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SECTION A: TREE FRUIT AND BERRY CROPS /ARBRES FRUITIERES ET PETITS FRUITS

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EDITORS

A. Tree Fruits **J. Mike Hardman** Email:hardmanm@em.agr.ca
Agriculture and Agri-Food Canada Tel: (902) 679-5730
Atlantic Food & Horticulture Research Centre Fax: (902) 679-2311
32 Main Street, Kentville, Nova Scotia B4N 1J5

A Berry Crops **Dr. Bruce Neill** Email: pf21801@em.agr.ca
PFRA Shelterbelt Centre Tel: 306) 695-2284
Agriculture and Agri-Food Canada Fax: (306) 695-2568

Indian Head, Saskatchewan S0G 2K0

1998 PMR REPORT # 1 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 9207

CROP: Apple cv. Jonagold

PEST: Fruittree leafroller, *Archips argyrospilus*
European leafroller, *Archips rosanus*
Eyespotted budmoth, *Spilonota ocellana*
Apple-and-thorn skeletonizer, *Choreutis pariana*

NAME and AGENCY:
COSSENTINE JE, AND JENSEN LBM
Agriculture and Agri-Food Canada,
Pacific Agri-Food Research Centre, Summerland, B.C. V0H 1Z0
E-mail:COSSENTINEJ@EM.AGR.CA, JENSENLB@EM.AGR.CA
Tel:250-494-7711 Fax:250-494-0755

TITLE: **EFFICACY OF SPINOSAD TO CONTROL SPRING LEAFROLLERS AT FULL BLOOM AND PETAL FALL**

MATERIALS: SPINOSAD (NAF85), DIPEL (16 000 BIU/kg *Bacillus thuringiensis* var. *kurstaki*)

METHODS: Treatments were applied to groups of 24-28 Jonagold apple trees laid out in a randomized block design, replicated twice. Two treatments, 125 g ai SPINOSAD /ha and 3.3 kg DIPEL/ha, were applied at full bloom (May 5). Treatments of 125 and 175 g ai SPINOSAD /ha and 3.3 kg DIPEL/ha were applied at petalfall (May 12). Ten cluster samples from each of 10 central trees from each treatment were collected one day prior to each treatment as well as three and 10 days post-application. All samples were inspected under a dissecting microscope and the number of leafrollers, eyespotted budmoth and apple-and-thorn skeletonizers determined. All apples were removed from each of the 10 central trees of each treatment on June 23rd and leafroller damage was assessed visually.

RESULTS: The SPINOSAD treatment at full bloom significantly ($P<0.05$) reduced the mean number of leafrollers and eyespotted budmoth found per cluster three days after treatment, however at 10 days post-treatment these reductions were not significantly ($P>0.05$) less than the numbers found in the control treatments (Table 1). Both SPINOSAD treatment levels and the DIPEL reduced the number of leafroller found per cluster three and 10 days post-treatment at petal fall, however the means were not significantly less than those found in the control (Table 1). The mean numbers of apple-and-thorn skeletonizer per cluster were significantly ($P<0.05$) reduced by all three treatments assessed three and 10 days after the petal fall treatments (Table 1). All treatments significantly ($P<0.05$) reduced the mean percentage of leafroller damaged apples (Table 2).

CONCLUSION: Both doses of SPINOSAD and the DIPEL reduced leafroller damage to apples. The Spinosad treatment at full bloom reduced eyespotted budmoth larvae in the blossom clusters. All three treatments applied at petal fall reduced the number of apple-and-thorn skeletonizer larvae.

Table 1. Mean number of leafroller, eyespotted budmoth and apple-and-thorn leaf skeletonizer larvae per cluster (sd).

Treatment	leafrollers	eyespotted budmoth	apple-and-thorn leaf skeletonizer
May 4: Pre-full bloom treatments			
SPINOSAD 125 g ai/ha	0.38 (0.08) a*	0.11 (0.09) a	0.00 (0.00) a
DIPEL	0.52 (0.42) a	0.09 (0.13) a	0.01 (0.01) a
Control	0.34 (0.26) a	0.10 (0.06) a	0.00 (0.00) a
3-days post-full bloom treatments			
SPINOSAD 125 g ai/ha	0.02 (0.01) a	0.01 (0.01) a	0.00 (0.00) a
DIPEL	0.17 (0.04) ab	0.06 (0.04) ab	0.03 (0.00) a
Control	0.61 (0.15) b	0.14 (0.14) b	0.04 (0.01) a
10-days post-full bloom treatments			
SPINOSAD 125 g ai/ha	0.00 (0.00) a	0.01 (0.01) a	0.00 (0.00) a
DIPEL	0.07 (0.02) a	0.03 (0.03) a	0.07 (0.01) a
Control	0.27 (0.14) a	0.11 (0.02) a	0.60 (0.21) a
May 10: Pre-petal fall treatments			
SPINOSAD 125 g ai/ha	0.23 (0.01) a	0.08 (0.01) a	0.29 (0.06) a
SPINOSAD 175 g ai/ha	0.39 (0.18) a	0.06 (0.05) a	0.32 (0.19) a
DIPEL	0.25 (0.10) a	0.09 (0.06) a	0.62 (0.41) a
Control	0.43 (0.04) a	0.14 (0.08) a	0.24 (0.13) a
3-days post-petal fall treatments			
SPINOSAD 125 g ai/ha	0.01 (0.00) a	0.03 (0.01) a	0.00 (0.00) a
SPINOSAD 175 g ai/ha	0.01 (0.01) a	0.05 (004) a	0.02 (0.01) a
DIPEL	0.06 (0.03) a	0.08 (0.02) a	0.04 (0.01) a
Control	0.27 (0.14) a	0.11 (0.02) a	0.60 (0.21) b
10-days post-petal fall treatments			
SPINOSAD 125 g ai/ha	0.00 (0.00) a	0.05 (0.03) a	0.00 (0.00) a
SPINOSAD 175 g ai/ha	0.01 (0.01) a	0.02 (0.00) a	0.00 (0.00) a
DIPEL	0.05 (0.04) a	0.03 (0.01) a	0.03 (0.01) a
Control	0.24 (0.11) a	0.06 (0.03) a	0.50 (0.11) b

* means within dates and columns followed by the same letter are not significantly (P>0.05) different as determined by Tukey's studentized range test.

Table 2. Percent of total apples damaged by spring leafrollers.

Treatment	Mean percent leafroller damaged apples (sd)	Total apples
SPINOSAD - 125 g ai/ha at full bloom	2.18 (0.88) a*	3,666
SPINOSAD - 125 g ai/ha at petal fall	1.30 (0.90) a	4,465
SPINOSAD - 175 g ai/ha at petal fall	2.49 (0.85) ab	6,022
DIPEL - at full bloom	4.73 (1.84) c	4,890
DIPEL - at petal fall	4.29 (2.87) bc	4,422
Control	8.78 (4.58) d	5,841

* means followed by the same letter are not significantly (P>0.05) different as determined by Tukey's studentized range test after arcsine transformation.

1998 PMR REPORT # 2 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 9207

CROP: Apples cv. Liberty/M9
PEST: Western flower thrips, *Frankliniella occidentalis* (Pergande)

NAME and AGENCY:
COSSENTINE JE, AND JENSEN LBM
Agriculture and Agri-food Canada
Pacific Agri-food Research Centre, Summerland, B.C. V0H 1Z0
E-mail:COSSENTINE@EM.AGR.CA, JENSENLB@EM.AGR.CA
Tel:250-494-7711 Fax:250-494-0755

TITLE: CONTROL OF WESTERN FLOWER THRIPS IN APPLE ORCHARDS BY SPINOSAD

MATERIALS: SPINOSAD (NAF85)

METHODS: The trial was conducted in a randomized block design, replicated twice in an orchard of 5 to 6 year-old Liberty M9 slender spindle apple trees. Three limbtap samples for western flower thrips on each of five trees per treatment were conducted immediately before treatments were applied and five days post-treatment. SPINOSAD was applied at 125 g ai/ha at full bloom on May 1. All fruit was harvested in late June from 10 trees in each treatment. The fruit was visually evaluated for the presence of western flower thrips induced pansy spots. To determine if the SPINOSAD treatment interfered with blossom pollination one limb on each of ten central trees per treatment was tagged and the total number of blossoms recorded. The number of set apples per tagged branch were counted during the June harvest.

RESULTS: Significantly ($P<0.05$) fewer western flower thrips were found in SPINOSAD-treated trees compared with the control trees five days after treatment (Table 1). A lower percentage of apples were damaged by the western flower thrips in the SPINOSAD versus the control treatments at the time of the June harvest (Table 2).

There were no significant differences, between treatment and control blocks, in the total number of blossoms per tree prior to insecticide treatments (SPINOSAD $\bar{x}$=40.55 sd. 19.95; CONTROL $\bar{x}$=31.00 sd 20.29). Although a lower percentage of the blossoms set in the SPINOSAD ($\bar{x}$=17.61 sd 12.21) versus the control trees ($\bar{x}$=28.67 sd. 25.21), in June there was no significant ($P>0.05$) difference in the blossom set per total blossom ratio between the treatment and the control trees.

CONCLUSION: A single application of SPINOSAD in an apple orchard at 80 to 100% full bloom caused significant reductions in western flower thrips populations and the SPINOSAD application reduced pansy spot damage to the apples. Although the successful blossom set was lower in the Spinosad treated trees than in the control trees the reduction was not significant and therefore does not indicate an immediate damaging effect on pollinating bees.

Table 1. Mean western flower thrips (WFT) per limbtap pre- and post-treatments with Spinosad. Replicated twice, n=10 trees.

Date	Treatment	Mean WFT per limbtap(sd)
Pretreatment	SPINOSAD	3.30 (4.01) a*
	control	1.00 (1.58) b
5 days posttreatment	SPINOSAD	1.90 (2.78) a
	control	3.43 (3.07) b

*means within date followed by different letters are significantly different as determined by Tukey's studentized range test ($P \leq 0.05$).

Table 2. Mean proportion of apples with western flower thrips induced 'pansy spots' per total apples harvested June 23-25. Replicated twice, n=10 trees.

Treatment	Percentage of total apples with pansy spots (sd)	Total apples
SPINOSAD	5.73 (4.83) a*	1,980
control	16.13 (7.56) b	1,631

*means followed by different letters are significantly different as determined by Tukey's studentized range test after arcsine transformation of the percentages ($P \leq 0.05$).

1998 PMR REPORT # 3 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 306-1261-9006

CROP: Apple, cv. McIntosh
PESTS: European red mite (ERM), *Panonychus ulmi* (Koch)
Apple rust mite (ARM), *Aculus schlechtendali* (Nalepa).
PREDATOR: *Typhlodromus pyri* (TP) Scheuten

NAME AND AGENCY:
HARDMAN J M, ROGERS M and MOREAU D
Agriculture and Agri-Food Canada, Atlantic Food and Horticulture Research Centre
32 Main Street, Kentville, Nova Scotia B4N 1J5
Tel:(902) 679-5729; **Fax:** (902) 679-2311; **Email:** hardmanm@em.agr.ca

TITLE: EFFECTS OF MITICIDES ON EUROPEAN RED MITE AND A PHYTOSEIID PREDATOR ON PYRETHROID-TREATED APPLE TREES

MATERIALS: AGRI-MEK 1.9% EC (Abamectin), SUPERIOR OIL 70 (acaricidal petroleum oil), PYRAMITE 75 WP (pyridaben), RIPCORD 400 EC (cypermethrin)

METHODS: The trial was conducted in a 19 yr-old block of McIntosh on Beautiful Arcade rootstock planted at a spacing of 2.1 x 6.1 m. The block included four rows of 20-40 trees. RIPCORD, a pyrethroid insecticide, at 125 mL/ha was applied by mistblower to all trees 26 May 1997. Each of the other treatments were applied 25 June 1997 to one of three plots that each comprised half the trees in two adjacent rows (Table 1). A fourth plot of two half rows served as an untreated control. Pesticides were diluted to a rate comparable to 600 litres/ha. Samples of 20 leaves from each of five trees per plot were taken on the dates shown below and passed through a mite-brushing machine. Note that the 18 June count was taken before treatments. Counts of the phytoseiid predator *T. pyri* were based on numbers on half of the glass collecting plate (i.e. equivalent to 10 leaves). Plate counts of *T. pyri* motile stages were multiplied by a scaling factors of 2.58 because data indicate that plate counts represent an average of 39% of the *T. pyri* actually found on leaves. Counts for *P. ulmi* were from 1/16th of the plate. This orchard had been inoculated with several thousand pyrethroid/organophosphate resistant *T. pyri* (the New Zealand strain) in the late summer of 1995 and again in March of 1996.

RESULTS: Before treatment there were more eggs of the European red mite (RME) in the AGRI-MEK plot than in the others (Table 1). Nine days after treatment (4 July) there were more red mite eggs in the AGRI-MEK and one of the PYRAMITE plots than in the control. However, on all subsequent dates there were fewer red mites in the treated plots than in the control, where the density increased steadily to 37 active mites per leaf by 25 August. Both PYRAMITE and the mixture of SUPERIOR OIL and AGRI-MEK gave season-long control of red mite keeping counts of active stages less than the economic threshold of 5 mites per leaf. Low numbers of *T. pyri* were detected despite the application of cypermethrin in the spring. These predators probably helped prevent mite resurgence after the miticide treatments.

Table 1. Densities of eggs (RME) and active stages (RM) of European red mite and active stages of *T. pyri*. For a given column and a given date, means followed by the same letter are not significantly different according to the Waller -Duncan *k* ratio *t* test after square root transformation of the data ($P > 0.05$).

Treatment	Rate [AI]/ha	RME	RM	TP	RME	RM	TP
			36328			18 July	
PYRAMITE	225.0	0.98c	0.04a	0.00a	0.60b	0.00c	0.00a
PYRAMITE	450.0	9.40b	0.20a	0.00a	1.00b	0.00c	0.41a
AGRI-MEK*	14.2	30.96a	0.88a	0.00a	4.80b	2.00b	0.05a
Control		6.40b	0.00a	0.00a	64.40a	11.00a	0.15a
			4 July			25 July	
PYRAMITE	225	1.40b	0.00d	0.00a	0.00b	0.00b	0.00a
PYRAMITE	450	19.40a	1.40c	0.15a	0.00b	0.00b	0.00a
AGRI-MEK*	14.2	11.67a	2.42b	0.00a	0.18b	0.40b	0.00a
Control		2.20b	4.40a	0.00a	8.20a	20.40a	0.00a
			11 July			30 July	
PYRAMITE	225.0	0.00c	0.00b	0.00a	0.00b	0.00b	0.00a
PYRAMITE	450.0	2.60b	0.40b	0.00a	0.00b	0.00b	0.21a
AGRI-MEK*	14.2	4.60b	1.40b	0.05a	0.00b	1.36b	0.00a
Control		15.40a	5.80a	0.05a	11.76a	21.85a	0.00a
			25 Aug.				
PYRAMITE	225	0.80b	1.20b	0.36a			
PYRAMITE	450	0.60b	0.20c	0.05a			
AGRI-MEK*	14.2	0.60b	4.20b	0.26a			
Control		10.70a	37.18a	0.00a			

* plus 10 L/ha of SUPERIOR OIL 70 sec

1998 PMR REPORT # 4 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 306-1261-9006

CROP: Apple, cv. McIntosh
PESTS: European red mite (ERM), *Panonychus ulmi* (Koch)
Apple rust mite (ARM), *Aculus schlechtendali* (Nalepa).
PREDATOR: *Typhlodromus pyri* (TP) Scheuten

NAME AND AGENCY:
HARDMAN J M
Agriculture and Agri-food Canada, Atlantic Food and Horticulture Research Centre
32 Main Street, Kentville, Nova Scotia B4N 1J5
Tel: (902) 679-5729; **Fax:** (902) 679-2311; **Email**: hardmanm@em.agr.ca

TITLE: ASSESSING EFFECTS OF MITICIDES ON APPLE RUST MITE AND A PHYTOSEIID PREDATOR MITE

MATERIALS: MATADOR 120 EC (cyhalothrin-lambda), PYRAMITE 75 WP (pyridaben)

METHODS: The trial was conducted in a 11 yr-old block of McIntosh on MM111 rootstock planted at a spacing of 4.3 x 6.1 m. Pesticides were applied by a mistblower sprayer 25 June 1997 to plots of 9 trees in each of 2 adjacent rows, i.e. 18 trees per treatment. Each set of 18 trees was sprayed with 75 L of solution. Pesticides were diluted to a rate comparable to 600 litres/ha. Samples of 20 leaves from each of six trees per block were taken on the dates shown below and passed through a mite-brushing machine. Petri dish bioassays done in 1997 with a discriminating dose of pyrethroid (70 ppm cypermethrin) indicated this portion of the orchard is populated by the native pyrethroid-susceptible strain of the phytoseiid predator mite *Typhlodromus pyri*. Counts of *T. pyri* were based on numbers on half of the glass collecting plate (i.e. equivalent to 10 leaves). Plate counts of *T. pyri* motile stages were multiplied by a scaling factors of 2.58 because data indicate that plate counts represent an average of 39% of the *T. pyri* actually found on leaves. Counts for *P. ulmi* and *A. schlechtendali* were from 1/16th of the plate.

RESULTS: Counts of active stages (RM) and summer eggs (RME) of European red mite remained < 1 per leaf all summer in all plots, probably because of feeding by *T. pyri* (Table 1). For all three sampling dates in July, counts of apple rust mite were significantly lower in the two PYRAMITE blocks and the MATADOR block than in the untreated control, indicating high toxicity of both materials to the apple rust mite. Counts of *T. pyri* on trees treated with the pyrethroid MATADOR or the higher (600 g) rate of PYRAMITE were lower than on the control trees for 3 out of 4 sampling dates. On two dates *T. pyri* counts were lower than control on trees sprayed with the lower rate of PYRAMITE. The higher rate of PYRAMITE also caused significant long-term suppression but the lower rate of PYRAMITE allowed a relatively high density of the predator to persist through the summer.

Table 1. Densities of eggs (RME) and active stages (RM) of European red mite and active stages of *T. pyri*. For a given column and a given date, means followed by the same letter are not significantly different according to the Waller Duncan *k* ratio *t* test after square root transformation of the data ($P > 0.05$).

Treatment	Rate/ha	RME	RM	ARM	TP
			10 July		
PYRAMITE	300g	0.00a	0.00a	0.83b	0.73a
PYRAMITE	600 g	0.00a	0.00a	3.67b	0.30a
MATADOR	230 mL	0.00a	0.00a	1.13b	0.04a
Control		0.00a	0.00a	26.56a	0.43a
			21 July		
PYRAMITE	300 g	0.00a	0.00a	1.97b	0.86a
PYRAMITE	600 g	0.00a	0.17a	0.00b	0.34b
MATADOR	230 mL	0.00a	0.00a	0.83b	0.09b
Control		0.00a	0.00a	97.16a	1.30a
			29 July		
PYRAMITE	300 g	0.00a	0.00a	0.69b	0.91b
PYRAMITE	600 g	0.17a	0.17a	1.19b	0.13b
MATADOR	230 mL	0.00a	0.00a	0.17b	0.00b
Control		0.17a	0.00a	44.17a	3.13a
			26 Aug		
PYRAMITE	300 g	0.00b	0.00a	0.70a	0.75b
PYRAMITE	600 g	0.17ab	0.00a	1.17a	0.09c
MATADOR	230 mL	0.83a	0.17a	4.83a	0.04c
Control		0.00b	0.00a	1.33a	3.60a

1998 PMR REPORT # 5 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 306-1461-9007

CROP: Apple, cv. McIntosh
PESTS: Rosy apple aphid *Dysaphis plantaginea* Passerini
Green apple aphid *Aphis pomi* DeGeer

NAME AND AGENCY:
HARDMAN J M, ROGERS M L and GERRITS T L
Agriculture and Agri-food Canada, Atlantic Food and Horticulture Research Centre
32 Main Street, Kentville, Nova Scotia B4N 1J5
Tel: (902) 679-5729; **Fax:** (902) 679-2311; **Email:** hardmanm@em.agr.ca

TITLE: **LARGE PLOT TRIALS WITH VARIOUS INSECTICIDES TO CONTROL APHIDS ON APPLE**

MATERIALS: ADMIRE 240 F (imidacloprid), MAESTRO 75 DF (captan), PIRIMOR 50 DF(primicarb), RIPCORD 400 EC (cypermethrin), CONFIRM 240 F (tebufenozide)

METHODS: The trial was conducted in a 11 yr-old block of McIntosh on MM111 rootstock planted at a spacing of 4.3 x 6.1 m. Pesticides were applied by an airblast sprayer to plots of 19 trees in each of 2 adjacent rows (38 trees sprayed per plot). Each rate of ADMIRE and the single rate of RIPCORD were applied to single plots, whereas the same rate of PIRIMOR was applied to two plots. All insecticide treatments were tank-mixed with MAESTRO at 3.0 kg AI/ha. Pesticides were diluted to a rate comparable to 600 litres/ha with ca 350 L sprayed on each plot, which varied from 0.5 to 0.6 ha. Before the trial began with the aphicide treatments applied 28 May, both of the ADMIRE plots had been treated with RIPCORD (50 g AI/ha) 13 May 1998 whereas the PIRIMOR plots were treated with CONFIRM 240 F (240 g AI/ha) on that same date. A pretreatment count of 26 May was only done for live colonies of RAA and GAA on 10 trees per plot (Table 1). These same trees were sampled 3 times after treatment for live colonies of aphids. On 17 September the number of apples injured by RAA per 52-100 (usually 100) apples per tree was counted for each of 9-10 trees per plot (Table 3). Analysis of covariance, with pretreatment aphid count as a covariate was used to determine the effects of treatment and initital aphid counts on posttreatment aphid counts (Table 2). Pretreatment counts of rosy apple aphid were used as the covariate to estimate treatment effects on aphid injury (Table 3). Hence the least squares means in Tables 2 and 3 are adjusted to take account of pretreatment aphid densities.

RESULTS: None of the treatments caused any noticeable phytotoxicity. Results are shown in Tables 1-3.

CONCLUSIONS: There were significant variations in numbers of live aphid colonies per tree 2 days before treatment. Ai that time, green apple aphids were most numerous in one of the plots later sprayed with PIRIMOR, whereas the rosy apple aphid was most numerous in the ADMIRE plots and one of the PIRIMOR plots (Table 1). After treatment the number of live colonies of green apple aphid rose in the RIPCORD plot but decreased in the others. Rosy apple aphid counts were quite variable and hence there were no significant differences among treatments. Aphid injury to fruit was highest in the RIPCORD plot

and significantly lower in the ADMIRE and PIRIMOR plots. The higher rate of ADMIRE was more effective than the lower rate in preventing aphid injury to fruit.

Table 1. Precount of number of live colonies of rosy apple aphid (RAA) and green apple aphid (GAA) per tree on 26 May. Means followed by the same letter are not significantly different according to Tukey's Studentized Range test after square root transformation of the data ($P = 0.05$).

Treatment	Rate g [AI]/ha	No. of trees sampled	GAA	RAA
RIPCORD 400 EC	50.0	10	1.70b	1.80b
ADMIRE 240 F	91.2	10	1.10b	6.90ab
ADMIRE 240 F	55.2	10	3.80b	8.20a
PIRIMOR 50 DF	425.0	10	9.50a	6.10ab
PIRIMOR 50 DF	425.0	10	1.90b	1.30b

Table 2. Least squares means for number of live colonies per tree of green apple aphid (GAA) and rosy apple aphid (RAA) in June and July 1998. For a given column and a given date, means followed by the same letter are not significantly different according to pairwise *t* tests after square root transformation of the data ($P = 0.05$).

Treatment	Rate g [AI]/ha	GAA	RAA	GAA	RAA	GAA	RAA
		9 June		18 June		2 July	
RIPCORD 400 EC	50.0	0.45a	4.61a	5.99a	0.60a	15.66a	0.22a
ADMIRE 240 F	91.2	0.67a	4.49a	3.70a	0.73a	1.79b	0.66a
ADMIRE 240 F	55.2	1.79a	12.82a	8.90a	0.39a	3.42b	0.99a
PIRIMOR 50 DF	425.0	0.54a	7.64a	5.70a	0.54a	6.01b	0.47a

Table 3. Least squares means for percentage of apples showing injury by rosy apple aphid when sampled on the tree 17 September 1998. Means followed by the same letter are not significantly different according to pairwise *t* tests after arcsine transformation of the square root of the proportions injured (*P* = 0.05).

Treatment	Rate g [AI]/ha	No. of trees sampled	Percentage injury
RIPCORD 400 EC	50.0	10	18.94a
ADMIRE 240 F	91.2	9	5.54c
ADMIRE 240 F	55.2	9	12.65b
PIRIMOR 50 DF	425.0	19.00	4.36c

1998 PMR REPORT # 6 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 306-1461-9007

CROP: Apple, cv. McIntosh
PEST: Apple brown bug

NAME AND AGENCY:
HARDMAN J M, ROGERS M L and GERRITS T L
Agriculture and Agri-Food Canada, Atlantic Food And Horticulture Research Centre
32 Main Street, Kentville, Nova Scotia B4N 1J5
Tel: (902) 679-5729; **Fax:** (902) 679-2311; **Email:** hardmanm@em.agr.ca

TITLE: **EFFICACY OF ADMIRE AGAINST APPLE BROWN BUG IN 1998**

MATERIALS: MALATHION 25WP, ADMIRE 240F (imidacloprid)

METHODS: Trees were sprayed to runoff by a truck-mounted lance gun sprayer at a pressure of 2800 kPa. Tree spacings were 7 x 5.5 m at a density of 260/ ha. Sets of twelve single-tree plots of 20 year old McIntosh trees per treatment were sprayed 2 June1998. Pesticides were diluted to a rate comparable to 3000 litres/ha and each tree was sprayed with ca.10 L of solution. A pre-count was taken 29 May consisting of 5 tapped limbs per tree on 5 trees per treatment. Posttreatment counts were taken 10 and 19 June based on 5 tapped limbs per tree, approximately 20 taps per limb. Counts of stinging bugs (apple brown bug, ABB) from five trees per sample date were given the square root transformation before analysis of variance for the effect of treatments on bug counts. Insect injury to fruit was assessed 25 September on all apples (on the tree and drops) from each of eight trees per treatment up to a maximum of 100 fruit per tree. We computed the arc sine of the square root of the proportion of apples damaged before doing analysis of variance to determine whether treatments affected the amount of damage caused by these pests.

RESULTS: There was no phytotoxicity. Although the counts varied greatly between trees as demonstrated in the pre-count on 29 May all treatments showed significant control on both the June 10

and 19 samplings. The high rate of Admire exerted better control than the low on both sample dates however this difference was not significant. Although there were no significant differences between the standard MALATHION and ADMIRE in the tappings, in the damage counts the damage on the high rate of Admire was significantly lower than both the MALATHION and the control.

CONCLUSIONS: The data indicates that both rates of ADMIRE were comparable to or better than the standard MALATHION in decreasing apple brown bug levels and preventing damage.

Table 1. Tapping tray counts of apple brown bug 29 May (pretreatment) and 2 dates after spray.

Treatment	Rate g [AI]/ha	36308 SB	36320 SB	36329 SB
Control	0	7.60b	5.33a	1.20a
Malathion 25 WP	875	14.88a	0.20b	0.00b
Admire 240 F	60	6.60b	2.60ab	0.40ab
Admire 240 F	91.2	14.40a	1.20ab	0.00b

* Means in the same column followed by the same letter are not different according to the Waller-Duncan *k* ratio *t*-test after square root transformation of the data.

Table 2. Percentage of apples injured by apple brown bug just before harvest (25 September 1998).

Treatment	Rate g [AI]/ha	Percentage Injury
Control	0	20.52a*
Malathion 25 WP	875	11.81ab
Admire 240 F	60	7.06bc
Admire 240 F	91.2	4.36c

* Means followed by the same letter are not different according to the Waller-Duncan *k* ratio *t*-test after arc sine transformation of the data.

1998 PMR REPORT # 7 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. Golden Delicious
PESTS: Codling Moth, *Cydia pomonella* (L.)
Plum Curculio, *Conotrachelus nenuphar* (Herbst)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Southern Crop Protection and Food Research Centre, Agriculture and Agri-Food Canada
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113; Fax: (905) 562-4335; E-mail: pogodam@em.agr.ca

TITLE: ASSESSMENT OF INSECTICIDES AGAINST CODLING MOTH AND PLUM CURCULIO ON APPLE; 1998

MATERIALS: CONFIRM 240F (tebufenozide), GUTHION 50 WP (azinphos-methyl), RH 2485 80 WP

METHODS: The trial was conducted in a 25-year-old orchard in the Jordan Station, Ontario area; trees cv. Golden Delicious were spaced 2.5 m by 4.6 m, and were on M26 rootstock. Treatments were replicated three times and assigned to two-tree plots, and arranged according to a randomised complete block design. Application timing was determined from pheromone trap catches of male codling moths (CM). Treatments were applied 25 May for the first generation, 100 DD (base 10C) after first male CM catch; treatments were reapplied 17 June, 250 DD (base 10C) after first application. Timing for the second generation was based on peak catches of male CM in pheromone traps; treatments were applied 16 July and reapplied 10 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. Approximately 8-9 L of spray mix were used per plot; pressure was set at 2000 kPa. Plots were first sampled 4 June; 100 apples per plot were examined on the tree for plum curculio (PC) damage. A sample was taken for first generation codling moth (CM) damage on 15 July, when 100 apples per plot were examined on the tree. Second generation CM damage was sampled on 25 August, 100 apples per plot were examined on the tree. On 28 September; a total of 100 apples per plot were harvested from the canopy and the ground, and examined for CM damage. Efficacy was expressed as percent fruit damaged by CM or PC. 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. Phytotoxic effects were observed in the plots treated with RH 2485. The fruit in the plots treated with RH 2485 exhibited ring-like markings where the spray mix residue had accumulated on the bottom of the apples. This effect was attributed to the addition of the COMPANION spreader/sticker, since RH 2485 had shown no phytotoxic effects when used in the past with other surfactants.

CONCLUSIONS: In the 15 July sample for first generation CM damage, all treated plots showed significantly lower damage than the control. All treatments significantly reduced CM damage in the

second generation sample taken 25 August. The 28 September harvest sample showed similar results, all treated plots showed lower CM damage than the control. Although application timing was based on CM phenology, the effects of treatments on levels of PC damage were also examined. In the sample taken 4 June to assess the effects of the first application on PC, none of the treatments were significantly different from the control. Infestations of CM and PC were considered high.

Table 1. Percent fruit damaged by codling moth.

Treatment[1]	Rate (a.i./ha)	Gen. 1 15 July	Gen. 2 25 Aug.	Harvest 28 September
GUTHION 50 WP	1.0 kg	2.0 b[2]	2.4 b	4.7 b
CONFIRM 240F	240 g	2.7 b	5.0 b	3.3 b
RH 2485 80 WP	240 g	1.7 b	2.7 b	2.7 b
CONTROL	-	23.0 a	26.4 a	40.0 a

[1] Applied 25 May, reapplied 17 June, 16 July, 10 August
[2] Numbers in the same column followed by the same letter are not significantly different P<0.05, Tukey test.

Table 2. Percent fruit damaged by plum curculio.

Treatment[1]	Rate (a.i./ha)	35949
GUTHION 50 WP	1.0 kg	12.6 a
CONFIRM 240F	240 g	17.7 a
RH 2485 80 WP	240 g	16.3 a
CONTROL	-	16.7 a

[1] Applied 25 May, reapplied 17 June, 16 July, 10 August
[2] Numbers in the same column followed by the same letter are not significantly different P<0.05, Tukey test.

1998 PMR REPORT # 8 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. Red Delicious
PEST: Oblique-Banded Leaf Roller, *Choristoneura rosaceana* (Harris)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Southern Crop Protection and Food Research Centre, Agriculture and Agri-Food Canada
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113; Fax: (905) 562-4335; E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF OVERWINTERED OBLIQUE-BANDED LEAF ROLLER ON APPLE WITH VARIOUS INSECTICIDES; 1998

MATERIALS: CONFIRM 240F (tebufenozide), DIPEL 2X (*Bacillus thuringiensis*, subsp. *kurstaki*), PYRIFOS 50 WP (chlorpyrifos)

METHODS: The trial was conducted in a 22-year-old orchard in the Grimsby, Ontario area; trees cv. Red Delicious were spaced 1.5 m by 3.0 m, and were on M26 rootstock. Treatments were replicated four times, assigned to four-tree plots, and arranged according to a randomised complete block design. Two protocols were followed for CONFIRM; the first program consisted of two applications of CONFIRM at a rate of 120 g ai/ha, and was applied at pink (29 April), and petal fall (20 May), 21 days after first application. The second program consisted of one application of CONFIRM at a rate of 240 g ai/ha, and was applied at petal fall (20 May). The DIPEL 2X and PYRIFOS treatments were applied at petal fall (20 May). Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 14-15 L of spray mix were used per plot; pressure was set at 2000 kPa. For all samples of terminals and fruit, samples were taken from the centre quadrants of the four trees in each plot. On 15 May, 28 May, and 15 July, 100 terminals were examined per plot, and the number of terminals containing live larvae was recorded. On 30 July, 100 terminals were examined per plot, and the number of terminals containing live larvae was recorded; 100 apples per plot were also examined on the tree, and the number of damaged fruit was recorded. On 24 September, 100 apples per plot were harvested and the number of damaged fruit was recorded. Efficacy ratings were expressed as percent terminals infested, and percent damaged fruit. Data were transformed (log(x+1)) and analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1 and 2. No phytotoxic effects were observed in any of the treated plots. Average fruit density was 63 apples/tree; this was considered a light crop.

CONCLUSIONS: In sample 1 taken 15 May to assess the effects on infestations in terminals, the CONFIRM treatment applied at pink was not significantly different from the control. In sample 2 taken 28 May to assess the effects of all treatments on infestations in terminals, all of the treatments were significantly different from the control; the plots treated with DIPEL 2X showed significantly fewer infested terminals than those treated with the single application of CONFIRM at petal fall. Only the plots

treated with PYRIFOS had significantly lower terminal infestation than the control in the 15 July sample. When the plots were examined 30 July for infested terminals, the PYRIFOS and DIPEL 2X treatments were the only plots to show significantly lower terminal infestation than the control; however, these treatments did not show significantly lower infestation than either of the CONFIRM programs.
All treatment programs reduced fruit damage significantly compared to the control in the 30 July fruit sample. However, at harvest, while all treated plots had lower numbers of damaged fruit than the control, only plots treated with CONFIRM at petal fall were significantly lower than the control. In conclusion, treatment of overwintered larvae gave sustained control of fruit damage through the end of July, and suppressed damage throughout the season.

Table 1. Percent terminals infested per plot.

Treatment	Rate (a.i./ha)	Sample 1 15 May	Sample 2 28 May	Sample 3 15 July	Sample 4 30 July
DIPEL 2X[1]	2.25 kg	-	7.25 c[3]	9.2 ab	5.0 b
PYRIFOS 50 WP[1]	1.7 kg	-	11.00 bc	7.2 b	9.25 b
CONFIRM 240F[2]	120 g	32.75 a	15.75 bc	11.7 ab	9.75 ab
CONFIRM 240F[1]	240 g	-	18.00 b	12.2 ab	10.0 ab
CONTROL	-	41.25 a	39.25 a	19.5 a	17.5 a

[1] Applied 20 May
[2] Applied 29 April, reapplied 20 May
[3] Numbers in the same column followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent damaged fruit per plot.

Treatment	Rate (a.i./ha)	% Damaged Fruit 30 July	% Damaged Fruit at Harvest 24 Sept
DIPEL 2X[1]	2.25 kg	6.2 b[3]	12.1 ab
PYRIFOS 50 WP[1]	1.7 kg	5.5 b	12.8 ab
CONFIRM 240F[2]	120 g	5.9 b	18.2 ab
CONFIRM 240F[1]	240 g	5.2 b	10.7 b
CONTROL	-	22.7 a	34.3 a

[1] Applied 20 May
[2] Applied 29 April, reapplied 20 May
[3] Numbers in the same column followed by the same letter are not significantly different $P<0.05$, Tukey test.

1998 PMR REPORT # 9 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. Red Delicious
PEST: Oblique-Banded Leaf Roller, *Choristoneura rosaceana* (Harris)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Southern Crop Protection and Food Research Centre, Agriculture and Agri-Food Canada
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113; Fax: (905) 562-4335; E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF OBLIQUE-BANDED LEAF ROLLER ON APPLE WITH VARIOUS INSECTICIDES; 1998

MATERIALS: CONFIRM 240F (tebufenozide), DECIS 5 EC (deltamethrin), GUTHION 50 WP (azinphos-methyl), PYRIFOS 50 WP (chlorpyrifos), RH 2485 80 WP

METHODS: The trial was conducted in a 22-year-old orchard in the Grimsby, Ontario area; trees cv. Red Delicious were spaced 1.5 m by 3.0 m, and were on M26 rootstock. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application timing was determined from pheromone trap catches of male moths. Two protocols were followed for CONFIRM; the first program was applied 18 June , 170 DD (base 6.1C) after first male moth catch, and repeated 14 days (2 July) and 27 days (15 July) after first application. The second program was applied 18 June, 170 DD (base 6.1C) after first male moth catch, and repeated 14 days (2 July) after first application. RH 2485 was applied as two programs at different rates, 240 g ai/ha, and 360 g ai/ha; the spreader/sticker COMPANION was added at a rate of 0.25% of the total spray mix for both RH 2485 programs. The DECIS, GUTHION, RH 2485, and PYRIFOS treatments were applied 18 June, 170 DD (base 6.1C) after first male moth catch, and were repeated on 2 July, 14 days after initial application. 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 8-9 L of spray mix were used per plot; pressure was set at 2000 kPa. On 15 July, 50 terminals were examined per plot, and the number of terminals containing live larvae was recorded. On 30 July, 50 terminals were examined per plot, and the number of terminals containing live larvae was recorded; 50 apples per plot were also examined on the tree, and the number of damaged fruit was recorded. On 24 September, 50 apples per plot were harvested and the number of damaged fruit was recorded. Efficacy ratings were expressed as percent terminals infested, and percent damaged fruit. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1 and 2. Phytotoxic effects were observed in the plots treated with RH 2485. The fruit in the plots treated with RH 2485 exhibited ring-like markings where the spray mix residue had accumulated on the bottom of the apples. This effect was attributed to the addition of the COMPANION spreader/sticker, since RH 2485 had shown no phytotoxic effects when used in the past with other surfactants. Average fruit density was 63 apples/tree.

CONCLUSIONS: In the sample taken 15 July to assess the effects of treatments on infestations in terminals, all of the treatments were significantly different from the control; in the 30 July sample of terminals, all treated plots showed significantly lower terminal infestation than the control.
All treatment programs consistently reduced fruit damage over the course of the season. In the 30 July fruit sample, all of the treatments significantly reduced fruit damage in comparison to the control. Meanwhile, at harvest, while all treated plots showed significantly lower fruit damage than the control, the percent fruit damaged in the DECIS, PYRIFOS, AND RH 2485 treatment programs were significantly lower than in the GUTHION treated plots.

Table 1. Percent terminals infested per plot.

Treatment	Rate (a.i./ha)	Sample 1 July 15	Sample 2 July 30
DECIS 5 EC[1]	10.0 g	1.5 b[3]	4.0 b
PYRIFOS 50 WP[1]	1.7 kg	2.0 b	2.5 b
GUTHION 50 WP[1]	1.0 kg	5.5 b	3.0 b
CONFIRM 240F[2]	240 g	6.5 b	2.5 b
CONFIRM 240F[1]	240 g	5.5 b	6.0 b
RH 2485 80 WP[1]	240 g	3.5 b	3.5 b
RH 2485 80 WP[1]	360 g	1.5 b	1.0 b
CONTROL	-	17.5 a	26.5 a

[1] Applied 18 June (170 DD from first male moth catch), reapplied 2 July
[2] Applied 18 June (170 DD from first male moth catch), reapplied 2 July, 15 July
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent damaged fruit per plot.

Treatment	Rate (a.i./ha)	% Damaged Fruit 30 July	% Damaged Fruit at Harvest 24 Sept
DECIS 5 EC[1]	10.0 g	3.1 b[3]	1.0 c
PYRIFOS 50 WP[1]	1.7 kg	4.0 b	2.0 c
GUTHION 50 WP[1]	1.0 kg	5.5 b	9.5 b
CONFIRM 240F[2]	240 g	1.5 b	4.5 bc
CONFIRM 240F[1]	240 g	3.7 b	7.7 bc
RH 2485 80 WP[1]	240 g	3.3 b	3.0 c
RH 2485 80 WP[1]	360 g	3.5 b	2.0 c
CONTROL	-	16.0 a	27.9 a

[1] Applied 18 June (170 DD from first male moth catch), reapplied 2 July
[2] Applied 18 June (170 DD from first male moth catch), reapplied 2 July, 15 July
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

1998 PMR REPORT # 10 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. Idared
PESTS: Spotted Tentiform Leafminer, *Phyllonorycter blancardella* (F.)
Mullein Leaf Bug, *Campylomma verbasci* (Meyer)
European Red Mite, *Panonychus ulmi* (Koch)
PREDATORS: *Pholetesor ornigis*, *Sympiesis spp.* (*Hymenoptera: Chalcidoidea*), *Amblyseius fallacis* (Garman)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Southern Crop Protection and Food Research Centre, Agriculture and Agri-Food Canada
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113; Fax: (905) 562-4335; E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF FIRST GENERATION SPOTTED TENTIFORM LEAFMINER AND MULLEIN LEAF BUG ON APPLE WITH VARIOUS INSECTICIDES; 1998

MATERIALS: ADMIRE 240F (imidacloprid), CYMBUSH 250 EC (cypermethrin)

METHODS: The trial was conducted in an eight-year-old orchard in the Simcoe, Ontario area; trees cv. Idared were spaced 4.8 m by 7.2 m, and were on MM106 rootstock. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Three rates of ADMIRE were examined, with CYMBUSH applied as a standard. Treatments were applied at petal fall (14 May), timed for egg hatch of the first generation of Spotted Tentiform Leafminer (STLM). 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 14-15 L of spray mix were used per plot; pressure was set at 2000 kPa. On 21 May, plots were examined for Mullein leaf bug (MB) by tapping each tree at three equally-spaced locations (six taps per plot), and catching MB nymphs on tapping trays. Numbers of MB per six taps were recorded for each plot. On 9 June 100 fruit per plot were examined on the tree for MB damage, and the percent fruit damaged per plot was recorded. On 9 June, a sample of 50 leaf clusters per plot was collected from the lower central part of the tree canopy. Samples were examined using a stereomicroscope and the percentage of clusters mined by STLM were recorded. The percentage of mines containing the parasitoids *Pholetesor ornigis* and *Sympiesis* spp. (Hymenoptera: Chalcicoideae) were also recorded. Effects on populations of European Red Mite (ERM) were also examined; four weeks (9 June) and eight weeks (9 July) after application, samples of 50 leaves per plot were picked randomly at arm's length into the canopy. Leaves were examined using a stereomicroscope (45 leaves brushed with a Henderson McBurnie mite brushing machine, and five leaves were examined without brushing), and numbers of live ERM motiles were recorded. Total numbers of beneficial mites observed were also recorded for each plot. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1, 2, and 3. No phytotoxic effects were observed in any of the

treated plots.

CONCLUSIONS: In the sample taken 9 June to assess the effects of treatments on STLM, all of the ADMIRE treatments were significantly different from the control, while the CYMBUSH standard was not significantly different from the control (Table 1). None of the treated plots showed significantly reduced parasitism of mines by either *P. ornigis* or *Sympiesis spp.* In the 21 May sample for MB, all treated plots showed significantly lower numbers of MB than the control; however, none of the treated plots showed significantly lower fruit damage in the 9 June sample for MB damage (Table 2). None of the treatments exhibited any effects on populations of ERM; there were not significant differences in either the four week (9 June) or eight week (9 July) samples (Table 3). Similarly, none of the treatments significantly reduced numbers of beneficial mites (predominately *A. fallacis*).

Table 1. Spotted tentiform leafminer efficacy data.

Treatment[1]	Rate (a.i./ha)	% mines per cluster 9 June	% mines parasitised 9 June
ADMIRE 240 F	96 g	3.9 c[2]	0.0 a[2]
ADMIRE 240 F	70 g	12.3 c	0.0 a
ADMIRE 240 F	45 g	17.0 bc	1.9 a
CYMBUSH 250 EC	100 g	33.8 ab	2.9 a
CONTROL	-	38.9 a	4.7 a

[1] Applied 14 May

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

Table 2. Mullein leaf bug efficacy data.

Treatment[1]	Rate (a.i./ha)	# MB per 6 taps per plot 21 May	% fruit damaged by MB 9 June
ADMIRE 240 F	96 g	1.00 b[2]	0.0 a[2]
ADMIRE 240 F	70 g	0.25 b	1.1 a
ADMIRE 240 F	45 g	0.25 b	1.7 a
CYMBUSH 250 EC	100 g	0.25 b	0.0 a
CONTROL	-	16.25 a	3.6 a

[1] Applied 14 May
[2] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

Table 3. Motile mites per leaf.

Treatment[1]	Rate (a.i./ha)	ERM motiles per leaf 9 June	ERM motiles per leaf 9 July	Beneficial mites per leaf 9 July
ADMIRE 240 F	96 g	0.61 a[2]	1.12 a[2]	0.30 a[2]
ADMIRE 240 F	70 g	0.25 a	3.05 a	0.39 a
ADMIRE 240 F	45 g	0.51 a	2.71 a	0.26 a
CYMBUSH 250 EC	100 g	0.16 a	3.79 a	0.02 a
CONTROL	-	0.12 a	1.58 a	0.31 a

[1] Applied 14 May
[2] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

1998 PMR REPORT # 11 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apple cv. Idared
PEST: Two Spotted Spider Mite, *Tetranychus urticae* (Koch)

NAME AND AGENCY:
POGODA, M K, APPLEBY, M, and PREE, D J
Southern Crop Protection and Food Research Centre, Agriculture and Agri-Food Canada
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113; Fax: (905) 562-4335; E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF TWO SPOTTED SPIDER MITE ON APPLE WITH VARIOUS ACARICIDES; 1998

MATERIALS: KELTHANE 50 W (dicofol), PYRAMITE 75 WP (pyridaben)

METHODS: The trial was conducted in an 18-year-old orchard in the Rednersville, Ontario, area; trees cv. Idared were spaced 4.5 m by 9.0 m and were on MM106 rootstock. Treatments were replicated four times and assigned to two-tree plots, and arranged according to a randomised complete block design. Plots were sampled pre-treatment 12 August, and three times post-treatment, 20 August, 27 August, and 3 September (7, 14, and 21 days after treatment). Efficacy ratings consisted of counts of motiles of Two Spotted Spider Mite (TSSM) on 50 leaves per plot, picked randomly at arm's length into the canopy. Leaves were examined using a stereomicroscope (45 leaves were brushed with a Henderson McBurnie mite brushing machine, and five leaves were examined without brushing), and numbers of live TSSM motiles (nymphs and adults) were recorded. On 13 August, acaricides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 8-9 L of spray mix were used per plot; pressure was set at 2000 kPa. 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 below. Prespray samples 12 August showed similar numbers of TSSM motiles (approximately 8 TSSM motiles per leaf) and TSSM eggs (approximately 10 TSSM eggs per leaf) in all plots. No phytotoxic effects were observed in any of the treated plots. Numbers of TSSM motiles and eggs were observed to decline naturally into September.

CONCLUSIONS: Numbers of TSSM motiles per leaf in all treated plots were significantly lower than the control in the 7 day and 14 day samples; however, none were significantly different from the control in the 21 day sample (Table 1), probably due to natural or seasonal decline. Only the PYRAMITE treatments had significantly fewer eggs per leaf than the control in the 7 day and 14 day samples (Table 2); after 21 days, none of the treated plots showed significantly fewer eggs per leaf than the control.

Table 1. Numbers of TSSM motiles per leaf.

Treatment[1]	Rate (a.i./ha)	12 August Prespray	20 August 7 days	27 August 14 days	3 September 21 days
PYRAMITE 75 WP	225 g	9.4 a[2]	0.00 b	0.03 b	0.03 a
KELTHANE 50 W	1.625 kg	8.3 a	0.01 b	0.04 b	0.03 a
CONTROL	-	8.2 a	3.04 a	1.24 a	0.03 a

[1] Applied 13 August
[2] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

Table 2. Numbers of TSSM eggs per leaf

Treatment[1]	Rate (a.i./ha)	12 August Prespray	20 August 7 days	27 August 14 days	3 September 21 days
PYRAMITE 75 WP	225 g	11.4 a[2]	1.7 b	0.40 b	0.10 a
KELTHANE 50 W	1.625 kg	12.4 a	6.4 ab	3.25 a	0.03 a
CONTROL	-	10.0 a	6.6 a	5.26 a	0.16 a

[1] Applied 13 August
[2] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

1998 PMR REPORT # 12 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 353-1261-9007

CROP: Apple, cv. McIntosh
PESTS: Codling moth, *Cydia pomonella* (L)
Pale apple leafroller, *Pseudexentera mali*
Winter moth, *Operophtera brumata*

NAME AND AGENCY:
SMITH R F[1], RIGBY S[1], SHEFFIELD, C [2], O'FLAHERTY, C [2] and TROMBLEY, M[1].
[1]Agriculture and Agri-Food Canada, Atlantic Food & Horticulture Research Centre
32 Main Street, Kentville, Nova Scotia, Canada, B4N 1J5
Tel: (902) 679-5730; **Fax:** (902) 679-2311; **Email**: SmithR@em.agr.ca

[2] Nova Scotia Fruit Growers' Association, Atlantic Food & Horticulture Research Centre
32 Main Street, Kentville, Nova Scotia, Canada, B4N 1J5

TITLE: COMPARATIVE EFFICACY OF SELECT INSECTICIDES AGAINST LEPIDOPTERAN CATERPILLARS IN APPLE ORCHARDS.

MATERIALS: RH-2485 (unknown), CONFIRM 240F (tebufenozide) , IMIDAN 50WP (phosmet) RIPCORD 400EC (cypermethrin), ZOLONE FLO (phosalone)

METHODS: Test site # 1 was a 2.0 ha block of 8 year old apple, cv. McIntosh at the Atlantic Food & Horticulture Research Centre, Kentville, Nova Scotia. Pre-treatment pest densities were determined by leaf cluster samples, pale apple leafroller and winter moth larvae abundance was resolved and spray applications, RIPCORD 400EC at 250 mL, RH-2485 80W at 300g and 450 g CONFIRM 240F at one litre, product/ ha were applied 13, May for pale apple leafroller and 1, July 1998, for winter moth and codling moth. Post treatment mortality of pale apple leafroller larvae was resolved at day seven from collection of infested leaf clusters. Wing type pheromone traps baited with 1 mg codlemone were used to monitor codling moth abundance, flight profile and a predictive degree day model used to determine #3% egg hatch; Economic injury levels were reached 8 July. 21 September fruit injury assessments were conducted on all fruit from five trees per treatment to resolve level of fruit protection from winter moth and codling moth larvae attack.

Test site #2 was a 3.0 ha thirteen year old orchard of comprised of 50% 'Summerland McIntosh' and 50%'Royal Court Cortland'. In this site CONFIRM 240F was evaluated against Lepidoptera larvae. Sequential sampling of fruit spur clusters at the 'pink bud' stage of tree development resolved a moderate winter moth population (three larvae in sixty clusters as per winter moth fact sheet # 8, Nova Scotia Pest Management Fact Sheets);pheromone baited monitoring traps determined economic injury levels of codling moth ($ 40 moths) were reached by 10 July. A Rittenhouse orchard mist sprayer delivering a 5x concentration of pesticide at 600L/ha and a tank pressure of 1380 kPa was used to treat 0.6 ha portions of the orchard. On 3 July the following treatments against codling moth were applied: ZOLONE FLO 600 mL (30% label rate) and IMIDAN 50WP at 1.12 kg (25% label rate) product/ha. At harvest, 21 September, fruit injury was assessed by examining all fruit from nine trees, in each treatment. Data

were transformed to arcsin(square root of proportion) prior to analysis of variance and separation of the means was by Least Significant Difference tests (SAS 1996).

RESULTS: The tables 1- 4 give efficacy and fruit damage results from the pesticide evaluations conducted during 1998.

CONCLUSIONS: In test site # 1 CONFIRM 240F gave satisfactory control of pale apple leafroller larvae and did not different from RIPCORD 400EC with mortality rated at 98.4% and 100%, respectively (Table 1). Codling moth damage was unacceptable high, ranging from 13% (CONFIRM) to a low of 2% (RIPCORD) (Table 2). Operational delays in applying the insecticides resulted in infested fruit prior to pesticide application were a factor that resulted in a lack of adequate control. In test site # 1 by contrast, winter moth suppression was satisfactory with only 0.02% fruit injury in the CONFIRM plots compared to 2-3% fruit loss in the other treatments (Table 2). In test site #2 reduced rates of the organophosphorus insecticides ZOLONE and IMIDAN gave fully acceptable fruit protection from codling moth allowing only 0.67% and 0.21%, respectively compared to 1.12% in the untreated plots (Table 3). Substantial cost savings could be realized if growers were to employ minimum rates of conventional insecticides. The 13 May applications of CONFIRM and RIPCORD (Table 4) did not keep winter moth damage # 1%, the generally accepted economic injury level employed by Nova Scotia apple producers. We suggest that, in part, this lack of pest suppression was a consequence of abnormally warm spring temperatures that permitted rapid feeding injury on expanding unprotected leaf and fruit tissue. By contrast applications made on 1 July (test site #1, Table 2) gave excellent winter moth control.

Table 1. Test site #1, percent pale apple leafroller larval mortality (mean ± SE) day seven post treatment. Bracketed values are product application rate per hectare. Within a column mean values sharing a common letter are not significantly different (P=.05) (SAS 1996)

Untreated check	6.45 ± 6.27a
CONFIRM 240F (1.0 litre)	98.40 ± 1.79b
RIPCORD 400EC (250 mL)	100.00 ± 0.0b

Table 2. Test site #1, percent fruit damage (mean ± SE) at harvest from larval feeding by winter moth and codling moth. Bracketed values are product application rate per hectare 13 May & 1 July against winter moth & codling moth, respectively. Within a row, mean values sharing a common letter are not significantly different (P=.05) (SAS 1996)

Pest species	untreated check	CONFIRM 240F (1.0 litre)	RH 2485 80W (300g)	RH 2485 80W (450g)	RIPCORD 400EC (250mL)
codling moth	4.98 ± 1.76b	13.02 ± 2.23a	3.99 ± 0.76b	7.95 ± 1.44a	2.09 ± 0.69b
winter moth	4.28 ±0.86b	0.02 ± 0c	2.12 ± 0.36ab	3.22 ± 0.75ab	2.13 ± 0.71a

Table 3. Test site #2, reduced rates of organophosphorus insecticides tested against codling moth, 3 July 1998. Percent fruit damage (mean ± SE) at harvest from larval feeding . Bracketed values are product application rate per hectare. Within a column, mean values sharing a common letter are not significantly different (P=.05) (SAS 1996)

Untreated check	1.12 ± 0.11a
ZOLONE FLO (600 mL) 30% label rate	0.67 ± 0.17b
IMIDAN 50 WP (1.12 kg) 25% label rate	0.21 ± 0.06c

Table 4. Test site #2, percent fruit damaged (mean ± SE) by winter moth larvae. Bracketed values are product application rate per hectare. Within a column, values sharing a common letter are not significantly different (P=.05) (SAS 1996)

CONFIRM 240F (1.0 litre)	3.00 ± 0.33a
RIPCORD 400EC (250 mL)	1.22 ± 0.16b

1998 PMR REPORT # 13 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Grapes cv. Concord
PEST: European Red Mite, *Panonychus ulmi* (Koch)
PREDATOR: *Amblyseius fallacis* (Garman)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Southern Crop Protection and Food Research Centre, Agriculture and Agri-Food Canada
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113; **Fax**: (905) 562-4335; **E-mail**: pogodam@em.agr.ca

TITLE: CONTROL OF EUROPEAN RED MITE ON GRAPE WITH EARLY SEASON ACARICIDES, 1998

MATERIALS: APOLLO 500 SC (clofentizine), BARTLETT SUPERIOR 70 OIL

METHODS: The trial was conducted in a mature vineyard in the Jordan, Ontario area; vines cv. Concord were spaced 2.7 m by 2.7 m. Treatments were replicated four times and assigned to six-vine plots, and arranged according to a randomised complete block design. All plots were sampled for the presence of overwintered (OW) eggs of European Red Mite (ERM); on 16 April, five 15 cm cuttings of mature vine were sampled from each plot, and examined with a stereomicroscope. Cuttings were assigned a rating based on numbers of OW ERM eggs; 0 (zero OW ERM eggs), 1 (1-50 OW ERM eggs), 2 (50-500 OW ERM eggs), and 3 (500+ OW ERM eggs). On 21 April (timed for application just prior to hatch of OW ERM eggs), with vines in a dormant state, a 2% (v/v) solution of BARTLETT SUPERIOR 70 OIL was sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. A dilution rate of approximately 1800 L/ha of spray solution was used; pressure was set at 2000 kPa. On 28 May (timed for predominance of the first summer generation of ERM eggs), APOLLO was diluted to a rate comparable to 2000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 9-10 L of spray mix were used per plot; pressure was set at 2000 kPa. Plots treated with BARTLETT SUPERIOR 70 OIL were sampled post-treatment 28 days (19 May), 37 days (28 May), 51 days (11 June), 72 days (2 July), 92 days (22 July), and 111 days (10 August) after treatment. Plots treated with APOLLO were sampled pre-treatment (28 May), and post-treatment 14 days (11 June), 35 days (2 July), 55 days (22 July), and 75 days (10 August) after treatment. Samples consisted of counts made on 40 leaves per plot, picked randomly from both sides of the row. Leaves were examined using a stereomicroscope (35 leaves were brushed with a Henderson McBurnie mite brushing machine, and five leaves were examined without brushing), and numbers of live European Red Mite (ERM) eggs and motiles (nymphs and adults) were recorded. Total numbers of beneficial mites observed were also recorded for each plot. Data were transformed (log (x+1)) and analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables below. Samples of vine cutting taken 16 April showed similar numbers of OW ERM eggs in all plots (average rating of 2.2, or approximately 50-500 eggs per 15 cm

cutting). Pre-APOLLO treatment samples taken 28 May indicated that ERM populations consisted of almost entirely adults and first summer generation eggs in all plots. Spray volume and coverage of dormant vines with BARTLETT SUPERIOR 70 OIL was considered good; however, it was observed that the spray solution did not penetrate below the surface of loose bark on old (third years plus) growth. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: Dormant application of BARTLETT SUPERIOR 70 OIL resulted in a good initial reduction of ERM numbers (Table 1); however, ERM populations were not significantly lower than the unsprayed check by the 11 June sample, remaining so throughout the rest of the season. This lack of sustained control may have been due to re-establishment of ERM populations by mites from the old growth areas of vines. Plots treated with APOLLO had significantly fewer ERM than the control after 14 days (11 June sample), and numbers remained low throughout the season (Table 1). ERM populations in the APOLLO treated plots were still significantly lower than the control in the 10 August sample, 75 days after treatment. Numbers of beneficial mites (primarily *A. fallacis*) in the treated plots were not significantly different from the control throughout the season (Table 2).

Table 1. Number of ERM motiles per leaf.

Treatment	Rate	Sample 1 19 May	Sample 2 28 May	Sample 3 11 June	Sample 4 2 July	Sample 5 22 July	Sample 6 10 Aug
BARTLETT SUPERIOR 70 OIL[1]	2.0 % (v/v)	2.1 b[3]	0.4 b	1.9 ab	4.0 b	14.1 a	48.3 a
APOLLO 500 SC[2]	150 g a.i./ha	-	1.7 a	0.5 b	0.3 b	1.9 b	15.9 b
CONTROL	-	17.3 a	2.6 a	3.0 a	5.7 a	9.2 a	29.8 a

[1] Applied 21 April
[2] Applied 28 May
[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Number of beneficial mites per leaf.

Treatment	Rate	Sample 1 19 May	Sample 2 28 May	Sample 3 11 June	Sample 4 2 July	Sample 5 22 July	Sample 6 10 Aug
BARTLETT SUPERIOR 70 OIL[1]	2.0 % (v/v)	0.0 a[3]	0.0 a	0.05 a	0.08 a	1.10 a	0.68 a
APOLLO 500 SC[2]	150 g a.i./ha	-	0.0 a	0.06 a	0.49 a	2.70 a	0.11 a
CONTROL	-	0.0 a	0.0 a	0.07 a	0.11 a	2.36 a	1.16 a

[1] Applied 21 April
[2] Applied 28 May
[3] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

1998 PMR REPORT # 14 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Grapes cv. Concord
PEST: European Red Mite, *Panonychus ulmi* (Koch)
PREDATOR: *Amblyseius fallacis* (Garman)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Southern Crop Protection and Food Research Centre, Agriculture and Agri-Food Canada
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113; Fax: (905) 562-4335; E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF EUROPEAN RED MITE ON GRAPE WITH ACARICIDES; 1998

MATERIALS: CARZOL 92 SP (formetanate hydrochloride), KELTHANE 50 W (dicofol), PYRAMITE 75 WP (pyridaben)

METHODS: The trial was conducted in a mature vineyard in the Jordan, Ontario area; vines cv. Concord were spaced 2.7 m by 2.7 m. Treatments were replicated four times and assigned to three-vine plots, and arranged according to a randomised complete block design. Blocks were sampled pre-treatment, and individual plots sampled 7, 14, 21, and 35 days after treatment. Samples consisted of counts made on 25 leaves per plot, picked randomly from both sides of the row. Leaves were examined using a stereomicroscope (20 leaves were brushed with a Henderson McBurnie mite brushing machine, and five leaves were examined without brushing), and numbers of live European Red Mite (ERM) eggs and motiles (nymphs and adults) recorded. Total numbers of beneficial mites observed were also recorded for each plot. On 23 July, acaricides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun

fitted with a D-6 orifice plate. Approximately 8-9 L of spray mix were used per plot; pressure was set at 2000 kPa. Data were transformed (log (x+1)) and analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Table 1. Pre-treatment samples 16 July showed similar numbers of ERM eggs (approximately 40 eggs per leaf) and ERM motiles (approximately 8 motiles per leaf) in all plots. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: In the 7 day sample, numbers of motiles in all of the treated plots were significantly lower than the control (Table 1). In the samples taken 14 days and 21 days after treatment, all treatments still had significantly fewer motiles than the control, but the PYRAMITE and KELTHANE treatments were significantly lower than the CARZOL treatment. After 35 days, only the PYRAMITE and KELTHANE treatments showed significantly fewer motiles per leaf than the control; the CARZOL treatment was not significantly different from the control. Treatment of plots with either PYRAMITE or KELTHANE gave season-long control of ERM, while treatment of plots with CARZOL resulted in short-term control over a period of 21 days. Numbers of beneficial mites (primarily *A. fallacis*) in the treated plots were not significantly different from the control in any of the samples (Table 2).

Table 1. Number of ERM motiles per leaf.

Treatment[1]	Rate a.i./ha	30 July 7 days	6 August 14 days	13 August 21 days	27 August 35 days
CARZOL 92 SP	1.000 kg	10.0 b[2]	14.1 b	31.2 b	31.1 a
PYRAMITE 75 WP	0.225 kg	7.4 b	4.0 c	3.5 c	8.1 b
KELTHANE 50 W	1.625 kg	1.8 b	2.1 c	1.9 c	3.5 b
CONTROL	-	55.2 a	74.5 a	66.5 a	43.2 a

[1] Applied 23 July

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

Table 2. Beneficial mites per leaf.

Treatment[1]	Rate a.i./ha	30 July 5 days	6 August 14 days	13 August 21 days	27 August 35 days
CARZOL 92 SP	1.000 kg	0.05 a[2]	0.02 a	1.16 a	0.76 a
PYRAMITE 75 WP	0.225 kg	0.23 a	0.00 a	0.00 a	0.06 a
KELTHANE 50 W	1.625 kg	0.07 a	0.01 a	0.00 a	0.43 a
CONTROL	-	0.17 a	0.00 a	0.72 a	0.46 a

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

1998 PMR REPORT # 15 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Peach cv. Harrow Beauty
PEST: Peach Silver Mite, *Aculus cornutus* (Banks)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Southern Crop Protection and Food Research Centre, Agriculture and Agri-Food Canada
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113; Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF PEACH SILVER MITE ON PEACH WITH VARIOUS ACARICIDES; 1998

MATERIALS: KELTHANE 50 W (dicofol), PYRAMITE 75 WP (pyridaben)

METHODS: The trial was conducted in a three-year-old orchard in the Jordan Station, Ontario, area; trees cv. Harrow Beauty were spaced 4.5 m by 5.5 m. Treatments were replicated four times and assigned to two-tree plots separated by guard trees, and arranged according to a randomised complete block design. Plots were sampled pre-treatment 24 August, and three times post-treatment, 1 September, 8 September, and 15 September (7, 14, and 21 days after treatment), and consisted of counts made on 50 leaves per plot, picked randomly at arm's length into the canopy. Leaves were examined using a stereomicroscope and assigned a rating based on numbers of live Peach Silver Mite (PSM); individual leaves were given a rating of 0 (zero PSM/leaf); 1 (1-10 PSM/leaf); 2 (11-25 PSM/leaf); 3 (26-50 PSM/leaf); 4 (51-100 PSM/leaf); or 5 (101+ PSM/leaf). Numbers of beneficial mites (primarily *A. fallacis*) were also recorded. On 25 August, acaricides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 11-13 L of spray mix were used per plot; pressure was set at 2000 kPa. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in the table below. Prespray samples 24 August showed similar numbers of PSM in all plots, with an average rating of approximately 3 (26-50 PSM/leaf); similar numbers of beneficial mites (approximately 0.2 per leaf) were also observed. No phytotoxic effects were observed in any of the treated plots. Numbers of PSM were observed to decline naturally into September.

CONCLUSIONS: Numbers of PSM in both the PYRAMITE and KELTHANE treated plots were significantly lower than the control in each of the 7, 14, and 21 day samples (Table 1). The PYRAMITE treatment was not significantly different from the KELTHANE treatment in any of the samples. In the 7 day sample of beneficial mites, only the KELTHANE treated plots showed significantly fewer beneficial mites than the control (Table 2); however, no significant differences were observed in any of the later samples. The PYRAMITE treated plots did not show significantly fewer beneficial mites than the control in any of the samples.

Table 1. Average PSM rating[1]

Treatment[2]	Rate a.i./ha	Prespray 24 Aug	7 days 1 Sept	14 days 8 Sept	21 days 15 Sept
KELTHANE 50 W	1.6 kg	2.88 a[3]	0.46 b	0.48 b	0.32 b
PYRAMITE 75 WP	225 g	3.63 a	0.26 b	0.23 b	0.18 b
CONTROL	-	3.83 a	2.03 a	1.61 a	0.90 a

[1] PSM Rating: 0 = 0; 1 = 1-10; 2 = 11-25; 3 = 26-50; 4 = 51-100; 5 = 100+
[2] Applied 25 August
[3] Numbers in the same column followed by the same letter are not significantly different P<0.05, Tukey test.

Table 2. Beneficial mites per leaf.

Treatment[1]	Rate a.i./ha	Prespray 24 Aug	7 days 1 Sept	14 days 8 Sept	21 days 15 Sept
KELTHANE 50 W	1.6 kg	0.12 a[2]	0.00 b	0.00 a	0.00 a
PYRAMITE 75 WP	225 g	0.19 a	0.03 a	0.01 a	0.01 a
CONTROL	-	0.24 a	0.25 a	0.08 a	0.04 a

[1] Applied 25 August
[2] Numbers in the same column followed by the same letter are not significantly different P<0.05, Tukey test.

1998 PMR REPORT # 16 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

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

NAME AND AGENCY:
POGODA, M K and PREE, D J
Southern Crop Protection and Food Research Centre, Agriculture and Agri-Food Canada
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113; Fax: (905) 562-4335; E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF ORIENTAL FRUIT MOTH ON PEACH WITH VARIOUS INSECTICIDES; 1998

MATERIALS: CYMBUSH 250 EC (cypermethrin), RH 2485 80 WP, PYRIFOS 50 WP (chlorpyrifos)

METHODS: The trial was conducted in a three-year-old orchard in the Jordan Station, Ontario area; trees cv. Harrow Beauty were spaced 4.5 m by 5.5 m. Treatments were replicated four times and assigned to two-tree plots, and arranged according to a randomised complete block design. Application timing was determined from pheromone trap catches of male moths. Treatments were applied at egg hatch; 13 May for the first generation, and 30 June for the second generation. RH 2485 was applied as two treatments at different rates, 240 g ai/ha and 360 g ai/ha. Both RH 2485 treatments were applied only for the second generation on 30 June; the spreader/sticker COMPANION was added at a rate of 0.25% of the total spray mix. 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 8-9 L of spray mix were used per plot; pressure was set at 2000 kPa. Plots were sampled post-treatment 1 June and 14 July; all infested terminals and fruit were removed, and examined for the presence of live larvae. Efficacy ratings were expressed as total damage, consisting of the total number of infested terminals and peaches. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in table 1 below. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: In the sample taken 1 June to assess the effects of treatments on the first generation, none of the treatments showed significantly less damage than the control. In the 14 July (second generation) sample, only the CYMBUSH treatment showed a significant difference from the control. Infestations were considered light.

Table 1. Total OFM damage per plot[1]

Treatment	Rate (a.i./ha)	Generation 1 1 June	Generation 2 14 July
CYMBUSH 250 EC[2]	70.0 g	0.00 a[4]	1.25 b
RH 2485 80 WP[3]	240.0 g	-	7.75 a
RH 2485 80 WP[3]	360.0 g	-	3.50 a
PYRIFOS 50 WP[2]	1.7 kg	0.00 a	5.00 a
CONTROL	-	2.25 a	11.25 a

1 Total Damage = # infested terminals + # damaged fruit
2 Applied 13 May, 30 June
3 Applied 30 June
4 Numbers in the same column followed by the same letter are not significantly different $P<0.05$, Tukey test.

SECTION B: VEGETABLES and SPECIAL CROPS /LÉGUMES ET CULTURES SPÉCIALES

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EDITOR: **Dr. Jeff H. Tolman**
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
1391 Sandford St.
London, Ontario N5V 4T3
Email: tolmanj@em.agr.ca
Tel: (519) 457-1470 Ext. 232
Fax: (519) 457-3997

1998 PMR REPORT # 17 **SECTION B: VEGETABLE AND SPECIAL CROPS**
ICAR: 61006537

CROP: Beans: S15-20 soybeans (Glycine max); Exrico white beans; Berna Dutch brown (*Phaseolus vulgaris*) beans
PEST: Seed corn maggot, *Delia platura*

NAME AND AGENCY:
SCHAAFSMA A W
Ridgetown College, University of Guelph, Ridgetown, Ontario, N0P 2C0
Tel: (519) 674-1624; Fax: (519) 674-1600; Email: aschaafs@wincom.net

TITLE: CONTROL OF SEED CORN MAGGOT WITH CRUISER

MATERIALS: CRUISER (CGA 293343 thiamethoxam 600 g/l); MAXIM XL (231g fludioxonil, 93g metalaxyl-m/l); APRON MAXX (96.5 g fludioxinil + 144 g metalaxyl-m/l)

METHODS: Seed was treated in 1 kg lots in individual plastic bags by applying a slurry of the material via a syringe to each bag. The seed was then mixed for 1 minute to ensure thorough seed coverage. The crops were planted on 22 May, 1998 at Ridgetown, Ontario using a 2-row cone seeder at 100 seeds per plot, except for the white beans which had 125 seeds per plot. Plots were 1 row planted at a row spacing of 0.76 m and 4 m in length placed in a randomized complete block design with 4 replications. Manure was placed on the plots 1 week before planting and the soil was disced once shortly after. The plots were fertilized and maintained according to provincial recommendations. Total plot emergence was evaluated on 1 June, 1998. Seed corn maggot (SCM) damage was also checked throughout a 1 m area in the centre of each plot. All seeds within the 1 m were counted, whether they had emerged or not and checked for seed corn maggot damage.

RESULTS: See Table 1.

CONCLUSIONS: The best emergence was achieved with Apron Maxx plus Cruiser in soybeans. There was significantly less SCM damage in soybeans treated with Cruiser. There was no SCM damage in the white or kidney beans. Max XL plus Cruiser resulted in the highest white bean emergence.

Table 1. Emergence and seed corn maggot damage on beans.

	Soybean		White Bean		Kidney Bean	
	Emergence Counts	% Damage	Emergence Counts	% Damage	Emergence Counts	% Damage
Control	70.3 bc	28.4 a	13.5 c	0.0 a	94.8 a	3.9 a
Apron MAXX & Cruiser *	108.0 a	13.7 b	54.3 b	1.3 a	98.3 a	2.3 a
Maxim XL & Cruiser **	90.3 ab	3.8 b	65.0 a	1.1 a	78.5 a	1.4 a
Cruiser ***	58.8 c	13.9 b	19.3 c	0.0 a	74.3 a	2.7 a
LSD	27.1	14.1	10.3	2.9	28.8	7.9
CV	20.7	59.2	16.9	298.9	20.8	190.3

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

* 7.5/5.0 & 50.0 g/kg seed
** 2.5/1.0 & 50.0 g/kg seed
*** 50.0 g/kg seed

1998 PMR REPORT # 18 **SECTION B: VEGETABLES and SPECIAL CROPS**
ICAR #: CC# 01030402 DC# 72020101

CROP: Broccoli (*Brassica oleracea*,var. *botrytis* L.), cv. Legend
PESTS: Cabbage looper (CL) *Trichoplusia ni* (Hubner)
Imported cabbage worm (ICW) *Artogeia rapae* (L.)
Diamondback moth (DBM) *Plutella xylostella* (L.).

NAME AND AGENCY:
SCOTT-DUPREE C D, REMPEL S J, CHEVERIE R M and HARRIS B J[1]
Dept. of Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1
[1]DowAgrosciences Canada Inc. Calgary, AB.
Tel: (519)824-4120 X2477; Fax: (519) 837-0442; E-mail: csdupree@evbhort.uoguelph.ca

TITLE: RELATIVE EFFICACY OF SPINOSAD 480SC AND DECIS 25EC AGAINST LEPIDOPTERAN PESTS OF BROCCOLI ON SANDY SOIL.

MATERIALS: SPINOSAD 480SC (spinosyn, *Saccharopolyspora spinosa*), DECIS 25EC (deltamethrin).

METHODS: On May 7, broccoli was planted in a seed bed at the Cambridge Research station. Seedlings were transplanted on June 17 into 4 row plots, 12 m in length with a row spacing of 0.9 m. Six treatments were replicated four times in a randomized complete block design. Plots, in the same replication, were separated by 3 m spray lanes. Foliar insecticide applications were applied using a tractor-mounted, four-row boom sprayer that delivered 750L/ha at 450 kPa. Populations of cabbage looper (CL), imported cabbage worm (ICW) and diamondback moth (DBM) were observed daily, for larval presence, beginning in the first week of July. On July 16, when populations of CL, ICW and DBM were peaking the initial spray of all treatments was applied. The second insecticide application was applied August 4. On July 21 (Day 5), and 28 (Day12); and, August 4 (Day 19/0) and 7 (Day 22/3), CL, ICW and DBM larvae were counted on 5 plants per plot using a destructive sampling technique. The larval counts were then converted to Cabbage Looper Equivalents (CLE) per head using the formula: (1x CL larvae/head)+(0.67x ICW larvae/head)+(0.2x DBM larvae/head). The broccoli was harvested on August 11 and CLE's were determined for 5 plants per plot. The same plants were graded using a harvest rating or marketability scale of 1-4. Marketable attributes include head diameter, stem length, and presence of larvae and frass on the head. Heads with harvest ratings of 2 or less are considered unmarketable.

RESULTS: Data are presented in Table 1.

CONCLUSIONS: Insect populations of CL, ICW and DBM were unusually low in this experiment. As indicated by the CLE's/head, all treatments significantly reduced populations of CL, ICW and DBM, relative to Untreated Check plots, through to harvest. Throughout the entire experiment, there were no significant differences among the insecticide treatments. According to harvest ratings, all broccoli heads were marketable. The good condition of the untreated broccoli heads is most likely a result of the low pest insect pressure experienced this season.

Table 1. Effect of SPINOSAD 480SC and DECIS 25EC on Cabbage Looper Equivalents (CLE) and harvest ratings for broccoli on sandy soil.

Treatments Ai/ha	July 21 (Day 5) CLE/head	July 28 (Day 12) CLE/head	August 4 (Day 19/0) CLE/head	August 7 (Day 22/3) CLE/head	Harvest CLE/head	Harvest Rating (1-4)
Untreated check	0.97a*	1.02a	0.92a	0.49a	1.11a	3.35a
SPINOSAD 25g+ SPINOSAD 25g	0.06b	0.34b	1.10a	0.03b	0.06b	3.55a
SPINOSAD 50g+ SPINOSAD 50g	0.04b	0.31b	0.42a	0.04b	0.18b	3.40a
SPINOSAD 75g+ SPINOSAD 75g	0.03b	0.28b	0.63a	0.06b	0.08b	3.40a
SPINOSAD 100g+ SPINOSAD 100g	0.07b	0.53ab	0.57a	0.03b	0.19b	3.70a
DECIS EC 50g+ DECIS EC 50g	0.07b	0.21b	0.85a	0.00b	0.07b	3.55a

* Treatment means in the same column followed by the same letter are not significantly different (p#0.05, Duncan's New MRT).

1998 PMR REPORT # 19 **SECTION B: VEGETABLES and SPECIAL CROPS**
ICAR #: CC# 01030402 DC# 72020101

CROP: Broccoli (*Brassica oleracea*, var. *botrytis* L.), cv. Legend
PESTS: Cabbage looper (CL) *Trichoplusia ni* (Hubner)
Imported cabbage worm (ICW) *Artogeia rapae* (L.)
Diamondback moth (DBM) *Plutella xylostella.*(L.).

NAME AND AGENCY:
SCOTT-DUPREE C D, REMPEL S J, CHEVERIE R M and HARRIS B J[1]
Dept. of Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1.
[1]Dow AgroSciences Canada Inc. Calgary, AB.
Tel: (519)824-4120 X2477; Fax: (519) 837-0442; E-mail: csdupree@evbhort.uoguelph.ca

TITLE: RELATIVE EFFICACY OF SPINOSAD 480SC AND DECIS 25EC AGAINST LEPIDOPTERAN PESTS OF BROCCOLI ON MUCK SOIL.

MATERIALS: SPINOSAD 480SC (spinosyn, *Saccharopolyspora spinosa*), DECIS 25EC (deltamethrin).

METHODS: On May 14, broccoli was planted in a seed bed at the Muck Crops Research Station – Holland Marsh, ON. Seedlings were transplanted on June 19 into 4 row plots, 12 m in length, with a row spacing of 0.9 m. Six treatments were replicated four times in a randomized complete block design. Plots, in the same replication, were separated by 3.0 m spray lanes. Foliar insecticide applications were applied using a tractor-mounted, four-row boom sprayer that delivered 750L/ha at 450 kPa. Populations of cabbage looper (CL), imported cabbage worm (ICW) and diamondback moth (DBM) were observed daily, for larval presence, beginning in the first week of July. On August 1, when populations of CL, ICW and DBM were peaking the initial spray of all treatments was applied. A second insecticide application was not done because flowering had already commenced before the populations of CL, ICW and DBM peaked for the second time. On July 31 (Day –1), August 5 (Day 4), 10 (Day 9) and 17 (Day 16), CL, ICW and DBM larvae were counted on 5 plants per plot using a destructive sampling technique. The larval counts were then converted to Cabbage Looper Equivalents (CLE) per head using the formula: (1 x CL larvae/head)+ (0.67 x ICW larvae/head) + (0.2 x DBM larvae/head). The broccoli was harvested on August 17 and CLE's were determined for 5 plants per plot. The same plants were graded using a harvest rating or marketability scale of 1-4. Marketable attributes include head diameter, stem length, and presence of larvae and frass on the head. Heads with harvest ratings of 2 or less are considered unmarketable.

RESULTS: Data are presented in Table 1.

CONCLUSIONS: Populations of ICW, CL, and DBM were unusually low in this trial. On Day 4 and Day 9, while the CLE/head were significantly lower in all treatments than in the Untreated Check, there were no significant differences among treatments. By Day 16, no significant difference was recorded between the CLE/head in any treatment and in the Untreated Check. All harvested broccoli heads were marketable; there were no significant differences in harvest ratings among treatments**.**

Table 1: Effect of SPINOSAD 480SC and DECIS 25EC on Cabbage Looper Equivalents (CLE) and harvest ratings for broccoli on much soil.

Treatments (ai/ha)	July 31 (Day-1) CLE/head	August 5 (Day 4) CLE/head	August 10 (Day 9) CLE/head	August 17 (Day 16) CLE/head	Harvest Rating (1-4)
Untreated Check	0.16b*	0.62a	0.92a	0.73a	3.55a
SPINOSAD 25g	0.34ab	0.13b	0.48b	0.77a	3.30a
SPINOSAD 50g	0.62ab	0.30b	0.46b	0.73a	3.15a
SPINOSAD 75g	0.53ab	0.03b	0.39b	0.62a	3.25a
SPINOSAD 100g	0.26b	0.15b	0.47b	0.49a	3.45a
DECIS 50 g	0.80a	0.13b	0.32b	0.27a	3.30a

* Treatment means within a column followed by the small same letter are not significantly different (p#0.05, Duncan's New MRT).

1998 PMR REPORT # 20 **SECTION B: INSECTS of VEGETABLES and SPECIAL CROPS**

ICAR: 61006535

CROP: Cabbage, cv. Galaxy
PESTS: Imported Cabbageworm, *Artogeia* (L.)
Diamondback Moth, *Plutella xylostella* (L.)

NAME AND AGENCY:
PITBLADO, R E
Ridgetown College, University of Guelph, Ridgetown, Ontario N0P 2C0
Tel: (519)674-1605; **Fax:** (519)674-1600; **E-mail:** rpitblad@ridgetownc.uoguelph.ca

TITLE: **INSECT CONTROL IN CABBAGE - 1998**

MATERIALS: ORTHENE 75SP, 97WP (acephate), CYMBUSH 250EC (cypermethrin).

METHODS: Cabbage was planted in single-row plots, 7 m in length with rows spaced 1.0 m apart, replicated four times in a randomized complete block design. Plants were transplanted using a commercial transplanter on May 29. Foliar treatments were applied using a specialized, small plot research CO_2 sprayer with a two-nozzled, hand-held boom applying 200L/ha of spray mixture on June 23, July 3, 14, 23, 28 and August 7. Assessments were taken by counting the number of feeding sites or feeding clusters and rating insect feeding damage per plot on June 29, July 13, 26, August 8 and 15. Results were analyzed using the Duncan's Multiple Range Test (P# 0.05).

RESULTS: Data are presented in Table 1.

CONCLUSIONS: The insecticides ORTHENE and CYMBUSH 250EC effectively controlled a severe infestation of imported cabbageworm and diamondback moth. The pressure from imported cabbageworm was higher than diamondback moth in a proportion of 80:20 respectively. Bridging data between formulations of ORTHENE 75SP vs 97WP showed equal effectiveness at the rates tested. A rate response was not observed as even the lower rate of both formulations showed effective and equivalent control of cabbage foliar insects.

Table 1. Control of foliar insects causing damage to cabbage.

Treatments	Rate Product/ha	Foliar Damage Ratings (0-10)[1]	# of Feeding Sites per plot[2] on indicated date			
		June 29	July 13	July 26	Aug. 8	Aug. 15
Control		7.0 a*	29.0 a	30.5 a	35.0 a	48.8 a
ORTHENE 75SP	1.1 kg	8.2 ab	3.5 b	2.0 b	2.8 b	1.8 b
ORTHENE 75SP	0.75 kg	9.7 b	3.0 b	2.0 b	2.5 b	1.8 b
ORTHENE 97WP	0.9 kg	8.0 ab	3.8 b	2.0 b	1.5 b	1.5 b
ORTHENE 97WP	0.61 kg	8.5 ab	4.8 b	1.8 b	1.5 b	1.8 b
CYMBUSH 250EC	0.14 L	8.0 ab	2.5 b	1.8 b	1.5 b	0.8 b
ANOVA P#0.05		s	s	s	s	s
Coefficient of Variation (%)		27.6	61.3	8.2	33.3	8.1

* Numbers within a column followed by the same letter are not significantly different according to a Duncan's Multiple Range Test (P#0.05).

[1] Foliar Damage Ratings (0-10) - 0, no control, foliage severely damaged; 10, complete control.

[2] Number of feeding clusters counted per plot. The larger the count, the greater the damage and the less effective the treatment.

1998 PMR REPORT # 21 **SECTION B: INSECTS of VEGETABLES and SPECIAL CROPS**

ICAR: 61006535

CROP: Cabbage, cv. Galaxy
PESTS: Imported cabbageworm, *Artogeia rapae* (L.)
Diamondback moth, *Plutella xylostella* (L.)

NAME AND AGENCY:
PITBLADO, R E
Ridgetown College, University of Guelph, Ridgetown, Ontario N0P 2C0
Tel: (519)674-1605; **Fax:** (519)674-1600; **E-mail:** rpitblad@ridgetownc.uoguelph.ca

TITLE: CONTROL OF CABBAGE FOLIAR INSECT PESTS USING RH-5992

MATERIALS: RH-5992 240F (tebufenozide), COMPANION (spreader/sticker, octalphenoxyploxyethoxy -(9)-ethanol), CROP BALANCE (natural surfactant), CYMBUSH 250EC (cypermethrin).

METHODS: Cabbage was planted in two-row plots in the research plots at Ridgetown College, 7 m in length with rows spaced 1 m apart, replicated four times in a randomized complete block design. Plants were transplanted using a commercial transplanter on May 29. Foliar treatments were applied using a specialized, small plot research CO_2 sprayer with a two-nozzled, hand-held boom applying 200L/ha of spray mixture on June 23, July 3, 14, 23, 28, and August 4. Assessments were taken by counting the number of feeding sites or feeding clusters and rating insect feeding damage per plot on July 7, 13, 26, August 8, and 15. Results were analyzed using the Duncan's Multiple Range Test (P# 0.05).

RESULTS: Data are presented in Table 1.

CONCLUSIONS: The insecticide RH-5992 240F with or without any additional surfactant materials significantly controlled foliar insect pests attacking cabbage. The pressure from imported cabbageworm was higher than diamondback moth in a proportion of 80:20 respectively. The standard CYMBUSH 250EC proved more effective in controlling cabbage insects than RH-5992 240F. The addition of the surfactant COMPANION to RH-5992 240F did not improve insect control. Indeed, in several cases, addition of COMPANION decreased control. On the other hand, the addition of CROP BALANCE improved cabbage insect control on July 13 and did not decrease the effectiveness of RH-5992 240F on any of the other assessment dates. Increasing the rate of RH-5992 240F did not appear to significantly improve the level of insect control in cabbage.

Table 1. Control of foliar insects causing damage to cabbage.

Treatments	Rate Product/ha	Foliar Damage Ratings (0-10)[1]	# of Feeding Sites per plot[2] on indicated date			
		July 7	July 13	July 26	Aug. 8	Aug. 15
Control		6.0 a*	24.0 a	31.3 a	35.0 a	50.0 a
RH-5992 240F	0.3 L	7.5 abc	17.0 b	8.3 cd	7.5 d	10.0 c
RH-5992 240F + COMPANION	0.3 L+ 0.1%v/v	7.7 bc	11.5 bcd	11.8 cd	9.5 cd	11.3 c
RH-5992 240F + COMPANION	0.3 L+ 0.25%v/v	6.8 a	14.8 bc	11.8 cd	12.8 bc	19.5 b
RH-5992 240F + COMPANION	0.6 L+ 0.1%v/v	7.4 abc	4.8 ef	14.0 bc	10.3 bcd	8.5 c
RH-5992 240F + COMPANION	0.6 L+ 0.25%v/v	6.6 ab	5.8 def	19.3 b	14.5 b	18.0 b
RH-5992 240F + CROP BALANCE	0.3 L+ 10.0 L	7.4 abc	9.3 cde	6.3 de	6.5 d	8.0 c
CYMBUSH 250EC	0.14 L	8.5 c	2.5 f	1.5 e	1.0 e	3.0 d
ANOVA P#0.05		s	s	s	s	s
Coefficient of Variation (%)		13.9	35.8	31.8	24.3	16.9

* Numbers within a column followed by the same letter are not significantly different according to a Duncan's Multiple Range Test (P#0.05).

[1] Foliar Damage Ratings (0-10) - 0, no control, foliage severely damaged; 10, complete control.

[2] Number of feeding clusters counted per plot. The larger the count, the greater the damage and the less effective the treatment.

1998 PMR REPORT # 22 **SECTION B: INSECTS of VEGETABLES and SPECIAL CROPS**

ICAR: 61006535

CROP: Cabbage, cv. Galaxy
PEST: Imported cabbageworm, *Artogeia rapae* (L.), diamondback moth, *Plutella xylostella* (L.)

NAME AND AGENCY:
PITBLADO, R E
Ridgetown College, University of Guelph, Ridgetown, Ontario N0P 2C0
Tel: (519)674-1605; **Fax:** (519)674-1600; **E-mail:** rpitblad@ridgetownc.uoguelph.ca

TITLE: CABBAGE FOLIAR INSECT CONTROL USING ORGANIC MATERIALS

MATERIALS: DIPEL WP (*Bacillus thuringiensis var. kurstaki*), CROP BALANCE (natural surfactant), AN (natural nutrient).

METHODS: Cabbage was planted in single-row plots in the research plots at Ridgetown College, 7 m in length with rows spaced 1 m apart, replicated four times in a randomized complete block design. Plants were transplanted using a commercial transplanter on June 1. Foliar treatments were applied using a specialized, small plot research CO_2 sprayer with a two-nozzled, hand-held boom applying 200L/ha of spray mixture on June 23, July 3, 14, 23, 28, and August 4. Assessments were taken by counting the number of feeding sites or feeding clusters and rating insect feeding damage per plot on July 7, 13, 26, August 8, and 15. Results were analyzed using the Duncan's Multiple Range Test (P# 0.05).

RESULTS: Data are presented in Table 1.

CONCLUSIONS: DIPEL WP when used alone provided a moderate measure of foliar insect control in cabbage. The addition of the surfactant CROP BALANCE and/or the natural nutrient mix, AN, did not further benefit insect control. The pressures from imported cabbageworm was higher than diamondback moth in a proportion of 80:20 respectively.

Table 1. Control of foliar insects causing damage to cabbage.

Treatments	Rate Product/ha	Foliar Damage Ratings (0-10)[1]	# of Feeding Sites per plot[2] on indicated date			
		July 7	July 13	July 26	Aug. 8	Aug. 15
Control		6.0 ab*	19.0 a	27.8	35.0 a	52.0 a
DIPEL WP	0.55 kg	6.7 b	10.8 b	17.5	23.3 b	34.0 c
DIPEL + CROP BALANCE	0.55 kg+ 10.0 L	6.5 b	10.8 b	17	21.5 b	38.3 bc
DIPEL + CROP BALANCE+ AN	0.55 kg+ 10.0 L+ 0.5 kg	6.1 ab	11.0 b	21.8	23.0 b	44.0 abc
CROP BALANCE+ AN	10.0 L+ 0.5 kg	5.3 a	16.3 ab	24.8	35.0 a	48.3 ab
ANOVA P#0.05		s	s	ns	s	s
Coefficient of Variation (%)		19.2	31.4		18.31	16.6

* Numbers within a column followed by the same letter are not significantly different according to a Duncan's Multiple Range Test (P#0.05).

[1] Foliar Damage Ratings (0-10) - 0, no control, foliage severely damaged; 10, complete control.

[2] Number of feeding clusters counted per plot. The larger the count, the greater the damage and the less effective the treatment.

1998 PMR REPORT # 23 SECTION B: INSECTS OF VEGETABLES AND SPECIAL CROPS
STUDY DATA BASE: 280-1252-9304

CROPS: Cabbage, cv. Lennox
Broccoli, cv. Fiesta
PEST: Cabbage maggot (CM), *Delia radicum* (Linnaeus)

NAME AND AGENCY:
TOLMAN J H, BARR T R, McFADDEN G A
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, Ontario N5V 4T3
Tel: (519) 457-1470 ext. 232; **Fax:** (519) 457-3997; **E-mail:** tolmanj@em.agr.ca

and McKEOWN A
University of Guelph, Horticulture Research Institute of Ontario
Box 587, Simcoe, Ontario N3Y 4N5
Tel: (519) 426-7127 ext. 329; **Fax:** (519) 426-1225; **E-mail:** AMckeown@hrio.uoguelph.ca

TITLE: EVALUATION OF SEED COATINGS FOR CONTROL OF CABBAGE MAGGOT ATTACKING CABBAGE AND BROCCOLI IN MINERAL SOIL - 1998

MATERIALS: REGENT 200 F (fipronil), GOVERNOR 75 WP (cyromazine), SNIPER 50 WP (azinphosmethyl), thiram/carbendazim, iprodione + metalaxyl

METHODS: Commercial film seed coatings, containing fungicides ± insecticide, were applied by BEJOZADEN Ltd. in Warmenhuizen, Holland. Coated seed was single-seeded into Cornell 17 plug-mix media in 200-cell plug-propagation trays at Simcoe, ON, on May 6. Seedlings were grown to the 4-leaf stage in the greenhouse at Simcoe. On June 3, seedlings were transplanted into 2-row microplots (2.25 m long x 0.9 m wide), filled with insecticide residue-free mineral soil, at the London Research Farm. Each row contained 15 transplants. All treatments received 100 ml starter fertilizer (soluble 10-52-10 [N-P-K] at 2.5 g/L) in the planting hole; insecticide for Tmt. 5 was added to the starter fertilizer. Separate experiments were established for cabbage and broccoli. All treatments were replicated three times in a randomized complete block design. On June 8, 10-15 CM eggs from an insecticide-susceptible, laboratory strain, originally collected near Chatham, ON, were buried 1 cm deep beside 10 of 15 plants in both rows in each plot. Infested plants were identified with a dated stake. On July 2, infested plants were carefully dug, roots washed and rated for CM feeding damage (0 - no feeding damage; 1 - small feeding channels on root/stem comprising < 5% surface area; 2 - 6%-25% surface area affected by feeding; 3 - 26%-50% surface area affected by feeding; 4 - 51%-75% surface area affected by feeding; 5 -76%-100% surface area affected by feeding, plant stunted, dying or dead. If feeding extended down into cortex of root, damage rating was increased by 1.). For each row, numbers of plants with ratings of 0 and 1 were summed, percentage of total infested plants calculated and data subjected to arcsin square root transformation prior to statistical analysis by analysis of variance. Significance of differences among treatments means was determined using Student-Neuman-Keul's Multiple Range Test. Untransformed

data are presented.

RESULTS/OBSERVATIONS: CM feeding damage to cabbage and broccoli roots following insecticide application in seed coating or planting water is shown in Table 1. below. At transplanting, both broccoli and cabbage seedlings grown from seed coated with GOVERNOR were noticeably smaller than seedlings in other treatments; broccoli seedlings appeared more sensitive than cabbage seedlings. Both cabbage and broccoli ultimately outgrew the damage symptoms after several weeks.

CONCLUSIONS: In both infestations, application of SNIPER 50WP in the transplant water provided excellent protection of both cabbage and broccoli roots; at least 90% of roots showed less than 5% damage from CM hatching from introduced eggs. Inclusion of the higher rate of REGENT 200F in the seed coating also significantly reduced CM-feeding to cabbage but not broccoli roots. Inclusion of GOVERNOR 75WP in the seed coating did not significantly decrease CM-damage to either cabbage or broccoli roots relative to the high feeding damage observed in plants grown from CONTROL seeds with no insecticide in the seed coating.

Table 1. Effect of seed coatings or planting treatment on damage to cabbage and broccoli roots by cabbage maggot - 1998.

Tmt. No.	Insecticide in Seed Coating	Rate (g AI/ kg seed	Mean % "Good Roots"* for Indicated Vegetable/Row			
			CABBAGE		BROCCOLI	
			Row I	Row II	Row I	Row II
1	GOVERNOR	50	16.7 c**	10.0 b	14.9 c	10.7 c
2	GOVERNOR	75	10.0 c	3.3 b	40.0 bc	44.8 bc
3	REGENT	10	46.7 bc	66.7 a	76.7 ab	60.0 ab
4	REGENT	20	70.0 b	70.0 a	60.0 abc	53.3 b
5	SNIPER	0.1***	100.0 a	93.3 a	96.3 a	89.3 a
6	CONTROL	--	10.0 c	6.7 b	45.6 bc	40.4 bc

* Roots with a rating of 0 (no damage) or 1 (small feeding channels on root/stem comprising < 5% surface area).

** Means within a column followed by the same letter are not significantly different (P#0.05) as determined by Student-Neuman-Keul's Multiple Range Test.

*** Planting Water treatment; 0.1 g AI/plant in 100 ml/plant.

1998 PMR REPORT # 24 SECTION B: INSECTS OF VEGETABLES AND SPECIAL CROPS
STUDY DATA BASE: 280-1252-9304

CROP: Cucumber, cv. Pioneer
Squash, cv. Mini-Hubbard
PEST: Striped cucumber beetle (SCB), *Acalymma vittatum* (Fabricius)

NAME AND AGENCY:
MACINTYRE J K, SCOTT-DUPREE C D
Dept. Environmental Biology, U. of Guelph, Guelph, Ontario N1G 2W1
Tel: (519) 824-4120 ext. 2477; **Fax:** (519) 837-0442; **E-mail:** csdupree@evbhort.uoguelph.ca

and TOLMAN J H
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, Ontario N5V 4T3
Tel: (519) 457-1470 ext. 232; **Fax:** (519) 457-3997; **E-mail:** tolmanj@em.agr.ca

TITLE: EVALUATION OF SEED TREATMENTS FOR CONTROL OF STRIPED CUCUMBER BEETLE ATTACKING CUCUMBER AND SQUASH IN MINERAL SOIL - 1998

MATERIALS: UBI 2627 175 SD (imidacloprid)

METHODS: Commercial seed treatments containing imidacloprid were applied by Uniroyal Chemicals Inc. in Guelph, ON in May 1998. Either 2 (squash) or 3 (cucumber) treated seeds were planted into each cell of 32-cell plug-propagation trays in Premier ProMix BX growing medium on July 7. On July 22, seedlings were transplanted into single row (6 seedlings-plugs) microplots (2.25 m long x 0.9 m wide), filled with insecticide residue-free mineral soil, at the London Research Farm. All treatments were replicated three times in a randomized complete block design. Systemic activity of imidacloprid, absorbed by growing seedlings, was measured in the laboratory using a leaf-bioassay. On July 27, August 4 and 11 (5, 13, 20 days after transplanting), leaves close to the growing point with a diameter of 7-8 cm were carefully cut from the stem and placed inside labelled plastic bags which were then transported back to the laboratory. In the laboratory each leaf was trimmed to a length of 8 cm. To maintain leaf quality, the butt end of each trimmed leaf was then carefully inserted through the rubber septum of a "rose vial" filled with 3.0 ml of water. The sharp tip of the completed preparation was pushed out through the bottom of a disposable 7.5 x 9.0 cm Styrofoam cup, leaving the treated leaf upright inside the cup. On each collection date a total of 9 bioassays (3 bioassays/plot x 3 plots/tmt.), each containing 1 leaf and 5 field-collected SCB adults, was established for each treatment Each bioassay was covered with a glass petri dish and transferred to a controlled environment cabinet at 25±1ºC, 55% ± 5% RH and 16:8(L:D). Mortality and leaf damage were recorded after 24, 48 and 72 hours. Leaf damage was rated using a 0-10 scale where 0 represented no feeding damage, 5 represented 50% loss of leaf area, and 10 represented 100% consumption of the leaf. Mortality was corrected using Abbott's correction. Statistical significance of differences among treatments was determined by analysis of variance and Fisher’s protected LSD. test. Adult-damage reduction was determined by subtracting individual bioassay damage ratings from the

average CONTROL damage rating and calculating % reduction. On July 24 (cucumbers) and July 29 (immature squash), samples were collected from all plots of a separate experiment planted, as described above on June 17 to produce vegetables for residue-analysis . All residues of imidacloprid were determined using HPLC by the Analytical Chemistry Services Group in the London laboratory of the Southern Crop Protection and Food Research Centre.

RESULTS/OBSERVATIONS: See Tables 1 and 2 below. For the sake of brevity, only results observed after 72 hours are reported. Cucumber seeds treated with imidacloprid at rates higher than 1.0 mg AI/plant did not germinate in this trial. Squash seedlings proved more tolerant to imidacloprid than cucumber seedlings. Excellent germination was recorded for squash seed treated with as much as 10.0 mg AI/plant imidacloprid.

CONCLUSIONS: While mortality of SCB introduced onto cucumber leaves harvested 13 days after transplanting (DAT) seedlings was quite low, virtually no feeding damage was observed on leaves from plants growing from seed treated with 1.0 mg AI/plant. An average of 60% of the area of leaves from untreated plants was consumed in the same bioassay. By 20 DAT, damage reduction in treated plants fell to just over 65% (Table 1). Protection of squash seedlings by imidacloprid 20 DAT did not approach levels of protection observed, in bioassay, for cucumber seedlings from seeds treated with imidacloprid at 1.0 mg AI/plant until the insecticide was applied to squash seeds at 10.0 mg AI/plant (Compare Tables 1 and 2). In microplots in 1998, imidacloprid absorbed from seed treatments would have adequately protected growing cucumber and squash seedlings from feeding by adult SCB during the vulnerable establishment period.

Residues: The limit of detection for imidacloprid in cucurbits in this trial was 0.17 ppm. No imidacloprid was detected in cucumbers or squash, harvested 37 and 42 days, respectively, after transplanting.

Table 1a. Effect of imidacloprid-seed treatments on damage to cucumber seedlings by adult striped cucumber beetle, *A. vittatum* (Fabr.), in bioassay - 1998.

Tmt. No.	Amount Imidacloprid Applied (mg AI/plant)	Adult Striped Cucumber Beetle Response on Indicated DAT[1]					
		Day 5		Day 13		Day 20	
		Mortality[2]	Damage Red.[3]	Mortality[2]	Damage Red.[3]	Mortality[2]	Damage Red.[3]
1	1	33.3 b[4]	100	23.7 b	100	9.0 a	66.7
4	0	0.0 a	2.05	0.0 a	6	0.0 a	4.5

Table 1b. Effect of imidacloprid-seed treatments on damage to squash seedlings by adult striped cucumber beetle, *A. vittatum* (Fabr.), in bioassay - 1998.

Tmt. No.	Amount Imidacloprid Applied (mg AI/plant)	Adult Striped Cucumber Beetle Response on Indicated DAT					
		Day 5		Day 13		Day 20	
		Mortality[2]	Damage Red.[3]	Mortality[2]	Damage Red.[3]	Mortality[2]	Damage Red.[3]
1	1	26.4 b[4]	100	0.0 a	50	3.1 a	21.4
2	5	61.5 c	100	0.0 a	76	5.1 a	71.4
3	10	39.6 c	100	25.6 a	100	12.2 a	64.3
4	0	0.0 a	6.05	0.0 a	5	0.0 a	7

[1] Days after Transplanting
[2] Corrected % Mortality
[3] % Damage Reduction relative to feeding damage to leaves from CONTROL plots (Tmt. 4)
[4] Means within a column followed by the same letter are not significantly different (P#0.05) as determined using Fisher's protected LSD means separation test.
[5] Actual 72-hour Damage Rating (0-10 scale where 0 represents no feeding damage, 5 represents 50% loss of leaf area, 10 represents 100% consumption of the leaf)

1998 PMR REPORT # 25 **SECTION B: VEGETABLES AND SPECIAL CROPS**
ICAR: 84100737

CROP: Onions, cv. Cortland
cv. Tribute

PEST: Onion maggot (OM), *Delia antiqua* (Meig.)

NAME AND AGENCY:
MCDONALD M R, JANSE S,
Department of Plant Agriculture, University of Guelph
Muck Crops Research Station, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783; Fax: (905) 775-4546; E-mail: mrmcdona@uoguelph.ca

SCOTT-DUPREE C D, RITCEY G M and HARRIS C R
Department of Environmental Biology, University of Guelph, Guelph, Ontario N1G 2W1
Tel: (519) 824-4120; Fax: (519) 837-0442; E-mail: csdupree@evbhort.uoguelph.ca

TITLE: INSECTICIDE SEED-COATINGS AND GRANULAR INSECTICIDES FOR ONION MAGGOT CONTROL

MATERIALS: LORSBAN G (chlorpyrifos 15%), AZTEC G (phosetbupirin 2.0% + cyfluthrin 0.1%), GOVERNOR WP (cyromazine 75%), REGENT (fipronil 500g/L), PRO GRO (carbathiin 30% + thiram 50%), DITHANE DG (mancozeb 75%), T-22 (*trichoderma harzianum*).

METHODS: The trial was arranged in a randomized complete block design with four replications at the Holland Marsh on muck soil. Commercial custom-coated PRO GRO and GOVERNOR WP (50 g ai/kg of seed) treated seed was provided by the Asgrow Seed Co. Commercial film seed coating REGENT (25g ai/kg of seed cv. Cortland) was provided by Bejozaden Ltd., Warmenhuizen, Holland. LORSBAN G at the rate of 4.8 kg ai/ha and AZTEC G at the rate of 0.5 kg ai/ha were applied in the furrow at planting time (May 15) by adding them with the seed (cv. Tribute) on a V-belt planter. For onion smut control, the DITHANE DG was applied in the furrow at planting time as a granular or drench treatment at the rate of 6.6 kg ai/ha. The granular T-22 was applied in the furrow at planting time at the rate of 44.4 g/100 m of row. Each four-row plot was 6 m long and rows spaced 40 cm apart. In each plot four, 2-m lengths were designated for OM-efficacy and the initial stand was determined by counting the number of plants in each, 2-m lengths on June 16. For the first generation the designated two, 2-m lengths were examined for OM-damage in each plot twice weekly from June 16 to July 7. The plants that were wilted from OM-damage were counted and removed. On July 9, the remaining plants were pulled and examined for OM-damage. At the end of the second and third generation, August 17 and September 22 respectively, all plants were pulled from the designated 2-m lengths in each plot and plants were examined for OM-damage. On October 6, the designated 2-m length of onions was harvested for yield.

RESULT: Data are presented in table 1.

CONCLUSION: In the first generation REGENT seed treatment with DITHANE granular and drench treatments was the most effective insecticide treatment for controlling the onion maggot infestation. The

insecticide treatments with DITHANE granular treatment had the lower stand losses and the higher yields than the same insecticide treatment with drench application of the fungicide. REGENT seed treatment was the most effective of the granular and seed treatments for OM control.

Table 1. Initial stand, percent maggot damage, percent stand loss, and yield following the indicated granular and seed treatments.

Treatments			Initial plant count/ 6m row	% Maggot damage	% Stand loss		Yield kg/ha x 10^3
Insecticides	Fungicides*						
				Gen 1	Gen 1&2	Gen 1,2&3	
- - - -	raw seed		1.17e+50	29.3b**	84.3a	90.8a	13.9h
	DITHANE	T-22					
- - - -	- - - -	- - - -		28.7b	66.5ab	69.2bc	46.5fg
- - - -	granular	- - - -		25.7b	54.8bc	51.3c-e	56.1e-g
- - - -	drench	- - - -		43.3a	84.2a	75.4ab	44.2fg
- - - -	- - - -	T-22		31.3b	58.9b	65.0b-d	36.2gh
Granular							
LORSBAN G	granular	- - - -		4.9c-e	19.4e-h	20.8g-i	93.1a-c
LORSBAN G	drench	- - - -		13.3c	32.6d-g	40.3e-g	78.6b-e
LORSBAN G	- - - -	T-22		14.6c	33.9d-f	31.5e-i	84.2b-d
AZTEC G	granular	- - - -		4.2c-e	7.2h	15.7i	95.5ab
AZTEC G	drench	- - - -		13.5c	49.6b-d	46.2d-f	79.7b-e
AZTEC G	- - - -	T-22		11.8cd	34.8d-f	34.8e-i	77.3b-e
Seed treatment							
GOVERNOR WP	granular	- - - -		1.6de	13.8gh	18.7hi	91.5a-c
GOVERNOR WP	drench	- - - -		4.8c-e	33.4d-f	37.9e-h	70.8c-e
GOVERNOR WP	- - - -	T-22		8.9c-e	38.0c-e	49.1c-f	64.4d-f
REGENT	granular	- - - -		1.2e	5.77h	14.3i	108.2a
REGENT	drench	- - - -		1.2e	17.4f-h	25.3g-i	99.4ab
REGENT	- - - -	T-22		2.7de	20.1e-h	30.5f-i	92.8a-c
ANOVA P#0.05				10.5	19.5	20.7	24

* All seeds treated with PRO GRO other than raw seed

** Numbers within a column followed by the same letter are not significantly different (P# 0.05; LSD test)

1998 PMR REPORT # 26 **SECTION B: INSECTS OF VEGETABLES AND SPECIAL CROPS**
STUDY DATA BASE: 280-1252-9304

CROP: Radish, cv. Scarlet Globe Rebel
PEST: Cabbage maggot (CM), *Delia radicum* (Linnaeus)

NAME AND AGENCY:
TOLMAN J H, BARR T R and McFADDEN G A
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, Ontario N5V 4T3
Tel: (519) 457-1470 ext. 232; **Fax:** (519) 457-3997; **E-mail:** tolmanj@em.agr.ca

TITLE: EVALUATION OF SEED COATINGS FOR CONTROL OF CABBAGE MAGGOT ATTACKING RADISHES IN MINERAL SOIL - 1998

MATERIALS: REGENT 200 F (fipronil), GOVERNOR 75 WP (cyromazine), LORSBAN 480 E (chlorpyrifos), thiram/carbendazim, iprodione + metalaxyl

METHODS: Commercial film seed coatings, containing fungicides ± insecticides, were applied by BEJOZADEN Ltd. in Warmenhuizen, Holland. On May 7 at the London Research Farm, a single row of radish (60 seeds/m) was planted down the centre of microplots (2.25 m long x 0.9 m wide) filled with insecticide residue-free mineral soil. All treatments were replicated three times in a randomized complete block design. On June 3, a row of cabbage transplants was planted on both sides of the radish row in each plot. On May 21 a total of 250 CM eggs from an insecticide-susceptible, laboratory strain, originally collected near Chatham, ON, were buried 1 cm deep beside a portion of the radish row in each plot. The infested row length was delineated by stakes and the number of radish plants was counted. Infestation to the remainder of the row was repeated on May 22. All radishes from both infestations were harvested on June 8. Roots were washed, counted, weighed, inspected for CM damage and the percent roots showing any feeding damage calculated. Data were subjected to arcsin square root transformation prior to statistical analysis by analysis of variance; significance of differences among treatments means was determined using Least Significant Difference (LSD). Untransformed data are presented. To evaluate effectiveness of seed coatings for control of CM-damage to radish later in the season, the entire experiment was repeated in a second set of plots. Radish were planted on July 31, CM-eggs were infested on August 17 and damage evaluated on August 28.

