 clusters randomly chosen for cluster powdery mildew replicated five times.

3 Numbers followed by the same letter are not significantly different according to the Waller-Duncan k ratio t test.

Table 1b. Percent incidence and severity of leaf and berry cluster powdery mildew on Pinot Noir grapes treated with PRONATEX after the second evaluation on 11 September, 2002

Treatment[1] and Rate (Product/1500 L)	Leaf Powdery Mildew		Cluster Powdery Mildew[2]	
	%Incidence	%Severity	%Incidence	%Severity
CONTROL	100 a[3]	69 a	100 a	68 a
PRONATEX (1.0%)	96 ab	24 b	92 a	33 b
SOVRAN (0.24 kg)	88 b	12 c	52 c	5 c
NOVA (0.2 kg)	86 b	13 bc	84 b	14 b
Pr> F	0.0145	<.0001	<.0001	<.0001

[1] Treatments were applied consecutively staring on 4 June and ending on 25 September, 14 days before harvest. The control was unsprayed.

[2] Percent incidence and severity of powdery mildew was evaluated by visually estimating the amount of surface area of leaves (adaxial side) and clusters covered by powdery mildew. Treatments consisted of 50 leaves on five shoots for leaf powdery mildew and 10 clusters randomly chosen for cluster powdery mildew replicated five times.

[3] Numbers followed by the same letter are not significantly different according to the Waller-Duncan k ratio t test.

Table 1c. Percent incidence and severity of powdery mildew on Pinot Noir grapes treated with PRONATEX after the third evaluation on 7 October, 2002

Treatment[1] and Rate (Product/1500 L)	Leaf Powdery Mildew		Cluster Powdery Mildew[2]	
	%Incidence	%Severity	%Incidence	%Severity
CONTROL	100 a[3]	67 a	100 a	78 a
PRONATEX (1.0%)	99 a	36 b	94 a	48 b
SOVRAN (0.24 kg)	78 b	11 c	72 b	9 d
NOVA (0.2 kg)	90 b	14 c	100 a	25 c
Pr> F	0.0029	<.0001	<.0001	<.0001

[1] Treatments were applied consecutively staring on 4 June and ending on 25 September, 14 days before harvest. The control was unsprayed.

[2] Percent incidence and severity of powdery mildew was evaluated by visually estimating the amount of surface area of leaves (adaxial side) and clusters covered by powdery mildew. Treatments consisted of 50 leaves on five shoots for leaf powdery mildew and 10 clusters randomly chosen for cluster powdery mildew replicated five times.

[3] Numbers followed by the same letter are not significantly different according to the Waller-Duncan k ratio t test.

Table 2. Incidence and severity of bunch rot and powdery mildew of treated Pinot Noir grapes at harvest on 9 October, 2002

Treatment[1] and Rate (Product/1500 L)	Cluster Bunch rot		Cluster Powdery Mildew[2]	
	%Incidence	%Severity	%Incidence	%Severity
CONTROL	16 a[3]	8.0 a	100 a	75 a
PRONATEX (1.0%)	10 a	4.2 a	100 a	27 b
SOVRAN (0.24 kg)	0.166667	1.7 a	42 b	3 c
NOVA (0.2 kg)	5 a	1.0 a	100 a	22 b
Pr> F	0.7225	0.8432	<.0001	<.0001

[1] Treatments were applied consecutively staring on 4 June and ending on 25 September, 14 days before harvest. The control was unsprayed.

[2] Fifty clusters were examined for powdery mildew and Botrytis bunch rot at harvest. Clusters were visually examined for percent powdery mildew and bunch rot.

[3] Numbers followed by the same letter are not significantly different according to the Waller-Duncan k ratio t test.

Table 3. Yield of Pinot Noir grapes as indicated by number of clusters and mean weight at harvest on 9 October, 2002

Treatment[1] and rate (Product/1500L)	Mean Number of clusters	Mean weight of 50 berries[2]
CONTROL	132 a[3]	33.4 b
PRONATEX (1.0%)	139 a	55.6 b
SOVRAN (0.24 kg)	115 a	70.4 a
NOVA (0.2 kg)	142 a	64.3 a
Pr> F	0.8765	<.0001

[1] Treatments were applied consecutively staring on 4 June and ending on 25 September, 14 days before harvest. The control was unsprayed.

[2] At harvest on 9 October, weight of a random sample of 50 berries and mean number of clusters per replicate panel were recorded.

[3] Numbers followed by the same letter are not significantly different according to the Waller-Duncan k ratio t test.

Table 4. Percent incidence and severity of *Botrytis cinerea* on Pinot noir grapes incubated at 13°C for 7 – 12 days

Treatment[1] and Rate (Product/1500 L)	After 7 days		After 12 days	
	Incidence	Severity	Incidence	Severity[2]
CONTROL	80 a[3]	7.2 a	44 a	2.8 a
PRONATEX (1.0%)	76 a	7.4 a	48 a	4.2 a
SOVRAN (0.24 kg)	8 b	0.6 b	12 b	0.6 b
NOVA (0.2 kg)	80 a	4.8 a	56 a	3.4 a
Pr> F	<.0001	<.0001	0.0044	0.0069

[1] Treatments were applied consecutively staring on 4 June and ending on 25 September, 14 days before harvest on October, 9, 2002 The control was unsprayed.

[2] Five clusters from each replicate were incubated at 13°C for 12 days to determine if they were infected by *Botrytis* spp.

[3] Numbers followed by the same letter are not significantly different according to the Waller-Duncan k ratio t test.

2003 PMR REPORT #73

SECTION K: DISEASES OF FRUIT
STUDY DATA BASE: 402-1531-8605

CROP: Grape, *Vitis vinifera* cv. Riesling
PEST: Powdery mildew, *Uncinula necator* (Schwein.) Burrill
Bunch rot, *Botrytis cinerea* Pers.:Fr.

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TITLE: EFFICACY OF AGROGREEN AGAINST POWDERY MILDEW OF GRAPE, 2002

MATERIALS: NOVA 40W (Myclobutanil), ROVRAL 50W, AGROGREEN (natural liquid fertilizer 4-1-1).

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 17 year-old Riesling grape vines. Spacing was 1.4 x 3.6 m for a panel of 5 grape vines. The cordon trained, spur pruned vines (ca. 20 nodes/m row) on vertical trained canopies were pruned around lag phase of berry development. The experimental design was a randomized complete block with four replicates. Each 5-vine replicate had vines 1 and 5 as guards for disease evaluation, thus treatments were separated by 2 buffer vines. The treatments were applied until run-off with a handgun operated at approximately 350 kPa at a rate of 1000 L water/ha. The grower standard program described below was applied on 4 June (3-8 cm shoot), 14 June (Bloom), 25 June (Post bloom),10 July (cover), 18 July (0.5 cm berry), 1 August (Bunch closure), 8 August (Post bunch closure), 22 August (Veraison), 28 August (Post veraison) and 24 September (Pre-harvest). The AGROGREEN program is described below. Percent powdery mildew was evaluated by visually recording the presence of powdery mildew (incidence) on leaves and clusters and the percent surface area of leaves (adaxial side) and clusters covered by powdery mildew (severity) on 6 August, 2 September, and 7 October by examining ten leaves on each of five shoots per three middle vines, and on 10 berry clusters per three middle vines. Fifty clusters were examined for powdery mildew at harvest on October 9, 2002. At harvest yield, number of clusters and number of clusters with bunch rot were also recorded. Clusters were considered to have bunch rot if gray mold was observed growing among the berries. Five clusters from each replicate were incubated at 13°C to determine if they were infected with *Botrytis cinerea*. Counts of cluster, and leaf powdery mildew incidence and severity and bunch rot incidence and severity were converted to the percent infected per replicate and arcsin-transformed. The transformed data for leaf and cluster mildew were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Waller-Duncan k-ratio t Test was used to separate means (k=100).

GROWER Program consisted of NOVA 40 W (20 g/100 L or 0.2 kg/ha) applied on 4 June, ROVRAL 50W (150 g/100 L or 1.5 kg/ha) tank mixed with NOVA 40W (20 g/100 L or 200 g/ha) on 14 June, NOVA 40 W (20 g/100 L or 0.2 kg/ha) on 25 June, 10 July, 18 July, ROVRAL 50W (150 g/100 L or 1.5 kg/ha) tank mixed with NOVA 40W (20 g/100 L or 200 g/ha) on 1 August. NOVA 40 W (20 g/100 L or 0.2 kg/ha) on 8 August, ROVRAL 50W (150 g/100 L or 1.5 kg/ha) tank mixed with NOVA 40W (20 g/100 L or 200 g/ha) on 22 August, NOVA 40W (20 g/100 L or 200 g/ha) on 28 August and ROVRAL 50W (150 g/100 L or 1.5 kg/ha) tank mixed with NOVA 40W (20 g/100 L or 200 g/ha) on 24 September. Harvest was on 9 October.

AGROGREEN Program consisted of AGROGREEN (1.0%) applied on 4, 14, and 25 June, 10,18 July, 1, 8, 22, 28 August, and 24 September. Harvest was on 9 October.

RESULTS: Powdery mildew was first observed on grape foliage in early July. Incidence of foliar powdery mildew was 100% in the control by August in this trial. Incidence of foliar powdery mildew was only controlled by the Grower standard program after the first reading in August (Table 1). The AGROGREEN treatment reduced disease severity after the second reading in September but was not as effective as NOVA. Incidence of cluster powdery mildew was extremely high in 2002 infecting 100% on the non-treated clusters after the first reading in August (Table 1). AGROGREEN did not reduce incidence of cluster powdery mildew but reduced severity of cluster powdery mildew by 47% after the second reading in September. Although AGROGREEN reduced severity on the other two dates that severity was recorded the values were not statistically significant. Fruit harvested on October 9 had an average berry weight and number of clusters significantly higher than the control in the AGROGREEN treatment (Table 2). AGROGREEN did not reduce bunch rot in the vineyard (Table 3). AGROGREEN did not reduce bunch rot of naturally contaminated grape clusters incubated at 13ºC after 12 days (Table 4).

CONCLUSIONS and COMMENTS: AGROGREEN reduced severity of powdery mildew on grape foliage and clusters. It did not reduce disease incidence and had no effect on bunch rot. Possibly the rate used in this trial was too low for control of powdery mildew considering the high level of disease pressure. In a similar trial in New Zealand the rate used was raised from 1.0% to 1.75% when the disease pressure became high. Perhaps disease control would have been better at this higher rate. It appeared that AGROGREEN had a positive nutritional effect on the Riesling grapes used in this trial by increasing the number of bunches and berry weight. The berry weight increase was the same as the Grower standard program which had much less disease so the AGROGREEN must have increased berry weight in spite of disease. The trial should be repeated with AGROGREEN at 1.75 to 2.0% to determine if it will control powdery mildew at the higher rates.

Table 1. Percent powdery mildew incidence and severity of Riesling grape foliage and berry clusters treated with AGROGREEN natural liquid fertilizer 4-1-1.

Treatment[1] Program and rate (g or L/100 L)	Leaf Powdery Mildew		Cluster Powdery Mildew[2]	
August 6	Incidence	Severity	Incidence	Severity
CONTROL	100 a[3]	47 a	100 a	57 a
AGROGREEN (1 L)	94 ab	32 a	100 a	38 a
GROWER (NOVA 20 g/ ROVRAL 150 g)	85 b	12 b	68 b	5 b
Pr> F	0.0587	0.0121	0.0194	0.0083
September 2				
CONTROL	100 a	59 a	100 a	70 a
AGROGREEN (1L)	100 a	33 b	92 a	23 b
GROWER (NOVA 20 g/ ROVRAL 150 g)	92 a	11 c	75 a	6 c
Pr> F	0.0761	0.0006	0.1159	0.0008
October 7				
CONTROL	---	---	100 a	78 a
AGROGREEN (1 L)	100 a	50 a	100 a	59 a
GROWER (NOVA 20 g/ ROVRAL 150 g)	100 a	19 b	35 b	3 b
Pr > F	0.391	0.0213	<.0001	0.0008

[1] Treatments were applied 10 times starting on 4 June and approximately every two weeks ending on 24 September. The Grower program of NOVA + ROVRAL was alternated with NOVA and AGROGREEN was applied consecutively. Control was unsprayed.

[2] Percent powdery mildew was evaluated by visually recording the presence of powdery mildew (incidence) on leaves and clusters and the percent surface area of leaves (adaxial side) and clusters covered by powdery mildew.

[3] Numbers followed by the same letter are not significantly different according to the Waller-Duncan k-ratio T test (k=100). Treatment means were based on four replications.

Table 2. Effect of AGROGREEN on mean berry weight and number of clusters of Riesling grapes.

Treatment Program[1] and rate (g or L/100 L)	Berry weight (g)	Number of clusters[2]
AGROGREEN (1 L)	55.36 a[3]	225 a
GROWER (NOVA 20 g/ ROVRAL 150 g)	59.60 a	140 ab
CONTROL	41.77 b	87 b
Pr> F	0.0093	0.0217

[1] Treatments were applied 10 times starting on 4 June and approximately every two weeks ending on 24 September. The Grower program of NOVA + ROVRAL was alternated with NOVA and AGROGREEN was applied consecutively. Control was unsprayed.

[2] Each treatment consisted of four replicates. The berry weight was based on a random sample of 50 berries from four replicates.

[3] Numbers followed by the same letter are not significantly different according to the Waller-Duncan k-ratio t test (k=100).

Table 3. Percent incidence and severity of bunch rot of Riesling grapes one month before harvest and at harvest.

Treatment Program[1] and rate (g or L/100 L)	September 2 Field Incidence	September 2 Field Severity	October 9 Harvest Incidence
AGROGREEN (1 L)	65 ab	8 b	8 b
GROWER (NOVA 20 g/ ROVRAL 150 g)	92 a	23 a	11 b
CONTROL	45 b	7 b	24 a
Pr> F	0.0636	0.0292	0.0196

[1] Treatments were applied 10 times starting on 4 June and approximately every two weeks ending on 24 September. The Grower program of NOVA + ROVRAL was alternated with NOVA and AGROGREEN was applied consecutively. Control was unsprayed.

[2] Bunch rot was determined by visually examining 10 berry clusters/replicate in the field and again at harvest.

[3] Numbers followed by the same letter are not significantly different according to the Waller-Duncan k-ratio t test (k=100).

Table 4. Incidence and severity of bunch rot on Riesling grapes incubated at 13°C for 7 and 12 days

Treatment Program[1] and rate (g or L/100 L)	Incidence after 7 days	Severity after 7 days	Incidence after 12 days	Severity after[2] 12 days
AGROGREEN (1 L)	45 a[3]	8.0 a	60 b	7.5 a
GROWER (NOVA 20 g/ ROVRAL 150 g)	70 a	9.2 a	100 a	13.5 a
CONTROL	80 a	7.2 a	95 a	28.5 a
Pr> F	0.1340	0.9183	0.0288	0.1216

[1] Treatments were applied 10 times starting on 4 June and approximately every two weeks ending on 24 September. The Grower program of NOVA + ROVRAL was alternated with NOVA and AGROGREEN was applied consecutively. Control was unsprayed.

[2] Five clusters from each replicate were incubated at 13°C to determine if they were infected with *Botrytis cinerea*. Clusters were considered to have bunch rot if gray mold was observed growing among the berries.

[3] Numbers followed by the same letter are not significantly different according to the Waller-Duncan k-ratio t test (k=100).

2005 PMRR Report #74

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

CROP: Peaches (Prunus persica) cv. Loring
PEST: Brown Rot (*Monilinia fructicola*)

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TITLE: EVALUATION OF BIOSAVE, SCHOLAR AND MERTECT FOR THE POSTHARVEST CONTROL OF BROWN ROT AND GRAY MOLD IN 'LORING' PEACHES IN COLD STORAGE, 2005.

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

METHODS: SCHOLAR 50wp (fludioxonil) and BIOSAVE (*Pseudomonas syringae*) were compared with MERTECT (thiabendazole, TBZ) for efficacy against brown rot of peaches caused by *Monilinia fructicola* and gray mold caused by *Botrytis cinerea*. Peaches at commercial maturity were harvested on August 15, 2005 from an orchard at Jordan Station, Ontario. All fruits were stored at 4°C until used in the experimental treatments on Sept 1, 2005. Peaches were disinfested in 10% household bleach (5% sodium hypochlorite) and 0.01% Tween 20 (Fisher Scientific) for 4 min and rinsed in reverse osmosis water for 4 min. After disinfestation, 24 peaches were placed on a plastic packing insert (24 fruit master) contained in a plastic box. Each box represents a treatment replication. Four replicate trays with 6 or12 fruits /replicate were prepared for each treatment. The peaches were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, peaches were inoculated with a 20 µl drop of TBZ-sensitive *M. fructicola* isolate MF-6 or *B. cinerea* BC-8dR at a concentration of 1 x 10^5 conidia/ml and appropriate concentrations of fungicides. Treatments were: control, 0.02, 0.10, 0.3, 0.6 and 1.2 g/L of SCHOLAR , 1.59 g /L of BIOSAVE and MERTECT at 1.15 g/L. The peaches were drop treated. The fruits were then placed on packing inserts. Untreated check had no fungicides. The treatments were completely randomized. Peaches, which were treated on September 2 were evaluated for disease incidence after 5 days of incubation at 20°C. Fruits were considered decayed when a lesion developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: As outlined in Table 1.

CONCLUSIONS: SCHOLAR at concentrations, 0.05, 0.3, 0.6 and 1.2 g/L gave 100% of control of brown rot and gray mold after 5 days of storage at 20°C. A very high incidence of brown rot was observed in BIOSAVE treatments. Latent brown rot symptoms were observed on the fruit. MERTECT gave 100% control of brown rot caused by thiabendazole-senstive isolate and 0% gray mold caused by thiabendazole-senstive isolate. SCHOLAR significantly reduced induced brown rot but had no effect on the latent infections.

Table 1. Mean percentage incidence of brown rot after post-harvest treatment of SCHOLAR (fludioxonil) on Peaches, cv. Loring, 2005.

Treatment	Disease incidence at 20°C for 5 days (%)	
	Brown rot	Gray mold
Inoculum only	100.0 c[1,2]	100.0 c
SCHOLAR @ 0.02 g/L	81.5 b	29.6 b
SCHOLAR @ 0.05 g/L	0.0 a	0.0 a
SCHOLAR @ 0.20 g/L	0.0 a	0.0 a
SCHOLAR @ 0.3 g/L	0.0 a	0.0 a
SCHOLAR @ 0.6 g/L	0.0 a	0.0 a
SCHOLAR @ 1.2 g/L	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	96.3 c	96.3 c
MERTECT @ 1.15 g/L	0.0 a	100.0 fc

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

[2] Data represent the mean of four replicates of 12 peaches per replicate. Each peach was wounded and inoculated with thiabendazole-sensitive *M. fructicola* and thiabendazole-resistant *B. cinerea* before treatment.

2005 PMRR Report #75

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

CROP: Peaches (*Prunus persica*) cv Red Haven
PEST: Gray mold (*Botrytis cinerea* Pers.:Fr.)

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TITLE: EVALUATION OF FUNGICIDES BIOSAVE AND SCHOLAR FOR THE POST-HARVEST CONTROL OF GRAY MOLD IN 'RED HAVEN' PEACHES IN COLD STORAGE, 2005.

MATERIALS: BIOSAVE (*Pseudomonas syringae*) and SCHOLAR (50% fludioxonil)

METHODS: SCHOLAR 50wp (fludioxonil) and BIOSAVE (*Pseudomonas syringae*) were tested for efficacy against brown rot of peaches caused by *Monilinia fructicola* and gray mold of peaches caused by *Botrytis cinerea*. Peaches at commercial maturity were harvested on August 15, 2005 from an orchard at Jordan Station, Ontario. All fruits were stored at 4°C until used in the experimental treatments on Sept 1, 2005. The peaches were placed on a plastic packing insert contained in a plastic box. Each box represents a treatment replication and four replicate trays with 6 or 12 fruits /replicate were prepared for each treatment. Peaches were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm.Within 45 minutes of wounding, peaches were inoculated with a 20 µl drop of TBZ-sensitive *M. fructicola* isolate MF-6 or *B. cinerea* BC-8dR at a concentration of 1×10^5 conidia/ml and appropriate concentrations of fungicides. Treatments were: control, 0.02, 0.10, 0.3, 0.6 and 1.2 g/L of SCHOLAR , 1.59 g /L of BIOSAVE and MERTECT at 1.15 g/L. The peaches were drop treated. The fruits were then placed on packing inserts. Untreated check had no fungicides. The treatments were completely randomized. Peaches, which were treated on September 2 were evaluated for disease incidence after 5 days of incubation at 20 °C. Fruits were considered decayed when a lesion developed on the fruit. The data obtained was analyzed by analysis of variance using appropriate transformations and significance between means was separated by the Tukey test.

RESULTS: As outlined in Table 1.

CONCLUSIONS: SCHOLAR at concentrations, 0.3, 0.6 and 1.2 g/L gave 100% of control of brown rot and gray mold after 5 days of storage at 20°C. A very high incidence of brown rot was observed in BIOSAVE treatments. Latent brown rot symptoms were observed on the fruit. MERTECT gave 100% control of brown rot caused by thiabendazole-sensitive isolate and 0% gray mold caused by thiabendazole-senstive isolate. SCHOLAR significantly reduced induced brown rot but had no effect on the latent infections.

Table 1. Mean percentage incidence of brown rot and gray mold after post-harvest treatment of SCHOLAR (fludioxonil) on Peaches, cv. Red Haven, 2005.

Treatment	Disease incidence at 20°C for 5 days (%)	
	Brown rot	Gray mold
Inoculum only	100.0 g[1,2]	100.0 cd
SCHOLAR @ 0.02 g/L	88.9 f	81.5 b
SCHOLAR @ 0.05 g/L	17.1 d	0.0 a
SCHOLAR @ 0.10 g/L	11.1 c	0.0 a
SCHOLAR @ 0.15 g/L	7.4 ab	0.0 a
SCHOLAR @ 0.3 g/L	0.0 a	0.0 a
SCHOLAR @ 0.6 g/L	0.0 a	0.0 a
SCHOLAR @ 1.2 g/L	0.0 a	0.0 a
BIOSAVE @ 1.59 g/L	100.0 g	92.6 c
MERTECT @ 1.15 g/L	59.2 e	100.0 d

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

[2] Data represent the mean of four replicate of 12 peaches per replicate. Each peach was wounded and inoculated with thiabendazole-resistant *B. cinerea* before treatment.

2005 PMR REPORT #76

SECTION K: FRUIT - Diseases
ICAR: 33331977

CROP: Strawberry (*Fragaria* x *ananassa* Duchesne), cv. Jewel
PEST: Angular leaf spot, *Xanthamonas fragariae* Kenn. & King

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TITLE: **EFFICACY OF TANOS 50DF AND CLEAN CROP COPPER 53W APPLIED ALONE AND TANK MIXED TOGETHER ON ANGULAR LEAF SPOT IN STRAWBERRY 2005.**

MATERIALS: TANOS 50DF (famoxidone 25% + cymoxanil 25%), CLEAN CROP COPPER 53W (53% tribasic copper sulphate), OXIDATE (27% hydrogen dioxide)

METHODS: Plots were established in a three year old strawberry field cv. Jewel with a history of angular leaf spot. (ALS). Each plot consisted of a 6 meter matted row spaced 30 cm apart separated by an untreated buffer row. The experiment was designed as a randomized complete block with each treatment replicated four times. TANOS 50DF at 0.84 kg/ha; CLEAN CROP COPPER 53W at 3.8 kg/ha, TANOS 50DF at 0.84 kg/ha tank mixed with CLEAN CROP COPPER 53W at 3.8 kg/ha and OXIDATE at 5.5 L/ha were applied as foliar sprays on May 12, 2005, (flower buds initiating), May 19, 2005 (flower buds emerging) and again on May 30, 2005, (full bloom) to the plots. In addition, a single application of TANOS 50DF at 0.84 kg/ha tank mixed with CLEAN CROP COPPER 53W at 3.8 kg/ha was applied on May 30, 2005, (full bloom) to separate plots to determine if a single application provides effective control of ALS compared to three applications each fungicide alone. The TANOS 50DF alone, CLEAN CROP COPPER 53W alone and TANOS 50DF tank mixed with CLEAN CROP COPPER 53W were applied with 250 L of water/ha were as the OXIDATE was applied at as a 10% solution in 500 L of water/ha. The foliar fungicides were applied with a hand held boom, CO_2 plot sprayer at 40 p.s.i. using adjustable hollow cone nozzles. The incidence of infected plants and severity of disease (0=healthy, 1=1-5% leaf area infected; 2= 6-10% leaf area infect; 3= 11-25% leaf area infect; 4=26-50% leaf are infected; and 5= 50-100% leaf are infected) was evaluated in each plot on 10 randomly selected plants/plot, on June 6, 13 and 20, 2005; 7, 14 and 21 days after the last application respectively. Disease incidence and severity progress curves were constructed from the data and the Area Under the Disease Incidence Progress Curve (AUDIC) and the Area Under the Disease Severity Progress Curve (AUDSC) were calculated. The calyx of 10 randomly selected berries/plot were rated for disease severity (0=healthy, 1=1-5% calyx area infected; 2= 6-10% calyx area infect; 3= 11-25% calyx area infect; 4=26-50% calyx are infected; and 5= 50-100% calyx are infected) on June 26, 2005, 27 days after the last fungicide application. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix 8. Fisher's protected least significant difference (LSD) test at P= 0.05 was used to separate differences among treatment means.

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

CONCLUSIONS: The incidence of Angular leaf spot on strawberry leaves was moderate to high during the spring of 2005, however, conditions were not favourable for disease development and the severity of disease remained very low throughout late spring and early summer. All treatments significantly reduced the incidence and severity of disease 7 days after the last fungicide application compared to the untreated check (Table 1 & 2). TANOS 50DF tank mixed with CLEAN CROP COPPER 53W applied three times at 7 day intervals significantly reduced the disease severity but not disease incidence 14 days after the last fungicide application compared to the untreated check. TANOS 50DF and CLEAN CROP COPPER 53W applied alone and as a tank mix also reduced the incidence of disease 21 days after the last application. TANOS 50DF tank mixed with CLEAN CROP COPPER 53W applied three times at 7 day intervals

reduced disease incidence and severity more than all other treatments 21 days after the last fungicide application. The AUDIC and AUDSC was significantly lower in plots treated with either TANOS 50DF or CLEAN CROP COPPER 53W applied alone and as a tank mix compared to untreated plots. TANOS 50DF tank mixed with CLEAN CROP COPPER 53W applied three times at 7 day intervals significantly reduced AUDIC and AUDSC more than all other treatments. A single application of TANOS 50DF tank mixed with CLEAN CROP COPPER 53W applied at bloom reduced disease incidence, severity, AUDIC and AUDSC equivalent to three applications of either TANOS 50DF alone or CLEAN CROP COPPER 53W alone applied at 7 day intervals (Table 1 and 2). Although none of the treatments reduced the incidence or severity of disease on the fruit calyx 27 days after the last fungicide application, disease incidence and severity on berry calyxes tended to be lowest in plots treated with TANOS 50DF tank mixed with CLEAN CROP COPPER 53W applied three times at 7 day intervals (Table 3).

Table 1. Efficacy of fungicide treatments on the incidence of Angular leaf spot on strawberry cv. Jewel leaves.