RESULTS/OBSERVATIONS: CM feeding damage and mean radish weight/root are shown in Tables 1a. and 1b. below. Inclusion of GOVERNOR 75WP in the seed coating both delayed and reduced emergence of radish seedlings. In addition, many of the weakened seedlings that did emerge failed to develop. Neither REGENT nor LORSBAN significantly delayed radish emergence.

CONCLUSIONS: All seed coatings significantly reduced CM damage to radish for both infestations in the spring-planting of radish; CM-control by LORSBAN was numerically but not significantly better than control by either GOVERNOR or REGENT. Results in the summer-planting were not as clear. No seed coating significantly reduced CM-damage for Infestation I; CM-damage in CONTROL plots was

relatively low, possibly due to egg infestation during the heat of the day. CM-damage was higher in CONTROL plots for Infestation II, infested late in the day. For Infestation II, significantly less damage was recorded in radishes from seeds coated with both GOVERNOR and LORSBAN. Neither rate of REGENT in the seed coating effectively controlled CM-damage for Infestation II in the summer-planting. While radish size was quite variable, roots were significantly smaller in plots planted with seed coated with GOVERNOR 75WP. Due to phytotoxicity, GOVERNOR 75WP should not be developed as a seed coating for radish.

Table 1a. Effect of seed coatings on damage to radish roots by cabbage maggot - May 1998.

Tmt. No.	Insecticide in Seed Coating	Rate (g AI/ kg seed	Mean Radish Response for Indicated Infestation			
			Infestation I		Infestation II	
			% Damage	Wt/Root (g)	% Damage	Wt/Root (g)
1	GOVERNOR	50	8.4 b*	3.06 cd	7.0 b	2.70 cd
2	GOVERNOR	75	14.9 b	1.97 d	3.7 bc	1.36 d
3	REGENT	5	13.9 b	5.33 abc	12.7 b	6.13 a
4	REGENT	10	7.5 bc	7.16 a	4.1 bc	5.41 ab
5	LORSBAN	9.6	0.6 c	4.01 bcd	0.0 c	5.28 ab
6	CONTROL	---	51.4 a	5.85 ab	54.0 a	4.11 bc

Table 1b. Effect of seed coatings on damage to radish roots by cabbage maggot - August 1998.

Tmt. No.	Insecticide in Seed Coating	Rate (g AI/ kg seed	Mean Radish Response for Indicated Infestation			
			Infestation I		Infestation II	
			% Damage	Wt/Root (g)	% Damage	Wt/Root (g)
1	GOVERNOR	50	5.6 a	0.47 b	3.8 b	1.46 cd
2	GOVERNOR	75	22.1 a	1.44 b	0.0 b	0.41 d
3	REGENT	5	17.9 a	4.44 a	9.7 a	5.43 ab
4	REGENT	10	21.7 a	4.25 a	17.5 ab	3.65 bc
5	LORSBAN	9.6	7.6 a	5.79 a	6.6 b	6.28 a
6	CONTROL	---	16.7 a	5.73 a	31.6 a	5.17 ab

* Means within a column followed by the same letter are not significantly different (P#0.05) as determined by LSD.

1998 PMR REPORT # 27: SECTION B: INSECTS OF VEGETABLES AND SPECIAL CROPS
STUDY DATA BASE: 280-1241-9580

CROP: Flue-cured tobacco, cv. Delfield
PEST: Tobacco aphid (TA), *Myzus nicotianae*

NAME AND AGENCY:
TOLMAN J H, MURCHIE K J and FONSECA E J A
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, Ontario N5V 4T3
Tel: (519) 457-1470 ext. 232; **Fax:** (519) 457-3997; **E-mail:** tolmanj@em.agr.ca

TITLE: "PLANTING", SIDE-DRESS AND FOLIAR INSECTICIDES FOR CONTROL OF APHIDS ATTACKING FLUE-CURED TOBACCO - 1998

MATERIALS: ADMIRE 240 F (imidacloprid), ORTHENE 75 SP, 97SP (acephate), PFIZOL-10 81% (N-decanol)(sucker control agent)

METHODS: Control of TA by several methods of insecticide application was investigated on the Delhi Research Farm of the Southern Crop Protection and Food Research Centre. With the exception of Tmts. 2 and 3, tobacco seedlings were grown in a glass-greenhouse in muck seedbeds precision-seeded with pelletized seed on April 6. Seedlings for Tmts. 2 and 3 were grown singly in Berger BM-2 propagation media in 288-cell Styrofoam float trays placed in the float tanks in a double poly-house on March 22. On May 15, Tmts. 2 and 3 were applied at 200 kPa in 80 L/100 m^2 and washed from tobacco foliage into the propagation media with 240 L/100 m^2 water, using a single-nozzled, CO_2-pressurized, R&D precision sprayer fitted with an 8002EVS flat fan spray tip. Tobacco seedlings had been clipped to a height of 15-18 cm. On May 20, all treatments were transplanted with a single row Delhi Foundry planter in a randomized complete block design with 4 replications. Each plot contained 4 rows of 36 plants; only the centre 2 rows were treated and subsequently sampled for bioassay. Tmt. 1 was applied in 150 ml transplant water/plant. All other treatments received 150 ml clear transplant water/plant. On June 24 Tmts. 4-6 were applied in a 5-cm band on top of side-dress fertilizer at 200 kPa in 4.8 L/100 m via a single TG3 hollow cone nozzle mounted on the shank of each fertilizer shoe. On July 20 and 28, Tmts. 7-9 were applied to topped tobacco at 100 kPa in 450 L/ha using a HAHN HI-BOY high clearance sprayer travelling at 5.5 km/h, fitted with a 3-nozzle boom over each row, 1 x TG5 full cone spray tip centred over the row and 1 x TG3 full cone spray tip directed downwards at 45E on either end of the 0.7 m boom. Residual effectiveness of all treatments was measured by bioassay at varying times after application. On each assay date, 5-cm diameter leaf discs were punched from either the youngest leaf large enough to permit collection of a sample without severing the mid-rib or from the third leaf from the severed top of the stalk. On each collection date a total of 12 bioassays (3 bioassays/plot x 4 plots/tmt.) was established for each treatment. Each bioassay contained 1 leaf disc on 50 cc moist (10% wt/wt) silica sand and 10 mature, wingless TA from a stock culture. Bioassays were held at 23EC, 60% RH, and 16:8 L:D photoperiod. For each bioassay, the number of surviving mature TA and the number of nymphs produced were recorded after 48 hrs. The number of nymphs/surviving TA was then calculated for each bioassay. Statistical significance of effect of treatments on numbers of surviving TA and numbers of

nymphs/surviving TA was determined by analysis of variance. Least Squares Differences (LSD) were calculated and used to estimate significance of differences among treatment means.

RESULTS/OBSERVATIONS: Experimental treatments are described in Table 1. Throughout the growing season, field TA populations were too low and too uneven to permit collection of meaningful field data. Results of measurement by bioassay of effectiveness of planting (PrePlant Tray-Drench [PPTD] and Planting Water [PW]) treatments are shown in Tables 2a and 2b. Results of similar measurement of effectiveness of side-dress insecticides are outlined in Tables 3a and 3b. Tables 4a-4d detail results of bioassay of persistence of effectiveness of 2 applications of insecticide in combination with a sucker control agent (SA-treatments).

PPTD-application of ORTHENE (Tmt. 3) resulted in noticeable damage to float transplants. Typical symptoms of acephate-injury, ie. brownish leaf margins and brownish discolouration of leaf lamella between veins, were observed on greenhouse leaves on transplants in the field 7 days after planting. While plants generally grew through the injury, topping was delayed in some plots. No damage was noted following any other treatment.

ORTHENE 97SP did not dissolve readily.

CONCLUSIONS: Effects of "planting treatments" on survival of introduced mature wingless TA and production of nymphs by introduced TA are shown in Tables 2a and 2b. By 5 days after planting (DAP), both TA-survival and TA-productivity were significantly lower in all treatments than in untreated CONTROL plots (Tmt. 10); there was, however, no significant difference among treatments. By 19 DAP, significantly higher mortality of introduced TA was recorded following PPTD-application of ORTHENE 75SP (Tmt. 3) than either method of application of ADMIRE 240F (Table 2a). By 26 DAP, relative toxicity of ORTHENE 75SP began to decline; there was no significant difference in TA-survival among treatments at this time. By 33 DAP, there was no significant difference between TA-survival on plants treated with ORTHENE 75SP PPTD and on untreated plants (Table 2a). Only PPTD-application of ADMIRE 240F significantly reduced TA-survival beyond 41 DAP; reduction however was only 13%.

Impact of "planting treatments" on TA-productivity generally lasted longer than direct effect on TA-survival (Cf. Tables 2a and 2b). As late as 55 DAP, PW application of ADMIRE 240F (Tmt. 1) significantly decreased the number living nymphs/surviving female by over 20%. TA-productivity was significantly decreased for 48 DAP following PPTD-application of ADMIRE 240F and for 41 DAP following PPTD-application of ORTHENE 75SP (Table 2b).

In an effort to extend the window of protection provided by the systemic activity of both imidacloprid (ADMIRE 240F) and acephate (ORTHENE 75SP) applied in the soil, both insecticides were applied in the furrow on top of side-dress fertilizer on 25 June. Subsequent effects of these side-dress (SD) treatments on both TA-survival and TA-productivity are shown in Tables 3a and 3b.

While no treatment had any impact on survival of TA introduced into bioassays established 4 days after treatment (DAT),(Table 3a), TA-productivity was significantly reduced on leaves from tobacco receiving SD-application of ORTHENE 75SP (Table 3b). Tobacco received 20 mm water by irrigation 2 days prior to side-dress application resulting in significant plant growth by the second sampling date, 11 DAT. SD-application of both ORTHENE 75SP and the higher rate of ADMIRE 240F resulted in significant

mortality of introduced TA at that time (Table 3a); only ADMIRE 240F significantly reduced TA-productivity (Table 3b). While SD-application of ORTHENE 75SP affected neither TA-survival nor productivity beyond 11 DAT, ADMIRE 240F @ 10.0 ml/100 row had a significant impact on TA as long as 25 DAT (Table 3a, b). SD-application of ADMIRE 240F this year certainly was not as effective as planting-application of the insecticide. Nonetheless, preliminary results suggest further investigation may well be warranted to either improve delivery of the spray in the fertilizer furrow or, perhaps, incorporate insecticide directly onto the side-dress fertilizer.

As shown in Tables 4a-d, b, all sucker application- (SA) treatments significantly reduced both survival and productivity of TA introduced into bioassays at varying times after treatment. Generally, SA-application of ORTHENE 75SP proved more effective (greater toxicity, longer duration) than similar application of ADMIRE 240F. For example, for the first application, SA-application of ADMIRE 240F significantly reduced TA-survival only until 4 DAT; both formulations of ORTHENE 75SP remained effected for at least 7 days (Table 4a). While both ADMIRE 240F and ORTHENE 75SP significantly reduced TA-productivity for at least 7 days following the first application, the impact of ORTHENE 75SP was significantly greater than that of ADMIRE 240F (Table 4b).

A similar trend was noted following the second application (Table 4c, d). Bioassays established as late as 21 DAT revealed significant mortality of introduced TA following application of ORTHENE 75SP (Table 4c). The effectiveness of ADMIRE 240F recorded 21 DAT is felt to be anomalous due to the lack of impact by the insecticide in bioassays established 10 and 14 DAT (Table 4c). On all but 2 sampling dates, there were no significant differences between the performances of the 2 formulations of acephate. Only at 7 DAT for the first application (Table 4a) and 21 DAT for the second application (Table 4c) was there significantly more survival of introduced TA on tobacco treated with ORTHENE 97SP.

While foliar application of acephate generally provided more effective TA-control than did similar application of imidacloprid, registration of ADMIRE 240F would nonetheless provide Ontario tobacco-growers with a useful tool for resistance management. A single application of the insecticide should effectively reduce problem TA-populations. As only insecticides that inhibit acetylcholinesterase have been available and applied for TA-management for many years, continued selection may well have increased tolerance to this group of insecticides. By “breaking the cycle”, application of ADMIRE 240F may well prolong the effective life of this useful group of insecticides, a group that includes ORTHENE 75SP.

RESIDUE ANALYSIS: Samples of dried tobacco from all ADMIRE-treatments have been collected to determine whether imidacloprid could be detected after curing and processing. Analyses are not yet complete.

Table 1. Experimental field treatments for control of tobacco aphid, *Myzus nicotianae* - 1998.

Tmt. No.	Material(s) Applied	Application Type	Rate(s) Applied
1	ADMIRE 240F	planting water (PW)	30.0 ml/1000 plants
2	ADMIRE 240F	pre-plant tray drench (PPTD)	30.0 ml/1000 plants
3	ORTHENE 75SP	pre-plant tray drench (PPTD)	75.0 g/1000 plants
4	ADMIRE 240F	side-dress (SD)	7.0 ml/100 m
5	ADMIRE 240F	side-dress (SD)	10.0 ml/100 m
6	ORTHENE 75SP	side-dress (SD)	15.0 g/100 m
7	ADMIRE 240F+ PFIZOL 10	sucker-application (SA)	230 ml /ha + 16.8 L /ha
8	ORTHENE 75SP+ PFIZOL 10	sucker-application (SA)	1100 g /ha + 16.8 L /ha
9	ORTHENE 97SP+ PFIZOL 10	sucker-application (SA)	850.5 g/ha + 16.8 L /ha
10	CONTROL	----	----

Table 2a. Effect of "Planting Treatments" on survival of introduced tobacco aphid, *Myzus nicotianae* - 1998.

Tmt. No.	Treatment Applied	Rate (/1000 plants)	Mean No. Surviving Females on Indicated Day afte					
			5	12	19	26	33	41
1	ADMIRE 240F- PW	30.0 ml	1.6 b[1]	0.4 b	2.1 b	3.9 b	6.3 b	8.4 a
2	ADMIRE 240F- PPTD	30.0 ml	0.3 b	0.4 b	2.3 b	3.9 b	6.4 b	8.3 a
3	ORTHENE 75SP-PPTD	75.0 g	0.0 b	0.1 b	0.5 c	6.1 b	7.8 ab	9.5 a
10	CONTROL	----	8.4 a	9.8 a	9.0 a	9.5 a	9.5 a	9.3 a

Table 2b. Effect of "Planting Treatments" on production of living nymphs by introduced tobacco aphid, *Myzus nicotianae* - 1998.

Tmt. No.	Treatment Applied	Rate (/1000 plants)	Mean No. Living Nymphs/Surviving Female on Indicated I					
			5	12	19	26	33	41
1	ADMIRE 240F- PW	30.0 ml	0.1 b	0.3 b	0.0 b	0.4 b	0.3 c	3.2 c
2	ADMIRE 240F- PPTD	30.0 ml	0.1 b	0.0 b	0.0 b	0.2 b	0.7 c	4.1 c
3	ORTHENE 75SP-PPTD	75.0 g	0.0 b	0.0 b	0.0 b	0.7 b	3.9 b	6.4 b
10	CONTROL	----	7.5 a	5.8 a	6.5 a	3.5 a	7.1 a	8.2 a

[1] Means within a column followed by the same letter are not significantly different (P#0.05) as determined using an L.S.D. means separation test.

Table 3a. Effect of "Side-Dress Treatments" on survival of introduced tobacco aphid, *Myzus nicotianae* - 1998.

Tmt. No.	Treatment Applied	Rate (pdct./100 m)	Mean No. Surviving Females on Indicated DAT[1]			
			4	11	18	25
4	ADMIRE 240F- SD	7.0 ml	9.2 a[2]	8.2 ab	7.8 b	8.9 ab
5	ADMIRE 240F- SD	10.0 ml	10.0 a	7.4 b	8.3 b	7.5 b
6	ORTHENE 75SP-SD	15.0 g	9.7 a	7.3 b	9.4 a	***[3]
10	CONTROL	----	9.3 a	9.5 a	9.9 a	9.8 a

Table 3b. Effect of "Side-Dress Treatments" on production of living nymphs by introduced tobacco aphid, *Myzus nicotianae* - 1998.

Tmt. No.	Treatment Applied	Rate (pdct./100 m)	Mean No. Living Nymphs/Surviving Female on Indicated DAT			
			4	11	18	25
4	ADMIRE 240F- SD	7.0 ml	9.1 a	3.3 bc	7.3 b	9.1 b
5	ADMIRE 240F- SD	10.0 ml	6.9 ab	1.8 c	4.8 b	8.2 b
6	ORTHENE 75SP-SD	15.0 g	5.6 b	5.9 ab	11.9 a	***
10	CONTROL	----	8.2 a	8.4 a	12.7 a	12.5 a

[1] Day after Treatment

[2] Means within a column followed by the same letter are not significantly different (P#0.05) as determined using an LSD means separation test.

[3] Bioassay not done due to high survival of introduced TA in preceding series of tests.

Table 4a. Effect of "Sucker-Application Treatments" on survival of introduced tobacco aphid, *Myzus nicotianae* - First Application - 1998.

Tmt. No.	Treatment Applied[1]	Rate (pdct./ha)	Mean No. Surviving Females on Indicated Day after Treatment		
			1	4	7
7	ADMIRE 240F- SA	230.0 ml	4.5 b[1]	6.0 b	8.7 a
8	ORTHENE 75SP-SA	1,100.0 g	2.8 bc	0.7 c	2.0 c
9	ORTHENE 97SP-SA	850.5 g	0.8 c	0.8 c	3.5 b
10	CONTROL	----	9.8 a	9.5 a	9.5 a

Table 4b. Effect of "Sucker-Application Treatments" on production of living nymphs by introduced tobacco aphid, *Myzus nicotianae* - First Application - 1998.

Tmt. No.	Treatment Applied[1]	Rate (pdct./ha)	Mean No. Living Nymphs/Surviving Female on Indicated Day after Treatment		
			1	4	7
7	ADMIRE 240F- SA	230.0 ml	3.8 b	6.3 b	3.3 b
8	ORTHENE 75SP-SA	1,100.0 g	2.6 b	3.3 bc	1.5 c
9	ORTHENE 97SP-SA	850.5 g	4.9 b	0.7 c	2.1 bc
10	CONTROL	----	12.5 a	10.5 a	12.5 a

Table 4c. Effect of "Sucker-Application Treatments" on survival of introduced tobacco aphid, *Myzus nicotianae* - Second Application - 1998.

Tmt. No	Treatment Applied[1]	Rate (pdct. /ha)	Mean No. Surviving Females on Indicated Day after Treatment					
			1	3	7	10	14	21
7	ADMIRE 240F- SA	230.0 ml	5.1 b[1]	6.2 b	7.3 b	9.3 a	8.5 a	3.9 b
8	ORTHENE 75SP-SA	1,100.0 g	1.8 c	0.7 c	1.6 c	2.0 b	0.8 b	3.8 b
9	ORTHENE 97SP-SA	850.5 g	0.5 c	0.7 c	1.8 c	1.7 b	1.4 b	7.2 a
10	CONTROL	----	9.2 a	9.0 a	8.8 a	8.9 a	8.7 a	8.1 a

Table 4d. Effect of "Sucker-Application Treatments" on production of living nymphs by introduced tobacco aphid, *Myzus nicotianae* - Second Application - 1998.

Tmt. No	Treatment Applied[1]	Rate (pdct. /ha)	Mean No. Living Nymphs/Surviving Female on Indicated Day after Treatment					
			1	3	7	10	14	21
7	ADMIRE 240F- SA	230.0 ml	0.9 b	1.5 b	3.5 b	5.6 a	5.0 ab	6.3 a
8	ORTHENE 75SP-SA	1,100.0 g	0.9 b	0.5 c	5.0 ab	2.8 b	1.7 b	6.0 a
9	ORTHENE 97SP-SA	850.5 g	0.7 b	0.9 bc	4.6 ab	2.7 b	5.6 ab	6.8 a
10	CONTROL	----	8.4 a	8.3 a	7.4 a	7.4 a	7.5 a	6.0 a

[1] all treatments tank mixed with 16.8 L/ha PFIZOL 10

[2] Means within a column followed by the same letter are not significantly different (P#0.05) as determined using an LSD means separation test.

PMR REPORT # 28: SECTION B: INSECTS OF VEGETABLES AND SPECIAL CROPS
STUDY DATA BASE: 280-1241-9580

CROP: Flue-cured tobacco, cv. AC-Cheng (Site 1); Delfield (Site 2)
PEST: Eastern field wireworm (EFW), *Limonius agonus* (Say)

NAME AND AGENCY:
TOLMAN J H and MURCHIE K J
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, Ontario N5V 4T3
Tel: (519) 457-1470 ext. 232; **Fax:** (519) 457-3997; **E-mail:** tolmanj@em.agr.ca

TITLE: PLANTING WATER INSECTICIDES FOR CONTROL OF WIREWORM ATTACKING FLUE-CURED TOBACCO - 1998

MATERIALS: ADMIRE 240 F (imidacloprid), ORTHENE 75 SP (acephate), ORTHENE 97 SP (acephate), REGENT 200F (fipronil)

METHODS: Trials were established on sandy loam near Mt. Brydges, ON (Site 1) on May 21 and near Otterville, ON (Site 2) on June 11 in fields already planted by the cooperating grower. All treatments were replicated 4 times in a Randomized Complete Block design. Plots measured 15 m long and consisted of a single row of 14-16 plants individually planted between established plants. Insecticides were applied in 150 ml planting water/plant; CONTROL plots received 150 ml clear planting water/plant. Individual transplants were established in planting holes as soon as possible after adding planting water. On June 18 (Site 1) and July 3 (Site 2), experimental plants were carefully dug from the soil, loose dirt shaken from the roots and tops trimmed approximately 5 cm above ground level. All roots were returned to the laboratory and carefully washed. Roots and underground portions of the stem were scored for EFW feeding damage using a 0-5 scale (0 - no feeding damage; 1 - small feeding channels on root/underground stem comprising < 5% root surface area; 2 - 6%-25% surface area affected by feeding; 3 - 26%-50% surface area affected by feeding; 4 - 51%-75% surface area affected by feeding; 5 - 76%-100% surface area affected by feeding. If one or more feeding tunnel extended into the cortex by no more than 2 mm, Damage Rating increased by 1 over rating that would have been assigned based on surface feeding.). Numbers of plants with ratings of 0 and 1 and with ratings of 4 and 5 were summed. The percentages of total plants in both categories were calculated and data subjected to arcsin square root transformation prior to statistical analysis by analysis of variance. Untransformed data are presented.

RESULTS: The effect of planting water treatments on EFW feeding damage to tobacco seedlings is shown in Table 1. No symptoms of phytotoxicity were noted in any treatment. ORTHENE 97SP did not dissolve readily.

CONCLUSIONS: While EFW were active at both sites, populations were not evenly distributed. Significant differences in feeding damage among replicates were recorded in both experimental plots. Differences in EFW-feeding damage among treatments shown in Table 1 were not statistically significant. While no conclusions could be drawn regarding relative efficacy of insecticides for EFW-control, no

planting water treatment totally eliminated feeding damage by this soil pest.

Table 1. Effect of planting water insecticides on feeding damage to roots and underground stems of flue-cured tobacco by Eastern field wireworm, *Limonius agonus*.

Tmt. No.	Treatment Applied	Rate (amt/1,000 plants)	% Tobacco Roots with Indicated Root Ratings[1]			
			Site 1		Site 2	
			0 + 1	4 + 5	0 + 1	4 + 5
1	ADMIRE 240F	40.0 ml	80.1a[2]	0.0a	80.0a	8.3a
2	ADMIRE 240F	80.0 ml	63.6a	3.5a	81.7a	5.0a
3	REGENT 200F	40.0 ml	78.8a	1.8a	73.3a	8.3a
4	REGENT 200F	80.0 ml	60.1a	5.0a	85.0a	1.7a
5	ORTHENE 75SP	75.0 g	58.9a	5.6a	81.7a	5.0a
6	ORTHENE 97SP	58.0 g	75.8a	0.0a	85.0a	0.0a
7	CONTROL	----	68.1a	1.7a	75.0a	6.7a

[1] 0 - no feeding damage; 1 - small feeding channels on root/underground stem comprising < 5% root surface area; 2 - 6%-25% surface area affected by feeding; 3 - 26%-50% surface area affected by feeding; 4 - 51%-75% surface area affected by feeding; 5 - 76%-100% surface area affected by feeding. If 1 or more feeding tunnel extended into the cortex by no more than 2 mm, Damage Rating increased by 1 over rating that would have been assigned based on surface feeding.

[2] Means within a column followed by the same letter are not significantly different (P**#**0.05) as determined using an LSD means separation test.

END OF SECTION B

SECTION C: POTATOES - Insects /INSECTES DE POTATES

REPORT #s: 29 - 40

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EDITOR **Dr. Jeff G. Stewart** Email:stewartj@em.agr.ca
Agriculture and Agri-Food Canada Tel: (902) 566-6844
Charlottetown Research Centre Fax: (902) 566-6821
440 University Avenue, P.O. Box 1210
Charlottetetown, PEI C1A 7M8

1998 PMR RAPPORT # 29 **SECTION C : INSECTES DES POMMES DE TERRE**
BASE DE DONNÉES DES ÉTUDES : 86000718

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

NOM ET ORGANISME :
BÉLANGER B et PAGÉ D
Centre de recherche en agroenvironnement, MAPAQ, 2700, rue Einstein, Sainte-Foy, Québec, G1P 3W8
Tél. : (418) 643-3145 Télécopieur : (418) 644-6855 Email : Bruno.Belanger@agr.gouv.qc.ca

TITRE: EFFICACITÉ DU CHLORFÉNAPYR EN MÉLANGE AVEC LA CYPERMÉTRINE CONTRE LE DORYPHORE DE LA POMME DE TERRE, SAISON 1998

PRODUITS: AC303,630 (chlorfénapyr 240 g/L) mélangé au RIPCORD 400 (cypermétrine 400 g/L), ADMIRE 240F (imidacloprid 240 g/L)

MÉTHODES: L'essai a été réalisé à Deschambault (Québec) selon un plan à blocs complets aléatoires avec 4 répétitions. Les pommes de terre ont été plantées le 15 mai 1998 à 25 cm d'espacement. Les parcelles de 7,5 m de longueur comprenaient 4 rangs espacés de 0,9 m. Les traitements étaient les suivants : 1. CHLORFÉNAPYR en mélange avec le RIPCORD (foliaire); 2. ADMIRE (foliaire); 3. TÉMOIN (sans traitement). Lors de la première intervention, la population larvaire était composée à 97% de larves de stade 1 et 2. Les insecticides ont été pulvérisés le 26 juin et le 3 juillet à l'aide d'un pulvérisateur monté sur tracteur (pression 1550 kPa, volume : 800 L/ha). L'évaluation des densités du doryphore a été effectuée sur 10 plants pris au hasard dans les deux rangées du centre. Le dommage aux plants a été évalué visuellement à l'aide d'un indice de défoliation de 0 à 8. Les plants de pommes de terre ont été défanés une première fois le 14 août avec du RÉGLONE (diquat 2,5 L p.c./ha) et le 21 août avec le même produit (diquat 1,5L p.c./ha). Le rendement en tubercules a été déterminé à partir de la récolte des deux rangées du centre de chaque parcelle faite le 3 septembre 1998.

RÉSULTATS: Voir le tableau ci-dessous.

CONCLUSION: L'efficacité de l'insecticide chlorfénapyr en mélange avec le RIPCORD a été comparée au ADMIRE. L'ensemble des résultats (densités, dommages et rendements) indiquent que ces insecticides se sont avérés très efficaces comparativement au Témoin sans traitement (Tableau 1). Le chlorfénapyr en mélange avec le RIPCORD s'est avéré aussi performant qu'ADMIRE. Dans un programme de lutte intégrée contre le doryphore, l'efficacité du chlorfénapyr en mélange avec le RIPCORD nous permettra, en associant leur emploi avec d'autres produits foliaire, de mieux gérer cet important ravageur de la pomme de terre.

Table 1. Nombre moyen de larves de doryphore/plant, dommage et rendement vendable, Deschambault, Qc, 1998.

Traitement Insecticide	Dose	Population larvaire			Dommage*				Rendement Vendable
		Juin		Juillet	Juin	Juillet			
	(p.c./ha)	25	30	08	26	2	10	17	(t/ha)
Clorfénapyr + RIPCORD	201 ml + 875 ml	22.3**	10,4b	1,5b	1,0b	1,0b	1,0b	1,0b	57,9a
ADMIRE	200 ml	20,1	12,4b	2,6b	1,0b	1,0b	1,0b	1,0b	58,4a
TÉMOIN	---	26,0	49,5a	90,7a	1,5a	1,9a	5,0a	5,5a	40,9b

* Évaluation visuelle par parcelle : indice de défoliation (Indice “Boiteau” de 0 à 8 : (0) pas de défoliation; (1) 2-60% des plantes avec folioles légèrement endommagés; (1.5) > de 60% des plantes avec folioles légèrement endommagés; (2) 2% des plantes avec $ une feuille composée défoliée à $ 50%; (3) 2-9% des plantes avec $ une tige défoliée à $ 50%; (4) 10-24% des plantes avec $ une tige défoliée à $ 50%; (5) 25-49% des plantes avec $ une tige défoliée à $ 50%; (6) 50-74% des plantes avec $ une tige défoliée à $ 50%; (7) 75-99% des plantes avec $ une tige défoliée à $ 50%; (8) 100% des plantes avec $ une tige défoliée à $ 50%.

** es résultats sans lettre ou suivis d'une même lettre ne sont pas significativement différents, à un seuil de 0,05 (Waller-Duncan).

1998 PMR REPORT # 30 **SECTION C: POTATO INSECTS**
STUDY DATA BASE: 309-1251-9321

CROP: Potato, cv. Russet Burbank
PEST: Colorado potato beetle, *Leptinotarsa decemlineata* (Say)

NAME AND AGENCY:
BOITEAU G and OSBORN W P L
Agriculture and Agri-Food Canada, Potato Research Centre, P.O. Box 20280, Fredericton, NB, E3B 4Z7
Tel: (506) 452-3260; Fax: (506) 452-3316; E-mail: boiteaug@em.agr.ca

TITLE: EFFICACY OF MATADOR 120EC AND 120CS AGAINST SMALL AND LARGE LARVAE OF THE COLORADO POTATO BEETLE (CPB)

MATERIALS: MATADOR 120EC (cyhalothrin-lambda), MATADOR 120CS (cyhalothrin-lambda), ADMIRE 240FS (imidacloprid)

METHODS: Plots consisted of four, 7.3 m long rows spaced at 0.9 m. The treatments were completely randomized with four replications. Potatoes were planted May 16, 1998, at a within row spacing of 0.4 m. Foliar pesticides were applied with a tractor-mounted hydraulic sprayer operating at 300 kPa, equipped with three D4-45 nozzles per row, at an application volume of 400 L/ha, and a speed of 6 kph. On May 25 LINURON (2.5 L product/ha) was applied. Except for the Untreated Check plots the rest of the plots were divided in two groups. All combinations of MATADOR rates and formulations tested (see Tables 1 and 2) were applied to one group soon after egg hatch to determine the efficacy against first and second instars. The same set of combinations was applied later, after 7 days, to determine the efficacy against third and fourth instars. ADMIRE (48 g AI/ha), applied as a foliar insecticide, at the same time in each group, was used for comparison. The timing of the first spray as determined as follows. When sufficient egg masses were laid in the experimental field (June 24), they were tagged. On June 25, 13 of 28 egg masses had hatched (46.4%). By June 26, 71.4% egg masses had hatched. The first set of sprays was carried out three days later, on June 29. Maintenance sprays of ADMIRE 240FS (48 g AI/ha) were made to all plots on July 21. DITHANE (2.2 kg product/ha) was applied to all plots on July 22 and BRAVO (2.4 L product/ha) was applied to all plots on July 31 to control late blight. Life stages of the CPB were counted on the day of a set of sprays and 1, 3, 7, 10 and 14 days after the spray, on 10 randomly-chosen plants in the middle two rows of each plot. The defoliation rating of the middle two rows of a plot was taken once a week from June 22 to July 27. Analyses of variance and LSD tests were carried out on the data.

RESULTS: The treatment means are presented in the Tables 1 and 2. The majority of first instars found in this trial were newly hatched and not yet exposed to insecticides. Thus, this growth stage is not in Table 1. The lack of significance despite the large differences in the means of the Untreated Check plots compared to the insecticide treated plots on some dates is due to high variation in the Untreated Check. The colonizing overwintered CPB adults population was low at the Potato Research Centre in the 1998 season and heavy rainfall during June and July destroyed many egg masses. The CPB population did start to increase in late July as indicated by the increase in defoliation in the Untreated Check (Table 2). All rates and formulations were free of phytotoxic effects.

CONCLUSIONS: All MATADOR rates and formulations tested were equally effective against all larval stages of the CPB. Fourteen days of plant protection below the critical defoliation rating of 2 was provided by both early and late application.

Table 1. The mean number of CPB instars per 10 plants (on specific dates), Fredericton, NB, 1998.*

Treatment	Rate (g AI/ha)	L2 (02/07) 3 d post S1	L3 (09/07) 10 d post S1, 3 d post S2	L4 (09/07) 10 d post S1, 3 d post S2	L4 (16/07) 10 d post S2
MATADOR 120EC - S1	10	7.8	40.3a	21.3	-
MATADOR 120EC - S1	15	4.3	21.0abc	13.8	-
MATADOR 120EC - S1	20	2.0	10.3bc	5.8	-
MATADOR 120CS - S1	15	1.0	24.8ab	7.8	-
ADMIRE 240FS - S1	48	1.0	16.5bc	4.3	-
MATADOR 120EC - S2	10	-	9.5bc	20.5	14.5b
MATADOR 120EC - S2	15	-	9.0bc	16.5	7.8b
MATADOR 120EC - S2	20	-	2.3c	6.5	7.0b
MATADOR 120CS - S2	15	-	15.3bc	8.3	21.3b
ADMIRE 240FS - S2	48	-	2.5c	4.0	4.0b
Untreated Check	-	36.5	39.8a	49.3	57.0a
ANOVA P#0.05	-	ns	s	ns	s

* Figures are means of 4 replications. Means followed by the same letter are not significantly different according to a LSD test (P#0.05). S1 = Spray 1, S2 = Spray 2.

Table 2. The mean defoliation ratings of the middle two rows of the treatment plots throughout the sampling period, Fredericton, NB, 1998.*

Treatment	Rate (g a.i/ha)	22/06	29/06	06/07	13/07	20/07	27/07
MATADOR 120EC - S1	10	1.5	1.5	1.0d	2.1b	6.0a	3.3a
MATADOR 120EC - S1	15	1.5	1.5	1.0d	1.9b	4.5b	2.8abc
MATADOR 120EC - S1	20	1.5	1.4	1.0d	1.9b	4.8ab	2.5abc
MATADOR 120CS - S1	15	1.5	1.5	1.0d	2.1b	4.5b	2.8abc
ADMIRE 240FS - S1	48	1.4	1.5	1.0d	2.0b	4.8ab	2.3bcd
MATADOR 120EC - S2	10	1.4	1.5	1.8bc	1.5b	2.3cd	1.6de
MATADOR 120EC - S2	15	1.5	1.5	2.3a	2.1b	2.0cd	2.0cd
MATADOR 120EC - S2	20	1.3	1.5	1.6bc	1.6b	1.4d	1.0e
MATADOR 120CS - S2	15	1.4	1.5	1.5c	1.8b	2.8c	2.0cd
ADMIRE 240FS - S2	48	1.5	1.5	2.0ab	1.4b	2.6cd	1.5de
Untreated Check	-	1.3	1.5	1.9abc	4.0a	5.5ab	3.0ab
ANOVA P#0.05	-	ns	ns	s	s	s	s

* Figures are means of 4 replications. Means followed by the same letter are not significantly different according to a LSD test (P#0.05). Defoliation ratings: (0) no defoliation; (1) 2-60% of plants with leaflets slightly damaged; (1.5) >60% of plants with leaflets slightly damaged; (2) 2% of plants with $1 compound leaf with $50% defoliation; (3) 2-9% of plants with $1 stem with $50% defoliation; (4) 10-24% of plants with $1 stem with $50% defoliation; (5) 25-49% of plants with $1 stem with $50% defoliation; (6) 50-74% of plants with $1 stem with $50% defoliation; (7) 75-99% of plants with $1 stem with $50% defoliation. S1 = Spray 1, S2 = Spray 2.

1998 PMR REPORT # 31 **SECTION C: POTATO INSECTS**
STUDY DATA BASE: 309-1251-9321

CROP: Potato, cv. Russet Burbank
PEST: Colorado potato beetle, *Leptinotarsa decemlineata* (Say)

NAME AND AGENCY:
BOITEAU G and OSBORN W P L
Agriculture and Agri-Food Canada, Potato Research Centre, P.O. Box 20280, Fredericton, NB, E3B 4Z7
Tel: (506) 452-3260; Fax: (506) 452-3316; E-mail: boiteaug@em.agr.ca

TITLE: CONTROL OF COLORADO POTATO BEETLES WITH AN EXPERIMENTAL FORMULATION OF *BEAUVERIA BASSIANA*

MATERIALS: MYCOTROL GH-ES (*Beauveria bassiana* Strain GHA), NOVODOR (*Bacillus thuringiensis* subspecies *tenebrionis*), ALERT 2SC (chlorfenapyr)

METHODS: The test was carried out in two 0.6 ha fields. One field was treated with a combination of fungi and bacteria (Biological Control) and the other one with a pyrethroid insecticide (Chemical Control). Plots consisted of 10, 9.1 m long rows spaced at 0.9 m. There were 13 replications of each treatment in each field. Four replications of an Untreated Check were isolated plots consisting of four, 7.3 m long rows spaced at 0.9 m, located in a field 600 m from the treated fields. Potatoes were planted May 25, 1997, at a within row spacing of 0.5 m in the Biological Control and Chemical Control plots; the Untreated Check plots were hand planted at 0.4 m spacing on June 4. On June 4 a plastic lined trench was installed 9.1 m from the edge of the Biological Control field edges. Pesticides were applied with a tractor-mounted hydraulic sprayer operating at 300 kPa, equipped with three D4-45 nozzles per row, at an application volume of 400 L/ha, and a speed of 6 kph. LINURON (3 L product/ha) was applied to the Biological Control and Chemical Control plots on June 11 and to the Untreated Check plots on June 18. BRAVO (2.4 L product/ha) was applied to all plots on July 11 to control fungal pathogens. MYCOTROL (2.5 L product/ha) and NOVODOR (4 L product/ha) were applied to the Biological Control plots on July 15 and 29. ALERT (150 g AI/ha) was applied to the Chemical Control plots on July 15 and 22. Colorado potato beetle (CPB) life stages were counted twice a week from July 11 to August 8 in the Biological Control and Chemical Control plots on 20 randomly-chosen plants. In the Untreated Check plots, CPB life stages were counted once a week from July 9 to August 13 on 10 randomly-chosen plants in the middle two rows of each plot; the resulting number was multiplied by two for ease in comparison with the two treatments. The defoliation rating (see Table 2) of the plots were taken on the same dates. T-tests were carried out on the Biological Control and Chemical Control treatment data. The Untreated Check data are included for reference only. MYCOTROL was supplied by Mycotech Corporation, Butte, Montana.

RESULTS: The mean abundance of Colorado potato beetles and the mean level of defoliation for each treatment are presented in the Tables 1 and 2.

CONCLUSIONS: The Biological Control treatment was as effective as the Chemical Control treatment at reducing the abundance of the different instars of the CPB and at protecting the plant from damage. The population dynamics of the CPB beetle in 1997 were affected by the unusually wet and cold weather

early in the season. The first and second instars, normally expected during the last week of June, did not reach levels where control was necessary before the first to second weeks of July. This delayed application of the MYCOTROL/NOVODOR to the time when fungicide sprays against late blight were required, especially in such wet weather. The fungicide was applied 4 days before MYCOTROL/NOVODOR to minimize negative interactions. There is no doubt that this may have affected the level of control obtained. The low abundance of the CPBs before the first treatment resulted in a limited amount of plant damage in the main study site and in the Untreated Check. Later in the season, beginning before the second treatment with MYCOTROL/NOVODOR, the increasing abundance of large larvae in the Untreated Check field led to the characteristic explosion in defoliation. In the treated plots, the defoliation index remained low suggesting that the consistent control of the young larvae over a 7 day period from July 15 to July 22 had resulted in a smaller population of the damaging large larvae. Thus the MYCOTROL formulation of *B. bassiana* mixed with NOVODOR was as effective as ALERT at protecting plant foliage.

Table 1. The mean number of CPB life stages per 20 plants (on specific dates), Fredericton, NB, 1997.*

Treatment	L1 (15/07)	L2 (15/07)	L3 (22/07)	L4 (29/07)	Adults (05/08)
Biological Control	33.0	71.0a	10.5b	2.2	2.2
Chemical Control	24.8	27.5b	37.6a	0.5	2.0
T-test P#0.05	ns	s	s	ns	ns
Untreated Check	191.7	266.3	207.7	324.3	8.0

* Figures are means of 13 replications, except for the Untreated Check (4 replications). Means followed by different letters within a column are significantly different according to a t-test (P#0.05).

Table 2. The mean defoliation ratings of the middle two rows of the treatment plots throughout the sampling period, Fredericton, NB, 1997.*

Treatment	15/07	18/07	22/07	25/07	29/07	01/08	05/08	08/08
Biological Control	1.7	1.8a	1.7	1.8	1.8	1.5	1.5	1.8
Chemical Control	1.5	1.4b	1.7	1.8	1.5	1.3	1.2	1.2
T-test P#0.05	ns	s	ns	ns	ns	ns	ns	ns
Untreated Check	2.3	-	6.0	-	6.8	-	6.0	6.0

* Figures are means of 13 replications, except for the Untreated Check (4 replications). Means followed by different letters within a column are significantly different according to a t-test (P#0.05). Defoliation ratings: (0) no defoliation; (1) 2-60% of plants with leaflets slightly damaged; (1.5) >60% of plants with leaflets slightly damaged; (2) 2% of plants with $1 compound leaf with $50% defoliation; (3) 2-9% of plants with $1 stem with $50% defoliation; (4) 10-24% of plants with $1 stem with $50% defoliation; (5) 25-49 of plants with $1 stem with $50% defoliation; (6) 50-74% of plants with $1 stem with $50% defoliation; (7) 75-99% of plants with $1 stem with $50% defoliation.

1998 PMR REPORT # 32 SECTION C: POTATO INSECTS
STUDY DATA BASE: 309-1251-9321

CROP: Potato, cv. Russet Burbank
PEST: Colorado potato beetle, *Leptinotarsa decemlineata* (Say)

NAME AND AGENCY:
BOITEAU G, and OSBORN W P L
Agriculture and Agri-Food Canada, Potato Research Centre, P.O. Box 20280, Fredericton, NB, E3B 4Z7
Tel: (506) 452-3260; Fax: (506) 452-3316; E-mail: boiteaug@em.agr.ca

TITLE: EFFECT OF ALERT ON ARTHROPOD PREDATORS AND PARASITES IN POTATO FIELDS

MATERIALS: ALERT 2SC (chlorfenapyr)

METHODS: Plots consisted of 10, 9.1 m long rows spaced 0.9 m apart. There were 13 (Site 1) or 14 (Site 2) replications in 0.6 ha blocks in each of the ALERT treatment and Integrated Pest Management (IPM) treatment blocks. The ALERT and IPM blocks were separated with 15 m of bare soil. Site 1 was planted on May 12 and 13, 1998, and Site 2 was planted on May 14, 1998 both at a 0.5 m within row spacing. Pesticides were applied with a tractor-mounted hydraulic sprayer operating at 300 kPa, and equipped with three D4-45 nozzles per row, with an application volume of 400 L/ha, and a speed of 6 kph. A plastic (4 mil) lined trench, surrounding the IPM blocks, 8 m from the block edges, was installed on May 21 at both Sites to trap colonizing Colorado potato beetles (CPB). A pre-emergence herbicide (LINURON, 3 L product/ha) was applied to both treatments on May 25 to both Sites. DITHANE (2.2 kg product/ha) was applied to both treatments and both Sites on July 22 for the management of plant pathogens. ALERT (50 g AI/ha) was applied to the ALERT treatment blocks in Sites 1 and 2 on June 28, July 4 and 13. NOVODOR, (8 L product/ha) for CPB control, was applied to the IPM treatment at Site 2 on June 28, July 4, and 13. MYCOTROL (2.4 L product/ha) was applied to the IPM treatment at Site 1 on June 28 and July 4 for CPB control. ADMIRE (200 mL product/ha) was applied to the IPM treatment of Site 1 on July 13 for CPB control. A scout walked between the rows of each plot of both treatments at both Sites at a speed of roughly 9 m/min and recorded the number of naturally occurring arthropod predators or parasites visible on the surface of the potato leaves in both rows, on July 23. The mean number of Coccinellidae and of all arthropod predators and parasites counted on each date and each Site for the ALERT and the IPM treatments were analysed with t-tests (P#0.05).

RESULTS: The survey found: ladybird beetle adults (Coleoptera: Coccinellidae - mainly *Coccinella septempunctata* L., also found were *Harmonia axyridis* (Pallas), *Coccinella trifasciata* L., *Propylea quatuordecimpunctata* L. and *Hippodamia convergens* Guérin-Méneville), larvae and pupae; hover fly adults (Diptera: Syrphidae); soldier beetles (Coleoptera: Cantharidae), hymenopterans; spiders (Araneida); predatory hemipterans, odontans, bee fly adults (Diptera: Bombyliidae), and daddy long legs (Phalangida). Treatment means for the number of Coccinellidae and all arthropod predators and parasites are presented in Table 1.

CONCLUSIONS: Three applications of the insecticide ALERT had no adverse effect on the index of

abundance of predators and parasites at either of the two sites. There was a consistent trend for more predators in the plots treated with ALERT than in the others. The use of ADMIRE 10 days before the survey in the IPM plot at Site 1 may have reduced drastically the prey population (aphids) and led to the relocation of the adult (mobile) predators populations. Prey populations were similar in IPM and ALERT plots of Site 2. These observations suggest that ALERT is compatible with IPM programs based on the encouragement or the release of natural enemies.

Table 1. Mean number of Coccinellidae and all arthropod predators or parasites found per plot in each treatment at each Site on July 23, Fredericton, NB, 1998.*

	Site 1		Site 2	
Treatment	Coccinellidae	All Predators	Coccinellidae	All Predators
ALERT	1.9 ± 0.3a	2.5 ± 0.4a	1.4 ± 0.5	1.9 ± 0.5
IPM	0.2 ± 0.1b	0.2 ± 0.1b	1.1 ± 0.3	1.7 ± 0.3
T-test P#0.05	s	s	ns	ns

* Figures are means of 13 (Site 1) or 14 (Site 2) replications. Numbers in a column followed by the same letter are not significantly different (t-test, P#0.05).

1998 PMR REPORT # 33 **SECTION C: POTATO INSECTS**
ICAR #: CC#01030414 DC#72020101

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

NAME AND AGENCY:
SCOTT-DUPREE C D, REMPEL S J, CHEVERIE R M, and HARRIS B J[1]
Dept. of Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1.
[1]Dow Agrosciences Canada Inc. Calgary, AB.
Tel: (519) 824-4120 X2477; Fax: (519) 837-0442; E-mail: csdupree@evbhort.uoguelph.ca

TITLE: RELATIVE EFFICACY OF ADMIRE 240F AND SPLIT APPLICATIONS OF SPINOSAD 480SC AGAINST COLORADO POTATO BEETLE (CPB) LARVAE ON MUCK SOIL.

MATERIALS: SPINOSAD 480SC (spinosyn, *Saccharopolyspora spinosa*), ADMIRE 240F (imidacloprid)

METHODS: Potato seed pieces were planted at the Muck Crops Research Station, Holland Marsh, ON, on May 14, 1998, in 4-row plots, 5 m in length with a row spacing of 0.9 m. Seven treatments were replicated 4 times in a randomized complete block design. Plots, in the same replication, were separated by two rows of untreated potatoes which acted as trap crop. Treatments were applied using a tractor-mounted four-row boom sprayer that delivered 750 L/ha at 450 kPa. Forty egg masses were flagged (5 per plot) on June 12 and checked daily to determine percent hatch. By June 19, 30% of the egg masses had hatched. The initial spray of all treatments was made that evening. A second insecticide application was applied June 27. On June 22 (Day 3) and 25 (Day 6); and, July 2 (Day 13/3) and 6 (Day 17/7), assessments were made by counting the number of CPB larvae and the % defoliation on 5 plants per plot. Potatoes from the inner two rows of each plot were harvested on August 27.

RESULTS: Population data are presented in Table 1 and defoliation data is presented in Table 2.

CONCLUSIONS: From June 25 to July 6 all of the SPINOSAD and ADMIRE 240F treatments had significantly less CPB damage compared to the untreated check. In comparison to the first spray, the larval populations were much smaller after the subsequent application (Table 1). Defoliation followed the same trend as the CPB larval counts (Table 2). Yields for SPINOSAD 480SC rates 60/60, 60/40, and 80/80 and ADMIRE 240F were significantly higher than those for the untreated check.

Table 1. Treatment comparisons of mean number of Colorado potato beetle larvae per 5 plants and total yield (Tonnes/Hectare) using split rate applications of SPINOSAD 480SC on muck soil. The sprays were applied on June 19 and June 27, Holland Marsh, ON, 1998.

Treatment	Mean number of CPB per 5 plants				TuberYield T/Ha
	June 22 (Day 3)	June 25 (Day 6)	July 2 (Day 13/5)	July 6 (Day 17/9)	August 27
Untreated Check	9.67a*	20.00a	25.73a	25.27a	28.66c
SPINOSAD 40g AI/ha + SPINOSAD 40g AI/ha	10.70a	13.90b	1.80b	5.10b	31.41bc
SPINOSAD 60g AI/ha + SPINOSAD 60g AI/ha	8.20a	10.90b	0.10b	1.00b	41.51ab
SPINOSAD 60g AI/ha + SPINOSAD 40g AI/ha	9.05a	8.90b	0.95b	3.10b	41.98ab
SPINOSAD 80g AI/ha + SPINOSAD 40g AI/ha	6.75a	6.70b	2.15b	0.90b	36.78bc
SPINOSAD 80g AI/ha + SPINOSAD 80g AI/ha	2.50a	0.50b	0.55b	0.00b	45.92ab
ADMIRE 50g AI/ha + ADMIRE 50g AI/ha	3.75a	4.80b	0.00c	0.00b	51.54a

* Treatment means in the same column followed by the same letter are not significantly different (p#0.05, Duncan's New MRT).

Table 2: Treatment comparisons of average % defoliation per 5 plants post -application, Holland Marsh, ON, 1998.

Treatment	Average % defoliation per 5 plants			
	June 22 (Day 3)	June 25 (Day 6)	July 2 (Day 13/5)	July 6 (Day 17/9)
Untreated Check	3.67a*	10.00a	46.33a	39.33a
SPINOSAD 40g AI/ha + SPINOSAD 40g AI/ha	4.50a	5.80b	6.25b	6.00b
SPINOSAD 60g AI/ha + SPINOSAD 60g AI/ha	4.75a	3.80bc	4.50b	4.00b
SPINOSAD 60g AI/ha + SPINOSAD 40g AI/ha	5.00a	2.80bc	6.25b	3.50b
SPINOSAD 80g AI/ha + SPINOSAD 40g AI/ha	4.00a	2.00c	5.25b	4.00b
SPINOSAD 80g AI/ha + SPINOSAD 80g AI/ha	2.50a	2.50bc	4.25b	3.00b
ADMIRE 50g AI/ha + ADMIRE 50g AI/ha	2.75a	3.30bc	4.25b	1.50b

* Treatment means in the same column followed by the same letter are not significantly different (p#0.05, Duncan's New MRT).

1998 PMR REPORT # 34 SECTION C: POTATO INSECTS
ICAR #: CC#01030414 DC# 72020101

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

NAME AND AGENCY:
SCOTT-DUPREE C D, REMPEL S J, CHEVERIE R M, and HARRIS B J[1]
Dept. of Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1.
[1]DowAgrosciences Canada Inc. Calgary, AB.
Tel: (519) 824-4120 X2477; Fax: (519) 837-0442; E-mail: csdupree@evbhort.uoguelph.ca

TITLE: RELATIVE EFFICACY OF ADMIRE 240F AND SPLIT APPLICATIONS OF SPINOSAD 480SC AGAINST COLORADO POTATO BEETLE (CPB) LARVAE ON SANDY SOIL.

MATERIALS: SPINOSAD 480SC (spinosyn, *Saccharopolyspora spinosa*), ADMIRE 240F (imidacloprid)

METHODS: Potato seed pieces were planted at the Cambridge Research Station, on April 20, 1998, in 4-row plots, 10 m in length with a between row spacing of 0.9 m. Seven treatments were replicated 4 times in a randomized complete block design. Plots, in the same replication, were separated by a 6 m spray lane halved by two guard rows used maintain a CPB population for the experiment. Insecticides were applied using a tractor-mounted four-row boom sprayer that delivered 750 L/ha at 450 kPA. Eighty four egg masses were flagged (3 per plot) on May 29 and checked daily to determine percent hatch. By June 3, 30 % of the egg masses had hatched. The initial spray of all treatments was applied on June 4. A second insecticide application was made on June14. On June 8 (Day 4), 18 (Day 14/4), 24 (Day 20/10) and 30 (Day 26/16), assessments were made by counting the number of CPB larvae and the % defoliation on 5 plants per plot. Potatoes were harvested on August 12.

RESULTS: Larval population and yield data are presented in Table 1. Defoliation data are presented in Table 2

CONCLUSIONS: By June 18, 24, and 30, all SPINOSAD 480SC and ADMIRE 240F treatments resulted in significantly less CPB larvae than the untreated Check (Table 1). By June 18 (4 days post second spray), significantly less defoliation was observed in the SPINOSAD (80/80) and ADMIRE treatments than all the other treatments tested, including the Check. By June 24, plants in all the treated plots had significantly less defoliation than the untreated Check. By June 30, SPINOSAD 480SC (80/80) and ADMIRE 240F provided significantly better foliage protection than all other SPINOSAD 480SC treatments and the untreated Check. Yields were significantly higher for all the SPINOSAD 480SC treatments and ADMIRE 240F compared to the untreated Check (Table 2). The total tuber yield numbers are low in this trial as there was little irrigation and no fertilizer applied to the field in this unusually dry season. Additionally, there is traditionally a lower yield of tubers in sandy soil in comparison to other soils.

Table 1. Treatment comparisons of mean number of Colorado potato beetle larvae per 5 plants and total tuber yield (tonnes/hectare) using split applications of SPINOSAD 480SC on sandy soil. The sprays were applied on June 4 and 14, Cambridge, ON, 1998.

Treatment	Mean number of CPB larvae per 5 plants				Tuber Yield
	June 8 (Day 4)	June 18 (Day 14/4)	June 24 (Day 20/10)	June30 (Day 26/16)	August 12
Untreated Check	2.10a*	24.90a	41.75a	7.40a	7.66c
SPINOSAD 40g + SPINOSAD 40g AI/ha	4.85a	0.20b	1.60b	3.90b	11.49b
SPINOSAD 60g + SPINOSAD 60g AI/ha	1.15a	0.15b	0.30b	1.35b	15.06ab
SPINOSAD 60g + SPINOSAD 40g AI/ha	3.20a	0.20b	1.60b	4.05ab	14.97ab
SPINOSAD 80g + SPINOSAD 40g AI/ha	4.85a	0.00b	2.25b	1.90b	14.71ab
SPINOSAD 80g + SPINOSAD 80g AI/ha	2.65a	0.05b	0.00b	0.20b	14.53ab
ADMIRE 50g + ADMIRE 50g AI/ha	1.95a	0.00b	0.00b	0.00b	17.58a

* Treatment means in the same column followed by the same letter are not significantly different (p#0.05, Duncan's New MRT).

Table 2. Treatment comparisons of average percent defoliation on five plants per plot on sandy soil.

Treatment	Average % CPB defoliation per 5 plants			
	June 8 (Day 4)	June 18 (Day 14/4)	June 24 (Day 20/10)	June 30 (Day 26/16)
Untreated Check	5.00a*	6.50a	35.0a	71.5a
SPINOSAD 40g+SPINOSAD 40g AI/ha	3.80a	5.00a	5.00b	27.5b
SPINOSAD 60g+SPINOSAD 60g AI/ha	5.30a	5.00a	5.30b	21.3b
SPINOSAD 60g+SPINOSAD 40g AI/ha	5.50a	5.00a	5.00b	20.5b
SPINOSAD 80g+SPINOSAD 40g AI/ha	4.50a	5.00a	5.00b	13.3c
SPINOSAD 80g+SPINOSAD 80g AI/ha	4.50a	2.30b	1.80b	5.00d
ADMIRE 50g+ ADMIRE 50g AI/ha	5.30a	1.50b	1.50b	4.5d

* Treatment means in the same column followed by the same letter are not significantly different (p#0.05, Duncan's New MRT).

1998 PMR REPORT # 35 **SECTION C: POTATO INSECTS**
ICAR #: CC# 01030414 DC# 72020101

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

NAME AND AGENCY:
SCOTT-DUPREE C D, REMPEL S J, CHEVERIE R M and HARRIS B J[1]
Dept. of Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1.
[1]Dow AgroSciences Canada Inc. Calgary, AB.
Tel: (519) 824-4120 X2477; Fax: (519) 837-0442; E-mail: csdupree@evbhort.uoguelph.ca

TITLE: LARGE SCALE EFFICACY TRIAL COMPARING SPLIT APPLICATIONS OF SPINOSAD 480SC WITH ADMIRE 240F AGAINST COLORADO POTATO BEETLE LARVAE.

MATERIALS: SPINOSAD 480SC (spinosyn, *Saccharopolyspora spinosa*), ADMIRE 240F (imidacloprid)

METHODS: Potato seed pieces were planted at the Cambridge Research Station on April 28, 1998, in 12-row plots, 27.3 m in length with a row spacing of 0.9 m. Plots were separated by 3 m spray lanes. This large scale trial was established with the intention of simulating commercial sized potato plantings. Four treatments were replicated 4 times in a randomized complete block design. Insecticide applications were made using a tractor-mounted four-row boom sprayer that delivered 750 L/ha at 450 kPA. One hundred and sixty egg masses were flagged (20 plants per plot) on May 29 and checked daily to determine percent hatch. By June 3, 30% of the egg masses had hatched. On June 4 the initial spray of all treatments was applied. The second spray was applied on June 14, 10 days after the first application. Assessments were made by counting the number of CPB larvae and the % defoliation on 20 plants per plot, on June 8 (Day 4), 10 (Day 6), 18 (Day 14/4), and 23 (Day 19/9). Potatoes from the inner 6 rows of each plot were harvested on August 12.

RESULTS: CPB population and tuber yield data are presented in Table 1. Percent defoliation data is presented in Table 2.

CONCLUSIONS: Following the second application all treatments contained significantly less CPB larvae than the untreated check on June 18 and 23 (Table 1). The results were similar for % defoliation throughout the entire sampling period (Table 2). An extremely dry and stressful growing season resulted in yields that were lower than expected. This was reinforced by the small amount of irrigation and that no fertilizer was applied to the sandy type soil that traditionally results in a low harvest of tubers. There was no significant difference in total yield between the untreated Check and all treatments.

Table 1. Treatment comparisons of mean number of Colorado potato beetle larva per five plants and total tuber yield (tonnes/hectare) using split applications of SPINOSAD 480SC in a large scale trial. The sprays were applied on June 4 and 14, Cambridge, ON, 1998.

Treatment	Mean number of CPB larvae per 5 plants				Tuber yield Tonnes/Ha
	June 8 (Day 4)	June 10 (Day 6)	June 18 (Day 14/4)	June 23 (Day 19/9)	August 12
Untreated Check	2.71a*	4.40a	16.84a	25.25a	9.58a
SPINOSAD 60g + SPINOSAD 60g AI/ha	1.78a	0.84a	0.83b	2.60b	11.61a
SPINOSAD 80g + SPINOSAD 40g AI/ha	1.21a	1.43a	0.66b	2.78b	13.09a
ADMIRE 50g + ADMIRE 50g AI/ha	2.28a	2.24a	0.78b	0.18b	14.27a

* Treatment means within the same column followed by the same letter are not significantly different (p#0.05, Duncan's New MRT).

Table 2: Average % defoliation of 5 plants in a large scale trial, Cambridge, ON, 1998.

Treatment	Average % defoliation per 5 plants			
	June 8 (Day 4)	June 10 (Day 6)	June 18 (Day 14/4)	June 23 (Day 19/9)
Untreated Check	3.13a*	3.13a	11.06a	26.69a
SPINOSAD 60g+ SPINOSAD 60g AI/ha	2.31a	4.13a	4.31b	4.25b
SPINOSAD 80g+ SPINOSAD 40g AI/ha	2.38a	3.24a	3.31b	3.94b
ADMIRE 50g + ADMIRE 50g AI/ha	3.69a	4.63a	3.44b	2.88b

* Treatment means within the same column followed by the same letter are not significantly different (p#0.05, Duncan's New MRT).

1998 PMR REPORT # 36 **SECTION C: POTATO INSECTS**
STUDY DATA BASE: 303-1452-8702

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

NAME AND AGENCY:
STEWART J G, SMITH M E, and MACDONALD I K
Agriculture and Agri-Food Canada, Crops and Livestock Research Centre, P O Box 1210
Charlottetown, Prince Edward Island, C1A 7M8
Tel: (902) 566-6800; Fax: (902) 566-6821; E-Mail: stewartj@em.agr.ca

TITLE: EVALUATION OF TWO FORMULATIONS OF FIPRONIL FOR CONTROL OF THE COLORADO POTATO BEETLE ON POTATOES

MATERIALS: FIPRONIL 200 SC (EXP60145A), FIPRONIL 80 WG (EXP60720A), ADMIRE 240 FS (imidacloprid)

METHODS: Small whole seed potatoes were planted in Harrington, P.E.I., on May 6, 1998. Plants were established in four-row plots and spaced at about 0.4 m within rows and 0.9 m between rows. The plots, measuring 9.1 m in length and 3.7 m in width, were separated from each other by two buffer rows of potatoes. Plots were arranged in a randomized complete block design, with six treatments (see Table 1) each replicated four times. Two spray thresholds (1- 2 CPB spring adults per plant and 1-2 summer adults per plant) were used for all plots except the untreated Check. The first threshold was not reached by June 30 but the treatments were initiated. The second threshold was reached on August 4, at which time insecticides were applied again. Treatments were applied using a CO_2-pressurized precision plot sprayer at 240 kPa and 303 L H_2O/ha. The number of CPB egg masses, early and late instars, and adults were counted on ten whole plants per plot on June 30 (pre-spray), on July 2, 3, and 7 (2, 3 and 7 days post spray, respectively), and weekly thereafter until July 28. A pre-spray count preceded the second application on August 4. Insects were counted on August 5, 7, and 10 (1, 3, and 6 days post spray), and on August 18. Damage ratings (% defoliation) were done weekly from July 10 to August 14. After planting, plots received a pre-emergence application of metribuzin at 1.1 kg AI/ha for weed control. On July 17, the buffer rows were sprayed with spinosyn A/D at 80 g AI/ha to prevent the intra-plot movement of insects. Throughout the summer, plots received recommended applications of chlorothalonil at 1.25 kg AI/ha and copper hydroxide at the same rate for late blight control. Diquat was applied at the rate of 370 g AI/ha on August 27 for top desiccation. Tubers from the center two rows of each plot were harvested on September 14, and total and marketable (dia.>38 mm) yields were recorded. Analyses of variance were performed on the data and Least Squares Differences (LSD) were calculated. Insect counts were transformed to Ln(x+1) before analysis. Percent defoliation was transformed to sqrt (arcsine(prop)) before analysis. Untransformed means are presented.

RESULTS: Two applications of FIPRONIL or ADMIRE effectively controlled adults of the CPB (Table 1). Although not statistically significant, a slight rate response was noted between the 12.5 and 25 g AI rates of both formulations of FIPRONIL. Relative to the Check, fewer egg masses were observed on plants treated with the WG formulation of FIPRONIL on both July 3 and 14 (Table 2). Otherwise, the

counts of egg masses throughout the sampling period were quite variable. Fewer L1-L2 instars were found on plants treated with either rate of FIPRONIL 240SC and the higher rate of FIPRONIL 80WG on July 7 and 14 relative to the Check (Table 3). No statistical differences in the seasonal average number of L1-L2 per plant were noted among the treatments tested (Table 3). Except for FIPRONIL 80WG at 12.5 g AI/ha, all products effectively reduced the numbers of L3-L4 per plant for 14 days after the first application (Table 4). Three days after the second treatment, L3-L4 counts on plants of all treatments were significantly lower than that of the Check (Table 4). A non-significant rate response was observed for both the SC and WG formulations of FIPRONIL based on the seasonal average number of L3-L4 per plant (Table 4). Defoliation ratings are a good indicator of product efficacy (Table 5). Defoliation in the Check plots was significantly greater than the damage observed to plants treated with FIPRONIL or ADMIRE. Plants treated with FIPRONIL at 25 gAI/ha tended to suffer less damage than plants treated at the 12.5 g AI/ha rate (Table 5). Tuber yields from plants treated with either rate of FIPRONIL 240SC or with FIPRONIL 80WG at 25 g AI/ ha were greater than the yields from the untreated Check (Table 5).

CONCLUSIONS: Although not usually statistically significant, FIPRONIL tended to be more effective at the 25 g AI/ha rate than at 12.5 g AI/ha in controlling the Colorado potato beetle and its damage. Based on the seasonal averages for insect counts (Tables 1-4) and on tuber yields (Table 5), the 240 SC formulation tended to be more efficacious than the 80 WG formulation at equivalent rates of application.

Table 1. Response of Colorado potato beetle (CPB) adults to applications of FIPRONIL, Harrington, PE, 1998.

Trtmt (rate in g AI/ha)	Mean No. CPB Adults/ Plant*							
	Jun 30 (Pre)**	Jul 02 (2)	Jul 07 (7)	Aug 04 (2^{nd} Pre)	Aug 5 (1)	Aug 7 (3)	Aug 10 (6)	Season Avg.
Check	0.43	0.40a	0.10	4.80a	4.15a	3.98a	0.73ab	1.33a
FIPRONIL 240SC (12.5)	0.53	0.10bc	0.13	1.55b	0.60bc	0.50b	0.20bc	0.39b
FIPRONIL 240SC (25.0)	0.55	0.08c	0.03	1.40b	0.15d	0.18b	0.13c	0.30b
FIPRONIL 80WG (12.5)	0.43	0.30a	0.05	2.38b	0.75b	0.58b	0.75a	0.54b
FIPRONIL 80WG (25.0)	0.38	0.08c	0.10	2.03b	0.33cd	0.53b	0.25abc	0.39b
ADMIRE 240FS (50.0)	0.55	0.28ab	0.28	1.50b	0.08d	0.85b	0.88a	0.51b
LSD p# 0.05	ns	-	ns	-	-	-	-	-

* Numbers in a column followed by the same letter are not significantly different (LSD, p#0.05); ns: not significant.

** Pre: Pre-spray counts before first application on June 30 or second application on August 4.

Table 2. Response of Colorado potato beetle (CPB) egg masses to applications of FIPRONIL, Harrington, PE, 1998.

Trtmt (rate in g AI/ha)	Mean No. CPB Egg Masses/ Plant*					
	Jun 30 (Pre)**	Jul 02 (2)	Jul 3 (3)	Jul 07 (7)	Jul 14 (14)	Season Avg.
Check	2.48	2.73	3.65a	1.08	0.60ab	0.90
FIPRONIL 240SC (12.5)	2.20	2.23	1.58c	0.65	0.35bc	0.59
FIPRONIL 240SC (25.0)	2.33	3.05	2.60ab	0.60	0.15c	0.75
FIPRONIL 80WG (12.5)	3.78	2.53	2.35b	0.83	0.13c	0.82
FIPRONIL 80WG (25.0)	2.90	2.53	2.00bc	0.55	0.25bc	0.71
ADMIRE 240FS (50.0)	2.40	2.18	1.73bc	0.60	1.13a	0.70
LSD p# 0.05	ns	ns	-	ns	-	ns

* Numbers in a column followed by the same letter are not significantly different (LSD, p#0.05); ns: not significant.

** Pre: Pre-spray counts before first application on June 30 or second application on August 4.

Table 3. Response of Colorado potato beetle (CPB) early instars (L1-L2) to applications of FIPRONIL, Harrington, PE, 1998.

Trtmt (rate in g AI/ha)	Mean No. CPB L1-L2/ Plant*							
	Jun 30 (Pre) **	Jul 03 (3)	Jul 07 (7)	Jul 14 (14)	Jul 28 (28)	Aug 4 (2nd Pre)	Aug 5 (1)	Season Avg.
Check	7.20	14.48	22.35a	26.80a	1.83ab	0.18c	0.10	8.08
FIPRONIL 240SC (12.5)	16.70	9.10	9.15c	9.38c	1.65b	0.40bc	0.08	5.26
FIPRONIL 240SC (25.0)	13.13	8.85	6.83c	8.75c	0.85b	0.20c	0.03	4.42
FIPRONIL 80WG (12.5)	18.28	7.28	17.40ab	19.15ab	0.88b	0.50abc	0.05	6.55
FIPRONIL 80WG (25.0)	15.73	12.78	9.85bc	10.50bc	1.90ab	1.13ab	0.15	5.44
ADMIRE 240FS (50.0)	15.45	4.55	7.68c	16.15abc	4.23a	1.40a	0.03	5.32
LSD p# 0.05	ns	ns	-	-	-	-	ns	ns

* Numbers in a column followed by the same letter are not significantly different (LSD, p#0.05); ns: not significant.

** Pre: Pre-spray counts before first application on June 30 or second application on August 4.

Table 4. Response of Colorado potato beetle (CPB) late instars (L3-L4) to applications of FIPRONIL, Harrington, PE, 1998.

Trtmt (rate in g AI/ha)	Mean No. CPB L3-L4/ Plant*							
	Jul 03 (3)	Jul 07 (7)	Jul 14 (14)	Jul 28 (28)	Aug 04 (2nd Pre)	Aug 07 (3)	Aug 10 (6)	Season Avg.
Check	0.18	3.85a	9.23a	4.43a	1.38	1.08a	0.18	3.00a
FIPRONIL 240SC (12.5)	0.00	0.30b	2.45b	2.25bc	1.25	0.08b	0.00	1.13b
FIPRONIL 240SC (25.0)	0.08	0.50b	1.85b	1.60c	0.73	0.00b	0.00	0.79b
FIPRONIL 80WG (12.5)	0.00	0.73b	5.93a	2.22bc	0.60	0.10b	0.00	1.77b
FIPRONIL 80WG (25.0)	0.03	0.53b	1.13b	1.20c	1.03	0.00b	0.00	0.77b
ADMIRE 240FS (50.0)	0.00	0.18b	1.38b	3.18ab	2.53	0.18b	0.03	1.44b
LSD p# 0.05	ns	-	-	-	ns	-	ns	-

* Numbers in a column followed by the same letter are not significantly different (LSD, p#0.05); ns: not significant.

** Pre: Pre-spray counts before first application on June 30 or second application on August 4.

Table 5. Defoliation and yield of plots treated with different formulations and rates of FIPRONIL, Harrington, PE, 1998.

Trtmt (rate in g AI/ha)	Defoliation (%)*						Marketable Yield (t/ha)
	July 10	July 20	July 24	July 30	Aug 7	Aug 14	
Check	15.0a	33.0a	39.0a	49.0a	62.0a	91.0a	26.2a
FIPRONIL 240SC (12.5)	7.0b	13.5d	17.0bc	18.3bc	30.5bc	34.8bc	31.3b
FIPRONIL 240SC (25.0)	6.5b	12.0d	13.5c	14.8c	26.3c	27.3c	32.4b
FIPRONIL 80WG (12.5)	8.0b	24.0b	21.5b	23.8b	39.0b	45.3b	28.5ab
FIPRONIL 80WG (25.0)	6.5b	13.8cd	16.0c	14.8c	28.3bc	30.5c	30.6b
ADMIRE 240FS (50.0)	4.0c	18.0c	15.5c	22.8b	24.0c	37.0bc	29.9ab
LSD p# 0.05	-	-	-	-	-	-	-

* Numbers in a column followed by the same letter are not significantly different (LSD, p#0.05); ns: not significant.

1998 PMR REPORT # 37 **SECTION C: POTATO INSECTS**
STUDY DATA BASE #: 303-1452-8702

CROP: Potato, cvs. Russet Burbank and NewLeaf Russet
PEST: Colorado potato beetle (CPB), *Leptinotarsa decemlineata* (Say)

NAME AND AGENCY:
STEWART J G, MACDONALD I K, and SMITH M E
Agriculture & Agri-Food Canada, Charlottetown Research Centre
P. O. Box 1210, Charlottetown, Prince Edward Island, C1A 7M8
Tel: (902) 566-6844; Fax: (902) 566-6821; Email: stewartj@em.agr.ca

TITLE: CONTROL OF THE COLORADO POTATO BEETLE (CPB) IN POTATOES USING SPINOSAD

MATERIALS: SPINOSAD 480 SC (NAF85) (spinosyn A/D)

METHODS: Cut seed-potato pieces were planted at Miscouche, Prince Edward Island, on May 13 (NewLeaf Russet) and May 15 (Russet Burbank), 1998, in 16-row plots with plant spacing of 0.4 m within rows and 0.9 m between rows. Plots were 30.5 m long and 14.6 m wide, and were replicated four times. With the exception of the NewLeaf plots, which were planted sequentially on the north side of the experiment, plots were arranged in a randomized complete block design. They were separated from each other within a replicate by two buffer rows of potatoes. Because CPB populations were low, adults were gathered from a nearby field and distributed throughout the experiment at the rate of 145 beetles per plot on June 25. Initial treatments were applied to the SPINOSAD plots on July 8, upon hatch of 30% of the egg masses monitored in the Check plots, and 7 days later on July 15. Treatments were applied as foliar sprays, using a PTO-driven sprayer at an output of 303 L/ha and a pressure of approximately 240 kPa. Counts of CPB early instars (L1-L2), late instars (L3-L4), and adults were done on 10 randomly-selected plants per plot at 2 and 7-days post-spray and thereafter on a weekly basis until August 5. Defoliation ratings were done weekly from July 10 to August 5. Weeds were controlled with a pre-emergence application of metribuzin at 0.6 kg AI/ha on June 12. For control of late blight, plots received recommended applications of chlorothalonil or propomocarb. All plots were sprayed with ADMIRE at 48 g AI/ha on September 16 to kill off beetle populations, and with diquat at 500 g AI/ha on October 7 for top desiccation. No tuber samples were harvested. Analyses of variance were performed on the data and Least Squares Differences (LSD) were calculated. Insect counts were transformed to Ln (x + 1) and percent defoliation was transformed to sqrt (arcsine (prop)) before analyses. The untransformed means are presented.

RESULTS: On July 10, fewer CPB adults were found on plants treated with either rate of SPINOSAD or the NewLeaf potatoes (Table 1). As a consequence of the reduction in adult counts, fewer egg masses were observed on the treated plants and NewLeaf potatoes compared to the Check from July 15 to 22 (Table 2). Two applications of SPINOSAD either as an 80/40 or a 60/60 g AI/ha combination reduced L1-L2 instars from July 10 to 29 (Table 3) and L3-L4 instars from July 15 to July 29 (Table 4). No larvae were observed on the NewLeaf potatoes throughout the sample period (Tables 3 and 4).The average number of CPBE per plant, a measure of all defoliating stages of the CPB, was significantly

reduced by either treatment combination of SPINOSAD or by the NewLeaf potatoes (Table 5).

CONCLUSIONS: Two applications of SPINOSAD within 7 days, either at 80 + 40 g AI/ha or at 60 + 60 g AI/ha, effectively controlled adults and larvae of CPB in plots of potatoes at Miscouche, PE, in 1998.

Table 1. Response of Colorado potato beetle (CPB) adults to SPINOSAD on potatoes, Miscouche, PE, 1998.

Trtmt	Rate (g AI/ha)	Mean No. CPB Adults/ Plant*						
		35985	35990	35992	35997	36004	36011	Avg.
Check	-	0.15a	0.25	0.03	0.10	0.05	2.55	0.52a
SPINOSAD	80 + 40	0.03b	0.05	0.00	0.00	0.00	0.55	0.10b
SPINOSAD	60 + 60	0.00b	0.05	0.00	0.03	0.03	1.55	0.28ab
NewLeaf	-	0.00b	0.00	0.00	0.00	0.00	0.25	0.04b
LSD (p# 0.05)		-	ns	ns	ns	ns	ns	-

* Numbers in a column followed by the same letter are not significantly different using a Protected LSD (p# 0.05). ns: not significant.

Table 2. Response of Colorado potato beetle (CPB) egg masses to SPINOSAD on potatoes, Miscouche, PE, 1998

Trtmt	Rate (g AI/ha)	Mean No. CPB Egg Masses/ Plant*						
		35985	35990	35992	35997	36004	36011	Avg.
Check	-	0.67	0.63a	0.43a	0.38a	0.03	0.00	0.35a
SPINOSAD	80 + 40	0.73	0.10b	0.08b	0.00b	0.05	0.00	0.16bc
SPINOSAD	60 + 60	0.95	0.08b	0.13b	0.05b	0.08	0.00	0.21ab
NewLeaf	-	0.00	0.00b	0.00b	0.00b	0.00	0.00	0.00c
LSD (p# 0.05)		ns	-	-	-	ns	ns	-

* Numbers in a column followed by the same letter are not significantly different using a Protected LSD (p# 0.05). ns: not significant.

Table 3. Response of Colorado potato beetle (CPB) early instars (L1-L2) to SPINOSAD on potatoes, Miscouche, PE, 1998

Trtmt	Rate (g AI/ha)	Mean No. L1-L2/ Plant*						
		35985	35990	35992	35997	36004	36011	Avg.
Check	-	6.73a	11.40a	12.20a	7.83a	1.98a	1.70a	6.97a
SPINOSAD	80 + 40	0.20bc	1.13b	0.80b	0.08b	0.00b	3.75a	0.99b
SPINOSAD	60 + 60	1.18b	0.50b	0.25b	0.00b	0.08b	2.30a	0.72b
NewLeaf	-	0.00c	0.00b	0.00b	0.00b	0.00b	0.00b	0.00b
LSD (p# 0.05)		-	-	-	-	-	-	-

* Numbers in a column followed by the same letter are not significantly different using a Protected LSD (p# 0.05). ns: not significant.

Table 4. Response of Colorado potato beetle (CPB) late instars (L3-L4) to SPINOSAD on potatoes, Miscouche, PE, 1998

Trtmt	Rate (g AI/ha)	Mean No. L3-L4/ Plant*						
		35985	35990	35992	35997	36004	36011	Avg.
Check	-	0.00	1.68a	3.68a	5.88a	8.53a	4.65a	4.07a
SPINOSAD	80 + 40	0.00	0.03b	0.00b	0.00b	0.08b	6.80a	1.15b
SPINOSAD	60 + 60	0.00	0.00b	0.00b	0.00b	0.10b	5.20a	0.88b
NewLeaf	-	0.00	0.00b	0.00b	0.00b	0.00b	0.00b	0.00b
LSD (p# 0.05)		ns	-	-	-	-	-	-

* Numbers in a column followed by the same letter are not significantly different using a Protected LSD (p# 0.05). ns: not significant.

Table 5. Colorado Potato Beetle Equivalents (CPBE)* in potato plots treated with to SPINOSAD, Miscouche, PE, 1998

Trtmt	Rate (g AI/ha)	Mean No. CPBE/ Plant**						
		35985	35990	35992	35997	36004	36011	Avg.
Check	-	0.99a	2.23a	2.78a	3.03a	3.14a	3.35a	2.59a
SPINOSAD	80 + 40	0.05b	0.20b	0.10b	0.01b	0.03b	3.08a	0.58b
SPINOSAD	60 + 60	0.15b	0.11b	0.03b	0.03b	0.07b	2.99a	0.56b
NewLeaf	-	0.00b	0.00b	0.00b	0.00b	0.00b	0.16b	0.03b
LSD (p# 0.05)		-	-	-	-	-	-	-

* Multiplication of Spring Adults x 1, L1-L2 x 0.125, L3-L4 x 0.333, and Summer Adults x 0.625 converts each growth stage to CPBE .

** Numbers in a column followed by the same letter are not significantly different using a Protected LSD (p# 0.05). ns: not significant.

1998 PMR REPORT # 38 **SECTION C: POTATO INSECTS**
STUDY DATA BASE: 303-1452-8702

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

NAME AND AGENCY:
STEWART J G, SMITH M E, and MACDONALD I K
Agriculture and Agri-Food Canada, Crops and Livestock Research Centre, P O Box 1210
Charlottetown, Prince Edward Island, C1A 7M8
Tel: (902) 566-6800; Fax: (902) 566-6821; E-Mail: stewartj@em.agr.ca

TITLE: DPX MP 062 FOR CONTROL OF THE COLORADO POTATO BEETLE AND POTATO FLEA BEETLE IN POTATOES

MATERIALS: DPX MP 062 , PBO (piperonyl butoxide 92%), ADMIRE 240 FS (imidacloprid)

METHODS: Small whole seed potatoes were planted in Harrington, PEI, on May 6, 1998. Plants were established in four-row plots at a within-row spacing of 0.4 m and a between-row spacing of 0.9 m. The plots, measuring 7.6 m in length and 3.7 m in width, were separated from each other by two buffer rows of potatoes. Nine treatments (see Table 1) with four replications were arranged in a randomized complete block design. On June 24, upon hatch of 30% of the egg masses monitored in the Check plots, initial treatments were applied to all plots except the untreated Check. The numbers of CPB egg masses, early instars (L1-L2), late instars (L3-L4), and adults, as well as potato flea beetles (PFB), were counted on five whole plants per plot at 2- and 7-days post-spray initially, and then weekly thereafter from July 8 to August 11. Following the first application on June 24, subsequent applications of DPX MP 062, up to a maximum of four per treatment, were made after a threshold of 2 Colorado Potato Beetle Equivalents (CPBE) per plant was reached or exceeded (see Table 1). The multiplication of spring adults by 1.0, L1-L2 larvae by 0.125, L3-L4 larvae by 0.333, or summer adults by 0.625 converts each life stage of the CPB to its CPBE. A second spray of ADMIRE was applied on August 4. Defoliation ratings were done weekly from July 10 to August 14. After planting, plots received a pre-emergence application of metribuzin at 1.1 kg AI/ha for weed control. On July 17, the buffer rows were sprayed with spinosyn A/D at 80 g AI/ha to prevent inter-plot movement. Throughout the summer, plots received recommended applications of chlorothalonil at 1.25 kg AI/ha and copper hydroxide at the same rate for late blight control. Diquat was applied at the rate of 370 g AI/ha on August 27 for top desiccation. Tubers from the centre two rows of each plot were harvested on September 14, and total and marketable (dia.>38 mm) yields were recorded. Analyses of variance were performed on the data and Least Squares Differences (LSD) were calculated. Insect counts were transformed to Ln(x+1) before analysis. Percent defoliation was transformed to sqrt (arcsine(prop)) before analysis. Untransformed means are presented.

RESULTS: Following the first application of insecticides on June 24 and relative to the Check, the number of CPB adults were reduced on June 26 (Table 2). By July 2, the number of egg masses on plants treated with ADMIRE or DPX MP 062 were reduced compared to the Check except for DPX + PBO at 25 g + 280 g AI/ha, and at 50 g + 140 g AI/ha (Table 3). Only ADMIRE and DPX MP 062 + PBO at 50 g + 280 g AI/ha reduced the number of L1-L2 instars following the first spray (Table 4).

However, a second application of DPX MP 062 + PBO at 25 g + 140 or 280 g AI/ha, or at 35 g + 140 or 280 g AI/ha significantly reduced the number of L1-L2 instars (Table 4) and L3-L4 instars (Table 5). Based on a seasonal average, four applications of DPX MP 062 at 50 g AI/ha without PBO were less effective than three applications at the 25 or 35 g AI/ha rates with PBO (Table 5) for the control of older larvae. On August 14, defoliation ratings for plants treated with any insecticide were lower than the ratings for the Check, but plants treated with ADMIRE, DPX MP 062 + PBO at 25 g + 280 g AI/ha, or at 35 g + 140 or 280 g AI/ha, or at 50 g + 280 g AI/ha tended to have the lowest defoliation ratings (Table 6). With the exception of DPX MP 062 + PBO at 35 g + 140 g AI/ha and 50 + 280 g AI/ha, marketable yields from plots treated with any insecticide, with or without PBO, were greater than the Check (Table 6). The first application of DPX MP 062, regardless of the rate of AI/ ha or the presence or absence of PBO, reduced early-season populations of the potato flea beetle (Table 7).

Different dates of treatments and different numbers of applications hinder comparisons among all rates of DPX MP 062 and PBO. Increasing the PBO from 140 to 280 g AI/ha did not result in an increased efficacy of DPX MP 062 at 25 g AI/ha (Tables 2-7). Increasing the rate of DPX MP 062 from 25 to 35 g AI/ha while holding the rate of PBO at 140 g AI/ha had no effect on the numbers of CPB adults (Table 2), egg masses (Table 3), L1-L2 instars (Table 4), L3-L4 instars (Table 5), defoliation or tuber yields (Table 6), or PFB adults (Table 7). Based on seasonal averages for CPB adults (Table 2), L1-L2 instars (Table 4), and L3-L4 instars (Table 5), the efficacy of four applications of DPX MP 062 at 50 g AI/ha without PBO was less than that of two applications of DPX MP 062 + PBO at 50 + 280 g AI/ha. However, this trend was not always statistically significant.

CONCLUSIONS: There is evidence that DPX MP 062 is efficacious against the CPB and PFB on potatoes but further research is needed to define optimum rates and timings of applications.

Table 1. Treatment list for the study of the response of the Colorado potato beetle to applications of DPX MP 062, Harrington, PE, 1998.

Trtmt	g AI/ ha	Spray Date and Number of Applications					
		June 24	July 5	July 15	July 24	Aug. 4	Total
Check	-	-	-	-	-	-	0
ADMIRE 240 FS	48	1st	-	-	-	2nd	2
DPX MP 062 + PBO	25 + 140	1st	2nd	3rd	-	-	3
DPX MP 062 + PBO	25 + 280	1st	2nd	3rd	-	-	3
DPX MP 062 + PBO	35 + 140	1st	2nd	3rd	-	-	3
DPX MP 062 + PBO	35 + 280	1st	2nd	-	3rd	-	3
DPX MP 062 + PBO	50 + 140	1st	-	2nd	3rd	-	3
DPX MP 062 + PBO	50 + 280	1st	-	2nd	-	-	2
DPX MP 062	50	1st	2nd	3rd	4th	-	4

Table 2. Response of Colorado potato beetle (CPB) adults to applications of DPX MP 062, Harrington, PE, 1998.

Trtmt	Rate	Mean No. CPB Adults/ Plant*						
	g AI/ ha	Jun 26	Jul 08	Jul 27	Jul 31	Aug 07	Aug 11	Season Avg.
Check	-	0.75a	0.15	0.35	1.35	3.15a	1.95ab	0.86
ADMIRE 240 FS	48	0.10b	0.20	0.30	0.90	0.65c	0.50c	0.32
DPX MP 062 + PBO	25 + 140	0.10b	0.20	0.05	0.70	2.05abc	1.80ab	0.58
DPX MP 062 + PBO	25 + 280	0.20b	0.15	0.00	0.35	2.30ab	2.55a	0.66
DPX MP 062 + PBO	35 + 140	0.15b	0.05	0.05	0.50	1.15bc	0.90bc	0.42
DPX MP 062 + PBO	35 + 280	0.10b	0.00	0.10	0.55	2.00ab	0.90bc	0.47
DPX MP 062 + PBO	50 + 140	0.05b	0.20	0.10	1.60	3.45a	1.20abc	0.77
DPX MP 062 + PBO	50 + 280	0.10b	0.25	0.10	0.80	1.15bc	0.90bc	0.44
DPX MP 062	50	0.20b	0.15	0.40	1.10	2.90a	2.75a	0.84
LSD p# 0.05		-	ns	ns	ns	-	-	ns

* Numbers in a column followed by the same letter are not significantly different (LSD, p#0.05); ns: not significant.

Table 3. Response of Colorado potato beetle (CPB) egg masses to applications of DPX MP 062, Harrington, PE, 1998.

Trtmt	Rate	Mean No. CPB Egg Masses/ Plant*						
	g AI/ ha	Jun 26	Jul 2	Jul 13	Jul 27	Jul 31	Aug 7	Season Avg.
Check	-	3.00	2.90a	0.45	0.00	0.00	0.00	0.80
ADMIRE 240 FS	48	1.50	0.15d	0.45	0.05	0.00	0.05	0.31
DPX MP 062 + PBO	25 + 140	1.80	1.20bc	0.30	0.00	0.00	0.05	0.49
DPX MP 062 + PBO	25 + 280	2.35	1.50abc	1.15	0.20	0.00	0.00	0.74
DPX MP 062 + PBO	35 + 140	2.35	1.40bc	0.55	0.00	0.05	0.00	0.60
DPX MP 062 + PBO	35 + 280	1.75	1.35bc	0.75	0.05	0.05	0.00	0.58
DPX MP 062 + PBO	50 + 140	2.30	2.00ab	0.70	0.05	0.00	0.10	0.63
DPX MP 062 + PBO	50 + 280	2.10	0.75cd	0.45	0.20	0.05	0.35	0.61
DPX MP 062	50	1.75	1.35bc	0.75	0.05	0.00	0.00	0.52
LSD p# 0.05		ns	-	ns	ns	ns	ns	ns

* Numbers in a column followed by the same letter are not significantly different (LSD, p#0.05); ns: not significant.

Table 4. Response of Colorado potato beetle (CPB) early instars (L1-L2) to applications of DPX MP 062, Harrington, PE, 1998.

Trtmt**	Rate	Mean No. CPB L1-L2/ Plant*						
	g AI/ ha	Jun 26	Jul 2	Jul 8	Jul 13	Jul 17	Jul 17	Season Avg.
Check	-	6.40	19.75a	34.95a	32.15a	23.30a	2.25bc	12.65
ADMIRE	48	3.75	4.35c	6.05cde	2.80d	6.20bc	13.75a	5.16
DPX + PBO	25 + 140	6.35	18.10a	8.75bcd	5.10cd	3.95c	3.25bc	5.06
DPX + PBO	25 + 280	6.15	17.40ab	5.25de	9.00bcd	2.70c	4.65ab	5.41
DPX + PBO	35 + 140	8.05	9.30abc	7.73bcd	9.15bc	6.55bc	4.40b	5.10
DPX + PBO	35 + 280	10.90	21.55a	2.95 e	6.25cd	6.60bc	3.60bc	6.45
DPX + PBO	50 + 140	8.25	7.40abc	15.65bc	17.60ab	6.60bc	1.10c	6.27
DPX + PBO	50 + 280	4.30	5.35bc	12.80bcd	9.20bc	6.40bc	3.60bc	4.88
DPX	50	1.95	11.60abc	15.50ab	14.30ab	11.95ab	3.25bc	6.59
LSD p# 0.05		ns	-	-	-	-	-	ns

* Numbers in a column followed by the same letter are not significantly different (LSD, p#0.05); ns: not significant.

** Trtmt: ADMIRE = ADMIRE 240 FS; DPX = DPX MP 062

Table 5. Response of Colorado potato beetle (CPB) late instars (L3-L4) to applications of DPX MP 062, Harrington, PE, 1998.

Trtmt**	Rate	Mean No. CPB L3-L4/ Plant*						
	g AI/ ha	Jul 8	Jul 13	Jul 17	Jul 22	Jul 27	Aug 11	Season Avg.
Check	-	6.00a	17.50a	20.45a	6.95a	3.10abc	0.45bc	6.33a
ADMIRE	48	0.10d	2.10 e	3.80cd	0.90 e	4.65ab	0.10c	1.60cd
DPX + PBO	25 + 140	0.20d	4.10cde	3.85cd	1.60cde	1.55bcd	1.35ab	1.60cd
DPX + PBO	25 + 280	0.15d	1.65 e	2.50cd	1.30de	1.25cd	1.55a	1.27cd
DPX + PBO	35 + 140	0.30d	2.65de	2.25d	1.70cde	1.45bcd	0.65abc	1.23cd
DPX + PBO	35 + 280	0.15d	1.15 e	4.55bc	1.75cde	0.85d	0.45bc	1.31d
DPX + PBO	50 + 140	4.15ab	10.95ab	4.35bcd	4.10ab	1.05cd	0.10c	2.92bc
DPX + PBO	50 + 280	2.20c	12.40abc	2.15cd	2.75bcd	1.30cd	0.10c	2.42bcd
DPX	50	2.45bc	6.70bcd	8.65b	3.15bc	6.50a	0.55bc	3.34ab
LSD p# 0.05		-	-	-	-	-	-	-

* Numbers in a column followed by the same letter are not significantly different (LSD, p#0.05); ns: not significant.

** Trtmt: ADMIRE = ADMIRE 240 FS; DPX = DPX MP 062

Table 6. Damage (% defoliation) and tuber yields from plots treated with applications of DPX MP 062, Harrington, PE, 1998.

Trtmt**	Rate	% Defoliation						Tuber Yield (t/ha)
	g AI/ ha	Jul 10	Jul 20	Jul 24	Jul 31	Aug 7	Aug 14	Marketable
Check	-	15.0a	30.8a	37.0a	39.0a	55.8a	80.5a	30.4a
ADMIRE	48	4.3d	10.3d	14.0bcd	16.0bc	24.3cd	39.8c	35.8c
DPX + PBO	25 + 140	7.0c	14.8bcd	13.5bcd	17.0bc	22.8cd	49.3bc	35.0c
DPX + PBO	25 + 280	8.5bc	10.8d	10.0d	12.5c	20.3cd	37.0c	34.5c
DPX + PBO	35 + 140	7.0c	9.8d	10.0d	14.5bc	19.5d	34.8c	33.2abc
DPX + PBO	35 + 280	6.0cd	11.0cd	9.0d	12.5c	19.0d	34.8c	33.8bc
DPX + PBO	50 + 140	10.0b	18.0bc	15.5bc	20.5b	36.8b	47.3bc	34.8c
DPX + PBO	50 + 280	8.0bc	14.8bcd	11.5cd	14.8bc	26.0bcd	43.0c	31.0ab
DPX	50	8.0bc	20.3b	18.0b	21.5b	30.5bc	61.8b	34.7c
LSD p# 0.05		-	-	-	-	-	-	-

* Numbers in a column followed by the same letter are not significantly different (LSD, p#0.05); ns: not significant.

** Trtmt: ADMIRE = ADMIRE 240 FS; DPX = DPX MP 062

Table 7. Response of potato flea beetle (PFB) adults to applications of DPX MP 062, Harrington, PE, 1998.

Trtmt	Rate	Mean No.PFB Adults/ Plant*						
	g AI/ ha	Jun 26	Jul 2	Jul 8	Jul 31	Aug 7	Aug 11	Season Avg.
Check	-	10.10a	5.70a	0.35ab	0.60bc	8.25	18.40	4.35
ADMIRE 240 FS	48	9.25a	7.95a	1.05a	2.70ab	10.95	29.70	6.23
DPX MP 062 + PBO	25 + 140	1.55bcd	0.90b	0.30b	4.50a	16.20	17.40	4.14
DPX MP 062 + PBO	25 + 280	3.05bc	1.80b	0.50ab	2.40ab	20.70	30.50	5.94
DPX MP 062 + PBO	35 + 140	3.25b	1.70b	0.05b	1.10abc	17.15	39.50	6.31
DPX MP 062 + PBO	35 + 280	1.65bc	1.60b	0.00b	0.50bc	22.05	22.50	4.93
DPX MP 062 + PBO	50 + 140	1.50bcd	1.25b	0.10b	0.20c	13.45	17.45	3.52
DPX MP 062 + PBO	50 + 280	0.40d	0.75b	0.55ab	0.80abc	13.35	11.25	2.76
DPX MP 062	50	1.15cd	1.45b	0.05b	0.20c	14.85	19.05	3.69
LSD p# 0.05		-	-	-	-	ns	ns	ns

* Numbers in a column followed by the same letter are not significantly different (LSD, p#0.05); ns: not significant.

1998 PMR REPORT # 39 SECTION C: POTATO INSECTS
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CROP: Potato, cv. Superior
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NAME AND AGENCY:
STEWART, J G, SMITH, M, and MACDONALD, I
Agriculture & Agri-Food Canada, Crops and Livestock Research Centre,
P. O. Box 1210, Charlottetown, Prince Edward Island C1A 7M8
Tel: (902) 566-6844; Fax: (902) 566-566-6821; Email: stewartj@em.agr.ca

TITLE: MANAGEMENT OF POTATO PESTS USING WARRIOR

MATERIALS: WARRIOR 120 EC and 120 CS (lambda-cyhalothrin); ADMIRE 240 SC (imidacloprid)

METHODS: Small, whole seed potatoes were planted at Harrington, Prince Edward Island, on May 6, 1998, in 4-row plots with plants spaced at 0.4 m within rows and 0.9 m between rows. Plots were 7.6 m long and 3.6 m wide, and were arranged in a randomized complete block design, with 11 treatments and four replications. They were separated from each other within a replicate by two buffer rows of potatoes. The products, formulations, rates, and timing of application are listed in Table 1. All treatments were applied as foliar sprays, using a CO_2-pressurized precision-plot sprayer at an output of 303 L/ha and a pressure of approximately 240 kPa. The number of CPB egg masses, early instars (L1-L2), late instars (L3-L4), and adults were counted on ten plants from the two centre rows of each plot throughout the growing season. Defoliation ratings were conducted from July 10 to August 14. Crop phytopathology was noted at one and seven days post-spray. Weeds were controlled with a pre-emergence application of metribuzin at 1.1 kg AI/ha on May 28. For control of late blight, plots received recommended rates of chlorothalonil or copper hydroxide. All plots were sprayed with diquat at 370 g AI/ha on August 27 for top desiccation. On September 14 and 15, tubers were harvested from the two center rows of each plot, and total and marketable (>38 mm dia.) yields were recorded. Analyzes of variance were performed on the data and Least Squares Differences (LSD) were calculated. Insect counts were transformed to Ln (x + 1) and percent defoliation was transformed to sqrt (arcsine (prop)) before analyzes. The untransformed means are presented.

RESULTS: The number of CPB adults was similar for all treatments except on Aug. 4 when significantly more adults were observed on plants in the Check (Table 2). Both formulations of Warrior applied 5 days after 50% egg hatch significantly reduced the number of early instars from 4 to 10 days after treatment for the lowest rate tested and from 4 to 14 days after treatment for the 15 and 20 g AI/ha rates and for Admire (Table 3). Applications of WARRIOR and ADMIRE on July 6 were efficacious until July 13 only (Table 3). Significantly fewer older instars were observed on plants from July 9 to 20 for all products tested except on July 20 for 20 g AI/ha rate of WARRIOR 120 EC applied 5 days after 50% egg hatch (Table 4). Seasonal average numbers of older instars for all treatments tested were significantly less than the untreated Check (Table 4). Although not always statistically significant, defoliation ratings for plots treated with WARRIOR or ADMIRE were lower than the Check from July 10 to August 14 (Table 5). The marketable yield of plots treated with WARRIOR 120EC or 120CS at 15

g AI/ha 5 days after 50% egg hatch, WARRIOR 120EC at 10 or 20 g AI/ha 5 days after 50% egg hatch, WARRIOR at 10 g AI/ha 12 days after 50% egg hatch, and ADMIRE was significantly greater than the yield from the Check plot (Table 5).

CONCLUSIONS: Although all products tested showed some activity against adults, L1-L2 instars, L3-L4 instars, tuber yields of plots treated with WARRIOR at 10 to 20 g AI/ha 5 days after 50% egg hatch tended to be greater than the equivalent rate applied 12 days after 50% egg hatch.

Table 1. Products, formulations, rates, and timings of application for experiment conducted at Harrington, PE, 1998.

Trtmt No.	Product	Rate (g A.I./ha)	Timing	Date of Application
1	Not treated Check	-	-	-
2	WARRIOR 120 EC	10	5 days post 50% egg hatch	35974
3	WARRIOR 120 EC	15	5 days post 50% egg hatch	35974
4	WARRIOR 120 EC	20	5 days post 50% egg hatch	35974
5	WARRIOR 120 CS	15	5 days post 50% egg hatch	35974
6	WARRIOR 120 EC	10	7 days after trtmts 2-5 sprayed	35981
7	WARRIOR 120 EC	15	7 days after trtmts 2-5 sprayed	35981
8	WARRIOR 120 EC	20	7 days after trtmts 2-5 sprayed	35981
9	WARRIOR 120 CS	15	7 days after trtmts 2-5 sprayed	35981
10	ADMIRE 240 F	48	5 days post 50% egg hatch	35974
11	ADMIRE 240 F	48	7 days after trtmts 2-5 sprayed	35981

Table 2. Effect of rate, formulation, and timing of application of WARRIOR on Colorado potato beetle (CPB) adults on potatoes, Harrington, PE, 1998.

Trt. No.*	Mean No. CPB Adults/ Plant**						Season Average
	35975	35978	35981	35984	35988	36010	
1	0.90	0.55	0.30	0.15	0.30	3.30a	0.76
2	0.50	0.55	0.70	0.35	0.40	1.35b	0.52
3	0.95	0.20	0.60	0.35	0.45	0.80bc	0.62
4	1.10	0.65	0.95	1.00	0.45	0.90bc	0.67
5	0.50	0.25	0.35	0.30	0.10	0.20c	0.28
6	0.45	0.65	0.20	0.20	0.25	0.80bc	0.41
7	0.90	0.75	0.70	0.05	0.30	0.40bc	0.47
8	1.00	0.55	0.45	0.30	0.40	0.75bc	0.62
9	0.95	0.55	0.25	0.30	0.01	0.80bc	0.41
10	0.35	0.20	0.50	0.60	0.40	0.05bc	0.44
11	0.50	0.90	0.15	0.00	0.15	0.65bc	0.48
LSD	ns	ns	ns	ns	ns	-	ns

* See Table 1 for the treatment list.

** Numbers in a column followed by the same letter are not significantly different (P# 0.05) using a protected LSD; ns: Not significant

Table 3. Effect of rate, formulation, and timing of application of WARRIOR on Colorado potato beetle (CPB) early instars (L1-L2) on potatoes, Harrington, PE, 1998.

Trt. No.*	Mean No. CPB L1-L2/ Plant**						Season Average
	35975	35978	35981	35984	35988	35991	
1	9.30	17.35a	38.00a	55.85a	46.90a	19.60	20.14a
2	10.35	7.95bc	8.05cd	15.45b	14.70ab	18.35	8.97bc
3	8.65	3.25cd	6.20d	9.45bc	7.85bc	10.80	7.01bc
4	6.35	5.55bcd	8.90cd	7.45bc	7.95bc	11.20	7.94bc
5	3.55	3.10d	7.55cd	10.15b	3.50bc	4.60	5.36bc
6	3.20	19.75a	14.85bcd	9.55b	4.20bc	5.80	7.69bc
7	5.20	20.70a	12.65bcd	7.05bc	5.75bc	8.20	7.09bc
8	12.25	20.55a	30.25ab	3.60bc	3.65bc	12.30	11.76ab
9	5.95	13.60ab	22.10abc	5.80bc	4.85c	7.75	8.09bc
10	8.50	8.95abc	2.80c	2.45bc	3.65c	4.80	5.45c
11	11.75	13.25abc	29.30abc	2.55c	8.10bc	4.60	9.54bc
LSD	ns	-	-	-	-	ns	-

* See Table 1 for the treatment list.

** Numbers in a column followed by the same letter are not significantly different (P# 0.05) using a protected LSD; ns: Not significant

Table 4. Effect of rate, formulation, and timing of application of WARRIOR on Colorado potato beetle (CPB) older instars (L3-L4) on potatoes, Harrington, PE, 1998.

Trt No.*	Mean No. CPB L3-L4/ Plant**					Season Average
	35981	35984	35988	35991	35995	
1	2.20a	6.40a	10.50a	16.55a	15.95a	6.29a
2	0.00c	1.50b	1.45bc	2.90b	6.10b	1.68bc
3	0.15c	0.05c	0.60cdef	3.10b	6.00bc	1.59bc
4	0.05c	0.60bc	0.85bcde	2.50b	7.70ab	1.89b
5	0.00c	0.20c	0.90bcde	2.05bc	1.50d	0.93bc
6	0.10c	0.45c	1.50b	1.20bc	0.85d	0.91bc
7	1.60a	0.55bc	1.35bcd	2.80bc	1.00d	1.11bc
8	0.70bc	0.05c	0.30ef	1.00bc	1.50d	1.80bc
9	1.75ab	0.50c	0.50def	1.80bc	1.55d	1.11bc
10	0.00c	0.05c	0.15f	0.85bc	1.95cd	1.08bc
11	0.25c	0.05c	0.20f	0.40c	0.75d	1.11c
LSD	-	-	-	-	-	-

* See Table 1 for the treatment list.

* Numbers in a column followed by the same letter are not significantly different (P# 0.05) using a protected LSD; ns: Not significant

Table 5. Defoliation ratings and yield of tubers from the Check plots and plots treated with WARRIOR or ADMIRE, Harrington, PE, 1998.

Trt. No.*	Defoliation (%)**						Marketable Yield (t/ha)**
	35985	35995	35999	36006	36013	36020	
1	14.5a	29.5a	37.0a	58.0a	53.8a	91.0a	27.85d
2	4.5cd	16.3b	16.0bc	28.5b	21.5bc	53.5b	31.60abc
3	4.3cd	13.5bcd	17.5b	22.8bc	22.8b	47.3bcd	32.60abc
4	6.5bc	13.5bc	15.8bc	19.3cd	22.3bc	47.3bcd	32.54abc
5	2.8d	4.5f	10.0cd	19.5cd	20.3bc	30.5cd	33.03ab
6	9.0ab	7.3def	11.0bcd	20.3bcd	20.3bc	41.0bcd	33.68a
7	8.5bc	8.0cdef	11.5bcd	18.0cd	16.0cd	28.0d	29.92bcd
8	11.5ab	10.0bcde	10.0cd	20.3bcd	24.5b	49.5bc	29.47cd
9	9.5ab	10.3bcde	9.0cd	15.8cd	13.0d	28.5d	29.88bcd
10	2.0d	5.8ef	9.5d	19.3cd	19.3bc	41.8bcd	34.00a
11	11.0ab	5.8ef	10.0cd	15.3d	21.5bc	31.0d	32.61abc
LSD	-	-	-	-	-	-	-

* See Table 1 for the treatment list.

** Numbers in a column followed by the same letter are not significantly different (P# 0.05) using a protected LSD.

1998 PMR REPORT# 40 **SECTION C: POTATO INSECTS**
STUDY DATA BASE: 303-1452-8702

CROP: Potato, cv. Shepody
PEST: Colorado potato beetle (CPB), *Leptinotarsa decemlineata* (Say); potato flea beetle (PFB), *Epitrix cucumeris* (Harr.); potato aphid (PA), *Macrosiphum euphorbia*e (Thos.)

NAME AND AGENCY:
STEWART J G, MACDONALD I K, and SMITH M E
Agriculture and Agri-Food Canada
Research Centre, P O Box 1210
Charlottetown, Prince Edward Island, C1A 7M8
Tel: (902) 566-6800; Fax: (902) 566-6821; E-Mail: stewartj@em.agr.ca

TITLE: COMPARISON OF ADULT AND LARVAL THRESHOLDS FOR THE MANAGEMENT OF POTATO INSECT PESTS

MATERIALS: FIPRONIL (EXP60145A), ADMIRE 240 FS (imidacloprid)

METHODS: Cut seed potato pieces were planted in Harrington, PEI, on May 14, 1998. Plants were established in four-row plots, with spacing at about 0.4 m within rows and about 0.9 m between rows. The plots, measuring 15.2 m in length and 3.6 m in width, were separated from each other by two buffer rows of potatoes. Plots were arranged in a randomized complete block design, with five treatments each replicated four times. Spray thresholds of either 1-2 spring or summer adults per plot (Adult Threshold) or 16-20 small larvae (L1/L2) with some large larvae (L3-L4) per plot (Larval Threshold) were used. Treatments were applied as foliar sprays using a CO_2-pressurized precision plot sprayer at 240 kPa and 303 L H_2O/ha, on June 30 and August 14 for the Adult Threshold and on July 7 for the Larval Threshold. The numbers of plants counted per plot for each sampling date were: 15 plants for the pre-spray and the 3 and 7-day post-spray counts; 10 plants for the 10 and 14-day post-spray counts; and 5 plants for 21 days post-spray. Counts of Colorado potato beetle (CPB) early instars, late instars, and adults were made on a whole-plant basis and converted to Colorado Potato Beetle Equivalents (CPBE). The multiplication of spring adults by 1.0, L1-L2 larvae by 0.125, L3-L4 larvae by 0.333, or summer adults by 0.625 converts each life stage of the CPB to its CPBE. Population levels of potato flea beetles and potato aphids were counted from 10 net sweeps (0.4 m dia.) per plot. Percent defoliation was recorded weekly from July 13 to September 11. After planting, plots received a pre-emergence application of metribuzin at 1.1 kg AI/ha for weed control. On July 17, the buffer rows were sprayed with spinosyn A/D at 80 g AI/ha to keep insects from moving between plots. Throughout the summer, plots received recommended applications of chlorothalonil at 1.25 kg AI/ha, plus propomocarb at 1.6 kg AI/ha for late blight control. Diquat was applied at the rate of 370 g AI/ha on September 18 for top desiccation. Tubers from the center two rows of each plot were harvested on October 8, and total and marketable (dia.>38 mm) yields were recorded. Analyses of variance were performed on the data and Least Squares Differences (LSD) were calculated. Insect counts were transformed to Ln(x+1) before analysis. Percent defoliation was transformed to sqrt (arcsine(prop)) before analysis. Untransformed means are presented.

RESULTS: The results are summarized in the tables that follow:

CONCLUSIONS: Based on the seasonal average, one application of FIPRONIL or ADMIRE on July 7 (Larval Threshold) was as or more effective in reducing the number of CPBE on plants as two applications using the Adult Threshold (Table 1). The activity of FIPRONIL and ADMIRE against the PFB was quite variable throughout the growing season (Table 2). Adults of the PFB are very mobile. Inter-plot movement of adults in small research plots tends to confound the results for this pest. Larger scale trials are a better assessment of products against the PFB. Although not always statistically significant, ADMIRE, applied at either the Adult or Larval Threshold, was more efficacious against potato aphids than FIPRONIL (Table 3). The damage in plots managed with FIPRONIL tended to be lower than for plots protected with ADMIRE regardless of the threshold used (Table 4). A similar trend was noted between FIPRONIL and ADMIRE for tuber yields (Table 4). With the exception of the application of ADMIRE and the Larval Threshold, marketable yields from plots treated with insecticides were greater than the yield for the Check.

Table 1. Effect of timing of applications of FIPRONIL or ADMIRE on Colorado Potato Beetle Equivalents (CPBE)* on potatoes, Harrington, PE, 1998.

Trtmt & Threshold***	Mean No. CPBE/ Plant **									
	Jul 7	36348	36354	36357	Jul 21	36375	36388	Aug 24	36399	Season Avg.
Check	2.2a	2.4a	4.7a	5.3a	6.0a	3.9a	2.4a	2.2a	2.7a	2.8a
FIPRONIL-Ad	1.6ab	0.8b	1.0b	1.3c	1.6bc	1.3bc	0.2c	0.3b	0.3c	0.8c
ADMIRE-Ad	0.9b	0.7b	1.1b	2.5b	2.3b	2.0b	0.8b	2.5a	3.3a	1.5b
FIPRONIL-Lar	2.4a	0.5b	0.4c	0.4d	0.5d	0.2d	1.0b	0.6b	0.8bc	0.8c
ADMIRE-Lar	2.4a	0.4b	0.4c	0.7cd	1.0c	0.9cd	1.2b	1.5a	1.2b	1.0c
LSD (P#0.05)	-	-	-	-	-	-	-	-	-	-

* CPBE: See text for calculation

** Numbers in a column followed by the same letter are not significantly different (P# 0.05) using a protected LSD; ns: Not significant

*** See text for rates of application. Ad: Adult threshold of 1-2 adult CPB/plot, Lar: Larval threshold of 16-20 L1-l2 and some L3-L4 per plot

Table 2. Effect of timing of applications of FIPRONIL or ADMIRE on potato flea beetle (PFB) adults on potatoes, Harrington, PE, 1998.

Trtmt & Threshold**	Mean. No. PFB/ 10 Sweeps*									
	Jul 3	Jul 7	Jul 8	Jul 10	Jul 14	Aug 21	Aug 24	Sep 3	Sep 11	Season Ave
Check	56a	48	51a	22ab	13ab	146a	201b	49c	56c	81
FIPRONIL-Ad	28b	44	53a	29a	22a	91c	200b	118ab	118ab	77
ADMIRE-Ad	44a	70	63a	53a	20a	274b	350a	86b	76bc	104
FIPRONIL-Lar	80a	32	7b	11c	7b	140b	169b	151a	95ab	82
ADMIRE-Lar	74a	38	7b	12bc	25a	142b	208b	97b	143a	90
LSD (P#0.05)	-	ns	-	-	-	-	-	-	-	ns

* Numbers in a column followed by the same letter are not significantly different (P# 0.05) using a protected LSD; ns: Not significant

** See text for rates of application. Ad: Adult threshold of 1-2 adult CPB/plot, Lar: Larval threshold of 16-20 L1-l2 and some L3-L4 per plot

Table 3. Effect of timing of applications of FIPRONIL or ADMIRE on aphids* on potatoes, Harrington, PE, 1998.

Trtmt & Threshold***	Mean No. Aphids/ 10 Sweeps**								
	Jul 10	Jul 14	Jul 21	Jul 27	Aug 4	Aug 10	Aug 24	Aug 28	Season Avg.
Check	6.0a	19.8a	31.5ab	88.3b	39.3	24.5	11.0	6.0a	17.6ab
FIPRONIL-Ad	4.8ab	15.3a	54.8a	115.8ab	50.3	23.3	26.3	9.8a	23.9a
ADMIRE-Ad	0.8c	6.3bc	20.0c	48.8c	23.8	15.8	9.0	1.8b	10.9c
FIPRONIL-Lar	4.3ab	12.5ab	51.8a	143.8a	52.0	15.0	16.0	5.3a	23.0ab
ADMIRE-Lar	2.3bc	3.8c	22.3bc	39.3c	37.8	21.8	12.0	8.5a	13.1bc
LSD (P#0.05)	-	-	-	-	ns	ns	ns	-	-

* Primarily potato aphids, *Macrosiphum euphorbiae* (Homoptera: Apididae)

** Numbers in a column followed by the same letter are not significantly different (P# 0.05) using a protected LSD; ns: Not significant.

*** See text for rates of application. Ad: Ault threshold of 1-2 adult CPB/plot, Lar: Larval threshold of 16-20 L1-l2 and some L3-L4 per plot

Table 4. Defoliation ratings and tuber yields from plots treated with FIPRONIL or ADMIRE, Harrington, PE, 1998.

Trtmt & Threshold**	% Defoliation*								Marketable Yield (t/ha)*
	Jul 13	Jul 20	Jul 30	Aug 7	Aug 13	Aug 21	Aug 28	Season Ave	
Check	0.25	26a	34a	41a	49a	58a	66a	47a	29.3a
FIPRONIL-Ad	8bc	13b	11c	11c	17b	21bc	21b	18c	35.2c
ADMIRE-Ad	5c	12bc	18b	19b	25b	33b	35b	26b	32.7bc
FIPRONIL-Lar	8bc	7cd	9c	10c	14b	16c	18b	16c	35.1bc
ADMIRE-Lar	9b	5d	10c	12c	19b	25bc	27b	20bc	32.1ab
LSD (P#0.05)	-	-	-	-	-	-	-	-	-

* Numbers in a column followed by the same letter are not significantly different (P# 0.05) using a protected LSD; ns: Not significant

** See text for rates of application. Ad: Adult threshold of 1-2 adult CPB/plot, Lar: Larval threshold of 16-20 L1-l2 and some L3-L4 per plot

END OF SECTION C

SECTION D: MEDICAL and VETERINARY - Insects /MÉDICALS et VÉTÉRINAIRES

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EDITOR **Dr. Doug Colwell**
Agriculture and Agri-Food Canada
Lethbridge Research Centre
P.O. Box 3000, Main
Lethbridge, Alberta T1J 4B1
Email: colwell@abrsle.agr.ca
Tel: (403) 327-4591 ext. 344
Fax: (403) 382-3156

1998 PMR REPORT # 41 **SECTION D: MEDICAL AND VETERINARY**
ICAR #: 86100101

HOST: Beef Cattle (mixed cross breeds)
PEST: Horn fly, *Haematobia irritans* (L.)
Face fly, *Musca autumnalis* (DeGeer)

NAME AND AGENCY:
BUTLER S M, SURGEONER G A and HEAL J D
Department of Environmental Biology
University of Guelph
Guelph, Ontario, N1G 2W1
Tel: (519) 824-4120 ext. 3966 Fax: (519) 837-0442 E-mail: gsurgeon@evbhort.uoguelph.ca

TITLE: CONTROL OF HORN FLIES AND FACE FLIES ON CATTLE USING A SINGLE PYTHON EAR TAG OR TWO PYTHON EAR TAGS IMPREGNATED WITH 10% â-CYPERMETHRIN OR BRUTE POUR-ON CONTAINING 10% PERMETHRIN

MATERIALS: PYTHON EAR TAGS (10% â-cypermethrin), BRUTE POUR-ON (10% permethrin).

METHODS: Four separate herds of beef cattle of mixed breeds (ca. 25 animals per herd) within two kilometers of each other were used in this trial. The four herds were located near Elora, Ontario. During early June 1997 animals in each herd were tagged with one or two PYTHON EAR TAGS (if two tags then one tag per ear) or were treated with 3.0 ml of BRUTE POUR-ON per 100 kg of body weight (up to a maximum of 15 ml per animal). The BRUTE POUR-ON was applied down the back line of each animal from the crest to the tail head. A fourth herd was non-treated and served as a control. At approximately weekly intervals, numbers of horn flies per side and face flies per face were counted on ten randomly selected animals in each herd on the same day between 11:30 am and 3:30 pm. Differences in the weekly means were analysed by a Student's t-test.

RESULTS: The results are summarized in the tables below.

CONCLUSIONS: The PYTHON EAR TAGS provided complete season long control of horn flies for herds tagged with one tag per animal or two tags per animal. The BRUTE POUR-ON provided $95% control of horn flies for seven weeks post treatment. The PYTHON EAR TAGS provided a season mean of 94.2% control of face flies on animals with one tag, and a season mean of 89.3% control of face flies on animals with two tags. The BRUTE POUR-ON provided a season mean of 58.3% control of face flies.

Table 1. Mean number (± one standard deviation) of horn flies (post - treatment) per side on cattle herds (n=10 animals) non - treated, treated with one or two insecticidal PYTHON EAR TAGS, or BRUTE POUR-ON, Elora, Ontario, 1997. Values followed with the same letter within a row are not significantly different (P>0.05).

Sample Date		Non - treated	One tag	Two tags	Pour-on
June	17	12.4 ± 9.6a	3.0 ± 1.6b*	--	6.4 ± 2.8ab*
	24	34.9 ± 20.4a	0.1 ± 0.3b	0.0 ± 0.0b	8.7 ± 5.5b*
July	3	59.1 ± 17.2a	0.0 ± 0.0b	0.0 ± 0.0b	0.0 ± 0.0b
	7	38.1 ± 17.0a	0.2 ± 0.6b	0.0 ± 0.0b	0.1 ± 0.3b
	15	37.5 ± 16.2a	0.2 ± 0.6b	0.0 ± 0.0b	0.4 ± 0.7b
	21	69.4 ± 27.1a	0.0 ± 0.0b	0.0 ± 0.0b	0.5 ± 1.3b
	28	78.4 ± 21.6a	0.0 ± 0.0b	0.0 ± 0.0b	4.1 ± 3.1b
August	6	57.1 ± 25.3a	0.0 ± 0.0b	0.0 ± 0.0b	0.8 ± 1.5b
	13	59.0 ± 25.5a	0.0 ± 0.0b	0.0 ± 0.0b	3.0 ± 5.0b
	18	55.3 ± 22.8a	0.0 ± 0.0b	0.0 ± 0.0b	12.1 ± 9.0b
	25	72.6 ± 32.9a	0.0 ± 0.0b	0.0 ± 0.0b	5.9 ± 6.2b
Sept.	4	48.8 ± 21.0a	0.0 ± 0.0b	0.0 ± 0.0b	19.0 ± 14.9c
Season Mean(±)		57.3 ± 25.6a	0.05 ± 0.3b	0.0 ± 0.0b	4.6 ± 8.4b

*These values represent pre-treatment counts.

Table 2. Mean number (± one standard deviation) of face flies (post-treatment) per face on cattle herds (n=10 animals) non - treated, treated with one or two insecticidal PYTHON EAR, or BRUTE POUR-ON, Elora, Ontario, 1997. Values followed with the same letter within a row are not significantly different (P>0.05).

Sample Date	Non - treated	One tag	Two tags	Pour-on
June 17	10.7 ± 7.1a	3.7 ± 1.5b*	--	5.8 ± 3.8ab*
24	17.8 ± 5.6a	0.3 ± 0.5c	0.2 ± 0.4c	9.0 ± 6.3b*
July 3	1.6 ± 1.3a	0.0 ± 0.0b	0.0 ± 0.0b	0.0 ± 0.0b
7	6.3 ± 3.4a	0.1 ± 0.3b	0.0 ± 0.0b	0.3 ± 0.5b
15	6.0 ± 3.7a	0.0 ± 0.0b	0.1 ± 0.3b	1.5 ± 1.4b
21	14.5 ± 5.2a	1.1 ± 1.1b	1.8 ± 1.9b	5.8 ± 4.5b
28	20.5 ± 12.2a	1.9 ± 1.4b	0.2 ± 0.4b	5.6 ± 2.5b
August 6	14.2 ± 4.7a	0.4 ± 0.7b	0.4 ± 0.7b	12.7 ± 8.3a
13	4.4 ± 1.6a	0.3 ± 0.9b	0.1 ± 0.3b	1.8 ± 2.7b
18	11.9 ± 8.2a	1.1 ± 1.3b	1.6 ± 1.5b	4.7 ± 4.3b
25	12.0 ± 5.4a	0.2 ± 0.4c	1.6 ± 1.6bc	6.7 ± 5.9ab
Sept. 4	11.6 ± 8.6a	0.6 ± 0.5b	4.8 ± 4.4b	3.6 ± 3.5b
Season Mean(±)	10.3 ± 8.1a	0.6 ± 1.0b	1.1 ± 2.2b	4.3 ± 5.3c

*These values represent pre-treatment counts.

1998 PMR REPORT # 42 **SECTION D: MEDICAL AND VETERINARY**
ICAR #: 86100101

HOST: Beef Cattle (mixed cross breeds)
PEST: Horn fly, *Haematobia irritans* (L.)
Face fly, *Musca autumnalis* (DeGeer)

NAME AND AGENCY:
SURGEONER G A, HEAL J D and BUTLER S M
Department of Environmental Biology
University of Guelph
Guelph, Ontario, N1G 2W1
Tel: (519) 824-4120 ext. 3966 Fax: (519) 837-0442 E-mail: gsurgeon@evbhort.uoguelph.ca

RIPLEY, B
Pesticide and Trace Contaminants Section
Regulatory Unit
Laboratory Services Division
University of Guelph
Guelph, Ontario, N1G 2W1
Tel: (519) 767-6200

TITLE: LAMBDA CYHALOTHRIN RESIDUES IN BOVINE TISSUE SAMPLES ASSOCIATED WITH THE USE OF INSECTICIDAL EAR TAGS

MATERIALS: SABER™ EAR TAGS (10% w/w lambdacyhalothrin).

METHODS: The purpose of this study was to analyse meat and various other tissues for lambdacyhalothrin residues at 7, 14, 28, 56 and 112 days after beef cattle had been tagged with ear tags containing 10% w/w lambdacyhalothrin. Animals used in this trial were not exposed to any insecticide treatments prior to inclusion in the study. Five Hereford steers were treated with two ear tags each (one per ear) on July 15, 1997. One additional animal was non-treated and served as a control. Animals were maintained indoors in six separate pens for the duration of the study at the Elora Research Station, University of Guelph. Treated animals were separated from the control animal by a vacant pen. After 7 days, one animal was slaughtered and sampled. Hair samples from the crest, dorsal midline and rump areas were collected and combined. Three replicate samples of at least 100 g of five selected tissue types (Table 1) were also collected. Samples of each tissue type were taken immediately to the laboratory and cut into at least 100 g sections, wrapped in aluminum foil and sealed in a pre-labelled plastic bag. Hair was hand mixed for 2 minutes , split into three samples , wrapped in aluminum foil, and sealed in a plastic bag. All samples were placed into -70 EC freezer within 90 minutes of slaughter. Two sets of samples from each animal were retained in the Department of Environmental Biology while the third set was taken to the Ontario Pesticide Residue Laboratory at the University of Guelph for analysis. Samples remained frozen for less than 2 months prior to analysis and were subsequently analysed for lambdacyhalothrin and lambdacyhalothrin metabolites by gas chromatography (Braun & Stanek 1982). The same protocol for sample collection was followed and identical samples were taken from one animal 14, 28, 56, and 112 days

after treatment. The control animal was slaughtered and sampled on the same day as the last treated animal (i.e., 112 days post-treatment).

RESULTS: The results are summarized in the table below. At slaughter animals ranged in weight from 300 to 470 kilograms.

CONCLUSIONS: Lambdacyhalothrin residues were detected in hair samples from treated animals from all sampling dates and ranged from 1.5 - 20.0 ppm. Lambdacyhalothrin residues were detected in both kinds of fat sampled up to and including 56 days post-treatment and ranged from 0.054 - 0.070 ppm (omental fat) and 0.050 - 0.068 ppm (perirenal fat). Residues were not detected in fat samples at 112 days post-treatment There was no accumulation of lambdacyhalothrin over time in the fat tissues. Residues were not detected in any of the liver, kidney or muscle tissues sampled at all sampling dates post-treatment.

Table 1. Lambdacyhalothrin residues (parts per million) in bovine tissue samples associated with use of insecticidal ear tags.

Tissue	Days post-treatment					
	7	14	28	56	112 (treated)	112 (non-treated)
omental fat	0.07	0.05	0.067	0.054	ND[1]	ND
perirenal fat	0.059	0.05	0.066	0.068	ND	ND
liver	ND	ND	ND	ND	ND	ND
kidney	ND	ND	ND	ND	ND	ND
muscle[2]	ND	ND	ND	ND	ND	ND
hair	18	20	7.9	8.7	1.5	ND

[1]Not detected (limits of detection = 0.002 ppm).
[2]Muscle removed from chuck area.

REFERENCE:

Braun, H.E. & J. Stanek. 1982. Application of AOAC multi-residue method to determination of synthetic pyrethroid residues in celery and animal products. J. Assoc. Analytical Chem. 65: 685-689.

1998 PMR REPORT # 43

SECTION D: MEDICAL AND VETERINARY
ICAR #: 86100101

HOST: Cattle (mixed cross breeds)
PEST: Horn fly, *Haematobia irritans* (L.)
Face fly, *Musca autumnalis* (DeGeer)

NAME AND AGENCY:
BUTLER S M, SURGEONER G A and HEAL J D
Department of Environmental Biology
University of Guelph
Guelph, Ontario, N1G 2W1
Tel: (519) 824-4120 ext. 3966 Fax: (519) 837-0442 E-mail: gsurgeoner@evbhort.uoguelph.ca

TITLE: CONTROL OF HORN FLIES AND FACE FLIES ON CATTLE USING ECTIGUARD, ELIMINATOR, PROTECTOR AND STOCKAID INSECTICIDE IMPREGNATED EAR TAGS NEAR PERTH ONTARIO, AN AREA KNOWN FOR HORN FLY RESISTANCE TO ORGANOPHOSPHATE INSECTICIDES

MATERIALS: ECTIGUARD EAR TAGS (10% tetrachlorvinphos w/w), ELIMINATOR EAR TAGS (11% diazinon and 6% cypermethrin w/w), PROTECTOR EAR TAGS (20% diazinon w/w), STOCKAID EAR TAGS (8% cypermethrin w/w)

METHODS: Six separate herds of cattle of mixed breeds (ca. 25 animals per herd) within ten kilometers of each other were used in this trial. During early June 1997 animals in each herd were tagged with two ECTIGUARD ear tags, two ELIMINATOR ear tags, two PROTECTOR ear tags or two STOCKAID ear tags. Two herds received the two PROTECTOR ear tags treatment. A sixth herd was non-treated and served as a control. At approximately weekly intervals, numbers of horn flies per side and face flies per face were counted on ten randomly selected animals in each herd on the same day between 11:30 am and 3:30 pm. Differences in the weekly means were analysed by a Student's t-test.

RESULTS: The results are summarized in the tables below.

CONCLUSIONS: The ECTIGUARD ear tags provided 0% control of horn flies and 0% control of face flies throughout the entire season. The ELIMINATOR ear tags provided 88.6% - 100% control of horn flies for 8 weeks post treatment. The ELIMINATOR ear tags provided 71.7% control of horn flies and 30.3% control of face flies throughout the entire season. The PROTECTOR ear tags provided 0% - 44.2% control of horn flies and 9.6% - 32.3% control of face flies throughout entire season. The STOCKAID ear tags provided 23.8% control of horn flies and 12.4% control of face flies throughout the entire season.

Table 1. Mean number (± one standard deviation) of horn flies per side on cattle herds (n=10 animals) treated with two PROTECTOR ear tags, two STOCKAID ear tags, two ELIMINATOR ear tags, or two ECTIGUARD ear tags, Perth, Ontario, 1997.

Sample Date	Non - treated	Protector	Protector	Stockaid	Eliminator	Ectiguard
Jun. 21	9.10 ± 7.08	7.30 ± 5.23	0.90 ± 0.99*	5.00 ± 3.02	0.80 ± 0.79*	2.00 ± 1.63*
Jun. 27	4.40 ± 2.63	1.00 ± 1.05*	1.40 ± 1.26	2.30 ± 2.21	0.50 ± 0.53*	2.70 ± 2.83
July 5	11.60 ± 6.96	22.70 ± 20.40	0.0 ± 0.0	2.00 ± 1.15	0.0 ± 0.0	8.30 ± 8.13
Jul. 11	2.30 ± 3.56	0.50 ± 0.71	2.10 ± 2.51	3.10 ± 4.25	0.0 ± 0.0	3.30 ± 1.50
Jul 18	5.70 ± 6.43	3.70 ± 4.42	0.20 ± 0.42	10.00 ± 14.99	0.0 ± 0.0	15.60 ± 20.95
Jul. 23	6.40 ± 3.57	13.00 ± 15.03	0.10 ± 0.32	15.90 ± 22.29	0.60 ± 1.07	50.10 ± 52.84
Aug. 1	11.80 ± 12.07	7.20 ± 5.51	0.30 ± 0.95	13.60 ± 10.54	0.10 ± 0.32	40.90 ± 47.37
Aug. 8	5.70 ± 3.56	11.83 ± 9.0	0.20 ± 0.63	19.20 ± 16.52	0.0 ± 0.0	33.20 ± 41.31
Aug.16	4.80 ± 1.99	27.25 ± 13.69	14.8 ± 15.26	**	1.10 ± 1.29	57.30 ± 45.58
Aug. 24	9.80 ± 5.41	40.33 ± 5.51	16.10 ± 4.01	4.40 ± 5.66	7.50 ± 6.04	45.20 ± 32.72
Sept. 2	23.40 ± 13.14	27.50 ± 12.14	10.10 ± 3.90	1.90 ± 2.42	8.60 ± 3.66	233.00 ± 97.76
Sept. 5	26.40 ± 12.50	9.83 ± 4.79	21.60 ± 8.13	7.40 ± 12.07	15.20 ± 7.80	226.5 ± 217.42
Season Mean (±)	10.11 ± 10.23	11.26 ± 13.75	5.65 ± 9.06	7.71 ± 11.98	2.87 ± 5.58	59.84 ± 106.15

* Values are significantly different from the non - treated values (P>0.05)
** Cattle were not available for this count

Table 2. Mean number (± one standard deviation) of face flies per face on cattle herds (n=10 animals) treated with two PROTECTOR ear tags, two STOCKAID ear tags, two ELIMINATOR ear tags, or two ECTIGUARD ear tags, Perth, Ontario, 1997.

Sample Date	Non treated	Protector	Protector	Stockaid	Eliminator	Ectiguard
Jun. 21	0.80 ± 1.03	0.30 ± 0.67	0.80 ± 1.87	0.50 ± 0.53	0.30 ± 0.48	0.40 ± 0.70
Jun. 27	0.70 ± 0.82	0.80 ± 0.42	0.70 ± 0.67	0.20 ± 0.42	0.20 ± 0.42	0.30 ± 0.48
Jul. 5	0.60 ± 0.70	0.90 ± 1.10	0.20 ± 0.42	1.20 ± 1.03	0.20 ± 0.42	1.00 ± 1.05
Jul. 11	2.30 ± 1.64	1.00 ± 1.56	0.70 ± 0.82*	0.70 ± 0.95*	2.00 ± 1.25	3.10 ± 2.13
Jul. 18	1.20 ± 0.79	4.70 ± 4.67	0.90 ± 0.74	1.60 ± 0.97	0.50 ± 0.85	2.10 ± 1.73
Jul. 23	2.10 ± 1.60	7.80 ± 2.59	2.90 ± 1.91	1.10 ± 0.99	0.70 ± 0.67	5.20 ± 3.88
Aug. 1	2.80 ± 1.93	0.30 ± 0.68	1.50 ± 0.97	0.80 ± 0.92	1.70 ± 1.06	5.40 ± 4.70
Aug. 8	6.60 ± 3.60	3.17 ± 2.71	8.00 ± 5.37	2.60 ± 2.01	2.70 ± 1.89	19.4 ± 9.81
Aug. 16	10.30 ± 5.17	4.75 ± 2.63	8.50 ± 3.87	**	5.20 ± 2.90	17.20 ± 8.16
Aug. 24	12.60 ± 4.90	11.00 ± 1.00	12.50 ± 5.32	16.40 ± 8.19	10.60 ± 6.42	19.80 ± 9.51
Sept. 2	3.50 ± 2.37	9.50 ± 4.64	7.40 ± 4.86	7.10 ± 3.98	9.20 ± 3.12	22.90 ± 5.04
Sept. 5	16.30 ± 9.02	9.33 ± 9.14	10.00 ± 5.77	15.80 ± 7.57	8.30 ± 2.58	7.00 ± 6.82
Season Mean (±)	4.98 ± 6.18	3.37 ± 4.69	4.51 ± 5.36	4.36 ± 6.82	3.47 ± 4.40	8.65 ± 9.81

* Values are significantly different from the non - treated values (P>0.05)
** Cattle were not available for this count

1998 PMR REPORT # 44 **SECTION D: MEDICAL and VETERINARY**
STUDY DATA BASE: 8909

CROP: Cattle
PEST: N/A

NAME AND AGENCY:
FLOATE K D
Agriculture and Agri-Food Canada, Lethbridge Research Centre
P.O. Box 3000, Lethbridge, Alberta T1J 4B1
Tel: (403) 317-2242 **Fax:** (403) 382-3156 **Email:** FLOATEK@EM.AGR.CA

TITLE: EFFECT OF IVERMECTIN THERAPY ON COLONIZATION OF CATTLE DUNG BY COPROPHILOUS BEETLES

MATERIALS: IVOMEC POUR-ON (ivermectin)

METHODS: The preference of coprophilous beetles for dung from untreated cattle versus dung from cattle treated with topically-formulated ivermectin (500 mcg/kg BW) was tested at two sites near Lethbridge, Alberta. Pitfall traps at each site were spaced at 5 m intervals along a transect. A wire screen (ca. 6 mm grid) over the mouth of each trap supported fresh cattle dung (ca. 75 g) wrapped in two layers of cheesecloth and frozen until use. Experiment 1 was performed in 1994 using 10 traps at each site baited in sequence with dung from untreated cattle and dung from cattle treated 1 wk previously. Experiment 2 was performed in 1995 using 15 traps at one site baited in sequence with dung from untreated cattle, dung from cattle treated 1 wk previously, and dung from cattle treated 4 wk previously. Experiment 3 also was performed in 1995 with dung from the same cattle as per Experiment 2, but used 10 traps at the second site baited in sequence with dung from untreated cattle and dung from cattle treated 1 wk previously. The order of this sequence was then changed three times during the summer. For all experiments, beetles were removed from traps and baits replaced each week.

Results were analysed using non-parametric tests. For Experiment 1 and Experiment 3, each pitfall trap baited with dung from untreated cattle was paired with an adjacent trap baited with dung from treated cattle. Paired samples from different weeks then were combined into one data set and analysed using Wilcoxon paired-sample t-tests ($p = 0.05$). Thus, four weeks of collections generated 20 pairwise comparisons. When data was lost for one member of a pair, that pair was excluded from analyses. For Experiment 2, weekly catches from traps baited with dung from untreated cattle, or from cattle treated 1 wk or 4 wk previously, were analysed using Kruskal-Wallis tests. If differences were detected, nonparametric Tukey-type multiple comparisons were used to determine which treatments differed ($p = 0.05$). Many species were not collected for periods of several weeks or months because of seasonal variation in adult activity. Because they provided no information on beetle preference; samples (i.e., number of beetles/trap/week) collected during these periods were omitted from analyses.

RESULTS: In Experiment 1, significantly more beetles were collected at each site using dung from treated cattle (Table 1). In Experiment 2 and in Experiment 3, significantly more beetles were collected using dung from untreated cattle (Table 2, Table 3). Changing the order of baits in the latter experiment did not alter this result.

CONCLUSIONS: Ivermectin therapy can alter insect colonization of dung from treated cattle. However, the nature of this effect can vary. Whereas Experiment 1 showed ivermectin therapy to enhance colonization, Experiments 2 and 3 showed ivermectin therapy to suppress colonization. These conflicting results may reflect a change in cattle diet. Cattle in Experiment 1 were fed alfalfa cubes, and cattle in Experiment 2 and in Experiment 3 were fed barley silage. Differences in diet can affect levels of ivermectin residues in dung, which may have altered the preference of beetles for dung from treated cattle. Complete results are reported in Floate (1998. Bulletin of Entomological Research 88:291-297).

Table 1. Results of Experiment 1

		MEAN ± SEM (# SAMPLES)		
	Species	Untreated	Treated (1 wk)	p-value
Site 1	Scarabaeidae			
	A.[1] *distinctus*	3.8 ± 1.6 (15)	6.7 ± 2.5 (15)	0.037
	A. fimetarius	2.1 ± 0.4 (35)	5.7 ± 1.1 (35)	0.002
Site 2	Scarabaeidae			
	A. distinctus	46.8 ± 21.4 (20)	92.9 ± 36.0 (20)	0.008
	A. fimetarius	11.6 ± 2.3 (35)	22.1 ± 3.6 (35)	0.004
	A. prodromus	21.1 ± 10.0 (15)	30.6 ± 12.5 (15)	0.138
	Staphylinidae	5.6 ± 2.2 (40)	7.9 ± 2.8 (40)	0.354

[1]*Aphodius*

Table 2. Results of Experiment 2.

	MEAN ± SEM (# OF SAMPLES)			
Species	Untreated	Treated (1 wk)	Treated (4 wk)	p-value
Hydrophilidae				
S.[1] *bipustulatum*	0.7 ± 0.1 (95)	0.4 ± 0.2 (93)	0.3 ± 0.1 (94)	0.005*
S. scarabaeoides	1.5a ± 0.3 (110)	0.6b ± 0.1 (108)	0.7ab ± 0.1 (109)	0.018
Scarabaeidae				
A.[2] *coloradensis*	1.4 ± 0.4 (65)	1.5 ± 0.5 (63)	0.3 ± 0.1 (65)	0.043*
A. distinctus	24.2 ± 8.6 (84)	20.4 ± 6.8 (83)	12.6 ± 4.2 (85)	0.498
A. fimetarius	4.4a ± 0.7 (119)	2.1ab ± 0.3 (118)	1.3b ± 0.2 (119)	0.004
A. haemorrhoidalis	1.7a ± 0.3 (95)	0.5b ± 0.1 (93)	0.3b ± 1.1 (94)	<0.001
A. prodromus	76.6 ± 22.1 (84)	69.6 ± 21.1 (85)	48.0 ± 13.0 (85)	0.469
A. vittatus	3.7 ± 0.9 (109)	3.5 ± 1.0 (108)	3.2 ± 0.9 (109)	0.040*
O.[3] *nuchicornis*	7.7 ± 1.1 (105)	7.2 ± 1.4 (103)	4.4 ± 1.3 (104)	0.074
Staphylinidae	4.3a ± 0.8 (124)	2.3b ± 0.6 (123)	1.9b ± 0.5 (124)	0.002

*significant differences not detected using nonparametric Tukey-type multiple comparisons.

[1] *Sphaeridium,* [2] *Aphodius,* [3] *Onthophagus*

Table 3. Results of Experiment 3.

Species		MEAN ± SEM (# OF SAMPLES) Untreated	Treated	p-value
Histeridae		1.5 ± 0.2 (78)	0.8 ± 0.2 (78)	0.013
Hydrophilidae	*S.*[1] *bipustulatum*	5.5 ± 1.4 (88)	1.7 ± 0.5 (88)	<0.001
	S. lunatum	1.6 ± 0.4 (103)	0.5 ± 0.1 (103)	<0.001
	S. scarabaeoides	1.8 ± 0.4 (108)	0.7 ± 0.1 (108)	<0.001
Scarabaeidae	*A.*[2] *coloradensis*	4.1 ± 1.8 (33)	2.9 ± 1.2 (33)	0.985
	A. distinctus	17.9 ± 3.8 (93)	11.2 ± 2.4 (93)	0.004
	A. fimetarius	22.9 ± 5.4 (152)	9.0 ± 1.5 (152)	0.001
	A. fossor	2.2 ± 1.0 (53)	1.8 ± 0.9 (53)	0.156
	A. haemorrhoidalis	2.6 ± 0.7 (88)	0.9 ± 0.2 (88)	0.002
	A. prodromus	98.3 ± 21.1 (93)	66.7 ± 13.7 (93)	<0.001
	A. vittatus	13.0 ± 3.6 (118)	10.9 ± 2.8 (118)	0.433
	O.[3] *nuchicornis*	251.9 ± 40.8 (123)	128.7 ± 19.8 (123)	<0.001
Staphylinidae		6.8 ± 1.1 (128)	3.3 ± 0.5 (128)	<0.001

[1] *Sphaeridium,* [2] *Aphodius,* [3] *Onthophagus*

1998 PMR REPORT # 45 **SECTION D: MEDICAL and VETERINARY**
STUDY DATA BASE: 8909

CROP: Cattle
PEST: House fly, *Musca domestica* L.

NAME AND AGENCY:
FLOATE K D and R W SPOONER
Agriculture and Agri-Food Canada, Lethbridge Research Centre
P.O. Box 3000, Lethbridge, Alberta T1J 4B1
Tel: (403) 317-2242 **Fax:** (403) 382-3156 **Email:** FLOATEK@EM.AGR.CA

TITLE: PREFERENTIAL HOST SELECTION BY MUSCIDIFURAX SPECIES

MATERIALS: *Muscidifurax raptorellus* Kogan & Legner, *Muscidifurax zaraptor* Kogan & Legner, *Muscidifurax raptor* Girault & Saunders, *Musca domestica* L., *Ophyra aenescens* (Wiedemann)

BACKGROUND/ METHODS: House fly (Muscidae: *Musca domestica*) is a common pest near confined livestock. Methods for its control include release of the pupal parasites *Muscidifurax raptor, M. zaraptor,* and *M. raptorellus* (Hymenoptera: Pteromalidae), and the black dump fly (Muscidae: *Ophyra aenescens*), which is predacious as a maggot. This research reports on initial tests that compare the preference of *Muscidifurax* species for pupae of the pestiferous house fly, versus that of the beneficial black dump fly.

Pupae (24-48 hr old) of house fly and of black dump fly were placed in an immunoassay plate to form a 'checkerboard' pattern (8 x 12 wells per plate, 48 pupae per species). Plates were exposed to *M. raptor, M. zaraptor,* or *M. raptorellus* for 48 hr. Plates were held at 25 ^{0}C for 4 wk for parasite emergence. This process was repeated three times for each *Muscidifurax* species. Data were analysed using chi-square tests with Yates correction for continuity, or using 1-way ANOVA tests.

RESULTS: In seven of seven replicates, wasps most often emerged from house fly pupae (Table 1). This is a significant deviation from the expected random result of 3.5 replicates having greatest emergence from house fly pupae and 3.5 replicates having greatest emergence from black dump fly pupae ($\div^2$ = 5.143, 2 df, $p < 0.05$). No differences were observed in two other replicates.

For the gregarious species, *M. raptorellus*, more offspring emerged from house fly pupae than from black dump fly pupae (Rep. 1: 3.6 vs 3.0; Rep. 2: 4.0 vs 2.0; Rep. 3: 2.9 vs 1.8). These differences were significant (1-way ANOVA, $p < 0.001$) for Replicates 2 and 3. Combined for the three replicates, the average number (±SE) of *M. raptorellus* emerging from house fly pupae and from black dump fly pupae, respectively, were 3.6 ± 0.2 (n = 93 pupae) and 2.2 ± 0.2 (n = 68 pupae). For the solitary species, *M. raptor* and *M. zaraptor,* only 1 offspring emerged per host pupa.

CONCLUSIONS: Differences observed in the number of pupae producing wasps indicate that house fly was the preferred host for each *Muscidifurax* species tested. This preference may reflect the larger size of house fly pupae. Whereas pupal weights from our laboratory colonies averaged (±SE) 24.0 ± 0.9 mg (n = 10 pupae) for house fly, they averaged only 16.2 ± 0.4 mg (n = 30 pupae) for black dump fly. Previous researchers have noted that preference for larger hosts may increase wasp fitness. This hypothesis is

supported by our observation that the average house fly pupa produced 63% more *M. raptorellus* than did the average black dump fly pupa.

These tentative results suggest that the use of parasitic wasps and black dump fly may provide better control of house fly than that obtained using either parasitic wasps or black dump fly.

Table 1. Emergence of *Muscidifurax* from pupae of house fly (HF, n=48) and of black dump fly (BDF, n=48) exposed to attack at the same time.

Species	#&&/%%	HF	BDF	÷^{2}
M. raptor				
Rep. 1	10/3	29	29	0.017
Rep. 2	10/3	40	20	6.017*
Rep. 3	10/3	36	28	0.766
M. zaraptor				
Rep. 1	3/1	28	24	0.173
Rep. 2	3/1	41	25	3.409
Rep. 3	3/1	0	0	- NA -
M. raptorellus				
Rep. 1	3/1	17	16	0.000
Rep. 2	3/1	44	26	4.129*
Rep. 3	3/1	32	26	0.431

* $p < 0.05$

1998 PMR REPORT # 46 **SECTION D: MEDICAL and VETERINARY**
STUDY DATA BASE: 8909

CROP: Cattle
PEST: House fly, *Musca domestica* L.; Stable fly, *Stomoxys calcitrans* (L.)

NAME AND AGENCY:
FLOATE K D, LYSYK T J, and COGHLIN PC
Agriculture and Agri-Food Canada, Lethbridge Research Centre,
P.O. Box 3000, Lethbridge, Alberta T1J 4B1
Tel: (403) 327-4561 **Fax:** (403) 382-3156 **Email:** FLOATEK@EM.AGR.CA

TITLE: COMPETITIVE EXCLUSION OF THE PARASITIC WASP, *MUSCIDIFURAX RAPTORELLUS*, IN MIXED CULTURE WITH *M. RAPTOR* AND WITH *M. ZARAPTOR*: AN UPDATE

MATERIALS: *Muscidifurax raptorellus* Kogan & Legner, *Muscidifurax zaraptor* Kogan & Legner, *Muscidifurax raptor* Girault & Sanders, *Musca domestica* L.

BACKGROUND/ METHODS: Species of *Muscidifurax* wasps are pupal parasitoids of house fly, *Musca domestica* L., and stable fly, *Stomoxys calcitrans* (L.). *Muscidifurax raptor* Girault & Sanders and *M. zaraptor* Kogan & Legner occur in Alberta. Both are solitary species, typically producing 1 wasp per host. *Muscidifurax raptorellus* Kogan & Legner is a gregarious species native to South American that produces up to 15 wasps per host. Previously research (1996, PMR Report #136) showed *M. raptorellus* unable to persist in mixed colonies with 1:1 starting ratios of *M. raptorellus*: *M. raptor*, or of *M. raptorellus*: *M. zaraptor*. Here, we describe competition experiments with 3:1 and 9:1 starting ratios of *M. raptorellus*: *M. raptor*, and of *M. raptorellus*: *M. zaraptor*. This research is part of an ongoing project funded by the Alberta Agriculture Research Institute, to evaluate the benefits of releasing *M. raptorellus* into southern Alberta feedlots for the control of pestiferous flies.

The ability of *M. raptorellus* to compete with native species of *Muscidifurax* was assessed using mixed colonies of *M. raptorellus* x *M. raptor* and of *M. raptorellus* x *M. zaraptor*. Starting populations comprised about 1,000 individuals with 3:1 and 9:1 starting ratios of *M. raptorellus*: *M. raptor*, and of *M. raptorellus*: *M. zaraptor*. Each combination was replicated three times. House fly pupae were added to colonies every 2-3 days, to provide wasps with a source of food and host pupae. Every 2 weeks, 500 fly pupae were placed in cages for 2 days, then removed and held individually for parasite emergence. Because these species are morphologically similar, pupae producing more than 1 wasp were assumed to be parasitized by *M. raptorellus*. Pupae producing only 1 wasp were assumed to be either *M. raptor* or *M. zaraptor*. Laboratory studies have shown that *M. raptor and M. zaraptor* seldom produce more than 1 wasp per host.

RESULTS: At starting ratios of 3:1, numbers of *M. raptorellus* declined dramatically in competition with *M. raptor* after four generations, and after seven to nine generations in competition with *M. zaraptor*. This result was repeated in each of three replications (Table 1). At starting ratios of 9:1, numbers of *M. raptorellus* declined dramatically in competition with *M. raptor* after two generations, and after five

generations in competition with *M. zaraptor*. This result was repeated in each of three replications (Table 2).

CONCLUSIONS: These results support our early conclusion (1996, PMR Report #136) that populations of *M. raptorellus* cannot persist in close competition with *M. raptor* or *M. zaraptor*. One immediate implication of this finding is that commercial insectaries rearing several species of *Muscidifurax*, may lose colonies of *M. raptorellus*, if they become contaminated by solitary species of *Muscidifurax*. A switch in species composition within the colony would not likely be detected unless host pupae were held for parasitoid emergence. Results also suggest that establishment of *M. raptorellus* may be inhibited in the field if species of solitary *Muscidifurax* are present. If so, field releases of *M. raptorellus* are unlikely to displace native species of *Muscidifurax*.

Table 1. Performance of *Muscidifurax raptorellus* reared in competition with *M. raptor* or in competition with *M. zaraptor* with a starting ratio of 3:1. Values are averages (SE) of three replications.

	Composition of colony (%)				Composition of colony (%)			
Generation	*M. raptorellus* vs *M. raptor*				*M. raptorellus* vs *M. zaraptor*			
0	75	(0)	25	(0)	75	(0)	25	(0)
1	54	(8)	46	(8)	93	(3)	7	(3)
2	90	(7)	10	(7)	99	(0.1)	1	(0.1)
3	25	(10)	75	(10)	92	(2)	8	(2)
4	7	(3)	93	(3)	79	(8)	21	(8)
5	5	(2)	95	(2)	96	(1)	4	(1)
6	5	(3)	95	(3)	83	(5)	17	(5)
7	0	(0.2)	100	(0.2)	59	(20)	41	(20)
8	0	(0.4)	100	(0.4)	36	(23)	64	(23)
9	0	(0)	100	(0)	28	(25)	72	(25)
10	0	(0.4)	100	(0.4)	10	(6)	90	(6)
11	0	(0.2)	100	(0.2)	8	(7)	92	(7)
12	0	(2)	100	(2)	5	(3)	95	(3)

Table 2. Performance of *Muscidifurax raptorellus* reared in competition with *M. raptor* or in competition with *M. zaraptor* with a starting ratio of 9:1. Values are averages (SE) of three replications.

	Composition of colony (%)				Composition of colony (%)			
Generation	*M. raptorellus* vs *M. raptor*				*M. raptorellus* vs *M. zaraptor*			
0	90	(0)	10	(0)	90	(0)	10	(0)
1	84	(7)	16	(7)	93	(3)	10	(6)
2	98	(0.2)	2	(0.2)	99	(0.1)	1	(0.2)
2	34	(5)	66	(5)	92	(2)	10	(5)
4	18	(4)	82	(4)	79	(8)	20	(0.4)
5	11	(1)	89	(1)	96	(1)	3	(2)
6	8	(2)	92	(2)	83	(5)	55	(7)
7	1	(0.5)	99	(0.5)	59	(20)	75	(9)
8	1	(0.9)	99	(0.9)	36	(23)	93	(2)
9	0	(0.3)	100	(0.3)	28	(25)	94	(4)
10	4	(2)	96	(2)	10	(6)	97	(0.2)
11	1	(0.5)	99	(0.5)	8	(7)	99	(0.3)
12	3	(1)	97	(1)	5	(3)	99	(1)

1998 PMR REPORT # 47 **SECTION D: MEDICAL and VETERINARY**
STUDY DATA BASE: 8909

CROP: Cattle
PEST: House fly, *Musca domestica* L.; Stable fly, *Stomoxys calcitrans* (L.)

NAME AND AGENCY:
FLOATE K D, GIBSON G A P, COGHLIN P C
Agriculture and Agri-Food Canada, Lethbridge Research Centre,
P.O. Box 3000, Lethbridge, Alberta T1J 4B1
Tel: (403) 317-2242 **Fax:** (403) 382-3156 **Email:** FLOATEK@EM.AGR.CA

TITLE: PARASITIC WASPS OF STABLE FLY AND HOUSE FLY IN SOUTHERN ALBERTA FEEDLOTS

MATERIALS: *Musca domestica* L.

BACKGROUND/ METHODS: Native species of wasps may be suitable for commercialization as biological control agents of stable fly (Muscidae: *Stomoxys calcitrans*) and house fly (Muscidae: *Musca domestica*), but little is known about their parasites in Canada. The current study reports on collaborative efforts by Agriculture & Agri-Food Canada (AAFC), Alberta Agriculture, Food & Rural Development (AAFRD), and feedlot operators to survey pupal parasites of stable fly and house fly in southern Alberta.

House fly pupae were mass-reared at the Lethbridge Research Centre (AAFC), killed by freezing to prevent fly emergence during transit, and then shipped to J. Hansen, P. Ramsey, B. Palichuk, B. Ralston-Chalmers, J. Popp, and B. Lyons, our AAFRD collaborators in southern Alberta. They placed these pupae in feedlots for 1 week to provide time for native parasites to locate and lay eggs in them. Pupae were then returned to Lethbridge and held for parasite emergence. This process was repeated every 2 weeks from May to October, in each of 12 feedlots, in 1996 and in 1997. Parasitic wasps emerging from these pupae were subsequently identified by G. Gibson (AAFC - Eastern Cereal and Oilseed Research Centre).

A similar survey is being coordinated by A. Khan (AAFRD) in feedlots north of Calgary. Results of both surveys will help identify native species of parasites for further study as biological control agents for stable fly and house fly.

RESULTS: Seven species of parasitic wasps were collected in the southern Alberta survey (Table 1). *Muscidifurax raptor*, *M. zaraptor*, and *Nasonia vitripennis*, are widely distributed in North America and are sold commercially as biocontrol agents of flies. To our knowledge, *Trichomalopsis sarcophagae* has been previously collected from house fly pupae, only near Lethbridge and from eastern Nebraska. A colony of this latter species is now being maintained at the Lethbridge Research Centre for further study. A second species of *Trichomalopsis* remains unidentified. *Phygadeuon* sp. and *Urolepis rufipes* also are widely distributed in North America but little is known about their biology. Overall levels of parasitism were less than one percent, indicating that efforts to increase natural levels of parasitism may be useful in reducing populations of pestiferous flies.

CONCLUSIONS: Of the seven species of wasps recovered to date, *Trichomalopsis sarcophagae* may

have the greatest potential for commercialization. Because it is gregarious, it can be reared more inexpensively than solitary species. It appears to have the longest period of activity, and its relatively high numbers in each year suggest that it is well-adapted to the local area. We recognize that our survey method excludes recovery of species that are not pupal parasites, and species of pupal parasites that require live hosts. Additional species have been recovered with other methods, and these results will be reported at a future date.

Table 1. Parasitic wasps of house fly pupae in southern Alberta feedlots and estimated periods of activity based upon emergence from sentinel pupae.

Identification	# coll. in 1996 (as % of total)	# coll. in 1997 (as % of total)[1]	Estimated period of activity
Pteromalidae			
Muscidifurax raptor	96 (10.1)	30 (6.9)	mid-June to early Sept.
Muscidifurax zaraptor	41 (4.3)	8 (1.9)	mid-June to mid-Aug.
Nasonia vitripennis	313[2] (33.1)	6[3] (1.4)	mid-June to late July
Trichomalopsis sarcophagae	465[4] (49.1)	306[5] (70.8)	mid-May to mid-Sept.
Trichomalopsis sp.	16 (1.7)	2 (0.5)	mid-June to mid Sept.
Urolepis rufipes	3 (0.3)	80 (18.5)	mid-July to mid-Sept.
Ichneumonidae			
Phygadeuon sp.	13 (1.4)	0	mid-July to mid-Sept.

[1] as of mid-September; [2] from 57 pupae; [3] from 1 pupa; [4] from 115 pupae; [5] from 59 pupae

1998 PMR REPORT # 48 **SECTION D: MEDICAL AND VETERINARY**
IRAC #: 86100101

HOST: Swine (Yorkshire breed)
PEST: Fruit fly, *Drosophila repleta* Wollaston
House fly, *Musca domestica* (L.)
Black garbage flies, *Ophyra* spp.

NAME AND AGENCY:
BUTLER S M, SURGEONER G A and HEAL J D
Department of Environmental Biology
University of Guelph
Guelph, Ontario, N1G 2W1
Tel: (519) 824-4120 ext. 3966 Fax: (519) 837-0442 E-mail: gsurgeon@evbhort.uoguelph.ca

TITLE: EVALUATION OF APACHE AND STIMUKIL FLY BAITS IN A SWINE FACILITY

MATERIALS: APACHE FLY BAIT, orange in colour, (1% methomyl, 0.025% Z-9 tricosene and special adjuvants (composition and concentration unknown)); STIMUKIL FLY BAIT, yellow in colour, (1% methomyl and 0.025% Z-9 tricosene)

METHODS: Twelve 27.5 cm x 21.5 cm x 4.0 cm aluminum trays containing fly bait (6 APACHE and 6 STIMUKIL) were used in this trial. The baits were applied as equal volumes to respective trays (±62.0ml). The corresponding weights of the baits were: 57.9 g of APACHE and 49.3 g of STIMUKIL, indicating that the APACHE had a higher density. Trays were grouped in pairs, one tray each of APACHE and STIMUKIL, and were placed in two alleyways of a swine facility (Arkell Research Station, Guelph, Ontario). Trays within a group were placed 0.5 m apart. Each group of trays were placed 2 m apart. Three groups of trays were placed in each alleyway. Trays were placed so that adjacent trays did not contain the same product.

The room in which the trial was conducted contained approximately 80 adult pigs. A row of individual pens separated the two alleyways. A row of group pens housing 4 pigs each were on the opposite sides of each alley. Ventilation brought fresh air into the first alley, moved air over the individual pens, the second alley and group pens. Air was removed by fans above the group pens facing the second alley. Thus, the air quality in the first alley was better than in the second alley.

Flies were observed and counted for three consecutive days, July 2, 3, and 4 1997, between 10:30 am - 12:30 pm. The number of dead and live flies per tray were counted at 5 minute intervals for a period of 1 hour. The trays were then removed and emptied. Each day fresh bait was added to the empty trays. Live and dead *Drosophila* species were counted separately from the live and dead muscoid species. Differences in the number of dead flies killed by APACHE versus STIMUKILand differences in the number of live flies attracted to APACHE versus STIMUKIL were analysed using a Student's t-test.

RESULTS: The results are summarized in the table below.

CONCLUSIONS: The APACHE fly bait containing 1% methomyl, 0.025% Z-9 tricosene and special adjuvants (composition and concentration unknown) attracted and killed significantly more flies in a swine

facility than the STIMUKIL fly bait containing 1% methomyl and 0.025% Z-9 tricosene.

Table 1. Mean number (± one standard deviation) of live and dead flies observed in trays of APACHE and STIMUKIL fly bait. (N = 36; 3 days, 12 observations per day). Values followed by the same letter within a column are not significantly different (P>0.05).

Treatment	Dead Flies		Live Flies	
	Muscoids	*Drosophila*	Muscoids	*Drosophila*
APACHE	6.2 ± 5.4a	228.1 ± 214.8a	0.8 ± 1.3a	15.3 ± 16.0a
STIMUKIL	1.3 ± 2.6b	1.7 ± 2.7b	0.4 ± 0.6b	0.1 ± 0.3b
Ratio: APACHE / STIMUKIL	4.8	134.2	2	153

END OF SECTION D

SECTION E **CEREALS, FORAGE CROPS and OILSEEDS - Insects /CÉRÉALES, CULTURES FOURRAGÈRES et OLÉAGINEUX**

REPORT #s **49 - 53**

PAGES **129 - 143**

EDITOR **Dr. Owen Olfert**
Agriculture and Agri-Food Canada
Saskatoon Research Centre
107 Science Place
Saskatoon, Saskatchewan S7N 0X2
Email: olferto@em.agr.ca
Tel: (306) 956-7288
Fax: (306) 956-7247

1998 PMR REPORT # 49 SECTION E: CEREALS, FORAGE CROPS AND OILSEEDS STUDY DATA BASE: 375 - 1122 - 9612

CROP: Canola (*Brassica napus* L.), cv. Invigor 2153
PEST: Lygus bugs, *Lygus lineolaris* (Palisot de Beauvois) and *L. borealis* Kelton

NAME AND AGENCY:
SOROKA, J.J. and DANYLUK, J.[1]
Agriculture and Agri-Food Canada, Saskatoon Research Centre
107 Science Place, Saskatoon, Saskatchewan S7N 0X2
Tel: (306) 956-7294; FAX: (306) 956-7247; Email: sorokaj@em.agr.ca

[1] Saskatchewan Agriculture and Food, Meadow Lake Rural Service Centre
719 1st Ave. West, Meadow Lake, Saskatchewan S9A 1T6
Tel: (306) 236-7600; Fax: (306) 276-7616

TITLE: **EFFICACY OF INSECTICIDES FOR THE CONTROL OF LYGUS BUGS IN CANOLA NEAR MAKWA, SASKATCHEWAN IN 1998**

MATERIALS: LORSBAN 4EC (chlorpyrifos) and DECIS 5EC (deltamethrin)

METHODS: A 64 ha field of canola cv Invigor 2153 was seeded near Makwa, Saskatchewan on May 4, 1998. On the evening of July 9, a custom applicator used a high clearance ground sprayer with a boom width of 13.8 m to apply LORSBAN at a rate of 405 ml/acre and DECIS at 80 ml/acre to four replicates in a corner of the field, the plots of each being 13.8 m long. Two spray passes the length of the total experimental area were made applying each chemical. Replicates were arranged in the direction of travel. For each chemical, each replicate of the first spray pass was randomly assigned a spray or no spray treatment. On the second spray pass, the opposite treatment was made. The no spray treatments did not have any liquid applied to them. The spray was applied with water volumes of 110 L/ha. The sprayer was equipped with near-instantaneous start and shutoff application capability. Weather at the time of application was hot and dry. Three hours prior to application, 180 sweep samples of ten walking sweeps

each were taken with a 38 cm insect net at two random sites in the field. The canola was at mid- to late bloom at the time of spraying. On July 12 and 29, each of the sixteen plots was sampled using 10 walking sweeps in the center of each plot as the sampling unit. Sweep samples were frozen for later analysis, whereupon the species and life stage of lygus bugs in each sweep sample were identified. A 6.1m wide swath was made in the center of each plot; swaths were hand separated at each plot border. Plots were combined on August 31, and a weigh wagon was used to measure yields from each plot. Data were tabulated, and subjected to ANOVA and paired *t*-tests.

RESULTS: Lygus levels were above the economic threshold (15 per 10 sweeps at late flower) at the time of spraying. Both chemical treatments had significantly lower lygus numbers than their unsprayed counterparts 4 days after spraying (Table 1). Twenty days after spraying, LORSBAN plots had significantly lower numbers of lygus than the unsprayed plots, while numbers in the DECIS-treated plots rebounded to levels similar to control and above the economic threshold at the time of pod fill (20/10 sweeps). Seed yields were higher in sprayed plots of both chemicals, but differences were not significant.

CONCLUSIONS: Both chemicals initially reduced lygus numbers below the economic threshold. Despite differences in lygus numbers between LORSBAN and control plots three weeks after spraying, the fact that there were no significant differences in seed yields between sprayed and unsprayed plots suggests that the harvested areas may have been too small to discern differences in yields. The plots themselves may have been too small to minimize the effects of lygus movement among DECIS and control treatments. Alternatively, economic thresholds at pod fill may be higher than previously estimated.

Table 1. Total number of lygus bugs per ten sweeps just prior to, four, and 20 days after application of two insecticides (LORSBAN and DECIS) for control of lygus bugs, and seed yields from canola with and without insecticide application in a field near Makwa, Saskatchewan in 1998.

	Lygus bugs/ 10m sweeps			
		4 Days	20 Days	Canola Yield
Treatment	Prespray	Post-spray	Post-Spray	(kg/ha)
Unsprayed check	41			
a) LORSBAN		0.25	8.75	1902
Unsprayed Check		12.55@*	86.50@*	1739@n.s.
b) DECIS		0.25	40.25	1834
Unsprayed Check		10.50@*	113.50@n.s.**	1612@n.s.

* Pairwise comparisons are statistically different at P#0.01, two-tailed *t*-test.
** n.s.- not significantly different.

PMR REPORT # 50 SECTION E: CEREAL, FORAGE, AND OILSEED CROPS INSECTS
ICAR: 61006537

CROP: Field Corn (*Zea mays*): Bt events CRY 9-C, Mon 810 Bt, Bt 11, Bt 176, DBT 418
PEST: Black Cutworm, *Agrotis ipsilon*
European Corn Borer, *Ostrinia nubilalis*

NAME AND AGENCY:
SCHAAFSMA A W, SEARS M K[1] and WHISTLECRAFT J[2]
Ridgetown College, University of Guelph, Ridgetown, Ontario, N0P 2C0
Tel: (519) 674-1624 Fax: (519) 674-1600 Email: aschaafs@ridgetownc.uoguelph.ca

[1]Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1
Tel: (519) 824-4120 Fax: (519) 837-0442 Email: msears@evbhort.uoguelph.ca

[2]Agriculture and Agri-food Canada, London, Ontario, N5V 4T3
Tel: (519) 457-1470 Fax: (519) 457-3997 Email: whistlecraftj@EM.AGR.CA

TITLE: CONTROL OF BLACK CUTWORM IN CORN WITH TRANSGENIC Bt CORN

MATERIALS: LORSBAN 4E (chlorpyrifos; 480 gm/L)

METHODS: The crop was planted on June 24 and June 29, 1998 at Cambridge Research Station and Ridgetown, respectively, using a 2-row cone seeder at 20 and 25 seeds per plot, respectively. Plots were comprised of 4 rows planted at a row spacing of 0.76 m and 2 m in length place in a randomized complete block design with 4 replications. Aluminum barriers 1.85 m X 1.85 m (6 ft. X 6 ft.) were installed in each plot to cover two rows, prior to the third leaf stage. The barriers were buried a minimum of 5 cm into the ground with 15 cm above ground. The total number of plants in each enclosure were counted before infestation. The plots were infested with black cutworms in the fourth to fifth instar at a rate of 1 larva per every 4 plants when the corn had reached the 3 leaf stage. At dusk, the larvae were placed in holes, made with a knife, next to the corn plants within the enclosure. LORSBAN 4E was applied prior to infestation at a rate of 2.4 l/400 l/ha as a broadcast. The number of damaged/cut plants were counted and flagged each day until feeding stopped, at which time a final stand count was recorded. At Ridgetown, plots were left to 1st tassel and then whole plants were scored for European corn borer damage (natural infestation) by simple % infested. Total tunnel length (cm) and total fresh weight of all above-ground plant tissue were recorded.
Percentage data were transformed to arcsin (%) before analysis. All data were analysed using ANOVA with means separated by LSD at P=0.05.

RESULTS: Results are presented in Tables 1 and 2 below.

CONCLUSIONS: The CRY 9-C event suppressed 4th and 5th instar cutworms at Ridgetown. At Cambridge most of the cutworms were beyond the 4th instar and poor control was achieved. Non of the other Bt events controlled cutworm. CRY 9-C also resulted in control of European corn borer comparable to the other Bt events tested. The CRY 9-C Bt event shows promise for management of black cutworm,

but further studies should be directed towards earlier instars.

Table 1. Plants cut, plants recovered, plant weight, corn borer damage and tunnel length in corn treated with insecticides for the control of black cutworm at Ridgetown, Ontario in 1998.

		Cutworm Damage			Corn Borer Damage (Incidental)	
Hybrid (Bt event)	# Larvae per Plant	% Plants Cut	# Plants Recovered	Plant Wt Kg/plot	# Plants Damaged	Total (cm) Tunnel Length
8773 CONTROL	0.25	23.2 a-d	2.8 ab	7.8 abc	4.5 a	10.5 a
8773 CONTROL	0.5	29.1 abc	2.8 ab	6.9 c	2.0 ab	3.2 b
8773 LORSBAN	0.25	15.3 cd	1.8 b	7.9 abc	0.5 b	1.9 b
8773 LORSBAN	0.5	16.3 bcd	2.8 ab	7.7 abc	1.0 b	2.5 b
8773 CRY 9-C Bt	0.25	10.1 d	2.5 ab	7.3 bc	0.5 b	0.0 b
8773 CRY 9-C Bt	0.5	10.3 d	3.0 ab	10.1 a	1.3 ab	1.9 b
MON 810 Bt	0.5	34.9 a	3.8 ab	9.8 ab	0.3 b	1.3 b
Bt 11	0.5	31.1 ab	3.8 ab	7.5 bc	0.0 b	0.0 b
Bt 176	0.5	31.3 ab	303 ab	7.1 c	2.0 ab	2.2 b
DBT 418 Bt	0.5	20.5 a-d	4.5 a	7.6 abc	3.3 ab	0.0 b
LSD		10.5	2.7	2.6	3.3	7.1
CV		26.2	60.3	22.1	151.1	209.4

Means followed by same letter do not significantly differ (P = .05, LSD)
Mean descriptions are reported in transformed data units, and are not de-transformed.

Table 2. Plants cut and plants recovered in corn treated with insecticides for the control of black cutworm. Cambridge, Ontario in 1998.

Hybrid (Bt event)	# Larvae/Plant	% Plants Cut	% Plants Recovered
8773 CONTROL	0.25	18.8 cd	43.8 a
8773 CONTROL	0.5	37.5 ab	23.3 a
8773 LORSBAN	0.25	14.8 d	48.0 a
8773 LORSBAN	0.5	50.0 a	15.8 a
8773 CRY 9-C Bt	0.25	16.3 d	39.8 a
8773 CRY 9-C Bt	0.5	45.0 ab	23.8 a
MON 810 Bt	0.5	40.0 ab	18.8 a
BT 11 Bt	0.5	28.8 bcd	44.5 a
BT 176 Bt	0.5	43.8 ab	24.5 a
DBT 418 Bt	0.5	36.3 abc	14.5 a
LSD		17.7	38.1
CV		36.8	88.6

Means followed by same letter do not significantly differ (P = .05, LSD)
Mean descriptions are reported in transformed data units, and are not de-transformed.

PMR REPORT # 51 SECTION E: CEREAL, FORAGE, AND OILSEED CROPS INSECTS
ICAR: 61006537

CROP: Corn (*Zea mays)*
PEST: Black Cutworm, *Agrotis ipsilon*
European Corn Borer, *Ostrinia nubilalis*

NAME AND AGENCY:
SCHAAFSMA A W, SEARS M K[1] and WHISTLECRAFT J[2]
Ridgetown College, University of Guelph, Ridgetown, Ontario, N0P 2C0
Tel: (519) 674-1624 Fax: (519) 674-1600 Email: aschaafs@wincom.net

[1]Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1
Tel: (519) 824-4120 Fax: (519) 837-0442 Email: msears@evbhort.uoguelph.ca

[2]Agriculture and Agri-food Canada, London, Ontario, N5V 4T3
Tel: (519) 457-1470 Fax: (519) 457-3997 Email: whistlecraftj@EM.AGR.CA

TITLE: CONTROL OF BLACK CUTWORM IN CORN WITH SEED TREATMENTS

MATERIALS: LORSBAN 4E (chlorpyrifos; 480 gm/L), CRUISER (CGA 293343 thiamethoxam 400 g ai/l)

METHODS: Seed was treated in 1 kg lots in individual bags by applying a slurry of the material via a syringe. The seed was then mixed for 1 minute to ensure thorough seed coverage. The crop was planted on 24 June and 29 June, 1998 at Cambridge Research Station and Ridgetown, respectively, using a 2-row cone seeder at 20 and 25 seeds per plot, respectively. Plots were comprised of 4 rows planted at a row spacing of 0.76 m and 2 m in length place in a randomized complete block design with 4 replications. Aluminum barriers 1.85 m X 1.85 m (6 ft. X 6 ft.) were installed in each plot to cover two rows, prior to the third leaf stage. The barriers were buried a minimum of 5 cm into the ground with 15 cm above ground. The total number of plants in each enclosure were counted before infestation. The plots were infested with black cutworms in the fourth to fifth instar at a rate of 1 larva per every 4 plants when the corn had reached the 3 leaf stage at Ridgetown, whereas most of the larvae used at Cambridge were 5th and 6th instars. At dusk, the larvae were placed in a hole, cut with a knife, next to the corn plant within the enclosure. LORSBAN 4E was applied prior to infestation at a rate of 2.4 l/400 l water/ha). Damaged/cut plants were counted and flagged each day until feeding stopped, at which time a final stand count was recorded. At Ridgetown, plots were left to 1st tassel and then whole plants were scored for European corn borer damage (natural infestation) by simple % infested. Total tunnel length (cm) and total fresh weight of all above-ground plant tissue were recorded.
Percentage data were transferred to arcsin (%) before analysis. All data were analyzed using ANOVA with means separated by LSD at P= 0.05.

RESULTS: Results are presented in Tables 1 and 2 below.

CONCLUSIONS: CGA 293343 resulted in fewer cut plants compare with non-treated controls, and more

total biomass than both the standard LORSBAN treatment or non-treated control at the Ridgetown site. The larvae used at Cambridge were more mature with no effects observed. CGA 293343 also resulted in numerically less corn borer damage compared with the controls.

Table 1. Plants cut, plants recovered, plant weight, corn borer damage and tunnel length in corn treated with insecticides for the control of black cutworm at Ridgetown, Ontario, in 1998.

	Cutworm Damage			Corn Borer Damage	
Treatment	% Plants Cut	No. Plants Recovered	Plant Weight kg/Plot	No. Plants Damaged	Total Tunnel Length (cm)
CONTROL	28.9 a	4	8.8 b	3.8	7.1
LORSBAN (STD)	5.7 c	2.3	11.5 ab	0.5	0.8
CGA 293343	19.5 b	2.3	12.4 a	0.3	0
LSD	9.4	ns	3.1	ns	ns
CV	22.4	62.7	19	126.3	149.9

Table 2. Plants cut and plants recovered in corn treated with insecticides for the control of black cutworm at Cambridge Research Station, Cambridge, Ontario, in 1998.

Treatment	% Plants Cut	% Plants Recovered
CONTROL	38	23.8
LORSBAN (STD)	26.3	32.5
CGA 293343	40	34.5
LSD	ns	ns
CV	48.2	87.7

Means followed by same letter do not significantly differ (p= 0.05, LSD)
Mean descriptions are reported in transformed data units, and are not de-transformed.

PMR REPORT # 52 SECTION E: CEREALS, FORAGE CROPS AND OILSEEDS INSECTS
ICAR: 93000480

CROP: Kentucky bluegrass (*Poa pratensis* L.), cvs. Midnight and Cynthia
PEST: Silvertop, *Fusarium* spp. and various species of thrips, leafhoppers, aphids and mites

NAME AND AGENCY:
CHANG K F, BRIANT M A, SIMS S M, and HOWARD R J
Alberta Agriculture, Food and Rural Development
Crop Diversification Centre, South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1334 **Fax:** (403) 362-1326 **Email:** changk@agric.gov.ab.ca

MOTTA J A and PRUSKI K W
Alberta Agriculture, Food and Rural Development
Crop Diversification Centre, North
RR#6, 17507 Fort Road
Edmonton, Alberta T5B 4K3
Tel: (403) 415-2320 **Fax:** (403) 422-6096 **Email:** motta@agric.gov.ab.ca

TITLE: EFFICACY OF TWO INSECTICIDES AGAINST SILVERTOP ON TWO CULTIVARS OF KENTUCKY BLUEGRASS AT BROOKS, ALBERTA, IN 1998

MATERIALS: CYGON 4E (dimethoate 480 g/L EC) and DECIS 5EC (deltamethrin 50 g/L EC)

METHODS: Insecticide efficacy trials were conducted in 4-year-old experimental plots of cvs. Midnight and Cynthia Kentucky bluegrass at CDC South. Each cultivar plot was subdivided into three, 96 m^2 subplots with 6 m buffer strips between them. One of the following treatments was assigned to each subplot at random: CYGON 4E, DECIS 5EC or an untreated check. Each insecticide was sprayed on May 19, May 27 and June 11. The sprayer was truck-mounted with a 6 m wide boom with Tee Jet 8002 nozzles, a boom pressure of 275 kPa and a ground speed of 6.9 km/hr. CYGON was applied at 425 mL/ha and DECIS at 200 mL/ha, both in 100 L water/ha. The check plots were not sprayed. The May treatments were applied pre-heading and the June spray at early heading. Three, 1 m^2 areas (replicates) were staked out in each subplot and the number of silvertop heads were counted on June 8, 15, 22 and 30. The subplots were swept on May 11, 20 and 29 and on June 9 and 19, and the numbers and types of insects and mites were determined. Silvertop incidence data were subjected to analysis of variance (ANOVA) and regression analysis. Percentage data were transformed prior to analysis where required.

RESULTS: See Tables 1 to 4. Some areas of the plots had been injured during the winter of 1997, which affected the uniformity and degree of seed set.
Midnight - On June 15, control subplots had significantly (P# 0.05) more silvertop heads/m^2 than CYGON- but not DECIS-treated subplots (Table 1a). No significant differences were seen on the other three sampling dates. There were no significant differences between treatments for percent silvertop heads (Table 1b); however, control plots had noticeably higher percentages of silvertop heads than did CYGON or DECIS plots. There were no statistically significant linear relationships between silvertop

occurrence and sampling date as determined by regression analysis (Tables 3a, 3b). Table 4a gives the family, genus and species names of the most common insects and mites found during sweeping, and Table 4b shows their relative abundance. Before spraying (May 11), plant hopper populations in the Midnight plot were relatively high. During the spraying period, plant bug and leaf hopper populations in the DECIS-treated subplots were considerably lower than in the control subplots and also generally lower than in the CYGON-treated subplots (Table 4b). Statistical analysis of insect sampling data was not carried out because they were unreplicated.

Cynthia - On June 15, the control and DECIS treatments had significantly (P# 0.05) fewer silvertop heads/m^2 compared to CYGON (Table 2a). No significant differences between treatments were seen on the other three sampling dates, although a similar trend in silvertop occurrence was evident. There were no significant differences in the percentage of silvertop heads between treatments; however, DECIS appeared more effective than CYGON in reducing silvertop incidence (Table 2b). There were no statistically significant linear relationships between silvertop occurrence and sampling date as determined by regression analysis (Tables 3a, 3b). Table 4a gives the family, genus and species names of the most common insects and mites found during sweeping, and Table 4b indicates their relative abundance. Before spraying (May 11), plant hopper populations in the Cynthia plot were moderately high. During the spraying period, plant bug, leaf hopper and plant hopper populations in the DECIS-treated subplots were generally lower than in the control and CYGON-treated subplots (Table 4b). Statistical analysis of insect sampling data was not carried out because they were unreplicated.

CONCLUSIONS: In general, DECIS was much more effective at reducing silvertop incidence and insect populations than CYGON, especially in Cynthia bluegrass. These trials showed that controlling insects, especially plant bugs and leaf hoppers, helped to reduce or eliminate silvertop in Kentucky bluegrass at CDC South in 1998.

ACKNOWLEDGEMENTS: We thank Mrs. S.P. Huggons, Ms. Y.A. Leduc and Ms. L.C. Bandura for technical assistance and Dr. J. Soroka for advice on insect nomenclature.

Table 1a. Number of silvertop heads in plots of Midnight Kentucky bluegrass sprayed three times with two insecticides and assessed on four dates at Brooks, AB in 1998.[x]

	Number of silvertop heads/m^2			
Treatment	June 8	June 15	June 22	June 30
CYGON	0.0	0.0 b	0.0	0.0
DECIS	0.0	0.6 ab	0.5	0.3
Control	0.3	1.3 a	0.9	0.3
ANOVA F-value	0.4444	0.0327	0.5249	0.6944

Table 1b. Percent silvertop heads in plots of Midnight Kentucky bluegrass sprayed three times with two insecticides and assessed on four dates at Brooks, AB in 1998.[x]

	Percent silvertop heads/m^2 [y]			
Treatment	June 8	June 15	June 22	June 30
CYGON	0.0	0.0	0.0	0.0
DECIS	0.0	5.4	2.7	1.5
Control	2.5	18.0	9.1	5.3
ANOVA F-value	0.4444	0.2052	0.4279	0.6169

[x] Values are means of three replications. Means followed by the same letter in a column do not significantly differ (P# 0.05, Duncan's New Multiple Range Test).

[y] Data were square root-transformed prior to analysis of variance and the detransformed means are presented here.

Table 2a. Number of silvertop heads in plots of Cynthia Kentucky bluegrass sprayed three times with two insecticides and assessed on four dates at Brooks, AB in 1998.[x]

	Number silvertop heads/m^2			
Treatment	June 8	June 15	June 22	June 30
CYGON	3.7	11.7 a	6.1	4.9
DECIS	2.1	3.1 b	3.9	2.7
Control	1.9	1.9 b	3.8	1.9
ANOVA F-value	0.143	0.0418	0.7499	0.397

Table 2b. Percent silvertop heads in plots of Cynthia Kentucky bluegrass sprayed three times with two insecticides and assessed on four dates at Brooks, AB in 1998.[x]

	Percent silvertop heads/m^2 [y]			
Treatment	June 8	June 15	June 22	June 30
CYGON	5.7	28.7	11.4	15.9
DECIS	1.6	3.3	3.9	3.7
Control	2.7	5.3	9.8	9.9
ANOVA F-value	0.2218	0.0724	0.6652	0.5745

[x] Values are means of three replications. Means followed by the same letter in a column do not significantly differ (P# 0.05, Duncan's New Multiple Range Test).

[y] Data were square root-transformed prior to analysis of variance and the detransformed means are presented here.

Table 3a. Estimated linear relationships between number of silvertop heads per square metre and sampling date for two insecticide treatments and an untreated control for two Kentucky bluegrass cultivars at Brooks, AB, in 1998.[w]

Cultivar	Treatment	Regression equation and coefficient of determination (R^2)	Statistical significance for R^2 (P# 0.05)
Midnight	CYGON	--	-- [y]
	DECIS	$y = 0.01x - 2.0$ $R^2 = 0.03$	ns [x]
	Control	$y = 0.00x - 1.6$ $R^2 = 0.002$	ns
Cynthia	CYGON	$y = 0.09x - 24.8$ $R^2 = 0.006$	ns
	DECIS	$y = 0.08x - 8.1$ $R^2 = 0.006$	ns
	Control	$y = 0.00x - 4.2$ $R^2 = 0.00$	ns

[w] Dependent variable (y) = silvertop heads/m^2, independent variable (x) = sampling (Julian) date. Regression equation is $y = mx + b$, where y = dependent variable, m = slope of regression line, x = independent variable, and b = y-axis intercept.

[X] ns = non-significant (P>0.05).

[Y] No variability in y; regression analysis was not carried out.

Table 3b. Estimated linear relationships between percentage of silvertop heads per square metre and sampling date for two insecticide treatments and an untreated control for two Kentucky bluegrass cultivars at Brooks, AB, in 1998.[w]

Cultivar	Treatment	Regression equation and coefficient of determination (R^2)	Statistical significance for R^2 (P# 0.05)
Midnight	CYGON	--	-- [y]
	DECIS	y = 0.08x - 9.9 R^2 = 0.01	ns [x]
	Control	y = 0.13x - 11.1 R^2 = 0.01	ns
Cynthia	CYGON	y = 0.16x - 10.3 R^2 = 0.01	ns
	DECIS	y = 0.21x - 30.4 R^2 = 0.03	ns
	Control	y = 0.54x - 81.4 R^2 = 0.12	ns

[w] Dependent variable (y) = silvertop heads/m^2, independent variable (x) = sampling (Julian) date. Regression equation is y = mx + b, where y = dependent variable, m = slope of regression line, x = independent variable, and b = y-axis intercept.

[X] ns = non-significant (P>0.05).

[Y] No variability in y; regression analysis was not carried out.

Table 4a. Identity of insects and mites from Kentucky bluegrass plots at Brooks, Alberta, 1998.

Order:Family:Subfamily	Common name	Genus and species
Hemiptera:Miridae	Plant bugs	*Labops hirtus* Knight *Litomiris debilis* Uhler *Lygus borealis* (Kelton) *Lygus shulli* Knight *Stenodema trispinosa* Reuter *Teratocoris discolor* (Uhler) *Trigonotylus ruficornis* (Geoffroy)
Hemiptera:Acanthosomatidae	Stink bugs	*Elasmucha lateralis* Say
Hemiptera:Anthocoridae	Pirate bugs	*Orius tristicolor* (White)
Hemiptera:Lygaediae	Seed bugs	*Nysius* spp.
Hemiptera:Tingidae	Lace bugs	*Acalypta* spp.
Hetmiptera:Thyreocoridae	Negro bugs	one species (not identified)
Homoptera:Fulgoridae	Plant hoppers	two species (not identified)
Homoptera:Cicadellidae	Leaf hoppers	*Acinopterus viridis* Ball *Auridius auratus* Gillette & Baker *Deltocephalus valens* Ball *Endria inimicus* Say *Helochara communis* Fitsch *Latulus personatus* Beirne *Macrosteles fascifrons* Stal *Psammotettix ferratus* De L. & Dav. *Psammotettix lividella* Zett. *Sorhoanus uhleri* Oman *Verdanus evansi* Ashmead
Homoptera:Cercopidae	Frog hoppers	one species (not identified)
Coleoptera:Anthicidae	Ant-like flower beetle	*Notoxus anchora* Hentz.
Coleoptera:Chrysomelidae: Alticinae	Flea beetles	one species (not identified)
Coleoptera:Curculionidae: Brachyderinae	Weevils	*Sitona cylindricollis* Fahr
Coleoptera:Curculionidae: Hyperinae	Clover weevils	not identified
Thysanoptera	Thrips	*Anaphothrips obscurus* (Mull.) *Thrips physapus* L.
Acarina	Mites	not unidentified

Table 4b. Numbers and classes of insects and mites sampled from plots of Kentucky bluegrass, cvs. Midnight and Cynthia, over a four-week period at Brooks, AB, in 1998.

		Midnight			Cynthia		
Insects captured	Date	CYGON	DECIS	Control	CYGON	DECIS	Control
Miridae	May 20	11	2	21257053	1031014	240410	889025
(plant bugs)	May 29	2	5				
	June 9	-	-				
	June 18	0	3				
Total		13	10				
Cicadellidae	May 20	31711250	11	293812584	241411049	50172345	356162279
(leaf hoppers)	May 29		14				
	June 9		-				
	June 18		11				
Total			36				
Fulgoridae	May 20	35827	18	43007	1953027	553013	960015
(plant hoppers)	May 29		10				
	June 9		-				
	June 18		0				
Total			28				
Alticinae	May 20	4	36174	30104	30003	101	10102
(flea beetles)	May 29	0					
	June 9	-					
	June 18	0					
Total		4					
Curculionidae	May 20	0	0	0	11	0	1001
(weevils)	May 29						
	June 9						
	June 18						
Total							
Thysanoptera	May 20	12003	0	0	40004	5005	0
(thrips)	May 29						
	June 9						
	June 18						
Total							
Acarina	May 20	1001	3003	0	0	0	0
(mites)	May 29						
	June 9						
	June 18						
Total							

- = missing samples

A sweep was done on May 11 before any chemical treatments were applied. Insects trapped were:
Midnight -- plant bugs = 6 nymphal instars; plant hoppers = 49; flea beetles = 1
Cynthia -- plant bugs = 1 nymphal instar; plant hoppers = 26.

PMR REPORT # 53 SECTION E: CEREALS, FORAGE CROPS AND OILSEEDS
STUDY DATA BASE: 364-1221-8803

CROP: Spring wheat, cv. Roblin
PEST: Orange wheat blossom midge, *Sitodiplosis mosellana* (GÁhin)

NAME AND AGENCY:
WISE I L and TUCKER J R
Agriculture & Agri-Food Canada, Winnipeg, Manitoba, R3T 2M9
Tel: (204) 983-1450; Fax: (204) 983-4604; Email: iwise@em.agr.ca

TITLE: ORANGE WHEAT BLOSSOM MIDGE CONTROL IN SPRING WHEAT WITH MATADOR

MATERIALS: MATADOR 12EC, 12CS (lambda cyhalothrin), LORSBAN 4EC (chlorpyrifos),

METHODS: Roblin spring wheat was seeded on 22 May 1998 at Glenlea, Manitoba with a double disc press drill. The test was sown at a field site that is split into a two year wheat-fallow crop rotation. The crop was seeded in the part of the field that was fallowed the previous year at a rate of 80 kg/ha to a depth of 3 to 4 cm in 17.5 cm row spacings. Plots were 1.25 m by 5.0 m and were replicated 4 times in a randomized complete block design. In June steel cone traps (50 cm dia) were placed in wheat stubble, from the previous year's crop, to record the date of emergence of the adult midge from the soil. The period of adult emergence was estimated in order to determine the synchrony of emergence of the wheat midge adults and of the wheat heads. Traps were left in the wheat stubble until adult emergence had ceased. The traps were then removed and this section of the field was cultivated. The treatments were applied 10, 13, and 15 July 1998 with a CO_2-pressurized backpack sprayer at a water volume of 220 L/ha and a pressure of 300 kPa, using D6-25 nozzles. The initial treatment was applied when 50% of the wheat heads had completely emerged from the boot (5 for the cereal growth stage of Zadoks).Ten wheat heads were randomly collected from each plot on 5 August before larvae dropped to the soil. The heads were dissected under a microscope and the number of larvae in the heads were counted. The number of larvae per wheat head were analysed by Duncan's Multiple Range test (P=0.05).

RESULTS: Adult wheat midge started to emerge from the soil in the last week of June (Table 1). The adults mostly emerged in early July, or about one week before wheat heads emerged from the boot, and had finished emerging before the second application date. Consequently, egg laying onto wheat heads would have been most intensive immediately after the wheat heads had emerged. Since adult females of the midge survive for only 3-4 days and no adult emergence was recorded after 9 July, few eggs likely were laid after the second application date on later developing wheat heads. Data for the field study are contained in Table 2.

CONCLUSIONS: The early emergence of the adult midge relative to the wheat heads reduced egg distribution amongst heads. Approximately 40% of the wheat heads in the check plots received no eggs, likely because the heads emerged after the adult flight had ended. Thus, the highest densities of adults were present on the earliest spray date. However, the most effective treatment, LORSBAN, reduced

larval densities by about 70-75% and was applied at least three days after 50% of the wheat heads had emerged. By this time, oviposition and initial larval emergence on the treated heads likely would have commenced before the treatment was applied. LORSBAN is known to be efficacious against both adults and newly hatched larvae, with larval control mainly by fumigative and/or contact activity. The two formulations of MATADOR applied on the first spray date and three days later also reduced larval infestation but to a lesser extent. The EC formulation of MATADOR, applied at the earliest spray date, provided the best control of all MATADOR treatments, although the differences amongst these treatments were not significant. While higher numbers of larvae were found in the early MATADOR treatments, the percentage of heads with no larvae in these treatments were identical to LORSBAN. Thus, the higher larval density in these MATADOR treatments was due to higher numbers of larvae in the infested heads. MATADOR treatments applied at the same time as LORSBAN had fewer uninfested heads, indicating extensive ovipositing by the adults before application. These results indicate MATADOR can effectively controlled adults, but does not have much effect on the eggs or larvae.

Table 1. The timing of emergence of wheat midge adults from wheat stubble located next to experimental site.

Date	Wheat Midge Adults/10 traps/Day		
	Males	Females	Total
June 24	0.3	0	0.3
July 2	5.1	1.4	6.5
July 6	3.5	8.0	11.5
July 9	1.3	4.0	5.3
July 13	0	0	0

Table 2. The number of orange wheat blossom midge larvae in spring wheat heads treated with MATADOR.

Treatments	Rate (g ai/ha)	Application Date	Larvae/ head	% of Heads with 0 larvae	Larvae/ infested head
CHECK	-	-	4.0a	35.0	6.0a
MATADOR 12EC	10	July 10	1.6bc	55.0	3.7a
MATADOR 12CS	10	July 10	2.2abc	57.5	5.4a
MATADOR 12EC	10	July 13	1.8bc	50.0	3.1a
MATADOR 12CS	10	July 13	2.8ab	45.0	5.2a
MATADOR 12EC	10	July 10, 15	2.4abc	60.0	5.3a
MATADOR 12CS	10	July 10, 15	2.6abc	55.0	3.9a
LORSBAN	400	July 13	1.1c	57.5	2.3a
CHECK	-	-	3.7ab	47.5	6.8a

*Means followed by the same letter are not significantly different (Duncan's MRT, $P>0.05$).

END OF SECTION E

SECTION F **ORNAMENTALS and GREENHOUSE - Insects /PLANTES ORNEMENTALES et DE SERRE**

REPORT #s **54 - 55**
See related reports # 60 (p.161) and # 62 (p.167)

PAGES **144 - 150**

EDITOR **Dr. Les Shipp**
Agriculture and Agri-Food Canada
Greenhouse and Processing Crops
Research Centre, Highway 18
Harrow, Ontario N0R 1G0
Email: shipps@em.agr.ca
Tel: (519) 738-2251
Fax: (519) 738-2929

1998 PMR REPORT # 54 **SECTION F: ORNAMENTALS *AND* GREENHOUSE**
STUDY DATABASE: 87000180

CROP: Siberian elm, *Ulmus pumila* L.
PEST: Spring Cankerworm, *Paleacrita vernata* (Peck).

NAME AND AGENCY:
NEILL G B, REYNARD D A and MUSQUA D R
Agriculture and Agri-Food Canada, P.F.R.A., Shelterbelt Centre, Indian Head, Saskatchewan S0G 2K0
Tel: (306) 695-2284; Fax: (306) 695-2568; E-mail: pf21801@em.agr.ca

TITLE: EVALUATION OF THREE RATES OF SPINOSAD FOR CONTROL OF EARLY INSTAR SPRING CANKERWORM IN SASKATCHEWAN, IN 1998.

MATERIALS: SPINOSAD 480 SC (spinoyns, *Saccharopolyspora spinosa* 48% SC) and DIPEL WP (*Bacillus thuringiensis* subsp. *kurstaki* 16,000 IU/mg).

METHODS: Spring cankerworm is a common defoliator of American elm, Siberian elm, green ash and Manitoba maple in rural and urban tree plantings throughout the Prairies. DIPEL WP, three rates of SPINOSAD and a water check were evaluated for control of the spring cankerworm at a single site in Saskatchewan. The site was comprised of a 34 year old single row Siberian elm field shelterbelt located at W14-18-13-W2, near Indian Head, Saskatchewan. The five treatments were replicated four times in a randomized complete block design. Treatment plots were 20 m long with a five m buffer between plots.

Treatments were applied on May 20, 1998 with a hand gun attached to a high pressure sprayer at 700 kPa. All treatments were applied at a rate of 30 L of solution per 100 m² of plant surface area. Treatments were applied to the shelterbelt from both sides until the foliage was wet but not dripping. At the time of application, spring cankerworm larvae averaged 4.3 mm in length. The Siberian elm were almost fully leafed out and the seeds were fully developed but had not started to drop.

Plant phytotoxicity assessments were taken May 23 and May 27. Evaluation of the trial was conducted on May 20 (pre treatment count), May 23 (three days after treatment [DAT]) and May 27 (DAT). Estimates of spring cankerworm populations were made by collecting 16 branches from each plot and then counting the number of cankerworm larvae. Each branch was approximately 15 cm long with eight branches taken from each side of the shelterbelt in each plot. Branches were placed in ziploc bags (2 branches per bag) and then taken to the laboratory where the number of live larvae per bag were recorded. Plot values were subjected to a square root (x + 1) transformation followed by an analysis of variance using the General Linear Model. Means were separated using the Duncan's multiple range test.

The residual impact of SPINOSAD was assessed by exposing late instar spring cankerworm larvae to treated and untreated Siberian elm foliage. Twenty-six days after application (June 15, 1998), foliage was removed from plots treated with the high rate of SPINOSAD (214.8 ml / 1000 L water). Check foliage was obtained from an untreated Siberian elm shelterbelt. Ten ziplock bags of SPINOSAD treated foliage and 10 bags of untreated foliage were prepared. Several hundred late instar spring cankerworm larvae were collected from an untreated Siberian elm shelterbelt on June 15. Ten larvae were placed in each bag for a total of 100 larvae per treatment. At the time of collection, spring cankerworm larvae averaged 20 mm in length. The condition of the spring cankerworm larvae in the residue trial was assessed 24, 48, 72 and 96 h after exposure to treated or untreated foliage. The bags containing the larvae and foliage were keep at room temperature during the assessment period. Larvae were classified as healthy, dying or dead. Larvae were assessed as dying when they had minimal movement even after prodding with tweezers, had twitching appendages, and had body contents that were liquefying. Dead larvae were removed from the bags each day.

RESULTS: No phytotoxic damage was noted on Siberian elm treated with DIPEL WP or the three rates of SPINOSAD. Three DAT, the SPINOSAD treatments had significantly lowered the cankerworm population as compared to the DIPEL treatment or the water check (Table 1). There was no difference between the SPINOSAD treatments at 3 DAT. All SPINOSAD treatments provided 99% control of cankerworm larvae by 3 DAT. DIPEL had provided 84.5% control of cankerworm larvae by 3 DAT which was significantly less control than the SPINOSAD treatments. By 7 DAT, cankerworm populations within the DIPEL and SPINOSAD plots were not significantly different with all treatments providing 99 to 100% control.

Only 21% of cankerworm larvae were classed as healthy after 4 days exposure to Siberian elm foliage with 26 days residue of the high rate of SPINOSAD (Table 2). In comparison, 83% of the cankerworm presented with untreated foliage were classed as healthy after the 4 day period. Parasitism was a cause of mortality in the check plots and could have cause similar mortality rates in the SPINOSAD plots.

CONCLUSIONS: The three rates of SPINOSAD and the one rate of DIPEL applied to early instar cankerworm larvae reduced the population by 99 to 100 % seven DAT. Since all rates of SPINOSAD tested gave almost complete control, lower rates of SPINOSAD should be tested to determine the dose response for early instar spring cankerworm larvae. SPINOSAD was as effective as DIPEL in controlling spring cankerworm larvae. SPINOSAD provided effective control of early instar spring cankerworm larvae within three days of application, whereas DIPEL required seven days for effective control.

Siberian elm foliage treated with SPINOSAD had an impact on cankerworm survival, even after a 26 day

post application interval. This residual control has implications for the timing of application and the duration of control for SPINOSAD.

Table 1. Number of live spring cankerworm larvae per 15 cm branch of Siberian elm following treatment with three rates of SPINOSAD, one rate of DIPEL or a water check.

Treatment	Rate (Product per 1000 L water)	Live spring cankerworm larvae per 15 cm branch							
		Pre-treatment		3 DAT*			7 DAT		
		Mean	SD	Mean	SD	%*** control	Mean	SD	% control
Spinosad 480 SC	58.5 ml	15.39 a**	6.15	0.05 c	0	99.6	0.02 b	0	99.8
Spinosad 480 SC	117.3 ml	25.53 a	8.07	0.03 c	0	99.9	0.00 b	0	100
Spinosad 480 SC	214.8 ml	15.69 a	11.1	0.10 c	0	99.3	0.00 b	0	100
Dipel WP	625 g	17.88 a	13.1	2.46 b	1.9	84.5	0.14 b	0.2	99
Water check	-----	9.21 a	6.93	8.19 a	4.5	-	7.11 a	2.8	-

* DAT = days after treatment

** Means in the same column followed by the same letter are not significantly different at the 5% level according to the Duncan's multiple range test.

*** Percent control calculated using Abbott's formula.

Table 2. Percentage of spring cankerworm larvae classed as healthy, dying or dead following exposure to Siberian elm foliage that was non treated or treated 26 days previous with SPINOSAD.

Hours after exposure	Percent of spring cankerworm larvae in					
	Check			SPINOSAD 480 SC at 214.8 ml / 1000 L		
	Healthy	Dying	Dead	Healthy	Dying	Dead
0	100	0	0	100	0	0
24	95	5	0	87	13	0
48	95	0	5	68	27	5
72	93	2	5	46	37	17
96	83	12	5	21	44	35

1998 PMR REPORT # 55 **SECTION F: ORNAMENTALS AND GREENHOUSE**
STUDY DATABASE: 87000180

CROP: Siberian elm, *Ulmus pumila* L.
PEST: Spring Cankerworm, *Paleacrita vernata* (Peck).

NAME AND AGENCY:
NEILL G B, REYNARD D A and MUSQUA D R
Agriculture and Agri-Food Canada, P.F.R.A., Shelterbelt Centre, Indian Head, Saskatchewan S0G 2K0
Tel: (306) 695-2284; Fax: (306) 695-2568; E-mail: pf21801@em.agr.ca

TITLE: EVALUATION OF TWO RATES OF SPINOSAD FOR CONTROL OF LATE INSTAR SPRING CANKERWORM IN SASKATCHEWAN, IN 1998

MATERIALS: SPINOSAD 480 SC (spinoyns, S*accharopolyspora spinosa* 48% SC).

METHODS: Spring cankerworm is a common defoliator of American elm, Siberian elm, green ash and Manitoba maple in rural and urban tree plantings throughout the Prairies. Two rates of SPINOSAD, a water check and a dry check were evaluated for control of the spring cankerworm at a single site in Saskatchewan. The site was comprised of a 30 year old single row Siberian elm field shelterbelt at W10-18-13-W2, near Indian Head, Saskatchewan. The four treatments were replicated five times in a randomized complete block design. Treatment plots were 20 m long with a five m buffer between plots.

Treatments were applied on May 29, 1998 with a hand gun attached to a high pressure sprayer at 700 kPa. All treatments were applied at a rate of 30 L of solution per 100 m² of plant surface area. Treatments were applied to the shelterbelt from one side until the foliage was wet but not dripping. At the time of application, spring cankerworm larvae averaged 14.5 mm in length. The Siberian elm were almost fully leafed out and the majority of the seed crop had dropped.

Evaluation of the trial was conducted on May 29 (prior to treatment), June 1 (three days after treatment [DAT]), June 5 (seven days DAT) and June 12 (14 DAT). Before application of treatments, four large branches were selected and tagged from each plot. Spring cankerworm populations were determined by removing eight (two from each tagged branch), 15 cm branch samples from each treatment plot. Branch samples were placed into a ziploc bag and taken to the laboratory where the number of live and moribund larvae per branch were recorded. Plant phytotoxicity assessments were taken June 1, 5 and 12. Plot values were subjected to a square root (x + 1) transformation followed by an analysis of variance using the General Linear Model. Means were separated using the Duncan's multiple range test.

The residual impact of SPINOSAD was assessed in two trials by exposing late instar spring cankerworm larvae to treated and untreated Siberian elm foliage. In the first trial, foliage was taken from plots that had been treated 14 days previous with the 117.3 ml /1000 L rate of SPINOSAD (treated May 29 and removed June 12, 1998). Check foliage was collected June 12 from an untreated Siberian elm shelterbelt. Ten ziplock bags of SPINOSAD treated foliage and 10 bags of untreated foliage were prepared. Several hundred late instar spring cankerworm larvae were collected from an untreated Siberian elm shelterbelt on June 12. Ten larvae were placed in each bag for a total of 100 larvae per treatment. At the time of

collection, spring cankerworm larvae averaged 20 mm in length. The condition of the spring cankerworm larvae in the residue trial was assessed 24, 48, 72, 96 and 120 h after exposure to treated or untreated foliage. The bags containing the larvae and foliage were keep at room temperature during the assessment period. Larvae were classified as healthy, dying or dead. Larvae were assessed as dying when they had minimal movement even after prodding with tweezers , had twitching appendages, and had body contents that were liquefying. Dead larvae were removed from the bags each day. In the second residual trial, foliage was taken from plots that had been treated 17 days previous with either the 58.5 ml / 1000 L rate or the 117.3 ml / 1000 L rate of SPINOSAD (treated May 29 and removed June 15, 1998). Check foliage and healthy cankerworm larvae were collected June 15 from an untreated Siberian elm shelterbelt. The setup and evaluation for this second trial was the same as described in the first trial

RESULTS: No phytotoxic damage was noted on Siberian elm treated with the two rates of SPINOSAD. Three DAT, the SPINOSAD treatments had significantly lowered the cankerworm population as compared to the water or dry check (Table 1). No difference was found between the SPINOSAD treatments at 3 DAT. The SPINOSAD treatments had provided 97 to 100 % control of spring cankerworm larvae at 3 DAT. By 7 DAT, spring cankerworm populations within the SPINOSAD plots were eliminated (100% control). At 14 DAT, there still were no cankerworm present in the SPINOSAD plots. Significantly fewer spring cankerworm larvae were found in the water check compared to the dry check at 3 and 7 DAT. The reduction in cankerworm populations in the water check were probably due to some larvae being dislodged from the trees by the high pressure spray. When disturbed, late instar spring cankerworm larvae will drop from the foliage using threads, but can also return via the threads to the trees. The high pressure spray may have broken the threads and not allowed the larvae to return to the host trees. The habit of dropping on threads is noted more for late instar larvae that for early instar larvae. By Day 14, the trees were almost completely defoliated in the check plots and larvae were either dropping to the ground to pupate or were moving to other locations with more foliage.

In the first residual impact study, none of the cankerworm larvae were classed as healthy after a 2 day exposure to foliage treated with the 117.3 ml / 1000 L rate (Table 2). This foliage had been treated with SPINOSAD 14 days before the start of this residue impact study. In comparison, 100% of the cankerworm presented with untreated foliage were classed as healthy after the 2 day period and 71 % were classed as healthy after 5 days. Parasitism was a cause of mortality in the check plots and could have cause similar mortality rates in the SPINOSAD plots.

In the second residual impact study, 26% and 1% of the cankerworm larvae were classed as healthy after a 2 day exposure to foliage treated with the 58.5 or 117.3 ml / 1000 L rates, respectively (Table 3). This foliage had been treated with SPINOSAD 17 days before the start of this residue impact study. In comparison, 95% of the cankerworm presented with untreated foliage were classed as healthy after the 2 day period. After 4 days, 5% and 1% of the cankerworm exposed to the 58.5 or 117.3 ml / 1000 L treated foliage were classed as healthy, respectively. In comparison, 83% of the larvae in the check were classed as healthy after 4 days. Parasitism was a cause of mortality in the check plots and could have caused similar mortality rates in the SPINOSAD plots.

CONCLUSIONS: The two rates of SPINOSAD applied to late instar cankerworm larvae provided 100 % control seven DAT. The reduction was not as great with the water check because of physical removal of some of the larvae and larval threads due to the high pressure of the water spray. Since both rates of SPINOSAD tested gave almost complete control within 3 days of application, lower rates of SPINOSAD

should be tested to determine the dose response for late instar spring cankerworm larvae.

Foliage treated 14 to 17 days previous with the 117.3 ml / 1000 L rate of SPINOSAD killed or incapacitated 99 to 100 % of late instar spring cankerworm larvae within a 48 h exposure period. The lower rate of SPINOSAD had similar affects with 95% of the larvae being dead or incapacitated after a 96 hour exposure period. This residual control has implications for the timing of application and the duration of control for SPINOSAD.

Table 1. Number of live spring cankerworm larvae per 15 cm branch of Siberian elm and percent control of spring cankerworm larvae following treatment with two rates of SPINOSAD.

Treat-ment	Rate (product per 1000 L water)	Live spring cankerworm larvae per 15 cm branch										
		Pre-treatment		3 DAT*			7 DAT			14 DAT		
		Mean	SD	Mean	SD	% *** cont.	Mean	SD	% cont.	Mean	SD	% cont.
Spinosad 480 SC	58.5 ml	5.93 a**	1.8	0.00 c	0	100	0.00 c	0	100	0.00 b	0	100
Spinosad 480 SC	117.3 ml	6.28 a	3.2	0.08 c	0	97.7	0.00 c	0	100	0.00 b	0	100
Water check	-----	5.68 a	4.4	3.15 b	3.9	-	1.65 b	2.1	-	3.95 a	6.2	-
Dry Check	-----	5.55 a	2	6.43 a	2	-	7.80 a	4.4	-	3.70 a	3	-

* DAT = days after treatment

** Means in the same column followed by the same letter are not significantly different at the 5% level according to the Duncan's multiple range test.

*** Percent control calculated using Abbott's formula.

Table 2. Percentage of spring cankerworm larvae classed as healthy, dying or dead following exposure to Siberian elm foliage that was non treated or treated 14 days previous with SPINOSAD.

Hours after exposure	Percent of spring cankerworm larvae in					
	Check			SPINOSAD 480 SC at 117.3 ml / 1000 L		
	Healthy	Dying	Dead	Healthy	Dying	Dead
0	100	0	0	100	0	0
24	100	0	0	3	97	0
48	100	0	0	0	66	34
72	99	1	0	0	40	60
96	87	13	0	0	26	74
120	71	10	19	0	14	86

Table 3. Percentage of spring cankerworm larvae classed as healthy, dying or dead following exposure to Siberian elm foliage that was non treated or treated 17 days previous with SPINOSAD.

Hours after exposure	Percent of spring cankerworm larvae in								
	Check			SPINOSAD 480 SC at 58.5 ml / 1000 L			SPINOSAD 480 SC at 117.3 ml / 1000 L		
	Healthy	Dying	Dead	Healthy	Dying	Dead	Healthy	Dying	Dead
0	100	0	0	100	0	0	100	0	0
24	95	5	0	56	44	0	43	57	0
48	95	0	5	26	54	20	1	55	44
72	93	2	5	8	48	44	1	36	63
96	83	12	5	5	40	55	1	20	79

END OF SECTION F

SECTION G **BASIC STUDIES (Laboratory) /ÉTUDES DE BASE**

REPORT #s **56 - 57**

PAGES **151 - 154**

EDITOR **Mrs. Stephanie A. Hilton**
Agriculture and Agri-Food Canada
Southern Crop Protection and Food
Research Centre, 1391 Sandford St.
London, Ontario N5V 4T3
Email: hiltons@em.agr.ca
Tel: (519) 457-1470 ext. 218
Fax: (519) 457-3997

1998 PMR REPORT # 56 **SECTION G: BASIC STUDIES**
STUDY DATA BASE: 9207

CROP: Apple
PEST: Obliquebanded leafroller, *Choristoneura rosaceana*

NAME and AGENCY:
COSSENTINE JE, JENSEN LBM and PHILIP HG[1]
Agriculture and Agri-Food Canada,
Pacific Agri-Food Research Centre, Summerland, B.C. V0H 1Z0
tel:250-494-7711; fax:250-494-0755; em:COSSENTINEJ@EM.AGR.CA, JENSENLB@EM.AGR.CA

[1]British Columbia Ministry of Agriculture, Fisheries and Food
200-1690 Powick Road, Kelowna, BC V1X 7G5
tel:250-861-7230; fax:250-861-7490;em: HUGH.PHILIP@GEMS8.GOV.BC.CA,

TITLE: COMPATABILITY OF ATS AND DIPEL VERSUS OBLIQUEBANDED LEAFROLLER NEONATES

MATERIALS: ATS (ammonium thiosulphate) and DIPEL (16 000 BIU/kg *Bacillus thuringiensis* var. *kurstaki*)

METHODS: Treatments included preparations of DIPEL at 0.074 g (rate A) and 0.0045 g (rate B)/100 ml dH_2O and ATS at 1.6 ml/100 ml dH_2O. Each treatment, either alone or in combination with the each other, was left for 30 minutes at room temperature before being used. An aliquot (0.2 ml) of each preparation was applied to the flat surface of an agar-based meridic diet in the bottom of 25 plastic cups (20-ml). The surface of the treated diet was allowed to dry before a single obliquebanded leafroller neonate was placed on the surface of each treated cup. dH_2O was used as a control. All cups were sealed with a plastic lid and the treatments were incubated at 25°C. The tests were replicated four times. Leafroller mortality was assessed three and seven days post exposure.

RESULTS: ATS did not cause significant obliquebanded leafroller mortality (Table 1). The addition of

ATS to the DIPEL preparation did not significantly influence the efficacy of the *Bacillus thuringiesis* in causing leafroller mortality.

CONCLUSION: The results indicate that the field rate of ATS does not affect the toxicity of DIPEL to obliquebanded leafroller when the two products are combined.

Table 1. Mean percent obliquebanded leafroller mortality three and seven days post exposure. Relicated four times, n=25.

Treatment	Mortality - day 3 (sd)			Mortality - day 7 (sd)		
Control	3.01	-3.83	a[1]	4.01	-4.61	a
ATS	8.17	-7.55	a	10	-10.6	a
DIPEL A	93.75	-9.92	a	98.96	-2.08	a
DIPEL A + ATS	96	-8	a	100	0	a
DIPEL B	72.65	-25	a	100	0	a
DIPEL B + ATS	76.99	-24	a	98	-2.31	a

[1] means within pairs of treatments and columns followed by the same letter are not significantly (P>0.05) different as determined with Tukey's test after arcsin transformation of the percentage.

1998 PMR REPORT # 57 **SECTION G: BASIC STUDIES**
STUDY BASE NUMBER: 280-1252-9304

CR0P: Potato
PEST: Colorado potato beetle, *Leptinotarsa decemlineata* (Say)

NAME AND AGENCY:
HILTON[1] S A, J H TOLMAN[1], and SEARS[2] M K
[1] Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, ON, Canada N5V 4T3
Tel: (519) 457-1470; **Fax:** (519) 457-3397; **Email:** hiltons@em.agr.ca

[2] Dept. of Environmental Biology, University of Guelph, Guelph, ON N1G 2W1
Tel: (519) 827-4120; **Fax:** (519) 837-0442; **Email:** msears@evbhort.uoguelph.ca

TITLE: SUSCEPTIBILITY OF COLORADO POTATO BEETLE TO ADMIRE AND SEVERAL OTHER INSECTICIDES OVER THREE YEARS, 1996-98

MATERIALS: ADMIRE 240 (imidacloprid), technical (>95% purity) imidacloprid, cypermethrin, endosulfan, azinphosmethyl, chlorfenapyr

METHODS: Leaf Dip. Potato leaves were dipped into 2 ml solution of ADMIRE 240F in water and allowed to dry. Ten replicates of 5 CPB adults were placed onto treated foliage. Treated foliage was replaced with fresh, untreated foliage after 2 days. Mortality was assessed for 8 days. A discriminating dose (0.005% solution v/v of ADMIRE 240F) that within 24 h would kill 100% of an insecticide-susceptible strain (Lab-S) maintained at this laboratory was used. In 1998, twenty field-collected populations were evaluated. Survival of test CPB at this discriminating dose would indicate the development of resistance. **Direct Contact**. In a Potter spray tower, 5 ml of technical (>90% purity) imidacloprid, cypermethrin, endosulfan, azinphosmethyl and chlorfenapyr in 19:1 acetone:olive oil were sprayed directly onto 4 replicates of 10 adult CPB from 28, 8, 8, 8, and 26 field collections in 1998, respectively for the above insecticides. Four concentrations were selected to kill from 10 to 90% of the treated insects. Results were compared to the Lab-S strain. The tolerance ratio (LC_{50} field/LC_{50} lab) for each population provided a measure of current field resistance. Comparison with earlier results provided a measure of change in susceptibility over the three years.

RESULTS: In the leaf-dip bioassay, all test insects from 12 of 20 CPB populations appeared dead 1 DAT after exposure to foliage treated with the discriminating dose of ADMIRE 240F (0.005% solution), while there was >89% mortality in the other 8 populations. Nearly all test CPB appeared dead for 4 days after exposure to treated foliage. Recovery (>16%) was then noted in 16 of 20 populations, to the extent that for one population, 85% of test CPB had recovered from intoxication by 8 days after initial exposure.

In direct contact bioassays, the ratio of the LC_{50} of imidacloprid of the most tolerant strain to the Lab-S strain was 1.6x at 1 DAT and 2.2x at 8 DAT. One outlier strain proved much more susceptible than the lab strain. When the outlier population was included in calculation, the tolerance ratio for imidacloprid

increased to 10.7x at 1 DAT (Table 1) and 4.0x at 8 DAT. The difference was not statistically significant and could reflect natural variability among populations and differences in ages of collected adults. For the other four insecticides, the laboratory CPB strain was the most susceptible. Resistance levels of the most tolerant populations compared to the Lab-S strain declined 85% and 47%, respectively, for azinphosmethyl and cypermethrin from Year 1 (1996) of the study. Endosulfan resistance level dropped by 33% from Year 1 to 2 but only an additional 10% in 1998. Averaging the ratios of the field LC_{50}s to LC_{50} of the most susceptible strain gave lower resistance ratios (in brackets) indicating that resistance levels had dropped in the majority of the populations.