Treatment	Application Frequency at 7 day Intervals	Rate/ha	% Incidence of Angular leaf spot infected strawberry plants			AUDIC[1]
			6/6/2005	6/13/2005	6/20/2005	
UNTREATED CHECK	0	0	70.0 a[2]	72.5 a	77.5 a	1023.8 a
TANOS 50DF	3[3]	0.84 kg	35.0 b	57.5 a	60.0 b	735.0 b
CLEAN CROP COPPER 53W	3	3.8 kg	35.0 b	60.0 a	57.5 b	743.8 b
TANOS 50DF + CLEAN CROP COPPER 53W	3	0.84 kg + 3.8 kg	27.5 b	42.5 a	37.5 c	525.0 c
TANOS 50DF + CLEAN CROP COPPER 53W	1[4]	0.84 kg + 3.8 kg	42.5 b	65.0 a	57.5 b	805.0 b
OXIDATE	3	5.500 L	45.0 b	65.0 a	70.0 ab	857.5 ab

1 Area Under the Disease Incidence Curve

2 Figures within columns followed by different letters are significantly different using a protected LSD ($P<0.05$).

3 Treatments were applied on May 12, 2005, (flower buds initiating), May 19, 2005 (flower buds emerging) and again on May 30, 2005, (full bloom)

4 Treatment was applied on May 30, 2005, (full bloom)

Table 2. Efficacy of fungicide treatments on the severity of Angular leaf spot on strawberry cv. Jewel leaves.

Treatment	Application Frequency at 7 day Intervals	Rate/ha	Severity[1] of Angular leaf spot infected strawberry plants 6/6/2005	6/13/2005	6/20/2005	AUDSC[2]
UNTREATED CHECK	0	0	0.73 a[2]	0.95 a	0.98 a	12.6 a
TANOS 50DF	33	0.84 kg	0.35 b	0.68 ab	0.70 ab	8.4 b
CLEAN CROP COPPER 53W	3	3.8 kg	0.35 b	0.70 ab	0.68 b	8.5 b
TANOS 50DF + CLEAN CROP COPPER 53W	3	0.84 kg + 3.8 kg	0.28 b	0.43 b	0.38 c	5.3 c
TANOS 50DF + CLEAN CROP COPPER 53W	14	0.84 kg + 3.8 kg	0.43 b	0.78 a	0.68 b	9.3 b
OXIDATE	3	5.500 L	0.55 b	0.80 a	0.85 ab	10.2 ab

[1] Area Under the Disease Severity Curve

[2] 0=healthy, 1=1-5% leaf area infected; 2= 6-10% leaf area infected; 3= 11-25% leaf area infected; 4=26-50% leaf area infected; and 5= 50-100% leaf area infected

[3] Figures within columns followed by different letters are significantly different using a protected LSD ($P<0.05$).

[3] Treatments were applied on May 12, 2005, (flower buds initiating), May 19, 2005 (flower buds emerging) and again on May 30, 2005, (full bloom)

[4] Treatment was applied on May 30, 2005, (full bloom)

Table 3. Efficacy of fungicide treatments on the incidence and severity of Angular leaf spot on calyx of strawberry cv. Jewel berries.

Treatment	Application Frequency at 7 day Intervals	Rate/ha	Angular leaf spot infected calyxes % Incidence	Severity[1]
UNTREATED CHECK	0	0	52 a[2]	0.93 a
TANOS 50DF	3[3]	0.84 kg	65 a	1.08 a
CLEAN CROP COPPER 53W	3	3.8 kg	48 a	0.78 a
TANOS 50DF + CLEAN CROP COPPER 53W	3	0.84 kg + 3.8 kg	25 a	0.38 a
TANOS 50DF + CLEAN CROP COPPER 53W	14	0.84 kg + 3.8 kg	58 a	0.73 a
OXIDATE	3	5.500 L	53 a	0.98 a

[1] 0=healthy, 1=1-5% calyx area infected; 2= 6-10% calyx area infected; 3= 11-25% calyx area infected; 4=26-50% calyx area infected; and 5= 50-100% calyx area infected

[2] Figures within columns followed by different letters are significantly different using a protected LSD ($P<0.05$).

[3] Treatments were applied on May 12, 2005, (flower buds initiating), May 19, 2005 (flower buds emerging) and again on May 30, 2005, (full bloom)

[4] Treatment was applied on May 30, 2005, (full bloom)

2005 PMR REPORT #77

SECTION L: VEGETABLE and SPECIAL CROPS - Diseases
ICAR: 206003

CROP: Carrot (*Daucus carota* subsp. *sativus* (Hoffm.) Arcang.)
PEST: Cavity spot (*Pythium intermedium* de Bary, *Pythium irregulare* Buisman and *Pythium sulcatum* Pratt and Mitchell)

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TITLE: **EVALUATION OF DIFFERENT COLOURED CARROTS FOR SUSCEPTIBILITY TO CAVITY SPOT, 2005**

MATERIALS: Carrot breeding lines from the University of Wisconsin, Commercial carrot cultivars from Bejo Seeds Inc., Bountiful Gardens, Garden City Seeds, Johnny's Selected Seeds and Seminis Vegetable Seed

METHODS: The trial was conducted on organic soil (pH ≃ 7.2, organic matter ≃ 38.6%) naturally infested with *Pythium* spp. at the Muck Crops Research Station, Holland Marsh, Ontario. A randomized complete block arrangement with four replicates per treatment was used. Carrots were direct seeded (70-80 seeds/m) on raised beds using a push V-belt seeder on 31 May. Each replicate consisted of two rows (86 cm apart), 5 m in length. On 4 August, a random sample of 25 carrots was removed from each treatment and assessed for cavity spot. At harvest on 27 October, a 50 carrot sample was put into cold storage and assessed for cavity spot on 23 November. Carrots were washed in a rotating carrot washer, examined for cavity spot lesions and sorted into classes based on the size of the largest lesion (measured as horizontal length). The six classes were as follows: no disease; very light < 1mm; light 1-2 mm; medium 2-5 mm; heavy 5-10 mm; very heavy > 10 mm. The disease severity index (DSI) was determined by the following equation:

$$\text{DSI} = \frac{\sum [(\text{class no.})(\text{no. of carrots in each class})]}{(\text{total no. carrots per sample})(\text{no. classes} - 1)} \times 100$$

The air temperatures in 2005 were below the long term (10 year) average for May (10.8°C), average for August (19.9°C), and above average for June (21.2°C), July (21.8°C), September (16.7°C) and October (10.0°C). The long term (10 year) average temperatures were: May 12.2°C, June 18.3°C, July 20.0°C, August 19.1°C, September 15.7°C and October 8.9°C. Monthly rainfall was below the long term (10 year) average for May (14 mm), June (63 mm), July (33 mm), September (53 mm) and October (41 mm), and average for August (56 mm). The long term (10 year) rainfall averages were: May 83 mm, June 87 mm, July 64 mm, August 59 mm, September 76 mm and October 53 mm.. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix 7. Means separation was obtained using Fisher's Protected LSD test at P = 0.05 level of significance.

RESULTS: As presented in Tables 1 & 2.

CONCLUSIONS: Significant differences were found on the 23 November assessment in both disease incidence and disease severity index (DSI), (Table 1). Atomic Red had significantly more disease than all other cultivars except Dark orange and Red. Purple Haze and Amarillo Yellow were the only cultivars that had disease incidence 10% or lower (Table 1). Atomic Red also had significantly higher DSI than all other cultivars except Dark orange and Red. Purple Haze had the lowest DSI of any cultivars (Table 1). On the 4 August assessment, no significant differences were found among the carrot cultivars in percent disease or DSI. Significant differences in groups of similar colour were found. Colours of Red and Dark orange had significantly higher DSI than all the other colours (Table 2).

Table 1. Disease incidence and disease severity index (DSI) of cavity spot in different coloured carrots, grown at the Muck Crops Research Station, Holland Marsh, Ontario, 2005.

Cultivar	Source[1]	Colour[2]	Disease Incidence (%)		DSI[3]	
			4 Aug	23 Nov	4 Aug	23 Nov
Atomic Red	JSS	R	2.5 ns[4]	60.7 a[5]	0.5 ns	43.6 a
Dark Orange	UW	DO	0	52.9 ab	0	32.2 abc
Red	UW	R	3	49.2 abc	1.6	38.1 ab
Mellow Yello	Bejo	Y	3.8	44.3 bc	1.8	21.7 c-f
Dragon	GCS	P	4	43.9 bcd	1.3	31.0 bc
Cosmic Purple	JSS	P	7.5	42.3 cde	3.8	26.9 bcd
White	UW	W	5	38.3 c-f	1.5	22.3 cde
Yellow	UW	Y	5	33.5 d-g	1.8	18.2 d-g
YaYa	Bejo	O	3.8	26.5 e-h	1.5	14.2 e-h
Cellobunch	Sem	O	1.4	20.6 fgh	0.6	9.6 gh
Rainbow	Bejo	M	11.3	19.1 gh	3.5	10.6 fgh
Yellowstone	GCS	Y	0	16.9 gh	0	7.6 gh
Belgian White	BG	W	2.5	15.4 gh	0.75	8.5 gh
Purple	UW	P	2.5	14.3 gh	1.5	7.6 gh
Amarillo Yellow	BG	Y	3.8	10.1 h	2	5.4 h
Purple Haze	Bejo	P	2.5	8.9 h	1.8	4.4 h

[1] Sources UW = University of Wisconsin , Bejo = Bejo Seeds Inc, BG = Bountiful Gardens, CGS = Garden City Seeds, JSS = Johnny's Selected Seeds Sem= Seminis Vegetable Seed

[2] Colour = O = Orange, DO = Dark Orange, M = Mixed colours, P = Purple, R = Red, W = White, Y = Yelllow

[3] Disease severity index (DSI) was determined using the following equation:

$$DSI = \frac{\sum [(\text{class no.})(\text{no. of petioles in each class})]}{(\text{total no. petioles per sample})(\text{no. classes } -1)} \times 100$$

[4] ns = no significant differences were found among the treatments

[5] Numbers in a column followed by the same letter were not significantly different at P=0.05, Fisher's Protected LSD Test.

Table 2. Disease severity (DSI) of cavity spot of different coloured carrots grouped by colour, grown at Muck Crops Research Station, Holland Marsh, Ontario, 2005.

Colour[1]	November 23 DSI[2]
Orange	11.5 a[3]
Purple	13.0 a
Yellow	13.2 a
White	15.4 a
Dark Orange	32.2 b
Red	37.5 b

[1] Cultivars and breeding lines of similar colour were grouped for analysis

[2] Disease severity index (DSI) was determined using the following equation:

$$DSI = \frac{\sum [(\text{class no.})(\text{no. of petioles in each class})]}{(\text{total no. petioles per sample})(\text{no. classes } -1)} \times 100$$

[3] Numbers in a column followed by the same letter were not significantly different at P=0.05, Fisher's Protected LSD Test.

2005 PMR REPORT #78

SECTION L: VEGETABLE and SPECIAL CROPS - Diseases
ICAR: 206003

CROP: Celery *Apium graveolens* L. var. *dulce* (Miller) Pers. cv. Sabroso
PEST: Septoria late blight (*Septoria apiicola* Speg.)

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TITLE: **EVALUATION OF FUNGICIDES FOR THE CONTROL OF SEPTORIA LATE BLIGHT ON CELERY, 2005**

MATERIALS: **ALEXIN** (potash 8%, calcium 2.4%), **BRAVO 500** (chlorothalonil 50%), **CUPROFIX** (copper 40%)

METHODS: The trial was conducted near the Muck Crops Research Station, Holland Marsh, Ontario, in organic soil (pH ≃ 7.2, organic matter ≃ 38.6%). Celery cultivar Sabroso was seeded into 288 cell plug trays on 25 April. Celery was hand transplanted into the field on 24 June (six rows/treatment) with in-row plant spacing of 18 cm. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of six rows, 55 cm apart and 5 m in length. Treatments were applied on 16, 25 August, 6, 19 and 28 September using a pull type plot sprayer with TeeJet D-2 hollow cone nozzles at 690 kPa (boom) in 500 L/ha of water. Treatments were: CUPROFIX at 6.5 kg/ha, ALEXIN at 4.0 L/ha + BRAVO 500 at 3.0 L/ha and ALEXIN at 4.0 L/ha. An untreated check was also included. On 16 August the trial was inoculated with diseased leaves from celery plants with active *S. apiicola* lesions that were chopped, combined with water, allowed to stand for 48 hours and spread evenly by hand over rows three and four (the middle two rows of each treatment). On 11 October, a sample of 12 plants from each replicate was harvested, weighed, measured and assessed for disease. The average harvest weight, and stalk height was recorded. Stalks were trimmed to 55 cm and the trimmed weight was recorded. After trimming, the remaining leaves were assessed for Septoria leaf blight and rated on a scale from 0-3: 0 = no lesions on leaves; 1 = <10% leaves diseased; 2 = 11–50% diseased; 3 = >50% diseased. Ten petioles were removed from the 12 harvested plants and rated for Septoria late blight on a scale from 0-5: 0 = no disease; 1 = <10% petiole area diseased; 2 = 10-25% diseased; 3 = 26-50% diseased; 4 = 51-75% diseased; 5 = >75% diseased. The disease severity index (DSI) was determined by the following equation:

$$DSI = \frac{\sum [(\text{class no.})(\text{no. of celery})}{(\text{total no. celery per sample})(\text{no. classes } -1)} \times 100$$

The air temperatures in 2005 were above the long term (10 year) average for June (21.2°C), July (21.8°C), September (16.7°C) and October (10.0°C) and average for August (19.9°C). The long term (10 year) average temperatures were: June 18.3°C, July 20.0°C, August 19.1°C, September 15.7°C and October 8.9°C. Monthly rainfall was below the long term (10 year) average for June (63 mm), July (33 mm), September (53 mm) and October (41 mm), and average for August (56 mm). The long term (10 year) rainfall averages were: June 87 mm, July 64 mm, August 59 mm, September 76 mm and October 53 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 1 and 2.

CONCLUSIONS: Disease incidence in the trial was very high (Table 1). Significant differences were found among treatments in the disease severity index (DSI) (Table 1). All treatments had lower DSI than the check. The CUPROFIX and ALEXIN + BRAVO treatments had significantly lower DSI than ALEXIN alone and the check. There were no significant differences in percent petiole disease, leaf blight rating (Table 1), harvest weights and plant height (Table 2).

Table 1. Petiole DSI , % petioles diseased and leaf blight ratings of celery treated with various fungicides for the control of Septoria leaf blight , grown at the Muck Crops Research Station, Holland Marsh, Ontario, 2005.

Treatment	Rate (ha)	DSI[1]	Petiole Disease (%)	Leaf Blight Rating[2]
Check	----	64.9 c[3]	100.0 ns[4]	2.9 ns
CUPROFIX	6.5 kg	27.1 a	95.6	2.7
ALEXIN	4.0 L	46.4 b	99	2.7
ALEXIN + BRAVO	4.0L+ 3.0 L	28.0 a	78.8	2.3

[1] Disease severity index (DSI) was determined using the following equation:

$$DSI = \frac{\sum [(\text{class no.})(\text{no. of petioles in each class})]}{(\text{total no. petioles per sample})(\text{no. classes } -1)} \times 100$$

[2] Septoria leaf blight rating: 0 = no lesions on leaves; 1 = <10% leaves diseased; 2 = 11–50% diseased; 3 = >50% diseased

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

[4] ns indicates that there were no significant differences found among the treatments.

Table 2. Harvest weight and plant height of celery treated with various fungicides for the control of Septoria leaf blight, grown at the Muck Crops Research Station, Holland Marsh, Ontario, 2005.

Treatment	Rate (ha)	Harvest Weight (kg)	Plant Height (cm)
Check	----	13.3 ns[1]	58.1 ns
CUPROFIX	6.5 kg	15.9	65.3
ALEXIN	4.0 L	15.1	62.5
ALEXIN + BRAVO	4.0L+ 3.0 L	15.8	63.6

[1] ns indicates that there were no significant differences found among the treatments.

2005 PMR Report #79 **SECTION L: VEGETABLES and SPECIAL CROPS- Diseases**

CROP: Celery (*Apium graveolens L.*), cv. Sabroso and cv. Florida 683
PEST: Septoria late blight (*Septoria apiicola*) Speg.

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TITLE: **EVALUATION OF DISEASE FORECASTING SYSTEMS FOR CONTROL OF SEPTORIA LATE BLIGHT ON CELERY IN ONTARIO, 2005**

MATERIALS: BRAVO 500 (chlorothalonil 50%), BAS 516 (pyraclostrobin 12.8%, boscalid 25.2%), CHAMP 2 (copper hydroxide 37.5%)

METHODS: Two trials were 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 15 Mar for Trial 1, and 14 Apr for Trial 2. For Trial 1, celery was hand transplanted into the field on 25 May (three rows/ cultivar/ treatment) with in-row plant spacing of 15 cm and 18 cm for Florida 683 and Sabroso respectively. For Trial 2, celery was hand transplanted into the field on 23 Jun (three rows/ cultivar/ treatment) with in-row plant spacing of 22 cm for Florida 683 and 15 cm for Sabroso. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of six rows, 55 cm apart and 5 m in length. 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. 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).

Trials were inoculated with diseased foliage from celery plants with actively growing *Septoria apiicola* lesions. The diseased tissue was hand chopped, mixed with water and soaked for 2 hours. The tissue and water suspension was then poured as evenly as possible over the middle two rows of each treatment. Trial 1 and Trial 2 were inoculated on 28 Jul and 11 Aug, respectively. All treatments were applied according to the criteria for the tested disease forecasting systems using a pull-type plot sprayer with TeeJet D-2 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 replicate were harvested and assessed on 16 and 19 Sept for Trial 1, and 3 and 5 Oct for Trial 2. For Sabroso, weight and average height were recorded. The harvested celery was trimmed to 55 cm and the trimmed weight was recorded. For Florida 683, the weight and average height were recorded, and the celery was trimmed to 40 cm. The celery was graded into 24's, 30's, and 48's, counted and weighed. For both cultivars, 120 outer stalks from the 12 harvested plants (10 outer stalks per plant) were removed and the petioles were rated for Septoria late blight from 0-5: 0 = no disease; 1 = < 10% petiole area diseased; 2 = 10-25% diseased; 3 = 25-50% diseased; 4 = 50-75% diseased; 5 = >75% diseased. The leaves were also assessed for Septoria leaf blight (after trimming for Sabroso) and rated on a scale from 0-3: 0 = no lesions on leaves; 1 = < 10% of leaves diseased; 2 = 10-51% diseased; 3 = > 51% diseased. The disease severity index (DSI) for the petioles was determined using the following equation:

$$DSI = \frac{\sum [(\text{class no.})(\text{no. of petioles in each class})]}{(\text{total no. petioles per sample})(\text{no. classes} - 1)} \times 100$$

Area under the disease progress curve (AUDPC) was determined using the formula

$$\text{AUDPC} = \frac{\sum (Y_i + Y_{i-1})(X_i - X_{i-1})}{2}$$

where Y_i = blight severity at *i*th observation and X_i = time at *i*th observation.

The air temperatures in 2005 were below the long term (10 year) average for May (10.8°C), average for August (19.9°C), and above average for June (21.2°C), July (21.8°C), September (16.7°C) and October (10.0°C). The long term (10 year) average temperatures were: May 12.2°C, June 18.3°C, July 20.0°C, August 19.1°C, September 15.7°C and October 8.9°C. Monthly rainfall was below the long term (10 year) average for May (14 mm), June (63 mm), July (33 mm), September (53 mm) and October (41 mm), and average for August (56 mm). The long term (10 year) rainfall averages were: May 83 mm, June 87 mm, July 64 mm, August 59 mm, September 76 mm and October 53 mm.

All data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.7. Means separation was obtained using Fisher's Protected LSD test with *P*=0.05 level of significance.

RESULTS: As presented in Tables 1 through 3.

CONCLUSIONS: For Trial 1(Table 1) and Trial 2 (Table 2), the disease severity index (DSI) on petioles, AUDPC, and foliar disease severity were significantly lower in all treatments compared to the unsprayed control. For petiole DSI in Trial 2, the Septoria Predictor and Tomcast DSV 15 using BAS 516 alternating with CHAMP 2 provided control as good as calendar sprays, and the forecasting systems reduced the number of sprays by 1, 3, and 4, respectively. In Trial 1, the Septoria Predictor, Tomcast DSV 10, and Tomcast DSV 15 reduced the number of sprays by 1, 1, and 2, respectively. For Trial 2, Florida 683 harvest weight and height were lower in the unsprayed control compared to all sprayed treatments (Table 3). There were no significant differences in harvest weight, trimmed weight, and harvest height in Trial 1 (data not shown), and Sabroso in Trial 2 (Table 3).

In both trials (Tables 1, 2), treatments of BAS 516 alternating with CHAMP 2 generally resulted in significantly lower AUDPC than treatments of BRAVO alternating with CHAMP 2. BAS 516 is a reduced-risk fungicide with good potential to be used for control of Septoria late blight within an integrated pest management program. No symptoms of phytotoxicity were observed in any treatments.

Table 1. Disease incidence, petiole disease severity index (DSI), and leaf blight rating of Septoria late blight in two celery cultivars (Florida 683 and Sabroso) treated under different disease forecasting systems, Trial 1, Muck Crops Research Station, Holland Marsh, Ontario, 2005.

Treatment & rate/ha	Application days [a]	Petiole DSI	Foliar disease rating	AUDPC[b]	
				Sabroso	Florida 683
Unsprayed control	Not applicable	44.77 b[c]	2.5 d	58.0 d	66.8 e
Calendar					
BRAVO 3.0 L	0, 7, 14, 21, 28, 34, 41	0.08 a	0.2 ab	3.8 abc	4.5 abc
alt. CHAMP 4.0 kg					
BAS 516 1.0 kg		0.00 a	0.0 a	0.6 a	0.0 a
alt. CHAMP 4.0 kg					
Septoria Predictor					
BRAVO 3.0 L	0, 9, 19, 28, 34, 42	0.06 a	0.2 ab	4.6 abc	11.1 cd
alt. CHAMP 4.0 kg					
BAS 516 1.0 kg		0.00 a	0.1 ab	0.6 a	4.4 abc
alt. CHAMP 4.0 kg					
Tomcast DSV 10					
BRAVO 3.0 L	0, 7, 14, 21, 28, 38	0.04 a	0.2 ab	0.0 a	3.3 ab
alt. CHAMP 4.0 kg					
BAS 516 1.0 kg		0.00 a	0.0 a	1.8 ab	0.0 a
alt. CHAMP 4.0 kg					
Tomcast DSV 15					
BRAVO 3.0 L	0, 9, 19, 34, 38	0.02 a	0.5 bc	8.1 c	10.5 bcd
alt. CHAMP 4.0 kg					
BAS 516 1.0 kg		0.00 a	0.2 ab	0.0 a	0.0 a
alt. CHAMP 4.0 kg					
Tomcast DSV 20					
BRAVO 3.0 L	0, 9, 21, 41	1.10 a	1.3 c	7.0 bc	15.6 d
alt. CHAMP 4.0 kg					
BAS 516 1.0 kg		0.52 a	0.8 c	3.1 abc	5.3 abc
alt. CHAMP 4.0 kg					

[a] First fungicide application was 27 Jul (27 Jul is day 0).
[b] Area under the disease progress curve.
[c] Numbers in a column followed by the same number are not significantly different at $P = 0.05$, Fisher's Protected LSD test.

Table 2. Petiole disease severity index (DSI), AUDPC, and leaf blight rating of Septoria late blight in two celery cultivars (Florida 683 and Sabroso) treated under different disease forecasting systems, Trial 2, Muck Crops Research Station, Holland Marsh, Ontario, 2005.

Treatment & rate/ha	Application days[a]	Petiole DSI	Foliar disease rating	AUDPC[b]	
				Sabroso	Florida 683
Unsprayed control	Not applicable	60.4 d[c]	3.00 d	86.5 f	103.5 f
Calendar					
BRAVO 3.0 L alt. CHAMP 4.0 kg	0, 7, 14, 20, 28, 35, 42, 47	1.7 ab	1.1 b	26.3 de	22.5 b
BAS 516 1.0 kg alt. CHAMP 4.0 kg		0.4 a	0.5 a	3.1 a	6.9 a
Septoria Predictor					
BRAVO 3.0 L alt. CHAMP 4.0 kg	0, 10, 16, 27, 35, 42, 47	5.1 b	1.4 b	28.1 de	38.0 d
BAS 516 1.0 kg alt. CHAMP 4.0 kg		0.1 a	0.4 a	7.9 ab	14.0 ab
Tomcast DSV 10					
BRAVO 3.0 L alt. CHAMP 4.0 kg	0, 7, 14, 24, 40	11.4 c	2.2 c	32.3 e	38.3 d
BAS 516 1.0 kg alt. CHAMP 4.0 kg		1.5 c	1.4 b	18.1 bcd	20.3 b
Tomcast DSV 15					
BRAVO 3.0 L alt. CHAMP 4.0 kg	0, 7, 20, 40	3.6 ab	1.2 b	20.4 cd	25.5 bc
BAS 516 1.0 kg alt. CHAMP 4.0 kg		1.4 ab	1.0 b	14.0 bc	14.5 ab
Tomcast DSV 20					
BRAVO 3.0 L alt. CHAMP 4.0 kg	0, 10, 27	12.6 c	2.0 c	36.3 e	53.1 e
BAS 516 1.0 kg alt. CHAMP 4.0 kg		5.4 b	1.9 c	22.8 cd	37.6 cd

[a] First fungicide application was 10 Aug (10 Aug is day 0).

[b] Area under the disease progress curve.

[c] Numbers in a column followed by the same number are not significantly different at $P = 0.05$, Fisher's Protected LSD test.

Table 3. Harvest weight, trimmed weight, and harvest height of two celery cultivars (Florida 683 and Sabroso) treated under different disease forecasting systems to the control of Septoria late blight, Trial 2, Muck Crops Research Station, Holland Marsh, Ontario, 2005.