CONCLUSIONS: There was no resistance detected to either ADMIRE or to chlorfenapyr, an experimental insecticide. However, increased recovery after a period of "intoxication" complicates design of a rapid field test for resistance detection and may be a warning sign of the development of resistance to ADMIRE. Decrease in resistance to cypermethrin and azinphosmethyl may be due to reversion in the absence of selection pressure.

Table 1. Range in susceptibility of populations of CPB to selected insecticides applied by direct contact, 1998.

Insecticide	n[1]	DAT	Susceptibility Range LC_{50} (% Solution)	Tolerance Ratio[2]			
				1996	1997	1998	1998 Avg.
imidacloprid	28	1	0.000054 - 0.00058	x 4.4	x 4.5	x 10.7[3]	5.23
cypermethrin	8	2	0.0038 - 0.13	x 64.0	x 28.0	x 34.2	20
azinphosmethyl	8	1	0.06 - 0.28	x 30.0	x 12.0	x 4.6	4
endosulfan	8	1	0.009 - >1.0	x 166.0	x 111.1	>100.0	-
chlorfenapyr	26	3	0.0052 - 0.04	x 3.0	x 4.1	7.7	2.5

[1] #s of field-collected populations were different in Year 1 and 2 (ranged from 15 to 19).

[2] Least susceptible/Lab-S strain = resistance ratio for conventional insecticides.

[3] Least susceptible/most susceptible.

END OF SECTION G

SECTION H (a-c) **PEST MANAGEMENT METHODS**

REPORT #s **58 - 62**

PAGES **155 - 173**

Ha. BIOLOGICAL CONTROL - Weeds

EDITOR **Dr. Rosemarie DeClerck-Floate** Email: floater@em.agr.ca
(No reports) Agriculture and Agri-Food Canada Tel: (403) 327-4561
Lethbridge Research Centre Fax: (403) 382-3156
Highway 3 East, P.O. Box 3000, Main
Lethbridge, Alberta T1J 4B1

Hb. BIOLOGICAL CONTROL - Insects, Mites, Nematodes

REPORT #s **58 - 60**
PAGES **156 - 165**

EDITOR **Dr. David R. Gillespie** Email: gillespied@em.agr.ca
Agriculture and Agri-Food Canada Tel: (604) 796-2221 ext. 210
Pacific Agriculture Research **C e n t r e (A g a s s i z)** Fax: (604) 796-0359
P.O. Box 1000, 6947 Number 7 Highway
Agassiz, British Columbia V0M 1A0

1998 PMR REPORT # 58 **SECTION Hb: BIOLOGICAL CONTROL OF INSECTS, MITES, NEMATODES**
STUDY DATA BASE: 8909

CROP: Canola, *Brassica napus* L.
PEST: Cabbage root maggot, *Delia radicum* (L.) (Diptera: Anthomyiidae)

NAME AND AGENCY:

FLOATE K D, SOROKA J[1], and SPOONER R W[2]
Agriculture and Agri-Food Canada, Lethbridge Research Centre,
P.O. Box 3000, Lethbridge, Alberta T1J 4B1
Tel: (403) 317-2242; Fax: (403) 382-3156; Email: floatek@em.agr.ca

[1]Agriculture and Agri-Food Canada, Saskatoon Research Centre,
107 Science Place, Saskatoon, Saskatchewan, S7N 0X2

[2]Agriculture and Agri-Food Canada, Lethbridge Research Centre,
P.O. Box 3000, Lethbridge, Alberta T1J 4B1

TITLE: DEVELOPMENT OF *MUSCIDIFURAX* AND *TRICHOMALOPSIS* (HYMENOPTERA: PTEROMALIDAE) ON CABBAGE ROOT MAGGOT (ANTHOMYIIDAE: *DELIA RADICUM*)

MATERIALS: *Muscidifurax raptorellus* Kogan & Legner, *Muscidifurax zaraptor* Kogan & Legner, *Trichomalopsis sarcophagae* Gahan

BACKGROUND/ METHODS: Species of *Muscidifurax* and *Trichomalopsis* (Hymenoptera: Pteromalidae) are parasitoids of stable fly (Muscidae: *Stomoxys calcitrans*) and house fly (Muscidae: *Musca domestica*). The cabbage root maggot (CRM) is a major pest of canola, and is closely related to these livestock pests. The current study tested whether these parasitoids could complete development on CRM, as a first step in evaluating their potential as biocontrol agents of CRM.

Fresh house fly and CRM pupae were exposed simultaneously to adult *Muscidifurax raptorellus* Kogan & Legner (n = 5 female + 2 male), *Muscidifurax zaraptor* Kogan & Legner (n = 5 female + 2 male), or to *Trichomalopsis sarcophagae* Gahan (n = 5 female + 5 male). Pupae were exposed in a laboratory arena for 24 hours at 25 degrees C. After exposure, pupae were held at 25 degrees C and checked daily for the emergence of wasps. Ten replicates were performed for *M. raptorellus* and *T. sarcophagae*. Twenty-two replicates were performed for *M. zaraptor*. Each replicate contained, on average, 20 pupae of each fly species. Wasps were obtained from the Lethbridge Research Centre, where colonies of each species are maintained on house fly pupae. House flies also were obtained from the Lethbridge Research Centre. Pupae of CRM were collected from the field near Saskatoon, Saskatchewan.

RESULTS: Each species of wasp completed development on pupae of house fly and CRM, with preferential parasitism of house fly (Table 1). For the gregarious species, *M. raptorellus* and *T. sarcophagae*, significantly more wasps emerged from each parasitized house fly pupa than from each parasitized CRM pupa (Table 1). Developmental time did not differ between host species, or was significantly slower on CRM than on house fly pupae (Table 2).

CONCLUSIONS: In laboratory conditions, CRM can serve as a host for *M. raptor, M. zaraptor*, and *T. sarcophagae*. To our knowledge, this is the first report of these host/parasite associations. This result suggests that species of wasps normally considered only for the control of livestock pests also may have potential value as biocontrol agents of a crop pest. Screening other species of *Muscidifurax* and *Trichomalopsis* may identify useful biocontrol agents of CRM, particular if these agents can be readily mass-reared on house fly pupae.

Table 1. Emergence of wasps from pupae of house fly and of cabbage root maggot. One replication contains 20 house fly and 20 cabbage root maggot pupae exposed simultaneously to parasitism. Means within a row that share a common letter are not significantly different ($P < 0.05$; 1-way ANOVA).

Wasp	House fly	Cabbage root maggot
Muscidifurax raptorellus (10 replications)		
mean (SE) number of pupae parasitized	18.2a (4.91)	6.1b (0.90)
mean (SE) number of wasps/parasitized pupa	2.8a (0.25)	2.2b (0.23)
Muscidifurax zaraptor (22 replications)		
mean (SE) number of pupae parasitized	9.9a (1.54)	4.9b (0.80)
mean (SE) number of wasps/parasitized pupa	1.0 (0.00)	1.0 (0.00)
Trichomalopsis sarcophagae (10 replications)		
mean (SE) number of pupae parasitized	5.3a (0.80)	0.7b (0.34)
mean (SE) number of wasps/parasitized pupa	4.6a (0.29)	1.4b (0.25)

Table 2. Wasp developmental time (days) at 25 degrees C, when reared on fresh pupae of house fly and on fresh pupae of cabbage root maggot (n = number of wasps per sample). Means within a row that share a common letter are not significantly different ($P < 0.05$; 1-way ANOVA).

		House fly		Cabbage root maggot	
Sex	Wasp	n	mean (SEM)	n	mean (SEM)
Female	*Muscidifurax raptorellus*	120	22a (0.1)	33	23b (0.3)
	Muscidifurax zaraptor	65	26a (0.1)	27	26a (0.2)
	Trichomalopsis sarcophagae	79	21a (0.2)	2	22a (1.0)
Male	*Muscidifurax raptorellus*	96	22a (0.1)	29	22a (0.2)
	Muscidifurax zaraptor	20	23a (0.2)	11	25b (0.4)
	Trichomalopsis sarcophagae	56	21 (0.2)	------- no data -------	

1998 PMR REPORT # 59 **SECTION Hb: BIOLOGICAL CONTROL - Insects**
STUDY DATA BASE: 309-1251-9321

CROP: Potato, cv. Russet Burbank and cv. Shepody
PEST: Colorado potato beetle, *Leptinotarsa decemlineatata* (Say)

NAME AND AGENCY:
BOITEAU G[1], WALSH J R[2] and OSBORN W P L[1]
[1]Agriculture and Agri-Food Canada, Potato Research Centre, P.O. Box 20280, Fredericton, NB, E3B 4Z7
Tel: (506) 452-3260; **Fax:** (506) 452-3316; **E-mail:** boiteaug@em.agr.ca
[2]McCain Foods (Canada), Florenceville, NB, E0J 1K0
Tel: (506) 392-5541; **Fax:** (506) 392-2815; **E-mail:** JRWALSH@MCCAIN.CA

TITLE: UTILISATION OF THE TWO-SPOTTED STINKBUG TO CONTROL COLORADO POTATO BEETLES IN NEW BRUNSWICK

MATERIALS: *Perillus bioculatus* (Fabr.)

METHODS: Live *P. bioculatus* were provided by the Mission Biological Control Center, Texas, USDA, APHIS. The insects packed in plastic gallon containers were released in Florenceville, New Brunswick in research plots at the McCain Research Farm. Releases date and the number of two-spotted stinkbug nymphs released is listed in Table 1. Pentatomid nymphs were broadcast released in two plots (32 rows by 30 m), of variety Russet Burbank (planted on May 11 and May 25 at 46 cm within row spacing, rows spaced 91 cm apart). Groups of nymphs were released on every third plant in a row (See Table 1). Groups of pentatomids of the approximate size of for the rate selected were assembled and dripped from a plastic container held immediately above every third plant by a field worker. If any nymphs remained after the initial release they were evenly and randomly distributed over the plots. Two plots immediately adjacent to the two Release plots were to serve as the Near Check plots. Plots (24 of them) in the rest of the 5 ha farm, that due to a sprayer malfunction did not receive complete insecticide coverage, were also sampled and served as the Far Check plots. A plastic (0.1 mm thick) lined trench surrounding all the plots, 8 m from the outer plot edges was installed on May 27 to trap colonizing Colorado potato beetles (CPBs). NOVODOR, for CPB control, was applied to all plots except the Release plots on July 7, to all plots except the Release and Near Check plots on July 14 and 21 (8 L product/ha). IMIDAN 50WP was sprayed for flea beetle control over all plots on August 18 (2.25 kg product/ha). The number of CPB adults and larvae, and stinkbugs were counted on five randomly selected potato plants in the Release plots, the Near Check plots and the Far Check plots on June 26, 29 and 30, July 3, 7, 10, 14, 17, 21, 24, 28 and 30, August 4, 7, 11, 14, 18, 21, 25 and 28. On all dates listed above the defoliation rating of each plot was assessed. Analyses of variance were performed on the count data.

RESULTS: Table 2 shows the mean abundance of CPB life stages and stinkbugs, and defoliation rating in the three sample areas throughout the sampling period.

CONCLUSIONS: Five broadcast field releases of *P. bioculatus* in 1997 from the time of first egg laying by the CPB to the end of the presence of CPB larvae showed a rapid dispersal of the nymphs to immediately adjacent plots, and showed excellent control of CPB larvae. The released also maintained

defoliation at pre-release (and acceptable) levels in the Release plots and to a lesser extent in the Near Check plots. Significant differences in the number of CPB adults between treatments before the appearance of the summer generation around July 27 cannot be attributed to stinkbug predation since stinkbugs generally do not feed on CPB adults. The efficacy of stinkbugs at controlling CPB requires a more efficient technique for the broadcast release of *P. bioculatus*.

Table 1. Date of release, total number, and number per three plants released of two-spotted stinkbug nymphs at the McCain Research Farm, Florenceville, New Brunswick.

Release Date	Total #Nymphs Released	#Nymphs Released/3 Plants
Jun 27/97	33700	20-25
Jul 5/97	20625	10-15
Jul 19/97	31500	20-25
Jul 26/97	50000	20-25
Aug 2/97	25000	10-15

Table 2. Mean number of Colorado potato beetle larvae and adults, and two-spotted stinkbugs per five plants per treatment and defoliation level per plot throughout the sampling period.*

Date	CPB Larvae			CPB Adults			Stinkbugs			Defoliation**		
	R	NC	FC	R	NC	FC	R	NC	FC	R	NC	FC
June 26	0.0	0.0	0.0	0.3	0.3	0.1	0.0	0.0	0.0	1.0	0.5	0.9
June 29	0.0	0.0	-	0.2	0.1	-	2.6a	0.8b	-	-	-	-
June 30	0.0	0.0	0.0	0.1b	0.5a	0.1b	0.0	0.0	0.0	1.0	1.0	0.5
July 3	0.0	0.0	2.2	0.1	0.0	0.1	0.0	0.2	0.0	1.0	1.3	0.7
July 7	0.0	0.0	1.5	0.0	0.1	0.1	0.4a	0.1b	0.0b	1.0	1.5	0.8
July 10	0.0	0.0	0.5	0.0	0.0	0.1	0.0	0.0	0.0	1.0	1.3	1.0
July 14	0.0	0.0	1.7	0.0	0.1	0.1	0.0	0.0	0.0	1.0	1.0	0.8
July 17	0.0	0.0	1.3	0.1a	0.1a	0.0b	0.0	0.0	0.1	1.0	1.3	0.9
July 21	0.1	0.0	0.4	0.1	0.1	0.1	5.1a	0.0b	0.0b	0.8	1.0	0.9
July 24	0.9a	0.0b	0.1b	0.2a	0.0b	0.0b	0.4a	0.0b	0.0b	1.0	1.0	0.9
July 28	0.0	0.1	0.1	0.0	0.0	0.0	0.5a	0.5a	0.0b	1.0	1.0	1.2
July 31	0.1	0.0	0.2	0.1	0.0	0.0	0.1	0.0	0.0	1.0	0.5	1.0
August 4	0.2	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.1	1.0	1.0	0.8
August 7	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.9
August 11	0.0	0.0	0.0	0.2a	0.1ab	0.0b	0.0	0.0	0.0	1.0	0.5	1.0
August 14	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	1.0	1.0	0.9
August 18	0.0	0.0	0.0	0.0	0.0	0.0	0.2a	0.0b	0.0b	1.0a	0.5b	1.0a
August 21	0.0	0.0	0.0	0.0b	0.1a	0.0b	0.1a	0.0b	0.0b	0.5	0.5	0.9
August 25	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.5	0.5	0.9
August 28	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	1.0	0.5	0.9

* Figures are means of two replications for R and NC and 24 replication for FC. R=Release, NC=Near Check, FC=Far Check. Numbers in a row within a variable followed by the same letter are not significantly different according to a LSD-test (P#0.05).

** Defoliation ratings: (0) no defoliation; (1) 2-60% of plants with leaflets slightly damaged; (1.5) >60% of plants with leaflets slightly damaged; (2) 2% of plants with $1 compound leaf with $50% defoliation.

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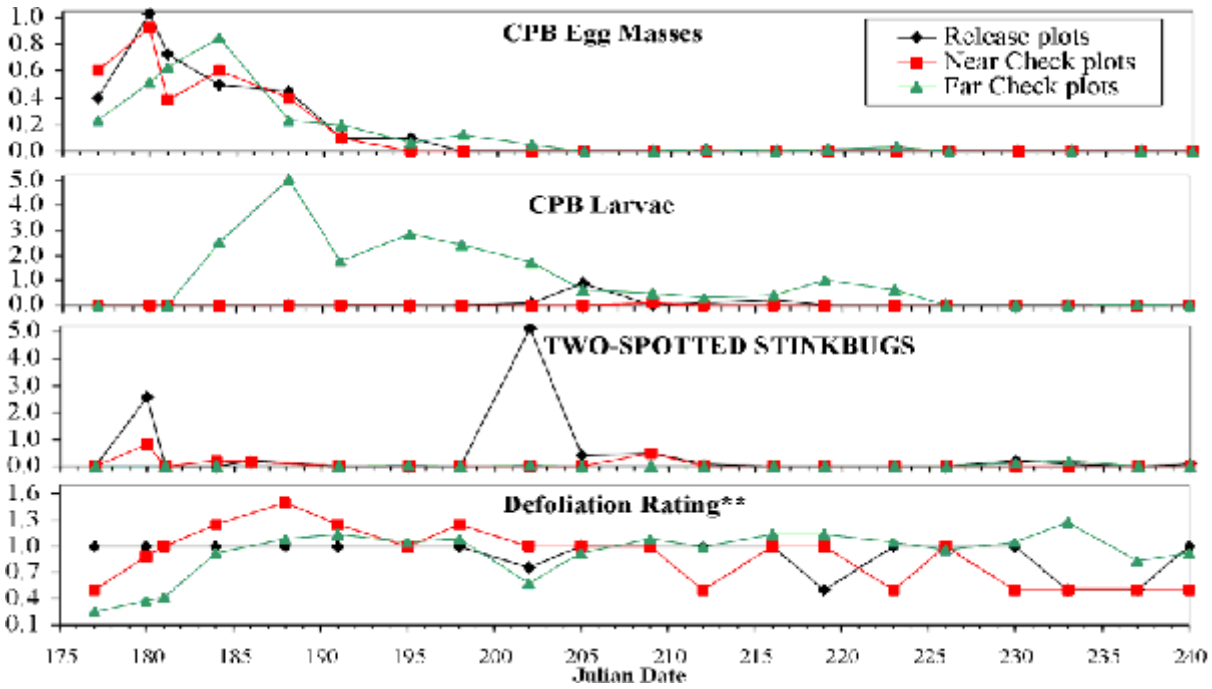
Fig.1 Mean number of Colorado potato beetle larvae and adults, and two-spotted stinkbugs per five plants per treatment and defoliation level per plot throughout the sampling period.
*, ** same as table 2.



1998 PMR REPORT# 60 **SECTION Hb: BIOLOGICAL CONTROL - Insects, Mites, Nematodes**
STUDY DATA BASE #: 344-1252-8901

CROP: Tomatoes (*Lycopersicon esculentum* Mill), cv.Trust
Cucumber (*Cucumis sativus* L.), cv Flamingo
PEST: Two-spotted spider mite, *Tetranychus urticae* Koch

NAME AND AGENCY:
J. L. SHIPP[1], K. WANG[1], and G. FERGUSON[2]
[1]Agriculture and Agri-Food Canada, Greenhouse and Processing Crops Research Centre
Harrow, Ontario, Canada N0R 1G0
[2]Ontario Ministry of Agriculture, Food and Rural Affairs
Greenhouse and Processing Crops Research Centre, Harrow, Ontario, Canada N0R 1G0
Tel: (519)738-2251 Fax: (519)738-2929 E-mail:SHIPPL@EM.AGR.CA

TITLE: RESIDUAL TOXICITY OF AVERMECTIN B1 AND PYRIDABEN TO EIGHT COMMERCIALLY-PRODUCED BENEFICIAL ARTHROPOD SPECIES USED FOR CONTROL OF GREENHOUSE PESTS

MATERIALS: *Amblyseius cucumeris* (Oudermans) (Acari: Phytoseiidae); *A. degenerans* Berlese (Acari: Phytoseiidae); *Aphidius colemani* Viereck (Hymenoptera: Aphidiidae); *Aphidoletes aphidimyza* (Rondani) (Diptera: Cecidomyiidae); *Dacnusa sibirica* Telenga (Hymenoptera: Braconidae); *Encarsia formosa* (Gahan) (Hymenoptera: Aphelinidae); *Orius insidiosus* (Say) (Hemiptera: Anthocoridae); *Phytoseiulus persimilis* Athias-Henriot (Acari: Phytoseiidae). AVID, avermectin b1(1.9%); DYNOMITE, pyridaben (75% WP)

METHODS: Laboratory Trials. Potted tomato 'Trust' plants were sprayed to run off. Both acaricides were also applied to the inner surfaces of petri dishes (60 x 15 mm) using a potter spray-tower. Timing of spray application for both plant and petri dish was designed to obtain residue time periods of 2, 4, 6, 14, 21 and 28 d. For each replicate, 15 adults of a single beneficial species were exposed to a specific residue time period in a treated petri dish containing a treated tomato leaf at 24$\pm$ 1°C, 70$\pm$10% RH and 16:8 h (L:D). After 48 h, adult mortality was assessed and expressed as a percentage, corrected by control mortality using Abbott's formula. Each treatment was replicated 10 times (150 individuals).

Greenhouse Trials. Cucumber `Flamingo` plants grown at greenhouse conditions (24 $\pm$ 1 °C, 60$\pm$10% RH, and 16:8 h [L:D]) were sprayed using a backpack sprayer until run off. Timing of spray application was designed to obtain residue time periods of 2, 4 , 6 , 14, 21 and 28 d. For each replicate, 20-25 adults of each species were confined to the lower surface of a leaf using a petri plate cage (60 x 15 mm, with a nylon-cloth ventilation hole of 50 mm diameter). After 48 h, adults mortality was assessed and expressed as a percentage, corrected by control mortality using Abbott's formula. Six replicates were completed for each treatment.

RESULTS: **Laboratory Trials.** Predatory mites (*A. cucumeris, A. degenerans,* and *P. persimilis)* and the predatory anthocorid, *O. insidiosus,* appeared to be less affected than *E. formosa, A. colemani* and

D. sibirca by avermectin b1 and pyridaben. Residual toxicity of both acaricides to these predator species decreased greatly after 2 weeks with the exception for the predator species, *A. aphidimyza* . However, residual toxicity of both acaricides to the parasitoid species remained at a high level with the exception of pyridaben to *E. formosa*. Mortalities for the parasitoid species were as high as 80-97% after exposure to 4-week residues (Table1).

Greenhouse Trials. Pyridaben had significantly greater residual toxicity to all beneficial species as compared to avermectin b1 ($F = 137.3$; df = 1, 244; $P = 0.0001$). Residual toxicity of avermectin b1 to all beneficial species, except *A. aphidimyza,* decreased rapidly to <25% mortality after a 6-d period (Table 2). However, 6-d residual toxicity of pyridaben caused mortalities of 67, 89, 61, 44, and 80% to *E. formosa, A. colemani, A. aphidimyza, A. degenerans* and *P. persimilis* respectively.

Residual toxicity of both acaricides decreased significantly over time under greenhouse conditions ($F = 40.93$; df = 2, 244; $P = 0.0001$). With the avermectin b1 treatment, >90% of the adults for all beneficial species, except for *A. aphidimyza* and *A. colemani,* survived after exposure to 6-d residues. With pyridaben, mortalities for *E. formosa, A. colemani, A. aphidmyza, A. degenerans* and *P. persimilis* decreased from 96-75% on 2-d residues to 10-20% on 28-d residues.

CONCLUSION: Avermectin b1 has lower residual toxicity (<10% mortality) to all predatory mite species after exposure to 4-d residues when compared to pyridaben. This suggests that avermectin b1 could be used as a selective acaricide before the introduction of predatory mites or as a spot-spray after the introduction of the predators, and therefore, could be combined in an IPM program for spider mite control on greenhouse crops. It could also be used in an IPM program where parasitoids are used when consideration is given to the duration of residual toxicity. Pyridaben is only slightly harmful to *D. sibirica, A. cucumeris* and *O. insidiosus* and would be compatible with the use of these species in an IPM program. Pyridaben can not be used in an integrated spider mite control program and should not be used with *A. degenerans, E. formosa* and *A. colemani.* Both acaricides should not be integrated with any biological control program using *A. aphidimyza*.

Table 1 Mortality (mean ± standard error) of eight biological control agents exposed to 2-28 d residues of avermectin b1 and pyridaben for 48 h under laboratory conditions

Treatment	Residual Time (day)	Species							
		P. persimilis	*A. cucumeris*	*A. degenerans*	*O. insidiosus*	*E. formosa*	*A. colemani*	*D. sibirica*	*A. aphidimyza*
Avermectin b1	2	99 ± 0.9 a	62 ± 4.7 a	100 ± 0.0 a	100 ± 0.0 a	100 ± 0.0 a	100 ± 0.0 a	100 ± 0.0 a	100 ± 0.0 a
	4	97 ± 1.1 a	68 ± 5.2 a	100 ± 0.0 a	99 ± 0.8 a	100 ± 0.0 a	100 ± 0.0 a	100 ± 0.0 a	100 ± 0.0 a
	6	82 ± 4.5 b	27 ± 4.8 b	100 ± 0.0 a	96 ± 2.2 a	100 ± 0.0 a	98 ± 1.0 a	100 ± 0.0 a	100 ± 0.0 a
	14	44 ± 3.3 c	20 ± 3.5 b	53 ± 7.4 b	40 ± 7.5 b	96 ± 1.4 a	98 ±1.5 a	79 ± 2.8 b	100 ± 0.0 a
	21	35 ± 3.6 c	14 ± 4.1 b	50 ± 7.9 b	42 ± 6.5 b	81 ± 4.2 b	96 ± 1.9 a	85 ± 3.1 b	100 ± 0.0 a
	28	38 ± 6.4 c	14 ± 2.2 b	51 ± 3.0 b	35 ± 4.5 b	80 ± 9.6 b	97 ± 2.2 a	79 ± 5.4 b	100 ± 0.0 a
Pyridaben	2	83 ± 4.5 a	74 ± 4.0 a	100 ± 0.0 a	100 ± 0.0 a	100 ± 0.0 a	100 ± 0.0 a	100 ± 0.0 a	100 ± 0.0 a
	4	71 ± 7.8 a	63 ± 4.9 a	99 ± 1.2 a	99 ± 0.8 a	99 ± 1.0 a	100 ± 0.0 a	98 ± 1.1 ab	100 ± 0.0 a
	6	13 ± 2.8 b	29 ± 8.1 b	99 ± 2.2 a	88 ± 2.9 b	100 ± 0.0 a	99 ± 0.9 a	93 ± 2.6 bc	100 ± 0.0 a
	14	16 ± 3.0 b	19 ± 3.2 b	42 ± 4.9 b	24 ± 5.2 c	59 ± 7.0 b	98 ± 1.5 a	89 ± 3.0 c	100 ± 0.0 a
	21	15 ± 8.1 b	19 ± 3.2 b	45 ± 7.5 b	27 ± 7.2 c	51 ± 8.3 b	99 ± 0.7 a	82 ± 4.3 c	100 ± 0.0 a
	28	6.9 ± 2.5 b	12 ± 1.5 b	41 ± 5.6 b	20 ± 5.1 c	56 ± 5.9 b	96 ± 1.6 a	80 ± 4.7 c	100 ± 0.0 a

Within columns for each acaricide, means followed by the same letter are not significantly different at $P > 0.05$ based on SNK multiple range test. Data were arcsine square root transformed before ANOVA. Untransformed data are presented in the table.

Table 2. Mortality (mean ± standard error) of eight biological control agents exposed to 2-28 d residues of avermectin b1 and pyridaben for 48 h under under greenhouse conditions

Treatment	Residual Time (day)	Species							
		P. persimilis	*A. cucumeris*	*A. degenerans*	*O. insidiosus*	*E. formosa*	*A. colemani*	*D. sibirica*	*A. aphidimyza*
Avermectin b1	2	27 ± 8.2 a	4 ± 4.2 a	15 ± 5.2 a	22 ± 2.1 a	79 ±16.0 a	94 ± 2.2 a	33 ± 0.3 a	72 ± 6.3a
	4	9 ± 5.3 b	0 ± 0.0 b	4 ± 3.2 b	22 ± 6.6 a	64 ± 6.6 a	67 ± 11.1 b	10 ± 2.7 b	56 ± 9.8 ab
	6	7 ± 2.8 b	6 ± 4.3 a	9 ± 3.2 ab	8 ± 2.5 b	5 ± 2.1 b	21 ± 5.7 c	2 ± 0.3 c	41 ± 9.8 bc
	14	---[a]	---	---	---	---	---	---	29 ± 1.9 c
	21	---	---	---	---	---	---	---	19 ± 3.1 d
	28	---	---	---	---	---	---	---	14 ± 4.5 d
Pyridaben	2	94 ± 1.5 a	14 ± 2.1 a	85 ± 3.4 a	53 ± 9.6 a	94 ± 1.8 a	96 ± 3.7 a	85 ± 9.7 a	75 ± 7.6 a
	4	91 ± 5.7 a	0.0 ± 0.0 b	82 ± 4.5 a	19 ± 4.8 b	91 ± 5.5 a	82 ± 10.6 a	61 ± 12.8 a	70 ± 6.4 ab
	6	72 ± 8.9 b	7 ± 6.7 a	51 ± 9.5 b	11 ± 7.5 b	67 ± 8.9 b	80 ± 7.0 a	10 ± 1.7 b	61 ± 4.6 b
	14	45 ± 5.6 c	---	38 ± 8.5 bc	---	41 ± 2.9 c	57 ± 5.9 b	---	44 ± 6.6 c
	21	35 ± 11.3 cd	---	28 ± 4.8 c	---	18 ± 4.5 d	37 ± 4.5 c	---	35 ± 5.3 c
	28	21 ± 6.1 d	---	13 ± 2.6 d	---	10 ± 2.4 e	12 ± 1.5 d	---	20 ± 5.1 d

Within columns for each acaricide, means followed by the same letter are not significantly different at $P > 0.05$ based on SNK multiple range test. Data were arcsine square root transformed before ANOVA. Untransformed data are presented in the table.

[a]When adult mortality was <25% after a beneficial species was exposed to 6-d residues, no further trials were conducted.

Hc. SEMIOCHEMICALS - Insect Pheromones and Natural Products
REPORT #s **61 - 62**
PAGES **166 - 174**
EDITOR **Dr. R.M. Trimble** Email: trimbler@em.agr.ca
Agriculture and Agri-Food Canada Tel: (905) 562-4113
Southern Crop Protection and Food Fax: (905) 562-4335
Research Centre, 4902 Victoria Ave. N.
P.O. Box 6000, Vineland Station, Ontario L0R 2E0

1998 PMR REPORT # 61 SECTION Hc: SEMIOCHEMICALS
Insect Pheromones and Natural Products
STUDY DATA BASE: 306-1262-9020

CROP: Lowbush blueberry
PEST: Blueberry maggot adult (BM), *Rhagoletis mendax* Curran(L.).

NAME AND AGENCY:
GAUL S O and SMITH R F
Agriculture and Agri-Food Canada, Atlantic Food and Horticulture Research Centre
32 Main St., Kentville, Nova Scotia, B4N 1J5
Tel: (902) 679-5333; **Fax:** (902) 679-2311; **Email:** gauls@em.agr.ca

TITLE: EFFICACY OF PHEROCON TRAP WITH SLOW RELEASE VOLATILE COMPARED WITH CONVENTIONAL BAITED PHEROCON TRAP

MATERIALS: Pherocon traps baited with a chitin based slow release formulation of blueberry volatile attractant (SR); Pherocon AM ammonium baited traps (conventional).

METHODS: The experiment was conducted on 4 commercial lowbush blueberry fields (4-10 ha each) in Colchester and Cumberland Co., NS. Traps (14/site) grouped by trap type, spaced at distances from 2.5 m to 10 m, with the groups separated by 50 m and the direction of spacing randomized by field in a factorial design, were set out on July 7. 1998. Adult *R. mendax* captures were monitored three times weekly from July 7 to August 17, 1998. The Pherocon traps (but not the SR) were replaced after 3 weeks. Trap capture counts were analyzed (following square root transformation) using ANOVA and the traps were compared to determine the relative efficacy to capture male, female, and total *R. mendax* in fruiting fields. The estimated standard error of the counts (Ese) was calculated.

RESULTS: There was no difference in captures of adult *R. mendax* in commercial lowbush blueberry fields ($p<0.05$) demonstrated due to trap type in this experiment.

CONCLUSIONS: The Pherocon trap with SR captured 4-fold more total adult *R. mendax* compared with the conventional baited Pherocon trap; however, both traps were effective in capturing adult *R. mendax* in commercial lowbush blueberry fields.

Table 1. Total seasonal adult *R. mendax* captures/trap (sem) on traps set in commercial lowbush blueberry fields in Nova Scotia in 1998.

Treatment	*R. mendax* adult captures		
	Males	Females	Total
Conventional baited Pherocon trap	0.2	0.3	0.6
Pherocon trap with SR	1.7	1	2.9
Ese	0.09	0.04	0.14

1998 PMR REPORT # 62 **SECTION Hc: SEMIOCHEMICALS**

CROP: Greenhouse Tomato
PEST: Tomato Pinworm, *Keiferia lycopersicella* (Walsingham)

NAMES & AGENCIES:
FERGUSON GM, SHIPP JL[1] and HUNT DWA[1]
Ontario Ministry of Agriculture, Food, & Rural Affairs
Greenhouse & Processing Crops Research Centre
Harrow, Ontario N0R 1G0
Tel: (519) 738-2251, Ext. 406; Fax: (519) 738-2929; Email: gfergus1@omafra.gov.on.ca

[1]Agriculture & Agri-Food Canada
Greenhouse & Processing Crops Research Centre
Harrow, Ontario N0R 1G0
Tel: (519) 738-2251, Ext. 406; Fax: (519) 738-2929
Email: shippl@em.agr.ca; Email: huntd@em.agr.ca

TITLE: EVALUATION OF 3M MEC TOMATO PINWORM PHEROMONE CONCENTRATE FOR CONTROL OF TOMATO PINWORM (TPW) IN GREENHOUSE TOMATOES

MATERIALS: 3M MEC Tomato Pinworm Pheromone Concentrate - Guarantee: (E)-4-Tridecen-1-yl acetate - 19.4% (Z)-4-Tridecen-1-yl acetate - 0.6%

METHODS: Two commercial trials were carried out, one at Pyramid Farms, and another at C & B Farms in Essex County, Ontario, from January to June, 1998.

Pyramid Farms. Tomato pinworm was present on this farm at the start of the spring crop in January 1998, due to carryover populations from the fall crop. There were three treatments, each treatment being allocated to a separate greenhouse section. The three greenhouse sections were separated by physical barriers. The physical barrier between the low-volume and high-volume applicator treatments was a wall made up of a double layer of polyethylene. The treatment closest to the control was the high-volume, and these two were separated by a 0.4 ha section of greenhouse pepper. This latter crop was enclosed in a manner as previously described. The treatments were as follows:

1) **High-volume Applicator (0.4 ha)** - application of the pheromone at the rate of 40 g a.i. per hectare using high volume hydraulic spray equipment. The measured concentrate was diluted in 300-450 litres of water per ha; the volume of spray material varied with the size and maturity of the crop. The pressure of spray delivery was 400 psi.
2) **Low-volume Applicator (1.2 ha)** - application of the pheromone at the rate of 40 g a.i. per hectare using low volume fogging equipment. The measured concentrate was applied in 10 litres of water for the entire 1.2 ha.
3) **Control (0.3 ha)** - not treated for TPW

For this trial, tomato seedlings (cv. Trust) were transplanted into a hydroponic system from January 5 to

January 13. The planting density was approximately 10,000 plants per 0.4 ha or 1.0 ac. Monitoring for TPW began on January 21 and continued weekly until June 10. Twelve pheromone traps (Pherocon II traps, Trece Inc.) per hectare were used to monitor male TPW. The traps were randomly placed and the minimum distance between two adjacent traps was at least about 30 metres. The rubber lures in the pheromone traps were changed at 4-week intervals. The plants were observed for presence of larvae and larval damage. Weekly observations taken included the following: number of males caught in pheromone traps; number of larvae per plant; percentage plants with TPW damage

Twenty percent of the total number of plants in each of the treatments were inspected. Plants to be inspected were selected using a V-shaped pattern for each greenhouse section within a treatment. The position of the bottom point of each V-pattern was alternated in the greenhouse sections for each treatment. Some randomness was introduced by selecting plants randomly in the vicinity of the three points of the "V" shape. Applications of the pheromone in both high- and low-volume applicator treatments began on January 22. A total of five applications were made and carried out at approximately 4-week intervals.

C & B Farms (1.1 ha). A high population of TPW was present on this farm at the start of the trial in January 1998 due to a carryover from populations that infested the fall crop. This high population describes a situation in which adult TPW could be readily observed fluttering in the walkways in the greenhouse. Within a square metre of walkway area, approximately 5-10 adult TPW were observed. Only a high-volume applicator treatment was carried out at this farm because of the absence of physical barriers within the greenhouse range. The hydraulic spray equipment delivered 300-450 litres per ha at 400 psi. Monitoring for TPW began on January 22 and continued weekly until June 11. The protocol for monitoring TPW populations was the same as that for Pyramid Farms. The first pheromone application was made on January 23, and four subsequent applications were made at 4-week intervals.

RESULTS:

Phytotoxic Effects. No phytotoxicity was observed on either the plants or fruits throughout the duration of the trial.

Compatibility with Beneficials. Based on the observation of parasitized whitefly scales throughout the crop's duration by the growers and researchers involved in this project, it appears that the pheromone did not exert any adverse effects on *Encarsia formosa* released for whitefly control. Markings on the stamen cones of flowers throughout the crop's duration also indicated that there were no adverse effects of the pheromone on pollination activity by the bumble bees introduced for this purpose.

Efficacy of pheromone on TPW. Table 1 shows that all the pheromone treatments resulted in significantly ($P < 0.05$) lower TPW populations and less damage when compared with the untreated control.

Trap Counts. The mean trap count in the control treatment was at least twice that in any of the treated greenhouses. Mean counts per trap in the treatments ranged from 0.2 in the high-volume applicator treatment at Pyramid Farms, to1.2 in the low-volume applicator treatment at the same farm, whereas the mean count in the control was 2.4. Figure 1 shows the mean trap count for all the treatments for the duration of the trial.

Larval Counts. The highest mean number of larvae per plant (based on 20 sample weeks) in any of the treatments was 0.8, whereas that in the control was 31.5 (Table 1). Figure 2 illustrates that larval counts in the control remained relatively low until early May, or about 16 weeks after the beginning of the trial. This indicates that the larval population of TPW takes about four generations to appreciably increase between January and May under greenhouse conditions in Essex County, Ontario.

Crop Damage. The mean percentage damaged plants, or plants with damage due to larval feeding, was approximately 10-13% in the treated sections, whereas in the control, damage was over 50% (Table 1). Such damage refers to mines with and without actively-feeding larvae. Figure 3 shows that all treatments started with a similar number of plants with TPW damage. During the first two months of the trial, the level of damage increased and subsequently decreased in all treatments. Thereafter, the number of damaged plants only in the control increased rapidly. By early May, when larval counts in the control were also high (Fig. 2), 100% of the plants exhibited TPW damage, and this damage level was maintained for the remainder of the trial duration. Damage in the treated sections started to increase slightly towards the end of the trial in early June and this was attributed to immigration of mated females from the control section at Pyramid Farms, and from neighbouring infested greenhouses at C & B Farms.

Figure 4 gives an indication of the impact of TPW on direct yield. Figure 4 shows the weight of fruits rendered unmarketable because of feeding by larval TPW at Pyramid Farms in the control treatment between April 29 and June 10. No damaged fruit were observed in any of the pheromone-treated greenhouses.

CONCLUSIONS: 3M MEC Tomato Pinworm Concentrate effectively controlled TPW populations, and seems to be compatible with the use of beneficial insects in greenhouse tomato.

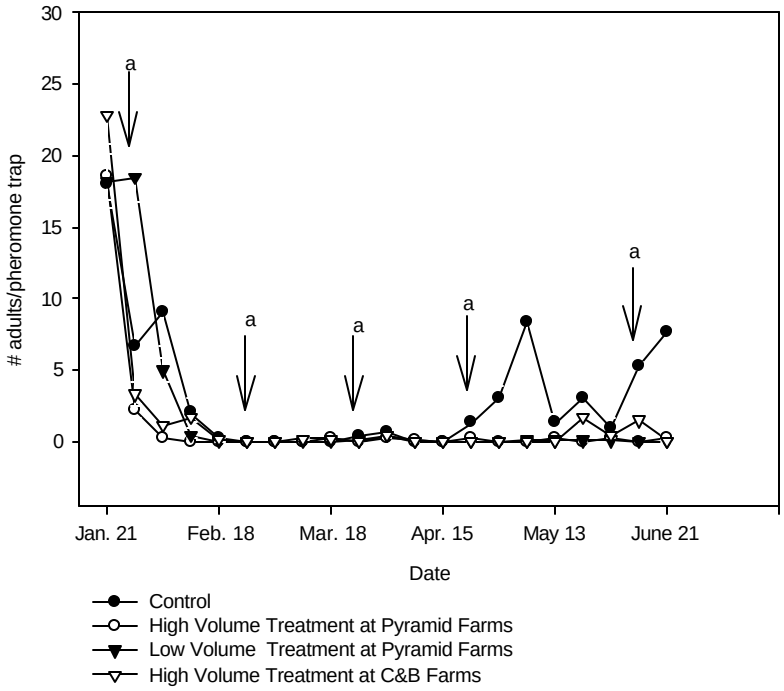
Table 1. Mean numbers (0 ± SE) of TPW adults per pheromone trap per week, larvae per plant per week, and percentage of plants damaged by TPW larvae per week on TPW pheromone treated and untreated greenhouse tomatoes in 1998

Treatment	Mean no. of adults/trap /week [a]	n	Mean no. of larvae/plant /week [a]	n	Mean % damaged plants /week [a]	n
Pyramid Farms - High Volume	0.2 ± 0.1d	120	0.5 ± 0.1bc	840	9.7 ± 2.5b	20
C&B Farms - High Volume	0.5 ± 0.1c	270	0.4 ± 0.0c	1512	7.6 ± 2.5b	18
Pyramid Farms - Low Volume	1.2 ± 0.3b	260	0.8 ± 0.1b	2158	13.3 ± 3.9b	20
Pyramid Farms - Control	2.4 ± 0.6a	59	31.5 ± 2.7a	540	53.3 ± 7.8a	20

[a] Within the same column, means with different letters are significantly different at *P*–0.05 (Duncan's

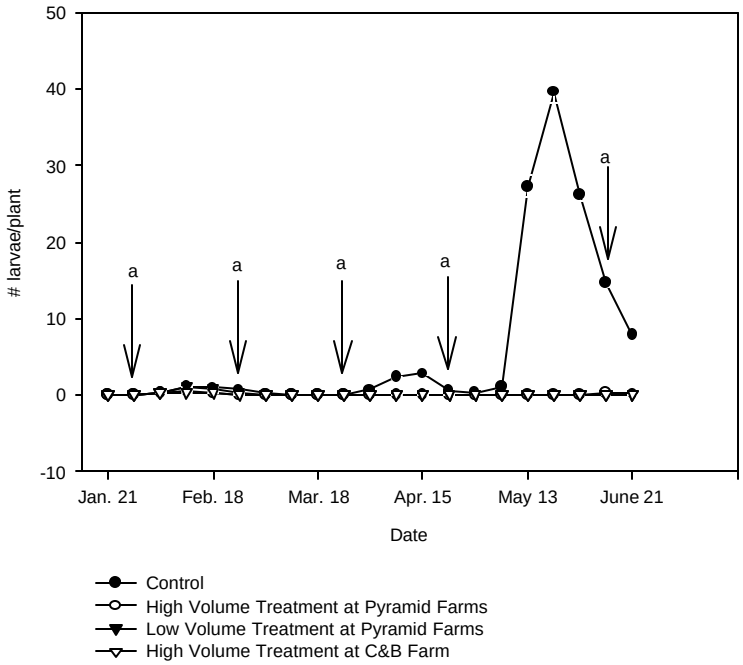
multiple range test). Data were arcsine or square root transformed before ANOVA. Untransformed data are presented. Means were calculated from weekly monitoring from Jan. 28 through June 10 1998.

Figure 1. Effect of high and low volume application of Tomato Pinworm (*Keiferia lycopersicella*) sex pheromone concentrate on number of adults caught in pheromone traps in greenhouse tomatoes



a - Arrows indicate date of pheromone application.

Figure 2. Effect of high and low volume application of Tomato Pinworm (*Keiferia lycopersicella*) sex pheromone concentrate on larval populations in greenhouse tomatoes



a - Arrows indicate date of pheromone application.

Figure 3. Effect of high and low volume application of Tomato Pinworm (*Keiferia lycopersicella*) sex pheromone on damage to foliage of greenhouse tomato

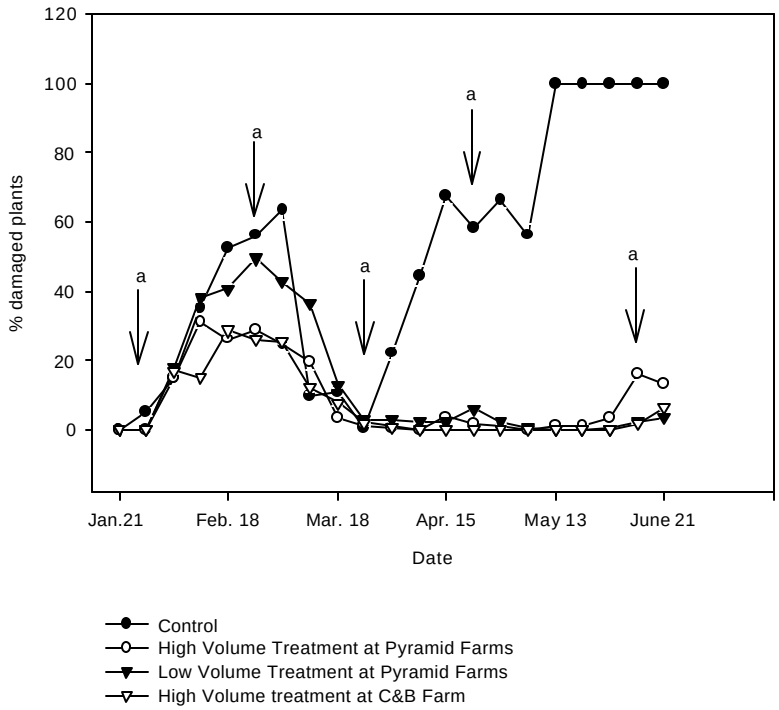
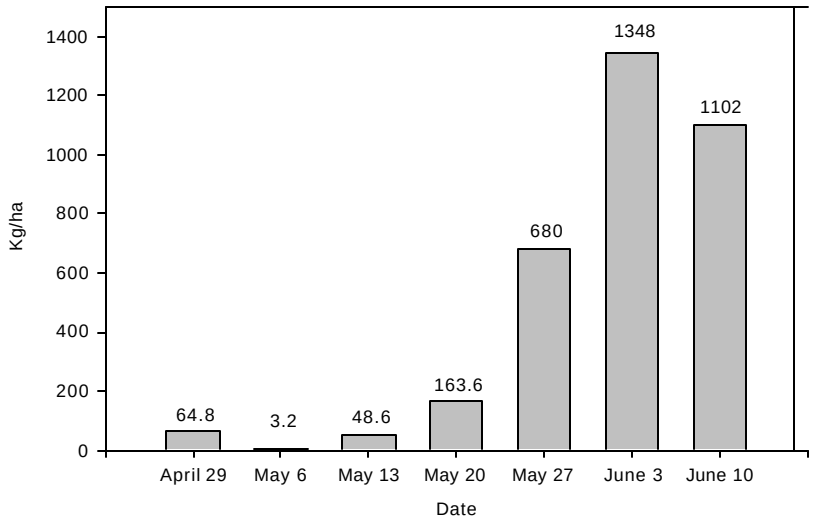


Fig. 4: Weight of unmarketable fruits due to feeding by larvae
of Tomato Pinworm (*Keiferia lycopersicella*) in greenhouse tomato in the control treatment



END OF SECTION H
END OF FILE 98INSECT.PMR.wpd

FILE: **98disease_pmrr.wpd**

TITLE: **1998 PEST MANAGEMENT RESEARCH REPORT**

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PLANT PATHOLOGY/PHYTOPATHOLOGIE

I) FRUIT/FRUITS
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O) RESIDUES/RÉSIDUS

SECTION I FRUIT - Diseases

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EDITOR **Ms. Leslie S. MacDonald** Email: leslie.macdonald@gems3.gov.bc.ca
B.C. Ministry of Agriculture, Fisheries &Food Tel: (604) 556-3029
1767 Angus Campbell Road Fax: (604) 556-3030
Abbotsford, British Columbia V3G 2M3

1998 PMR REPORT # 63

SECTION I: DISEASES OF FRUIT
STUDY DATA BASE: 402-1531-8605

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

NAME AND AGENCY:
SHOLBERG P L, and LASHUK, L C
Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 **Fax:** (250) 494-0755 **Email:** Sholbergp@em.agr.ca

TITLE: EFFICACY OF BAS 490 AND VANGARD AGAINST POWDERY MILDEW ON APPLE, 1997

MATERIALS: BAS 490 02F 50WG (kresoxim-methyl), KUMULUS S 80 WDG (sulphur), NOVA 40 WP (myclobutanil), POLYRAM 80WP (metiram), VANGARD 75WDG (cyprodinil)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on ten-year-old Jonagold apple trees on M7A rootstocks. Thirty-five trees in three rows were separated into 5 blocks of 7 random single tree replicates per block. The single tree replicates were separated from one another by a non-sprayed tree on each side. The five treatments were applied until run-off with a handgun operated at 345 kPa. Treatments were applied on April 25 (tight cluster), May 7 (pink), May 21 (blossom) and June 5 (petal fall). Cover sprays of KUMULUS were applied on June 14 (first cover) and July 2 (second cover)for the BAS 490 and NOVA treatments. The VANGARD treatments received the same VANGARD sprays as applied in the previous applications. Primary powdery mildew was evaluated on May 16 by counting 25 shoots and recording the number of terminals infected with powdery mildew. Secondary powdery mildew was evaluated on June 20 and August 1 by randomly selecting 25 shoots per tree and estimating the percent area infected on two fully expanded leaves nearest the shoot tip. These counts were converted to percent infected leaves per tree, 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 was used at $k=100$, which approximates $p=0.05$ for multiple comparison of means and estimation of the minimum significant differences between means.

RESULTS: Primary powdery mildew ranged between 1and 6% and was not significantly different between the treatments. Secondary powdery mildew recorded on June 20 was controlled by the high rate of BAS 490 and the low rate of BAS 490 in combination with POLYRAM (Table1). The second evaluation of secondary powdery mildew on August 1 showed that all three treatments of BAS 490 reduced powdery mildew as effectively as NOVA. VANGARD did not control secondary powdery mildew at the rates that were used in this trial.

CONCLUSIONS: BAS 490 at the rate of 10.0 g of product per 100L of water was as effective as the standard rate of NOVA in controlling secondary powdery mildew on apple foliage. On the other hand VANGARD is not effective as a control for powdery mildew at the rates used in this trial.

Table 1. Percent incidence and severity of powdery mildew on Jonagold apple leaves and fruit sprayed with fungicides.

Treatment	Rate of product /100 L water	% Foliage Mildew* Jun 20	Aug 01	% Mildew Severity** Jun 20	Aug 01	% Fruit Mildew Sept 26
BAS 490F 50 WG	8.0 g	16.9abc	35.9b	7.2ab	13.5 b	2.3ab
BAS 490F 50 WG	10.0 g	10.8 bc	34.1b	7.0ab	14.8ab	1.1 b
BAS 490F 50 WG + POLYRAM 80 WP	8.0 g 100.0 g	7.8 bc	28.0 b	5.7ab	14.8ab	1.6ab
NOVA 40 WP	6.8 g	2.6 c	24.4 b	3.7 b	11.1 b	2.0ab
VANGARD 75 WDG	16.0 g	27.2ab	60.6a	9.0ab	21.3ab4.7a	
VANGARD 75 WDG + POLYRAM 80 WP	8.0 g 100.0 g	28.0ab	56.8a	8.4ab	17.3ab	1.2b
CONTROL	---	40.7a	66.8a	11.2a	29.7a	1.8a
ANOVA		P#0.006	P#0.0001	P#0.09	P#0.0001	P#0.08

*These data were arcsin transformed prior to analysis of variance. The detransformed means are presented here. Figures are the means of 5 replications. Numbers followed by the same letter are not significantly different at p = 0.05 as decided by the Waller-Duncan K-ratio t-test.
**Mildew severity is the average percent mildew covering the leaf surface for infected leaves.

1998 PMR REPORT # 64

SECTION I: FRUIT - Diseases
STUDY DATA BASE: 402-1252-9715

CROP: Highbush Blueberry (*Vaccinium corymbosum*)
PEST: Mummy Berry, *Monilinia vaccinii-corymbosi*

NAME AND AGENCY:
BROOKES VR and MACDONALD L[1]
Agriculture and Agri-Food Canada, Pacific Agri-food Research Centre
Agassiz, B.C. VOM 1A0
Tel: (604) 796-2221 x 228; **Fax**: (604)796-0359; **Email**: BROOKESV@EM.AGR.CA
[1]B.C. Ministry of Agriculture
Abbotsford, B.C. V3G 2M3
Tel: (604) 556-3029; **Fax** (604) 556-3030; **Email**: Leslie.MacDonald@gems3.gov.bc.ca

TITLE: **EFFICACY OF TOPAS, ELITE AND AZOXYSTROBIN FOR THE CONTROL OF MUMMY BERRY IN HIGHBUSH BLUEBERRIES**

MATERIALS: TOPAS (Propiconazole 250 g/l), ELITE (Tebuconazole 45DF), AGRAL 90 and AZOXYSTROBIN (250 g/l).

METHODS: The trial was conducted in 1998 on a commercial blueberry field known to be infected with mummy berry. Blueberry rows were spaced 3 m apart. Plants were spaced 60 cm apart within the row. Each treatment was applied to 2 m x 3 m plots replicated four times in a randomized complete block. Only the middle two bushes within each plot were assessed. Two untreated bushes at either end of each plot were left as a buffer between each treatment. The treatments were applied with a carbon-dioxide-pressured backpack sprayer in 1000L/ha of water. Treatments included ELITE 125 g ai/ha + AGRAL 90 0.6%, two rates of TOPAS 125 and 190 g ai/ha and two rates of AZOXYSTROBIN 100 g and 200 g ai/ha. TOPAS and ELITE were applied either 2 times (first two dates), 3 times (first three dates) or 4 times (all dates) on the following;; March 12 (flower bud swell), March 25 (vegetative bud swell), April 9 (early blossom stage) and April 27 (full bloom). AZOXYSTROBIN was applied 4 times on the previous dates. Primary (ascospore) infection was assessed on May 22, by counting the number of blighted flower clusters. Berries were harvested on July 20, cut open and examined for the presence of hyphal growth in the seed cavity to assess the mummy berry (conidia) infection stage of the disease. Data were subjected to Anova.

RESULTS: The primary and secondary infection of mummyberry was higher than in 1997. Primary infection was reduced by all TOPAS and ELITE treatments. All treatments reduced secondary infection except for two applications of TOPAS at the low rate.

CONCLUSIONS: TOPAS and ELITE can significantly reduce mummy berry infection. In years of high infection more than two sprays will be needed. AZOXYSTROBIN can reduce the secondary infection stage. There was no indication of any phytotoxicity.

TABLE 1. Effect of TOPAS, ELITE and AZOXYSTROBIN on the number of mummy berry infected blossom clusters per bush and percentage of infected berries out of 300 harvested in 1998.*

Treatment	Rate (g ai/ha)	Number of sprays	Number of blighted blossom clusters May 22, 1998	Percentage of infected berries July 20, 1998
--untreated check	-	-	136.3 a	7.4 a
TOPAS	125	2	43.9 b	4.4 ab
TOPAS	125	3	23.9 b	2.9 bc
TOPAS	125	4	23.0 b	3.6 bc
TOPAS	190	2	44.9 b	3.7 bc
TOPAS	190	3	29.5 b	3.4 bc
TOPAS	190	4	25.5 b	2.9 bc
ELITE + AGRAL 90	125 0.6%	2	36.7 b	3.5 bc
ELITE + AGRAL 90	125 0.6%	3	24.5 b	2.8 bc
ELITE + AGRAL 90	125 0.6 %	4	28.4 b	0.6 c
AZOXYSTROBIN	100	4	95.7 ab	3.8 bc
AZOXYSTROBIN	200	4	95.5 ab	3.0 bc

*Numbers followed by the same letter are not significantly different according to Tukey's Test (P 0.05).

1998 PMR REPORT # 65 **SECTION I: DISEASES OF FRUIT**
ICAR: 88880030

CROP: Grape, cv. Pinot noir (clone 93 Ritter)
PEST: Powdery mildew, *Uncinula necator* (Schwein) Burrill; Bunch rot, *Botrytis cinerea* Pers.:Fr.

NAME AND AGENCY:
SHOLBERG P L, and LASHUK L C
Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre
Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 **Fax:** (250) 494-0755 **Email:** Sholbergp@em.agr.ca

TITLE: EFFICACY OF ICIA5504 AGAINST POWDERY MILDEW AND BUNCH ROT ON GRAPE, 1997

MATERIALS: ICIA5504 250 SC + YF9246 (Azoxystrobin + Bond Adjuvant), MAESTRO 75 DG (Captan), NOVA 40W (Myclobutanil)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 7 year old vines. Spacing was 1.5 x 3.0 m (vine by row). The cordon trained, spur pruned vines (ca. 20 nodes/m row)on 5C rootstocks with vertical trained canopies were hedged around lag phase of berry development. The experimental design was a randomized complete block with four replicates. Each 5-vine replicate had vines 1and 5 as guards, thus treatments were separated by 2-vine buffers. The five treatments were applied until run-off with a handgun operated at approximately 3,000 kPa. Fungicides were applied according to an anti-resistance strategy. ICIA5504 treatments were alternated with MAESTRO at 74.8 g/100 L after two consecutive ICIA5504 treatments. ICIA5504 and NOVA were applied on June 6, July 17, and August 7 and MAESTRO and NOVA were applied on June 19 and August 27. Powdery mildew was evaluated at harvest on October 23 by visually examining ten leaves on each of four shoots per vine, by rating percent infection on five internodes on each of three canes per vine and by examining 10 clusters per three vines for incidence of powdery mildew on the berries. Also at harvest, yield, number of clusters and number of clusters with bunch rot per replicate were recorded. Clusters were considered to have bunch rot if gray mold was observed growing among the berries. Counts of leaf, cane and cluster mildew were converted to the percent infected per replicate and arcsin-transformed. Percent bunch rot, number of clusters, mean cluster weight and yield as well as the transformed data for leaf cane 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 at K = 100, which approximates p = 0.05 for multiple comparison of means and estimation of the minimum significant difference between means.

RESULTS: As presented in the table.

CONCLUSIONS: Powdery mildew did not occur on the grapes until a few weeks before harvest. Due to this extremely late development of mildew there were no significant differences between the nontreated vines and the experimental treatments or the mildew standard. The ICI5504 treatments had no effect on yield, cluster weight or number of clusters. However the high rate of ICI5504 alternated

with MAESTRO significantly reduced the number of clusters with bunch rot from 50.7 to 24.9% showing that the antiresistance strategy also increased the disease spectrum.

Table 1. Pinot noir grape powdery mildew, bunch rot, number of clusters, cluster weight and yield.

Trtment	Rate Kg ai /100 L	Percent Powdery Mildew			Clusters	% Bunch Rot	Cluster Wt (g)	Yield (Kg)
		Leaves	Canes	Clusters				
Check	-----	57.1	30.3	5.0	150	50.7 a**	77.2	12.1
ICI5504 250 SC*	0.00665	76.7	29.0	0.0	168	39.9 ab	76.9	13.4
ICI5504 250 SC*	0.00832	78.3	22.5	12.5	120	24.9 b	98.8	11.9
NOVA 40 WP	0.00270	80.0	28.2	0.0	146	32.8 ab	76.7	11.1
ANOVA		NS	NS	NS	NS	P#0.100	NS	NS

*These treatments were alternated with MAESTRO 75DF at 74.8 g/100L.

**Figures are the means of four replications. Numbers followed by the same letter are not significantly different at p=0.05 as decided by the Waller-Duncan K-ratio t-test.

1998 PMR REPORT # 66 **SECTION I: DISEASES OF FRUIT**
ICAR: 88880030

CROP: Grape, cv. Johannesburg (clone 21B Weis)
PEST: Powdery mildew, *Uncinula necator* (Schwein) Burrill; Bunch rot, *Botrytis cinerea* Pers.:Fr.

NAME AND AGENCY:
SHOLBERG P L, and LASHUK L C
Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre
Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 **Fax:** (250) 494-0755 **Email:** Sholbergp@em.agr.ca

TITLE: EFFICACY OF IRONWOOD (MINERALL) CLAY AGAINST POWDERY MILDEW AND BUNCH ROT AND EFFECT ON GRAPE QUALITY IN 1997

MATERIALS: MINERALL Clay (Glacial Marine Mud), NOVA 40W (Myclobutanil)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 7 year old vines. Spacing was 2.0 x 3.0 m (row by vine). The cordon trained, spur pruned vines (ca. 20 nodes/m row), own rooted vines with vertical trained canopies were hedged around lag phase of berry development. The experimental design was a randomized complete block with three replicates. Each 5-vine replicate had vines 1and 5 as guards, thus treatments were separated by 2-vine buffers. The two treatments were applied until run-off with a handgun operated at approximately 3,000 kPa. MINERALL clay was applied on June 13, June 27, July 16, July 31, August 21 and September 12. Powdery mildew was evaluated at harvest on November 5 by visually examining ten leaves on each of four shoots per vine, by rating percent infection on five internodes on each of three canes per vine and by examining 10 clusters per three vines for incidence of powdery mildew on the berries. Also at harvest, yield, number of clusters and number of clusters with bunch rot per replicate were recorded. Clusters were considered to have bunch rot if gray mold was observed growing among the berries. Counts of leaf, cane and cluster mildew were converted to the percent infected per replicate and arcsin-transformed. In order to test the effect of MINERALL clay applications on grape quality the following tests were done on each replicate. A 50-g subsample from each 100-berry sample was subjected to a nonvolatile acid extraction procedure and titratable acidity was determined on the obtained extracts using a Brinkmann Titroprocessor ensemble. The rest of the sample was juiced, and soluble solids concentration and pH were measured on settled juice using an Abbé refractometer and a pH meter, respectively. Percent bunch rot, number of clusters, mean cluster weight , yield, berry weight per 100 berries, pH, titratable acid and soluble solids as well as the transformed data for leaf cane 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 at K = 100, which approximates p = 0.05 for multiple comparison of means and estimation of the minimum significant difference between means.

RESULTS: As presented in table 1 and 2.

CONCLUSIONS: Powdery mildew did not occur on the grapes until a few weeks before harvest. However even though mildew development was very late, MINERALL clay at the 4.0 kg/100L rate was

significantly more effective than the Nova fungicide standard reducing mildew to 70.9% compared to 90.2% for Nova. On the other hand the low rate of MINERALL clay at 2.0 kg/100L increased bunch rot compared to the check although it was not significantly different from the Nova standard. MINERALL clay had no significant effect on yield, number of clusters and cluster weight or any of the quality parameters such as berry weight, juice pH, soluble solids and titratable acidity.

Table 1. Reisling grape powdery mildew, bunch rot, number of clusters, cluster weight and yield

Trtment	Rate Kg ai /100 L	Percent Powdery Mildew			Total No. of Clusters	% Bunch Rot	Cluster Wt (g)	Yield (Kg)
		Leaves	Canes	Clusters				
Check	-----	93.2 a*	36.0	0.00	216.8	20.2b	213.6	13.9
MINERALL Clay	2.0	77.4 bc	23.8	0.00	185.7	43.5a	220.4	11.1
MINERALL Clay	4.0	70.9 c	15.3	0.00	220.3	35.4ab	233.4	16.6
NOVA 40 WP	0.0027	90.2 ab	25.7	0.00	204.2	34.4ab	208.9	14.6
ANOVA		P$0.04	NS	NS	NS	P$0.14	NS	NS

*Figures are the means of three replications. Numbers followed by the same letter are not significantly different at p=0.05 as decided by the Waller-Duncan K-ratio t-test.

Table 2. Effect of MINERALL clay on grape quality

Treatment	Kg ai/100L	Berry wt g/100 berries	pH	Titratable acid grams	Percent Soluble Solids
Check	----	116.0*	3.13	1.74	18.8
MINERALL Clay	2.0	123.2	3.02	1.72	18.8
MINERALL Clay	4.0	121.1	3.12	1.70	18.6
Nova	0.0027	118.4	3.16	1.61	19.6
ANOVA	NS	NS	NS	NS	NS

*Figures are the means of three replications.

1998 PMR REPORT # 67 **SECTION I: DISEASES OF FRUIT**
ICAR: 88880030

CROP: Pear cvs. Anjou &Bartlett
PEST: Fire blight, *Erwinia amylovora* (Burrill) Winslow et al

NAME AND AGENCY:
SHOLBERG P L, BEDFORD, K E, LASHUK, L
Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre
Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 **Fax:** (250) 494-0755 **Email:** Sholbergp@em.agr.ca

TITLE: EFFICACY OF BLIGHTBAN A506 FOR CONTROL OF PEAR FIRE BLIGHT IN 1998

MATERIALS: BLIGHTBAN A506 (*Pseudomonas fluorescens* A506), Streptomycin 17 (Streptomycin sulfate 25.2%).

METHODS: Thirty pear shoots were randomly cut from several mature 'Anjou' pear trees in the Pacific Agri-Food Research Centre, Summerland, B.C. orchard. Each shoot had 10 or more blossom clusters that were about to open in a few days. Ten shoots per treatment were sprayed to drip with BLIGHTBAN A506 at 0.5g/L and Streptomycin 17 at 0.6g/L on May 15, and on May 17 blossoms on all shoots were inoculated with a spray suspension of *E. amylovora* at 1 X 10^8 colony-forming-units/mL. Number of blighted blossoms per 10 on each shoot were recorded on May 22. Reisolations were made from several blighted blossoms to confirm the presence of *E. amylovora*. An orchard trial was also conducted with BLIGHTBAN A506 at a rate of 0.5g/L and Streptomycin 17 at a rate of 0.6 g/L in an orchard block of 15 'Bartlett' pear trees arranged in two rows. The experimental design was a randomized complete block replicated five times with single tree replicates. The trees were sprayed to drip with a handgun sprayer operated at 60 psi. Treatments were applied on April 27 at full bloom, May 5 at petal fall, and on May 15 at rat tail bloom. Trees were evaluated for the presence of blighted blossoms or shoots on May 29 and June 10, 1998.

RESULTS: Fire blight did not occur in the orchard trial even though the disease was present in the orchard block. None of the trees treated with BLIGHTBAN A506 showed any signs of phytotoxicity. In the greenhouse trial significantly fewer blossoms were blighted in the BLIGHTBAN A506 treatment than the untreated check or the streptomycin standard.

CONCLUSIONS: BLIGHTBAN A506 is an effective control of blossom fire blight.

Table 1. Percent blossoms blighted by *Erwinia amylovora* when sprayed with streptomycin or BLIGHTBAN A506

Treatment	Rate of Product/L	% Blighted Blossoms
Control	------	82.0 a*
Streptomycin 17	0.6 g	72.0 a
BLIGHTBAN A506	0.5 g	53.0 b

*Numbers followed by the same letter are not significantly different at p#0.05 as decided by Duncan's Multiple Range Test.

1998 PMR REPORT # 68 **SECTION I: DISEASES OF FRUIT**
ICAR: 88880030

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

NAME AND AGENCY:
SHOLBERG P L, and BEDFORD, K E
Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre
Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 **Fax:** (250) 494-0755 **Email:** Sholbergp@em.agr.ca

TITLE: EFFICACY OF FOSETYL-AL FOR CONTROL OF FIRE BLIGHT IN 1996

MATERIALS: ALIETTE 80% WDG (Fosetyl-al granular)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on three year old Bartlett pear trees grown in the research station nursery. Twelve trees were brought into the greenhouse for use in this trial. When the trees begin to bloom, six trees were randomly selected and sprayed to runoff over the entire tree with ALIETTE at a rate of 4.0 grams active ingredient per litre of water. Twenty-four blossom clusters on six control trees and similarly 24 blossom clusters on six trees sprayed 48 hours earlier with fosetyl-al were misted with a suspension of *E. amylovora* (10^6 CFU/mL). One month later fire blight was evaluated on the trees by counting the number of blackened blossom clusters. The data was subjected to Chi-square analysis to determine if the treatment differences were significant.

RESULTS: Application of *E. amylovora* to control trees resulted in 19 of 24 blossom clusters becoming blighted. On the other hand only 5 of 24 blossoms were blighted in the trees that had been treated with ALIETTE. Applying the Chi-square contingency test to this data it was hypothesized that there was an equal chance of the blossoms being blighted or not being blighted. This means that 12 of the 24 blossom clusters are expected to be blighted based on chance alone. The Chi-square value was calculated to be 16.33 indicating that the treatments were significantly different (P#0.001).

CONCLUSIONS: In this greenhouse trial ALIETTE significantly reduced the number of fire blight strikes in pear blossoms that were inoculated with *E. amylovora*.

1998 PMR REPORT # 69 **SECTION I: FRUIT - Diseases**
STUDY DATA BASE: 402-1252-9715

CROP: Raspberry, cv. Willamette
PEST: *Botrytis cinerea, Rhizopus sp., Cladosporium sp*.

NAME AND AGENCY:
BROOKES V R
Agriculture & Agri-Food Canada, PARC
Agassiz, B.C. V0M 1A0
Tel: (604) 796-2221 **Fax:** (604) 796-0359 **Email:** BROOKESV@EM.AGR.CA

TITLE: FUNGICIDE TREATMENTS FOR THE CONTROL OF FIELD AND POSTHARVEST FRUIT ROT IN RASPBERRIES

MATERIALS: VANGUARD 75 WG (cyprodinil), MAXIM 4FS (fludioxonil), ROVRAL 50WDG (iprodione), EXP 10830A 500 g/l, ELEVATE 50WDG (fenhexamid)

METHODS: The study was done in a field known to have fruit rot. Each plot consisted of one 4.25 m row of raspberries, cv. Willamette. There were 3 replicates and treatments were arranged in a randomized block design. Raspberries were planted in 1988. The weather in 1998 was warmer and had less precipitation than average. Blossom development occurred quickly, 5 to 10 % of the blossoms were open by May 13, 25 % by May 21, 50 % by May 29 and 90% by June 18. VANGUARD + MAXIM was applied on May 13, May 21, May 21 and June 4. All other treatments were applied on May 13, May 21, May 29, June 4 and June 18. Treatments were applied with a hand-held boom attached to a carbon-dioxide-pressurized backpack sprayer at a pressure of 60 psi. Harvest began on June 19 and continued until July 16. At each picking, marketable, rot and cull weights were recorded. Size index based on the gram weight of 50 berries was also recorded at each picking. A postharvest fruit rot trial was also set up. 15 randomly picked berries from the marketable yield were placed on styrofoam plates covered with damp paper towels. The plates were then covered with plastic wrap. Two sets of all treatments were made up. One set was left at ambient temperature and rots counted 1 to 3 days later. The other set was put in cold storage at 2 C for 6 days, then removed and left at ambient temperature and rots counted 1 to 3 days later. *Botrytis cinerea* was the main postharvest rot with some *Rhizopus sp.* and *Cladosporium sp*. also developing.

RESULTS: Data are presented in Tables 1, 2, and 3. No phytotoxic effects were observed in any of the treated plots. None of the fungicide treatments consistently affected *Rhizopus sp*. or *Cladosporium sp*.

CONCLUSIONS: Field rots were reduced by all fungicide treatments. There was a trend for all fungicide treatments to reduce storage rots. In the storage trials *Botrytis cinerea* was reduced by all treatments at the one day postharvest ambient temperature setup. Berries were counted as having a particular rot as soon as any fungal growth was seen on the berries. In all cases the size of the growth on the check was always larger than on any of the fungicide treated berries.

Table 1. Marketable weight, rot weight and cull weight in grams/m2 and percent field rots of raspberries treated with VANGUARD + MAXIM, ROVRAL, EXP10830A and ELEVATE at Agassiz, B.C. in June and July, 1998.

Treatments	Number of Applications	Rate (g ai/ha)	Marketable Weight (grams/m^2)	Rot Weight (grams/m^2)	Rot + Cull Weight (grams/m^2)	% Field Rots
CHECK	-	---	2519 a*	46 a	83 a	2.0 a
VANGUARD + MAXIM	4	375 250	3072 a	22 b	51 b	0.7 b
ROVRAL + Agral 90 0.1%v/v	5	1000	2597 a	20 b	52 b	0.7 b
EXP 10830A	5	750	2096 a	15 b	39 b	0.7 b
EXP 10830A	5	1000	2236 a	19 b	53 b	0.7 b
ELEVATE	5	560	2231 a	20 b	48 b	0.8 b
ELEVATE	5	840	2537 a	15 b	43 b	0.6 b

*Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

Table 2. Postharvest fruit rot counts of raspberries treated with VANGUARD + MAXIM, ROVRAL, EXP10830A, and ELEVATE at Agassiz, B.C. in June and July, 1998. For each treatment 15 randomly picked berries from the marketable yield were placed on styrofoam plates covered with wet paper towels. Plastic wrap was placed around the plates. The number of berries with *Botrytis cinerea* after 1and 2 days at ambient temperatures are recorded.

Treatments	Number of Application	Rate (g ai/ha)	Set up July 7** Counted July 8	Set up July 7** Counted July 9	Set up July 9 Counted July10
CHECK	-	---	48.9 a	100.0 a	55.6 a
VANGUARD + MAXIM	4	375 250	24.4 b	75.6 b	22.2 c
ROVRAL + AGRAL 90 0.1%	5	1000	24.4 b	82.2 ab	40.0 b
EXP 10830A	4	750	8.9 b	84.4 ab	33.3 bc
EXP 10830A	4	1000	13.3 b	82.2 ab	28.9 bc
ELEVATE	5	560	11.1 b	84.4 ab	35.6 bc
ELEVATE	5	840	13.3 b	80.0 b	24.4 bc

---

* Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test (P<0.05).

** Counts are from the same berries, ie, one day and two day counts after set up.

Table 3. Postharvest fruit rot counts of raspberries treated with VANGUARD + MAXIM, ROVRAL, EXP10830A, and ELEVATE at Agassiz, B.C. in June and July, 1998. For each treatment 15 randomly picked berries from the marketable yield were placed on styrofoam plates covered with wet paper towels. Plastic wrap was placed around the plates. After 6 days in cold storage (2 C)and 1 or 2 days at ambient temperature the number of berries with *Botrytis cinerea* were counted.

Treatments	Number of Applications	Rate g ai/ha	Set up June 26 Counted July 2	Set up June 31 Counted July 8
CHECK	-	---	60.0 a*	80.0 a
VANGUARD + MAXIM	4	375 250	35.6 ab	53.3 ab
ROVRAL + AGRAL 90 0.1%	5	1000	46.7 ab	53.3 ab
EXP 10830A	5	750	22.2 b	44.4 b
EXP 10830A	5	1000	31.1 ab	44.4 b
ELEVATE	5	560	44.4 ab	73.3 ab
ELEVATE	5	840	31.1 ab	71.1 ab

*Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test (P<0.05).

1998 PMR Report # 70 **SECTION I: DISEASES OF FRUIT**

CROP: Saskatoon (*Amelanchier alnifolia* Nut.)
PEST: Leaf and Berry spot *Entomosporium mespili*

NAME AND AGENCY:
RONALD P S and ST-PIERRE R G
Native Fruit Development Program
University of Saskatchewan
51 Campus Drive, Saskatoon , Saskatchewan S7N 5A8
Tel: (306) 966-8608; **Fax:** (306) 966-5015; **E-mail:** ronald@sask.usask.ca

TITLE: EVALUATION OF SASKATOON CULTIVARS FOR SUSCEPTIBILITY TO *ENTOMOSPORIUM* LEAF AND BERRY SPOT

MATERIALS AND METHODS: *Entomosporium* leaf and berry spot is the most serious disease of saskatoon and represents a potential barrier to consistent and economical fruit production in the prairies. During the 1998 growing season, both artificial inoculation and natural infection were used to characterize the foliar response of 14 cultivars of saskatoon to the fungus, *Entomosporium mespili*. The detached leaf assay required collection of six current year stem sections and their associated leaves from a single tree of each of 14 saskatoon cultivars growing at a site in Saskatoon, SK on July 10th, 1998. Six replicates comprised of five fully expanded leaves of each cultivar were placed in order of age into foam sheets floating in six separate tanks of distilled water. A conidiospore suspension of *Entomosporium mespili* prepared from sporulating lesions of saskatoon leaves and berries, was applied to four tanks of leaves using a garden mister. The two control tanks were sprayed with distilled water. Following a 24 hour incubation period, treated leaves were maintained for nine days at 20 ^{0} C, 92% relative humidity and 14 hours of light per day. Natural infection was assessed for leaves sampled from the replicated saskatoon cultivar trial at Hudson Bay, SK. on July 22nd, 1998. Six branches were sampled from a single tree of each cultivar in three replicates. For each sample, leaves were stripped from three of the six branches and grouped based on the age of the wood to which they were attached. Leaves borne on 1998 wood were classified as "new", while those on one year-old wood were classed as "old". Both artificially inoculated and naturally infected leaves were cleared with a mixture of 95% Ethanol : Glacial Acetic Acid (3:1 v/v). Images of the cleared leaves were captured using a desktop scanner and analyzed for percent leaf area affected (PLAA) using SigmaScan Pro (SPSS).

RESULTS: The results of both experiments revealed significant differences in *Entomosporium* disease response among cultivars of saskatoon (Table 1). PLAA data from artificially inoculated leaves showed a significant 'cultivar by leaf age' interaction, indicating that cultivar disease response may be dependent on the age of the leaves examined. In the case of natural infection, neither 'wood age' or 'cultivar by wood age' interaction had significant effects on PLAA. When the disease response of naturally infected plants was compared to that from the artificial inoculation experiment, data for the 14 cultivars showed a correlation coefficient of 0.438. In comparing the disease response among saskatoon cultivars in both sets of data, the cultivars 'PAR90', 'Regent' and 'Success' were consistently the least susceptible to infection by *Entomosporium*, whereas the cultivars 'Buffalo' and 'Northline' were consistently the most susceptible.

CONCLUSIONS: Both artificial inoculation, and the assessment of natural infection provided consistent disease response data for *Entomosporium* leaf spot infection on different cultivars of saskatoon. The genotype 'PAR90' will be released as a new saskatoon cultivar based on its relative resistance to *Entomosporium* leaf and berry spot, combined with good fruit yield and quality.

Table 1: Rankings of 14 saskatoon cultivars based on data for percent leaf area affected by *Entomosporium mespili* in two different experiments. Cultivars having the same letter are not significantly different. Mean separation by LSD, $P = 0.05$.

Percent Leaf Area Affected Following Natural Infection (%)		Percent Leaf Area Affected Following Artificial Inoculation (%)	
Buffalo	8.78 a	Northline	13.84 a
Pearson 2	8.59 a	Bluff	11.44 ab
Forestburg	7.24 ab	Buffalo	9.34 ab
Northline	6.98 ab	Theissen	7.12 b
Smoky	6.14 b	Parkhill	4.78 bc
Pembina	5.50 bc	Martin	4.48 bc
Bluff	4.82 bc	Pearson 2	3.41 bc
Theissen	3.85 c	Forestburg	3.37 bc
Honeywood	3.81 c	Honeywood	2.56 bc
Parkhill	3.68 c	Pembina	2.47 bc
Par 90	3.55 c	Smoky	1.32 bc
Regent	3.00 cd	Par 90	1.12 c
Success	2.70 cd	Success	0.79 c
Martin	1.59 d	Regentt	0.52 c

1998 PMR REPORT # 71 **SECTION I: DISEASES OF FRUIT**

CROP: Strawberry, cv. Totem
PEST: *Botrytis cinerea, Rhizopus sp., Cladosporium sp.*

NAME AND AGENCY:
BROOKES V R and ELMHIRST J[1]
Agriculture & Agri-Food Canada, PARC,
Agassiz, B.C. V0M 1A0
Tel: (604) 796-2221 **Fax:** (604) 796-0359 **Email:** BROOKESV@EM.AGR.CA

[1]B.C. Ministry of Agriculture & Food
Abbotsford, B.C. V3G 2M3
Tel: (604)-556-3032 **Fax**: (604)-556-3030 **Email**:Janice.Elmhirst@gems6.gov.bc.ca

TITLE: FUNGICIDE TREATMENTS FOR THE CONTROL OF FIELD AND POSTHARVEST FRUIT ROT IN STRAWBERRIES

MATERIALS: BRAVO 500 g/l (chlorothalonil), VANGUARD 75 WG (cyprodinil), MAXIM 4FS (fludioxonil), ROVRAL 50WDG (iprodione), EXP 10830A 500 g/l, ELEVATE 50WDG (fenhexamid), MAESTRO 75 DF (captan)

METHODS: The study was done in a field known to have fruit rot. Each plot consisted of one 5-m row of strawberries, cv. Totem. There were 4 replicates and treatments were arranged in a randomized block design. Strawberries were planted in 1997. The number of applications of a particular treatment was determined by the registered label, restrictions on the maximum amount of fungicide applied per year and seasonal weather conditions. The weather in 1998 was warmer and had less precipitation than average. Blossom development occurred quickly: 5 to 10 % of the blossoms were open by May 1, 50 % by May 6, 75 % by May 9, 90% by May 16. Many of the berries were set by May 16. BRAVO was applied on April 29 and May 5. VANGUARD was applied on May 1, May 6 and May 21. VANGUARD + MAXIM was applied on May 1, May 6, May 16 and May 21. ROVRAL was applied on May 1, May 6, May 16, May 21 and June 8. EXP 10830A was applied on May 9, May 16, May 21 and June 8. ELEVATE was applied on May 1, May 6, May 16, May 21, and June 9. MAESTRO was applied on May 1, May 6, May 16, May 21 and June 7. Treatments were applied with a hand-held boom attached to a carbon-dioxide-pressurized backpack sprayer at a pressure of 60 psi. Harvest began on June 5 and continued for two weeks. At each picking, marketable, rot and cull weights were recorded. Size index based on the gram weight of 25 berries was also recorded at each picking. A postharvest fruit rot trial was set up at each picking. 10 randomly picked berries from the marketable yield were placed on styrofoam plates covered with damp paper towels. The plates were then covered with plastic wrap. Two sets of all treatments were made up at each picking. One set was left at ambient temperature and rots counted 3 days later. The other set was put in cold storage at 2 C for 6 days, then removed and left at ambient temperature and rots counted 3 days later. Three postharvest rots developed: *Botrytis cinerea., Rhizopus sp. and Cladosporium sp*.

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

the treated plots.

CONCLUSIONS: Field rots were reduced by all fungicide treatments. ELEVATE and the tank mix of VANGUARD + MAXIM reduced *botrytis cinerea* in the ambient temperature only postharvest trials. CAPTAN and EXP 10830A appeared to have some effect on *Rhizopus sp*. but this was not consistent. CAPTAN was the only treatment to reduce *Cladosporium sp*. In the cold storage + ambient temperatures trials, ELEVATE was the only fungicide to consistently reduce *Botrytis cinerea*.

Table 1. Marketable weight, rot weight and cull weight of strawberries treated with BRAVO, VANGUARD, MAXIM, ROVRAL, EXP10830A, ELEVATE AND MAESTRO at Agassiz, B.C. in June, 1998.

Treatments	Number of Applications	Rate (g ai/ha)	Marketable Weight (grams/m^2)	Rot Cull Weight (grams/m^2)	Weight (grams/m^2)
Check	-	---	1258 ab*	97 a	80 ab
BRAVO	2	1750	1365 ab	55 b	63 ab
VANGUARD	3	500	1467 ab	35 bc	93 a
VANGUARD		375			
+ MAXIM	4	250	1475 ab	17 c	72 ab
ROVRAL	5	1000	1534 ab	24 bc	77ab
EXP 10830A	4	500	1532 ab	59 b	48 b
EXP 10830A	4	750	1528 ab	41 bc	83 ab
EXP 10830A	4	1000	1283 ab	34 bc	65 ab
ELEVATE	5	560	1193 b	25 bc	99 a
ELEVATE	5	840	1632 a	26 bc	61 ab
MAESTRO	5	2250	1452 ab	28 bc	74 ab

*Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

Table 2. Postharvest fruit rot counts of strawberries treated with BRAVO, VANGUARD, MAXIM, ROVRAL, EXP10830A, ELEVATE AND MAESTRO at Agassiz, B.C. in June, 1998. For each treatment 10 randomly picked berries from the marketable yield were placed on styrofoam plates covered with wet paper towels. Plastic wrap was placed around the plates. After 6 days in cold storage (2 C) and 3 days at ambient temperature the number of berries with *Botrytis cinerea*, *Rhizopus sp*. and *Cladosporium sp*. were counted.

Treatments	Number of Applications	Rate (g ai/ha)	Set up June 5[1] Counted June 14			Set up June 9 Counted June 18		
			Bt[2]	Rh[2]	Cl[2]	Bt	Rh	Cl
Check	-	---	100.0 a *	2.5 b	65.0 a	100.0 a	15.0 a	65.0 a
BRAVO	2	1750	97.5 ab	7.5 ab	75.0 a	92.5 a	30.0 a	75.0 a
VANGUARD	3	500	95.0 ab	7.5 ab	92.5 a	95.0 a	12.5 a	92.5 a
VANGUARD + MAXIM	4	375 250	80.0 c	7.5 ab	82.5 a	95.0 a	0.0 a	82.5 a
ROVRAL	5	1000	97.5 ab	22.5 ab	72.5 a	97.5 a	2.5 a	72.5 a
EXP 10830A	4	500	100.0 a	5.0 ab	95.0 a	100.0 a	27.5 a	95.0 a
EXP 10830A	4	750	96.7 a	26.7 a	90.0 a	86.7 ab	6.7 a	90.0 a
EXP 10830A	4	1000	100.0 a	12.5 ab	70.0 a	97.5 a	0.0 a	70.0 a
ELEVATE	5	560	85.0 bc	7.5 ab	87.5 a	67.5 b	12.5 a	87.5 a
ELEVATE	5	840	75.0 c	20.0 ab	80.0 a	47.5 c	10.0 a	80.0 a
MAESTRO	5	2250	95.0 ab	5.0 ab	70.0 a	85.0 ab	15.0 a	70.0 a

* Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

[1] 4 applications of ROVRAL and ELEVATE and 3 applications of EXP 10830A at this date.

[2] Bt= *Botrytis cinerea*, Rh= *Rhizopus sp*., Cl= *Cladosporium sp*.

Table 3. Postharvest fruit rot counts of strawberries treated with BRAVO, VANGUARD, MAXIM, ROVRAL, EXP10830A, ELEVATE AND MAESTRO at Agassiz, B.C. in June, 1998. For each treatment 10 randomly picked berries from the marketable yield were placed on styrofoam plates covered with wet paper towels. Plastic wrap was placed around the plates. After 6 days in cold storage (2 C) and 3 days at ambient temperature the number of berries with *Botrytis cinerea*, *Rhizopus sp*. and *Cladosporiumsp*. were counted.

Treatment	Number of Applications	Rate (g ai/ha)	Set up June 13 Counted June 22			Set up June 17 Counted June 26		
			Bt[1]	Rh[1]	Cl[1]	Bt	Rh	Cl
Check	-	---	97.5 a*	0.0 b	80.0 ab	95.5 a	0.0 b	90.0 a
BRAVO	2	1750	100.0 a	30.0 ab	87.5 ab	87.5 ab	2.5 b	87.5 ab
VANGUARD	3	500	95.0 a	7.5 ab	90.0 a	82.5 ab	0.0 b	92.5 a
VANGUARD		375						
+ MAXIM	4	250	85.0 a	5.0 ab	80.0 ab	92.5 a	0.0 b	90.0 a
ROVRAL	5	1000	100.0 a	37.5 ab	85.5 ab	100.0 a	0.0 b	87.5 ab
EXP 10830A	4	500	72.5 a	42.5 a	95.0 a	92.5 a	30.0 a	72.5 ab
EXP 10830A	4	750	96.7 a	13.3 ab	80.0 ab	96.7 a	5.0 b	96.7 a
EXP 10830A	4	1000	82.5 a	0.0 b	77.5 ab	80.0 a	0.0 b	85.0 ab
ELEVATE	5	560	87.5 a	12.5 ab	95.0 a	57.5 b	2.5 b	87.5 ab
ELEVATE	5	840	72.5 a	20.0 ab	95.0 a	55.0 b	2.5 b	95.0 a
MAESTRO	5	2250	95.0 a	12.5 ab	67.5 b	87.5 ab	12.5 ab	62.5 b

* Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

[1] Bt= *Botrytis cinerea*, Rh= *Rhizopus sp*., Cl= *Cladosporium sp*.

Table 4. Postharvest fruit rot counts of strawberries treated with BRAVO, VANGUARD, MAXIM, ROVRAL, EXP10830A, ELEVATE AND MAESTRO at Agassiz, B.C. in June, 1998. For each treatment 10 randomly picked berries from the marketable yield were placed on styrofoam plates covered with wet paper towels. Plastic wrap was placed around the plates. After 3 days at ambient temperature the number of berries with *Botrytis cinerea*, *Rhizopus sp*. and *Cladosporium sp*. were counted.

Treatments	Number of Applications	Rate (g ai/ha)	Set up June 6[1] Counted June 9			Set up June 9 Counted June 12			Set up June 16 Counted June 19		
			Bt[2]	Rh[2]	Cl[2]	Bt	Rh	Cl	Bt	Rh	Cl
Check	-	---	97.5 a*	7.5 a	72.5 a	85.0 a	25.0 ab	72.5 a	77.5 ab	27.5 ab	50.0 abc
BRAVO	2	1750	92.5 a	0.0 a	72.5 a	60.0 ab	15.0 abc	72.5 a	85.0 ab	22.5 ab	27.5 cd
VANGUARD	3	500	77.5 ab	7.5 a	67.5 a	37.5 bc	30.0 a	67.5 a	62.5 bc	27.5 ab	67.5 a
VANGUARD + MAXIM	4	375 250	35.0 c	0.0 a	57.5 a	32.5 bc	17.5 abc	57.5 a	65.0 bc	15.0 a	45.0 abc
ROVRAL	5	1000	82.5 ab	2.5 a	62.5 a	57.5 ab	20.0 abc	62.5 a	92.5 a	37.5 a	32.5 bc
EXP 10830A	4	500	92.5 a	0.0 a	65.0 a	72.5 a	5.0 c	65.0 a	87.5 ab	10.0 a	35.0 bc
EXP 10830A	4	750	92.5 a	2.5 a	60.0 a	57.5 ab	7.5 c	60.0 a	77.5 a	22.5 ab	52.5 abc
EXP 10830A	4	1000	80.0 ab	0.0 a	62.5 a	60.0 ab	17.5 abc	62.5 a	72.5 abc	17.5 ab	60.0 ab
ELEVATE	5	560	75.0 ab	17.5 a	65.0 a	20.0 c	12.5 abc	65.0 a	50.0 cd	15.0 ab	52.5 abc
ELEVATE	5	840	55.0 bc	7.5 a	65.0 a	15.0 c	27.5 a	65.0 a	37.5 d	50.0 a	60.0 ab
MAESTRO	5	2250	90.0 a	0.0 a	25.0 a	52.5 ab	25.0 a	25.0 a	75.0 abc	20.0 ab	5.0 d

* Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

[1] 4 applications of ROVRAL and ELEVATE and 3 applications of EXP 10830A at this date.

[2] Bt= *Botrytis cinerea*., Rh= *Rhizopus sp*., Cl= *Cladosporium sp*.

1998 PMR REPORT # 72 **SECTION I: DISEASES OF FRUIT**

CROP: Strawberry (*Fragaria ananassa* Duchesne), cv. Camarosa
PEST: Powdery mildew, *Sphaerotheca macularis* (Wallr. ex Fr.) Magn.

NAME AND AGENCY:
DELBRIDGE RW AND ARNOLD JR
Nova Scotia Department of Agriculture and Marketing
Kentville, Nova Scotia B4N 1J5
Tel:(902) 679-6040, Fax:(902) 679-6062, Email: rdelbridge@gov.ns.ca

TITLE: EVALUATION OF FUNGICIDES FOR CONTROL OF POWDERY MILDEW OF STRAWBERRY NURSERY STOCK

MATERIALS: CGA 279202 (50% WG), NOVA (myclobutanil 40% WP), KUMULUS S (sulphur 80% DG), ARM AND HAMMER BAKING SODA (sodium bicarbonate), KALIGREEN (potassium bicarbonate 80% SP), VWR CANLAB POTASSIUM BICARBONATE (potassium bicarbonate), QUADRIS (azoxystrobin 250 SC), AGRAL (90% nonylphenoxy polyethoxy ethanol), BENLATE (benomyl 50% WP).

METHODS: This trial was conducted in Lakeville, NS in 1998 in a strawberry nursery field. The experimental design was a randomized complete block with four replications: Each replicate consisted of one row, 3 meters long. Treatments were applied using a hand held pressurized $C0_2$ sprayer using 608, 1216, or 2920 L water per ha at 207 kPa. Water volume per hectare was increased as plant population increased (608 L on June 29, 1216 L on July 10 and 2920 L thereafter). The surfactant AGRAL 90 was used at the rate of 0.3 ml per liter of water with the KALIGREEN and ARM AND HAMMER BAKING SODA treatments. Treatments were applied on June 29, July 10, July 23, Aug 5, Aug 19 and Sept 1. In the QUADRIS-BENLATE treatment, QUADRIS was applied on June 29, July 10, Aug 5 and Aug 19 while BENLATE was applied on July 23 and Sept 1. Leaf assessments consisting of 20 leaves per replicate were made on Sept 9 using a 1-12 scale based on the ADAS, Strawberry mildew Key No. 8.11 published by the Ministry of Agriculture, Fisheries & Food, UK.

RESULTS: as presented in Table 1.

CONCLUSIONS: All treatments were significantly different than the control. Powdery mildew pressure was considered to be high. NOVA provided excellent control followed by CGA 279202. Fair-good control was achieved by ARM AND HAMMER BAKING SODA, QUADRIS-BENLATE and KALIGREEN.

Table 1. Powdery mildew of Camarosa strawberry nursery plants treated with foliar fungicides in 1998.

Treatment	Rate	Powdery Mildew Rating*
NOVA	340 g/ha	1.8 a**
CGA279202	210 g/ha	2.6 b
ARM AND HAMMER	5 g/L	4.1 c
QUADRIS; BENLATE	800 mL; 1100 g/ha	4.2 c
KALIGREEN	3400 g/ha	4.2 c
VWR	5 g/L	5.2 d
KUMULUS	4000 g/ha	5.3 d
CONTROL	---	6.4 e

* Ratings were on a 1-12 scale; 1-healthy, 12-lower leaf surface totally covered with mildew.
** Means followed by the same letter are not significantly different according to the Waller-Duncan K-ratio test
($P \leq 0.05$)

END OF SECTION I

SECTION J VEGETABLES and SPECIAL CROPS/LÉGUMES et CULTURES SPÉCIALES

REPORT #s: 73 - 109
PAGES: 198 - 316
EDITOR **Dr. Ray F. Cerkauskas** Email: cerkauskasr@em.agr.ca
Agriculture and Agri-Food Canada Tel: (519) 738-2251
Greenhouse and Processing Crops Fax: (519) 738-2929
Research Centre, Highway 18, Harrow, Ontario N0R 1G0

1998 PMR REPORT # 73 SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS

CROP: Sugar beet (*Beta vulgaris* L.) cv. E17
PEST: Cercospora blight (*Cercospora beticola*) Sacc.

NAME AND AGENCY:
CERKAUSKAS, R.F., ZHENG, J.M., AND BROWN, J.
Agriculture and Agri-Food Canada, Greenhouse and Processing Crops Research Centre
Harrow, Ontario N0R 1G0.
Tel: (519)738-2251; **Fax:** (519)738-2929; **Email:** cerkauskasr@em.agr.ca

TITLE: EFFICACY OF FUNGICIDES FOR CONTROL OF FOLIAR BLIGHT OF SUGAR BEET AT HARROW, ONTARIO IN 1998.

MATERIALS: BRAVO 500 (50% w/w chlorothalonil), QUADRIS (22.9% w/w azoxystrobin), MANZATE 200DF (80% w/w mancozeb). Sugar beet cv. E17

METHODS: The trial was established at the research farm at Harrow, Ontario in a Harrow clay loam soil using sugar beet cv. E17. Ro-Neet 72 EC was pre-plant incorporated at 4.73 L/ha for weed control, and fertilizer (20-10-10) was broadcast at 300 Kg/ha prior to planting. A randomized complete block design with four replicates was used. Each subplot consisted of four 5m rows spaced 0.5m apart and a plant spacing of 0.15m. Dry weather conditions following initial planting of sugar beet on 12 May necessitated re-planting on 4 June. Sweet corn (cv. Supersweet) was planted as a border around each subplot to prevent interplot interference from fungal inoculum. Inoculum of *Cercospora beticola* was obtained from affected sugar beet plants during a survey of grower fields in 1998, and from greenhouse-inoculated plants. Inoculum consisted of 5×10^3 and 1×10^4 spores/ml for the first and second inoculation on 7 August and 24 August, respectively. Inoculum was prepared by swirling affected leaves in 1 L of distilled water, passing through four layers of cheesecloth and adjusting spore concentration accordingly. All plants in each subplot were sprayed to run-off with a SPO backpack sprayer. BRAVO, QUADRIS, and MANZATE were applied at 1.14L, 0.09L, and 0.72 kg per hectare in 825 L/ha spray volume using a backpack sprayer with adjustable Rapid-5 nozzles at about 200 kPa. Fungicide sprays were applied 0, 11, 17, 27, 34, 42, 48, 56, 67, and 76 days after the first inoculation. Cercospora blight severity was rated using the Horsfall-Barratt scale (1) generally on a weekly basis from 10 August to 9 November. Area under the disease progress curve (AUDPC) was evaluated according to Shaner and Finney (2). Yield per subplot, obtained on 9 November, consisted of 10 roots randomly chosen from the middle two rows.

Analysis of variance (General Linear Model Procedure, SAS) was used to analyze foliar disease and yield data. The FLSD at P=0.05 was used for comparison of means.

RESULTS: There were no significant differences in Cercospora blight severity among the fungicide treatments, however, all fungicides significantly reduced foliar disease severity in comparison to the control, whether measured as AUDPC or final percent Cercospora blight severity (Table 1). There were no significant differences in yield among any treatments although yields were highest in the fungicide subplots.

CONCLUSIONS: Fungicide treatments reduced Cercospora blight severity and increased yields in sugar beet plants.

REFERENCE: 1. Horsfall, J.G., and Barratt, R.W. 1945. An improved grading system for measuring plant diseases. Phytopathology 35:655. (Abstr.)
2. Shaner, G., and Finney, R.E. 1977. The effect of nitrogen fertilization on the expression of slow-mildewing resistance in Knox wheat. Phytopathology 67:1051-1056.

ACKNOWLEDGEMENTS: We thank Mr. M. Ferrar for technical assistance.

Table 1. Effect of foliar fungicide treatments in sugar beet on Cercospora blight final disease severity, area under the disease progress curve (AUDPC), and yield at Harrow, Ontario, 1998*

Fungicide Treatment	Rate L/ha	Final % Disease Severity	AUDPC	Yield kg/10 roots
Unsprayed		67.2	34.32	7.41
QUADRIS	0.09	12.6	6.42	9.43
BRAVO	1.14	9	3.94	8.74
MANZATE	0.72[a]	11.4	5.33	8.66
$FLSD_{0.05}$		10.6	2.61	NS

NS not significant
* The values in this table are the means of four replications
[a] kg/ha

1998 PMR REPORT # 74 **SECTION J: VEGETABLE and SPECIAL CROPS - Diseases**
ICAR: 206003

CROP: Carrot (*Daucus carota*) cv. Cellobunch
PEST: Sclerotinia Rot, *Sclerotinia sclerotiorum* (Lib de Bary)

NAME AND AGENCY:
MCDONALD M R, JANSE S AND VANDER KOOI K
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph
RR#1, 1125 Woodchoppers Lane, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775- 4546 Email: mrmcdona@uoguelph.ca

TITLE: EVALUATION OF VARIOUS FIELD AND POST-HARVEST FUNGICIDE AND CALCIUM TREATMENTS FOR THE CONTROL OF SCLEROTINIA ON CARROTS IN STORAGE, 1997/98

MATERIALS: BENLATE 50WP (benomyl 50%), BOTRAN 75W (dicloran 75%), BRAVO 500 (chlorothalanil 50%), CALCIMAX (calcium 8%), NITRO 9 (calcium 7%)

METHODS: Carrots were direct seeded (96 seeds/m) in organic soil (pH 6.4, organic matter 60%) naturally infested with the fungus at the Muck Crops Research Station on 27 May, 1997. A randomized complete block arrangement was used. Each replicate consisted of four raised beds (86 cm apart), 5 m in length. There were two field treatments: BENLATE 50WP at 1.1 kg/ha and BRAVO 500 at 3.2 L/ha. Both treatments were applied on 15, 23 Sep and 8 Oct as foliar sprays using a pull type plot sprayer with D-3 hollow cone nozzles in 500 L/ha of water at 100 psi (boom). Air temperatures were below the long term (10 year) average for May, Jul and Aug, above for Jun and not different from the long term average for Sep and Oct. Total rainfall was below the long term (10 year) average for May (62.2 mm), Jun (65.8 mm), Jul (25.6 mm), Aug (48 mm) and Oct (32 mm) and above average for Sep (119 mm). A tap water washed check at 15°C and unwashed field check were also included. Carrots were harvested from the two center rows of each plot on 3 and 4 Nov, 1997. Twenty-four bushels (approx. 600 kg) were also harvested on 4 Nov, 1997 from adjacent untreated check plots and were washed and dipped on 5 Nov, 1997 for 30 seconds in one of five solutions: BENLATE 50WP at 2.2 g/L water; BRAVO 500 at 6 mL/L water; BOTRAN 75W at 3.7 g/L water; CALCIMAX at 0.1% solution (1.25 mL/L water) and NITRO 9 at 0.1% solution (1.42 mL/L water). An untreated washed drench check was also included. All treatments were placed in a Filacell storage where the temperature and relative humidity were kept at approximately 1°C and 95% respectively. The number of carrots with and without white mold (Sclerotinia) were counted on 30 Jan, 2 Feb, 1998 and 11 May, 1998. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.4.1.

RESULTS: As presented in Table 1.

CONCLUSIONS: Significant differences were found among treatments on both assessment dates. Sclerotinia disease infection (%) was the lowest in Jan and May in the BRAVO 500 drench and the unwashed field check, but they were not significantly lower than any of the other fungicide treatments. The five fungicide treatments had significantly lower percent infection than the CALCIMAX 0.1%

drench and the washed field and washed drench checks in Jan and May. Both calcium treatments had high levels of infection but were significantly lower than the washed drench check in May. The washed field and drench checks had the highest percent infection both in Jan and May.

Table 1. Evaluation of various field and post harvest fungicide and calcium treatments for the control of Sclerotinia Rot on carrots in storage, 1997-98.

Treatments	Rate of Product	Disease Infection (%) Jan 98	May 98
Unwashed Field Check		0.3 a *	4.7 ab
Washed Field Check		14.8 e	23.3 cd
Washed Drench Check		13.3 de	25.1 e
BENLATE 50WP	1.1 kg/ha	2.9 ab	7.7 ab
BRAVO 500	3.2 L/ha	4.1 ab	5.5 ab
BENLATE 50WP Drench	2.2 g/L	2.1 ab	9.6 ab
BRAVO 500 Drench	6.0 mL/L	0.8 a	1.5 a
BOTRAN 75W Drench	3.7 g/L	1.4 ab	9.2 ab
CALCIMAX 0.1% Drench	1.25 mL/L	9.4 cd	20.3 cd
NITRO 9 0.1% Drench	1.42 mL/L	5.9 bc	13.9 bc

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

1998 PMR REPORT # 75 **SECTION J: VEGETABLE and SPECIAL CROPS - Diseases**
ICAR: 206003

CROP: Celery (*Apium graveolens*) cv. Florida 683
PEST: Septoria Late Blight, *Septoria apiicola* (Speg.)

NAME AND AGENCY:
MCDONALD M R, JANSE S AND VANDER KOOI K
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph
RR#1, 1125 Woodchoppers Lane, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775- 4546 Email: mrmcdona@uoguelph.ca

TITLE: EVALUATION OF FUNGICIDES FOR THE CONTROL OF SEPTORIA LATE BLIGHT ON CELERY, 1998

MATERIALS: BRAVO 500 (chlorothalonil 50%), CHAMP 2 F (copper hydroxide 37.5%), TOPAZ (propiconazole 25%), BRAVO ULTREX 825 (tetrachloroisophthalonitrile 82.5%), DITHANE DG (mancozeb 75%)

METHODS: Celery was seeded into Plastomer plug trays (200 cells/tray) on 6 May, 1998. Fifty percent of the trays were seeded with *Septoria apiicola* infested seed. A *Septoria apiicola* spore suspension
(250 g diseased tissue in 1000 mL), was prepared from dried infected celery leaves collected in 1997. Florida 683 celery seeds (35 g) were immersed in the suspension, continuously agitated for 24 hours, dried and then seeded into the trays. The celery was transplanted out on 30 Jun. Clean and infected plants were transplanted in alternating rows throughout the trial. A randomized complete block arrangement with four blocks per treatment was used. Each replicate consisted of 6 rows (55 cm apart), 5 m in length. Spraying began when evidence of blight appeared in the trial. Treatments were applied on 11, 20, 29 Aug and 11 Sep using a pull type plot sprayer with TeeJet D-3 hollow cone nozzles at 100 psi (boom) and 500 L/ha of water. CHAMP 2F at 5.0 L/ha, TOPAZ at 295 mL/ha, TOPAZ at 150mL/ha + BRAVO 500 at 1.6 L/ha and BRAVO ULTREX at 2.4 kg/ha were applied at each spray. DITHANE DG at 2.25 kg/ha was applied on 11, 20 Aug and 11 Sep and BRAVO 500 at 3.0 L/ha on 29 Aug as recommended in the Ontario Ministry of Agriculture, Food and Rural Affairs Publication #363, 1998/1999 Vegetable Production Recommendations. An untreated check was also included. Visual ratings of the area of leaves infected with Septoria Late Blight were taken using a scale of 1 to 5 on 1 Oct. Harvest yields of ten plants and the percentage of blight on the ten oldest stalks were also taken. The air temperatures were not different from the long term (10 year) average for Jun, Jul, Aug and Sep. Total rainfall was below
the long term (10 year) average for Jul (50.2 mm), and Sep (18.6 mm), above the average for Aug (114.6 mm) and not different from the long term average for Jun (78.4 mm). Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.4.1.

RESULTS: As presented in Table 1.

CONCLUSIONS: The fungicide treatments effectively reduced the number of petioles with blight

lesions but had no effect on visual disease ratings or yield (Table 1). All of the fungicide treatments were equally effective. Percent infection was low throughout the entire trial compared to previous years. The light pressure could be a result of low rainfall during September or unsatisfactory seed inoculation prior to plug tray establishment.

Table 1. Evaluation of foliar applied fungicides for the control of Septoria Late Blight on celery, 1998.

Treatment	Visual Field Blight Rating *	% Petioles Infected	Average Plant Length (cm)	Harvest Yield 10 plants (kg)
Check	4.0 NS**	12.5 b***	68.4	15.6
Conventional	4.4	0.3 a	70.3	15.9
TOPAZ at 295 mL/ha	4.2	0.3 a	71.3	15.0
TOPAZ at 150 mL/ha +4.3 BRAVO 500 at 1.6 L/ha		0.0 a	69.8	18.2
BRAVO ULTREX at 2.4 kg/ha	4.4	0.5 a	69.4	16.3
CHAMP 2F at 5.0 L/ha	4.3	0.0 a	68.9	16.1

* 5.0 = no infection evident, 3.7 = infection on petioles and stalk, 1.0 = entire plant infected

** NS = no significant treatment effects were observed.

*** Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

1998 PMR REPORT # 76
SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS
ICAR: 61009653

CROP: Chickpea (*Cicer arietinum* L.), cv. Sanford (Kabuli type)
PEST: Botrytis blight, *Botrytis cinerea* Pers.

NAME AND AGENCY:
CHANG K F, HOWARD R J, BRIANT M A and HWANG S F[1]
Crop Diversification Centre South
SS 4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1334 **Fax:** (403) 362-1326 **Email:** changk@agric.gov.ab.ca

[1]Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (403) 632-8228 **Fax:** (403) 632-8612 **Email:** hwang@arc.ab.ca

TITLE: EFFICACY OF FUNGICIDES FOR THE CONTROL OF BOTRYTIS BLIGHT ON CHICKPEA AT BROOKS, ALBERTA IN 1998

MATERIALS: CROWN (carbathiin 92 g/L + thiabendazole 58 g/L FL), APRON FL (metalaxyl 317 g/L SN), VITAFLO 280 (thiram 13.2% + carbathiin 14.9% SU)

METHODS: A field plot experiment on clay-loam type soil was established in Brooks, Alberta, in the spring of 1998. Two *Botrytis*-infested seed lots of Kabuli type chickpea cv. Sandford were planted 4 cm deep on May 14 using 50 seeds/4 m row. A peat based inoculant (Enfix-P™) at 30 mL/row was used as a source of root-nodulating bacteria. Each plot consisted of four 4 m rows with a 20 cm row spacing. Adjacent plots were separated by 0.4 m and replicate plots by 2 m. The experiment was arranged in a randomized complete block with four replicates. Seed treatments consisted of CROWN at 3.0 mL/kg seed + APRON FL at 0.16 mL/kg seed; CROWN at 6.0 mL/kg seed + APRON FL at 0.16 mL/kg seed; APRON FL at 0.16 mL/kg seed; VITAFLO 280 at 3.3 mL/kg seed + APRON FL at 0.16 mL/kg seed, and an untreated control. Seedling emergence was counted on June 9 on all four, 4 m rows. The chickpeas were harvested on August 24. The data was subjected to analysis of variance using the Pesticide Research Manager Program, and Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: For seedlot 1, all fungicide treatments significantly improved emergence and yield of chickpea when compared to the control treatment (Table 1). Seeds treated with the high rate of CROWN + APRON resulted in a significantly better yield than those of the control and VITAFLO + APRON treatments. For seedlot 2, all fungicide treatments significantly improved emergence and yield of chickpea when compared to the control treatment.