Treatment & rate/ha	Harvest Weight (kg)		Trimmed Weight (kg)		Harvest Height (cm)	
	Sabroso	Florida 683	Sabroso	Florida 683	Sabroso	Florida 683
Unsprayed control	11.4 ns[a]	11.6 b[b]	10.7 ns	10.7 ns	61.8 ns	50.1 c
Calendar						
BRAVO 3.0 L alt. CHAMP 4.0 kg	17.3	17.6 a	15.4	14.2	72.8	64.8 ab
BAS 516 1.0 kg alt. CHAMP 4.0 kg	15.4	19.1 a	13.4	15.1	67.6	65.0 ab
Septoria Predictor						
BRAVO 3.0 L alt. CHAMP 4.0 kg	15.5	19.4 a	14.6	15.6	70.3	62.5 ab
BAS 516 1.0 kg alt. CHAMP 4.0 kg	17.3	17.4 a	15.0	13.8	67.	65.0 ab
Tomcast DSV 10						
BRAVO 3.0 L alt. CHAMP 4.0 kg	15.9	17.4 a	14.2	14.2	69.8	62.6 ab
BAS 516 1.0 kg alt. CHAMP 4.0 kg	17	19.1 a	15.2	15.3	70.6	65.8 ab
Tomcast DSV 15						
BRAVO 3.0 L alt. CHAMP 4.0 kg	16.3	17.9 a	14.4	14.3	69.5	63.2 ab
BAS 516 1.0 kg alt. CHAMP 4.0 kg	15.8	18.3 a	13.9	15.1	69.7	66.4 a
Tomcast DSV 20						
BRAVO 3.0 L alt. CHAMP 4.0 kg	14.8	17.2 a	13.1	13.6	67.8	62.7 ab
BAS 516 1.0 kg alt. CHAMP 4.0 kg	15.9	18.0 a	14.0	14.4	69.7	59.5 b

[a] ns = not significant difference between treatments

[b] Numbers in a column followed by the same number are not significantly different at $P = 0.05$, Fisher's Protected LSD test

2005 PMR REPORT #80

SECTION L: VEGETABLES and SPECIAL CROPS - Diseases
AAFC Study: 52326

CROP: Ginseng (*Panax quinquefolius* L.)
PEST: Damping-off, *Rhizoctonia solani* (Kühn)

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TITLE: EFFICACY OF QUADRIS, BAS 500, OMEGA AND MEDALLION FOR CONTROL OF RHIZOCTONIA DAMPING-OFF IN GINSENG, 2003-2004

MATERIALS: QUADRIS (azoxystrobin; 229 g ai /L); BAS 500 (CABRIO; pyraclostrobin; 200 g ai /kg); OMEGA (fluazinam; 500 g ai/L); MEDALLION (fludioxonil; 500 g ai/kg)

METHODS: The experiment was established on a fumigated (Telone C-17; 362 L/ha) brunisolic grey-brown luvisol (Fox loamy sand; Delhi research farm) in Nov 2003. Plots (2.5 m long x 1.5 m wide), separated by 0.5 - m buffers, were laid out in a conventional cambered ginseng bed under plastic shade cloth using a randomized complete block design with four replications. Plots were seeded at a rate of 322 seeds/m^2. Each plot was subdivided into two 1- m^2 subplots, designed to receive pathogen inoculum either in the fall (5 Nov 2003), or the following spring (9 Mar 2004). Inoculum consisted of pieces of *R. solani*-colonized ginseng roots, prepared by slicing fresh roots into 5 mm thick sections then double-autoclaving in erlenmeyer flasks. Root pieces were inoculated with an agar culture of *R. solani* then incubated under ambient light in the laboratory for 4 wk. Five g (fresh wt) of colonized root were placed in a shallow (2 cm) depression in the soil centrally located in each fall-infested subplot. Additional inoculum, prepared simultaneously, was stored at 8 C until 9 Mar 2004, when it was added to spring-infested subplots, as per the fall inoculum. Fall application of fungicide treatments was made to both subplots on 6 Nov 2003, prior to placement of an oat straw mulch over the seeded beds. Spring fungicide applications to both subplots were made on 20 April 2004, over the existing straw mulch. Applications were made in the fall in 2000 L water/ha (TG-2 nozzle; 276 kPa) and, in the spring, in 4000 L water/ha (TG-3 nozzle; 234 kPa), using a CO_2 - powered backpack sprayer. Movable spray curtains were placed around each plot during application, in order to minimize spray drift. Control plots were untreated. Ginseng stand counts and radial extension of disease (cm) from the central inoculum point for each 1.0 m^2 area subplot were recorded in July 2004. In each subplot, the extent of disease spread (as expressed by missing or damped-off seedlings) was measured in the south and west directions; means of the two radii were used in analysis. Data were analysed using ANOVA; the Holms-Sidak test was used to separate treatment means (SigmaStat v. 3).

RESULTS: Considerable disease pressure was evident in fall-inoculated control plots but little disease developed in spring-inoculated plots. Significant differences between treatments were found in fall-infested subplots when data were analyzed (Table1).

CONCLUSIONS: Quadris, the product currently registered for use on ginseng for control for this disease, provided a high level of disease control when applied at the label rate. Both rates of BAS 500 (CABRIO) were efficacious when compared to the control. Medallion was similar to Quadris with respect to damped-off area but not significantly different from the control in terms of plant stand. Omega was ineffective, regardless of rate. Further investigation of fludioxonil for control of this disease may be warranted.

Table 1. Effect of fungicides on plant stand and radius of damped-off area in *Rhizoctonia*-infested plots, 2004.

Treatment and rate a.i./ ha[1]	Fall-infested subplots[3] (8 July 2004)[4]					
	Plant stand[5]			Radius (cm)[6]		
1. Quadris; 280 g ai/ha (2X)	147.0	a	*	6.0	ab	*
2. BAS 500; 220 g ai/ha (2X)	133.2	ab	*	9.3	abc	*
3. BAS 500; 440 g ai/ha (2X)	144.2	a	*	2.9	a	*
4. Omega; 280 g ai/ha (2X)	116	bc		21.2	d	
5. Omega; 560 g ai/ha (2X)	115.2	bc		16.7	cd	
6. Medallion; 250 g ai/ha (2X)	128.2	abc		5.4	ab	*
7. Medallion; 500 g ai/ha (2X)	120.0	abc		4.6	ab	*
8. Check, untreated.[2]	107.8	c		20.9	d	
P > F	0.028			0.001		

[1] Applications were made twice (6 Nov 2003 and 20 April 2004) to each plot, at the rate indicated.

[2] Untreated plots to which inoculum was added (positive control).

[3] Fungal inoculum was added to fall-infested subplots on 6 Nov 2003, prior to treatment application. No significant treatment effects were observed in spring-infested subplots and data from these plots are not shown.

[4] Date when observations of plant stand and disease radius were recorded.

[5] Plant stand / m^2. Treatment values in a column followed by the same letter indicate that treatments are not significantly different according to the Holm-Sidak test (alpha=0.05). Values followed by asterisks (*) are significantly different from the control.

[6] Radius of damped-off area (cm). Treatment values in a column followed by the same letter indicate that treatments are not significantly different according to the Holm-Sidak test (alpha=0.05). Values followed by asterisks (*) are significantly different from the control.

2005 PMR REPORT#81

SECTION L: VEGETABLE and SPECIAL CROPS - Diseases
ICAR: 206003

CROP: Iceberg head lettuce (*Lactuca sativa* L.) cv. Skyline
PEST: Downy Mildew (*Bremia Lactucae* Regal)

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TITLE: COMPARISON OF RIDOMIL GOLD MZ 68WP AND RIDIMOL GOLD MZ 68WG FOR THE CONTROL OF DOWNY MILDEW IN LETTUCE, 2005

MATERIALS: RIDOMIL GOLD MZ 68WP (metalaxyl-m 4%, mancozeb 64%), RIDOMIL GOLD MZ 68WG (metalaxyl-m 4%, mancozeb 64%)

METHODS: Lettuce was direct seeded (14 seeds/m) into organic soil (pH ≃ 6.4, organic matter ≃ 60%) on 11 July using a Stan Hay Precision seeder at the Muck Crops Research Station, Holland Marsh, Ontario. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of eight 5 m long rows, 42 cm apart. Treatments were: RIDOMIL GOLD MZ 68WP at 2.5 kg/ha and RIDOMIL GOLD MZ 68WG at 2.5 kg/ha. An untreated check was also included. Treatments were applied on 8, 25 August and 3 September using a pull type plot sprayer with TeeJet D-2 hollow cone nozzles at 690 kPa (boom) in 500 L/ha of water. The lettuce was thinned to an in-row plant spacing of 30 cm on 27 July. At harvest on 15 September, 15 heads were harvested and examined for disease and graded for downy mildew incidence and severity. Downy mildew disease severity was assessed using a scale from 0-5: 0 = no lesions; 1 = 1 lesion; 2 = 2-5 lesions; 3 = 6-10 lesions; 4 = 11-15 lesions; 5 = > 16 lesions. The same 15 heads were used to obtain a yield sample. The air temperatures in 2005 were above the long term (10 year) average for July (21.8°C) and September (16.7°C) and average for August (19.9°C). The long term (10 year) average temperatures were: July 20.0°C, August 19.1°C and September 15.7°C. Monthly rainfall was below the long term (10 year) average for July (33 mm) and September (53 mm) and average for August (56 mm). The long term (10 year) rainfall averages were: July 64 mm, August 59 mm and September 76 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 and 2.

CONCLUSIONS: Significant differences were found among the treatments in percent downy mildew, disease severity and percentage of marketable heads (Tables 1,2). The RIDOMIL treatments had significantly lower percentage of leaves with downy mildew, lower disease severity and higher percentage marketable heads than the untreated check (Tables 1,2). Disease pressure in the trial was very high. No phytotoxicity was observed with the RIDOMIL treatments after each application.

Table 1. Comparison of RIDOMIL GOLD MZ 68WP and RIDOMIL GOLD MZ 68WG for the control of Downy mildew on lettuce grown at the Muck Crops Research Station, Holland Marsh, Ontario, 2005.

Treatment	Rate (kg/ha)	% of Leaves with Downy Mildew	Downy Mildew DSI[1]
Check	---	93.9 b[2]	81.0 b
RIDOMIL GOLD MZ 68WP	2.5	11.1 a	3.0 a
RIDOMIL GOLD MZ 68WG	2.5	16.1 a	4.3 a

[1] Disease severity index (DSI) was determined using the following equation:

$$DSI = \frac{\sum [(\text{class no.})(\text{no. of petioles in each class})]}{(\text{total no. petioles per sample})(\text{no. classes } -1)} \times 100$$

[2] Numbers in a column followed by the same letter were not significantly different at $P=0.05$, Fisher's Protected LSD test

Table 2. Yield data for lettuce treated with different formulations of RIDOMIL GOLD MZ, grown at the Muck Crops Research Station, Holland Marsh, Ontario, 2005

Treatment	Rate (kg/ha)	Yield (kg)[1]	(%) of Marketable Heads	Weight/Head (g)
Check	---	14.1 ns[2]	25.0 b[3]	936 ns
RIDOMIL GOLD MZ 68WP	2.5	16.7	100.0 a	1115
RIDOMIL GOLD MZ 68WG	2.5	18.3	100.0 a	1218

[1] Yield was based upon a sample of 15 heads

[2] ns indicates no significant differences found among the treatments

[3] Numbers in a column followed by the same letter were not significantly different at $P=0.05$, Fisher's Protected LSD test

2005 PMR REPORT #82

SECTION L: VEGETABLE and SPECIAL CROPS-Diseases
ICAR: 206003

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

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TITLE: **EVALUATION OF REDUCED-RISK FUNGICIDE SEED TREATMENTS FOR CONTROL OF ONION SMUT AND DAMPING-OFF**

MATERIALS: RAXIL 2.6F (tebuconazole 28.4%), APRON XL LS (mefenoxam 28.4%), MAXIM 4FS (fludioxinil 40.3%), PRO GRO 80D (carbathiin 30%, thiram 50%), THIRAM 42S (thiram 42%), DYNASTY (azoxystrobin 3.2%), TRILEX (trifloxystrobin 22%).

METHODS: In fall 2004 and winter 2005, greenhouse trials were conducted at the Muck Crops Research Station (MRS) to compare onion smut OS incidence between fungicide seed treatments. Onion seeds (cv. Millennium) were commercially film coated with the appropriate treatments at the Agricultural Experiment Station, Geneva, New York. Four fungicide treatments: PRO GRO at 2000 mg ai/100 of seeds; APRON XL at 15 mg ai/ 100 of seeds; MAXIM at 5 mg ai /100 of seeds; THIRAM at 188 mg ai/100 of seeds; and six fungicide combinations: THIRAM at 188 mg ai/100 of seeds+ APRON XL at 15 mg ai/ 100 of seeds; THIRAM at 188 mg ai/100 of seeds+ APRON XL at 15 mg ai/ 100 of seeds + MAXIM at 5 mg ai /100 of seeds; THIRAM at 188 mg ai/100 of seeds + DYNASTY at 150 mg ai/100 of seeds; PRO GRO at 2000 mg ai/100 of seeds + APRON XL at 15 mg ai/ 100 of seeds; THIRAM at 188 mg ai/100 of seeds + TRILEX at 150 mg ai/100 of seeds; THIRAM at 188 mg ai/100 of seeds + RAXIL at 250 mg ai/100 of seeds were used with four replications. Onion seeds were hand-sown 1 cm deep in 200- plug trays filled with organic soil (pH ≈ 6.4, organic matter ≈ 60%) naturally infested with OS collected from MCRS. Trays were moved to the cool and dark germination room ([Avg.] mean temp. 13° C) and kept for 14 days to increase the OS incidence. When most of the seedlings had reached the loop stage, trays were moved to the greenhouse for approximately 8 weeks. Each tray was divided in half, 100 plants in each half. Onion trays were checked for damping-off after they were moved to the greenhouse at the early seedling stage. Onion smut assessments were made twice, first when the flag leaves were fully developed in the first half and again when the flag leaves had died in the other half of each tray. Assessment was done by pulling out the onion plants and visually examining them. This experiment was repeated once [one more time to confirm our results]. Statistical significance of differences was determined with analysis of variance (ANOVA) and Fisher's Protected LSD test ($\propto$=0.05).

RESULTS: As presented in Tables 1 & 2.

CONCLUSIONS: In general, considerable OS damage was observed in the check, APRON and THIRAM treatments and in the combinations of these fungicides either alone or with MAXIM (Table 1). These combinations are mostly applied to control damping-off. Combinations of PRO-GRO+ APRON, THIRAM+ TRILEX and MAXIM alone gave an intermediate level of smut control (Table 1). Fungicide trials were also evaluated for damping off damage (Table 2). Damage caused by damping off was significant in the check plot. However, MAXIM alone had the highest incidence of damping-off. No significant difference was observed between other fungicide treatments (Table 2). Consequently they were all effective against damping-off incidence. In conclusion, the combination of THIRAM + RAXIL was the most effective treatment for the control of onion smut and damping off.

Table 1. Evaluation of reduced risk seed treatment fungicides for onion smut (OS) incidence in greenhouse trials, 2004 and 2005.

Treatments	Average percent (%) OS			
	1st true leaf 25 Jan. 2004	3-5 true leaf 15 Feb. 2004	1st true leaf 08 Mar. 2005	3-5 true leaf 24 Mar. 2005
Check	26.1 f[1]	8.6 c-e	13.8 d	4.7 b-d
Apron	25.6 ef	8.2 c-e	26.3 e	5.8 b-d
Thiram	22.9 ef	6.3 b-e	13.5 cd	6.7 cd
Thiram+Apron	20.9 de	9.6 e	21.1 e	8.3 d
Pro Gro	16.3 cd	4.0 d b	8.3 b-d	2.0 ab
Thiram + Apron + Maxim	15.6 c	9.4 de	11.6 cd	6.5 cd
Thiram+ Dynasty	15.6 c	6.0 b-d	10.9 b-d	3.4 a-c
Pro Gro + Apron	10.1 b	4.6 b	7.5 bc	3.2 a-c
Thiram+ Trilex	8.0 b	3.5 ab	9.3 b-d	2.4 ab
Maxim	7.8 a	5.5 bc	5.1 ab	4.3 bc
Thiram + Raxil	0.0 a	0.0 a	0.0 a	0.3 a

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

Table 2. Evaluation of reduced risk seed treatment fungicides for damping off incidence in greenhouse trials, 2004 and 2005.

TREATMENTS	Average percent (%) damping-off			
	1st true leaf 25 Jan. 2005	3-5 true leaf 15 Feb.2005	1st true leaf 08 March, 2005	3-5 true leaf 24 March, 2005
Check	23.0 c[1]	23.1 c	0.0 a	0.5 a
Apron	2.6 a	4.3 a	1.4 a	3.2 a
Thiram	1.6 a	1.6 a	1.6 a	1.6 a
Thiram+Apron	1.3 a	0.6 a	.5 a	0.3 a
Pro Gro	0.3 a	1.5 a	0.0 a	0.0 a
Thiram + Apron + Maxim	0.8 a	1.9 a	0.8 a	1.0 a
Thiram+ Dynasty	0.8 a	0.8 a	0.3 a	0.3 a
Pro Gro + Apron	0.0 a	0.8 a	0.3 a	0.0 a
Thiram+ Trilex	1.6 a	0.0 a	0.8 a	0.8 a
Maxim	12.9 b	10.3 b	22.5 b	26.1 b
Thiram + Raxil	0.5 a	0.0 a	0.8 a	0.3 a

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

2005 PMR REPORT #83

SECTION L: VEGETABLE and SPECIAL CROPS - Diseases
ICAR: 33331975

CROP: Spinach (*Spinacia oleracea* L.), cv. 151 Seminis
PEST: Downy Mildew, *Peronospora farinosa* (Fr.:Fr.) Fr. f.sp. *spinaciae* Byford

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TITLE: **EFFICACY OF FUNGICIDES APPLIED ALONE AND FOLLOWING A DRENCH WITH RIDOMIL ON DOWNY MILDEW IN SPINACH 2005**

MATERIALS: RIDOMIL GOLD EC 480 (metalaxy-M, 490 g.a.i./L), TANOS 50DF (famoxidone 25% + cymoxanil 25%), QUADRIS FLOWABLE (azoxystrobin, 250 g.a.i./l), PREV AM (sodium te[t]raborohydrate decahydrate 0.99%)

METHODS: A trial was conducted in a commercial spinach production field near Orangeville, Ontario where downy mildew was observed previously. Treatments were applied to 6 meter long plots of Spinach cv. Seminis 151 seeded on August 12, 2005 in 135 cm wide beds with 8 rows/bed. The treated plots were arranged in a randomized complete block design with each treatment replicated four times. Half of the plots were treated with RIDOMIL GOLD EC 480 applied as a soil drench at 1.4 L in 2400 L water/ha with a 5 liter plastic watering can on August 12, 2005 immediately after seeding. TANOS 50DF at 0.84 kg/ha; QUADRIS FLOWABLE at 1.125 L/ha and PREV AM at 2.2 L/ha were applied as foliar sprays on September 13, 2005, 32 days after seeding (4-5 leaves emerging) and again on September 20, 2005, 39 days after seeding (7-8 leaves emerging) to plots that were either drenched or not drenched with RIDOMIL GOLD EC 480 previously at seeding. The TANOS 50DF and QUADRIS FLOWABLE were applied with 250 L of water/ha whereas the PREV AM was applied with 500 L of water/ha. The foliar fungicides were applied with a hand held boom, CO_2 plot sprayer at 40 p.s.i. using adjustable hollow cone nozzles. The number of total leaves/plant, number of infected leaves/plant, incidence of infected plants and severity of disease (0=healthy, 1=1-10% of leaf area infected; 2= 11-25% leaf area infect; 3= 25-50% leaf area infect; 4=50-100% leaf are infected; and 5= systemic infection) was evaluated on 10 randomly sampled plants/plot, on September 27 and October 4, 2005; 7 and 13 days after the last fungicide application respectively. Incidence data was transformed using Arcsine for statistical analysis to improve normality and additivity, however actual means are presented. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix 8. Fisher's protected least significant difference (LSD) test at P= 0.05 was used to separate differences among treatment means.

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

CONCLUSIONS: Environmental conditions were favourable for *P. farinosa* f. sp. *spinaciae* infection of spinach and disease development during late August through September 2005. Disease was moderate to high in plots and several spinach plants/plot were observed to be systemically infected with downy mildew. None of the treatments caused significant injury to spinach plants or affected the mean number of leaves per plant (Table 1) however; some plants treated with TANOS 50DF appeared slightly stunted. All treatments significantly reduced the incidence of downy mildew infected plants, the severity of disease and number of diseased leaves/plant, 14 days after the last treatment except where PREV AM was applied to plots that previously received a drenched with RIDOMIL GOLD EC 480 at seeding (Table 2). Downy mildew incidence, severity and the number of diseased leaves/plant was significantly lower 13 days after the last foliar application in plots treated with TANOS 50DF or QUADRIS FLOWABLE, alone and following a drench with RIDOMIL GOLD EC 480 at seeding compared to the untreated check. PREV AM applied as a foliar application alone also significantly reduced downy mildew incidence, severity and the number of diseased leaves/plant 13 days after the last foliar application compared to the untreated

check. Applying PREV AM to plots that received a drench with RIDOMIL GOLD EC 480 at seeding significantly reduced the incidence and severity of downy mildew but did not reduce the number of diseased leaves/plant compared to the untreated check when evaluated 13 days after the last foliar application. Over all, the incidence of downy mildew and number of diseased leaves/plant was significantly lower 13 days after the last foliar application in plots treated with TANOS 50DF than plots treated with QUADRIS FLOWABLE or PREV AM regardless if plots were previously drenched at seeding with RIDOMIL GOLD EC 480 (Table 3). Although disease severity and the number of diseased leaves/plant were significantly lower in plots drenched at seeding with RIDOMIL GOLD EC 480 alone than in untreated check plots (Table 2), the main effect of applying RIDOMIL GOLD EC 480 as a drench at seeding prior to a foliar application with another fungicide did not significantly reduce the incidence of diseased plants, the severity of disease or the number of diseased leaves/plant compared to the foliar fungicides applications alone (Table 4).

Table 1. Effect of foliar fungicides applied alone or following a RIDOMIL GOLD EC 480 drench at seeding on the mean number of leaves/plant.

Treatment	Product Rate/ha	Mean No. of leaves/plant	
		9/27/2005	10/4/2005
Untreated	-	9.8 a[1]	10.9 a
RIDOMIL GOLD EC 480 drench	1400 ml	9.8 a	10.8 a
TANOS 50DF	840 g	10.2 a	11.2 a
TANOS 50DF +	840 g +	9.9 a	11.0 a
RIDOMIL GOLD EC 480 drench	1400 ml		
QUADRIS FLOWABLE	400 ml	10.1 a	11.4 a
QUADRIS FLOWABLE +	400 ml +	10.4 a	11.3 a
RIDOMIL GOLD EC 480 drench	1400 ml		
PREV AM	2200ml	10.1 a	11.0 a
PREV AM +	2200 ml +	9.8 a	10.4 a
RIDOMIL GOLD EC 480 drench	1400 ml		

[1] Figures within columns followed by different letters are significantly different using a protected LSD ($P<0.05$).

Table 2. Effect of fungicides applied alone or following a RIDOMIL GOLD EC 480 drench at seeding on the incidence of downy mildew infected plants, disease severity and the number of diseased spinach leaves/plant.

Treatment	% Incidence[1]		Severity (0-5) [2]		Mean No. of diseased leaves/plant	
	9/27/2005	10/4/2005	9/27/2005	10/4/2005	9/27/2005	10/4/2005
Untreated	97.5 a[3]	100.0 a	2.0 a	2.3 a	2.6 a	2.6 a
RIDOMIL GOLD EC 480 drench	72.5 bc	87.5 ab	1.0 bc	1.4 b	1.4 bc	1.8 bc
TANOS 50DF	40.0 c	47.5 d	0.7 c	0.9 c	0.8 c	0.8 d
TANOS 50DF + RIDOMIL GOLD EC 480 drench	45.0 c	55.0 cd	0.8 bc	0.8 c	0.8 c	0.8 d
QUADRIS FLOWABLE	60.0 bc	85.0 b	1.2 bc	1.2 bc	1.5 bc	1.4 bcd
QUADRIS FLOWABLE + RIDOMIL GOLD EC 480 drench	70.0 bc	80.0 bc	0.9 bc	1.1 bc	1.1 bc	1.3 cd
PREV AM	62.5 bc	72.5 bcd	0.8 bc	1.3 bc	1.3 bc	1.5 bc
PREV AM + RIDOMIL GOLD EC 480 drench	85.0 ab	85.0 b	1.4 ab	1.6 b	1.9 ab	2.1 ab

1. Percentage of infected plants.
2. 0=healthy, 1=1-10% of leaf area infected; 2= 11-25% leaf area infected; 3= 25-50% leaf area infected; 4=50-100% leaf are infected; and 5= systemic infection
3. Figures within columns followed by different letters are significantly different using a protected LSD ($P<0.05$).

Table 3. Main effect of applying a foliar fungicide with or without a RIDOMIL GOLD EC 480 drench after seeding, on the incidence of downy mildew infected plants, disease severity and the number of diseased spinach leaves/plant.

Treatment	% Incidence[1]		Severity (0-5)[2]		Mean No. of diseased leaves/plant	
	9/27/2005	10/4/2005	9/27/2005	10/4/2005	9/27/2005	10/4/2005
Check	85.0 a[3]	93.8 a	1.5 a	1.8 a	1.5 a	2.2 a
TANOS 50DF	42.5 c	51.3 c	0.7 b	0.8 c	0.7 b	0.8 c
QUADRIS	65.0 bc	82.5 b	1.0 b	1.1 bc	1.0 b	1.3 b
PREV AM	73.8 ab	78.8 b	1.1 ab	1.4 b	1.1 ab	1.8 ab

1. Percentage of infected plants.
2. 0=healthy, 1=1-10% of leaf area infected; 2= 11-25% leaf area infected; 3= 25-50% leaf area infected; 4=50-100% leaf are infected; and 5= systemic infection
3. Figures within columns followed by different letters are significantly different using a protected LSD ($P<0.05$).

Table 4. Main effect of applying a RIDOMIL GOLD EC 480 drench immediately after seeding and prior to a foliar applications of another fungicides on the incidence of downy mildew infected plants, disease severity and the number of diseased spinach leaves/plant.

Treatment	% Incidence[1]		Severity (0-5)[2]		Mean No. of diseased leaves/plant	
	9/27/2005	10/4/2005	9/27/2005	10/4/2005	9/27/2005	10/4/2005
Without a RIDOMIL	68.1 a[3]	76.3 a	1.2 a	1.6 a	1.5 a	1.4 a
With RIDOMIL GOLD	65.0 a	76.9 b	1.0 a	1.5 a	1.3 a	1.2 a

1. Percentage of infected plants.
2. 0=healthy, 1=1-10% of leaf area infected; 2= 11-25% leaf area infected; 3= 25-50% leaf area infected; 4=50-100% leaf are infected; and 5= systemic infection
3. Figures within columns followed by different letters are significantly different using a protected LSD ($P<0.05$).

2005 PMR REPORT #84

SECTION M: FIELD LEGUMES - Diseases
ICAR: 61009653

CROP: Fababean (*Vicia faba* L.), cv. Snowbird
PEST: Root rot, *Rhizoctonia solani* Kühn; *Fusarium avenaceum* (Corda) Sacc.

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TITLE: **EVALUATION OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF RHIZOCTONIA AND FUSARIUM SEEDLING BLIGHT OF FABA BEAN IN ALBERTA IN 2005**

MATERIALS: VITAFLO 280 (carbathiin 14.9% + thiram 13.2% SU), THIRAM (thiram 75% WP), APRON MAXX (metalaxyl-M 13.6% + fludioxonil 9.11% SU)

METHODS: Seed of the fababean cv. Snowbird was treated in a Hege small batch seed treater with APRON MAXX at 3.25 mL/kg seed, THIRAM at 1.2 g/kg seed, or with VITAFLO 280 at 3.3 mL/kg seed. An experimental plot was established on 6 May at Vegreville, AB, in a black chernozemic sandy loam soil and on 4 May at Lacombe AB in a black chernozemic clay loam soil. The plot was seeded in a randomized split block design with four replications. Main plots consisted of inoculated treatments of *Fusarium avenaceum*, *Rhizoctonia solani*, or a non-inoculated control. Subplots consisted of the seed

treatments listed above or a non-treated control and contained four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 5 cm deep at a rate of 20 g per row. *Rhizoctonia solani* and *Fusarium avenaceum* were grown on sterilized oat grains for 14 days, dried, ground, and incorporated at the time of seeding at the rate of 15 and 30 mL/row, respectively. Emerged seedlings were counted on 25 May at Vegreville and on 30 May at Lacombe. At maturity (21 Sept. at Vegreville and 30 Sept. at Lacombe), plants were harvested by small plot combine. Seeds were cleaned and weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Since there was a significant ($P \leq 0.05$) inoculum x treatment interaction for both emergence and yield at both sites, the results of each inoculum treatment are presented separately. Emergence was significantly ($P \leq 0.05$) greater than the inoculated control for VITAFLO 280 and APRON MAXX in all inoculated plots and also in the non-inoculated plots at Vegreville (Table 1). Emergence for THIRAM was significantly greater than the inoculated control for inoculated plots at Vegreville. Emergence for VITAFLO 280 was significantly greater than APRON MAXX for plots inoculated with *Rhizoctonia* at Vegreville, but not at Lacombe and not for any of the Fusarium-inoculated plots. Seed yield was greater ($P \leq 0.05$) in inoculated plots treated with APRON MAXX and VITAFLO 280 compared to those left untreated. Yield for plots treated with THIRAM at Lacombe was significantly greater than the *Rhizoctonia*-inoculated control, but was less than in plots treated with VITAFLO 280 or APRON MAXX. Seed yield for plots grown from seed treated with APRON MAXX at Vegreville was significantly greater than for those treated with VITAFLO 280 or THIRAM, in soil infested with *Fusarium*, but not with *Rhizoctonia*.

CONCLUSIONS: VITAFLO 280 and APRON MAXX consistently improved emergence and yield compared to non-treated controls inoculated with either *Fusarium* or *Rhizoctonia*. Emergence was improved by APRON MAXX and VITAFLO 280 in non-inoculated plots at the Vegreville site, indicating an influence of indigenous plant pathogenic soil fungi at this location.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of fababean cv. Snowbird grown in soil inoculated with *Rhizoctonia solani* or *Fusarium avenaceum* at Vegreville and Lacombe, AB in 2005.

Non-inoculated	Rate (mL/kg seed)	Emergence (plants/m^2)		Seed yield (t/ha)	
		Vegreville	Lacombe	Vegreville	Lacombe
Control	--	42.5 b[1]	19.9 a	3.61 a	5.13 a
APRON MAXX	3.25	45.7 a	23.7 a	3.81 a	5.56 a
THIRAM	1.2 g	44.2 ab	20.5 a	3.71 a	5.21 a
VITAFLO 280	2.6	45.8 a	20.7 a	3.42 a	5.10 a

Fusarium	Rate (mL/kg seed)	Emergence (plants/m^2)		Seed yield (t/ha)	
		Vegreville	Lacombe	Vegreville	Lacombe
Control	--	9.3 c[1]	4.2 b	2.33 c	1.99 b
APRON MAXX	3.25	23.3 a	8.5 a	3.56 a	4.50 a
THIRAM	1.2 g	16.0 b	5.5 b	2.48 bc	2.18 b
VITAFLO 280	2.6	17.7 a	15.5 a	2.97 b	4.51 a

Rhizoctonia	Rate (mL/kg seed)	Emergence (plants/m^2)		Seed yield (t/ha)	
		Vegreville	Lacombe	Vegreville	Lacombe
Control	--	9.9 d[1]	1.8 b	2.46 b	1.29 c
APRON MAXX	3.25	34.8 b	13.8 a	3.72 a	4.66 a
THIRAM	1.2 g	15.0 c	4.5 b	2.69 b	2.54 b
VITAFLO 280	2.6	41.4 a	14.9 a	3.58 a	4.08 a

[1] Means within a column followed by the same letter are not significantly different within each inoculum treatment, using Duncan's New Multiple Range Test ($P \leq 0.05$).

2005 PMR REPORT #85

SECTION M: FIELD LEGUMES - Diseases
ICAR: 61009653

CROP: Lupin (*Lupinus angustifolius* L.), cv. Arabella
PEST: Root rot, *Rhizoctonia solani* Kühn; *Fusarium avenaceum* (Corda) Sacc.

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TITLE: **EVALUATION OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF RHIZOCTONIA AND FUSARIUM SEEDLING BLIGHT OF LUPIN IN ALBERTA IN 2005**

MATERIALS: VITAFLO 280 (carbathiin 14.9% + thiram 13.2% SU), THIRAM (thiram 75% WP), APRON MAXX (metalaxyl-M 13.6% + fludioxonil 9.11% SU)

METHODS: Seed of the lupin cv. Arabella was treated in a Hege small batch seed treater with APRON MAXX at 3.25 mL/kg seed, THIRAM at 1.2 g/kg seed, or with VITAFLO 280 at 3.3 mL/kg seed. An experimental plot was established on 26 April at Vegreville, AB, in a black chernozemic sandy loam soil and on 4 May at Lacombe, AB in a black chernozemic clay loam soil. The plot was seeded in a randomized split-block design with four replications. Main plots consisted of inoculated treatments of *Fusarium avenaceum*, *Rhizoctonia solani*, or a non-inoculated control. Subplots consisted of the seed treatments listed above or a nontreated control, and contained four, 6 m rows of plants spaced 20 cm

apart. Seeds were planted 5 cm deep at a rate of 20 g per row. *Rhizoctonia solani* and *Fusarium avenaceum* were grown on sterilized wheat grains for 14 days, dried, ground, and incorporated at the time of seeding at the rate of 15 and 30 mL/row, respectively. Emerged seedlings were counted on 30 May at both sites. At maturity (26 August at Vegreville and 8 September at Lacombe), plants were harvested by small plot combine. Seeds were cleaned and weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Since there was a significant ($P \leq 0.05$) inoculum x treatment interaction for both emergence and yield, the results of each inoculum treatment are presented separately. Emergence was similar for all treatments in the noninoculated controls (Table 1). Emergence was significantly ($P \leq 0.05$) greater than the inoculated control for all three fungicide treatments in *Fusarium*- and *Rhizoctonia*-inoculated soils at both trial locations. Emergence was significantly greater in *Fusarium*-inoculated plots treated with VITAFLO 280 than for those treated with THIRAM or APRON MAXX at Lacombe, but not at Vegreville. There were significant differences between all four treatments in the *Rhizoctonia*-inoculated soils at Lacombe: VITAFLO 280 > APRON MAXX > THIRAM > Control. Seed yield was similar among all treatments at Vegreville. At Lacombe, seed yield was significantly lower ($P \leq 0.05$) in noninoculated plots treated with APRON MAXX and VITAFLO 280 compared to the control and THIRAM treatments. However, yield for APRON MAXX and VITAFLO 280 was significantly greater than the *Fusarium*- and *Rhizoctonia*-inoculated controls and was also greater than the *Rhizoctonia*-inoculated THIRAM treatment at Lacombe.

CONCLUSIONS: All three fungicides in the trial improved emergence over controls in soils inoculated with *Fusarium* and *Rhizoctonia*. VITAFLO 280 and APRON MAXX showed greater efficacy than THIRAM at both Vegreville and Lacombe.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of lupin cv. Arabella grown in soil inoculated with *Rhizoctonia solani* or *Fusarium avenaceum* at Vegreville and Lacombe, AB in 2005.

Non-inoculated	Rate (mL/kg seed)	Stand (plants/m^2)[1]		Seed yield (t/ha) [1]	
		Vegreville	Lacombe	Vegreville	Lacombe
Control	--	53.1 a[1]	56.4 a	0.11875	0.1041667
APRON MAXX	3.25	55.2 a	48.6 a	2.61 a	1.96 b
THIRAM	1.2 g	55.1 a	54.4 a	2.66 a	0.1083333
VITAFLO	2.6	57.8 a	56.4 a	0.120833	2.00 b

Fusarium	Rate (mL/kg seed)	Stand (plants/m^2) [1]		Seed yield (t/ha) [1]	
		Vegreville	Lacombe	Vegreville	Lacombe
Control	--	29.8 b	23.1 c	0.0840278	1.31 b
APRON MAXX	3.25	45.7 a	44.5 b	0.1048611	0.0944
THIRAM	1.2 g	43.4 a	40.4 b	0.1104167	1.87 ab
VITAFLO	2.6	47.0 a	52.6 a	0.1048611	0.09306

Rhizoctonia	Rate (mL/kg seed)	Stand (plants/m^2) [1]		Seed yield (t/ha) [1]	
		Vegreville	Lacombe	Vegreville	Lacombe
Control	--	21.8 b	4.8 d	1.64 a	0.52 b
APRON MAXX	3.25	38.3 a	29.3 b	0.093056	1.73 a
THIRAM	1.2 g	30.7 a	11.7 c	0.092361	0.85 b
VITAFLO	2.6	38.0 a	42.7 a	0.097917	1.72 a

[1] Means within a column followed by the same letter are not significantly different within each inoculum treatment, using Duncan's New Multiple Range Test ($P \leq 0.05$).

2005 PMR REPORT #86

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
ICAR: 61009653

CROP: Alfalfa (*Medicago sativa* L.), cv. Beaver
PEST: Seedling blight and root rot caused by *Rhizoctonia solani* Kühn, *Fusarium avenaceum* (Corda) Sacc., and *Pythium ultimum* Trow.

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TITLE: **FIELD AND GREENHOUSE EVALUATIONS OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF SEEDLING BLIGHT AND ROOT ROT OF ALFALFA IN ALBERTA IN 2005**

MATERIALS: DFC (difenconazole, 360 g/L SU), TRIBUNE (difenconazole, 1.61% SU; metalaxyl M, 0.51% LS; fludioxonil, 0.17% SU), APRON XL (metalaxyl M, 33.3% LS), MAXIM 480 (fludioxonil, 480g/L FS) APRON MAXX (fludioxonil, 0.73% SU; metalaxyl-M, 1.1% LS).

METHODS: Seed of alfalfa cv. Beaver was treated in a Hege II small batch seed treater with TRIBUNE at 0.34 g a.i./kg seed, DFC at 0.24 g a.i./kg seed, MAXIM 480 at 0.025 or 0.05 g a.i./kg seed, APRON XL at 0.075 or 0.15 g a.i./kg seed, APRON MAXX at 0.0625 or 0.125 g a.i./kg seed, or APRON XL combined with MAXIM 480 at 0.15 and 0.025 g a.i./kg seed, respectively. Experimental plots were established on 12 May, 2005 at Brooks, AB in a brown chernozemic loam soil. Plots were seeded in a randomized complete block design with four replications. Each plot consisted of four, 4 m rows spaced 25 cm apart. Seeds were planted 1 cm deep at a rate of 0.1 g/m of seeds. *Rhizoctonia solani*, *Fusarium avenaceum* and *Pythium ultimum* were grown on sterilized grains (1:1, oat:wheat) for 14 days, dried, ground, and incorporated as inoculum at the time of seeding at the rate of 10 mL/row. Nontreated seeds were planted as inoculated and non-inoculated controls. Three seedling counts were taken for each plot after emergence. Seedling vigour was assessed visually and field plots were harvested by hand-cutting the plants on 22 August. The material collected was dried and weighed to determine forage yield. Greenhouse experiments were established on 24 May, 2005 at the Alberta Research Council facility at Vegreville, AB. The inoculum was prepared as above and diluted with sterile sand at two concentrations (1:20 and 1:100) for each pathogen. The diluted pathogen inoculum was incorporated at the time of seeding at the rate of 5 mL/cup into 350 mL foam cups filled with steam-pasteurized soil mix (1:1, loam:peat moss). The same amount of clean sand was incorporated into non-inoculated controls. Ten cups were used for each treatment with ten seeds planted into each cup. Three seedling stand counts were collected at 7, 14 and 21 days after seeding. Emergence, seed decay (%) and phytotoxicity were assessed and recorded in the greenhouse experiment. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS 9.1) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Seedling emergence, seedling vigour and forage yield were not significantly ($P \leq 0.05$) affected by fungicide treatments and no phytotoxicity was observed in the non-inoculated treatment in either experiment (Tables 1 and 2).

In the *Fusarium*-inoculated treatments, TRIBUNE, APRON XL + MAXIM, MAXIM and APRON MAXX at the high rate significantly increased final seedling stands in weeks 2 and 3 of the field experiment, compared to the non-treated inoculated control (Table 1). TRIBUNE significantly increased emergence and decreased seed decay at both inoculum concentrations in the greenhouse experiment, except at the low concentration in week one (Table 2). Emergence was also significantly increased by MAXIM at the rate of 0.05 g a.i./kg seed, APRON MAXX at both rates, and APRON XL + MAXIM (except for week 3) in the *Fusarium*-inoculated treatments at the high concentration. Forage yield in the field trial was not significantly affected by any of the treatments, although all of the treatments increased seedling vigour (Table 1).

In the *Pythium*-inoculated treatments, there was no statistical difference in seedling stand and vigour among the fungicide treatments under field conditions. However, APRON XL at both rates significantly increased forage yields. TRIBUNE, APRON XL and APRON MAXX at both rates (except for the high rate and low inoculum concentration), and APRON XL + MAXIM significantly increased seedling emergence and decreased seed decay compared with the inoculated control under greenhouse conditions (Table 2).

In the *Rhizoctonia*-inoculated treatments in both field and greenhouse trials, all of the treatments, except DFC and APRON XL at both rates, showed significantly greater emergence, better seedling vigour, less seed decay and higher forage yield than the *Rhizoctonia*-inoculated control (Tables 1 and 2). MAXIM and APRON MAXX at the low rates increased final stands compared to the inoculated control under field conditions, on some, but not all, of the three dates on which emergence counts were taken (Table 1).

CONCLUSIONS: Under field conditions, TRIBUNE, MAXIM and APRON MAXX showed the greatest improvement in seedling stands in the *Rhizoctonia* and *Fusarium* experiments, and these treatments were also effective at increasing forage yield in *Rhizoctonia*-inoculated plots. APRON XL was the only fungicide that significantly increased forage yield in the *Pythium*-inoculated plots.

Under greenhouse conditions, TRIBUNE showed the greatest improvement in emergence and disease control in all three pathogens compared to the inoculated control. MAXIM also was effective at reducing *Rhizoctonia* and *Fusarium* infection. APRON MAXX was partially effective at controlling *Rhizoctonia* infection. DFC failed to control any of the three pathogens.

Table 1. Effects of fungicidal seed treatments on seedling stand, seed vigour and forage yield of the alfalfa cv. Beaver in field experiments conducted at Brooks, AB in 2005.

Treatment	Rate (g a.i./kg)	Seedling count (plants/m^2) Week one	Week two	Week three	Seedling vigour (1 - 5)	Forage yield (t/ha)
Non-inoculated:						
Non-inoc. CK	-	65.1 a	74.3 a	85.6 a	4.3 a	5.32 a
Inoc. CK	-	66.7 a	82.9 a	84.8 a	4.5 a	4.71 a
TRIBUNE	0.34	63.9 a	68.0 a	90.4 a	4.5 a	4.94 a
DFC	0.24	47.9 a	71.9 a	76.8 a	4.3 a	3.56 a
MAXIM	0.025	61.5 a	64.1 a	78.1 a	4.3 a	5.46 a
MAXIM	0.05	55.6 a	74.5 a	82.4 a	4.5 a	5.37 a
APRON XL	0.075	66.7 a	83.1 a	98.4 a	4.5 a	5.16 a
APRON XL + MAXIM	0.15 + 0.025	63.2 a	74.4 a	78.1 a	4.3 a	5.31 a
APRON XL	0.15	58.7 a	75.3 a	92.5 a	4.8 a	4.95 a
APRON MAXX	0.0625	67.5 a	82.3 a	99.1 a	4.3 a	4.92 a
APRON MAXX	0.125	66.0 a	80.7 a	88.5 a	4.5 a	5.96 a
Fusarium-inoculated (10 ml/3m row):						
Non-inoc. CK	-	53.6 a	72.3 ab	83.5 a	4.3 a	4.87 a
Inoc. CK	-	39.3 a	46.5 cd	51.5 c	2.3 c	4.67 a
TRIBUNE	0.34	55.1 a	81.2 a	83.2 a	3.3 b	4.30 a
DFC	0.24	45.5 a	66.3ab	69.2 abc	3.8 ab	4.66 a
MAXIM	0.025	44.0 a	68.4 ab	73.5 abc	4.0 ab	4.33 a
MAXIM	0.05	46.1 a	70.5 ab	76.9 ab	3.5 ab	4.34 a
APRON XL	0.075	31.1 a	46.4 d	54.5 bc	3.8 ab	4.13 a
APRON XL + MAXIM	0.15 + 0.025	47.2 a	66.8 ab	83.3 a	4.3 a	4.45 a
APRON XL	0.15	35.5 a	50.5 cd	62.4 abc	4.0 ab	4.10 a
APRON MAXX	0.0625	44.8 a	62.8 bc	74.9 abc	3.8 ab	4.33 a
APRON MAXX	0.125	48.4 a	69.7 ab	78.5 ab	3.8 ab	4.60 a
Pythium-inoculated (10 ml/3m row):						
Non-inoc. CK	-	67.9 a	90.9 a	114.3 a	3.8 a	6.24 a
Inoc. CK	-	53.3 a	83.1 a	84.4 bc	3.8 a	4.77 c
TRIBUNE	0.34	61.7 a	81.6 a	89.9 bc	3.5 a	5.53 abc
DFC	0.24	51.7 a	75.5 a	86.8 bc	4.0 a	5.52 abc
MAXIM	0.025	53.7 a	72.4 a	80.4 bc	3.8 a	5.27 abc
MAXIM	0.05	55.2 a	80.8 a	77.2 c	4.3 a	5.45 abc
APRON XL	0.075	65.1 a	83.9 a	93.3 bc	5.0 a	5.88 ab
APRON XL + MAXIM	0.15 + 0.025	62.8 a	82.9 a	86.8 bc	4.0 a	4.78 c
APRON XL	0.15	63.1 a	96.7 a	102.9 ab	4.3 a	6.02 ab
APRON MAXX	0.0625	62.0 a	82.1 a	90.5 bc	4.3 a	5.00 bc
APRON MAXX	0.125	50.8 a	73.3 a	92.7 bc	4.0 a	5.47 abc

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

Table 1. Continued.

Treatment	Rate (g a.i./kg)	Seedling count (plants/m^2) Week one	Week two	Week three	Seedling vigour (1 - 5)	Forage yield (t/ha)
Rhizoctonia-inoculated (10 ml/3m row):						
Non-inoc. CK	-	78.5 a	73.5 a	109.2 a	4.0 a	5.73 a
Inoc. CK	-	7.9 de	7.7 e	10.8 c	1.5 c	0.86 c
TRIBUNE	0.34	29.6 bc	37.1 bc	51.2 b	3.5 ab	3.84 b
DFC	0.24	6.3 e	8.5 e	13.1 c	1.5 c	1.52 c
MAXIM	0.025	22.1 cd	26.0 cd	32.1 bc	3.0 ab	3.39 b
MAXIM	0.05	26.8 c	36.4 bc	47.6 b	3.3 ab	4.43 ab
APRON XL	0.075	10.8 de	13.6de	14.4 c	2.3 bc	1.27 c
APRON XL + MAXIM	0.15 + 0.025	33.6 bc	39.2 bc	54.1 b	3.5 ab	4.27 ab
APRON XL	0.15	9.2 de	9.1 e	12.3 c	2.3 bc	1.11 c
APRON MAXX	0.0625	24.9 c	30.1 bc	35.2 bc	2.8 ab	3.86 b
APRON MAXX	0.125	41.9 b	43.9 b	48.5 b	3.5 ab	3.55 b

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

Table 2. Effects of fungicidal seed treatments on seedling stand and seed decay of the alfalfa cv. Beaver in greenhouse experiments conducted at Vegreville, AB in 2005.

Treatment	Rate (g a.i./kg)	Seedling count (10 seeds)			Seed decay (%)
		Week one	Week two	Week three	
Non-inoculated:					
Non-inoc. CK	-	8.6 a	8.7 a	8.5 a	12.0a
Inoc. CK	-	8.2 a	8.7 a	8.6 a	13.0 a
TRIBUNE	0.34	9.4 a	9.6 a	9.6 a	4.0 a
DFC	0.24	8.2 a	8.7 a	8.6 a	13.0 a
MAXIM	0.025	8.5 a	8.5 a	8.1 a	17.0 a
MAXIM	0.05	8.2 a	8.4 a	8.4 a	15.0 a
APRON XL	0.075	8.5 a	9.0 a	8.8 a	10.0 a
APRON XL + MAXIM	0.15 + 0.025	8.4 a	8.9 a	9.0 a	10.0 a
APRON XL	0.15	8.2 a	8.6 a	8.5 a	14.0 a
APRON MAXX	0.0625	7.9 a	8.4 a	8.5 a	15.0 a
APRON MAXX	0.125	8.5 a	8.7 a	8.6 a	13.0 a
Fusarium at low concentration (1:100):					
Non-inoc. CK	-	9.6 a	10.0 a	9.6 a	0.0 e
Inoc. CK	-	6.8 bc	7.5 c	6.1 cd	25.0 c
TRIBUNE	0.34	8.1 b	9.1 ab	8.2 ab	9.0 de
DFC	0.24	7.5 b	7.1 c	6.0 cd	21.0 cd
MAXIM	0.025	7.7 b	7.3 c	7.3 bc	22.0 cd
MAXIM	0.05	7.5 b	8.0 bc	7.5 bc	16.0 cd
APRON XL	0.075	5.7 cd	5.1 d	4.3 e	38.0 ab
APRON XL + MAXIM	0.15 + 0.025	7.7 b	6.9 c	6.4 c	19.0 cd
APRON XL	0.15	5.4 d	4.8 d	4.7 de	40.0 a
APRON MAXX	0.0625	6.9 bc	6.8 c	6.4 c	27.0 bc
APRON MAXX	0.125	6.7 bcd	6.6 c	6.7 bc	28.0 abc
Fusarium at high concentration (1:20):					
Non-inoc. CK	-	8.9 a	9.4 a	8.5 a	5.0 d
Inoc. CK	-	4.4 d	4.8 d	4.6 def	49.0 ab
TRIBUNE	0.34	8.5 ab	8.7 ab	7.7 abc	13.0 cd
DFC	0.24	6.3 c	6.1 c	4.5 ef	38.0 b
MAXIM	0.025	7.7 abc	7.7 b	6.2 bcd	21.0 c
MAXIM	0.05	7.6 abc	8.4 ab	7.8 ab	15.0 cd
APRON XL	0.075	4.1 d	4.2 d	3.4 f	55.0 a
APRON XL + MAXIM	0.15 + 0.025	7.4 bc	7.7 b	6.0 cde	23.0 c
APRON XL	0.15	3.8 d	4.1 d	3.2 f	54.0 a
APRON MAXX	0.0625	7.8 ab	8.1 ab	6.6 bc	19.0 c
APRON MAXX	0.125	7.8 ab	8.4 ab	7.2 abc	15.0 cd

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

Table 2. Continued.

Treatment	Rate (g a.i./kg)	Seedling count (10 seeds)			Seed decay (%)
		Week one	Week two	Week three	
Pythium at low concentration (1:100):					
Non-inoc. CK	-	8.9 a	9.2 a	9.2 a	8.0 f
Inoc. CK	-	1.3 d	1.7 d	1.7 f	83.0 a
TRIBUNE	0.34	6.8 b	7.2 b	7.1 b	23.0 ef
DFC	0.24	1.9 d	2.4 d	2.2 f	74.0 ab
MAXIM	0.025	1.0 d	1.3 d	1.1 f	86.0 a
MAXIM	0.05	1.0 d	1.1 d	1.1 f	85.0 a
APRON XL	0.075	4.3 c	5.2 c	5.4 bcd	44.0 cd
APRON XL + MAXIM	0.15 + 0.025	4.0 c	5.0 c	5.1 cd	44.0 cd
APRON XL	0.15	5.0 c	6.0 bc	6.1 bc	37.0 de
APRON MAXX	0.0625	3.8 c	4.7 c	4.1 de	47.0 cd
APRON MAXX	0.125	1.1 d	2.4 d	2.9 ef	58.0 bc
Pythium at high concentration (1:20):					
Non-inoc. CK	-	8.7 a	9.7 a	9.6 a	2.0 c
Inoc. CK	-	0.1 e	0.6 d	0.7 c	93.0 a
TRIBUNE	0.34	5.2 bc	5.0 bc	4.9 b	40.0 b
DFC	0.24	0.0 e	0.0 d	0.0 c	100.0 a
MAXIM	0.025	0.2 e	0.3 d	0.3 c	97.0 a
MAXIM	0.05	0.4 e	0.4 d	0.5 c	94.0 a
APRON XL	0.075	5.5 b	4.8 bc	4.1 b	42.0 b
APRON XL + MAXIM	0.15 + 0.025	6.5 b	6.4 b	5.5 b	32.0 b
APRON XL	0.15	5.1 bc	5.3 bc	5.1 b	45.0 b
APRON MAXX	0.0625	3.8 cd	4.4 c	4.5 b	48.0 b
APRON MAXX	0.125	2.5 d	4.6 bc	5.1 b	46.0 b
Rhizoctonia at low concentration (1:100):					
Non-inoc. CK	-	9.4 a	9.3 a	8.8 a	4.0 e
Inoc. CK	-	0.0 d	0.0 e	0.0 d	100.0 a
TRIBUNE	0.34	7.3 b	6.4 bc	5.9 b	26.0 cd
DFC	0.24	0.3 d	0.3 e	0.4 d	96.0 a
MAXIM	0.025	6.0 c	5.2 cd	5.2 bc	38.0 b
MAXIM	0.05	7.5 b	6.4 bc	5.9 b	25.0 d
APRON XL	0.075	0.0 d	0.0 e	0.0 d	100.0 a
APRON XL + MAXIM	0.15 + 0.025	6.1 c	5.5 bcd	5.3 bc	37.0 bc
APRON XL	0.15	0.1 d	0.2 e	0.6 d	94.0 a
APRON MAXX	0.0625	5.0 c	4.8 d	4.5 c	44.0 b
APRON MAXX	0.125	7.2 b	6.7 b	6.3 b	26.0 cd

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

Table 2. Continued.

Treatment	Rate (g a.i./kg)	Seedling count (10 seeds)			Seed decay (%)
		Week one	Week two	Week three	
Rhizoctonia at high concentration (1:20):					
Non-inoc. CK	-	9.1 a	9.5 a	8.2 a	2.0 f
Inoc. CK	-	0.0 f	0.1 d	0.1 d	99.0 a
TRIBUNE	0.34	5.4 bc	3.9 c	3.4 c	48.0 cd
DFC	0.24	0.0 f	0.0 d	0.0 d	100.0 a
MAXIM	0.025	4.4 cd	3.8 c	2.8 c	51.0 cd
MAXIM	0.05	6.2 b	5.6 b	5.0 b	37.0 e
APRON XL	0.075	0.0 f	0.0 d	0.0 d	100.0 a
APRON XL + MAXIM	0.15 + 0.025	3.9 de	4.1 c	3.3 c	54.0 bc
APRON XL	0.15	0.0 f	0.0 d	0.0 d	100.0 a
APRON MAXX	0.0625	3.2 e	3.5 c	3.3 c	63.0 b
APRON MAXX	0.125	4.9 cd	5.3 b	4.6 b	43.0 de

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

2005 PMR REPORT #87

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
ICAR: 61009653

CROP: Barley (*Hordeum vulgare* L.), cv. Copeland
PEST: Net blotch (*Pyrenophora teres* Drechsler); Scald (*Rhynchosporium secalis* (Oud.) Davis)

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TITLE: **GREENHOUSE ASSESSMENT OF FUNGICIDAL FOLIAR TREATMENTS FOR THE CONTROL OF NET BLOTCH AND SCALD OF BARLEY IN ALBERTA IN 2005**

MATERIALS: QUILT 200SC (azoxystrobin, 7.0% SC, propiconazole, 11.7% SC), STRATEGO 250EC (propiconazole + CGA-279202, 125 + 125 g/L EC), QUADRIS 250SC (azoxystrobin, 250 g/L SC), and TILT 250EC (propiconazole, 250 g/L EC).