CONCLUSIONS: Fungicides had a positive effect on emergence and yield. The CROWN + APRON combination in seedlot #1 improved yield considerably.

ACKNOWLEDGEMENTS: Technical supported by S.P. Huggons, S.M. Sims and C.L. Bandura was greatly acknowledged.

Table 1. Effect of seed treatment on seedling emergence and seed yield of chickpea cv. Sanford which naturally infected with *Botrytis cinerea* at Brooks, Alberta 1998.

Treatment	Rate (mL/kg seed)	Seedlot 1[x]		Seedlot 2[x]	
		Emergence (%)	Yield (g/4m row)	Emergence (%)	Yield (g/4m row)
1. Control (no fungicide)	-	2.3 b	140.3 c	1.9 b	70.0 b
2. APRON	0.16	50.6 a	933.8 ab	64.4 a	1043.5 a
3. CROWN + APRON	3.0+0.16	47.1 a	1143.8 a	66.3 a	897.9 a
4. CROWN + APRON	6.0+0.16	48.1 a	886.2 ab	57.8 a	906.6 a
5. VITAFLO + APRON	3.3+0.16	54.5 a	777.2 b	60.5 a	1021.7 a
ANOVA P#0.05		S	S	S	S
Coefficient of variation		11.9	23.6	11.7	23.1

[x] Means within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test (P#0.05).

1998 PMR REPORT # 77 SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS
ICAR: 61009653

CROP: Chickpea (*Cicer arietinum* L.),
cvs. Marango (Desi type) and UC27 (Kabuli type)
PEST: Fusarium root rot, *Fusarium avenaceum* (Fr.) Sacc.

NAME AND AGENCY:
WANG H, HWANG S F, and TURNBULL G D
Alberta Research Council
P.O. Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (403) 632-8610 **Fax:** (403) 632-8612 **Email**: wangh@arc.ab.ca

CHANG K F and HOWARD R J
Crop Diversification Centre - South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1334 **Fax:** (403) 362-1326 **Email**: changk@agric.gov.ab.ca

TITLE: EVALUATION OF MAXIM AND APRON XL AS SEED TREATMENTS FOR THE CONTROL OF FUSARIUM ROOT ROT OF CHICKPEA

MATERIALS: MAXIM 40.3% (fludioxonil 1.22g/mL), APRON XL LS 33.3% (metalaxyl-M 1.113g/mL)

METHODS: An *in vitro* fungicide bioassay was conducted in the laboratory by growing *Fusarium avenaceum* on potato-dextrose agar (PDA) plates amended with Maxim and Apron XL, respectively. The final concentration of fungicides in the plate was adjusted to 0.01, 0.1, 0.5, 1.0, 5.0 and 10.0 µg/mL. Non-amended PDA plates served as controls. A cork borer was used to remove 5-mm plugs of mycelium and agar from actively growing colonies of *Fusarium.* The plugs were inserted into the center of the bioassay plates which were then incubated at room temperature. A completely randomized design was used. Colony diameters were measured every 24 hr until the non-fungicide control plates were fully overgrown. Each treatment was tested on 10 plates and the bioassay was repeated once.

In the greenhouse experiment, seed of two chickpea cultivars (Marango and UC27) was treated with Maxim 40.3% plus Apron XL 33.3% (at 2.5 + 3.75 g a.i./100 kg of seed) or Maxim 40.3% (at 2.5 g a.i./100 kg of seed) alone. Treated and non-treated seeds were planted in flats (25 x 30 cm) filled with greenhouse potting soil. Each replicate treatment consisted of 20 seeds planted by hand along a 30 cm furrow at a depth of 2.5 cm. *Fusarium* inoculum was grown on oat grains for 14 days, which were subsequently air-dried, ground and incorporated with the seed at three different rates: low (10 CFU/cm), medium (20 CFU/cm) and high (40 CFU/cm). Treatments were arranged in the flats in a randomized complete block design with four replications. The incidence of fusarium root rot (percentage of seedlings with root rot symptoms) was recorded and disease severity was measured using a scale of 0 (no disease) to 4 (over 75% of root infested with *Fusarium*) at four weeks after planting. Data were subjected to analysis of variance and least significant difference (LSD) mean separations with the Statistical Analysis System (SAS Institute, Cary, NC).

RESULTS: Maxim was highly suppressive to *Fusarium* growth on the PDA plates even at very low concentrations. It inhibited 76% of *Fusarium* growth at 0.1 µg/mL and 100% growth where the concentration exceeded 0.5 µg/mL, while Apron XL had no effect on *Fusarium* growth (Figure 1). Fungicide seed treatments with Maxim plus Apron or Maxim alone significantly reduced both root rot incidence and disease severity (P # 0.05) in chickpeas (Table 1), although the two cultivars varied in disease reaction, i.e. UC 27 was less susceptible to *Fusarium* infection than Marango. Disease incidence and severity levels were proportional to the inoculum dosage.

CONCLUSIONS: Maxim was moderately effective as a seed treatment for controlling *Fusarium* root rot in chickpea. Combining Apron XL with Maxim did not improve efficacy.

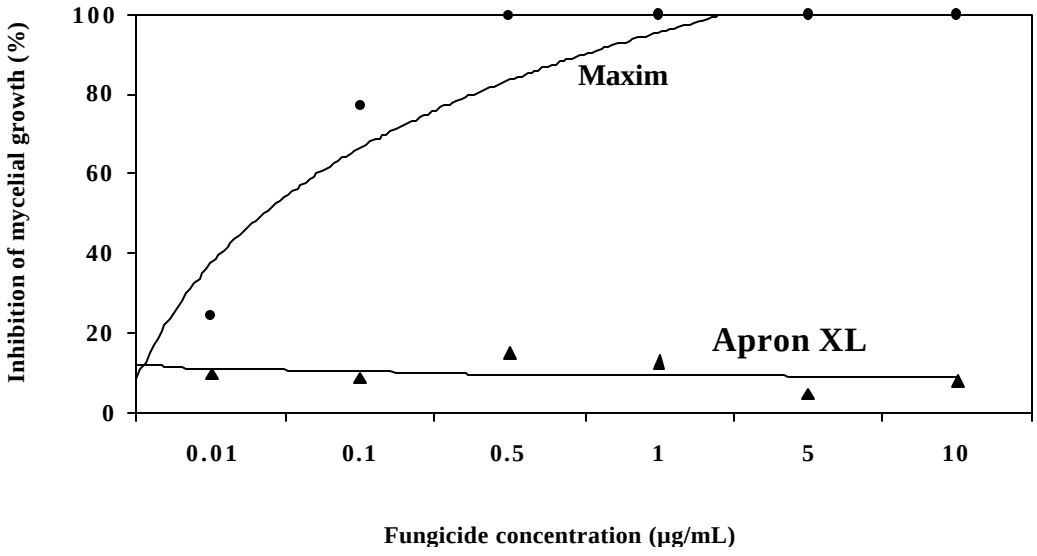

Figure 1. Dose-response of *Fusarium avenaceum* to two fungicides in the laboratory. **Ž and • represent the mean of four replications for Maxim and Apron XL, respe solid lines represent the predicted curves for the two treatments.**

Table 1. Effect of Maxim and Apron XL seed treatment on fusarium root chickpea, 1998.

Treatment	Marango		UC27	
	Root rot Incidence (%)	Severity (0-4)	Root rot Incidence (%)	Severity (0-4)
Non-treated	73.7 a*	1.2 a	57.8 a	0.7 a
Maxim	25.4 b	0.3 b	8.3 b	0.1 b
Maxim + Apron XL	36.6 b	0.7 b	12.9 b	0.2 b
LSD (P # 0.05)	13.3	0.4	9.1	0.1
Inoculum level				
Low	37.5 b	0.6 a	20.4 b	0.2 b
Medium		46.7 b	0.7 a	26.6 ab 0.3 a
High	51.4 a	0.8 a	32.0 a	0.4 a
LSD (P # 0.05)	13.3	0.4	9.1	0.1

* Values are means of four replications, and means in a column followed by a common letter are not significantly different at P # 0.05 according to the least significant difference test.

1998 PMR REPORT # 78 SECTION J: DISEASES OF VEGETABLES AND SPECIAL CROPS

ICAR: 93000482

CROP: Dry bean (*Phaseolus vulgaris* L.), cv. Othello (Pinto type)
PEST: Halo blight (*Psuedomonas syringae* pv. *phaseolicola*)

NAME AND AGENCY:
CHANG K F, HOWARD R J, BRIANT M A and VAN ROESSEL W[1]
Alberta Agriculture, Food and Rural Development
Crop Diversification Centre South
SS 4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1334 **Fax:** (403) 362-1326 **Email:** changk@agric.gov.ab.ca

[1]Specialty Seeds Inc.
P.O. Box 965, Bow Island, Alberta T0K 0G0
Tel: (403) 545-6018 **Fax:** (403) 545-6018

TITLE: SEED TREATMENT AND FOLIAR APPLICATION WITH KOCIDE TO CONTROL HALO BLIGHT OF DRY BEAN AT BOW ISLAND, ALBERTA IN 1998

MATERIALS: KOCIDE LF (copper hydroxide 23% SU)

METHODS: Seeds of Othello, a blight-susceptible cultivar, were inoculated with the halo blight pathogen (*Pseudomonas syringae* pv. *phaseolicola* - [*Psp*]). Flasks of nutrient broth containing isolates of *Psp* were shaken for 18 hours at 22° C on a rotary shaker, then centrifuged for 10 minutes at 8,000 rpm. The supernatant was discarded and the pellets were resuspended in water and diluted to get a final bacterial cell count of ca. 10^7 cfu/mL. This bacterial suspension was added to 1 kg of seed, which was allowed to air dry for two days. Some of the inoculated seeds were treated with KOCIDE LF (1.5 mL KOCIDE on 575 g seed), a copper-based fungicide and bactericide, using a Gustafson Batch Lab Treater. The trial consisted of six treatments: 1. control (clean seed, no foliar sprays), 2. inoculated seed, no foliar sprays, 3. inoculated seed, early foliar spray, 4. inoculated seed, early and late foliar sprays, 5. inoculated seed, late sprays, and 6. inoculated seed, treated with a copper fungicide with early and late foliar sprays. The treated and untreated seeds were sown in a four, 5 m rows per plot on June 3 at Bow Island on sandy-loam type soil. The treatments were randomized within each of four replicate blocks. Emergence was determined by counting all the plants in each row on July 8. KOCIDE solution (1:500 ratio) was sprayed onto leaves at 300 mL/row on July 10 (early spray) and August 4 (late spray). Blight incidence and severity were rated on July 9 and September 2. The visual assessment key for common bacterial blight of beans developed by James (1971) was used to estimate severity, ie. 0 = no disease, 1 = slight (1-10% leaf area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted). Severity ratings were done on 25 randomly selected leaves and 10 pods per row. Seeds from each plot were harvested on September 14-18. Data were square root transformed where necessary and subjected to ANOVA using the Pesticide Research Manager Program.

RESULTS: There were no significant differences between the treatments for emergence and disease incidence (Table 1). However, seed inoculated with *Psp*, then treated with KOCIDE and given an early and late foliar spray with KOCIDE had a significantly lower disease severity than those of the other treatments. There were no significant differences in yield between treatments. Non-significant differences in yield among treatments may have been partially due to unsuccessful inoculation of seeds with bacteria. The practice of air drying the seed after inoculation with *Psp* suspension did not allow sufficient time for the bacteria to penetrate into the seed coat. The use of a vacuum infiltration method for inoculating bean seeds or using different concentrations of bacterial suspension should be investigated.

CONCLUSIONS: The use of a copper fungicide (KOCIDE) for seed treatment plus as an early and late folial spray provided the best control for halo blight under the conditions of this experiment, although there were no significant differences in yield.

REFERENCE:

James, W.C. 1971. A manual of assessment keys for plant diseases. Publ. 1458, Agric. Canada, Ottawa.

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Table 1. Emergence, halo blight disease incidence and severity, and yield of Othello dry bean under six treatment regimes in a field trial at Bow Island, Alberta, 1998.

Treatment	Emergence (%)	Disease incidence (%)	Disease [x] severity (0-4)	Yield (g/5m row)
Clean seed - control	73.6	26.9	0.7 bc	3830.0
Inoculated seed - no spray	78.0	44.6	1.0 abc	4008.0
Inoculated seed + early spray [z]	71.9	43.5	1.3 a	3688.0
Inoculated seed + early & late sprays	68.0	42.9	1.1 ab	4068.0
Inoculated seed + late spray	69.1	37.0	1.1 ab	3882.5
Inoculated seed + seed [y] treated + early & late sprays	65.9	24.9	0.6 c	3800.0
ANOVA (P#0.05)	NS	NS	S	NS
Coefficient of variation %	7.8	33.9	30.3	9.6

Table 1. Emergence, halo blight disease incidence and severity, and yield of Othello dry bean under six treatment regimes in a field trial at Bow Island, Alberta, 1998.

Treatment	Emergence (%)	Disease incidence (%)	Disease [x] severity (0-4)	Yield (g/5m row)

[x] Values are means of four replications. Means followed by the same letter in column do not significantly differ (P#0.05 Duncans New Multiple Range Test).
[y] Seed treatment: 1.5 ml KOCIDE LF/575 gm seed.
[z] Plant spray with KOCIDE LF at 1:500 ratio to water.

1998 PMR REPORT # 79 SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS
ICAR: 93000482

CROP: Dry bean (*Phaseolus vulgaris* L.), cvs. Viva (pink type) and Envoy (navy type)
PEST: Halo blight, *Pseudomonas syringae* pv. *phaseolicola* (Burkh.) Young *et al.*; common blight, *Xanthomonas campestris* pv. *phaseoli* (Smith) Dye

NAME AND AGENCY:
HOWARD R J, LEDUC Y A, HUGGONS S P, BRIANT M A, SIMS S M, and BANDURA C L
Alberta Agriculture, Food and Rural Development
Crop Diversification Centre, South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1328 **Fax:** (403) 362-1326 **Email:** ron.howard@agric.gov.ab.ca

TITLE: EFFICACY OF SEED TREATMENTS FOR THE CONTROL OF HALO BLIGHT AND COMMON BLIGHT ON DRY EDIBLE BEANS IN FIELD TRIALS AT BROOKS, ALBERTA IN 1998

MATERIALS: BLUESTONE (copper sulphate 99% SG), KOCIDE LF (cupric hydroxide 23% SU), COPPER 53W (tribasic copper sulphate 53% WP), COPPER OXYCHLORIDE 50 (copper oxychloride 50% WP), ZINEB 80W (zineb 80% WP), DITHANE M-22 (maneb 80% WP), DITHANE DG (mancozeb 75% WDG), AGRICULTURAL STREPTOMYCIN (streptomycin sulphate 62.6% WP; equivalent to 50% streptomycin base), VITAFLO-280 (thiram 13.2% + carbathiin 14.9% SU), SELF-STICK™ (*Rhizobium leguminosarum* bv. *phaseoli* [1 x 10^9 viable cells/g])

METHODS: Envoy navy bean seed naturally infested with halo blight (*Pseudomonas syringae* pv. *phaseolicola*) and common blight (*Xanthomonas campestris* pv. *phaseoli*) bacteria, and Viva pink bean seed artificially infested with the same two pathogens, were treated with VITAFLO-280 alone or with this fungicidal product combined with one of the following fungicides/bactericides: BLUESTONE, KOCIDE LF, COPPER 53W, COPPER OXYCHLORIDE 50, ZINEB 80W, DITHANE M-22, DITHANE DG, or AGRICULTURAL STREPTOMYCIN. Three checks were included in each trial, i.e. VITAFLO-280 alone, VITAFLO-280 + AGRICULTURAL STREPTOMYCIN, and no chemical treatment (untreated). Each chemical treatment (Tables 1a, 1b, 2a, 2b) was applied as a slurry to separate lots of seed, i.e. 350 g of Envoy and 450 g of Viva. Distilled water (3.5 mL/kg seed) was used in preparing the slurries for chemical formulations that were in a powder or crystalline form. The seed

treatment mixtures were applied in the laboratory with a Gustafson Batch Lab Treater. Before each lot was treated, 300 g of seed was run through the treater to pre-coat the drum with the respective chemical treatment in order to minimize adhesion losses during subsequent treatments. Each lot of treated seed was allowed to air dry in the dark for several hours and stored in a cooler until it was planted.

The Viva seed was artificially infested with halo blight (*Psp*) and common blight (*Xcp*) bacteria prior to chemical treatment. Isolates of *Psp* and *Xcp* were added to separate flasks of nutrient broth and incubated for approximately 18 hours at room temperature (ca. 25EC) on a rotary shaker. Afterwards, the cultures were centrifuged for 10 minutes at 8000 rpm, the liquid portion was poured off and 100 mL of a phosphate-buffered saline solution was added to each tube containing the bacterial sediment. The saline solution was prepared with 0.1 M sodium phosphate dibasic anhydrous and 0.85% sodium chloride in sterile distilled water with the pH adjusted to 7.2 with 5 M hydrochloric acid. The tubes were hand shaken to resuspend the bacteria, and the *Psp* suspensions were combined in one flask and the *Xcp* suspensions in another. The density of each bacterial suspension was estimated under a microscope using a hemacytometer. Each bacterial suspension was then diluted with phosphate-buffered saline solution to a density of ca. 10^7 colony-forming units/mL and this was applied at a rate of 5 mL/kg seed for both the *Xcp* and *Psp*, i.e. 10 mL total bacterial suspension/kg Viva seed, then tumbled in a drum. The inoculated seed was spread onto clean paper to air dry in a darkened area before dividing into ten, 450 g lots for subsequent seed treatment as described above. An agar plating test determined that the Envoy seed had sufficient natural infestation and did not need to be inoculated with blight bacteria.

Just prior to planting, *Rhizobium leguminosarum* bv. *phaseoli* inoculant (sterile, peat-based, SELF-STIK™) manufactured by MicroBio RhizoGen Corp., Saskatoon, SK was mixed with the seed at a rate of 1 g/818 g seed. Viva seed was planted on May 28 with a tractor-drawn, wide-row, 4-cone seeder, in a field plot at CDC South. The treatments were arranged in a randomized complete block design with four replications. Each treatment consisted of four, 6 m rows, 70 cm apart with 120 seeds per row. Envoy was planted on May 29 with a hand-driven cone seeder close to the Viva trial. The treatments were arranged in a randomized complete block design with four replications. Each treatment consisted of two, 5 m rows, spaced 70 cm apart with 90 seeds per row. Both plots were sprinkler irrigated, as needed, throughout the growing season.

Emergence was determined by counting all of the plants in each row on June 24. The plots were not trimmed. Blight incidence (% diseased plants) was rated on July 8 (Envoy) and July 10 (Viva) by counting the number of diseased and healthy plants in each row. Leaf blight incidence (number of diseased leaves) and severity (proportion of leaf area affected) were rated on July 8 (Envoy) and July 13 (Viva), and pod blight incidence (number of diseased pods) and severity (proportion of pod area affected) were rated on August 26 for both varieties. Severity ratings were done on 50 leaves and 25 pods randomly selected from both rows in the Envoy plots, and on 50 leaves and 25 pods randomly selected from the centre two rows in the Viva plots. The visual assessment key for common bacterial blight of beans developed by James (1971) was used to estimate disease severity in the leaves and pods, i.e. 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted). The Envoy and Viva trials were undercut on September 10 and 14, respectively, and allowed to dry in the field before threshing. Seed yields were subsequently determined for each subplot. Mean percentage data were transformed to arcsin or square root, where necessary, and subjected to ANOVA. Duncan's Multiple Range Test was used to compare treatment means where ANOVA tests were statistically significant (P#0.05) (see Tables 1a, 1b, 2a, 2b).

RESULTS: *Envoy (naturally infested seed)* - Low to moderate levels of bacterial blight occurred in this trial. Significant differences ($P \leq 0.05$) among treatments were observed for emergence, pod disease incidence and pod disease severity (Tables 1a, 1b). Emergence was lowest, and significantly different from all three checks, for seed treated with KOCIDE LF, COPPER 53W and COPPER OXYCHLORIDE 50. There were no significant differences between the other seven treatments, including the untreated check. Blight incidence on pods was highest for the STREPTOMYCIN-treated seed and was significantly different from the values observed for seed treated with KOCIDE LF and ZINEB 80W, which had the lowest disease incidence. None of these three treatments, however, was significantly different from the untreated check. Pod disease severity was highest for plants grown from STREPTOMYCIN-treated seed and was significantly different from seed treated with KOCIDE LF, COPPER 53W and ZINEB 80W. None of these four treatments was significantly different from the untreated check. No significant differences ($P \leq 0.05$) among treatments were observed for any of the other data parameters measured in this trial, including yield.

Orthogonal analyses were used to compare the effects of one group or class of treatments to another group or class for data parameters with statistically significant ($P \leq 0.05$) ANOVA tests (Tables 1c, 1d):
Treated vs. untreated seed (treatments 1 to 9 vs. 10) - Treated seed had a significantly ($P \leq 0.05$) lower emergence than the untreated check. There were no significant differences between the treated seed and the check for disease incidence and severity on pods.
Treatments containing VITAFLO-280 + a bactericide vs. VITAFLO-280 alone (treatments 1 to 8 vs. 9) - There were no significant ($P \leq 0.05$) differences between these two groups for emergence, pod disease incidence or pod disease severity.
Metal ion-containing treatments vs. STREPTOMYCIN (treatments 1 to 7 vs. 8) - STREPTOMYCIN-treated seed had significantly ($P \leq 0.05$) higher emergence than the group of metal-containing seed treatment chemicals. However, the metal-containing chemicals had significantly lower disease incidence and severity ratings on pods compared to plants grown from STREPTOMYCIN-treated seed.
Copper-based vs. non-copper-based treatments (treatments 1 to 4 vs. 5 to 7) - Non-copper-containing seed treatments had significantly ($P \leq 0.05$) higher emergence than the copper product group. There were no significant differences between the two groups for pod disease incidence and severity.

Viva (artificially infested seed) - Bacterial blight levels were low to moderate in this trial. No significant ANOVA tests ($P \leq 0.05$) were noted for the emergence, disease incidence and severity, or yield (Tables 2a, 2b).

CONCLUSIONS: STREPTOMYCIN-treated seed had the highest emergence, but also showed the highest pod blight incidence and severity in the Envoy trial. The application of KOCIDE LF, COPPER 53W and COPPER OXYCHLORIDE 50 to the naturally infested Envoy seed adversely affected emergence relative to all three checks. KOCIDE LF and ZINEB 80W treatments had significantly less pod blight than the STREPTOMYCIN check, as did COPPER 53W for pod blight severity only. Orthogonal analyses revealed that seed treatments containing metals, particularly copper, had a negative effect on emergence. However, these same chemicals decreased disease incidence and severity in the pods compared to the STREPTOMYCIN check.

The potential benefits of seed treatment for increasing seedling emergence and seed yields and on reducing disease incidence and severity were not clearly demonstrated in the Viva trial. Nonetheless, the nine product combinations under test did not appear to have any significant phytotoxic effects on

emergence or plant development.

REFERENCE: James, W.C. 1971. A manual of assessment keys for plant diseases. Publ. 1458, Agric. Canada, Ottawa.

Table 1a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence and disease incidence on Envoy navy dry beans in a field trial at Brooks, Alberta in 1998.*

Treatment	Rate of product /kg seed	Emergence (%)**	Disease incidence (%)**		
			Plants	Leaves	Pods
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	92.8 a	34.1	24.9	35.3 abc
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	75.9 c	46.3	44.2	15.5 c
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	80.0 bc	42.5	34.4	24.9 abc
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	85.3 b	40.1	37.1	31.7 abc
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	92.1 a	56.9	47.0	21.6 bc
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	93.4 a	59.9	56.8	44.8 ab
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	92.3 a	65.1	41.3	46.0 ab
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	94.9 a	59.5	39.6	53.1 a
9. VITAFLO-280	2.60 mL	91.1 a	74.4	55.3	49.0 ab
10. Untreated Check	-	93.0 a	61.2	54.6	38.8 abc
ANOVA ($P \leq 0.05$)		0.0001	0.4883	0.8094	0.0465
Coefficient of Variation (%)		4.69	31.91	38.74	28.08

* The values in this table are the means of four replications. Numbers within a column followed by the same small letter are not significantly different according to a Duncan's Multiple Range Test ($P \leq 0.05$).

** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 1b. The effect of nine fungicidal/bactericidal seed treatments on disease severity and seed yield on Envoy navy dry beans in a field trial at Brooks, Alberta in 1998.*

Treatment	Rate of product /kg seed	Disease severity (0-4)** Leaves	Disease severity (0-4)** Pods	Yield ($g/7\ m^2$)
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	0.3	0.4 abc	2389
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	0.6	0.2 c	2148
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	0.5	0.3 bc	2002
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	0.4	0.3 abc	2397
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	0.8	0.2 c	2292
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	0.8	0.5 abc	2489
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	0.5	0.5 abc	2399
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	0.5	0.6 a	2152
9. VITAFLO-280	2.60 mL	0.9	0.6 ab	2734
10. Untreated Check	-	0.7	0.4 abc	2162
ANOVA ($P \leq 0.05$)		0.5285	0.0463	0.5033
Coefficient of Variation (%)		67.23	43.86	18.75

* The values in this table are the means of four replications. Numbers within a column followed by the same small letter are not significantly different according to a Duncan's Multiple Range Test ($P \leq 0.05$).

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted).

Table 1c. Results of four orthogonal comparisons for seed treatments applied to Envoy navy dry beans: Emergence and pod disease incidence.

	Required F	Emergence		Pod disease incidence	
Treatment comparisons*	(P≤0.05)	Observed F**	Group means (%)***	Observed F**	Group means (%)
#1 to #9 vs. #10	4.2	4.6	88.6 vs. 93.0	0.1	36.6 vs. 39.0
#1 to #8 vs. #9	4.2	1.3	88.3 vs. 91.1	3.2	35.0 vs. 49.0
#1 to #7 vs. #8	4.2	16.2	87.4 vs. 94.9	6.8	32.4 vs. 53.0
#1 to #4 vs. #5 to #7	4.2	36.8	83.5 vs. 92.6	2.7	28.5 vs. 37.7

* See Tables 1a and 1b for a list of the products that correspond with each treatment number.
** Test is significant when observed F is greater than required F.
*** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 1d. Results of four orthogonal comparisons for seed treatments applied to Envoy navy dry beans: Pod disease severity.

	Required F	Pod disease severity	
Treatment comparisons*	(P≤0.05)	Observed F**	Group means (0-4) ***
#1 to #9 vs. #10	4.2	0.0	0.4 vs. 0.4
#1 to #8 vs. #9	4.2	3.8	0.4 vs. 0.6
#1 to #7 vs. #8	4.2	7.4	0.3 vs. 0.6
#1 to #4 vs. #5 to #7	4.2	1.8	0.3 vs. 0.4

* See Tables 1a and 1b for a list of the products that correspond with each treatment number.
** Test is significant when observed F is greater than required F.
*** Severity rating: 0 = no disease, 1 = slight (1-10% pod surface blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted).

Table 2a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence and disease incidence on Viva pink dry beans in a field trial at Brooks, Alberta in 1998.*

Treatment	Rate of product /kg seed	Emergence (%)**	Disease incidence (%)**		
			Plants	Leaves	Pods
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	74.7	66.5	40.5	32.2
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	74.8	83.0	45.4	37.2
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	67.4	76.3	33.8	25.7
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	81.8	81.9	49.0	34.8
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	77.9	94.8	42.4	35.2
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	78.4	91.5	43.0	37.8
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	72.3	88.4	51.6	41.9
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	76.7	76.2	45.4	41.0
9. VITAFLO-280	2.60 mL	73.9	91.5	41.4	52.2
10. Untreated Check	-	75.9	81.1	49.6	26.7
ANOVA ($P \leq 0.05$)		0.9045	0.4473	0.8386	0.4869
Coefficient of Variation (%)		12.88	20.30	19.88	25.25

* The values in this table are the means of four replications.

** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 2b. The effect of nine fungicidal/bactericidal seed treatments on disease severity and seed yield on Viva pink dry beans in a field trial at Brooks, Alberta in 1998.*

Treatment	Rate of product /kg seed	Disease severity (0-4)** Leaves	Pod	Yield (g/16.8 m^2)
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	0.5	0.4	5870
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	0.6	0.4	6843
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	0.5	0.3	6315
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	0.6	0.4	6215
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	0.5	0.4	6048
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	0.6	0.4	6130
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	0.7	0.4	6370
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	0.5	0.5	6940
9. VITAFLO-280	2.60 mL	0.6	0.6	6588
10. Untreated Check	-	0.6	0.3	5665
ANOVA ($P \leq 0.05$)		0.6946	0.3815	0.9851
Coefficient of Variation (%)		32.05	41.86	26.33

* The values in this table are the means of four replications.

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted).

1998 PMR REPORT # 80 **SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS**
ICAR: 93000482

CROP: Dry bean (*Phaseolus vulgaris* L.), cv. US1140 (great northern type)
PEST: Halo blight, *Pseudomonas syringae* pv. *phaseolicola* (Burkh.) Young *et al.*; common blight, *Xanthomonas campestris* pv. *phaseoli* (Smith) Dye

NAME AND AGENCY:
HOWARD R J, LEDUC Y A and HUGGONS S P
Alberta Agriculture, Food and Rural Development
Crop Diversification Centre, South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1328 **Fax:** (403) 362-1326 **Email:** ron.howard@agric.gov.ab.ca

HOGG T J and PEDERSON M
Saskatchewan Irrigation Diversification Centre
Box 700
Outlook, Saskatchewan S0L 2N0
Tel: (306) 867-5405 **Fax:** (306) 867-9656 **Email:** Pf22405@em.agr.ca

TITLE: EFFICACY OF SEED TREATMENTS FOR THE CONTROL OF HALO BLIGHT AND COMMON BLIGHT ON DRY EDIBLE BEANS IN A FIELD TRIAL AT OUTLOOK, SASKATCHEWAN IN 1998

MATERIALS: BLUESTONE (copper sulphate 99% SG), KOCIDE LF (cupric hydroxide 23% SU), COPPER 53W (tribasic copper sulphate 53% WP), COPPER OXYCHLORIDE 50 (copper oxychloride 50% WP), ZINEB 80W (zineb 80% WP), DITHANE M-22 (maneb 80% WP), DITHANE DG (mancozeb 75% WDG), AGRICULTURAL STREPTOMYCIN (streptomycin sulphate 62.6% WP; equivalent to 50% streptomycin base), VITAFLO-280 (thiram 13.2% + carbathiin 14.9% SU), SELF-STICK™ (*Rhizobium leguminosarum* bv. *phaseoli* [1 x 10^9 viable cells/g])

METHODS: US1140 great northern dry bean seed artificially infested with halo blight (*Pseudomonas syringae* pv. *phaseolicola*) and common blight (*Xanthomonas campestris* pv. *phaseoli*) bacteria was treated with VITAFLO-280 alone or with this fungicidal product combined with one of the following fungicides/bactericides: BLUESTONE, KOCIDE LF, COPPER 53W, COPPER OXYCHLORIDE 50, ZINEB 80W, DITHANE M-22, DITHANE DG, or AGRICULTURAL STREPTOMYCIN. Three checks were included the trial, i.e. VITAFLO-280 alone, VITAFLO-280 + AGRICULTURAL STREPTOMYCIN, and no chemical treatment (untreated). Each chemical treatment (Tables 1a and 1b) was applied as a slurry to separate 600 g lots of seed using a Gustafson Batch Lab Treater. Distilled water (3.5 mL/kg seed) was used in preparing the slurries for chemical formulations that were in a powder or crystalline form. Before each lot was treated, 300 g of seed was run through the treater to pre-coat the drum with the respective chemical treatment in order to minimize adhesion losses during subsequent treatments. Each lot of treated seed was allowed to air dry in the dark for several hours and stored in a cooler until it was planted.

The seed was artificially infested with halo blight (*Psp*) and common blight (*Xcp*) bacteria prior to chemical treatment. Isolates of *Psp* and *Xcp* were added to separate flasks of nutrient broth and incubated for approximately 18 hours at room temperature (ca. 25EC) on a rotary shaker. Afterwards, the cultures were centrifuged for 10 minutes at 8000 rpm, the liquid portion was poured off and 100 mL of a phosphate-buffered saline solution was added to each tube containing the bacterial sediment. The saline solution was prepared with 0.1 M sodium phosphate dibasic anhydrous and 0.85% sodium chloride in sterile distilled water with the pH adjusted to 7.2 with 5 M hydrochloric acid. The tubes were hand shaken to resuspend the bacteria, and the *Psp* suspensions were combined in one flask and the *Xcp* suspensions in another. The density of each bacterial suspension was estimated under a microscope using a hemacytometer. Each bacterial suspension was then diluted with phosphate-buffered saline solution to a density of ca. 10^7 colony-forming units/mL and this was applied at a rate of 5 mL/kg seed for both the *Xcp* and *Psp*, i.e. 10 mL total bacterial suspension/kg seed, then tumbled in a drum. The inoculated seed was spread onto clean paper to air dry in a darkened area before dividing into ten, 600 g lots for subsequent seed treatment as described above.

Just prior to planting, *Rhizobium leguminosarum* bv. *phaseoli* inoculant (sterile, peat-based, SELF-STIK™) manufactured by MicroBio RhizoGen Corp., Saskatoon, SK was mixed with the seed at a rate of 1 g/818 g seed. The seed was planted on May 25 with a tractor-drawn, wide-row, 4-cone seeder operating only on two cones in a field plot at SIDC at Outlook, SK. The treatments were arranged in a randomized complete block design with four replications. Each treatment consisted of four, 6 m rows, 60 cm apart with 120 seeds per row. Rows were trimmed back to 5 m in length. The plot was irrigated, as needed, throughout the growing season.

Emergence was determined by counting all of the plants in each 5 m row on July 3. Blight incidence (% diseased plants) was rated on July 6 by counting the number of diseased plants in each row. Leaf blight incidence (number of diseased leaves) and severity (proportion of leaf area affected) were rated on July 3. Pod blight incidence (number of diseased pods) and severity (proportion of pod area affected) were not rated. Severity ratings were done on 50 leaves randomly selected from the centre two rows in each treatment plot. The visual assessment key for common bacterial blight of beans developed by James (1971) was used to estimate disease severity in the leaves, i.e. 0 = no disease, 1 = slight (1-10% leaf area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted). The trial was harvested on September 23. Seed yields and average weight (mg)/seed were subsequently determined for each subplot. Mean percentage data were transformed to arcsin or square root, where necessary, and subjected to ANOVA. Duncan's Multiple Range Test was used to compare treatment means where ANOVA tests were statistically significant (P#0.05) (see Tables 1a, 1b).

RESULTS: Blight levels across the trial were low to moderate. Significant differences (P#0.05) among treatments were observed for all data parameters, except seed weight (Tables 1a, 1b). Seed treated with KOCIDE LF or COPPER 53W had significantly lower emergence than the three checks and the other seed treatments. The highest emergence was observed from seed treated with DITHANE M-22, but this was not significantly different from any of the checks. Disease incidence amongst plants was significantly higher in the DITHANE M-22, VITAFLO-280 alone and untreated check treatments compared to the rest. Disease incidence and severity on the leaves was lowest in the KOCIDE LF, COPPER 53W, DITHANE DG and STREPTOMYCIN treatments, and was significantly different from the treatments that showed the most blight, i.e. the untreated check, VITAFLO-280 alone and DITHANE M-22. The highest yielding treatments, STREPTOMYCIN, DITHANE M-22, ZINEB 80W, and

VITAFLO-280 alone, were significantly different from the lowest yielding treatments, KOCIDE LF and COPPER OXYCHLORIDE 50.

Orthogonal analyses were used to compare the effects of one group or class of treatments to another group or class for data parameters with statistically significant (P#0.05) ANOVA tests (Tables 1c, 1d, 1e):
Treated vs. untreated seed (treatments 1 to 9 vs. 10): The treated seed group did not have significantly (P#0.05) different emergence or yield numbers compared to the untreated check. However, beans grown from treated seed had a significantly lower blight incidence on plants and leaves, and significantly lower disease severity on leaves, than those grown from untreated seed.
Treatments containing VITAFLO-280 + a bactericide vs. VITAFLO-280 alone (treatments 1 to 8 vs. 9): As a group, beans grown from seed treated with VITAFL0-280 + a bactericide had significantly (P#0.05) poorer emergence, reduced disease incidence on plants and leaves, and lower disease severity on leaves compared to those treated with VITAFLO-280 alone. There were no significant yield differences between these two treatment groups.
Metal ion-containing treatments vs. STREPTOMYCIN (treatments 1 to 7 vs. 8): There were no significant (P#0.05) differences in emergence, disease incidence on leaves, or disease severity on leaves between the group of seed treatments containing copper, zinc or manganese compared to the STREPTOMYCIN treatment. However, plants grown from STREPTOMYCIN-treated seed had significantly less disease incidence and significantly higher yields than those grown from seed treated with metal ion-containing products.
Copper-based vs. non-copper-based treatments (treatments 1 to 4 vs. 5 to 7): Treatments without copper had significantly (P#0.05) higher emergence, a higher incidence of blight on leaves, and higher yields than treatments containing the copper ion. There were no significant differences between the two groups for leaf blight incidence and severity.

CONCLUSIONS: Treating US1140 bean seed with KOCIDE LF or COPPER 53W significantly reduced emergence and resulted in lower yields. KOCIDE LF, COPPER 53W and DITHANE DG were as effective as STREPTOMYCIN at reducing disease incidence and severity on leaves. From orthogonal analyses, it can be concluded that the chemical seed treatments used in this trial, as a group, did not adversely affect the emergence or yield of US1140 beans. These treatments reduced disease incidence on plants and leaves and disease severity on leaves, but not to a level that was significantly different from the STREPTOMYCIN check. Amongst the metal ion-containing mixtures, the copper products adversely affected emergence and yields, but did appear to provide better disease control than STREPTOMYCIN.

REFERENCE: James, W.C. 1971. A manual of assessment keys for plant diseases. Publ. 1458, Agric. Canada, Ottawa.

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Table 1a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence and disease incidence on US1140 great northern dry beans in a field trial at Outlook, Saskatchewan, in 1998.*

Treatment	Rate of product /kg seed	Emergence (%)**	Disease incidence (%)**	
			Plants	Leaves
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	78.4 ab	16.7 b	26.8 bc
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	59.1 c	7.9 b	17.0 c
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	60.8 c	10.4 b	14.1 c
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	73.8 b	14.9 b	24.1 bc
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	78.3 ab	24.7 b	26.9 bc
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	81.6 a	51.3 a	42.0 ab
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	79.8 ab	23.2 b	12.9 c
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.0 g	78.3 ab	8.9 b	13.0 c
9. VITAFLO-280	2.60 mL	80.1 ab	54.1 a	41.8 ab
10. Untreated Check	-	78.5 ab	47.2 a	52.8 a
ANOVA ($P \leq 0.05$)		0.0001	0.0001	0.0010
Coefficient of Variation (%)		5.11	28.26	27.64

* The values in this table are the means of four replications. Numbers within the column followed by the same small letter are not significantly different according to a Duncan's Multiple Range Test ($P \leq 0.05$).

** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 1b. The effect of nine fungicidal/bactericidal seed treatments on disease severity, seed yield and seed weight on US1140 great northern dry beans in a field trial at Outlook, Saskatchewan, in 1998.*

Treatment	Rate of product /kg seed	Disease severity	Yield ($g/12\ m^2$)	Average seed weight (mg)
		Leaves (0-4)**		
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	0.3 cd	4048 ab	342
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	0.2 d	3663 b	344
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	0.2 d	3967 ab	349
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	0.3 cd	3642 b	341
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	0.3 bcd	4358 a	322
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	0.6 ab	4390 a	345
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	0.2 d	4128 ab	340
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.0 g	0.2 d	4632 a	347
9. VITAFLO-280	2.60 mL	0.5 abc	4340 a	337
10. Untreated Check	-	0.7 a	3960 ab	337
ANOVA ($P \leq 0.05$)		0.0003	0.0388	0.9600
Coefficient of Variation (%)		47.52	10.12	7.75

* The values in this table are the means of four replications. Numbers within a column followed by the same small letter are not significantly different according to a Duncan's Multiple Range Test ($P \leq 0.05$).

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted).

Table 1c. Results of four orthogonal comparisons for seed treatments applied to US1140 great northern dry beans: emergence and plant disease incidence.

	Required F	Emergence		Plant disease incidence	
Treatment comparisons*	(P≤0.05)	Observed F**	Group means (%)***	Observed F**	Group means (%)***
#1 to #9 vs. #10	4.2	2.4	74.5 vs. 78.5	12.5	23.6 vs. 47.2
#1 to #8 vs. #9	4.2	6.4	73.8 vs. 80.1	24.6	19.7 vs. 54.1
#1 to #7 vs. #8	4.2	3.8	73.1 vs. 78.3	4.4	21.3 vs. 8.9
#1 to #4 vs. #5 to #7	4.2	42.4	68.0 vs. 80.0	20.2	12.5 vs. 33.1

* See Tables 1a and 1b for a list of the products that correspond with each treatment number.
** Test is significant when observed F is greater than required F.
*** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 1d. Results of four orthogonal comparisons for seed treatments applied to US1140 great northern dry beans: leaf disease incidence and leaf disease severity.

	Required F	Leaf disease incidence		Leaf disease severity	
Treatment comparisons*	(P≤0.05)	Observed F**	Group means (%)	Observed F**	Group means (0-4)***
#1 to #9 vs. #10	4.2	18.3	25.6 vs. 52.5	21.0	0.3 vs. 0.7
#1 to #8 vs. #9	4.2	8.5	23.5 vs. 42.0	6.3	0.3 vs. 0.5
#1 to #7 vs. #8	4.2	2.3	24.7 vs. 15.0	2.5	0.3 vs. 0.2
#1 to #4 vs. #5 to #7	4.2	1.9	22.0 vs. 28.3	3.5	0.2 vs. 0.3

* See Tables 1a and 1b for a list of the products that correspond with each treatment number.
** Test is significant when observed F is greater than required F.
*** Severity rating: 0 = no disease, 1 = slight (1-10% leaf area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted).

Table 1e. Results of four orthogonal comparisons for seed treatments applied to US1140 great northern dry beans: yield.

	Required F	Yield	
Treatment comparisons*	(P≤0.05)	Observed F**	Group means (g/12 m^2)
#1 to #9 vs. #10	4.2	0.6	4130 vs. 3960
#1 to #8 vs. #9	4.2	1.2	4104 vs. 4340
#1 to #7 vs. #8	4.2	7.4	4028 vs. 4632
#1 to #4 vs. #5 to #7	4.2	8.4	3830 vs. 4292

* See Tables 1a and 1b for a list of the products that correspond with each treatment number.
** Test is significant when observed F is greater than required F.

1998 PMR REPORT # 81 **SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS**
ICAR: 93000482

CROP: Dry bean (*Phaseolus vulgaris* L.), cvs. Othello (pinto type), UI906 (black type), AC Skipper (navy type)
PEST: Halo blight, *Pseudomonas syringae* pv. *phaseolicola* (Burkh.) Young *et al.*; common blight, *Xanthomonas campestris* pv. *phaseoli* (Smith) Dye

NAME AND AGENCY:
HOWARD R J, LEDUC Y A and HUGGONS S P
Alberta Agriculture, Food and Rural Development,
Crop Diversification Centre, South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1328 **Fax:** (403) 362-1326 **Email:** ron.howard@agric.gov.ab.ca

NLEYA, T and VANDENBERG, A
Crop Development Centre, University of Saskatchewan, 51 Campus Drive
Saskatoon, Saskatchewan S7N 5A8
Tel: (306) 966-8683 **Fax:** (306) 966-5015 **Email:** nleya@sask.usask.ca

TITLE: EFFICACY OF SEED TREATMENTS FOR THE CONTROL OF HALO BLIGHT AND COMMON BLIGHT ON DRY EDIBLE BEANS IN FIELD TRIALS AT SASKATOON, SASKATCHEWAN IN 1998

MATERIALS: BLUESTONE (copper sulphate 99% SG), KOCIDE LF (cupric hydroxide 23% SU), COPPER 53W (tribasic copper sulphate 53% WP), COPPER OXYCHLORIDE 50 (copper oxychloride 50% WP), ZINEB 80W (zineb 80% WP), DITHANE M-22 (maneb 80% WP), DITHANE DG (mancozeb 75% WDG), AGRICULTURAL STREPTOMYCIN (streptomycin sulphate 62.6% WP; equivalent to 50% streptomycin base), VITAFLO-280 (thiram 13.2% + carbathiin 14.9% SU), SELF-STICK™ (*Rhizobium leguminosarum* bv. *phaseoli* [1 x 10^9 viable cells/g])

METHODS: Three types of bean seed, Othello (pinto), UI906 (black) and AC Skipper (navy), artificially infested with halo blight (*Pseudomonas syringae* pv. *phaseolicola*) and common blight (*Xanthomonas campestris* pv. *phaseoli*) bacteria were treated with VITAFLO-280 alone or with this fungicidal product combined with one of the following fungicides/bactericides: BLUESTONE, KOCIDE LF, COPPER 53W, COPPER OXYCHLORIDE 50, ZINEB 80W, DITHANE M-22, DITHANE DG, or AGRICULTURAL STREPTOMYCIN. Three checks were included in each trial, i.e. VITAFLO-280 alone, VITAFLO-280 + AGRICULTURAL STREPTOMYCIN, and no chemical treatment (untreated). Each chemical treatment (Tables 1a, 1b, 2a, 2b, 3a, 3b) was applied as a slurry to separate lots of seed, i.e. 700 g of Othello, 300 g of UI906 and 450 g of AC Skipper. Distilled water (3.5 mL/kg seed) was used in preparing the slurries for chemical formulations that were in a powder or crystalline form. The seed treatment mixtures were applied in the laboratory with a Gustafson Batch Lab Treater. Before each lot was treated, 300 g of seed was run through the treater to pre-coat the drum with the respective chemical treatment in order to minimize adhesion losses during subsequent treatments. Each lot of treated seed was allowed to air dry in the dark for several hours and stored in a cooler until it was planted.

The seed was artificially infested with halo blight (*Psp*) and common blight (*Xcp*) bacteria prior to chemical treatment. Isolates of *Psp* and *Xcp* were added to separate flasks of nutrient broth and incubated for approximately 18 hours at room temperature (ca. 25EC) on a rotary shaker. Afterwards, the cultures were centrifuged for 10 minutes at 8000 rpm, the liquid portion was poured off and 100 mL of a phosphate- buffered saline solution was added to each tube containing the bacterial sediment. The saline solution was prepared with 0.1 M sodium phosphate dibasic anhydrous and 0.85% sodium chloride in sterile distilled water with the pH adjusted to 7.2 with 5 M hydrochloric acid. The tubes were hand shaken to resuspend the bacteria, and the *Psp* suspensions were combined in one flask and the *Xcp* suspensions in another. The density of each bacterial suspension was estimated under a microscope using a hemacytometer. Each bacterial suspension was then diluted with phosphate-buffered saline solution to a density of ca. 10^7 colony-forming units/mL and this was applied at a rate of 5 mL/kg seed for both the *Xcp* and *Psp*, i.e. 10 mL total bacterial suspension/kg seed, then tumbled in a drum. The inoculated seed was spread onto clean paper to air dry in a darkened area before dividing each variety into ten lots for subsequent seed treatment as described above.

Just prior to planting, *Rhizobium leguminosarum* bv. *phaseoli* inoculant (sterile, peat-based, SELF-STIK™) manufactured by MicroBio RhizoGen Corp., Saskatoon, SK was mixed with the seed at a rate of 1 g/818 g seed. The three trials were planted on May 27 with a tractor-drawn, narrow-row, 4-cone seeder in a field plot at the University of Saskatchewan, in Saskatoon, SK. The treatments were arranged in a randomized complete block design with four replications. Each treatment consisted of four, 6 m rows, 30 cm apart with 120 seeds per row. The rows were trimmed to 5 m. The plots were not irrigated.

Emergence was determined by counting all of the plants in each 5 m row on July 2 (Othello and UI906) and July 3 (AC Skipper). Blight incidence (% diseased plants) was rated on July 2 (Othello) and July 29 (Othello, UI906 and AC Skipper) by counting the number of diseased plants in each row. Leaf blight incidence (number of diseased leaves) and severity (proportion of leaf area affected) were rated on July 29 in all three bean types. Pod blight incidence (number of diseased pods) and severity (proportion of pod surface affected) were not rated. Severity ratings were done on 50 leaves randomly selected from the centre two rows in each treatment plot. The visual assessment key for common bacterial blight of beans developed by James (1971) was used to estimate disease severity in the leaves, i.e. 0 = no disease, 1 = slight (1-10% leaf area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted). The trials were harvested on October 8 and seed yields were subsequently determined for each subplot. Mean percentage data were transformed to arcsin or square root, where necessary, and subjected to ANOVA. Duncan's Multiple Range Test was used to compare treatment means where ANOVA tests were statistically significant (P#0.05).

RESULTS: *Othello* - Bacterial blight levels in this trial were relatively low. No significant differences ($P \leq 0.05$) among treatments were observed for any of the data parameters (Tables 1a, 1b), except for disease incidence among the plants measured on July 2, at which time disease levels were very low. On this date, disease incidence was highest for the untreated check and for seed treated with VITAFLO-280 alone, and these two treatments were significantly different from the COPPER 53W, ZINEB 80W, DITHANE DG and STREPTOMYCIN treatments, which had the lowest disease incidence. When disease incidence was measured approximately one month later, there were no significant differences amongst the treatments. Also, there were no significant differences between treatments for emergence.

UI906: Levels of bacterial blight infection in this trial were also relatively low. No significant differences ($P \leq 0.05$) among treatments were observed for any of the data parameters measured (Tables 2a, 2b).

AC Skipper - Significant differences ($P \leq 0.05$) among treatments were observed for emergence and yield, but not for disease incidence or severity (Tables 3a, 3b). Emergence was highest and significantly different from the untreated check for seed treated with BLUESTONE, DITHANE M-22, ZINEB 80W and VITAFLO-280 alone, but these treatments were not significantly different from the STREPTOMYCIN check. Emergence was lowest, and significantly different from all three checks, for KOCIDE LF, COPPER 53W and COPPER OXYCHLORIDE 50. Yields were highest for BLUESTONE, ZINEB 80W and STREPTOMYCIN, and lowest for KOCIDE LF, COPPER 53W and COPPER OXYCHLORIDE 50. However, neither the treatments with the lowest yields, nor those with the highest yields, were significantly different from the untreated check.

Orthogonal analyses were used to compare the effects of one group or class of treatments to another group or class for data parameters with statistically significant ($P \leq 0.05$) ANOVA tests (Tables 1c, 3c).
Treated vs. untreated seed (treatments 1 to 9 vs. 10): In Othello, there were significant differences between the treatment groups for disease incidence at an early stage of crop development. The treated seed group had a significantly lower disease incidence in plants than the untreated check. In AC Skipper, there were no significant differences between the treated and untreated groups for emergence or yield.
Treatments containing VITAFLO-280 + a bactericide vs. VITAFLO-280 alone (treatments 1 to 8 vs. 9): Othello seed treated with VITAFLO-280 in combination with a bactericide had significantly less disease incidence than when it was treated with VITAFLO-280 alone. In AC Skipper, seed treated with VITAFLO-280 alone showed significantly better emergence than seed treated with VITAFLO-280 plus another chemical. There were no significant differences in yield between plants grown from seed treated with VITAFLO-280 alone and from seed treated with VITAFLO-280 and a bactericide.
Metal ion-containing treatments vs. STREPTOMYCIN (treatments 1 to 7 vs. 8): In Othello, STREPTOMYCIN-treated seed did not differ significantly different from the metal-containing products. In AC Skipper, STREPTOMYCIN-treated seed showed significantly higher emergence than in the group of metal ion-containing products. However, in this same comparison, there was no significant difference in yield between the two groups.
Copper-based vs. non-copper-based treatments (treatments 1 to 4 vs. 5 to 7: In Othello, the non-copper products did not differ significantly from the copper product group. In AC Skipper, the non-copper products had significantly higher emergence and yields than the copper products.

CONCLUSIONS: The application of a bactericidal seed treatment, in addition to the VITAFLO-280, appeared to slow down the development of disease in Othello beans at an early stage of crop development. As the crop matured, however, none of the treatments appeared to have any significant effect on disease development and expression. In the Othello and UI906 trials, none of the chemical treatments adversely affected emergence compared to the untreated check. However, with AC Skipper, KOCIDE LF-, COPPER 53W- and COPPER OXYCHLORIDE 50-treated seed had significantly lower emergence than seed treated with the zinc-, manganese- and streptomycin-containing products, and this appeared to be correlated with lower yields. None of the treatments appeared to have any statistically significant effect on disease development.

REFERENCE: James, W.C. 1971. A manual of assessment keys for plant diseases. Publ. 1458, Agric. Canada, Ottawa.

ACKNOWLEDGEMENTS: We thank Mr. M.A. Briant, Ms. S.M. Sims and Ms. C.L. Bandura for technical assistance.

Table 1a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence and disease incidence on Othello pinto dry beans in a field trial at Saskatoon, Saskatchewan, in 1998.*

Treatment	Rate of product /kg seed	Emergence (%)	Disease incidence (%)		
			July 2 Plants**	July 29 Plants**	Leaves***
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	74.3	2.6 bc	16.3	30.2
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	72.8	2.4 bc	23.8	40.6
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	66.8	0.5 c	25.0	43.5
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	72.8	3.2 bc	19.0	32.4
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	78.0	2.2 c	26.5	55.6
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	76.8	4.2 abc	24.6	48.5
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	76.0	1.8 c	19.5	31.3
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	72.5	1.0 c	24.2	16.8
9. VITAFLO-280	2.60 mL	76.8	10.9 a	31.8	56.6
10. Untreated Check	-	73.0	8.6 ab	33.7	48.7
ANOVA ($P \leq 0.05$)		0.2694	0.0103	0.2007	0.3663
Coefficient of Variation (%)		7.59	43.4	20.1	36.63

* The values in this table are the means of four replications. Numbers within a column followed by the same small letter are not significantly different according to a Duncan's Multiple Range Test ($P \leq 0.05$).

** These data were square root transformed before ANOVA and the detransformed means are presented here.

*** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 1b. The effect of nine fungicidal/bactericidal seed treatments on disease severity and seed yield on Othello pinto dry beans in a field trial at Saskatoon, Saskatchewan, in 1998.*

Treatment	Rate of product /kg seed	Disease severity Leaves (0-4)**	Yield ($g/6\ m^2$)
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	0.3	511
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	0.4	622
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	0.5	539
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	0.4	591
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	0.6	596
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	0.5	611
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	0.4	517
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	0.3	477
9. VITAFLO-280	2.60 mL	0.6	792
10. Untreated Check	-	0.5	529
ANOVA ($P \leq 0.05$)		0.5253	0.7349
Coefficient of Variation (%)		48.78	37.96

* The values in this table are the means of four replications.

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted).

Table 1c. Results of four orthogonal comparisons for seed treatments applied to Othello pinto dry beans.

	Required F	Plant disease incidence	
Treatment comparisons*	($P \leq 0.05$)	Observed F**	Group Means (%)***
#1 to #9 vs. #10	4.2	7.3	3.2 vs. 8.6
#1 to #8 vs. #9	4.2	15.5	2.2 vs. 10.9
#1 to #7 vs. #8	4.2	0.9	2.4 vs. 1.0
#1 to #4 vs. #5 to #7	4.2	0.3	2.2 vs. 2.7

* See Tables 1a and 1b for a list of the treatment products that correspond with each number.
** Test is significant when observed F is greater than required F.
*** These data were square root transformed before ANOVA and the detransformed means are presented here.

Table 2a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence and disease incidence on UI906 black dry beans in a field trial at Saskatoon, Saskatchewan, in 1998.*

Treatment	Rate of product /kg seed	Emergence (%)	Disease incidence (%)**	
			Plants	Leaves
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	64.5	6.4	24.2
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	64.0	8.2	21.4
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	65.3	12.6	26.4
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	63.3	7.6	30.3
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	64.5	15.9	35.7
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	68.5	21.6	35.5
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	64.5	5.8	19.8
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	69.0	3.8	34.8
9. VITAFLO-280	2.60 mL	65.3	8.7	27.0
10. Untreated Check	-	64.5	13.1	30.4
ANOVA ($P \leq 0.05$)		0.7924	0.5252	0.8581
Coefficient of Variation (%)		7.55	56.64	32.33

* The values in this table are the means of four replications.

** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 2b. The effect of nine fungicidal/bactericidal seed treatments on disease severity and seed yield on UI906 black dry beans in a field trial at Saskatoon, Saskatchewan, in 1998.*

Treatment	Rate of product /kg seed	Disease severity	Yield ($g/6\ m^2$)
		Leaves (0-4)**	
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	0.3	551
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	0.3	624
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	0.4	573
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	0.4	550
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	0.6	571
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	0.5	448
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	0.2	539
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	0.4	674
9. VITAFLO-280	2.60 mL	0.5	362
10. Untreated Check	-	0.4	483
ANOVA ($P \leq 0.05$)		0.6544	0.5949
Coefficient of Variation (%)		65.63	36.18

* The values in this table are the means of four replications.

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted).

Table 3a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence and disease incidence on AC Skipper navy dry beans in a field trial at Saskatoon, Saskatchewan, in 1998.*

Treatment	Rate of product /kg seed	Emergence (%)**	Disease incidence (%)	
			Plant***	Leaf**
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	71.9 a	3.9	13.1
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	30.2 c	7.3	5.2
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	26.2 c	11.9	15.4
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	32.9 c	5.8	6.9
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	70.4 a	18.0	29.5
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	72.6 a	12.6	30.8
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	57.6 b	22.1	27.7
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	63.8 ab	5.2	9.4
9. VITAFLO-280	2.60 mL	70.2 a	12.1	23.2
10. Untreated Check	-	59.3 b	13.6	18.9
ANOVA ($P \leq 0.05$)		0.0001	0.3934	0.1438
Coefficient of Variation (%)		8.23	49.39	47.34

* The values in this table are the means of four replications. Numbers within a column followed by the same small letter are not significantly different according to a Duncan's Multiple Range Test ($P \leq 0.05$).

** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

*** These data were square root transformed before ANOVA and the detransformed means are presented here.

Table 3b. The effect of nine fungicidal/bactericidal seed treatments on disease severity and seed yield on AC Skipper Navy dry beans in a field trial at Saskatoon, Saskatchewan, in 1998.*

Treatment	Rate of product /kg seed	Disease severity Leaves (0-4)**	Yield ($g/6\ m^2$)
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	0.1	652 a
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	0.1	332 bc
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	0.2	280 c
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	0.1	331 bc
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	0.3	591 a
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	0.3	511 ab
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	0.3	522 ab
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	0.1	610 a
9. VITAFLO-280	2.60 mL	0.3	547 ab
10. Untreated Check	-	0.2	480 abc
ANOVA ($P \leq 0.05$)		0.2783	0.0051
Coefficient of Variation (%)		81.8	28.17

* The values in this table are the means of four replications. Numbers within the column followed by the same small letter are not significantly different according to a Duncan's Multiple Range Test ($P \leq 0.05$).

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted).

Table 3c. Results of four orthogonal comparisons for seed treatments applied to AC Skipper navy beans.

Treatment comparisons*	Required F ($P \leq 0.05$)	Emergence		Yield	
		Observed F**	Group means (%)***	Observed F**	Group means (g/6 m^2)
#1 to #9 vs. #10	4.2	1.3	55.1 vs. 59.3	0.0	486 vs. 480
#1 to #8 vs. #9	4.2	22.6	53.2 vs. 70.2	0.9	478 vs. 547
#1 to #7 vs. #8	4.2	10.8	51.7 vs. 63.8	4.2	460 vs. 609
#1 to #4 vs. #5 to #7	4.2	106.7	40.3 vs. 66.9	7.4	399 vs. 541

* See Tables 3a and 3b for a list of the treatment products that correspond with each number.
** Test is significant when observed F is greater than required F.
*** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

1998 PMR REPORT # 82 **SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS**
ICAR: 93000482

CROP: Dry bean (*Phaseolus vulgaris* L.), cv. NW63 (red Mexican type)
PEST: Halo blight, *Pseudomonas syringae* pv. *phaseolicola* (Burkh.) Young *et al.*; common blight, *Xanthomonas campestris* pv. *phaseoli* (Smith) Dye

NAME AND AGENCY:
HOWARD R J, LEDUC Y A, and HUGGONS S P
Alberta Agriculture, Food and Rural Development
Crop Diversification Centre, South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1328 **Fax:** (403) 362-1326 **Email:** ron.howard@agric.gov.ab.ca

XUE A G and TUEY H
Agriculture and Agri-Food Canada
Morden Research Centre
Unit 100 - 101 Route 100, Morden, Manitoba R6M 1Y5
Tel: (204) 822-7221 **Fax:** (204) 822-7207 **Email:** axue@em.agr.ca

TITLE: EFFICACY OF SEED TREATMENTS FOR THE CONTROL OF HALO BLIGHT AND COMMON BLIGHT ON DRY EDIBLE BEANS IN A FIELD TRIAL AT MORDEN, MANITOBA IN 1998

MATERIALS: BLUESTONE (copper sulphate 99% SG), KOCIDE LF (cupric hydroxide 23% SU), COPPER 53W (tribasic copper sulphate 53% WP), COPPER OXYCHLORIDE 50 (copper oxychloride 50% WP), ZINEB 80W (zineb 80% WP), DITHANE M-22 (maneb 80% WP), DITHANE DG (mancozeb 75% WDG), AGRICULTURAL STREPTOMYCIN (streptomycin sulphate 62.6% WP; equivalent to 50% streptomycin base), VITAFLO-280 (thiram 13.2% + carbathiin 14.9% SU), SELF-STICK™ (*Rhizobium leguminosarum* bv. *phaseoli* [1 x 10^9 viable cells/g])

METHODS: NW63 red Mexican dry bean seed artificially infested with halo blight (*Pseudomonas syringae* pv. *phaseolicola*) and common blight (*Xanthomonas campestris* pv. *phaseoli*) bacteria was treated with VITAFLO-280 alone or with this fungicidal product combined with one of the following fungicides/bactericides: BLUESTONE, KOCIDE LF, COPPER 53W, COPPER OXYCHLORIDE 50, ZINEB 80W, DITHANE M-22, DITHANE DG, or AGRICULTURAL STREPTOMYCIN. Three checks were included the trial, i.e. VITAFLO-280 alone, VITAFLO-280 + AGRICULTURAL STREPTOMYCIN, and no chemical treatment (untreated). Each chemical treatment (Tables 1a, 1b) was applied as a slurry to separate 600 g lots of seed using a Gustafson Batch Lab Treater. Distilled water (3.5 mL/kg seed) was used in preparing the slurries for chemical formulations that were in a powder or crystalline form. Before each lot was treated, 300 g of seed was run through the treater to pre-coat the drum with the respective chemical treatment in order to minimize adhesion losses during subsequent treatments. Each lot of treated seed was allowed to air dry in the dark for several hours and stored in a cooler until it was planted.

The seed was artificially infested with halo blight (*Psp*) and common blight (*Xcp*) bacteria before chemical treatment. Isolates of *Psp* and *Xcp* were added to separate flasks of nutrient broth and incubated for approximately 18 hours at room temperature (ca. 25EC) on a rotary shaker. Afterwards, the cultures were centrifuged for 10 minutes at 8000 rpm, the liquid portion was poured off and 100 mL of a phosphate-buffered saline solution was added to each tube containing the bacterial sediment. The saline solution was prepared with 0.1 M sodium phosphate dibasic anhydrous and 0.85% sodium chloride in sterile distilled water with the pH adjusted to 7.2 with 5 M hydrochloric acid. The tubes were hand shaken to resuspend the bacteria, and the *Psp* suspensions were combined in one flask and the *Xcp* suspensions in another. The density of each bacterial suspension was estimated under a microscope using a hemacytometer. Each bacterial suspension was then diluted with phosphate-buffered saline solution to a density of ca. 10^7 colony-forming units/mL and this was applied at a rate of 5 mL/kg seed for both the *Xcp* and *Psp*, i.e. 10 mL total bacterial suspension/kg seed, then tumbled in a drum. The inoculated seed was spread onto clean paper to air dry in a darkened area before dividing into ten, 600 g lots for subsequent seed treatment as described above.

Just prior to planting, *Rhizobium leguminosarum* bv. *phaseoli* inoculant (sterile, peat-based, SELF-STIK™) manufactured by MicroBio RhizoGen Corp., Saskatoon, SK was mixed with the seed at a rate of 1 g/818 g seed. The seed was planted on May 21 with a tractor-drawn, narrow-row, 4-cone seeder in a field plot at the Agriculture and Agri-Food Canada Research Station at Morden, Manitoba. The treatments were arranged in a randomized complete block design with four replications. Each treatment consisted of four, 6 m rows, 30 cm apart with 120 seeds per row. Rows were trimmed back to 5 m in length. The plot was not irrigated.

Emergence was determined by counting all of the plants in each 6 m row (untrimmed) over the period June 16-18. Blight incidence (% diseased plants) was rated on August 11 by examining 20 plants at the ends of the centre two rows of each treatment plot (10 from one row and 10 from the other row at the opposite end) and counting the number of diseased plants among them. Leaf blight incidence (number of diseased leaves) and severity (proportion of leaf area affected) and pod blight incidence (number of diseased pods) and severity (proportion of pod area affected) were all rated on August 11. Severity ratings were done on 50 leaves and 60 pods randomly selected from the centre two rows in each treatment plot. The visual assessment key for common bacterial blight of beans developed by James (1971) was used to estimate disease severity in the leaves and pods, i.e. 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted). The trial was harvested on September 8. Seed yields were subsequently determined for each subplot. Mean percentage data were transformed to arcsin or square root, where necessary, and subjected to ANOVA. Duncan's Multiple Range Test was used to compare treatment means where ANOVA tests were statistically significant (P#0.05) (see Tables 1a, 1b).

RESULTS: Blight levels in this trial were high. No significant differences ($P \leq 0.05$) among treatments were observed for any of the seven data parameters measured (Tables 1a, 1b).

CONCLUSIONS: The potential benefits of seed treatment for increasing seedling emergence and seed yields and on reducing disease incidence and severity were not clearly demonstrated in this trial. Nonetheless, the nine product combinations under test applied at the rates indicated did not appear to have any significant negative effects on emergence or plant development.

REFERENCE: James, W.C. 1971. A manual of assessment keys for plant diseases. Publ. 1458, Agric. Canada, Ottawa.

ACKNOWLEDGEMENTS: We thank Mr. M.A. Briant, Ms. S.M. Sims and Ms. C.L. Bandura for technical assistance.

Table 1a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence and disease incidence on NW63 red Mexican dry beans in a field trial at Morden, Manitoba, in 1998.*

Treatment	Rate of product /kg seed	Emergence (%)**	Disease incidence (%)**		
			Plants	Leaves	Pods
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	82.5	100	88.4	57.6
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	79.7	100	87.4	56
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	89.1	100	86.9	60.2
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	79.9	100	89	57.2
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	85.7	100	92.5	54.2
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	83.7	100	92.3	53.9
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	81.7	100	89	54.7
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	85.6	100	89.5	60
9. VITAFLO-280	2.60 mL	86	100	91	57.7
10. Untreated Check	-	85.5	100	89.9	60.6
ANOVA ($P \leq 0.05$)		0.3394	1	0.81	0.875
Coefficient of Variation (%)		3.26	0	2.77	6.25

* The values in this table are the means of four replications.

** These data were square root transformed before ANOVA and the detransformed means are presented here.

Table 1b. The effect of nine fungicidal/bactericidal seed treatments on disease severity and seed yield on NW63 red Mexican dry beans in a field trial at Morden, Manitoba, in 1998.*

Treatment	Rate of product /kg seed	Disease severity (0-4)**		Yield (g/6 m^2)
		Leaves	Pods	
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	1.3	0.7	2248
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	1.3	0.7	2368
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	1.3	0.7	2235
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	1.3	0.7	2152
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	1.4	0.6	2210
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	1.3	0.6	2190
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	1.2	0.7	2193
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	1.4	0.7	2327
9. VITAFLO-280	2.60 mL	1.4	0.7	2210
10. Untreated Check	-	1.3	0.7	2260
ANOVA ($P \leq 0.05$)		0.826	0.6918	0.7512
Coefficient of Variation (%)		12.23	15.17	7.3

* The values in this table are the means of four replications.

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted).

1998 PMR REPORT # 83 SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS
ICAR: 93000482

CROP: Dry bean (*Phaseolus vulgaris* L.), cvs. Envoy (navy type) and UI906 (black type)
PEST: Halo blight, *Pseudomonas syringae* pv. *phaseolicola* (Burkh.) Young *et al.*; common blight, *Xanthomonas campestris* pv. *phaseoli* (Smith) Dye

NAME AND AGENCY:
HOWARD R J, LEDUC Y A and HUGGONS S P
Alberta Agriculture, Food and Rural Development
Crop Diversification Centre, South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1328 **Fax:** (403) 362-1326 **Email:** ron.howard@agric.gov.ab.ca

GILLARD, C L and HARDY, D
Ridgetown College, University of Guelph
Ridgetown, Ontario N0P 2C0
Tel: (519) 674-1632 **Fax:** (519) 674-1600 **Email:** cgillard@ridgetownc.uoguelph.ca

TITLE: EFFICACY OF SEED TREATMENTS FOR THE CONTROL OF HALO BLIGHT AND COMMON BLIGHT ON DRY EDIBLE BEANS IN FIELD TRIALS AT EXETER, ONTARIO, IN 1998

MATERIALS: BLUESTONE (copper sulphate 99% SG), KOCIDE LF (cupric hydroxide 23% SU), COPPER 53W (tribasic copper sulphate 53% WP), COPPER OXYCHLORIDE 50 (copper oxychloride 50% WP), ZINEB 80W (zineb 80% WP), DITHANE M-22 (maneb 80% WP), DITHANE DG (mancozeb 75% WDG), AGRICULTURAL STREPTOMYCIN (streptomycin sulphate 62.6% WP; equivalent to 50% streptomycin base), VITAFLO-280 (thiram 13.2% + carbathiin 14.9% SU), SELF-STICK™ (*Rhizobium leguminosarum* bv. *phaseoli* [1 x 10^9 viable cells/g])

METHODS: Envoy navy bean seed naturally infested with halo blight (*Pseudomonas syringae* pv. *phaseolicola*) and common blight (*Xanthomonas campestris* pv. *phaseoli*) bacteria, and UI906 black bean seed artificially infested with the same two pathogens, were treated with VITAFLO-280 alone or with this fungicidal product combined with one of the following fungicides/bactericides: BLUESTONE, KOCIDE LF, COPPER 53W, COPPER OXYCHLORIDE 50, ZINEB 80W, DITHANE M-22, DITHANE DG, or AGRICULTURAL STREPTOMYCIN. Three checks were included in each trial, i.e. VITAFLO-280 alone, VITAFLO-280 + AGRICULTURAL STREPTOMYCIN, and no chemical treatment (untreated). Each chemical treatment (Tables 1a, 1b, 2a, 2b) was applied as a slurry to separate lots of seed, i.e. 350 g of Envoy and 300 g of UI906. Distilled water (3.5 mL/kg seed) was used in preparing the slurries for chemical formulations that were in a powder or crystalline form. The seed treatment mixtures were applied in the laboratory with a Gustafson Batch Lab Treater. Before each lot was treated, 300 g of seed was run through the treater to pre-coat the drum with the respective chemical treatment in order to minimize adhesion losses during subsequent treatments. Each lot of treated seed was allowed to air dry in the dark for several hours and stored in a cooler until it was planted.

The UI906 seed was artificially infested with halo blight (*Psp*) and common blight (*Xcp*) bacteria prior to chemical treatment. Isolates of *Psp* and *Xcp* were added to separate flasks of nutrient broth and incubated for approximately 18 hr at room temperature (ca. 25EC) on a rotary shaker. Afterwards, the cultures were centrifuged for 10 min at 8000 rpm, the liquid portion was poured off, and 100 mL of a phosphate-buffered saline solution was added to each tube containing the bacterial sediment. The saline solution was prepared with 0.1 M sodium phosphate dibasic anhydrous and 0.85% sodium chloride in sterile distilled water with the pH adjusted to 7.2 with 5 M hydrochloric acid. The tubes were hand shaken to resuspend the bacteria, and the *Psp* suspensions were combined in one flask and the *Xcp* suspensions in another. The density of each bacterial suspension was estimated under a microscope using a hemacytometer. Each bacterial suspension was then diluted with phosphate-buffered saline solution to a density of ca. 10^7 colony-forming units/mL and this inoculum was applied at a rate of 5 mL/kg seed for both the *Xcp* and *Psp*, i.e. 10 mL total bacterial suspension/kg seed, then tumbled in a drum. The inoculated seed was spread onto clean paper to air dry in a darkened area before dividing into ten, 350 g lots for subsequent seed treatment as described above. An agar plating test determined that the Envoy seed had sufficient natural infestation and did not need to be inoculated with blight bacteria.

Just prior to planting, *Rhizobium leguminosarum* bv. *phaseoli* inoculant (sterile, peat-based, SELF-STIK™) manufactured by MicroBio RhizoGen Corp., Saskatoon, SK was mixed with the seed at a rate of 1 g/818 g seed. Both types of beans were planted on June 15 with a self-propelled, narrow row, precision planter in plots at the Huron Research Station, Exeter, Ontario. The treatments were arranged in a randomized complete block design with four replications. Each treatment consisted of four, 6 m rows, 37.5 cm apart, with 120 seeds per row. Buffer strips of winter wheat were planted in one direction between subplots and around the perimeter of the entire plot. Harvest stakes were placed one metre in from each end to delineate the centre 4 m of each row. Additionally, one half metre was trimmed off the end of each plot, reducing the total row length to 5 m. The plots were not irrigated. Fertilizer (6-28-28) had been applied to the plot area on May 22 at a rate of 100 kg/ha. Both experiments were treated with Cygon on July 17 at a rate of 1 L/ha to control potato leafhoppers. Plots were weeded by hand.

Emergence was determined 4 wk after seeding by counting all of the plants along the centre 4 m of each row. Blight incidence (number of diseased plants, leaves or pods) was not rated. Blight severity was visually rated at flowering (leaves and stems assessed) and again just prior to harvest (pods and stems assessed) by estimating the proportion of plant area covered with lesions. The visual assessment key for common bacterial blight of beans developed by James (1971) was used to estimate disease severity in the leaves and pods, i.e. 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted). The assessment key was modified for assessing the stem area affected by lesions. UI906 was harvested on September 12 and Envoy on September 23. Yield (centre 4 m of each row harvested), seed weight (g/100 seed) and seed quality (visual rating where 1 = good and 5 = poor) were subsequently determined for each subplot. Mean percentage data were transformed to arcsin or square root, where necessary, and subjected to ANOVA. Duncan's Multiple Range Test was used to compare treatment means where ANOVA tests were statistically significant (P#0.05) (see Tables 1a, 1b, 2a, 2b).

RESULTS: *Envoy (naturally infested seed)* - Although very low levels of bacterial blight occurred in this trial, significant differences ($P \leq 0.05$) among treatments were observed for emergence, blight severity, seed weight and seed quality (Tables 1a, 1b). None of the seed treatments significantly improved emergence over any of the three checks. Seed treated with KOCIDE LF, COPPER 53W and COPPER

OXYCHLORIDE 50 had significantly lower emergence than the three checks, and seed treated with DITHANE DG had significantly lower emergence than those treated with either STREPTOMYCIN or VITAFLO-280 alone. No significant differences in blight severity were noted for the initial rating at flowering; however, for the second rating just prior to harvest, plants grown from seed treated with a metal-containing product had statistically equivalent or a significantly higher blight severity than any of the three checks. Plants grown from seed treated with COPPER OXYCHLORIDE 50 had significantly more blight than any other treatment, except KOCIDE LF. The latter produced plants with significantly more blight than both the STREPTOMYCIN and VITAFLO-280 checks.

All treatments produced significantly larger average seed weights or the same average seed weight when compared to the three checks (Table 1b). The KOCIDE LF treatment produced seed with significantly greater average weight than any other treatment, including the untreated check. The COPPER 53W treatment produced seed with a significantly greater average weight than the untreated and STREPTOMYCIN checks, as well as the DITHANE M-22 treatment. Seed quality was comparable among treatments with one exception, seed from KOCIDE LF subplots had a significantly higher rating than any other treatment. No significant differences ($P \leq 0.05$) among treatments were observed for yield.

Orthogonal analyses were used to compare the effects of one group or class of treatments to another group or class for data parameters with statistically significant ($P \leq 0.05$) ANOVA tests (Tables 1c, 1d):
Treated vs. untreated seed (treatments 1 to 9 vs. 10) - Treated seed had a significantly ($P \leq 0.05$) lower emergence than the untreated check, but there were no significant differences between these two groups for blight severity, seed weight and seed quality.
Treatments containing VITAFLO-280 + a bactericide vs. VITAFLO-280 alone (treatments 1 to 8 vs. 9) - Seed treated with VITAFLO-280 alone had significantly ($P \leq 0.05$) higher emergence than the group of treatments with VITAFLO-280 in combination with a bactericide. There were no significant differences between these two groups for blight severity, seed weight and seed quality.
Metal ion-containing treatments vs. STREPTOMYCIN (treatments 1 to 7 vs. 8) - STREPTOMYCIN-treated seed had significantly ($P \leq 0.05$) higher emergence than the group of seed treated with metal-containing chemicals. There were no significant differences between these two groups for blight severity, seed weight and seed quality.
Copper-based vs. non-copper-based treatments (treatments 1 to 4 vs. 5 to 7) - Non-copper-containing seed treatments had significantly ($P \leq 0.05$) higher emergence, lower blight severity, smaller average seed weight, and poorer quality seed than the copper product group.
UI906 (artificially infested seed) - Bacterial blight levels were very low in this trial. No significant ANOVA tests ($P \leq 0.05$) were noted for emergence, disease severity, yield, seed weight or seed quality (Tables 2a, 2b).

CONCLUSIONS: In the Envoy trial, KOCIDE LF, COPPER 53W and COPPER OXYCHLORIDE 50 had poor seedling emergence relative to the other treatments. However, the KOCIDE LF treatment, produced seed with significantly greater average weight and quality than any other treatment. The disease levels in this trial were very low and remained low throughout the growing season. Prior to harvest, blight severity was greatest in the KOCIDE LF and COPPER OXYCHLORIDE 50 treatments. Orthogonal analyses revealed that under the conditions of this trial, treated seed had lower emergence than untreated seed. The seed treated with a metal-containing product, particularly copper, had a negative effect on emergence. However, seed treated with copper products had greater seed weight and quality than seed treated with non-copper products.

Disease levels were also very low in the UI906 trial and the potential benefits of seed treatment for increasing seedling emergence, seed yields, weight and quality and on reducing disease severity were not clearly demonstrated. Nonetheless, the nine product combinations under test did not appear to have any statistically significant negative effects on emergence, yield, seed weight or seed quality.

REFERENCE: James, W.C. 1971. A manual of assessment keys for plant diseases. Publ. 1458, Agric. Canada, Ottawa.

ACKNOWLEDGEMENTS: We thank Mr. M.A. Briant, Ms. S.M. Sims and Ms. C.L. Bandura for technical assistance.

Table 1a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence and disease severity on Envoy navy dry beans in a field trial at Exeter, Ontario in 1998.*

Treatment	Rate of product /kg seed	Emergence (%)**	Disease severity (%)***	
			Flowering (1st rating)	Harvest (2nd rating)
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	88.5 a	2.2	1.4 c
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	36.7 e	0.9	3.9 ab
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	50.3 d	1.4	1.8 c
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	66.6 c	1.3	4.5 a
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	87.2 a	2.7	1.9 c
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	86.2 a	2.1	1.0 c
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	79.0 b	2.2	1.0 c
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	88.1 a	2	1.4 c
9. VITAFLO-280	2.60 mL	86.3 a	2.1	1.4 c
10. Untreated Check	-	83.6 ab	1.8	2.3 bc
ANOVA ($P \leq 0.05$)		0.0001	0.3938	0.0021
Coefficient of Variation (%)		5.43	21.83	21.61

* The values in this table are the means of four replications. Numbers within a column followed by the same small letter are not significantly different according to a Duncan's Multiple Range Test ($P \leq 0.05$).

** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

*** These data were square root transformed before ANOVA and the detransformed means are presented here.

Table 1b. The effect of nine fungicidal/bactericidal seed treatments on yield, seed weight and seed quality on Envoy navy dry beans in a field trial at Exeter, Ontario in 1998.*

Treatment	Rate of product /kg seed	Yield (kg/ha)	Seed weight (g/100 seed)	Seed quality (1-5)**
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	1818	18.5 bc	2.8 a
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	1827	20.2 a	2.3 b
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	1734	19.2 b	2.8 a
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	1651	18.7 bc	3.0 a
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	1870	18.5 bc	3.0 a
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	1925	18.3 c	2.8 a
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	2056	18.6 bc	3.0 a
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	1933	18.4 c	2.8 a
9. VITAFLO-280	2.60 mL	1803	18.4 bc	2.8 a
10. Untreated Check	-	1605	18.2 c	3.0 a
ANOVA ($P \leq 0.05$)		0.0711	0.0004	0.033
Coefficient of Variation (%)		10.34	2.75	10.42

* The values in this table are the means of four replications. Numbers within a column followed by the same small letter are not significantly different according to a Duncan's Multiple Range Test ($P \leq 0.05$).

** Seed quality: 1 = good, 5 = poor.

Table 1c. Results of four orthogonal comparisons for seed treatments applied to Envoy navy dry beans: emergence and blight severity.

	Required F	Emergence		Blight severity	
Treatment comparisons*	(P≤0.05)	Observed F**	Group means (%)***	Observed F**	Group means (%)****
#1 to #9 vs. #10	4.2	10	74.3 vs. 83.6	0.4	2.0 vs. 2.3
#1 to #8 vs. #9	4.2	24.3	72.8 vs. 86.3	1.1	2.1 vs. 1.4
#1 to #7 vs. #8	4.2	43.1	70.6 vs. 88.1	1.4	2.2 vs. 1.4
#1 to #4 vs. #5 to #7	4.2	137	60.5 vs. 84.1	13.4	2.9 vs. 1.3

* See Tables 1a and 1b for a list of the products that correspond with each treatment number.
** Test is significant when observed F is greater than required F
*** These data were arcsin transformed before ANOVA and the detransformed means are presented here.
**** These data were square root transformed before ANOVA and the detransformed means are presented here.

Table 1d. Results of four orthogonal comparisons for seed treatments applied to Envoy navy dry beans: seed weight and seed quality.

	Required F	Seed weight		Seed quality	
Treatment comparisons*	(P≤0.05)	Observed F**	Group means (g/100 seed)	Observed F**	Group means (1-5)***
#1 to #9 vs. #10	4.2	4	18.7 vs. 18.2	2.1	2.8 vs. 3.0
#1 to #8 vs. #9	4.2	2	18.8 vs. 18.4	0	2.8 vs. 2.8
#1 to #7 vs. #8	4.2	3.3	18.9 vs. 18.4	0.1	2.8 vs. 2.8
#1 to #4 vs. #5 to #7	4.2	12.2	19.1 vs. 18.5	4.2	2.7 vs. 2.9

* See Tables 1a and 1b for a list of the products that correspond with each treatment number.
** Test is significant when observed F is greater than required F.
*** Seed quality rating: 1 = good, 5 = poor.

Table 2a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence and disease severity on UI906 black dry beans in a field trial at Exeter, Ontario in 1998.*

Treatment	Rate of product /kg seed	Emergence (%)**	Disease severity (%)**	
			Flowering (1st rating)	Harvest (2nd rating)
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	88.4	1.7	1.8
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	86.2	1.7	1.5
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	83.2	2.4	2
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	87.4	2.1	1.9
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	87	2.1	1.2
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	87.5	2.3	1.8
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	86.7	1.7	2
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	85.2	1.2	1.9
9. VITAFLO-280	2.60 mL	87.4	2.2	1.1
10. Untreated Check	-	86.2	2	1.3
ANOVA ($P \leq 0.05$)		0.8971	0.3531	0.793
Coefficient of Variation (%)		2.53	13.43	22.09

* The values in this table are the means of four replications.

** These data were square root transformed before ANOVA and the detransformed means are presented here.

Table 2b. The effect of nine fungicidal/bactericidal seed treatments on seed yield, weight, and quality on UI906 black dry beans in a field trial at Exeter, Ontario in 1998.*

Treatment	Rate of product /kg seed	Yield (kg/ha)	Seed weight (g/100 seed)	Seed quality (1-5)**
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	1509	15	2.3
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	1671	15.2	2
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	1755	14.9	2
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	1597	15.2	1.8
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	1595	15.4	2
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	1940	15.5	1.8
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	1467	14.6	2.3
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	1529	14.9	1.8
9. VITAFLO-280	2.60 mL	1559	15	2
10. Untreated Check	-	1823	15.2	1.5
ANOVA ($P \leq 0.05$)		0.2659	0.1464	0.2015
Coefficient of Variation (%)		15.98	2.65	20.18

* The values in this table are the means of four replications.

** Seed quality: 1 = good, 5 = poor.

1998 PMR REPORT # 84 **SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS**

ICAR: 93000482

CROP: Dry bean (*Phaseolus vulgaris* L.), cvs. Othello (pinto), NW63 (red Mexican), US1140 (great northern), Viva (pink), UI906 (black), AC Skipper (navy) and Envoy (navy)

PEST: Halo blight, *Pseudomonas syringae* pv. *phaseolicola* (Burkh.) Young *et al.*; common blight, *Xanthomonas campestris* pv. *phaseoli* (Smith) Dye

NAME AND AGENCY:
HOWARD R J, LEDUC Y A, HUGGONS S P, and BRIANT M A
Alberta Agriculture, Food and Rural Development
Crop Diversification Centre, South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1328 **Fax:** (403) 362-1326 **Email:** ron.howard@agric.gov.ab.ca

TITLE: EFFICACY OF CHEMICAL SEED TREATMENTS AGAINST SEED-BORNE BACTERIAL BLIGHT IN DRY BEANS IN GREENHOUSE TRIALS AT BROOKS, ALBERTA IN 1998

MATERIALS: BLUESTONE (copper sulphate 99% SG), KOCIDE LF (cupric hydroxide 23% SU), COPPER 53W (tribasic copper sulphate 53% WP), COPPER OXYCHLORIDE 50 (copper oxychloride 50% WP), ZINEB 80W (zineb 80% WP), DITHANE M-22 (maneb 80% WP), DITHANE DG (mancozeb 75% WDG), AGRICULTURAL STREPTOMYCIN (streptomycin sulphate 62.6% WP; equivalent to 50% streptomycin base), VITAFLO-280 (thiram 13.2% + carbathiin 14.9% SU), SELF-STICK™ (*Rhizobium leguminosarum* bv. *phaseoli* [1 x 10^9 viable cells/g])

METHODS: Seven types and cultivars of dry edible beans, artificially or naturally infested with halo blight (*Pseudomonas syringae* pv. *phaseolicola*) and common blight (*Xanthomonas campestris* pv. *phaseoli*) bacteria, were treated with various copper-, zinc- or manganese- based fungicides/bactericides to assess the effects of these treatments on seedling emergence, plant height and root nodulation under greenhouse conditions. Othello, NW63, US1140, Viva, UI906 and AC Skipper seed was artificially infested with halo blight (*Psp*) and common blight (*Xcp*) bacteria. Isolates of *Psp* and *Xcp* were added to separate flasks of nutrient broth and incubated for approximately 18 hours at room temperature (ca. 25EC) on a rotary shaker. Afterwards, the cultures were centrifuged for 10 minutes at 8000 rpm, the liquid portion was poured off, and 100 mL of a phosphate-buffered saline solution was added to each tube containing the bacterial sediment. The saline solution was prepared with 0.1 M sodium phosphate dibasic anhydrous and 0.85% sodium chloride in sterile distilled water with the pH adjusted to 7.2 with 5 M hydrochloric acid. The tubes were hand shaken to resuspend the bacteria and the *Psp* suspensions were combined in one flask and the *Xcp* suspensions in another. The density of each bacterial suspension was estimated under a microscope using a hemacytometer. Each bacterial suspension was then diluted with phosphate-buffered saline solution to a density of ca. 10^7 colony-forming units/mL and this was applied at a rate of 5 mL/kg seed for both the *Xcp* and *Psp*, i.e. 10 mL total bacterial suspension/kg seed. The bacterial suspension and seed were tumbled in the drum of a Gustafson Batch Lab Treater. Prior to treating the seed, the drum was cleaned out and 1 kg of spare seed with 10 mL of bacterial suspension

were tumbled in the drum to precoat it in order to minimize adhesion losses in subsequent batches. This "dummy batch" was discarded and the experimental seed was then treated. The drum was rotated for 2 minutes for each batch of seed to allow for even coating and moistening. The inoculated seed was spread onto clean paper to air dry in a darkened area before each cultivar was divided into ten lots for subsequent seed treatment. It was determined by laboratory testing that the cultivar Envoy had sufficient natural infestation and did not need to be inoculated with blight bacteria.

The seven cultivars of inoculated bean seed were then treated with VITAFLO-280 alone or with this fungicidal product combined with one of the following fungicides/bactericides: BLUESTONE, KOCIDE LF, COPPER 53W, COPPER OXYCHLORIDE 50, ZINEB 80W, DITHANE M-22, DITHANE DG, or AGRICULTURAL STREPTOMYCIN. Three checks were included in each trial, i.e. VITAFLO-280 alone, VITAFLO-280 + AGRICULTURAL STREPTOMYCIN, and no chemical treatment. Experimental application rates (Tables 1a to 7a) were determined from the manufacturer's recommended rates. Each chemical treatment was applied as a slurry to separate 300 g lots of seed. Distilled water (3.5 mL/kg seed) was used in preparing the slurries for chemical formulations that were in a powder or crystalline form. The seed treatments were applied in the laboratory with a Gustafson Batch Lab Treater. Before each lot was treated, 300 g of spare seed was run through the treater to pre-coat the drum with the respective chemical treatment in order to minimize adhesion losses during subsequent treatments. The drum was cleaned before each change in treatment product. Each lot of treated seed was allowed to air dry in a darkened area for several hours and stored in a cooler until seeding time.

Each variety of bean was set up as a separate trial consisting of a randomized complete block design with six replications (pots) and ten treatments. For each trial, sixty, 15 cm pots were filled with non-pasteurized, silt loam field soil. The soil was moistened prior to planting and 20 seeds per pot were planted at a depth of approximately 2.5 cm. Envoy seed was planted at a rate of 13 seeds/pot. Just prior to planting, the seed was coated with a peat-based inoculant containing *Rhizobium leguminosarum* bv. *phaseoli*. The trials were conducted in a greenhouse at CDC South under natural light conditions. The plants were watered as needed and misted regularly to create a favourable microclimate for bacterial blight development. UI906 plants were fertilized with a 20-20-20 (NPK) fertilizer because they were exhibiting chlorosis.

Seedling emergence was recorded two weeks after seeding by counting the number of emerged (live or dead) plants in each pot. Plant height was rated after three and one half weeks of growth by measuring the distance from the soil level to the growing point of five plants/pot and calculating the average. Under greenhouse conditions, symptoms of halo blight and common blight did not develop to any measurable extent, except on the Viva plants where disease incidence was visually assessed after approximately five weeks of growth by counting the number of diseased plants per pot. The plants were taken out of their pots after approximately six weeks of growth, the roots were washed and separated, and each was rated for nodule development. Root nodulation was assessed using a scale of 1-4, i.e. 1 = no nodules, 2 = very few nodules (slight infection), 3 = several nodules; no clumping around crown (moderate infection), and 4 = many nodules; clumping around crown (heavy infection).

All data were tabulated using the Pesticide Research Manager software. Mean percentage data were transformed to arcsin or square root, where necessary, and subjected to ANOVA. Duncan's Multiple Range Test was used to compare treatment means where ANOVA tests were statistically significant (P#0.05).

RESULTS: There were no significant (P#0.05) differences in nodulation ratings between treatments in any of the cultivars under test, except for Viva. Although all seven cultivars were artificially or naturally infested with halo and common blight bacteria, disease symptoms did not develop to any measurable extent on the foliage, except for Viva, where lesions were observed on the leaves.

US1140 - Significant (P#0.05) differences amongst treatments were noted for emergence and plant height (Table 1a). None of treatments 1-7 had a significantly higher mean emergence compared to the untreated and STREPTOMYCIN checks. ZINEB 80W and COPPER OXYCHLORIDE 50 performed as well as these two checks, and were significantly better than VITAFLO-280 alone. Poor emergence that would affect sample size (measured as less than 10 plants germinating in three replicates of a treatment) was noted for DITHANE M-22 and the VITAFLO-280 check. None of the treatments had significantly greater mean plant heights than the three checks.

NW63 - Significant (P#0.05) differences amongst treatments were seen for mean emergence and plant height (Table 2a). All treatments, except DITHANE M-22, showed greater seedling emergence compared to the three checks, in which emergence was equally poor. KOCIDE LF- and ZINEB 80W-treated seed showed the best emergence, followed by COPPER OXYCHLORIDE 50 and DITHANE DG. Poor emergence that would affect sample size (measured as less than 10 plants germinating in five replicates of a treatment) was noted for DITHANE M-22, STREPTOMYCIN, VITAFLO-280 alone and the untreated check. All treatments, except for DITHANE M-22, had significantly greater mean plant heights than the three checks.

UI906 - Significant (P#0.05) differences in mean emergence and plant height were noted amongst chemical treatments (Table 3a); however, none was significantly greater than the untreated check. Seed treated with COPPER 53W, COPPER OXYCHLORIDE 50, ZINEB 80W, DITHANE M-22 and VITAFLO-280 alone had significantly higher emergence in comparison to seed treated with STREPTOMYCIN. Significantly lower emergence than in the untreated check was observed with the BLUESTONE, KOCIDE LF and STREPTOMYCIN treatments. Poor emergence that would affect sample size (measured as less than 10 plants germinating in three replicates of a treatment) was noted for the BLUESTONE. Plants grown from seed treated with COPPER OXYCHLORIDE 50, DITHANE DG and VITAFLO-280 alone had significantly greater mean plant heights than from seed treated with STREPTOMYCIN.

Othello - Significant (P#0.05) differences in mean emergence were observed amongst treatments (Table 4a); however, none was significantly higher than the untreated check. Seed treated with COPPER 53W and ZINEB 80W had significantly higher emergence than seed treated with VITAFLO-280 alone, and these two products, as well as BLUESTONE and DITHANE M-22, resulted in significantly higher seedling emergence than STREPTOMYCIN. Seedling emergence was good in all treatments, i.e. at least 10 plants germinating in four or more replicates of a treatment). There were no significant differences amongst treatments for mean plant height.

AC Skipper - Significant (P#0.05) differences among treatments were detected for mean emergence and plant height (Table 5a). COPPER 53W- and ZINEB 80W-treated seed had significantly better emergence than all three checks. The DITHANE M-22 and DITHANE DG seed treatments resulted in significantly greater emergence compared to the STREPTOMYCIN treatment. Poor emergence that would affect sample size (measured as less than 10 plants germinating in four or more replicates of a treatment) was noted for the BLUESTONE, KOCIDE LF AND STREPTOMYCIN treatments. Seed treated with ZINEB 80W produced plants with a greater mean height than the untreated and STREPTOMYCIN checks.

Envoy - Significant (P#0.05) differences in mean emergence were noted amongst treatments (Table 6a); however, none outperformed the untreated check. Seed treated with DITHANE M-22 and VITAFLO-

280 alone exhibited the highest emergence and it was significantly greater than with STREPTOMYCIN-treated seed. The ZINEB 80W and STREPTOMYCIN treatments had significantly poorer emergence than both the untreated check and VITAFLO-280 alone. Poor emergence that would affect sample size (measured as less than six plants germinating in at least three replicates of a treatment) was noted for ZINEB 80W and STREPTOMYCIN. There were no significant (P#0.05) differences between treatments for mean plant height.

Viva - Significant (P#0.05) differences in emergence, mean plant height, nodulation and disease incidence were noted amongst treatments (Table 7a). Seed treated with COPPER OXYCHLORIDE 50 and DITHANE DG had significantly higher emergence than untreated and STREPTOMYCIN-treated seed. Seed treated with KOCIDE LF and STREPTOMYCIN had a significantly lower emergence than the untreated check. Poor emergence that would affect sample size (measured as less than 10 plants germinating in six or more replicates of a treatment) was noted for the STREPTOMYCIN treatment. None of the seed treatments resulted in significantly greater plant height compared to the untreated check or VITAFLO-280 alone, but all treatments were significantly better than STREPTOMYCIN, with COPPER OXYCHLORIDE 50 showing the greatest difference. Viva was the only cultivar that showed significant differences among treatments for nodulation. Only STREPTOMYCIN-treated seed had significantly greater nodulation than the untreated check and the VITAFLO-280 alone. However, due to poor emergence, the sample size for this treatment was very small (1-2 plants/replication). None of the other treatments were significantly less nodulated than the untreated check or the VITAFLO-280 alone. COPPER OXYCHLORIDE 50-treated seed produced plants with the poorest nodulation; this rating was significantly lower than in the STREPTOMYCIN-, DITHANE M-22- and DITHANE DG-treated seed. There were significant differences in disease incidence between treatments, with the lowest level observed in plants grown from STREPTOMYCIN-treated seed. However, due to poor emergence, the sample size for this treatment was very small (1-2 plants/replication). The highest disease incidence occurred in the DITHANE M-22 treatment, but it was not significantly different from any other chemical treatment, except STREPTOMYCIN. Blight levels in this latter treatment and the untreated check were both much lower.

Orthogonal analyses were used to compare the effects of one group or class of treatments to another group or class for data parameters with statistically significant (P #0.05) ANOVA tests (Tables 1b, 2b, 3b, 4b, 5b, 6b, 7b, 7c):

Treated vs. untreated seed (treatments 1 to 9 vs. 10) - Only in NW63 were there significant differences in emergence and plant height between these two groups, i.e. the treated seed group had a significantly greater emergence and height than the untreated check. There were no significant differences in height between the treated and untreated groups for US1140, UI906, AC Skipper and Viva. In Viva, there were no significant differences between the treated and untreated groups for nodulation or disease incidence.

Treatments containing VITAFLO-280 + a bactericide vs. VITAFLO-280 alone (treatments 1 to 8 vs. 9) - Significant differences in emergence between these groups were noted in US1140 and NW63, where seed treated with VITAFLO-280 plus a bactericide showed significantly greater emergence than seed treated with VITAFLO-280 alone. The opposite trend occurred in Envoy, where seed treated with VITAFLO-280 and a bactericide had significantly poorer emergence than seed treated with VITAFLO-280 alone. NW63 seed treated with VITAFLO-280 plus a bactericide also produced plants that were significantly taller than those from seed treated with VITAFLO-280 alone. There were no significant differences in height between these two treatment groups for US1140, UI906, AC Skipper and Viva.

Metal ion-containing treatments vs. STREPTOMYCIN (treatments 1 to 7 vs. 8) - There were significant differences in emergence between these two groups for all cultivars but US1140. STREPTOMYCIN-

treated seed had significantly poorer emergence than seed treated with metal ion-containing products. In US1140, STREPTOMYCIN-treated seed had better emergence than seed treated with copper, zinc and manganese products, but it was not statistically greater. However, in the same cultivar, plants grown from STREPTOMYCIN-treated seed were significantly taller than those from seed treated with metal-containing products. There were no significant differences in height between these treatment groups for UI906 and AC Skipper. For NW63 and Viva, seed treated with metal ion products produced plants with greater heights than did seed treated with STREPTOMYCIN. In Viva, the STREPTOMYCIN treatment had plants with more nodules and less disease compared to the group of metal-containing products.
Copper-based vs. non-copper-based treatments (treatments 1 to 4 vs. 5 to 7) - There were significant differences in emergence and height between these two treatment groups for NW63 and AC Skipper, and in emergence and nodulation for Viva. In NW63, copper-treated seed had significantly greater emergence and plant height values than non-copper-treated seed. The opposite was true in AC Skipper. In Viva, the non-copper-treated seed showed significantly greater emergence and nodulation, but there was no significant difference between it and copper-treated seed for plant height and disease incidence. There were no significant differences in emergence and/or height between these two groups in US1140, UI906, Othello and Envoy.

CONCLUSIONS: The best performing metal-ion containing seed treatment in this trial was ZINEB 80W, which produced emergence and height values greater than or equal to the eight other treatments and the untreated check in all cultivars except Envoy. In Envoy, ZINEB 80W-treated seed had lower emergence than the untreated check, VITAFLO-280 alone and the best-performing treatment, DITHANE M-22. In Viva, the ZINEB 80W treatment had a nodulation rating that was not significantly different from the three checks. Disease incidence, however, was higher than in the STREPTOMYCIN treatment and was statistically equivalent to the other two checks. The BLUESTONE and KOCIDE LF treatments appeared to have the poorest performance across cultivars, with COPPER OXYCHLORIDE 50, COPPER 53W, DITHANE M-22 and DITHANE DG performing better or worse depending on the cultivar.

Poor emergence (as measured by less than half the seeds germinating in three to five of the six replications for any treatment) was noted for some treatments, particularly STREPTOMYCIN (NW63, AC Skipper, Envoy and Viva) and BLUESTONE (UI906, AC Skipper and Envoy). With STREPTOMYCIN, this may indicate a phytotoxic effect brought on by the high temperatures (35-40EC) in the greenhouse at the time of seeding and germination. Significantly lower emergence than the untreated check, which may also indicate phytotoxicity, was also observed with KOCIDE LF-treated Viva and UI906 seed, in BLUESTONE-treated UI906 seed, and in ZINEB 80W-treated Envoy seed.

The lack of significant differences among treatments for the nodulation rating in six of the cultivars suggests that nodulation was generally unaffected by the application of the seed treatments. In Viva, however, nodulation appeared to be adversely affected by the copper products, with BLUESTONE, COPPER OXYCHLORIDE 50 and COPPER 53W resulting in nodulation ratings lower than the STREPTOMYCIN check, which had the highest nodulation. Blight disease did not develop to any measurable extent under the conditions of this trial, except in Viva.

From the orthogonal analyses, it can be concluded that treating the seed did not statistically improve emergence or plant height, except in NW63, and did not affect nodulation or disease incidence, except in Viva. Treating seed with a combination of VITAFLO-280 plus a bactericide versus treating it with

VITAFLO alone improved emergence in some cultivars, but not in others. Plant height appeared unaffected, except in NW63 where it was greater in the group that had a bactericidal treatment mixed with VITAFLO-280. Nodulation and disease incidence in Viva were not affected. The metal-ion containing products improved emergence as compared to STREPTOMYCIN in all bean types, except US1140 where there was no difference. Height differences were variable. Treating with STREPTOMYCIN produced better nodulation and disease control, however, the sample size was small. In comparing copper versus non-copper products, emergence was improved or relatively the same in five bean types treated with copper products. In AC Skipper and Viva, non-copper treatments resulted in better emergence. Height was generally unaffected, except in NW63 where it was improved by the copper treatments, and in AC Skipper where it was improved by the non-copper treatments. In Viva, nodulation was adversely affected by the copper products, and disease incidence was not affected.

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Table 1a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence, plant height and nodulation on US1140 great northern dry beans in greenhouse trials at Brooks, AB in 1998.*

Treatment	Rate of product/ kg seed	Emergence (%)**	Height (cm)	Nodulation (1-4)***
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	64.5 d	13.4 b	3.6
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	75.7 bcd	13.1 b	3.4
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	74.2 bcd	13.5 b	3.7
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	96.2 ab	15.4 ab	3.5
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	98.4 a	17.4 a	3.7
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	56.5 d	12.6 b	3.8
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	67.7 cd	13.8 b	3.6
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	92.3 abc	17.9 a	3.6
9. VITAFLO-280	2.60 mL	49.3 d	14.8 ab	3.7
10. Untreated Check	-	80.0 abcd	15.4 ab	3.8
ANOVA (P#0.05)		0.0008	0.0155	0.2527
Coefficient of Variation (%)		25.1	6.7	6.7

* The values in this table are the means of six replications. Numbers within a column followed by the same small letter are not significantly different according to Duncan's Multiple Range Test (P#0.05).

** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

*** Nodulation rating: 1 = none, 2 = slight, 3 = moderate, 4 = heavy.

Table 1b. Results of four orthogonal comparisons for seed treatments applied to US1140 great northern dry beans: emergence and plant height.

Treatment comparisons*	Required F (P#0.05)	Emergence		Height	
		Observed F**	Group means (%)***	Observed F**	Group means (cm)
#1 to #9 vs. #10	4.1	0.1	75.0 vs. 80.0	0.4	14.7 vs. 15.4
#1 to #8 vs. #9	4.1	8.3	78.2 vs. 49.3	0	14.6 vs. 14.8
#1 to #7 vs. #8	4.1	2.7	76.2 vs. 92.3	10	14.2 vs. 17.9
#1 to #4 vs. #5 to #7	4.1	0	77.6 vs. 74.2	0.7	13.9 vs. 14.6

* See Table 1a for a list of the treatment products that correspond with each number.
** Test is significant when observed F is greater than required F.
*** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 2a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence, plant height and nodulation on NW63 red Mexican dry beans in greenhouse trials at Brooks, AB in 1998.*

Treatment	Rate of product/ kg seed	Emergence (%)**	Height (cm)	Nodulation (1-4)***
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	75.1 bc	14.6 a	3.5
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	95.2 a	15.9 a	3.5
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	67.9 c	15.0 a	3.3
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	92.0 ab	15.3 a	2.8
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	95.6 a	14.7 a	3.4
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	21.5 d	10.2 b	3.4
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	87.4 abc	13.9 a	2.4
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	13.6 d	11.0 b	3.4
9. VITAFLO-280	2.60 mL	11.3 d	8.3 b	3.5
10. Untreated Check	-	18.3 d	10.7 b	3.2
ANOVA (P#0.05)		0.0001	0.0001	0.0766
Coefficient of Variation (%)		24.5	18.1	20.2

* The values in this table are the means of six replications. Numbers within a column followed by the same small letter are not significantly different according to Duncan's Multiple Range Test (P#0.05).

** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

*** Nodulation rating: 1 = none, 2 = slight, 3 = moderate, 4 = heavy.

Table 2b. Results of four orthogonal comparisons for seed treatments applied to NW63 red Mexican dry beans: emergence and plant height.

Treatment comparisons*	Required F (P#0.05)	Emergence		Height	
		Observed F**	Group means (%)***	Observed F**	Group means (cm)
#1 to #9 vs. #10	4.1	27.8	62.2 vs. 18.3	6.3	13.2 vs. 10.7
#1 to #8 vs. #9	4.1	50.3	68.5 vs. 11.3	29.4	13.8 vs. 8.3
#1 to #7 vs. #8	4.1	58	76.4 vs. 13.6	10.2	14.2 vs. 11.0
#1 to #4 vs. #5 to #7	4.1	4.6	82.5 vs. 68.2	9.5	15.2 vs. 12.9

* See Table 2a for a list of the treatment products that correspond with each number.
** Test is significant when observed F is greater than required F.
*** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 3a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence, plant height and nodulation on UI906 black dry beans in greenhouse trials at Brooks, AB in 1998.*

Treatment	Rate of product/ kg seed	Emergence (%)**	Height (cm)	Nodulation (1-4)***
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	65.9 b	9.3 b	2.6
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	65.0 b	10.2 ab	2.9
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	95.4 a	11.6 ab	2.4
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	95.8 a	12.1 a	2.7
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	93.1 a	11.1 ab	3.1
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	95.8 a	11.3 ab	3.2
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	89.7 ab	12.4 a	2.9
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	62.0 b	9.6 b	2.4
9. VITAFLO-280	2.60 mL	95.8 a	12.6 a	2.9
10. Untreated Check	-	93.2 a	11.3 ab	2.6
ANOVA (P#0.05)		0.0056	0.0490	0.4844
Coefficient of Variation (%)		22.6	17.0	23.9

* The values in this table are the means of six replications. Numbers within a column followed by the same small letter are not significantly different according to Duncan's Multiple Range Test (P#0.05).

** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

*** Nodulation rating: 1 = none, 2 = slight, 3 = moderate, 4 = heavy.

Table 3b. Results of four orthogonal comparisons for seed treatments applied to UI906 black dry beans: emergence and plant height.

Treatment comparisons*	Required F (P#0.05)	Emergence		Height	
		Observed F**	Group means (%)***	Observed F**	Group means (cm)
#1 to #9 vs. #10	4.1	0.9	84.3 vs. 93.2	0.1	11.1 vs. 11.3
#1 to #8 vs. #9	4.1	2.4	82.9 vs. 95.8	3.9	11.0 vs. 12.6
#1 to #7 vs. #8	4.1	6.8	85.8 vs. 62.0	3.5	11.1 vs. 9.6
#1 to #4 vs. #5 to #7	4.1	3.3	80.5 vs. 92.9	1.7	10.8 vs. 11.6

* See Table 3a for a list of the treatment products that correspond with each number.
** Test is significant when observed F is greater than required F.
*** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 4a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence, plant height and nodulation on Othello pinto dry beans in greenhouse trials at Brooks, AB in 1998.*

Treatment	Rate of product/ kg seed	Emergence (%)**	Height (cm)	Nodulation (1-4)***
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	91.2 ab	18.4	3.5
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	73.1 bc	17.5	3.4
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	96.8 a	17.1	3.3
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	85.9 bc	18.6	3.4
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	97.5 a	16.0	3.4
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	90.9 ab	17.0	3.6
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	87.8 abc	14.8	3.0
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	65.4 c	16.5	3.6
9. VITAFLO-280	2.60 mL	79.3 bc	17.1	3.6
10. Untreated Check	-	87.0 abc	17.2	3.5
ANOVA (P#0.05)		0.0117	0.1174	0.2789
Coefficient of Variation (%)		18.3	12.1	10.4

* The values in this table are the means of six replications. Numbers within a column followed by the same small letter are not significantly different according to Duncan's Multiple Range Test (P#0.05).

** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

*** Nodulation rating: 1 = none, 2 = slight, 3 = moderate, 4 = heavy.

Table 4b. Results of four orthogonal comparisons for seed treatments applied to Othello pinto dry beans: emergence.

	Required F	Emergence	
Treatment comparisons*	(P#0.05)	Observed F**	Group means (%)***
#1 to #9 vs. #10	4.1	0	85.3 vs. 87.0
#1 to #8 vs. #9	4.1	1.5	86.1 vs. 79.3
#1 to #7 vs. #8	4.1	10.5	89.0 vs. 65.4
#1 to #4 vs. #5 to #7	4.1	1.4	86.7 vs. 92.1

* See Table 4a for a list of the treatment products that correspond with each number.
** Test is significant when observed F is greater than required F.
*** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 5a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence, plant height and nodulation on AC Skipper navy dry beans in greenhouse trials at Brooks, AB in 1998.*

Treatment	Rate of product/ kg seed	Emergence (%)**	Height (cm)	Nodulation (1-4)***
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	39.5 bcd	8.3 b	2.7
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	42.6 bcd	9.2 b	2.3
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	87.3 a	11.5 ab	2.9
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	34.9 cd	9.3 b	3.7
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	88.1 a	14.1 a	3.5
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	63.4 abc	9.4 b	2.8
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	72.0 ab	9.9 b	3.3
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	19.5 d	8.7 b	3.5
9. VITAFLO-280	2.60 mL	52.0 bcd	11.5 ab	3.0
10. Untreated Check	-	39.5 bcd	9.3 b	2.7
ANOVA (P#0.05)		0.0001	0.0032	0.2814
Coefficient of Variation (%)		33.3	23.1	26.0

* The values in this table are the means of six replications. Numbers within a column followed by the same small letter are not significantly different according to Duncan's Multiple Range Test (P#0.05).

** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

*** Nodulation rating: 1 = none, 2 = slight, 3 = moderate, 4 = heavy.

Table 5b. Results of four orthogonal comparisons for seed treatments applied to AC Skipper navy dry beans: emergence and plant height.

Treatment comparisons*	Required F (P#0.05)	Emergence		Height	
		Observed F**	Group means (%)***	Observed F**	Group means (cm)
#1 to #9 vs. #10	4.1	2	55.5 vs. 39.5	0.9	10.2 vs. 9.3
#1 to #8 vs. #9	4.1	0.2	55.9 vs. 52.0	2	10.1 vs. 11.5
#1 to #7 vs. #8	4.1	14.2	61.1 vs. 19.5	2.2	10.2 vs. 8.7
#1 to #4 vs. #5 to #7	4.1	8	51.1 vs. 74.5	4.8	9.6 vs. 11.2

* See Table 5a for a list of the treatment products that correspond with each number.
** Test is significant when observed F is greater than required F.
*** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 6a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence, plant height and nodulation on Envoy navy dry beans in greenhouse trials at Brooks, AB in 1998.*

Treatment	Rate of product/ kg seed	Emergence (%)**	Height (cm)	Nodulation (1-4)***
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	60.9 bcd	6.9	3.4
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	72.0 abcd	6.0	2.7
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	81.0 abc	7.8	2.8
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	79.4 abc	7.2	2.6
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	52.6 cd	7.1	3.5
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	91.6 a	7.7	3.1
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	79.4 abc	6.9	2.9
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	38.4 d	6.2	3.0
9. VITAFLO-280	2.60 mL	96.9 a	8.9	3.1
10. Untreated Check	-	87.5 ab	8.0	2.7
ANOVA (P#0.05)		0.0019	0.0715	0.2524
Coefficient of Variation (%)		26.4	20.6	21.5

* The values in this table are the means of six replications. Numbers within a column followed by the same small letter are not significantly different according to Duncan's Multiple Range Test (P#0.05).

** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

*** Nodulation rating: 1 = none, 2 = slight, 3 = moderate, 4 = heavy.

Table 6b. Results of four orthogonal comparisons for seed treatments applied to Envoy navy dry beans: emergence.

	Required F	Emergence	
Treatment comparisons*	(P#0.05)	Observed F**	Group means (%)***
#1 to #9 vs. #10	4.1	2	72.4 vs. 87.5
#1 to #8 vs. #9	4.1	10	69.4 vs. 96.4
#1 to #7 vs. #8	4.1	9.5	73.8 vs. 38.4
#1 to #4 vs. #5 to #7	4.1	0.1	73.3 vs. 74.5

* See Table 6a for a list of the treatment products that correspond with each number.
** Test is significant when observed F is greater than required F.
*** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 7a. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence, plant height and nodulation on Viva pink dry beans in greenhouse trials at Brooks, AB in 1998.*

Treatment	Rate of product/ kg seed	Emergence (%)**	Height (cm)	Nodulation (1-4)***	Disease Incidence (%)****
1. VITAFLO-280 + BLUESTONE	2.60 mL + 2.00 g	78.4 cd	12.3 ab	3.1 bcd	30.1 ab
2. VITAFLO-280 + KOCIDE LF	2.60 mL + 2.64 mL	57.5 d	11.1 b	3.4 abcd	31.8 ab
3. VITAFLO-280 + COPPER 53W	2.60 mL + 1.66 g	96.7 ab	12.7 ab	3.0 cd	27.6 ab
4. VITAFLO-280 + COPPER OXYCHLORIDE 50	2.60 mL + 1.66 g	98.9 a	14.7 a	2.8 d	22.5 ab
5. VITAFLO-280 + ZINEB 80W	2.60 mL + 1.66 g	96.7 ab	13.2 ab	3.3 abcd	20.1 ab
6. VITAFLO-280 + DITHANE M-22	2.60 mL + 1.87 g	90.5 abc	13.1 ab	3.5 abc	40.5 a
7. VITAFLO-280 + DITHANE DG	2.60 mL + 5.88 g	97.9 a	13.3 ab	3.6 ab	19.9 ab
8. VITAFLO-280 + AGRICULTURAL STREPTOMYCIN	2.60 mL + 1.00 g	8.2 e	7.0 c	3.9 a	0.1 c
9. VITAFLO-280	2.60 mL	90.6 abc	12.3 ab	3.3 bcd	27.5 ab
10. Untreated Check	-	83.1 bc	12.3 ab	3.3 bcd	10.3 b
ANOVA (P#0.05)		0.0001	0.0001	0.0105	0.0002
Coefficient of Variation (%)		18.0	15.3	13.5	38.9

* The values in this table are the means of six replications. Numbers within a column followed by the same small letter are not significantly different according to Duncan's Multiple Range Test (P#0.05).

** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

*** Nodulation rating: 1 = none, 2 = slight, 3 = moderate, 4 = heavy.

**** These data were square root transformed before ANOVA and the detransformed means are presented here.

Table 7b. Results of four orthogonal comparisons for seed treatments applied to Viva pink dry beans: emergence and plant height.

	Required F	Emergence		Height	
Treatment comparisons*	(P#0.05)	Observed F**	Group means (%)***	Observed F**	Group means (cm)
#1 to #9 vs. #10	4.1	0	79.5 vs. 83.1	0.2	12.2 vs. 12.3
#1 to #8 vs. #9	4.1	1.6	78.1 vs. 90.6	0.1	12.2 vs. 12.3
#1 to #7 vs. #8	4.1	115.8	88.1 vs. 8.2	181.8	12.9 vs. 7.0
#1 to #4 vs. #5 to #7	4.1	5.8	82.9 vs. 95.1	3	12.7 vs. 13.2

* See Table 7a for a list of the treatment products that correspond with each number.
** Test is significant when observed F is greater than required F.
*** These data were arcsin transformed before ANOVA and the detransformed means are presented here.

Table 7c. Results of four orthogonal comparisons for seed treatments applied to Viva pink dry beans: nodulation and disease incidence.

	Required F	Nodulation		Disease Incidence	
Treatment comparisons*	(P#0.05)	Observed F**	Group means (1-4)***	Observed F**	Group means (%)****
#1 to #9 vs. #10	4.1	0	3.3 vs. 3.3	3.6	24.5 vs. 10.3
#1 to #8 vs. #9	4.1	0.1	3.3 vs. 3.3	0.6	24.1 vs. 27.5
#1 to #7 vs. #8	4.1	10.9	3.2 vs. 3.9	32.7	27.5 vs. 0.1
#1 to #4 vs. #5 to #7	4.1	8.2	3.1 vs. 3.5	0.1	28.0 vs. 26.9

* See Table 7a for a list of the treatment products that correspond with each number.
** Test is significant when observed F is greater than required F.
*** Nodulation rating: 1 = none, 2 = slight, 3 = moderate, 4 = heavy.
**** These data were square root transformed before ANOVA and the detransformed means are presented here.

1998 PMR REPORT # 85 SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS

CROP: Field pea (*Pisum sativum* L.)
PEST: Mycosphaerella blight, *Mycosphaerella pinodes* (Berk. & Blox.) Vestergr. / *Phoma Medicaginis* Malbr. & Roum. var. *pinodella* (Jones) Boerema

NAME AND AGENCY:
BUCHWALDT L [1)], GOSSEN B [1)], HWANG S-F [2)], KUTCHER R [3)], TURKINGTON K [4)], XUE A [5)]
[1)] AAFC, SRC, 107 Science Place, Saskatoon, SK S7N 0X2;
Tel. (306) 956-2826 Fax. -7247 BuchwaldtL@em.agr.ca, GossenB@em.agr.ca
[2)] Alberta Research Counsil, Bag 4000, Vegreville, AB T9C 1T4, Tel. (403) 632-8228 Fax. - 8379
[3)] AAFC, MRF, Box 1240, Melfort, SK S0E 1A0, Tel. (306) 752-227 ext. 232 Fax -4911
[4)] AAFC, LRC, 6000 C & E Trail, AB T4L 1W1, Tel (403) 782-8138, Fax -6120
[5)] AAFC, MRC, Unit 100-101 Route 100, Morden, MB R6M 1Y5, Tel (204) 822-4471, Fax -6841

TITLE: EFFECT OF FOLIAR FUNGICIDE APPLICATION FOR CONTROL OF MYCOSPHAERELLA BLIGHT IN PEA.

MATERIALS: BRAVO 500 (50% w/w chlorthalonil) and QUADRIS (22.9% w/w azoxystrobin). Pea cultivars Carneval and Keoma both susceptible to powdery mildew, and Highlight mildew-resistant.

METHODS: Pea trials were established at Melfort, Lacombe, Morden and Vegreville research farms. A split-plot design was used with cvs Carneval and Highlight as main-plot and fungicide treatment as sub-plots. Seed from the same source was planted. Each sub-plot was 1.3 m x 5.0 m (i.e. 4 rows at 1' row spacing). The trials were planted between May 7-12. Another trial was established in a commercial pea crop of cv Keoma at Star City, SK. There were seven treatments at all locations: an unsprayed control, BRAVO 500 at 1.0 and 1.5 kg a.i./ha and QUADRIS at 125 and 175 g a.i./ha each applied at early flower; and two applications of either BRAVO or QUADRIS applied at early and late flower. The first application was made July 3-7 and the second July 15-20. The fungicides were applied in app. 220 L water/ha at 275 kPa with hand-held spray equipment. Foliar disease severity caused by Mycosphaerella blight was rated on the first (FDS1) and second day (FDS2) of fungicide application to evaluate the importance of early disease symptoms in a decision support system currently under development at AAFC, Saskatoon Research Centre. The foliar disease severity was also rated three weeks after the last fungicide application (FDS3) around July 27-31. All FDS were rated at five sites per plot on a 0-9 scale (Table 1, after Xue et al. 1996. Can. J. Pl. Path. 18:370-374).

The stem disease severity (SDS) caused by Mycosphaerella blight was rated on a 0-9 scale just before harvest to study its relationship to yield (Table 2). Powdery mildew was rated in the last week of July. Each plot was given one disease severity value based on a combination of % infected plants and % infected leaf area (Table 3). The plots were combined directly on August 13-14. The seed was dried, cleaned and weighed. The General Linear Models Procedure (SAS) was used to analyze disease and yield data. Duncan's New Multiple Range Test were performed for comparison of means.

RESULTS AND CONCLUSIONS: There was a large variation in plant establishment between and within locations. Plants per m^2 ranged between 30-70 in Melfort, 50-110 in Star City, and 60-120 in Morden (no count in Vegreville). Pea yields ranged between 2000-2200 kg/ha in Melfort, 2500-3200

kg/ha in Star City, 3100-3900 kg/ha in Vegreville and 6000-6600 kg/ha in Morden (Table5). Thus, a relationship between plant stand and yield level was apparent. The trial at Lacombe was damaged by pigeons, so these data are not shown. None of the fungicide treatments in cv Highlight resulted in significant yield differences, therefore only data from cvs Carneval and Keoma are reported. Powdery mildew did not develop on cv Highlight, but on cv Carneval the disease severities were 5.5 in Morden, 3.5 in Vegreville, 0.7 in Melfort and 2.0 and on cv Keoma in Star City. Neither BRAVO nor QUADRIS significantly reduced powdery mildew. The stem disease severity (SDS) caused by Mycosphaerella blight ranged between 4.8-5.8 in control plots at harvest (Table 4). There were significant differences for fungicide treatments, however, no common trend could be found at the four locations. SDS was not related to neither FDS nor seed yield.

The foliar disease severity for Mycosphaerella blight three weeks after the last fungicide application (FDS3) was significantly different at Morden and Vegreville (Table 4). In Morden, the first foliar rating was higher than at the other locations (FDS1 = 2.5). Weather conditions continued to promoted disease development to FDS2 = 3.6 on the second date of application, and to FDS3 = 4.6 in the unsprayed control (Table 4). Because of the early and relative high FDS1 in Morden the highest seed yield was obtained with an early application of BRAVO 500 at the high rate, however, the yield increase was not highly significant (Table 5). The foliar disease severity of Mycosphaerella blight in Vegreville was low at the first date of fungicide application (FDS1 = 1.0), but high on the second date (FDS2 = 3.4), reaching FDS3 = 4.8 in the unsprayed control three weeks later (Table 4). As a result, the highest seed yields were obtained with two applications of either BRAVO or QUADRIS (Table 5), most of the effect probably due to the second fungicide application at late flower. At Star City, the foliar disease severities were relative low at both applications dates (FDS1 = 1.0 and FDS2 = 2.2), but Mycosphaerella blight developed to FDS3 = 5.2 three weeks later (Table 4). In this case, an application of Quadris at early flower significantly increased yield (Table 5). At Melfort, low disease severities were found at both application dates (FDS1 = 1.0 and FDS2 = 2.0) and the disease did not develop further, so yield was not improved by fungicide treatment and there were no significant differences amongst treatments.

It seems that Mycosphaerella foliar disease severities (FDS1 and FDS2) observed during flowering in pea might be useful to growers when deciding whether to apply a fungicide. Variable plant establishment within and between trials in 1998 confounded the effect of fungicide treatments. The absence of measurable effect of fungicide treatment in cv Highlight remain unexplained. The study will continue in 1999.

Table 1. Rating scale for Mycosphaerella blight in pea.

	Percent infected leaf area		
FDS	Bottom 1/3 of plant	Middle 1/3 of plant	Upper 1/3 of plant
0	0	0	0
1	1-20	0	0
2	21-50	0	0
3	21-50	1-20	0
4	21-50	1-20	1-20
5	21-50	21-50	1-20
6	51-100	21-50	1-20
7	51-100	21-50	21-50
8	51-100	51-100	21-50
9	51-100	51-100	51-100

Table 2. Rating scale for Mycosphaerella stem disease severity (SDS) in pea.

SDS	Symptoms on stem base
0	No symptoms
1	Small flecks
3	Few large lesions
5	Many large lesions
7	Main stem girdled
9	Plant dead

Table 3. Rating scale for powdery mildew in pea (Allen Xue, unpublished).

Rating	% infected plants	%infected leaf area
0	0	0
1	1-4	trace
2	5-9	1-2
3	10-49	3-4
4	50-99	5-9
5	100	10-24
6	100	25-49
7	100	50-74
8	100	75-99
9	100	100

Table 4. Effect of fungicide treatment in pea on Mycosphaerella foliar disease severity three weeks after the last fungicide application (FDS3) and stem disease severity rated before harvest (SDS).

Fungicide	Early	Late	Melfort, SK		Star City, SK		Vegreville, AB		Morden, MB	
treatment	flower		flower	FDS3	SDS	FDS3	SDS	FDS3	SDS	FDS3SDS
Unsprayed			2.0	4.8 a	5.2	5.2 a	4.8 a	5.2 bcd	4.6 a	5.8 a
BRAVO	1000 [1)]		2.0	4.5 a	4.0	2.5 bc	3.2 b	6.1 ab	4.3 ab	5.4 ab
BRAVO	1500		2.0	5.0 a	3.5	4.7 ab	3.1 b	5.8 abc	3.8 c	4.9 bc
BRAVO	1000	1000	2.0	3.5 b	4.5	2.0 c	3.0 b	5.0 cd	3.9 bc	4.8 bc
QUADRIS	125		2.0	5.0 a	3.5	3.5 abc	3.3 b	6.3 a	4.2 abc	4.8 c
QUADRIS	175		2.0	4.5 a	4.2	2.5 bc	3.0 b	5.1 cd	3.9 bc	4.6 bc
QUADRIS	125	125	2.0	4.8 a	4.0	1.5 c	3.3 b	4.4 d	4.3 ab	4.3 c
Pr>F			ns	*	ns	*	***	**	*	**
$LSD_{0.05}$				0.8		2.6	0.6	1.0		0.5 0.7

1) gram active ingredient per hectare

Table 5. Effect of fungicide treatment on pea yield (kg/ha) and relative yield (Rel.) at four locations in 1998.

Fungicide	Early	Late	Melfort, SK		Star City [2)],SK		Vegreville, AB		Morden, MB	
treatment	flower	flower	kg/ha	Rel.	kg/ha	Rel.	kg/ha	Rel.	Kg/ha	Rel.
Unsprayed			1961	100	2496	100	3090	100	6081	100
BRAVO	1000 [1)]		2063	105	3027	121	3440	111	6418	105
BRAVO	1500		2185	111	2699	108	3593	116	6550	107
BRAVO	1000	1000	2170	111	2993	120	3903	126	6315	104
QUADRIS	125		1787	91	3207	128	3362	108	6073	100
QUADRIS	175		2172	111	2897	116	3434	111	5947	98
QUADRIS	125	125	1862	95	2948	118	3995	129	6185	102
Pr>F			ns		*		*		ns	
$LSD_{0.05}$			702	36	580	23	710	23	654	7

1) gram active ingredient per hectare 2) cv. Keoma

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1998 PMR REPORT # 86 **SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS**
ICAR: 61009653

CROP: Field pea (Pisum sativum L.), cvs. Carneval and Carrera
PEST: Root rot, *Pythium ultimum* Trow, *P. irregulare* Buisman.

NAME AND AGENCY:

CHANG K F, HOWARD R J and BRIANT M A
Crop Diversification Centre - South
SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 **Fax:**(403) 362-1326 **Email:** changk@agric.gov.ab.ca

HWANG S F, TURNBULL G D and WANG H
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (403) 632-8228 **Fax:**(403) 632-8379 **Email**: hwang@arc.ab.ca

TITLE: COMPARISON OF TWO APRON FORMULATIONS FOR THE CONTROL OF ROOT ROT DISEASES OF FIELD PEA IN 1998

MATERIALS: APRON XLS (metalaxyl 360 g/L LS), APRON FL (metalaxyl 317 g/L SN)

METHODS: Experimental plots were established on 13 May and 7 May, 1998 at Brooks and Vegreville, Alberta, in brown chernozemic clay loam and black chernozemic sandy loam soil, respectively. Field pea cvs. Carneval and Carrera were seeded in a split-split-plot, randomized complete block design with four replications. Pea cultivars served as main plots, plots with and without inoculum as sub-plots and fungicide formulations as sub-subplots. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds of Carneval and Carrera were planted 5 cm deep at a rate of 22 g and 20 g per row, respectively. Seed was treated in a Hege II small batch seed treater at the rates shown in Table 1. *P. ultimum* and *P. irregulare* were grown on sterilized oat grains for 14 days, then mixed and incorporated at the time of seeding at the rate of 40 mL/row (5×10^2 CFU/mL). Emerged seedlings were counted 5 weeks after seeding along 6 m of the two middle rows of each plot. At maturity (12 August), plants from each plot were harvested by small plot combine at Brooks and Vegreville. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Both fungicide formulations significantly (P#0.05) improved the average number of emerged seedlings and seed yield over the untreated controls (Table 1). Inoculation with the *P. ultimum* - *P. irregulare* mixture significantly reduced emergence at both sites and yield at Brooks. Carneval produced a greater seed yield than Carrera at both sites despite a smaller number of seedlings at Brooks.

CONCLUSIONS: Both fungicide formulations improved pea emergence and yield where plots were inoculated with *Pythium.*

Table 1. Effect of two APRON seed treatments on number of emerged seedlings and seed yield of field pea cvs. Carneval and Carrera at Vegreville and Brooks, Alberta in 1998.

Treatment	Rate (mL/kg seed)	Brooks		Vegreville	
		Plants/6 m	Yield ($g/5\ m^2$)	Plants/6 m	Yield ($g/5\ m^2$)
Seed Treatment:					
APRON XLS	0.5	63.3 a*	2227 a	64.0 a	1038 a
APRON FL	1.1	64.5 a	2228 a	61.8 a	1046 a
Control		33.8 b	1701 b	55.5 b	835 b
Inoculation:					
Noninoculated		56.4 a	2196 a	66.2 a	1004 a
Pythium-inoculated		51.4 b	1908 b	54.8 b	942 a
Cultivar:					
Carneval		50.9 b	2503 a	70.2 a	1004 a
Carrera		56.8 a	1601 b	50.7 b	942 a

* Means within a column followed by the same letter are not significantly different for each experimental variable using Duncan's New Multiple Range Test (P#0.05).

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1998 PMR REPORT # 87 SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS
ICAR: 61009653

CROP: Field pea (*Pisum sativum* L.), cvs. Carneval and Carrera
PEST: Mycosphaerella blight, *Mycosphaerella pinodes* (Berk. & Blox.)

NAME AND AGENCY:
CHANG K F and HOWARD R J
Crop Diversification Centre - South
SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 **Fax:**(403) 362-1326 **Email:** changk@agric.gov.ab.ca

HWANG S F, TURNBULL G D and WANG H
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (403) 632-8228 **Fax:**(403) 632-8379 **Email**: hwang@arc.ab.ca

TITLE: ASSESSMENT OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF MYCOSPHAERELLA BLIGHT OF FIELD PEA

MATERIALS: APRON (metalaxyl 317 g/L SN), THIRAM (thiram 75% WP), CROWN (carbathiin 92 g/L + thiabendazole 58 g/L SU)

METHODS: Experimental plots were established on 4 May and 6 May, 1998 at Westlock and Mundare, Alberta, respectively in black chernozemic loam soil. Field pea seed (cv. Carrera) was selected from 40% infected seed and treated with fungicidal seed dressings using a Hege small batch seed treater. All treatments included APRON at 0.16 mL/kg seed. THIRAM was added to 2 treatments at 0.75 and 0.90 g/kg seed and CROWN was added to 3 treatments at 0.85, 1.80 and 3.00 mL/kg seed. One seedlot was treated with APRON alone and one was left untreated to serve as a control. The seed was planted 5 cm deep at a rate of 22 g per row in a randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Emerged seedlings were counted on 2 and 25 June at Mundare and Westlock, respectively. At maturity, on 13-14 August, plants were hand-harvested at Mundare and threshed when dry. Plants at Westlock were harvested by small plot combine on 19 August, 1998. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Data are presented in Table 1. All fungicidal seed treatments resulted in a greater number of emerged seedlings than in untreated seedlots at Mundare. Seed yield was improved over the controls by the highest rate of CROWN. There was no significant (P#0.05) difference in emergence or yield between controls and seed treatments at Westlock. Untreated seedlots ranked lowest in seedling emergence and seed yield at both sites.

CONCLUSIONS: All fungicidal seed treatments resulted in higher numbers of seedlings than the untreated controls.

Table 1. Effect of fungicidal seed treatments on seedling emergence and seed yield of field pea at Mundare and Westlock in 1998.

Treatment	Rate (mL /kg seed)	Number of seedlings/6 m		Seed yield (g/4 m^2)	
		Mundare	Westlock	Mundare	Westlock
Control		34.9 b*	38.4	226.6 b	1292.3
APRON + THIRAM	0.16 0.90 g	43.2 a	44.0	412.2 ab	1584.4
APRON + THIRAM	0.16 0.75 g	42.2 a	38.8	274.6 ab	1540.9
APRON + CROWN	0.16 3.00	43.4 a	41.9	591.4 a	1327.9
APRON + CROWN	0.16 1.80	41.0 a	41.6	525.1 ab	1438.6
APRON + CROWN	0.16 0.85	44.3 a	41.8	445.0 ab	1560.4
APRON	0.16	45.3 a	39.3	359.2 ab	1467.0

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (P#0.05).

1998 PMR REPORT # 88 **SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS**
ICAR: 61009653

CROP: Field pea (*Pisum sativum* L.), cvs. Carneval and Carrera
PEST: Mycosphaerella blight, *Mycosphaerella pinodes* (Berk. & Blox.)

NAME AND AGENCY:
HWANG S F and TURNBULL G D
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (403) 632-8228 **Fax:**(403) 632-8379 **Email**: hwang@arc.ab.ca

CHANG K F, and HOWARD R J
Crop Diversification Centre - South
SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 **Fax:**(403) 362-1326 **Email:** changk@agric.gov.ab.ca

TITLE: EVALUATION OF BRAVO FOLIAR SPRAY FORMULATIONS FOR THE CONTROL OF MYCOSPHAERELLA BLIGHT OF FIELD PEA IN 1998

MATERIALS: BRAVO 500 F (chlorothalonil 500 g/L SU), BRAVO ZN (chlorothalonil 500 g/L + zinc SU), BRAVO WEATHERSTIK (chlorothalonil 720 g/L SU)

METHODS: Experimental plots were established on 4 May and 6 May, 1998 at Westlock and Mundare, Alberta, respectively in black chernozemic loam soils. Field pea cvs. Carrera and Montana were seeded in a split-plot randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 5 cm deep at a rate of 22 g per row. Foliar fungicide treatments (BRAVO 500 applied at 2 and 3.1 kg a.i./ha at early bloom and at 2 kg a.i./ha at mid-bloom, BRAVO ZN applied at 2 kg a.i./ha at early and mid-bloom and BRAVO WEATHERSTIK applied at 1.75 kg a.i. at early and mid-bloom, and a nontreated check) were applied using a knapsack sprayer with a 8002 tee-jet nozzle at 250 kpa at early bloom (2 and 4 July at Westlock and Mundare, respectively) and at mid-bloom (16 and 17 July at Mundare and Westlock, respectively) using 1000 L/ha water volume. Ascochyta severity was rated on a 0-3 scale for the upper, middle and lower leaves (0=healthy, 1=1-25% of leaf area covered by lesions, 2=26-50 % covered, 3=greater than 50% of leaf area covered by lesions) and on a 0-4 scale for the stem (0= healthy, 1= <10%, 2= 11-50%, 3=> 50% of lower stem covered by lesions, 4= lower stem over 50% girdled) on 29 and 30 July at Westlock and Mundare, respectively. At maturity, on 19 August, 1998, plants from each plot were harvested by small plot combine at Westlock; plants were hand-harvested on 13-14 August at Mundare and threshed when dry. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Data are presented in Tables 1-4. All fungicide treatments reduced disease severity on leaves throughout the plant canopy at Westlock, and all except BRAVO 500 at the higher rate reduced stem infection. BRAVO 500 applied to Montana at the lower rate reduced stem infection compared with

the control and the Bravo ZN and WEATHER STIK formulations, and it improved seed yield over the control. Plots at Mundare were more heavily infected than at Westlock. All fungicide treatments resulted in lower foliar disease severity in mid-canopy for Carrera and, except for the higher rate of BRAVO 500, resulted in less severe stem infection. No significant differences were observed between treatments and the control for Montana, except for a lower stem disease severity rating where the WEATHER STIK formulation was applied.

CONCLUSIONS: All BRAVO formulations tested reduced ascochyta disease severity compared with untreated plots. Seed yield was also generally lower in the untreated control plots than in those that were sprayed.

Table 1. Effect of BRAVO foliar spray treatments on the severity of mycosphaerella blight and seed yield of field pea cv. Carrera at Mundare in 1998.

Treatment	Rate	Disease Severity				Yield
	(kg a.i./ha)	Upper†	Middle†	Lower†	Stem‡	(g/4m^2)
Control		0.65	1.30 a	2.90	2.70 a	1269.6
BRAVO 500	2+2§	0.20	1.00 b	2.60	1.95 b	1405.7
BRAVO 500	3.1+2	0.15	0.95 b	2.75	2.40 ab	1343.7
BRAVO ZN	2+2	0.30	1.05 b	2.80	2.10 b	1475.1
WEATHER STIK	1.75+1.75	0.25	1.00 b	2.50	1.85 b	1306.2

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (P#0.05).

† Foliar disease severity rating scale: 0=healthy, 1=1-25% of leaf area covered by lesions, 2=26-50 % covered, 3=greater than 50% of leaf area covered by lesions.

‡ Disease severity on stem: 0= healthy, 1= <10%, 2= 11-50%, 3=> 50% of lower stem covered by lesions, 4= lower stem over 50% girdled

§ Rate applied at early flowering+rate applied at mid-flowering.

Table 2. Effect of BRAVO foliar spray treatments on the severity of mycosphaerella blight and seed yield of field pea cv. Montana at Mundare in 1998.

Treatment	Rate	Disease Severity				Yield
	(kg a.i./ha)	Upper†	Middle†	Lower†	Stem‡	(g/4m^2)
Control		0.65	1.35	2.65	1.95 a	889.4
BRAVO 500	2+2§	0.65	1.00	2.10	1.45 ab	1125.7
BRAVO 500	3.1+2	0.60	1.00	2.50	1.45 ab	1123.8
BRAVO ZN	2+2	0.65	1.25	2.60	1.85 ab	883.0
WEATHER STIK	1.75+1.75	0.50	1.00	2.20	1.40 b	1108.1

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (P#0.05).

† Foliar disease severity rating scale: 0=healthy, 1=1-25% of leaf area covered by lesions, 2=26-50 % covered, 3=greater than 50% of leaf area covered by lesions

‡ Disease severity on stem:0= healthy, 1= <10%, 2= 11-50%, 3=> 50% of lower stem covered by lesions, 4= lower stem over 50% girdled

§ Rate applied at early flowering+rate applied at mid-flowering.

Table 3. Effect of BRAVO foliar spray treatments on the severity of mycosphaerella blight and seed yield of field pea cv. Carrera at Westlock in 1998.

Treatment	Rate (kg a.i./ha)	Disease Severity Upper†	Middle†	Lower†	Stem‡	Yield ($g/4m^2$)
Control		0.20 a	1.00 a	2.90 a	1.15	1879.3
BRAVO 500	2+2§	0.00 b	0.05 b	1.90 b	0.90	1839.2
BRAVO 500	3.1+2	0.00 b	0.00 b	1.65 b	0.80	1835.0
BRAVO ZN	2+2	0.00 b	0.10 b	1.65 b	0.90	1968.7
WEATHER STIK	1.75+1.75	0.00 b	0.05 b	1.75 b	0.80	1912.2

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (P#0.05).

† Foliar disease severity rating scale: 0=healthy, 1=1-25% of leaf area covered by lesions, 2=26-50 % covered, 3=greater than 50% of leaf area covered by lesions

‡ Disease severity on stem:0= healthy, 1= <10%, 2= 11-50%, 3=> 50% of lower stem covered by lesions, 4= lower stem over 50% girdled

§ Rate applied at early flowering+rate applied at mid-flowering.

Table 4. Effect of BRAVO foliar spray treatments on the severity of mycosphaerella blight and seed yield of field pea cv. Montana at Westlock in 1998.

Treatment	Rate (kg a.i./ha)	Disease Severity Upper†	Middle†	Lower†	Stem‡	Yield ($g/4m^2$)
Control		0.30 a	0.95 a	2.70 a	1.15 a	1552.4 b
BRAVO 500	2+2§	0.00 b	0.05 c	1.60 b	0.70 c	1832.4 a
BRAVO 500	3.1+2	0.00 b	0.15 bc	1.85 b	0.80 bc	1787.9 ab
BRAVO ZN	2+2	0.00 b	0.25 b	1.95 b	0.95 b	1641.4 ab
WEATHER STIK	1.75+1.75	0.00 b	0.05 c	1.90 b	0.90 b	1746.3 ab

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (P#0.05).

† Foliar disease severity rating scale: 0=healthy, 1=1-25%, 2=26-50 %, 3= over 50% of leaf area covered by lesions.

‡ Disease severity on stem: 0= healthy, 1= <10%, 2= 11-50%, 3= over 50% of lower stem covered by lesions, 4= lower stem over 50% girdled

§ Rate applied at early flowering+rate applied at mid-flowering.

1998 PMR REPORT # 89 SECTION J: DISEASES OF VEGETABLES/ SPECIAL CROPS
STUDY DATA BASE #: 375-1113-9613

CROP: Field Pea (*Pisum sativum* L.), cvs Carneval and Highlight
PEST: Powdery mildew *Erysiphe pisi* Syd.

NAME AND AGENCY:
KUTCHER H R, and KIRKHAM C
Melfort Research Farm, Agriculture and Agri-Food Canada
Box 1240, Melfort, Saskatchewan S0E 1A0
Tel: (306) 752-2776 **Fax:** (306) 752-4911 **Email:** kutcherr@em.agr.ca

TITLE: CONTROL OF POWDERY MILDEW ON FIELD PEA USING KUMULUS AND NOVA 40 W

MATERIALS: KUMULUS (80% sulphur, BASF), NOVA 40W (Myclobutanil 40%, Rohm and Haas)

METHODS: Cultivars were seeded into a firm summer-fallow seed-bed of Melfort silty clay loam soil with a Fabrow double-disc press drill in sub-plots 1.45 x 8 meters. The experimental design was a split plot, with fungicide applications made using a shop built, single boom push sprayer, equipped with an odometer to calculate walking speed. Cultivars (Highlight and Carneval) were the main plots and fungicide treatments the sub-plots. Plots were seeded on June 2 to encourage disease development, with 22 kg ha^{-1} phosphate in the furrow. Target seeding rate was 75 plants m^{-2} of each cultivar to a depth of 5.0 cm. Plots were monitored daily for signs of powdery mildew, which was first noted July 27. Fungicide treatments were made in 100 L of water ha^{-1}. The treatments were: 1) Check; 2) KUMULUS 1.5 kg ha^{-1} applied once when symptoms first noted; 3) KUMULUS 1.5 kg ha^{-1} applied twice, when symptoms are first noted and 16 days later; 4) KUMULUS 1.5 kg ha^{-1} applied multiple times beginning shortly before the symptoms were noted; 5) NOVA 40W 56 g a.i.ha^{-1} applied when symptoms first noted; **6)** NOVA 40W 56 g a.i.ha^{-1} applied when symptoms first noted and 16 days later. KUMULUS was applied on July 12, 24, 28 and August 12 for Treatment 4. All other treatments were applied on July 28 and when required a second application on August 12. Plots were rated on August 14 and August 30 for powdery mildew using a 0-9 scale, where 0=no infection and 9=all of the foliage infected and for mycosphaerella blight on August 30 (0-9 scale). Yield and quality measurements were taken from samples harvested from each plot on September 19. Data were analysed using analysis of variance procedures.

RESULTS: Data are presented in Table 1. No differences between cultivars were found for any of the factors examined, and there were no significant interaction effects between fungicide treatments and cultivars. Pea yield was improved over the check when NOVA 40W was applied twice. Powdery mildew severity ratings taken on August 14 showed that all treatments had a lower disease severity rating than the check, but fungicide treatments were not different from each other. Ratings for powdery mildew severity on August 30 showed an improvement of fungicide treatments over the check, and a lower rating with a single application of NOVA 40W than with a single application of KUMULUS. There were no significant differences found among treatments for mycosphaerella blight severity, thousand kernel weight

or bushel weight.

CONCLUSIONS: Under conditions at Melfort in 1998 application of fungicides reduced powdery mildew severity but had little effect on yield or quality, and no effect on mycosphaerella blight. One application of either KUMULUS or NOVA 40W was as effective as two or more applications for powdery mildew control. Differences between the powdery mildew susceptible cultivar, Carneval and the resistant cultivar, Highlight were not detected for any of the factors examined.

Table 1. Effect of KUMULUS and NOVA 40W on the control of powdery mildew on field pea in Melfort in 1998. Yield (kg ha^{-1}), powdery mildew (PM) severity (0-9), mycosphaerella blight (MB) severity (0-9), thousand kernel weight (TKW in grams) and bushel weight (lbs/bu).

	Yield	PM 14-Aug	PM 30-Aug	MB 30-Aug	TKW	Bushel weight
Fungicide						
Check	2234	5.8	6.5	6.9	147.6	65.4
KUMULUS 1X	2346	2.6	3.0	6.5	143.6	65.1
KUMULUS 2X	2338	2.8	2.5	6.6	153.4	65.4
KUMULUS 4X	2278	2.4	2.3	6.4	155.5	64.9
NOVA 40W 1X	2359	0.3	0.4	6.6	152.0	65.4
NOVA 40W 2X	2528	1.3	1	6.6	165.2	65.8
Lsd	211 *	2.9 **	2.3**	0.5 ns	17.5 ns	0.8 ns
Cultivar						
Carneval	2351	2.7	3.2	6.6	153.0	65.5
Highlight	2343	2.3	2.1	6.6	152.8	65.2
Lsd	175 ns	1.9 ns	2.1 ns	0.7 ns	3.0 ns	0.5 ns

1998 PMR REPORT # 90 **SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS**
ICAR: 61009653

CROP: Field pea (*Pisum sativum* L.), cv. Carneval
PEST: Mycosphaerella blight, *Mycosphaerella pinodes* (Berk. & Blox.)

NAME AND AGENCY:
TURNBULL G D and HWANG S F
Alberta Research Council, Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (403) 632-8228 **Fax:**(403) 632-8612 **Email**: hwang@arc.ab.ca

CHANG K F and HOWARD R J
Crop Diversification Centre - South, SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 **Fax:**(403) 362-1326 **Email:** changk@agric.gov.ab.ca

TITLE: EVALUATION OF FOLIAR FUNGICIDES FOR THE CONTROL OF MYCOSPHAERELLA BLIGHT OF FIELD PEA AT VEGREVILLE, ALBERTA IN 1998

MATERIALS: BAS 500 (250 g/L EC), BRAVO 500 F (chlorothalonil, 500 g/L SU)

METHODS: An experimental plot was established in black chernozemic sandy loam soil on 7 May, 1998 at Vegreville, Alberta. Field pea cv. Carneval 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 5 cm deep at a rate of 22 g per row. Eight foliar fungicide treatments were applied using a knapsack sprayer with a 8002 tee-jet nozzle at 250 kpa at early flowering (6 July) and at mid-flowering stage (16 July) using 100 L/ha water volume. Treatments included: BAS 500 applied once at 0.1, 0.15 and 0.2 kg a.i./ha and twice at 0.15kg a.i./ha; a second formulation of BAS 500 applied once at 0.15 kg a.i./ha, and BRAVO 500 applied once and twice at 1.0 kg a.i/ha. Ascochyta severity was rated on a 0-3 scale for the upper, middle and lower leaves: 0= healthy, 1= 1-25% of leaf area covered by lesions, 2=26-50% covered, 3= > 50% of leaf area covered by lesions. Stem lesions were rated on a 0-4 scale: 0=healthy, 1=< 10%, 2=10-50%, 3=51-100% of lower stem covered by lesions and 4=stem deteriorated or extensively girdled, plant dead. At maturity, on 13 August, 1998, plants from each plot were harvested by small plot combine. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: All fungicide treatments significantly reduced disease severity on the lower leaves and stems over the untreated control, but there were no significant (P#0.05) differences between control and fungicide treatments for disease severity on the upper and middle leaves (Table 1). Yield was improved over the control and BAS 500 01, the second formulation of BAS 500, by BRAVO 500 applied at early and mid-flowering.

CONCLUSIONS: All fungicidal spray treatments suppressed ascochyta on the lower leaves and stems, but disease severity was generally very low since weather conditions were not conducive to spore

development and dispersal.

Table 1. Effect of spraying BAS 500 and BRAVO on the severity of mycosphaerella blight and seed yield of field pea cv. Carneval at Vegreville, Alberta in 1998.

Treatment	Rate (kg a.i./ha)	Timing§	Foliar disease severity†			Stem dis. severity‡	Yield ($g/6m^2$)
			Upper	Middle	Lower		
Control			0.50	0.85 ab*	2.85 a	1.95 a	1210.3 b
BAS 500 00	0.1	EF	0.05	0.75 ab	1.80 b	1.10 b	1293.6 ab
BAS 500 00	0.15	EF	0.00	0.50 b	1.45 b	0.95 b	1273.4 ab
BAS 500 00	0.2	EF	0.00	0.85 b	1.75 b	1.05 b	1289.0 ab
BAS 500 01	0.15	EF	0.15	0.55 b	1.45 b	1.20 b	1244.4 b
BAS 500 00	0.15	EF+MF	0.15	0.95 a	2.00 b	1.15 b	1307.7 ab
BRAVO 500	1.0	EF	0.00	0.65 ab	1.45 b	0.90 b	1375.2 ab
BRAVO 500	1.0	EF+MF	0.00	0.65 ab	1.85 b	1.15 b	1472.6 a
ANOVA (P#0.05)			ns	s	s	s	s

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (P#0.05).

† Foliar disease rating scale: 0= healthy, 1= 1-25%, 2=26-50%, 3= > 50%of leaf area covered by lesions.

‡ Stem lesions disease severity 0-4 scale 0=healthy, 1=< 10%, 2=10-50%, 3=50-100% of stem covered by lesions, and 4=stem deteriorated or extensively girdled, plant dead.

§ Foliar fungicide applied at early flowering (EF) and at mid-flowering (MF) stages.

1998 PMR REPORT # 91 SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS

CROP: Lentils (*Lens culinaris* Medik.)
PEST: Anthracnose (*Colletotrichum truncatum* (Schwein.) Andrus and W. D. Moore)

NAME AND AGENCY:
BUCHWALDT L, GOSSEN B and CHONGO G
Agriculture and Agri-Food Canada, Saskatoon Research Centre,
107 Science Place, Saskatoon, Saskatchewan S7N 0X2
Tel: (306) 956-2826 **Fax:** (306) 956-7247 **Email:** BuchwaldtL@em.agr.ca

TITLE: EFFECT OF FOLIAR FUNGICIDE APPLICATION FOR CONTROL OF ANTHRACNOSE IN LENTIL

MATERIALS: BRAVO 500, BRAVO ULTREX, BRAVO IB 10353 (50%, 82.5% and 90% w/w chlorothalonil, respectively) and QUADRIS (22.9% w/w azoxystrobin). Lentil cultivars Laird and Crimson, both susceptible to anthracnose.

METHODS: In 1998, field trials were established in commercial lentil crops at four locations in Saskatchewan. Three locations in Tessier, Zelandia and Elrose were planted to cv. Laird and one location in Elrose was planted to cv Crimson. Each trial was arranged in a randomized complete block design with four replications. At early flowering 1.2 m walkways were rotor-tilled to establish plots in an area of the field with uniform plant stand and low weed pressure. The plot size was 2.4 x 6 m. The ten treatments were: an unsprayed control, a single application of BRAVO 500 at 1 kg a.i./ha and QUADRIS at 125 g a.i./ha applied at early flowering, late flowering, and twice at early and late flowering. In addition, two powder formulations of BRAVO, ULTREX and IB10353, were compared to BRAVO 500 at a rate of 1.68 a.i./ha applied at early flowering. The first fungicide applications were made between July 8-13 and the second 10-14 days later. The fungicides were applied by a hand-held sprayer fitted with TeeJet 8003 nozzles spaced 0.5 m apart. The spray solution was carried by CO_2 at 275 kPa and the water volume was 200 L per hectare. A rating of anthracnose was made at the two spray dates and will be used in a decision support system currently under development at AAFC, Saskatoon Research Centre. Anthracnose was also rated one week before harvest by assessing the severity (on a 0-3 scale) of 10-15 plants per plot and calculating the percent disease severity index (% DSI) for each plot as shown below. The crops were desiccated with Roundup between August 5 and 10, except cv Laird in Elrose, which dried out without desiccation and was harvested on August 20. The other trials were direct combined 10-14 days after dessication. The seed samples were dried, cleaned and weighed. The General Linear Models Procedure (SAS) was used to analyze % DSI and yield data.

RESULTS: There were no symptoms of anthracnose in cv Laird at Tessier and in cv Crimson at Elrose. Anthracnose developed slowly in cv Laird at Zelandia and the DSI was 18% in the unsprayed control at harvest (Table 2). The disease developed rapidly in cv Laird at Elrose reaching 57 % DSI in the unsprayed control (Table 2). Ascochtya blight did not develop at any of the four locations. There were no significant differences between the unsprayed control and the fungicide treatments at any of the four locations with regards to anthracnose severity and lentil yield (Table 2). In a few cases, two fungicide treatments were significantly different, but they were not the same at two or more locations.

CONCLUSIONS: At the date of the first fungicide application, symptoms of anthracnose were observed in the field trials at Zelandia and Elrose both planted to cv Laird. Necrotic lesions were present on lower leaflets and a premature leaf drop was evident, indicating that fungicide application might be economically beneficial. Both of these fields were planted to lentils for the first time, so the primary infection was most likely caused by wind-borne inoculum. As the season progressed, patches of heavily infected plants became evident, especially in cv Laird at Elrose. With a patchy distribution of infection loci it was not possible to obtain significant differences among fungicide treatments. The study will continue in 1999.

Acknowledgment: Financial support from the Agri-Food Innovation Fund and Zeneca Agro is gratefully appreciated.

Table 1. Rating scale for anthracnose in lentil

Value	Stem symptoms
0 =	The main stem and all side stems are green without lesions
1 =	Some lesions are present on the stems, but they are clearly separate from one another and surrounded by healthy, green tissue
2 =	Some stems have clearly separated lesions, while other stems of the same plant have brown and necrotic areas covering 1" or more of the stem base
3 =	All stems of the plant are infected and the brown and necrotic areas cover 1-2" or more of the stem base; lesions with pinhead sized, black microsclerotia are often present

Calculation of percent disease severity index in a plant sample:
% DSI = [(0 x X) + (1 x Y) + (2 x Z) + (3 x W) / N x 3] x 100
X = number of plants rated 0; Y = number of plants rated 1; Z = number of plants rated 2; W = number of plants rated 3; N x 3 = total number of plants rated in the plot multiplied by the maximum disease severity value. The DSI values rang between 0 - 100%.

Table 2. Effect of BRAVO and QUADRIS on anthracnose severity (% DSI) and yield in four commercial lentil crops in Saskatchewan, 1998.

Fungicide treatments	Early flower	10-14 days later	Tessier cv Laird		Zelandia cv Laird		Elrose cv Laird		Elrose cv Crimson	
			%DSI	Yield	%DSI	Yield	%DSI	Yield	%DSI	Yield
Control			0	954.7	18	1013.3	57	948.8	0	886.2
BRAVO 500	1000 [1)]		0	984.0	31	1052.2	51	924.0	0	891.7
BRAVO 500		1000*	0	838.8	18	1163.2	46	869.7	0	812.7
BRAVO 500	1000	1000	0	933.4	31	957.9	50	970.3	0	895.9
QUADRIS	125		0	1089.5	20	999.2	52	950.0	0	1039.2
QUADRIS		125	0	870.7	18	1125.8	56	961.5	0	936.1
QUADRIS	125	125	0	925.6	20	1073.3	58	1119.8	0	929.7
BRAVO 500	1680		0	924.8	6	1140.5	49	860.1	0	1062.7
BRAVO ULTREX	1680		0	1066.4	13	942.4	57	939.9	0	978.8
BRAVO IB10353	1680		0	925.0	25	998.1	48	961.1	0	1019.7
GLM			ns		ns		ns		ns	

1) gram active ingredient per hectare

1998 PMR REPORT #92 **SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS**
ICAR: 61009653

CROP: Lentil (*Lens culinaris* L.), cvs. 512, Laird and Redwing
PEST: Root rot, *Fusarium avenaceum* (Fr.) Sacc.

NAME AND AGENCY:
HWANG S F and TURNBULL G D
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (403) 632-8228 **Fax:**(403)632-8379 **Email:** hwang@arc.ab.ca

CHANG K F and HOWARD R J
Crop Diversification Centre - South
SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 **Fax:**(403)362-1326 **Email:** changk@agric.gov.ab.ca

TITLE: EVALUATION OF CROWN AND VITAFLO 280 TO CONTROL FUSARIUM ROOT ROT OF ASCOCHYTA-RESISTANT LENTIL CULTIVARS IN 1998

MATERIALS: CROWN (carbathiin 92 g/L + thiabendazole 58 g/L SU), VITAFLO 280 (carbathiin 14.9%, thiram 13.2% SU)

METHODS: Experimental plots were established on 8 May at Namao, Alberta in black chernozemic clay-loam soil using lentil cvs. 512, Laird and Redwing seeded in a split-plot randomized complete block design with four replications. Lentil cultivars served as main plots and fungicide seed treatment, along with *Fusarium*-inoculated and non-inoculated controls, served as subplots. Each subplot consisted of four, 6 m rows of plants spaced 25 cm apart. Seeds of 512, Laird and Redwing were planted 5 cm deep at a rate of 6 , 10 and 6 g per row, respectively. Seed was treated in a Hege II small batch seed treater at the rates given in Table 1. *Fusarium avenaceum* was grown on a mixture of sterilized oat and rye kernels for 14 days and incorporated as inoculum (10^3 cfu/mL) at the rate of 30 mL/row at the time of seeding. Emerged seedlings were counted three weeks after seeding on 2 m lengths of the middle two rows of each plot. At maturity (31 August), plants from each plot, discounting a 1-m section from each end, were hand-harvested. Seeds were threshed 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: Both CROWN fungicide seed treatments significantly (P#0.05) improved the average number of emerged seedlings for cvs. Laird and Redwing over the inoculated controls (Table 1). None of the treatments significantly affected seedling emergence for cv. 512. VITAFLO 280 improved seedling emergence in Redwing. Seed yield was not significantly affected by seed treatment, except for a higher yield observed where Redwing was treated by CROWN at the lower rate.

CONCLUSIONS: Application of CROWN at 6 mL/kg did not improve its efficacy over 3 mL/kg for either seedling emergence or seed yield, but it improved seedling emergence over the inoculated control

and over the VITAFLO 280 treatment in most cases.

Table 1. Effects of fungicidal seed treatments on germination and seed yield of three lentil cultivars at Brooks and Namao, Alberta in 1998.

Treatment	Rate (mL/kg)	512		Laird		Redwing	
		Plants /2 m	Seed yield (g/4 m^2)	Plants /2m	Seed yield (g/4 m^2)	Plants /2 m	Seed yield (g/4 m^2)
Control		47.1	1579.6 a*	36.6 a	1429.1 a	27.2 ab	1099.5 ab
CROWN+F†	3.0	46.6	1428.0 bc	33.3 a	1355.3 a	28.8 a	1241.5 a
CROWN+F†	6.0	44.0	1525.8 ab	31.7 a	1262.4 ab	28.6 a	1102.1 ab
VITAFLO+F†	3.3	44.0	1379.8 c	20.0 b	1099.5 b	28.5 a	986.1 b
Control+F†	42.8	1415.7 bc	23.8 b	1261.7 ab	23.2 b	1047.3 b	

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (P#0.05).

† Denotes inoculation with *Fusarium avenaceum*

1998 PMR REPORT # 93 SECTION J: DISEASES OF VEGETABLES/SPECIAL CROPS
ICAR: 61009653

CROP: Lentil (*Lens culinaris* L.),
cvs. Laird and Eston

PEST: Fusarium root rot, *Fusarium avenaceum* (Fr.) Sacc.

NAME AND AGENCY:
WANG H, HWANG S F, and TURNBULL G D
Alberta Research Council
P.O. Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (403) 632-8610 **Fax:** (403) 632-8612 **Email**: wangh@arc.ab.ca

CHANG K F and HOWARD R J
Crop Diversification Centre - South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1334 **Fax:** (403) 362-1326 **Email**: changk@agric.gov.ab.ca

TITLE: EVALUATION OF MAXIM AND APRON XL SEED TREATMENT FOR THE CONTROL OF FUSARIUM ROOT ROT OF LENTIL

MATERIALS: MAXIM 40.3% (fludioxonil 1.22g/mL), APRON XL LS 33.3% (metalaxyl-M 1.113g/mL)

METHODS: Seed of two lentil cultivars (Laird and Eston) was treated with MAXIM 40.3% plus APRON XL 33.3% (at 2.5 + 3.75 g a.i./100 kg of seed) or MAXIM 40.3% (at 2.5 g a.i./100 kg of seed) alone. Treated and non-treated seeds were planted in flats (25 x 30 cm) filled with greenhouse potting soil. Each replicate consisted of 20 seeds planted by hand along a 30 cm furrow at a depth of 2.5 cm. *Fusarium* inoculum was grown on oat grains for 14 days, which were subsequently air-dried, ground and incorporated with the seed at three different rates: low (10 CFU/cm), medium (20 CFU/cm) and high (40 CFU/cm). Treatments were arranged in the flats in a randomized complete block design with four replications. The incidence of fusarium root rot (percentage of seedlings with root rot symptoms) was recorded and disease severity was measured using a scale of 0 (no disease) to 4 (over 75% of root infested with *Fusarium*) in four weeks after planting. Data were subjected to analysis of variance and least significant difference (LSD) mean separations with the Statistical Analysis System (SAS Institute, Cary, NC).

RESULTS: MAXIM plus APRON or MAXIM alone significantly reduced root rot incidence and disease severity (P # 0.05) in lentils (Table 1). Although different cultivars exhibited different disease levels, Laird became more severely infected than Eston. Root rot incidence and severity levels increased with inoculum concentration.

CONCLUSIONS: MAXIM was moderately effective as a seed treatment for controlling fusarium root rot in lentil. Mixing APRON XL with MAXIM did not improve efficacy.

Table 1. Effect of MAXIM and APRON XL seed treatment on fusarium root rot of lentil under greenhouse conditions, 1998.

Treatment	Eston		Laird	
	Root rot Incidence (%)	Severity (0-4)	Root rot Incidence (%)	Severity (0-4)
Non-treated	66.3 a*	1.0 a	83.4 a	1.1 a
MAXIM	28.4 b	0.3 b	41.7 b	0.6 b
MAXIM + APRON XL	32.4 b	0.4 b	43.5 b	0.6 b
LSD (P # 0.05)	7.4	0.1	8.9	0.2
Inoculum level				
Low	18.6 c	0.2 c	37.3 c	0.4 c
Medium		46.4 b	0.5 b	59.5 b 0.8 b
High	62.1 a	0.9 a	71.8 a	1.1 a
LSD (P # 0.05)	7.4	0.1	8.9	0.2

* Values are means of four replications, and means in a column followed by a common letter are not significantly different at P # 0.05 according to the least significant difference test.

1998 PMR REPORT # 94 **SECTION J: VEGETABLES and SPECIAL CROPS - Diseases**
ICAR: 206003

CROP: Lettuce (*Lactuca sativa* L), cv. Ithaca
PEST: Pythium stunt, *Pythium spp.*

NAME AND AGENCY:
HOVIUS, M H Y AND M R MCDONALD
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph,
RR#1, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775-4546 Email: mhovius@uoguelph.ca

TITLE: FIELD EVALUATION OF FURROW APPLICATIONS OF RIDOMIL FOR THE CONTROL OF PYTHIUM STUNT OF LETTUCE, 1998.

MATERIALS: Lettuce (cv. Ithaca) and RIDOMIL 2G (metalaxyl 2%) and RIDOMIL GOLD 1G (mefanoxam 1%).

METHODS: Lettuce was direct seeded, using a Stan Hay precision seeder, into organic soil (pH 6.4, organic matter 60%) on 22 April in a commercial field site, with a history of pythium stunt, in the Holland Marsh, Ontario. In-furrow treatments consisted of a control, RIDOMIL 2G and RIDOMIL GOLD 1G both at 115 g of product per 100 m of row. All lettuce plants were assessed for pythium stunt after thinning (rows thinned to 3 heads per m with 4 rows per bed) was complete and continued once per week until harvest. Plants with pythium stunt were counted weekly, beginning on 21 May and rogued out of the plots. Treatments were arranged in a randomized complete block design with four replications per treatment. Air temperatures were above the long term (10 year) average for May and not different from the long term average for June. Total rainfall was below the long term (10 year) average for May (42.6 mm) and not different from the long term average for June (78.4 mm). No irrigation was used to offset the lack of precipitation during seedling emergence and plant growth. Recommended control procedures for fungal and bacterial pathogens, weeds and insects were followed. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix, V. 4.1.

RESULTS: As presented in Table 1.

CONCLUSIONS: Incidence of pythium stunt was low. These low levels could have been due to the very dry conditions during the first 6 weeks of plant emergence and growth. Even so, significant differences (P=0.0001) were found among the treatments. Levels of pythium stunt in lettuce treated with RIDOMIL GOLD 1G and RIDOMIL 2G were significantly lower than those in the untreated control but were not significantly different from each other.

Table 1. Cumulative incidence of pythium stunt of lettuce from thinning to harvest, in a commercial lettuce field in the Holland Marsh, Ontario, 1998.

Treatment	Application rate /100 m of row	Cumulative pythium stunt incidence (%)
RIDOMIL GOLD 1G	115 g	0.22 a*
RIDOMIL 2G	115 g	0.98 a
CONTROL	------	10.30 b

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

1998 PMR REPORT # 95 **SECTION J: VEGETABLES and SPECIAL CROPS - Diseases**
ICAR: 206003

CROP: Yellow Cooking Onion (*Allium cepa* L.)
PEST: White rot, *Sclerotium cepivorum* (Berk)

NAME AND AGENCY:
HOVIUS, M H Y AND M R MCDONALD
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph,
RR#1, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775-4546 Email: mhovius@uoguelph.ca

TITLE: EVALUATION OF COMMERCIAL YELLOW COOKING ONION CULTIVARS AND BREEDING LINES FOR RESISTANCE TO WHITE ROT USING A SCALE INOCULATION TECHNIQUE, 1998.

MATERIALS: Onions bulbs harvested from the 1997 White Rot Resistant field trials grown in the Holland Marsh. Onion breeding lines obtained from Dr. I.L. Goldman at the University of Wisconsin, Petoseed, Asgrow Ltd and 6 commercial cultivars. Three isolates of *Sclerotium cepivorum* Berk, MCG-1, MCG-2, and MCG-3.

METHODS: Scale segments of harvested yellow cooking onion bulbs of 6 commercial cultivars and 18 breeding lines, grown in the Holland Marsh, Ontario, in a commercial field in 1997, were inoculated with mycelial plugs of three isolates of *Sclerotium cepivorum* in Jan, 1998. Onion scale segments were prepared for inoculation as follows: bulbs were surface disinfested, after removal of outer scales, in a 10% Javex bleach solution (5 min), rinsed and air dried. Segments (7 cm x 7 cm) were cut, the inner membrane was removed and the scales were inoculated. Three *S. cepivorum* isolates were used for inoculation representing three distinct mycelial compatibility groups (MCG-1, MCG-2 and MCG-3) present in the Holland Marsh. Agar discs, 5 mm in diameter, were cut from the margins of actively growing cultures using a sterile cork borer and placed mycelium side down in the center of each segment (concave side). Each mycelial line was replicated four times in a randomized complete block design in sterilized plastic trays and stacked in a plexiglass chamber, filled with water to 7.5 cm. A hygro-thermograph was placed inside and the chamber was covered with a black sheet. After 7 days incubation, at room temperature, the lesion diameter on each scale (convex side) was measured. All data were analyzed using the General Analysis of Variance function and the Pearson Correlation function of the Linear Models section of Statistix, V. 4.1.

RESULTS: As presented in Table 1.

CONCLUSIONS: Significant (P=0.05) differences were found in lesion diameters (13.9 to 32.6 mm) among onion lines and cultivars harvested in 1997 and inoculated in 1998. There was a significant (P=0.00001) MCG isolate by onion interaction, therefore, the results from the three isolates could not be pooled. Within MCG-1 and MCG-2, the breeding lines from the University of Wisconsin had the largest lesions and the smallest lesions were found on the Petoseed lines (in contrast to previous years), but the contrast was not significant. The University of Wisconsin breeding line, W91297 had the largest lesion

diameter which was significantly larger than most of the other breeding lines and cultivars when inoculated with MCG-1 and MCG-2. The Petoseed, PS650096 breeding line had the smallest lesion diameter when inoculated with all 3 MCG's and was significantly smaller than approximately one third of the other breeding lines and cultivars. There was a significant, positive Pearson correlation among diameters of lesions formed by MCG-1 and MCG-2 on the 18 breeding lines (r^2=0.61, P=0.00001). The onion lines which had the largest lesion diameters when inoculated with MCG-1, also had the largest lesion diameters when inoculated with MCG-2. The resulting correlation is not high, indicating that there are more factors than the onion cultivar/breeding line and MCG involved in determining the resulting lesion diameter. MCG-1 tended to result in larger lesions overall than MCG-2; the isolate, MCG-1 is considered more virulent than MCG-2. The MCG-3 cultures used for inoculation resulted in highly variable results among replicates with no significant differences among cultivars. MCG-3 was consistently less pathogenic than MCG-1 and 2.

Table 1. Onion scale lesion diameters 7 days after *Sclerotium cepivorum* mycelia inoculation, 1998.

Onion Cultivar/Line	Source	Lesion diameters (mm)		
		MCG-1	MCG-2	MCG-3
W91297	Wisconsin	32.6 a*	30.7 a	21.5 NS**
W91097	Wisconsin	32.1 a	26.4 b	19.3
Norstar	Stokes	29.6 ab	26.8 b	16.3
W10596	Wisconsin	28.8 bc	26.6 b	18.2
PSW457	Petoseed	28.7 bc	24.7 bc	17.8
W10196	Wisconsin	28.7 bc	24.3 b-d	17.5
Paragon	Sun Seeds	28.2 b-d	26.2 b	14.6
XPH15055	Asgrow	28.1 b-e	24.8 bc	17.2
W10496	Wisconsin	28.0 b-e	23.8 b-e	17.6
W92097	Wisconsin	27.5 b-f	24.7 bc	16.2
Joint Venture	Stokes	27.2 b-f	21.5 c-e	17.7
Fortress	Asgrow	27.2 b-f	26.8 b	16.8
W91897	Wisconsin	27.1 b-f	23.4 b-e	15.7
W91697	Wisconsin	27.1 b-f	24.0 b-e	18.9
Prince	Seedway	26.7 b-g	24.9 bc	14.3
Hamlet	Asgrow	26.2 c-h	24.1 b-e	18.9
PSWR465	Petoseed	26.1 c-h	20.9 de	16.1
W10296	Wisconsin	25.7 d-h	23.5 b-e	17.8
PS650196	Petoseed	25.2 e-h	24.5 b-d	18.2
W91497	Wisconsin	25.2 e-h	24.1 b-e	15.1
PS650396	Petoseed	25.0 f-h	23.3 b-e	17.2
W92497	Wisconsin	24.6 f-h	21.8 c-e	15.9
PS650296	Petoseed	24.1 gh	20.9 de	15.5
PS650096	Petoseed	23.5 h	20.4 e	13.9

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

** NS - no significant treatment effects were observed.

1998 PMR REPORT # 96 **SECTION J: VEGETABLES and SPECIAL CROPS - Diseases**
ICAR: 206003

CROP: Yellow Cooking Onion (*Allium cepa* L.)
PEST: White rot, *Sclerotium cepivorum* (Berk)

NAME AND AGENCY:
HOVIUS, M H Y AND M R MCDONALD
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph,
RR#1, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775-4546 Email: mhovius@uoguelph.ca

TITLE: EVALUATION OF COMMERCIAL YELLOW COOKING ONION CULTIVARS TO WHITE ROT USING A SCALE INOCULATION TECHNIQUE, 1998.

MATERIALS: Onions bulbs harvested from the 1997 Muck Crops Research Station Main Cultivar Trial. Three isolates of *Sclerotium cepivorum* Berk, MCG-1, MCG-2, and MCG-3.

METHODS: Scale segments of harvested yellow cooking onion bulbs of 32 commercial cultivars, grown in the Holland Marsh, Ontario, at the Muck Crops Research Station in 1997, were inoculated with mycelial plugs of three isolates of *Sclerotium cepivorum* in Feb, 1998. Onion scale segments were prepared for inoculation as follows: bulbs were surface disinfested, after removal of outer scales, in a 10% Javex bleach solution (5 min), rinsed and air dried. Segments (7 cm x 7 cm) were cut, the inner membrane was removed and the scales were inoculated. Three *S. cepivorum* isolates were used for inoculation representing three distinct mycelial compatibility groups (MCG-1, MCG-2 and MCG-3) present in the Holland Marsh. Agar discs, 5mm in diameter, were cut from the margins of actively growing cultures using a sterile cork borer and placed mycelium side down in the center of each segment (concave side). Each mycelial line was replicated four times in a randomized complete block design in sterilized plastic trays and stacked in a plexiglass chamber, filled with water to 7.5 cm. A hygro-thermograph was placed inside and the chamber was covered with a black sheet. After 7 days incubation, at room temperature, the lesion diameter on each scale (convex side) was measured. All data were analyzed using the General Analysis of Variance function and the Pearson Correlation function of the Linear Models section of Statistix, V. 4.1.

RESULTS: As presented in Table 1.

CONCLUSIONS: There was a significant (P=0.0001) MCG isolate by onion cultivar interaction, therefore, the results from the three isolates could not be pooled. Significant (P=0.05) differences in lesion diameters (20.5 to 31.8 mm) were found among onion cultivars harvested in 1997 and inoculated with MCG-2. There was no significant (at P=0.05) Pearson correlation between lesion diameters formed by MCG-1 and MCG-2. There were no significant differences in lesion diameters among cultivars when inoculated with either MCG-1 or MCG-3. It was observed that the MCG-1 stock cultures appeared to have slower mycelial growth than previously seen. The MCG-3 cultures used for inoculation resulted in highly variable results among replicates with no significant differences among cultivars. MCG-3 was consistently less pathogenic than MCG-1 and 2.

Table 1. Onion scale lesion diameters (ls) 7 days after *Sclerotium cepivorum* mycelia inoculation.

Cultivar	Source	MCG-1, ls (mm)	MCG-2, ls (mm)	MCG-3, ls (mm)
Benchmark	Asgrow	26.5 NS*	31.8 a**	18.0 NS*
Frontier	American Takii	28.5	31.2 ab	20.3
HMX4633	Harris Moran	27	31.2 ab	21.8
Precedent	Sun Seeds	23.8	28.5 a-c	22.5
Hoopla	J.C. Canners	27.6	28.3 a-d	26.7
Prince	Bejo/Seedway	23.2	28.0 a-d	18.7
Corona	Bejo/Seedway	25.6	27.5 a-e	23
XPH15039	Asgrow	26.9	27.3 a-e	22
Tornado	Bejo/Seedway	26.3	27.2 a-f	22.5
Festival	Bejo/Seedway	26.8	26.9 a-f	23.6
Norstar	Stokes	26.8	26.8 a-f	29.5
Gazette	Stokes	26.2	26.3 a-g	24.5
V.L. 224	Vilmoran	23.4	26.0 a-g	22.3
Livingston	J.C. Canners	26.4	25.8 b-g	17.3
Express Pak	Norseco	26.8	25.5 b-g	27.2
Spectrum	Sun Seeds	30.6	25.3 b-g	24
Quantum	Petoseed	28.2	25.2 c-g	23.8
Barrage	Asgrow	24.4	25.0 c-g	18.3
V.L. 221	Vilmoran	27.6	24.7 c-g	19.5
Advancer	Harris Moran	26.2	24.2 c-g	19
Tamara	Bejo/Seedway	24.7	24.0 c-g	18
Uniglobe 108	Petoseed	25.5	23.8 c-g	19.2
Hamlet	Asgrow	24.3	23.7 c-g	22
Tribute	Asgrow	26.7	23.7 c-g	18.3
XPH15038	Asgrow	23.4	23.7 c-g	20
Arsenal	Asgrow	27.6	23.3 c-g	20.5
Headliner	Stokes	22.9	23.2 c-g	15.5
Uniglobe 100	Petoseed	26.4	22.7 c-g	22.3
XPH94396	Crookham	26.8	22.5 d-g	28.3
Stanley	J.C. Canners	23.2	21.7 e-g	16.3
Topnotch	Crookham	19.8	21.3 fg	21
Millennium	Sun Seeds	25.3	20.5 g	21

* NS - no significant treatment effects were observed. ** Numbers in a column followed by the same letter are not significantly different at P=0.05, Fisher's Protected LSD test.

1998 PMR REPORT # 97 **SECTION J: VEGETABLES and SPECIAL CROPS - Diseases**
ICAR: 206003

CROP: Yellow Cooking Onion (*Allium cepa* L.), cvs. Fortress and Frontier
PEST: White rot, *Sclerotium cepivorum* (Berk)

NAME AND AGENCY:
HOVIUS, M H Y AND M R MCDONALD
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph, RR#1, Kettleby, Ontario L0G 1J0 Tel: (905) 775-3783 Fax: (905) 775-4546 Email: mhovius@uoguelph.ca

TITLE: FIELD EVALUATION OF COMMERCIAL YELLOW COOKING ONION CULTIVARS AND BREEDING LINES FOR RESISTANCE TO THE WHITE ROT PATHOGEN, *SCLEROTIUM CEPIVORUM* BERK, 1998.

MATERIALS: Onions breeding lines obtained from Dr. I.L. Goldman (University of Wisconsin), R. Maxwell at Petoseed, Asgrow Ltd and Sun Seeds, and 9 commercial cultivars, PRO GRO (carbathiin 30%, thiram 50%) and methyl cellulose (1%).

METHODS: Field resistance to white rot was investigated at one commercial field site (organic muck soil) with a history of white rot and in an outdoor pot trial at the Muck Crops Research Station, Holland Marsh, Ontario, 1998. Onion lines from three sources and 9 commercial cultivars were seeded in 288 plug trays on 28 and 29 Apr and hand-transplanted on 9 and 10 June (commercial field site) and 23 Jun (pot trial). Each cultivar was replicated four times in a randomized complete block design. Each replicate consisted of one 3 m row, at 40 plants/m with 42cm between rows in the commercial field trial. In the pot trial, each replicate consisted of one half of a pail (30cm in diameter, 36cm deep); with a barrier made of corrugated plastic to split the pail in half. White rot free organic muck soil was inoculated with sclerotia of *Sclerotium cepivorum* at 300 viable (tested on potato dextrose agar) sclerotia per kg of soil, mixed with a hand trowel. Seven plants were transplanted per replication, spaced 3 cm apart. Recommended control procedures for fungal and bacterial pathogens, weeds and insects were followed. Air temperatures were above the long term (10 year) average for May, and not different from the long term average for Jun, Jul, Aug and Sept. Total rainfall was below the long term (10 year) average for May (42.6 mm), Jul (50.2 mm) and Sept (18.6 mm); above average for Aug (114.6 mm) and not different from the long term average for Jun (78.4 mm). No irrigation was used to offset the lack of precipitation during plant growth in the commercial field site. The lack of accumulated precipitation and the lack of irrigation resulted in a drought stress situation for the plants in the commercial field site. The plants in the pot trial were watered when the soil appeared dry. Onion bulbs were assessed for visible white rot incidence, in the field, at harvest maturity, on 11 Sept and 18 Sept for the pot trial. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix, V. 4.1.

RESULTS: As presented in Table 1.

CONCLUSIONS: Incidence of white rot was low (0 to 12.8%) at the commercial field site and in the pot trial due to the hot dry weather during the growing season, which was unfavorable for white rot development. In the pot trial, a small sample size and high standard errors resulted in no significance.

Significant differences were found among cultivars tested in the field trial. Three cultivars had the highest incidences of white rot while almost no significant differences were found among the breeding lines.

Table 1. White rot harvest incidence in onions at one commercial field site and in a pot trial, 1998.

Cultivar/Line	Source	Incidence - field (%)	Incidence - pot (%)
Turbo	Stokes	12.8 a*	0.0 NS**
Top Notch	Stokes	6.9 b	4.2
Headliner	Petoseed	3.7 c	0
PSR650296	Petoseed	2.7 cd	3.6
PSR650096	Petoseed	2.5 c-e	0
Joint Venture	Stokes	2.3 c-e	0
Prince	Bejo/Seedway	1.8 c-e	6.7
PSR650196	Petoseed	1.3 c-e	5
WR1752	Petoseed	1.3 c-e	10.7
XPH15055	Asgrow	1.1 de	3.6
Norstar	Stokes	0.9 de	0
Corona	Bejo/Seedway	0.8 de	0
104-96	Wisconsin	0.7 de	0
918-97	Wisconsin	0.7 de	7.1
PSR650396	Petoseed	0.7 de	10.7
Frontier	American Takii	0.7 de	0
914-97	Wisconsin	0.5 de	3.6
906-98	Wisconsin	0.4 de	3.6
101-96	Wisconsin	0.4 de	4.2
WR447	Petoseed	0.2 de	5
920-97	Wisconsin	0.2 de	0
XPH15056	Asgrow	0.2 de	10.7
912-97	Wisconsin	0.2 de	0
WR457	Petoseed	0.2 de	3.6
B901-1	Sun Seeds	0.2 de	0
916-97	Wisconsin	0.2 de	8.3
102-96	Wisconsin	0.2 de	0
Fortress	Asgrow	0.2 de	3.6
910-97	Wisconsin	0.0 e	3.6
924-97	Wisconsin	0.0 e	0
WR456	Petoseed	0.0 e	5

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

** NS - no significant treatment effects were observed.

1998 PMR REPORT # 98 **SECTION J: VEGETABLES and SPECIAL CROPS - Diseases**
ICAR: 206003

CROP: Yellow Cooking Onion (*Allium cepa* L.), cvs. Fortress and Frontier
PEST: White rot, *Sclerotium cepivorum* (Berk)

NAME AND AGENCY:
HOVIUS, M H Y AND M R MCDONALD
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph,
RR#1, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775-4546 Email: mhovius@uoguelph.ca

TITLE: FIELD EVALUATION OF FURROW APPLICATIONS OF *TRICHODERMA HARZIANUM* FOR THE CONTROL OF ONION WHITE ROT (*SCLEROTIUM CEPIVORUM* BERK), 1998.

MATERIALS: Onions (cv. Fortress and Frontier) and T-22 ROOT SHIELD DRENCH (*Trichoderma harzianum* Rifai strain KRL-AG2 1.15%, contains at least 1 x 10^7 colony forming units/g dry weight), T-22G BIOLOGICAL PLANT PROTECTANT GRANULES (*Trichoderma harzianum* Rifai strain KRL-AG2 1.15%, contains at least 1 x 10^7 colony forming units/g dry weight), PRO GRO (carbathiin 30%, thiram 50%) and methyl cellulose (1%).

METHODS: Raw onion seed of cultivars Fortress and Frontier, were treated with PRO GRO at 25 g of product with 1% methyl cellulose per kg of seed on 11 May. The onions were seeded in two commercial field sites (organic muck soil) with histories of white rot in the Holland Marsh, Ontario., on 15 May (site 1) and 22 May (site 2), 1998. The treatments consisted of furrow applications of: 1) T-22G BIOLOGICAL PLANT PROTECTANT GRANULES applied at 44.8 g/100 m of row, 2) T-22 ROOT SHIELD DRENCH applied at 4.48 g/100 m of row in 1500 L of water/ha (low rate) and 3) T-22 ROOT SHIELD DRENCH applied at 22.5 g/100 m of row in 1500 L of water/ha (high rate) applied to both Fortress and Frontier. An untreated check was also included. The onions were seeded using a V-belt push seeder delivering a spacing and depth of 1.5 to 2.0 cm. T-22G was applied on the V-belt along with the seed. The T-22 DRENCH treatments were applied using a gravity flow line placing the drench directly in the seed furrow. Each treatment and cultivar combination was replicated four times in a randomized complete block design. Each replicate consisted of one 3 m row. Recommended control procedures for fungal and bacterial pathogens, weeds and insects were followed. Air temperatures were above the long term (10 year) average for May, and not different from the long term average for Jun, Jul, Aug and Sept. Total rainfall was below the long term (10 year) average for May (42.6 mm), Jul (50.2 mm) and Sept (18.6 mm); above average for Aug (114.6 mm) and not different from the long term average for Jun (78.4 mm). No irrigation was used to offset the lack of precipitation during seedling emergence and plant growth. The lack of accumulated precipitation and the lack of irrigation resulted in a drought stress situation at all sites. Onion bulbs were assessed for visible white rot incidence, in the field, at harvest maturity, on 19 Sept (site 1) and 21 Sept (site 2). Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix, V. 4.1.

RESULTS: As presented in Table 1.

CONCLUSIONS: Incidence of white rot was low (0 to 3.85%) at all sites due to the hot dry weather during the growing season, which was unfavorable for white rot development. No significant differences were found among treatments between or within the two cultivars tested, Fortress and Taurus. *Trichoderma harzianum* did not appear to give control of onion white rot. The rhizosphere (area around the plant root) is subject to rapid and long-term fluctuations in water, salt, pH, nutrients, temperature and microorganism population due to plant growth and development and changing environmental and climatic conditions. It is not understood what these changes are or how the changes affect the efficacy of *T. harzianum* in controlling white rot. *T. harzianum* has broad range of activity against a number of plant pathogens utilizing various control mechanisms. With many biocontrol agents, trials conducted on numerous crops in multi-year, multi-locational trials at different times of the year have demonstrated that the environment can alter the efficacy of the test product. Therefore, replicated, multi-location and multi-year trials are required to indicate the level of variability inherent with the use of *T. harzianum.* Continued research, under controlled conditions, testing different modes of application and application rates and timing, using *T. harzianum* is necessary to determine its effectiveness for controlling onion white rot before continuing with field trials.

Table 1. Harvest incidence of white rot in two onion cultivars grown at two commercial sites in the Holland Marsh, Ontario, treated with granular and drench formulations of the fungus, *Trichoderma harzianum*, in 1998.

Cultivar	Treatment	Rate /100 m of row	White Rot Harvest Incidence (%)	
			Site 1	Site 2
Fortress	Check	------	0.58 NS*	3.60 NS*
Fortress	T-22G BIOLOGICAL PROTECTANT GRANULES	44.8 g	0	1.82
Fortress	T-22 ROOT SHIELD DRENCH	4.48 g	1.17	0
Fortress	T-22 ROOT SHIELD DRENCH	22.5 g	0	3.85
Frontier	Check	------	0	1.11
Frontier	T-22G BIOLOGICAL PROTECTANT GRANULES	44.8 g	0	0
Frontier	T-22 ROOT SHIELD DRENCH	4.48 g	0	0.3
Frontier	T-22 ROOT SHIELD DRENCH	22.5 g	1.06	0.43

* NS - no significant treatment effects were observed.

1998 PMR REPORT # 99 **SECTION J: VEGETABLES and SPECIAL CROPS - Diseases**
ICAR: 206003

CROP: Yellow Cooking Onion (*Allium cepa* L.)
PEST: White rot, *Sclerotium cepivorum* (Berk)

NAME AND AGENCY:
HOVIUS, M H Y AND M R MCDONALD
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph,
RR#1, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775-4546 Email: mhovius@uoguelph.ca

TITLE: FIELD EVALUATION OF DIALLYL DISULPHIDE (DADS) FOR CONTROL OF ONION BULB INFECTION BY THE WHITE ROT PATHOGEN *, SCLEROTIUM CEPIVORUM* BERK, AT HARVEST, 1998.

MATERIALS: Sclerotia germination stimulant (synthetic garlic oil) DADS (diallyl disulphide 85.5%, diallyl sulphide 4.5%).

METHODS: Onions were assessed for incidence of white rot on 30 and 31 Jul (site 1), 10 (site 2) and 25 Aug (site 3), 1998 in three commercial onion fields (organic muck soil) which had been established in Sept, 1996, in the Holland Marsh, Ontario. These sites had known histories of white rot and had been treated with DADS once (site 1) and twice (sites 2 and 3) including an untreated check. The treatments (DADS and check) were replicated 6 times and arranged in a randomized complete block design. Applications were made when the grower finished harvesting the crop which was present at the site and the maximum soil temperature, 10 cm deep, remained below 21°C for several days in order to avoid the possibility of soil temperatures exceeding 24°C at any time in the fall after treatment. The treatment product, DADS was applied on 19 Sept, 1996 (all sites) and 24 Sept, 1997 (sites 2 and 3), to depths of 10 and 20 cm using a modified Vorlex soil fumigation apparatus with eleven injection hoses spaced 20 cm apart at a rate of 10 L of product/ha in 500 L of water/ha. The plot areas were sealed, following treatment, using a mechanical roller and the soil remained undisturbed until spring. In the spring of 1998, site 1 was transplanted in early Jun and sites 2 and 3 were seeded (mid-May) and managed, for the full season, by the grower. Recommended control procedures for fungal and bacterial pathogens, weeds and insects were followed. Air temperatures were above the long term (10 year) average for May, and not different from the long term average for Jun, Jul and Aug. Total rainfall was below the long term (10 year) average for May (42.6 mm) and Jul (50.2 mm), above average for Aug (114.6 mm) and not different from the long term average for Jun (78.4 mm). No irrigation was used to offset the lack of precipitation during seedling emergence and plant growth, with the exception of a mid-season irrigation at site 1. The lack of accumulated precipitation and the lack of irrigation resulted in a drought stress situation. Onion were assessed from 4 subplots in each of the 6 replications at harvest maturity for incidence of white rot. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix, V. 4.1.

RESULTS: As presented in Table 1.

CONCLUSIONS: Incidence of white rot was low (0.09 to 3.66%) at all sites due to the hot dry weather during the growing season, which was unfavorable for white rot development. Nevertheless, onions grown in DADS treated soil at all sites had significantly (at P=0.05) lower levels of white rot than the untreated checks. Two applications of DADS resulted in the lowest white rot incidence overall, reducing incidence, compared to the untreated control, by 81% (site 1), 86% (site 2) and 96% (site 3). Therefore, two applications of DADS in consecutive years gives better disease control compared to one application.

Table 1. Evaluation of DADS (diallyl disulphide) and an untreated check, for the control of white rot in muck soils, in the Holland Marsh, Ontario, at three commercial field sites, in 1998.

	Onion bulb White Rot Incidence (%)		
Treatment	Site 1	Site 2	Site 3
DADS	0.71 a*	0.13 a	0.09 a
Check	3.66 b	0.94 b	2.35 b
P-value (ANOVA) - Treatment	0.027	0.031	0.045
# Times DADS applied	once	twice	twice
Dates DADS applied	Sept, 1996	Sept 1996 & 1997	Sept 1996 & 1997

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

1998 PMR REPORT # 100 SECTION J: VEGETABLES and SPECIAL CROPS - Diseases
ICAR: 206003

CROP: Yellow Cooking Onion (*Allium cepa* L.), cv. Frontier
PEST: White rot, *Sclerotium cepivorum* (Berk)

NAME AND AGENCY:
HOVIUS, M H Y AND M R MCDONALD
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph,
RR#1, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775-4546 Email: mhovius@uoguelph.ca

TITLE: FIELD EVALUATION OF TEBUCONAZOLE SEED AND PLANT BASE DRENCH TREATMENTS FOR THE CONTROL OF ONION WHITE ROT (*SCLEROTIUM CEPIVORUM* BERK), 1998.

MATERIALS: Onions (cv. Frontier), RAXIL (tebuconazole 8%), FOLICUR (tebuconazole 38.7%), PRO GRO (carbathin 30%, thiram 50%) and methyl cellulose (1%).

METHODS: Raw onion seed (cultivar Frontier) was treated with PRO GRO at 25 g of product with 1% methyl cellulose per kg of seed on 4 May. The onions were seeded in two commercial field sites (organic muck soil) with histories of white rot in the Holland Marsh, Ontario., on 6 and 7 May (site 1) and 13 and 14 May (site 2), 1998. The 10 treatments consisted of tebuconazole seed treatments using RAXIL at 1 g a.i./kg of seed and plant base drenches using FOLICUR at 1 L/ha in 500 L of water, applied at different times during the growing season (Table 1) using a Solo back pack sprayer (60 psi.) with a fan-jet nozzle. All seed for the RAXIL treatments was treated on 4 May. RAXIL was applied to the seed using methyl cellulose to ensure proper distribution of the chemical. An untreated check was also included. The onions were seeded using a V-belt push seeder delivering a spacing and depth at 1.5 to 2.0 cm. A randomized complete block design with 4 replications per treatment was used. Each replicate consisted of 8 rows (site 1) and 4 rows (site 2), 42 cm apart and 3 m in length. Recommended control procedures for fungal and bacterial pathogens, weeds and insects were followed. Air temperatures were above the long term (10 year) average for May, and not different from the long term average for Jun, Jul, Aug and Sept. Total rainfall was below the long term (10 year) average for May (42.6mm), Jul (50.2mm) and Sept (18.6mm); above average for Aug (114.6mm) and not different from the long term average for Jun (78.4mm). No irrigation was used to offset the lack of precipitation during seedling emergence and plant growth, except for a mid-season irrigation at site 1. The lack of accumulated precipitation and the lack of irrigation resulted in a drought stress situation at all sites. Onion bulbs were assessed for visible white rot incidence, in the field, at harvest maturity, on 28 and 29 Sept (site 1) and 21 and 22 Sept (site 2). Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix, V. 4.1.

RESULTS: The results are summarized in Table 1.

CONCLUSIONS: Incidence of white rot was low (0 to 1.93%) at both sites due to the hot dry weather in 1998 which was unfavorable for white rot development. No significant differences were found among

treatments tested, at either site. Under low disease pressures, tebuconazole did not appear to give control over white rot bulb infection. At site 2, only replications one and two were assessed because replications three and four were lost during commercial field harvesting. Phytotoxicity, as an effect of the RAXIL seed treatment was observed at seed emergence. Total number of bulbs at harvest, at sites 1 and 2, were significantly lower, 62% and 64% respectively, in the RAXIL and RAXIL plus FOLICUR treatments than the check and FOLICUR treatments alone. Continued research, under controlled conditions, testing different rates of RAXIL and FOLICUR is necessary to determine its effectiveness for controlling onion white rot.

Table 1. Harvest incidence of white rot in one onion cultivar (Frontier) grown at two commercial sites in the Holland Marsh, Ontario, treated with seed and plant base drenches of tebuconazole, in 1998.

		FOLICUR Application		White Rot Harvest Incidence (%)	
Treatment	Tebuconazole formulation	# of times	weeks after seeding	Site 1	Site 2
Check	untreated	NA*	NA	0.82 NS**	1.48 NS**
Seed	RAXIL	NA	NA	1.25	0
Plant base drench	FOLICUR	two	11 & 13	0.67	1.46
Plant base drench	FOLICUR	two	13 & 15	0.51	0.85
Plant base drench	FOLICUR	two	15 & 17	1.93	0.18
Plant base drench	FOLICUR	one	17	1.17	0.2
Seed + Plant base drench	RAXIL + FOLICUR	two	11 & 13	0.38	0
Seed + Plant base drench	RAXIL + FOLICUR	two	13 & 15	1.06	1.44
Seed + Plant base drench	RAXIL + FOLICUR	two	15 & 17	0.42	0
Seed + Plant base drench	RAXIL + FOLICUR	one	17	1.83	0

* NA = not applicable

** NS - no significant treatment effects were observed.

1988 PMR REPORT # 101 **SECTION J: VEGETABLE and SPECIAL CROPS - Diseases**
ICAR: 206003

CROP: Yellow cooking onions (*Allium cepa* L.), cv. Hamlet
PEST: Botrytis Leaf Blight, *Botrytis squamosa* (Walker) Purple Blotch, *Alternaria porri* (Ellis)

NAME AND AGENCY:
MCDONALD M R, JANSE S AND VANDER KOOI K
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph
RR#1, 1125 Woodchoppers Lane, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775- 4546 Email: mrmcdona@uoguelph.ca

TITLE: EFFICACY OF FUNGICIDES FOR THE CONTROL OF BOTRYTIS LEAF BLIGHT AND PURPLE BLOTCH ON ONIONS, 1998

MATERIALS: CHAMP 2 F (copper hydroxide 37.5%), ULTRA CHAMP DF (copper 36.3%), CHAMPION WP (metallic copper equivalent 50%), DITHANE DG (mancozeb 75%), ROVRAL (iprodione 50%)

METHODS: Onions were seeded (36 seeds/m) into naturally infested soil (pH 6.4, organic matter 60%) at the Muck Crops Research Station on 24 Apr, 1998. A randomized complete block arrangement with four blocks per treatment was used. Each replicate consisted of 8 rows (42 cm apart), 5 m in length. Treatments were applied on 18, 28 Jul and 4 Aug using a pull type plot sprayer with TeeJet D-3 hollow cone nozzles at 100 psi (boom) in 500 L/ha of water. CHAMP 2F at 1.56 L/ha, ULTRA CHAMP DF at 1.50 kg/ha and CHAMPION WP at 2.25 kg/ha were applied at each spray. Conventional treatments of DITHANE DG at 2.25 kg/ha were applied on 18, 28 Jul and ROVRAL at 0.75 kg/ha was added on 4 Aug as recommended in the Ontario Ministry of Agriculture, Food and Rural Affairs Publication 363, 1998/1999 Vegetable Production Recommendations. An untreated check was also included. Twenty-five plants per replicate were harvested on 12 Aug when the plants were near maturity. The three oldest green leaves per plant with 80% or more of non-necrotic tissue were evaluated for Botrytis Leaf Blight. The percentage of green tissue area was rated using The Manual of Assessment Keys for Plant Diseases by Clive James, Key No. 1.6.1. The total number of green and dead leaves were also recorded. Purple Blotch was assessed by looking at all leaves, dead and green and counting the number and length of lesions. A harvest yield of 4.66 m was taken on 28 Aug. The air temperatures were above the long term (10 year) average for May and not different from the long term average for Jun, Jul, Aug and Sep. Total rainfall was below the long term (10 year) average for May (42.6 mm), Jul (50.2 mm), and Sep (18.6 mm), above average for Aug (114.6 mm) and not different from the long term average for Jun (78.4 mm). Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.4.1.

RESULTS: As presented in Tables 1 and 2.

CONCLUSIONS: No significant differences in levels of Botrytis Leaf Blight (Table 2) or number of Purple Blotch lesions (Table 1) were found. The treatments also had no effect on yield. The warm and dry summer may have slowed the development of the disease in this trial.

Table 1. Evaluation of fungicides for the control of Purple Blotch on all leaves, 1998.

Treatment	Total # Purple Blotch lesions/ 25 plants	Total # dead leaves/ 25 plants	Total # green leaves/ 25 plants	Harvest Yield Tons/Ha **
Check	7.3 NS*	70	166	45.9
Conventional	10.3	74	152	49.9
CHAMPION WP	11.5	61	175	53.5
CHAMP 2F	6.0	60	170	49.8
ULTRA CHAMP DF	9.5	71	146	52.8

Table 2. Effect of fungicide treatments on frequency of onion leaves with different severity levels of Botrytis Leaf Blight, 1998.

Treatment	Leaf area infected (%)			
	0-2%	2-5%	5-10%	10-15%
Check	33.8 NS*	45.0	17.5	2.5
Conventional	36.3	48.8	11.3	3.8
CHAMPION WP	42.5	45.0	10.0	2.5
CHAMP 2F	30.0	52.5	17.5	0.0
ULTRA CHAMP DF	33.8	50.0	16.3	0.0

* Both tables, NS = no significant treatment effects were observed.

** Table 1, Bushels per Acre = Tons per Hectare x 17.8

1998 PMR REPORT # 102 SECTION J: VEGETABLE and SPECIAL CROPS - Diseases
ICAR: 206003

CROP: Yellow cooking onions (*Allium cepa* L.), cvs. Gazette and Quantum
PEST: Onion Smut, *Urocystis cepulae* (Frost)

NAME AND AGENCY:
MCDONALD M R, JANSE S AND VANDER KOOI K
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph
RR#1, 1125 Woodchoppers Lane, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775- 4546 Email: mrmcdona@uoguelph.ca

TITLE: EVALUATION OF FURROW FUNGICIDE AND DRENCH TREATMENTS FOR CONTROL OF ONION SMUT, 1998

MATERIALS: DITHANE DG (mancozeb 75 %), DITHANE M-45 (mancozeb 80%), PRO GRO (carbathiin 30%, thiram 50%), methyl cellulose

METHODS: Raw onion seed (46 seeds/m) of two cultivars Gazette and Quantum were seeded in organic soil (pH 6.4, organic matter 60%) naturally infested with onion smut at the Muck Crops Research Station on 30 Apr, 1998. The standard treatment for onion smut used was PRO GRO at 25 kg/ha plus a 1% methyl cellulose solution per kg of seed. Other treatments were: DITHANE DG at 4.4 kg/ha and 8.8 kg/ha, PRO GRO seed treatment plus the high rate of DITHANE DG, a drench of DITHANE M-45 at 3.125 kg/ha in 1000 L of water was also applied, and an untreated check. A randomized complete block arrangement with 4 blocks per treatment was used. Each replicate consisted of 2 rows (42 cm apart) of Gazette and Quantum, 5 m in length. All treatments were seeded using a push V-belt seeder. The DITHANE M-45 drench was applied using a gravity flow line placing the drench directly in the seed furrow. All DITHANE DG treatments were applied on the V-belt along with the seed. Three random 2 m sections were marked off, and germination counts were recorded (13, 19, 22, 25, May) to determine initial stands. At one (2 Jun) and three (7 Jul) true leaves, one of the 2 m sections were harvested and evaluated by looking at the bulb and leaves for evidence of smut. The remaining 2 m section was evaluated on 21 Aug, and a yield section of 2.33 m was taken on 10 Sep. The air temperatures were above the long term (10 year) average for May and not different from the long term average for Jun, Jul, Aug and Sep. Total rainfall was below the long term (10 year) average for May (42.6 mm), Jul (50.2 mm), and Sep (18.6 mm), above average for Aug (114.6 mm) and not different from the long term average for Jun (78.4 mm). Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.4.1.

RESULTS: As outlined in Tables 1 and 2.

CONCLUSIONS: Significant differences in the incidence of onion smut was found on 7 Jul in cv. Gazette (Table 1) and 8 Jun in cv. Quantum (Table 2). The treatments significantly effected yield in cv. Quantum but not in Gazette. DITHANE DG at 8.8 kg/ha and DITHANE DG plus the PRO GRO and methyl cellulose were significantly lower than the untreated check and the DITHANE M-45 drench on 7 Jul. The DITHANE M-45 drench was the only treatment with a higher incidence of smut than the

check. Significant differences were found within the cultivar Quantum where the DITHANE DG plus PRO GRO and methyl cellulose had the lowest incidence of smut for all three assessment dates, however only the 8 Jun assessment date was significantly lower than all other treatments. The check and the DITHANE M-45 drench had the highest incidence of smut for the 13 Jul assessment. Significant differences in the yield were found within Quantum only. DITHANE DG plus PRO GRO and methyl cellulose had the highest yield (89.8 T/ha) of any treatment, and was significantly higher than the check and DITHANE M-45 (47.3 and 45.2 T/Ha respectively). The DITHANE M-45 drench had the lowest yields in both cultivars (Gazette 34.1 T/Ha, Quantum 45.2 T/Ha) and within Quantum was significantly lower than DITHANE DG, PRO GRO and methyl cellulose and DITHANE DG plus PRO GRO and methyl cellulose (74.1, 79.6 and 89.8 T/Ha respectively). The DITHANE DG at 8.8 kg/ha plus PRO GRO and methyl cellulose resulted in the highest yield and the lowest incidence of smut in both cultivars.

Table 1. Evaluation of furrow fungicide and drench treatments for the control of onion smut on cultivar Gazette, 1998.

Treatments	Rate of Product	Incidence of Smut (%) 2 Jun	7 Jul	21,24 Aug	Yield T/Ha*
Check		49.7 NS**	18.1 bc***	8.3	39.9
DITHANE DG	4.4 kg/ha	60.0	11.3 ab	8.6	77.7
DITHANE DG	8.8 kg/ha	43.2	4.5 a	3.2	65.0
DITHANE M-45	3.125 kg/ha in 1000 L	59.8	23.9 c	1.5	34.1
PRO GRO + mc****	25 g/kg seed	36.2	8.8 ab	2.4	79.7
DITHANE DG + PRO GRO + mc	8.8 kg/ha 25 g/kg seed	20.1	4.9 a	0.9	88.6

Table 2. Evaluation of furrow fungicide and drench treatments for the control of onion smut on cultivar Quantum, 1998.

Treatments	Rate of Product	Incidence of Smut % 8 Jun	13 Jul	21, 24 Aug	T/Ha*	Yield
Check			52.3 b***	16.8 NS**	1.9	47.3 bc
DITHANE DG	4.4 kg/ha		49.9 b	8.7	6.2	73.2 bc
DITHANE DG	8.8 kg/ha		42.1 b	4.6	4.4	74.1 ab
DITHANE M-45	3.125 kg/ha in 1000 L		52.5 b	16.5	3.6	45.2 c
PRO GRO + mc	25 g/kg seed		41.4 b	6.2	1.3	79.6 a
DITHANE DG + PRO GRO + mc	8.8 kg/ha 25 g/kg seed		17.8 a	3.1	0.089.8 a	

* Both tables, Bushels per Acre = Tons per Hectare x 17.8
** Both tables, NS = no significant treatment effects were observed.
*** Both tables, numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.
**** Both tables, mc = methyl cellulose

1998 PMR REPORT # 103

SECTION J: VEGETABLE and SPECIAL CROPS - Diseases
ICAR: 206003

CROP: Yellow cooking onions (*Allium cepa* L.), cvs. Gazette and Quantum
PEST: Onion Smut, *Urocystis cepulae* (Frost)

NAME AND AGENCY:
MCDONALD M R, JANSE S AND VANDER KOOI K
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph
RR#1, 1125 Woodchoppers Lane, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775- 4546 Email: mrmcdona@uoguelph.ca

TITLE: EVALUATION OF FUNGICIDE SEED TREATMENTS FOR CONTROL OF ONION SMUT, 1998

MATERIALS: DIVIDEND (difenoconazole 32.8%), PRO GRO (carbathiin 30%, thiram 50%), methyl cellulose

METHODS: Raw onion seed (46 seeds/m) of two cultivars Gazette and Quantum were seeded in organic soil naturally infested with onion smut (pH 6.4, organic matter 60%) at the Muck Crops Research Station on 13 May, 1998. The standard treatment for onion smut used was PRO GRO at 25 kg/ha plus 1% methyl cellulose per kg of seed. DIVIDEND at 2.38 mL/kg of seed and 9.52 mL/kg of seed were applied to the seed using a 1% methyl cellulose solution, to ensure proper distribution of the chemical. An untreated check was also included. A randomized complete block arrangement with 4 blocks per treatment was used. Each replicate consisted of 2 rows of Gazette and 2 rows of Quantum (42 cm apart

), 5 m in length. All treatments were seeded using a push V-belt seeder. Three random 2 m sections were marked off, and germination counts were recorded (25, 27, 29 May and 1 Jun) to determine initial stand. At one (15 Jun) and three (15 Jul) true leaves one of the 2 m sections were harvested and evaluated by looking at the bulb and leaves for evidence of smut. The remaining 2 m section was evaluated on (11 Sep), and a yield section of 2.33 m was taken on 25 Sep. The air temperatures were above the long term (10 year) average for May and not different from the long term average for Jun, Jul, Aug and Sep. Total rainfall was below the long term (10 year) average for May (42.6 mm), Jul (50.2 mm), and
Sep (18.6 mm), above average for Aug (114.6 mm) and not different from the long term average for Jun (78.4 mm). Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.4.1.

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

CONCLUSIONS: Significant differences in incidence of smut among the treatments were only found on the 15 Jun assessment for Gazette. The low rate of DIVIDEND at 2.38 mL/kg seed had the highest levels of smut on all assessment dates for cultivar Gazette (Table 1) and was significantly higher than the PRO GRO and methyl cellulose on 15 Jun. The cultivar Quantum had similar levels of smut for all treatments within assessment dates (Table 2). The standard treatment of PRO GRO and methyl cellulose had the lowest levels of smut on the first assessment (15 Jun). The DIVIDEND treatment at 9.52 mL/kg seed resulted in the highest yield on cultivar Gazette (65.0 T/Ha); however it was not significantly higher than the check (57.5 T/Ha). The standard PRO GRO and methyl cellulose treatment had the highest yield for cultivar Quantum, (82.5 T/Ha) and the check had the lowest yield (57.5 T/Ha).

Table 1. Evaluation of fungicide seed treatment for the control of onion smut on cultivar Gazette, 1998.

Treatments	Rate of Product	Incidence of Smut % 15 Jun	15 Jul	11 Sep
Check		66.8 ab*	16.8 NS**	5.0
PRO GRO + mc***	25 g/kg seed	51.6 a	21.5	6.4
~~DIVIDEND~~	~~2.38 mL/kg seed~~	~~80.5 b~~	~~27.3~~	~~7.2~~
DIVIDEND	9.52 mL/kg seed	65.4 ab	29.5	2.8

Table 2. Evaluation of fungicide seed treatment for the control of onion smut on cultivar Quantum, 1998.

Treatments	Rate of Product	Incidence of Smut % 15 Jun	15 Jul	11Sep
Check		65.3 NS**	14.4	2.9
~~PRO GRO + mc~~	~~25 g/kg seed~~	~~46.2~~	~~20.1~~	~~4.0~~
DIVIDEND	2.38 mL/kg seed	58.8	18.7	2.9
DIVIDEND	9.52 mL/kg seed	65.2	14.0	1.9

Table 3. Yield data in Tons per Hectare of both cultivars Gazette and Quantum, 1998.

Treatments	Product	Rate of Gazette	Yield in T/Ha**** Quantum
Check		57.5 NS**	57.5
PRO GRO + mc	25 g/kg seed	65.0	82.5
DIVIDEND	2.38 mL/kg seed	52.5	67.5
DIVIDEND	9.52 mL/kg seed	70.0	65.0

* All tables, numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

** All tables, NS = no significant treatment effects were observed.

*** All tables, mc = methyl cellulose

**** Bushels per Acre = Tons per Hectare x 17.8

1998 PMR REPORT # 104 SECTION J: VEGETABLE and SPECIAL CROPS - Diseases
ICAR: 206003

CROP: Yellow cooking onions (*Allium cepa* L.), cvs. Gazette and Quantum
PEST: Onion Smut, *Urocystis cepulae* (Frost)

NAME AND AGENCY:
MCDONALD M R, JANSE S AND VANDER KOOI K
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph
RR#1, 1125 Woodchoppers Lane, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775- 4546 Email: mrmcdona@uoguelph.ca

TITLE: EVALUATION OF FURROW TREATMENTS FOR CONTROL OF ONION SMUT, 1998

MATERIALS: PRO GRO (carbathiin 30%, thiram 50%), methyl cellulose, RAXIL (tebuconozole 8%), VITAVAX (carbathiin 97%)

METHODS: Raw onion seed (46 seeds/m) of two cultivars Gazette and Quantum were seeded in organic soil (pH 6.4, organic matter 60%) naturally infested with onion smut at the Muck Crops Research Station on 5 and 6 May, 1998. The standard treatment for control of onion smut was PRO GRO at 25 kg/ha plus 1% methyl cellulose per kg of seed. RAXIL at 36 mL/kg of seed and 72 mL/kg of seed were applied to the seed. PRO GRO at 25kg/ha plus a 1% methyl cellulose solution were also applied to both rates of RAXIL. VITAVAX at two rates (0.6 g/m of row and 1.2 g/m of row) was applied at seeding. An untreated check was also included. A randomized complete block arrangement with 4 blocks per treatment was used. Each replicate consisted of 2 rows of Gazette and 2 rows of Quantum (42 cm apart), 5 m in length. All treatments were seeded using a push V-belt seeder. VITAVAX treatments were applied on the V-belt along with the seed. Three random 2 m sections were marked off, and germination counts were recorded (19, 22, 25, 27 May) to determine initial stand. At one (8 Jun) and three (13 Jul) true leaves, one of the 2 m sections were harvested and evaluated by looking at the bulb and leaves for evidence of smut. The remaining 2 m section was evaluated on (21, 24 Aug), and a yield section of 2.33 m was taken on 10 Sep. The air temperatures were above the long term (10 year) average for May and not different from the long term average for Jun, Jul, Aug and Sep. Total rainfall was below the long term (10 year) average for May (42.6 mm), Jul (50.2 mm), and Sep (18.6 mm), above average for
Aug (114.6 mm) and not different from the long term average for Jun (78.4 mm). Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.4.1.

RESULTS: As outlined in Tables 1 and 2.

CONCLUSIONS: The fungicide treatments significantly reduced onion smut incidence on the 8 Jun assessment of Gazette (Table 1). Significant differences in yield were found among treatments for both cultivars. Within the cultivar Gazette assessed on 8 Jun VITAVAX at 1.2 g/m of row had the lowest incidence of smut and was significantly lower than the RAXIL at 36 mL/kg and the check. No significant differences were found between any treatments on the other assessment dates (Table 1). No significant

differences were found on the first two assessments for the cultivar Quantum, but the check did have the highest percentage of smut on both dates (Table 2). On the third assessment the PRO GRO and methyl cellulose had the lowest percentage of smut at 0.8 % and was significantly lower than RAXIL plus PRO GRO and methyl cellulose (8.4%) and RAXIL at 36 mL/kg (10.9%). When yield was assessed, PRO GRO plus methyl cellulose resulted in the highest yield in both cultivars (Gazette 77.5 T/Ha, Quantum 82.5 T/Ha) and the untreated check the lowest (Gazette 37.5 T/Ha, Quantum 42.5 T/Ha). VITAVAX applied in the seed furrow at 1.2 g/m was as effective as the PRO GRO seed treatment. There was no advantage to applying RAXIL with PRO GRO.

Table 1. Evaluation of furrow fungicide treatment for the control of onion smut on cultivar Gazette,1998.

Treatments	Rate of Product	Incidence of Smut % 8 Jun	13 Jul	21, 24 Aug	Yield T/Ha*
Check		72.6 c**	29.6 NS***	9.6	37.5 d
PRO GRO + mc****	25 g/kg seed	25.0 a	15.2	3.6	77.5 a
RAXIL	36 L/kg	52.9 b	33.4	5.2	60.0 abc
RAXIL	72 mL/kg	31.3 a	16.5	12.3	57.5 bc
RAXIL	36 mL/kg	32.6 a	10.1	3.5	72.5 ab
+ PRO GRO + mc	25 g/kg seed				
RAXIL	72 mL/kg	29.2 a	17.1 a	2.5 a	57.5 bc
+ PRO GRO + mc	25 g/kg seed				
VITAVAX	0.6 g/m	36.7 ab	17.3 a	3.3 a	52.5 cd
VITAVAX	1.2 g/m	23.8 a	16.5 a	3.1 a	72.5 ab

Table 2. Evaluation of furrow fungicide treatment for the control of onion smut on cultivar Quantum,1998.

Treatments	Rate of Product	Incidence of Smut % 8 Jun	13 Jul	21, 24 Aug	Yield T/HA*
Check		58.5 NS***	30.9	7.7 abc **	42.5 c
PRO GRO + mc****	25 g/kg seed	40.2	14.0	0.8 a	82.5 a
RAXIL	36 mL/kg	42.3	24.9	10.9 c	77.5 ab
RAXIL	72 mL/kg	32.3	29.5	3.3 ab	60.0 bc
RAXIL	36 mL/kg	34.5	7.1	1.3 ab	80.0 ab
+ PRO GRO + mc	25 g/kg seed				
RAXIL	72 mL/kg	21.2 a	13.5 a	8.4 bc	75.0 ab
+ PRO GRO + mc	25 g/kg seed				
VITAVAX	0.6 g/m	30.0 a	16.9 a	1.3 a	62.5 abc
VITAVAX	1.2 g/m	36.2 a	18.1 a	4.3 abc	75.0 ab

* Both tables, Bushels per Acre = Tons per Hectare x 17.8

** Both tables, numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

*** Both tables, NS = no significant treatment effects were observed.

**** Both tables, mc = methyl cellulose

1998 PMR REPORT # 105 SECTION J: VEGETABLES and SPECIAL CROPS - Diseases
ICAR # 206003

CROP: Yellow cooking onions (*Allium cepa* L.), cvs. Cortland and Tribute
PEST: Onion Smut (*Urocystis cepulae* Frost)

NAME AND AGENCY:
MCDONALD M R and JANSE S
Muck Crops Research Station , HRIO, Dept. of Agriculture, University of Guelph
1125 Woodchoppers Lane, RR # 1, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783; Fax: (905) 775-4546; Email: mrmcdona@uoguelph.ca

TITLE: EVALUATION OF DITHANE 75DG FURROW TREATMENTS AND ROOTSHIELD T-22 IN COMBINATION WITH INSECTICIDES FOR ONION SMUT CONTROL: FIELD TRIAL IN THE HOLLAND MARSH, 1998.

MATERIALS: PRO GRO (carbathiin 30% + thiram 50%), DITHANE 75DG (mancozeb 75%), ROOTSHIELD T-22 (*Trichoderma harzianum* Rifai strain KRL-AG2 1.15%, $1x10^7$cfu/g dry weight), LORSBAN 15G (chlorpyrifos 15%) AZTEC G (phosetbupirin 2.0% + cyfluthrin 0.1%), GOVERNOR 75WP (cyromazine 75%), REGENT (fiprinol 500 g/L).