METHODS: Experiments were established in August, 2005 in a greenhouse at the Alberta Research Council facility at Vegreville, AB. Seed of the two-row barley cv. Copeland was seeded into 450 mL plastic Tuffcups (Georgia-Pacific, Dixie Business, Norwalk, CT), which were filled with steam-pasteurized soil mix (1:1, loam: peat moss). Ten seeds were seeded in each cup. The experiments employed a randomized complete block design with one cup of each treatment per replicate, and five replicates per treatment. Spore suspensions (in 0.05% Tween 80) of *Rhynchosporium secalis* or *Pyrenophora teres* were sprayed onto all treatments at the flag leaf stage, and inoculated plants were maintained in darkness and high humidity for 72 h before the foliar fungicide treatments were applied. The foliar fungicide spray treatments included QUILT 200SC at 75, 100, 150 and 200 g ai/ha, STRATEGO 250EC at 125 g ai/ha, QUADRIS 250SC at 28, 38, 56 and 75 g ai/ha, and TILT 250EC at 94 and 125 g ai/ha. All spray treatments were applied in 200 L/ha water and all area measurements were based on the soil surface area within the plastic Tuffcups. The control consisted of an inoculated, non-fungicide treatment. Disease incidence (% of plants infected) and severity (0 – 9, where 0 = no disease and 9 ≥ 90% of leaf area diseased over the whole cup) were assessed once a week for three weeks, beginning two weeks after application of foliar fungicide. Phytotoxicity was also assessed. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS 9.1) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: There was no phytotoxicity observed in either experiment (not shown). Scald severity was significantly reduced by all of the fungicide treatments on all three rating dates (Table 1). On the first assessment date, all QUADRIS 250 SC and TILT treatments had a lower scald severity compared to QUILT 200SC at the lowest rate; by the third assessment date, only QUADRIS 250 SC at the highest rate showed significantly lower scald severity compared to QUILT 200SC at the two lowest rates. Net blotch severity was unaffected in the first two weeks of disease assessment, but all foliar fungicide treatments significantly ($P \leq 0.05$) reduced disease severity in the third assessment (Table 2).
Disease incidence was significantly ($P \leq 0.05$) reduced by all foliar fungicide treatments in the third week of assessment for both pathogens and in all three weeks of assessment for scald (Tables 1 and 2). In the first scald assessment, all QUADRIS 250SC and TILT treatments resulted in a significantly lower disease incidence compared to any of the QUILT or STRATEGO treatments. In the third scald assessment, QUADRIS 250 SC, when applied at the highest rate, showed a significantly lower ($P \leq 0.05$) incidence of disease compared to TILT at the low rate, STRATEGO 250 EC, or the three lowest rates of QUILT 200SC (Table 1). Relative to the non-treated control, QUADRIS 250SC at the lowest rate and QUILT 200SC at the two lowest rates did not significantly reduce net blotch incidence in the first disease assessment, but both fungicides significantly ($P \leq 0.05$) reduced net blotch incidence in the two subsequent disease assessments (Table 2). Neither rate of TILT affected net blotch incidence in the second assessment.

CONCLUSIONS: All fungicide treatments evaluated in this experiment reduced scald severity by 2 weeks after application and net blotch severity by 4 weeks. With respect to scald, QUADRIS 250SC and TILT showed greater efficacy compared to QUILT 200SC or STRATEGO 250EC in the initial assessment, but in the third assessment, only the highest rate of QUADRIS 250SC showed lower disease severity compared to the two lowest rates of QUILT 200SC. With respect to net blotch, there were no differences in disease severity among the fungicide treatments. Among the treatments, QUADRIS 250SC provided the most effective protection against scald on barley when applied at the highest rate. QUADRIS 250SC, STRATEGO 250EC and QUILT 200SC were all effective fungicides for controlling barley net blotch. QUILT 200SC and TILT 250EC required higher application rates to ensure control of the disease within the first two weeks after application. TILT 250EC was less effective at controlling net blotch compared to the other fungicides in the evaluation.

Table 1. Effects of fungicidal foliar treatments on the control of scald on the two row barley cv. Copeland in greenhouse experiments conducted at Vegreville, AB in 2005.

Treatment	Rate (g ai/ha)	Disease incidence (%)			Disease severity (0 – 9)		
		2nd week*	3rd week	4th week	2nd week	3rd week	4th week
Non-treated	-	73.0 a	72.0 a	76.0 a	2.6 a	2.8 a	2.8 a
QUILT 200SC	75	61.0 b	67.0 a	76.0 a	1.6 b	1.8 b	1.8 b
QUILT 200SC	100	50.0 c	51.0 bcd	72.0 a	1.4 bc	1.6 bc	1.8 b
QUILT 200SC	150	48.0 c	49.0 cd	61.0 b	1.2 bc	1.8 b	1.6 bc
QUILT 200SC	200	44.0 c	43.0 d	56.0 bc	1.2 bc	1.2 bc	1.4 bc
STRATEGO 250EC	125	46.0 c	58.0 b	60.0 b	1.2 bc	1.6 bc	1.6 bc
QUADRIS 250SC	28	34.0 d	55.0 bc	55.0 bc	1.0 c	1.4 bc	1.4 bc
QUADRIS 250SC	38	34.0 d	49.0 cd	50.0 bc	1.0 c	1.2 bc	1.2 bc
QUADRIS 250SC	56	36.0 d	50.0 bcd	50.0 bc	1.0 c	1.0 c	1.2 bc
QUADRIS 250SC	75	30.0 de	44.0 d	46.0 c	1.0 c	1.2 bc	1.0 c
TILT 250EC	94	31.0 de	48.0 cd	60.0 b	1.0 c	1.2 bc	1.6 bc
TILT 250EC	125	25.0 e	46.0 d	56.0 bc	1.0 c	1.0 c	1.4 bc

Values are the means of the five replicates in each of 20 leaves were examined. Means followed by the same letter within a column are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

* After fungicide application

Table 2. Effects of fungicidal foliar treatments on the control of net blotch on the two row barley cv. Copeland in greenhouse experiments conducted at Vegreville, AB in 2005.

Treatment	Rate (g ai/ha)	Disease incidence (%)			Disease severity (0 – 9)		
		2nd week*	3rd week	4th week	2nd week	3rd week	4th week
Non-treated	-	37.0 ab	61.0 a	75.0 a	1.0 a	1.0 a	2.4 a
QUILT 200SC	75	35.0 bc	48.0 c	53.0 cd	1.0 a	1.0 a	1.4 b
QUILT 200SC	100	30.0 bcd	45.0 c	51.0 cde	1.0 a	1.0 a	1.0 b
QUILT 200SC	150	28.0 cde	48.0 c	51.0 cde	1.0 a	1.0 a	1.2 b
QUILT 200SC	200	23.0 de	46.0 c	49.0 cde	1.0 a	1.0 a	1.2 b
STRATEGO 250EC	125	28.0 cde	52.0 bc	55.0 c	1.0 a	1.0 a	1.4 b
QUADRIS 250SC	28	44.0 a	49.0 bc	50.0 cde	1.0 a	1.4 a	1.0 b
QUADRIS 250SC	38	25.0 de	44.0 c	53.0 cd	1.0 a	1.2 a	1.4 b
QUADRIS 250SC	56	20.0 e	44.0 c	44.0 e	1.0 a	1.2 a	1.6 b
QUADRIS 250SC	75	12.0 f	44.0 c	46.0 de	1.0 a	1.0 a	1.4 b
TILT 250EC	94	22.0 de	57.0 ab	65.0 b	1.0 a	1.2 a	1.6 b
TILT 250EC	125	21.0 de	53.0 abc	64.0 b	1.0 a	1.0 a	1.2 b

Values are the means of the five replicates in each of 20 leaves were examined. Means followed by the same letter within a column are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

* After fungicide application

2005 PMR REPORT #88

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
STUDY DATA BASE: 303-1212-8907

CROP: Barley, cv. Harrington
PEST: Net Blotch - *Pyrenophora teres*
Covered smut - *Ustilago hordei*
False loose smut - *Ustilago nigra*

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TITLE: EFFICACY OF FUNGICIDE SEED TREATMENTS ON NET BLOTCH AND ON YIELD OF SPRING BARLEY, 2005

MATERIALS: RAXIL T FS (tebuconazole 6.6 g ai/L thiram 222 g ai/L), G7087-00 (mancozeb 6.2 g ai/L, tebuconazole 3.1 g ai/L, prothioconazole 15.4 g ai/L)

METHODS: Spring barley seed, cv Harrington, was treated and supplied by Bayer CropScience. Plots were established on May 16, 2005, 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 22nd.

Emergence counts were taken on 2 x 1m of row, prior to tillering. Net blotch was rated on July 29, ZGS 77, on the 2nd and 3rd leaves from the head using the Horsefall and Barrett rating system, on ten randomly selected tillers per plot. Smut levels (no separation was made between covered and false loose smut levels) were determined based on the total number of smutted heads per plot. The entire plot area was harvested, on September 3rd, 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. Both treatments reduced smut levels to zero. G7087-00 did have a significant impact on foliar disease, in particular as measured by net blotch on the penultimate leaf, where severity was significantly reduced by 36.5%, reduction from RAXIL T FS was only 22.5% but was not significant. A similar reduction was not apparent on the 3rd leaf, however disease severity was very high at time of rating, and it would be expected that responses would to be less evident. There were no significant yield or kernel weight effects evident.

CONCLUSIONS: Fungicide seed treatments used in this study were effective in reducing smut levels to zero. G7087-00 provided for reduced net blotch on the penultimate leaf well into the growing season.

Table 1: Influence of fungicide seed treatments on spring barley, cv. Harrington, Charlottetown, PEI, 2005

Treatment	Rate*	Emergence	Net Blotch July 29 ZGS 77 2nd leaf	3rd leaf	Smutted Heads per Plot	Yield	1000 kernel weight
		(plants/m)	(%)	(%)	(#)	(kg/ha)	(g)
Untreated Control	0	38	62	91.3	11	5248	37.35
RAXIL T FS	2.25	41	48	85.4	0	5434	41.7
G7087-00	3.25	38	39.4	80.2	0	5499	43.2
LSD (0.05)		ns	16.6	ns	4.5	ns	ns
SEM		2.25	4.8	2.76	1.31	116.9	1.532

* ml product/kg seed

2005 PMR REPORT #89

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
STUDY DATA BASE: 303-1212-8907

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 NET BLOTCH AND LOOSE SMUT, AND ON YIELD OF SPRING BARLEY, 2005**

MATERIALS: RAXIL T FS (tebuconazole 6.6 g ai/L thiram 222 g ai/L), G7087-00 (mancozeb 6.2 g ai/L, tebuconazole 3.1 g ai/L, prothioconazole 15.4 g ai/L), DIVIDEND XL RTA (difenoconazole 3.64% w:w, metalaxyl 0.27% w:w), L1397-A1 (tebuconazole 3.1 g ai/L, metalaxyl 6.2 g ai/L, prothioconazole 15.4 g ai/L), RAXIL MD (tebuconazole 5 g ai/L, metalaxyl 6.2 g ai/L), GEMINI (triticonazole 14 g ai/L, thiram 140 g ai/L) and Vitaflo 280 (carbathiin 169.6 g ai/L, thiram 150.6 g ai/L)

METHODS: Spring barley seed, cv Westford, was treated and supplied by Bayer CropScience. Plots were established on May 16, 2005, 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 22nd.

Emergence counts were taken on 2 x 1m of row prior to tillering. Root rot was rated on July 5th using a 0 - 9 scale (0 = disease free). On July 19th, net blotch was rated on a whole plot basis, using the 0 - 9 scale. On July 29th, at ZGS 29, 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 September 3rd, using a small plot combine, and yield and thousand kernel weight determined.

RESULTS: Results are contained in Table 1. There was no significant impact of seed treatment on emergence, root rot or early season net blotch expression (not shown). Nor was there a significant effect of seed treatment on late season net blotch, at ZGS 79. All seed treatments resulted in a significant reduction in loose smut. In addition all seed treatments resulted in significant yield increases, although there was no effect on kernel weights.

CONCLUSIONS: The most effective seed treatments were those which contained tebuconazole or triticonazole (RAXIL T FS, RAXIL MD, GEMINI, G7087-00 and L1397-A1). Reductions in loose smut for these compounds ranged from 91.1 to 95.5%. Vitaflo 280 also reduced loose smut significantly, by 72.6%. Dividend XL RTA was the least effective of the seed treatments evaluated, reducing loose smut by only 43.9%. All seed treatments resulted in a significant increase in yield compared to the untreated control, with no significant difference among treatments. Yield advantages ranged from 22.8% with DIVIDEND XL RTA to over 35.0% with L1397-A1 and G7087-00, both of which contained the active ingredients, tebuconazole and prothioconazole. Based on loose smut control and improvement in yield, seed treatments containing tebuconazole, triticonazole and prothioconazole appeared to be the most effective over all.

Table 1: Influence of fungicide seed treatments on spring barley, cv. Westford, Charlottetown, PEI, 2005

Treatment	Rate*	Emergence	Root Rot	Net Blotch 3rd leaf ZGS 79	Smut	Yield	1000 kwt
		(plants/m)	(0-9)	(%)	(%)	(Kg/ha)	(g)
Untreated Control		38.4	2.5	15.3	15.7	3784	39
RAXIL T FS	2.25	41.1	2.5	29.1	1.4	4901	40.8
G7087-00	3.25	46.4	2.8	24.8	1.2	5107	40.6
DIVIDEND XL RTA	3.25	40.3	2.8	19.9	8.8	4645	39.8
L1397-A1	3.25	44.4	2.3	19.6	0.8	5054	41.1
RAXIL MD	3	36.1	3.5	17.3	1.4	4858	39.9
GEMINI	3.6	37.5	2	19.3	0.7	4976	40.1
VITAFLO 280	3.3	43.9	2.8	21.3	4.3	4887	40.9
LSD (0.05)		ns	ns	ns	1.25	516.1	ns
SEM		3.06	0.283	6.86	0.394	174.9	0.868

* ml product/kg seed

2005 PMR REPORT #90

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
STUDY DATA BASE: 303-1212-8907

CROP: Spring Barley, various cultivars and lines
PEST: Fusarium head blight, *Fusarium graminearum Schwabe*

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TITLE: **BARLEY RESPONSE TO FUSARIUM HEAD BLIGHT AND RESULTING DEOXYNIVALENOL (DON) ON LEVELS IN ARTIFICIAL INOCULATION TRIALS, PEI 2004/2005.**

MATERIALS: Cultivars as indicated in Table 1 and 2

METHODS: The Atlantic 2-row and 6-row Barley Registration Recommendation Coop Trials were seeded in 2004 and 2005 in an area which was artificially inoculated with *Fusarium graminearum* and provided with misting from before anthesis to near harvest. Each cultivar or line was seeded using a Hege cartridge seeder which provided individual plots which were approximately 45-50 cm long in rows which were 17.8 cm apart. Within row separation was approximately 40 cm. Each line and cultivar was replicated 4 times in a randomized complete block 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 vigorously bubbled through the media for about one week, or until spore production reached satisfactory levels. Starting when approximately 50-75% of the heads had reached anthesis, 75,000 spores per ml were applied on a weekly basis, three times, using a standard pesticide sprayer delivering 200 L/ha water. The field was misted for 2 minute bursts at a rate of 660 L/ha; misting was done every half hour from hour 0700 to 1030, at 15 minute intervals thru to 1900, half hour intervals to 2100 and then on an hourly basis until 0700.

Levels of fusarium head blight was assessed based on visual symptoms in the field (FHB Index) and deoxynivalenol (DON) analysis. FHB Index was determined based on the product of a whole plot incidence rating (0 - 10, where zero was no head was infected to 10 where all heads had some level of infection) and an average severity rating on heads with some level of FHB symptom (0 - 10, where 10 was all infected heads entirely covered in symptoms). DON levels were determined via competitive direct enzyme-linked immunosorbent assay (CD-ELISA) using Neogen Veratox 5/5 DON kits, on a bulk sample of all replicates.

RESULTS: Results are contained in Table 1 for 6-row barley and Table 2 for 2-row barley.

CONCLUSIONS: FHB levels were relatively low at the time of recording, however significant differences were recorded which indicates that improvements in resistance were being made. The 6-row trail demonstrate a higher overall level of susceptibility when compared to the 2 row trial entries. In the 2 row barley trial the FHB ranged from 2.5 - 6.3 and 1.3 - 8.3, in 2004 and 2005, respectively. The DON levels in the same trial ranged from 7.0 - 14.5 ppm and 1.1 - 5.8 ppm, in 2004 and 2005 respectively. The 6-row barley trial demonstrated higher ranges, and for FHB these were 5.5 - 16.0 and 6.5 - 23.0 and for DON they were 12.8 - 25.0 ppm and 2.6 - 8.1 ppm, for 2004 and 2005 respectively. That 2-row

barley is less susceptible to FHB and DON, and this was supported when compared in 2004 to the barley check line of the opposite row type. AC Helena, the spring wheat check, showed relatively low levels of FHB, but at the time when barley has to be rated the disease is often not well developed on wheat. It should however be noted that in this trial situation the level of DON in AC Helena is often lower than the barley cultivars. Usually in natural infections and natural disease development in the field barley, DON levels are lower than those in spring wheat, in the Atlantic Region. The very long misting period in the trial may be partially responsible for the higher DON levels in the barley trial compared to the wheat entry.

Table 1: Response of 6-row barley cultivars and lines to fusarium head blight, 2004 and 2005.

	2004 FHB Index (0-100)	DON (ppm)	2005 FHB Index (0-100)	DON (ppm)
AC Klinck	9.3	13.6	9	8.5
AC Alma	11.3	16	16.8	3.2
AC Legend	14.5	20.8	11.3	3.8
AC Maple	14.8	20.8	18.8	6.7
AC Westech	13.5	23.2	12.5	7
Balance	16	16.8		
CFO277AA148	14.5	20.8		
CFO281AA40	7.8	22.4	8.5	4.9
CFO283AA184	12.8	16		
CFO300AA12	12.5	25.6	12	3.3
CFO328	12.5	21.6		
CFO481-027			14	8.1
Chambly	7.8	19.2	13	3
Chapais	14.3	18.4	13.3	2.6
Encore			9.5	6.1
Excel	10.8	22.4		
GB006028			23	6.4
OB4993-6			13.3	3.6
OB5047-3	5.5	15.2		
OB5240-2			9	2.7
OB5240-3			9.5	8.5
OB5275-1			6.5	5.3
OB5275-1	7.5	16.8		
OB5297-3			9.5	5.1
QB979.7			6.8	5
UL016.6	12.5	16	11.5	2.9
UL028.3	11.3	17.6		
UL033.8	7.8	12.8		
UL033.9			14	4.3
UL037.7	10.3	16.8		
UL052.10			13.8	5.4
AC Sterling*	7	12.8		
AC Helena*	4.8	16.8	4.5	1.9
LSD (0.05)	5	na	6.46	na

na - not applicable as values based on bulk sample from all four replicates
* AC Sterling is a 2- row barley cultivar, AC Helena is a spring wheat cultivar

Table 2: Response of 2-row barley cultivars and lines to fusarium head blight, 2004 and 2005.

	2004 FHB Index (0-100)	DON (ppm)	2005 FHB Index (0-100)	DON (ppm)
CH9625-12	4.8	13		
CH9627-3	4.8	13.5		
CFO367-032	4	8.5		
Newdale	3.3	10.5		
CH9721-22			3	1.1
CH9622-7	3.8	13	5.5	2.5
AC Sterling	5.5	11	1.3	3.2
CFO343-003			2	3.7
AC Alberte	3	10	3.3	4
CH9520-30	4	14	3.5	4.6
Island	4	7	2	4.7
AC Queens	4.8	11.5	2.3	4.9
CH9526-9	4.5	11.5	4	5
BM9856D-200			4.8	5
CFO365-041	6.3	14.5	7.5	5
Almonte			2.3	5
AC Metcalfe			2	5.3
Formosa			2.5	5.4
CH9419-9	3	10	1.3	5.5
CH9528-10	4.8	10	8.3	5.7
CDC Copeland	2.5	12	1.3	5.8
AC Westeck*	6.5	16		
AC Helena*			0.3	3.8
LSD (0.05)	ns	na	2.99	na

ns - not significant
na - not applicable as values based on bulk sample from all four replicates
* AC Westeck is a 6- row barley cultivar, AC Helena is a spring wheat cultivar

2005 PMR REPORT #91

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
STUDY DATA BASE: 303-1212-8907

CROP: Spring Barley, various cultivars and lines
PEST: Fusarium head blight, *Fusarium graminearum Schwabe*

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TITLE: BARLEY RESPONSE TO FUSARIUM HEAD BLIGHT AND RESULTING DEOXYNIVALENOL (DON) ON LEVELS IN ARTIFICIAL INOCULATION TRIALS, PEI 2002/2003.

MATERIALS: Cultivars as indicated in Table 1 and 2

METHODS: The Atlantic 2-row and 6-row Barley Registration Recommendation Co-op Trials were seeded in 2002 and 2003 in an area which was artificially inoculated with *Fusarium graminearum* and provided with misting from before anthesis to near harvest. Each cultivar or line was seeded using a Hege cartridge seeder which provided individual plots which were approximately 45-50 cm long in rows which were 17.8 cm apart. Within row separation was approximately 40 cm. Each line and cultivar was replicated 4 times in a randomized complete block 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 vigorously bubbled through the media for about one week, or until spore production reached satisfactory levels. Starting when approximately 50-75% of the heads had reached anthesis, 75,000 spores per ml were applied on a weekly basis, three times, using a standard pesticide sprayer delivering 200 L/ha water. The field was misted for 2 minute bursts at a rate of 660 L/ha; misting was done every half hour.

Levels of fusarium head blight was assessed based on visual symptoms in the field (FHB Index) and deoxynivalenol (DON) analysis. FHB Index was determined based on the product of a whole plot incidence rating (0 - 10, where zero was no head was infected to 10 where all heads had some level of infection) and an average severity rating on heads with some level of FHB symptom (0 - 10, where 10 was all infected heads entirely covered in symptoms). DON levels were determined via competitive direct enzyme-linked immunosorbent assay (CD-ELISA) using Neogen Veratox 5/5 DON kits.

RESULTS: Results are contained in Table 1, for FHB Index in 2002 and DON levels in 2002 and 2003.

CONCLUSIONS: DON levels in 2002 were very high and there was little difference between the 2-row and 6-row trials. In 2003 the 6-row trial has approximately 30% higher DON levels, which is consistent with studies where 6-row and 2- row cultivars are mixed in a single trial. While there were no lines with a good resistance level there were several which indicated a potential for reduced risk of high DON. In the 6-row material AC Maple and Chapais exhibited relatively low DON levels in both years. A number of first year entries demonstrated low DON levels in 2003 (CFO226AA46 and OAC Baxter). In the 2-row trials there were several lines which preformed well in both years. Island, Serena and CH9423-20 were at the low end on DON production in both years.

There was variability between years however, noting lines such as Excel which was low in DON in 2003 but moderately high in 2002. Variability between years was also observed in the 2-row trial, noting AC Alberte which was relatively high in 2002 but low in 2003. The variability in resistance may have been a

cultivar effect, or due to different patterns in the disease development and epidemic progression between the two years. It does highlight a major problem experienced in determining resistance levels, between sites and years; and confirm that multiple testing years and/or sites are necessary.

Roblin had a relatively high FHB index in 2002 in both trials, but low to moderate DON levels. Roblin was placed in the trial to provide a field indication of infection. It is extremely susceptible and as such many of the kernels are so badly contaminated that in the process of harvesting and cleaning these highly contaminated kernels are lost, thus reducing the DON level. This was particularly evident in 2002.

Table 1: Response of 6-row and 2-row barley cultivars and lines to fusarium head blight, 2004 and 2005.

6-row Cultivars	2002 FHB Index (0-100)	2002 DON (ppm)	2003 DON (ppm)	**2-row Cultivars**	2002 FHB Index (0-100)	2002 DON (ppm)	2003 DON (ppm)
AB256	19.5	26.2		AC Alberte	11..0	31.2	8.6
AC Alma	21.3	19.9	15.6	AC Queens	5.5	27.3	21
AC Legend	15.5	28.4	17	AC Sterling	11.5	29.2	12
AC Maple	20.5	21.1	12.9	Belmore	9	27.7	11.2
AC Westech	7.8	38.4	15.8	CFO203-075	16.5	35	
BT950	10.8	25.3		CFO303-019	10	20.1	
C332-009	17.8	33.1		CFO0367-032			8.2
CFO142AA2	29.8	23.8		CFO97516	6.8	46.6	
CFO226AA29			14.3	CH9118-5	10.8	32.6	
CFO226AA46			10.5	CH9419-9	5.5	33.5	16.6
CFO328	23.8	41.1	13.7	CH9423-20	11	20.8	10
CFO37AA14	8.8	26.2		CH9435-10	3	37.4	
CFO417-074	33.8	46.3		CH9520-30			21.8
CFO440-012	21.3	17.8		CH9526-9			28
CFO460-044			17.6	Island	5.3	20.5	9.9
Chapais	14.8	14	14.6	Orthega			8.2
Excel	22.5	27.1	10.3	Serena	12.5	25.9	10.5
BT390	19.5	28.7	16.3				
Foster	28	26.9		AC Westech*			19.8
OAC Baxter			10.3	Chapais*			9.1
OB4898-28			50.8	Roblin*	58.8	31.8	19.7
OB5287-4			15.1				
OBS4898-14	19.8	44.2		LSD (0.05)	9.85	14.53	8.9
OBS4898-19	16.5	46.1	36.6				
OBS4898-20	30.3	44.7					
OBS4955-9	21	34					
Stander	32.5	30.3	18.5				
Sumosan			17.2				
AC Sterling*			14.1				
Roblin*	54.3	16.7	26.4				
LSD (0.05)	19.85	ns	13				

ns - not significant

* AC Sterling is a 2- row barley cultivar, AC Westech and Chapais are 6-row cultivars, and Roblin is a spring wheat cultivar

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SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
ICAR: 61009653

CROP: Bird's foot trefoil (*Lotus corniculatus* L.), cv. Leo
PEST: Seedling blight and root rot caused by *Rhizoctonia solani* Kühn, *Fusariumavenaceum* (Corda) Sacc., and *Pythium ultimum* Trow.

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TITLE: **FIELD AND GREENHOUSE EVALUATIONS OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF SEEDLING BLIGHT AND ROOT ROT OF BIRD'S FOOT TREFOIL IN ALBERTA IN 2005**

MATERIALS: DFC (difenconazole, 360 g/L SU), TRIBUNE (difenconazole, 1.61% SU; metalaxyl M, 0.51% LS; fludioxonil, 0.17% SU), APRON XL (metalaxyl M, 33.3% LS), MAXIM 480 (fludioxonil, 480g/L FS) APRON MAXX (fludioxonil, 0.73% SU; metalaxyl-M, 1.1% LS).