METHODS: The trial was conducted in naturally infested muck soil (pH 6.4, organic matter 60%) at the Muck Crops Research Station in the Holland Marsh and was arranged in a randomized complete block design with four replications. PRO GRO 30/50D and GOVERNOR 75WP seed treatments were commercially custom-coated at rates of 20 g ai/kg and 50 g ai/kg of seed (cv. Tribute) by Asgrow Seed Company. Similarly, Bejo Zaden Ltd., provided seed custom-coated with REGENT at a rate of 25 g ai/kg of seed (cv. Cortland). The trial was seeded at a rate of 47 seeds m of row on 15 May, using a push V-belt seeder. All granular formulations were placed on the seeder belt with the seed. These were LORSBAN 15G, AZTEC 2.0/0.1G, DITHANE 75DG and ROOTSHIELD T-22 1.15%G (4.8 kg ai/ha, O.5 kg ai/ha, 6.6 kg ai/ha respectively). Also at the time of seeding the DITHANE 75DG drench (6.6 kg ai/ha in 1000 L/ha of water) was applied directly in the seed furrow with a gravity flow line. Raw seed of both cultivars were included as untreated checks. Each treatment plot consisted of four 6 m rows of onions spaced 40 cm apart. Four separate 2 m sections were designated for each of three onion smut assessments and final yield. To determine initial stand, emergence counts were taken on 2, 9 and 16 Jun in each 2 m section. At the first (25 Jun) and third and fourth (21 Jul) true leaf stages and at final harvest (22 Sep) all the onions in the 2 m sections of row were pulled, washed and examined for onion smut infection. Harvest weight was taken from the remaining 2 m section of onions. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.4.1. Interaction between fungicides (DITHANE 75DG granular, drench, ROOTSHIELD T-22) and insecticides (none, LORSBAN 15G, AZTEC G, GOVERNOR 75WP, REGENT) were analyzed using a 3 x 5 factorial design.

RESULTS: Results are summarized in Table 1.

CONCLUSIONS: Significant differences were found among treatments for incidence of onion smut at the second and third assessments and final yield (Table 1). A significant interaction between fungicides and insecticides was found in yield and all assessments except for the third. In general, treatment combinations that included DITHANE 75DG granular had less incidence of onion smut and higher yield than the other fungicide treatments. Treatment combinations with REGENT and GOVERNOR 75WP had higher incidence of onion smut than treatments with only fungicide(s), while those with LORSBAN 15G and AZTEC G enhanced onion smut control. The highest yields occurred in the treatments containing insecticide in addition to fungicide(s), which is a result of the additional onion maggot control.

Table 1. Percent incidence of onion smut at the first, third and fourth true leaf stages and final harvest of onions treated with DITHANE 75DG furrow treatments and ROOTSHIELD T-22 in combination with insecticides at the Muck Crops Research Station, Bradford, Ontario, 1998.

Treatment	Rate (g ai/ha)	Incidence of onion smut (%) 1st true leaf 25 Jun	3-4 true leaf[1] 21 Jul	Harvest[1] 22 Sep	Yield (kg/2m) 6 Oct
Check (Cortland)		73.9 NS[2]	47.6 a[3]	22.2 a	1.30 hi
Check (Tribute)		84.4	60.0 a	16.9 ab	0.78 i
PRO GRO 20(s)[4]		60.8	27.7 b	3.7 cd	4.34 fg
PRO GRO + DITHANE 75DG	20(s)+6.6	56.5	6.34 ef	7.6 a-d	5.24 e-g
PRO GRO+ DITHANE 75DG DRENCH	20(s)+6.6	68.4	8.94 ef	8.1 a-c	4.13 fg
PRO GRO+ DITHANE 75DG + LORSBAN 15G	20(s)+6.6+4.8	40.5	2.52 f	1.0 cd	8.70 a-c
PRO GRO+ DITHANE 75DG DRENCH + LORSBAN 15G	20(s)+6.6+4.8	60.0	7.21 ef	5.5 a-d	7.35 b-e
PRO GRO+ DITHANE 75DG + AZTEC G	20(s)+6.6+0.5	46.2	4.92 ef	4.3 b-d	8.93 ab
PRO GRO+ DITHANE 75DG DRENCH + AZTEC G	20(s)+6.6+0.5	42.8	5.21 ef	1.5 cd	7.45 b-d
PRO GRO + DITHANE 75DG + GOVERNOR 75WP	20(s)+6.6+50(s)	52.8	9.68 de	1.1 cd	8.55 a-c
PRO GRO+ DITHANE 75DG DRENCH + GOVERNOR 75WP	20(s)+6.6+50(s)	73.9	12.4 c-e	0.8 d	6.61 c-e
PRO GRO+ DITHANE 75DG + REGENT	20(s)+6.6+25(s)	64.8	7.55 ef	1.8 cd	10.11 a
PRO GRO+ DITHANE 75DG DRENCH + REGENT	20(s)+6.6+25(s)	69.3	13.1 c-e	3.2 cd	9.29 ab
PRO GRO + ROOTSHIELD T-22	20(s)+11.2	70.1	20.3 b-d	1.0 cd	3.38 gh
PRO GRO + ROOTSHIELD T-22 + LORSBAN 15G	20(s)+11.2+4.8	57.3	10.4 de	4.5 b-d	7.87 b-d
PRO GRO + ROOTSHIELD T-22 + AZTEC G	20(s)+11.2+0.5	37.0	13.7 c-e	5.0 b-d	7.23 d-f
PRO GRO + ROOTSHIELD T-22 + GOVERNOR 75WP	20(s)+11.2+50(s)	71.8	18.5 b-d	6.6 a-c	6.02 d-f
PRO GRO + ROOTSHIELD T-22 + REGENT	20(s)+11.2+25(s)	67.6	23.9 bc	5.0 b-d	8.67 a-c

[1] Statistics performed on arcsin transformed date

[2] NS = no significant treatment effects were observed

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

[4] Seed treatment: g ai/kg of seed

1998 PMR REPORT # 106 SECTION J: VEGETABLES and SPECIAL CROPS - Diseases
ICAR # 206003

CROP: Yellow cooking onions (*Allium cepa* L.), cvs. Cortland and Tribute
PEST: Onion Smut (*Urocystis cepulae* Frost)

NAME AND AGENCY:
MCDONALD M R and JANSE S
Muck Crops Research Station , HRIO, Dept. of Agriculture, University of Guelph
1125 Woodchoppers Lane, RR # 1, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783; Fax: (905) 775-4546; Email: mrmcdona@uoguelph.ca

TITLE: EVALUATION OF PRO GRO IN COMBINATION WITH INSECTICIDES FOR CONTROL OF ONION SMUT CONTROL: FIELD TRIAL IN THE HOLLAND MARSH, 1998.

MATERIALS: PRO GRO (carbathiin 30% + thiram 50%), LORSBAN 15G (chlorpyrifos 15%), AZTEC G (phosetbupirin 2.0% + cyfluthrin 0.1%), GOVERNOR 75WP (cyromazine 75%), REGENT (fiprinol 500 g/L).

METHODS: The trial was conducted in naturally infested muck soil (pH 6.4, organic matter 60%) at the Muck Crops Research Station in the Holland Marsh and was arranged in a randomized complete block with four replications. PRO GRO and GOVERNOR 75WP seed treatments were commercially custom-coated at rates of 20 g ai/kg and 50 g ai/kg of seed (cv. Tribute) by Asgrow Seed Company. Similarly, Bejo Zaden Ltd. provided seed custom-coated with REGENT at a rate of 25 g ai/kg of seed (cv. Cortland). The trial was seeded at a rate of 47 seeds m of row on 26 May and 29 May using a push V-belt seeder. LORSBAN 15G (4.8 kg ai/ha) and AZTEC G (0.5 kg ai/ha) were placed on the seeder belt with the seed. Raw seed of both cultivars were included as untreated checks. Each treatment plot consisted of four 6 m rows of onions spaced 40 cm apart. Four separate 2 m sections were designated for each of three onion smut assessments and final yield. To determine initial stand, emergence counts were taken on 10 Jun and 17 Jun in each 2 m section. At the first (2 Jul) and third and fourth (23 Jul) true leaf stages of onions, and at final harvest (22 Sep) all the onions in the 2 m sections of row were pulled, washed and examined for onion smut infection. Harvest weight was taken from the remaining 2 m section of onions. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix, V.4.1. Interaction between PRO GRO and insecticides (none, LORSBAN 15G, GOVERNOR 75WP, AZTEC G, REGENT) was analyzed using a 2 x 5 factorial design.

RESULTS: Data is summarized in Table 1.

CONCLUSIONS: Significant differences were found among treatments for incidence of onion smut in the first and second assessments and at final harvest (Table 1). A significant interaction between PRO GRO and the insecticides was found in yield and all assessments except the third. Incidence of onion smut was less in all fungicide-insecticide combination treatments (significantly less with LORSBAN 15G) than those with PRO GRO alone, with the exception of PRO GRO + REGENT where incidence of onion smut increased. The PRO GRO + LORSBAN 15G treatment consistently had the least incidence of

onion smut throughout the season and the highest yield. Raw seed treated with LORSBAN 15G had significantly less incidence of onion smut than the check throughout the season. The nature of these results suggest a possible synergistic reaction between these two pesticides. Raw seed treated with GOVERNOR 75WP had significantly higher incidence of onion smut than the check at the first assessment. The highest yields occurred in combination treatments which is attributed to the additional onion maggot control.

Table 1. Percent incidence of onion smut on onions at the first and third and fourth true leaf stages and at final harvest in onions treated with PRO GRO and insecticides.

Treatment	Rate	Incidence of Onion Smut (%) 1st true leaf 2 Jul	3-4 true leaf 23 Jul22 Sep	Harvest 6 Oct	Yield (kg/plot)
Check (Cortland)		44.3 bc**	40.9 a	6.75 a	5.42 e
Check (Tribute)	42.0	bc	33.3 a-c	3.86 a	5.61 de
PRO GRO	20 g ai/kg seed	35.0 b-f	27.1 b-e	4.63 a	7.06 cd
LORSBAN 15G	4.8 kg ai/ha	19.4 d-f	25.2 b-f	4.15 a	7.53 bc
GOVERNOR 75WP	50 g ai/kg seed	62.3 a	28.7 a-d	3.70 a	5.27 e
AZTEC G	0.5 kg ai/ha	4.76 a-c	34.5 ab	6.28 a	5.44 de
REGENT	25 g ai/kg seed	38.0 b-d	15.2 d-f	4.29 a	9.70 a
PRO GRO + LORSBAN 15G	20 g ai/kg seed + 4.8 kg ai/ha	15.7 f	11.8 f	3.22 a	9.12 ab
PRO GRO + GOVERNOR 75WP	20 g ai/kg seed + 50 g ai/kg seed	28.8 c-f	26.6 b-f	3.69 a	8.02 bc
PRO GRO + AZTEC G	20 g ai/kg seed + 0.5 kg ai/ha	17.7 ef	12.3 ef	3.38 a	8.19 a-c
PRO GRO + REGENT	20 g ai/kg seed + 25 g ai/kg seed	50.8 ab	19.0 c-f	4.83 a	9.09 ab

* Statistics performed on arcsin transformed data

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

SECTION K: POTATO DISEASES
Report #s: 107 - 108
Pages: 317 - 321

Editor **Ms. Agnes M. Murphy** Email: murphya@em.agr.ca
Agriculture and Agri-Food Canada Tel: (506) 452-3260
Fredericton Rearch Centre Fax: (506) 452-3316
850 Lincoln Road, P.O. Box 20280, Fredericton, New Brunswick E3B 4Z7

1998 REPORT # 107 **SECTION K: POTATO DISEASES**
STUDY DATA BASE: 303-1251-9002

CROP: Potato (*Solanum tuberosum(L.))*cv. Green Mountain
PEST: Late Blight (*Phytophthora infestans* (Mont.) DeBary)

NAME AND AGENCY:
PLATT, HW, ARSENAULT, W, MACKENZIE, G, and JENKINS, G.
Agriculture & Agri-Food Canada, Charlottetown Research Centre, P.O. Box 1210
Charlottetown, Prince Edward Island, Canada C1A 7M8

Tel:(902) 566-6800; **Fax**:(902) 566-6821; **Email**: PlattH@em.agr.ca

TITLE: POTATO LATE BLIGHT CONTROL FUNGICIDE EFFICACIES IN 1997

MATERIALS:
chlorothalonil (BRAVO 500; 40% EC; ISK- Biosciences); chlorothalonil and zinc (BRAVO ZN; 40% EC; ISK- Biosciences); dimethomorph and mancozeb (ACROBAT MZ; 72% WP; Cyanamid); metalaxyl and mancozeb (RIDOMIL GOLD; 68% WP; Novartis); metalaxyl + mancozeb (RIDOMIL MZ; 72% WP; Novartis); propamocarb and chlorothalonil (TATTOO C; 75% EC; AgrEvo); copper hydroxide (KOCIDE DF; 72% WP; Griffin); mancozeb (DITHANE; 75% DG; Rohm & Haas); fluazinam (pre-registration product; 40% EC; ISK- Biosciences); mancozeb and cymoxanil (CURZATE M8; 72% WP; Dupont); triphenyltin hydroxide (SUPERTIN; 80% WP; Griffin).

METHODS: A randomized complete block design with four replicate plots consisting of three rows (7.5 m in length, spaced 0.9 m apart) was used in 1997 field studies. All three-row plots were separated by untreated plants for tractor operations and/or inoculation. Whole (35-55 mm), green-sprouted, Elite 3 seed tubers (cv. Green Mountain) were planted 30 cm apart and recommended crop management practices followed. Plant emergence counts on the centre row of each three-row plot were made 40-50 days post-planting. A sporangial suspension of *P. infestans* was applied to the foliage of plants in inoculated rows adjacent to each plot 2-4 days after the first fungicide application. Plots were mist irrigated (3-5 mm hr^{-1} for 2-4 hr periods) on 4 occasions during July to maintain disease development in the inoculated rows. Late blight incidence (amount of diseased foliage as a percentage of total plant foliage) in plants in the centre row of each plot were made throughout August and September. Fungicides were applied to only the centre three rows of each plot according to the treatment application schedule. Top desiccant was applied mid-late September, two weeks prior to plot harvest when tuber yields and late blight tuber rot

occurrence (% by weight) were determined. All data were subjected to analysis of variance; area under disease progress curves calculated before analyses.
On 22 July, the following treatments commenced: chlorothalonil (BRAVO 500; 40% EC; ISK-Biosciences) at 0.8 litres a.i. ha^{-1} every 7 days; chlorothalonil and zinc (BRAVO ZN; 40% EC; ISK-Biosciences) at 0.8 litres a.i. ha^{-1} every 7 days; chlorothalonil (BRAVO 500) at 0.8 litres a.i. ha^{-1} every 7 days except when dimethomorph and mancozeb (ACROBAT MZ; 72% WP; Cyanamid) 1.8 kg a.i. ha^{-1}, respectively, were applied on 24 July and 8 August or as another treatment on 31 July and 9 September; chlorothalonil (BRAVO 500) at 0.8 litres a.i. ha^{-1} every 7 days but with metalaxyl and mancozeb (RIDOMIL GOLD; 68% WP; Novartis) at 1.8 kg a.i. ha^{-1} on 1 and 15 August; chlorothalonil (BRAVO 500) at 0.8 litres a.i. ha^{-1} every 7 days but with propamocarb and chlorothalonil (TATTOO C; 75% EC; AgrEvo) at 2.0 litres a.i. ha^{-1} on 2 or 3 occasions beginning 1 August and repeated every 14 days; copper hydroxide (KOCIDE DF; 72% WP; Griffin) at 1.68 kg a.i. ha^{-1} every 7 days; copper hydroxide (KOCIDE DF; 72% WP; Griffin) plus mancozeb (DITHANE; 75% DG; Rohm & Haas) at 1.68 kg a.i. ha^{-1} and 1.75 kg a.i. ha^{-1}, respectively, every 7 days; fluazinam (pre-registration product; 40% EC; ISK-Biosciences) at 0.8 litres a.i. ha^{-1} every 7 days; mancozeb (DITHANE) at 1.75 kg a.i. ha^{-1} every 7 days; mancozeb and cymoxanil (CURZATE M8; 72% WP; Dupont) at 1.0 kg a.i. ha^{-1} every 14 days with mancozeb (DITHANE) at 1.75 kg a.i. ha^{-1} every 14 days on alternate dates; mancozeb (DITHANE) at 1.75 kg a.i. ha^{-1} every 7 days but with metalaxyl + mancozeb (RIDOMIL MZ; 72% WP; Novartis) at 1.8 kg a.i. ha^{-1} on 3 occasions beginning 1 August and every 14 days; mancozeb (DITHANE) at 1.75 kg a.i. ha^{-1} every 7 days but with metalaxyl + mancozeb (RIDOMIL GOLD) at 1.7 kg a.i. ha^{-1} on 3 occasions beginning 1 August and every 14 days; and triphenyltin hydroxide (SUPERTIN; 80% WP; Griffin) plus mancozeb (DITHANE) at 0.2 kg and 1.75 kg a.i. ha^{-1}, respectively, every 7 days. Untreated control plots did not receive any fungicides.

RESULTS: Foliar late blight damage was 100% in untreated plots by 26 August (Table 1). Many fungicide treatments provided better control of foliar late blight until 26 August than did Curzate M8 and Kocide DF. However, wet weather and high inoculum levels resulted in disease control failures during the next 2-3 weeks. Based on the relative area under the disease progress curve, Acrobat MZ [1] and both Tattoo C treatments provided the best control. All fungicide treatments had significantly higher tuber yields than the untreated. Late blight tuber rot occurrence was greatest in the Acrobat MZ [2] and Kocide DF plus Dithane plots but was minimal in the others.

CONCLUSIONS: Most of the fungicides tested prevented foliar late blight damage for part of the season and providing acceptable yields and little late blight tuber rot. However, as disease pressures increased, foliar disease control was lost. In part, this may have been due to the use of fixed application intervals set at the beginning of the study. If fungicide application schedules varied according to disease pressure, i.e. shorter intervals with greater disease pressures, disease losses may have been prevented. Further tests are needed to confirm these results.

Table 1. Fungicide efficacies for control of late blight and effect on potato yields in 1997.

Foliar Treatment	Rate (a.i. ha^{-1})	Appl. No.	Foliar Late Blight (%) 26 Aug.	Foliar Late Blight AUDPC 9 Sept.	Tuber Yield Total (t/ha)	Tuber Yield LBTR (%)
Acrobat MZ & Bravo [1]	1.8 &1.8 kg	2&6	2	6.6	28.5	0.6
Acrobat MZ & Bravo [2]	1.8 &1.8 kg	2&6	4	17.1	28.4	5.5
Bravo	0.8 L	8	1	11.2	31.8	1.0
Bravo Zn	0.8 L	8	4	25.3	28.8	1.0
Curzate M8 & Manzate	1.2 & 1.7 kg	4&4	60	42.3	27.6	2.1
Dithane	1.8 kg	8	4	18.6	28.9	0.9
Fluazinam	0.8 L	8	3	17.4	30.3	1.9
Kocide DF	1.7 kg	8	88	54.7	23.7	1.2
Kocide DF + Dithane	1.7 +1.8 kg	8	17	31.7	27.6	3.2
Ridomil Gold & Bravo	1.7 kg & 0.8 L	2&6	11	29.4	28.7	0.4
Ridomil MZ & Dithane	1.8 & 1.8 kg	2&6	8	26.5	26.7	1.8
Ridomil Gold & Dithane	1.7 & 1.8 kg	2&6	5	21.4	30.0	1.2
Supertin + Dithane	0.2 +1.8 kg	8	8	25.4	28.9	0.5
Tattoo C & Bravo	2.0 kg & 0.8 L	3&5	0.5	1.9	35.6	2.9
Tattoo C & Bravo	2.0 kg & 0.8 L	2&6	1	3.1	33.3	2.4
Untreated		0	100	71.2	18.8	0.7
SED (263 df)	-	-	3.3	2.05	2.34	1.04

[1] Acrobat MZ applied on 24 July and 8 August; [2] Acrobat MZ applied on 31 July and 9 September.

1998 REPORT # 108 **SECTION K: POTATOES - Diseases**

CROP: Potato (Solanum tuberosum L), cv. Shepody
PEST: Late blight, Phytophthora infestans (Mont.) de Bary

NAME AND AGENCY:
VAN DEN BERG, C.G.J. and ELMHIRST, J.F.[1]
ICMS, Inc. Suite 313, 151-32500 South Fraser Way
Abbotsford. BC. V2T 4W1
Tel: (604)853-7322 **Fax:** (604)853-7322 **Email:** vandenbg@icms-inc.com

[1]BC Ministry of Agriculture & Food
1767 Angus Campbell Road, Abbotsford. BC. V3G 2M3
Tel: (604)556-3032 **Fax:** (604)556-3030 **Email:** jfelmhirst@galaxy.gov.bc.ca

TITLE: EFFICACY OF FOLIAR FUNGICIDES FOR CONTROL OF LATE BLIGHT ON POTATOES AT ABBOTSFORD, BC, IN 1998.

MATERIALS: ACROBAT MZ (9% dimethomorph + 60% mancozeb WP), BRAVO 500 (500 g/L chlorothalonil), CURZATE (60% cymoxanil WG), DITHANE (mancozeb 75% DG), RH141,457B (8% RH117,281 + 67% mancozeb), MANZATE 200 (mancozeb 75% DF), TATTOO C (375 g/L propamocarb + 375 g/L chlorothalonil).

METHODS: Cut pieces of Shepody potatoes (Elite III) were planted using a single row planter on May 18, 1997 in a silt loam soil at Abbotsford, BC. Experimental plots were 7 m long and 1.8 m wide (2 rows). Plots were separated by 1 m bare ground. The experiment was conducted as a RCBD with 4 replications. Fungicides were applied in a volume of 250 L/ha using a hand-held sprayer with flat-fan nozzles beginning June 30 and ending on August 25. One application of ACROBAT was made after dessication on September 10 to control tuber rot. Isolates from infected leaves were identified at AAFC, Charlottetown, PEI. Plots were hilled on June 22. The trial was irrigated on June 10, July 28, August 3 and 12 and September 1. Late blight was rated on July 9, 16, 24, 30 and August 6, and 21 using key no. 3.1.2 (Can. Plant Dis. Surv. 51: 60). The rating 10% was added to the scale: it represents plants with several infected growing tips and several destroyed leaves, accounting for about 10% of the total leaf area. The crop was desiccated on September 3 with REGLONE and harvested on September 26. Tuber yield was determined at harvest. All analyses were based on untransformed data. Means were separated using Duncan's multiple range test.

RESULTS: The entire growing season was drier and warmer than normal. The first symptoms of late blight were observed on July 9. Late blight progressed rapidly in the untreated control (Table 1). Late blight progressed very slowly in the treated plots. Symptoms were mainly limited to stem lesions and dead growing tips, due to the hot, dry weather. The isolate was identified as an A2-genotype. Spray schedules with DITHANE, RH141,457B, CURZATE/MANZATE and early applications of TATTOO C had consistently the lowest disease ratings on all three rating dates. Treatments yielded at least 200% more than the untreated check (Table 1). Yield differences among treatments were not significant. Very few tubers showed late blight symptoms at the time of harvest.

CONCLUSIONS: All treatments reduced foliar infection and increased tuber yield.

Table 1. Rating of late blight on potato leaves, tuber yield and application dates for each treatment.

Treatments		Disease rating			Tuber yield	
(Chemicals used in schedule)	Rate kg/ha, L/ha	July 16 %	July 30 %	Aug 21 %	t/ha	Application dates
Untreated	--	11.0a	95.0a	95.0a	14.6b	--
BRAVO 500	2.4	2.9bc	10.3b	8.8b	44.4a	6/30, 7/6, 7/10, 7/17, 7/23, 7/29, 8/5, 8/11, 8/18, 8/25
DITHANE	2.25	0.5cd	2.7d	4.8cd	43.7a	6/30, 7/6, 7/10, 7/17, 7/23, 7/29, 8/5, 8/11, 8/18, 8/25
RH141,457B	2	1.0bcd	4.4cd	3.8cd	49.2a	6/30, 7/6, 7/10, 7/17, 7/23, 7/29, 8/5, 8/11, 8/18, 8/25
RH141,457B	2.5	0.8cd	3.6cd	3.1d	50.8a	6/30, 7/6, 7/10, 7/17, 7/23, 7/29, 8/5, 8/11, 8/18, 8/25
RH141,457B	1.5 2.0 2.5	1.3bcd	4.9cd	5.4cd	44.5a	6/30 7/6, 7/10 7/17, 7/23, 7/29, 8/5, 8/11, 8/18, 8/25
MANZATE 200 + CURZATE MANZATE 200	2.0 0.23 2.25	0.2d	3.4d	4.8cd	44.5a	7/6, 7/17, 8/5 6/30, 7/10, 7/23, 7/29, 8/11, 8/18, 8/25
MANZATE 200 + CURZATE MANZATE 200	2.0 0.35 2.25	0.2d	2.3d	3.7cd	49.8a	7/6, 7/17, 8/5 6/30, 7/10, 7/23, 7/29, 8/11, 8/18, 8/25
TATTOO C BRAVO 500	2.7 2.4	1.0bcd	4.1cd	4.4cd	49.1a	7/6, 7/10, 7/17 6/30, 7/23, 7/29, 8/5, 8/11, 8/18, 8/25
TATTOO C BRAVO 500	2.7 2.4	3.4b	3.0d	3.0d	47.7a	7/17, 7/23, 7/29 6/30, 7/6, 7/10, 8/5, 8/11, 8/18, 8/25
ACROBAT BRAVO 500	2.5 2.4	1.2bcd	6.3c	6.9bc	47.3a	7/6, 9/10 6/30, 7/10, 7/17, 7/23, 7/29, 8/5, 8/11, 8/18, 8/25
LSD(0.05)		2.3	2.5	2.9	7.8	

END OF K
SECTION L DISEASES OF CEREAL, FORAGE and OILSEED CROPS /CÉRÉALES, CULTURES FOURRAGÈRES et OLÉAGINEUX

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EDITOR **Dr. Richard A. Martin** Email: martinra@em.agr.ca
Agriculture and Agri-Food Canada Tel: (902) 566-6851
Charlottetown Research Centre Fax: (902) 566-6821
440 University Avenue, P.O. Box 1210, Charlottetown, P.E.I. C1A 7M8

1998 PMR REPORT # 109

SECTION L: CEREALS, FORAGE CROPS AND OILSEEDS - Diseases
STUDY DATA BASE: 375-1431-7631

CROP: Alfalfa (*Medicago sativa*)
PEST: Blossom blight (*Botrytis cinerea* and *Sclerotinia sclerotiorum*)

NAME AND AGENCY:
GOSSEN B D and WONG B
AAFC Research Centre, 107 Science Place, Saskatoon, SK S7N 0X2
Tel (306) 956-7259 Fax (306) 956-7247 EM GossenB@em.agr.ca

TITLE: **EFFECT OF FUNGICIDE APPLICATION ON BLOSSOM BLIGHT OF ALFALFA IN 1998.**

MATERIALS: BENLATE (benomyl, 50% WP); BRAVO 500 (chlorothalonil, 50% F); DITHANE (mancozeb, 75% DG)

METHODS: The impact of fungicide application (BENLATE at 0.93 kg a.i. ha^{-1}, BRAVO 500 at 1.5 L a.i. ha^{-1} and DITHANE at 1.6 kg a.i. ha^{-1}) on blossom blight severity was evaluated in small-plot trials in alfalfa seed fields at Saskatoon, Rosthern and MacDowall, SK in 1998. A single application of each fungicide was made at mid- to full-bloom in mid July and compared to an untreated control. The trials were arranged in a 4 replicate RCBD. Mature florets (20 per plot) were collected 5-12 days after treatment and plated onto acidified PDA without surface sterilization. Infection with *S. sclerotiorum* or *B. cinerea* was assessed after 6 days of incubation at room temperature. Seed yields were taken on 15 or 30 m^2 areas.

In addition, two test strips of BENLATE were applied at each of two sites using the grower's equipment. At Ridgedale, SK, BENLATE was applied at 0.75 kg a.i. ha^{-1} on 18 July (early flowering). Florets (8 per site) were collected at each of 5 paired sites on the edge of the spray area (treated and control) for each strip on 23 July. Seed yields were taken on 12 m^2 areas at each site. At Atwater SK, BENLATE was applied at 0.75 kg a.i. ha^{-1} on 15 July , and samples were taken 30 July. Yield results are calculated from a combine-mounted yield monitor for each sampling site. All data were analysed using ANOVA.

RESULTS: In the small plot trials, *B. cinerea* was the pathogen most frequently isolated from alfalfa blossoms, but pathogen incidence at all three sites was very low due to the hot, dry conditions that prevailed across most of the region during flowering. There were no consistent differences in pathogen incidence or seed yield among treatments. Seed yield at Rosthern was very low, due to a combination of drought and low leafcutter bee numbers at this site.

In the commercial-scale trial at Ridgedale, BENLATE reduced the incidence of *B. cinerea*, but a 17% difference in mean seed yield was not significant at P > 0.05. At Atwater, pathogen incidence was low and BENLATE did not affect pathogen incidence or seed yield.

CONCLUSIONS: The pathogens causing blossom blight were found at trace levels at four of five sites in this study. There were no differences among treatments at these sites. At the one site where levels were high, application of BENLATE reduced the incidence of *B. cinerea*.

ACKNOWLEDGEMENT: Thanks to ADF, CSGA and MII for funding, and to K. Bassendowski and Z. Lan for technical assistance.

Table 1. Impact of fungicides applied at flowering on the incidence (%) of *Botrytis cinerea* (Bc) and *Sclerotinia sclerotiorum* (Ss) on alfalfa flowers at three sites in Saskatchewan, 1998 (n = 4).

	Rosthern		MacDowall		Saskatoon		Mean	
Fungicide	Bc	Ss	Bc	Ss	Bc	Ss	Bc	Ss
Control	10	1	8	4	8 b	0	8	2
BRAVO	16	4	9	3	0 a	0	8	2
DITHANE	9	4	5	8	9 b	1	8	4
BENLATE	15	4	4	8	0 a	0	6	1
	NS	NS	NS	NS	*	NS	NS	NS

NS - Treatments did not differ at P #0.05.

Table 2. Impact of fungicides applied at flowering on alfalfa seed yield (kg/ha) in three sites in Saskatchewan, 1998 (n = 4).

Fungicide	Rosthern	MacDowall	Saskatoon	Mean
Control	38	312	149	166
BRAVO	39	334	157	177
DITHANE	49	366	144	186
BENLATE	28	353	149	177
	NS	NS	NS	NS

NS - Treatments did not differ at P #0.05.

Table 3. Impact of commercial-scale fungicide application on incidence of *Botrytis cinerea* (Bc), *Sclerotinia sclerotiorum* (Ss) and alfalfa seed yield (kg/ha) in two sites in 1998 (n = 2).

Fungicide	Atwater			Ridgedale			Mean
	Bc	Ss	Yield	Bc	Ss	Yield	Yield
BENLATE	1	3	543	0	0	435	489
Control	4	1	531	59	0	371	451
	NS	NS	NS	*	NS	NS	

NS - Treatments did not differ at P #0.05.

1998 PMR REPORT # 110 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS Diseases

CROP: Barley (*Hordeum vulgare* L. emend. Bowden)
PEST: Root rot (*Cochliobolus sativus* (Ito & Kurib.) Drechsl. ex Dastur

NAME AND AGENCY:
BISHT V S, CURREY D, DOELL R and ROURKE D R S
Ag-Quest Inc., P.O. Box 144, Minto, Manitoba R0K 1M0
Phone: (204) 776-2087; Fax: (204) 776-2250; E-mail: agquest@agquest.com

TITLE: EFFICACY OF PROSEED AND JF13850 IN CONTROLLING ROOT ROT IN BARLEY

MATERIALS: PROSEED (hexaconazole 0.5% w/v), BAYTAN 30 (triadimenol 317 g/ L), JF13850.

METHODS: Seeds of barley cv. Harrington were infested with the spores of *Bipolaris sorokiniana* (perfect state: *Cocliobolus sativus*), taken from 4-wk. old cultures in petri-plates. The infested seeds were then seed treated with the following products: two rates of PROSEED: 3ml and 4ml product per kg seed, BAYTAN 30: 5ml product per kg seed, of JF13850: 2.5ml product per kg seed and no chemical treatment for the untreated check (UTC). The trial consisted of 20 plots, 1.5m x 7.5m (8rows/plot), in randomized complete block design with 4 replications of 5 treatments. The trial was seeded at a rate of 120 g per plot on 15 May 1998. Fertilizer (11-55-0) was applied at the rate of 40 kg/ha at seeding. Emergence was recorded on 26 May from 4 rows of 1m length. For root rot observation, samples (50 plants/plot) were collected at the seedling stage (18 June), boot stage (6 July) and pre-harvest stage (11 August). After washing, roots of the sampled plants were rated for infection (mainly in the sub-crown internode=SCI) using a 0-5 scale (0=healthy, ... 5=100% of SCI infected & plant dying/dead). Efficacy of the treatment was represented as % healthy plants. Plots were harvested on 25 August and yields adjusted to 14.8% seed moisture.

RESULTS: All seed treatments resulted in higher emergence than the UTC, but only PROSEED (3ml/kg seed) was statistically significant (Table 1). However, there was no statistical difference between the seed treatments. All seed treatments resulted in significantly higher % of healthy plants as compared to UTC based on observations at seedling, boot and pre-harvest stages. At seedling and boot stages of observation PROSEED at both rates was significantly less effective than BAYTAN 30 and JF13850. BAYTAN30 resulted in highest % healthy plants at the pre-harvest observation, while PROSEED (3ml/kg seed) resulted in lowest of all chemical treatments. The percentage of healthy plants did not seem to change appreciably between the 3 stages for each of the treatments. All seed treatments also

exhibited significantly lower severity of root rot infection as compared to the UTC. PROSEED (3ml/kg seed) was least effective of the 4 seed treatments, though differences were not always significant. Root rot severity at pre-harvest stage, suggested that BAYTAN30 performed the best, though not significantly better than JF13850. The higher rate of PROSEED proved to be better than the lower rate in seedling stage only. All seed treatments resulted in higher barley yields; only BAYTAN 30 was not statistically higher than UTC. There was no statistical difference in yield between the two rates of PROSEED.

CONCLUSIONS: PROSEED (both rates : 3ml and 4ml per kg seed) and JF13850 seed treatment increased seedling emergence and the percentage of healthy plants due to reduction in the root rot severity; performed similarly. In general, the percentage of healthy plants did not change appreciable but the severity of root rot increased over the period of observation (from seedling to pre-harvest stage) suggesting that the plants were infected only in the early stages of the crop growth and the disease severity increased in the plants over time.

Table 1. Effect of seed treatments with PROSEED, BAYTAN 30 and JF13850 on emergence, root rot and yield of barley, cv. Harrington artificially inoculated with *Bipolaris sorokiniana*, at Minto, Manitoba, in 1998.

Treatment	Emergence count in 1m x 4 rows	Healthy Plants (%)			Infection Severity (0-5)			Yield (kg/ha)
		Seedling	Boot	Pre-harvest	Seedling	Boot	Pre-harvest	
UTC	120.8 b	25.8 c	27.5 c	27.8 d	1.22 a	1.25 a	1.70 a	2611.5 b
PROSEED 3 ml/kg seed	172.0 a	53.8 b	51.8 b	46.6 c	0.73 b	0.69 b	1.15 b	3281.8 a
PROSEED 4 ml/kg seed	152.5 ab	62.4 b	51.2 b	59.8 bc	0.50 c	0.64 b	0.84 bc	3202.5 a
BAYTAN 30 5 ml/kg seed	137.8 ab	74.1 a	76.7 a	79.2 a	0.34 c	0.29 b	0.35 d	2715.3 ab
JF13850 2.5ml/kg seed	156.0 ab	74.5 a	75.6 a	69.4 ab	0.34 c	0.31 b	0.62 cd	3236.3 a
LSD(P=0.05)	35.72	9.07	12.62	15.8	0.17	0.38	0.4	536.23
CV	15.68	10.14	14.49	18.14	17.78	38.41	27.85	11.45

* Means followed by the same alphabet do not differ significantly from one another at Prob (F)=0.05.

1998 PMR REPORT # 111 SECTION L: CEREALS, FORAGE CROPS/OILSEED DISEASES
STUDY DATA BASE: 375-113-9613

CROP: Barley (*Hordeum vulgare* L.) cultivar Harrington
PEST: Net blotch, *Pyrenophora teres* Drechs.

NAME AND AGENCY:
KUTCHER H R, and KIRKHAM C
Melfort Research Farm, Agriculture and Agri-Food Canada
Box 1240, Melfort, Saskatchewan S0E 1A0
Tel: (306) 752-2776**; Fax:** (306) 752-4911**; Email:** kutcherr@em.agr.ca

TITLE: TIMING OF TILT APPLICATION ON HARRINGTON BARLEY

MATERIALS: TILT (Propiconazole, 250 g ai/L Ciba)

METHODS: Harrington barley was block seeded directly into barley stubble with a John Deere hoe drill. After emergence 2 X 10 m plots were measured out with a 2 m alleyway between each plot. Plots were seeded May 13/98 with 22 kg ha of phosphate in the furrow. Nitrogen (34-0-0) was broadcast May 21/98 at the rate of 224 kg/ha. The experimental design was a randomized complete block with 125 g ai/L TILT applied in 200 L/ha water at four plant growth stages (GS). The Zadoks growth stage scale was used. The treatments were: 1) Check, 2) GS 31 (first node of stem visible), 3) GS 37 (flag leaf just emerging), 4) GS 47 (flag leaf fully emerged) and 5) GS 65 (heading). Plots were rated for disease severity during the milk stage of kernel development using a 0 to 11 scale based on the percentage of leaf area diseased (0 – no disease, 11 – 100% leaf area infected). Yield measurements were made on harvest samples taken from 1.25 X 10 m of each plot. Thousand kernel weight, bushel weight and % plump kernels were determined.

RESULTS: Data are presented in Table 1. Foliar diseases were visually identified as the spot and net form of net blotch.

CONCLUSIONS: Under conditions at Melfort in 1998 TILT applied at all growth stages reduced disease severity of Harrington barley compared to the check. Among TILT applied treatments there were no visible effects on disease severity at the milk stage of kernel development. Differences between treatments and the check were obtained for yield, bushel weight and % plump kernels. Application of TILT made between stages 31 and 65 increased yield and crop quality over the check. However, best results for all factors were obtained when TILT was applied to the fully emerged flag leaf (GS 47).

Table 1. Disease severity rating (0-11), yield, thousand kernel weight (TKW), bushel weight (BW) and percent plump kernels (% Plump) of Harrington barley sprayed with TILT at Melfort, Saskatchewan, in 1998.

Treatment	Growth Stage	Disease Severity	Yield (kg/ha)	TKW (grams)	BW (kg/hl)	% Plump (>2.4 x 19 mm)
1	Check	9.8	2670	31.3	54.4	67
2	31	8.3	2820	31.6	55.3	72.3
3	37	7.8	3240	33.4	56.2	74.6
4	47	7.8	3669	35	59.7	85.1
5	65	8.5	3391	35.2	57.9	80.1
$Lsd_{(0.05)}$		0.9	367	2.3	1.3	3.2

= Growth stage (GS) represented by the Zadok scale.

1998 PMR REPORT # 112 SECTION L: CEREALS ,FORAGE CROPS/OILSEEDS Diseases
STUDY DATA BASE: 303-1212-9604

CROP: Barley, cv. AC Sterling
PEST: Net blotch, *Pyrenophora teres*
Scald, *Rhynchosprioum secalis*

NAME and AGENCY:
MARTIN R A, and MATTERS R
Agriculture and Agri-Food Canada, Research Centre, P.O. Box 1210, Charlottetown, PEI C1A 7M8
Tel: (902) 566-6851; **Fax:**(902) 566-6821; **Internet:** MARTINRA@EM.AGR.CA

TITLE: INFLUENCE OF FUNGICIDE SEED TREATMENT AND FOLIAR SPRAY ON DISEASE AND YIELD IN BARLEY, 1998

MATERIALS: DIVIDEND XL RTA(difenoconazole, 3.21% plus mefenoxam 0.27%), VITAFLO 280 (carbathiin 14.9%, thiram 13.2%), NOA9525 (250EC), TILT (propiconazole, 125 g/L)

METHODS: Certified barley seed, cv. AC Sterling, was treated with the fungicides listed above at the rates listed in the table, in a small batch seed treater. Barley plots were established on May 11, 1998, at a seeding rate of 300 viable seeds per m^2. Each plot was ten rows wide and five metres long, 17.8 cm between rows. Treatments were replicated four times in a randomized complete block design, Each barley plot was separated by an equal sized wheat plot. Plots received a herbicide application of MCPA (1L/ha) plus Refine Extra (20g/ha) at Zadok's Growth Stage 32. TILT was applied to the plots using a tractor mounted small plot sprayer at Zadok's Growth Stages 39 and/or 60.

At Zadok's Growth Stage (ZGS) 80 and 85 foliar net blotch and scald was assessed on the penultimate and or 3rd leaf of 10 randomly selected tillers per plot using the Horsfall & Barratt Rating System. Yield and thousand kernel weight were determined from the harvest of nine rows, using a small plot combine.

RESULTS: Disease severity was insufficient to warrant rating of the plots for seedling blight. There was no effect of treatment on severity of scald. In this study the application of seed treatments in the absence of a later foliar fungicide application had no significant effect on either disease control or yield. The foliar application of TILT did however result in a significant decrease in disease severity and a significant increase in yield, in all but one instance.

CONCLUSIONS: Conditions in 1998 were not conducive to the development of a severe net blotch epidemic, nor for the development of scald. Net blotch did not develop rapidly. This in part may explain the lack of activity from the seed treatment applications and the resulting yield responses. There was a significant correlation between net blotch and yield. Thus the application of TILT which significantly impacted on disease severity also resulted in a significant yield increase. There was however no difference between the timing of applications or whether a single or multiple application was made. The relatively low level of net blotch severity being largely responsible for the low level of response to treatment.

Table 1. Efficacy of fungicide seed treatments and foliar spray in barley, Charlottetown, PEI, 1998.

Treatment	Rate gai/kg seed	gai/ha	ZGS*	Net Blotch (%) 2nd leaf Jul 21	3rd leaf Jul 21	3rd leaf Jul 28	Scald (%) 3rd leaf Jul 21	2nd leaf Jul 28	Yield (kg/ha)	1000 Kwt (g)
Untreated Control				4.9	17.6	32.3	1.2	1.3	3506	45.3
DIVIDEND XL	0.13			5.7	21.3	25.3	2.3	1.7	3599	45.7
DIVIDEND XL	0.26			3.6	10.4	31.3	1.8	3.2	3618	46.4
DIVIDEND XL	0.13									
plus TILT		125	39	2.4	5.0	5.7	0.6	1.4	4066	49.3
DIVIDEND XL	0.26									
plus TILT		125	39	3.1	6.4	6.0	0.6	0.5	4117	48.3
DIVIDEND XL	0.13									
plus TILT		125	60	3.1	5.7	4.9	2.3	0.8	3904	48.4
DIVIDEND XL	0.26									
plus TILT		125	60	3.2	10.1	4.3	1.8	2.9	4085	48.1
DIVIDEND XL	0.13									
plus TILT		125	39							
plus TILT		125	60	2.8	5.3	2.3	1.8	0.8	4117	48.0
DIVIDEND XL	0.26									
plus TILT		125	39							
plus TILT		125	60	0.9	2.3	2.6	0.6	0.6	4199	49.1
TILT		125	39	2.2	4.7	8.1	2.3	1.6	3880	47.5
TILT		125	60	3.9	10.3	8.0	1.8	1.2	3772	46.3
TILT		125	39							
plus TILT		125	60	2.3	4.7	2.5	0.6	0.6	4109	48.5
DIVIDEND XL	0.13									
plus NOA9525		125	60	3.6	8.3	8.6	1.8	2.9	3817	47.3
DIVIDEND XL	0.13									
plus NOA9525		125	39	2.2	3.6	4.9	1.8	0.7	4040	48.0
VITAFLO 280	0.92			3.8	12.7	23.3	4.1	2.3	3669	45.9
VITAFLO 280	0.92									
plus TILT		125	60	0.8	2.5	4.6	0.6	1.2	4238	48.1
VITAFLO 280	0.92									
plus TILT		125	39	2.7	5.3	3.8	5.3	0.9	3955	48.4
VITAFLO 280	0.92									
plus TILT		125	39							
plus TILT		125	60	0.9	2.5	2.3	0.6	0.2	4372	50.1
SEM**				0.642	2.638	5.08	1.195	0.680	108.3	0.703
LSD (0.05)				1.82	7.50	14.44	NS***	NS	307.8	2.00

* ZGS = Zadok's Growth Stage when TILT application was made

** SEM = standard error of mean

*** NS = not significant at a 0.05 level of probability

1998 PMR REPORT # 113 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS Diseases
STUDY DATA BASE: 303-1212-9604

CROP: Barley, cv. AC Sterling
PEST: Net blotch, *Pyrenophora teres*

NAME and AGENCY:
MARTIN R A, and MATTERS R
Agriculture and Agri-Food Canada, Research Centre, P.O. Box 1210, Charlottetown, PEI C1A 7M8
Tel: (902) 566-6851; **Fax:**(902) 566-6821; **Internet:** MARTINRA@EM.AGR.CA

TITLE: INFLUENCE OF FUNGICIDE FOLIAR SPRAYS ON DISEASE AND YIELD IN BARLEY, 1998

MATERIALS: TILT (propiconazole, 125 g/L), NOA9525 (250EC), NOA9360 (125EC), QUADRIS (azoxystrobin, 125 g/L), BRAVO (chlorothalanil, 500 g ai/kg)

METHODS: Barley plots of certified AC Sterling were established on May 11, 1998, at a seeding rate of 300 viable seeds per m^2. Each plot was ten rows wide and five metres long, 17.8 cm between rows. , Each barley plot was separated by an equal sized wheat plot. Plots received a herbicide application of MCPA (1L/ha) plus Refine Extra (20g/ha) at Zadok's Growth Stage 32. Treatments were applied at the rates indicated in the table and were applied to the plots using a tractor mounted small plot sprayer at Zadok's Growth Stages 39. Treatments were replicated four times in a randomized complete block design

At Zadok's Growth Stage (ZGS) 80 and 85 foliar net blotch and scald was assessed on the penultimate and/or 3rd leaf of 10 randomly selected tillers per plot using the Horsfall & Barratt Rating System. Yield and thousand kernel weight were determined from the harvest of nine rows, using a small plot combine.

RESULTS: Disease pressure was very low in 1998 however each foliar spray did result in a significant reduction in disease, net blotch, expression. Scald levels were very variable and low and there were no significant effects. There was no significant impact of treatment on yield.

CONCLUSIONS: Conditions in 1998 were not conducive to the development of a severe net blotch epidemic. Net blotch did not develop rapidly or to high levels which would, in part, explain the lack of a significant yield response. While not significant at a 0.05 level of probability the top treatment was NOA9525, where yield was increased by approximately 18%. Of all the treatments BRAVO demonstrated the least disease control ability although it was still significantly better that the untreated control.

Table 1. Efficacy of fungicide foliar spray in barley, Charlottetown, PEI, 1998.

Treatment	Rate	ZGS*	Net Blotch (%)			Yield (kg/ha)	1000 Kwt (g)
	gai/ha		2nd leaf Jul 21	3rd leaf Jul 21	3rd leaf Jul 28		
Untreated Control			11.6	34.4	18.8	3541	45.4
TILT	125	39	2.4	6.4	7.5	3742	47.7
NOA9360	125	39	2.3	6.6	7.0	3748	47.1
NOA9525	62.5/62.5	39	3.5	9.7	7.6	4186	48.5
NOA9525	125/125	39	1.7	3.6	3.3	4100	48.3
QUADRIS	200	39	3.1	8.3	4.7	3939	48.2
QUADRIS + BRAVO 500F	200 1200	39	3.6	11.9	3.7	3906	47.6
BRAVO 500F	1200	39	5.4	17.1	13.3	3710	45.6
SEM**			0.649	2.416	1.948	152.2	0.662
LSD (0.05)			1.89	7.05	5.69	NS***	1.93

* ZGS = Zadok's Growth Stage when applications were made
** SEM = standard error of mean
*** NS = not significant at a 0.05 level of probability

1998 PMR REPORT # 114 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS Diseases
STUDY DATA BASE: 303-1212-9604

CROP: Barley, cv. AC Sterling
PEST: Net blotch, *Pyrenophora teres*

NAME and AGENCY:
MARTIN R A, and MATTERS R
Agriculture and Agri-Food Canada, Research Centre, P.O. Box 1210, Charlottetown, PEI C1A 7M8
Tel: (902) 566-6851; **Fax:**(902) 566-6821; **Internet:** MARTINRA@EM.AGR.CA

TITLE: INFLUENCE OF FOLIAR SPRAYS OF AZOXYSTROBIN ON DISEASE AND YIELD IN BARLEY, 1998

MATERIALS: QUADRIS (azoxystrobin 250g/L SC), TILT (propiconazole, 125 g/L).

METHODS: Barley plots of certified AC Sterling were established on May 11, 1998, at a seeding rate of 300 viable seeds per m^2. Each plot was ten rows wide and five metres long, 17.8 cm between rows. , Each barley plot was separated by an equal sized wheat plot. Plots received a herbicide application of MCPA (1L/ha) plus Refine Extra (20g/ha) at Zadok's Growth Stage 32. Treatments were applied at the rates indicated in the table and were applied to the plots using a tractor mounted small plot sprayer at Zadok's Growth Stages 39, 50 or 62. Treatments were replicated four times in a randomized complete block design.

At Zadok's Growth Stage (ZGS) 80 and 85 foliar net blotch and scald was assessed on the penultimate and/or 3rd leaf of 10 randomly selected tillers per plot using the Horsfall & Barratt Rating System. Yield and thousand kernel weight were determined from the harvest of nine rows, using a small plot combine.

RESULTS: Disease pressure was low in 1998 however each foliar spray did result in a significant reduction in disease, net blotch, expression at the later assessment date, and with most treatments significantly reducing disease at the early assessment. Azoxystrobin was as effective as TILT in disease control and effect on yield. However azoxystrobin was more effective that TILT when applied after heading.

CONCLUSIONS: Conditions in 1998 were not conducive to the development of a severe net blotch epidemic. QUADRIS and TILT were effective in disease control and yield benefit. Yield increases of between 6 and 19% were recorded with QUADRIS applications. QUADRIS would appear to have more activity than TILT when applied after heading, however more evaluation is required to confirm this observation.

Table 1. Efficacy of fungicide foliar spray in barley, Charlottetown, PEI, 1998.

Treatment	Rate (g ai/ha)	ZGS*	Net Blotch (%)			(g)	Yield (kg/ha)	1000 Kwt
			2nd leaf Jul 22	3rd leaf Jul 22	2rd leaf Jul 30			
Untreated Control			7.3	21.6	38.2		3371	46.38
QUADRIS	75	39	2.8	6.0	9.1		4014	48.26
QUADRIS	125	39	2.8	6.6	9.3		3871	48.17
QUADRIS	175	39	2.9	6.7	10.5		3952	48.54
QUADRIS	75	50	3.9	11.4	9.7		3958	48.87
QUADRIS	125	50	6.7	21.9	14.2		3653	47.43
QUADRIS	175	50	3.8	10.1	13.4		3904	48.48
QUADRIS	75	62	4.7	17.3	5.8		3753	47.77
QUADRIS	125	62	7.3	20.4	13.1		3575	48.06
QUADRIS	175	62	4.2	15.8	19.1		3768	47.54
QUADRIS	75+75	39+62	3.0	7.2	3.9		3885	48.88
TILT	125	39	2.7	5.9	9.1		3821	48.45
TILT	125	50	3.3	9.5	6.0		3714	48.15
TILT	125	62	8.5	25.7	12.4		3288	46.61
SEM			0.863	2.533	4.07		91.5	0.651
LSD (0.05)			2.47	7.25	11.6		261.8	NS

* ZGS = Zadok's Growth Stage when applications were made

** SEM = standard error of mean

*** NS = not significant at a 0.05 level of probability

1998 PMR REPORT # 115 SECTION L: CEREALS, FORAGE CROPS/OILSEED Diseases

CROP: Canola (*Brassica napus* L.), cv. LG 3295
PEST: Sclerotinia stem rot *(Sclerotinia sclerotiorum* (Lib.) De Bary)

NAME AND AGENCY:
BISHT V S, MALIK A H A, ROURKE D R S and DOELL R.
Ag-Quest Inc., Box 144, Minto, Manitoba, R0K 1M0.
Tel: (204) 776-2087 **Fax:** (204) 776-2250 **E-mail:** agquest@agquest.com

TITLE: COMPARISION OF PROCHLORAZ 450 EW AND PROCHLORAZ 450 EC FOR CONTROL OF SCLEROTINIA STEM ROT (*Sclerotinia sclerotiorum* (Lib.) De Bary) IN CANOLA

MATERIALS: PROCHLORAZ 450 EC, ENHANCE SL 0.5 % v/v, AGRAL 90 SL 0.2 % v/v, AZOXYSTROBIN 250 SC and BENLATE 50WP**.**

METHODS: The trial was conducted at Ag-Quest Research Station, Minto, MB. Prior to planting sclerotia were broadcast in the trial area and lightly cultivated. Canola, cv. LG 3295 was seeded at 8 kg/ha on 23 May 98; Nitrogen (70 kg/ha),P205 (40 kg/ha), K (15 kg/ha and S (15 kg/ha) were banded at seeding. Roundup at 880 g ai/ha was applied on 10 Jun 98 for weed control. The experimental design was randomized complete block design with four replications, with the plots size was of 2.0 x 7.5 m . *Sclerotinia* inoculum (mycelial suspension) was spread in the trial area 8-10 days prior to treatment application. The trial was irrigated to keep relative humidity high to facilitate sclerotia germination. Chemical treatments were applied 25-30% and 50% bloom. Two untreated controls were used as checks. Incidence and severity of sclerotinia stem rot disease was recorded 32 days after application (DAA) of the last chemical treatment. A sample of fifty canola plants per plot were assessed for stem infection and rated on a 1-5 scale, with 1 and 5 being healthy and severely infected plants, respectively (PMRR, 1982, p238). By assigning numerical values (NV) of 0, 1.25, 2.5, 3.75 and 5, respectively, to categories 1 to 5, the overall disease intensity expressed as "percent disease rating " was computed using the following equation: DR (%)=(no. of plants in category x NV) x 100 / total no. of plants x 5. The crop was harvested on 9 September 98 and yield transformed and analysed using ANOVA.

RESULT: The disease development was good and uniform throughout the plots. Compared to UTC, all fungicide treatments significantly reduced severity of sclerotinia disease. PROCHLORAZ 450 EC and PROCHLORAZ 450 EW showed better sclerotinia stem rot control when applied at early growth stage (25-30% bloom) compared to late applications (50% bloom). There were non-significant differences between EC and EW formulation of PROCHLORAZ. Increasing rates from 400 to 500 g ai/ha did not improve sclerotinia control. All fungicide treated plots had higher yield than untreated control.

CONCLUSION: In this trial, PROCHLORAZ 450 EC and 450 EW application at early crop growth stage (25-30% bloom) resulted in excellent sclerotinia stem rot control compared to their late application (50% bloom). The timing of PROCHLORAZ EC and EW application is more important than their application rates, i.e. 400 verses 500 g ai/ha.

Table 1. Effect of PROCHLORAZ 450 EW and PROCHLORAZ 450 EC for control of Sclerotinia stem rot (*Sclerotinia sclerotiorum* (Lib.) De Bary) in canola at Minto, Manitoba , 1998.

Trt No	Treatment	Application rate *(g ai/ha)*	Stage *(% bloom)*	Scleroinia rot *(DR %)**	Seed Yield (*Kg/ha)*
1	PROCHLORAZ 450 EC	400	30 %	4.30 f **	1528 a
2	PROCHLORAZ 450 EC ENHANCE SL	400 0.5 % v/v	30 %	2.98 f	1259 ab
3	PROCHLORAZ 450 EW	400	30 %	4.91 f	1370 ab
4	PROCHLORAZ 450 EW AGRAL 90 SL	400 0.2 % v/v	30 %	6.07 ef	1401 ab
5	PROCHLORAZ 450 EW	400	50 %	10.27 de	1413 ab
6	PROCHLORAZ 450 EW AGRAL 90 SL	400 0.2 % v/v	50 %	19.19 c	1538 a
7	PROCHLORAZ 450 EC	500	30 %	4.18 f	1578 a
8	PROCHLORAZ 450 EC ENHANCE SL	500 0.5 % v/v	30 %	5.16 f	1496 a
9	PROCHLORAZ 450 EW	500	30 %	2.37 f	1453 ab
10	PROCHLORAZ 450 EW AGRAL 90 SL	500 0.2 % v/v	30 %	6.91 ef	1442 ab
11	PROCHLORAZ 450 EW	500	50 %	10.59 de	1422 ab
12	PROCHLORAZ 450 EW AGRAL 90 SL	500 0.2 % v/v	50 %	13.74 d	1479 a
13	AZOXYSTROBIN 250 SC	250	30 %	4.93 f	1471 a
14	BENLATE 50 WP	500	30 %	3.31 f	1346 ab
15	AZOXYSTROBIN 250 SC	250	50 %	3.22 f	1335 ab
16	BENLATE 50 WP	500	50 %	3.67 f	1144 ab
17	UNTREATED			32.67 a	971 b
18	UNTREATED			27.90 a	962 b
	LSD (P=0.05)			4.698	414.2
	CV.			35.94	21.43

* DR % = percent disease rating of sclerotinia stem rot.

** Values in a column, followed by the same letter are not significantly different at Prob (F)=0.05.

1998 PMR REPORT # 116 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS Diseases

CR0P: Canola (*Brassica napus* L.), cv. Westar
PEST: Blackleg, *Leptosphaeria maculans* (Desm.) Ces. *et* de Not.

NAME AND AGENCY:
LANGE R M, KHARBANDA P D, WEREZUK S P and OSTASHEWSKI M J
Alberta Research Council
Highway 16A and 75 Street
PO Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (403) 632-8226; Fax: (403) 632-8612; Email: Ralph@arc.ab.ca

TITLE: CONTROL OF BLACKLEG OF CANOLA WITH FOLIAR SPRAYS OF ICIA5504 AT LAVOY, ALBERTA IN 1998

MATERIALS: ICIA5504 (azoxystrobin 25% SC), TILT 250 EC (propiconazole 25%), VITAVAX RS

METHODS: Westar canola was planted on May 21 at a rate of 32 seeds per meter. All seed was treated with VITAVAX RS (22.5 ml per kg seed). Each plot consisted of four 6m-long rows spaced 20 cm apart. The plots were arranged in a four-replicate randomized complete block design. Fungicide treatments were applied June 10 and 17, when the plants were in the 2- and 4-leaf growth stages, respectively. All fungicide sprays were applied with a CO2-powered backpack sprayer using a water volume of 200 L/ha at a boom pressure of 207 kPa. Disease severity and incidence were determined on September 10 by evaluating a random sample of 30 plants taken from the two center rows of each plot. Yield data were obtained by harvesting all four rows from each plot. Green seed counts were collected by crushing and examining 100 seeds per yield sample. All data were subjected to ANOVA, and means were compared using Duncan's Multiple Range Test. Green seed count data were square-root transformed prior to analysis.

RESULTS: See Table 1.

CONCLUSIONS: Disease severity in all treatments was significantly (P=0.05) less than the unsprayed check, except for the low rate of azoxystrobin. Azoxystrobin was equally effective as propiconazole in reducing blackleg severity at all application rates. Two applications of azoxystrobin did not significantly decrease disease severity in comparison to the other fungicidal treatments. Disease incidence, green seed counts and seed yield were unaffected by the fungicides applied in this study.

Table 1. Effect of foliar application of Azoxystrobin on blackleg disease severity and incidence at Lavoy, Alberta in 1998.

Treatment	g ai/ha	Application stage	MDS*	Incidence (%)	Green	Yield****
Control	-	-	2.7a**	74.2a**	0.8a**	1225a**
Azoxystrobin	75	2 leaf stage	2.1ab	73.6a	0.5a	1234a
Azoxystrobin	100	2 leaf stage	1.5b	57.4a	1.0a	1142a
Azoxystrobin	125	2 leaf stage	1.5b	56.7a	0.8a	1270a
Azoxystrobin	125+125	2 and 4 leaf stage	1.9b	66.7a	1.8a	1241a
Propiconazole	125	2 leaf stage	1.7b	65.9a	1.0a	1225a

* Mean disease severity on September 10, 1998, 0 (no disease) to 5 (dead plant). Mean of 30 plants per plot. n=4.

** Means with the same letter are not significantly different according to a Duncan's multiple range test, á = 0.05.

*** Mean number of green seeds in 100-seeds randomly sampled per plot. Analyses were performed on square-root transformed data. Back-transformed means are presented here. n=4.

**** Mean seed yield per plot. n=4.

1998 PMR REPORT # 117 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS Diseases

CR0P: Canola (*Brassica rapa* L.), cv. Reward
PEST: Alternaria blackspot, *Alternaria brassicae* (Berk.) Sacc.

NAME AND AGENCY:
LANGE R M, KHARBANDA P D, OSTASHEWSKI M J and WEREZUK S P
Alberta Research Council
Highway 16A and 75 Street
PO Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (403) 632-8226; Fax: (403) 632-8612; Email: Ralph@arc.ab.ca

TITLE: CONTROL OF ALTERNARIA BLACKSPOT OF CANOLA WITH FOLIAR SPRAYS OF ICIA5504 AT VEGREVILLE, ALBERTA IN 1998

MATERIALS: ICIA5504 (azoxystrobin 25% SC), ROVRAL FLO (iprodione 250 g/L), VITAVAX RS

METHODS: Reward canola was planted on May 26 at a rate of 32 seeds per meter. All seed was treated with VITAVAX RS (22.5 ml per kg seed). Plots were arranged in a four-replicate randomized complete block design. Each plot consisted of four 6m-long rows spaced 20 cm apart. Fungicide treatments were applied July 10 and 22, when the plants were in the 10- and 95%-petal fall maturity stages, respectively. All fungicides were applied with a CO2-powered backpack sprayer using a water volume of 200 L/ha at a boom pressure of 207 kPa. Disease severity was determined on August 11 by estimating the percentage of pod area affected on ten randomly-selected plants from the middle two rows of each plot. Twenty-five pods were examined per plant. Yield data were obtained by hand-harvesting the two center rows in each plot. Border effects were minimized prior to harvest by removing all plants within 50 cm of the end of each plot. Green seed counts were collected by crushing and examining 100 seeds per yield sample. All data were subjected to ANOVA, and means were compared using Duncan's Multiple Range Test. Green seed count data were square-root transformed prior to analysis.

RESULTS: See Table 1.

CONCLUSIONS: Disease severity in all treatments was significantly less than the unsprayed check. Late application of azoxystrobin or iprodione (95% petal fall) was more effective in reducing disease severity than application at the 10% petal fall stage. Two applications of azoxystrobin did not reduce disease severity over a single application at 95% petal fall. Azoxystrobin significantly reduced the green seed count over the untreated check when applied at a rate of 175g ai/ha at 10% petal fall. Essentially, azoxystrobin was as effective as iprodione. Seed yield was unaffected by the fungicide treatments used in this study.

Table 1. Effect of azoxystrobin and iprodione foliar sprays on Alternaria black spot disease severity at Vegreville Alberta in 1998.

Treatment	g ai/ha	Application stage	Disease severity*	Green seeds***	Mean yield (g)****
Control	-	-	12.6a**	1.5a**	349a**
Azoxystrobin	125	10% petal fall	4.6b	1.6a	361a
Azoxystrobin	175	10% petal fall	3.2bc	1.2b	377a
Azoxystrobin	250	10% petal fall	2.0bc	1.4ab	361a
Azoxystrobin	125	10 & 95 % petal fall	0.4c	1.4ab	371a
Iprodione	500	10% petal fall	3.8b	1.5a	332a
Azoxystrobin	125	95% petal fall	0.4c	1.7a	374a
Azoxystrobin	175	95% petal fall	0.8c	1.6a	377a
Iprodione	500	95% petal fall	0.4c	1.6a	338a

* Percent pod area affected. Mean of ten plants per plot, 25 pods per plants. n=4.

** Means with the same letter are not significantly different according to a Duncan's multiple range test, á = 0.05.

*** Mean number of green seeds in three 100-seed subsamples per plot. Analyses were performed on square-root transformed data. Back-transformed means are presented here. n=12.

**** Mean seed yield per plot. n=4.

1998 PMR REPORT # 118 SECTION L: CEREALS, FORAGE CROPS/OILSEED Diseases

CROP: Canola (*Brassica napus* L.), cv. LG 3295
PEST: Sclerotinia, *Sclerotinia sclerotiorum.*

NAME AND AGENCY:
MALIK A H A, BISHT V S, ROURKE D R S and DOELL R
Ag-Quest Inc.,Box 144, Minto, Manitoba, Canada, R0K 1M0.
Tel: (204) 776-2087; Fax: (204) 776- 2250; E-mail: agquest@agquest.com

TITLE: EFFICACY OF SPLIT APPLICATION OF RONILAN FOR SCLEROTINIA (*Sclerotinia sclerotiorum*) CONTROL IN CANOLA

MATERIALS: RONILAN EG 50 WG, BENLATE 50 WP, EASOUT 70 WP, EASOUT 70 WP LORSBAN 4 E 480 EC and DECIS 5 EC

METHODS: The trial was conducted at Ag-Quest Research Station, Minto, Manitoba in 1998. Sclerotia of S. sclerotiorum were broadcast in the field and lightly cultivated. Canola (LG 3295) was planted on 23 May 98 with plot size of 2.0 x 7.5 m , using a randomized complete block design. 70 kg/ha N, 40 kg/ha P2O5, 15 kg/ha K and 15 kg/ha S banded prior to seeding. ROUNDUP at 880 g ai/ha was used for weed control. Mycelial suspension of *S .sclerotiorum* was applied 8-10 days prior to treatments application. Each of the fungicide treatments (Table 1) was applied at early (25%) or late (50%) bloom stage of plant growth on 10 and 17 July 1998, respectively, to evaluate their efficacy in sclerotinia disease control. Two untreated controls (UTC) were used as check. The trial was irrigated to keep relative humidity high to facilitate sclerotial germination. Incidence and severity of sclerotinia disease was recorded 32 days after treatment. A sample of fifty canola plants per plot were assessed for disease infection and rated on a 1-5 scale, with 1= healthy and 5= severely infected plants (PRRM.1982, p238). By assigning numerical values (NV) of 0, 1.25, 2.50, 3.75 and 5.00 to categories 1 through 5, respectively, the overall disease intensity expressed as "percent disease rating" (DR %), was computed using the following equation: DR (%) = (no. of plants in category x NV) x 100 / total no .of plants x 5. The crop was harvested on 9 September 98.

RESULTS: Sclerotinia disease was effectively reduced by all fungicide treatments and some resulted in higher grain yields, compared to the untreated control (Table 1). RONILAN EG 50 WG @ 0.25 and 0.50 kg/ha, when treated alone or in split application at 20-25 and 50 % bloom growth stages also showed similar Sclerotinia disease control and crop yield. Early bloom application of BENLATE 50WP (0.56 kg/ha), late bloom application of RONILAN EG 50WG (0.5 kg/ha) + LORSBAN 4E 480EC (0.725 kg/ha) and split application of RONILAN EG 50WG (0.25 kg/ha) at early and late bloom were the 3 highest yielding treatments, though not significantly better than some other treatments. Single application of RONILAN EG 50WG at 0.25 or 0.50 kg/ha did not lead to significant yield increase in comparison to the UTC.

CONCLUSIONS: Under the conditions of this trial, all fungicide treatments showed improved sclerotinia disease control compared to untreated control. There were no significant differences between any of the RONILAN EG 50 WG treatments, suggesting that rate and timing of application did not have any significant effect on disease control.

Table 1: Sclerotinia disease rating (DR %) and seed yield (kg/ha) of canola, as affected by fungicide treatments alone, in various combinations and rates, applied at different growth stages (25 and 50 % bloom), in a field trial at Minto, Manitoba, in 1998.

No.	Treatment	Rate (*kg/ha*)	Growth Stg (*% bloom*)	Sclerotinia (*DR %*)	Yield (*kg/ha*)
1	UTC			32.5 a	1021 b
2	RONILAN EG 50WG	0.25	20-25	3.8 bc	1157 ab
3	RONILAN EG 50WG	0.25	50	5.2 bc	1157 ab
4	RONILAN EG 50WG RONILAN EG 50WG	0.25 0.25	20-25 50	2.3 c	1299 a
5	RONILAN EG 50WG	0.5	50	3.2 bc	1162 ab
6	BENLATE 50WP	0.325	20-25	1.4 c	1235 ab
7	BENLATE 50WP	0.56	20-25	3.6 bc	1378 a
8	RONILAN EG 50WG LORSBAN 4E 480EC	0.50 0.725	50 50	2.7 c	1309 a
9	RONILAN EG 50WG DESIS 5EC	0.50 0.008	50 50	6.7 b	1273 a
10	EASOUT 70 WG RONILAN EG 50WG	0.80 0.25	20-25 20-25	4.4 bc	1254 ab
11	EASOUT 70WG	1.6	20-25	2.5 c	1286 a
	LSD (P= 0.05)			3.43	207.31
	Standard Deviation			2.37	143.57
	CV			38.17	11.67

Means followed by same letter are not significantly different from one another at Prob (F) = 0.05.

1998 PMR REPORT # 119 SECTION L: CEREAL, FORAGE/OILSEED CROPS Diseases
ICAR: 61006537

CROP: Corn (*Zea mays*), Pioneer 3515 (Ridgetown), Pioneer 3905 (London)
PEST: *Fusarium spp., Alternaria spp., Trichoderma spp. , Penicillium spp.*

NAME AND AGENCY:
SCHAAFSMA A W AND HOOKER D
Ridgetown College, University of Guelph, Ridgetown, Ontario, N0P 2C0
Tel: (519) 674-1624 Fax: (519) 674-1600 Email: aschaafs@wincom.net

TITLE: CORN - DISEASE SEED TREATMENTS - NO-TILL ADVERSE CONDITIONS

MATERIALS: MAXIM (fludioxinil, 480 g/L); APRON XL (mefenoxam, 369 g/L); APRON FL (metalaxyl-m, 317 g/L); CAPTAN (captan 400 g ai./kg); MAXIM 480 FS (fludioxonil, 480 g ai./L); MAXIM XL 324 FS (fludioxonil & metalaxyl, 324 g ai./L).

METHODS: Seed was treated in 1 kg lots in individual plastic bags by applying a slurry of the material via a syringe to each bag. The seed was then mixed for 1 minute to ensure thorough seed coverage. The crop was planted on May 15, 1998 in Ridgetown and on May 13 in London using a 4-row no-till planter at 16 seeds/m. Plots were 4 rows planted at a row spacing of 0.76 m and 10m in length placed in a randomized complete block design with 4 replications. The plots were fertilized and maintained according to provincial recommendations. Total plot emergence was evaluated on June 4, 1998 for both locations. Four plants were collected from each of the control plots at both locations for evaluation of diseases. These plants were collected at Ridgetown on June 17, 1998 and the plants were between the 8th and 9th leaf stage. In London the plants were collected on July 8, 1998 and the plants were between the 13th and 14th leaf stage.

RESULTS: Results are presented in Tables 1 and 2. Frequency of fungi isolated from 4 seedlings in each of the check plots at Ridgetown: *Alternaria* spp.- 0 %, *Trichoderma* spp.- 1.3 %, *Penicillium* spp. - 3.8 %, *Fusarium.graminearum* - 0 %, *F. solani* - 2.5 %. Frequency of fungi isolated from 4 seedlings in each of the check plots at London: *Alternaria* spp.-15 %, *Trichoderma* spp. - 8.8 %, *Penicillium* spp.- 10.0 %, *F.graminearum* -2.50 %, *F. solani* - 0 %.

CONCLUSIONS: MAXIM plus APRON significantly improved emergence at the Ridgetown site and numerically improved yield. A similar trend occurred at the London site, however it was not significant. MAXIM plus APRON may have potential as an effective replacement for CAPTAN seed treatments.

Table 1: Effect of fungicide seed treatments on no-till corn, Ridgetown, Ontario in 1998.

Treatments	Rate (ml or g/kg seed)	% Emergence	Yield T/ha	% Moisture
Untreated		91.7	10.1	16.8
MAXIM+APRON XL	0.025 + 0.01	93.6	11.2	16.6
MAXIM XL	0.025 + 0.01	93.1	10.6	15.8
MAXIM	0.025	97.1	10.6	15.8
CAPTAN	0.6	94.9	10.1	16.5
CAPTAN+APRON	0.6 + 0.02	95.5	9.9	16.5
LSD (P=.05)		4.5	1.2	1.3
CV		3.2	8	5.2

Table 2: Effect of fungicide seed treatments on no-till corn, London, Ontario in 1998.

Treatments	Rate (ml or g/kg seed)	% Emergence	Yield T/ha	% Moisture
Untreated		93.5	8.7	19.1
MAXIM+APRON XL	0.025 + 0.01	94.2	9.3	18.8
MAXIM XL	0.025 + 0.01	94.1	8.5	18.8
MAXIM	0.025	95	8.5	18.6
CAPTAN	0.6	92.4	8.6	19.4
CAPTAN+APRON	0.6 + 0.02	94.6	8.4	18.9
LSD (P=.05)		3.6	1.2	0.7
CV		2.6	9.1	2.5

1998 PMR REPORT # 120 **SECTION L: CEREAL, FORAGE CROPS AND OILSEEDS**
ICAR: 61006537

CROP: Field Corn, *Zea mays*
PEST: Corn disease and insect

NAME AND AGENCY:
SCHAAFSMA A W, HOOKER D C, and SURGEONER G
Ridgetown College, University of Guelph
Ridgetown, Ontario N0P 2C0
Tel: (519)674-1624; Fax (519)674-1600; Email: aschaafs@ridgetownc.uoguelph.ca

TITLE: ON-FARM SEED TREATMENT RESPONSE IN CORN AS AFFECTED BY TILLAGE AND SOIL TYPE ACROSS SOUTHWESTERN ONTARIO

MATERIALS: Seed treatments: MAXIM 480FS (Fludioxonil) at 0.052 mL kg^{-1} of seed with and without LINDANE 25 at 2.5 g kg^{-1} of seed, CAPTAN 30 at 1.6 mL kg^{-1} of seed, with and without LINDANE (same respective rate), and a check with no seed treatment. The seed variety for the Guelph, London, and Ridgetown areas was Pioneer 3905, Pioneer 37M81, and Pioneer 3515, respectively.

METHODS: On-farm experiments were initiated in the Spring of 1998 among three maturity regions in southwestern Ontario: Ridgetown, London, and Guelph. Fields intended for corn were selected across three soil types (coarse-, medium-, and fine-textured) and three tillage regimes (conventional, minimum, and no-till), for a total of up to 9 tillage-soil type combinations per region. Most of the fields selected had been in a corn-soybean-wheat rotation for at least one cycle, and under the same tillage regime for at least three years. Some fields with specific tillage-soil type combinations were not found in some regions, while some combination of treatments were replicated at other fields. In total, 37 fields were selected, and various seed treatments were imposed.

Five seed treatments were acquired for the project prior to seeding. They were selected based on the recommendations provided by the chemical manufacturers, that the treatments are effective in the control of prevalent disease and/or insect pests. Each chemical treatment was applied to the seed with a small-scale commercial seed treater approximately 1 to 2 wk prior to planting. All seed of the same variety allotted to one treatment was treated before the application of the next treatment. Uniform coverage was achieved with a bristle auger attachment on the treater.

On each field, the seed treatments were replicated three times in a RCBD, for a total of 15 plots per field. Most plots were planted the length of the field in strips by the co-operators with their own planting equipment. Measurements included: the date of seedling emergence, early plant population, plant heights 6 wk after planting where height differences were visible, precipitation, residue cover, maturity dates and grain yield. Any diseases or insect pests were documented. Grain was harvested for yield with field-scale harvesting equipment, and measured with a combine-equipped monitor or weigh wagon.

RESULTS: Corn was planted in ideal seedbeds at all sites. Seedlings rapidly emerged and early growth was rapid under almost ideal conditions. No visible differences were detected among the treatments at almost all sites from emergence through to silking. A height difference was suspected at two sites; however height differences were not significant ($P > 0.10$) following intensive measurement of 200 plants

per treatment.

In general, seed treatments did not affect corn yield when analyzed across all sites (Table 1). There was no response to either MAXIM or CAPTAN when used alone regardless of tillage system. The addition of the insecticide LINDANE did increase corn yields in no-till systems by an average of 0.15 t ha^{-1}, however this beneficial response occurred only on two sites (Table 2). In fact, on two other no-till sites, the addition of LINDANE to either MAXIM or CAPTAN significantly reduced corn yields compared to the fungicide treatments alone.

CONCLUSIONS: Overall there was no response to seed treatments when data was averaged across all sites in 1998; the yield response was more site-specific. The lack of response was expected due to the combination of ideal conditions for crop growth and dry weather throughout the growing season across most of Ontario. Responses may have been different with cool and wet conditions that reduce plant growth and at the same time conditions that favour insect and disease populations. Adverse conditions are more typical of no-till than that experienced in 1998.

Table 1. Mean corn yield response to various seed treatments as affected by tillage system.

	Seed Treatment						Contrasts[2]		
Tillage System	Maxim	Maxim + Lindane	Captan	Captan + Lindane	none	n[1]	Maxim vs Captan	Lindane vs Fung only	no tmt vs treated
	---------- Yield (t ha^{-1}) ----------								
Conventional	12.15	12.04	12.07	11.75	12.1	11	ns	ns	ns
Minimum	10.54	10.41	10.39	10.44	10.37	36	ns	ns	ns
No-till	11.07	11.3	11.14	11.2	11.21	27	ns	0.07	ns
mean	11.25	11.25	11.2	11.13	11.23	74	ns	ns	ns

[1]Number of observations per mean

[2]ns = not significant at the 10% level of probability

Table 2. Mean corn yield response to seed treatment at individual field sites across Southwestern Ontario in 1998.

			Seed Treatment					Contrasts[1]		
Site	Soil Type	Tillage System	Maxim	Maxim + Lindane	Captan	Captan + Lindane	none	Maxim vs Captan	Lindane vs Fung only	no tmt vs treated
			---------- Yield (t ha^{-1}) ----------							
1	sand	minimum	5.75	5.85	6.51	6.36	6.51	0.03	ns	ns
2	sand	no-till	11.21	11.14	11.15	11.24	11.37	ns	ns	ns
3	sand	no-till	11.43	11.37	11.64	11.48	11.45	ns	ns	ns
4	clay	minimum	11.13	11.09	11.28	11.3	11.15	ns	ns	ns
6	clay	no-till	11.28	10.88	11.05	10.84	10.92	ns	0.03	ns
7	sand	minimum	8.54	8.15	8.34	8.29	8.27	ns	ns	ns
8	loam	minimum	10.03	10.37	10.17	10.19	10.5	ns	ns	ns
9	loam	minimum	12.5	12.06	12.59	12.19	12.24	ns	0.05	ns
10	loam	no-till	10.37	10.48	10.4	10.05	10.33	ns	ns	ns
11	clay	minimum	12.72	12.67	12.53	12.67	12.53	ns	ns	ns
12	loam	minimum	11.35	11.48	10.6	11.45	10.9	0.1	ns	ns
13	loam	minimum	11.74	11.86	11.52	11.32	11.41	0.1	ns	ns
14	loam	no-till	8.74	10.16	9.3	10.72	9.26	0.06	<0.001	ns
15	loam	minimum	11.52	10.39	10.64	11.49	10.65	ns	ns	ns
16	clay	no-till	11.01	11.52	11.68	11.07	12.24	ns	ns	0.06
17	loam	no-till	10.4	10.91	10.61	11.03	10.47	ns	ns	ns
18	clay	no-till	12.05	11.75	11.29	11.56	11.62	ns	ns	ns
19	loam	convention	10.78	10.49	10.81	10.82	10.16	ns	ns	0.01
20	clay	convention	10.99	11.06	10.92	10.35	11.32	ns	ns	ns
21	clay	minimum	9.97	10.09	9.89	9.43	9.71	0.09	ns	ns
22	loam	no-till	13.14	13.45	13.09	13.56	13.3	ns	0.09	ns
23	clay	convention	14.15	13.53	14.19	13.61	14.57	ns	ns	ns
24	loam	convention	13.35	13.59	13.05	12.84	13.19	0.05	ns	ns
25	loam	minimum	12.67	12.49	12.42	12.32	12.2	ns	ns	ns
26	loam	minimum	8.5	8.38	8.14	8.6	8.4	ns	ns	ns

[1]ns= not significant at the 10% level of probability

1998 PMR REPORT # 121

SECTION L:CEREALS, FORAGE CROPS and OILSEEDS Diseases
ICAR: 61006537

CROP: Soybeans (*Glycine max*), cv. Columbus, PI Line # 442031
PEST: Rhizoctonia root rot, *Rhizoctonia solani*

NAME AND AGENCY:
SCHAAFSMA A W
Ridgetown College, University of Guelph, Ridgetown, Ontario, N0P 2C0
Tel: (519) 674-1624 Fax: (519) 674-1600 Email: aschaafs@wincom.net

TITLE: CONTROL OF RHIZOCTONIA ROOT ROT WITH SEED TREATMENTS IN SOYBEANS

MATERIALS: VITAFLO (thiram + carbathiin, 148 + 167 g ai./L); APRON (metalaxyl-m, 317 g ai./L); APRON XL (mefenoxam, 369 g ai./L); APRON MAXX (fludioxinil + metalaxyl-m, 96.5 + 144 g/l); MAXIM (fludioxinil, 480 g ai./L); PROSEED (hexaconazole, 12.5 g/L)

METHODS: Seed was treated in 1 kg lots in individual plastic bags by applying a slurry of the material via a syringe to each bag. The seed was then mixed for 1 minute to ensure thorough seed coverage. The crop was planted on June 30, 1998 at Ridgetown, Ontario using a 2-row cone seeder at 55 seeds per plot. Plots were comprised of 1 row planted at a row spacing of 0.76 m and 2 m in length placed in a randomized complete block design with 4 replications. The plots were inoculated with *Rhizoctonia* either in the furrow at planting or at the plant base at the first true leaf stage. For the first method, 40g of dry oat inoculum was applied as the seed was planted. The plots were then misted to activate the *Rhizoctonia* the same day as planting. In the second method, 2 ml of inoculum was applied to all the plants in each plot using a syringe. The inoculum was prepared by soaking 1000 g of hulless oats in 20 % V8 juice for 1-2 hr in a wide mouth flask, removing excess liquid and autoclaving for 30 min. The flasks were allowed to sit for 3 days and autoclaved again. Previously inoculated PDA was cut into small squares and 6-8 were placed on the oat medium, incubated at RT for 2 weeks, and shaken every 2 days. Soduim alginate was added to 300 gm of inoculum to make a 1.6 % suspension for plant inoculation. The plots were misted for 7 days after inoculation. The plots were fertilized and maintained according to provincial recommendations. Emergence was evaluated on July 9, 1998. Rhizoctonia root rot was evaluated at the 5-6 leaf stage using a root rot rating scale from 1-7 (where 1 = no lesions on hypocotyl and 7 = hypocotyl girdled by severe lesions and plant is dead) from a 52-cm length of row in the centre of each plot.

RESULTS: Results are presented in Tables 1 and 2.

CONCLUSIONS: Seed rot or damping off due to *Rhizoctonia* was not protected against at the infection level presented in this trial with any of the seed treatments (Table 1). Significantly higher emergence without *Rhizoctonia* inoculum between seeding and emergence (therefore other organisms in the soil or on the seed were likely present) was obtained with APRON XL (Table 2). Only when a resistant soybean variety was used in combination with MAXIM plus Apron XL, was there a significant reduction in rhizoctonia root rot ratings (Table 2).

Table 1. Inoculum applied in furrow at planting, emergence protection at Ridgetown, Ontario in 1998.

Treatment	Rate (ml/kg Seed)	Emergence	Ratings (1 - 7)
Check		28.8 a	6.5 a
VITAFLO	2.6	34.3 a	6.7 a
VITAFLO & APRON	2.6 & .063	36.3 a	6.2 a
MAXIM	0.052	38.5 a	6.2 a
APRON XL	0.1	32.0 a	6.6 a
MAXIM & APRON XL	0.052 & 0.1	33.5 a	6.2 a
MAXIM & APRON XL	0.104 & 0.2	32.0 a	6.6 a
APRON MAXX	0.26	38.3 a	6.1 a
APRON MAXX	0.52	35.3 a	6.1 a
PROSEED	4	30.8 a	6.1 a
PI 442031 - resistant Untreated		32.8 a	6.6 a
PI 442031 - resistant MAXIM & APRON XL	0.052 & 0.1	30.3 a	6.7 a
LSD (P=.05)		11.2	0.7
CV		23.2	7.7

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

Table 2. Inoculum treatments applied to plant base at 1st leaf at Ridgetown, Ontario in 1998.

Treatment	Rate (ml/kg seed)	Emergence # / 2	Ratings (1 - 8)
Check		43.8 bc	6.0 abc
VITAFLO	2.6	45.0 bc	6.0 abc
VITAFLO & APRON	2.6 & .063	50.8 ab	5.9 abc
MAXIM	0.052	47.8 abc	6.1 ab
APRON XL	0.19	52.8 a	5.6 bc
MAXIM & APRON XL	0.052 & 0.1	42.0 cd	6.3 ab
MAXIM & APRON XL	0.104 & 0.2	47.3 abc	6.4 ab
APRON MAXX	0.26	44.5 bc	5.8 abc
APRON MAXX	0.52	44.3 b	5.8 abc
PROSEED	4	34.8 d	6.6 a
PI....resistant Untreated		47.5 abc	5.8 abc
PI....resistant MAXIM & APRON XL	0.052 & 0.1	45.3 abc	5.3 c
LSD		7.6	0.8
CV		11.5	9.2

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

1998 PMR REPORT # 122

SECTION L: CEREALS, FORAGE CROPS and OILSEEDS Diseases
ICAR: 61006537

CROP: Soybeans (*Glycine max*), cv. RCAT Columbus; WestAg 97; RCAT Bobcat
PEST: Soybean emergence diseases

NAME AND AGENCY:
SCHAAFSMA A W AND HOOKER D
Ridgetown College, University of Guelph, Ridgetown, Ontario, N0P 2C0
Tel: (519) 674-1624 Fax: (519) 674-1600 Email: aschaafs@wincom.net

TITLE: SOYBEANS - DISEASE SEED TREATMENTS IN NO-TILL

MATERIALS: VITAFLO (thiram + carbathiin, 148 + 167 g/L); APRON (metalaxyl-m, 317 g/L); APRON XL (mefenoxam, 369 g/L); APRON MAXX (fludioxinil + metalaxyl-m, APRON FL (metalaxyl-m, 317 g/L); MAXIM (fludioxinil; 480 g/L); PROSEED (hexaconazole, 12.5 g/L): BAYTAN GRANULAR (planted in 2 locations with an early and late planting at each location. The early crop was planted on May 7, 1998 at Ridgetown and on May 13, 1998 at London. The late planting took place on May 25, 1998 in Ridgetown and on June 4, 1998 in London. All the plantings were done using a 4 row no-till planter with Gustafson modified seeder units at 6-7 seeds per m. Plots were comprised of 4 rows planted at a row spacing of 0.76 m and 10 m in length placed in a randomized complete block design with 4 replications. Emergence was evaluated on May 19, 1998 for the early planting and on June 15, 1988 for the late planting on a 1 metre section of the plot at the Ridgetown site only. Plant vigour was also evaluated at this time at the Ridgetown site using a scale from 1 to 10 with 10 being the best rating and 1 the worst. Vigour was evaluated a second time at the Ridgetown location on June 4, 1998 for the early planting and on June 25, 1998 for the late planting. At this time all of the plants within a 1 metre section of the plot were also measured to calculate the average height for each plot. The total number of plants within this 1 metre section was also recorded at this time. At the London location, plot vigour and the average plant height within a 1 metre section of each plot were evaluated on June 4, 1998 for the early planting and on June 24, 1998 for the late planting. Again the total number of plants within the 1 metre evaluated was recorded.

RESULTS: The results are presented in the six tables below.

CONCLUSIONS: PROSEED was phytotoxic to soybeans. Early plantings of soybeans could benefit from seed treatments containing fludioxinil plus mefenoxam or metalaxyl-m. Late plantings did not benefit. BAYTAN treatments tended to decrease plant height significantly.

Table 1. Field data from Westag 97 Soybeans at Ridgetown - May 7 planting..

Treatments	Rate (g ai/kg seed)	Emerge. Counts (1 m)	Plant Vigor (1-10) May 19	Plant Vigor (1-10) June 4	Avg. Plant Height (cm)	Total Plants (1 m)	Yield (T/ha)
Untreated		17.8	6.8	5.5	4.1	19.8	2.2
PROSEED	0 .05	8.3	3.5	2.5	3.1	16.8	1.8
MAXIM+APRON XL	.025+.0375	21.3	7.5	7.5	4.2	21.3	2.3
MAXIM+APRON XL	.05+.075	18	7.5	5.5	4.2	25.3	2.5
APRON MAXX	.0375/.025	19.8	7	5.8	4.2	21.8	2.4
APRON MAXX	.075/.050	22	5.8	4.3	4.3	23.3	2.1
MAXIM	.025	17.5	7.5	4.3	4	17.3	2.1
APRON XL	.0375	12.3	7	4.8	4.4	19	2.3
VITAFLO	.82	16.5	7	5	4.5	19.5	2.4
VITAFLO + APRON	.82+.02	18	7.8	6	4.3	20	2.2
VITAFLO + BAYTAN	.82 + 0.0042	13.5	6	4.8	4.2	19.3	2.3
VITAFLO + BAYTAN	.82 + 0.0084	15.5	5.8	4	4.1	25.3	2.3
LSD (P=.05)		7.3	1.9	2.2	0.6	7	0.6
CV		30.2	19.5	30.2	10.1	23.4	18

Table 2. Field data from RCAT Columbus Soybeans at Ridgetown - May 7 planting.

Treatments	Rate (g ai/kg seed)	Emerg. Counts (1 m)	Plant Vigour (1-10)	Plant Vigour (1-10)	Avg. Plant Height (cm)	Total Plants (1 m)	Yield (T/ha)
Untreated		19.5	7	5.8	4.7	19.5	2.4
PROSEED	0 .05	6.8	2.3	2.8	2.9	18.3	1.9
MAXIM+APRON XL	.025+.0375	20.5	7.5	6	4.2	22.8	2.1
MAXIM+APRON XL	.05+.075	15.3	7	5.8	4.5	20.3	2.7
APRON MAXX	.0375/.025	20	7	5.3	4.4	21.8	2.5
APRON MAXX	.075/.050	21.3	7.5	6.8	4.3	18.8	2.7
MAXIM	.025	17.3	7.8	6	4.1	18.8	2.7
APRON XL	.0375	17.5	6.8	4.3	4.5	20	2.6
VITAFLO	.82	18.3	6.8	5.8	4.4	23.3	2.2
VITAFLO + APRON	.82+.02	18	8	5.8	4.8	18	2.5
VITAFLO + BAYTAN	.82 + 0.0042	18.5	6.8	4.8	4	21.5	2.5
VITAFLO + BAYTAN	.82 + 0.0084	13	7	4.5	4	21.8	2.6
LSD (P=.05)		6.7	1.9	2.2	0.6	6	0.5
CV		27	19.6	28.5	9.2	20.3	15

Table 3. Field data from Westag 97 Soybeans at Ridgetown - May 24 planting.

Treatments	Rate (g ai/kg seed)	Emerg Counts (1 m)	Plant Vigour (1-10)	Plant Vigour (1-10)	Avg. Plant Height (cm)	Total Plants (1 m)	Yield (T/ha)
Untreated		23.8	5.5	5.8	4.6	22.3	2.7
PROSEED	0.05	10	1.8	2.8	2	16.5	2.1
MAXIM+APRON XL	.025+.0375	22.8	6	6	4.4	20	2.9
MAXIM+APRON XL	.05+.075	18.5	4.8	5	4.6	19.5	2.7
APRON MAXX	.0375/.025	21	5.3	5.3	4.3	24.5	2.6
APRON MAXX	.075/.050	22.5	4.8	3.8	4	18.3	2.5
MAXIM	.025	20.5	5	5.5	4	22	2.6
APRON XL	.0375	13.5	4.3	3.3	3.8	16.5	2.3
VITAFLO	.82	16.8	4.3	4.3	4.2	21.8	2.6
VITAFLO + APRON	.82+.02	21.8	4.5	4.5	4.1	22.5	2.5
VITAFLO + BAYTAN	.82 + 0.0042	20.3	4.5	5	4.3	18.8	2.5
VITAFLO + BAYTAN	.82 + 0.0084	21.5	3.5	4.3	3.4	20.5	2.5
LSD (P=.05)		5.9	2.9	2.3	1.3	6.2	0.4
CV		20.9	44.5	34.5	22.8	21.3	10.1

Table 4. Field data from RCAT Bobcat at London - May 13 planting.

Treatments	Rate (g ai/kg seed)	Plant Vigour (1-10)	Avg. Plant Height (cm)	Total Plant Count (1 m)	Yield (T/ha)
Untreated		4.8	3	23	1.6
PROSEED	0 .05	2.5	2.1	17.8	1.6
MAXIM+APRON XL	.025+.0375	5.5	2.9	28.3	2
MAXIM+APRON XL	.05+.075	5.5	3	23.8	2
APRON MAXX	.0375/.025	6	3.3	25	2.2
APRON MAXX	.075/.050	4.5	3.2	24	2
MAXIM	.025	5	3.1	25.8	1.9
APRON XL	.0375	5.5	3.4	25.5	2.1
VITAFLO	.82	4.8	3	22.3	1.9
VITAFLO + APRON	.82+.02	5	3	23.8	2.1
VITAFLO + BAYTAN	.82 + 0.0042	4	2.9	25.3	2
VITAFLO + BAYTAN	.82 + 0.0084	3.3	2.3	23.5	1.6
LSD (P=.05)		1.6	0.5	5.2	1.3
CV		23.2	11.1	15.1	7

Table 5. Field data from Westag 97 Soybeans at London - June 4 planting.

Treatments	Rate (g ai/kg seed)	Plant Vigour (1-10)	Avg. Plant Height (cm)	Total Plant Count (1 m)	Yield (T/ha)
Untreated		6.5	3.1	25.8	2.2
PROSEED	0 .05	2	1.9	18.5	2
MAXIM+APRON XL	.025+.0375	5.5	3.38	27.8	2.3
MAXIM+APRON XL	.05+.075	5.3	3.3	27	2
APRON MAXX	.0375/.025	6	2.95	22.5	2
APRON MAXX	.075/.050	6.8	3.45	26.8	2.7
MAXIM	.025	7	3.25	27.3	2.5
APRON XL	.0375	7	3.27	27.8	2.6
VITAFLO	.82	5	3.13	22	2.3
VITAFLO + APRON	.82+.02	4.8	3.35	24	2
VITAFLO + BAYTAN	.82 + 0.0042	5.8	2.85	21.5	2.5
VITAFLO + BAYTAN	.82 + 0.0084	4	2.8	22.8	2.1
LSD (P=.05)		1.8	0.3	5.4	0.6
CV		22.4	7.4	15.2	17.1

Table 6. Field data from RCAT Bobcat Soybeans at London - June 4 planting.

Treatments	Rate (g ai/kg seed)	Plant Vigour (1-10)	Avg. Plant Height (cm)	Total Plants (1 m)	Yield (T/ha)
Untreated		8.5	3.8	30.8	1.6
PROSEED	0 .05	6	2.2	21.3	1.4
MAXIM+APRON XL	.025+.0375	9	3.6	28.8	1.6
MAXIM+APRON XL	.05+.075	8.5	3.6	25	1.8
APRON MAXX	.0375/.025	8.5	3.6	27.5	1.8
APRON MAXX	.075/.050	8.5	3.5	27.3	1.5
MAXIM	.025	8.8	3.7	26.3	1.5
APRON XL	.0375	7.5	3.4	28.5	1.5
VITAFLO	.82	7.5	3.2	24.3	1.5
VITAFLO + APRON	.82+.02	8.3	3.4	25.8	1.7
VITAFLO + BAYTAN	.82 + 0.0042	7.5	2.9	26.5	1.5
VITAFLO + BAYTAN	.82 + 0.0084	8.5	3.2	27.8	1.7
LSD (P=.05)		1.8	0.6	5.7	0.3
CV		15.8	12.3	14.7	13.9

1998 PMR REPORT # 123

SECTION L:CEREALS, FORAGE CROPS and OILSEEDS Diseases
ICAR: 61006537

CROP: Soybean, *Glycine max*
PEST: Soybean disease and insect

NAME AND AGENCY:
SCHAAFSMA A W, HOOKER D C, and SURGEONER G
Ridgetown College, University of Guelph
Ridgetown, Ontario N0P 2C0
Tel: (519)674-1624; Fax (519)674-1600; Email: aschaafs@ridgetownc.uoguelph.ca

TITLE: ON-FARM SEED TREATMENT RESPONSE IN SOYBEAN AS AFFECTED BY TILLAGE AND SOIL TYPE ACROSS SOUTHWESTERN ONTARIO

MATERIALS: The seed treatments were: 1) VITAFLO 280 at 3.30 mL kg^{-1} seed, VITAFLO 280 (same rate) plus APRON FL (Metalaxyl) at 0.063 mL kg^{-1} of seed, VITAFLO 280 plus APRON FL (same rates, respectively) plus LINDANE 25 at 1.25 g kg^{-1} of seed, and a check with no seed treatment.

METHODS: On-farm experiments were initiated in the Spring of 1998 among three maturity regions in southwestern Ontario: Ridgetown, London, and Guelph. Fields intended for soybean were selected across three soil types (coarse-, medium-, and fine-textured) and three tillage regimes (conventional, minimum, and no-till), for a total of up to 9 tillage-soil type combinations per region. Most of the fields selected had been in a corn-soybean-wheat rotation for at least one cycle, and under the same tillage regime for at least three years. Some fields with specific tillage-soil type combinations were not found in some regions, while some combination of treatments were replicated at other fields. In total, 28 fields were selected, and various seed treatments were imposed.

Four seed treatments were acquired for the project prior to seeding. They were selected based on the recommendations provided by the chemical manufacturers, that the treatments are effective in the control of prevalent disease and/or insect pests. Each chemical treatment was applied to the seed with a small-scale Gustafson "On-Farm Treater" that was modified with a longer auger and bristle flighting to achieve uniform chemical coverage of the seed. All treatments were completed approximately 1 to 2 wk prior to planting. All seed of the same variety allotted to one treatment was treated before the application of the next treatment. Uniform coverage was achieved with a bristle auger attachment on the treater.

The seed variety for the Guelph area was First Line "Korada", and for the London and Ridgetown areas either NK 2020 or NK S14-H4. On each field, seed treatments were replicated three times in a field in strips by the co-operators with their own planting equipment. Measurements included: the date of seedling emergence, early plant population, precipitation, residue cover, maturity dates and grain yield. Any diseases or insect pests were documented. Grain was harvested for yield with field-scale harvesting equipment, and measured with a combine-equipped monitor or weigh wagon.

RESULTS: Soybean was planted in ideal seedbeds at most sites. Dry weather shortly after planting caused poor or delayed germination and emergence at a few sites, but in general yields were not affected. Those seedlings that did germinate rapidly emerged, and early growth was good under dry growth

conditions. No visible differences were detected among the treatments at almost all sites from emergence through to flowering.

In general, seed treatments did not increase soybean yields on most sites. The addition of a seed treatment only increased soybean yield on one site, but reduced yield on another when yields were compared in all treated plots vs untreated check. Significant yield response to the addition of APRON to VITAFLO was site-specific. On some sites, APRON increased yield while on others yields were lower. There were no tillage or soil type trends in the data.

CONCLUSIONS: Most soybean sites did not respond to seed treatments in 1998. This was generally expected this year since disease and insect pressure was low and crop growth rates were high. Results may be different in years that favour disease and insect populations.

Table 1. Mean soybean yield response to seed treatment at individual field sites across Southwestern Ontario in 1998.

			Seed Treatment				Contrasts[1]		
Site	Soil Type	Tillage System	Vitaflo	Vitaflo + Apron	Vitaflo + Apron + Lindane	none	Vitaflo vs Vitaflo + Apron	All Vitaflo vs Lindane	no tmt vs treated
			---------- Yield (t ha^{-1}) ----------						
27	clay	no-till	3.11	2.98	2.94	2.87	ns	ns	ns
28	loam	conventional	3.04	3.25	3.01	3.66	ns	ns	ns
29	clay	no-till	1.07	1.23	1.42	1.18	ns	0.06	ns
30	loam	no-till	2.46	2.61	2.5	2.5	ns	ns	ns
31	loam	minimum	3.84	3.81	3.67	3.98	ns	ns	ns
32	clay	conventional	4.51	4.21	4.69	4.41	ns	ns	ns
33	loam	no-till	3.47	3.55	3.6	3.44	ns	ns	ns
34	loam	conventional	2.07	2.32	2.21	2.33	ns	ns	ns
35	loam	no-till	3.33	3.48	3.47	3.38	0.03	ns	ns
36	loam	conventional	4.33	4.2	4.18	4.37	ns	ns	ns
37	loam	no-till	1.54	1.46	1.52	1.55	0.009	ns	0.05
38	loam	no-till	4.3	4	4.1	3.99	0.01	ns	0.08
39	clay	no-till	2.88	2.96	2.84	2.79	ns	ns	ns
40	loam	no-till	3.11	2.88	2.92	2.99	ns	ns	ns
41	loam	no-till	3.03	2.73	2.86	3.03	ns	ns	ns
42	clay	no-till	3.32	3.39	3.39	3.62	ns	ns	ns
44	clay	conventional	2.79	3.03	3.3	2.84	ns	ns	ns

[1]ns= not significant at the 10% level of probability

1998 PMR REPORT # 124 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS Diseases

CROP: Winter wheat, cv. Kestrel
PEST: Dwarf bunt, *Tilletia controversa* Kühn

NAME AND AGENCY:
JESPERSON G D, LASHUK L and HEDGES B
BC Ministry of Agriculture and Food
200-1690 Powick Road, Kelowna, British Columbia V1X 7G5
Tel: (250) 861-7211 Fax: (250) 861-7490 E-mail: Gayle.Jesperson@gems1.gov.bc.ca

TITLE: EFFECT OF SEED TREATMENTS ON CONTROL OF SOIL-BORNE DWARF BUNT OF WINTER WHEAT, 1997/98

MATERIALS: DIVIDEND 3FS (difenoconazole 360 g/L), DIVIDEND RTA (difenoconazole 3.21% + metalaxyl 0.27%), BAYTAN 30 (triadimenol 317 g/L), VITAVAX SINGLE (carbathiin 230 g/L) GUSTAFSON LSP (thiabendazole 317 g/L).

METHODS: DIVIDEND and DIVIDEND RTA seed treatments were applied with a Hege II seed treater by Novartis Crop Protection on September 19, 1997. The remaining treatments were applied in a glass jar on October 3, 1997. Plots were seeded using a one-row cone seeder on Oct. 6, 1997 at Armstrong BC in soil naturally infested with dwarf bunt. The trial consisted of 8 treatments, replicated four times in a randomized complete block design. Each plot consisted of 2 rows, 6 m long, and 23 cm apart. Plots were separated by 46 cm. Each row was seeded with 18 g of seed. Emergence was assessed on October 23, 1997 by counting the number of plants emerged along a randomly selected, one metre length of row per plot. A three metre section from the middle of each plot was harvested on July 28, 1998 using a 2-row binder. Percent bunt infection was determined by counting the number of healthy and bunted wheat spikes per plot.

RESULTS: Mean percent bunt infection and emergence are summarized in Table 1. There were no significant differences in emergence between treatments.

CONCLUSIONS: DIVIDEND 3FS, DIVIDEND RTA, DIVIDEND RTA+GUSTAFSON LSP, and GUSTAFSON LSP at the high rate provided significant control of soil-borne dwarf bunt compared to the check. DIVIDEND treatments provided significantly better control than GUSTAFSON LSP at the low rate, BAYTAN and VITAVAX SINGLE. BAYTAN-treated plots had a significantly higher level of dwarf bunt than the control. DIVIDEND, either the 3FS or RTA forumulation, was the only treatment providing a commercially acceptable level of control.

Table 1. Percent dwarf bunt infection and emergence counts, by treatment.

Treatment	Rate (g a.i./kg seed)	Emergence (plants/m)	% Spikes with Bunt
Control	-	73 a*	26.4 bc*
BAYTAN	0.3	62 a	43.3 a
VITAVAX SINGLE	0.69	62 a	39.3 ab
GUSTAFSON LSP	1.5	63 a	15.8 cd
GUSTAFSON LSP	3.0	63 a	8.7 de
DIVIDEND 3FS	0.12	60 a	0.0 e
DIVIDEND RTA	0.12 + 0.01	64 a	0.1 e
DIVIDEND RTA + GUSTAFSON LSP	0.12 + 0.01 + 1.5	68 a	0.1 e

* Numbers followed by the same letter are not significantly different according to Tukey's Honestly Significant Difference Test (P=0.05)

1998 PMR REPORT # 125 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS Diseases
STUDY DATA BASE: 303-1212-9604

CROP: Wheat, cv.Belvedere
PEST: Septoria leaf blotch, *Septoria nodorum*

NAME and AGENCY:
MARTIN R A, and MATTERS R
Agriculture and Agri-Food Canada, Research Centre, P.O. Box 1210, Charlottetown, PEI C1A 7M8 **Tel:** (902) 566-6851, **Fax:**(902) 566-6821, **Internet:** MARTINRA@EM.AGR.CA

TITLE: INFLUENCE OF FUNGICIDE SEED TREATMENT AND FOLIAR SPRAY ON DISEASE AND YIELD IN WHEAT, 1998

MATERIALS: DIVIDEND XL RTA(difenoconazole, 3.21% plus mefenoxam 0.27%), VITAFLO 280 (carbathiin 14.9%, thiram 13.2%), NOA9525 (250EC), TILT (propiconazole, 125 g/L)

METHODS: Certified wheat seed, cv. Belvedere, was treated with the fungicides listed above at the rates listed in the table, in a small batch seed treater. Wheat plots were established on May 11, 1998, at a seeding rate of 350 viable seeds per m^2. Each plot was ten rows wide and five metres long, 17.8 cm between rows. Treatments were replicated four times in a randomized complete block design, Each barley plot was separated by an equal sized wheat plot. Plots received a herbicide application of MCPA (1L/ha) plus Refine Extra (20g/ha) at Zadok's Growth Stage 32. Tilt was applied to the plots using a tractor mounted small plot sprayer at Zadok's Growth Stages 37 and/or 55.

At Zadok's Growth Stage (ZGS) 82 septoria leaf blotch, rust and powdery mildew were assessed on the penultimate leaf of 10 randomly selected tillers per plot using the Horsfall & Barratt Rating System. Yield and thousand kernel weight were determined from the harvest of nine rows, using a small plot combine.

RESULTS: Disease severity was very low for both rust and powdery mildew (less than 2%) and no differences were observed in the plots. In this study the application of seed treatments in the absence of a later foliar fungicide application had little significant effect on either disease control or yield. In one case DIVIDEND did result in a significant yield increase for a 0.26 g ai/kg seed application rate. TILT was effective in disease control and providing a yield benefit, particularly when applied in conjunction with a seed treatment.

CONCLUSIONS: Conditions in 1998 were not conducive to the development of a severe septoria leaf blotch epidemic. Since single applications of TILT, in the absence of seed treatment had no effect on yield, it would appear that the application of DIVIDEND or VITAFLO 280 did have a positive effect on production when in combination with the foliar spray.

Table 1. Efficacy of fungicide seed treatments and foliar spray in wheat, Charlottetown, PEI, 1998.

Treatment	Rate gai/kg seed	gai/ha	ZGS*	Septoria leaf blotch (%) 2nd leaf Aug 4	Yield (kg/ha)	1000 Kwt (g)
Untreated control				8.7	3763	36.1
DIVIDEND XL	0.13			7.7	3849	35.2
DIVIDEND XL	0.26			5.6	4102	36.2
DIVIDEND XL	0.13					
plus TILT		125	37	4.4	4024	37.1
DIVIDEND XL	0.26					
plus TILT		125	37	5.9	4187	36.4
DIVIDEND XL	0.13					
plus TILT		125	55	3.4	4156	37.1
DIVIDEND XL	0.26					
plus TILT		125	55	2.5	4322	37.3
DIVIDEND XL	0.13					
plus TILT		125	37			
plus TILT		125	55	2.3	4242	36.8
DIVIDEND XL	0.26					
plus TILT		125	37			
plus TILT		125	55	4.2	4042	36.5
TILT		125	37	4.7	3985	36.2
TILT		125	55	3.1	3995	37.4
TILT		125	37			
plus TILT		125	55	2.6	4131	36.6
DIVIDEND XL	0.13					
plus NOA9525		125	55	4.3	4204	36.1
DIVIDEND XL	0.13					
plus NOA9525		125	37	3.4	4097	36.3
VITAFLO 280	0.92	125	37	7.4	3775	35.1
VITAFLO 280	0.92					
plus TILT		125	55	5.5	4255	36.8
VITAFLO 280	0.92					
plus TILT		125	37	3.2	4137	37.1
VITAFLO 280	0.92					
plus TILT		125	37			
plus TILT		125	55	3.0	4348	37.7
SEM				1.147	109.6	0.572
LSD (0.05)				3.26	311.5	NS

* Zadok's Growth Stage when TILT application was made

** SEM = standard error of mean

*** NS = not significant at a 0.05 level of probability

1998 PMR REPORT # 126 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS diseases
STUDY DATA BASE: 303-1212-8907

CROP: Wheat, cv. Belvedere
PEST: Septoria leaf blotch, *Septoria nodorum*

NAME and AGENCY:
MARTIN R A, and MATTERS R
Agriculture and Agri-Food Canada, Research Centre, P.O. Box 1210
Charlottetown, PEI C1A 7M8
Tel: (902) 566-6851, **Fax:**(902) 566-6821, **Internet:** MARTINRA@EM.AGR.CA

TITLE: INFLUENCE OF FUNGICIDE FOLIAR SPRAYS ON DISEASE AND YIELD IN WHEAT, 1998

MATERIALS: TILT (propiconazole, 125 g/L), NOA9525 (250EC), NOA9360 (125EC), QUADRIS (azoxystrobin, 125 g/L), BRAVO (chlorothalanil, 500 g ai/kg)

METHODS: Wheat plots, cv. Belvedere, were established on May 11, 1998, at a seeding rate of 350 viable seeds per m^2. Each plot was ten rows wide and five metres long, 17.8 cm between rows. , Each wheat plot was separated by an equal sized barley plot. Plots received a herbicide application of MCPA (1L/ha) plus Refine Extra (20g/ha) at Zadok's Growth Stage 32. Treatments were applied at the rates indicated in the table and were applied to the plots using a tractor mounted small plot sprayer at Zadok's Growth Stages 37. Treatments were replicated four times in a randomized complete block design

At Zadok's Growth Stage (ZGS) 84 foliar septoria leaf blotch and rust were assessed on the penultimate or 3rd leaf of 10 randomly selected tillers per plot using the Horsfall & Barratt Rating System. Yield and thousand kernel weight were determined from the harvest of nine rows, using a small plot combine.