METHODS: Seed of bird'sfoot trefoil cv. Leo was treated in a Hege II small batch seed treater with TRIBUNE at 0.34 g a.i./kg seed, DFC at 0.24 g a.i./kg seed, MAXIM 480 at 0.025 or 0.05 g a.i./kg seed, APRON XL at 0.075 or 0.15 g a.i./kg seed, APRON MAXX at 0.0625 or 0.125 g a.i./kg seed, or APRON XL combined with MAXIM 480 at 0.15 and 0.025 g a.i./kg seed, respectively. Experimental plots were established on 12 May, 2005 at Brooks, AB in a brown chernozemic loam soil. Plots were seeded in a randomized complete block design with four replications. Each plot consisted of four, 4 m rows spaced 25 cm apart. Seeds were planted 1 cm deep at a rate of 0.1 g/m of seeds. *Rhizoctonia solani, Fusarium avenaceum* and *Pythium ultimum* were grown on sterilized grains (1:1, oat:wheat) for 14 days, dried, ground, and incorporated as inoculum at the time of seeding at the rate of 10 mL/row. Non-treated seeds were planted as inoculated and non-inoculated controls. Three seedling counts were taken for each plot after emergence. Seedling vigour was assessed visually and plots were harvested by hand-cutting the plants on 23 August. The material collected was dried and weighed to determine forage yield. Greenhouse experiments were established on 24 May, 2005 at the Alberta Research Council facility at Vegreville, AB. Inoculum was prepared as above and diluted with sterile sand at two concentrations (1:20 and 1:100) for each pathogen. The diluted pathogen inoculum was incorporated at the time of seeding at the rate of 5 mL/cup in 350 mL foam cups filled with steam-pasteurized soil mix (1:1, loam:peat moss). The same amount of clean sand was incorporated into non-inoculated controls. Ten cups were used for each treatment with ten seeds planted into each cup. Three seedling stand counts were collected at 7, 14 and 21 days after seeding. Seed decay (%) and phytotoxicity were also assessed and recorded. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS 9.1) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Seedling emergence, seedling vigour, seed decay and forage yield were not significantly ($P \leq 0.05$) affected by fungicide treatments, and no phytotoxicity was observed in either the field or greenhouse trials (Tables 1 and 2). Emergence was significantly ($P \leq 0.05$) lower in most of the pathogen-inoculated controls compared to the healthy controls in the greenhouse experiments (Table 2).

In the *Fusarium*-inoculated treatments, MAXIM at both rates and APRON MAXX at the high rate significantly increased seedling stands and forage yields in the field trials (Table 1). There was no significant difference in seedling vigour among these treatments. Greenhouse experiments showed that APRON MAXX at both rates, APRON XL + MAXIM, and MAXIM at the rate of 0.05 g a.i./kg seeds significantly increased seedling emergence and decreased seed decay at both *Fusarium* inoculum concentrations (Table 2). TRIBUNE and MAXIM at the low rate also improved seedling stands and reduced seed decay at the low inoculation level.

In the *Pythium*-inoculated treatments, APRON MAXX at the high rate, APRON XL + MAXIM, and MAXIM at both rates increased the final seedling stands compared to the inoculated control, but the forage yield was not significantly increased by these treatments (Table 1). There was no statistical difference in seedling vigour among all fungicide treatments. In greenhouse trials, TRIBUNE, APRON XL and APRON MAXX at the high rate, and APRON XL + MAXIM significantly increased seedling emergence and decreased seed decay compared with the inoculated control at both inoculum concentrations (Table 2).

In the *Rhizoctonia*-inoculated field treatments, MAXIM at the high rate and APRON MAXX at both rates showed significantly greater emergence, better seedling vigour and higher forage yield than the *Rhizoctonia*-inoculated control. Seedling vigour and emergence were also increased by TRIBUNE, while seedling vigour and forage yield were increased by the treatment with APRON XL + MAXIM. In the greenhouse trial, APRON MAXX at high rate and MAXIM at both rates significantly increased seedling emergence, and decreased seed decay compared to the *Rhizoctonia*-inoculated control at both inoculation levels. TRIBUNE, APRON XL + MAXIM and APRON MAXX at the low rate also significantly improved seedling stands at the low inoculum level

CONCLUSIONS: In both field and greenhouse trials, MAXIM and APRON MAXX showed the greatest improvement in seedling stands and forage yields in *Rhizoctonia* and *Fusarium*-inoculated plots. TRIBUNE increased seedling emergence in field trials inoculated with *Rhizoctonia*. APRON MAXX, APRON XL + MAXIM, and MAXIM increased seedling emergence in field trials under *Pythium* infection, and TRIBUNE, APRON XL, APRON XL + MAXIM and APRON MAXX reduced *Pythium* infection in greenhouse trials.

Table 1. Effects of fungicidal seed treatments on seedling stand, seed vigour and forage yield of the bird's foot trefoil cv. Leo in field experiments conducted at Brooks, AB in 2005.

Treatment	Rate (g a.i./kg)	Seedling count (plants/m^2) Week one	Week two	Week three	Seedling vigour (1 - 5)	Forage yield (t/ha)
Non-inoculated:						
Non-inoc. CK	-	83.1 a	76.4 a	81.6 a	3.8 a	2.28 a
Inoc. CK	-	70.3 a	65.3 a	62.5 a	3.8 a	1.90 a
TRIBUNE	0.34	73.6 a	67.5 a	61.2 a	3.5 a	1.71 a
DFC	0.24	75.3 a	69.2 a	75.2 a	3.3 a	1.13 a
MAXIM	0.025	74.4 a	72.5 a	73.9 a	3.4 a	2.21 a
MAXIM	0.05	57.9 a	68.5 a	70.8 a	4.0 a	2.08 a
APRON XL	0.075	63.5 a	67.5 a	64.5 a	3.3 a	1.80 a
APRON XL + MAXIM	0.15 + 0.025	65.7 a	70.7 a	75.6 a	4.0 a	2.07 a
APRON XL	0.15	61.9 a	70.4 a	67.1 a	4.0 a	2.03 a
APRON MAXX	0.0625	90.0 a	83.2 a	87.9 a	4.0 a	2.19 a
APRON MAXX	0.125	74.8 a	79.2 a	73.5 a	4.3 a	2.33 a
Fusarium-inoculated (10 ml/3m row):						
Non-inoc. CK	-	73.7 bc	81.2 ab	80.7 abc	4.3 a	1.68 ab
Inoc. CK	-	55.7 c	64.1 c	65.2 cd	3.8 a	1.26 b
TRIBUNE	0.34	81.1 abc	82.9 ab	78.4 a-d	3.8 a	1.49 ab
DFC	0.24	72.3 bc	60.0 c	63.3 d	3.5 a	1.26 b
MAXIM	0.025	97.2 ab	82.4 ab	84.3 ab	4.3 a	1.97 a
MAXIM	0.05	103.6 a	86.9 a	86.5 ab	4.3 a	1.90 a
APRON XL	0.075	75.3 bc	62.9 c	66.5 cd	3.3 a	1.52 ab
APRON XL + MAXIM	0.15 + 0.025	94.5 ab	82.3 ab	81.3 abc	3.3 a	1.78 ab
APRON XL	0.15	78.0 bc	69.7 bc	69.7bcd	3.8 a	1.78 ab
APRON MAXX	0.0625	80.7 abc	73.3 abc	80.3 a-d	3.8 a	1.55 ab
APRON MAXX	0.125	98.1 ab	88.3 a	93.7 a	4.3 a	2.08 a
Pythium-inoculated (10 ml/3m row):						
Non-inoc. CK	-	94.3 a	85.5 a	84.1 a	3.5 a	2.48 a
Inoc. CK	-	49.5 c	51.3 cd	48.4 ef	2.5 a	1.57 b
TRIBUNE	0.34	61.3 bc	45.2 cd	51.3 def	3.0 a	1.36 b
DFC	0.24	53.9 c	38.1 d	48.8 ef	2.8 a	1.41 b
MAXIM	0.025	69.1 bc	60.5 bc	66.3 bcd	3.3 a	1.77 ab
MAXIM	0.05	71.1 bc	60.5 bc	74.0 ab	4.0 a	1.79 ab
APRON XL	0.075	58.8 bc	58.5 bc	55.1 c-f	3.5 a	1.68 ab
APRON XL + MAXIM	0.15 + 0.025	79.2 ab	72.1 ab	65.3 bcd	3.8 a	2.17 ab
APRON XL	0.15	70.7 bc	62.1 bc	59.1 b-e	3.5 a	2.10 ab
APRON MAXX	0.0625	59.1 bc	39.6 d	42.9 f	3.0 a	1.38 b
APRON MAXX	0.125	77.2 ab	73.3 ab	70.1 abc	3.8 a	1.91 ab

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

Table 1. Continued.

Treatment	Rate (g a.i./kg)	Seedling count (plants/m^2) Week one	Week two	Week three	Seedling vigour (1 - 5)	Forage yield (t/ha)
Rhizoctonia-inoculated (10 ml/3m row):						
Non-inoc. CK	-	81.2 a	83.1 a	80.4 a	3.8 a	1.62 a
Inoc. CK	-	11.6 d	15.5 de	17.3 d	1.5 d	0.42 d
TRIBUNE	0.34	37.7 bc	48.4 b	46.7 bc	3.0 ab	0.68 cd
DFC	0.24	14.7 d	28.4 b-e	25.2 cd	2.0 bcd	0.79 bcd
MAXIM	0.025	32.1 bcd	37.7 bc	39.5 bcd	2.0 bcd	0.75 bcd
MAXIM	0.05	41.1 bc	50.7 b	50.5 b	3.0 ab	0.95 bc
APRON XL	0.075	14.5 d	14.8 e	24.4 cd	1.5 d	0.41 d
APRON XL +	0.15 +	23.7 bcd	37.2 bcd	35.6 bcd	2.8 abc	0.86 bc
APRON XL	0.15	20.4 cd	22.1 cde	23.7 cd	1.8 cd	0.68 cd
APRON MAXX	0.0625	37.9 bc	34.3 b-e	44.5 bc	2.8 abc	1.11 b
APRON MAXX	0.125	44.8 b	43.6 bc	45.1 bc	3.0 ab	0.89 bc

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

Table 2. Effects of fungicidal seed treatments on seedling stand and seed decay of the bird's foot trefoil cv. Leo in greenhouse experiments conducted at Vegreville, AB in 2005.

Treatment	Rate (g a.i./kg)	Seedling count (10 seeds)			Seed decay (%)
		Week one	Week two	Week three	
Non-inoculated:					
Non-inoc. CK	-	7.4 c	7.7 a	8.1 a	19.0 a
Inoc. CK	-	7.9 abc	8.3 a	8.6 a	12.0 a
TRIBUNE	0.34	8.7 abc	8.7 a	8.9 a	11.0 a
DFC	0.24	8.4 abc	8.7 a	8.7 a	13.0 a
MAXIM	0.025	8.9 ab	8.9 a	9.0 a	10.0 a
MAXIM	0.05	9.1 a	9.0 a	9.3 a	10.0 a
APRON XL	0.075	8.3 abc	8.6 a	8.4 a	13.0 a
APRON XL + MAXIM	0.15 + 0.025	8.7 abc	8.9 a	8.7 a	11.0 a
APRON XL	0.15	9.1 a	9.2 a	8.9 a	5.0 a
APRON MAXX	0.0625	7.6 bc	8.1 a	7.9 a	19.0 a
APRON MAXX	0.125	8.2 abc	8.6 a	8.5 a	14.0 a
Fusarium at low concentration (1:100):					
Non-inoc. CK	-	6.2 bc	7.7 ab	8.0 a	19.0 b
Inoc. CK	-	5.9 c	5.7 c	5.7 b	37.0 a
TRIBUNE	0.34	7.5 abc	8.0 ab	8.4 a	14.0 b
DFC	0.24	6.3 bc	6.6 bc	7.0 ab	26.0 ab
MAXIM	0.025	7.8 ab	8.1 ab	7.9 a	16.0 b
MAXIM	0.05	8.0 ab	8.3 a	8.1 a	15.0 b
APRON XL	0.075	7.2 abc	7.4 ab	7.3 a	25.0 ab
APRON XL + MAXIM	0.15 + 0.025	7.9 ab	7.8 ab	7.8 a	18.0 b
APRON XL	0.15	6.4 bc	5.6 c	5.5 b	35.0 a
APRON MAXX	0.0625	8.6 a	8.7 a	8.4 a	14.0 b
APRON MAXX	0.125	8.4 a	8.4 a	8.3 a	15.0 b
Fusarium at high concentration (1:20):					
Non-inoc. CK	-	6.1 cde	6.9 abc	6.9 abc	28.0 abc
Inoc. CK	-	5.1 e	4.6 d	4.4 d	45.0 a
TRIBUNE	0.34	6.9 a-e	6.2 a-d	6.0 a-d	28.0 abc
DFC	0.24	5.3 de	4.6 d	4.4 d	43.0 a
MAXIM	0.025	7.1 a-d	6.5 a-d	6.2 a-d	29.0 abc
MAXIM	0.05	8.2 ab	8.3 a	8.0 a	15.0 bc
APRON XL	0.075	6.1 cde	5.0 cd	4.9 cd	33.0 ab
APRON XL + MAXIM	0.15 + 0.025	8.6 a	8.0 a	8.0 a	13.0 c
APRON XL	0.15	6.5 b-e	5.4 bcd	5.1 bcd	32.0 ab
APRON MAXX	0.0625	7.5 abc	7.2 ab	7.1 ab	23.0 bc
APRON MAXX	0.125	7.8 abc	7.8 a	7.8 a	18.0 bc

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

Table 2. Continued.

Treatment	Rate (g a.i./kg)	Seedling count (10 seeds)			Seed decay (%)
		Week one	Week two	Week three	
Pythium at low concentration (1:100):					
Non-inoc. CK	-	8.3 ab	8.9 a	8.9 a	10.0 c
Inoc. CK	-	5.6 d	5.2 c	5.2 de	39.0 a
TRIBUNE	0.34	8.7 a	8.6 ab	8.1 abc	12.0 c
DFC	0.24	6.9 a-d	5.7 c	5.5 de	31.0 ab
MAXIM	0.025	6.0 cd	5.3 c	4.8 e	39.0 a
MAXIM	0.05	6.1 cd	5.5 c	5.3 de	34.0 ab
APRON XL	0.075	6.6 bcd	6.4 bc	6.2 cde	34.0 ab
APRON XL + MAXIM	0.15 + 0.025	8.7 a	8.6 ab	8.6 ab	11.0 c
APRON XL	0.15	7.9 abc	8.1 ab	7.9 abc	18.0 bc
APRON MAXX	0.0625	7.5 a-d	7.0 abc	6.6 b-e	24.0 abc
APRON MAXX	0.125	8.7 a	8.0 ab	7.4 abc	13.0 c
Pythium at high concentration (1:20):					
Non-inoc. CK	-	6.8 abc	7.3 a	7.9 a	20.0 c
Inoc. CK	-	4.4 d	3.6 c	3.2 e	55.0 a
TRIBUNE	0.34	7.2 abc	6.8 ab	6.4 ab	27.0 bc
DFC	0.24	6.0 a-d	5.9 abc	5.6 a-d	37.0 abc
MAXIM	0.025	5.1 cd	4.3 bc	3.8 de	48.0 ab
MAXIM	0.05	5.1 cd	4.6 bc	4.0 cde	48.0 ab
APRON XL	0.075	5.8 bcd	4.9 abc	4.6 b-e	28.0 bc
APRON XL + MAXIM	0.15 + 0.025	7.8 ab	6.8 ab	6.6 ab	21.0 c
APRON XL	0.15	7.1 abc	6.3 ab	6.3 abc	37.0 abc
APRON MAXX	0.0625	6.6 abc	6.0 abc	5.6 a-d	24.0 c
APRON MAXX	0.125	8.1 a	7.4 a	7.0 ab	19.0 c
Rhizoctonia at low concentration (1:100):					
Non-inoc. CK	-	7.6 a	7.3 a	7.3 a	14.0 d
Inoc. CK	-	0.0 e	0.0 e	0.0 e	98.0 a
TRIBUNE	0.34	4.6 cd	3.8 cd	3.8 cd	88.0 ab
DFC	0.24	0.1 e	0.1 e	0.2 e	100.0 a
MAXIM	0.025	3.2 d	3.0 d	2.7 d	47.0 c
MAXIM	0.05	5.8 bc	4.8 bc	4.8 bc	54.0 c
APRON XL	0.075	0.0 e	0.0 e	0.0 e	100.0 a
APRON XL + MAXIM	0.15 + 0.025	3.6 d	2.6 d	2.7 d	79.0 b
APRON XL	0.15	0.0 e	0.0 e	0.0 e	100.0 a
APRON MAXX	0.0625	3.8 d	3.0 d	2.8 d	78.0 b
APRON MAXX	0.125	6.3 ab	6.3 ab	5.8 ab	48.0 c

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

Table 2. Continued.

Treatment	Rate (g a.i./kg)	Seedling count (10 seeds)			Seed decay (%)
		Week one	Week two	Week three	
Rhizoctonia at high concentration (1:20):					
Non-inoc. CK	-	7.6 a	8.6 a	8.3 a	23.0 e
Inoc. CK	-	0.0 d	0.2 cd	0.1 c	100.0 a
TRIBUNE	0.34	0.9 cd	1.1 cd	0.9 c	53.0 bc
DFC	0.24	0.0 d	0.0 d	0.0 c	98.0 a
MAXIM	0.025	4.0 b	3.1 b	3.7 b	67.0 b
MAXIM	0.05	4.1 b	3.3 b	2.7 b	41.0 cd
APRON XL	0.075	0.1 d	0.0 d	0.0 c	100.0 a
APRON XL + MAXIM	0.15 + 0.025	2.1 c	1.5 c	1.2 c	61.0 b
APRON XL	0.15	0.0 d	0.0 d	0.0 c	100.0 a
APRON MAXX	0.0625	2.0 c	1.6 c	1.1 c	62.0 b
APRON MAXX	0.125	4.8 b	3.3 b	3.0 b	34.0 de

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

2005 PMR REPORT #93

SECTION O: CEREALS, FORAGE CROPS AND OILSEEDS - Diseases
ICAR: 61009653

CROP: Canola (*Brassica napus* L.), cv. DKL 34-55
PEST: Root rot, *Rhizoctonia solani* Kühn

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TITLE: **EFFICACY OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF RHIZOCTONIA SEEDLING BLIGHT OF CANOLA IN ALBERTA IN 2005**

MATERIALS: PONCHO 600 (clothianidin, 600 g/L FS), PROSPER 400 (clothianidin, 240 g/L + carbathiin, 42 g/L + metalaxyl, 3 g/L + thiram, 90 g/L SU), FLINT RTU (clothianidin,143 g/L + carbathiin, 50 g/L + metalaxyl, 5.4 g/L + trifloxystrobin, 7.1 g/L SU), HELIX (difenconazole, 16 g/L + fludioxonil, 1.7 g/L + metalaxyl-M, 5 g/L + thiamethoxam, 133 g/L SU), HELIX XTRA (difenconazole, 16 g/L + fludioxonil, 1.7 g/L + metalaxyl-M, 5 g/L + thiamethoxam, 266 g/L SU), EXP RTU (clothianidin, 286 g/L + carbathiin, 50 g/L + metalaxyl, 5.4 g/L + trifloxystrobin, 7.1 g/L SU)

METHODS: Seed of the canola cv. DKL 34-55 was treated in a Hege small batch seed treater with the insecticide PONCHO 600 at 3.33 mL/kg seed, or with the insecticide-fungicide mixtures PROSPER 400 at 16.67 mL/kg seed, EXP RTU or FLINT RTU at 14 mL/kg seed, or HELIX or HELIX XTRA at 15.0 mL/kg seed. An experimental plot was established on 16 May, 2005 at Vegreville, AB, in a black chernozemic sandy loam soil. The plot was seeded in a randomized split-block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 1.5 cm deep at a rate of 1.0 g of seed per row. *Rhizoctonia solani* was grown on cracked (screened to exclude particles smaller than 1mm), sterilized oat and barley grains for 14 days, air dried, and incorporated at the time of seeding at the rate of 0, 15 or 30 mL/row as main plots. Each of the seed treatments was seeded as subplots, and non-treated seeds were planted as inoculated controls. Emerged seedlings were counted on 10 June. At maturity (October 6), plants were harvested and seed was weighed to determine yield. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Each of the main plots is presented separately since there were significant inoculation x treatment interactions. Emergence was not significantly ($P \leq 0.05$) affected by seed treatment or inoculation (Table 1). Yield was significantly ($P \leq 0.05$) greater than the untreated control for PROSPER 400 and HELIX at the low inoculum rate, and for FLINT RTU at the high inoculum rate.

CONCLUSIONS: Treatments received insufficient disease pressure to affect emergence. However yield was improved compared to the inoculated control by PROSPER 400, HELIX or FLINT RTU in at least one of the main plot treatments.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of the canola cv. DKL 34-55 grown in a field plot inoculated with two rates of *Rhizoctonia solani* at Vegreville, AB in 2005.

Control

Treatment	Rate (mL/kg seed)	Stand (plants/m^2)	Yield (t/ha)
Untreated	-	63.9 a[*]	2.66 ab
PONCHO 600	3.33	59.3 a	2.35 b
PROSPER 400	16.7	55.3 a	3.00 a
FLINT RTU	14	55.4 a	2.54 ab
EXP RTU	14	59.8 a	2.36 b
HELIX	15	60.3 a	2.60 ab
HELIX XTRA	15	63.4 a	2.58 ab

Rhizoctonia @ 15 mL/row

Treatment	Rate (mL/kg seed)	Stand (plants/m^2)	Yield (t/ha)
Untreated[†]	-	50.3 a	2.33 b
PONCHO 600	3.33	52.7 a	2.86 ab
PROSPER 400	16.67	53.4 a	3.04 a
FLINT RTU	14	50.0 a	2.85 ab
EXP RTU	14	49.8 a	2.60 ab
HELIX	15	53.8 a	3.04 a
HELIX XTRA	15	45.2 a	2.68 ab

Rhizoctonia @ 30 mL/row

Treatment	Rate (mL/kg seed)	Stand (plants/m^2)	Yield (t/ha)
Untreated[†]	-	38.4 a	2.30 b
PONCHO 600	3.33	37.9 a	2.46 ab
PROSPER 400	16.67	51.8 a	2.46 ab
FLINT RTU	14	46.4 a	2.82 a
EXP RTU	14	44.3 a	2.64 ab
HELIX	15	46.8 a	2.61 ab
HELIX XTRA	15	37.7 a	2.48 ab

[*] Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test ($P \leq 0.05$).

[†] All treatments were inoculated with *Rhizoctonia solani* at the time of seeding.

2005 PMR REPORT #95

SECTION O: CEREALS, FORAGE CROPS AND OILSEEDS - Diseases
ICAR: 61009653

CROP: Canola (*Brassica napus* L.), cv. DKL 34-55
PEST: Root rot, *Fusarium avenaceum* (Corda ex Fries) Sacc.

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TITLE: **EFFICACY OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF FUSARIUM SEEDLING BLIGHT OF CANOLA IN ALBERTA IN 2005**

MATERIALS: PONCHO 600 (clothianidin, 600 g/L FS), PROSPER 400 (clothianidin, 240 g/L + carbathiin, 42 g/L + metalaxyl, 3 g/L + thiram, 90 g/L SU), FLINT RTU (clothianidin,143 g/L + carbathiin, 50 g/L + metalaxyl, 5.4 g/L + trifloxystrobin, 7.1 g/L SU), HELIX (difenconazole, 16 g/L + fludioxonil, 1.7 g/L + metalaxyl-M, 5 g/L + thiamethoxam, 133 g/L SU), HELIX XTRA (difenconazole, 16 g/L + fludioxonil, 1.7 g/L + metalaxyl-M, 5 g/L + thiamethoxam, 266 g/L SU), EXP RTU (clothianidin, 286 g/L + carbathiin, 50 g/L + metalaxyl, 5.4 g/L + trifloxystrobin, 7.1 g/L SU)

METHODS: Seed of the canola cv. DKL 34-55 was treated in a Hege small batch seed treater with the insecticide PONCHO 600 at 3.33 mL/kg seed, and with the insecticide-fungicide mixtures PROSPER 400 at 13.33 mL/kg seed, EXP RTU or FLINT RTU at 14 mL/kg seed, or HELIX or HELIX XTRA at 15.0 mL/kg seed, or left untreated. An experimental plot was established on 16 May, 2005 at Vegreville, AB, in a black chernozemic sandy loam soil. The plot was seeded in a randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 1.5 cm deep at a rate of 1.0 g of seed per row. *Fusarium avenaceum* was grown on sterilized oat grains for 14 days, air-dried, ground, and incorporated at the time of seeding at the rate of 30 mL/row, into all treatments, except for a non-inoculated insecticide treatment. Emerged seedlings were counted on 10 June. At maturity (October 6), plants were harvested and seed was weighed to determine yield. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Emergence was significantly ($P \leq 0.05$) greater for plots treated with FLINT RTU, EXP RTU or HELIX compared to untreated plots and inoculated plots planted with seed treated with the insecticide PONCHO 600 (Table 1). There were no significant ($P \leq 0.05$) yield differences among the treatments.

CONCLUSIONS: FLINT RTU, EXP RTU and HELIX mitigated stand losses caused by *Fusarium avenaceum*.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of the canola cv. DKL 34-55 grown in a field plot inoculated with *Fusarium avenaceum* at Vegreville, AB in 2005.

Treatment	Rate (mL/kg seed)	Stand (plants/m^2)	Yield (t/ha)
PONCHO 600	3.33	74.0 ab*	2.41 a
PONCHO 600 †	3.33	66.2 b	2.04 a
PROSPER 400	13.3	89.8 ab	2.11 a
FLINT RTU	14	92.9 a	2.55 a
EXP RTU	14	96.2 a	2.41 a
HELIX	15	93.2 a	2.22 a
HELIX XTRA	15	89.1 ab	2.41 a
Untreated	-	64.6 b	2.22 a

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test ($P \leq 0.05$).

† This and all subsequent treatments were inoculated with *Fusarium avenaceum* at the time of seeding.

2005 PMR REPORT #96

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
ICAR: 61009653

CROP: Sweet clover (*Melilotus officinalis* (L.) Lam.), cv. Blend
PEST: Seedling blight and root rot caused by *Rhizoctonia solani* Kühn, *Fusarium avenaceum* (Corda) Sacc., and *Pythium ultimum* Trow.

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TITLE: **FIELD AND GREENHOUSE EVALUATIONS OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF SEEDLING BLIGHT AND ROOT ROT OF SWEET CLOVER IN ALBERTA IN 2005**

MATERIALS: DFC (difenconazole, 360 g/L SU), TRIBUNE (difenconazole, 1.61% SU; metalaxyl M, 0.51% LS; fludioxonil, 0.17% SU), APRON XL (metalaxyl M, 33.3% LS), MAXIM 480 (fludioxonil, 480g/L FS) APRON MAXX (fludioxonil, 0.73% SU; metalaxyl-M, 1.1% LS).