RESULTS: Disease pressure was very low in 1998 however each foliar spray did result in a significant reduction in disease, for both rust and septoria leaf blotch. There was no significant impact on yield from any treatment.

CONCLUSIONS: Conditions in 1998 were not conducive to the development of a severe septoria leaf blotch epidemic. There was significant disease control from each treatment however the disease pressure was very small. This was in part would contribute to the lack of a significant increase in yield as a result of disease control.

Table 1. Efficacy of fungicide foliar spray in wheat, Charlottetown, PEI, 1998.

Treatment	Rate gai/ha	ZGS*	Septoria leaf blotch (%) 2nd leaf Aug 4	Rust (%) 3rd leaf Aug 4	Yield (kg/ha)	1000 Kwt (g)
Untreated Control			15.2	2.0	3968	35.2
TILT	125	37	6.0	0.8	4267	37.3
NOA9360	125	37	7.7	0.8	3944	36.6
NOA9525	62.5/62.5	37	6.4	0.8	4141	36.1
NOA9525	125/125	37	3.9	0.8	4099	35.8
QUADRIS	200	37	2.6	0.8	4198	36.8
QUADRIS BRAVO 500F	200 1200	37	3.0	0.5	4273	37.1
BRAVO 500F	1200	37	7.1	1.0	4099	36.1
SEM**			2.15	0.19	160.3	0.45
LSD (0.05)			5.95	0.54	NS	NS

* Zadok's Growth Stage when applications were made

** SEM = standard error of mean

*** NS = not significant at a 0.05 level of probability

1998 PMR REPORT # 127 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS Diseases
STUDY DATA BASE: 303-1212-9604

CROP: Wheat, cv. Belvedere
PEST: Septoria leaf blotch, *Septoria nodorum*

NAME and AGENCY:
MARTIN R A, and MATTERS R
Agriculture and Agri-Food Canada, Research Centre, P.O. Box 1210, Charlottetown, PEI C1A 7M8
Tel: (902) 566-6851; **Fax:**(902) 566-6821; **Internet:** MARTINRA@EM.AGR.CA

TITLE: INFLUENCE OF FUNGICIDE FOLIAR AZOXYSTROBIN ON DISEASE AND YIELD IN WHEAT, 1998

MATERIALS: QUADRIS (azoxystrobin 250SC), TILT (propiconazole, 125 g/L).

METHODS: Wheat plots, cv. Belvedere, were established on May 11, 1998, at a seeding rate of 350 viable seeds per m^2. Each plot was ten rows wide and five metres long, 17.8 cm between rows. , Each wheat plot was separated by an equal sized barley plot. Plots received a herbicide application of MCPA (1L/ha) plus Refine Extra (20g/ha) at Zadok's Growth Stage 32. Treatments were applied at the rates indicated in the table and were applied to the plots using a tractor mounted small plot sprayer at Zadok's Growth Stages 36, 47 or 55, depending on treatment protocal. Treatments were replicated four times in a randomized complete block design.

At Zadok's Growth Stage (ZGS) 84 foliar septoria leaf blotch was assessed on the penultimate leaf of 10 randomly selected tillers per plot using the Horsfall & Barratt Rating System. Yield and thousand kernel weight were determined from the harvest of nine rows, using a small plot combine.

RESULTS: Disease pressure was very low in 1998 however each foliar spray did result in a significant reduction in foliar disease severity. There was no significant impact on yield or thousand kernel weight from any treatment. While rated the data on rust and powdery mildew is not presented as there was only very low levels of either disease (less than 1%) and no effect from treatment.

CONCLUSIONS: Conditions in 1998 were not conducive to the development of a severe septoria leaf blotch epidemic. However even though there was not high disease pressure treatment with QUADRIS did result in some increase in yield. There was variability however QUADRIS at 175 g ai/ha applied at ZGS 55 did result in a yield increase of 13%. QUADRIS would appear to have potential as a foliar spray in wheat however more evaluation would appear to be warranted, particularly in conditions of higher disease pressure.

Table 1. Efficacy of azoxystrobin fungicide foliar spray in wheat, Charlottetown, PEI, 1998.

Treatment	Rate (gai/ha)	ZGS*	Septoria leaf blotch (%) 2nd leaf Aug 4	Yield (kg/ha)	1000 Kwt (g)
Untreated Control			6.4	3814	34.97
QUADRIS	75	36	3.0	4272	35.75
QUADRIS	125	36	3.5	4082	36.19
QUADRIS	175	36	2.9	4238	35.75
QUADRIS	75	47	2.3	4122	36.13
QUADRIS	125	47	3.7	3915	35.62
QUADRIS	175	47	2.6	4176	36.79
QUADRIS	75	55	3.1	3984	36.50
QUADRIS	125	55	2.6	4131	35.87
QUADRIS	175	55	2.3	4322	36.69
QUADRIS	75+75	36+55	2.5	4309	36.67
TILT	125	36	4.2	4231	35.63
TILT	125	55	2.9	4072	36.18
TILT	125	47	2.8	3919	35.69
SEM			0.590	108.0	0.461
LSD (0.05)			1.7	309	NS

* ZGS = Zadok's Growth Stage when applications were made

** SEM = standard error of mean

*** NS = not significant at a 0.05 level of probability

1998 PMR REPORT# 128 SECTION L: CEREALS, FORAGE CROPS/ OILSEEDS Disease

CROP: Winter wheat (*Triticum aestivum* L.), cv. Harus
PEST: Fusarium head blight**,** *Fusarium graminearum* Schwabe

NAME AND AGENCY:
SCHAAFSMA A W, TAMBURIC-ILINCIC L, and CRUTCHLEY M.C.
Ridgetown College, University of Guelph, Ridgetown, Ontario NOP 2CO
Tel: (519) 674-1624; **Fax:** (519) 674-1600; **Email:** aschaafs@ridgetownc.uoguelph.ca

TITLE: FUSARIUM HEAD BLIGHT CONTROL IN WINTER WHEAT BY FOLICUR 3.6 F APPLIED WITH DIFFERENT APPLICATION TECHNOLOGIES IN ARTIFICIALLY INOCULATED, MISTED PLOTS

MATERIALS: FOLICUR 3.6 F(431 g ai/L tebuconazole)

METHODS: Winter wheat (Harus) was planted on October 20, 1997 at Ridgetown using a 6-row cone seeder at 400 seeds/m^2. Plots were six rows planted 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 provincial recommendations. FOLICUR 3.6 F (250 g ai /L) was applied on May 29, 1998 when primary wheat heads were at 50% anthesis for each variety (Zadoks growth stage 60 to 69) using a three type of nozzles (twin jet, flat fan, hollow cone), two water volumes (240 and 480 L/ha), three assistive methods (air, bar, none), and electrostatic on/off . The back pack precision sprayer, with a 1-m boom, was fitted with 2 nozzles spaced at 50 cm. Each plot was inoculated with a 100-ml suspension of macroconidia of *F. graminearum* at 500,000 spores/ml two days following treatment with fungicide. 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 misters delivered about 7.5 mm of water each day. The mist system was engaged until three days after inoculation. Wheat was assessed for visual symptoms when the early dough stage was reached. Ten primary heads were selected at random out of each plot. Heads were placed into one of seven classes 0,5,15,30,50,75,100 % infected spikelets. A fusarium head blight index (FHBI) was applied to the data, which was the product of the percent heads infected and the percent spikelets infected. The plots were harvested on 14 July and the yields were corrected to 14 % moisture. Percent of tombstone by weight was calculated from 25 g grain samples. Deoxynivalenol (DON) content was estimated from the three most highly infected replications using a quantitative ELISA test. Percentage data were transformed to SQR (arcsin%). Reported means are untransformed.

RESULTS: Results are given in the table below.

CONCLUSIONS: Electrostatic application of FOLICUR with 24 L/ha of water appeared to give the best protection against FHB in both visible symptoms and DON accumulation, although not significantly different from many other treatments. Generally, lower water volume seemed to be a better option than higher ones, perhaps higher water volume encouraged disease. Although, DON level was the same (0.9 ppm) when the fungicide was applied with twin jet nozzles, and air assistive method with different water volumes.

Table 1. *Fusarium* head blight control in winter wheat (Harus) by FOLICUR 3.6 F and different application technologies in artificially inoculated and misted plots at Ridgetown, Ontario. 1998.

Method	Assistive Method	Water Volume	Percent spikelets l/ha	Percent heads infected	FHB index (PSI x PHI) infected	Yield T/ha	Percent FDK*	DON (ppm)
Flat fan	Air	240	32.7	100.0	32.7	5.1	0.8	1.0
Flat fan	Air	480	43.7	100.0	43.7	5.2	0.9	1.2
Flat fan	Bar	240	37.3	96.7	36.2	5.1	0.5	1.0
Flat fan	Bar	480	47.5	96.7	45.9	5.0	1.4	2.0
Flat fan	None	240	28.8	90.0	26.1	5.1	1.1	0.8
Flat fan	None	480	35.5	100.0	35.5	4.8	1.0	1.3
Hollow cone	Air	240	39.0	100.0	39.0	4.9	0.7	0.9
Hollow cone	Air	480	37.0	93.3	35.2	5.0	1.7	2.4
Hollow cone	Bar	240	27.2	90.0	24.9	5.1	1.0	1.9
Hollow cone	Bar	480	35.5	96.7	34.7	5.4	1.2	0.7
Hollow cone	None	240	29.8	100.0	29.8	5.3	1.0	1.3
Hollow cone	None	480	39.2	96.7	38.1	5.2	1.0	1.0
Twin jet	Air	240	33.3	96.7	32.3	5.2	0.6	0.9
Twin jet	Air	480	44.8	93.3	42.1	5.4	0.6	0.9
Twin jet	Bar	240	30.0	96.7	29.3	5.1	1.4	1.8
Twin jet	Bar	480	41.5	96.7	40.2	5.2	0.8	1.3
Twin jet	None	240	32.3	96.7	31.3	4.7	1.1	1.3
Twin jet	None	480	35.8	90.0	32.6	5.3	1.1	1.9
Electrostatic	On	24	29.0	93.3	27.3	5.2	1.5	1.6
Electrostatic	On	48	22.7	93.3	21.3	5.3	0.7	1.1
Electrostatic	Off	24	30.2	96.7	29.1	5.3	0.9	1.4
Electrostatic	Off	48	41.2	96.7	39.5	5.2	1.3	2.1
Untreated check			47.3	100.0	47.3	5.1	1.3	2.6
LSD (P=.05)			10.60	8.76	11.53	0.61	0.82	1.3
CV			17.78	5.53	20.00	7.25	46.92	56.0

* Fusarium damaged kernels

1998 PMR REPORT # 129 **SECTION L: CEREALS, FORAGE CROPS/ OILSEEDS Diseases**

CROP: Winter wheat (*Triticum aestivum* L.), cv. Freedom and Harus
PEST: Fusarium head blight**,** *Fusarium graminearum* Schwabe

NAME AND AGENCY:
SCHAAFSMA A W, and TAMBURIC-ILINCIC L
Ridgetown College, University of Guelph, Ridgetown, Ontario NOP 2CO
Tel: (519) 674-1624; **Fax:** (519) 674-1600; **Email:** aschaafs@ridgetownc.uoguelph.ca

TITLE: CONTROL OF FUSARIUM HEAD BLIGHT IN WINTER WHEAT WITH FUNGICIDES IN ARTIFICIALLY INOCULATED, MISTED PLOTS

MATERIALS: BRAVO WEATHER STIK (500 g ai/L chlorothalonil); FOLICUR 3.6 F (431 g ai/L tebuconazole); TILT 250 EC (250 g ai/L propiconazole); BENLATE (500 g ai/L benomyl);

METHODS: Two varieties of winter wheat (Freedom, Harus) were planted on October 20, 1997 at Ridgetown using a 6-row cone seeder at 400 seeds/m^2. Plots were six rows planted at a row spacing of 17.8 cm and 4.0 m in length placed in a randomized complete block design with four replications. Spray applications were made on May 29, 1998 when primary wheat heads were at 50 % anthesis for each variety (Zadoks growth stage 60 to 69) using a back pack precision sprayer with a 1-m boom fitted with 2 twin jet nozzles spaced at 50 cm operated at 240 kPa delivering 240 L/ha. Each plot was inoculated with a 100-ml suspension of macroconidia of *F. graminearum* at 500,000 spores/ml two days following first treatment of fungicide. The suspension was produced in liquid shake culture using modified Bilay's medium. The inoculum was amended with two drops of TWEEN 20 per 100 ml of inoculum. Plots were misted daily beginning after the first plots were inoculated. The misting rate was about 7.5 mm of water each day. The mist system was engaged until three days after inoculation. Each variety was assessed for visual symptoms when the early dough stage was reached. Ten heads were selected at random out of each plot. Heads were placed into one of seven classes 0,5,15,30,50,75,100 % infected spikelets. A fusarium head blight index (FHBI) was applied to the data, which was the product of the percent heads infected and the percent spikelets infected . The plots were harvested on July 14, 1998 and the yields were corrected to 14% moisture. Percent of fusarium head blight damaged kernels (FDK) by weight was calculated from 25 g grain samples. Deoxynivalenol (DON) content was estimated for the three most highly infected replications using a quantitative ELISA test. Percentage data were transformed to SQR (arcsin %). Reported means are untransformed.

RESULTS: Results are given in the tables below.

CONCLUSIONS: Freedom as a more *Fusarium*-resistant cultivar responded better to protection by fungicides than did the more susceptible Harus wheat. However Freedom and Harus wheat in non-sprayed plots ended up with similar FHBIs. DON was not detected in Freedom wheat when BRAVO 500 WEATHER STIK was applied in combination with FOLICUR or BENLATE. FOLICUR and BENLATE combination, as well as TILT had a significantly lower percent FDK in Harus wheat by comparison with the untreated check.

Table 1. Fusarium head blight control in winter wheat (Freedom) with foliar application of fungicides. Ridgetown, Ontario. 1998.

Treatments	Rate of product/ha	Percent spikelets infected	Percent heads infected	FHB index	Percent FDK*	Yield T/ha	DON (ppm)
BRAVO WEATHER STIK	2.00 L	24.3	100.0	24.3	0.9	5.6	0.9
BRAVO WEATHER STIK	1.50 L	17.7	86.7	14.9	0.6	5.2	0.3
BRAVO WEATHER STIK + FOLICUR 3.6 F	1.50 L 0.64 L	28.3	93.3	26.8	0.8	5.2	0.0
TILT 250 EC	0.50 L	24.7	86.7	21.6	0.7	5.1	0.6
FOLICUR 3.6 F	0.64 L	28.2	100.0	28.2	0.6	5.5	0.1
BENLATE	1.00 kg	29.3	100.0	29.3	0.4	5.3	0.3
FOLICUR 3.6 F + BENLATE	0.64 L 1.00 kg	25.3	93.3	24.2	0.6	5.6	0.1
BRAVO WEATHER STIK + BENLATE	1.50 L 1.00 kg	24.3	100.0	24.3	0.8	5.0	0.0
Untreated check		32.5	96.7	31.7	0.9	5.3	0.7
LSD (P=.05)		11.98	15.09	12.62	0.54	0.57	0.72
CV		28.86	9.80	32.34	50.31	6.29	132.11

* Fusarium damaged kernels

Table 2. Fusarium head blight control in winter wheat (Harus) with foliar application of fungicides. Ridgetown, Ontario. 1998.

Treatments	Rate of product/ha	Percent spikelets infected	Percent heads infected	FHB index	Percent FDK *	Yield T/ha	DON (ppm)
BRAVO WEATHER STIK	2.00 L	37.7	96.7	36.8	1.2	5.2	0.7
BRAVO WEATHER STIK	1.50 L	40.2	96.7	39.0	0.9	5.0	1.1
BRAVO WEATHER STIK + FOLICUR 3.6 F	1.50 L 0.64 L	34.5	96.7	33.7	0.7	5.2	0.8
TILT 250 EC	0.50 L	39.7	100.0	39.7	0.4	5.0	0.3
FOLICUR 3.6 F	0.64 L	37.0	96.7	36.2	0.8	5.2	0.9
BENLATE	1.00 kg	42.2	96.7	41.1	0.6	4.8	0.4
FOLICUR 3.6 F + BENLATE	0.64 L 1.00 kg	45.3	100.0	45.3	0.3	5.1	0.2
BRAVO WEATHER STIK + BENLATE	1.50 L 1.00 kg	39.7	100.0	39.7	0.7	4.7	0.9
Untreated check		36.2	100.0	36.2	1.1	5.2	1.8
LSD (P=.05)		11.21	5.42	11.85	0.58	0.48	1.02
CV		17.05	3.27	18.17	45.75	5.57	70.52

* Fusarium damaged kernels

1998 PMR REPORT # 130 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS Diseases

CROP: Winter wheat (*Triticum aestivum* L.), cv. AC RON
PEST: Fusarium seedling blight, *Fusarium graminearum* Schwabe

NAME AND AGENCY:
SCHAAFSMA A W, and TAMBURIC-ILINCIC L
Ridgetown College, University of Guelph, Ridgetown, Ontario NOP 2CO
Tel: (519) 674-1624; **Fax:** (519) 674-1600; **Email:** aschaafs@ridgetownc.uoguelph.ca

TITLE: SEED TREATMENTS TO CONTROL FUSARIUM SEEDLING BLIGHT IN WINTER WHEAT

MATERIALS: VITAFLO 280 (thiram, 130 g a.i/L + carbathiin 150 g a.i. /L), DIVIDEND 360FS (difeconazole 360 g a.i/L), DIVIDEND RTA 36FS (difeconazole 36 g a.i/L), DIVIDEND XL (difeconazole 38.3 g a.i/L+ metalaxyl 3.19 g a.i/L), MAXIM 480FS (fludioxonil 42% w/w), APRON XL (metalaxyl-m 369 g a.i/L), EXP80472H (triticonazole 2.22 %), THIRAM 42-S (thiram 42 % a.i.), EXP80992A (maneb 25.6 % + lindane 8.6 %), EXP80991A (ICIA5504 800 g/kg), UBI 2584-3 (tebuconazole 8.33 g a.i./L), UBI 2770 (imazalil 1.2% + carbathiin 16.7 % + thiabendazole 1.5 %), UBI 2092-1A4 (carbathiin 25.37 %), UBI 2643 (thiabendazole 348 g. a.i./L), UBI 2379-1(metalaxyl 317 g a.i./L).

METHODS: Seed was obtained from non-treated infected plots from the previous season. *Fusarium* damaged kernels were not removed. Seed was treated on 17 October, 1997 in individual plastic bags and rolled until throughly covered in 750 g lots. The crop was planted on 21 October, 1997 at Huron Research Station, Ontario and on 20 October, 1997 at Ridgetown, Ontario using a 6-row cone seeder at 400 seeds/m^2. Plots were six rows planted at a row spacing of 17.8 cm, and 4 m in length placed in a randomized complete block design with four replications. The plots were fertilized and maintained according to provincial recommendations. The number of emerged plants in 1 m (2 rows), was evaluated on 1 December, 1997 at Ridgetown. Due to muddy field conditions, a relative rating of emerged plants was taken on 2 December, 1997 at Huron following the scale: 0 = no germination, 1 = 25%, 2 = 50%, 3 = 75 %, 4= 100 % germination. Survival notes were taken on 3 April, 1998 at Huron and 1 April, 1998 at Ridgetown in the same 1m strip (2 rows). Plots were trimmed back to 3.5 m before harvest. Yields were taken on 14 July, 1997 at both locations and corrected to 14% moisture.

RESULTS: Results are presented in Table 1 below.

CONCLUSIONS: At Ridgetown, the EXP80472H plus THIRAM 42-S treatment significantly improved yield. However emergence was not higher than the untreated control plus the number of tillers in the spring was the lowest of all treatments. Perhaps fewer tillers allowed more photosynthates to be concentrated in the remaining heads. Yield was significantly lower with MAXIM 480FS plus DIVIDEND XL, as well as number of tillers/2m with EXP80472H plus APRON XL at Huron.

Table 1. Emergence, survival and yield of winter wheat where seed was treated with fungicides for the control of Fusarium seedling blight. Huron and Ridgetown, Ontario, 1998.

Seed Treatment (mL product / kg seed)	Emergence (0-4)	Survival (plants/2m)		Yield (Tillers/2m)		(T/ha)	
		Huron	Ridget.	Huron	Ridget.	Huron	Ridget.
VITAFLO 280 3.33	1.0	93.5	62.8	92.8	4.30	5.01	
DIVIDEND 360FS 0.33	1.3	90.0	62.3	88.0	4.62	5.16	
DIVIDEND 360FS 0.67	2.0	96.0	72.5	82.8	5.02	5.08	
DIVIDEND RTA 36FS 3.33	1.5	103.0	65.0	108.3	4.70	4.96	
DIVIDEND RTA 36FS 6.67	2.0	83.3	63.0	79.3	4.44	5.24	
DIVIDEND XL RTA 3.13	2.0	72.3	72.8	76.5	4.96	5.19	
DIVIDEND XL RTA 6.26	1.0	99.3	67.3	96.5	4.40	4.71	
UBI 2584-3 2.40	1.8	98.0	72.3	100.3	4.61	5.23	
UBI 2770 3.06	1.5	93.5	52.5	98.5	4.50	4.95	
MAXIM 480FS 0.05 + APRON XL 0.03	2.0	97.3	76.8	101.3	4.75	5.08	
MAXIM 480FS 0.05 + DIVIDEND XL 3.13	1.8	83.8	71.5	80.5	3.59	5.17	
EXP80472H 2.00 + APRON XL 2.70	1.3	81.8	49.3	76.8	4.31	5.09	
EXP80472H 4.00 + APRON XL 2.70	1.3	88.8	72.3	85.3	4.44	5.15	
EXP80472H 2.00 + EXP80992A 3.10	1.8	82.0	69.8	80.0	4.88	5.40	
EXP80472H 2.00 + THIRAM 42-S 1.00	2.0	90.3	64.8	73.3	4.91	5.63	
EXP80472H 2.00 + EXP80991A 1.30	1.3	103.0	66.0	91.3	4.76	5.51	
UBI 2584-3 2.40 + UBI 2379-1 2.00	1.5	88.8	65.8	86.3	4.47	4.97	
UBI 2092-1A4 1.94 + UBI 2643 1.00 + UBI 2379-1 2.00	1.8	96.8	65.8	94.3	4.73	5.19	
CONTROL	1.8	94.3	71.0	85.8	4.90	5.00	
LSD (P=.05)	1.10	21.01	14.68	30.41	0.66	0.61	
CV 49.0	16.26	15.62	24.36	10.2	18.40		

1998 PMR REPORT # 131 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS Disease

CROP: Winter wheat (*Triticum aestivum* L.), cv. several
PEST: Fusarium head blight**,** *Fusarium graminearum* Schwabe

NAME AND AGENCY:
SCHAAFSMA A W, and TAMBURIC-ILINCIC L
Ridgetown College, University of Guelph, Ridgetown, Ontario NOP 2CO
Tel: (519) 674-1624; **Fax:** (519) 674-1600; **Email:** aschaafs@ridgetownc.uoguelph.ca

TITLE: SUSCEPTIBILITY OF WINTER WHEAT VARIETIES TO FUSARIUM HEAD BLIGHT, AND CONTROL BY TEBUCONAZOLE (FOLICUR 3.6) IN ARTIFICIALLY INOCULATED, MISTED PLOTS

MATERIALS: FOLICUR 3.6 F(431 g ai/L tebuconazole)

METHODS: The crop was planted on 17 October, 1997 at Ridgetown, Ontario using a 6-row cone seeder at 400 seeds/m^2. Plots were six rows planted 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 provincial recommendations. Half of each plot was sprayed with FOLICUR 3.6 F (250 g ai /L) when primary wheat heads were at 50% anthesis for each variety (Zadoks growth stage 60 to 69,) using a back pack precision sprayer with a 1-m boom fitted with 2 twin jet nozzles spaced at 50 cm delivering 240 L/ha of water. Each plot was inoculated with a 100-ml suspension of macroconidia of *F. graminearum* at 500,000 spores/ml two days following treatment with fungicide. 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 rate was about 7.5 mm of water each day. The mist system was engaged until three days after the last variety was inoculated. Each variety was assessed for visual symptoms when the early dough stage was reached. Primary wheat heads were selected at random out of each plot. Heads were placed into one of seven classes 0,5,15,30,50,75,100 % infected spikelets. A fusarium head blight index (FHBI) was applied to the data, which was the product of the percent heads infected and the percent spikelets infected. The plots were harvested on 14 July and the yields were corrected to 14 % moisture. Percent of FDK by weight was calculated from 25 g grain samples. DON content was estimated from the three most highly infected replications using a quantitative ELISA test. The limit of detection was 0.1 ppm. Percentage data were transformed to SQR (arcsin%). Reported means are untransformed.

RESULTS: The results are given in the table below.

CONCLUSIONS: Mean FHB indices (15.8 versus 37.2), percent Fusarium-damaged kernels (FDK) (1.8 versus 2.1), and DON content (0.6 versus 1.7 ppm) across cultivars tended to be lower, and yield tended to be higher (5.4 versus 5.1 T/ha) when FOLICUR 3.6 F applications were made. Generally, fusarium-resistant varieties responded better to protection by FOLICUR 3.6 F than did the more susceptible varieties. However, treatment 24 (WBI0638E1 a.k. a Pioneer 25W60) was an interesting exception. Here the use of FOLICUR 3.6 F reduced DON from 1.8 ppm to ND. Correlation coefficient between DON content and percent of FDK across cultivars without/with FOLICUR was 0.54, and 0.62, respectively. PIONEER B (# 67) and AC MORLEY (#10) had the lowest FHB index, percent of FDK,

and DON level. Hanover, CM 96097, and PRC 9308 had the highest DON content with/without FOLICUR 3.6 F (3.6, 2.3, 2.1 ppm versus 4.3, 3.3, 3.0 ppm, respectively) by comparison with other varieties tested. Regardless of the mechanism of resistance, planting susceptible varieties should be discouraged.

Table 1. Fusarium head blight control in sixty nine winter wheat varieties without/with foliar application of FOLICUR 3.6 F in artificially inoculated and misted plots at Ridgetown, Ontario. 1998.

Winter	----------no FOLICUR----------				-----FOLICUR 3.6 F----------			
wheat	FHB	Percent	DON	Yield	FHB	Percent	DON	Yield
cultivar	index	FDK **	(ppm)	T/ha	index	FDK	(ppm)	T/ha
1 HARUS	40.1	1.5	1.7	5.8	16.8	1.2	0.6	5.7
2 KARENA	33.4	2.0	1.5	5.8	8.5	1.5	0.6	5.7
3 AC RON	42.3	1.7	1.1	5.3	11.7	1.8	0.3	5.8
4 OAC ARISS	33.4	1.8	2.8	5.6	12.3	2.0	0.8	5.5
5 FUNDULEA	48.4	2.5	2.2	4.5	36.1	1.8	1.4	5.0
6 MARILEE	35.2	2.0	1.8	5.2	9.1	2.1	0.7	5.3
7 FREEDOM	46.8	1.7	1.0	6.0	15.0	1.9	0.5	5.9
8 AC DEXTER	38.6	2.9	2.6	4.7	18.6	3.0	0.9	5.7
9 AC CARTIER	36.8	2.5	2.6	4.9	10.9	2.7	0.2	5.4
10 AC MORLEY	23.7	1.3	0.5	5.5	6.5	1.1	0.0	5.6
11 2737W	39.0	1.7	2.5	5.6	28.8	1.8	0.8	5.6
12 2510	43.7	2.3	2.8	5.0	25.1	3.6	1.5	5.7
13 25W33	39.1	1.6	2.4	5.8	24.0	1.5	0.7	5.9
14 HANOVER	55.0	9.2	4.3	4.2	29.0	7.3	3.6	4.7
15 MENDON	46.1	4.0	2.2	5.3	26.6	2.1	1.6	5.5
16 OAC MONTROSE	49.6	3.4	0.9	5.1	16.0	1.8	0.4	5.4
17 CM94090	49.6	3.3	2.7	5.3	22.0	2.3	0.7	5.2
18 2540	34.3	1.5	1.1	5.8	13.5	1.7	0.2	6.3
19 25R57	42.9	2.2	1.3	5.9	18.8	1.9	0.1	5.9
20 HURON(BAVARIA)	35.6	2.4	1.6	5.0	6.2	1.0	0.3	6.1
21 TW91203	36.3	3.3	1.5	4.8	9.4	3.5	0.8	5.2
22 TW93211	35.6	1.1	2.1	5.3	18.8	1.3	0.8	5.4
23 25R26	32.9	0.7	1.4	4.8	10.0	0.9	0.1	5.7
24 WBI0638E1	39.7	0.7	1.8	6.2	14.5	1.1	0.0	6.0
25 PRC9308	57.8	1.9	3.0	5.1	28.3	3.1	2.1	5.6
26 H649:14	37.2	1.6	2.5	5.0	17.9	1.4	0.6	5.9
27 H649:5	43.5	2.3	2.7	6.1	16.8	1.9	0.0	5.7
28 PRC9325	20.0	3.3	1.2	4.3	7.3	1.4	0.1	4.5
29 PRC9327	9.7	1.6	0.8	4.2	6.5	1.0	0.0	4.8
30 S93:1	15.3	0.6	0.6	4.5	1.8	0.5	0.0	4.7
31 MWH95:069531	54.1	2.3	2.1	5.2	26.6	1.1	0.7	5.4
32 LJH95:0189	62.0	3.4	1.6	5.0	27.5	1.9	0.9	5.5
33 TW94415	19.8	1.4	0.6	4.6	5.5	2.5	0.0	5.2
34 SALS 9721	46.1	2.6	2.2	4.3	19.6	1.1	0.7	5.3
35 P88288C1-6-1-2	28.2	1.0	1.1	4.9	18.1	1.2	0.1	5.1
36 KY 86C-61-8	34.0	2.9	1.5	5.4	15.9	1.0	0.0	6.0

37 IL87-2834-1	40.1	0.9	0.6	5.7	14.6	0.7	0.0	5.2
38 IL90-9110	47.0	0.3	0.9	5.5	13.9	0.8	0.0	5.2
39 OAC93W.86P	33.6	2.0	0.9	5.9	16.0	2.2	1.2	5.9
40 OAC94W:51P	31.9	1.2	1.5	4.6	8.7	1.0	0.0	5.1
41 OAC943R.7	29.8	2.5	1.1	4.7	6.9	1.4	0.2	5.3
42 OAC93R.31P	39.3	0.7	1.2	5.5	11.0	0.4	0.1	6.0
43 OAC95R:8P	7.7	1.9	0.9	4.6	3.5	1.7	0.1	4.6
44 OAC95R:43S	24.4	3.0	0.9	4.9	25.9	2.2	0.4	5.2
45 AUGUSTA	36.3	2.0	2.1	5.2	12.7	1.2	0.0	5.9
46 KARAT	1.2	2.9	0.6	4.3	2.1	2.3	0.0	4.6
47 PRH97-05316	34.0	1.0	1.5	5.1	17.8	0.8	0.3	6.1
48 PRH97-054046	50.9	1.2	1.2	5.0	25.2	1.1	0.3	5.3
49 RML97-155	42.1	2.0	1.9	4.5	13.5	1.7	0.5	5.8
50 CM 95009	45.3	3.1	2.4	4.4	20.5	1.6	1.4	4.9
51 CM 96089	40.0	4.9	2.6	4.7	19.2	4.0	0.8	4.9
52 CM 96097	61.3	5.4	3.3	4.5	26.0	3.8	2.3	5.1
53 CM 97001	16.6	1.1	1.1	4.1	3.9	1.1	1.8	4.1
54 CM 97002	27.0	2.8	1.3	4.8	10.2	2.6	0.8	4.6
55 CM 97003	36.4	2.5	2.3	4.9	17.5	0.8	0.2	5.4
56 CM 97020	39.4	3.3	1.6	4.9	27.3	3.0	0.9	5.2
57 CM 951067	27.6	2.3	2.3	5.4	9.8	1.3	0.6	5.5
58 CM 950282	43.9	1.6	2.3	5.5	19.9	1.6	0.3	5.9
59 CM 950455	41.6	2.0	1.8	5.6	17.3	1.6	0.0	6.2
60 CM 951078	46.4	2.7	2.5	5.7	18.0	2.5	1.3	6.1
61 CM 546	26.3	1.1	0.7	5.2	15.6	0.9	0.3	5.8
62 F97-1326-0	50.4	1.0	1.9	5.1	24.0	1.6	0.8	5.9
63 F96-1044-0	39.0	1.1	0.6	4.9	14.1	0.9	0.0	5.1
64 F94-010-S1	47.5	2.5	1.0	4.6	20.1	1.5	0.2	6.1
65 F97-1017-0	13.9	2.8	1.6	4.9	4.0	2.6	0.7	4.6
66 PIONEER A*	35.0	1.6	1.7	5.2	13.7	1.7	0.3	5.7
67 PIONEER B*	26.9	0.6	0.0	5.0	7.6	0.6	0.0	5.7
68 PIONEER C*	45.0	0.9	0.3	5.7	15.5	0.8	0.2	6.1
69 PIONEER D*	27.8	0.7	0.6	5.7	11.5	1.0	0.0	5.5
LSD (P=.05)	15.8	2.1	1.4	0.9	13.7	1.6	1.2	0.7
CV	30.8	60.6	52.9	11.3	62.8	56.0	131.6	7.7
AVG	37.2	2.1	1.7	5.1	15.8	1.8	0.6	5.4

* experimental

** Fusarium damaged kernels

1998 PMR REPORT # 132 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS Diseases

CROP: Winter wheat (*Triticum aestivum* L.), cv. Pioneer 2510
PEST: Powdery mildew, *Erysiphe graminis* f. sp. *tritici*

NAME AND AGENCY:
SCHAAFSMA A W, and TAMBURIC-ILINCIC L
Ridgetown College, University of Guelph, Ridgetown, Ontario NOP 2CO
Tel: (519) 674-1624; **Fax:** (519) 674-1600; **Email:** aschaafs@ridgetownc.uoguelph.ca

TITLE: SEED TREATMENTS TO CONTROL POWDERY MILDEW IN WINTER WHEAT

MATERIALS: VITAFLO 280 (thiram, 130 g a.i/L + carbathiin 150 g a.i. /L), BAYTAN 30 (triadimenol 30 %), UBI 2722-1 (BAYTAN 1G triadimenol 1% w/w).

METHODS: Seed was treated on 17 October, 1997 in individual plastic bags and rolled until throughly covered in 750 g lots. The crop was planted on 21 October, 1997 at Huron Research Station, Ontario and on 20 October, 1997 at Ridgetown, Ontario using a 6-row cone seeder at 400 seeds/m^2. Plots were six rows planted at a row spacing of 17.8 cm, and 4 m in length placed in a randomized complete block design with four replications. The plots were fertilized and maintained according to provincial recommendations. The number of plants emerged in 1 m (2 rows), was evaluated on 1 December, 1997 at Ridgetown. A relative rating of plants emerged was taken on 2 December, 1997 at Huron following the scale: 0 = no germination, 1 = 25%, 2 = 50%, 3 = 75 %, 4= 100 % germination. Survival notes were taken on 3 April, 1998 at Huron and 1 April, 1998 at Ridgetown in the same 1m strip (2 rows). Powdery mildew infections were estimated as percentage of the area of each leaf covered with lesions for the same leaf taken from 10 plants at random out of the centre two rows of each plot at 21 May, 1998 at Huron and 20 May, 1998 at Ridgetown. Plots were trimmed back to 3.5 m before harvest. Yields were taken on 14 July , 1997 at both locations and corrected to 14% moisture.

RESULTS: The results are summarized in Table 1.

CONCLUSIONS: BAYTAN 30 and 1G suppressed powdery mildew. No significant differences in emergence between treatments and control were observed, however BAYTAN granular reduced the number of tillers counted in the spring at Ridgetown. This was no reflected in yield, in that BAYTAN granular resulted in the highest yields at Ridgetown and these were significantly higher than the non-treated controls.

Table 1. Emergence, survival and yield of winter wheat where seed was treated with fungicides for the control of powdery mildew. Huron and Ridgetown, Ontario.1998.

Seed Treatment	ml prod. /kg seed	Emergence (0-4) (plants/2m)		Survival (Tillers/2 m)		Percent Powdery mildew		Yield (T/ha)	
		Huron	Ridge	Huron	Ridge	Huron	Ridge	Huron	Ridge
VITAFLO 280	3.33	3.5	119.8	102.5	126.0	25.5	18.4	4.3	6.2
VITAFLO 280 BAYTAN 30 WATER	3.33 0.95 4.05	3.3	110.0	99.0	116.8	10.9	13.6	4.7	6.3
VITAFLO 280 UBI2722-1 (Baytan 1G)	3.33 0.14*	3.3	101.5	102.8	89.0	11.0	6.5	4.4	6.4
VITAFLO 280 UBI2722-1 (Baytan 1G)	3.33 0.28*	3.3	115.8	106.3	105.8	17.2	12.3	4.0	6.4
CONTROL		3.5	111.5	90.3	131.0	33.2	19.2	4.3	5.7
LSD (P=.05)		0.5	28.0	14.1	19.1	13.9	8.3	1.0	0.5
CV		9.8	16.3	9.1	11.4	46.1	38.4	15.1	5.6

*g/m row

1998 PRM REPORT # 133 **SECTION L: CEREALS, FORAGE CROPS/OILSEEDS**
Diseases

CROP: Winter wheat (*Triticum aestivum* L.), cv. Unknown
PEST: Loose smut, *Ustilago tritici*

NAME AND AGENCY:
SCHAAFSMA A W, and TAMBURIC-ILINCIC L
Ridgetown College, University of Guelph, Ridgetown, Ontario NOP 2CO
Tel: (519) 674-1624; **Fax:** (519) 674-1600; **Email:** aschaafs@ridgetownc.uoguelph.ca

TITLE: SEED TREATMENTS TO CONTROL LOOSE SMUT IN WINTER WHEAT

MATERIALS: VITAFLO 280 (thiram, 130 g a.i/L + carbathiin 150 g a.i. /L), APRON XL (metalaxyl-m 369 g a.i/L), EXP80472H (triticonazole 2.22 %), THIRAM 42-S (thiram 42 % a.i.), UBI 2584-3 (tebuconazole 8.33 g a.i./L), UBI 2770 (imazalil 1.2% + carbathiin 16.7 % + thiabendazole 1.5 %), UBI 2092-1A4 (carbathiin 25.37 %), UBI 2643 (thiabendazole 348 g. a.i./L), UBI 2379-1(metalaxyl 317 g a.i./L).

METHODS: Seed was obtained from non-treated, loose smut-infected plots from the previous season. Seed was treated on 17 October, 1997 in individual plastic bags and rolled until throughly covered in 750 g lots. The crop was planted on 21 October, 1997 at Huron Research Station, Ontario and on 20 October, 1997 at Ridgetown, Ontario using a 6-row cone seeder at 400 seeds/m^2. Plots were six rows planted at a row spacing of 17.8 cm, and 4 m in length placed in a randomized complete block design with four replications. The plots were fertilized and maintained according to provincial recommendations. The number of emerged plants in 1 m (2 rows), was evaluated on 1 December, 1997 at Ridgetown. A relative rating of emerged plants was taken on 2 December, 1997 at Huron following the scale: 0 = no germination, 1 = 25%, 2 = 50%, 3 = 75 %, 4= 100 % germination. Survival notes were taken on 3 April, 1998 at Huron and 1 April, 1998 at Ridgetown in the same 1m strip (2 rows). Loose smut was evaluated at heading, on 4 June, 1998 at Huron and 5 June, 1998 at Ridgetown. The number of heads were estimated per plot by counting all the heads in 1m of row and then multiplying by the total row length of the plot. Total infected heads were counted per plot and these were expressed as a percentage of the total heads/plot. Plots were trimmed back to 3.5 m before harvest. Yields were taken on 14 July , 1997 at both locations and corrected to 14% moisture.

RESULTS: The results are summarized in Table 1.

CONCLUSIONS: All the materials tested provided excellent control of loose smut with the exception of the combination treatment containing UBI 2092-1A4, UBI 2643, and UBI 2379, as well as UBI 2770 and EXP80472H plus THIRAM 42-S at Huron. There was no significant effect on emergence. None of the treatments resulted in significant increases in yield.

Table 1. Emergence, survival and yield of winter wheat treated with fungicides for the control of Loose Smut. Huron and Ridgetown, Ontario. 1998.

Seed Treatment	(mL product /kg seed)	Emergence (0-4) (plants/2m)		Survival (Tillers/2m)		Percent heads infected L. Smut		Yield (Tonne/ha)	
		Huron	Ridge	Huron	Ridge	Huron	Ridge	Huron	Ridge
VITAFLO 280	3.33	2.5	104.3	120.8	105.3	0.043	0.000	4.28	4.47
EXP80472H APRON XL	2.00 2.70	2.8	107.5	101.5	116.0	0.000	0.000	3.96	4.76
EXP80472H APRON XL	4.00 2.70	2.8	116.8	113.8	110.8	0.000	0.000	4.27	4.65
EXP80472H THIRAM 42-S	2.00 1.00	3.0	120.0	112.0	124.0	0.015	0.000	4.23	4.43
UBI 2584-3	2.40	3.0	107.0	108.0	123.0	0.000	0.000	4.29	4.56
UBI 2584-3 UBI 2379-1	2.40 2.00	2.8	117.0	109.0	118.8	0.000	0.000	4.29	4.56
UBI 2770 3.06	3.5	99.3	102.3	104.3	0.015	0.000	4.15	4.53	
UBI 2092-1A4 UBI 2643 1.00 UBI 2379-1	1.95 2.00	3.3	108.5	102.8	109.5	0.125	0.015	4.23	4.28
CONTROL		3.3	103.5	112.8	115.5	0.085	0.320	4.22	4.56
LSD (P=.05)		0.79	17.63	18.44	28.00	0.08	0.027	0.59	0.42
CV		18.17	11.05	11.57	16.81	170.05	51.31	9.54	6.38

1998 PMR REPORT # 134 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS Disease

CROP: Winter wheat (*Triticum aestivum* L.), cv. several
PEST: Fusarium head blight**,** *Fusarium graminearum* Schwabe

NAME AND AGENCY:
SCHAAFSMA A W, and TAMBURIC-ILINCIC L
Ridgetown College, University of Guelph, Ridgetown, Ontario NOP 2CO
Tel: (519) 674-1624; **Fax:** (519) 674-1600; **Email:** aschaafs@ridgetownc.uoguelph.ca

TITLE: COMPARISON BETWEEN *FUSARIUM GRAMINEARUM* MACROCONIDIA SPRAY METHOD AND CORN KERNEL ASCOSPORES INOCULUM METHOD IN ARTIFICIALLY INOCULATED, MISTED PLOTS

METHODS: Nine winter wheat varieties were planted on 23 October, 1997 at Ridgetown using a 6-row cone seeder at 400 seeds/m^2. Plots were six rows planted 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 provincial recommendations. Each plot was inoculated with a macroconidia of *F. graminearum* or ascospores of *Gibberella .zeae* produced on corn kernels. For ascospores inoculation method the whole, yellow-dent corn kernels were autoclaved and inoculated with two weeks old *Fusarium graminearum* culture (DAOM 178148). The kernels were colonized within two weeks, and inoculum was spread onto the soil surface on May 12, 1998. The field was irrigated three consecutive evenings to moisten soil surface. For the macroconidia spray method the plots were inoculated with 100-ml suspension of macroconidia of *F. graminearum* at 500,000 spores/ml. 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 misters delivered about 7.5 mm of water each day. The mist system was engaged until three days after the last variety was inoculated. Each variety was assessed for visual symptoms when the early dough stage was reached. Ten primary heads were selected at random out of each plot. Heads were placed into one of seven classes 0,5,15,30,50,75,100 % infected spikelets. A fusarium head blight index (FHBI) was applied to the data, which was the product of the percent heads infected and the percent spikelets infected. The plots were harvested on 14 July and the yields were corrected to 14 % moisture. Percent of tombstone by weight was calculated from 25 g grain samples. Deoxynivalenol (DON) content was estimated from the three replications using a quantitative ELISA test. Percentage data were transformed to SQR (arcsin%). Reported means are untransformed.

RESULTS: Results are given in the table below.

CONCLUSIONS: Perithecia started to form within ten days of spreading corn inoculum in the field. Many perithecia was formed on corn kernels, but because of cold weather (five day post anthesis mean max. temperature was 18.7^0 C, and mean min. temperature was $6.8\,^0$C) ascospores didn't released well and visual infection was greater using the macroconidia sprayed method. Percent FDK and DON content were also higher when macroconidia sprayed method was used in comparison to the ascospores from corn kernels method, except for most resistant cultivars: Ena, Pioneer experimental A and Pioneer experimental D. High DON levels and lower visible symptoms in the ascospore-inoculated plots suggest that the infection from ascospore was much later than that for the macroconidia-spray inoculations, where disease

expression was lower but infection level high and resulting DON production high.

Table 1. Fusarium head blight reaction of nine winter wheat varieties in artificially inoculated and misted plots at Ridgetown, Ontario. 1998.

Cultivar	Percen spikelets infected	Percent heads infected	FHB index	Yield T/ha	Percent FDK**	DON (ppm)
		----------macroconidia sprayed----------				
Harus	65.4	100.0	65.4	3.5	5.5	18.0
Freedom	21.1	85.0	18.3	3.2	8.3	16.2
Ena	18.5	87.5	16.6	3.1	1.8	9.0
25R57	66.0	100.0	66.0	3.5	16.9	21.0
Fundulea	44.5	100.0	44.5	3.4	3.8	13.8
PIONEER A*	29.6	97.5	29.3	3.7	5.3	14.7
PIONEER B*	14.6	90.0	13.4	3.9	3.1	9.9
PIONEER C *	13.0	77.5	9.8	4.1	1.4	8.1
PIONEER D*	15.6	97.5	15.4	4.2	5.6	16.4
LSD (P=.05)	13.3	14.2	13.8	0.5	3.8	10.1
CV	28.5	10.5	30.5	7.9	38.2	41.4
		------ascospores from corn kernels-------				
Harus	28.4	85.0	24.3	3.6	2.4	9.5
Freedom	10.8	77.5	8.4	3.4	4.5	11.6
Ena	9.4	80.0	7.6	3.1	3.2	17.5
25R57	27.1	97.5	26.6	4.0	8.5	16.9
Fundulea	13.4	92.5	12.5	3.7	2.7	12.0
PIONEER A*	10.3	82.5	8.6	3.4	4.6	11.6
PIONEER B*	7.1	70.0	5.0	4.0	8.2	19.0
PIONEER C*	7.1	72.5	5.4	4.3	2.4	12.7
PIONEER C*	7.3	77.5	5.6	4.5	1.9	9.1
LSD (P=.05)	5.0	10.9	5.4	0.7	5.4	8.8
CV	25.8	9.2	32.1	10.3	74.2	38.2

* experimental

** Fusarium damaged kernels

1998 PMR REPORT # 135 SECTION L: CEREAL, FORAGE, AND OILSEED CROPS
ICAR: 61006537

CROP: Winter Wheat *Triticum aestivum* L.
PEST: Wheat diseases

NAME AND AGENCY:
SCHAAFSMA A W, HOOKER D C, and SURGEONER G
Ridgetown College, University of Guelph, Ridgetown, Ontario N0P 2C0
Tel: (519)674-1624; Fax (519)674-1600; Email: aschaafs@ridgetownc.uoguelph.ca

TITLE: ON-FARM SEED TREATMENT RESPONSE IN WINTER WHEAT AS AFFECTED BY TILLAGE AND SOIL TYPE ACROSS SOUTHWESTERN ONTARIO

MATERIALS: Seed treatments and use rates kg^{-1} of seed: VITAFLO 280 at 3.30 mL, RAXIL (tebuconazole) at 0.02 g a.i. plus APRON XL at 0.03 mL. In 1998, two seed treatment combinations were added: RAXIL (same rate as 1997) plus APRON XL at 0.03 mL, and DIVIDEND (difenoconazole) at 0.33 mL plus APRON XL (at same respective rate).

METHODS: On-farm experiments were initiated in the Fall of 1997 among 26 fields in three maturity regions in southwestern Ontario: Ridgetown, London, and Guelph. The experiment was continued in the Fall of 1998 on 16 different farms with additional seed treatments. No wheat was planted in the Fall of 1998 in the Guelph area. In both years, fields intended for wheat were selected across three soil types (coarse-, medium-, and fine-textured) and three tillage regimes (conventional, minimum, and no-till), for a total of up to 9 tillage-soil type combinations per region. Most of the fields selected had been in a corn-soybean-wheat rotation for at least one cycle, and under the same tillage regime for at least three years. Some fields with specific tillage-soil type combinations were not found in some regions, while some combination of treatments were replicated at other fields.

Three seed treatments were available for the project prior to seeding in the fall of 1997. In each field, the seed treatments were replicated four times in a RCBD, for a total of 12 plots per field. All plots were planted by co-operators with their own planting equipment. Measurements include: the date of seedling emergence, precipitation, residue cover, maturity dates and grain yield. Any diseases or insect pests were documented. Grain was harvested for yield with field-scale harvesting equipment, and measured with a combine-equipped monitor or weigh wagon.

RESULTS: Preliminary analysis of wheat emergence rates, seedling density measurements, and disease ratings did not detect differences among seed treatments at individual fields, or among tillage systems and soil types during mid-November in either 1997 or 1998.

At most sites, wheat yields did not respond to seed treatments when compared to the untreated check. Only four sites responded to a seed treatment, and most of these were in no-till. Wheat yields were significantly higher ($P=0.02$) with treated seed planted no-till in clay soil (Table 2). Of those sites that responded to a seed treatment, there was no differences between VITAFLO 280 and RAXIL+APRON.

CONCLUSIONS: The lack of wheat yield response to seed treatment was expected for the 1998 crop.

Ideal growing conditions favoured crop growth and reduced disease pressure. Despite these conditions, a seed treatment appeared to be beneficial in no-till systems. Wheat yield response to seed treatments may greater under cool and wet conditions that favour most diseases.

Table 1. Wheat yield response to seed treatment means by field sites across Southwestern Ontario in 1998.

			Seed Treatment					Contrasts[3]	
Site	Soil Type	Tillage System	Vitaflo	Raxil + Apron	none	Pooled SE[1]	n[2]	none vs treated	Vitaflo vs Raxil+ Apron
			--------- Yield (t ha^{-1}) --------						
1	sand	no-till	5.03	5.07	4.81	0.12	4	0.1	ns
2	clay	no-till	4.78	4.44	3.94	0.19	4	0.02	ns
3	clay	minimum	6.21	6.28	6.37	0.06	4	ns	ns
4	loam	no-till	4.81	4.83	4.8	0.04	4	ns	ns
5	sand	minimum	5.02	4.9	5.03	0.06	4	ns	ns
6	clay	minimum	6.14	6.11	6.17	0.06	4	ns	ns
7	loam	no-till	4.44	4.45	4.79	0.15	4	ns	ns
8	clay	minimum	3.53	3.63	3.45	0.03	4	0.09	ns
9	clay	conventional	6.16	6.22	6.24	0.06	4	ns	ns
10	clay	no-till	5.98	5.95	5.89	0.06	4	ns	ns
11	loam	minimum	5.13	4.98	4.96	0.06	4	ns	ns
12	clay	minimum	5.33	5.44	5.3	0.09	4	ns	ns
13	sand	no-till	4.57	4.34	4.45	0.11	4	ns	ns
14	loam	no-till	4.26	3.94	4.15	0.12	4	ns	ns
16	loam	minimum	6.47	6.31	6.61	0.08	4	ns	ns
17	clay	minimum	4.53	4.67	4.32	0.18	4	ns	ns
19	clay	minimum	4.68	5.09	5.25	0.2	4	ns	ns
20	clay	no-till	4.75	4.95	4.99	0.18	4	ns	ns
21	sand	minimum	3.63	4.5	3.86	0.17	2	0.09	0.01

[1]Pooled SE across seed treatments

[2]Number of observations per mean

[3]ns= not significant at the 10% level of probability

Table 2. Tillage by soil type wheat yield means across sites as affected by seed treatments.

		Seed Treatment				Contrasts	
Soil Type	Tillage System	Vitaflo	Raxil+ Apron	none	n	none vs treated	Vitaflo vs Raxil+ Apron
Sand	Conventional	-1	-	-	-	-	-
	Minimum	4.56	4.77	4.64	6	ns	ns
	No-till	4.78	4.79	4.75	12	ns	ns
	Mean	4.67	4.78	4.7	18	ns	ns
Loam	Conventional	-	-	-	-	-	-
	Minimum	5.8	5.72	5.67	8	ns	ns
	No-till	4.5	4.41	4.58	12	ns	ns
	Mean	5.22	5.18	5.24	20	ns	ns
Clay	Conventional	6.16	6.22	6.24	4	ns	ns
	Minimum	5.07	5.16	5.09	24	ns	ns
	No-till	5.38	5.2	4.91	8	0.02	ns
	Mean	5.23	5.18	5	36	ns	ns

[1]- = no data available

1998 PMR REPORT # 136 SECTION L: CEREALS, FORAGE CROPS/OILSEEDS Diseases
STUDY DATA BASE: 364-1211-9604

CROP: Wheat, cvs. AC Cora, Roblin
PEST: *Fusarium graminearum*, fusarium head blight

NAME AND AGENCY:
TEKAUZ A and GILBERT J
Cereal Research Centre, Agriculture and Agri-Food Canada, 195 Dafoe Road, Winnipeg MB, R3T 2M9
Tel: (204) 983-0944 Fax: (204) 983-4604 E-mail: atekauz@em.agr.ca

TITLE: EFFICACY OF FOLIAR FUNGICIDES FOR CONTROL OF FUSARIUM HEAD BLIGHT IN WHEAT IN MANITOBA IN 1996.

MATERIALS: FOLICUR (tebuconazole, 431 ml ai/L); TILT (propiconazole, 250 g ai/L).

METHODS: Plots of wheat cvs. AC Cora and Roblin were established at the Cereal Research Centre Field Station at Glenlea MB on June 12 1996. Plots were 5 m long, of 4 rows with 30 cm row spacing, and were replicated 3 times. Three treatments were applied with a hand-held sprayer: a single application of FOLICUR at 125 ml ai/ha (plus RENEX 36 at .25% v/v) or TILT at 125 g ai/ha at GS 65 and a non-treated control. Treatments were targeted to the spikes/heads of plants. Roblin was treated on July 29 and AC Cora on August 6. A few days later, when 50% of heads were at anthesis (August 1 for Roblin, Aug 12 for AC Cora), spikes were inoculated (sprayed) with an aqueous conidial suspension (5×10^4 spores per ml) of a mixture of *Fusarium graminearum* isolates. This was repeated 4 days later. Controls were sprayed with distilled water. Plots were sampled 18 days after inoculation by collecting 40 heads at random and evaluating these for FHB on the basis of their 'FHB Index' (FHB Index = %incidence x %severity / 100). Plots were harvested September 13 (Roblin) and September 18 (AC Cora) to determine yields. Harvested grain samples were used to determine levels of Fusarium damaged kernels (FDK) and deoxynivalenol (DON) using ELISA.

RESULTS: Fusarium head blight developed to moderately severe levels in cv. Roblin (32%), but only very light levels in AC Cora (4%). In the near-by inoculated and mist-irrigated FHB Nursery at Glenlea in 1996, Roblin and AC Cora had 48 and 19 % FHB, respectively. No supplemental moisture was applied to the fungicide test plots. Severity of FHB and other measured parameters are shown in Table 1.

CONCLUSIONS: AC Cora is classified as MR-MS to FHB while Roblin is rated as susceptible. No significant effect on FHB was observed in AC Cora with either product. In Roblin, TILT reduced disease severity significantly, by 64%, and FDK levels numerically by 25%. Deoxynivalenol levels were not affected by treatments. Yield was enhanced numerically 11% and 25% by TILT and FOLICUR, respectively. Roblin had considerably higher levels of FHB, FDK and DON compared to AC Cora.

Table 1. Effect of fungicide treatment on Fusarium head blight in spring wheat.

Cv	Treatment	Rate g ai/ha	FHB Index %	FDK %	DON ppm	Yield kg
AC Cora	Control	- -	3.6 a*	1.4 a	0.95a	1.98 a
	FOLICUR	125	2.9 a	2.2 a	0.90a	1.91 a
	TILT	125	3.3 a	2.5 a	0.50a	1.83 a
Roblin	Control	- -	32.2 b	31.8 b	7.67b	0.95 b
	FOLICUR	125	28.6 b	28.8 b	7.05b	1.15 b
	TILT	125	11.5 c	23.9 b	8.10b	1.06 b

* For individual cultivars., values in a column followed by the same letter are not significantly different from each other at $P<0.05$

1998 PMR REPORT # 137 SECTION L: CEREALS, FORAGE CROPS/ OILSEEDS Diseases
STUDY DATA BASE: 364-1211-9604

CROP: Wheat, cvs. Roblin, AC Splendor
PEST: *Fusarium graminearum, Pyrenophora tritici-repentis, Septoria tritici*

NAME AND AGENCY:
TEKAUZ A, GILBERT J and McCALLUM B
Cereal Research Centre, Agriculture and Agri-Food Canada, 195 Dafoe Road, Winnipeg MB, R3T 2M9
Tel: (204) 983-4604 Fax: (204) 983-4604 E-mail: atekauz@em.agr.ca

TITLE: EFFICACY OF FOLIAR FUNGICIDES FOR CONTROL OF FUSARIUM HEAD BLIGHT AND LEAF SPOTS IN WHEAT IN MANITOBA IN 1997.

MATERIALS: BRAVO (chlorothalonil [tetrachloroisophthalonitrile], 500 ml ai/L); TILT (propiconazole, 250 g ai/L)

METHODS: Plots of Roblin and AC Splendor hard red spring wheat were established at the Cereal Research Centre Field Station at Glenlea MB on June 20 1997. Plots were of 7 rows wide with 20 cm row spacing and 5 m long. Six treatments were applied: 1) non-treated control, sprayed with water at ZGS 46; 2) BRAVO, 2.5L/ha at ZGS 46; 3) TILT, 0.5L/ha at ZGS 46; 4) BRAVO, 2.5 L/ha at ZGS 64; 5) TILT, 0.5L/ha at ZGS 58; and 6) BRAVO + TILT, 2.5L and 0.5L/ha at ZGS 58. Treatments were applied as a spray to the upper canopy and/or spikes using a hand-held garden sprayer. Subsequently, at ZGS 65 (50% anthesis), all plants were inoculated (sprayed) with a conidial suspension prepared from several *Fusarium graminearum* isolates. This was repeated 4 days later. Plants were mist-irrigated following inoculation. After 21 days, 100 heads per plot were sampled at random, and stored in plastic bags at -20C, to later assess FHB severity using the 'FHB Index' = %incidence x %severity / 100. Beginning at ZGS 70 (July 24) and on five subsequent occasions (final sampling Aug 22), 10 flag leaves per plot were rated for percent infection (non-green tissue) caused by leaf spots. At maturity the 3 centre rows of each plot were harvested to compare yields, and deoxynivalenol (DON) levels using ELISA.

RESULTS: Fusarium head blight developed to moderate levels in both test cultivars, while leaf spot development was classified as 'light'. The latter was based on naturally occurring inoculum. The results for FHB are shown in Tables 1 (severity) and 2 (test weight and thousand kernel weight) for the six treatments. There were no treatment differences for DON accumulation, but levels of DON were higher in Roblin (10.9 ppm) than AC Splendor (7.4 ppm). Leaf spots developed very slowly, and appreciable levels and differences between treatments were not apparent until ZGS 82. There were no variety by treatment interactions for leaf spot severity and therefore the data for the two cultivars are combined. Leaf spot severity for the final reading (ZGS 90) is shown in Table 1. Uneven germination and stand establishment at the Glenlea test site invalidated the yield data. Therefore, test weight and thousand kernel weight (TKW) were analyzed instead. Average test weight in AC Splendor was higher than in Roblin (80.2 vs 76.9), but there were no treatment by variety interactions.

CONCLUSIONS: Roblin and AC Splendor wheats are classified as susceptible to FHB and leaf spots. All treatments controlled FHB, but there were some variety by treatment interactions. Tilt at ZGS 46

gave the best control in AC Splendor, but in Roblin, best control was achieved by Tilt at ZGS 58, Bravo at ZGS 64 and the combined treatment at ZGS 58. All treatments reduced FHB in Roblin, but not in AC Splendor. Test weights and TKW may have been affected by variable stands, and by both FHB and leaf spots, but the late onset and light severity of leaf spotting suggests most of the disease effects were due to FHB. Test weights were highest (greatest effect) with the later-applied treatments, i.e., treatments 4, 5 and 6. Thousand kernel weights were generally low, likely the result of late-seeding (due to flooding). Any differences in TKW caused by fungicide treatment should therefore be interpreted with caution.

Table 1. Fusarium head blight and leaf spot severity (least square means) in Roblin and AC Splendor spring wheat following fungicide treatment.

Treatment	Timing	FHB Index		Leaf spot severity (%)
		Roblin	AC Splendor	
1. Control	- - - - - -	31.3*a**	22.8 a	26.5 a
2. BRAVO	ZGS 46	23.8 b	20.0 a	11.8 b
3. TILT	ZGS 46	23.9 b	13.2 b	5.9 c
4. BRAVO	ZGS 64	13.6 c	19.0 ab	16.0 b
5. TILT	ZGS 58	13.7 c	19.6 ab	6.2 c
6. TILT+BRAVO	ZGS 58	15.4 c	17.4 ab	5.5 c

* FHB Index = %incidence x % severity / 100

** Means in a column followed by the same letter are not significantly different at P<0.05

Table 2. Test weight and thousand kernel weight in spring wheat treated with fungicides and inoculated with *Fusarium graminearum* (Fusarium head blight)

Treatment	Timing	Test weight (g/dL)	TKW (g)	
			Roblin	AC Splendor
1. Control	- - - - -	77.8 a*	26.1 b	26.3 c
2. BRAVO	ZGS 46	77.8 a	24.9 a	27.2 c
3. TILT	ZGS 46	78.5 ab	26.2 b	27.3 c
4. BRAVO	ZGS 64	78.9 b	26.0 b	27.1 c
5. TILT	ZGS 58	79.1 b	26.2 b	25.2 a
6. TILT+BRAVO	ZGS 58	79.3 b	27.4 c	26.1 b

* Means in a column followed by the same letter are not significantly different at P<0.05

1998 PMR REPORT # 138 **SECTION L: CEREALS, FORAGE CROPS/OILSEEDS - Diseases**
STUDY DATA BASE: 379-1211-9501

CROP: Durum (*T. turgidum* L. var. *durum*) and hard red spring (*T. aestivum* L.) wheat
PEST: Tan spot, *Pyrenophora tritici-repentis*

NAME AND AGENCY:
WANG H, FERNANDEZ M R, DEPAUW R M AND CLARKE J M
Semiarid Prairie Agricultural Research Centre, Agriculture and Agri-Food Canada
P.O. Box 1030, Swift Current, Saskatchewan S9H 3X2
Tel: (306) 778-7200; **Fax:** (306) 773-9123; **Email:**wangh@em.agr.ca

TITLE: THE IMPACT OF LEAF SPOT CONTROL WITH FUNGICIDE APPLICATION ON GRAIN YIELD AND QUALITY IN WHEAT

MATERIALS: FOLICUR 3.6F (tebuconazole, 39 %) and BRAVO 500 (chlorothalonil, 500 g/L)

METHODS: A study to determine the impact of leaf spots on grain yield and quality of wheat was conducted at Swift Current (Brown soil) and Indian Head (Black soil), in Saskatchewan in 1998. Three durum (Durex, Kyle and DT665) and three hard red spring (AC Domain, Laura and AC Elsa) genotypes were grown on summerfallow in four replicates, using a factorial, randomized complete block design. Two fungicides, FOLICUR 3.6F (tebuconazole) and BRAVO 500 (chlorothalonil) were used in seven treatments (Table 1) at spray rates of 336 ml product ha^{-1} and 2500 ml product ha^{-1}, respectively. Plots were 16-row, 3m long and 0.23 m apart, with 1 m wide buffer areas seeded to fababean in between plots. Twenty flag leaves and penultimate leaves were sampled randomly from each plot within one day before each fungicide application and at the late milk stage. Leaf spot severity was determined by estimating the percentage of leaf area infected. Grain yield, kernel weight, test weight, grain protein content and the incidence of black point and red smudge were determined after harvest.

RESULTS: Tan spot (*Pyrenophora tritici-repentis*) was the most prevalent leaf spotting disease at both locations, accounting for about 95% of leaf area infected. Other pathogens found in low frequency were *Cochliobolus sativus* and *Septoria tritici.* Leaf spot severity was higher at Swift Current than Indian Head (Table 1). Genotype differences in the incidence of leaf spotting diseases were similar at both sites. The mean flag leaf spot severity at late milk of the control (untreated) treatment for both sites was highest for Durex (27 %), followed by AC Domain (17 %), Laura (10 %), Kyle (8 %), AC Elsa (5 %) and DT 665 (5 %). Fungicide applications significantly reduced leaf spot severity at both sites. In general, FOLICUR had a greater effect than BRAVO. Early applications of BRAVO (Treatment 5) were more effective than late applications (Treatments 6). For both fungicides, applications at both growth stages (Treatments 4 and 7) did not cause a significantly greater reduction in leaf spot severity than early applications (Treatments 2 and 5). There were no significant differences in grain yield among treatments at Swift Current, although some of the treatments (4 and 5) had greater kernel weight than the untreated control. Applications of FOLICUR (Treatments 2 to 4) and early application of BRAVO (Treatment 5) showed higher yield and greater kernel weight than the untreated at Indian Head. Most fungicide treatments at Swift Current, and FOLICUR treatments at Indian Head, increased test weight. There were no significant differences in grain

protein content among treatments at Swift Current. At Indian Head, the double application of BRAVO (Treatment 7) was the only treatment that resulted in an increase in protein concentration. The incidence of kernel black point and red smudge was lower at Swift Current than at Indian Head. There were significant differences among treatments in black point at both sites and in red smudge at Indian Head. Late and double application of BRAVO (Treatments 6 and 7) reduced kernel diseases. Early applications of both fungicides (Treatments 2 and 5) resulted in an increase in black point at Indian Head. There were significant genotype X treatment interactions for leaf spot severity, grain yield, kernel weight, test weight, protein content, black point, and red smudge at Indian Head, meaning that the effects of the treatments differed among genotypes. For example, Treatment 3 resulted in a significant increase in grain yield of Durex (4.3 t ha^{-1} for the untreated and 5.4 t ha^{-1} for Treatment 3) but not of AC Domain. For both genotypes, leaf spotting severity was significantly reduced by Treatment 3.

CONCLUSIONS: Both fungicides caused a significant reduction in leaf spotting diseases of common and durum wheat at Swift Current and Indian Head. FOLICUR applications had a greater effect than those of BRAVO. In most cases, fungicide treatments caused an increase in grain yield, kernel weight and test weight. Late and double application of BRAVO reduced black point and red smudge on kernels, but early application of both fungicides resulted in an increase in black point incidence at Indian Head.

Table 1. Leaf spot severity on the flag leaf at late milk stage, grain yield, kernel weight, test weight, grain protein content, kernel black point and red smudge (means of all genotypes).

Treatment No.	Fungicide	Growth stage†	Leaf spot severity %	Grain yield t ha^{-1}	Kernel weight mg	Test weight kg hL^{-1}	Protein content %	Black point %	Red smudge %
Swift Current									
1	Untreated control		13.0	3.6	33.1	78.9	13.7	0.4	0.0
2	FOLICUR	37	5.7	3.6	33.9	79.6	13.9	0.4	0.0
3	FOLICUR	58	6.9	3.7	33.3	79.4	13.6	0.3	0.0
4	FOLICUR	37 & 58	4.2	3.8	34.4	79.7	13.5	0.3	0.0
5	BRAVO	39	6.5	3.6	34.2	80.0	13.5	0.4	0.1
6	BRAVO	58	9.8	3.6	33.6	79.7	13.3	0.2	0.0
7	BRAVO	39 & 58	.1	3.7	33.8	79.8	14.0	0.2	0.0
LSD (0.05)			2.5	NS	0.9	0.6	NS	0.1	NS
Indian Head									
1	Untreated control		10.8	4.2	36.6	79.0	14.1	5.0	0.6
2	FOLICUR	39	3.2	4.7	38.1	79.4	14.3	9.1	0.5
3	FOLICUR	58	3.2	4.8	38.2	80.0	13.9	4.9	0.4
4	FOLICUR	39 & 58	2.9	4.7	38.1	80.0	14.0	4.7	0.5
5	BRAVO	39	2.9	4.5	37.7	79.3	14.4	6.9	0.5
6	BRAVO	58	5.5	4.3	36.1	79.1	14.4	3.8	0.3
7	BRAVO	39 & 58	3.3	4.3	36.2	78.4	14.8	4.1	0.3
LSD (0.05)			1.5	0.2	0.6	0.2	0.4	1.0	0.2

† Zadoks-Chang-Konzak scale.

END OF L.
SECTION M - NO REPORTS

SECTION N - NO REPORTS
SECTION 0 - NO REPORTS - For related reports, see # 24, 27, 42.
END OF DISEASES SECTION I - L.

English **1998 PEST MANAGEMENT RESEARCH REPORT**

Compiled for: THE EXPERT COMMITTEE ON INTEGRATED PEST MANAGEMENT
Chairperson: Hugh G. Philip, P.Ag.

Prepared by: Research Branch, Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
London, Ontario, CANADA N5V 4T3

The Official Title of the Report
1998 Pest Management Research Report - 1998 Growing Season: Compiled for the Expert Committee on Integrated Pest Management, by Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre, London, Ontario, Canada N5V 4T3. February, 1999. 391pp.
Published on diskette and Internet at http://res.agr.ca/lond/pmrc/pmrchome.html.

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 138 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 Stephanie Hilton for editorial and computer compilation services. Suggestions for improving this publication are always welcome.

What is on the diskette? There are three WordPerfect text files on this diskette or with this Email.
1. **98contents.wpd** (1) contains the title page and **TABLE OF CONTENTS** and **INDEXES.**
2. **98insect_pmrr.wpd** (2) contains the entomology sections and the biological control practices.
3. **98disease_pmrr.wpd** (3) contains the diseases sections.
Note: Files (2 - 3) have sequential page numbers.
Indexes consist of:
Crop/Host, Pests (Insects/Mites; Diseases), Pest Management and Biological Control Methods (includes Cultivar testing), Products, Authors*, Establishments. (* Report and page numbers - others are page number only)

To Read the Report The files can be read by any IBM or IBM compatible PC using WordPerfect software. Most PC will convert to Word. The files on diskette have been compressed with an executable program included to expand them. If you have any trouble accessing the files, please let me know and I will see if I can make appropriate changes for your system.
Contact Compiler, Stephanie Hilton at Tel. (519) 457-1470 Ext. 218
Fax (519) 457-3997
Email hiltons@em.agr.ca

To Print the Report
To print individual research reports, or the complete version of the report, WordPerfect will automatically reformat the file for your printer. The pitch and margin settings are stored as part of the document and should not be changed.

Procedures for the 1999 Annual Report will be sent in September, 1999, or contact Stephanie Hilton.

Français **Rapport de recherches sur la lutte dirigée - 1998**

Préparé pour: **LE COMITÉ D'EXPERTS SUR LA LUTTE INTÉGRÉE**
Président: **Hugh G. Philip, P.Ag.**
Préparé par: **Agriculture et agroalimentaire Canada**
Centre des recherches du Sud sur la phytoprotectin et les aliments
London, (Ontario) CANADA N5V 4T3

Titre officiel du document
1998 Rapport de recherches sur la lutte dirigée - pour le saison 1998. Compilé par le Comité d'experts sur la lutte intégrée, par Agriculture et Agroalimentaire Canada, London (Ontario) Canada N5V 4T3. Février, 1999. 391p. Publié sur disquette et l'Internet à http://res.agr.ca/lond/pmrc/pmrchome.html

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

Cette année, nous avons donc reçu 138 rapports. Les membres du Comité d'experts sur la lutte intégrée tiennent à remercier chaleureusement les chercheurs des ministères provinciaux et fédéraux, des universités et du secteur privé sans oublier les rédacteurs, qui ont fait la révision scientifique de chacun des rapports et en ont assuré la qualité, et Stephanie Hilton qui ont fourni les services d'édition et de compilation sur ordinateur. Vos suggestions en vue de l'amélioration de cette publication sont toujours très appréciées.

Instructions pour l'utilisation de la disquette.
Cette disquette contient quatre fichiers de texte WordPerfect.
98contents (1) contient l'avant-propos et **LA TABLE DES MATIÈRES** et **LES INDICES.**
98insect_pmrr.wpd (2) contient les sections d'entomologie et les pratiques biologiques.
98diease_pmrr.wpd (3) contient les sections sur les maladies.
Les sept indices liste pour le Rapport de recherche: Hôtes (cultures), Ravageurs (des insectes; des maladies des plantes), Méthodes de lutte biologique et Variéties, Produits (chimiques), Auteurs*, et Établissements.
*** numéros de rapport et numéros de page.**

Pour lire le rapport. On peut lire ces fichiers à l'aide d'un ordinateur personnel IBM ou d'un ordinateur personnel compatible IBM et d'un logiciel WordPerfect. Si vous avez des probleme, contacter Stephanie Hilton à Tel. (519) 457-1470 Ext. 218 ou Email hiltons@em.agr.ca

Pour imprimer le rapport.
Si vous désirez imprimer des rapports de recherche partiels, ou la version complète du rapport, WordPerfect va automatiquement reformater le fichier selon les valeurs implicites de votre imprimante. Les paramètres pour l'interligne et les marges sont enregistrés comme faisant partie du document et ne devraient pas être modifiés.
Note : À cause des variations d'imprimantes, les fichiers 2 à 3 commencent avec avec les numéros de pages continuelles. On mettre les fichiers ensemble pour faire un document sur le disque dur en suivant l'ordre mentionné ci-haut.

On vous enverra les procédures pour l'année 1999 en septembre, 1999 ou s'il-vous-plaît contacter Stephanie Hilton au Centre de recherches du Sud sur la phytoprotection et les aliments à London.
Tél. (519) 457-1470 Ext. 218 ou Télécopie (519) 457-3997./ Email: hiltons@em.agr.ca

TABLE OF CONTENTS /TABLE DES MATIERES

Index 1. CROP/HOST

Index 2. PESTS

Index 3. PEST MANAGEMENT AND BIOLOGICAL CONTROL METHODS

Index 4. PRODUCTS

Index 6. Establishments. **Page #**

EXPERT COMMITTEE ON INTEGRATED PEST MANAGEMENT (ECIPM)

TO: ALL RESEARCH, EXTENSION AND REGULATORY PERSONNEL IN CANADA CONCERNED WITH PEST MANAGEMENT

SUBJECT: **"Pest Management Research Report - Insects and Plant Diseases"**

One of the objectives of the ECIPM is to facilitate the exchange of information on Integrated Pest Management (IPM) among persons involved in research and advisory services on IPM of insect pests and plant diseases of importance to the agri-food industry in Canada. To this end, the Pest Management Research Report (PMRR) is published annually as a compilation of research reports by federal and provincial government, university and industry research and advisory personnel. These reports are available to support the registration of pest control products and devices and to develop recommendations for insect and disease management programs throughout Canada.

To increase the value of the report, everyone in Canada who is carrying on studies involving pest management in agriculture is urged to report their results in the form outlined in the attached guide (also available in French). Sufficient information should be supplied to permit the reader to clearly understand the way in which the work was done, the design of experiments, and the reasoning behind the interpretation of data. This does not mean that the report is to be lengthy. We believe that ONE or two pages is sufficient to cover all relevant details in a precise, informative manner.

Industry research managers and directors of research establishments are asked to bring this material to the attention of those on their staff who could be contributors to the Report.

Note: The deadlines have been moved to a later date than previous years, to allow time for researchers to complete data collection and to do the necessary statistical analyses. Deadlines will be strictly observed.

Thank you for your cooperation.

Sincerely,

Hugh G. Philip, P.Ag.

Chairman/Président - ECIPM/CELI
Expert Committee on Integrated Pest Management
Mr. Hugh G. Philip, P.Ag.
B.C. Min. Agriculture, Food and Fisheries
200 - 1690 Powick Road
Kelowna, British Columbia V1X 7G5

Email: hugh.philip@gems8.gov.bc.ca
Tel: (250) 861-7230
Fax: (250) 861-7490

Secretary/Secrétaire - ECIPM/CELI
Dr. Owen Olfert
Agriculture and Agri-Food Canada
Saskatoon Research Centre
107 Science Place, Saskatoon, Saskatchewan S7N 0X2

Email: olferto@em.agr.ca
Tel: (306) 956-7288
Fax: (306) 956-7247

INSTRUCTIONS FOR SUBMITTING RESEARCH REPORTS
(Also available in French)

The process for submitting research reports for publication in the 1998 Pest Management Research Report is as follows:

1. Authors: Prepare the electronic version of your report as outlined (see typing instructions, page 3), following the format in the examples. Include a Study Data Base or ICAR number, if available. Send a PAPER COPY to the appropriate Section Editor by **NOVEMBER 13, 1998** (refer to the list of sections and editors on page 4-6).

2. Editors: Return the original paper copy to the author with corrections, if any, by **DECEMBER 4**. Editors are requested to make sure reports are correctly formatted. Prepare a list of papers edited for your section and send it to Stephanie Hilton.

3. Authors: Make any corrections as suggested by the Section Editor. For collation purposes, indicate the Section Editor's name for each file name. Please save each report in a separate file. FILENAME: first letter - Section; next three letters - first 3 letters of crop; next 3 letters - first 3 letters of author; last - # of submission (if you sent in three, they would be 1, 2 and 3. e.g. for English example on page 7: HDRYHOW1). WordPerfect is preferred but Word acceptable. If you do not have access to WordPerfect or Word, save the file as an ASCII file in DOS. Label your diskette accordingly. Authors should return a revised copy of their report to the respective section editor, as well as to the Compiler.

4. Authors: Send the corrected report to the Compiler, S. A. Hilton (see below) by the **DEADLINE OF DECEMBER 18, 1998** in one of two ways:

- on a 3 ½ IBM-compatible high density (1.4 megabyte) DISKETTE, saved in WordPerfect or Word and ONE PAPER COPY of the report by courier or priority post, or

- by Email to hiltons@em.agr.ca

The Compiler (S.A. Hilton) will collate, index and format reports to produce one complete document on diskette. Users, authors, editors, federal, provincial and industry representatives will receive the file by email unless they request a diskette copy. Libraries will receive a diskette copy of the report from the compiler. Users can also request the report by email. It will also be available for downloading from the SCPFRC web site on the Internet at <http://res.agr.ca/lond/pmrc/pmrchome.html>

Users are invited to print or copy the diskette and distribute the information freely among colleagues.

Your cooperation is greatly appreciated. Any questions, please contact:

Stephanie Hilton
Pest Management Research Report
Agriculture and Agri-Food Canada
Tel: (519) 457-1470 Ext 218
Fax: (519) 457-3997

Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, Ontario N5V 4T3

Email: hiltons@em.agr.ca

1998 PMRR FORMATTING INSTRUCTIONS

The final report is available in ELECTRONIC format only. Please follow the instructions to reduce compilation errors and ensure retrieval of the data in the final report.

FORMAT IN WORDPERFECT (preferred) or WORD

Initial Base Font	- Times New Roman, 11 pt
Paper size	- 8.5" x 11"
Justification	- Left
Line spacing	- 1
Line length	- not to exceed margins
Margins	- all 1" (left, right, top, bottom)

ORDER AND STYLE

REPORT # xxx (assigned by compiler) **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE or ICAR #: see p.6

Headings: UPPERCASE and **BOLD**, followed by a close-up full colon:
e.g. **STUDY DATA BASE:**
[blank line]
CROP: Text follows on the same line after tab
PEST: Text follows on the same line after tab
[blank line]
NAME AND AGENCY: on a line by itself
AUTHOR's SURNAME followed by initials in UPPERCASE, *e.g.* HILL B D and CHANG C
Affiliation, full address, postal code
Tel**. (**xxx)xxx-xxxx Fax (xxx) xxx-xxxx E-mail**:** hiltons@em.agr.ca
[blank line]
TITLE: [INDENT] **EFFECTS OF PYRIDABEN ON RED MITES**
[blank line]
MATERIALS: [on same line] PRODUCT TRADE NAMES IN UPPERCASE; common names in lowercase
[blank line]
METHODS: Follow English and French examples on following pages. *Latin names in italics.*
[blank line]
RESULTS: Data are presented in table 1. Or text and/or table.
[blank line]
CONCLUSIONS:
[blank line]
Table 1. Title of table not in bold.
DO NOT use underline to input tables or divide text. Use hyphens or horizontal lines and tabs.
OR use Table feature with same style. Align all decimals within your table(s). Use decimal tab.
[blank line to end report to separate it from the next when compiled]

BLOCK PROTECT - very important
Block protect from # to the end of the title as one block, and block protect tables, Latin names and other

text that must remain close together in the final report. DO NOT use forced page breaks.

1998 - SECTIONS AND EDITORS

ENTOMOLOGY - Sections A - G

A) FRUIT/FRUITS

Insects of Tree Fruits
J. Mike Hardman
Agriculture and Agri-Food Canada
Atlantic Food & Horticulture Research Centre
32 Main Street
Kentville, Nova Scotia B4N 1J5
Email:hardmanm@em.agr.ca
Tel: (902) 679-5730
Fax: (902) 679-2311

A also) Insects of Berry Crops
Dr. Bruce Neill
PFRA Shelterbelt Centre
Agriculture and Agri-Food Canada
Indian Head, Saskatchewan S0G 2K0
Email: pf21801@em.agr.ca
Tel: 306) 695-2284
Fax: (306) 695-2568

B) VEGETABLES and SPECIAL CROPS
Dr. Jeff H. Tolman
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre, 1391 Sandford St.
London, Ontario N5V 4T3
Email: tolmanj@em.agr.ca
Tel: (519) 457-1470 Ext. 232
Fax: (519) 457-3997

C) POTATO INSECTS
Dr. Jeff G. Stewart
Agriculture and Agri-Food Canada
Charlottetown Research Centre
440 University Avenue, P.O. Box 1210
Charlottetetown, PEI C1A 7M8
Email:stewartj@em.agr.ca
Tel: (902) 566-6844
Fax: (902) 566-6821

D) MEDICAL and VETERINARY
Dr. Doug Colwell
Agriculture and Agri-Food Canada
Lethbridge Research Centre
P.O. Box 3000, Main
Lethbridge, Alberta T1J 4B1
Email: colwelld@em.agr.ca
Tel: (403) 327-4591 ext. 344
Fax: (403) 382-3156

E) CEREALS, FORAGE CROPS and OILSEEDS
Dr. Owen Olfert
Agriculture and Agri-Food Canada
Saskatoon Research Centre
107 Science Place
Saskatoon, Saskatchewan S7N 0X2
Email: olferto@em.agr.ca
Tel: (306) 956-7288
Fax: (306) 956-7247

F) ORNAMENTALS and GREENHOUSE
Dr. Les Shipp
Agriculture and Agri-Food Canada
Greenhouse and Processing Crops
Research Centre, Highway 18
Harrow, Ontario N0R 1G0
Email: shipps@em.agr.ca
Tel: (519) 738-2251
Fax: (519) 738-2929

ENTOMOLOGY - Sections A - G ... continued

G) BASIC STUDIES

Mrs. Stephanie A. Hilton Email: hiltons@em.agr.ca
Agriculture and Agri-Food Canada **Tel: (519) 457-1470 ext. 218**
Southern Crop Protection and Food Fax: (519) 457-3997
Research Centre, 1391 Sandford St.
London, Ontario N5V 4T3

PEST MANAGEMENT METHODS - Section H (a-c)

H) a. BIOLOGICAL CONTROL OF WEEDS

Dr. Rosemarie DeClerck-Floate Email: floater@em.agr.ca
Agriculture and Agri-Food Canada Tel: (403) 327-4561
Lethbridge Research Centre Fax: (403) 382-3156
Highway 3 East, P.O. Box 3000, Main
Lethbridge, Alberta T1J 4B1

H) b. BIOLOGICAL CONTROL of Insects, Mites, Nematodes

Dr. David R. Gillespie Email: gillespied@em.agr.ca
Agriculture and Agri-Food Canada Tel: (604) 796-2221 ext. 210
Pacific Agriculture Fax: (604) 796-0359
Research **Centre (Agassiz)**, P.O. Box 1000
6947 Number 7 Highway
Agassiz, British Columbia V0M 1A0

H) c. SEMIOCHEMICALS - Insect Pheromones and Natural Products

Dr. R.M. Trimble Email: trimbler@em.agr.ca
Agriculture and Agri-Food Canada Tel: (905) 562-4113
Southern Crop Protection and Food Fax: (905) 562-4335
Research Centre, 4902 Victoria Ave. N.
P.O. Box 6000
Vineland Station, Ontario L0R 2E0

PLANT PATHOLOGY - Sections I - P

I) FRUIT - Diseases

Ms. Leslie S. MacDonald Email: leslie.macdonald@gems3.gov.bc.ca
B.C. Ministry of Agriculture, Fisheries &Food Tel: (604) 556-3029
1767 Angus Campbell Road Fax: (604) 556-3030
Abbotsford, British Columbia V3G 2M3

J) VEGETABLES and SPECIAL CROPS - Diseases

Dr. Ray F. Cerkauskas Email: cerkauskasr@em.agr.ca
Agriculture and Agri-Food Canada Tel: (519) 738-2251
Greenhouse and Processing Crops Fax: (519) 738-2929
Research Centre, Highway 18
Harrow, Ontario N0R 1G0

K) POTATOES - Diseases

Ms. Agnes M. Murphy Email: murphya@em.agr.ca
Agriculture and Agri-Food Canada Tel: (506) 452-3260
Fredericton Rearch Centre Fax: (506) 452-3316
850 Lincoln Road, P.O. Box 20280
Fredericton, New Brunswick E3B 4Z7

PLANT PATHOLOGY - Sections I - P ... continued

L) CEREALS, FORAGE CROPS and OILSEEDS - Diseases

Dr. Richard A. Martin
Agriculture and Agri-Food Canada
Charlottetown Research Centre
440 University Avenue, P.O. Box 1210
Charlottetown, P.E.I. C1A 7M8
Email: martinra@em.agr.ca
Tel: (902) 566-6851
Fax: (902) 566-6821

L Also)
SMUT - Diseases

Dr. Jim G. Menzies
Agriculture and Agri-Food Canada
Winnipeg Research Centre
195 Dafoe Road
Winnipeg, Manitoba R3T 2M9
Email: jmenzies@em.agr.ca
Tel: (204) 983-5714
Fax: (204) 983-4604

M) ORNAMENTALS, GREENHOUSE and TURF - Diseases

Dr. Gary Platford
Soils and Crops Branch
Manitoba Agriculture
Box 1149, 65 - 3rd Avenue N.E.
Carman, Manitoba R0G 0J0
Email: gplatfor@agric.gov.mb.ca
Tel: (204) 745-2040
Fax: (204) 745-2299

N) NEMATODES

Dr. Joe Kimpinski **Email: kimpinskij@em.agr.ca**
Agriculture and Agri-Food Canada
Charlottetown Research Centre
440 University Avenue, P.O. Box 1210
Charlottetown, Prince Edward Island C1A 7M8
Tel: (902) 566-6851
Fax: (902) 566-6821

RESIDUES

O) CHEMICAL RESIDUES

Dr. Brian D. Ripley
Lab Services Div.
University of Guelph
95 Stone Road West, Loading Zone 2
Guelph, Ontario N1H 8J7
Email: lsd.lsd_po(BRipley)
Tel: (519) 767-6206
Fax: (519) 767-6240

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PMR REPORT # 84 **SECTION H: DISEASES OF VEGETABLES AND SPECIAL CROPS**
ICAR: 93000482

CR0P: Dry bean (*Phaseolus vulgaris* L.), cv. CDC Expresso
PEST: Halo blight, *Pseudomonas syringae* pv. *phaseolicola* (Burkh.) Young *et al.*

NAME AND AGENCY:
HOWARD R J, CHANG K F, BRIANT M A, MADSEN B M and GRAHAM S G
Alberta Agriculture, Food and Rural Development
Crop Diversification Centre, South
SS 4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1328; Fax: (403) 362-1326; Email: howardr@agric.gov.ab.ca

TITLE: EFFICACY OF SEED TREATMENTS FOR THE CONTROL OF HALO BLIGHT ON DRY EDIBLE BEANS: I. GREENHOUSE TRIALS WITH NATURALLY INFESTED SEED AT BROOKS, ALBERTA, IN 1996

MATERIALS: AGRICULTURAL STREPTOMYCIN (streptomycin sulphate 62.6% WP; equivalent to 50% streptomycin base), STREPTOMYCIN 17 (streptomycin sulphate 25.2% WP; equivalent to 17% streptomycin base), THIRAM 75 WP (thiram 75% WP), CHEM-COP 53 (tribasic copper sulfate 53% WP)

METHODS: CDC Expresso black bean seed naturally infested with *Pseudomonas syringae* pv. *phaseolicola* was treated with one rate of AGRICULTURAL STREPTOMYCIN + THIRAM 75 WP, three rates of STREPTOMYCIN 17 + THIRAM 75 WP, one rate of CHEM-COP 53 + THIRAM 75 WP, and one rate of THIRAM 75 WP. The prescribed amounts of AGRICULTURAL STREPTOMYCIN were each mixed in 3.5 mL of water, and 13.0 mL of water was added to each portion of STREPTOMYCIN 17. Each chemical treatment (Table 1) was applied as a slurry to a separate, 1000 g lot of seed that had been commercially treated with THIRAM 75 WP. An additional lot of seed was treated with tap water as a control. In the laboratory, seed treatments were applied with a Gustafson Batch Lab Treater. Before each test lot was treated, 1000 g of seed was run through the treater to pre-coat the drum with the respective chemical treatment in order to minimize adhesion losses during subsequent treatments. A sample of CDC Expresso bean seed treated with AGRICULTURAL STREPTOMYCIN + THIRAM 75 WP (1.0 g + 1.0 g) was obtained from a commercial seed treatment plant in southern Alberta for comparison with the laboratory-treated seed. On May 28, the treated and untreated seeds was planted in sterilized potting soil. Each treatment consisted of eight, 15 cm diameter pots (replications) with 25 seeds per pot. The pots were placed in a greenhouse at CDC South using a randomized complete block design. Emergence counts were done June 7 and 10, and the data were tabulated, arcsin transformed and subjected to ANOVA.

RESULTS: Treated bean seed germinated and emerged much better than untreated seed (Table 1). Mixing streptomycin with thiram significantly (P#0.05) improved emergence, when compared to thiram alone, in three of the five cases where they were combined. Overall, the mixture of STREPTOMYCIN 17 + THIRAM 75 WP (2.0 g + 1.0 g) appeared to perform the best.

CONCLUSIONS: Under the conditions of this trial, treating bean seed with a fungicide or fungicide-bactericide combination significantly improved emergence compared to untreated seed.

Table 1. Percent emergence of CDC Expresso dry bean plants grown from naturally infested seed treated with three bactericides (AGRICULTURAL STREPTOMYCIN, STREPTOMYCIN 17 and CHEM-COP 53) and one fungicide (THIRAM 75 WP), alone or in various combinations, in a greenhouse trial at Brooks, Alberta, in 1996.

Treatment	Rate of product /kg seed	Emergence (%)*
AGRICULTURAL STREPTOMYCIN + THIRAM 75 WP	1.0 g + 1.0 g	81.9 bc
AGRICULTURAL STREPTOMYCIN + THIRAM 75 WP**	1.0 g + 1.0 g	90.7 ab
STREPTOMYCIN 17 + THIRAM 75 WP	1.0 g + 1.0 g	89.3 abc
STREPTOMYCIN 17 + THIRAM 75 WP	2.0 g + 1.0 g	97.9 a
STREPTOMYCIN 17 + THIRAM 75 WP	3.0 g + 1.0 g	93.6 ab
CHEM-COP 53 + THIRAM 75 WP	1.0 g + 1.0 g	84.0 c
THIRAM 75 WP	1.0 g	76.3 c
Untreated check	-	49.2 d
ANOVA P#0.05		s
Coefficient of Variation (%)		15.4

* These values are the means of eight replications. Raw data were arcsin transformed before ANOVA and the detransformed means are presented here. Numbers within a column followed by the same small letter are not significantly different according to a Duncan's Multiple Range Test (P#0.05).

** These chemicals were applied by a commercial seed treatment plant.

AU : COMITÉ D'EXPERTS SUR LA LUTTE INTEGRÉE (CELI)

À : TOUS LES EMPLOYÉS DU SECTEUR DE LA RECHERCHE, DE LA VULGARISATION ET DE LA RÉGLEMENTATION AU CANADA QUI S'INTÉRESSENT À LA LUTTE ANTIPARASITAIRE.

OBJET : «Rapport de recherche sur la lutte dirigée - Insectes et maladies des plantes»

Entre autres fonctions, le Comité d'experts s'occupe de résumer, d'interpréter et de divulguer l'information la plus récente concernant les produits, les méthodes et les stratégies de protection des cultures et des animaux. Le comité revoit également les règlements nationaux et étrangers qui s'appliquent dans ces domaines. Cette information sera recueillie par des organismes de recherche, de vulgarisation et de réglementation et par l'industrie des produits chimiques et servira de base à la rédaction de recommandations détaillées sur la lutte antiparasitaire à l'échelle locale.

Afin d'enrichir le rapport, tous ceux qui effectuent des études sur la lutte antiparasitaire en agriculture sont priés de consigner leurs résultats sur le formulaire inclut dans le guide ci-joint. Ils devront fournir assez de renseignements pour expliquer clairement au lecteur la façon dont le travail a été effectué, le protocole d'expérimentation et la logique sous-jacente à l'interprétation des données. Le rapport ne doit pas être long. UNE à deux pages peuvent suffire pour donner tous les détails pertinents sous une forme précise et instructive.

Les responsables de la recherche dans l'industrie et les directeurs d'établissements de recherche sont priés de porter cette lettre à l'attention des membres de leur personnel qui pourraient contribuer au rapport.

Avis. On demande que les auteurs et les réviseurs prennent note des dates limites nouvelles.

Nous vous remercions de votre collaboration.

Sincèrement,

Hugh G. Philip, Agronome

Président -CELI/ ECIPM
Comité d'experts sur la lutte integrée
Mr. Hugh G. Philip, P.Ag.
B.C. Min. Agriculture, Food and Fisheries
200 - 1690 Powick Road
Kelowna, British Columbia V1X 7G5
Email: hugh.philip@gems8.gov.bc.ca
Tel: (250) 861-7230
Fax: (250) 861-7490

Secrétaire - CELI/ECIPM
Dr. Owen Olfert
Agriculture and Agri-Food Canada
Saskatoon Research Centre
107 Science Place
Saskatoon, Saskatchewan S7N 0X2
Email: olferto@em.agr.ca
Tel: (306) 956-7288
Fax: (306) 956-7247

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Votre collaboration sera grandement appréciée.
Si vous avez des questions, veuillez contacter:

Mme Stephanie Hilton
Rapport de recherches sur la lutte dirigée
Agriculture et Agroalimentaire Canada
Centre de Recherches
du Sud sur la phytoprotection et les aliments
1391, rue Sandford
London (Ontario) N5V 4T3

Tél. (519) 457-1470 Est. 218
Télécopieur (519) 457-3997
Email: hiltons@em.agr.ca

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J. Mike Hardman
Agriculture and Agri-Food Canada
Atlantic Food & Horticulture Research Centre
32 Main Street
Kentville, Nova Scotia B4N 1J5
Email:hardmanm@em.agr.ca
Tel: (902) 679-5730
Fax: (902) 679-2311

A aussi) Les insectes des petits fruits / Insects of Berry Crops
Dr. Bruce Neill
PFRA Shelterbelt Centre
Agriculture and Agri-Food Canada
Indian Head, Saskatchewan S0G 2K0
Email: pf21801@em.agr.ca
Tel: 306) 695-2284
Fax: (306) 695-2568

B) LES LÉGUMES et LES CULTURES SPÉCIALES
Dr. Jeff H. Tolman
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre, 1391 Sandford St.
London, Ontario N5V 4T3
Email: tolmanj@em.agr.ca
Tel: (519) 457-1470 Ext. 232
Fax: (519) 457-3997

C) LES INSECTES DE POTATES
Dr. Jeff G. Stewart
Agriculture and Agri-Food Canada
Charlottetown Research Centre
440 University Avenue, P.O. Box 1210
Charlottetetown, PEI C1A 7M8
Email:stewartj@em.agr.ca
Tel: (902) 566-6844
Fax: (902) 566-6821

D) MÉDICALS et VÉTÉRINAIRES
Dr. Doug Colwell
Agriculture and Agri-Food Canada
Lethbridge Research Centre
P.O. Box 3000, Main
Lethbridge, Alberta T1J 4B1
Email: colwelld@em.agr.ca
Tel: (403) 327-4591 ext. 344
Fax: (403) 382-3156

E) LES CÉRÉALES, CULTURES FOURRAGÈRES et OLÉAGINEUX
Dr. Owen Olfert
Agriculture and Agri-Food Canada
Saskatoon Research Centre
107 Science Place
Saskatoon, Saskatchewan S7N 0X2
Email: olferto@em.agr.ca
Tel: (306) 956-7288
Fax: (306) 956-7247

F) LES PLANTES ORNEMENTALES et DE SERRE
Dr. Les Shipp
Agriculture and Agri-Food Canada
Greenhouse and Processing Crops
Research Centre, Highway 18
Harrow, Ontario N0R 1G0
Email: shipps@em.agr.ca
Tel: (519) 738-2251
Fax: (519) 738-2929

ENTOMOLOGIE: Sections A - G ... continué

G) LES ÉTUDES DE BASE

Mrs. Stephanie A. Hilton
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre, 1391 Sandford St.
London, Ontario N5V 4T3
Email: hiltons@em.agr.ca
Tel: (519) 457-1470 ext. 218
Fax: (519) 457-3997

MÉTHODES DE LUTTE DIRIGÉE - Section H (a-c)

H) a. LA LUTTE BIOLOGIQUE DE MAUVAISES HERBES

Dr. Rosemarie DeClerck-Floate
Agriculture and Agri-Food Canada
Lethbridge Research Centre
Highway 3 East, P.O. Box 3000, Main
Lethbridge, Alberta T1J 4B1
Email: floater@em.agr.ca
Tel: (403) 327-4561
Fax: (403) 382-3156

H) b. LA LUTTE BIOLOGIQUE - insectes, acariens, nématodes

Dr. David R. Gillespie
Agriculture and Agri-Food Canada
Pacific Agriculture
Research **Centre (Agassiz)**, P.O. Box 1000
6947 Number 7 Highway
Agassiz, British Columbia V0M 1A0
Email: gillespied@em.agr.ca
Tel: (604) 796-2221 ext. 210
Fax: (604) 796-0359

H) c. LES SÉMIOCHIMIQUES - phéromones des insectes et produits naturelles

Dr. R.M. Trimble
Agriculture and Agri-Food Canada
Southern Crop Protection and Food
Research Centre, 4902 Victoria Ave. N.
P.O. Box 6000
Vineland Station, Ontario L0R 2E0
Email: trimbler@em.agr.ca
Tel: (905) 562-4113
Fax: (905) 562-4335

PHYTOPATHOLOGIE - Sections I - P

I) LES MALADIES DES FRUITS

Ms. Leslie S. MacDonald
B.C. Ministry of Agriculture, Fisheries &Food
1767 Angus Campbell Road
Abbotsford, British Columbia V3G 2M3
Email: leslie.macdonald@gems3.gov.bc.ca
Tel: (604) 556-3029
Fax: (604) 556-3030

J) LES MALADIES DES LÉGUMES et CULTURES SPÉCIALES

Dr. Ray F. Cerkauskas
Agriculture and Agri-Food Canada
Greenhouse and Processing Crops Research Centre, Highway 18
Harrow, Ontario N0R 1G0
Email: cerkauskasr@em.agr.ca
Tel: (519) 738-2251
Fax: (519) 738-2929

K) LES MALADIES DES POMMES DE TERRE

Ms. Agnes M. Murphy
Agriculture and Agri-Food Canada
Fredericton Research Centre
850 Lincoln Road, P.O. Box 20280
Fredericton, New Brunswick E3B 4Z7
Email: murphya@em.agr.ca
Tel: (506) 452-3260
Fax: (506) 452-3316

PHYTOPATHOLOGIE - Sections I - P ... continué

L) LES MALADIES DES CÉRÉALES, CULTURES FOURRAGÈRES et OLÉAGINEUX

Dr. Richard A. Martin
Agriculture and Agri-Food Canada
Charlottetown Research Centre
440 University Avenue, P.O. Box 1210
Charlottetown, P.E.I. C1A 7M8
Email: martinra@em.agr.ca
Tel: (902) 566-6851
Fax: (902) 566-6821

L Aussi)
LE TACHE DE SUIE

Dr. Jim G. Menzies
Agriculture and Agri-Food Canada
Winnipeg Research Centre
195 Dafoe Road
Winnipeg, Manitoba R3T 2M9
Email: jmenzies@em.agr.ca
Tel: (204) 983-5714
Fax: (204) 983-4604

M) LES MALADIES DES PLANTES ORNEMENTALES, DE SERRE et DE GAZON

Dr. Gary Platford
Soils and Crops Branch
Manitoba Agriculture
Box 1149, 65 - 3rd Avenue N.E.
Carman, Manitoba R0G 0J0
Email: gplatfor@agric.gov.mb.ca
Tel: (204) 745-2040
Fax: (204) 745-2299

N) LES ÉTUDES DES NÉMATODES

Dr. Joe Kimpinski Email: kimpinskij@em.agr.ca
Agriculture and Agri-Food Canada
Charlottetown Research Centre
440 University Avenue, P.O. Box 1210
Charlottetown, Prince Edward Island C1A 7M8
Tel: (902) 566-6851
Fax: (902) 566-6821

LES RÉSIDUS

O) LES ÉTUDES DES RÉSIDUS CHIMIQUES

Dr. Brian D. Ripley
Lab Services Div.
University of Guelph
95 Stone Road West, Loading Zone 2
Guelph, Ontario N1H 8J7
Email: lsd.lsd_po(BRipley)
Tel: (519) 767-6206
Fax: (519) 767-6240

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RAPPORT # 30 **SECTION B: INSECTES DES LÉGUMES CULTURES SPÉCIALES**

BASE DE DONNÉES DES ÉTUDES: 86000718

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

NOM ET ORGANISME:
DUCHESNE R-M et GOULET B
Centre de recherche et d'expérimentation en régie et protection des cultures, MAPAQ, 2700, rue Einstein, Sainte-Foy, Québec, G1P 3W8
Tél: (418) 644-2156 Télécopieur: (418) 644-6855 Email: rmduches@riq.qc.ca

TITRE: EFFICACITÉ DE FIPRONIL CONTRE LE DORYPHORE DE LA POMME DE TERRE, SAISON 1996.

PRODUITS: EXP60115A (fipronil, 200 g/L); ADMIRE 240FS (imidacloprid).

MÉTHODES: L'essai a été réalisé à Deschambault (Québec) selon un plan à blocs complets aléatoires avec 4 répétitions. Les pommes de terre ont été plantées le 27 mai 1996 à 25 cm d'espacement. Les parcelles de 7,5 m de longueur comprenaient 4 rangs espacés de 0,9 m. Les traitements étaient les suivants: 1. ADMIRE foliaire; 2. ADMIRE sol; 3. fipronil; 4. TÉMOIN (sans traitement). Le taux d'éclosion des masses d'oeufs étaient de 43% (100% L1 + L2) lors de la première intervention et les intervalles entre les autres traitements varient de 7 à 10 jours. ADMIRE au sol a été appliqué lors de la plantation, tandis que les autres insecticides ont été pulvérisés le 27 juin et les 5 et 12 juillet à l'aide d'un pulvérisateur monté sur tracteur (pression: 1575 kPa, volume: 800 L/ha). L'évaluation des densités du doryphore a été effectuée sur 10 plants pris au hasard dans les deux rangées du centre. Le dommage aux plants a été évalué visuellement à l'aide d'un indice de défoliation de 0 à 8. Les plants de pomme de terre ont été défanés le 15 août avec du RÉGLONE (diquat 2 L p.c./ha). Le rendement en tubercules a été déterminé à partir de la récolte des deux rangées du centre de chaque parcelle faite le 28 août 1996.

RÉSULTATS: Voir le tableau ci-dessous.

CONCLUSIONS: L'efficacité de l'insecticide fipronil a été comparé à ADMIRE appliqué sur le feuillage ou au sol lors de la plantation. L'ensemble des résultats (densités, dommages et rendement) indiquent que ces insecticides se sont avérés très performant comparativement au Témoin, sans traitement (Tableau 1). En regard de toutes nos évaluations de densités, fipronil a été plus efficace contre les adultes qu'ADMIRE foliaire et significativement plus efficace qu'ADMIRE au sol vers la fin de juillet contre les larves. De plus, ces deux insecticides sembleraient affecter le comportement de la ponte, puisque des masses d'oeufs ont été retrouvées plus fréquemment sur la face supérieure des feuilles. Pour fipronil et ADMIRE foliaire les densités larvaires sont demeurées très basses et significativement inférieures à ADMIRE au sol à la fin juillet. Il est à noter que la rémanence d'ADMIRE (au sol) diminue à partir de la troisième semaine de juillet et se traduit par une augmentation du dommage suite à une colonisation tardive des parcelles par des adultes printaniers et l'arrivée de masses d'oeufs et de larves. La protection du feuillage a été tout aussi valable avec ADMIRE foliaire. La saison fraîche et pluvieuse a

réduit l'incidence du doryphore et le dommage est demeuré faible (#1,0) et stable durant la période de floraison, et ce, même pour le Témoin (#2,0). En août, un retour à des conditions climatiques plus normales de saison a accentué le développement des larves et le dommage aux plants. Ainsi, l'indice de dommage chez le Témoin est passée de 2,0 à 6,0 du 5 au 12 août. Pour ADMIRE et fipronil, le dommage est demeuré sensiblement identique à celui observé le 5 août. Le rendement chez le Témoin a été très affecté comparativement à ADMIRE et fipronil. Pour ces insecticides, les rendements ne diffèrent pas significativement entre eux. En dépit d'un indice de dommage relativement faible et stable chez le Témoin en saison, l'incidence sur le rendement a tout de même été très significative avec une réduction d'environ 6,8 t/ha. Cela supporte de nouveau l'importance de bien protéger le feuillage pendant toute la saison et de maintenir des seuils d'interventions bas. Selon les conditions qui prévalaient en 1996, fipronil a été tout aussi performant qu'ADMIRE foliaire et ADMIRE au sol. Fipronil et ADMIRE, appliqués sur le feuillage, demeurent donc des produits plus rentables économiquement que des interventions strictement orientées au sol en début de saison. Dans un programme de lutte intégrée contre le doryphore, la performance de fipronil permettra d'associer stratégiquement son emploi à celui d'ADMIRE en saison.

Table 1. Nombre moyen de larves de doryphores/plant, dommage et rendement vendable, saison 1996.

Traitement		Population larvaire					Dommage*				Rendement	
Insecticide	Dose	juin	juillet				juillet		août		(t/ha)	
	(p.c./ha)		26	05	17	30		05	19	26	05	
1. ADMIRE 45,8a fol.	200 ml			0,6**	3,3b	0,0b	0,0c		0,0c	0,0c	0,0c	0,8b
2. ADMIRE 47,1a sol	850 ml			0,0	0,0c	0,4b	3,8b		0,0c	0,0c	1,0b	1,0b
3. Fipronil	125 ml	0,4	3,8b	0,5b	0,5c		0,5b	0,8b	1,0b	1,0b	46,3a	
4. TÉMOIN	---	0,5	6,2a	23,2a	15,3a		1,0a	2,0a	2,0a	2,0a	39,7b	

* Évaluation visuelle par parcelle: indice de défoliation (Indice «Boiteau») de 0 à 8: (0) pas de défoliation; (1) 2-60% des plantes avec folioles légèrement endommagés; (1.5) > de 60% des plantes avec folioles légèrement endommagées; (2) 2% des plantes avec $ une feuille composée défoliée à $ 50%; (3) 2-9% des plantes avec $ une tige défoliée à $ 50%; (4) 10-24% des plantes avec $ une tige défoliée à $ 50%; (5) 25-49% des plantes avec $ une tige défoliée à $ 50%; (6) 50-74% des plantes avec $ une tige défoliée à $ 50%; (7) 75-99% des plantes avec $ une tige défoliée à $ 50%; (8) 100% des plantes avec $ une tige défoliée à $ 50%.

** Les résultats sans lettre ou suivis d'une même lettre ne sont pas significativement différents, à un seuil de 0,05 (Waller-Duncan).