METHODS: Seed of cv. Blend yellow blossom sweet clover was treated in a Hege II small batch seed treater with TRIBUNE at 0.34 g a.i./kg seed, DFC at 0.24 g a.i./kg seed, MAXIM 480 at 0.025 or 0.05 g a.i./kg seed, APRON XL at 0.075 or 0.15 g a.i./kg seed, APRON MAXX at 0.0625 or 0.125 g a.i./kg seed, or APRON XL combined with MAXIM 480 at 0.15 and 0.025 g a.i./kg seed, respectively. Experimental plots were established on 12 May, 2005 at Brooks, AB in a brown chernozemic loam soil. Plots were seeded in a randomized complete block design with four replications. Each plot consisted of four, 4 m rows spaced 25 cm apart. Seeds were planted 1 cm deep at a rate of 0.1 g/m of seeds. *Rhizoctonia solani*, *Fusarium avenaceum* and *Pythium ultimum* were grown on a sterilized 1:1 blend of wheat and oat grains for 14 days, dried, ground, and incorporated as inoculum at the time of seeding at the rate of 10 mL/row. Non-treated seeds were planted as inoculated and non-inoculated controls. Three seedling counts were collected for each plot after emergence. Seedling vigour was assessed visually and plots were harvested by hand-cutting the plants on 29 August. The material collected was dried and weighed to determine forage yield.
Greenhouse experiments were established on 24 May, 2005 at the Alberta Research Council facility at Vegreville, AB. Inoculum was prepared as above and diluted with sterile sand at two concentrations (1:20 and 1:100) for each pathogen. The diluted pathogen inoculum was incorporated at the time of seeding at the rate of 5 mL/cup in 350 mL foam cups filled with steam-pasteurized soil mix (1:1, loam:peat moss). The same amount of clean sand was incorporated into non-inoculated controls. Ten cups were used for each treatment with ten seeds planted into each cup. Three seedling stand counts were collected at 7, 14 and 21 days after seeding. Seed decay (%) and phytotoxicity were also assessed and recorded. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS 9.1) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Seedling emergence, seedling vigour, seed decay and forage yield were not significantly ($P \leq 0.05$) affected by fungicide treatments, and no phytotoxicity was observed in either the field or greenhouse trials (Tables 1 and 2).

In field trials, MAXIM and APRON MAXX at the high rate and APRON XL + MAXIM significantly increased final seedling stands compared to the *Fusarium*-inoculated controls (Table 1). There was no significant difference in seedling vigour among the fungicide treatments. None of the treatments resulted in significantly greater yield than the inoculated control. APRON MAXX and APRON XL at the high rate increased seedling stand in the first two seedling counts and forage yield compared to the *Pythium*-inoculated controls. There were no statistical differences in seedling vigour among the fungicide treatments. In the *Rhizoctonia*-inoculated field treatments, TRIBUNE, MAXIM at both rates (except week 1 at the low rate), APRON MAXX at the high rate, and APRON XL + MAXIM showed significantly higher emergence, seedling vigour and forage yield than the *Rhizoctonia*-inoculated control.

In greenhouse trials, emergence was significantly ($P \leq 0.05$) lower in some, but not all of pathogen-inoculated controls, compared to the healthy controls (Table 2). In the *Fusarium*-inoculated treatments, most of the fungicide treatments increased seedling emergence compared to the control, but only DFC and APRON XL at the high rate significantly reduced seed decay at the low inoculation level. Emergence was increased and seed decay was decreased in the treatments with DFC, APRON MAXX at both rates, MAXIM and APRON XL at the high rate, and APRON XL + MAXIM at the high inoculum concentration.
In the *Pythium*-inoculated treatments, TRIBUNE, MAXIM at the high rate, and APRON XL + MAXIM significantly increased seedling emergence by week 3, while seed decay was reduced only by TRIBUNE and MAXIM compared with the inoculated control at the low inoculum concentration. However, APRON XL at the high rate and APRON XL + MAXIM significantly improved seedling emergence and decreased seed decay at the high inoculation level.
In the *Rhizoctonia*-inoculated treatments, APRON MAXX at the high rate and TRIBUNE significantly increased seedling emergence, and reduced seed decay comparing to the *Rhizoctonia*-inoculated control at both inoculation levels. Similar results were also obtained from MAXIM at the high rate and high inoculation level, and APRON XL + MAXIM at the low inoculation level.

CONCLUSIONS: In field trials, MAXIM and APRON MAXX showed the greatest improvement in seedling stands in *Fusarium*-inoculated plots. APRON MAXX and APRON XL were effective at increasing seedling emergence under *Pythium* infection. TRIBUNE, MAXIM, APRON MAXX and APRON XL + MAXIM improved seedling emergence, stand vigour and yield in *Rhizoctonia*- inoculated plots.
In greenhouse trials, MAXIM, APRON XL, APRON MAXX and APRON XL + MAXIM were effective against both *Fusarium* and *Pythium* infections. TRIBUNE was also effective at reducing *Pythium* infection. TRIBUNE, APRON MAXX, MAXIM and APRON XL + MAXIM improved seedling stands under *Rhizoctonia* infection.

Table 1. Effects of fungicidal seed treatments on seedling stand, seed vigour and forage yield of the cv. Blend yellow blossom sweet clover in field experiments conducted at Brooks, AB in 2005.

Treatment	Rate (g a.i./kg)	Seedling count (plants/m^2)			Seedling vigour (1 - 5)	Forage yield (t/ha)
		Week one	Week two	Week three		
Non-inoculated:						
Non-inoc. CK	-	80.5 a	102.4 a	80.4 a	4.5 a	12.34 a
Inoc. CK	-	84.5 a	100.1 a	82.5 a	4.5 a	13.30 a
TRIBUNE	0.34	88.7 a	106.9 a	89.2 a	4.5 a	13.74 a
DFC	0.24	72.4 a	97.7 a	78.1 a	4.0 a	8.18 a
MAXIM	0.025	85.9 a	105.9 a	83.9 a	4.5 a	11.69 a
MAXIM	0.05	84.8 a	94.5 a	76.3 a	4.5 a	11.87 a
APRON XL	0.075	93.2 a	108.1 a	86.7 a	5.0 a	12.66 a
APRON XL + MAXIM	0.15 + 0.025	94.1 a	101.9 a	79.7 a	4.8 a	13.36 a
APRON XL	0.15	97.2 a	117.1 a	90.4 a	4.5 a	13.03 a
APRON MAXX	0.0625	72.1 a	97.2 a	75.2 a	4.3 a	11.21 a
APRON MAXX	0.125	73.9 a	84.1 a	72.1 a	4.5 a	11.88 a
Fusarium-inoculated (10 mL/3m row):						
Non-inoc. CK	-	82.8 a	98.7 a	85.9 a	4.3 a	11.19 a
Inoc. CK	-	55.2 b	58.8 d	54.7 d	3.3 a	9.00 bcd
TRIBUNE	0.34	55.5 b	67.6 bcd	63.3 cd	3.0 a	9.97 ab
DFC	0.24	58.8 b	72.8 bcd	64.9 bcd	3.5 a	9.10 bcd
MAXIM	0.025	51.2 b	63.3 cd	64.1 bcd	3.3 a	9.00 bcd
MAXIM	0.05	61.3 b	77.1 bcd	68.4 bc	3.3 a	9.74 abc
APRON XL	0.075	54.4 b	67.2 bcd	61.5 cd	3.8 a	7.82 d
APRON XL + MAXIM	0.15 + 0.025	69.1 ab	85.1 ab	75.5 ab	3.3 a	8.79 bcd
APRON XL	0.15	65.5 b	56.9 d	65.1 bcd	3.3 a	9.55 bc
APRON MAXX	0.0625	53.3 b	66.4 bcd	64.1 bcd	3.0 a	7.59 d
APRON MAXX	0.125	59.1 b	80.5 abc	71.6 bc	3.3 a	8.12 cd
Pythium-inoculated (10 mL/3m row):						
Non-inoc. CK	-	88.1 ab	109.2 ab	86.7 a	4.3 a	9.94 abc
Inoc. CK	-	56.4 d	79.9 def	69.2 a	3.8 a	8.04 bc
TRIBUNE	0.34	85.6 ab	97.3 bcd	76.3 a	4.5 a	9.47 abc
DFC	0.24	71.9 bcd	77.2 ef	73.7 a	3.5 a	7.90 bc
MAXIM	0.025	71.2 bcd	82.7 def	68.8 a	3.8 a	9.45 abc
MAXIM	0.05	78.3 bc	82.7 def	73.7 a	4.3 a	10.06 ab
APRON XL	0.075	87.9 ab	92.9 b-e	82.5 a	4.5 a	9.93 abc
APRON XL + MAXIM	0.15 + 0.025	63.6 cd	71.7 f	67.2 a	3.3 a	7.69 c
APRON XL	0.15	99.2 a	107.2 abc	87.1 a	4.8 a	10.52 a
APRON MAXX	0.0625	76.3 bcd	90.3 cde	73.7 a	4.0 a	8.74 abc
APRON MAXX	0.125	90.8 ab	116.8 a	90.8 a	4.8 a	10.78 a

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

Table 1. Continued.

Treatment	Rate (g a.i./kg)	Seedling count (plants/m^2)			Seedling vigour (1 - 5)	Forage yield (t/ha)
		Week one	Week two	Week three		
Rhizoctonia-inoculated (10 mL/3m row):						
Non-inoc. CK	-	68.1 a	89.2 a	75.1 a	4.0 a	8.90 a
Inoc. CK	-	6.1 de	6.4 e	5.7 e	1.0 d	2.00 cd
TRIBUNE	0.34	36.1 b	57.9 b	50.8 b	3.0 bc	7.57 a
DFC	0.24	5.3 de	6.8 e	7.2 de	1.0 d	3.18 cd
MAXIM	0.025	23.2 bcd	28.5 cd	25.5 c	2.3 c	6.82 ab
MAXIM	0.05	32.4 bc	45.1 b	46.3 b	2.5 c	7.87 a
APRON XL	0.075	3.2 e	3.2 e	4.0 e	1.0 d	1.32 d
APRON XL + MAXIM	0.15 + 0.025	35.7 b	41.2 bc	43.5 b	3.0 bc	8.12 a
APRON XL	0.15	2.4 e	2.9 e	3.1 e	1.0 d	1.01 d
APRON MAXX	0.0625	17.2 cde	18.4 de	19.2 cd	1.3 d	4.47 bc
APRON MAXX	0.125	39.7 b	50.5 b	51.5 b	3.5 ab	8.93 a

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

Table 2. Effects of fungicidal seed treatments on seedling stand and seed decay of the cv. Blend yellow blossom sweet clover in greenhouse experiments conducted at Vegreville, AB in 2005.

Treatment	Rate (g a.i./kg)	Seedling count (10 seeds)			Seed decay (%)
		Week one	Week two	Week three	
Non-inoculated:					
Non-inoc. CK	-	3.0 a	8.1 a	6.3 c	18.0 a
Inoc. CK	-	4.4 a	6.7 a	6.8 bc	27.0 a
TRIBUNE	0.34	5.6 a	8.0 a	7.5 abc	19.0 a
DFC	0.24	6.0 a	8.6 a	7.8 abc	12.0 a
MAXIM	0.025	5.0 a	8.6 a	8.3 ab	11.0 a
MAXIM	0.05	4.8 a	7.8 a	6.6 bc	22.0 a
APRON XL	0.075	7.8 a	8.0 a	7.3 bc	16.0 a
APRON XL + MAXIM	0.15 + 0.025	6.0 a	7.0 a	7.2 bc	20.0 a
APRON XL	0.15	6.3 a	7.7 a	8.1 ab	16.0 a
APRON MAXX	0.0625	6.1 a	8.9 a	9.2 a	5.0 a
APRON MAXX	0.125	5.0 a	7.8 a	7.3 bc	19.0 a
Fusarium at low concentration (1:100):					
Non-inoc. CK	-	5.2 bcd	5.1 ab	4.8 a	37.0 abc
Inoc. CK	-	3.5 d	3.5 b	2.2 b	58.0 a
TRIBUNE	0.34	4.0 cd	5.7 a	4.3 a	36.0 abc
DFC	0.24	4.5 abc	6.8 a	5.0 a	24.0 c
MAXIM	0.025	5.3 a-d	5.8 a	4.6 a	52.0 ab
MAXIM	0.05	6.9 abc	6.9 a	6.3 a	38.0 abc
APRON XL	0.075	6.2 a-d	6.0 a	5.2 a	37.0 abc
APRON XL + MAXIM	0.15 + 0.025	6.3 a-d	7.2 a	4.7 a	37.0 abc
APRON XL	0.15	8.2 a	6.5 a	6.2 a	30.0 bc
APRON MAXX	0.0625	7.8 ab	7.3 a	6.1 a	41.0 abc
APRON MAXX	0.125	6.5 abc	6.1 a	5.3 a	59.0 a
Fusarium at high concentration (1:20):					
Non-inoc. CK	-	4.3 a	5.6 ab	4.6 abc	42.0 ab
Inoc. CK	-	2.3 a	3.8 bc	2.8 c	56.0 a
TRIBUNE	0.34	3.6 a	6.0 a	4.5 abc	39.0 ab
DFC	0.24	5.3 a	6.5 a	5.9 a	29.0 bc
MAXIM	0.025	2.1 a	4.6 abc	3.6 bc	41.0 ab
MAXIM	0.05	3.2 a	6.0 a	5.2 ab	24.0 bc
APRON XL	0.075	3.3 a	6.1 a	5.2 ab	35.0 abc
APRON XL + MAXIM	0.15 + 0.025	4.3 a	6.1 a	4.8 abc	21.0 bc
APRON XL	0.15	6.0 a	6.3 a	5.8 a	18.0 bc
APRON MAXX	0.0625	3.3 a	3.3 c	2.8 c	32.0 bc
APRON MAXX	0.125	4.4 a	5.2 abc	5.1 ab	15.0 c

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

Table 2. Continued.

Treatment	Rate (g a.i./kg)	Seedling count (10 seeds)			Seed decay (%)
		Week one	Week two	Week three	
Pythium at low concentration (1:100):					
Non-inoc. CK	-	4.6 a	7.4 a	3.7 bc	23.0 d
Inoc. CK	-	2.1 bcd	4.4 cd	1.7 cd	55.0 b
TRIBUNE	0.34	4.4 ab	7.0 ab	6.2 a	28.0 cd
DFC	0.24	0.9 d	4.4 cd	1.7 cd	56.0 b
MAXIM	0.025	0.4 d	5.1 bcd	1.0 d	49.0 bc
MAXIM	0.05	3.3 abc	6.7 abc	4.1 b	29.0 cd
APRON XL	0.075	1.0 cd	4.2 d	1.7 cd	56.0 b
APRON XL + MAXIM	0.15 + 0.025	3.3 abc	5.1 bcd	4.0 b	44.0 bcd
APRON XL	0.15	0.3 d	4.3 d	2.4 bcd	57.0 b
APRON MAXX	0.0625	0.6 d	1.0 e	0.4 d	90.0 b
APRON MAXX	0.125	0.6 d	4.7 cd	3.4 bc	53.0 b
Pythium at high concentration (1:20):					
Non-inoc. CK	-	1.7 cd	4.8 bc	4.0 bc	59.0 ab
Inoc. CK	-	2.0 cd	3.9 cd	2.3 cd	58.0 ab
TRIBUNE	0.34	2.0 cd	5.9 abc	4.1 bc	41.0 bcd
DFC	0.24	4.0 abc	5.9 abc	4.5 abc	36.0 bcd
MAXIM	0.025	2.6 bcd	4.6 bc	3.7 c	46.0 bcd
MAXIM	0.05	3.7 abc	3.8 cd	3.7 c	57.0 ab
APRON XL	0.075	2.0 cd	4.6 bc	3.2 cd	53.0 abc
APRON XL + MAXIM	0.15 + 0.025	5.8 a	7.4 a	6.5 a	22.0 d
APRON XL	0.15	4.9 ab	6.6 ab	6.3 ab	31.0 cd
APRON MAXX	0.0625	1.7 cd	5.7 abc	3.8 c	43.0 bcd
APRON MAXX	0.125	0.6 d	2.0 d	1.3 d	77.0 a
Rhizoctonia at low concentration (1:100):					
Non-inoc. CK	-	0.7 a	3.7 abc	4.2 a	59.0 bc
Inoc. CK	-	1.4 a	0.9 d	0.9 d	85.0 a
TRIBUNE	0.34	2.4 a	4.4 a	3.4 abc	53.0 c
DFC	0.24	1.3 a	2.2 a-d	1.4 cd	76.0 abc
MAXIM	0.025	2.2 a	3.0 a-d	2.4 a-d	62.0 abc
MAXIM	0.05	1.1 a	2.7 a-d	2.4 a-d	71.0 abc
APRON XL	0.075	1.5 a	1.5 cd	1.4 cd	81.0 ab
APRON XL + MAXIM	0.15 + 0.025	2.9 a	3.4 abc	3.3 abc	51.0 c
APRON XL	0.15	1.8 a	1.5 cd	1.9 bcd	76.0 abc
APRON MAXX	0.0625	2.8 a	3.9 abc	3.8 ab	57.0 bc
APRON MAXX	0.125	2.5 a	4.1 ab	2.8 a-d	52.0 c

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

Table 2. Continued.

Treatment	Rate (g a.i./kg)	Seedling count (10 seeds)			Seed decay (%)
		Week one	Week two	Week three	
Rhizoctonia at high concentration (1:20):					
Non-inoc. CK	-	1.7 bcd	3.9 a	1.6 ab	56.0 d
Inoc. CK	-	0.3 cd	0.1 c	0.1 c	97.0 a
TRIBUNE	0.34	4.4 a	3.8 a	2.4 a	56.0 d
DFC	0.24	0.2 d	0.4 c	0.2 c	96.0 ab
MAXIM	0.025	2.0 bcd	1.5 bc	1.3 abc	80.0 abc
MAXIM	0.05	4.3 a	3.1 ab	2.3 a	56.0 d
APRON XL	0.075	0.4 cd	0.3 c	0.2 c	96.0 ab
APRON XL + MAXIM	0.15 + 0.025	2.1 bc	1.8 bc	1.2 abc	78.0 bc
APRON XL	0.15	0.7 cd	0.6 c	0.5 bc	92.0 ab
APRON MAXX	0.0625	1.4 cd	0.6 c	0.3 c	86.0 ab
APRON MAXX	0.125	3.4 ab	2.9 ab	2.2 a	65.0 cd

Means followed by the same letter within a column under each inoculation group are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

2005 PMR REPORT #97

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
ICAR #

CROP: Winter wheat (*Triticum aestivum* L.), cv. several
PEST: Fusarium head blight, *Fusarium graminearum* Schwabe

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TITLE: **SUSCEPTIBILITY OF WINTER WHEAT VARIETIES TO FUSARIUM HEAD BLIGHT (FHB) IN ARTIFICIALLY INOCULATED, MISTEDPLOTS-ONTARIO PERFORMANCE TRIAL**

METHODS: The crop was planted on October 12, 2004 at Ridgetown, Ontario using a 6-row cone seeder at 400 seeds/m^2. Plots were six rows wide, at a row spacing of 17.8 cm and 4 m in length, placed in a randomized block design with four replications. The plots were fertilized and maintained using Ontario provincial recommendations. Each plot was inoculated with a combined suspension of macroconidia of four *F. graminearum* isolates at 50,000 spores/ml, when primary wheat heads were at 50% anthesis for each variety (Zadoks growth stage 65). The suspension was produced in liquid shake culture using modified Bilay's medium. Plots were misted daily beginning after the first plots were inoculated. The mist system was engaged until three days after the last variety was inoculated. The overhead mister produced one 8 second 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 at early dough (ZGS 83). Fifty wheat heads were selected at random out of each plot, and rated for disease incidence and severity using the scoring system developed by Stack and McMullen (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/100. Deoxynivalenol (DON) content was estimated from the three replications with highest mean FHB index using a quantitative fluorometric test-FluoroQuan (Romer® Labs, Inc, Union MO). The number of healthy and Fusarium damaged kernels (FDK) were counted from the same three replications and % of FDK were calculated.

RESULTS: The results are given below.

CONCLUSIONS: Variety 'FT Wonder' had the best overall performance based on ranking position of FHB index, DON level and % of FDK.

Table 1: Fusarium head blight reaction of winter wheat cultivars in *F.graminearum* inoculated and misted plots at Ridgetown, Ontario. 2004-2005.

Cultivar	Incidence (%)	Severity (%)	FHBI (%)	FHBI rank	DON ppm	DON rank	FDK (%)	FDK rank
AC RON	75	31.9	24.8	29	1.2	14	1.9	12
AC MORLEY	55	7.2	4.1	2	0.7	4	1.8	10
SUPERIOR	65	20.6	14.2	12	1.6	20	1.9	13
AC MACKINNON	95	52	49.7	37	1.7	24	1	3
AC MOUNTAIN	55	14.4	8.3	4	0.6	1	0.9	2
MAXINE	75	26.9	20.9	25	2	29	3.5	28
CALEDONIA	75	43.2	32.7	33	2.9	37	4.4	35
WISDOM	52.5	10.6	6	3	1.1	13	2.3	19
PLATINUM	65	14.4	9.7	7	1	8	2.3	20
WHITBY	70	18.7	13.1	10	1.7	26	1.5	5
WEBSTER	65	20.2	13.9	11	2	30	5	36
WARWICK	70	21.4	15.6	15	1.6	19	2.1	17
WARTHOG	62.5	16.5	10.5	9	0.9	6	3.3	25
SISSON	70	28.5	20.1	22	2	31	3.5	29
25R23	80	29	23.5	27	1.6	21	3.4	26
HARVARD	85	36.7	31.4	32	2.2	32	3.6	30
CARLISLE	67.5	21.9	15	14	2.3	34	5.1	37
VIENNA	65	13.8	8.9	5	1	9	2.7	23
FT WONDER	50	7.1	3.8	1	0.6	2	1.4	4
AC SAMPSON	77.5	30.5	24.9	30	2.5	36	4.3	34
TW060:075	72.5	29.6	20.8	23	2.5	35	2.3	18
25R47	87.5	45.3	40.8	35	1.5	18	1.6	7
RC STRATEGY	77.5	23.8	19.1	20	0.8	5	2.8	24
OTF013:081	70	14	10.1	8	1	10	2.1	14
TWF020:038	67.5	13.8	9.4	6	0.9	7	0.9	1
25W41	75	32.3	25	31	2.3	33	2.1	16
TRIBUTE	70	28.4	20.9	24	1.1	12	2.5	22
GENESIS-D8006	85	45.1	38.9	34	1.6	22	3.4	27
TW044:094	70	21.4	16.5	18	0.7	3	3.6	31
TW0122:001	77.5	19.8	15.9	16	1	11	1.7	8
HONDO	70	20.4	15.9	17	1.3	15	1.5	6
PRC0111	80	28.9	24.7	28	1.8	27	3.7	32
GENESIS	65	20	14.8	13	1.7	25	1.7	9
GENESIS:E1007	75	30.6	23.2	26	1.9	28	2.1	15
GENESIS:R045	77.5	25.1	19.6	21	1.5	17	3.7	33
IL98:5278	72.5	22.9	17.2	19	1.7	23	1.8	11
VAN00W:186	90	52.2	46.9	36	1.4	16	2.4	21
LSD (*P*=.05)	17.3	12.7	12.9		1		2.5	
CV	17.2	35.6	46.6		39.3		60.2	
Grand Mean	71.8	25.4	19.7		1.5		2.6	

2005 PMR REPORT #98

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
ICAR :

CROP: Winter wheat (*Triticum aestivum* L.), cv. several
PEST: Fusarium head blight, *Fusarium graminearum* Schwabe

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TITLE: **NUWWSN TEST- EVALUATION OF WINTER WHEAT CULTIVARS AND BREEDING LINES FOR RESISTANCE TO FUSARIUM HEAD BLIGHT (FHB) IN ARTIFICIALLY INOCULATED, MISTED PLOTS**

METHODS: The crop was planted on October 19, 2004 at Ridgetown, Ontario using a 8-row cone seeder at 270 seeds/plot. The cultivars and breeding lines represent NUWWSN (Northern Uniform Winter Wheat Scab Nursery) test established across North America. Plots were single rows, planted 4 m in length, and placed in a randomized block design with four replications. The plots were fertilized and maintained using Ontario provincial recommendations. Each plot was inoculated with a combined suspension of macroconidia of four *F. graminearum* isolates at 50,000 spores/ml, when primary wheat heads were at 50% anthesis for each variety (Zadoks growth stage 65). The suspension was produced in liquid shake culture using modified Bilay's medium. Plots were misted daily beginning after the first plots were inoculated. The overhead mister produced one 8 second burst every minute from 10:00 to 16:00 h each day, delivering about 7.5 mm of water daily. The mist system was engaged until three days after the last variety was inoculated. Each variety was assessed for visual symptoms at early dough (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/100.

RESULTS: The results are given in the Table 1.

CONCLUSIONS: Variety 'Ernie' had the lowest (4.8%), while variety 'Pioneer 2545' had the highest (45.0%) FHB index, with a number of cultivars and lines exhibiting good potential resistance levels. There was a statistical significant correlation between FHB index and severity (r=0.99) and between FHB index and incidence (r=0.90). Correlation between FHB index and heading date was positive (r=0.45, P= 0.0013). Line RCATL31 was the most resistant line among those from the Ridgetown breeding program.

Table 1: Heading date, height and Fusarium head blight reaction of winter wheat cultivars and breeding lines in inoculated and misted plots at Ridgetown, Ontario.
2004-2005.

Variety	Heading date	Height (inches)	Severity (%)	Incidence (%)	FHBI (%)
ERNIE	154*	32	8.1	52.5	4.8
TRUMAN	158	35	27.4	70.0	20.6
FREEDOM	158	36	32.4	82.5	27.9
PIONEER 2545	155	34	60.0	75.0	45.0
P.981238A1-11-3W	154	31	12.0	57.5	7.1
P.981517A1-1-5-2	154	34	11.4	52.5	6.1
P.981542A1-10-4-5-6	154	30	43.1	82.5	36.1
P.9824C1-26-2	154	33	30.1	75.0	23.0
P.99794RA4-14-10	154	31	19.9	65.0	13.7
E0001	157	36	23.6	67.5	17.0
E2017	158	37	41.9	77.5	33.1
E2042	158	37	15.4	55.0	9.1
E2043	158	36	30.0	75.0	24.3
E3012	158	36	27.9	72.5	21.8
IL00-1665	157	35	36.3	82.5	31.2
IL00-8061	154	38	13.0	60.0	8.4
IL00-8530	154	36	29.1	77.5	23.2
IL01-15511	154	33	25.5	72.5	19.7
IL01-5943	155	37	17.8	67.5	12.0
KS01HW163-4	155	34	32.1	72.5	24.1
KS950910-8-2	154	33	19.8	67.5	13.4
KY93C-0378-5-2	156	33	30.1	80.0	24.2
KY96C-0399-5	154	35	15.3	60.0	9.5
KY96C-0769-7-1	155	35	20.0	67.5	13.7
KY97C-0304-16	155	34	10.5	52.5	5.8
KY97C-0574-01	155	34	26.0	65.0	17.4
MV-5-46	155	32	48.1	90.0	44.0
NE01643	157	36	19.1	70.0	14.6
NE02465	154	37	14.0	62.5	9.1
NE02495	154	36	20.0	62.5	12.8
NE02549	156	35	19.9	57.5	13.3
NE02588	154	36	14.0	62.5	9.4
NY91017-8080	158	34	24.9	72.5	18.4
NY91028-7085	158	37	49.5	90.0	44.7
OH01-75	154	36	32.1	75.0	24.6
OH01-7664	156	36	12.4	62.5	8.2
OH902	156	39	23.0	65.0	16.0
OH903	156	40	17.9	62.5	11.9
OH904	157	41	19.9	60.0	12.7
RCAT13/18	157	40	33.1	67.5	23.4
RCAT23/1	158	42	20.8	62.5	13.9
RCATL24	158	42	24.5	67.5	18.6
RCATL28	157	48	20.5	70.0	14.9
RCATL31	154	45	12.0	52.5	7.5
VA01W-99	155	33	21.5	65.0	14.3
VA04W-439	154	35	25.8	65.0	17.7
VA04W-474	155	33	13.9	57.5	8.3
VA04W-561	155	33	37.0	82.5	30.5
VA04W-568	155	33	35.0	77.5	27.6
Grand mean	156	36	24.3	68.3	18.1
LSD (*P*=0.05)	1.1	1.4	13.5	17.2	13.0
CV	0.5	2.9	39.8	18.0	51.4

* Jan 1=1

2005 PMR REPORT #99

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
STUDY DATA BASE: 303-1212-8907

CROP: Wheat, cv. Superb
PEST: Septoria leaf blotch, *Stagonospora nodorum*
Fusarium head blight, *Fusarium graminearum*

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TITLE: **EFFICACY OF FUNGICIDE SEED TREATMENTS ON CONTROL OF SEPTORIA LEAF BLOTCH AND FUSARIUM HEAD BLIGHT, AND ON YIELD OF SPRING WHEAT, 2005**

MATERIALS: RAXIL T FS (tebuconazole 6.6 g ai/L thiram 222 g ai/L), G7087-00 (mancozeb 6.2 g ai/L, tebuconazole 3.1 g ai/L, prothioconazole 15.4 g ai/L), DIVIDEND XL RTA (difenoconazole 3.64% w:w, metalaxyl 0.27% w:w), L1397-A1 (tebuconazole 3.1 g ai/L, metalaxyl 6.2 g ai/L, prothioconazole 15.4 g ai/L), RAXIL MD (tebuconazole 5 g ai/L, metalaxyl 6.2 g ai/L), GEMINI (triticonazole 14 g ai/L, thiram 140 g ai/L) and VITAFLO 280 (carbathiin 169.6 g ai/L, thiram 150.6 g ai/L)

METHODS: Spring wheat seed, cv Superb, was treated and supplied by Bayer CropScience. Plots were established on May 16, 2005, at a seeding rate of 350 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 barley 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 22nd. At seeding a solid phase *Fusarium* inoculum was added with the seed at planting, except the untreated uninfected control treatment.

Emergence counts were taken on 2 x 1m of row prior to tillering. Septoria leaf blotch was rated on July 29, ZGS 77, on the 3rd and 4th leaves of ten randomly selected tillers per plot, using the Horsfall and Barratt Rating System. Fusarium head blight (FHB) was based on the FHB index which was derived by the product of the incidence of infected heads (0-10, where 0 = disease free) and the severity on infected heads (0-10, where 10 = totally diseased head), and on % fusarium damaged kernels (FDK). DON (deoxynivalenol) was determined via ELISA analysis, using Neogen Veratox 5/5 kits. The entire plot area was harvested, on September 3rd, using a small plot combine, and yield and thousand kernel weight were determined.

RESULTS: Results are contained in Table 1. The addition of *Fusarium* inoculum, with the seed, had a profound effect on emergence, reducing emergence from 46.8 plants/m in the absence of inoculum to 19.5 plants/m row with inoculum. The use of seed treatments had a positive effect in increasing emergence in the presence of inoculum, resulting in many cases of emergence levels equivalent to the emergence level where no inoculum was applied. G7087-00 and DIVIDEND XL RTA were the most effective. VITAFLO 280 significantly improved emergence compared to the inoculated untreated control, but not to the level associated with the untreated control with no inoculum.

There was no significant effect of any treatment on septoria leaf blotch, or fusarium head blight index, FDK or DON. There was no loose smut (*Ustilago tritici*) in any plot. There was a notable increase in the number of spikes per row, although only one replication was counted. There was an 8% reduction in yield from the addition of *Fusarium* inoculum, of 8%, although this was not significant. Several seed treatments resulted in a significant increase in yield, over the inoculated control.

CONCLUSIONS: *Fusarium* inoculum had a significant impact on emergence, and some treatments reversed this effect. There was no impact of any seed treatment on either septoria leaf blotch or fusarium head blight (as measured by FHB index, FDK or DON). The lack of any difference between fusarium head blight in either the inoculuated or uninoculated control was an indication of either a lack of an effect from seedling *Fusarium* activity (damping off and root rot) and fusarium head blight, or the level of natural airborne inoculum and subsequent infection were high enough to overwhelm any fusarium head blight reduction that may have been derived from the seed treatments. It was evident that the use of seed treatments was a valid method for reducing the impact of soil borne *Fusarium* inoculum.

From a yield perspective, G7087.00, DIVIDEND XL RTA, RAXIL MD and L1397-A1 were the most effective when compared with the inoculated control, with a maximum increase of 15.2%, over the inoculated control.

Table 1: Influence of fungicide seed treatments on spring wheat, cv. Superb, Charlottetown, PEI, 2005

Treatment	Rate*	Emergence	Septoria 4th leaf ZGS 77	Heads per row**	Fusarium head blight Index	DON	Yield	1000 kwt
		(plants/m)	(%)	(#)	(0-100)	(ppm)	(Kg/ha)	(g)
Uninoculated Untreated Control		46.8	71	367	61.5	2.7	2894	36.9
Inoculated Untreated Control		19.5	66	690	59.5	2.3	2663	34.3
RAXIL T FS	2.25	36.3	63	321	52.5	2.1	2776	35.9
G7087-00	3.25	53.1	74	505	54	2.6	3068	36.8
DIVIDEND XL RTA	3.25	49.6	78	351	58.5	3.3	3057	36.8
L1397-A1	3.25	46.4	71	400	48.5	2.3	3006	36.4
RAXIL MD	3	46.2	83	351	53.8	2	3026	33.6
GEMINI	3.6	37	68	290	47.3	1.8	2806	32.9
VITAFLO 280	3.3	32.8	69	404	59	2.2	2740	34.4
LSD (0.05)		9.88	ns		ns	ns	269.9	ns
SEM		3.41	7		4.77	0.402	92.5	3.01

* ml product/kg seed; plus each seed treatment was accompanied by inoculum
** one replication only
ns = no significant difference at p=0.05

2004 PMR REPORT #100

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
STUDY DATA BASE: 303-1212-8907

CROP: Wheat, cv. AC Taber
PEST: Septoria leaf blotch, *Stagonospora nodorum*
Loose smut, *Ustilago tritici*
Fusarium head blight, *Fusarium graminearum*

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TITLE: **EFFICACY OF FUNGICIDE SEED TREATMENTS ON CONTROL OF LOOSE SMUT AND FUSARIUM HEAD BLIGHT, AND ON YIELD OF SPRING WHEAT, 2005**

MATERIALS: RAXIL T FS (tebuconazole 6.6 g ai/L thiram 222 g ai/L), G7087-00 (mancozeb 6.2 g ai/L, tebuconazole 3.1 g ai/L, prothioconazole 15.4 g ai/L)

METHODS: Spring wheat seed, cv AC Taber, was treated and supplied by Bayer CropScience. Plots were established on May 16, 2005, at a seeding rate of 300 viable seeds per m^2. Each plot was 5 rows wide, five metres long and 15.6 cm between rows. Between each treatment plot was an equal sized barley 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 22nd.

Emergence was taken on 2x1m of row prior to tillering. Septoria leaf blotch was rated on July 29, ZGS 83, on the penultimate and 3rd leaves of ten randomly selected tillers per plot, using the Horsfall and Barratt Rating System. The total number of smutted heads per plot and number of heads in one row was determined. Fusarium head blight was assessed based on the FHB index which was derived by product of the incidence of infected heads (0-10, where 0 = disease free) and the severity on infected heads (0-10, where 10 = totally diseased head). The entire plot area was harvested, on September 3rd, using a small plot combine, and yield and thousand kernel weight determined.

RESULTS: Results are contained in Table 1. There was no significant effect of treatment on emergence. Loose smut levels were to low for any meaningful measure of the effect of the seed treatments. Seed treatment had no effect on the reduction of either septoria leaf blotch or of fusarium head blight. There was a significant increase in the number of heads, with G7087-00 treatment resulting in a 21.5% increase. Similarly there was a significant increase in yield from both seed treatments.

CONCLUSIONS: While there was no significant effect on either septoria leaf blotch or fusarium head blight, there was a significant yield advantage from both RAXIL T FS and G7087-00, 21.3% and 18.0% increases respectively. There was a significant correlation between emergence and heads per row (p=0.05), as well as a significant correlation between heads per row and yield (p=0.01). Since there were no significant effects on 1000 kernel weights it would appear that the yield response was based on an increase in heads as opposed to changes in seed size.

Table 1: Influence of fungicide seed treatments on loose smut of spring wheat, cv. AC Taber, Charlottetown, PEI, 2005

Treatment	Rate*	Emergence	Smut per Plot	Heads per row	Fusarium head blight Index	Yield	1000 kwt
		(plants/m)	(#)	(#)	(0-100)	(Kg/ha)	(g)
Untreated Control	0	37.6	1.5	217	33.5	2336	34
RAXIL T FS	2.25	41	0	239.5	33.8	2833	33.5
G7087-00	3.25	49.8	0	263.8	34.5	2756	36
LSD (0.05)		ns	ns	18.28	ns	309.1	ns
SEM		3.86	0.5	5.28	2.27	89.3	1.94

* ml product/kg seed
ns = no significant difference at p=0.05

2005 PMR REPORT #101

SECTION O: CEREAL, FORAGE CROPS, and OILSEEDS - Insects
ICAR: 61006537

CROP: Winter wheat, (*Triticum* spp. L.), cv Wisdom, P25R47
PEST: Leaf diseases, black point (*Alternaria* spp.) and fusarium head blight (*Fusarium graminearum).*

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TITLE: CONTROL OF DISEASES AND FHB ON WINTER WHEAT WITH FOLIAR TREATMENTS

MATERIALS: BAS 55501 90 SL (Exp); FOLICUR 432 SC (tebuconazole, 432 g ai/L); PROLINE 480 SC (prothioconazole, 480 g ai/L).

METHODS: Wheat variety Wisdom was planted on a conventional till site on 26 Oct, 2004 at Ridgetown using a John Deere Conventional Drill at a seeding rate of 4 m seeds/ha. Wheat variety P25R47 was planted on a no-till site on 2 Oct, 2004 at London, ON using a JD 750 planter at a seeding rate as above. Plots were staked in areas 3 m wide by 15 m long in RCBD with 3 replications. Plots were fertilized and maintained according to provincial recommendations.
Corn inoculum was spread in the centre of each plot on 30 May, 2005 at Ridgetown, ON only in a 2 m by 8 m area. The inoculum was prepared by soaking 1 kg corn in 600 ml distilled water for 2 hours in plastic 4 L loosely capped bottles, pouring off excess water and autoclaving the bottles for 30 min. Corn was mixed by shaking the bottle to loosen the kernels and then allowed to stand at room temperature for 2 days. The corn was mixed again and the bottles were autoclaved a second time for 30 min. Corn was allowed to cool overnight, shaken again and then inoculated with 4-5 small plugs of 2 strains of *Fusarium graminearum* growing on Potato Dextrose Agar (PDA). The loosely capped bottles were laid on their side and incubated at room temperature under fluorescent light banks for 2 weeks, shaking the bottles every 2 days until corn was fully infected with the fungus. Inoculum was spread by hand at a rate of 1 kg/mini-plot with a broadcast spreader.

Fungicides were applied by a custom-designed, self-propelled sprayer, equipped with a boom fitted with three, paired nozzles of Turbo TeeJet^{U} TT110015-VP spray tips (Spraying Systems Co.) in double-swivel nozzle holders spaced 50-cm apart. One nozzle in each pair was adjusted on the swivel to spray forward in the direction of travel, and the other was adjusted to spray backward. The sprayer was calibrated to deliver 175 L ha^{-1} of spray solution, using CO_2-pressurized canisters. Plots were sprayed at 40% flower (Zadoks growth stage 65) on 8 June, 2005 at Ridgetown at 40 psi pressure with 1.5 m boom width, 1.0 m boom length at a forward speed of 6.7 kph. In London, plots were sprayed as above, at Zadoks growth stage 65, on 10 June, 2005. The stay green assessments (a visual assessment of whole plots to compare fungicide sprayed plots with untreated control plots for their ability to stay green longer) were done at both locations right before senescence. Plots (1.5 m by 8 m) were harvested on 28 July, 2005 at Ridgetown and plots (1.5 m by 15 m) on 25 July, 2005 at London and yields were converted to 14.5% moisture. Black point assessments were done using sub samples from each harvested treatment from Ridgetown. Seeds with a black discoloration of the embryo (germ) and surrounding areas of the kernel considered to be damaged and assessed on a %wt/wt basis. Deoxynivalenol (DON) analysis was performed using the Romer^{U} FluoroQuant™ method. Data were analysed using analysis of variance and means were separated using least significant differences (LSD) at $P = 0.05$.

RESULTS: Tables 1 and 2.

CONCLUSIONS: There were no significant differences between the fungicides sprayed and the untreated control for % stay green plants (75% of the plant tissue was green in both sprayed and non-sprayed plots), DON level or black point in Ridgetown (Table 1), or for % stay green plants, DON level or yield in London (Table 2). However, yield (T/ha) was significantly higher in Ridgetown following application of the fungicides (Table 1). Fungicides increased wheat grain yields in Ridgetown by an average of 0.3 T/ha or 12%. It is important to note that different wheat varieties were used at Ridgetown (Wisdom) and London (P25R47) and that a response of variety to fungicides could explain increased yield at the first location, but not at the second one. We assume that the fungicides did not reduce DON level as expected because the plots were not irrigated and the natural conditions between flowering and grain maturity was very dry and not conducive to fusarium head blight development. In addition, very high temperatures were recorded during the wheat flowering and inoculation. No leaf or head diseases other than *Alternaria* were observed. However, *Alternaria* was a serious problem and not mitigated by fungicide application.

Table 1. Stay green, yield, DON and blackpoint assessments in winter wheat at Ridgetown, ON. 2005

Treatment	Rate g ai/ha	Stay green	Yield T/ha	DON ppm**	Black % w/w**
UNTREATED		75	2.2 b *	0.3	7.6
BAS 55501 90 SL	0.03	75	2.5 a	0.2	4.2
BAS 55501 90 SL	0.06	75	2.5 a	0.1	4.7
BAS 55501 90 SL	0.09	75	2.5 a	0.3	4.2
BAS 55501 90 SL	0.18	75	2.4 a	0.1	3.7
FOLICUR 3.6 F 432 SC	0.125	75	2.5 a	0.2	5
PROLINE 480 SC	0.175	75	2.6 a	0.1	4.3
FOLICUR 3.6 F 432 SC	0.1	75	2.6 a	0.3	4.7
+PROLINE 480 SC	0.1				
FOLICUR 3.6 F 432 SC	0.125	75	2.5 a	0.3	5
+PROLINE 480 SC	0.125				
CV		0	3.4	91.9	29.4

* Means followed by same letter do not significantly differ (*P*= 0.05, LSD).
** no significant differences (P=0.05)

Table 2. Stay green, yield and DON assessments in winter wheat at London, ON, 2005

Treatment	Rate g ai/ha	Stay green (%)	Yield T/ha **	DON ppm **
Untreated		50	4.4	0.7
BAS 55501 90 SL	0.03	50	4.6	0.7
BAS 55501 90 SL	0.06	50	4.6	0.7
BAS 55501 90 SL	0.09	50	4.6	0.7
BAS 55501 90 SL	0.18	50	4.6	0.5
FOLICUR 3.6 F 432 SC	0.125	50	4.7	0.6
PROLINE 480 SC	0.175	50	4.5	0.8
FOLICUR 3.6 F 432 SC	0.1	50	4.8	0.5
+PROLINE 480 SC	0.1			
FOLICUR 3.6 F 432 SC	0.125	50	4.7	0.5
+PROLINE 480 SC	0.125			
CV		0	3.9	23.6

** no significant differences (*P*=0.05)

2005 PMR REPORT #102

SECTION O: CEREALS, FORAGE CROPS and OILSEEDS - Diseases
ICAR: 61009653

CROP: Wheat (*Triticum aestivum* L.), cv. AC Superb
PEST: Septoria leaf blotch (*Septoria tritici* Roberge.); Tan spot (*Pyrenophora tritici-repentis* (Died.) Drechs.)

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TITLE: **GREENHOUSE ASSESSMENT OF FUNGICIDAL FOLIAR TREATMENTS FOR THE CONTROL OF SEPTORIA LEAF BLOTCH AND TAN SPOT OF SPRING WHEAT IN ALBERTA IN 2005**

MATERIALS: QUILT 200SC (azoxystrobin, 7.0% SC, propiconazole, 11.7% SC), STRATEGO 250EC (propiconazole + CGA-279202, 125 + 125 g/L EC), QUADRIS 250SC (azoxystrobin, 250 g/L SC), and TILT 250EC (propiconazole, 250 g/L EC).

METHODS: Experiments were established in August, 2005 in a greenhouse at the Alberta Research Council facility at Vegreville, AB. Seed of the hard red spring wheat cv. AC Superb was seeded into 450 mL plastic Tuffcups (Georgia-Pacific, Dixie Business, Norwalk, CT), which were filled with steam-pasteurized soil mix (1:1, loam: peat moss). Ten seeds were seeded in each cup. The experiments employed a randomized complete block design with one cup of each treatment per replicate, and five replicates per treatment. Spore suspensions (in 0.05% Tween 80) of *Septoria tritici* or *Pyrenophora tritici-repentis* were sprayed onto all treatments at the flag leaf stage, and inoculated plants were maintained in darkness and high humidity for 72 h before the foliar fungicide treatments were applied. The foliar fungicide spray treatments included QUILT 200SC at 75, 100, 150 and 200 g ai/ha, STRATEGO 250EC at 125 g ai/ha, QUADRIS 250SC at 28, 38, 56 and 75 g ai/ha, and TILT 250EC at 94 and 125 g ai/ha. All spray treatments were applied in 200 L/ha water and all area measurements were based on the soil surface area within the plastic Tuffcups. The control consisted of an inoculated, non-fungicide treatment. Disease incidence (% of plants infected) and severity (0 – 9, where 0 = no disease and 9 ≥ 90% of leaf area diseased over the whole cup) were assessed once a week for three weeks, beginning two weeks after application of foliar fungicide. Phytotoxicity was also assessed. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS 9.1) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Disease incidence and severity were significantly ($P \leq 0.05$) affected by all of the fungicide treatments for both diseases (Tables 1 and 2), and there was no phytotoxicity observed in the experiments.

The best disease control was observed in the treatments with QUADRIS 250SC. TILT 250EC and STRATEGO 250EC also partially controlled septoria leaf blotch, but TILT 250EC at the low rate did not significantly suppress disease severity levels (Table 1). The efficacy of QUILT 200SC against leaf blotch increased with application rate. Statistically significant control was only observed at higher rates (150 – 200 g ai/ha) of this product.
All four fungicides helped control tan spot in the experiments, but QUADRIS 250SC had the lowest disease incidence and severity (Table 2). The efficacy of QUILT 200SC and TILT 250EC against tan spot increased with increasing application rate.

CONCLUSIONS: QUADRIS 250SC and STRATEGO 250EC were the most effective fungicides for controlling septoria leaf blotch. QUILT 200SC and TILT 250EC were more effective at higher application rates. QUADRIS 250SC, STRATEGO 250EC, QUILT 200SC and TILT 250EC provided very good to moderate control of tan spot. QUILT 200SC and TILT 250EC needed higher application rates to ensure effective control.

Table 1. Effects of fungicidal foliar treatments on the control of septoria leaf blotch on the spring wheat cv. AC Superb in greenhouse experiments conducted at Vegreville, AB in 2005.

Treatment	Rate (g ai/ha)	Disease incidence (%)			Disease severity (0 – 9)		
		2nd week*	3rd week	4th week	2nd week	3rd week	4th week
Non-treated	-	57.0 a	63.0 a	79.0 a	1.8 ab	2.2 a	2.8 a
QUILT 200SC	75	58.0 a	64.0 a	71.0 b	1.8 ab	1.8 abc	2.4 ab
QUILT 200SC	100	56.0 a	65.0 a	67.0 b	2.0 b	2.0 ab	2.2 ab
QUILT 200SC	150	44.0 b	47.0 bc	57.0 c	1.4 bc	1.6 bc	2.0 bc
QUILT 200SC	200	29.0 c	40.0 cd	48.0 d	1.0 c	1.0 d	1.4 d
STRATEGO 250EC	125	35.0 bc	36.0 d	39.0 e	1.0 c	1.0 d	1.0 d
QUADRIS 250SC	28	13.0 d	27.0 e	28.0 f	1.0 c	1.0 d	1.2 d
QUADRIS 250SC	38	11.0 d	20.0 e	21.0 f	1.0 c	1.0 d	1.0 d
QUADRIS 250SC	56	13.0 d	23.0 e	24.0 f	1.0 c	1.0 d	1.0 d
QUADRIS 250SC	75	16.0 d	23.0 e	25.0 f	1.0 c	1.0 d	1.2 d
TILT 250EC	94	43.0 b	50.0 b	55.0 cd	2.0 a	2.0 a	2.4 ab
TILT 250EC	125	35.0 bc	46.0 bc	48.0 d	1.4 bc	1.4 cd	1.6 cd

Values are the means of the five replicates in each of 20 leaves were examined. Means followed by the same letter within a column are not significantly different ($P \leq 0.05$) according to Duncan's New Multiple Range Test.

* After fungicide application

Table 2. Effects of fungicidal foliar treatments on the control of tan spot on the spring wheat cv. AC Superb in greenhouse experiments conducted at Vegreville, AB in 2005.

Treatment	Rate (g ai/ha)	Disease incidence (%)			Disease severity (0 – 9)		
		2nd week*	3rd week	4th week	2nd week	3rd week	4th week
Non-treated	-	75.0 a	88.0 a	92.0 a	2.6 a	3.0 a	3.2 a
QUILT 200SC	75	40.0 b	63.0 b	67.0 b	1.8 b	1.8 c	2.0 bc
QUILT 200SC	100	43.0 b	56.0 bc	59.0 c	1.8 b	2.0 bc	2.2 b
QUILT 200SC	150	42.0 b	55.0 bc	64.0 bc	1.8 b	2.4 b	2.4 b
QUILT 200SC	200	35.0 bc	37.0 e	46.0 d	1.2 bcd	1.2 d	1.4 d
STRATEGO 250EC	125	28.0 cd	37.0 e	45.0 d	1.0 cd	1.0 d	1.0 d
QUADRIS 250SC	28	11.0 e	18.0 fg	24.0 e	1.0 cd	1.0 d	1.0 d
QUADRIS 250SC	38	9.0 e	19.0 f	24.0 e	1.0 cd	1.0 d	1.0 d
QUADRIS 250SC	56	7.0 e	10.0 g	24.0 e	0.8 d	1.0 d	1.0 d
QUADRIS 250SC	75	8.0 e	15.0 fg	21.0 e	1.0 cd	1.0 d	1.2 d
TILT 250EC	94	21.0 d	49.0 cd	55.0 d	1.6 bc	1.6 cd	1.6 cd
TILT 250EC	125	11.0 e	46.0 d	47.0 d	1.0 cd	1.2 d	1.2 d

* After fungicide application

2005 PMR REPORT #103

SECTION P: ORNAMENTALS, GREENHOUSE CROPSand TURF – Diseases
ICAR: 33330998

CROP: Wintergreen (*Gaultheria procumbens* L.)
PEST: Anthracnose (*Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc.in Penz.)

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TITLE: LESION DEVELOPMENT AND EFFICACY OF CHEMICAL AND BIOLOGICAL FUNGICIDES FOR CONTROL OF ANTHRACNOSE OF WINTERGREEN, 2002

MATERIALS: BAS 516 (pyraclostrobin + boscalid 38%), DACONIL 2787 F (chlorothalonil 40.4%), Hydrogen peroxide 3%, MYCOSTOP (*Streptomyces griseoviridis*), PRESTOP WP (*Gliocladium catenulatum*), TOPAS 250 E (propiconazole 250 g/L), SENATOR 70 WP (thiophanate-methyl)

METHODS: The trial was conducted at the British Columbia Ministry of Agriculture, Food and Fisheries (BCMAFF) Centre for Agricultural Research and Development Site (CARDS) greenhouse in Abbotsford, British Columbia. Plants were seeded in 72-cell plug flats in a commercial potting mix in a commercial nursery greenhouse on May 6 and taken to the BCMAFF greenhouse on August 1st. Each cell typically contained 3 to 8 seedlings. Eighteen flats were divided in half to obtain 4 half-flats per treatment. Using a hand-atomizer, 16 half-flats were sprayed with 400 mL (25 mL each) of a 10^8 c.f.u./mL mycelial and spore suspension of *Collectotrichum gloeosporioides* isolated from diseased nursery plants and covered with black plastic for 24 hours after inoculation. Flats were placed in solid trays with water and received daily overhead misting for 2 minutes. There were 4 half-flats per treatment in a randomized complete block design with 4 replicates per treatment. Treatments were applied 24 hours after each inoculation with a hand atomizer in 90 mL water per replicate. Plants were inoculated and treated three times: at 17 weeks (Aug. 29), 19 weeks (Sept. 12) and 21 weeks after seeding (Sept. 26). Greenhouse temperature was 28 - 30°C day and 22°C night for the first two inoculations. Day temperature was reduced to 22°C for the third inoculation. Disease incidence was calculated by counting the number of seedlings with stem or petiole lesions at 14 days after inoculation versus the total number of seedlings per half-flat and expressed as a percentage of diseased seedlings. Data was analysed with the general linear models procedure (JMP 5.0.1, SAS Institute, Cary, NC) and means were compared using Tukey-Kramer HSD at P=0.05.

RESULTS: No disease lesions developed after 14 days in inoculated check flats at daytime greenhouse temperatures of 28 - 30°C and night temperatures of 22°C. When daytime temperature was reduced to 22°C before the third inoculation, stem and petiole lesions developed on inoculated check plants within 10 days. Data from the third inoculation and treatment on Sept. 21st is presented in Table 1. A few seedlings in the non-inoculated check became diseased over the course of the trial, probably as a result of inoculum transmission from nearby inoculated flats.

CONCLUSIONS: Anthracnose lesion development was inhibited at day temperatures of 28 - 30°C but progressed quickly when day temperature was reduced to 22°C. SENATOR 70 WP and TOPAS 250 E significantly reduced the percentage of infected seedlings. Both treatments left some visible residue on leaves. BAS 516 provided excellent control of the disease with no phytotoxicity and no visible residue.

Table 1: Mean percentage of wintergreen (*Gaultheria procumbens*) seedlings per treatment with symptoms of anthracnose disease after inoculation with *Colletotrichum gloeosporiodes* at 21 weeks after seeding.

Treatment	Rate of Product/L	Mean No. of Seedlings	Mean % Diseased Seedlings[1]
Non-inoculated check	-	136	5.9 a
Inoculated check	-	187	90.5 e
BAS 516	0.15 g	215	11.2 a
TOPAS 250 E[2]	0.18 mL	168	24.5 b
SENATOR 70 WP	0.75 g	200	26.7 bc
DACONIL 2787 F	2.5 mL	184	46.7 cd
PRESTOP WP	10.0 g	179	67.7 d
MYCOSTOP	1.0 g	179	86.7 e
Hydrogen peroxide 3%	1 mL	177	91.6 e

[1] Values are the means of four replications. Numbers within the same column followed by the same letter are not significantly different in Tukey-Kramer HSD at P=0.05.

[2] Equivalent to 0.34 mL/L BANNER 130EC.